Request IR-1:

Please indicate when construction work will occur, including the estimated completion date for this project.

(a) Please indicate the percentage of the project work that has been completed by the ATO Application date.

(b) Does NS Power expect further delays to this project? If so, please explain.

Response IR-1:

Construction is anticipated to begin in July 2025, with completion expected in March 2026.

(a) NS Power estimates approximately 10 percent of the construction work has been completed by the ATO application date. This includes the procurement of the gates and actuators, procurement of the rubber dams and completion of the rubber dam controls building.

(b) NS Power does not expect further delays to the project which would affect the revised costs The General Contractor was awarded the work, and the NSECC and Transport Canada permits were obtained in June 2024. NS Power continues to work towards receiving FAA from DFO as the Project cannot proceed until the FAA has been granted. This is contingent on satisfying additional information requests directed to NS Power through DFO's email on June 6, 2024. Please refer to NSUARB IR-12 Attachment 14.

Request IR-2:

Please confirm that NS Power has included all the measures required by DFO in the "Capital Project Detailed Cost Estimate" and in the project specifications and design.

(a) Has NS Power made any changes to the DFO requirements in the project specifications and design? If so, please explain why and whether approval from DFO has been obtained.

Response IR-2:

NS Power has received a complete letter on its Fisheries Act Authorization application from DFO and has received confirmation from DFO that outlines what information is required before the FAA will be issued. The Company has incorporated this information into the project scope of work and within the Capital Project Detailed Cost Estimate.

(a) No. NS Power has not made any changes to DFO requirements in the project specifications and design.

Request IR-3:

Please confirm the Version number and date of the CDA Guidelines to which the proposed project is designed.

Response IR-3:

The project is designed to CDA Guidelines 2007 (Revised 2013).

Request IR-4:

In Undertaking U-6 submitted by NS Power as part of the 2019 ACE Plan proceeding (Matter M08984), NS Power stated:

> **(a) Riprap work is not included in the scope of this project. The riprap on the embankments remains in good condition with no signs of erosion or instability. Although the riprap sizing may be smaller than the recommended sizing, the condition of the riprap, the change in the flood levels in the reservoir, and the fact that the embankments are also protected by islands just upstream of the dam were all considered in the assessment process and it was determined that the existing riprap was performing adequately and replacement or refurbishment is not required at this time.**
>
> **(b) There is no minimum freeboard work related to embankments included in the scope of this project. With the change in the design of the dam to have a free overflow section and rubber dam sections, the discharge capacity will be increased, which will lower the flood levels in the upstream reservoir. Based on the increased discharge capacity, the freeboard requirements will be met and the corewall elevations will be adequate.**
>
> **(c) Concrete erosion work is included in the scope of this project. The existing dam has concrete deterioration issues on the main deck and on the upstream and downstream sides of the dam. As part of the new design, the concrete deck will be removed and replaced with a steel walkway and the crest and downstream spillway sections will be refaced.**

Please confirm that the above statements by NS Power still apply to the project.

(a) If not confirmed, please explain why they no longer apply, and identify the related cost associated with each change.

Response IR-4:

Confirmed.

(a) N/A

Request IR-5:

In response to NSUARB IR-65d) in the 2019 ACE Plan Proceeding (M08994), NS Power stated:

> **The new structure will be constructed on the footprint of the existing structure with only a small extension of the footprint on the downstream side of the dam. The extension on the downstream side is additional concrete required to complete the new spillway surface of the dam and is approximately 5 feet in width at the tallest section. The width of the concrete extension varies per height of the dam.**

Please confirm that this remains the case.

(a) If not confirmed, please explain and identify the related cost associated with any change from this statement.

Response IR-5:

Confirmed.

(a) N/A

Request IR-6:

In response to NSUARB IR-65f) in the 2019 ACE Plan Proceeding (M08994), NS Power stated:

> **Potential geotechnical issues were reviewed as part of the design phase of the project. Since the existing dam is founded on bedrock and the new dam will be constructed on the same footprint as the existing dam, no geotechnical issues are anticipated at this time.**

Please confirm that this remains the case.

(a) If not confirmed, please explain and identify the related cost associated with any change from this statement.

(b) Has NS Power completed a detailed geotechnical investigation at the project site to confirm geotechnical conditions for incorporation into project design and construction?

(i) If not, why not?

(ii) If so, please describe the work completed and provide a copy of the related geotechnical report.

Response IR-6:

Confirmed.

(a) N/A

(b) No.

(i) NS Power has not completed a detailed geotechnical investigation at the project site. Potential geotechnical issues were reviewed during the conceptual design

phase of the project, and the Company's external engineering consultant was able to proceed with the detailed design phase and issuance of the IFC drawing package based on that review.

(ii) N/A

Request IR-7:

Given the new (as compared to the 2019 ACE Plan Submission) project requirements and costs for environmental permitting, fish passage, environmental offsetting, temporary lowering of the reservoir, and additional archaeological assessment and Mi'kmaw engagement requirements, did NS Power re-evaluate project options to assess whether other options beyond the one currently proposed may now be more cost effective (i.e., lower cost)?

(a) If not:

(i) Why not?

(ii) Please explain specifically why NS Power has confidence that Option 4 remains the lowest cost option for the project.

(b) If so:

(i) Please provide the results of this analysis, complete with a table showing the updated cost estimate for each option, similar to the table provided in response to NSUARB IR-65e) in the 2019 ACE Plan proceeding (M08984).

(ii) Did NS Power consider other options beyond the five alternatives noted on Page 2 of 10 of the current Application?

(a) If not, why not?

(b) If so, please describe these options, complete with a related cost estimate, and explain why they were dropped from further consideration.

Response IR-7:

No.

(a) Re-evaluation was not necessary as all five options considered would have the same cost increases as a result of increases in costs associated with environmental permitting. A Fisheries Act Authorization with the same conditions would be required regardless of the option selected. All five options would also see increases in costs as a result of the deferral of construction and the construction cost differences between the five options remains the same. Therefore, Option 4 continues to be the lowest cost option.

(b)

(i) N/A

(ii)

(a) N/A

(b) Please refer to Attachment 1 for a copy of the design memo provided by the Company's external Engineering Consultant which outlines additional options that were considered and ruled out.

MEMORANDUM

TO: Nova Scotia Power Inc. (NSPI)

FROM: Kleinschmidt Associates Canada Inc. (Kleinschmidt)

DATE: June 7, 2018

RE: **RUTH FALLS REFURBISHMENT – SHEET HARBOUR HYDRO SYSTEM, SHEET HARBOUR, NS**

Kleinschmidt Associates Canada Inc. (Kleinschmidt) has been requested to provide options for the refurbishment of Ruth Falls Dam and associated appurtenances. A site visit was completed March 31, 2017 with Nova Scotia Power Inc. (NSPI) and Kleinschmidt representatives present. The dam site was inspected briefly and options for refurbishment were reviewed with NSPI.

All references to elevations within this memorandum correspond to the October 1994 Geodetic Datum. The October 1994 Geodetic Datum elevations, listed on existing project drawings provided to Kleinschmidt, are approximately 1.65 feet below CGVD 28.

- October 1994 Datum = CGVD 28 - 1.65 feet

The Main Dam embankment is an earth fill embankment with a crest elevation of approximately 116 feet, and an approximate length of 125 feet. The Main Dam three-bay stoplog controlled sluiceway is approximately 50 feet long, with short concrete gravity bulkhead sections on either side of the spillway section. The Main Dam spillway is approximately 415 feet in length, and consists of a 30-bay concrete overflow section, with crest and deck elevations of 104.1 and 113.1 feet, respectively. Under normal conditions with the stoplogs installed, the normal water elevation is 109.25 feet which is the full supply level (FSL) for the reservoir. The wing dams are not included in the current scope of this project. There is a power canal approximately 8,000 feet long consisting of an embankment on the east side, and an embankment fill section on the west side. The crest elevation of the west canal embankment is 114.5 feet.

In 2015 a Dam Safety Review (DSR) was completed of the Ruth Falls Hydro System by Kleinschmidt. Deficiencies at that time were identified and are summarized as follows:

- The minimum freeboard available is less than the required minimum freeboard.
- The elevation of the top of the corewall is less than the Inflow Design Flood (IDF) value.
- Factors of safety for slope stability of the main dam are below required acceptance criteria.
- Extensive concrete erosion was identified at the right side of the concrete deck and at the abutment retaining wall.

REFURBISHMENT OPTIONS

Four different refurbishment options and one new dam option were reviewed with NSPI and are described below. The feasibility of each option was evaluated by modifying the hydraulic model used for the 2015 Sheet Harbour DSR (Kleinschmidt 2015) to determine the peak headpond elevation at Ruth Falls during the IDF resulting from the modifications. The peak IDF inflow to Ruth Falls Dam is approximately 30,700 cubic feet per second (cfs), and the 100-year peak inflow is approximately 17,000 cfs. The U.S. Army Corps of Engineers' (USACE) HEC-RAS v5.0.1 was used to complete all simulations. The hydraulic analysis indicated that Options 1 and 3 would reduce the peak IDF water surface elevation enough that the dam would not need to be raised. Option 2 does not provide sufficient freeboard during the IDF to prevent overtopping due to wave action in the impoundment, and would require the embankment dam to be raised a minimum of 1 foot. If Option 2 is selected, there is potential for making further adjustments to the remaining spillway bays to allow for more capacity, removing the need for raising the dam. Stability analyses of the concrete structures for each option were completed using KAStable v1.06, Kleinschmidt's in-house stability software. Analyzed gravity sections were completed by modifying the model used for the 2015 Sheet Harbour DSR (Kleinschmidt 2015).

- Option 1: Remove the stoplogs and replace with screw stem vertical gates.
- Option 2: Remove stoplogs to create an uncontrolled overflow section within a portion of the existing spillway and replace remaining stoplogs with screw stem vertical gates.
- Option 3: Remove a portion of the stoplogs and install a labyrinth spillway and replace remaining stoplogs with screw stem vertical gates.
- Option 4: Remove all stoplog bays, replace sluiceway gates with screw stem vertical gates, install a rubber dam for the spillway portion river left of the sluiceway structure, and install an uncontrolled overflow section for the spillway portion river right of the sluiceway structure.
- Option 5: Construct a new dam immediately downstream of the existing dam.

An opinion of probable construction costs (OPC) was generated for each of the five options. In addition to the options above, additional OPC's were completed for hydraulic operation of the gates as an alternative in lieu of the screw stem option where applicable. For the purposes of the OPC and comparing options, costs for stabilizing the embankment were not included as this will be required for all options. Costs for raising the embankment was included for options that will require it, including Option 1C and Option 2. Further details are included in the OPC section of this memorandum. For purposes of the OPC, the screw stem operators were assumed to be mounted on a raised deck of steel construction to allow lifting the gates clear of the deck with a gate center of gravity connection to screw stem. The ability to raise gates clear of the deck facilitates maintenance of the gates and seals. As an alternative, the screw stem operators can be mounted on the concrete deck level utilizing an off-center attachment. An off-center arrangement removes the need for a raised steel deck and framing, allows the operators to be deck mounted, and can raise the gates above the deck for maintenance.

Conceptual level sketches for Options 1 through 4 are included in Attachments 1 and 2 of this memorandum as a visual representation of what the screw stem operators, uncontrolled overflow, rubber dam, and labyrinth spillway options would appear. Conceptual sketches for Options 5, as well as sketches for the hydraulic operation, were not generated as part of this options memorandum. A conceptual arrangement of the deck mounted screw stem operators is provided in Attachment 4.

DISCUSSION OF OPTIONS

OPTION 1: REMOVE THE STOPLOGS AND REPLACE WITH SCREW STEM VERTICAL GATES

Option 1 would remove the wood stoplogs from all spillway and sluiceway bays and replace them with steel vertical slide gates. Two alternatives were considered for gate operation including Option 1A, dedicated screw stem operators; and Option 1B, dedicated hydraulic operators.

The DSR hydraulic analyses assumed that not all the stoplogs would be removed from the dam, since it would be difficult for operators to remove the stoplogs from all 33 bays in anticipation of a flood. Under the Option 1 scenario, with dedicated operators, every bay could be completely opened to pass flow since each one-piece slide gate would have its own operator. The invert elevations of the 30 stoplog bays in the concrete overflow section were not changed from the existing elevation 104.1 feet, and the widths of the bays were not changed from the existing 11 feet. Similarly, the invert elevations of the sluiceway structure bays were not changed from the existing elevations 94.1 feet and 90.1 feet (the middle bay's invert is 90.1 feet and the other bays' inverts are 94.1 feet), and the sluiceway bays' widths were not changed from the existing 10 feet.

For this study the gate operations in the hydraulic model were modified such that all gates were operated to maintain the FSL, 109.2 feet, at the Ruth Falls Dam before and after the arrival of the IDF flow and to otherwise minimize the rise in the headpond during the flood. The resulting peak IDF elevation for Option 1 with all gates fully open was 111.55 feet. The flood conditions wave run-up and wind set-up at the dam is 1.9 feet (Kleinschmidt 2015), which combined with peak IDF elevation for Option 1 is approximately 113.45 feet. The hydraulic model results indicate that Option 1 would provide 2.8 feet of freeboard from the peak IDF to the top of embankment and 0.9 foot from the peak IDF plus wave run-up and wind set-up. Therefore, Option 1A and 1B would avoid NSPI needing to raise the embankment to safely route the IDF. The spillway deck would be overtopped by approximately 0.35 feet at the peak IDF with wave run-up and wind set-up. Option 1C requires manual operation of the rail mounted hoist and was modelled with gates in the closed position during an IDF event. Option 1C would therefore require raising of the embankments to safely pass the IDF event.

To meet the Canadian Dam Association (CDA) Dam Safety Guidelines (Guidelines) for stability, the stoplog bays may require anchoring or additional mass to meet recommended sliding safety factors (SSFs). The stoplog bays meet recommended SSFs for normal, ice, and post-earthquake loading conditions. The stoplog bays have a SSF of 1.04 during IDF conditions, or slightly below the 1.1 recommended SSF. The stability analysis was completed for the most conservative and unstable stoplog bay. If this option is chosen, additional stoplog bay sections can be analyzed using survey data to determine if adjacent bays provide adequate sliding resistance to prevent the need for rock anchors or additional concrete mass. The analysis was completed without including any additional weight from the slide gates or operators. However, a conservative check of the IDF loading conditions with gate weight results in a SSF of only 1.05. Rock anchors were assumed for stabilization in the OPC.

The sluice structure was found to be stable for all loading conditions and will not require stabilization methods.

OPTION 2: REMOVE STOPLOGS TO CREATE AN UNCONTROLLED OVERFLOW SECTION WITHIN THE EXISTING SPILLWAY AND REPLACE REMAINING STOPLOGS WITH SCREW STEM VERTICAL GATES

Option 2 would replace stoplog bays and piers with an uncontrolled spillway section, which would pass lower frequency return interval flows (i.e., less than the 100-year flood) without any operation of gates, and all remaining bays would have their stoplogs replaced with vertical slide gates. The length of the uncontrolled spillway section modeled was 215 feet with a crest elevation equal to 109.2 feet, maintaining the FSL. Replacing stoplog bays with this uncontrolled spillway required the removal of 15 stoplog bays, as well as one bay in the sluiceway structure. The inverts of the remaining stoplog bays were not modified. The hydraulic model's gate operations were set to open the vertical gates when the water surface elevation reached 1 foot above the FSL, to approximate how NSPI might allow the uncontrolled spillway section to pass flows at lower headpond elevations and only operate the gates when the capacity of the uncontrolled spillway is no longer sufficient. The hydraulic model indicates that with the vertical gates closed, the 215-foot-long uncontrolled spillway could pass approximately 32 percent of the peak 100-year flood inflow at the top of the concrete dam elevation 113.1 feet. The resulting peak IDF water surface elevation for Option 2 was 113.2 feet. The combined flood conditions wave run-up and wind set-up of 1.9 feet (Kleinschmidt 2015), and the peak IDF water surface elevation is approximately 115.1 feet. The hydraulic model results indicate that Option 2 would provide 1.15 feet of freeboard from the peak IDF elevation to the top of embankment, but would overtop the embankment by 0.75 feet when accounting for wave run-up and wind set-up. Therefore, with Option 2 NSPI would need to raise the dam and embankment to safely route the IDF. Further modelling will be completed if Option 2 is selected as the preferred method. The remaining bays can be modified to increase capacity of the project, and remove the requirement to raise the dam to meet wave run-up and wind set-up estimates. The spillway deck would be overtopped by approximately 2.0 feet at the peak IDF with wave run-up and wind set-up.

For stability of the 200-foot-long overflow section, it was assumed the same ogee shape will be kept; however, raised from a crest of 104.1 feet to 109.2 feet. The significant additional mass to the ogee, despite the reduction in mass from removing the piers and walkway, results in a structure meeting all stability load cases analyzed and required by the CDA Guidelines.

The remaining stoplog bays to be converted to slide gate bays will have the same stability results as described in Option 1. The stability analysis was completed for the most conservative and unstable stoplog bay. If this option is chosen, additional stoplog bay sections can be analyzed using survey data to determine if adjacent bays provide adequate sliding resistance to prevent the need for rock anchors or additional concrete mass. Rock anchors were assumed for stabilization in the OPC.

The sluice structure was found to be stable for all loading conditions and will not require stabilization methods.

OPTION 3: REMOVE THE STOPLOGS AND INSTALL A LABYRINTH SPILLWAY AND REPLACE REMAINING STOPLOGS WITH SCREW STEM VERTICAL GATES

Option 3 would replace stoplog bays and piers with a labyrinth spillway section, which would pass lower frequency return interval flows (i.e., less than the 100-year flood) without operation of any gates, and the remaining bays would have their stoplogs replaced with vertical slide gates. The primary benefit of a labyrinth spillway is that the design of the crest fits more total length in a straight length, allowing a labyrinth to pass more flow at lower headpond elevations than a conventional straight uncontrolled spillway. The length of labyrinth spillway modelled was 200 feet long with a crest elevation of 109.2 feet, which would maintain the existing FSL. This length of spillway required the removal of 15 stoplog bays. The inverts of the remaining stoplog bays were not changed from their existing elevations. Like Option 2, the vertical gates in Option 3 were operated when the water surface elevation reached 1 foot above the FSL to approximate how NSPI might allow the labyrinth spillway section to pass flows at lower headpond elevations and only operate the gates when the capacity of the spillway is no longer sufficient. The hydraulic model indicates that with the vertical gates closed, the 200-foot-long labyrinth spillway could pass approximately 53 percent of the peak 100-year flood inflow at the top of the concrete dam elevation 113.1 feet. The resulting peak IDF elevation for Option 3 with all gates fully open was 112.01 feet. The combined flood conditions wave run-up and wind set-up of 1.9 feet (Kleinschmidt 2015), and the peak IDF water surface elevation is approximately 113.91 feet. The hydraulic model results indicate that Option 3 would provide 2.34 feet of freeboard from the peak IDF elevation to the top of embankment and 0.44 feet from the peak IDF plus wave run-up and wind set-up to the top of the embankment. Option 3 would avoid NSPI needing to raise the embankment to safely route the IDF. The spillway deck would be overtopped by approximately 0.81 feet at the peak IDF water surface with wave run-up and wind set-up.

The remaining stoplogs bays to be converted to slide gate bays will have the same stability as the slide gate bays discussed in Option 1. Reanalyzing the structures for stability based on survey data may result in no additional stabilizing modifications to meet CDA Guidelines. Rock anchors were assumed for stabilization in the OPC.

The sluice structure is replaced by the labyrinth spillway structure in this option, and therefore was not analyzed for stability.

OPTION 4: REMOVE THE STOPLOGS AND INSTALL AN UNCONTROLLED OVERFLOW SECTION, A RUBBER DAM, AND REPLACE SLUICEGATES WITH SCREW STEM OPERATED VERTICAL GATES

Option 4 would replace fifteen stoplog bays and piers adjacent to the sluice structure on river-right (facing in the downstream direction) with an uncontrolled spillway section, which would pass lower frequency return interval flows (i.e., less than the 50-year flood) without any operation of gates. The other fifteen stoplog bays and piers on the river-left side of the sluice structure would be replaced with a rubber dam divided into four sections with three piers. A walkway will need to be added to access the sluice gate section. All three stoplog bays in the sluice structure would have their stoplogs replaced with vertical slide gates.

The length of the uncontrolled spillway section modelled was 200 feet, with a crest elevation equal to 109.2 feet, which would maintain the FSL. There would be three 1.5-foot-wide piers in the spillway to provide support for a walkway above the spillway. The rubber dam would be 7.1 feet tall, 200 feet long, and would have three tapered piers (1 foot wide at the top and 6 feet wide at the bottom). The invert of the rubber dam would be at elevation 102.1 feet, 2 feet below the existing crest elevation of the stoplog bays.

The hydraulic model's gate operations were set to deflate the rubber dam bladder when the water surface elevation reached 1 foot above the FSL to approximate how NSPI might allow the uncontrolled spillway section to pass flows at lower headpond elevations and only operate the gates when the capacity of the uncontrolled spillway is no longer sufficient. The hydraulic model indicates that with the vertical gates closed, the 200-foot-long uncontrolled spillway could pass approximately 30 percent of the peak 100-year flood inflow at the top of the concrete dam elevation 113.1 feet. The resulting peak IDF elevation for Option 4 with all gates fully open and rubber dam deflated was 111.2 feet. The combined flood conditions wave run-up and wind set-up is 1.9 feet (Kleinschmidt 2015), and the peak IDF water surface elevation is approximately 113.1 feet. The hydraulic model results indicate that Option 4 would provide 3.15 feet of freeboard from the peak IDF elevation to the top of embankment, and 1.25 feet from the peak IDF plus wave run-up and wind set-up to the top of the embankment. Option 4 would avoid NSPI needing to raise the embankment to safely route the IDF. The spillway deck would not be overtopped by the peak IDF water surface with wave run-up and wind set-up.

For stability of the 200-foot-long overflow section, it was assumed the same general ogee shape will be kept; however, raised from a crest of 104.1 feet to 109.2 feet. The significant additional mass to the ogee, results in a structure meeting all stability load cases analyzed and required by the CDA Guidelines.

The stoplog sections being converted to rubber dam sections will involve demolition of the existing concrete walkway, most pies, and two feet of concrete from the ogee crest. The reduction in mass will require stabilization methods, likely in the form of rock anchors, to stabilize the proposed rubber dam spillway section. Rock anchors were assumed for stabilization in the OPC.

The sluice structure was found to be stable for all loading conditions and will not require stabilization methods.

OPTION 5: NEW DAM CONSTRUCTED IMMEDIATELY DOWNSTREAM OF EXISTING DAM

Option 5 would utilize the existing dam spillway structure as a cofferdam to control water during construction of a new dam immediately downstream. The new dam would require a significant portion of the existing fishway be relocated to allow for the new structure. Additionally, additional construction difficulties and costs are often encountered when constructing in a new location. Environmental and cultural impacts are of greater concern when relocating a dam and new geotechnical investigations are likely required to design the foundation of the new dam. Two spillway layouts were analyzed for the new dam option: 5A includes a labyrinth spillway and screw stem gates, and 5B includes an ogee/rubber dam spillway and screw stem gates.

The hydraulic model will result in similar water surface elevations during the IDF event as Options 2 through 4 listed above. With a new dam, there is greater flexibility in designing the structure to manage the reservoir in the most preferred method. The new dam would be designed to be stable and meet current CDA Guidelines through self-weight alone.

OPTIONS CONSIDERED BUT RULED OUT

Additional options were considered during the analysis, but were ultimately ruled out for a variety of reasons. One option that was considered but ruled out was to remove every other pier from the stoplog and sluiceway sections, and replace the remaining stoplog bays with vertical steel gates. This option was ruled out as the aspect ratio of the proposed gates; 24.5W:5.1H for the stoplog bays, and 25W:19.1H for the sluiceway bay would be much greater than the typical maximum ratio of 1W:1H. Aspect ratios for gates greater then 1W:1H result in significantly increased chance for gate jamming, increased cost for a double lift point operator, and a significant increase in member sizes increasing the cost to fabricate, install, and operate the gates.

For Option 4, consideration was given to providing additional options for hydraulic cylinder and travelling hoist operators for the remaining bays that will have a steel gate. Option 4 only includes three steel gates. For the limited number of remaining gates, a travelling hoist was ruled out as the cost savings would be relatively insignificant to overall project cost, and not allow for automation of the deep gates. The hydraulic cylinder option was ruled out due to the prohibitive equipment install and cost required at the project for the three remaining gates.
For Option 1, consideration was given to removing the dedicated operators and using track mounted trolleys to operate all gates. This change would save the cost of the screw stem operators and add the cost of a pair of trolleys; however, it would remove all automation from the spillway, the sluice gates would need to be made smaller or the track mounted trolley made taller to allow lifting the gates clear of the flood water, and trolley operation is significantly more labour intensive and time consuming for a 30-bay spillway.

OPINION OF PROBABLE CONSTRUCTION COST

The OPC for each option is included in Tables 1A through 5 (Attachment 3) of this memorandum. The OPC is meant to provide a conceptual level estimate to complete modifications to the spillway structures as described in the Refurbishment Options Section of this memorandum, and includes permitting and construction monitoring costs. The OPC does not include any costs associated with sales tax, HST, or insurance. The OPC does not include any costs associated with stabilizing, raising, or modifying the Main Dam embankment structure in any way. The table below summarizes the conceptual level construction costs for the five refurbishment options and associated gate options. Costs for stabilization of concrete structures are included where required (see Attachment 3 for rock anchor costs).

REFURBISHMENT OPTION	LABEL	GATE OPTION	TOTAL COST ($ CAD)
Option 1 – Slide Gates	A	Screw Stem	8,608,000
	B	Hydraulic Cylinder	9,709,000
Option 2 – Overflow and Slide Gates	A	Screw Stem	6,694,000
	B	Hydraulic Cylinder	7,444,000
Option 3 – Labyrinth and Slide Gates	A	Screw Stem	7,116,000
	B	Hydraulic Cylinder	7,884,000
Option 4 – Rubber Dam and Overflow	A	Screw Stem	6,431,000
Option 5 – New Dam	A	Labyrinth w/ Screw Stem	12,516,000
	B	Ogee/Rubber w/ Screw Stem	13,891,000

DISCUSSION

The OPC determined that the most cost-effective refurbishment option for the Ruth Falls spillway would be Option 4. Option 4, which involves replacing fifteen stoplog bays with an uncontrolled spillway section, and the other 15 stoplog bays with a rubber dam, and the three wood stoplog sluice bays with steel vertical slide gates, is approximately $250 thousand less expensive than the next closest option. This option allows for automation of the gates and rubber dam, would not require personnel on the dam to operate the gates, and would not require the embankment to be raised to achieve the recommended freeboard. Push bottom operation of the vertical gates and rubber dam could be mounted in the blower house for on-site operation.

The OPC determined the most expensive option for the Ruth Falls spillway to be Option 5B. Option 5B allows for adequate spillway capacity and a new structure resulting in potential reduced maintenance and upkeeps costs and longer lifespan. However, at an estimated cost of $13.95 million, this option is approximately $4 million more than the most-costly refurbishment option. Option 5A and 5B was determined to be the most expensive options overall, with Options 1B, 2B, and 3B being the most expensive refurbishment options. The higher cost for Options 1B, 2B, and 3B versus the other refurbishment options is driven by the supply and installation of stainless steel tubing between the gates and hydraulic power unit (HPU) rather than simply laying conduit for electric power to screw stem operators.

Options 1A, 2A, and 3A with screw stem vertical gates were determined to be less expensive than the hydraulic cylinder options. The screw stem gate option was priced with an elevated walkway to access the actuators. The walkway was provided to allow lifting the gates above the deck to both clear the water and to facilitate maintenance. An alternative screw stem operator arrangement places the operators on the deck as shown in Attachment 4. This would remove about $400 thousand dollars from Option 1A, $200 thousand from Options 2A and 3A, and $90 thousand from Option 4.

RECOMMENDATION

Based on the results of the comparison between the three refurbishment options, Kleinschmidt recommends that Option 4 be the chosen refurbishment. Option 4 with the uncontrolled spillway section will allow for reduced operation to pass flows above unit flow, or when a unit is not operating. The rubber dam and screw stem operated sluice gates will allow for additional reservoir control and automation of the project to pass flood events up to the IDF without overtopping the earthen structures or concrete decks. The screw stem actuators will allow the sluiceway bays to be fully automated, again reducing the need for personnel to arrive on site to pass flows, and is less expensive than other automated operators such as hydraulic operators. Full automation is not a requirement and on-site push bottom operation from a control shack, blower house is typical. Option 4 requires much less operator time and labour than the existing trolley operators, and would be significantly faster going from full closed to full open, or anything in between. The overflow spillway will result in a stable structure that does not require additional anchoring to meet required sliding safety factors. The rubber dam structure will require rock anchors to stabilize the structure due to the loss of concrete mass. Option 4 is estimated to cost $6.61 million, or well below Options 1 through 3 with screw stem and hydraulic operators. This cost may be lowered to about $5.7 million with the use of deck mounted operators.

REFERENCES

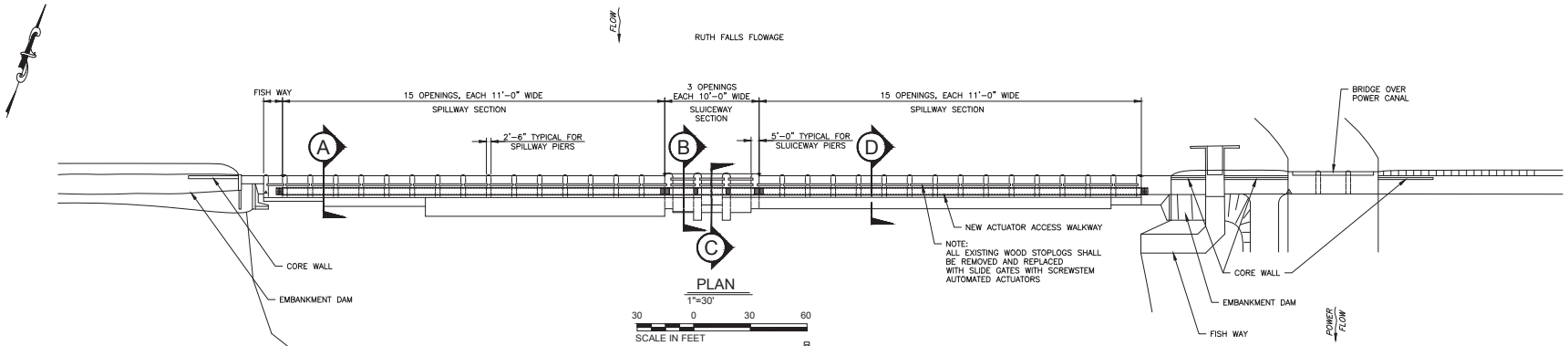
Kleinschmidt (Kleinschmidt Associates). 2015. 2015 Sheet Harbour Hydro System Dam Safety Review. December 2015.

ATTACHMENTS

Attachment 1 – Ruth Falls Conceptual Sketches, Options 1 to 3
Attachment 2 – Conceptual Sketches, Option 4 Binder
Attachment 3 – Opinion of Probable Construction Cost
Attachment 4 – Alternative Deck Mounted Screw Stem Operator

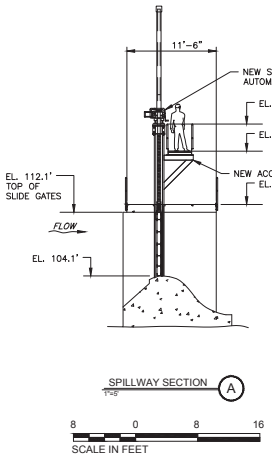
ATTACHMENT 1

RUTH FALLS CONCEPTUAL SKETCHES, OPTIONS 1 TO 3



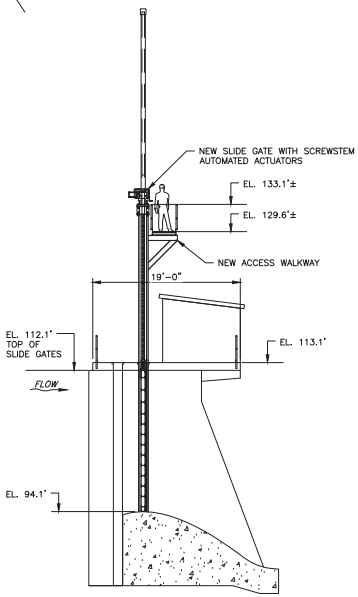
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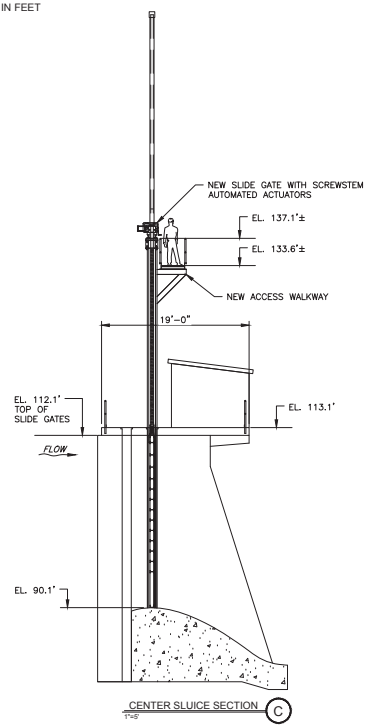


SPILLWAY SECTION A
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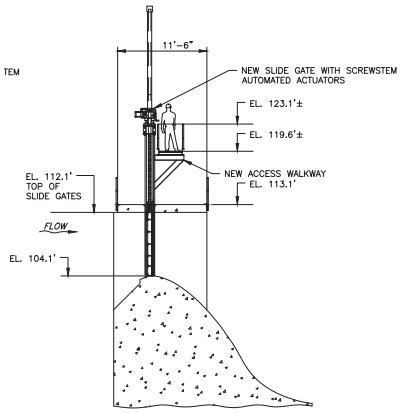
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SCALE IN FEET



END SLUICE SECTION B
1"=5' (TYPICAL 2 OPENINGS)



CENTER SLUICE SECTION C
1"=5'



SPILLWAY SECTION D
1"=5'

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RUTH FALLS REFURBISHMENT
SHEET HARBOUR HYDRO SYSTEM

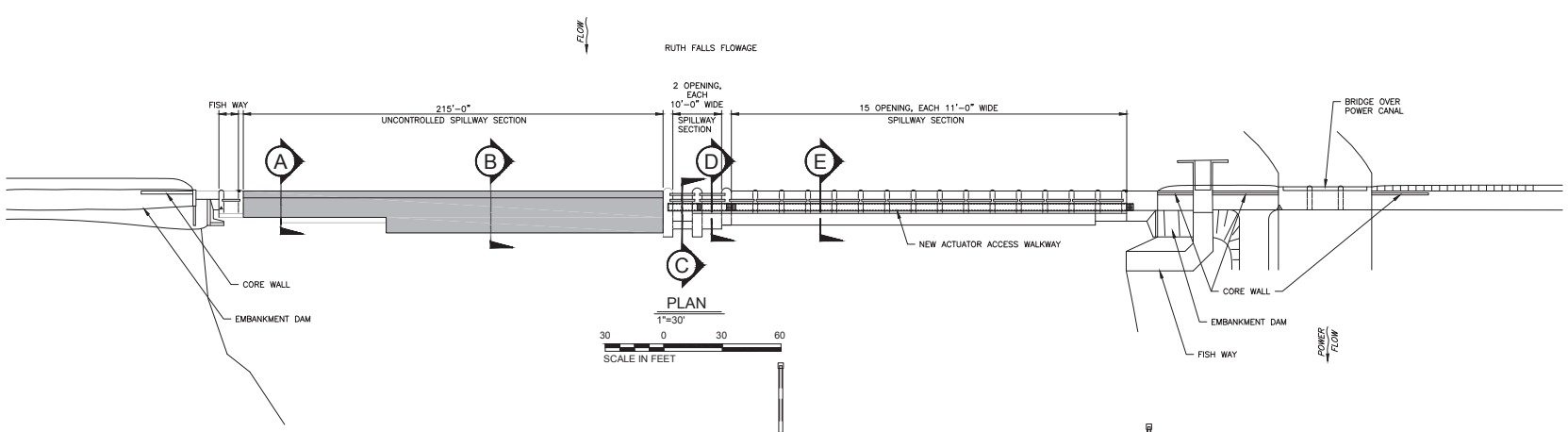
CONCRETE SPILLWAY OPTION 1
PLAN AND SECTIONS

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Project No.	Date Revised	Drawing No.
1890-018	5-16-17	FIGURE

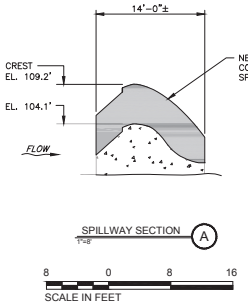
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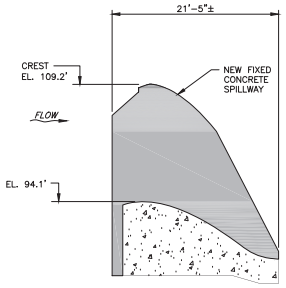
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1"=30'

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SCALE IN FEET

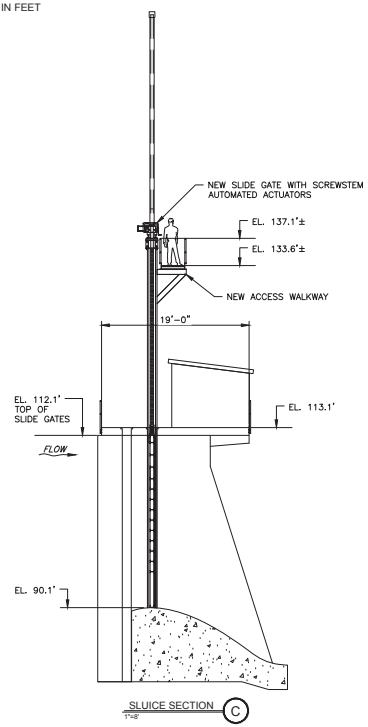


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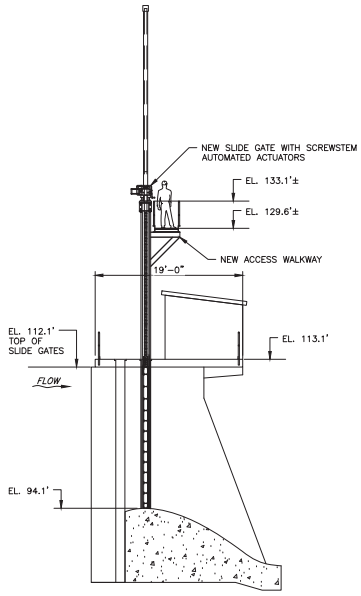
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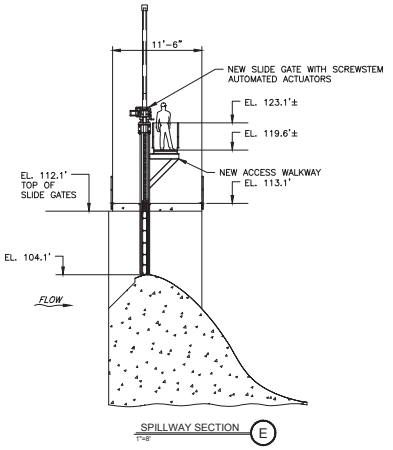
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1"=8' (TYPICAL 2 BAYS)



SLUICE SECTION C
1"=8'



END SLUICE SECTION D
1"=8' (TYPICAL 2 OPENINGS)



SPILLWAY SECTION E
1"=8'

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HALIFAX, NOVA SCOTIA

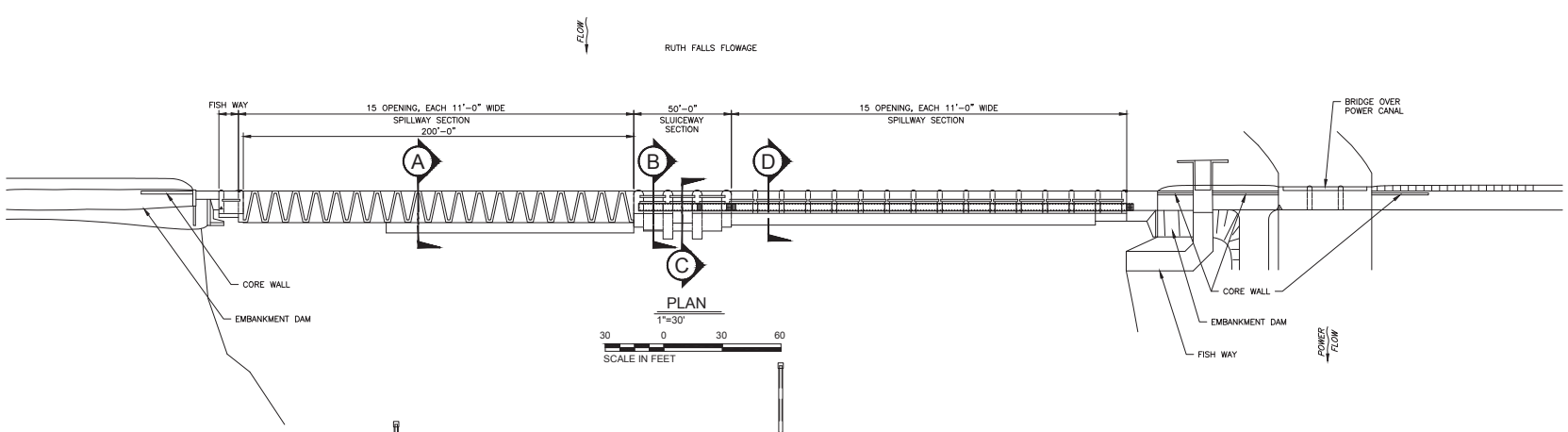
RUTH FALLS REFURBISHMENT
SHEET HARBOUR HYDRO SYSTEM

CONCRETE SPILLWAY OPTION 2
PLAN AND SECTIONS

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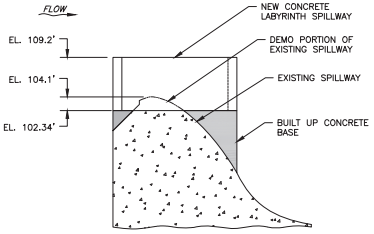
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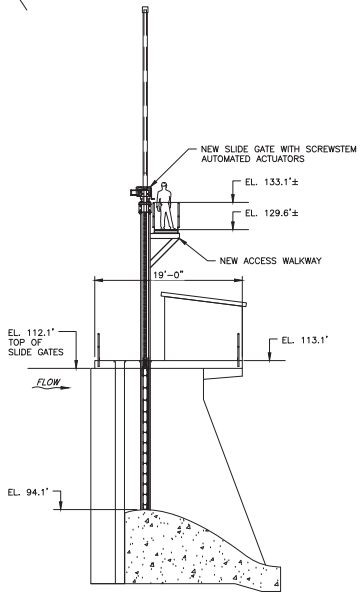
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1"=30'

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SCALE IN FEET

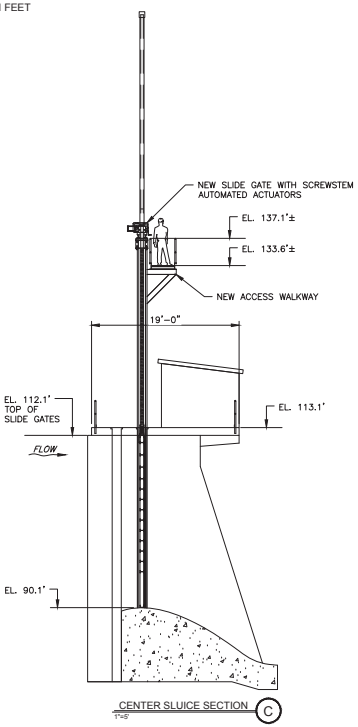


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1"=5'

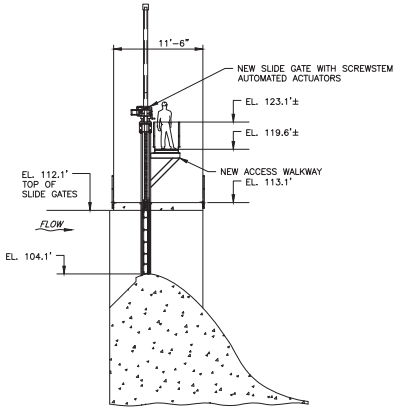
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END SLUICE SECTION B
1"=5' (TYPICAL 2 OPENINGS)



CENTER SLUICE SECTION C
1"=5'



SPILLWAY SECTION D
1"=5'

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RUTH FALLS REFURBISHMENT
SHEET HARBOUR HYDRO SYSTEM

CONCRETE SPILLWAY OPTION 3
PLAN AND SECTIONS

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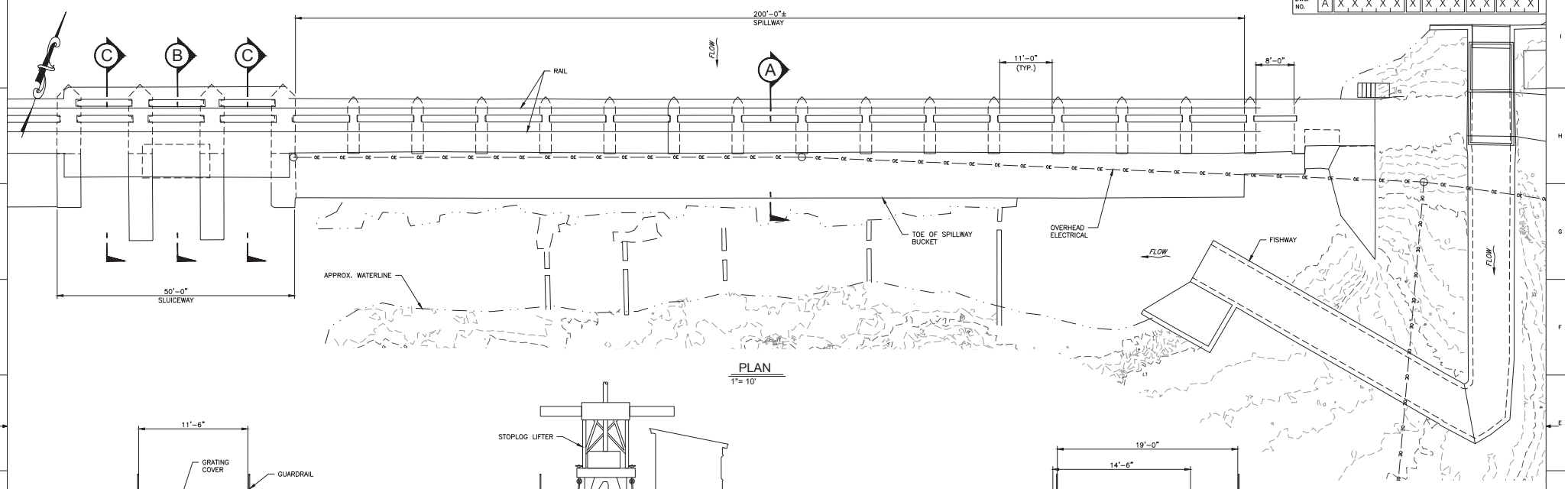
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1890-018	5-16-17	FIGURE

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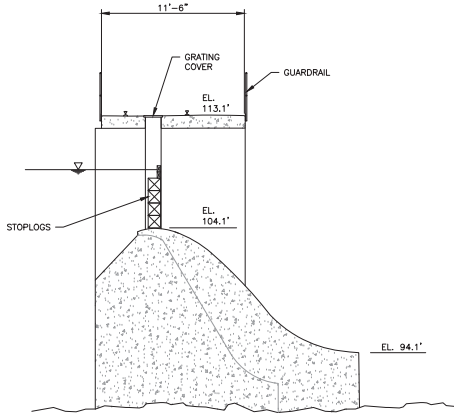
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ATTACHMENT 2

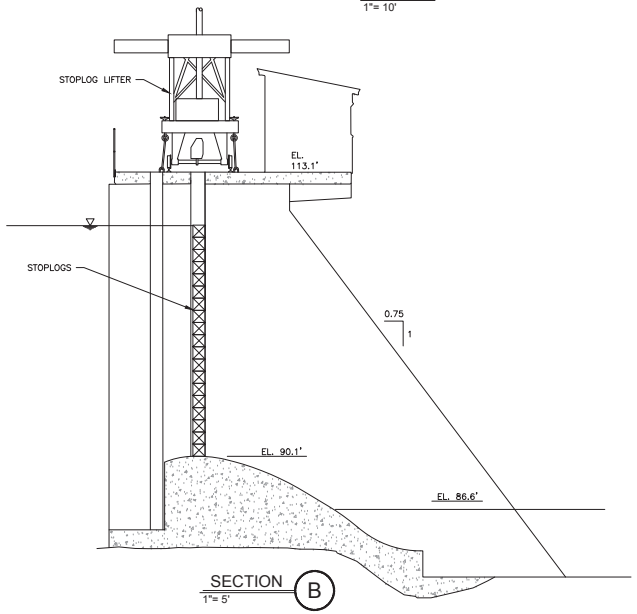
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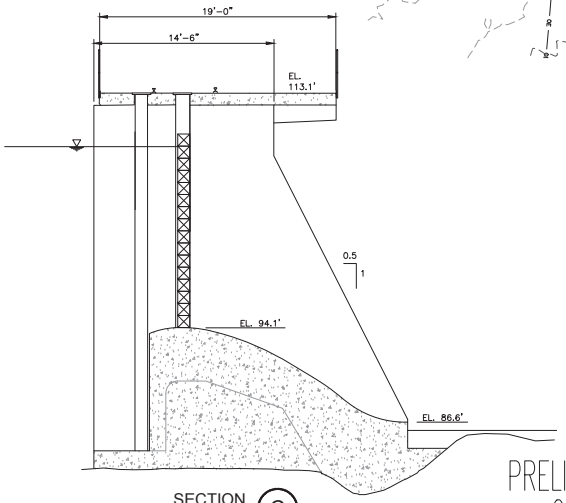
PLAN
1"= 10'



SECTION A
1"= 5'



SECTION B
1"= 5'



SECTION C
1"= 5'

PRELIMINARY
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BY: _____ DATE: ____-__-__					

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MECH ——— CONST ———

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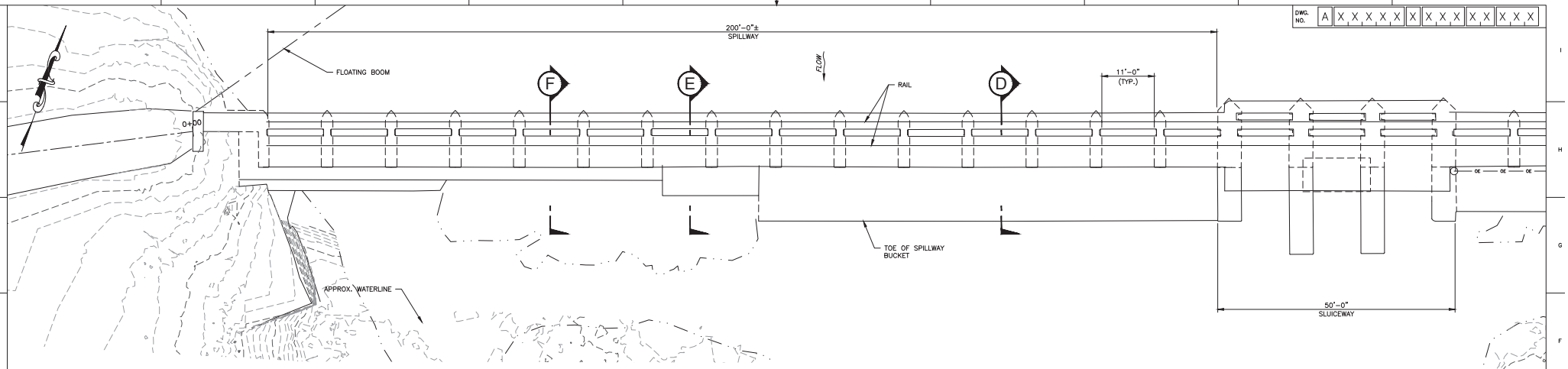
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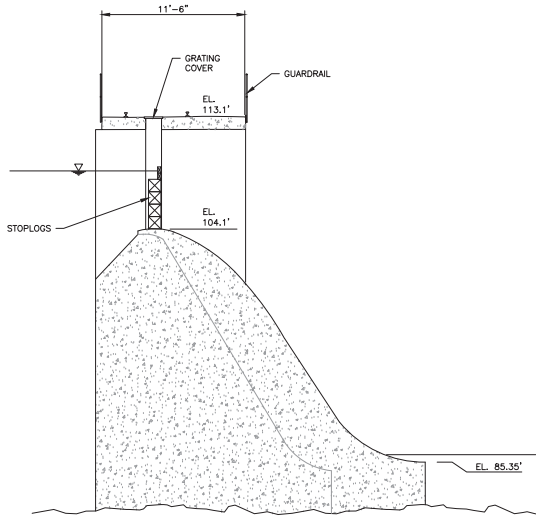
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS
PLAN AND SECTION I

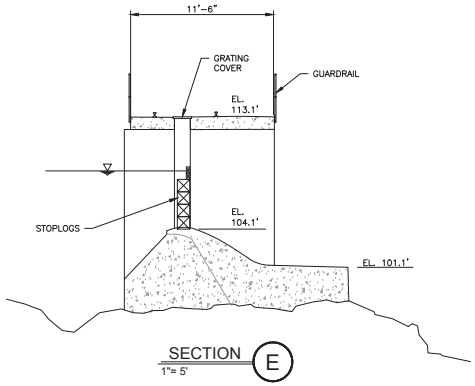
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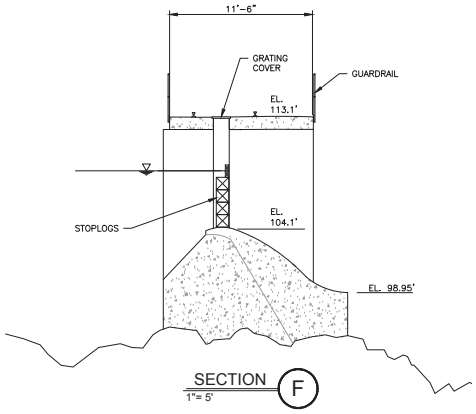
PLAN
1"= 10'



SECTION D
1"= 5'



SECTION E
1"= 5'



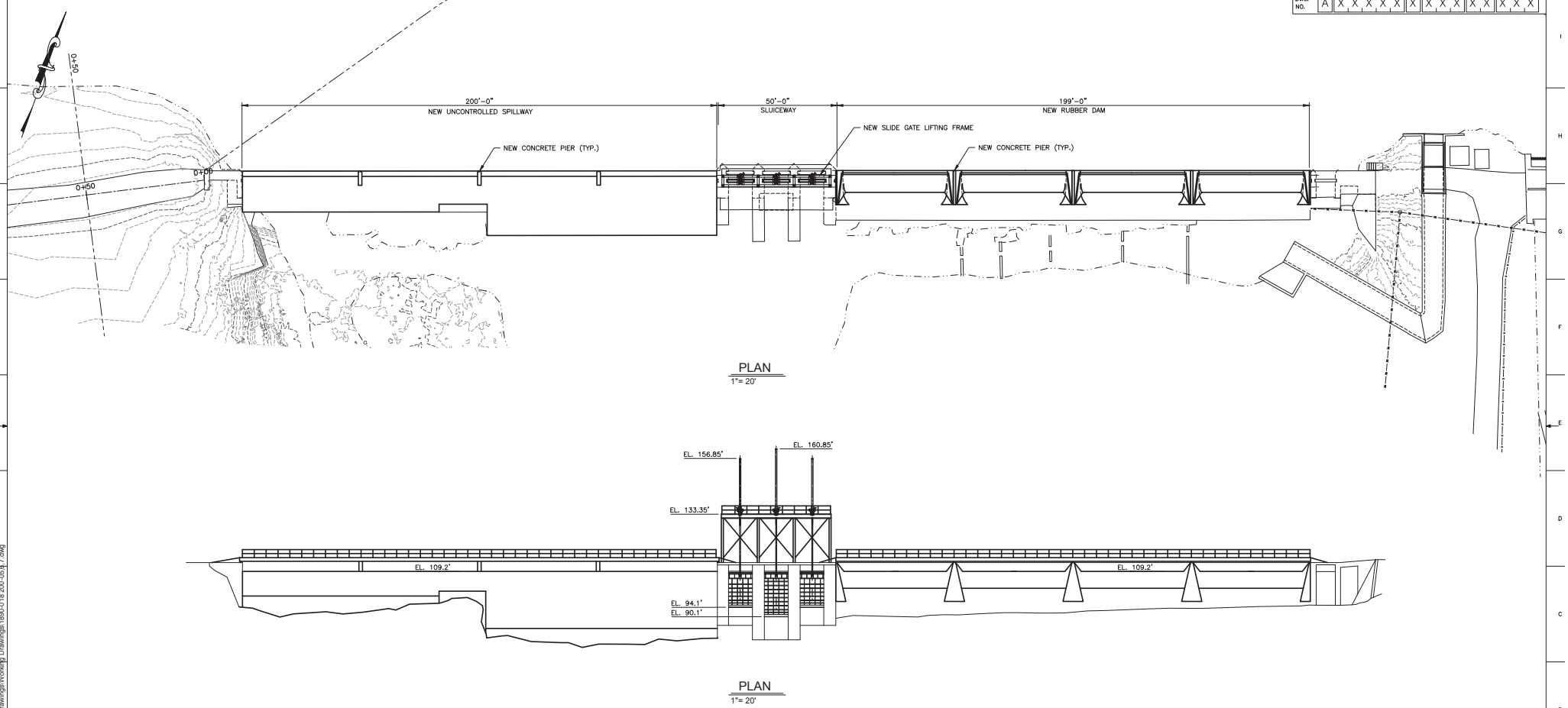
SECTION F
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PRELIMINARY
ONLY

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200-03

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SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , .

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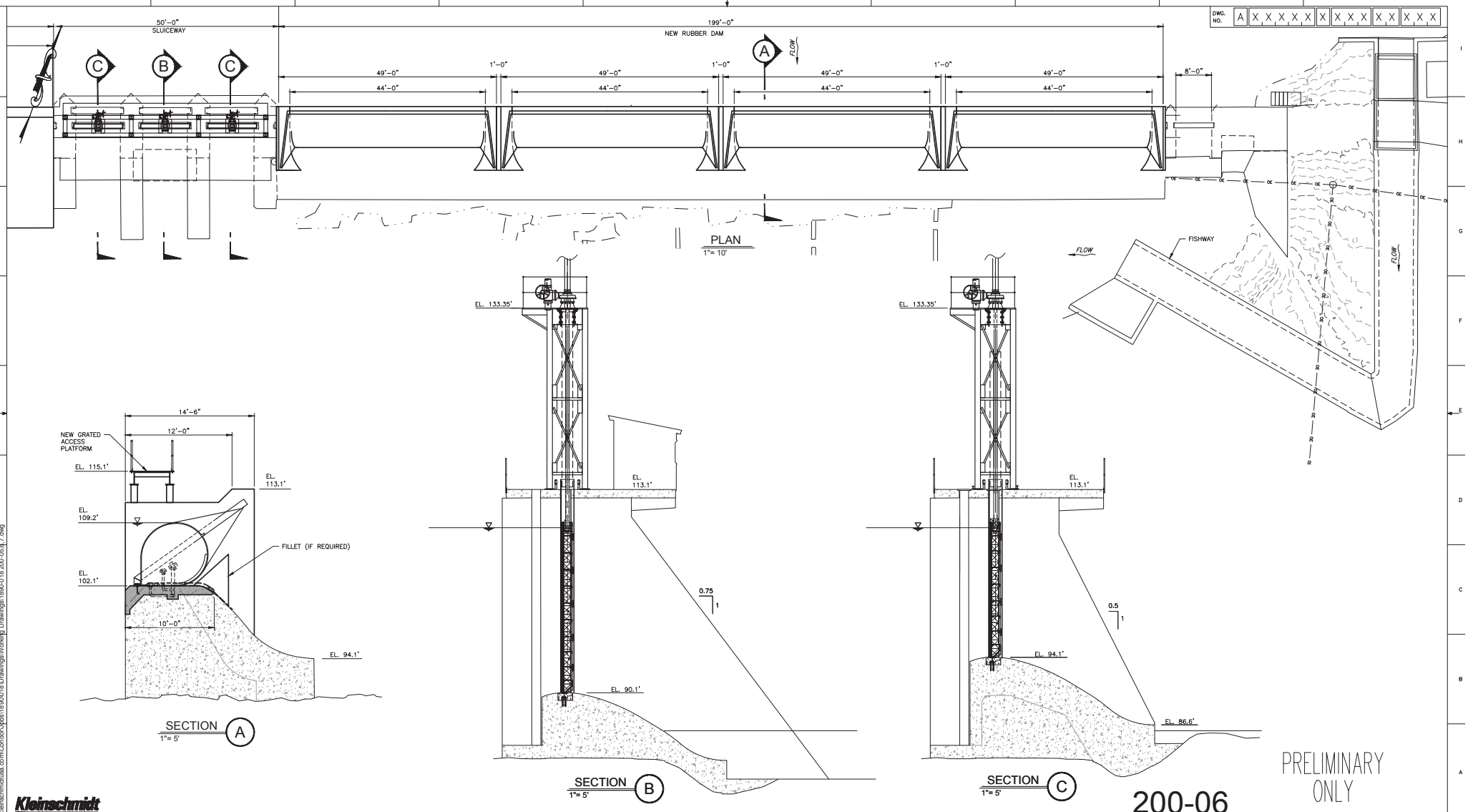
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
DAM PLAN AND ELEVATION

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BY:		DATE:			

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CIVIL	E & I
MECH	CONST

APPROVED

DATE

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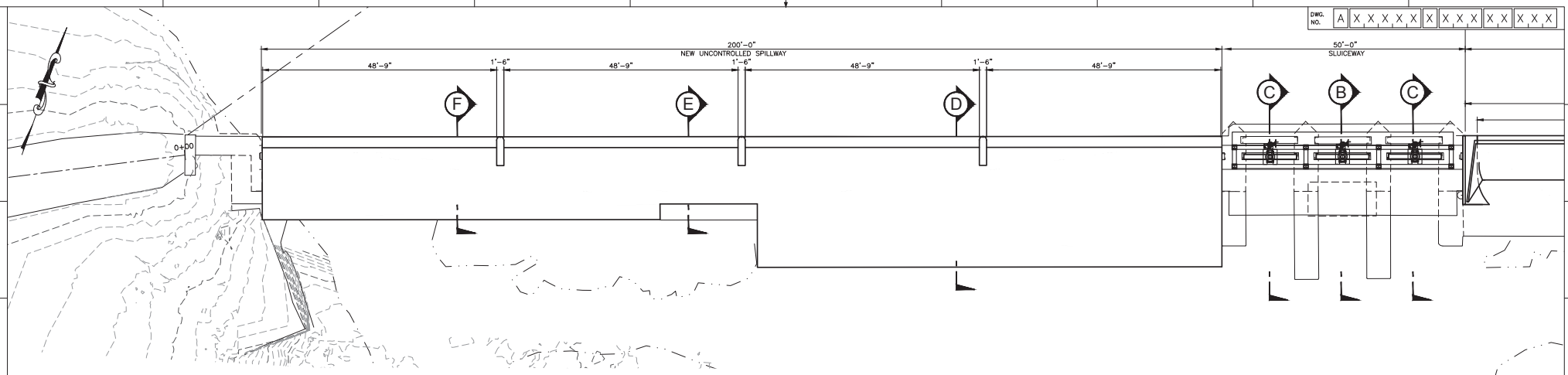
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

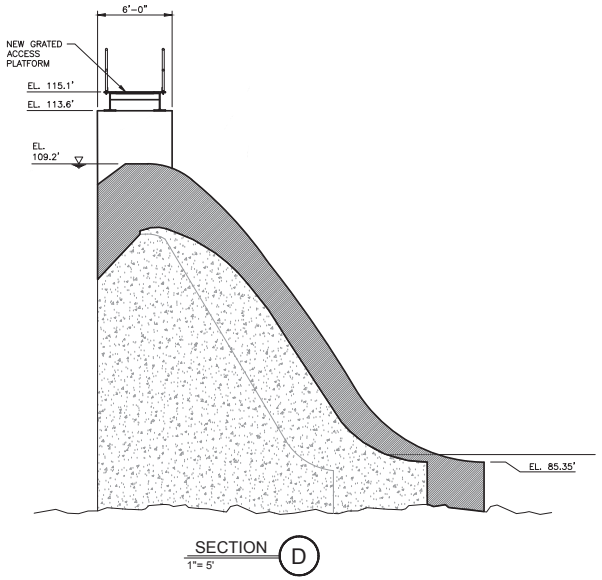
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
RUBBER DAM AND SLIDE GATES
PLAN AND SECTIONS

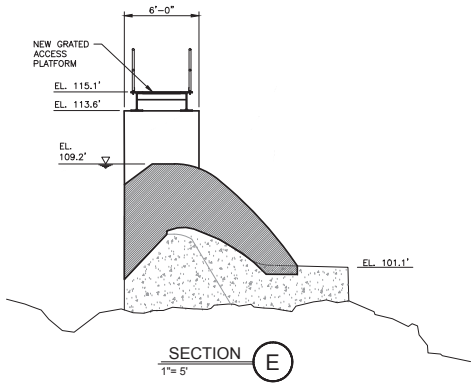
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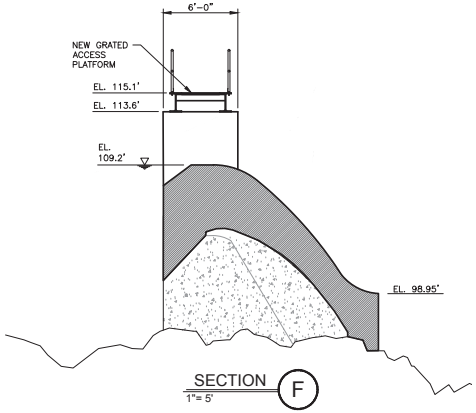
PLAN
1"= 10'



SECTION D
1"= 5'



SECTION E
1"= 5'



SECTION F
1"= 5'

PRELIMINARY ONLY

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BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

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MECH	———	CONST	———

APPROVED

DATE , .

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DESIGNED	ENG
DRAWN	TECH
CHECKED	__
CHECKED	__
DATE	2017-12-08
W.O.	XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW CONDITIONS
UNCONTROLLED SPILLWAY
PLAN AND SECTIONS

DWG.NO. A X X X X X X X X X X X X X X REV. A

ATTACHMENT 3

OPINION OF PROBABLE CONSTRUCTION COST

TABLE 1A
RUTH FALLS SPILLWAY MODIFICATIONS
OPTION 1A - STOP LOG BAYS TO SCREW STEM GATES

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 405,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 100,000	$ 100,000	$ 100,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 30,000	$ 30,000	$ 30,000	
3	SITE ACCESS				$ 70,000	
	GENERAL	1 LS	$ 20,000	$ 20,000		
	STAGING/SCAFFOLDING	1 LS	$ 50,000	$ 50,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	3 MONTH	$ 65,000 /MONTH	$ 195,000	$ 195,000	
B. DEWATERING						$ 199,000
6	TEMPORARY DEWATERING BULKHEAD (5)	1250 SF	$ 70 /SF	$ 87,500	$ 87,500	
7	REMOVAL AND REINSTALLATION ALONG THE SPILLWAY	1 LS	$ 87,500	$ 87,500	$ 87,500	
8	DEWATER PUMPING	24 WK	$ 1,000 /WK	$ 24,000	$ 24,000	
C. SPILLWAY GATES						$ 5,327,500
9	NEW GATES (STOPLOG BAYS)	30 EA	$ 16,000 /EA	$ 480,000	$ 480,000	
10	NEW GATES (SLUICEWAYS)	3 EA	$ 40,000 /EA	$ 120,000	$ 120,000	
11	GATE ACTUATORS (STOPLOG BAYS)	30 EA	$ 100,000 /EA	$ 3,000,000	$ 3,000,000	
12	GATE ACTUATORS (SLUICEWAYS)	3 EA	$ 110,000 /EA	$ 330,000	$ 330,000	
13	NEW GATE INSTALLATION				$ 982,500	
	STOPLOG BAY GATES	30 EA	$ 29,000 /EA	$ 870,000		
	SLUICEWAY GATES	3 EA	$ 37,500 /EA	$ 112,500		
14	NEW ACCESS WALKWAY (APPROXIMATELY 460')				$ 405,000	
	NEW STEEL	90,000 LB	$ 4 /LB	$ 360,000		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 45,000	$ 45,000		
15	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 10,000	$ 10,000	$ 10,000	
D. SPILLWAY MODIFICATIONS						$ 921,750
16	CONCRETE DEMOLITION				$ 129,750	
	RESURFACING OF STOPLOG BAYS	660 CY	$ 150 /CY	$ 99,000		
	RESURFACING OF SLUICEWAYS	150 CY	$ 150 /CY	$ 22,500		
	RESURFACING OF SPILLWAY DECK	55 CY	$ 150 /CY	$ 8,250		
17	NEW CONCRETE				$ 692,000	
	RESURFACING OF STOPLOG BAYS	660 CY	$ 800 /CY	$ 528,000		
	RESURFACING OF SLUICEWAYS	150 CY	$ 800 /CY	$ 120,000		
	RESURFACING OF SPILLWAY DECK	55 CY	$ 800 /CY	$ 44,000		
18	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 100,000	$ 100,000	$ 100,000	
19	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 200,000	$ 200,000	$ 200,000	
20	ROCK ANCHORS	24 EA	$ 5,000	$ 120,000	$ 120,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 7,173,000*	
	CONTINGENCY	20%			$ 1,435,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 8,608,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 1B
RUTH FALLS SPILLWAY MODIFICATIONS
OPTION 1B - STOP LOG BAYS TO HYDRAULIC CYLINDERS

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 405,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 100,000	$ 100,000	$ 100,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 30,000	$ 30,000	$ 30,000	
3	SITE ACCESS				$ 70,000	
	GENERAL	1 LS	$ 20,000	$ 20,000		
	STAGING/SCAFFOLDING	1 LS	$ 50,000	$ 50,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	3 MONTH	$ 65,000 /MONTH	$ 195,000	$ 195,000	
B. DEWATERING						$ 199,000
6	TEMPORARY DEWATERING BULKHEAD (5)	1250 SF	$ 70 /SF	$ 87,500	$ 87,500	
7	REMOVAL AND REINSTALLATION ALONG THE SPILLWAY	1 LS	$ 87,500	$ 87,500	$ 87,500	
8	DEWATER PUMPING	24 WK	$ 1,000 /WK	$ 24,000	$ 24,000	
C. SPILLWAY GATES						$ 6,565,000
9	NEW GATES (STOPLOG BAYS)	30 EA	$ 16,000 /EA	$ 480,000	$ 480,000	
10	NEW GATES (SLUICEWAYS)	3 EA	$ 40,000 /EA	$ 120,000	$ 120,000	
11	GATE ACTUATORS (HYRAULIC) (STOPLOG BAYS)	30 EA	$ 130,000 /EA	$ 3,900,000	$ 3,900,000	
12	GATE ACTUATORS (HYRAULIC) (SLUICEWAYS)	3 EA	$ 140,000 /EA	$ 420,000	$ 420,000	
13	NEW GATE INSTALLATION				$ 1,230,000	
	STOPLOG BAY GATES	30 EA	$ 36,500 /EA	$ 1,095,000		
	SLUICEWAY GATES	3 EA	$ 45,000 /EA	$ 135,000		
14	NEW ACCESS WALKWAY (APPROXIMATELY 460')				$ 405,000	
	NEW STEEL	90,000 LB	$ 4 /LB	$ 360,000		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 45,000	$ 45,000		
15	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 10,000	$ 10,000	$ 10,000	
D. SPILLWAY MODIFICATIONS						$ 921,750
16	CONCRETE DEMOLITION				$ 129,750	
	RESURFACING OF STOPLOG BAYS	660 CY	$ 150 /CY	$ 99,000		
	RESURFACING OF SLUICEWAYS	150 CY	$ 150 /CY	$ 22,500		
	RESURFACING OF SPILLWAY DECK	55 CY	$ 150 /CY	$ 8,250		
17	NEW CONCRETE				$ 692,000	
	RESURFACING OF STOPLOG BAYS	660 CY	$ 800 /CY	$ 528,000		
	RESURFACING OF SLUICEWAYS	150 CY	$ 800 /CY	$ 120,000		
	RESURFACING OF SPILLWAY DECK	55 CY	$ 800 /CY	$ 44,000		
18	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 100,000	$ 100,000	$ 100,000	
19	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 200,000	$ 200,000	$ 200,000	
20	ROCK ANCHORS	24 EA	$ 5,000	$ 120,000	$ 120,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 8,091,000*	
	CONTINGENCY	20%			$ 1,618,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 9,709,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 2A
RUTH FALLS SPILLWAY MODIFICATIONS
OPTION 2A - HORIZONTAL/STRAIGHT UNCONTROLLED SPILLWAY AND SCREW STEM GATES

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 455,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 100,000	$ 100,000	$ 100,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 50,000	$ 50,000	$ 50,000	
3	SITE ACCESS				$ 100,000	
	GENERAL	1 LS	$ 50,000	$ 50,000		
	STAGING/SCAFFOLDING	1 LS	$ 50,000	$ 50,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	3 MONTH	$ 65,000 /MONTH	$ 195,000	$ 195,000	
B. DEWATERING						$ 503,000
6	TEMPORARY DEWATERING BULKHEAD (5)	1250 SF	$ 70 /SF	$ 87,500	$ 87,500	
7	REMOVAL AND REINSTALLATION ALONG THE SPILLWAY	1 LS	$ 45,000	$ 45,000	$ 45,000	
8	DEWATER PUMPING FOR BULKHEAD	24 WK	$ 1,000 /WK	$ 24,000	$ 24,000	
9	BRACED COFFERDAM (FOR SPILLWAY)	3450 SF	$ 90 /SF	$ 310,500	$ 310,500	
10	DEWATER PUMPING FOR COFFERDAM	12 WK	$ 3,000 /WK	$ 36,000	$ 36,000	
C. NEW SPILLWAY GATES						$ 2,625,000
11	NEW GATES (STOPLOGS BAYS)	15 EA	$ 20,000 /EA	$ 300,000	$ 300,000	
12	NEW GATES (SLUICEWAYS)	2 EA	$ 40,000 /EA	$ 80,000	$ 80,000	
13	GATE ACTUATORS (STOPLOG BAYS)	15 EA	$ 100,000 /EA	$ 1,500,000	$ 1,500,000	
14	GATE ACTUATORS (SLUICEWAYS)	2 EA	$ 110,000 /EA	$ 220,000	$ 220,000	
15	NEW GATE INSTALLATION				$ 525,000	
	STOPLOG BAY GATES	15 EA	$ 30,000 /EA	$ 450,000		
	SLUICEWAY GATES	2 EA	$ 37,500 /EA	$ 75,000		
D. SPILLWAY MODIFICATIONS						$ 1,935,000
16	CONCRETE DEMOLITION				$ 130,500	
	STOPLOG BAYS TO NEW SPILLWAY	335 CY	$ 150 /CY	$ 50,250		
	SLUICEWAYS TO NEW SPILLWAY	105 CY	$ 150 /CY	$ 15,750		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 150 /CY	$ 49,500		
	RESURFACING OF SLUICEWAYS	100 CY	$ 150 /CY	$ 15,000		
17	NEW CONCRETE				$ 1,252,000	
	STOPLOG BAYS TO NEW SPILLWAY	965 CY	$ 800 /CY	$ 772,000		
	SLUICEWAYS TO NEW SPILLWAY	170 CY	$ 800 /CY	$ 136,000		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 800 /CY	$ 264,000		
	RESURFACING OF SLUICEWAYS	100 CY	$ 800 /CY	$ 80,000		
18	NEW ACCESS WALKWAY (APPROXIMATELY 235')				$ 202,500	
	NEW STEEL	45,000 LB	$ 4 /LB	$ 180,000		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 22,500	$ 22,500		
19	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 150,000	$ 150,000	$ 150,000	
20	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 200,000	$ 200,000	$ 200,000	
21	ROCK ANCHORS	12 EA	$ 5,000	$ 60,000	$ 60,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 5,578,000*	
	CONTINGENCY	20%			$ 1,116,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 6,694,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 2B
RUTH FALLS SPILLWAY MODIFICATIONS
OPTION 2B - HORIZONTAL/STRAIGHT UNCONTROLLED SPILLWAY AND HYDRAULIC CYLINDERS

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 455,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 100,000	$ 100,000	$ 100,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 50,000	$ 50,000	$ 50,000	
3	SITE ACCESS				$ 100,000	
	GENERAL	1 LS	$ 50,000	$ 50,000		
	STAGING/SCAFFOLDING	1 LS	$ 50,000	$ 50,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	3 MONTH	$ 65,000 /MONTH	$ 195,000	$ 195,000	
B. DEWATERING						$ 503,000
6	TEMPORARY DEWATERING BULKHEAD (5)	1250 SF	$ 70 /SF	$ 87,500	$ 87,500	
7	REMOVAL AND REINSTALLATION ALONG THE SPILLWAY	1 LS	$ 45,000	$ 45,000	$ 45,000	
8	DEWATER PUMPING FOR BULKHEAD	24 WK	$ 1,000 /WK	$ 24,000	$ 24,000	
9	BRACED COFFERDAM (FOR SPILLWAY)	3450 SF	$ 90 /SF	$ 310,500	$ 310,500	
10	DEWATER PUMPING FOR COFFERDAM	12 WK	$ 3,000 /WK	$ 36,000	$ 36,000	
C. NEW SPILLWAY GATES						$ 3,262,500
11	NEW GATES (STOPLOGS BAYS)	15 EA	$ 20,000 /EA	$ 300,000	$ 300,000	
12	NEW GATES (SLUICEWAYS)	2 EA	$ 40,000 /EA	$ 80,000	$ 80,000	
13	GATE ACTUATORS (HYRAULIC) (STOPLOG BAYS)	15 EA	$ 130,000 /EA	$ 1,950,000	$ 1,950,000	
14	GATE ACTUATORS (HYRAULIC) (SLUICEWAYS)	2 EA	$ 140,000 /EA	$ 280,000	$ 280,000	
15	NEW GATE INSTALLATION				$ 652,500	
	STOPLOG BAY GATES	15 EA	$ 37,500 /EA	$ 562,500		
	SLUICEWAY GATES	2 EA	$ 45,000 /EA	$ 90,000		
D. SPILLWAY MODIFICATIONS						$ 1,982,250
16	CONCRETE DEMOLITION				$ 117,750	
	STOPLOG BAYS TO NEW SPILLWAY	250 CY	$ 150 /CY	$ 37,500		
	SLUICEWAYS TO NEW SPILLWAY	105 CY	$ 150 /CY	$ 15,750		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 150 /CY	$ 49,500		
	RESURFACING OF SLUICEWAYS	100 CY	$ 150 /CY	$ 15,000		
17	NEW CONCRETE				$ 1,252,000	
	STOPLOG BAYS TO NEW SPILLWAY	965 CY	$ 800 /CY	$ 772,000		
	SLUICEWAYS TO NEW SPILLWAY	170 CY	$ 800 /CY	$ 136,000		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 800 /CY	$ 264,000		
	RESURFACING OF SLUICEWAYS	100 CY	$ 800 /CY	$ 80,000		
18	NEW ACCESS WALKWAY (APPROXIMATELY 235')				$ 202,500	
	NEW STEEL	45,000 LB	$ 4 /LB	$ 180,000		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 22,500	$ 22,500		
19	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 150,000	$ 150,000	$ 150,000	
20	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 200,000	$ 200,000	$ 200,000	
21	ROCK ANCHORS	12 EA	$ 5,000	$ 60,000	$ 60,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 6,203,000*	
	CONTINGENCY	20%			$ 1,241,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 7,444,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 3A
RUTH FALLS SPILLWAY MODIFICATIONS
OPTION 3A - LABYRINTH SPILLWAY AND SCREW STEM GATES

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 425,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 100,000	$ 100,000	$ 100,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 20,000	$ 20,000	$ 20,000	
3	SITE ACCESS				$ 100,000	
	GENERAL	1 LS	$ 50,000	$ 50,000		
	STAGING/SCAFFOLDING	1 LS	$ 50,000	$ 50,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	3 MONTH	$ 65,000 /MONTH	$ 195,000	$ 195,000	
B. DEWATERING						$ 503,000
6	TEMPORARY DEWATERING BULKHEAD (5)	1250 SF	$ 70 /SF	$ 87,500	$ 87,500	
7	REMOVAL AND REINSTALLATION ALONG THE SPILLWAY	1 LS	$ 45,000	$ 45,000	$ 45,000	
8	DEWATER PUMPING FOR BULKHEAD	24 WK	$ 1,000 /WK	$ 24,000	$ 24,000	
9	BRACED COFFERDAM (FOR SPILLWAY)	3450 SF	$ 90 /SF	$ 310,500	$ 310,500	
10	DEWATER PUMPING FOR COFFERDAM	12 WK	$ 3,000 /WK	$ 36,000	$ 36,000	
C. GATE MODIFICATIONS						$ 2,812,500
11	NEW GATES (STOPLOGS BAYS)	15 EA	$ 20,000 /EA	$ 300,000	$ 300,000	
12	NEW GATES (SLUICEWAYS)	3 EA	$ 40,000 /EA	$ 120,000	$ 120,000	
13	GATE ACTUATORS (STOPLOG BAYS)	15 EA	$ 100,000 /EA	$ 1,500,000	$ 1,500,000	
14	GATE ACTUATORS (SLUICEWAYS)	3 EA	$ 110,000 /EA	$ 330,000	$ 330,000	
15	NEW GATE INSTALLATION				$ 562,500	
	STOPLOG BAY GATES	15 EA	$ 30,000 /EA	$ 450,000		
	SLUICEWAY GATES	3 EA	$ 37,500 /EA	$ 112,500		
D. SPILLWAY MODIFICATIONS						$ 2,189,000
16	CONCRETE DEMOLITION				$ 129,000	
	STOPLOG BAYS TO NEW LABYRINTH	330 CY	$ 150 /CY	$ 49,500		
	SLUICEWAYS TO NEW LABYRINTH	50 CY	$ 150 /CY	$ 7,500		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 150 /CY	$ 49,500		
	RESURFACING OF SLUICEWAYS	150 CY	$ 150 /CY	$ 22,500		
17	NEW CONCRETE				$ 1,434,000	
	LABYRINTH WALLS	190 CY	$ 1,000 /CY	$ 190,000		
	LABYRINTH APRON/FOUNDATION	810 CY	$ 1,000 /CY	$ 810,000		
	ANCHORAGE INTO EXISTING CONCRETE	1 LS	$ 50,000	$ 50,000		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 800 /CY	$ 264,000		
	RESURFACING OF SLUICEWAYS	150 CY	$ 800 /CY	$ 120,000		
18	NEW ACCESS WALKWAY (APPROXIMATELY 235')				$ 216,000	
	NEW STEEL	48,000 LB	$ 4 /LB	$ 192,000		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 24,000	$ 24,000		
19	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 150,000	$ 150,000	$ 150,000	
20	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 200,000	$ 200,000	$ 200,000	
21	ROCK ANCHORS	12 EA	$ 5,000	$ 60,000	$ 60,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 5,930,000*	
	CONTINGENCY	20%			$ 1,186,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 7,116,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 3B
RUTH FALLS SPILLWAY MODIFICATIONS
OPTION 3B - LABYRINTH SPILLWAY AND HYDRAULIC CYLINDERS

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 425,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 100,000	$ 100,000	$ 100,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 20,000	$ 20,000	$ 20,000	
3	SITE ACCESS				$ 100,000	
	GENERAL	1 LS	$ 50,000	$ 50,000		
	STAGING/SCAFFOLDING	1 LS	$ 50,000	$ 50,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	3 MONTH	$ 65,000 /MONTH	$ 195,000	$ 195,000	
B. DEWATERING						$ 503,000
6	TEMPORARY DEWATERING BULKHEAD (5)	1250 SF	$ 70 /SF	$ 87,500	$ 87,500	
7	REMOVAL AND REINSTALLATION ALONG THE SPILLWAY	1 LS	$ 45,000	$ 45,000	$ 45,000	
8	DEWATER PUMPING FOR BULKHEAD	24 WK	$ 1,000 /WK	$ 24,000	$ 24,000	
9	BRACED COFFERDAM (FOR SPILLWAY)	3450 SF	$ 90 /SF	$ 310,500	$ 310,500	
10	DEWATER PUMPING FOR COFFERDAM	12 WK	$ 3,000 /WK	$ 36,000	$ 36,000	
C. GATE MODIFICATIONS						$ 3,487,500
11	NEW GATES (STOPLOGS BAYS)	15 EA	$ 20,000 /EA	$ 300,000	$ 300,000	
12	NEW GATES (SLUICEWAYS)	3 EA	$ 40,000 /EA	$ 120,000	$ 120,000	
13	GATE ACTUATORS (HYDRAULIC) (STOPLOG BAYS)	15 EA	$ 130,000 /EA	$ 1,950,000	$ 1,950,000	
14	GATE ACTUATORS (HYRAULIC) (SLUICEWAYS)	3 EA	$ 140,000 /EA	$ 420,000	$ 420,000	
15	NEW GATE INSTALLATION				$ 697,500	
	STOPLOG BAY GATES	15 EA	$ 37,500 /EA	$ 562,500		
	SLUICEWAY GATES	3 EA	$ 45,000 /EA	$ 135,000		
D. SPILLWAY MODIFICATIONS						$ 2,154,500
16	CONCRETE DEMOLITION				$ 94,500	
	STOPLOG BAYS TO NEW LABYRINTH	100 CY	$ 150 /CY	$ 15,000		
	SLUICEWAYS TO NEW LABYRINTH	50 CY	$ 150 /CY	$ 7,500		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 150 /CY	$ 49,500		
	RESURFACING OF SLUICEWAYS	150 CY	$ 150 /CY	$ 22,500		
17	NEW CONCRETE				$ 1,434,000	
	LABYRINTH WALLS	190 CY	$ 1,000 /CY	$ 190,000		
	LABYRINTH APRON/FOUNDATION	810 CY	$ 1,000 /CY	$ 810,000		
	ANCHORAGE INTO EXISTING CONCRETE	1 LS	$ 50,000	$ 50,000		
	RESURFACING OF STOPLOG BAYS	330 CY	$ 800 /CY	$ 264,000		
	RESURFACING OF SLUICEWAYS	150 CY	$ 800 /CY	$ 120,000		
18	NEW ACCESS WALKWAY (APPROXIMATELY 235')				$ 216,000	
	NEW STEEL	48,000 LB	$ 4 /LB	$ 192,000		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 24,000	$ 24,000		
19	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 150,000	$ 150,000	$ 150,000	
20	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 200,000	$ 200,000	$ 200,000	
21	ROCK ANCHORS	12 EA	$ 5,000	$ 60,000	$ 60,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 6,570,000*	
	CONTINGENCY	20%			$ 1,314,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 7,884,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 4A
RUTH FALLS SPILLWAY MODIFICATIONS
OPTION 4A - HORIZONTAL/STRAIGHT UNCONTROLLED SPILLWAY, RUBBER DAM, AND SCREW STEM GATES

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 455,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 100,000	$ 100,000	$ 100,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 50,000	$ 50,000	$ 50,000	
3	SITE ACCESS				$ 100,000	
	GENERAL	1 LS	$ 50,000	$ 50,000		
	STAGING/SCAFFOLDING	1 LS	$ 50,000	$ 50,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	3 MONTH	$ 65,000 /MONTH	$ 195,000	$ 195,000	
B. DEWATERING						$ 693,000
6	BRACED COFFERDAM (FOR SPILLWAY)	6900 SF	$ 90 /SF	$ 621,000	$ 621,000	
7	DEWATER PUMPING FOR COFFERDAM	24 WK	$ 3,000 /WK	$ 72,000	$ 72,000	
C. NEW SPILLWAY GATES						$ 562,500
8	NEW GATES (SLUICEWAYS)	3 EA	$ 40,000 /EA	$ 120,000	$ 120,000	
9	GATE ACTUATORS (SLUICEWAYS)	3 EA	$ 110,000 /EA	$ 330,000	$ 330,000	
10	NEW GATE INSTALLATION	3 EA	$ 37,500 /EA	$ 112,500	$ 112,500	
D. SPILLWAY MODIFICATIONS						$ 3,648,804
11	RUBBER DAM				$ 1,237,000	
	SUPPLY OF RUBBER DAM	200 LF	$ 4,085 /LF	$ 817,000		
	CONSTRUCTION (SEE TAKEOFFS FOR DETAILS)	200 LF	$ 2,000 /LF	$ 400,000		
	COMPRESSOR AND BLOWER HOUSE	1 LS	$ 20,000	$ 20,000		
12	CONCRETE DEMOLITION				$ 123,000	
	STOPLOG BAYS TO UNCONTROLLED SPILLWAY	335 CY	$ 150 /CY	$ 50,250		
	STOPLOG BAYS TO RUBBER DAM	335 CY	$ 150 /CY	$ 50,250		
	RESURFACING OF SLUICEWAYS	150 CY	$ 150 /CY	$ 22,500		
13	NEW CONCRETE				$ 1,129,000	
	STOPLOG BAYS TO UNCONTROLLED SPILLWAY	965 CY	$ 800 /CY	$ 772,000		
	STOPLOG BAYS TO RUBBER DAM	190 CY	$ 800 /CY	$ 152,000		
	RESURFACING OF SLUICEWAYS	150 CY	$ 800 /CY	$ 120,000		
	NEW PIERS (6 TOTAL)	85 CY	$ 1,000 /CY	$ 85,000		
14	NEW ACCESS WALKWAY (APPROXIMATELY 450')				$ 749,804	
	NEW STEEL	170,410 LB	$ 4 /LB	$ 681,640		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 68,164	$ 68,164		
15	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 150,000	$ 150,000	$ 150,000	
16	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 200,000	$ 200,000	$ 200,000	
17	ROCK ANCHORS	12 EA	$ 5,000	$ 60,000	$ 60,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 5,359,000*	
	CONTINGENCY	20%			$ 1,072,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 6,431,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 5A
RUTH FALLS NEW DAM OPTION
OPTION 5A - LABYRINTH SPILLWAY AND SCREW STEM GATES

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
ASSUMES (2) 7 MONTH CONSTRUCTION SEASONS
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 1,065,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 200,000	$ 200,000	$ 200,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 100,000	$ 100,000	$ 100,000	
3	SITE ACCESS				$ 300,000	
	GENERAL	1 LS	$ 150,000	$ 150,000		
	STAGING/SCAFFOLDING	1 LS	$ 150,000	$ 150,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	7 MONTH	$ 65,000 /MONTH	$ 455,000	$ 455,000	
B. DEWATERING						$ 370,500
6	DEWATER PUMPING FOR COFFERDAM	56 WK	$ 3,000 /WK	$ 168,000	$ 168,000	
7	BRACED COFFERDAM BETWEEN SPILLWAY SECTIONS	2250 SF	$ 90 /SF	$ 202,500	$ 202,500	
	HEIGHT	25 FT				
	LENGTH	75 FT				
	% INCREASE ACCOUNTING FOR D/S DIVERSION	20%				
C. GATE MODIFICATIONS						$ 562,500
8	NEW GATES (SLUICEWAYS)	3 EA	$ 40,000 /EA	$ 120,000	$ 120,000	
9	GATE ACTUATORS (SLUICEWAYS)	3 EA	$ 110,000 /EA	$ 330,000	$ 330,000	
10	NEW GATE INSTALLATION	3 EA	$ 37,500 /EA	$ 112,500	$ 112,500	
D. SPILLWAY MODIFICATIONS						$ 8,432,121
11	CONCRETE DEMOLITION				$ 1,125,000	
	OLD DAM - ABOVE WATER	1500 CY	$ 150 /CY	$ 225,000		
	OLD DAM - UNDER WATER	1500 CY	$ 600 /CY	$ 900,000		
12	NEW CONCRETE				$ 3,701,481	
	LABYRINTH WALLS (AVG. DIMS.)	1737 CY	$ 1,000 /CY	$ 1,737,037		
	HEIGHT	16.75 FT				
	LENGTH (ALONG SPILLWAY, 3.5' WALL/1' OF SPILLWAY)	400 FT				
	THICKNESS	24 IN				
	LABYRINTH & GATE APRON/FOUNDATION	956 CY	$ 800 /CY	$ 764,444		
	HEIGHT	3 FT				
	LENGTH (ALONG SPILLWAY)	430 FT				
	WIDTH	20 FT				
	GATE PIERS	611 CY	$ 1,000 /CY	$ 611,111		
	NUMBER	4 (-)				
	X-SXN AREA	825 FT2				
	THICKNESS	5 FT				
	WALKWAY PIERS	89 CY	$ 1,000 /CY	$ 88,889		
	NUMBER	6 (-)				
	X-SXN AREA	200 FT2				
	THICKNESS	2 FT				
	ANCHORAGE INTO BEDROCK	1 LS	$ 500,000	$ 500,000		
13	NEW ACCESS WALKWAY (APPROXIMATELY 450')				$ 705,640	
	NEW STEEL	170,410 LB	$ 4 /LB	$ 681,640		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 24,000	$ 24,000		
14	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 500,000	$ 500,000	$ 500,000	
15	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 400,000	$ 400,000	$ 400,000	
16	FISH PASSAGE MODIFICATIONS	1 LS	$ 2,000,000	$ 2,000,000	$ 2,000,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 10,430,000*	
	CONTINGENCY	20%			$ 2,086,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 12,516,000**	**CAD**

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX, HST, AND INSURANCE ARE NOT INCLUDED.
4. MOBILIZATION AND DEMOBILIZATION COSTS WERE BASED ON CLIENT PROVIDED INFORMATION.
5. INDIRECT COSTS SUCH AS PERMITTING, ENGINEERING, AND CONSTRUCTION MONITORING WERE NOT INCLUDED BASED ON CLIENT PREFERENCE.

BY: KLEINSCHMIDT ASSOCIATES

TABLE 5B
RUTH FALLS NEW DAM OPTION
OPTION 5B - OGEE/RUBBER DAM SPILLWAY AND SCREW STEM GATES

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
ASSUMES (2) 7 MONTH CONSTRUCTION SEASONS
(COST IN $2017)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 1,065,000
1	MOBILIZATION/DEMOBILIZATION	1 LS	$ 200,000	$ 200,000	$ 200,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 100,000	$ 100,000	$ 100,000	
3	SITE ACCESS				$ 300,000	
	GENERAL	1 LS	$ 150,000	$ 150,000		
	STAGING/SCAFFOLDING	1 LS	$ 150,000	$ 150,000		
4	CRANE MOBILIZATION AND DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE RENTAL AND OPERATION	7 MONTH	$ 65,000 /MONTH	$ 455,000	$ 455,000	
B. DEWATERING						$ 370,500
6	DEWATER PUMPING FOR COFFERDAM	56 WK	$ 3,000 /WK	$ 168,000	$ 168,000	
7	BRACED COFFERDAM BETWEEN SPILLWAY SECTIONS	2250 SF	$ 90 /SF	$ 202,500	$ 202,500	
	HEIGHT	25 FT				
	LENGTH	75 FT				
	% INCREASE ACCOUNTING FOR D/S DIVERSION	20%				
C. GATE MODIFICATIONS						$ 562,500
8	NEW GATES (SLUICEWAYS)	3 EA	$ 40,000 /EA	$ 120,000	$ 120,000	
9	GATE ACTUATORS (SLUICEWAYS)	3 EA	$ 110,000 /EA	$ 330,000	$ 330,000	
10	NEW GATE INSTALLATION	3 EA	$ 37,500 /EA	$ 112,500	$ 112,500	
D. SPILLWAY MODIFICATIONS						$ 9,577,640
11	RUBBER DAM				$ 1,237,000	
	SUPPLY OF RUBBER DAM	200 LF	$ 4,085 /LF	$ 817,000		
	CONSTRUCTION (SEE TAKEOFFS FOR DETAILS)	200 LF	$ 2,000 /LF	$ 400,000		
	COMPRESSOR AND BLOWER HOUSE	1 LS	$ 20,000	$ 20,000		
12	CONCRETE DEMOLITION				$ 1,125,000	
	OLD DAM - ABOVE WATER	1500 CY	$ 150 /CY	$ 225,000		
	OLD DAM - UNDER WATER	1500 CY	$ 600 /CY	$ 900,000		
13	NEW CONCRETE				$ 3,610,000	
	OGEE (EQUIV. SQ. DIMS.)	2269 CY	$ 600 /CY	$ 1,361,111		
	HEIGHT	17.5 FT				
	LENGTH (ALONG SPILLWAY)	200 FT				
	WIDTH	17.5 FT				
	BASE OF RUBBER DAM (EQUIV. SQ. DIMS.)	474 CY	$ 600 /CY	$ 284,444		
	HEIGHT	8 FT				
	LENGTH (ALONG SPILLWAY)	200 FT				
	WIDTH	8 FT				
	SPILLWAY APRON/FOUNDATION	956 CY	$ 800 /CY	$ 764,444		
	HEIGHT	3 FT				
	LENGTH (ALONG SPILLWAY)	430 FT				
	WIDTH	20 FT				
	GATE PIERS	611 CY	$ 1,000 /CY	$ 611,111		
	NUMBER	4 (-)				
	X-SXN AREA	825 FT2				
	THICKNESS	5 FT				
	WALKWAY/RUBBER DAM PIERS	89 CY	$ 1,000 /CY	$ 88,889		
	NUMBER	6 (-)				
	X-SXN AREA	200 FT2				
	THICKNESS	2 FT				
	ANCHORAGE INTO BEDROCK	1 LS	$ 500,000	$ 500,000		
14	NEW ACCESS WALKWAY (APPROXIMATELY 450')				$ 705,640	
	NEW STEEL	170,410 LB	$ 4 /LB	$ 681,640		
	WALKWAY MOUNTING CONNECTIONS	1 LS	$ 24,000	$ 24,000		
15	CONCRETE DISPOSAL (INCLUDING LOADING & HAULING)	1 LS	$ 500,000	$ 500,000	$ 500,000	
16	LEFT & RIGHT CONCRETE/EARTHEN ABUTMENTS	1 LS	$ 400,000	$ 400,000	$ 400,000	
17	FISH PASSAGE MODIFICATIONS	1 LS	$ 2,000,000	$ 2,000,000	$ 2,000,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 11,576,000*	
	CONTINGENCY	20%			$ 2,315,000	
	TOTAL OF DIRECT CONSTRUCTION COSTS				**$ 13,891,000**	**CAD**

NOTES:
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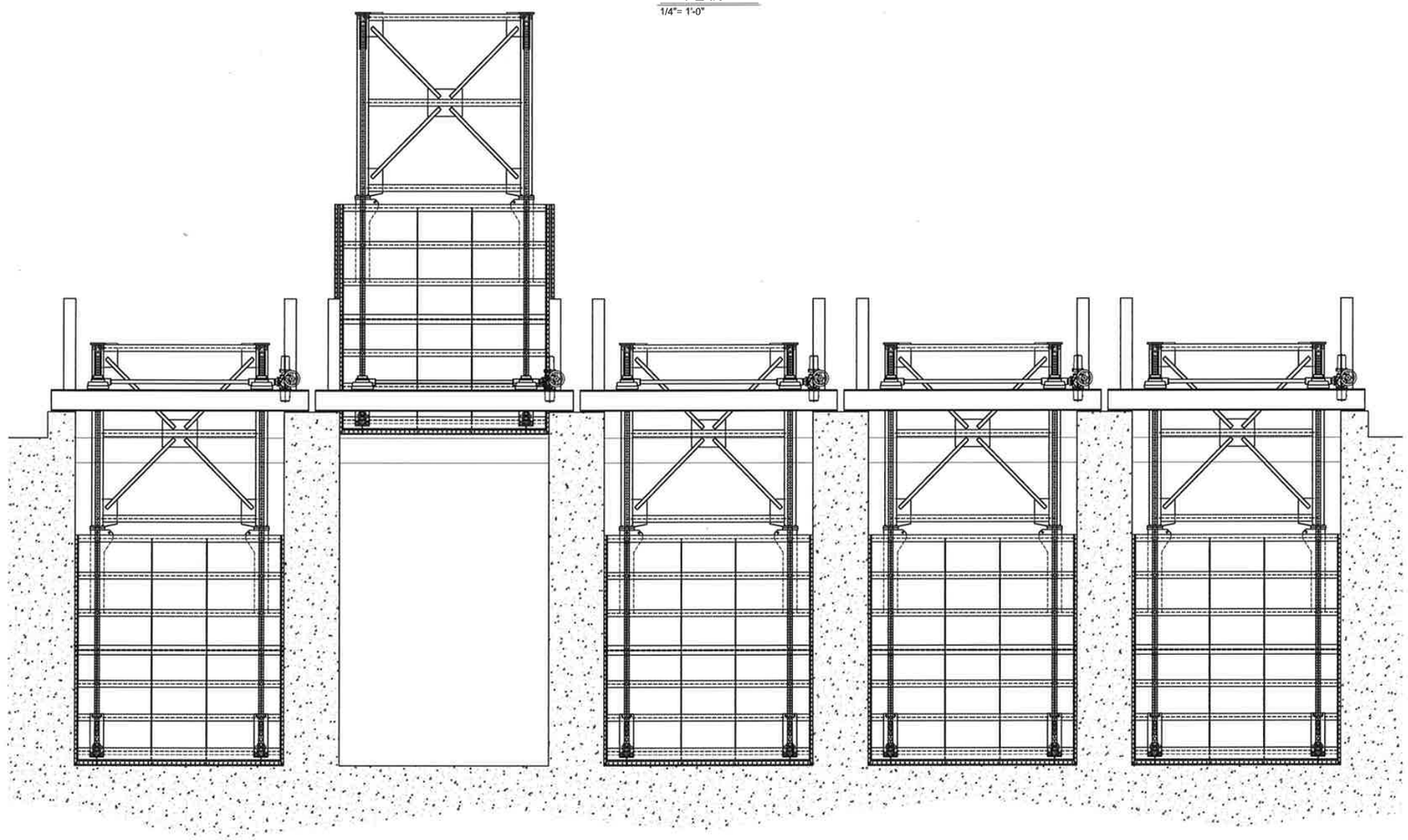
BY: KLEINSCHMIDT ASSOCIATES

ATTACHMENT 4

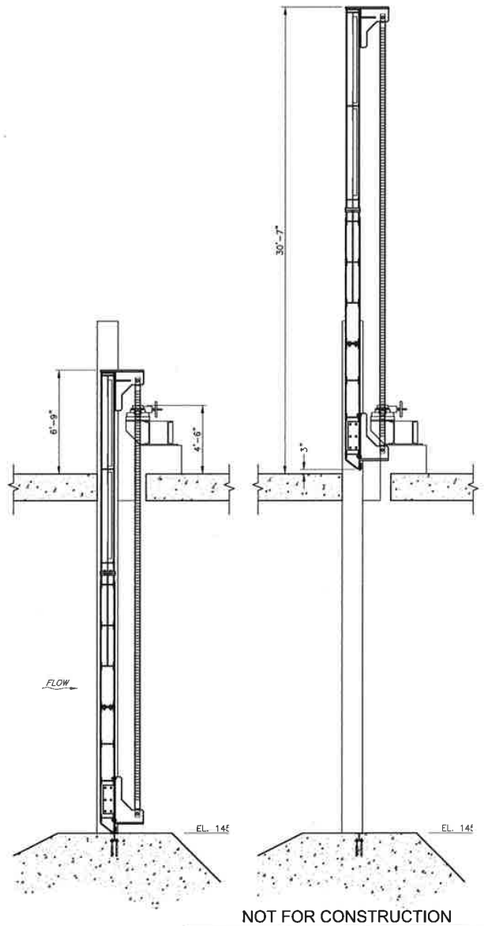
ALTERNATIVE DECK MOUNTED SCREW STEM OPERATOR

24x36 = FULL SCALE

PLAN
1/4"= 1'-0"



ELEVATION
1/4"= 1'-0"



DECK MOUNTED SCREW STEM OPERATOS

NOT FOR CONSTRUCTION

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DAM REPLACEMENT PROJECT

SLIDE GATES
OVERALL PLAN, ELEVATION, & PROFILE

No.	Revision	Date	Drawn	Checked
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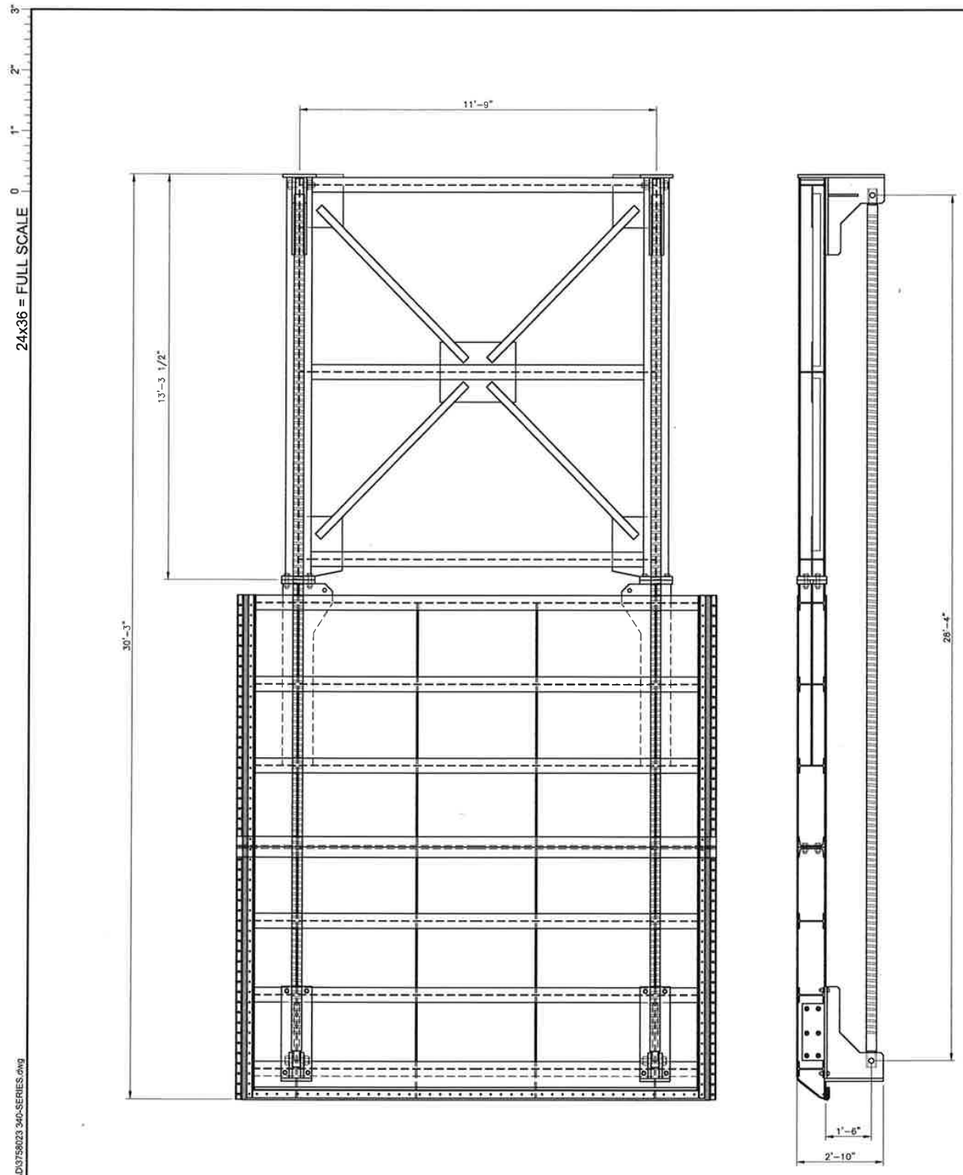
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Project No. [redacted] | Date Revised [redacted] | Drawing No. 696-340-01

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24x36 = FULL SCALE

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DAM REPLACEMENT PROJECT

SLIDE GATES
PLAN, ELEVATION, & PROFILE

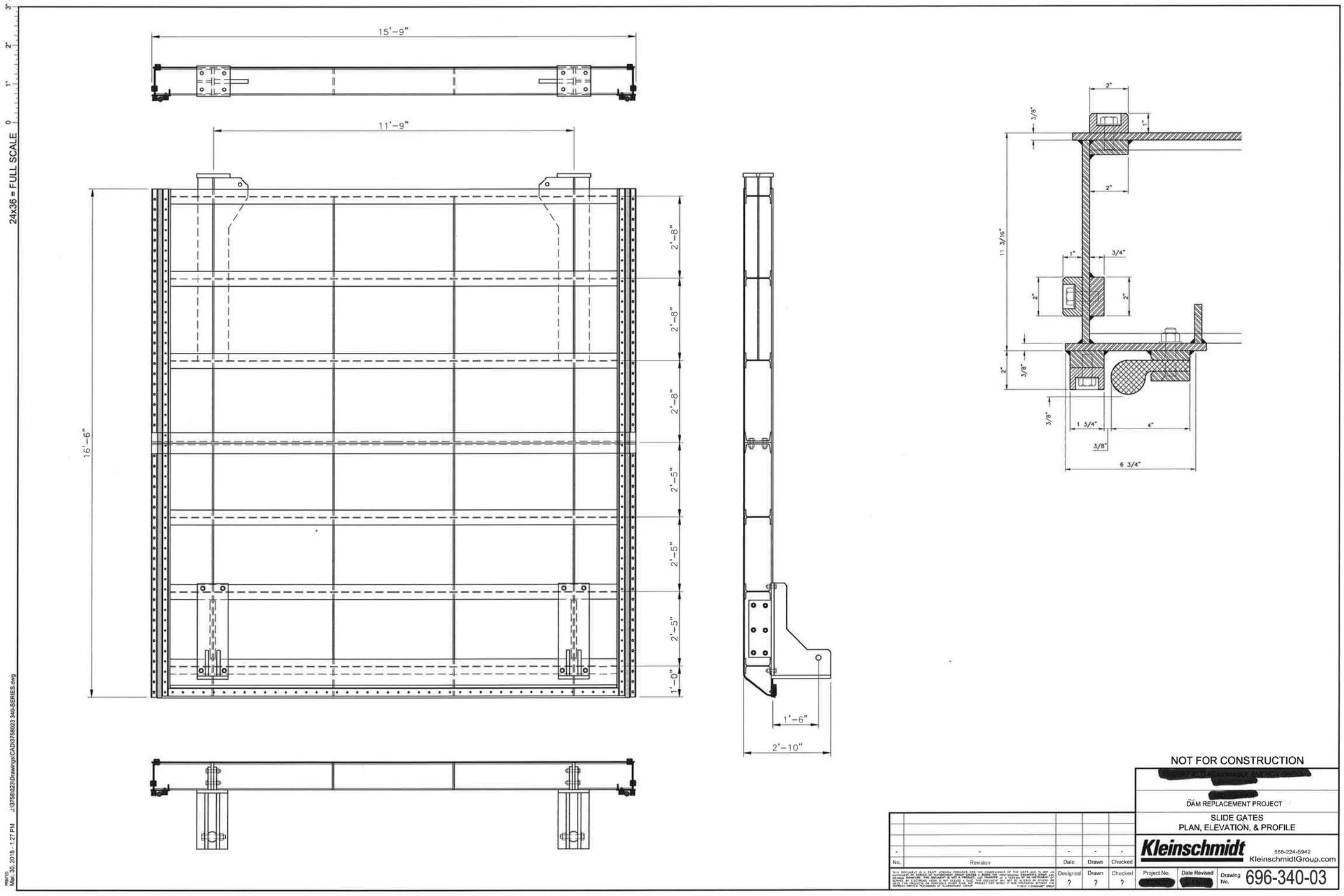
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Project No.	Date Revised	Drawing No.
[redacted]	3-15-18	696-340-02

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DAM REPLACEMENT PROJECT

SLIDE GATES
PLAN, ELEVATION, & PROFILE

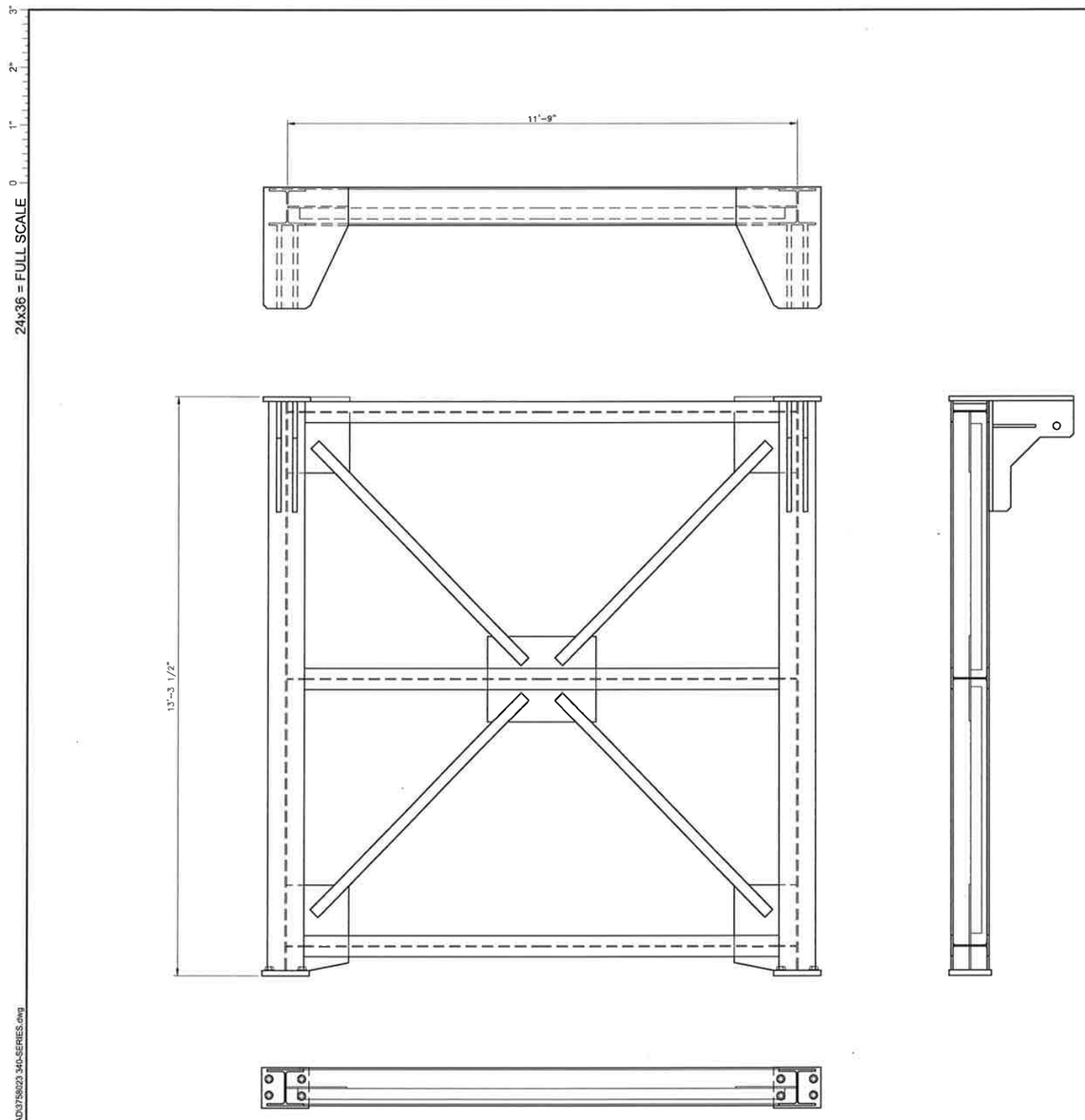
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DAM REPLACEMENT PROJECT

SLIDE GATES
LIFTING FRAME PLAN, ELEVATION, & PROFILE

No.	Revision	Date	Drawn	Checked
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Date Revised [redacted]
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Request IR-8:

The Board understands that Option 4 has been selected for the proposed project, as described on page 2 of 10 of the Application, while Option 5, a new dam, has been discarded. In this context, please explain what NS Power means when it says "…while constructing the new dam" on page 2 of 10 of the current Application where NS Power states: "Environmental Permitting Requirements – Additional project costs of approximately $4.4 million are directly attributable to the additional work required to obtain the necessary environmental permits from Fisheries and Oceans Canada (DFO), Nova Scotia Department of Environment and Climate Change (NSECC), as well as an authorization in accordance with Transport Canada's Navigation Protection Program to temporarily lower the Ruth Falls Reservoir by approximately 18 feet while constructing the new dam."

Response IR-8:

The "Environmental Permitting Requirements" on Page 2 of 10 of the Application should have stated "while refurbishing the dam" rather than "while constructing the new dam".

Request IR-9:

On page 2 of 10 of the current Application, NS Power states that it requires an authorization in accordance with Transport Canada's Navigation Protection Program to temporarily lower the Ruth Falls Reservoir by approximately 18 feet while constructing the new dam.

(a) Please explain why the reservoir needs to be temporarily lowered by 18 feet.

(b) Was the requirement to temporarily lower the reservoir a requirement of the original project plan as presented in the 2019 ACE Plan Application (M08984)? Please explain.

Response IR-9:

(a) A drawdown of 18 ft was determined to be the safest and most effective way to complete refurbishment activities for the Project. A drawdown of 18 ft allows for the section of the dam undergoing concrete replacement to be fully exposed and allows for run-of-river conditions through the middle sluiceway section. This also provides a method for fish passage during construction activities.

(b) Yes, the Company planned to complete the work with the reservoir temporarily lowered as part of the original project plan.

Request IR-10:

Regarding the Account Variance Sheet on pages 5 and 6 of the current Application:

(a) For the "Materials" Line Item:

(i) Please identify the percentage increase in materials cost that NS Power has allowed for since the 2019 ACE Plan Application and provide support to justify this allowance.

(ii) Please identify the cost of materials associated with new scope items that were not included in the 2019 ACE Plan Application.

(b) For the "Contracts" Line Item:

(i) Please identify the percentage increase in contracts cost that NS Power has allowed for since the 2019 ACE Plan Application and provide support to justify this allowance.

(ii) Please identify the cost of contracts associated with new scope items that were not included in the 2019 ACE Plan Application.

(iii) Please identify the cost of additional security for the exposed archeological sites, explain how this cost was developed, and explain why this cost is required beyond those that were envisioned in the 2019 ACE Plan Application.

(iv) Please identify the additional pumping, mobilization and demobilization cofferdam costs and explain why these costs are required beyond those that were envisioned in the 2019 ACE Plan Application.

(v) Please identify the cost of additional site supervision resulting from delays in project execution.

(a) Please explain why these costs are required beyond those that were envisioned in the 2019 ACE Plan Application.

(b) Please explain how a delay project execution results in additional site supervision costs.

(c) Please explain why freight costs associated with delivery of rubber bladders and sluice gates were not included in the 2019 ACE Plan Application.

(d) For the "Consulting" Line Item: Please explain why the costs associated with archaeological assessments and mitigation are required beyond those that were envisioned in the 2019 ACE Plan Application.

(e) Please explain why equipment rental costs were not included in the 2019 ACE Plan Application.

(f) Please explain why Mi'kmaw Engagement costs were not included in the 2019 ACE Plan Application.

Response IR-10:

(a)

(i)

The percentage increase in material cost is 93 percent. This is primarily driven by the following items to be compliant with the additional permitting requirements and increased material costs due to the extended construction timeline:

Description	Increase in costs (in Thousands)
ADDITIONAL SCOPE: NEW PERMITTING REQUIREMENTS	
Fish passage upgrades	$667
EXTENDED CONSTRUCTION TIMELINES	
Increased Material Costs - concrete works	$689
Increased Material Costs - rebar dowels	$196
General contract - steel walkway	$176
Generator for the rubber dams control building	$125
General contract - lighting system	$100
Insulated storage containers (for rubber dams)	$16
Back-up generator (winter construction)	$15
Rubber dams control building	-$20
Gates and actuators	-$256
Rubber dam supply	-$300
TOTAL[1]	**$1,409**

(ii) Table below summarizes the cost of materials from the table in (a) (i) associated with new scope items that were not included in the 2019 ACE Plan Application:

Description	New Scope Items (in Thousands)
Fish Passage upgrades	$667
Generator for the rubber dams control building	$125
Insulated storage containers (for rubber dams)	$16
Back-up generator (winter construction)	$15
TOTAL	**$823**

(b)

(i) The percentage increase in contracts cost is 71 percent. This is primarily driven by requirements associated with additional permitting requirements and increased contract costs.

[1] Totals may be off due to rounding of individual line items.

Description	Increase in costs (in Thousands)
ADDITIONAL SCOPE: NEW PERMITTING REQUIREMENTS	
Fish Passage upgrades	$1,630
Engineering support for environmental permit application	$15
Barn Swallow nest removal	$11
Pre-tree clearing nesting bird survey	$10
Bird habitat building construction	$10
ARCHEOLOGY AND MI'KMAQ ENGAGEMENT	
Security services during archaeological mitigation	$134
Methodology and costing for archaeological screening	$6
EXTENDED CONSTRUCTION TIMELINE	
Limited Notice to Proceed (LNTP)	$1,137
Escalation costs for project deferral	$613
Concrete installation	$308
Construction supervision	$241
Equipment rental costs	$91
Concrete removal & disposal	$86
Vegetation removal	$68
Electrical work	$62
Dewatering - cofferdam & pumping	$48
Concrete testing	$45
Rubber dam inspection in 2024	$38
Gate installation & modification to gate guides	$38
Contractor costs (mob/demob, etc.)	$25
Engineering Support	-$2
Environmental controls costs	-$25
Embankment dam upgrades (riprap, etc.)	-$175
Crane rental and operation	-$205
Site access (roads, laydown areas, staging, etc.)	-$209
Access walkway	-$378
Rubber dam installation	-$475
Access bridge	-$548
TOTAL[2]	**$2,596**

(ii) Table below summarizes the cost of contracts associated with new scope items from the table in (b) (i) that were not included in the 2019 ACE Plan Application:

[2] Totals may be off due to rounding of individual line items.

Description	New Scope items (in Thousands)
Fish Passage upgrades	$1,630
Limited Notice to Proceed	$331
Construction supervision	$241
Security services during archaeological mitigation	$134
Equipment rental costs	$91
Vegetation removal	$68
Electrical work to wire compressor building	$62
Concrete testing	$45
Rubber dam inspection in 2024	$37
Engineering support for environmental permit application	$15
Barn Swallow nest removal	$11
Bird habitat building construction	$10
Pre-tree clearing nesting bird survey	$10
Methodology and costing for archaeological screening	$6
SUBTOTAL	**$2,689**

(iii) Additional security costs for the exposed pre-contact First Nations archaeological sites on the reservoir during the drawdown of Ruth Falls reservoir in 2025-2026 are required to avoid artifact looting. NS Power used historical data from similar work during the Gaspereau archaeological program that took place in 2021, and scaled it to apply to Ruth Falls project. At the time of the 2019 NSUARB submission, the requirement for provision of additional security services did not exist and was applied as a good practice later during the archaeological mitigation at Gaspereau.

(iv) Please refer to the table provided under (b) (i) for details. Cost variance in pumping, mobilization/demobilization, and cofferdam costs are driven by the 3 years difference between development of the original NSUARB estimate and provision of the Contractors bids (February 2021).

(v)

(a-b) Estimated site supervsion costs of $374,451 have been included in the ATO application. At the time of 2019 NSUARB submission, the monthly costs of a dedicated supervisor were estimated at approximately $15,000 per

month and total cost included in the original NSUARB submission were $133,000. However, more recent hydro projects saw site supervision costs of approximately $30,000 per month. The increase in site supervision costs is attributed to the increased hourly labour rates, per diems, and accomodation costs due to inflation as well as increases in monthly mileage costs due to the increased costs of fuel. Site supervision costs associated with dedicated supervisors are estimated at $28,000/month for nine month in 2025-2026 resulting in $252,000, included in the ATO application. The remaining $122,450 was required as a result of the increased project timeline:

- $8,423 in 2021 when Elliot Excavators were mobilized to site, cleared vegetation, grubbed the laydown area, laid out safety and environmental storage containers, started work on the access roads downstream of the dam, and demobilized from site. These costs occurred when NS Power issued Elliot Excavators a Limited Notice to Proceed while waiting for environmental permits approvals.
- $114,027 in 2022 when Elliot Excavators mobilized to site to construct the Rubber Dam Controls building (May-October 2022). These costs occurred when NS Power decided to split the scope of work and proceed with Rubber Dam Controls building installation separately from Main Dam refurbishment activities while waiting for environmental permits approvals.

(c) Freight costs associated with delivery of rubber bladders and sluice gates were not included in the 2019 ACE Plan Application because at the time of submission, it was assumed that the rubber dams would be manufactured locally. However, through the competitive RFP process that was used to select the manufacturing vendor, the lowest cost option required the materials to be shipped from overseas.

(d) The revised costs associated with archaeological assessment are a result of ongoing collaboration with the Mi'kmaq of Nova Scotia on hydro capital refurbishment projects, changing expectations for archaeological protection both from the Mi'kmaq and NS Communities Culture, Tourism and Heritage (CCTH), and lessons learned from recent hydro capital refurbishment projects that included an extended drawdown. Refer to CA IR-13 for a breakdown of Mi'kmaq Engagement costs, including archaeological assessment proposes for the Ruth Falls Main Dam Refurbishment Project.

(e) The assumption in the estimate included with the original filing anticipated the General Contractor would include the costs for the rental of on-site trailers/generators/fuel for the NS Power site supervision/environmental services personnel as part of their bid. However, the selected General Contractor did not include an allowance for these rental costs in their bid submission and must be added to the overall cost to execute the project as planned.

(f) Mi'kmaq Engagement costs were included in the 2019 ACE Plan Application under the "Consulting" section, "KMKNO Capacity Payments" in the amout of $[redacted].

Request IR-11:

Regarding the Capital Project Detailed Cost Estimate on pages 7 and 8 of the current Application:

(a) Has construction of the project been tendered?

(i) If so, please provide a copy of each tender submission.

(ii) If not, what is the expected tender date and close of tender date.

(b) Please confirm that Consulting Services for the project were procured using a competitive RFP/tender process.

(i) If not confirmed, please explain why such a procurement process was not used.

(c) For "Regular Labour", please provide a breakdown of costs in the same format as was project in the Capital Project Detailed Cost Estimate submitted in the 2019 ACE Plan Application.

(d) Please explain why Materials costs associated with "Supply of Gates and Actuators" and "Supply of Rubber Dams" are lower than the costs shown in the 2019 ACE Plan Application.

(e) Please explain why Materials costs associated with "Backup generator during winter construction" and "Generator for Compressor Building" were not included in the 2019 ACE Plan Application.

(f) Please describe the work scope included in "General Contract – LNTP".

(g) Please explain why Contracts cost associated with "Rubber Dam Installation" is lower than the cost shown in the 2019 ACE Plan Application.

(h) Please explain why each of the following Contracts costs were not included in the 2019 ACE Plan Application: Rubber Dam Inspection, Wiring electrical to Compressor Building, Pre-Clearing nesting bird survey, and Concrete Testing.

(i) Under "Contracts", please explain why "Escalation Costs due to execution deferral" are not included in the other line item costs.

(j) Please explain the significant increase in Contracts "Construction Supervision" cost as compared to the 2019 ACE Plan Application and explain how the cost was developed.

(k) Please explain the significant increase in Consulting "Conceptual/Detailed design of refurb" cost as compared to the 2019 ACE Plan Application "Design" cost and explain how the cost was developed.

(l) Please describe the scope of "Offsetting (West River Project)" costs and explain how the cost was developed.

(m) Please provide documentation from DFO confirming the scope of the required Offsetting work.

(n) What is the Class level and expected accuracy of the project cost estimate?

Response IR-11:

(a) Yes. However, NS Power issued a request for proposal for construction services, not a tender.

(i) Please refer to Confidential Attachments 1 and 3, and Partially Confidential Attachment 2 for copies of proposals received.

(b) Confirmed. Consulting Services for the project were procured through a competitive RFP process.

(c) Please refer to the table below:

Description	**Unit**	**Quantity**	**Unit Estimate**	**Total Estimate**
Regular Labour				
Hydro River Staff	days	13.04	$403	$5,254
Environmental Staff	days	71.83	$447	$32,109
Administrative Support	days	32.05	$403	$12,917
Project Support Staff	days	1,273.94	$447	$569,453
Total				**$619,734**

(d) Materials costs associated with "Supply of Gates and Actuators" and "Supply of Rubber Dams" are lower than the costs shown in the 2019 ACE Plan Application because the costs used in the ACE submission were based on estimates from the external engineering consultant. The gates, actuators and rubber dams were procured through a competitive RFP process, which took place after submission of the original application and the bids received were lower than the estimate prepared by the external engineering consultant.

(e) The General Contractor alerted the Company to the requirement for the back-up generator to support construction through the winter months and to allow for construction to be completed over one season after award of the Limited Notice to Proceed in April 2021. The requirement for the Generator for the Compressor building also came from the General Contractor. A propane fueled insulation type generator was recommended by the electrical designer engineer for the operation of Rotork Actuators and lighting across the dam structure.

(f) The following scope of work was included as part of the Limited Notice to Proceed:

- Environmental management;
- Water control;
- Site access;
- Procurement of steel walkway, rebar dowels and lighting system;
- An ROV survey to verify isolation of the sluice gates/access bridge analysis;
- Construction of the dam controls building (new concrete piers and suspended slab, electrical scope, piping, concrete testing; and
- A dedicated safety officer.

(g) **Rubber Dam Installation**:

Costs associated with "Rubber Dam Installation" are lower than the costs shown in the 2019 ACE Plan Application because the costs used in the ACE submission were based on estimates from the external engineering consultant. The revised installation costs were established through a competitive RFP process for the General Contractor, which took place after submission of the original application and the bids received were lower than the estimate prepared by the external engineering consultant.

(h) **Rubber Dam Inspection:**

Due to the project delays, the Rubber dams were stored outside for 20% (4 of 20 years) of their design life. Therefore, it was decided to bring the rubber dam manufacturer representative to site to perform an inspection proactively to assess any damage from prolonged storage ahead of planned construction in 2025.

Wiring Electrical to Compressor Building:

The requirement for wiring electrical to the Rubber Dam Controls Building not identified by NS Power at the time of the 2019 ACE submission.

Pre-Clearing nesting bird survey:

Pre-Clearing nesting bird survey is required by the NS Department of Natural Resources and Renewables (DNRR) each time prior to commensement of construction to make sure there are no active birds nests in the vicinity of the project impact area. The survey was first conducted in 2022 prior to construction of the rubber dams control building. Another survey is required prior to commencement of construction activities in 2025. Costs for this survey was not accounted for by NS Power in the 2019 ACE submission.

Concrete Testing:

Concrete testing costs not accounted for by NS Power in the 2019 ACE submission.

(i) "Escalation Costs due to execution deferral" were quoted by the General Contractor. These costs reflect the Contractor's anticipated increases to the contract commodity costs due to market fluctuations as a result of execution deferral to 2025 caused by delays with obtaining approval of environmental permitting. These costs are not identified inthe other line item costs because the General Contractor was contracted under the Limited Notice to Proceed and it was decided to maintain a competitively arranged contract rather than go back to another RFP. Other values in the ATO submissipon were escalated for inflation separately.

(j) Please refer to NSUARB IR-10 part (b) (v).

(k) The additional $89,093 of design work was primarily required for:

- $3,136 - Additional efforts to finalize conceptual/detailed design in 2020
- $24,321 - Between 2020 and 2022 additional design efforts were required for:
  - Designing the raising/extension of the sluiceway deck to accommodate the new rubber dam controls building;
  - Completing the design of the right abutment retaining wall;
  - Developing the rerouting of the piping for the rubber dam;
  - Completing air-line piping drawings in and across sluiceway;

- Completing re-design work required to move the controls building to the left side of the dam.
- $45,000 - Construction support services and site visits during construction in 2025
- $15,000 - Development of as-builts in 2026

(l) In 2020, NS Power contracted the Confederacy of Mainland Mi'kmaq (CMM) to evaluate offsetting options for the Ruth Falls Project and to develop an offsetting plan in support of NS Power's Fisheries Act Authorization application. The scope of the contract included the development of an offsetting project in collaboration with local Mi'kmaq communities, that aligns with their interest and concern for fish and fish habitat but also meets DFO requirements for offsetting. CMM initially sub-contracted the NS Salmon Association (NSSA) to complete Atlantic salmon habitat restoration on the West River Sheet Harbour, where extensive restoration efforts had been taking place through NSSA and other organizations. The amount of habitat restoration proposed by CMM and NSSA was 2,700 m^2. This offsetting project was chosen by CCM because of the proximity of the location to the Sheet Harbour hydro system, the targeted species for restoration (salmon) which is a species of interest on the Sheet Harbour system, the ongoing active restoration work already taking place on the West River, and Millbrook First Nation feedback. CMM developed the costing, working with NSSA on the offset execution and Millbrook First Nation on costs for collaboration and capacity building for the Community. This plan was finalized in August 2023. Costing for the project is provided in NSUARB IR-12 Attachment 4.

As part of the direction received by NS Power from DFO on June 6, 2024, DFO indicated the proposed 2,700 m^2 offsetting project was insufficient to compensate for the potential impacts on fish and fish habitat resulting from the drawdown of Ruth Falls Headpond. As such, DFO directed NS Power to explore additional offsetting and provide an updated offsetting plan for review and approval prior to further consultation with the Mi'kmaq of NS and issuance of the authorization. DFO provided additional guidance in an email on

June 6, 2024 indicating that expected offsetting could be up to 57,500 m^2 (please refer to NSUARB IR-12, Attachment 14).

(m) Please refer to NSUARB IR-12, Attachment 3.

(n) Project cost estimate is at AACE Class 1. Typical accuracy range for Class 1 estimates are -3% to -10% on the low side, and +3% to +15% on the high side.

M11927 CI 50518 NSUARB IR-11 Attachment 1 has been removed due to confidentiality.

Ruth Falls Dam Refurbishment
RFP-P-20-259-01

Proposal For:

Nova Scotia Power Inc.

In Response to Request for Proposal P-20-259-01

Lake Mulgrave Dam Refurbishment

Submitted to:
Andrea MacKay, Procurement Manager
andrea.mackay@nspower.ca

Prepared by:
Elliot Excavators Limited
Scott Haverstock, President
103 Park Road, Elmsdale, NS B2S 2L3
Tel: 902-883-0616
Fax: 902-883-8900
e.excavators@ns.sympatico.ca

Ruth Falls Dam Refurbishment
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February 4, 2021

Nova Scotia Power Inc.
Attn: Andrea MacKay, Procurement Manager
1223 Lower Water Street
Halifax, NS
B3J 3S8

Re:

Request for Proposal: RFP P-20-259-01

Please find attached our proposal for this RFP.

I would like to take this opportunity to thank you for inviting Elliot Excavators Limited to submit a proposal for this project.

Please do not hesitate to contact me if you have any questions or need any clarifications regarding our proposal.

Scott Haverstock, President

ELLIOT EXCAVATORS LTD.
Tel: 902-883-0616 Fax: 902-883-8900
e.excavators@ns.sympatico.ca

11.1 ORGANIZATIONAL CAPABILITIES

A. BRIEF COMPANY OVERVIEW

Elliot Excavators Limited (Elliot) was incorporated in March, 1988. Our head office and repair shop is located at 103 Park Road in Elmsdale, Nova Scotia. Scott Haverstock is the president and owner of Elliot.

Elliot has worked as a general contractor or subcontractor on projects for Nova Scotia Power Inc. since 1988. Elliot was the main excavation contractor on site for the Trenton Unit 6 construction from October 1988 through June 1991.

Since 1991, we have worked extensively with the Hydro Division of Nova Scotia Power as well as work at the Tufts Cove Generating Station. Elliot Excavators Limited has also completed projects at the Lingan Generating Station for their fuel tank farm.

We have successfully completed 16 pipeline replacement contracts for Nova Scotia Power Inc. as well as acted as a general contractor or civil subcontractor on hydro projects every year since 1992. Included in the work completed during this timeframe is the replacement of six surge tanks. As noted in our list of similar work Elliot Excavators Limited has worked on all three previous projects that have inflatable rubber dams incorporated in them.

We currently own a fleet of 32 pieces of heavy equipment with the capabilities to rent whatever other equipment may be required to complete our projects on schedule.

Elliot Excavators Limited HST number is 12087 2254 RT0001.

Elliot has agreements with both the Labourers International Union of North America as well as the Operating Engineers Union.

Elliot Excavators Limited is recognized as a contractor in good standing with both the Nova Scotia Construction Safety Association as well as the Workers Compensation Board of Nova Scotia (documents attached).

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B. SIMILAR PROJECTS

Examples of previous completed projects similar to this RFP:

- Sissiboo Dam(1992)
- Lumsden Spillway (1994)
- Malay Falls Spillway (1999)
- Lequille Dam & Spillway (2018)
- Sandy Lake Dam & Pipeline (2012)

References:

Elliot Excavators Limited has worked extensively for Nova Scotia Power's Hydro Division for 30 years. For references on our firms' capabilities and reliability contact any or all of the following personnel within Nova Scotia Power Inc.; Annie Beth Sampson, EIT, Cletus MacIssac, Darcy Pettipas, Senior Environmental Technologist, and Elaine Locke, M.Eng.

For a reference outside of Nova Scotia Power Inc., please contact Craig Reith, General Manager, Harbour Developments Limited, 902-494-5767.

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C.KEY PERSONNEL

Our project management team would be set up similar to the below example. The superintendent and/or surveyor may vary depending on workload from other sites.

Scott Haverstock
President/Project Manager
(Primary Point of Contact Office: 902-883-0616 Cell: 902-456-3732)
(E-Mail: e.excavators@ns.sympatico.ca)
(40 years supervisory experience in the construction industry)

↓

Edwin Goble
Project Superintendent
(33 years supervisory experience in the construction industry)

↓

Chuck Jackson
Surveyor/Foreman
(31 years experience in the construction industry)

See attached resumes for above personnel.

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D. HST NUMBER

Elliot Excavators Limited 12087 2254 RT 0001

11.2 TECHNICAL REQUIREMENTS

A. ALTERNATIVES/DEVIATIONS/CLARIFICATIONS FROM THE SPECIFICATION OR REQUIREMENTS STATED IN ATTACHMENT 'A'

[redacted]

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B. ACKNOWLEDGEMENT OF ADDENDA RECEIVED

ADDENDUM / Q&A #	Date Received
Addendum #1	January 8, 2021
Addendum #2	January 12, 2021
Addendum #3	January 20, 2021
Addendum #4	January 25, 2021
Addendum #4 (Revised)	January 26, 2021
Addendum #5	January 26, 2021

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11.3 PROJECT PLAN

A. PROJECT PLAN

[redacted]

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B. PRELIMINARY SCHEDULES

[redacted]

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[redacted]

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C. SUBCONTRACTORS

[redacted]

D. MUTUALLY BENEFICIAL RELATIONSHIPS

Elliot Excavators Limited is committed to establishing relationships with Mi'kmaq and work to incorporate local Mi'kmaw community opportunities into projects where appropriate.

E. LOCAL LABOUR

Elliot Excavators Limited has agreements with both the Operating Engineers Union Local 721 as well as the Laborers' International Union Local 615.

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11.4 REPORTING

Elliot Excavators Limited reports are delivered by email unless a document is not able to be scanned and requires hand delivery. Most of our reports are red lined drawings which come with required notes on the drawings. If third party testing is required, i.e. concrete testing, etc., then copies of these will be forwarded as received during project. There are no charges for reports and a non- standard report will be provided two months after project completion.

11.5 ACCOUNT MANAGEMENT

A signed contract followed by a purchase order number being issued would be required prior to commencement of work.

Scott Haverstock, President, will be the first point of contact. He can be reached at 902-883-0616 (office) or 902-456-3732 (cell). At time of project being awarded the contact information for the Project Supervisor will be supplied.

11.6 QUALITY AND MONITORING

All testing required for this project will be performed by Elliot Excavators Limited through an external Consultant.

Tel: 902-883-0616 Fax: 902-883-8900
e.excavators@ns.sympatico.ca

11.7PERFORMANCE STANDARDS

A.RESOLVING SERVICE ISSUE: STANDARDS

As not only the project manager for this project but also as the owner of Elliot Excavators Limited, Scott Haverstock is responsible for the performance of both the Elliot Excavators Limited crew as well as all subcontractors.

The project superintendent will be the first line contact with the customer and if the issue cannot be resolved at that level then the project manager will become involved and work to a resolution with the customer. There are no current contractual issues with any unions that will affect the level of service that Elliot Excavators Limited provides to its customers.

Tel: 902-883-0616 Fax: 902-883-8900
e.excavators@ns.sympatico.ca

B.CUSTOMER RESPONSE

Below are Elliot Excavators Limited key contacts:

Scott Haverstock
President
Office: 902-883-0616
Cell: 902-456-3732
e.excavators@ns.sympatico.ca

Edwin Goble
Senior Project Superintendent
Office: 902-883-0616
Cell: 902-471-0759
edwin@elliotgroup.ca

Warren Lange
Senior Project Superintendent
Office: 902-883-0616
Cell: 902-456-0479
warren@elliotgroup.ca

C.SERVICE LEVELS: UNIONS & AFFLIATES

Union	Contract Expiration
Operating Engineers Local 721	April 30, 2021
Laborers' Union of North America Local 615	April 30, 2021

11.8 WARRANTY

Elliot Excavators Limited will warrant the work performed on this site for 12 months from completion of work. No extended warranty will apply and any problems that occur that are related to a design flaw will not be covered by our warranty.

Ruth Falls Dam Refurbishment
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11.9 SAFETY

A.WORKERS'COMPENSATION BOARD-EXPERIENCE RATINGS

[redacted]

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B. DETAILED SAFERTY PLAN (CORPORATE SAFETY POLICY, PERSONAL PROTECTIVE EQUIPMENT)

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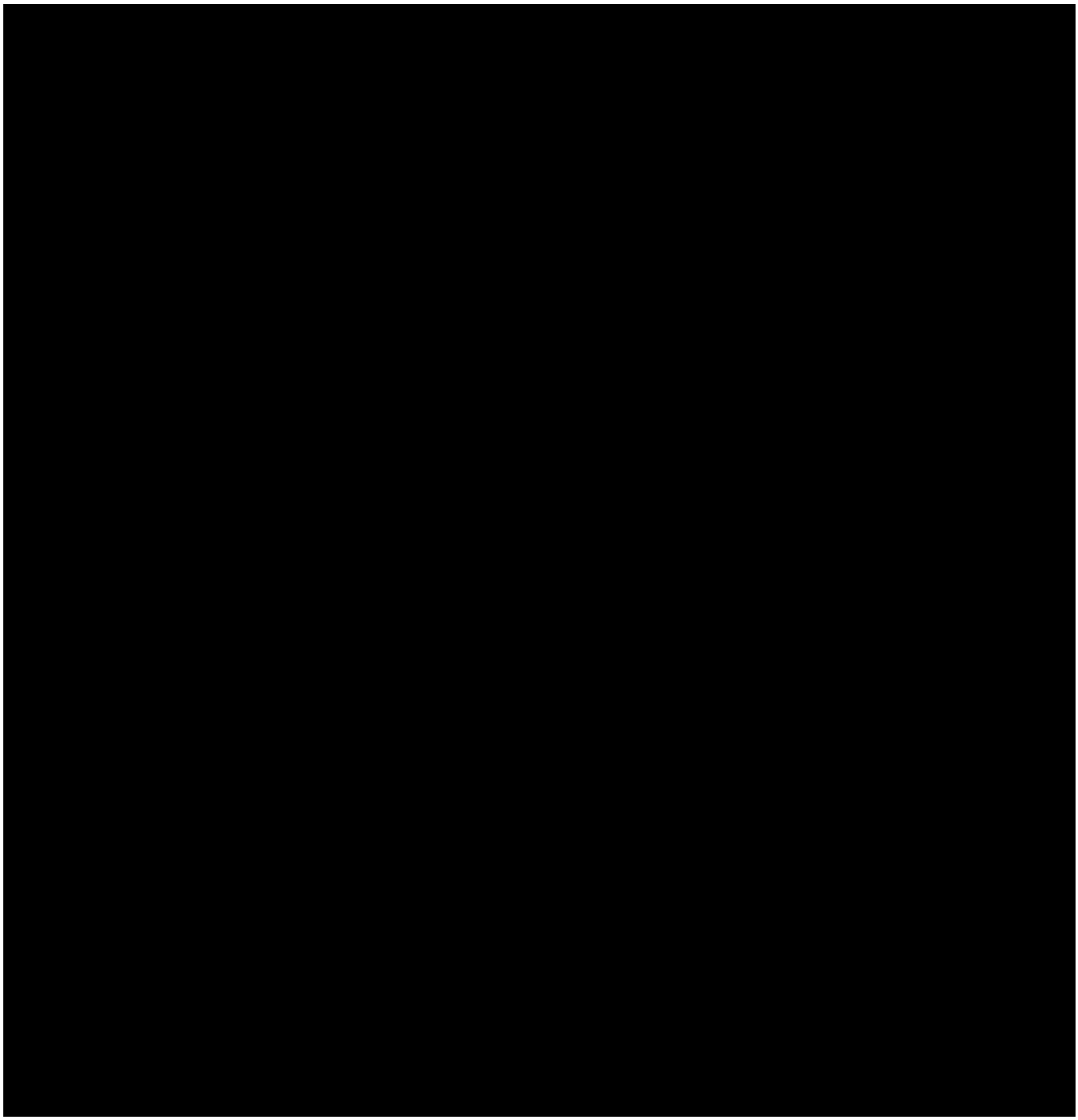
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Ruth Falls Dam Refurbishment
RFP-P-20-259-01

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C.HEALTH & SAFETY LEGISLATION

We acknowledge that Elliot Excavators Limited employees, sub- suppliers, agents and representatives shall comply with all federal, provincial and municipal health, safety and environmental statutes, regulations, policies, guidelines and all health, safety and environmental rules as prescribed by NSPI including but not limited to:

- Occupational Health & Safety Act and Regulations
- Elliot Excavators Limited Safety Manual
- Nova Scotia Power Safety Manual
- Nova Scotia Power's SWP 14 Contractor Safety & Environmental Performance Requirements

D.REGULATORY DIRECTIVES/OFFENCES/ORDERS

Please be advised that Elliot Excavators Limited has not been given any regulatory directives/orders from the Provincial Department of Labour.

Please also be advised that Elliot Excavators Limited has not been convicted of any regulatory offences from the Provincial Department of Labour.

F. OUT OF PROVINCE PROPONENTS

Elliot Excavators Limited will ensure all out of province proponents are compliant with Nova Scotia provincial safety training requirements and provide verification to NSPI. Elliot Excavators Limited will ensure all safety gear has a documented annual inspection and is CSA approved for use in Nova Scotia.

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E. ISNETWORLD REGISTRATION

Elliot Excavators Limited has subscribed to ISNetworld. Our account # is 400-618982.



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11.10 PANDEMIC PLANNING & SUPPLIER RISK MITIGATION

Pandemic Preparedness Plan

1.0 Introduction

The Elliot Group of Companies is implementing the following Pandemic Preparedness Plan. This plan has been developed as a result of the current Covid-19 Pandemic but will be maintained as a "go forward" plan for all Elliot Group business activities to prevent, as much as possible, any future pandemics from affecting any employees or those of our subcontractors or business associates and clients. As senior management of companies within The Elliot Group, both Scott and Dale Haverstock will be responsible for the development and implementation of this plan. Nova Scotia Power's Covid-19 information has been reviewed and will be not only shared with all employees at our various sites but will be adhered to by all site personnel.

2.0 Site Management

The company site supervisors will be responsible for dealing with any disease related issues on the worksite. These supervisors, with support from Head Office, will be responsible for dealing with ill individuals as per information provided by local Health Departments and Health Care Providers.

All Elliot Group sites will be provided with all appropriate PPE, hand wash facilities, hand sanitizers, hand soap, disposable towels, appropriate disinfectant wipes or sprays and any site specific products which may be necessary. Signage will be posted at various points on site to remind employees about hand washing, physical distancing, proper disinfecting and sanitizing.

Elliot acknowledges that NS Power will be utilizing a contractor pandemic screening form and sticker program for the duration of the Covid-19 Pandemic. This program requires all Elliot employees and sub-contractors to complete a screening form prior to entering a Nova Scotia Power work site. If the employee passes the screening by answering "No" to all questions on the form, they will be admitted to site and provided with a color coded sticker. If any employee answers yes to any question, they will be denied access to the site. At the point an employee fails a screening test they must report to their supervisor and call 811for further instructions. The employee screening and issuance of stickers is required to be completed every 2 weeks and will be administered by the Nova Scotia Power's site representative. Elliot Excavators will fully adhere to this

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contractor screening and sticker program, and to build on this plan, Elliot Excavators has modified employee's daily task cards to ask similar questions to employees, and receive responses on a daily basis. Please see section 3.0-Documents and Process of this plan and for more details.

All employees of Elliot Excavators are residents of Nova Scotia.

Note: Nova Scotia Power will be responsible for screening their own site employees, consultants and manufacturer representatives, in strict accordance with the above process.

3.0 Documentation & Processes

Elliot Excavators Limited employees and subcontractors are required to fill out a daily task card at the start of their shift. The only exception will be during a concrete pour with a pump truck operator and several ready mix truck drivers. The pump operator will be required to complete a daily task card. The ready mix truck drivers will be required to stay in their trucks until they are backed up to the pump truck and then will be able to exit their truck to discharge the load and immediately get back into their truck and proceed to the truck washout area. If another driver is present washing out their truck, they will remain in their truck and wait for the first truck to leave before advancing to the washout area. These task cards have been modified to add questions related to Covid-19. Site access will only be granted if all questions are answered "NO", otherwise site access will not be permitted. All employees will attend the daily tool-box and risk assessment meeting either in person with physical distancing of 2m (likely outside), by phone call (in vehicles) or through two way radio. Site superintendents will sign off on employee's daily task card after each daily tool box meeting.

Additionally, as Nova Scotia Power site representative completes the daily Nova Scotia Power risk assessment, all employees will verbally "sign off" on risk assessment by acknowledging that the site representative has read through the risks and controls. Once everyone has agreed to the risk assessment, the Nova Scotia Power representative will sign the document on behalf of the group. This will limit unnecessary contact between the groups sharing documentation.

A safety observation will be completed daily by the Nova Scotia Power site representative. This form will indicate whether or not employees are adhering to pandemic protocols identified for the site.

All workers will be encouraged to obtain any and all immunizations that are required/available. If time off from work is required for an immunization, employees are to notify their supervisor and an appropriate time will be granted/arranged.

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The employee information sheet filled out by all employees of the Elliot Group will be maintained in the event that an employee or their key contact person should be required to be contacted.

As training/courses become available for pandemic awareness we will evaluate the information available and have our safety consultant present this to all employees onsite.

During a pandemic event the gate to access our head office/shop will be left closed. Access will be granted after calling the phone number provided on the gate and if, and only if, the reason for entrance is deemed necessary by a management representative.

As prepared as we may be our world as we know it is constantly changing and we all must be prepared to implement new protocols as we evolve and participation by all personnel is encouraged.

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FIELD LEVEL HAZARD ASSESSMENT (DAILY)

Name:		Work to be Performed:		Project Name:		Date:	
				Task Location		Supervisor:	

Check off the applicable hazards

Confined Space	Yes	No	N/A
1. Are permit conditions met? (eg. man watch, gas test readers,etc.)	□	□	□
2. Sign in place to warn others of confined space?	□	□	□
3. Barricades in place?	□	□	□
4. Proper training in place?	□	□	□
Emergency Procedures	**Yes**	**No**	**N/A**
1. Do you know location of nearest phone/radio and how to use it?	□	□	□
2. Adequate fire extinguishers available?	□	□	□
3. Aware of emergency response plan?	□	□	□
4. Aware of Muster point?	□	□	□
5. Do you know civic address?	□	□	□
6. Eye wash station?	□	□	□
7. First Aid Kit?	□	□	□
8. Public Safety?	□	□	□
Environmental	**Yes**	**No**	**N/A**
1. Environmental control? (eg. Silt Fence, Hay, Filter Fabric, etc.)	□	□	□
2. Water control? (eg. Pumps, settling ponds, silt bags, etc)	□	□	□
3. Spill kits on site?	□	□	□
4. Dust Control?	□	□	□
5. Controlled products have WHMIS?	□	□	□
6. Hot/Cold?	□	□	□
7. Noise?	□	□	□
8. Fumes?	□	□	□
9. Chemicals?	□	□	□
10 Refueling 30m from water?	□	□	□
Miscellaneous	**Yes**	**No**	**N/A**
1. Distraction in area?	□	□	□
2. Clear understand of the work being performed?	□	□	□
3. Appropriate training has been provided?	□	□	□
4. Working Alone?	□	□	□
5. First Time performing the task?	□	□	□
6. Proactive?	□	□	□
7. Security?	□	□	□
8. Fatigue Awareness?	□	□	□
Scaffolding	**Yes**	**No**	**N/A**
1. Is Scaffolding properly installed?	□	□	□
2. What is the inspection date?			

Electrical	Yes	No	N/A
1. Extension cords/cables in good working condition and protected?	□	□	□
2. Equipment properly grounded? (eg. generators, light plant)	□	□	□
3. Lock out/Tag out system in place?	□	□	□
4. Temporary Lighting?	□	□	□
Housekeeping	**Yes**	**No**	**N/A**
1. Access/egress limited?	□	□	□
2. Slip/trips/ falls possible?	□	□	□
3. Walkway & ladders clear of debris?	□	□	□
4. Materials stored appropriately?	□	□	□
5. Waste containers available?	□	□	□
6. Projecting nails, wires, bolts? etc. removed.	□	□	□
7. Combustibles and flammables out of hot work areas?	□	□	□
8. Good Housekeeping?	□	□	□
Rigging /Hoisting Hazards	**Yes**	**No**	**N/A**
1. Has all rigging been inspected and certified?	□	□	□
2. Load weight identified?	□	□	□
3. Lifting overhead/live equipment?	□	□	□
4. Lift equipment inspected & certified? (eg Crane etc.)	□	□	□
5. Barricades/signs/tags/flags in place?	□	□	□
6. Tag line on load?	□	□	□
7. Hand signals understood?	□	□	□
Tools:	**Yes**	**No**	**N/A**
1. Working with power tools? (guards; inspected)	□	□	□
2. Hand tools? (knives, saws, hammer, pry bar)	□	□	□
3. Proper tools for the job?	□	□	□
4. Training for tools to be used?	□	□	□
Excavation:	**Yes**	**No**	**N/A**
1. Proper PPE Required?	□	□	□
2. Good Communication? (visual/audio)	□	□	□
3. Safe sloping & trenching?	□	□	□
4. Spotter required?	□	□	□
5. Signage and/or barricades required?	□	□	□
6. Overhead Power lines?	□	□	□
7. Underground services identified?	□	□	□
8. Speed limit?	□	□	□
9. Competent operators?	□	□	□

Ergonomics	Yes	No	N/A
1. Awkward body positioning?(eg twisting, bending, repetitive motion)	□	□	□
2. Overhead positions required for the task?	□	□	□
3. Part of body in the line of fire/pinch points?	□	□	□
Overhead work/Working at Heights	**Yes**	**No**	**N/A**
1. Workers working below/above?	□	□	□
2. Anchor points identified (withstand 5000lbs)?	□	□	□
3. Holes covered/secured and identified?	□	□	□
4. Objects falling from work area?	□	□	□
5. Fall protection required?	□	□	□
Vehicle/Equipment Operators	**Yes**	**No**	**N/A**
1. Vehicle walk around before operating?	□	□	□
2. Equipment maintenance recorded?	□	□	□
3. Required licensing/training for operating?	□	□	□
Ladders	**Yes**	**No**	**N/A**
1. Installs at a 4/1 ratio?	□	□	□
2. Inspected and extended 1m over landing?	□	□	□
3. Tie off at top?	□	□	□
Placing Concrete	**Yes**	**No**	**N/A**
1. Proper PPE worn by workers placing concrete?	□	□	□
2. Pump truck outrigged safe & secure?	□	□	□
3. Overhead power lines in area?	□	□	□
4. Communication between pump operator and workers?	□	□	□
5. Adequate walkway on forms and rebar? (access/Egress)	□	□	□
6. Spotter in place for concrete trucks?	□	□	□
7. Aware of boom position? Avoid workers under boom.	□	□	□
Personal Protective Equipment:	**Yes**	**No**	**N/A**
1. Hard Hat?	□	□	□
2. Work Boots?	□	□	□
3. Safety Glasses?	□	□	□
4. Work gloves?	□	□	□
5. Hi Vis Vests?	□	□	□
6. Hearing Protection?	□	□	□
7. Respiratory Protection?	□	□	□
8. Fall Protection?	□	□	□
9. Face Shield?	□	□	□
10 Chain Saw Pants & Shield?	□	□	□
11 Other specialized PPE?	□	□	□

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FIELD LEVEL HAZARD ASSESSMENT (DAILY)

Task	Hazards	Plans to Eliminate/Control Risk

VISUAL INSPECTION RIGGING COMPONENTS			
Item	SERIAL #	PASS	FAIL

Pandemic Questions			
1	Do you have two or more of the following Symptoms: A fever higher than 38°C, a new or worsening cough, a sore throat, a Runny nose or headache?	Yes	No
2	Have you travelled outside of the province In the past 14 days?	Yes	No
3	In the past 14days, have you had close contact with someone who has received a Positive COVID-19 test?	Yes	No

All workers to print & sign name before work is to start.

Print	Sign	Print	Sign
Foreman's Signature:		Spot Checker's Signature	

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4.0 Travel & Accommodations

If a jobsite is close enough to an employee's place of residence then travelling home at the end of each shift will be encouraged. If staying at a motel is required, each employee will be provided with their own room.

We have installed plexi-glass dividers in several of our company pickup trucks. All personnel will be encouraged to travel in their own vehicles as much as possible but on some of our remote sites the access roads are not passable by car so in those instances the properly divided company pick-ups will be provided. While sharing a company vehicle, employees will ensure the air flow for circulating internal air in the vehicle will be turned off and masks are worn at all times.

5.0 Communication

Communication will immediately be made with Nova Scotia Power project manager if any employee reports symptoms or is tested for Covid-19 with appropriate follow up information as it becomes available.

Elliot Excavators acknowledges that the Ruth Falls Refurbishment project is taking place on the Sheet Harbour Hydro system while the system is still fully operating. Elliot Excavators is aware that the Eastern Hydro Operations group is isolating from external work groups and as a result there will be no crossover between Eastern Hydro Operations and Elliot Excavator's employees. In order to achieve this, Elliot Excavators plans to maintain regular communications with the Nova Scotia Power operations through the project, especially while working in areas that may need to be accessed by the operations group throughout the execution of the project.

All communication between Elliot Excavators and the Operations group will go through Nova Scotia Power site representative appointed to site.

Media/news bulletins from various sources will be monitored on an ongoing basis by Elliot Group Management. As word of any potential new pandemic is received this information will be immediately forwarded to our sites.

Elliot Excavators Limited will follow the Nova Scotia government Covid-19 action plan and ensure all employees are aware of ALL required alterations to our plan as they become necessary.

The site supervisors will communicate all information to all site personnel as it becomes available. This information will include symptoms to watch for and any specific additional preventative measures being recommended by the appropriate health professionals. Any specific containment plans or measures to be taken if any illness occurs will also be communicated to sites as soon as information is available.

The Pandemic Plan will be reviewed during site orientation with all personnel working on site.

Gathering in groups for meetings will be discouraged as much as possible. If cellular service at each specific site is good, conference or virtual calls will be encouraged as much as possible. If physical attendance at a meeting is required then physical distancing will be observed. Respect of co-workers to be of utmost importance.

During, as well as at the completion of any pandemic event, we will review any opportunities for improvement in our pandemic plan.

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6.0 Facilities & Hygiene

Cleaning/sanitizing supplies will be available at all Elliot Group sites and all personnel are encouraged to maintain a clean and healthy site. Handrails, door knobs, vehicles door handles and steering wheels, equipment joysticks, etc. will be cleaned at the start of each shift. Any small tools used will be cleaned on a regular basis as well. Employees are encouraged to use their own or the same company provided tools as much as possible to prevent any possibility of germ transfer. There will be a trailer on site. There will be three portable toilets (along with hand sanitizer at each toilet). Washrooms will be serviced weekly. There will be a spray bottle of Enviro 64placed in each portable toilet for user's use.

Disinfecting product used is Enviro Solutions 64 (See attached SDS). This is a mixed concentrate and each employee will be provided with their own spray bottle of this product.

Each employee will be responsible for maintaining cleanliness of their tools and heavy equipment.

Employees start work at 7am, there is a 10 min break at 9:30am, one half hour lunch break at 12pm and a 10 minute break at 3pm. Equipment operators will take their breaks in either their equipment or their vehicles, labourer's will take their breaks in their vehicles or onsite weather permitting. There will no longer be a common lunch room. Elliot Excavators Limited will provide bottled water in coolers. Each employee will have to go to the cooler and get their own water instead of someone bringing it to them. Employees must keep water bottles with them until disposal, to prevent cross contamination by someone else picking up the wrong bottle by mistake.



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7.0 Physical Distancing

Maintain appropriate personal distancing as much as possible and in the event that personal distancing is compromised due to site specific requirements please ensure that appropriate PPE is utilized at all times. In addition to our routine PPE (hi-vis safety vest, hard hat, work boots, gloves and safety glasses) face masks will be required when employees must perform a task in which they cannot maintain proper physical distancing. We have identified a few tasks where face masks may be required, concrete formwork installation, placing of rebar, rubber bag installation, and sluice gate installation. Masks will be worn when these task require employees to be working 2m/6ft of another person.

Elliot Excavators will adhere to recommended procedures, precautions and supply recommended specialized PPE for first aid preparedness during this pandemic event as outlined in Nova Scotia Power's Procedure for Emergency Response Team & First Aiders for Covid-19.

Proper and appropriate respect of co-workers is of utmost importance at all times, even more so during a pandemic event. Although we cannot control what employees do in their off hours we encourage employees to maintain proper personal distancing practices at all times and to obey Health Protection Act Orders.





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8.0 Resourcing

If an employee becomes ill as a result of the pandemic the employee will be asked to leave the jobsite immediately, call 811 and follow the protocol as directed. Any employees who had close contact with the individual (less than 2m) will be advised to also contact 811 for instruction. The task in which the possibly ill employee will be suspended to allow for sanitizing of all "high touch" surfaces (i.e. Tools, trailer, equipment, and/or company vehicle) prior to the restart of work. Non impacted phases of the project will continue, all employees and Nova Scotia Power site representative will be notified.

The employee will be required to keep us informed on results of testing. If testing is negative, the employee will be permitted to return to site. If testing is positive, we will follow recommendations provided by Nova Scotia Department of Health and the infected employee will not be allowed to return to site until proof of negative test is provided, or they have finished their quarantine period and do not have any symptoms. In all scenarios, if they still have symptoms (meaning they wouldn't pass the screening form) they would need approval from the Director of Capital Projects and the Nova Scotia Power Pandemic Lead before returning to the site.



If a small percentage of employees fall ill then we will substitute with another employee. If a large percentage of employees fall ill work will be suspended until employees have recovered. After work resumes, efforts will be taken to make up for time lost as much as possible.

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11.11 ENVIRONMENT

ENVIRONMENTAL POLICY

As a responsible company we will ensure that the proper safeguards are taken to protect our environment. All individuals will have responsibility and we will take the necessary action to protect the environment. **Elliot Group of Companies** will ensure that all acceptable recycling practices are adhered to throughout our organization.

We will train and educate our employees on environmental issues that may affect their work. Employees will also have a good understanding of environmental practices and what measures are needed to control them.

On our projects, we shall use, store, and dispose of excess materials in such a manner that will provide appropriate protection to our employees, clients and the environment through following appropriate waste management practices. We insist that all personal garbage be disposed of in the onsite containers provided. Dispose of paper coffee cups with your construction debris.

Management will develop and enforce good environmental standards in accordance with relevant legislation. All waterways shall be protected in accordance with each provincial Environment Act. The **Elliot Group of Companies** shall adhere to each provinces recycling program.

In the event of an environmental emergency, spill kits shall be available on every jobsite.

All environmental incidents on any work site will be reported, ensuring compliance to statutory obligations.

Scott Haverstock, President

JAN 22, 2021
Date

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The Elliot Group

Environmental Site Inspection Form

Location _____ Project _____

Inspector _____ Foreman _____

Date _____

☐	Silt fence or silt berm placed in a recommended condition & location.
☐	If necessary, extra silt fence and/or filter cloth on site.
☐	Oil spill kits on site.
☐	Copy of Department of Environment Act on site.
☐	All equipment is properly maintained with no fluid leaks.
☐	Silty water routed through natural settling ponds & if necessary man-made settling ponds or marsh areas before entering waterways.
☐	All oil & construction debris are kept away from possible flood zones.
☐	Spoil piles are not deposited in or near flood plains.
☐	All potential erosion sites are covered with seed, hay or straw as work progresses.
☐	Garbage, empty oil containers, soiled rags, & grease tubes are placed in proper place for disposal.
☐	Dust control in place.
☐	No natural land drainage has been disturbed.
☐	Ditches do not run directly into water courses.
☐	All controlled products have proper WHMIS labels.
☐	All petroleum products are stored more than 3 meters away from water supply.
☐	Waste oil is properly disposed of periodically.

- A weekly environmental site inspection will be completed by the site superintendent recording the monitoring, maintenance and execution of all environmental measures on site during construction activities.

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ENVIRONMENTAL PLAN

[redacted]

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B.ENVIRONMENTAL EMERGENCY PREPAREDNESS

The following list of materials will be made available:

- Adequate number and properly sized pumps/hoses
- Silt fence, filter fabric, hay bales, silt bags, absorbent pads
- Silt booms/ Oil Booms
- Properly sized oil spill kits
- Extra fire extinguishers
- Emergency contact numbers posted

C.REPORTING AND INVESTIGATING ENVIRONMENTAL INCIDENTS

The Nova Scotia Power production oil spill notification procedure and power production chemical spill notification procedure will be followed.

D.COMPLIANCE

Elliot Excavators Limited shall comply with all applicable environmental legislation, regulations, standards, work practices and provisions including but not limited to:

- Environmental Act of Nova Scotia
- Nova Scotia Power Inc. Contractor Environmental Requirements
- Elliot Excavators Limited will assume responsibility for the disposal and/or destruction of all scrap treated wood at an approved facility. All work will be completed using Elliot Excavators Limited employees and equipment in accordance with all applicable laws governing the disposal/destruction of treated wood products. A Certificate of Disposal/Destruction will be provided to NSPI confirming material have been disposed of and/or destroyed in accordance with all applicable laws.

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E.ENVIRONMETAL REGULATORY DIRECTIVES/OFFENCES/ORDERS

Please also be advised that Elliot Excavators Limited has not been convicted of any regulatory offences from the Provincial Department of Environment.

F. ENVIRONMENTAL REGULATORY DIRECTIVES/OFFENCES/ORDERS

Please be advised that Elliot Excavators Limited has not been given any regulatory directives/orders from the Provincial Department of Environment.

11.12 (C) EMPLOYEE REQUIREMENTS

1. Elliot Excavators acknowledges that our employees shall be experienced and qualified to safely perform the work required.
2. Elliot Excavators Limited acknowledges that our employees shall maintain a professional appearance and attitude.
3. We acknowledge that NSPI reserves the right to reject any employees who have been appointed to perform the work where field personnel determine that the individual does not meet NSPI safety or performance standards and we shall be obligated to replace the individuals.

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11.13 INSURANCE/CERTIFICATIONS

[redacted]

We have not included in our quote for Builder's Risk insurance as we will need to provide the insurance company with further information and confirmed dates. The approximate cost of this insurance will be $45,000.00.

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NSPI SITE ORIENTATION

Site orientations for the Mersey Redevelopment Big Falls Bridge Replacement Installation for 2021 have been completed, as well orientations for Lake Mulgrave Dam Refurbishment in 2021.

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e.excavators@ns.sympatico.ca

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An Emera Company

Ruth Falls Dam Refurbishment
RFP-P-20-259-01

[redacted]

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EMPLOYEE CERTIFICATIONS

[redacted]

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RFP-P-20-259-01

11.14 PERFORMANCE SECURITY

Please note that the cost for Performance Security as outlined in the RFP is not currently in our price. The cost for this security is $[redacted] per $[redacted] of the project value plus HST.

[redacted]

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RFP-P-20-259-01

11.15 COMMERCIAL/PRICE PROPOSAL REQUIREMENTS

NSPI – Ruth Falls Dam Refurbishment

Schedule of Prices – Rev. 1

ITEM NO.	DESCRIPTION	UNIT	APPROX. QTY	UNIT PRICE	TOTAL
	General	L.S.	1		
1	Mobilization	L.S.	1	[redacted]	
2	Demobilization	L.S.	1		
3	Environmental Management	L.S.	1		
4	Water Controls	L.S.	1		
5	Site Access	L.S.	1		
	Demolition		1		
6	General Demolition-Steel, Stoplogs, Handrails, etc.	L.S.	1	[redacted]	
7	Concrete Demolition –Spillway & Sluiceway (Shallow/Surface Demolition)	L.S.	1		
8	Concrete Demolition –Piers, Deck and Retaining Wall	L.S.	1		
	Concrete Work				
9	Bulkheads or Other Proposed Alternatives	L.S.	1	[redacted]	
10	Waterstop	L.FT.	440		
11	New Concrete – Spillway Resurfacing and Headwall	CU.YD.	870		
12	New Concrete-Piers	CU.YD.	115		
113	New Concrete – Right End Retaining Wall	CU.YD.	135		
14	New Concrete – Sluiceway Deck	CU.YD.	40		
15	New Concrete – Fill at Abutments	CU.YD.	150		
16	Rebar Dowels	KG	4900		
	Rubber Dams & Controls Building				
17	Piping for Rubber Dams	L.FT.	1800	[redacted]	
18	Rubber Dam Installation, including Electrical/Mechanical Controls	L.S.	1		
19	New Wood Framed Controls Building	L.S.	1		
	Gates				
20	Installation of Vertical Lift Gates	L.S.	1		
	Earthworks (Right Retaining Wall)				
21	Common Excavation, Granular Fill, Filter Gravel (NSTIR Type 2 Gravel), and Geotextile	L.S.	1		
	Walkway & Lighting				
22	New Steel Walkway, including Connections	L.S.	1		
23	New Lighting System	L.S.	1		
Subtotal					[redacted]
HST					
Total					

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Ruth Falls Dam Refurbishment
RFP-P-20-259-01

ITEM NO.	DESCRIPTION	UNIT	APPROX. QTY	UNIT PRICE	TOTAL
	Unit Prices –Should additional work be required beyond the scope noted above				
A	Concrete (excluding formwork and rebar)	CU.YD.	-	[redacted]	
B	Formwork (only)	SQ. YD.	-		
C	Rebar (only)	KG	-		
D	Rebar Dowels	KG	-		
E	Common Excavation	CU.YD.	-		
F	Granular Fill	CU.YD.	-		
G	Filter Gravel	CU.YD.	-		
H	Geotextile	SQ. YD.	-		

Note: The quantities noted above were estimated. Review the quantities based on the Drawings and update on the Schedule of Prices, as required.

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Ruth Falls Dam Refurbishment
RFP-P-20-259-01

NSPI – Ruth Falls Dam Refurbishment

Schedule of Prices –Lowered Reservoir Option – Rev. 1

ITEM NO.	DESCRIPTION	UNIT	APPROX. QTY	UNIT PRICE	TOTAL
	General	L.S.	1		
1	Mobilization	L.S.	1	[redacted]	[redacted]
2	Demobilization	L.S.	1		
3	Environmental Management	L.S.	1		
4	Water Controls	L.S.	1		
5	Site Access	L.S.	1		
	Demolition		1		
6	General Demolition-Steel, Stoplogs, Handrails, etc.	L.S.	1	[redacted]	[redacted]
7	Concrete Demolition –Spillway & Sluiceway (Shallow/Surface Demolition)	L.S.	1		
8	Concrete Demolition –Piers, Deck and Retaining Wall	L.S.	1		
	Concrete Work				
9	Bulkheads or Other Proposed Alternatives	L.S.	1	[redacted]	[redacted]
10	Waterstop	L.FT.	440		
11	New Concrete – Spillway Resurfacing and Headwall	CU.YD.	870		
12	New Concrete-Piers	CU.YD.	115		
113	New Concrete – Right End Retaining Wall	CU.YD.	135		
14	New Concrete – Sluiceway Deck	CU.YD.	40		
15	New Concrete – Fill at Abutments	CU.YD.	150		
16	Rebar Dowels	KG	4900		
	Rubber Dams & Controls Building				
17	Piping for Rubber Dams	L.FT.	1800	[redacted]	[redacted]
18	Rubber Dam Installation, including Electrical/Mechanical Controls	L.S.	1		
19	New Wood Framed Controls Building	L.S.	1		
	Gates				
20	Installation of Vertical Lift Gates	L.S.	1	[redacted]	[redacted]
	Earthworks (Right Retaining Wall)				
21	Common Excavation, Granular Fill, Filter Gravel (NSTIR Type 2 Gravel), and Geotextile	L.S.	1	[redacted]	[redacted]
	Walkway & Lighting				
22	New Steel Walkway, including Connections	L.S.	1	[redacted]	[redacted]
23	New Lighting System	L.S.	1		
Subtotal					[redacted]
HST					
Total					

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Ruth Falls Dam Refurbishment
RFP-P-20-259-01

ITEM NO.	DESCRIPTION	UNIT	APPROX. QTY	UNIT PRICE	TOTAL
	Unit Prices –Should additional work be required beyond the scope noted above				
A	Concrete (excluding formwork and rebar)	CU.YD.	-	[redacted]	
B	Formwork (only)	SQ. YD.	-		
C	Rebar (only)	KG	-		
D	Rebar Dowels	KG	-		
E	Common Excavation	CU.YD.	-		
F	Granular Fill	CU.YD.	-		
G	Filter Gravel	CU.YD.	-		
H	Geotextile	SQ. YD.	-		

Note: The quantities noted above were estimated. Review the quantities based on the Drawings and update on the Schedule of Prices, as required.

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Ruth Falls Dam Refurbishment
RFP-P-20-259-01

EXTRA WORK

We have included our hourly rate sheet for our equipment. These rates include for all costs such as operator wages, fuel, and per diems for operators. Any material or subcontractors will be at our cost plus 10% mark up.

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Equipment Rental Rates Effective March 1, 2020

Description	Rate*
Volvo 210 Excavator	[redacted]
Volvo 210 Hydraulic Excavator (c/w Allied 750 Hydraulic Hammer)	
John Deere 135D Hydraulic Excavator	
John Deere 350 Excavator	
John Deere 350 c/w Hydraulic Hammer	
John Deere 350 Excavator c/w Long Reach	
John Deere 245 Excavator	
Komatsu 308 Hydraulic Excavator	
Hitachi 35 Mini Excavator	
Hitachi 35 Mini Excavator (c/w Hydraulic Hammer)	
Bobcat E85 Excavator	
Bobcat E85 Excavator c/w Hydraulic Hammer	
Komatsu 380 Rubber Tire Loader	
Dresser 530 Rubber Tire Loader	
Komatsu WA250 Rubber Tire Loader	
Komatsu WA320 Rubber Tire Loader	
John Deere 324 Loader	
Komatsu D39 Dozer	
Komatsu D51 Dozer	
B.W. 142 Vibratory Roller	
B.W. 210 Vibratory Roller	
Tandem Dump Truck	
Single Axle Dump Truck	
Moxy Rock Truck (25 Ton)	
Moxy Rock Truck (30 Ton)	
90T RT Hydraulic Crane	
Foreman	
Labourer	
Surveyor	
Diesel Plate Tamper	
Vibrating Deck Screener	
Chainsaw	
Jumping Jack	
Pipe Cutoff Saw (Blades $15.00 each)	
Honda 2" Gas Pump	
Honda 3" Gas Pump	
Honda 4" Gas Pump	
2" High Head Electric Pump	
3" High Head Electric Pump	
6" Diesel Pump	
Air Compressor (185 C.F.M.)	
Air Compressor (185 C.F.M.) w/ Concrete Breaker	
Pick Up (1 Ton)	
Grade Laser	
5000 W Honda Generator	
6500 W Honda Generator	
25000 W Generator	
Welder (400 AMP)	

*HST Not Included in Hourly or Daily Rental Pricing
Power not included in electric pump rentals

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Ruth Falls Dam Refurbishment
RFP-P-20-259-01

_____ End of Submission_____

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M11927 CI 50518 NSUARB IR-11 Attachment 3 has been removed due to confidentiality.

Request IR-12:

Regarding the summary of correspondence between DFO and NS Power provided in Attachment 1 of the current Application:

(a) Please provide copies of the referenced correspondence between DFO and NS Power.

(b) With regards to DFO's supplemental information request of August 4, 2020:

(i) Please explain why the information requested by DFO was not provided in NS Power's original June 24, 2020, response given NS Power's experience on other similar hydro projects.

(ii) Please explain why it took approximately nine months to respond to DFO's request.

(c) With regards to DFO's supplemental information request of July 8, 2021:

(i) Please confirm that DFO's referenced "change in scope" is related to NS Power's decision to complete a portion of the Ruth Falls project separately from the larger refurbishment project.

(a) If not confirmed, please describe the referenced "change in scope".

(ii) Please describe NS Power's reasoning for completing a portion of the Ruth Falls project separately from the larger refurbishment project.

(a) Please describe this specific scope of work.

(b) Please provide a breakdown of the cost to complete this scope of work.

(c) Please confirm that the construction work associated with this scope was procured using a competitive procurement process.

(i) If not confirmed, please explain why such a procurement process was not used.

(iii) Please explain why it took approximately six months to respond to DFO's request.

(d) With regards to DFO's letter of January 29, 2024, please describe the "other considerations" that DFO stated still must be addressed.

(e) What was the date of NS Power's response to DFO's email of June 6, 2024?

Response IR-12:

(a) Please refer to the table below for the corresponding attachment for each communication summarized in Attachment 1 of NS Power's ATO application.

DFO Communication to NS Power	Date Received	Supplemental Information Requested by DFO	NS Power Follow up Actions and Response to DFO	NS Power Response Date	Attachment Reference
Letter requiring Fisheries Application Authorization	March 13, 2020	In response to NS Power's request for review submitted December 2, 2019 DFO letter stated authorization in accordance with the Fisheries Act was required for the Project	Submission of FAA application and supporting information	June 24, 2020	1 & 2

DFO Communication to NS Power	Date Received	Supplemental Information Requested by DFO	NS Power Follow up Actions and Response to DFO	NS Power Response Date	Attachment Reference
Supplemental Information Requested	August 4, 2020	NS Power Application considered incomplete by DFO. DFO requested additional information including details of fish habitat available during drawdown, offsetting plan, normal operating procedures and construction site access requirements	Responded to information requests Development of offsetting plan (Confederacy of Mainland Mi'kmaq) Development of drawdown monitoring plan	May 8, 2021	3 & 4
Supplemental Information Requested	July 8, 2021	DFO indicated that due to a change in scope of the project, they will not be providing comments on NS Power's May 8, 2021 submission until an updated construction execution plan is provided to DFO.	On July 12, 2021 NS Power submitted an application for watercourse alteration to NSECC to complete a portion of the Ruth Falls project separately from the larger refurbishment project. Approval was received October 22, 2021, and work completed September 22, 2022. NS Power resubmitted an updated supporting information document to DFO to clarify the scope of the broader Ruth Falls Project and the intent to remove the smaller portion of the work to take place in 2022. Updated supporting information document included a third-party wetland monitoring plan, and third party juvenile gaspereau/habitat	Application Resubmitted January 21, 2022	5, 6, 7 & 8

DFO Communication to NS Power	Date Received	Supplemental Information Requested by DFO	NS Power Follow up Actions and Response to DFO	NS Power Response Date	Attachment Reference
			characterization/entrainment monitoring plan to support the drawdown		
Supplemental Information Requested	May 5, 2022	NS Power Application considered incomplete by DFO. DFO requested additional information including: results of historical fish passage studies performed at Ruth Falls	Summary report of downstream eel tracking study	Application Resubmitted July 10, 2023	9 & 10
			Fish ladder counts completed		
		Professional assessment on potential impacts of dam design and operation to upstream and downstream fish passage for all species likely migrating in the area	Overarching evaluation completed by consultant		
			3D hydraulic modelling completed by consultant		
		Upstream fish passage plan (including American Eel)	Evaluation of existing fishway Conceptual and detailed designs completed by consultant		
		Downstream fish passage plan	Evaluation of existing louver/downstream bypass system Conceptual and detailed designs completed by consultant		
		Post-construction monitoring plan to evaluate upstream and downstream passage	Development of post-construction monitoring plan including tracking studies and instream sampling		

DFO Communication to NS Power	Date Received	Supplemental Information Requested by DFO	NS Power Follow up Actions and Response to DFO	NS Power Response Date	Attachment Reference
		Further clarification on construction execution	Revision of supporting information document		
		Further clarification on wetland fish habitat monitoring plan	Revision to third party wetland monitoring plan completed by consultant		
		Further clarification on habitat characterization/entrainment monitoring plan	Revision to third party entrainment monitoring plan completed by consultant		
Supplemental Information Requested	September 11, 2023	NS Power Application considered incomplete by DFO. DFO requested additional information including clarifications on Post-Construction Monitoring Plan	Revision to Post-Construction Monitoring Plan	December 7, 2023	11 & 12
		Additional detailed design drawings of the existing fishway	Drawings developed by a consultant		
		Additional clarifications on third party wetland monitoring plan	Revision to wetland monitoring plan		
		Additional clarifications on third party fish entrainment monitoring plan	Revision to entrainment plan		
		Additional offsetting for death of fish	Updates to original offsetting plans by the Confederacy of Mainland Mi'kmaq (CMM)		

DFO Communication to NS Power	Date Received	Supplemental Information Requested by DFO	NS Power Follow up Actions and Response to DFO	NS Power Response Date	Attachment Reference
Complete Letter	January 29, 2024	DFO noted "Other considerations that still must be addressed which may result in modifications to NS Power's proposal"	-		13
Email	June 6, 2024	DFO indicated feedback was received from the Mi'kmaq of NS regarding NS Power's proposed application. Feedback was in relation to NS Power's proposed offsetting plan. DFO also provided additional information requests and requested further clarification on NS Power's proposed monitoring plan submitted as part of the December 7, 2023 submission.	Assessment/scoping for additional offsetting for the Project (Confederacy of Mainland Mi'kmaq/NS Salmon Association) Development of site-specific archaeological plan Assessment of temporary fish passage measures during construction Revisions to post-construction monitoring plan		14, 14a & Confidential 14b

(b)

(i) At the time of NS Power's application to DFO for Ruth Falls, the implementation of the modernized Fisheries Act (2019) was in the early stages and information requirements to satisfy an FAA for hydro capital refurbishment projects under the modernized Act, specifically for extended drawdowns and temporary construction footprints were not well understood. Previous to the modernization of the Act in 2019, drawdown for hydro capital refurbishment and maintenance activities were not a typical trigger for FAA, nor was temporary construction footprint.

(ii) Between August 2020 and May 2021, NS Power worked to develop an offsetting plan, in working with CMM and local First Nation community, and to develop a drawdown monitoring plan which required additional time to prepare to satisfy DFO requirements.

(c)

(i) Confirmed.

(ii) Due to the extended timeframe for the DFO FAA process, NS Power evaluated options to complete some aspects of the Ruth Falls main dam refurbishment work without a drawdown. Specifically, the Company evaluated whether refurbishment of the sluiceway scope of the project could be completed with the headpond at normal supply level using other alternatives, such as engineered platforms and bulkheads. To expedite the environmental permitting process, NS Power notified DFO of the intent to apply for a stand-alone Watercourse Alteration Approval in July 2021 to complete the sluiceway refurbishment, as well as construction of the new controls building required for the operation of the new vertical lift gates and rubber dams. This application was submitted on July 12, 2021. Please refer to CA IR-5, Attachment 9. NS Power received this approval in October 2021 (please refer to CA IR-5, Attachment 10). In parallel to receiving NSECC approval, NS Power determined the sluiceway scope could not be separated from the broader dam refurbishment due to safety concerns with executing the work without lowering the headpond.

a. NS Power completed the construction of the new controls building.

b. Breakdown of costs associated with construction of the Rubber Dams Controls Building (May-October 2022):

Construction Contract:

- Building Construction: $50,000
- Elliot Excavators labour: $115,467

- Remobilization/demobilization: $50,000
- Additional concrete for building piers: $131,250
- Piping for rubber dams: $25,000
- Inflation costs for labour/fuel/accommodations: $7,610)
- Additional Handrail crane handling fee: $5,500
- Inflation costs rebar/formwork: $43,200
- Electrical scope: $15,525
- Dedicated safety officer requirement: $22,700
- Additional concrete for Suspended Slab: $64,400
- Additional construction efforts: $13,792
- Concrete Strength Testing of fish ladder: $4,212
- Additional equipment mob/demob costs: $35,000

SUBTOTAL: $583,656

- Construction supervision: $112,326
- Internal NS Power Labour (incl. travel/meals/rentals): $69,915

SUBTOTAL: $182,240

TOTAL: **$765,896**

c. Confirmed.

(iii) The extended submission period was due to efforts to evaluate the alternative to complete the sluiceway refurbishment separately from the broader Ruth Falls Project, and to expand on the drawdown monitoring plan to include wetland fish habitat and entrainment monitoring. These aspects were contracted to third party consultants.

(d) DFO clarified additional considerations that must be addressed by NS Power in the June 6, 2024 email. Please refer to Attachment 14.

(e) NS Power has not formally responded to the June 6, 2024 DFO email to date. NS Power continues to work to address additional information requirements in the email to satisfy the FAA application, namely increasing the offsetting amount for the Project.

Fisheries and Oceans Canada | Pêches et Océans Canada

Ecosystem Management
1 Challenger Drive
PO Box 1006, Station P500
Dartmouth NS
B2Y 4A2

March 13, 2020

Your file *Votre référence*
2019-2638165

Our file *Notre référence*
19-HMAR-00549

Nadine Thomas
Nova Scotia Power Inc. (NSPI)
PO Box 910
Halifax, NS B3J 2W5

Subject: Ruth Falls Headpond Dam – Application for Authorization under the *Fisheries Act* Required.

Dear Ms. Thomas:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received your proposal on December 2, 2019. We understand that you propose to:

- Refurbish the Ruth Falls Headpond Dam, located within Sheet Harbour Hydroelectric System.
- Replacement of the existing 30 stoplog bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, resurfacing the concrete crests and the downstream slope of the main dam, and replace sluice gates. This will result in a permanent instream footprint of 60 m^2.
- Install a cofferdam downstream side of the dam to allow work to be completed in the dry. Bulkheads will be used to isolate work area on the upstream side of the dam.
- Construct a temporary road and water crossing downstream of the dam.
- Drawdown the Ruth Falls headpond by approximately 2.1-4.6 m or 0.66 to 1.35 km^2 of littoral zone exposed and dewater the canal.
- Install and operate a fish conveyance system during the migration period to allow for upstream passage during construction.
- Provide downstream passage through the existing sluice gates during construction.
- Suspend for 2020, the requirement to provide supplementary flows downstream.
- Suspend for 2020, the operation of the fish trap at Ruth Falls.

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Canada

- The project is scheduled to be completed between May 1, 2020 and November 30, 2020.

Our review considered the following information:

- DFO's Request for Review form, received on December 2, 2019
- NSE's Application for Approval and supporting documentation, received on December 20, 2019.
- Additional information letter, received from NSPI on February 27, 2020.
- Additional information letter, received from NSE on March 2, 2020.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*; and
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*.

The aforementioned outcomes are prohibited unless authorized under their respective legislation and regulations.

Based on the review of the above information, the Program has concluded that the following work, undertaking or activity is likely to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption or destruction of fish habitat:

- Result in the temporary (6-7 months) disruption of up to approximately 1.35km^2 of littoral zone habitat that fish species use for a portion of their life cycle.
- Potential of additional temporary instream footprint associated with activities required for the dam refurbishment.(ie. cofferdam(s), access roads & crossings)

Your proposal requires authorization pursuant to paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* in order to proceed. As your proposal is not likely to result in prohibited effects on listed aquatic species at risk, no permit will be required under the *Species at Risk Act.*

Please submit the following information and documents to apply for a *Fisheries Act* authorization:

- a completed Application Form for the Issuance of an Authorization under Paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* (Non-Emergency Situations) (http://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/request-review-demande-d-examen-005-eng.html);
- the required information and documentation set out in the *Authorizations Concerning Fish and Fish Habitat Protection Regulations* (the Regulations) (http://www.gazette.gc.ca/rp-pr/p2/2019/2019-08-21/html/sor-dors286-eng.html); and

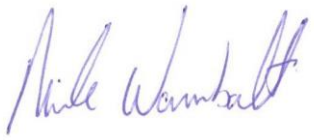
.../3

- an irrevocable letter of credit (for requirements see: http://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/applicants-guide-candidats-eng.html#131) to cover the cost of offsetting plan, if you are not exempted from providing one as set out in subsection 2(2) of the Regulations.

Should you choose to relocate or redesign your proposal, this could reduce the potential impacts of your proposal to a level where the aforementioned prohibited effects to fish and fish habitat can be avoided and authorization under the *Fisheries Act* would no longer be required. If you choose to modify your proposal to avoid a need for authorization, please submit your revised Request for Review form.

Please be advised that any unauthorized work, undertaking or activity that violates sections 34.4 and 35 of the *Fisheries Act* could lead to corrective action such as enforcement.

If you have any questions with the content of this letter, please contact Lynsey Crowell at our Dartmouth office at 902-220-5976 or by email at lynsey.crowell@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.



Yours sincerely,

Michael Wambolt
A/ Manager Regulatory Reviews
Fish and Fish Habitat Protection Program

c.c.: G. Brown, NSE Inspector Specialist

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada

Application Form for the Issuance of an Authorization under Paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* (Non-Emergency Situations)

I, the undersigned, hereby request an authorization for the purpose of paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* . I understand that this authorization, if granted, is only from the standpoint of the Minister of Fisheries and Oceans in regards to the above named provisions and does not release me from my obligation to obtain permission from other concerned regulatory agencies or from other act or regulations such as *Species at Risk Act* or the *Aquatic Invasive Species Regulations*.

Texts in brackets refer to the provisions of the *Authorizations Concerning Fish and Fish Habitat Protection Regulations* (hereafter "the Regulations") or of their Schedules.

1. Applicant Contact Information

Applicant's Name:	If applicable: Authorized Representative's Name:
Nadine Thomas Environmental Scientist Nova Scotia Power Incorporated	
Address:	Address:
25 Lakeside Park Dr. PO Box 910 Halifax, N.S. B3J 2W5	
Telephone No.:	Telephone No.:
902-719-5990	
Fax No.:	Fax No.:
E-mail:	E-mail:
nadine.thomas@nspower.ca	

DFO File Referral No. (if known):

19-HMAR-00549

2. Checklist for Prescribed Information [schedule 1]

An applicant does not need to re-submit documents that have already been submitted to DFO for review. An applicant may reference documents such as Environmental Impact Statements, technical supplements, etc. in their application but must provide the appropriate reference to any document cited, including the chapter, section, page reference and date of submission.

Type of Information/ Documentation	Have you submitted the following? (Yes/No)	Identify the appropriate reference document: Title, Chapter, Section, Page Number and Date of Submission	DFO Comments (For official use only)
Financial Guarantee **[paragraph 2(1)(b)]**	Yes	Letter of Credit was issued to DFO March 24, 2020. See Appendix E of the Supporting Information Document for a copy of the Letter of Credit.	
Description of Proposed work, undertaking or activity **[schedule 1, section 2]**	Yes	See page 1, Section 2.0 of the Supporting Information Document.	

Project engineering specifications, scale drawings and dimensional drawings (for physical works) **[schedule 1, section 3]**	Yes	See Appendix C of the Supporting Information Document.	
Phases and schedule information **[schedule 1, section 4]**	Yes	See page 3, Section 4.0 of the Supporting Information Document.	
Location information **[schedule 1, sections 5& 6]**	Yes	See page 3, Section 5.0 of the Supporting Information Document.	
Descriptions of any consultations undertaken prior to application (if any) **[schedule 1, section 7]**	Yes	See page 4, Section 7.0 of the Supporting Information Document.	
Description of Fish and Fish Habitat (Aquatic Environment) **[schedule 1, section 8]**	Yes	See page 4, Section 8.0 of the Supporting Information Document.	
Description of Effects on Fish and Fish Habitat **[schedule 1, section 9]**	Yes	See page 6, Section 9.0 of the Supporting Information Document.	
Description of Measures and Standards to Avoid or Mitigate death of fish or harmful alteration, disruption or destruction of fish habitat **[schedule 1, section 10]**	Yes	See page 8, Section 10.0 of the Supporting Information Document.	
Description of monitoring measures to assess effectiveness of measures and standards described in section 10 **[schedule 1, section 11]**	Yes	See page 9, Section 11.0 of the Supporting Information Document.	
Description of contingency measures that will be implemented if measures and standards (section 10) do not meet their objectives **[schedule 1, section 12]**	Yes	See page 9, Section 12.0 of the Supporting Information Document.	
Description of the death of fish after measures and standards are implemented **[schedule 1, section 13]**	Yes	See page 10, Section 13.0 of the Supporting Information Document.	
Description of the Residual harmful alternation, disruption or destruction of fish habitat after measures and standards are implemented **[schedule 1, section 14]**	Yes	See page 10, Section 14.0 of the Supporting Information Document.	
Habitat Credits **[schedule 1, section 15]**	No	Habitat Credits will not be used for this project.	
Offsetting Plan (including geographic coordinates and small scale site plan) **[schedule 1, section 16]**	No	See page 12, Section 16.0 of the Supporting Information Document for an explanation. An offsetting project is under development	

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Canada

3. Fisheries Management Objectives

Did you consider local Fisheries Management Objectives in your planning process? (•) Yes ( ) No

If yes, please identify the Fisheries Management Objective(s)/Plan considered and, if applicable, reference the relevant sections.

There are no known formal FMOs associated with the Sheet Harbour Hydro System

Please identify any effects that the proposed work, undertaking or activity may have on achieving these objectives.

The project will not impact any Fisheries Management Plans.

Applicant Declaration

I solemnly declare the that information provided for this application are true, complete and correct, and I make this declaration conscientiously believing it to be true knowing that it is of the same force and effect as if made under oath. This declaration applies to all material submitted as part of this application for paragraphs 34.4(2)(b) and 35(2)(b) *Fisheries Act* Authorization.



Applicant's signature (and corporate seal):

24/06/2020

Date

Information about the above-noted proposed work, undertaking or activity is collected by DFO under the authority of the *Fisheries Act* for the purpose of administering the Fish and Fish Habitat Protection Provisions of the *Fisheries Act*. Personal information will be protected under the provisions of the *Privacy Act* and will be stored in the Personal Information Bank number DFO PPU 680. Under the provisions of the *Privacy Act*, individuals have a right to, and on request shall be given access to, any personal information about them contained in a personal information bank. Instructions for obtaining personal information are contained in the Government of Canada's Info Source publications available at www.infosource.gc.ca or in Government of Canada offices. Information other than “personal” information may be accessible or protected as required by the provision of the *Access to Information Act*.

If you require additional space to provide relevant information, please attach that information and indicate the title of the form being used and the section to which you are responding.

NOVA SCOTIA POWER INCORPORATED

SUPPORTING INFORMATION – APPLICATION FOR AUTHORIZATION - *FISHERIES ACT* –
RUTH FALLS DAM REFURBISHMENT
SHEET HARBOUR HYDRO SYSTEM

2021

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1.0 CONTACT INFORMATION

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2.0 DESCRIPTION OF PROPOSED WORK, UNDERTAKING OR ACTIVITY

NSPI is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2021. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the centre, and two short concrete gravity bulkhead sections that abut either side of the spillway. The crest elevation of the spillway is 31.7 m and stoplogs can be installed to an elevation of 33.3 m. The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the power canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix A for mapping of the Sheet Harbour Hydro System and Appendix B for site photos.

The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates. NSPI is anticipating an additional permanent instream footprint of approximately 60 m2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections.

Flow in the area is controlled by NSPI Hydro Operations. Water levels can fluctuate between the full supply level of 33.6 m (110.4') and the low supply level of 27.5 m (90.1'). In order to complete work in dry conditions, the Project will include temporarily lowering the Ruth Falls Headpond and canal approximately 7-15 feet below the minimum operating level of 33.3 m (109.4') observed from April 1 – Nov. 30 each year, and installing a temporary bulkhead to isolate the existing sluiceway. The required reservoir elevation will be determined once the Project starts. It will be the lowest elevation possible while ensuring proper functioning of the fish conveyance system, passage of fish migrating downstream from Malay Falls, and provision of a 35 cfs maintenance flow below Ruth Falls. The Ruth Falls fish ladder and downstream bypass will be dewatered during construction and a fish conveyance system put in

place to ensure continued movement of fish upstream during the Project. Fish will be moved downstream via the sluiceway and/or spillway.

Nova Scotia Environment (NSE) operating approval 2008-062826-01 stipulates annual environmental requirements associated with operations at Ruth Falls as follows:

- Year round: 35 cfs maintenance flow downstream of dam;
- April 1 – November 30: 6 cfs of 35 cfs maintenance flow provided to the fish ladder, 29 cfs provided to operate the louvers;
- April 1 – November 30: Minimum operating level of 33.3 m (109.4 ft.);
- May 15 – November 30: operation of the fish trap;
- Supplemental flows required June 15 – July 15 and September 26 – November 30 annually.

The required 35 cfs maintenance flow will be provided throughout construction via the sluiceway or spillway sections as required. The remaining conditions will not be met which will be addressed through a request for variance from the operating approval.

The approval also stipulates requirements for Marshall Falls (minimum elevation of 191.4' Apr 1 – Sept 1 and a year round 45 cfs flow downstream of the dam). NSPI will maintain the 45 cfs flow but will be requesting some flexibility on the 191.4' elevation while remaining within normal operating levels.

The proposed refurbishment activities are as follows:

- installation of fish conveyance system near the entrance of the fish ladder;
- lowering of Ruth Falls reservoir approximately 7-15 feet (to be determined at start of Project);
- dewatering of the Ruth Falls fishladder during the construction activities;
- provision of temporary access for machinery on both the upstream and downstream sides of the dam consisting of rock, swamp mats, or other material. This will be evaluated once the area is dry and the bottom conditions assessed;
- removal of the existing stoplog bays, piers, and walkway;
- reface the concrete on the crest and downstream slope of the main dam ogee sections;
- installation of new rubber dam bladders on the crest of the existing ogee spillway sections;
- construction of a free overflow spillway section at the right end of the main dam;
- installation of a bulkhead to isolate the existing sluiceway section;
- refurbishment of the existing low level sluiceway section of the dam and the installation of three new low level sluice gates, which will replace the existing low level stoplogs. The existing piers will remain in-place;
- install a new steel walkway for access across the main dam;
- removal of bulkhead and temporary access material;

- watering Ruth Falls Headpond to within normal operating levels.

Hydrology in the area following the completion of construction will not be changed or altered as a result of the project. Operations will resume as normal once the headpond is back to within normal operating levels.

The details related to the temporary access for heavy machinery will be developed by the contractor once the reservoir has been lowered and conditions assessed. The contractor will determine where the access will be located and materials to be used. The area just downstream of the dam, where the temporary access road may be required, currently consists of exposed bedrock and boulders. Typically, temporary access roads are constructed using geotextiles and clean rockfill materials. Should a temporary road below the dam be required, it will be built to bypass the flow through the gates, likely with a clear span bridge, to be determined by the contractor. This can be accomplished with steel beams and building abutments out of swamp maps as an example. This will be determined by the contractor. All materials will be removed following the work and the site remediated back to its original condition.

Construction materials include rubber dams, concrete for headwalls and portions of ogee, and slide gates. A list of other products to be used by the contractor will be submitted to NSPI prior to start of work for approval based on health, safety, and environmental parameters. All materials stored on site shall be stored, handled and labeled according to Workplace Hazardous Materials Information System (WHMIS) regulations, as well as any other applicable federal or provincial regulation. Product Safety Data Sheets (SDS) shall be available on site at all times. All construction material and debris will be stored in designated areas on NSPI property away from watercourses and wetlands and in a manner that will prevent materials from entering a watercourse, for example, in seacans and/or on containment as required. Any debris that requires disposal will be done so in accordance with application regulations and guidelines.

While working with and/or applying materials, measures will be taken to prevent any materials from entering the watercourse by applying materials in a controlled manner and containing excess material during application.

3.0 ENGINEERING SPECIFICATIONS

Engineering drawings for the proposed work are located in Appendix C.

4.0 PHASES AND SCHEDULE

The Project is expected to take six to seven months starting in May 2021 the Project and Environmental Description document submitted to NSE as part of the Watercourse Alteration Approval Application and finishing in late November 2021. This includes both the lowering and subsequent recharging of water in the headpond. The goal is to drawdown the reservoir prior to fish spawning in order to allow fish to spawn in the smaller body of water and avoid exposing eggs. The detailed construction schedule will be developed by the contractor once the contract is awarded. Additional information regarding water management, erosion and sedimentation control, and environmental protection is described the Project

and Environmental Description document submitted to NSE as part of the Watercourse Alteration Approval Application, see Appendix D.

5.0 LOCATION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs in the System including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall Reservoir, then into the Malay Falls Headpond. The Malay Falls power canal conducts water from to the Malay Falls generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. The Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power.

Mapping, site photos, and engineering drawings are located in Appendices A, B, and C respectively. The Property Identification Number for the Ruth Falls Main Dam is 40221673. GPS coordinates per coordination system NAD83, UTM Zone 20N are: 539,486mE and 4,978,146mN.

6.0 COMMUNITY

The Project site is located near the community of Sheet Harbout, HRM, Nova Scotia.

7.0 CONSULTATIONS

NS Power initiated Mi'kmaq engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant Project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant Project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020.

NS Power presented the updated project information and design option to the KMKNO during the 2019 One Window meeting to discuss 2020 hydro capital projects. NS Power initiated engagement with the Millbrook Mi'kmaw community in January 2020 to provide an overview of the project and discuss next steps and approach to engagement for the project. This included working with the Mi'kmaw Conservation Group and the Millbrook Mi'kmaw community for a DFO Fisheries Act authorization offsetting project. In January 2020, NS Power initiated engagement with the Mi'kmaw Conservation Group to collaborate on an offsetting project. NS Power, in February and March 2020, continued engagement with the Mi'kmaw Conservation Group, continuing discussions to identify an offsetting

project with the group and the Millbrook Mi'kmaw community. NS Power will continue to engage the Millbrook Mi'kmaq community regarding the project. Weekly project manager communications will be available to the Millbrook Mi'kmaw community, as construction begins, currently scheduled for May to November 2021.

NS Power is planning to conduct public engagement for the Project with an Open House and provide local residents, along the Ruth Falls headpond, with relevant Project information and notification of the drawdown activities to conduct the Project. The public Open House and local resident communications will provide information in a timely manner about the Project, prior to drawdown activities and construction, increasing awareness and understanding of the Project scope, objectives, and timelines and addressing public areas of interest and potential concern.

8.0 DESCRIPTION OF FISH AND FISH HABITAT

The project site is located on the Ruth Falls Reservoir in the NSPI Sheet Harbour Hydro System. Upstream of the dam is lake habitat while downstream of the dam is the East River of Sheet Harbour. The Sheet Harbour Hydro System has been studied extensively as part of NSPI's hydro relicensing program. The most recent relicensing for Sheet Harbour was completed in 2018, during which various parameters including water quality and fish and fish habitat were studied. Qualitative and quantitative field studies were completed in the various reservoirs and streams of the Sheet Harbour Hydro System. The 2018 Sheet Harbour Hydro System Relicensing Report was provided to DFO in 2018 and provides an indication of the fish species found in the system.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that we see higher returns in the East River over time. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system.

Ruth Falls Reservoir was sampled by NSPI in 2017 using gill nets, minnow traps and eel pots. Species found to be present in Ruth Falls Reservoir include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat is found in the area. Table 1 summarizes fish species caught in the Ruth Falls Reservoir during surveys in 2017.

Table 1. Summary of fish sampled during the 2007 and 2017 Ruth Falls Reservoir surveys

Reservoir	Site #	Method	Species Caught	Number Caught	
				2007	2017
Ruth Falls	84	Minnow trap	Yellow perch	0	11
	85	Minnow trap	Yellow perch	0	12
	88	Minnow trap	Yellow perch	0	9
	89	Gill net	Brown bullhead	0	3
			Speckled trout	3	3
			Unknown	1	0
			White sucker	7	13
			Yellow perch	2	7
	92	Eel pot	Brown bullhead	0	2
	94	Gill net	Alewife	0	3
			Brown bullhead	0	1
			Golden shiner	0	1
			Lake chub	0	1
			Speckled trout	1	3
			White sucker	2	21
			Yellow perch	0	9
	124	Eel pot	Brown bullhead	0	11
	125	Eel pot	American eel	6	1
			Brown bullhead	0	12
			Yellow perch	7	0
	126	Eel pot	American eel	4	0
			Brown bullhead	7	0
			White sucker	2	0
	128	Minnow trap	Yellow perch	8	5
	130	Minnow trap	Yellow perch	3	28

Fish sampling using electrofisher was also conducted in stream sites located above the Ruth Falls Reservoir on Grant River as well as one site located below the Ruth Falls Reservoir on the East River of Sheet Harbour. Table 2 summarizes fish species captured during electrofishing surveys in 2006/7 and 2017.

Table 2. Summary of fish sampled during the 2006/2007 and 2017 stream electrofishing surveys

Location	Species	Number Caught	
		2006/7	2017
Grant River	American eel	12	4
	Brown bullhead	1	0
	Lake chub	7	9
	Pearl dace	4	0
	White sucker	0	1
	Banded killifish	1	0
	Blacknose dace	1	0
	Yellow perch	1	0
East River	American eel	2	0
	Lake chub	1	0

A physical fish habitat survey was also completed at all electrofishing sites. The substrate at Site 68 downstream of the Ruth Falls Main Dam was characterized by a mixture of boulder (50%), bedrock (40%), and cobble (10%). Habitat types observed were riffle (80%), smooth (10%) and rough (10%). Instream cover was noted as moderate while riparian vegetation included a canopy of 5% on the left bank and 0% on the right bank. A summary of physical characteristics of the downstream site (East River), as well as upstream sites on Grant River can be found in Table 3.

Table 3. Quantitative fish habitat data at stream sites near Ruth Falls in 2017.

Location	Area surveyed (m^2)	Gradient (%)	Flow m3/sec	Mean. water depth (m)	Max. water depth (m)	Mean velocity (m/s)	Max water velocity (m/s)
Grant River, site 43	254	1.28	-	0.19	0.24	-	-
Grant River, site 96	155	1.38	0.05	0.22	0.26	0.03	0.08
East River	203	1.32	-	0.36	0.46	-	-

Water quality sampling was performed at two sample sites in the Ruth Falls Reservoir in 2017. pH in Ruth Falls is considerably lower than reservoirs further upstream with a range of 4.32-5.14. Other water quality parameters measured were generally good. TDS is low, ranging from 9 mg/L to 12 mg/L, and conductivity ranges from 20 µS/cm to 23 µS/cm. Laboratory measurements of pH are considerably higher than in situ measurements, with values between 6.05 and 6.41. There are elevated metals concentrations in deeper waters, with exceedances of CCME FWAL guidelines for iron and zinc. Water quality measurements were taken at a site downstream of Ruth Falls in the East River of Sheet Harbour in 2017. pH was 4.94, dissolved oxygen was 10.23 mg/L, while conductivity was 20 µS/cm.

An ACCDC search of fish species at risk in the Sheet Harbour watershed identified American eel as threatened by COSEWIC while provincial rarity ranks of S3 was given to Alewife, Brook trout, and Lake trout; S2 to American eel; and S1 to Brook trout.

Flow in the area is controlled by NSPI Hydro Operations. Water levels can fluctuate between the full supply level of 33.6 m (110.4') and the low supply level of 27.5 m (90.1'). A minimum operating level of

33.3 m (109.4') is observed from April 1 - Nov. 30 each year. As per NSE Approval, a 35 cfs maintenance flow is provided downstream year round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is targeting downstream migration of American eel. The fish ladder at Ruth Falls operates from May 15-November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 11 salmon have been captured since 2007 with no salmon being captured 2017 and 2018 and two in 2019.

9.0 DESCRIPTION OF EFFECTS ON FISH AND FISH HABITAT

The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates. The Project will include a new footprint of approximately 60 m2 below the main dam. The reservoir will also be temporarily drawn down 7-15 feet below the minimum operating level of 33.3 m (109.4') required from April 1 – November 30 each year.

DFO have concluded that the following water management strategies related to the Project are likely to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction of fish habitat:

- The temporary drawdown of the reservoir which will result in the temporary disruption of up to approximately 1.35 km^2 of littoral zone habitat that fish species use for a portion of their life cycle;
- The potential installation of cofferdams and access for machinery resulting in a temporary instream footprint.

The Project will result in a permanent loss of fish habitat, however, it is felt that the Project will not be removing a critical piece of habitat from the ecosystem due to the small amount (60 m^2), the location immediately below the dam, the bedrock substrate located in the area, and the lack of vegetation in the area. The temporary lowering of the reservoir by 7-15 feet will cause the biggest disruption, however, it is felt the potential effects of fish and fish habitat is low due to the following:

1. The drawdown is temporary and will not have a long term effect on fish populations;
2. The water level will be drawn down prior to spawning in order to avoid stranding of eggs;
3. Measures will be put in place to ensure the safe upstream and downstream migration of fish during construction.

Project activities with the potential to impact fish and fish habitat have been identified and discussed in Table 4.

Table 4: Summary of potential effects on fish and fish habitat due to refurbishment of the Ruth Falls Main Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect
Temporary loss of fish habitat due to lowering reservoir beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 600 m^2 - 1350 m^2 in Ruth Falls	High	Low
Temporary loss of fish habitat due to temporary installation of access road/crossings and cofferdams.	Localized: area immediately above and below the dam	High	Low
Loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly below the dam	High	Low
Fish mortality due to stranding when lowering reservoir.	Localized: Ruth Falls Reservoir	Low	Low
Potential downstream scour during drawdown of reservoir.	Localized: East River of Sheet Harbour	Low	Low
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Reservoir	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Reservoir	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Reservoir	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Reservoir, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Reservoir, East River of Sheet Harbour	Low	Low

The amount of exposed shoreline around the Ruth Falls Reservoir during construction will depend on the amount the reservoir is lowered, to be determined on site during monitored drawdown. The following provides an estimate of exposed shoreline based on a number of drawdown scenarios:

- Lower reservoir from elevation 109.4’ to 105.4’ = 0.662988 sq km exposed shoreline;
- Lower reservoir from elevation 109.4’ to 103.4’ = 0.867364 sq km exposed shoreline;
- Lower reservoir from elevation 109.4’ to 101.4’ = 1.072936 sq km exposed shoreline;
- Lower reservoir from elevation 109.4’ to 99.4’ = 1.226612 sq km exposed shoreline;
- Lower reservoir from elevation 109.4’ to 97.4’ = 1.349704 sq km exposed shoreline.

Based on discussions with DFO in 2017, the DFO Science Branch advised that 250 m^2 was the average amount of habitat required to support an adult equivalent fish and all associated offspring. As such, the potential permanent loss of 60 m^2 plus a maximum exposed shoreline of 1349 m^2 will result in a temporary habitat loss supporting on average 6 adult fish and their progeny.

There are no formal fisheries management objectives for the East River of Sheet Harbour, however, the streams and reservoirs are used for recreational fishing by the local community. The temporary localized loss of fish habitat in Sloane Reservoir and associated 6 adult fish equivalent is not anticipated to have an effect on local fish populations.

10.0 MEASURES AND STANDARDS TO AVOID OR MITIGATE SERIOUS HARM TO FISH

NSP recognizes DFO's mitigation hierarchy, which emphasizes that efforts must be made to prevent impact first and, where avoidance is not possible, efforts must be made to minimize impacts. Any residual impacts require authorization and must be addressed by offsetting measures.

Table 5 summarizes the potential effects and mitigation measures to be employed to avoid direct or indirect impacts to fish and fish habitat. Therefore, no permanent impacts to the East River of Sheet Harbour or to Ruth Falls Reservoir (beyond the 60 m2 new dam footprint) in relation to its qualitative, chemical and physical characteristics are anticipated as a result of the Project for the new dam structure.

Table 5: Summary of potential impacts associated with the Project and mitigation measures to prevent or minimize impacts.

Potential Effect	Measure to Mitigate Serious Harm
Temporary loss of fish habitat (approximately 600 m^2 - 1350 m^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the reservoir 7-15' is required in order to complete work in dry conditions. There is a potential for exposing eggs during the drawdown. To mitigate this potential impact, NSPI will endeavor to begin lowering the reservoir prior to fish spawning (pending receipt of environmental approvals) and will pass fish upstream once the reservoir is lowered. Lowering the reservoir will occur in mid May and will take no more than one day. This will allow fish (gaspereau) to spawn in an area where water levels will not fluctuate and expose eggs. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Reservoir coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NSPI will lower the reservoir the minimum amount possible to create dry conditions while still ensuring enough water is available to maintain a 35 cfs flow below the dam and to operate the upstream fish conveyance system. In addition, offsetting as described in section 16 is considered appropriate mitigation to offset the temporary loss of habitat (600 m^2 to 1350 m^2) during the 2021 season.
Temporary loss of fish habitat due to potential temporary installation of access road/crossings and cofferdams.	The means for moving machinery from one side of the dam to the other will be via temporary access roads/crossings on either the upstream or downstream side of the dam, to be determined by the contractor. The site can only be accessed from the east side. There is no access or potential to create access from the west side. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All materials will be removed following the work and the site remediated back to its original condition. Cofferdams will only be installed if the reservoir cannot be lowered enough to provide dry work conditions while providing the 35 cfs flow and access to Grant River for fish. Cofferdams will only be installed where required in order to minimize instream footprint. Fish monitoring and rescue during cofferdam installation will be conducted by qualified individuals.

Potential Effect	Measure to Mitigate Serious Harm
Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately below the dam which is primarily bedrock and does not provide spawning habitat or cover for fish, offsetting described in section 16 is considered appropriate mitigation to offset serious harm.
Fish mortality due to stranding when lowering reservoir.	In order to conduct work in dry conditions, the reservoir will be lowered 7-15' below the minimum operating level of 109.4' observed from April 1st to November 30th each year. This option was chosen over installation of a cofferdam as the cofferdam would have to be very large given the length of the dam (300 m) and would pose an additional obstacle for fish passage. The drawdown of the reservoir will be monitored by qualified staff from NSPI Environmental Services to ensure no fish become stranded in pools or low spots. If stranded fish are found, qualified staff will capture the fish immediately and move them to deeper faster flowing water.
Potential downstream scour during drawdown of reservoir.	The reservoir will be lowered primarily through generation. Water will flow through the power canal to the generating station until the reservoir level reaches the level of the intake. While the generating station is online, a flow of 35 – 45 cfs will be flowing through the sluice bay and into the river channel as per year round requirements. Once the reservoir reaches the level of the intake, the plant will stop generating. The reservoir will continue to be lowered by removing stop logs individually from each bay in a controlled manner until the reservoir reaches the desired level for construction. The flow downstream will be controlled in order to avoid scour and sedimentation. The drawdown will be monitored by Environmental Services employees for stranded fish in the reservoir as well as issues downstream when stop logs are being pulled. The drawdown is expected to take a day.
Inability to provide safe fish passage upstream and downstream during construction.	Upstream fish passage will be provided using a fish pump conveyance system designed to safely transfer fish. The system is being custom built for the Ruth Falls site and is targeted to move fish as large as salmon. Qualified staff from the Supplier will install the mobile system, will conduct initial monitoring to ensure the system is functioning properly, and will provide training to NSPI personnel. The system will be monitored closely throughout construction to ensure proper functioning and safe transfer of fish. Should issues arise, the situation will be immediately assessed and decisions will be made regarding alternate methods by the Contractor, Project Manager and Engineers, Environmental Services, and Hydro Operations personnel. This type of system has been successfully used by the Halifax Regional Municipality and NSPI feel confident that this is the best method to transfer fish upstream. Downstream migration will be provided primarily via the sluice bays located in the middle of the main dam. A 35 cfs flow will be provided through the sluice bays throughout the duration of the Project. In order to ensure provision of flow while the sluice gates are being installed, the installation will likely be a staged approach where two of the gates are bulkheaded for work in the dry and installed first, while maintaining the flow through the third gate. During the installation of the third gate, gates one and two will maintain the discharge of the maintenance flows, thus allowing fish passage. The approach used will be proposed by the Contractor to NSPI's satisfaction. Access for machinery working downstream of the main dam will be built to bypass the flow through the gates, likely with a clear span bridge, to be determined by the contractor. This can be accomplished with steel beams and building abutments out of swamp maps as an example. This will be determined by the contractor. Downstream fish passage will be monitored throughout the duration of the Project to ensure fish are successfully moving through the work area and

Potential Effect	Measure to Mitigate Serious Harm
	continuing downstream.
Inability to monitor for salmon while trap is out of service.	NSPI have considered options for continuing to operate the salmon trap during construction. Given associated difficulties and the fact that not operating the fish trap will not lead to serious harm to salmon, the trap will not be operated for the 2021 season, pending approval from NSE and DFO.
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15 – July 15 and September 26 – November 30. These flows are meant to simulate large rain events which typically trigger salmon to move upstream. Since 2007, only 12 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018 and two in 2019. Salmon tend to prefer migrating to the West River of Sheet Harbour. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2021 season will cause serious harm to the salmon population.
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NSPI's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. Erosion and sedimentation controls will be employed to prevent sedimentation of the reservoir or wetlands. The successful contractor will be required to submit a site specific erosion and sedimentation control plan prior to start of construction. Excavation is not required, therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The reservoir will be monitored during dewatering for sediment and the rate of dewatering decreased as required.
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.

11.0 MONITORING MEASURES

Short-term monitoring will be completed during construction to ensure mitigation measures proposed for potential impacts identified in Table 5 are effective. Drawdown of the reservoir will be monitored by NSPI Environmental Services personnel throughout and will transfer any stranded fish. Operation of the fish conveyance system for upstream passage as well as downstream passage through the sluice bays will be closely monitored to ensure the safe passage of fish. Environmental Services staff will be on site while fish passage systems are being put in place and will remain on site until fish passage is deemed to be properly functioning. NSPI personnel will conduct multiple daily checks of fish passage and will report any issues to Environmental Services immediately. Contractor personnel will be instructed to immediately report any issues or dead fish they may observe over the course of the work to the NSPI

site representative. Environmental Services will conduct regular compliance audits (typically weekly) to monitor the effectiveness of fish passage as well as erosion and sedimentation control measures. Erosion and sedimentation control measures will also be monitored regularly by on site staff. The Contractor will be required to provide a site-specific water management, erosion and sedimentation control plan, and oil/chemical spill contingency plan to address all construction activities as part of the tender process. All construction personnel will be provided with environmental orientation prior to the start of construction to ensure compliance with NSPI standards and best practices and all Project-specific approvals or authorizations. Water quality sampling will be performed as required by associated environmental approvals.

A Project-specific environmental protection plan (EPP) will be developed to address all potential environmental risks associated with the Project and will include appropriate incident reporting procedures and key contacts. The Contractor will be required to review the EPP and provide training to all staff with respect to its contents.

12.0 CONTINGENCY MEASURES

Both upstream and downstream fish passage will be closely monitored throughout construction. Should issues arise, the situation will be immediately assessed and decisions made regarding alternate methods by the Contractor, Project Manager and Engineers, Environmental Services, and Hydro Operations. Should mitigation measures described in Section 10 prove to be ineffective, work will be stopped and issues reported to NSPI for resolution and reporting as required. By following the EPP, providing environmental orientation, providing appropriate supervision, conducting frequent inspections, and monitoring weather forecasts, it is not anticipated that there will be significant issues with the proposed mitigation.

13.0 DEATH OF FISH AFTER IMPLEMENTATION OF MEASURES AND STANDARDS

DFO have concluded that the following water management strategies are likely to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction of fish habitat:

- The temporary drawdown of the reservoir which will result in the temporary disruption of up to approximately 1.35 km^2 of littoral zone habitat that fish species use for a portion of their life cycle;
- The potential installation of cofferdams and access for machinery resulting in a temporary instream footprint.

A major goal of the project is to complete the work without causing death to fish. Water management strategies required to complete the project are not expected to result in death to fish and will include monitoring of the site as discussed in section 11. No residual serious harm to fish is anticipated in relation to all other potential impacts identified in Table 5. Refer to Table 6 for a final summary of potential impacts to fish and fish habitat, proposed mitigation, and potential residual harm.

14.0 HARMFUL ALTERATION, DISRUPTION, OR DESTRUCTION OF FISH HABITAT AFTER IMPLEMENTATION OF MEASURES AND STANDARDS

Table 6 provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Main Dam refurbishment.

Table 6: Residual Harm from Potential Impacts Associated with the Ruth Falls Main Dam Refurbishment

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Temporary loss of fish habitat (approximately 600 m^2 - 1350 m^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the reservoir 7-15' is required in order to complete work in dry conditions. There is a potential for exposing eggs during the drawdown. To mitigate this potential impact, NSPI will endeavor to begin lowering the reservoir prior to fish spawning (pending receipt of environmental approvals) and will pass fish upstream once the reservoir is lowered. Lowering the reservoir will occur in mid May and will take no more than one day. This will allow fish (gaspereau) to spawn in an area where water levels will not fluctuate and expose eggs. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Reservoir coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NSPI will lower the reservoir the minimum amount possible to create dry conditions while still ensuring enough water is available to maintain a 35 cfs flow below the dam and to operate the upstream fish conveyance system. In addition, offsetting as described in section 16 is considered appropriate mitigation to offset the temporary loss of habitat (between 600 m^2 and 1350 m^2) during the 2021 season.	No residual harm anticipated
Temporary loss of fish habitat due to potential temporary installation of access road/crossings and cofferdams.	The means for moving machinery from one side of the dam to the other will be via temporary access roads/crossings on either the upstream or downstream side of the dam, to be determined by the contractor. The site can only be accessed from the east side. There is no access or potential to create access from the west side. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All materials will be removed following the work and the site remediated back to its original condition. Cofferdams will only be installed if the reservoir cannot be lowered enough to provide dry work conditions while providing the 35 cfs flow and access to Grant River for fish. Cofferdams will only be installed where required in order to minimize instream footprint. Fish monitoring and rescue during cofferdam installation will be conducted by qualified individuals.	No residual harm anticipated
Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately below the dam which is primarily bedrock and does not provide spawning habitat or cover for fish, offsetting described in section 16 is considered appropriate mitigation to offset serious harm.	Loss of 60 m^2 of fish habitat immediately below the Ruth Falls Dam

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Fish mortality due to stranding when lowering reservoir.	In order to conduct work in dry conditions, the reservoir will be lowered 7-15' below the minimum operating level of 109.4' observed from April 1st to November 30th each year. This option was chosen over installation of a cofferdam as the cofferdam would have to be very large given the length of the dam (300 m) and would pose an additional obstacle for fish passage. The drawdown of the reservoir will be monitored by qualified staff from NSPI Environmental Services to ensure no fish become stranded in pools or low spots. If stranded fish are found, qualified staff will capture the fish immediately and move them to deeper faster flowing water.	No residual harm anticipated
Potential downstream scour during drawdown of reservoir.	The reservoir will be lowered primarily through generation. Water will flow through the power canal to the generating station until the reservoir level reaches the level of the intake. While the generating station is online, a flow of 35 – 45 cfs will be flowing through the sluice bay and into the river channel as per year round requirements. Once the reservoir reaches the level of the intake, the plant will stop generating. The reservoir will continue to be lowered by removing stop logs individually from each bay in a controlled manner until the reservoir reaches the desired level for construction. The flow downstream will be controlled in order to avoid scour and sedimentation. The drawdown will be monitored by Environmental Services employees for stranded fish in the reservoir as well as issues downstream when stop logs are being pulled. The drawdown is expected to take a day.	No residual harm anticipated
Inability to provide safe fish passage upstream and downstream during construction.	Upstream fish passage will be provided using a fish pump conveyance system designed to safely transfer fish. The system is being custom built for the Ruth Falls site and is targeted to move fish as large as salmon. Qualified staff from the Supplier will install the mobile system, will conduct initial monitoring to ensure the system is functioning properly, and will provide training to NSPI personnel. The system will be monitored closely throughout construction to ensure proper functioning and safe transfer of fish. Should issues arise, the situation will be immediately assessed and decisions will be made regarding alternate methods by the Contractor, Project Manager and Engineers, Environmental Services, and Hydro Operations personnel. This type of system has been successfully used by the Halifax Regional Municipality and NSPI feel confident that this is the best method to transfer fish upstream. Downstream migration will be provided primarily via the sluice bays located in the middle of the main dam. A 35 cfs flow will be provided through the sluice bays throughout the duration of the Project. In order to ensure provision of flow while the sluice gates are being installed, the installation will likely be a staged approach where two of the gates are bulkheaded for work in the dry and installed first, while maintaining the flow through the third gate. During the installation of the third gate, gates one and two will maintain the discharge of the maintenance flows, thus allowing fish passage. The approach used will be proposed by the Contractor to NSPI's satisfaction. Access for machinery working downstream of the main dam will be built to bypass the flow through the gates, likely with a clear span bridge, to be determined by the contractor.	No residual harm anticipated

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
	This can be accomplished with steel beams and building abutments out of swamp maps as an example. This will be determined by the contractor. Downstream fish passage will be monitored throughout the duration of the Project to ensure fish are successfully moving through the work area and continuing downstream.	
Inability to monitor for salmon while trap is out of service.	NSPI have considered options for continuing to operate the salmon trap during construction. Given associated difficulties and the fact that not operating the fish trap will not lead to serious harm to salmon, the trap will not be operated for the 2021 season, pending approval from NSE and DFO.	No residual harm anticipated
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15 – July 15 and September 26 – November 30. These flows are meant to simulate large rain events which typically trigger salmon to move upstream. Since 2007, only 12 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018 and two in 2019. Salmon tend to prefer migrating to the West River of Sheet Harbour. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2021 season will cause serious harm to the salmon population.	No residual harm anticipated
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NSPI's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. Erosion and sedimentation controls will be employed to prevent sedimentation of the reservoir or wetlands. The successful contractor will be required to submit a site specific erosion and sedimentation control plan prior to start of construction. Excavation is not required, therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The reservoir will be monitored during dewatering for sediment and the rate of dewatering decreased as required.	No residual harm anticipated
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.	No residual harm anticipated

15.0 HABITAT CREDIT

Habitat Credits will not be used as an offset for death of fish or the harmful alteration, disruption, or destruction of fish habitat as described in Sections 13 and 14.

16.0 OFFSETTING PLAN

NSPI is proposing, in partnership with the Mi'kmaw Conservation Group (MCG), a restoration project that is suitable for offsetting of serious harm for the Ruth Falls Dam refurbishment and the Sloane Reservoir Wing Dam 2 refurbishment project in conjunction. The amount of fish habitat permanently impacted due to infilling associated with the Sloane Wing Dam project is 900 m^2. The amount of habitat potentially impacted temporarily due to lowering of the reservoir for the duration of the Ruth Falls project is approximately 600 m^2 to 1350 m^2 depending on how low the reservoir is lowered. Applying a 3:1 ratio results in a maximum offset of 6750 m^2. NSPI are currently working with MCG to identify a project in the nearby area, potentially in partnership with a local group such as the Nova Scotia Salmon Association. MCG will provide oversight and guidance on the project and will also collaborate with the Millbrook First Nations Community on the project in order to potentially engage community members to implement habitat offset work. The general plan is to conduct project planning and site/method selection in year 1 (2020), execute offsetting and conduct pre-monitoring in years 2 and 3, followed by 3 years of post offset monitoring. Given restrictions put in place across the province in response to the COVID-19 pandemic, collaboration and development of an offsetting plan by MCG is still ongoing. As discussed with DFO, in order to start the application process prior to the development of an offsetting plan, NSPI has obtained a letter of credit for the offset project which was estimated based on a 5:1 ratio for the Sloane project. This will be followed by submission of an offsetting plan once available. The amount of the letter of credit was estimated based on the cost for a previous offsetting plan developed by MCG for a project conducted at the Trenton Generating Station in 2019. The amount of the letter of credit will be adjusted once the cost for the offsetting project is finalized by MCG. A Letter of Credit for $62,000 is presented in Appendix E.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Reservoir Bathymetry
3. Ruth Falls Reservoir Location of Structures

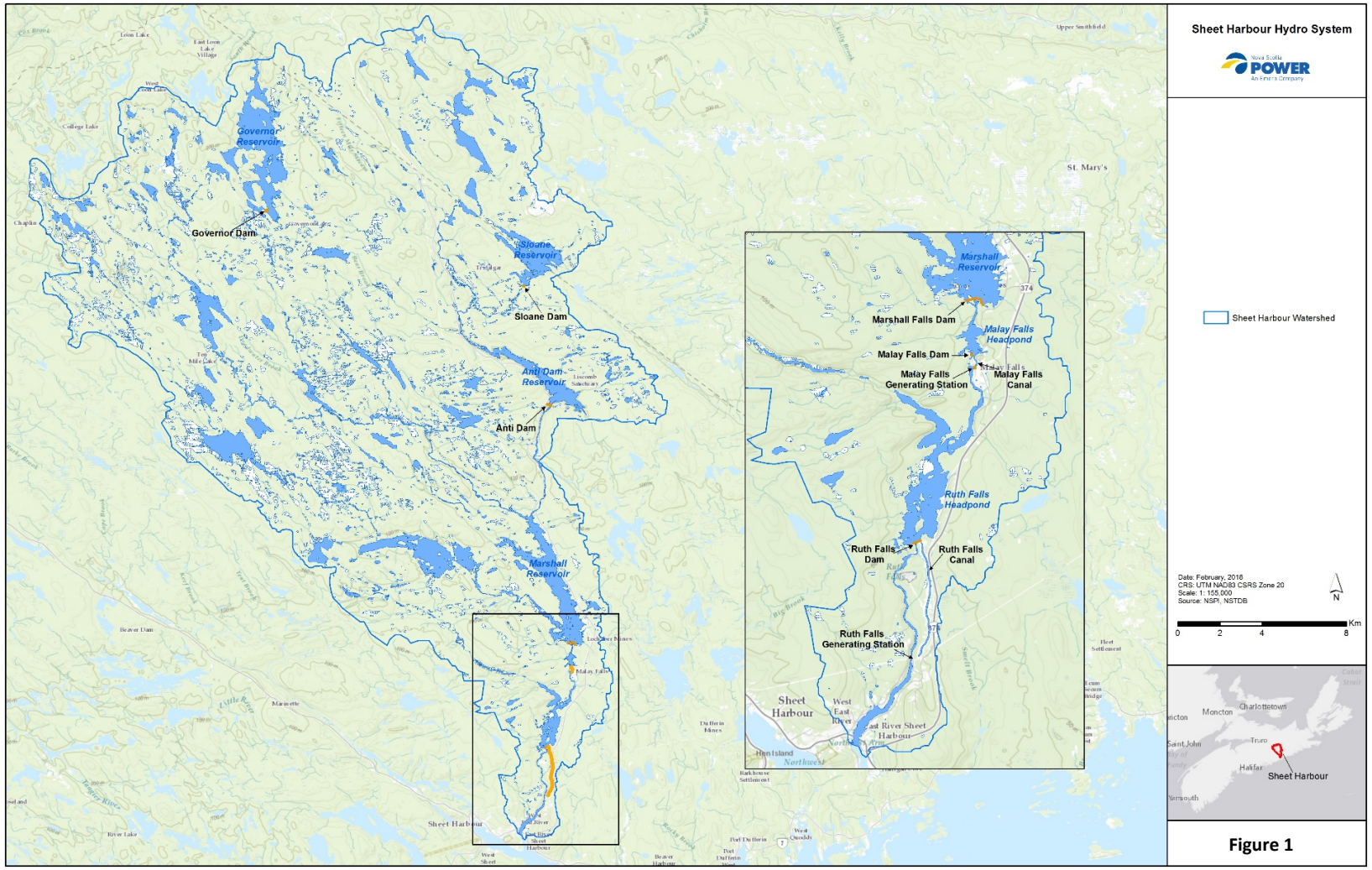

Sheet Harbour Hydro System
Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
Sheet Harbour Watershed
Date: February, 2016
CRS: UTM NAD83 CSRS Zone 20
Scale: 1: 155,000
Source: NSPI, NSTDB
N
Km
0 2 4 8
Moncton
Charlottetown
Truro
Halifax
Sheet Harbour

Figure 1

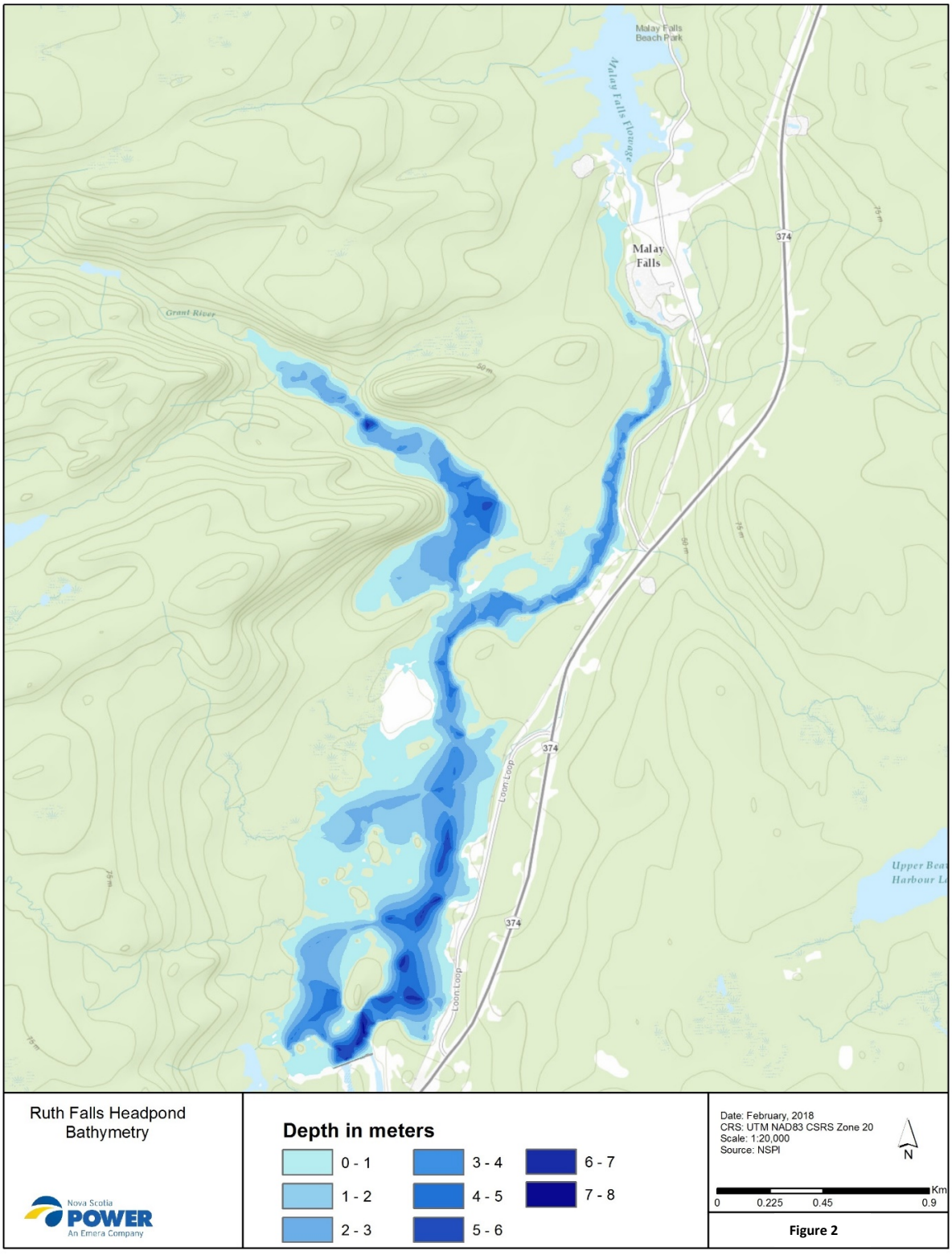

Malay Falls Beach Park
Malay Falls Flowage
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Beat
Harbour L
Ruth Falls Headpond Bathymetry
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
N
Km
0
0.225
0.45
0.9

Figure 2

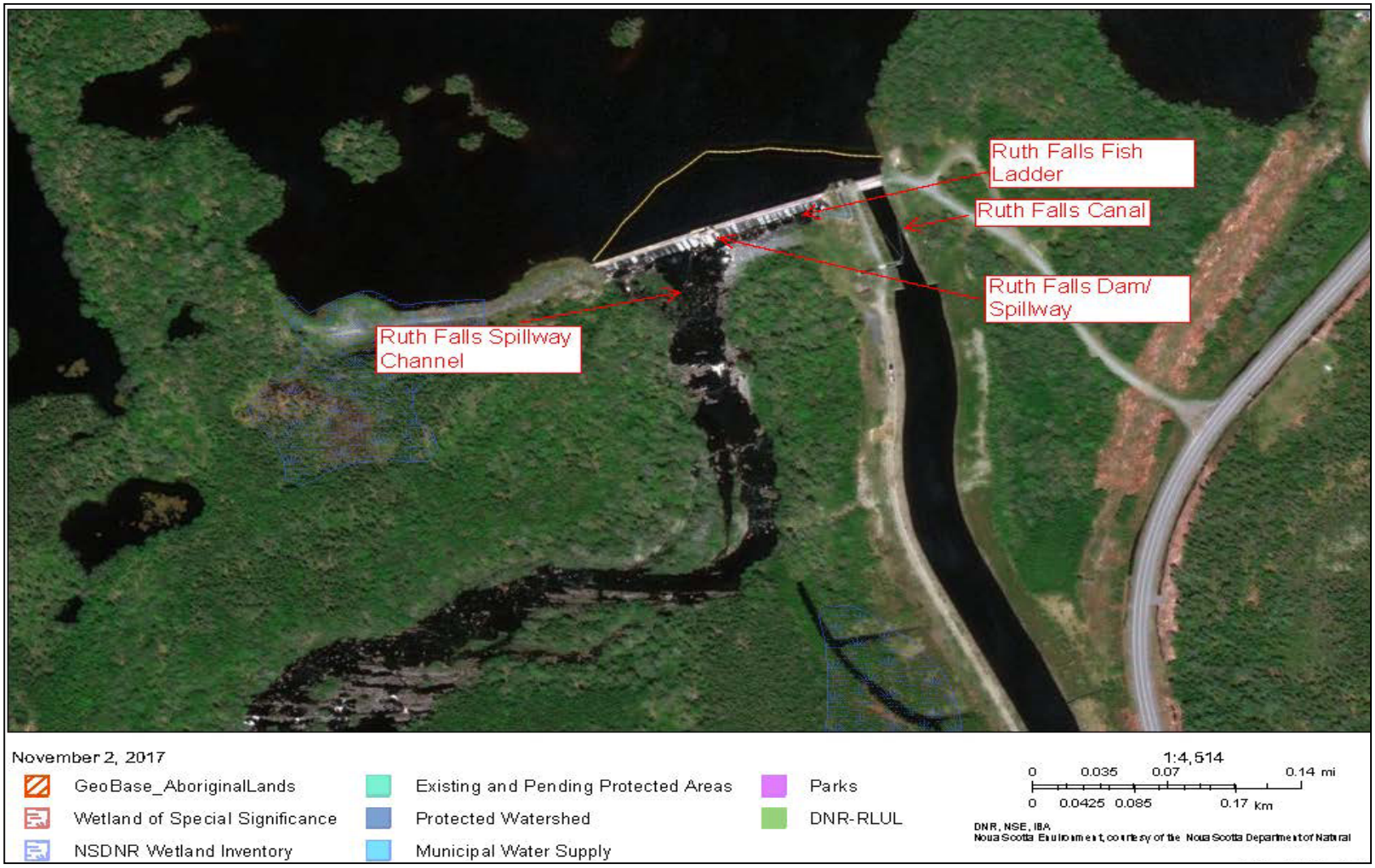


Figure 3. Ruth Falls Reservoir Location of Structures

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

APPENDIX C – ENGINEERING DRAWINGS

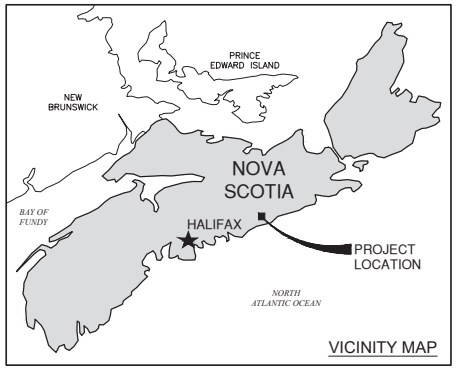
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NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

Explanatory markups provided by NSPI for NSE.
April 2, 2020

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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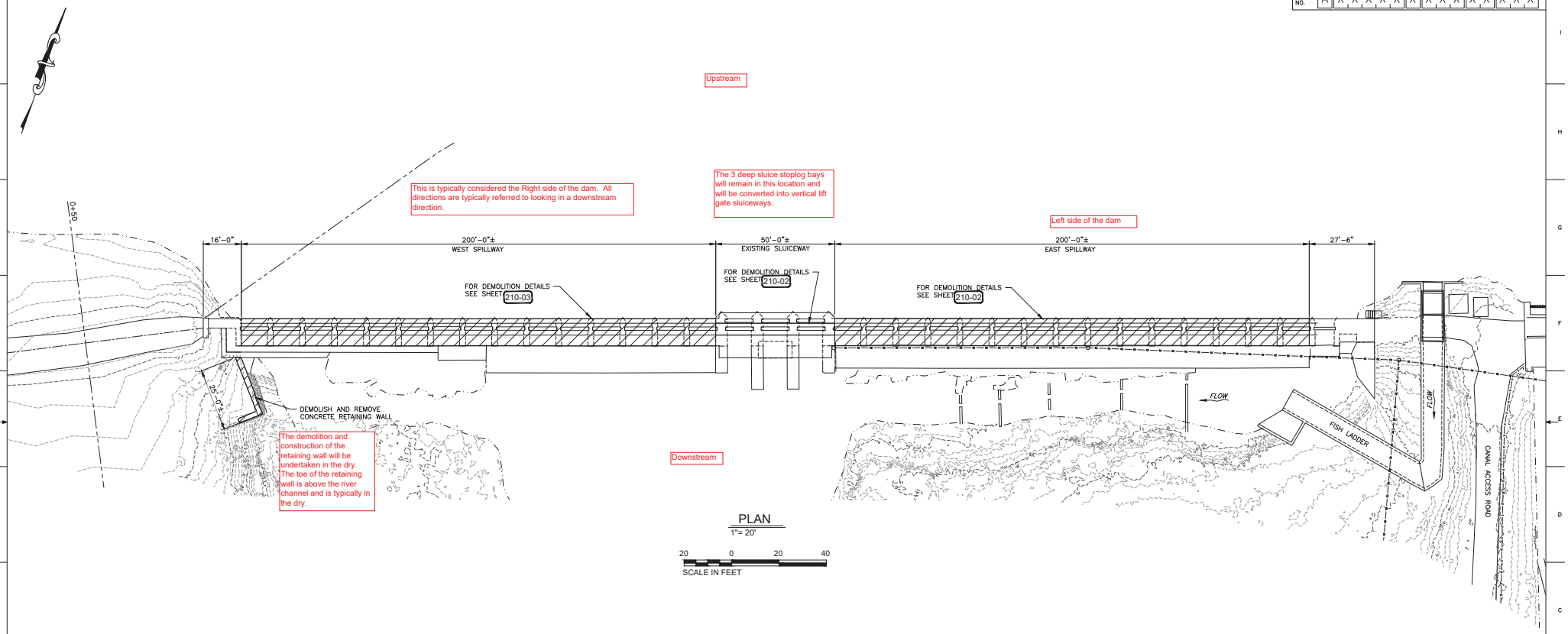
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

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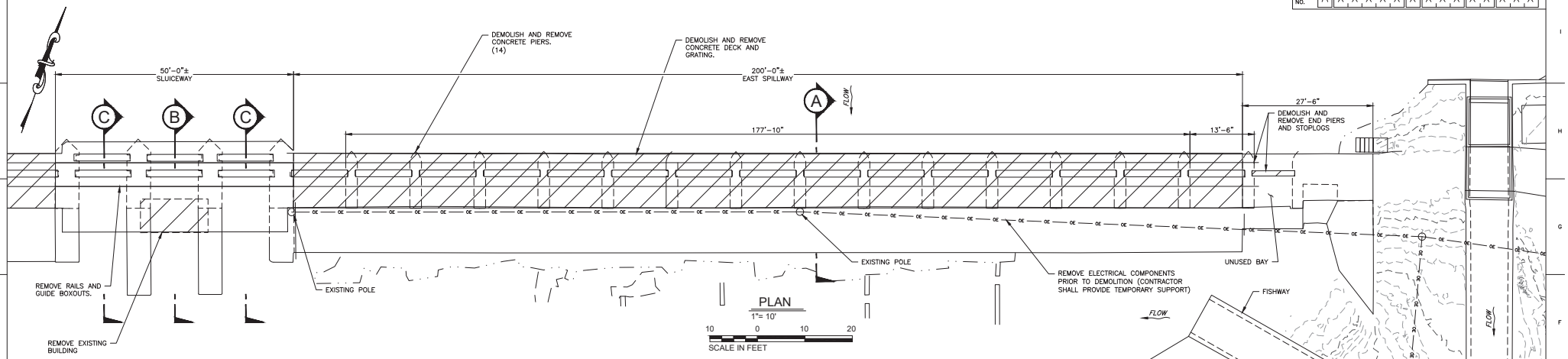
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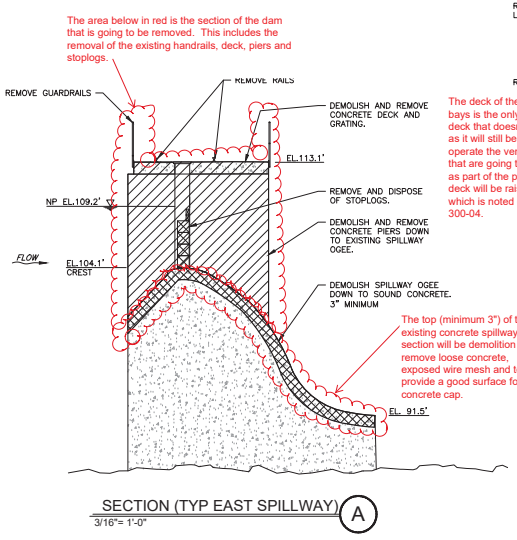
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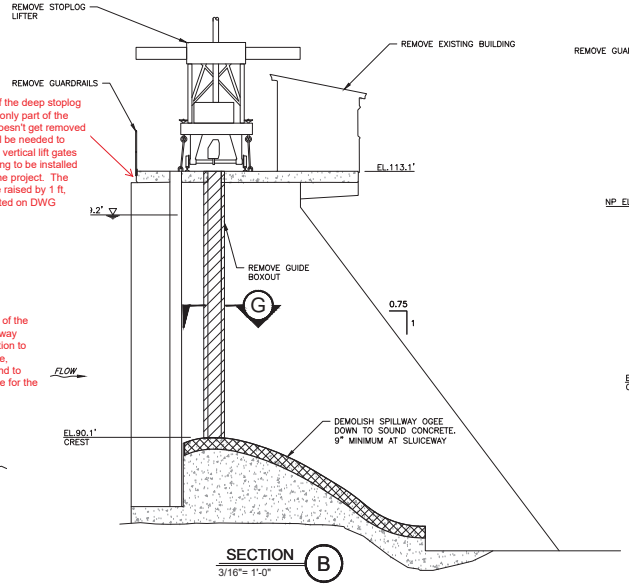
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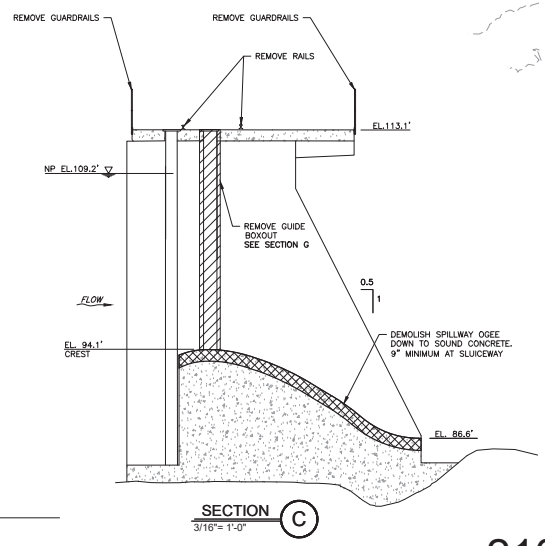
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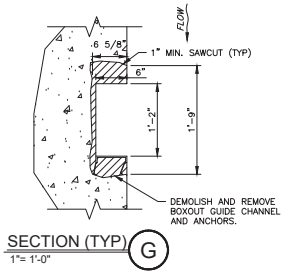
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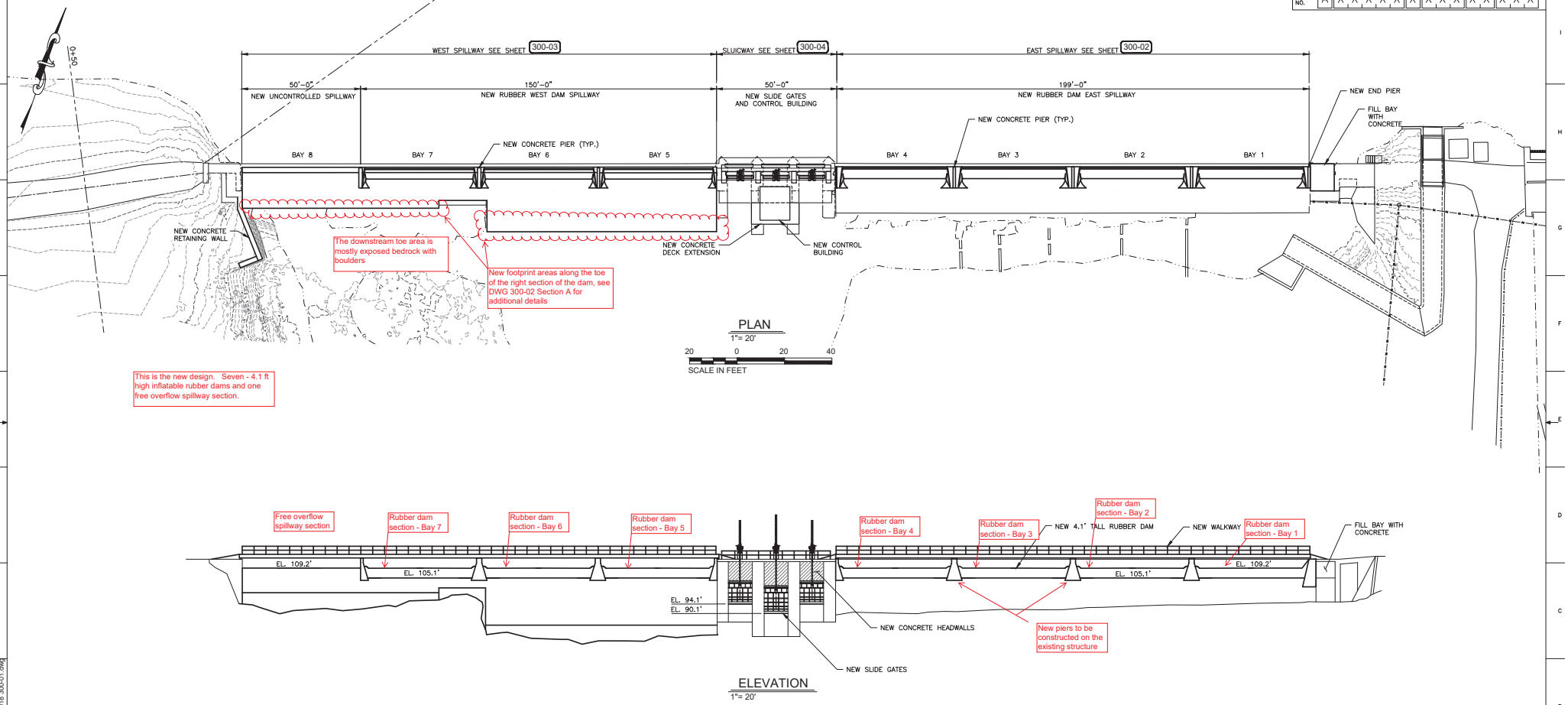
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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

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EAST SPILLWAY PLAN AND SECTIONS

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
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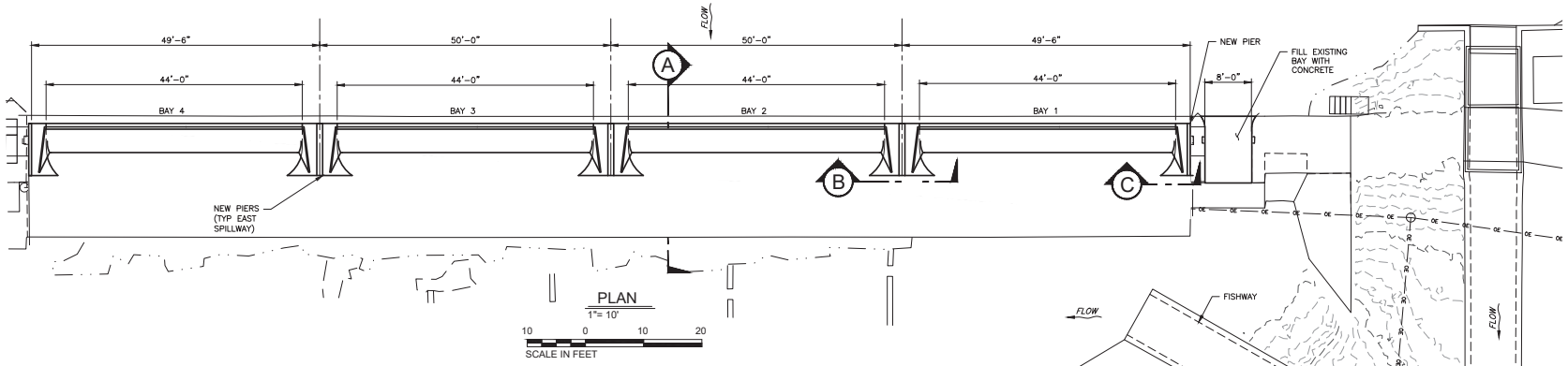
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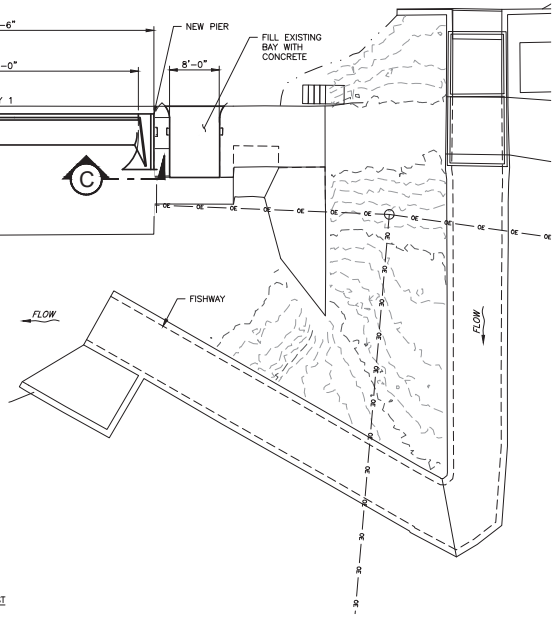
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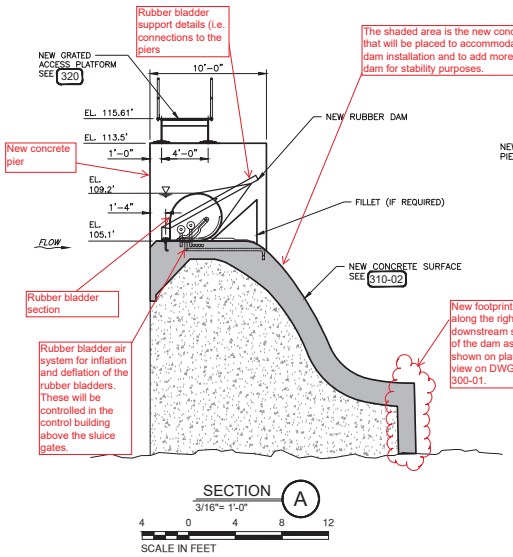
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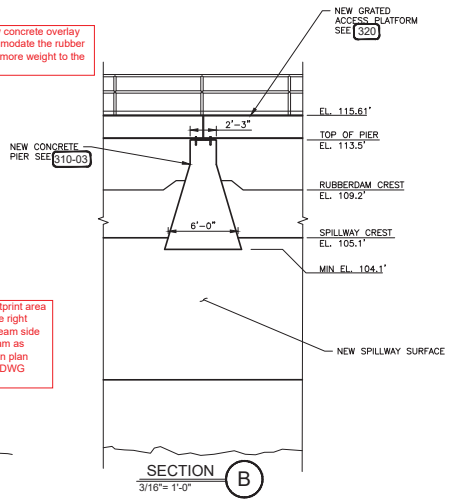
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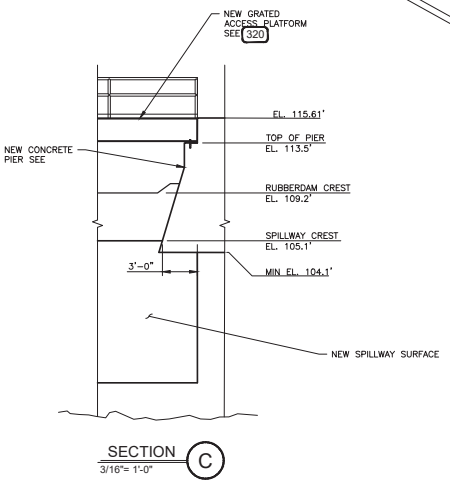
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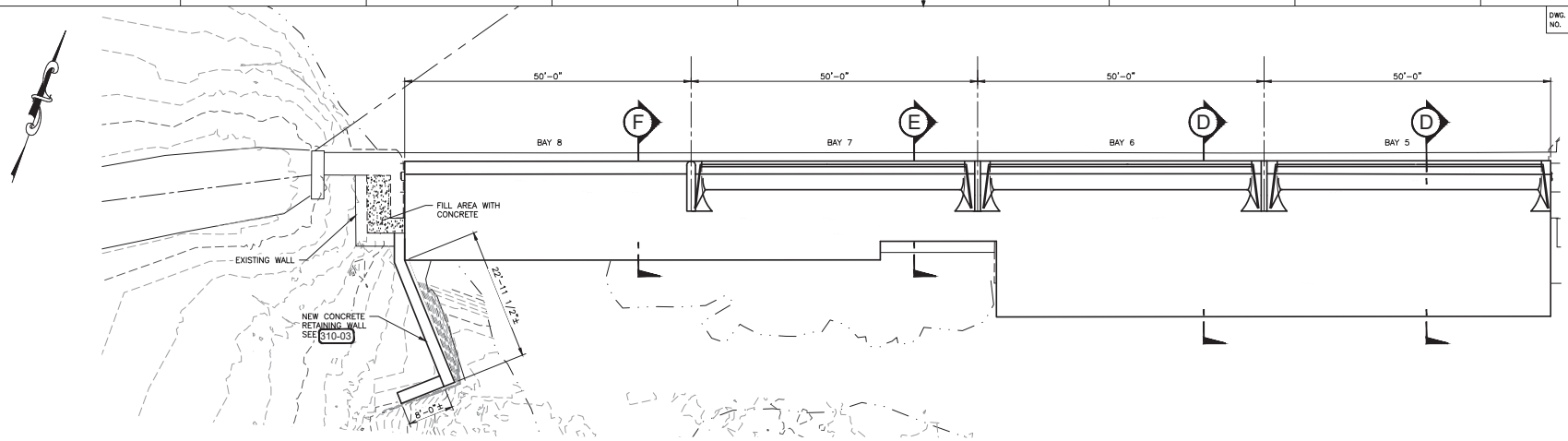
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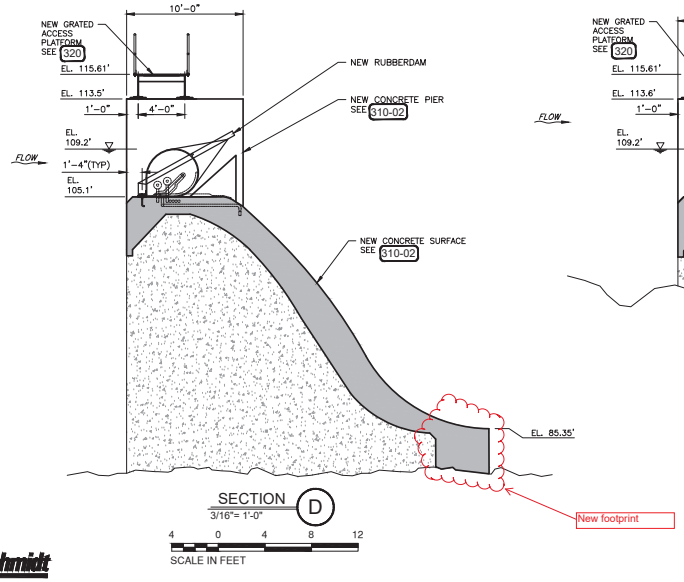
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

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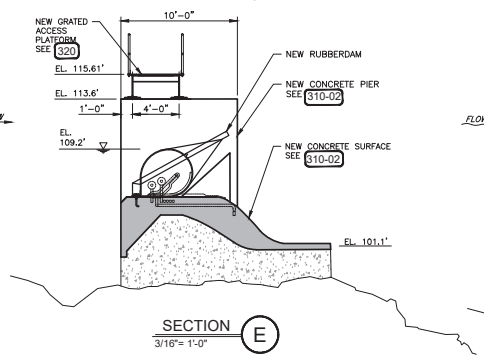


PLAN
1"= 10'
SCALE IN FEET

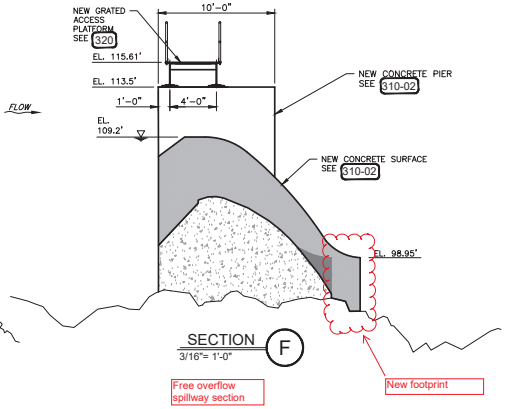


SECTION D
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION F
3/16"= 1'-0"

New footprint

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300-03

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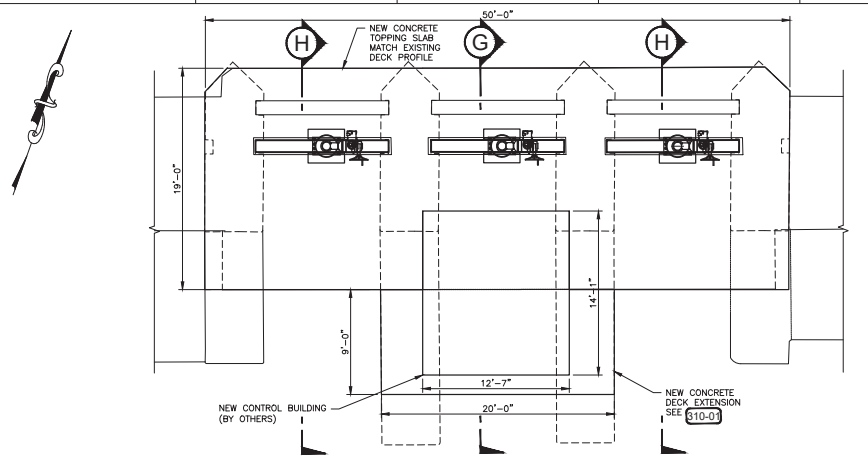
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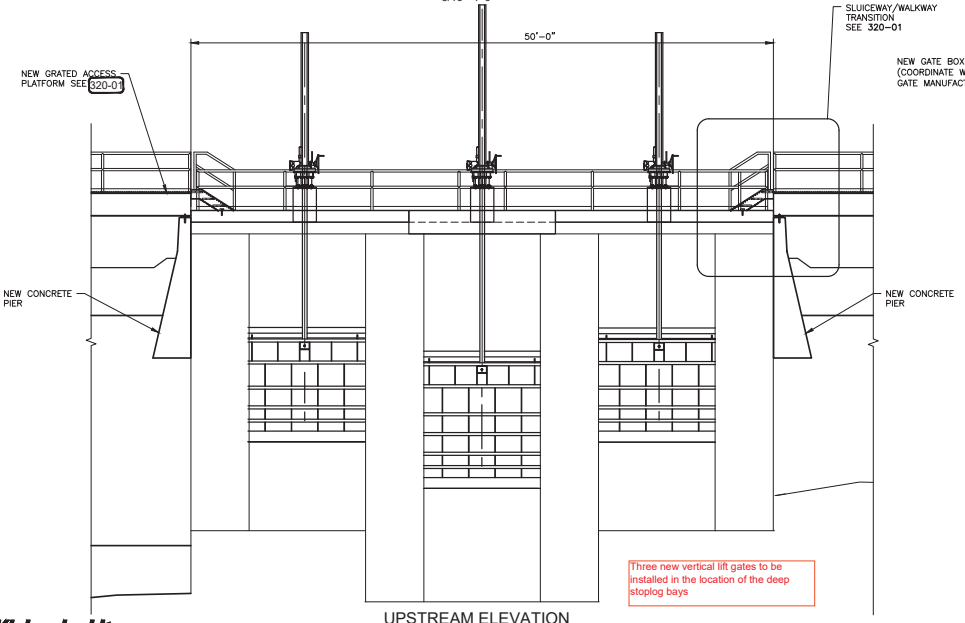
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

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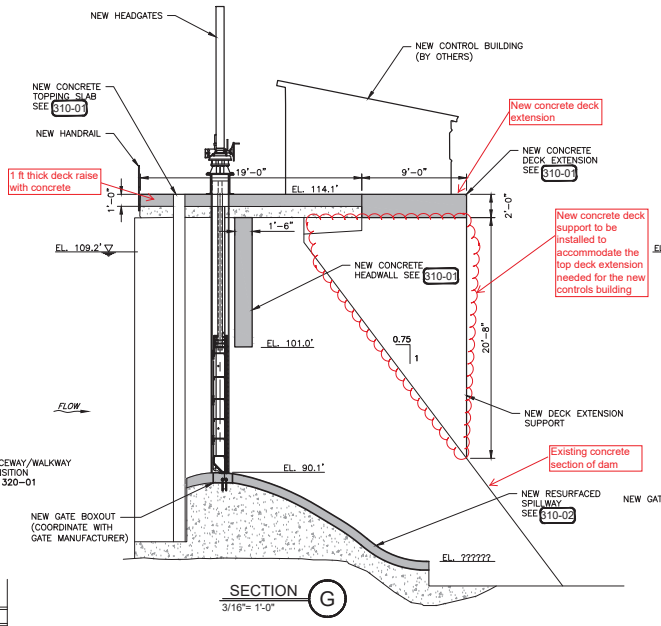
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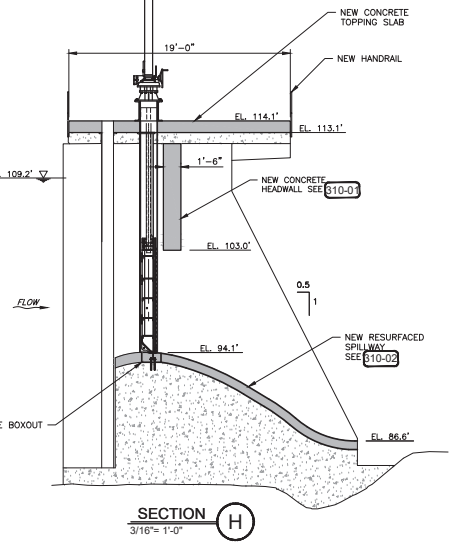
PLAN
3/16"=1'-0"



UPSTREAM ELEVATION
3/16"=1'-0"



SECTION G
3/16"= 1'-0"



SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

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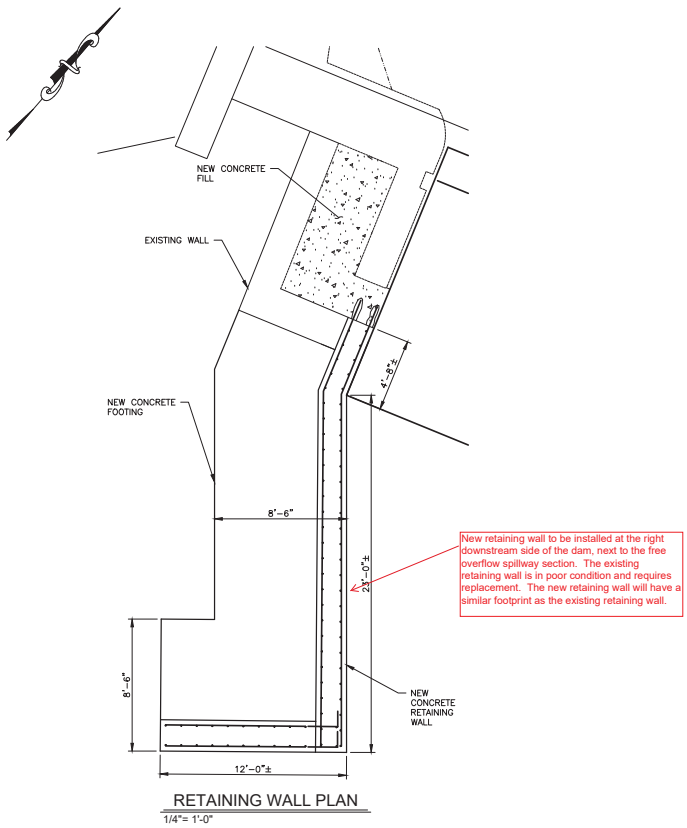
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

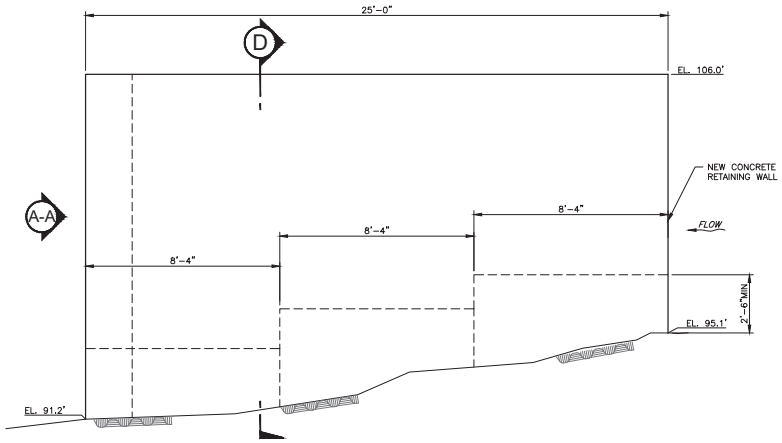
NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

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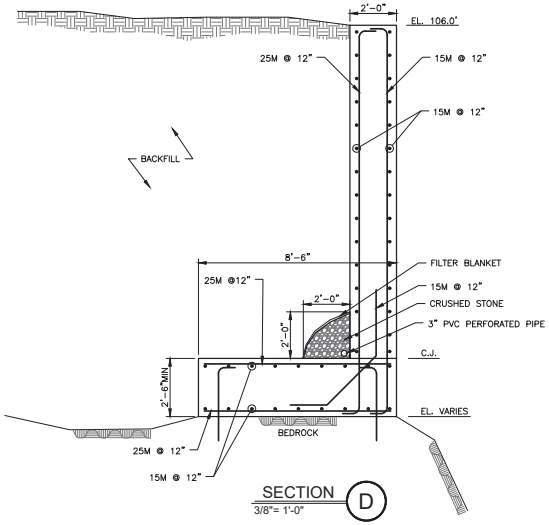
RETAINING WALL PLAN

1/4"= 1'-0"



RETAINING WALL ELEVATION

3/8"= 1'-0"



SECTION D

3/8"= 1'-0"

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE RETAINING WALL AND PIER DETAILS

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APPENDIX D – NSE WATERCOURSE ALTERATION APPLICATION – PROJECT AND ENVIRONMENTAL DESCRIPTION

PROJECT OVERVIEW

NSPI is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2021. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. The project involves refurbishing the main dam by replacing the existing stop log bays with rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

Activities proposed for the Project include lowering the Ruth Falls Headpond and canal approximately 7-15 feet and dewatering the Ruth Falls fish ladder and downstream bypass during construction. A fish conveyance system will be put in place to ensure continued movement of fish upstream during the Project. Fish will be moved downstream via the sluiceway and/or spillway.

The Project is scheduled to take approximately six months to complete starting approximately May 1st, 2021.

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel.

Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

2.0 CONSTRUCTION

Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The project involves

refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

NSPI is anticipating an additional permanent instream footprint of approximately 60 m^2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections. The reservoir will be temporarily drawn down approximately 7-15 feet and a temporary cofferdam or bulkhead installed to isolate the existing sluiceway. The fish ladder and fish bypass will be dewatered, however, a fish conveyance system will be put in place to ensure continued movement of fish upstream during the Project. Fish will be moved downstream via the sluiceway or spillway sections as required.

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the centre, and two short concrete gravity bulkhead sections that abut either side of the spillway. The crest elevation of the spillway is 31.7 m and stoplogs can be installed to an elevation of 33.3 m. The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Flow in the area is controlled by NSPI Hydro Operations. Water levels can fluctuate between the full supply level of 33.6 m (110.4') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.4') is observed from April 1 - Nov. 30 each year. As per NSE Approval, a 35 cfs maintenance flow is provided downstream year round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is targeting downstream migration of American eel. The fish ladder at Ruth Falls operates from May 15-November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 9 salmon have been captured since 2007 and none since 2017.

2.2 Proposed Refurbishment Activities

The proposed maintenance activities are as follows:

- installation of fish conveyance system near the entrance of the fish ladder;
- lowering of Ruth Falls reservoir approximately 7-15 feet; the actual elevation will be the lowest elevation possible while ensuring proper functioning of the fish

conveyance system, passage of fish migrating downstream from Malay Falls, and provision of a 35 cfs maintenance flow below Ruth Falls;

- dewatering of the Ruth Falls fishladder during the construction activities;
- provision of temporary access for machinery on both the upstream and downstream sides of the dam consisting of rock, swamp mats, or other material. This will be evaluated once the area is dry and the bottom conditions assessed;
- removal of the existing stoplog bays, piers, and walkway;
- reface the concrete on the crest and downstream slope of the main dam ogee sections;
- installation of new rubber dam bladders on the crest of the existing ogee spillway sections;
- construction of a free overflow spillway section at the right end of the main dam;
- installation of cofferdam or bulkhead to isolate the existing sluiceway section;
- refurbishment of the existing low level sluiceway section of the dam and the installation of three new low level sluice gates, which will replace the existing low level stoplogs. The existing piers will remain in-place;
- install a new steel walkway for access across the main dam;
- removal of bulkhead/cofferdam and temporary access material;
- watering Ruth Falls Headpond to within normal operating levels.

2.3 Construction Schedule

The Project is expected to take six months starting in early May 2021 and finishing in late November 2021. This includes both the lowering and subsequent recharging of water in the headpond.

3.0 REGULATORY PERMITS/APPROVALS

A Watercourse Alteration Approval is required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*. A separate request for review has been submitted to DFO to determine if a Fisheries Act Authorization is required.

4.0 ENVIRONMENTAL PROTECTION

4.1 Water Management

In order to expose the portions of the concrete dam to be refurbished, the Ruth Falls Headpond will be lowered between 2-4.5 m (7-15 feet) from the 33.3 m (109.4') minimum operating level maintained April 1st to November 30th each year. The amount will be determined once the fish

conveyance system is installed and lowering of the reservoir begins in May/June. The canal, fishladder, and fish bypass will also be dewatered. The amount will depend on how low the water level can go while operating the fish conveyance system properly and ensuring fish can migrate downstream from Malay Falls. A 35 cfs flow will also be maintained downstream of the dam. Supplemental flow required as part of the operating approval will not be provided during construction and the fish trap will not be operated.

Dewatering activities will begin between early May and early June by closing the gates at Malay Falls and lowering primarily through generation at Ruth Falls until water levels have dropped below generation level. At this point, a staged approach will be used to remove remaining stop logs until the desired headpond elevation is reached. The fish conveyance system will be put in place prior to dewatering and will remain in place for the duration of construction. The 35 cfs maintenance flow and downstream fish passage will be provided through the sluiceway or via the concrete ogee sections as required. Once the headpond is lowered to the desired elevation, temporary access upstream and downstream of the dam will be installed in the dry, if practical, based on the ground conditions.

Qualified NSPI personnel will be on site during the drawdown to monitor water quality (visual silt) and conduct a fish rescue for any isolated fish in the headpond and canal. The headpond will be subsequently recharged at a controlled rate and monitored for silt and fish issues.

4.2 Erosion and Sedimentation Control

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NSPI personnel monitoring for any visible water quality issues.

4.3 Construction Material and Debris

Measures will be taken to prevent any materials used in the various work activities from entering the watercourse. All such materials will be applied in a controlled manner and any excess material will be contained during application. All construction debris will be stored on NSPI property or disposed to an approved landfill. Any debris that requires disposal will be done so in accordance with **NSE Construction and Demolition Debris Disposal Site Guidelines**.

4.4 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refuelling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. Oil spill contingency plans will be followed and spill kits maintained on-site, in the event a petroleum product spill occurs.

4.5 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

5.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Ruth Falls Headpond was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas is considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

6.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window Meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020. NS Power further presented the Project and design option with the KMKNO during the One Window meeting to discuss 2020 hydro capital projects. NS Power will continue engagement regarding the project with monthly project updates to the KMKNO and notifications regarding the permitting schedule for the submission of an NSE Watercourse Alteration application. Weekly project manager communications will be provided to the KMKNO, as construction begins, currently scheduled for May to November 2021.

APPENDIX E – COPY OF LETTER OF CREDIT



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Insofar as any provisions contained or referred to in this Agreement may be contrary to any applicable laws, government regulations, orders or requirements, such other provisions shall remain in effect as a part of this Agreement to the extent that they are not overridden. The invalidity or unenforceability of any provisions of this Agreement shall not affect any other part hereof. The parties expressly agree that this Agreement be drawn up in the English language. FEDERAL EXPRESS CANADA LTD., Head Office, 5985 Explorer Drive, Mississauga, ON L4W 5K6.

The Bank of Nova Scotia

Trade Services Centre
4th Floor, 1 St. Clair Avenue East
Toronto, Ontario M4T 1Z3
Tel: 1-888-722-3867
Fax: 416-866-4286
SWIFT: NOSCCATTTPG

Irrevocable Standby Letter of Credit No.: OSB62460GWS

Beneficiary:
Receiver General for Canada
on behalf of Fisheries and Oceans
Canada C/O Fisheries Protection
Program Fisheries and Oceans Canada Canada

Applicant:
Nova Scotia Power Incorporated
1223 Lower Water Street
Halifax, NS B3J 3S8 Canada

Date of Issue:
March 18, 2020

Date and Place of Expiry:
March 17, 2021 At our counter

Amount:
CAD 62,000.00 Sixty Two Thousand Canadian Dollars

Complete Beneficiary's name and address:
Receiver General for Canada on behalf of Fisheries and Oceans Canada
C/O Fisheries Protection Program
Fisheries and Oceans Canada
1 Challenger Drive,
Dartmouth, NS B2Y 4A2

Reference Number: DFO Referral File Numbers 19-W-549 and 20-HMAR-00017

We hereby authorize you to draw upon the Bank of Nova Scotia, Montreal Trade Service Centre, 1800 McGill College, 10th floor, Montreal, Quebec H3A 3K9 for the account of our Customer, Nova Scotia Power Incorporated, up to the sum total of CAD62,000.00 (Sixty Two Thousand and 00/100 Canadian Dollars) available on demand as follows:

Pursuant to the request of our Customer, we, the Bank of Nova Scotia, Montreal Trade Service Centre hereby establish and give to you an Irrevocable Standby Letter of Credit (the "Credit") in your favor in the total amount of CAD62,000.00 (Sixty Two Thousand and 00/100 Canadian Dollars). The Credit may be drawn on, by you, at any time and from time to time upon written demand by you. We will honor any such demand made by you without inquiring whether you have a right as between yourself and our Customer to make such demand and without recognizing any claim, instructions, direction or notification to the contrary from the Customer.

The Bank of Nova Scotia

Provided, however, that you are to deliver to us at such time as a written demand for payment is made upon us, a certificate purported to be signed by you, agreeing and/or confirming that monies drawn pursuant to this Credit will be retained and used by you to meet our Customer's obligations in connection with offsetting and monitoring required for completions of capital projects on the Sheet Harbour Hydro System and Sloane Lake in 2020. The original Letter of Credit must also be presented at the time for endorsement of the claim paid and will be returned to you.

It is understood and agreed that the obligation of the undersigned under this Credit is an obligation to pay money only and that in no circumstances shall the undersigned be obliged to perform or cause to perform any of our Customer's actual obligations to you.

Conditions:

- The sum total of this Credit shall be reduced from time to time as advised by written notice given to this office from time to time by you.

- The Credit will continue until March 17, 2021 and will expire at our above mentioned office address at the close of banking business on that date.

- This Credit is irrevocable until that date.

- This Credit shall be deemed to be automatically extended for one year from the present or any future expiration date hereof, unless at least thirty (30) days before any such date we give you written notice that we elect not to consider this Credit renewed for any such additional period. Upon receipt by you of such notice, you may draw upon, accompanied by written certification, the amount to be retained and used by you to meet obligations incurred or to be incurred in connection with the Authorization.

However, our Credit will not be extended beyond December 31, 2025 (the 'Final Expiry Date').

- Partial drawings on this Credit are permitted in which case the letter of Credit will be reduced by the draw amount.

- Upon successful completion of Nova Scotia Power Incorporated responsibilities under the offsetting and monitoring conditions of the Authorization, as determined by Fisheries and Oceans Canada, the original Letter of Credit shall be returned to the Bank of Nova Scotia, Montreal Trade Service Centre, 1800 McGill College, 10th floor, Montreal, Quebec H3A 3K9 for cancellation.

- This Standby Letter of Credit will be effective on March 17, 2020.

- This Standby Letter of Credit is subject to the International Chamber of Commerce (ICC) Uniform Customs and Practices for Documentary Credits, 2007 Revision, ICC Publication No. 600.

Regards,

The Bank of Nova Scotia

FERNANDO MARTINEZ

Authorised Signature(s)

ORIGINAL

Fisheries and Oceans Canada | Pêches et Océans Canada

Bedford Institute of Oceanography
1 Challenger Drive
P.O. Box 1006, Station P500
Dartmouth, Nova Scotia, B2Y 4A2

August 4, 2020

Our file *Notre référence*
19-HMAR-00549

Nova Scotia Power
Attention: Nadine Thomas
Environmental Scientist
PO Box 910
Halifax, NS B3J 2W5

Subject: Sheet Harbour Ruth Falls Headpond Dam Refurbishment – Additional information is required for the review of your request.

Dear Ms. Thomas:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) would like to acknowledge the receipt of your application for authorization under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* which was received on June 24, 2020. We understand that you propose to:

- Refurbish the dam located at Ruth Falls within the NSPI East River – Sheet Harbour Hydroelectric System, Halifax County, Nova Scotia. Work includes drawdown of the headpond by 15ft, replacement of 30 stop log bays, installing a uncontrolled spillway, refacing concrete on the dam and spillways, and replacing the deep stop logs with a vertical lift gate. The work is anticipated to take 7 months starting in May 2021, during this time the fish ladder will not be functional, minimum operating levels will not be maintained and supplemental flows will not be provided. Operating water levels at Marshall Falls, upstream of Ruth Falls will be impacted by the activity.

Our review considered the following information:

- Fisheries and Oceans Canada Request for review and attached information received via email from NSPI December 2, 2019.
- Nova Scotia Environment Application for Approval and supporting documentation received December 27, 2019
- Correspondence regarding additional information requested, received via email from NSPI on February 27, 2020.

- Fisheries Act Authorization application and supporting documents received via email from NSPI on June 24, 2020.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*; and
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*.

The aforementioned outcomes are prohibited unless authorized under their respective legislation and regulations.

Upon reviewing your application, the Program determined that some of the information and documentation set out in the *Authorizations Concerning Fish and Fish Habitat Protection Regulations* (the Regulations) has not been provided and as such, the application is incomplete or inadequate.

The following information and documentation is required in order for the application to be complete:

- Drawdown of Ruth Falls Headpond
    - As a part of the project, NSPI is planning on lowering the Ruth Falls Headpond up to 15ft, with a goal to drawdown the reservoir prior to fish spawning in order to allow fish to spawn in the smaller body of water and potentially exposing eggs of fish that may have already spawned. Is there available spawning habitat once the reservoir is reduced as this could likely be the only spawning habitat (if there is no access to deeper pools or stillwaters upstream) in particular for Gaspereau as there is no fish passage above Ruth Falls?.
    - What contingencies are in place to prevent stranding or predation during and after the drawdown?
    - Bathymetry data was provided for the Ruth Falls Headpond. The headpond is fairly narrow and long in shape, with deeper pools occurring throughout the watercourse. With a drawdown anticipated of 15ft, will fish be able to successfully move between pools or to any stillwaters upstream?

- Offsetting Plan
    - We understand that NSPI would like to combine offsetting work for Sloane and Ruth Falls as they are within the same watershed. With both projects being delayed to 2021, sufficient time is available for NSPI to provide additional details related to planned offsetting. However, the offsetting for Ruth Falls may be more difficult to determine upfront until we have more project details and have a better understanding of the

residual impacts of the project associated with the temporary drawdown of the reservoir.
    - An additional letter of credit is likely required for Ruth Falls as the existing letter of credit may not be sufficient to cover offsetting for Ruth Falls and Sloane Reservoir.

- Marshall Falls Impacts
    - NSPI is requesting flexibility on the 191.4' elevation requirements of the NSE Operating Approval while remaining within normal operating levels. Provide a summary of normal operating levels, including minimum and maximum water levels during the proposed construction period.

- Construction Site Access:
    - Any downstream site access may constitute a HADD under the *Fisheries Act*, as such, additional information is required to adequately assess the potential for impacts on fish and fish habitat.
    - We understand that the details are to be determined in the future by the contractor. However, in order to adequately assess potential impacts, details regarding footprint, flow of water through the work site, material selection, and erosion and sedimentation, additional information should be provided.

Upon receipt of this outstanding information and documentation, the Program will notify you to confirm receipt. The Program will notify you as to whether the application is complete within a period of 60 days after receiving this outstanding information and documentation.

If you have any questions with the content of this letter, please contact Lynsey Crowell at our Dartmouth office at (902) 220-5976 or by email at Lynsey.crowell@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Stacey Nurse

Stacey Nurse
Senior, Regulatory Review Biologist
Fish and Fish Habitat Protection Program

cc. Grant Brown, Nova Scotia Environment

Ruth Falls Dam Refurbishment Project

Fisheries Act Authorisation Application
Supporting Information #1

May 2021

Ruth Falls Dam Refurbishment
S 35(2)(b) Fisheries Act Authorization
Supporting Information #1
Monitoring Activities

Nova Scotia POWER An Emera Company

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1.0 Introduction

This Addendum is to outline NS Power's proposed monitoring activities and additional avoidance and mitigation measures for the Ruth Falls Dam Refurbishment Project (the Project) as well as to address DFO's letter requesting additional information to support NS Power's application for authorization for the Project (DFO file 19-HMAR-00549). The following information is included:

i. Proposed water management plan (revised) and construction sequencing plan for the Project.

ii. Proposed monitoring activities for upstream gaspereau and Atlantic salmon migration during 2021.

iii. Proposed monitoring activities associated with the drawdown of Ruth Falls Headpond including post-construction monitoring.

iv. Proposed monitoring of construction activities in 2021.

The following construction activities are proposed for the Project:

i. Lowering of Ruth Falls Headpond from full supply level (FSL) of elevation 109.4 ft (33.3 m) to elevation 98.0 ft (29.9 m). The majority of the drawdown will take place through the deep stoplog bays on the existing dam. Refer to Section 3.1 for more information on the drawdown methodology.

ii. During the lowering of Ruth Falls Headpond, the Ruth Falls fish ladder will be non-operational. NS Power is proposing to delay the drawdown until early July, after the upstream alewife migration and the majority of fish spawning windows. The Ruth Falls fish ladder will be dewatered and a fish rescue conducted to move any stranded fish to the headpond. A fish rescue will also be conducted in Ruth Falls Headpond throughout the duration of the drawdown to monitor for stranded fish.

iii. Installation of two temporary cofferdams/access paths on the upstream side of the existing dam, once the headpond is dewatered. The cofferdams/access paths will be constructed on either side of the deep stoplog/sluiceway bays and will not block the deep sluiceway bays. This will consist of clean rockfill material.

iv. Installation of a temporary access path on the downstream side of the existing dam, across the existing spillway channel. The majority of the access path will be on dry land connecting from the existing site access road; a portion of the access path will cross over the existing spillway channel in order to access the west side of the dam.

v. A section of existing concrete dam will be notched out to construct a downstream bypass for water management. Refer to Section 3.3 for more information. The bypass will be used to provide

the required 35 cfs maintenance flow, as well as to maintain water flow through the dam to maintain construction elevations.

vi. Placement of sandbags on the upstream and downstream sides of the bypass to divert water, as required.

vii. Removal of existing stoplogs, piers and walkway; the deep stoplog bays will be a focus during the summer months to allow for the new vertical lift gates to be operational during fall inflows.

viii. Installation of stoplogs/other metal sheeting in existing deep stoplog bays will be undertaken to isolate the existing sluiceway section.

ix. Refurbishment of the existing sluiceway to accommodate three low level sluice gates. Existing sluiceway piers will remain in place.

x. Installation of low level sluice gates and associated operators.

xi. Reface existing concrete on the crest and downstream slope of the main dam ogee sections.

xii. Installation of new rubber dam bladders on the crest of the existing ogee spillway sections.

xiii. Construction of a free overflow spillway section at the west end (right looking downstream) of the main dam.

xiv. Replacement of the west retaining wall, to the west of the free overflow spillway section.

xv. Removal of temporary cofferdam/access path material.

xvi. Watering of Ruth Falls Headpond to normal operating levels.

NS Power has considered the potential environmental and archaeological risks associated with the lowering of Ruth Falls Headpond and believes that with implementing the mitigation measures discussed in the following sections of this application, the proposed approach is the safest for its employees and contractors. NS Power has evaluated whether the use of bulkheads, barges, work platforms or larger cofferdams would be an appropriate alternative, and has determined that these scenarios present significant safety risk, potential quality issues and scheduling risks to the Project should the methodologies not be sufficient in providing safe access to work areas. NS Power considers the lowering of Ruth Falls Heapdond to be the safest and most efficient solution to undertake the Project.

The 95% engineering drawings can be found in Appendix A. Refer to Appendix B for a diagram showing the location of the water management control structures proposed for the Project.

1.1 PROJECT SCHEDULE

The Project is planned to start in May/June with the construction of the on-land portion of the downstream access path, the construction of the laydown area, and the stockpiling of clean rockfill

material for use in the cofferdams/access paths. No instream work, or construction activities on the Ruth Falls Main Dam proper will take place until all required approvals are in place.

Following receipt of required approvals, the Ruth Falls Headpond will then be drawn down in early July 2021. Following the drawdown, the remaining portion of the temporary downstream access path and upstream cofferdams/access path will be constructed.

Following the construction of the temporary access paths, work will begin on the existing main dam and sluiceway structure with demolition of the deck and piers beginning form the east side of the dam. Chipping of the existing spillway surface will also be part of the demolition phase as well as the removal of the downstream retaining wall at the right abutment.

Concurrently during the demolition activities, the construction work will begin with the installation of the vertical lift gates. The three-low level stoplog sections will be isolated using stoplogs placed in the most upstream stoplog gains. If stoplogs are not available for use, reinforced steel sheeting may be used to block the flow of water. When the reservoir is at 98 ft, there will be approximately 8 ft of water on the upstream side of the deep stoplog bays to hold back. The existing stoplog slots will be chipped and prepped for the installation of the gate frames. Once the gate frames are placed and the headwalls are constructed, the gate frames are grouted into place. The operators and supports will be installed on the sluiceway deck.

NS Power will endeavor to complete the refurbishment of the new sluiceway structure during the summer months (prior to October 31) to allow for the operation of the new vertical lift gates as the primary water management strategy for the fall/winter months. In practice, work on the main dam and sluiceway will be taking place in parallel.

Following the demolition activities, the spillway overlay will begin with the installation of the rebar, embedded parts, and rubber dam air lines. Concrete will be placed to reform the spillway surface. New concrete piers will be constructed, and the sluiceway deck will be extended in the downstream direction and raised to accommodate the new rubber dam controls building. The controls building will be constructed off site and will be placed on the deck with a crane at the appropriate time.

A free overflow concrete spillway section will be constructed at the right end of the dam. Once the concrete spillway surfaces and piers are complete, the installation of the seven (7) rubber bladders will begin. The rubber bladders are bolted in place with clamping plates attached to the embedded parts and the bladders are attached to the air lines. The rubber dam controls will be installed in the controls building.

Work is proposed to extend until March 25, 2022 to accommodate shorter days, potential weather-related delays, and slower concrete curing during the winter months. NS Power will ensure Ruth Falls

Heapdond is raised to its normal operating level prior to the 2022 upstream alewife migration (April 1). A total construction period of 8-9 months is anticipated.

2.0 Description of Effects on Fish and Fish Habitat

The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates. The Project will include a new footprint of approximately 60 m^2 below the main dam. The reservoir will also be temporarily drawn down below the minimum operating level of 33.3 m (109.4') required from April 1 – November 30 each year. The desired construction elevation is 29.9 m (98.0'); this would temporarily return Ruth Falls Headpond to approximate natural conditions of the East and Grant Rivers.

The following water management strategies related to the Project have the potential to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction of fish habitat:

- The temporary drawdown of Ruth Falls Headpond, which could result in the temporary disruption of up to approximately 0.09 km^2 of littoral zone habitat that fish species use for a portion of their life cycle (see Appendix C Bathymetry);
- The installation of cofferdams and access for machinery on both the upstream and downstream sides of the dam, resulting in a temporary instream footprint. The total estimated temporary instream footprint for control measures is 2,316 $m^{2.}$

All Project activities with the potential to impact fish and fish habitat have been identified and discussed in Table 1.

Table 1: Summary of potential effects on fish and fish habitat due to refurbishment of the Ruth Falls Main Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect

Temporary loss of fish habitat due to lowering headpond beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.3 km^2 in Ruth Falls Headpond	High	Low
Temporary loss of fish habitat due to temporary installation of access road/crossings and cofferdams.	Localized: area immediately above and below the dam	High	Low
Permanent loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly below the dam	High	Low
Fish mortality due to stranding when lowering headpond.	Localized: Ruth Falls Headpond	Medium	Low
Potential downstream scour during drawdown of headpond.	Localized: East River of Sheet Harbour	Low	Low
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low

3.0 Proposed Avoidance and Mitigation Measures and Standards

3.1 DRAWDOWN SCHEDULE

NS Power intends to approach the drawdown of Ruth Falls Headpond the same way as all previous drawdowns conducted on its various hydro systems. Based on operational experience, the drawdown of Ruth Falls to elevation 98.0 ft is anticipated to take 1-2 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized.

The Ruth Falls generating units will be used to initially lower the headpond elevation to 109.4 ft, after which the drawdown will be completed using the Ruth Falls main dam stoplog bays. This is to prevent fish from passing downstream through the generating units once the bypass in the canal becomes non-operational (it is unknown at what elevation the bypass becomes less optimal/non-operational). The drawdown will continue by removing the top 2-3 stoplogs from several of the stoplog bays to achieve a

discharge through the dam that is equivalent to generation at one of the Ruth Falls units (approximately 500 cfs) following NS Power's spill calculations. Depending on the length of time the headpond takes to lower to the next level of stoplogs, NS Power may increase the number of stoplogs pulled to achieve a discharge equivalent to both Ruth Falls generating units (1,000 cfs). If the drawdown is proceeding as scheduled with a discharge of 500 cfs, NS Power will continue to draw down following this method. The drawdown will continue in this manner until the desired elevation of 98.0 ft is reached. Thus, discharge into the spillway will not exceed 1,000 cfs at any given time (with the exception of some minor leakage through the other bays of the main dam).

NS Power is not anticipating any additional impacts with respect to erosion/scour and sedimentation during the drawdown. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NS Environment and Climate Change (ECC), and make necessary repairs in order to stabilize the area.

A spill in excess of 500 cfs is an extremely common occurrence at the Ruth Falls dam (equivalent of one generating unit). This is because the elevation of Ruth Falls Headpond is kept at a minimum of 109.4 ft for the majority of the year (April-November) for optimal operation of the fish ladder and louvers and there is negligible storage capacity in Ruth Falls Headpond. Hydro Operations has confirmed that spill in excess of 500 cfs is very common, and a spill in excess of 1,000 cfs (equivalent to both generating units running) is common with 6-12 occurrences annually.

Given the anticipated discharge through the dam, very short duration and methodical approach NS Power is proposing for the drawdown, NS Power is not anticipating any risk of entrainment of juvenile fish species present in Ruth Falls Headpond and therefore is not proposing entrainment monitoring for this Project. The headpond will be monitored throughout the drawdown for fish entrapment, see Section 4.2.

3.2 FISH PASSAGE

To reduce the potential significant risk of impact to fish and fish habitat, NS Power has revised the construction schedule to avoid lowering water levels, thus maintaining operation of the Ruth Falls fish ladder during critical migration and spawning windows. By delaying the drawdown until after July 1st , access to and use of all accessible habitat upstream of Ruth Falls Dam remains available to migrating species, such as gaspereau for spawning, hatching, and subsequent growth until juveniles become mobile.

In order to provide ongoing upstream passage for Atlantic salmon after Ruth Falls Headpond is dewatered, a fish conveyance system, owned and operated by NS Power staff, will be used to provide access for salmon to continue to migrate. Qualified staff from the Supplier will install the mobile system, will conduct initial monitoring to ensure the system is functioning properly, and will provide training to NS Power

personnel. The system will be monitored closely throughout construction to ensure proper functioning and safe transfer of fish. This type of system has been successfully used by the Halifax Regional Municipality. Using NS Power's proposed water management and construction sequencing (refer to Section 3.3), water will be continuously bypassed downstream of the Ruth Falls dam throughout construction; at minimum NS Power is committed to providing the required 35 cfs downstream maintenance flow required until November 1st in accordance with the Sheet Harbour Hydro System Water Approval, however it is likely that the amount of discharge will exceed 35 cfs throughout the entirety of construction (Section 3.3). NS Power's proposed water management methodology will allow for continuous downstream discharge to substitute for NS Power's supplementary flow release requirements in accordance with the Water Approval. NS Power will seek a variance with ECC to ensure that modifications to supplementary flow releases are communicated and approved appropriately.

In order to transfer salmon upstream into Ruth Falls Headpond, the conveyance system will be positioned with the piping entrance located below the proposed temporary access road (refer to Section 3.3 for information on the access road), where the downstream flows will be concentrated; NS Power will assess site conditions prior to the installation of the conveyance system piping to field fit the system to best attract fish to the piping. NS Power will work with the system supplier to ensure the appropriate attraction flows and vacuum settings are being applied for migrating Atlantic salmon. The conveyance system will be continuously monitored, although the system is equipped with automated controls, to ensure it is functioning properly throughout the salmon migration season. NS Power is committed to the operation of the system from the start of construction until the end of November, 2021.

Atlantic salmon returns to the East River continue to remain extremely low. In 2020 throughout NS Power's operation of the salmon trap located in the Ruth Falls fishladder, one salmon was captured and released to the Ruth Falls Headpond on July 31st, 2020. NS Power provided 15 supplementary flow release events throughout the months of June, July, September, October and November 2020. Thus, NS Power is anticipating low returns to continue in 2021.

NS Power is also committed to maintaining downstream fish passage. Throughout construction, water will be continuously passed downstream either through the constructed bypass or deep stoplog bays. This will also allow NS Power to provide the required ecological maintenance flows in accordance with the Sheet Harbour Hydro System Water Approval.

While there is no fish passage above the Ruth Falls Headpond on the Sheet Harbour Hydro System, NS Power understands that salmonid habitat is available on the Grant River Watershed, the confluence of which is located within the Ruth Falls Headpond. NS Power anticipates that at a construction elevation of 98.0', fish passage will be maintained into the Grant River. Through previous assessment of pre-inundation conditions of the East and Grant Rivers, in particular through review of historical mapping and aerial imagery during the Project archaeological assessment, there was historically fish passage from the East River into the Grant River prior to the construction of the Ruth Falls Dam. Natural river conditions are

evident when examining NS Power bathymetry of the Ruth Falls Headpond completed in 2010 (Appendix C). During the drawdown, NS Power will assess the headpond at the Grant River/East River confluence in particular, to determine whether any barriers to passage into Grant River are being observed; in the unlikely event that barriers are preventing passage, NS Power will notify DFO as well as ECC to discuss temporary measures if required.

3.3 WATER MANAGEMENT AND CONTROL

Once the desired construction elevation of 98.0 ft is reached, work will begin on the temporary upstream cofferdam/access paths. There will be two cofferdams installed on the upstream side of the dam placed on either side of the low level stop log bays: one extending from the left dam abutment to the left end of the low level stop log bays and one extending from the right dam abutment and tieing into the right side of the low level stop log bays. The cofferdams will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and a slope of 1.5H:1V using clean rock material that is free of fines, geotextile fabric and a poly liner on the upstream side. The right upstream cofferdam will be 343 ft (104.5 m) long while the left upstream cofferdam will be 209 ft (64 m) long. The estimated temporary instream footprint of the right cofferdam is 694 m^2 while the left cofferdam is 535 m^2. See Appendix B for the location of the cofferdams. Using available bathymetry, approximately 74% of the upstream cofferdam/access path will be placed in the dry at an elevation of 98.0 ft. It is expected that elevations in Ruth Headpond will fluctuate throughout construction due to inflows from Malay Falls as well as uncontrolled inflows from Grant River watershed. The use of these cofferdams will allow for Ruth Falls Headpond to rise to elevation 100.0 ft before additional water control measures are required, see Section 3.4 for a discussion on contingency planning should the elevation exceed 100.0 ft.

NS Power will complete monitoring and a fish rescue, if required, for any fish that may become stranded between the cofferdams and existing dam. NS Power anticipates this risk to be extremely low as the majority of cofferdams will be placed in the dry.

It is expected that at minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, as well as required maintenance flows and spill over the rubber dams (when required) from Malay Falls would be managed through the construction site. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power lead engineer and Hydro System Superintendent.

To maintain water passage through the main dam during construction, a bypass will be installed approximately 65 ft from the west end of the deep stoplog bays, see Appendix B. The bypass is intended to provide water passage during Phase I when the sluiceway is under construction. The bypass will be created by removing a section of concrete from the dam approximately 10 ft wide and down to elevation

96.0 ft (29.3 m). The right upstream cofferdams will be installed to accommodate the bypass. The estimated maximum discharge flows through the bypass, assuming a 10 ft wide opening and a 0.1% slope is shown in Table 2:

Table 2: Estimated Discharge Flows by Bypass

Reservoir Elevation (ft)	Discharge (cfs)
98	620
100	1,460

Expected flows through the bypass are expected to be much lower during construction, see Section 3.4 for contingency planning for higher inflows. Following the drawdown of Ruth Falls Headpond, the remaining section of the downstream access for the site will be completed. To cross the existing spillway channel, clean rock material that is free of fines will be placed across the spillway to construct a road 12 ft (3.6 m) wide at 1H:1V slope. Geotextile and an upstream poly liner will also be used. The road will be approximately 536 ft (163 m) in length and will extend from the existing access road by the canal to the right side of the dam. The estimated temporary instream footprint for downstream access is 1087 m^2. Two (2) 5 ft diameter HDPE culverts will be placed in the main flow of the channel to accommodate discharge through the bypass. Sandbags may be used to divert flows to the culverts, as necessary when the bypass is in use. NS Power acknowledges that the bypass alone will be insufficient to pass larger inflows should a larger return period event occur, see Section 3.4 Contingency Planning.

Phase II of the water management strategy has been developed for periods of expected higher inflows. Once the sluiceway gates are installed and operational, water management will switch to the use of the gates as the primary method of passing water. The estimated discharge flows from the new vertical lift gates are found in Table 3. Gates will be adjusted in the field based on the inflows and discharge requirements. Based on a typical 1:20-year return period flood for a construction season, with a peak flow of 11,946 cfs (modelling is based on the headpond at full supply level) and the gates operational, the reservoir could be maintained at approximately El. 100 ft with all three gates fully open (Table 3).

Table 3 : Estimated Discharge Flow from New Vertical Lift Gates (estimated based on full open position).

Reservoir El.	98 ft	100 ft	102 ft	104 ft
Outer Gate 1	1,544 cfs	2,874 cfs	4,453 cfs	6,246 cfs
Outer Gate 2	1,544 cfs	2,874 cfs	4,453 cfs	6,246 cfs

Middle Gate	4,453 cfs	6,246 cfs	8,232 cfs	10,392 cfs
Totals	7,541 cfs	11,994 cfs	17,138 cfs	22,884 cfs

Appendix B provides a drawing of the proposed water control structures for construction.

3.4 CONTINGENCY PLANNING

Table 4 demonstrates the statistical flood peaks for the Ruth Falls Main Dam, from the 2008 Sheet Harbour Hydro System Flood Study.

Table 4: Instantaneous Flood Peaks for the East River

Return period (years)	Instantaneous Flow Peaks (cfs)
2	5,850
5	8,340
10	10,130
20	11,940
50	14,430
100	16,420
1000	24,220

The instantaneous flood peaks outlined in Table 4 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

The primary means of water management for the Project is the lowering of Ruth Falls Headpond to elevation 98.0 ft. For phase I of the water management strategy, temporary upstream cofferdams have been designed to withstand a rise to elevation 100 ft; however, it is unknown how much instantaneous inflow would result in a rise in elevation from 98.0 ft to over 100 ft as there is no storage curve for Ruth Falls Headpond (due to lack of storage). It is possible, given that Ruth Falls Headpond is relatively small with no storage, that this could occur for a 1:2-year return period event. Should unexpected inflows be received during Phase I of water management execution, NS Power will implement contingencies to safely pass water. This may include the addition of sandbags on the upstream crest of the cofferdams to accommodate increased water levels, or the use of one or more of the existing deep stoplog sluiceway bays to pass additional water. If extreme heavy rain or significant sustained inflows are forecasted, NS Power will develop a plan to accommodate the expected increased inflows and make adjustments to construction, if needed, to allow for the use of the stoplog bays. This may involve removing stoplogs/steel sheeting and prepping the gate check to safety pass water. Since the existing structure is being modified, rather than a new structure constructed, NS Power can revert to the use of stoplog bays, if necessary

(existing stoplog bays are of similar dimension and discharge capacity as the new vertical lift gates), with minimal planning time.

For Phase II of water management execution, the new vertical lift gates will be used to pass water and have been designed to withstand a 1,000 year return period event. As outlined in Section 4.2, the new gates can sustain a rise in elevation to 100 ft for a 1:20 return period event; should more significant sustained inflows or a higher return period flood event be forecasted, NS Power will develop a plan for additional contingency, which may involve removal of any sandbags and armouring of the upstream cofferdam/access path to accommodate a breach. Upstream cofferdams will consist of only clean rockfill material; if in the event some migration of material is observed the associated risk of sedimentation is extremely low. NS Power will assess for any cofferdam material migration once water levels have receded.

If during Phase I or II of water management execution, significant discharge is anticipated downstream of the dam, NS Power may make adjustments to the downstream temporary access road to accommodate the additional flows. This may involve the removal of access road material and prepping sections of the access road to allow water to pass safely beyond it. The downstream cofferdams consist of only clean rockfill material; if in the event some migration of material is observed, the associated risk of sedimentation is extremely low. NS Power will assess for any cofferdam material migration once water levels have receded. Since Ruth Falls Headpond will be drawn down to 98.0 ft, NS Power has the ability to attenuate water in order to implement contingency measures, if necessary.

NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

3.5 EROSION AND SEDIMENTATION CONTROL

NS Power is anticipating minimal impacts to the surrounding environment with respect to erosion, scour and associated sedimentation of watercourses. The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined above.

There will be some excavation of the west abutment retaining wall that is scheduled for removal and replacement (refer to Appendix A for engineering drawings showing the west retaining wall). During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be

small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry and any silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the Ruth Falls Dam and the other is located north east of the dam (Figure 1). Both of these areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both of these areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.



Figure 1: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2021.

Silt fencing will also be used adjacent to the portion of the downstream access path that is on dry land, to capture any sediment and prevent it from entering the spillway channel. As no excavation for the temporary access path is required, and material will be rock that is free of fines, NS Power is not anticipating a high risk of sediment transport as a result of construction, use and removal of the road. Any use of silt fencing will be monitored periodically for sediment build up and will be cleaned, as necessary.

All cofferdam material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

NS Power will evaluate the use of silt curtains downstream during the construction of the downstream access path – silt curtains are applicable for still or very slow moving water, but can assist in providing areas where any silt-laden water can be pumped out using negative pressure.

The removal of cofferdam material will take place with Ruth Falls Headpond at elevation 98 ft, which will allow for visual observation of the majority of material being removed. The filling of Ruth Falls Headpond will be completed using a combination of natural inflows, inflows from Malay Falls, and if there is insufficient inflow, some generation using Malay Generating Station. As such, the headpond is expected to fill slowly in a controlled manner; NS Power will be on site to monitor for any potential sedimentation as a result of re-watering activities.

The chosen contractor to complete refurbishment activities will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of any water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1 – September 30) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of cofferdam sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power also requires the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This allows for NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

4.0 2021 Drawdown Monitoring Activities

4.1 BACKGROUND

NS Power completes fish and fish habitat surveys as part of the Hydro Relicensing Program, which takes place on a 10-year cycle as part of the renewal of Hydro System Water Storage Approvals. The relicensing fish data collection is qualitative in nature; however, NS Power has two datasets for the Sheet Harbour Hydro System collected 10 years apart and some trends and observations can be drawn from that data. A list of commonly found fish species in the Sheet Harbour watershed is provided in Table 5, along with an indication of their presence during the previous relicensing.

Table 5: Fish species present in the Sheet Harbour watershed.

Common Name	Scientific Name	NSPI 2007	NSPI 2017
Alewife	*Alosa pseudoharengus*		Confirmed
American eel	*Anguilla rostrata*	Confirmed	Confirmed
Banded killifish	*Fundulus diaphanous*	Confirmed	Confirmed
Blacknose dace	*Rhinichthys atratulus*	Confirmed	
Brown bullhead	*Ictalurus nebulosus*	Confirmed	Confirmed
Common shiner	*Luxilus cornutus*	Confirmed	Confirmed
Golden shiner	*Notemigonus crysoleucas*	Confirmed	Confirmed
Lake chub	*Couesius plumbeus*	Confirmed	Confirmed
Pearl dace	*Margariscus margarita*	Confirmed	
Speckled trout	*Salvelinus fontinalis*	Confirmed	Confirmed
Stickleback	*Pungitius*	Confirmed	Confirmed
White perch	*Morone americana*	Confirmed	Confirmed
White sucker	*Catastomus commersoni*	Confirmed	Confirmed
Yellow perch	*Perca flavescens*	Confirmed	Confirmed
Atlantic salmon*	*Salmo salar*		

* Atlantic salmon were not observed during 2007 and 2017 sampling, however, small returns of Atlantic salmon have been observed in the salmon trap operated at Ruth Falls.

4.2 FISH RESCUE

As outlined in Section 3.1, NS Power anticipates the drawdown of Ruth Falls Headpond to elevation 98.0' to take approximately 1-2 days. Fish rescue efforts will start at the same time as the drawdown. NS Power has extensive experience completing fish rescues on various hydro systems and handling and transferring fish to support past hydro projects and initiatives. NS Power will conduct the fish rescue using a team of two, led by an experienced field biologist, during daylight hours for the duration of the drawdown. The rescue team will be equipped with a boat, backpack electrofishing units, lip seines, dip nets and beach seines. The team may need to travel on foot to certain areas that are not accessible by boat. A fish rescue of the Ruth Falls fish ladder and power canal will also be conducted once the elevation is low enough to expose the canal bed, however given the drawdown will be occurring through the lower level stoplog bays

and the louvers present in the canal are very effective in preventing fish from entering the canal, it is anticipated that there will be little to no fish in the canal to transfer.

Capture method will be determined on a per site basis, depending on water, sediment, and weather conditions. Fish will either be immobilized using electrofishing and transferred to buckets using the dip nets, then moved as quickly as possible to the main reservoir with the minimal amount of handling as possible, or herded toward the main reservoir using seining when electrofishing is not possible. Species of conservation concern, namely Atlantic salmon, alewife, American eel and speckled trout will be given special attention, with the goal of transferring these fish as quickly as possible to the main reservoir. Fish will be handled as little as possible during the rescue process. Fish rescue efforts will be maintained until the level of the reservoir has reached its minimum. Shoreline observations will also identify any stranded fish which will be identified and counted.

Fish rescued will be identified to the species level, counted individually for larger species or estimated for smaller species, and any instances of mortalities will be recorded. In the interest of time, no morphometric information will be recorded. The data recorded during the fish rescue will be used to estimate the fish mortality caused by the drawdown.

Based on a long experience of conducting fish rescues across all hydro systems, NS Power estimates that approximately 10% of the number of fish/life stages greater than 10 cm and 20% of the fish/life stages smaller than 10 cm, are not successfully rescued. Acknowledging that not all stranding areas will be identified during the fish rescue, NS Power proposes to double these values and estimate total mortality resulting from the drawdown as follows:

$$=Total\ Fish\ Mortality = Sum\ (observed\ mortality\ for\ each\ species) + 0.2 * (number\ of\ fish\ rescued > 10cm) + 0.4 * (number\ of\ fish\ rescued < 10cm)$$

NS Power is expecting there to be continuous ongoing sources of inflows into Ruth Falls Headpond (Section 3.3), therefore the risk of ongoing fish mortality as a result of stranding is low.

4.3 WATER QUALITY

Ruth Falls Headpond is a relatively small, shallow headpond with depths of up to 26.2 ft (8 m) in the deepest parts. Water quality of the headpond is heavily influenced by inflows from the Grant River Watershed as well as by the East River and its tributaries.

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system.

The water quality surveys completed for Ruth Falls Headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, Ruth Falls Headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for Ruth Falls Headpond, approximately 0.5 miles square (1.3 km^2) of total shoreline will be exposed as a result of a drawdown to 98.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.4 ft, with depths of less than 9.8 ft (3 m). At an elevation of 98.0 ft, Ruth Falls Headpond will look similar to pre-inundation conditions of the East and Grant Rivers (Appendix C). It is unknown how the drawdown of approximately 11 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed although inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

As such, NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to October for temperature, dissolved oxygen, total suspended solids and turbidity.

Monitoring sites for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth
- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

NS Power will use 23 degrees Celsius in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November.

In addition to monthly water quality sampling in accordance with the CCME water quality guidelines for aquatic life, NS Power will complete construction water quality monitoring downstream of the dam for

total suspended solids to ensure compliance to standard Approval conditions. This will involve establishing a background sample during normal and high inflow periods and comparison to weekly water sampling action downstream of the Ruth Falls Main Dam for TSS.

4.4 EGG/LARVAE STRANDING

NS Power proposes to use a worst-case scenario approach to estimate the impact of the drawdown on gaspereau eggs and larvae.

This estimate will rely on upstream migration counts at the Ruth Falls fishladder (to be conducted until July 1). NS Power will monitor upstream escapement at the Ruth Falls fish ladder using NS Power's video recording system; NS Power is intending to install a new system at the Ruth Falls ladder in mid-May 2021 in order to capture the upstream gaspereau migration and also capture other species of fish moving up or down the ladder. NS Power will estimate upstream escapement using the system footage and accepted protocols developed by DFO. Anecdotally and based on historical observation, the gaspereau upstream migration run is generally later than other NS Power hydro facilities due to the more northern location. This method of monitoring upstream escapement has been implemented at various hydro locations and has provided valuable data for fisheries management purposes. NS Power will continue to operate the camera system at the Ruth Falls fish ladder post-construction.

The following assumptions will be used as base for the calculation of an egg/larvae mortality estimate:

- The bulk of the gaspereau upstream migration on the Sheet Harbour watershed occurs between May and June of each year, when temperatures increase above 10°C. NS Power will assume a sex ratio of 50%/50%. Gaspereau typically spawn within a few days of reaching their spawning grounds.
- Gaspereau fecundity has been documented as ranging from 10,000s to 100,000s of eggs per female. A review of the available literature suggests that gaspereau freshwater mortality is generally very high (30%-60% or more). NS Power will assume that 60% of the fish survive to spawn and the average fecundity is 150,000 eggs per surviving female.
- Gaspereau eggs typically hatch in 3 to 8 days depending on water temperature and resorption of the yolk-sac lasts 2-5 days. NS Power will assume that all female gaspereau entering Ruth Falls on or after June 15th will have eggs/larvae at risk of being stranded during the drawdown.

Based on these assumptions, the mortality estimate for eggs and larvae will be calculated as follows:

$$Egg\ mortality = N * SR * SV * F$$

Where:

N= Number of fish counted on or after July 1st at the Ruth Falls ladder

SR= Sex Ratio (assumed to be 50%)

SV= Survival Rate (assumed to be 60%)

F= Fecundity (assumed to be 150,000)

Given these assumptions: $Egg\ mortality = N * 22{,}500$

This number will then be compared to the overall estimated number of gaspereau eggs produced in Ruth Falls Headpond (using the same assumptions) to assess the impact of the drawdown on egg/larvae survival.

Anecdotally and based on historical observations, upstream gaspereau escapement into Ruth Falls Headpond is generally low as there are challenges downstream in the East River that prevent large numbers of gaspereau from reaching the base of the dam. Thus, NS Power is anticipating the number of gaspereau moving upstream after June 15th to be extremely low.

4.5 LAKE HABITAT CHARACTERIZATION

4.5.1 Drone Surveys

NS Power will apply the following methodology to characterize the habitat in Ruth Falls Headpond during the drawdown.

A baseline drone survey, completed within 1 week of the drawdown will be conducted using a drone-mounted high-resolution camera. The focus of the baseline drone survey will be to identify and delineate areas where aquatic and emergent vegetation are observed. NS Power anticipates that these areas will coincide with areas where riparian wetland habitat is present. The imagery will be used to identify and delineate shoreline habitat types and will help in identifying the best locations for the establishment of monitoring transects. Following this, drone surveys will be conducted once a month starting in July 2021 and ending in November 2021 (to capture peak biomass timing windows). This time series will provide the basis for an assessment of the evolution of the shorelines of each lake during and after the drawdown. The first survey will be conducted 24hrs after the start of the drawdown to capture the shoreline in its original state.

GIS will be used to assess the amount of suitable habitat for fish species that is located on Ruth Falls Headpond and monitor change within this habitat over time. The focus of the habitat characterization will be in areas that are dewatered during the drawdown; suitable habitat will be assumed to be located within the littoral zone of the headpond, have little to no slope and demonstrate high diversity and/or density of emergent and aquatic vegetation. An estimate of the total area of change over time within the identified suitable habitat can be extracted from this exercise, which can be used to inform potential temporary HADD. NS Power would like to note that short term changes in observable features of the shoreline as a

result of the drawdown does not necessarily constitute permanent harm to the habitat and requests further engagement with DFO on how data collected with respect to changes in habitat characteristics will be used to inform offsetting requirements.

4.5.2 Monitoring Transects

Monitoring transects will also be completed once per month to supplement the drone surveys. One (1) monitoring transect will be selected on Ruth Falls Headpond. The position of the transect will not be located randomly but rather will be based on the analysis of the lake's shoreline drone surveys with the aim to monitor areas of greater ecological value (i.e. highest diversity). The location of the transects will be determined by analysis of the baseline drone survey.

The transect will be approximately 15 m wide and extend 15 m into the riparian zone from the bank edge, and 10 m into the littoral zone from the waterline, if safe to do so (Figure 2). The shore zone, if present, lies between the littoral and riparian zones, and may include a beach and/or a bank face. Where both are present these are separated by a break in slope. The transects will be delineated with high-visibility stakes to be visible from the drone camera. Detailed GIS data will be recorded at each site.

Observations for the entire plot will be made from a boat and on foot. The dimensions of the riparian and littoral zones are based on Rowan et al. (2006) and were selected to capture the composition and diversity of features to be assessed and correspond to the field of view of the surveyor from an offshore station (Figure 2). The shore zone (especially beach width) will likely be of variable dimensions depending on the water level at the time of the survey.

A baseline transect will be conducted within 1 week of the start of the drawdown at the transect location chosen through the baseline drone survey. Subsequently, each transect will be surveyed once per month starting in July 2021 and extending to November 2021 to capture peak biomass windows. The surveys will include the identification and quantification of sediment classes, vegetation types and coverage of each within a transect zone. Comparison between sequential assessments will provide the ability to quantify any changes in vegetation coverage and identify changes in habitat types over time. Changes observed within habitats where transects are located will be assumed to apply to all suitable habitat identified on the lake, based on drone surveys.

Data collected during the monitoring transects, in combination with the drone surveys will be used to determine any potential impact within the identified suitable habitat from the drawdown. NS Power would like to note that short term changes to vegetative types and coverage or sediments as a result of the drawdown does not necessarily constitute permanent harm to the habitat.

NS Power will also complete a literature review of available scientific publications to supplement the drone survey and monitoring transects to qualify observed changes in vegetation, soils and overall habitat loss, if any, and assist in quantifying the temporal extent of impact.

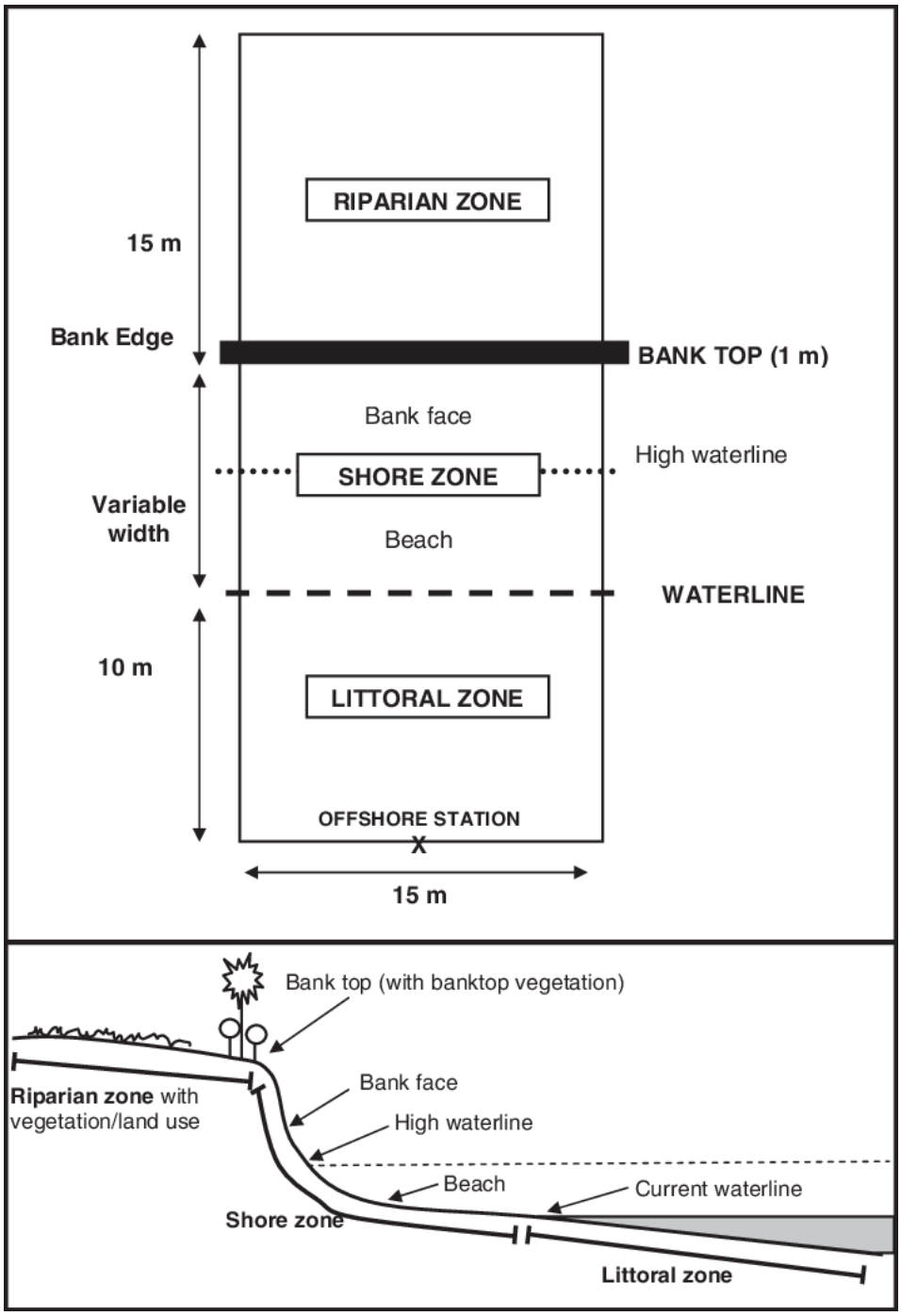


Figure 2: Plan view and schematic section of a Transect (from Rowan et al., 2006)

4.5.2.1 Sediment characterization

The sediment classes used for the identification of sediment types are described in Table 6. Percent coverage of each type of substrate will be determined within each zone, delineated, and documented with digital imagery.

Table 6: Classification of substrate types

Class	Size Range (mm)
Bedrock	Continuous rock
Boulder	>250
Rubble	130-250
Cobble	30-130
Gravel	2-30
Sand	0.06-2
Mud	0.06

4.5.2.2 Vegetation Characterization

Observations for the entire plot are made from an 'offshore station', either from a boat or while standing in the water (not exceeding the maximum wading depth of 0.75 m), to ensure consistency between boat- and foot-based versions. The dimensions of the riparian and littoral zones were selected to capture the composition and diversity of features to be assessed and corresponds to the field of view of the surveyor from the offshore station. The shore zone (especially beach width) is of variable dimension depending on the water level at the time when the survey is carried out.

Vegetation characterization will be conducted in each zone of the transect. Identification of plant species/assemblage and percent coverage will be determined. Each type of vegetation will be delineated and documented with digital imagery. Identification of rare and protected species will be documented. Based on observations conducted during previous drawdowns, the current knowledge of the watershed, and the transient nature of this project, the drawdown is not expected to cause significant harm to the shoreline of the lake.

4.5.3 Wetlands

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey (Figure 3). In cross referencing the mapped wetlands during the 2007 survey with the current

NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Main Dam was not identified during the 2007 survey (Figure 4). For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond. Table 7 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 7: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. In examining the ACCDC search completed in 2017 for the previous relicensing of the Sheet Harbour Hydro System, 4 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond (Figure 4). There are two records of Salted shell lichen (Coccocarpia palmicola) located in a wetland on the northwest portion of the headpond, which appears to be hydraulically connected by a small stream. Salted shell lichen is listed as secure within the NS General Status Rank. There are also two records of Ruby-crowned Kinglet (Regulus calendula) on the east side of the headpond along the Lochaber Mines Road. Ruby-crowned Kinglet is listed as Sensitive within the NS General Status Rank. Neither of these species are anticipated to be impacted by the drawdown of Ruth Falls Headpond.

Ruth Falls Dam Refurbishment
S 35(2)(b) Fisheries Act Authorization
Supporting Information #1
Monitoring Activities

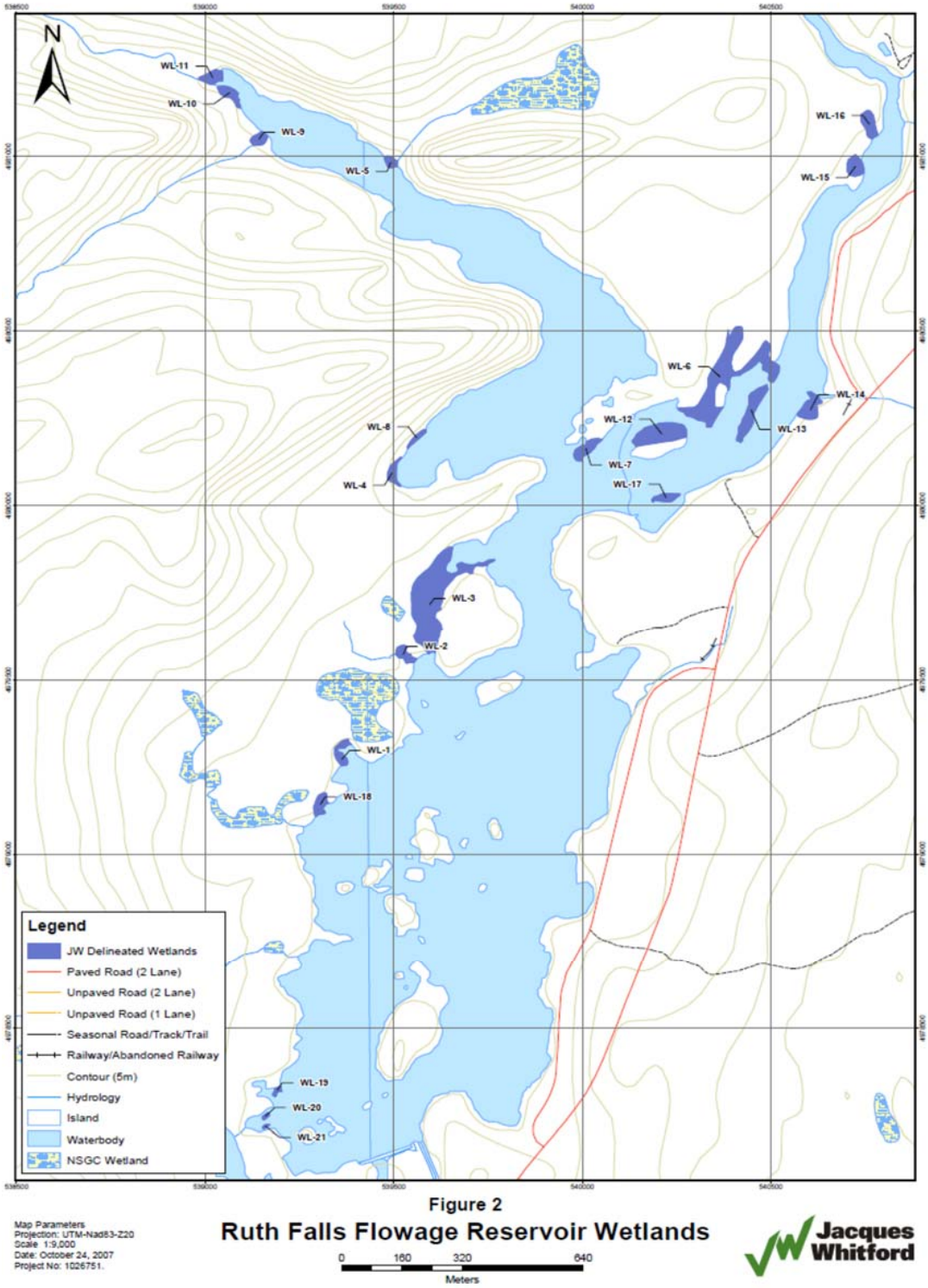


Figure 3: Mapped wetlands on Ruth Falls Headpond (2007).

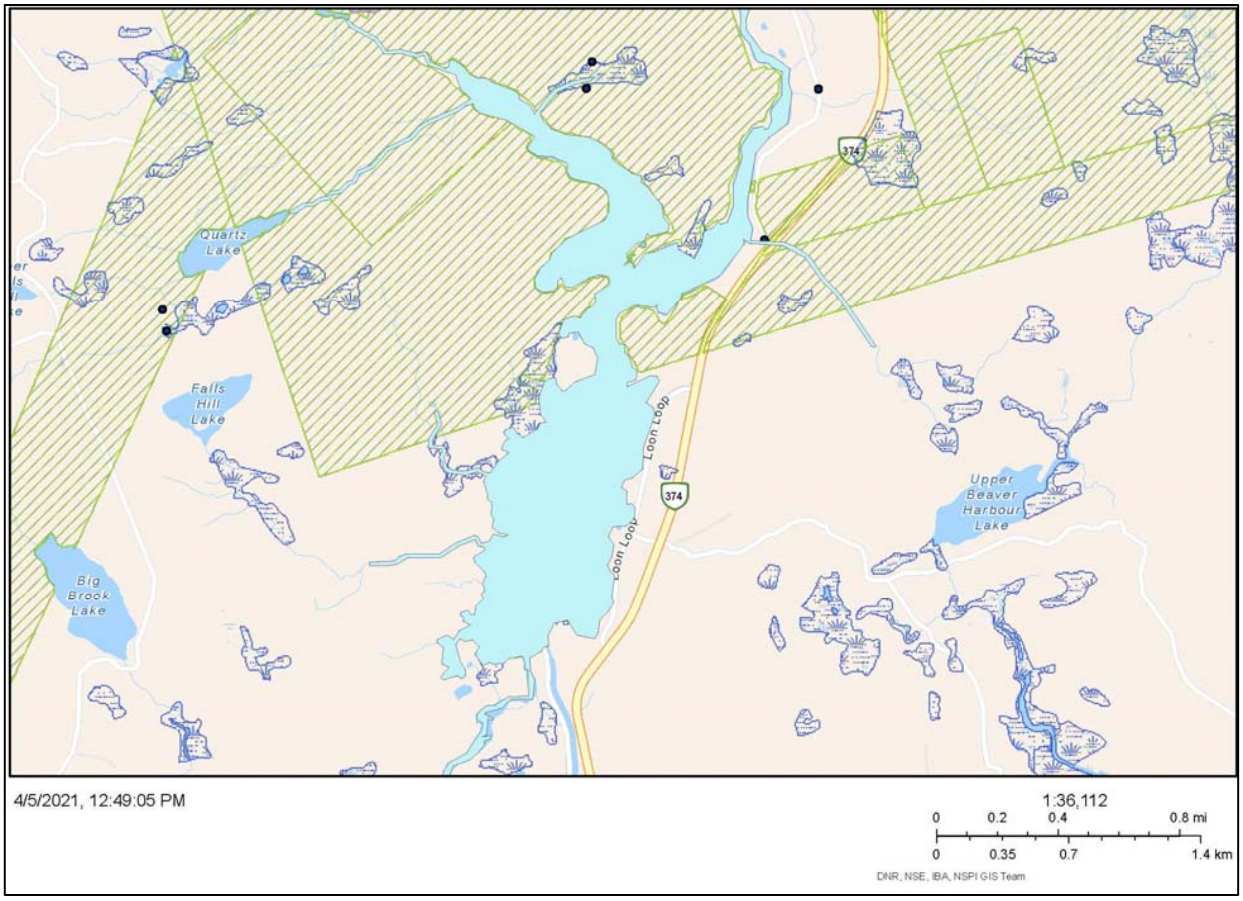


Figure 4: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of Ruth Falls for a 9 month period is unknown.

While no permanent long-term alterations to the wetlands on Ruth Falls Headpond are anticipated, NS Power proposes to contract a third party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels and water levels throughout the duration of the Project. NS Power has recently developed a wetland monitoring plan, working with a qualified consultant, for the Tusket Main Dam Refurbishment Project, which involves a similar drawdown of the headpond and potential impacts to a similar density of littoral zone wetlands; this plan was reviewed and approved by ECC, thus NS Power is proposing to use this plan as a basis for monitoring at Ruth Falls. This includes:

- An updated desktop assessment, using an updated ACCDC search and available provincial data to verify potential wetland locations identified in the 2007 survey.
- Establishing monitoring stations on a select sample of wetlands. For the Tusket monitoring plan, 8 representative wetlands were chosen to establish monitoring stations.
- Baseline assessment, including wetland edge mapping, vegetation data collection, baseline functional assessment and baseline hydrological monitoring prior to the drawdown.
- Construction monitoring, including vegetation and hydrological monitoring while the reservoir is drawndown
- Post-construction monitoring, at minimum, will include monitoring immediately after refilling of Ruth Falls Headpond and again the following year. The length of post-construction monitoring will be determined in consultation with the NSE Wetland Specialist and will include monitoring for vegetation and hydrological conditions. NS Power understands that a post-construction monitoring program is typically 5 years, with a repeated functional assessment in the last year of monitoring.

Data collected during the wetland monitoring program can be used to supplement and compare to the habitat surveys outlined in Section 4.5.2, and will assist in identifying and quantifying changes to wetland habitat, if any, associated with areas of higher abundance and diversity of aquatic and emergent vegetation which in turn is associated with higher value fish habitat. Please note, mapping of wetland reservoir edges and delineation of aquatic and emergent vegetation is not part of the scope of the wetland monitoring program. Areas of aquatic and emergent vegetation will be delineated and assessed through drone surveys and monitoring transects outlined above; however data collected during the wetland monitoring program can be used to support the surveys and confirm areas of higher value habitat.

4.5.4 Post-Construction Monitoring

As part of the wetland monitoring program, a post-construction monitoring program will be implemented for 5 years starting in 2022 once construction is completed and reservoir elevations return to normal operation. The purpose of the post-construction monitoring is to determine if any changes observed during construction monitoring are observed once the lakes have permanently returned to normal operating levels and result in a long-term impact to wetlands.

Upon completion of construction in 2022, NS Power will evaluate all data collected through wetland monitoring, drone habitat surveys and monitoring transects to develop an appropriate post-construction monitoring program that adequately addresses potential long term impacts to fish habitat. This may include an extension of the drone survey and monitoring transects post-construction, or inclusion of aquatic habitat assessments into the wetland monitoring program. The scope of the post-monitoring program will depend on the results of monitoring during the drawdown in 2021. A post-monitoring program will be finalized by May 30, 2022.

4.6 REPORTING

NS Power will provide a report on 2021 drawdown monitoring activities by June 30, 2022, detailing results of the fish rescue survey and mortality estimates, estimates for loss of egg/larval stage fish due to stranding, results and estimates for downstream entrainment and results of the habitat assessment. The report will also include a summary of water quality surveys conducted as mandated by ECC.

5.0 Construction Monitoring

NS Power requires that the main civil contractor (or general contractor) develop a site-specific water management and erosion and sedimentation control plan that must align with NS Power's established water management and contingency plan as described in this document and as provided in Appendix B. The contractor plan is reviewed by the Project Manager, Engineer and Environmental Lead to ensure the plan conforms with established design and constructability criteria and environmental standards. The contractor plan must also include details for regular inspection of control measures, water quality (as required) and machinery and processes for identifying and addressing deficiencies as well as reporting mechanisms for environmental incidents.

In addition to the contractor plan, NS Power develops a Project specific Environmental Protection Plan (EPP) which details NS Power's regulatory requirements, approval and authorization terms and conditions, and best practices that will be employed during construction. As part of NS Power's EPP, a regular inspection program is implemented in addition to the contractor inspection program, to evaluate contractor compliance to the contractor plan and to NS Power's EPP. Both the contractor's and NS Power's inspection program will extend throughout construction in 2021 and a summary report confirming all measures and standards as committed in this document and NS Power's supporting information document #2 will be provided to DFO by June 30, 2022.

6.0 Post-Construction Monitoring

NS Power will monitor the operation of the new dam structure as part of its regular bi-annual dam inspection and maintenance program as well as weekly inspections conducted by Hydro Operations. NS Power does not anticipate any issues with erosion or scour downstream of the new dam structure.

7.0 Death of Fish/HADD after Avoidance and Mitigation Measures and Standards

Table 8 provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Main Dam refurbishment.

Table 8: Residual Harm from Potential Impacts Associated with the Ruth Falls Main Dam Refurbishment

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect	Measures to Mitigation Death of Fish/HADD	Potential Residual Death of Fish/HADD
Temporary loss of fish habitat due to lowering headpond beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.3 km^2 in Ruth Falls Headpond	High	Low	Refer to Section 4	No residual HADD anticipated, to be confirmed through monitoring
Temporary loss of fish habitat due to temporary installation of access road/crossings and cofferdams.	Localized: area immediately above and below the dam	High	Low	Refer to Section 3	No residual HADD anticipated
Permanent loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly below the dam	High	Low	Area is extremely small (60 m2)	No residual HADD anticipated
Fish mortality due to stranding when lowering headpond.	Localized: Ruth Falls Headpond	Medium	Low	Refer to Section 3 and 4	Residual death of fish anticipated, to be confirmed through monitoring (refer to Section 8 Offsetting)
Potential downstream scour during drawdown of headpond.	Localized: East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated

Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated

8.0 Offsetting Plan

NSPI has engaged the Mi'kmaw Conservation Group (MCG) to lead the development and execution of a restoration project that is suitable for offsetting of serious harm for the Ruth Falls Dam refurbishment and the Sloane Reservoir Wing Dam 2 refurbishment projects in conjunction. MCG partnered with the Nova Scotia Salmon Association (NSSA) to develop an offsetting plan to restore Atlantic salmon habitat in the West River of Sheet Harbour. MCG have also consulted with the Millbrook First Nation regarding the plan including potential involvement. The offsetting plan involves a 7 year project to restore a 5000 m^2 stretch of the West River at a cost of $343,000. The amount of fish habitat permanently impacted due to infilling associated with the Sloane Wing Dam project is 900 m^2 and 60 m^2 for the Ruth Falls project. Other potential temporary impacts associated with lowering the Ruth Falls reservoir include possible death to fish and the temporary loss of littoral zone habitat. These impacts will be determined as described in section 4 above in conjunction with DFO. The offsetting proposed by MCG and NSSA is sufficient to address the permanent and potential temporary impacts associated with the refurbishment activities. The offsetting plan will be submitted to DFO under separate cover. A letter of credit for $62,000 was submitted to DFO in 2020. An additional letter of credit to cover full execution of the offsetting plan will be provided to DFO.

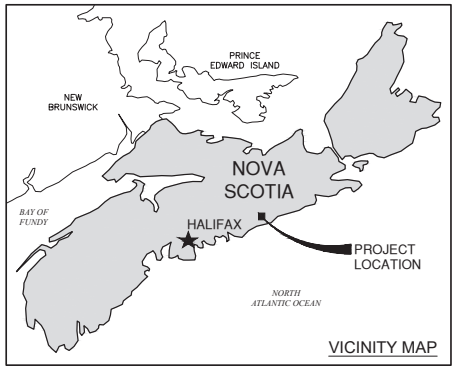
APPENDIX A – Engineering Designs

DWG. NO. H096H1163100040

NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

COVER SHEET

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DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-052
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-056
320-01	NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-057
320-02	NEW STEEL GRATED ACCESS PLATFORM	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-060

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

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GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.
     - III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6–8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310–04 FOR EARTHWORK.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

100-02 Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____–__–__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE . . . . . .

. . . . . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	CMV
CHECKED	__
DATE	2020–12–11
W.O.	XXXX

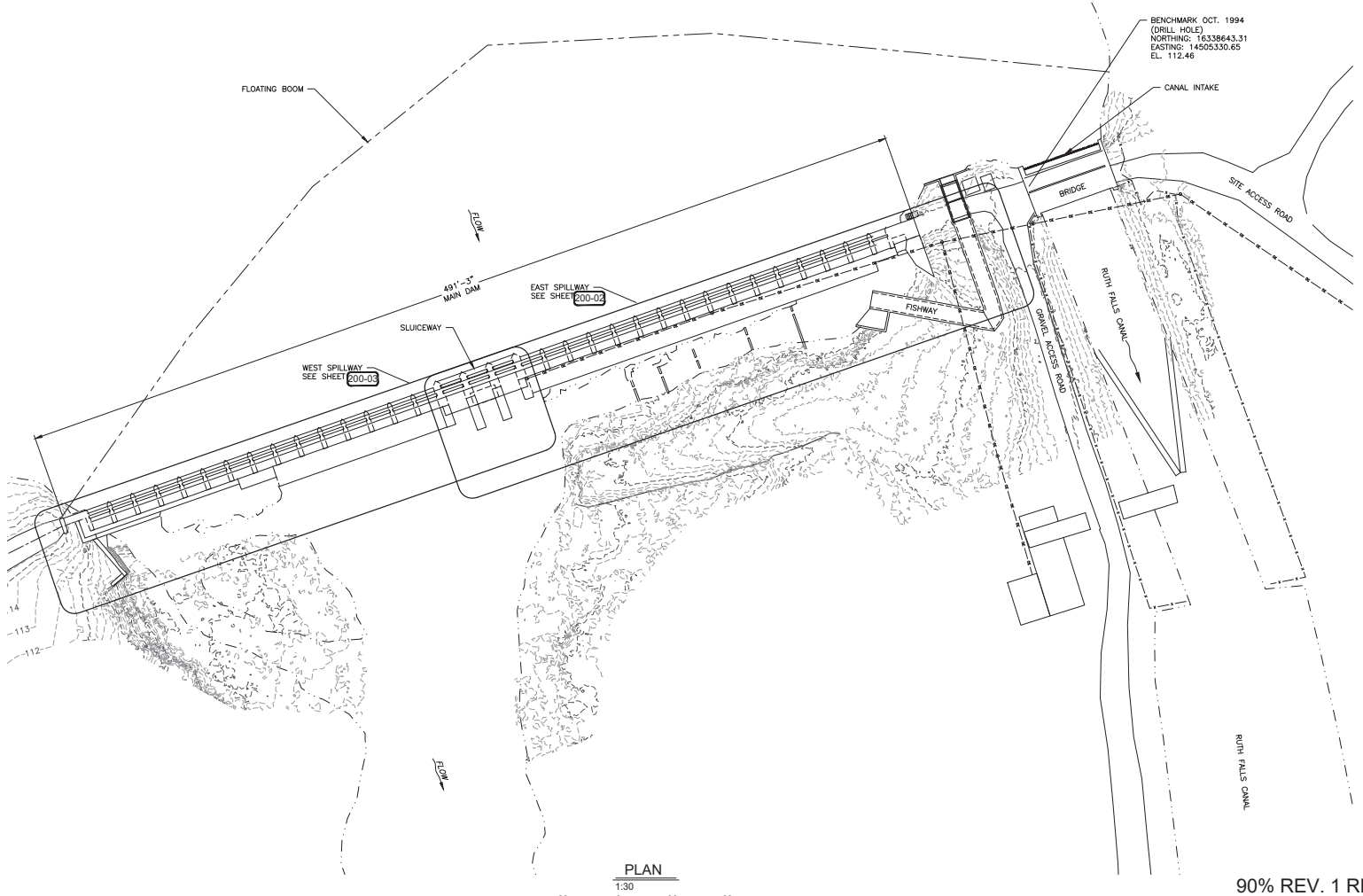
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

GENERAL NOTES

DWG.NO. H096H1163100042 REV. C

DWG. NO. H096H1163100043



PLAN
1:30

30 0 30 60
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

200-01

Kleinschmidt

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PRINTED: Dec. 9, 2020 - 2:53 P.M.

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

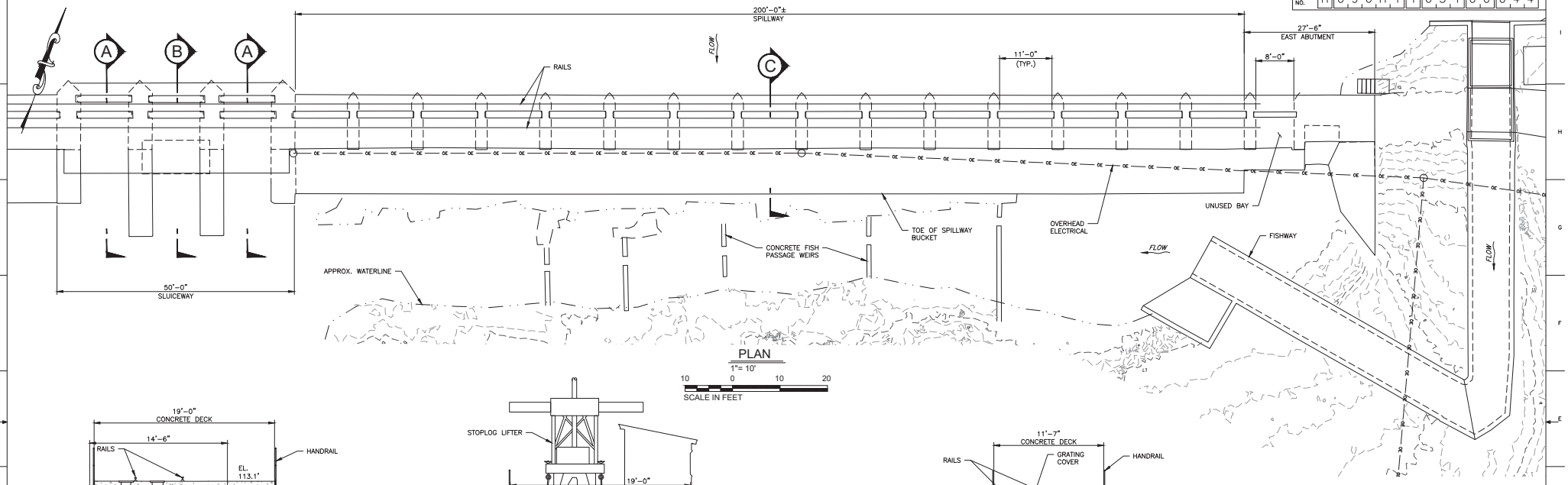
SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2020-12-11
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

EXISTING CONDITIONS
OVERALL SITE PLAN

DWG.NO. H096H1163100043 REV. C

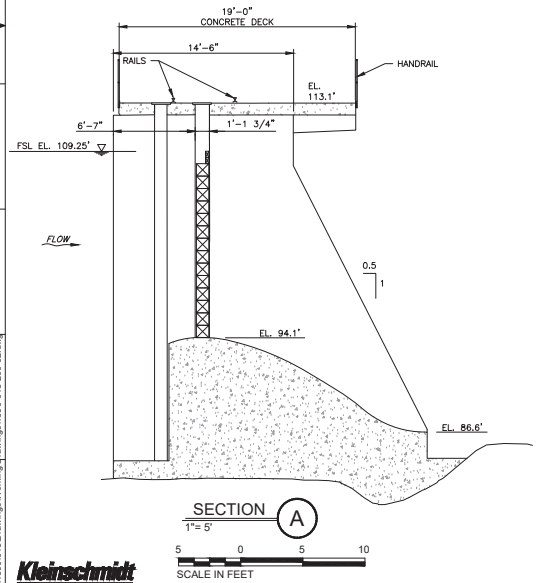


PLAN

1"= 10'

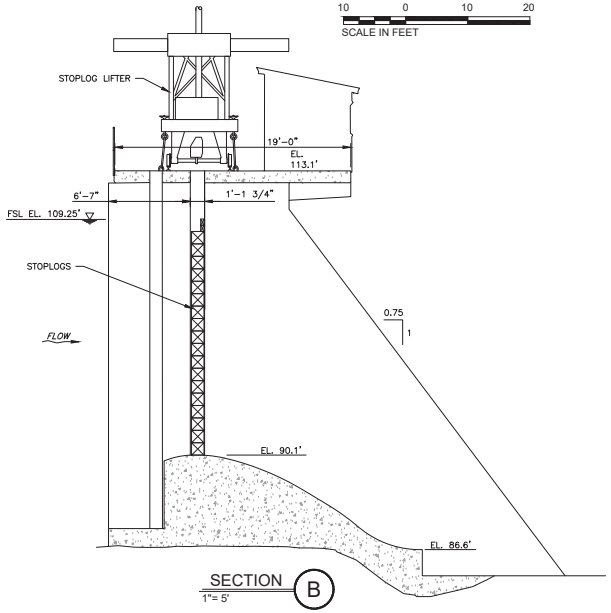
10 0 10 20

SCALE IN FEET



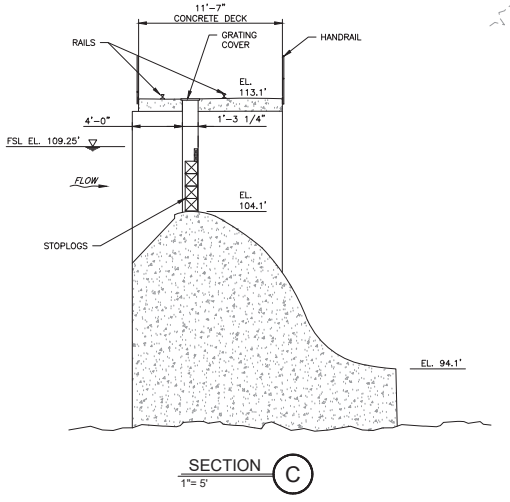
SECTION A

1"= 5'



SECTION B

1"= 5'



SECTION C

1"= 5'

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

200-02

Kleinschmidt

SCALE IN FEET

5 0 5 10

J:\18900\018\Drawings\Working Drawings\1890-018 200-02.dwg

PRINTED: Dec. 11, 2020 - 2:32 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-11

W.O. XXXX

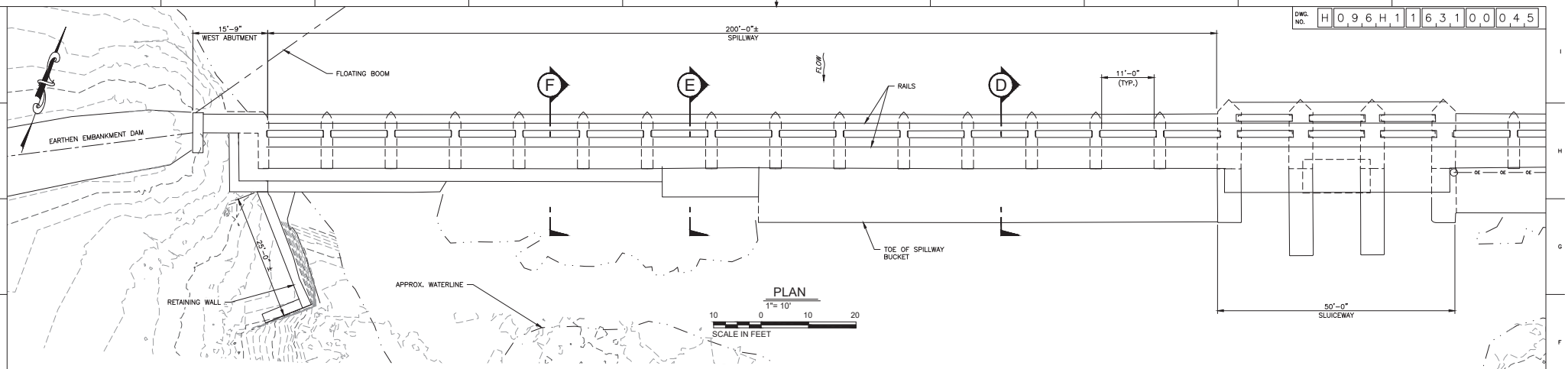
Nova Scotia POWER An Emera Company energy everywhere.

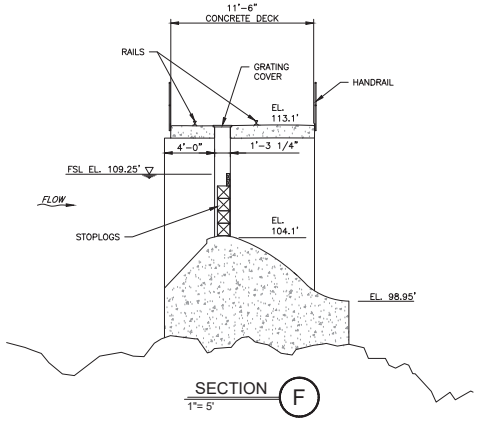
RUTH FALLS

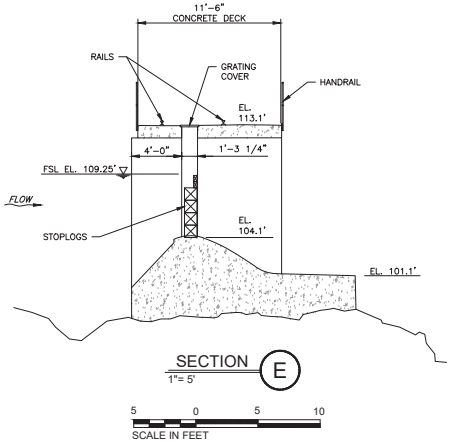
RUTH FALLS REFURBISHMENT PROJECT

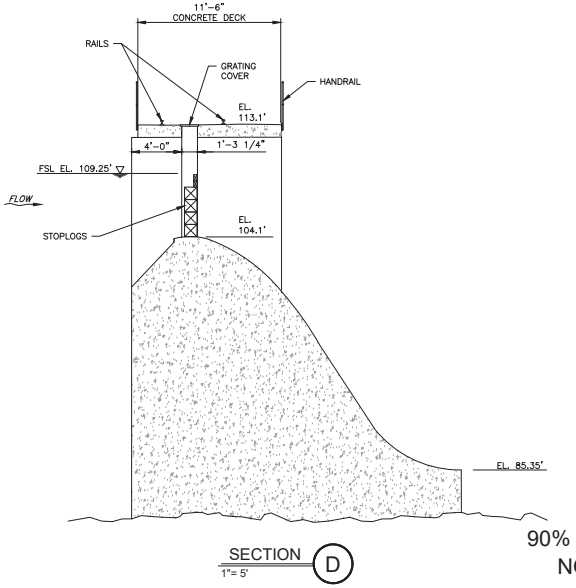
EXISTING CONDITIONS EAST SPILLWAY
PLAN AND SECTION

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 4 REV. C









90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

200-03

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 5

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PRINTED: Dec. 9, 2020 - 3:36 PM

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REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

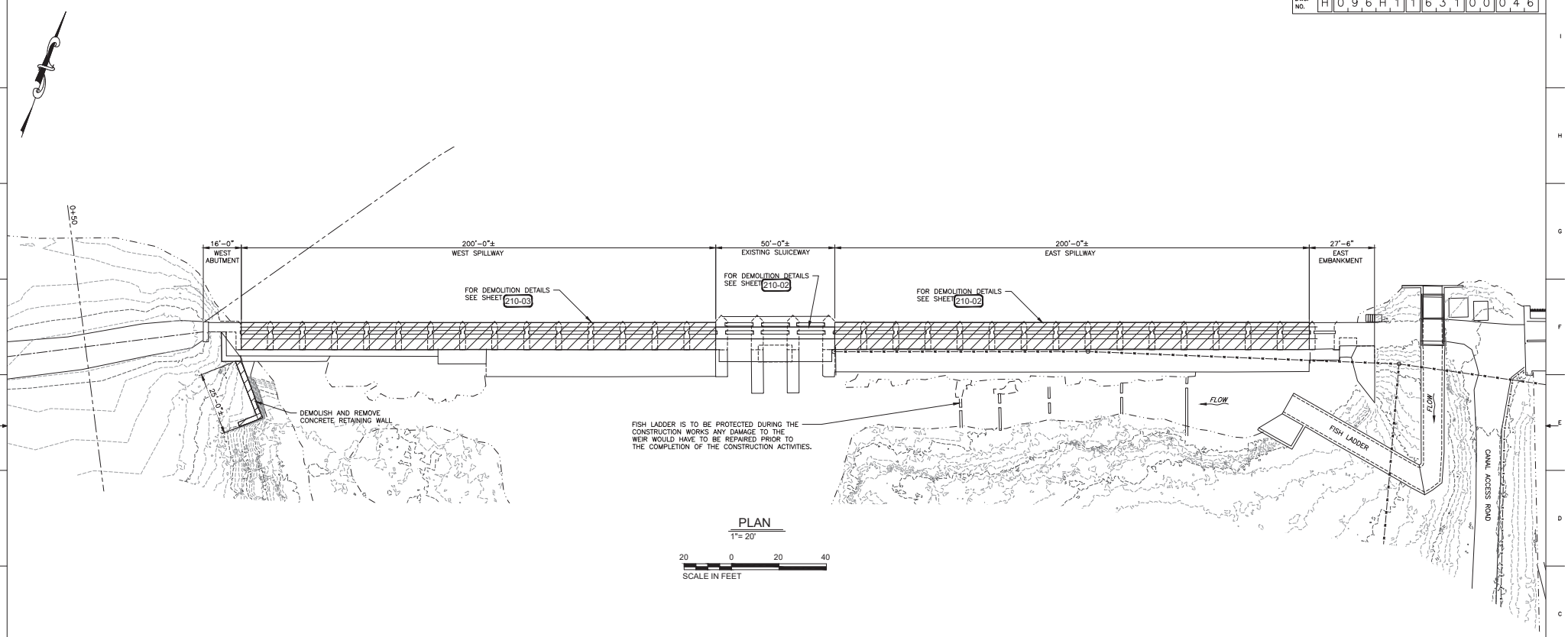
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS WEST SPILLWAY
DAM PLAN AND SECTIONS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 5 REV. C

DWG. NO. H096H1163100046



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

210-01

J:\1890\018\Drawings\Working Drawings\1890-018-210-01.dwg
PRINTED: Dec. 9, 2020 - 2:55 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

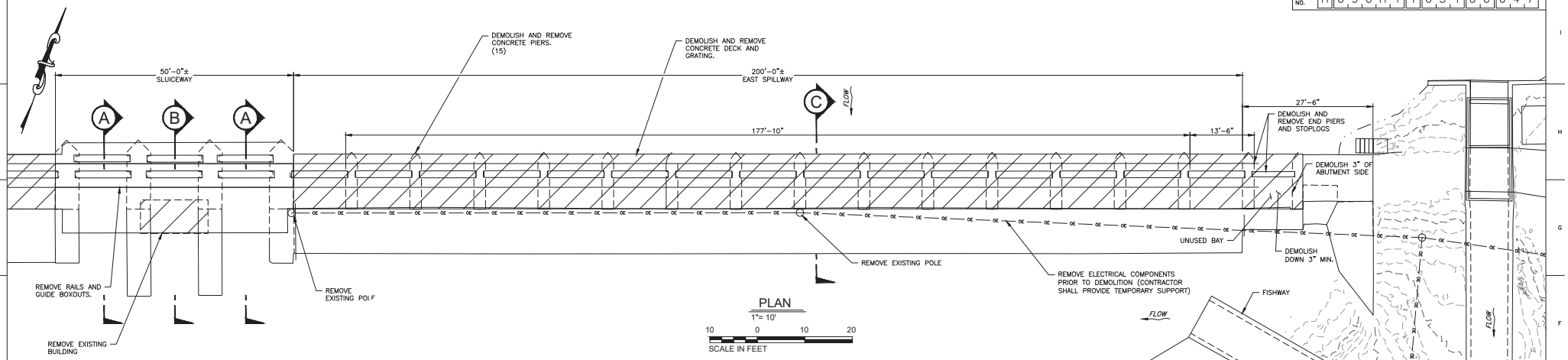
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

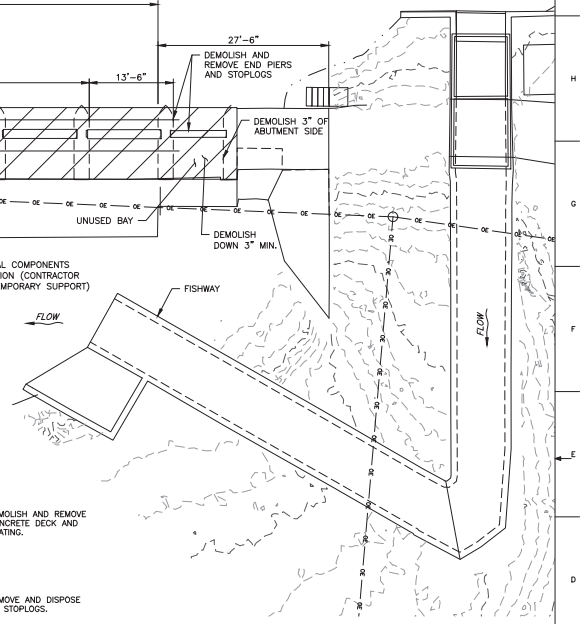
TEMPORARY CONDITIONS/DEMO PLAN

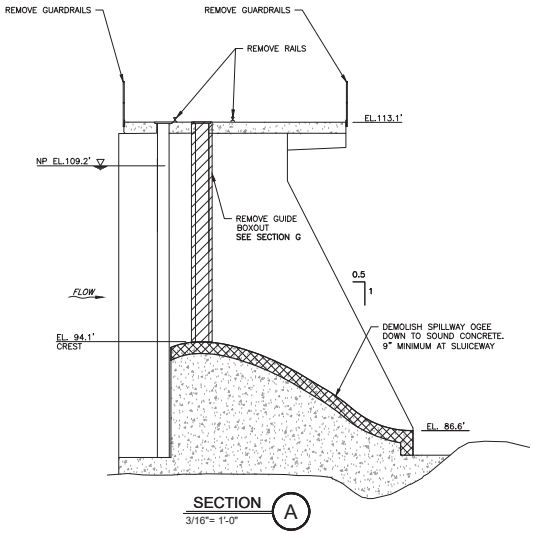
DWG.NO. H096H1163100046 REV. C

DWG. NO. H096H1163100047

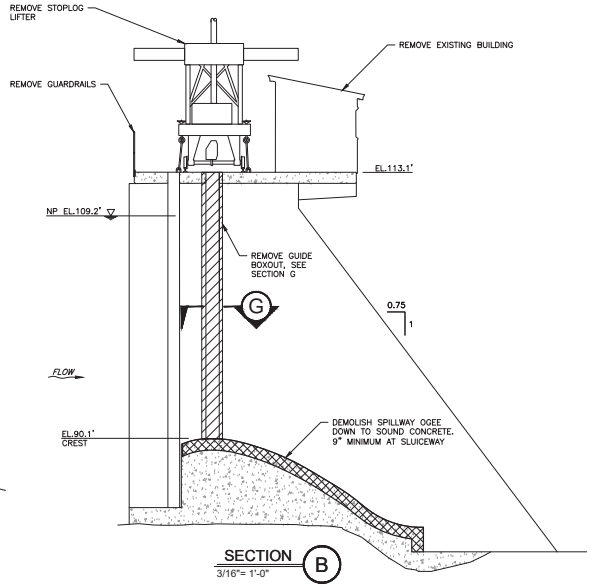


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

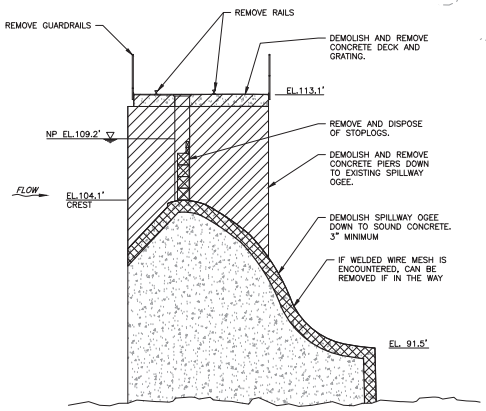




SECTION A
3/16"= 1'-0"

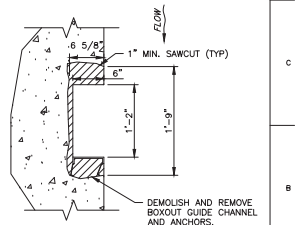


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

210-02

Kleinschmidt

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PRINTED: Dec. 9, 2020 - 2:56 PM

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RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2020-12-11
W.O. XXXX

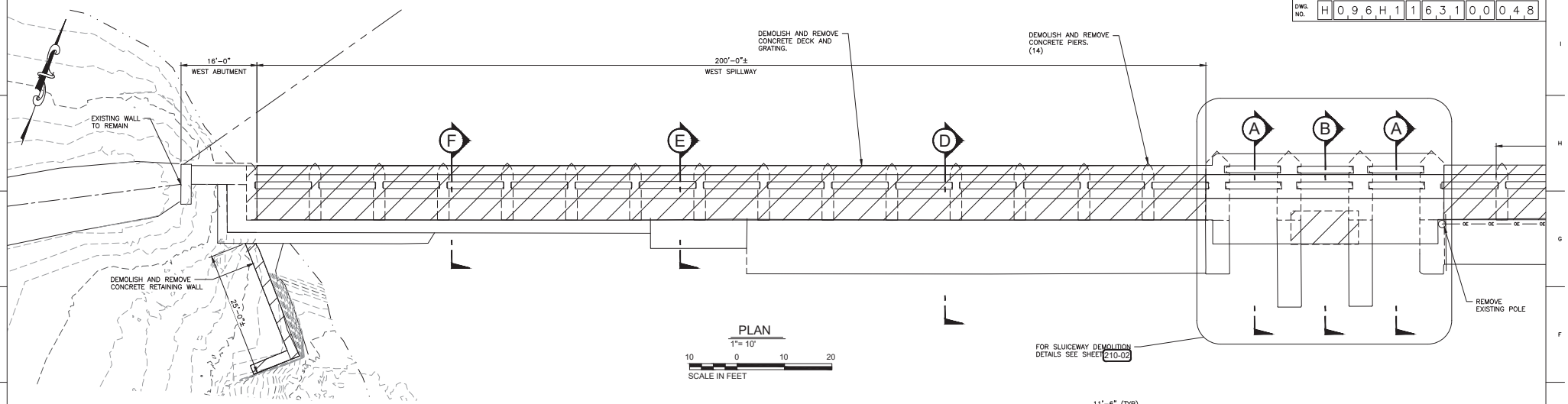
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

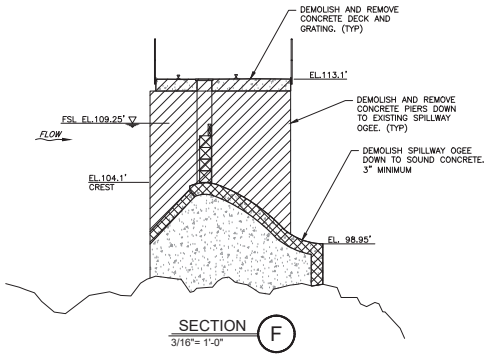
DWG.NO. H096H1163100047 REV. C

DWG. NO. H096H1163100048



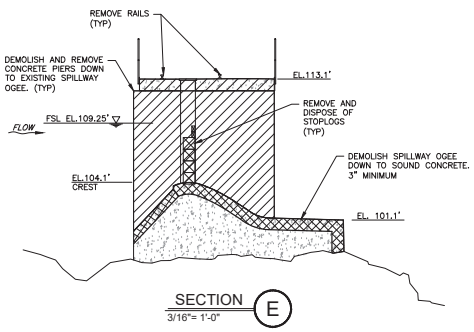
PLAN
1"= 10'

10 0 10 20
SCALE IN FEET

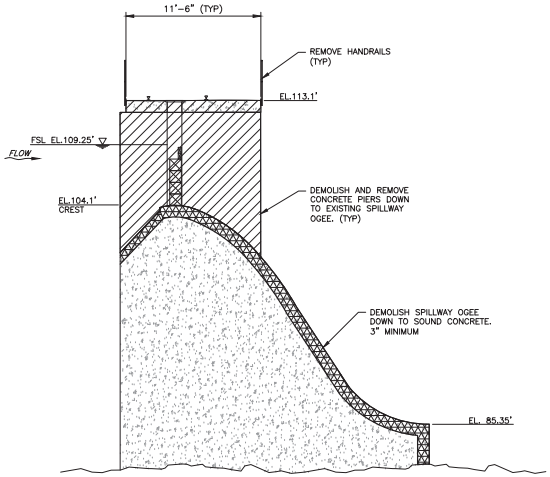


SECTION F
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION D
3/16"= 1'-0"

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210-03

Kleinschmidt

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PRINTED: Dec. 11, 2020 - 9:55 AM

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2020-12-11
W.O.	XXXX

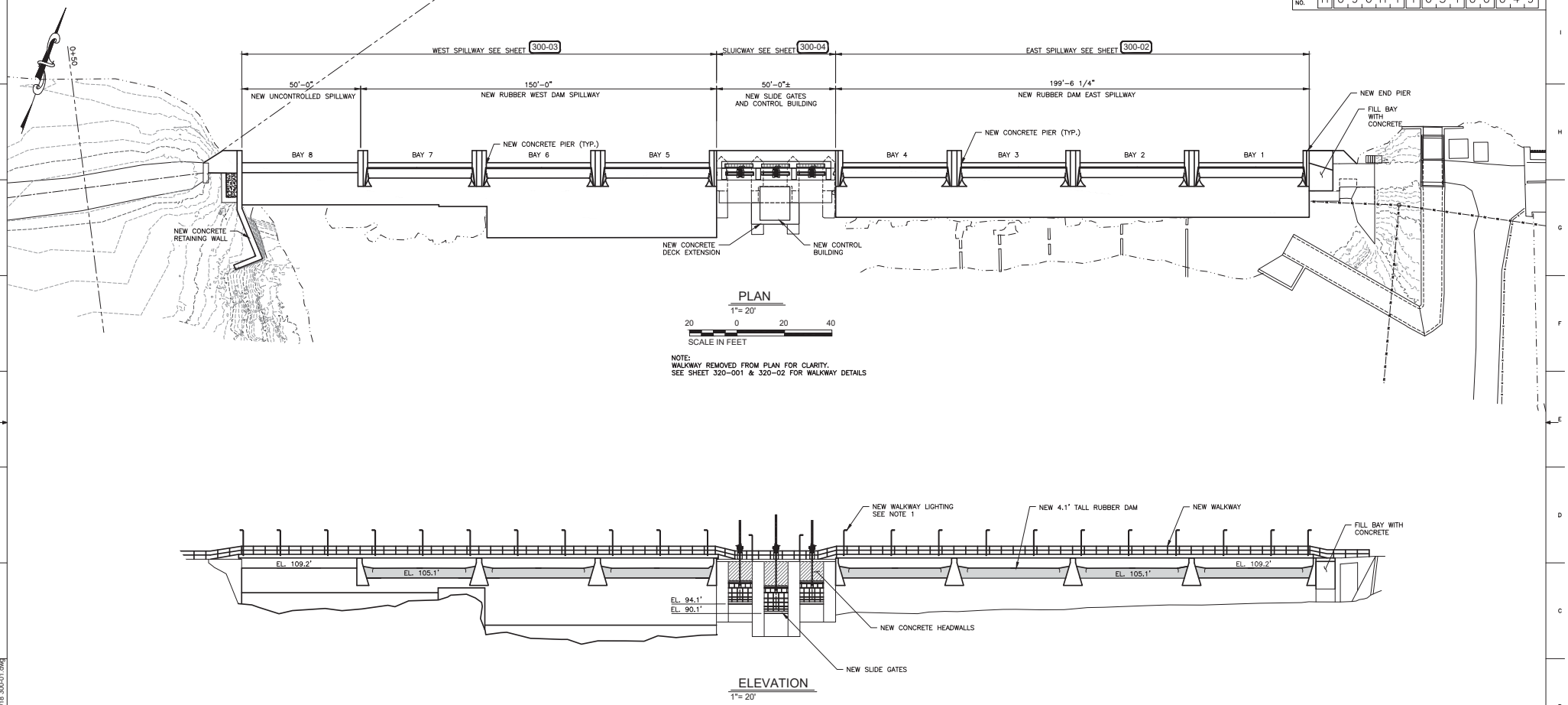
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. C

DWG. NO. H096H1163100049



NOTE:
1. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

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300-01

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PRINTED: Dec. 9, 2020 - 3:37 PM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED
DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

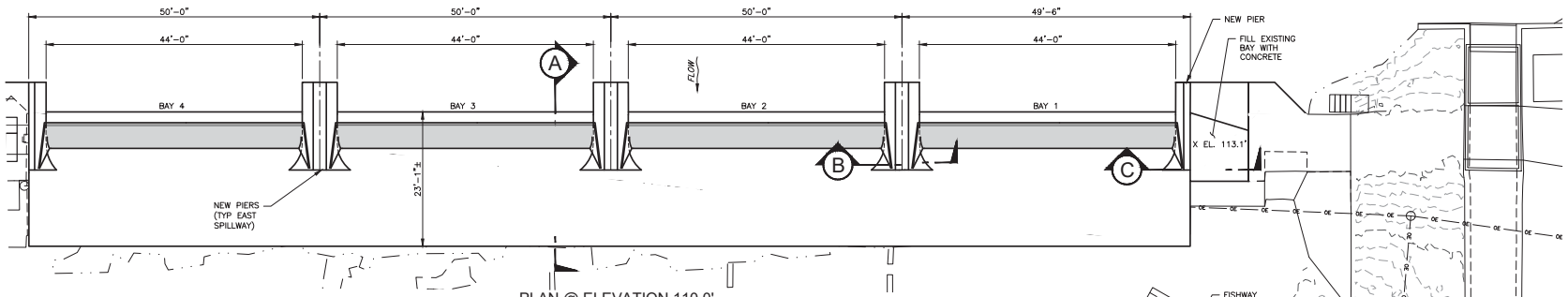
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

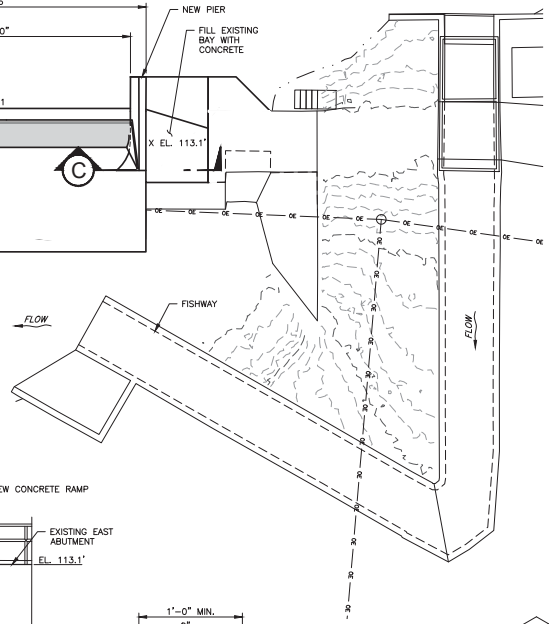
NEW CONDITIONS
DAM PLAN AND ELEVATION

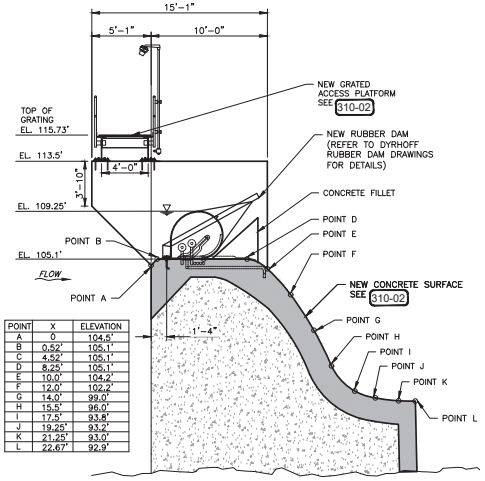
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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 0



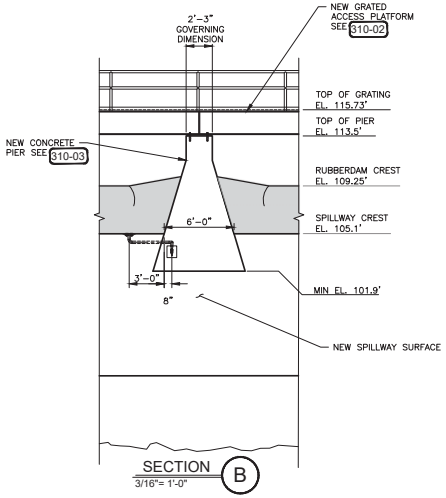
PLAN @ ELEVATION 110.0'
1"= 10'
10 0 10 20
SCALE IN FEET



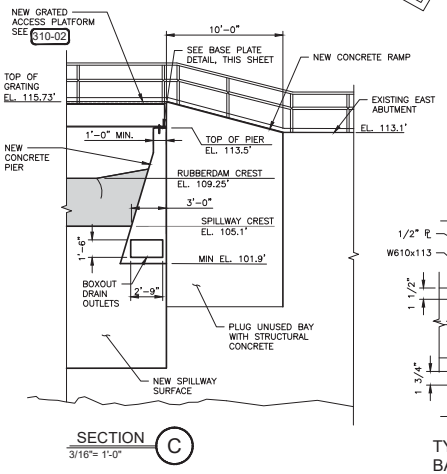


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5'	93.8'
J	19.25'	93.2'
K	21.25'	93.0'
L	22.67'	92.9'

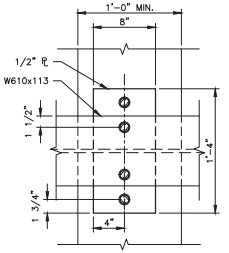
SECTION A
3/16"= 1'-0"
4 0 4 8 12
SCALE IN FEET



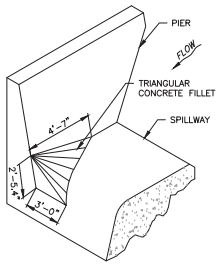
SECTION B
3/16"= 1'-0"



SECTION C
3/16"= 1'-0"



TYPICAL END PIER
BASE PLATE DETAIL
1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020–12–11
W.O.	XXXX

Nova Scotia POWER An Emera Company energy everywhere.

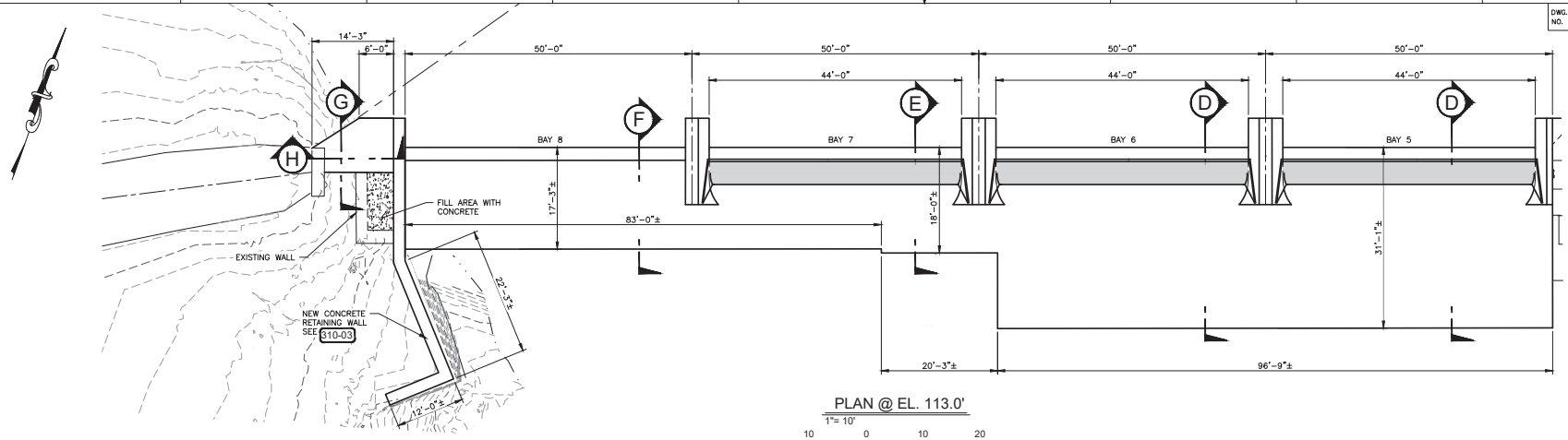
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

H 0 9 6 H 1 1 6 3 1 0 0 0 5 0 REV. C
DWG.NO.

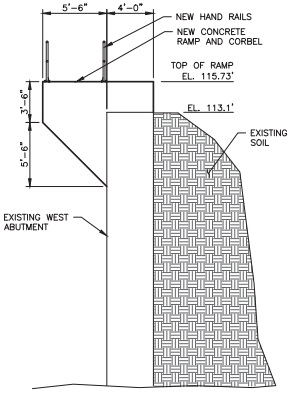
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DWG. NO. H096H1163100051

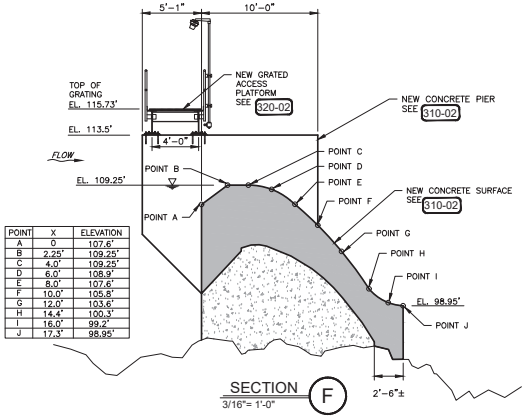


PLAN @ EL. 113.0'
1"= 10'
10 0 10 20
SCALE IN FEET

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS

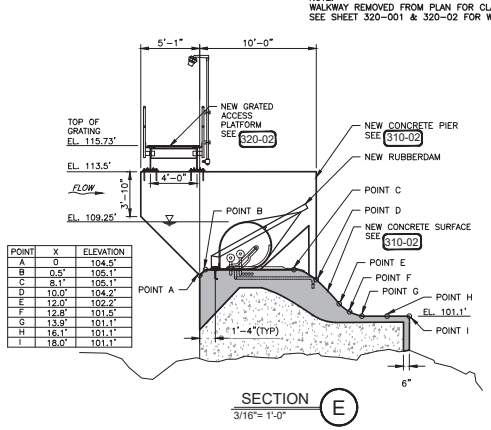


SECTION G
3/16"= 1'-0"



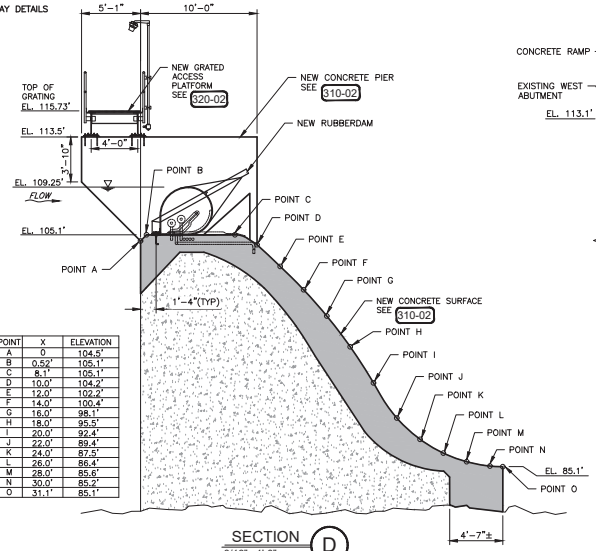
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

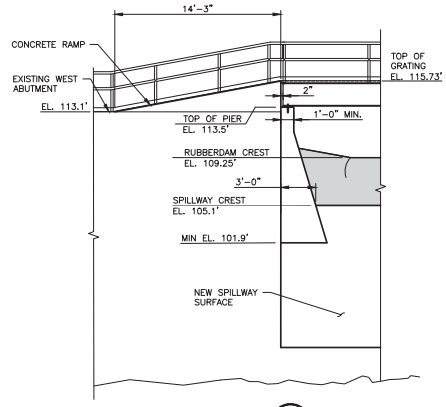
SECTION E
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION H
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY: _____ DATE: ____-__-__					

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED
DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-11
W.O.	XXXX

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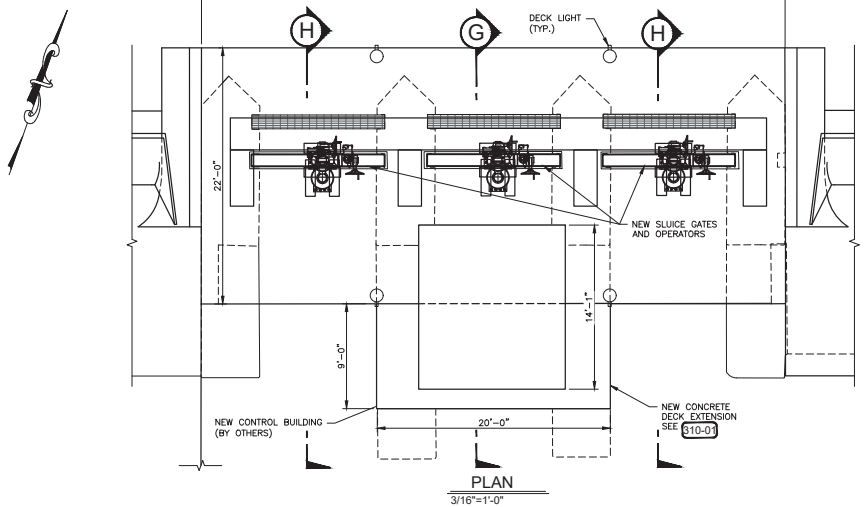
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

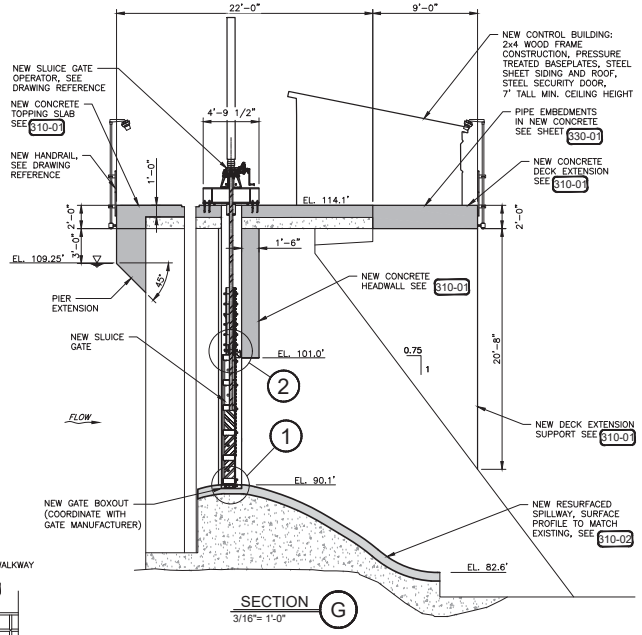
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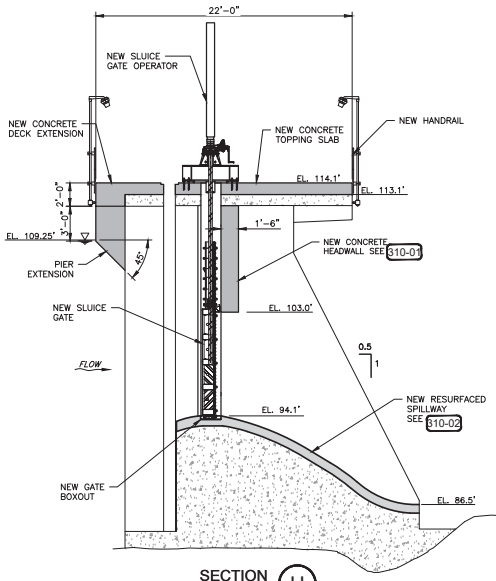
DWG. NO. H096H1163100052



PLAN
3/16"=1'-0"

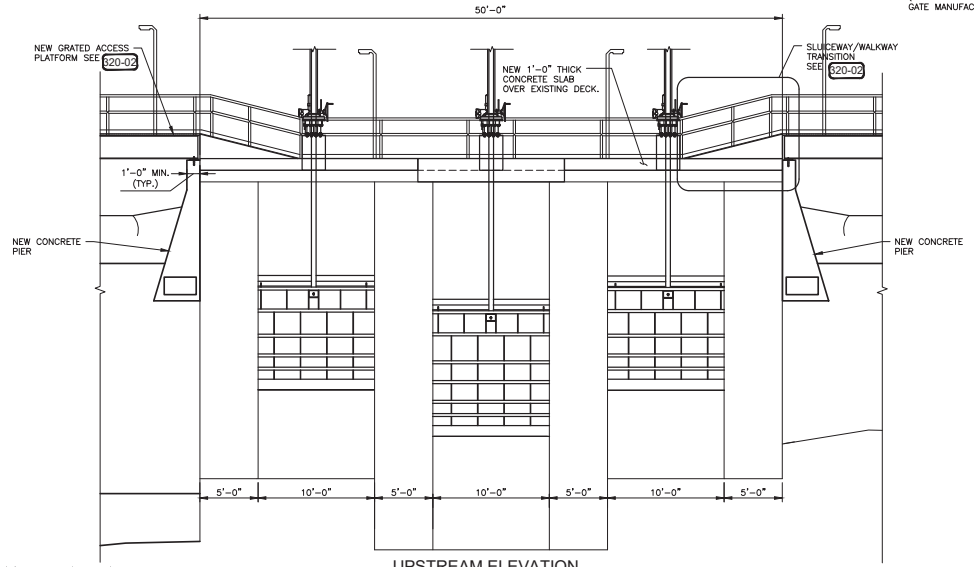


SECTION G
3/16"= 1'-0"

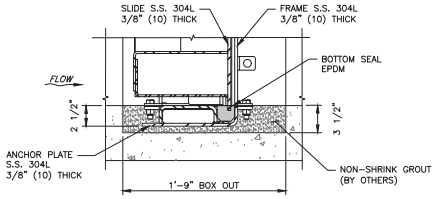


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

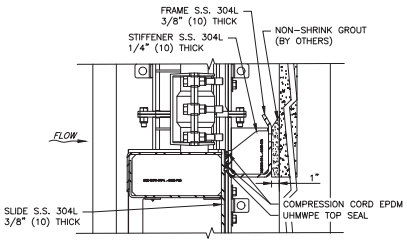


UPSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

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NOT FOR CONSTRUCTION

Kleinschmidt

300-04

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REFERENCE DRAWINGS	DWG.NO.

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE . .

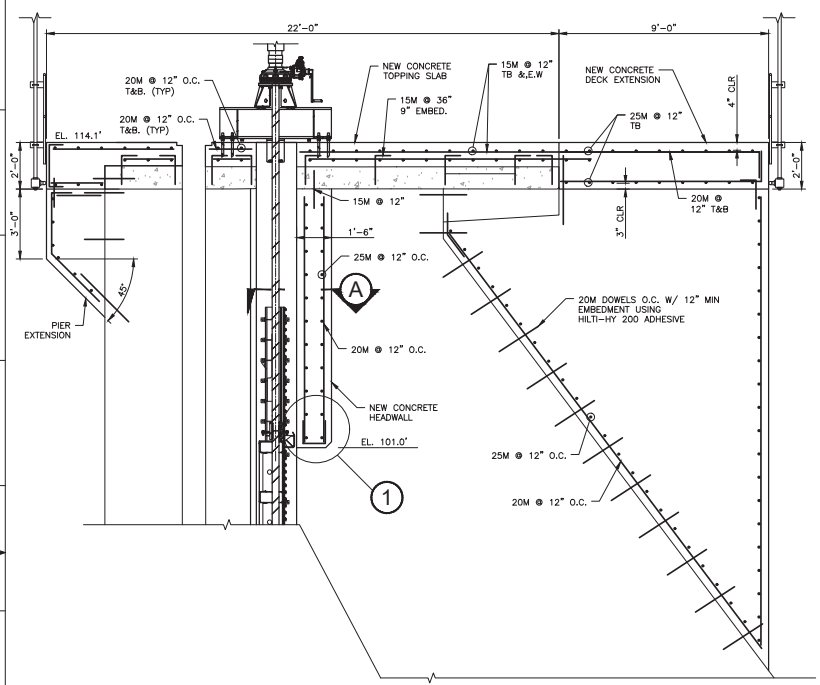
SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-11
W.O.	XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

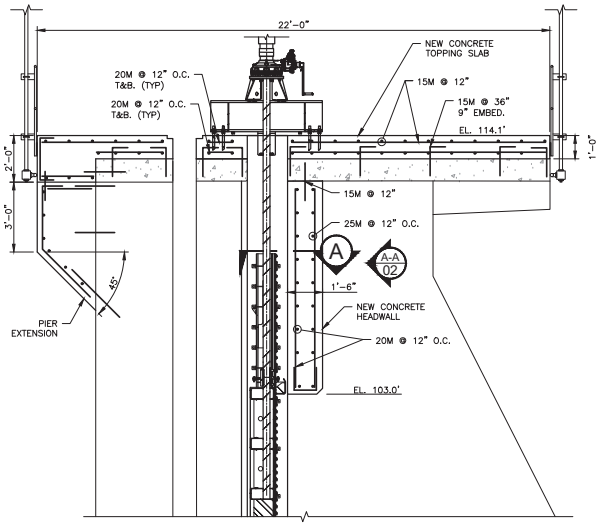
DWG.NO. H096H1163100052 REV. C



INNER SLUICEWAY DETAIL

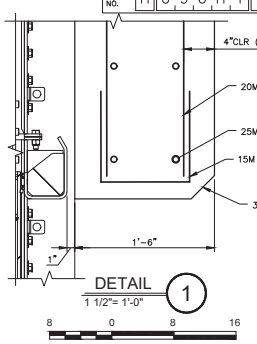
3/8"= 1'-0"

SCALE IN FEET



OUTER SLUICEWAY DETAIL

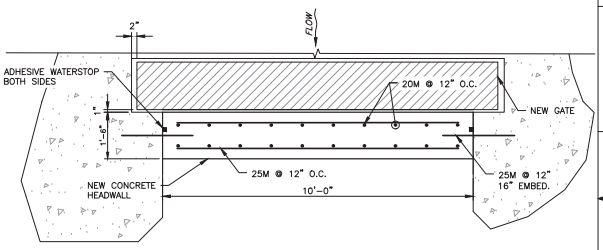
3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

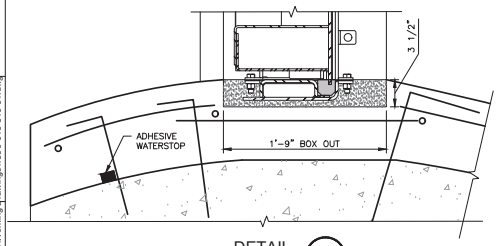
SCALE IN INCHES



SECTION A

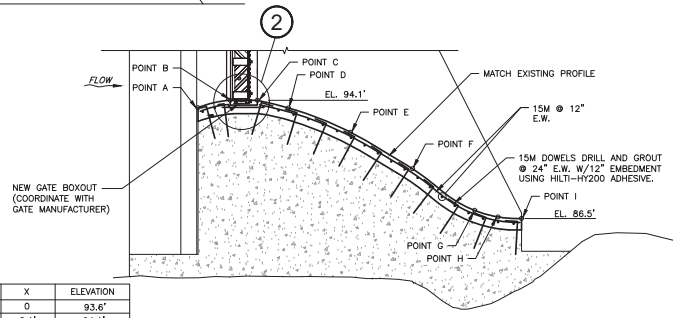
1/2"= 1'-0"

SCALE IN FEET



DETAIL 2

1 1/2"= 1'-0"

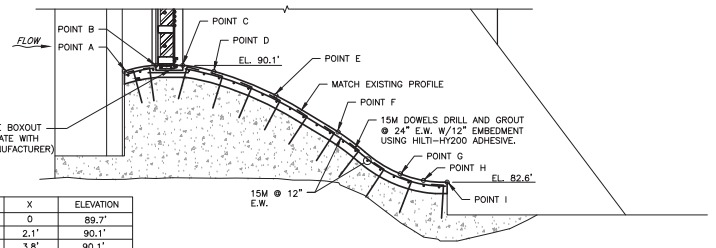


POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-01

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PRINTED: Dec. 18, 2020 - 8:42 AM

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FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22														
REFERENCE DRAWINGS		DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-18
W.O. XXXX

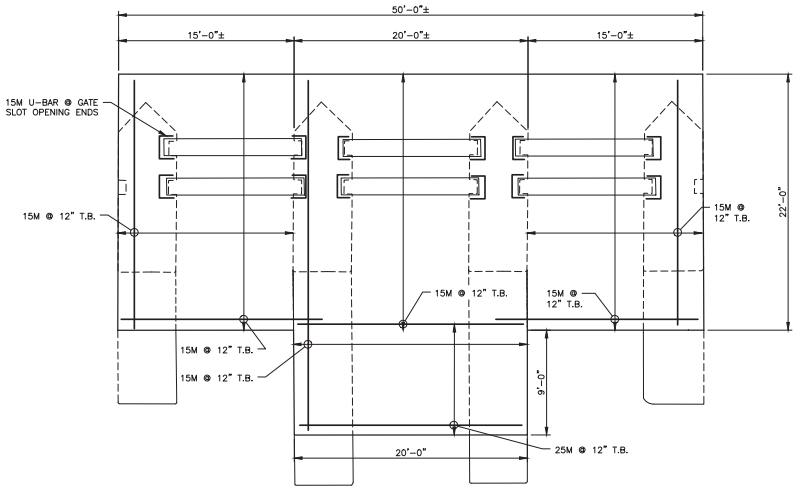
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE
SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 3 REV. C

DWG. NO. H096H1163100054

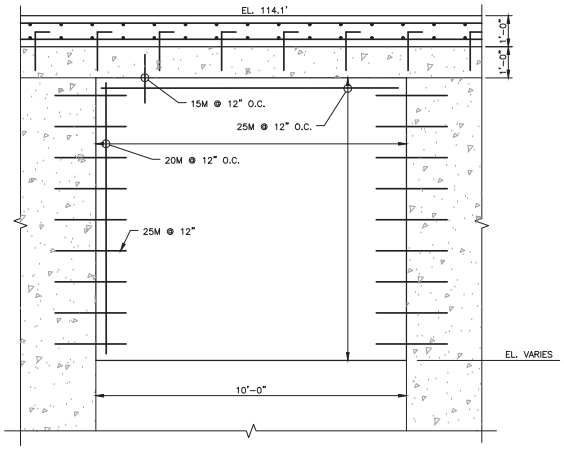


SLUICEWAY DECK REBAR PLAN

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

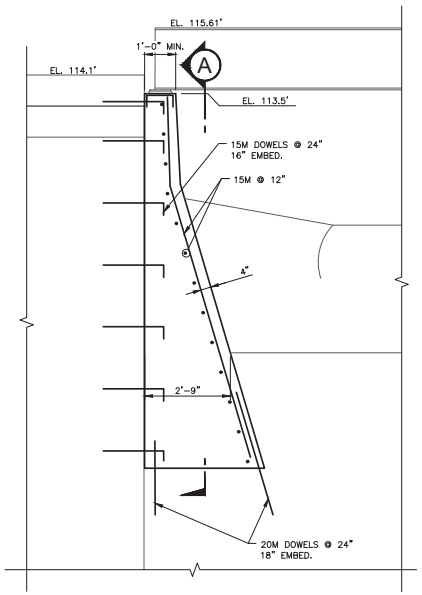


TYPICAL HEADWALL ELEVATION A-A 01

1/2"= 1'-0"

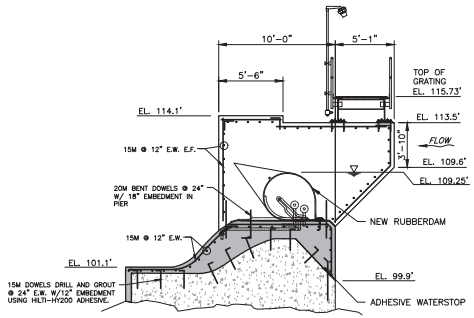
2 0 2 4

SCALE IN FEET



PIER TO SLUICEWAY REBAR DETAIL

1/2"= 1'-0"



SECTION A

3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.														

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED ——

CHECKED ——

DATE 2020-12-18

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

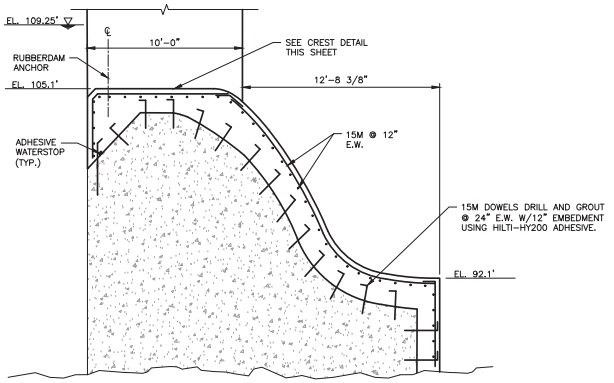
NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100054 REV. C

PRINTED: Dec. 18, 2020 - 8:42 AM

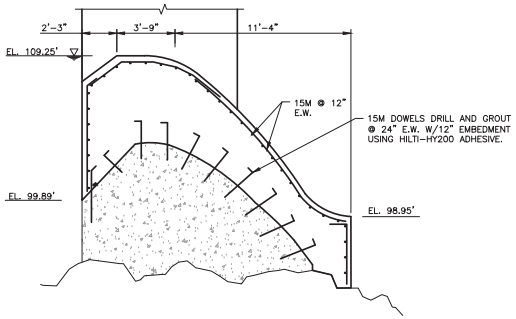
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DWG. NO. H096H1163100055



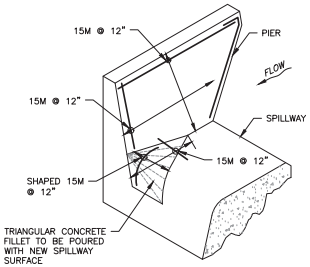
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



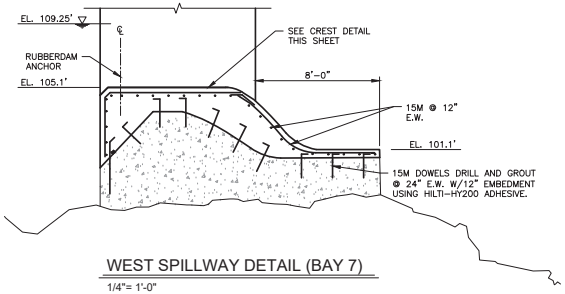
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

1/4"= 1'-0"



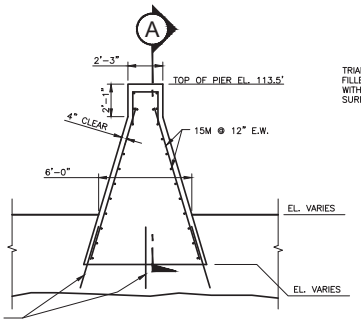
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



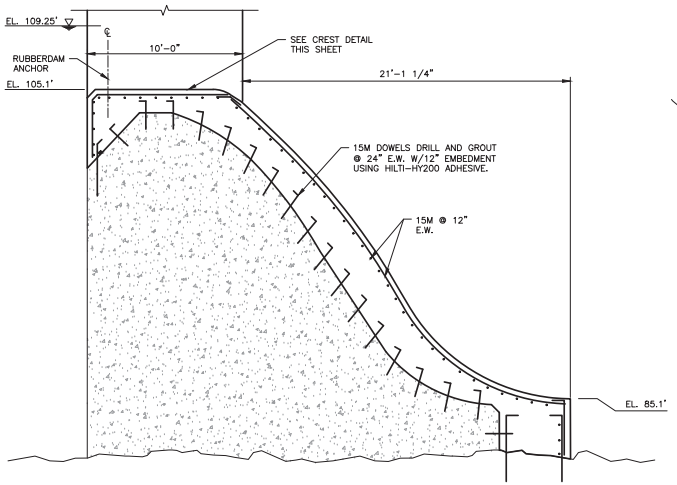
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



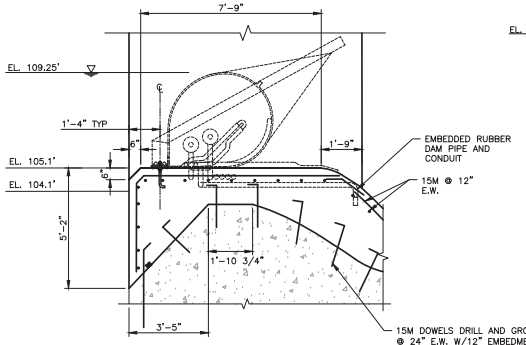
TYPICAL PIER DETAIL

1/4"= 1'-0"



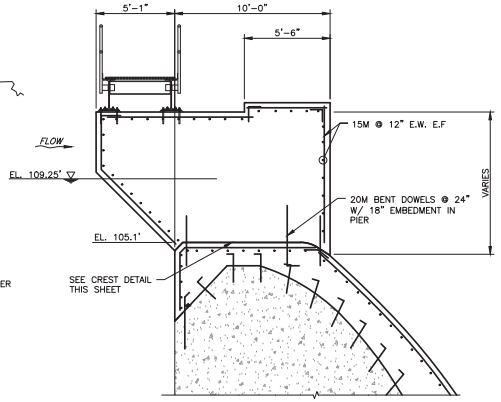
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION A

1/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-03

Kleinschmidt

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PRINTED: Dec. 18, 2020 - 8:42 AM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

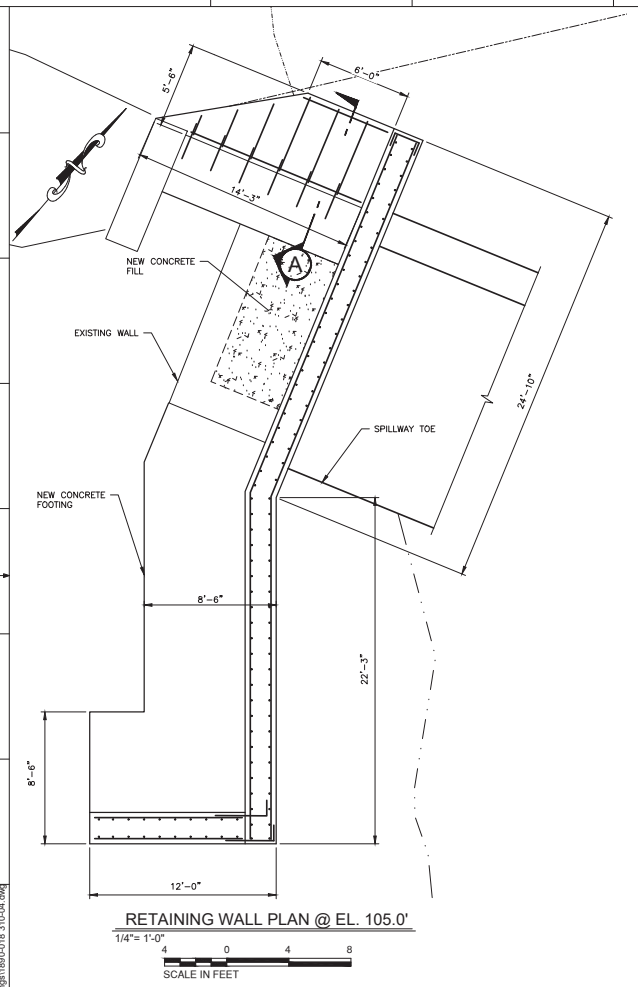
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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

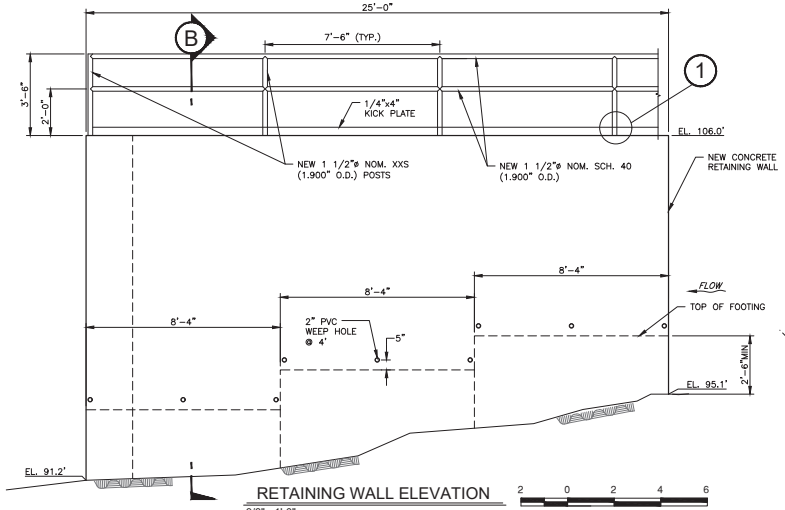
DWG.NO. H096H1163100055 REV. C



RETAINING WALL PLAN @ EL. 105.0'

1/4"= 1'-0"

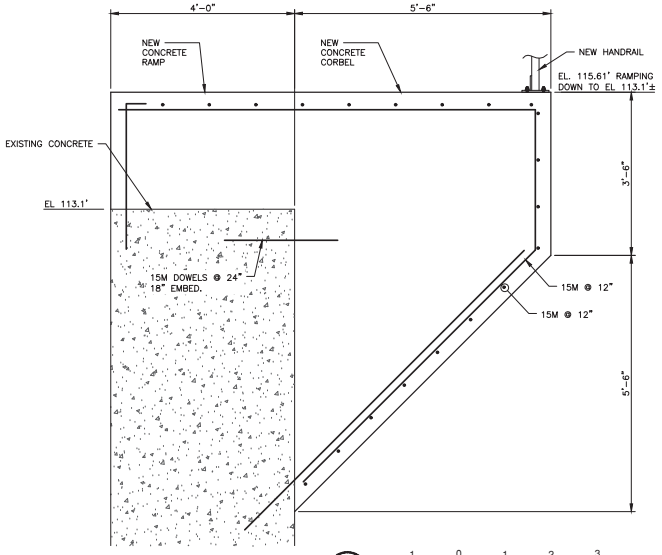
SCALE IN FEET



RETAINING WALL ELEVATION

3/8"= 1'-0"

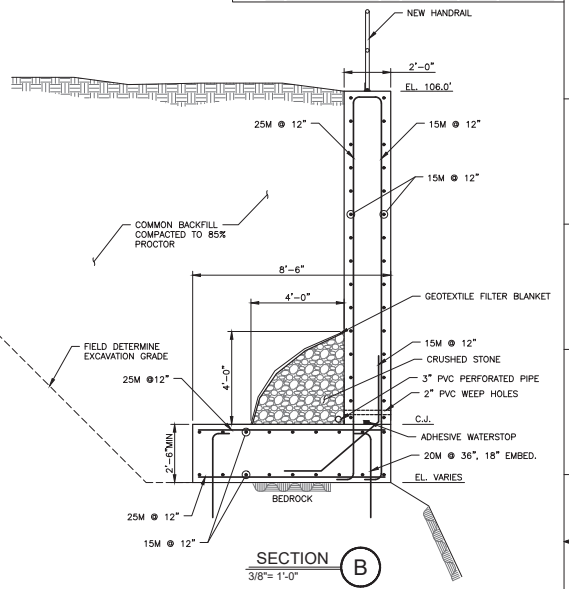
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SECTION A

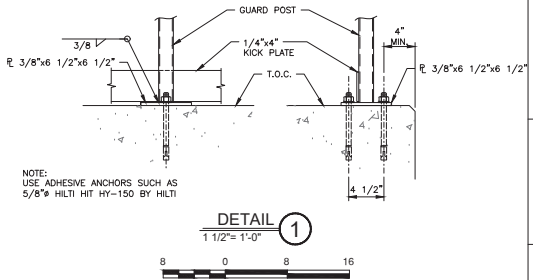
3/4"= 1'-0"

SCALE IN FEET



SECTION B

3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

SCALE IN INCHES

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-04

Kleinschmidt

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BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

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SCALE .....

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DRAWN ZJA

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DATE 2020-12-18

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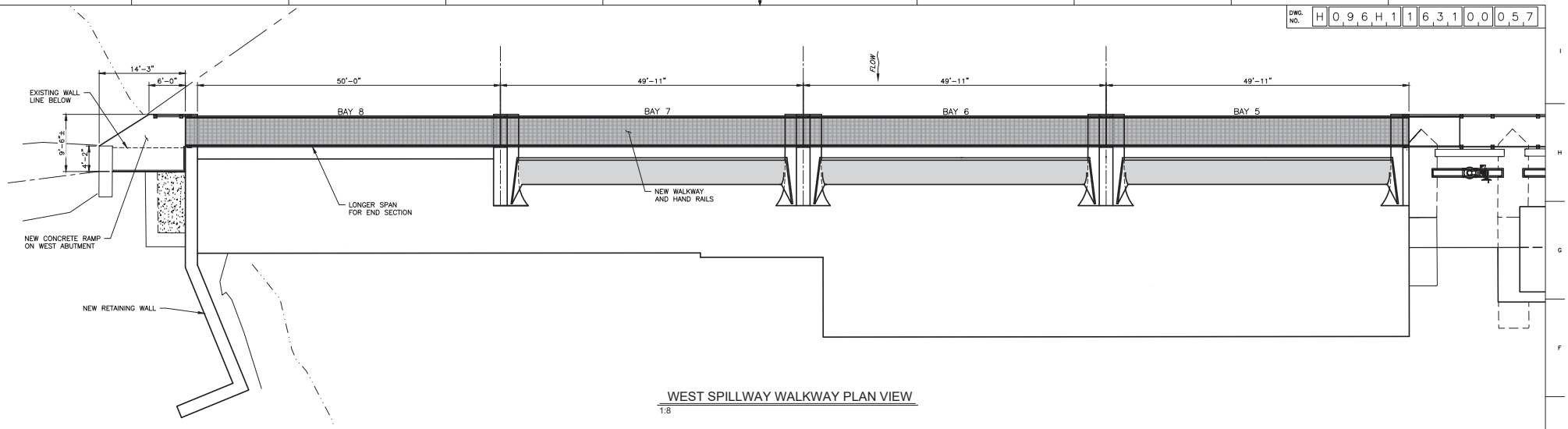
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

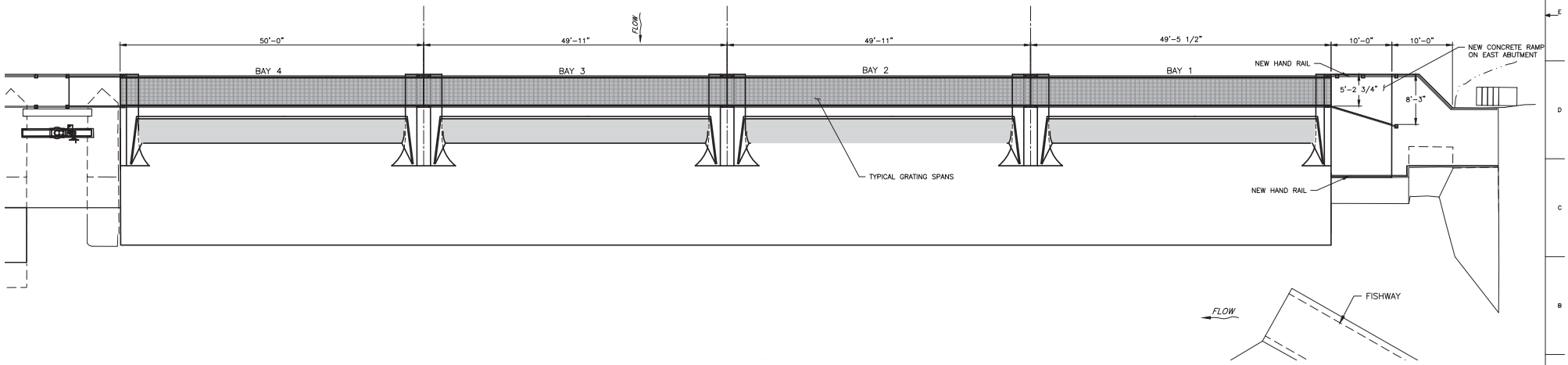
NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 6 REV. C

DWG. NO. H096H1163100057



WEST SPILLWAY WALKWAY PLAN VIEW
1:8



EAST SPILLWAY WALKWAY PLAN VIEW
1:8

8 0 8 16
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

320-01

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

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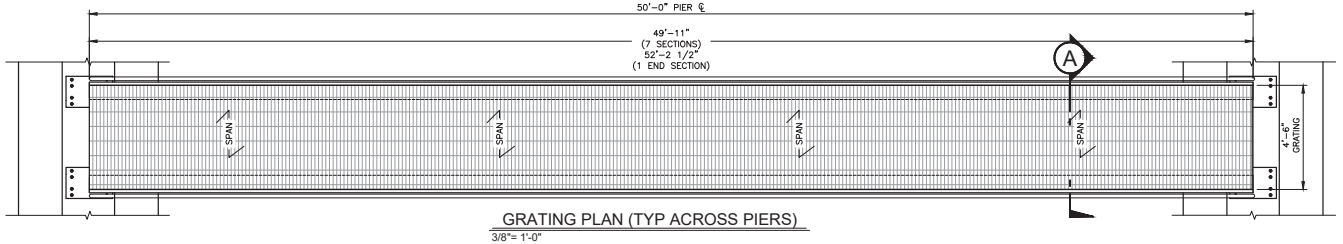
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DESIGNED	CMV
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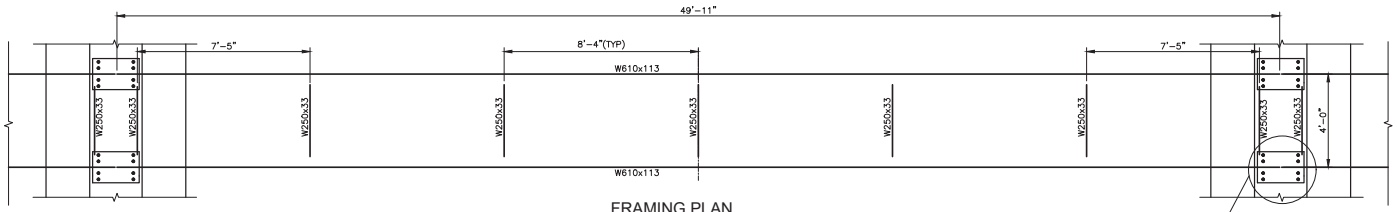
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW

DWG.NO. H096H1163100057 REV. C

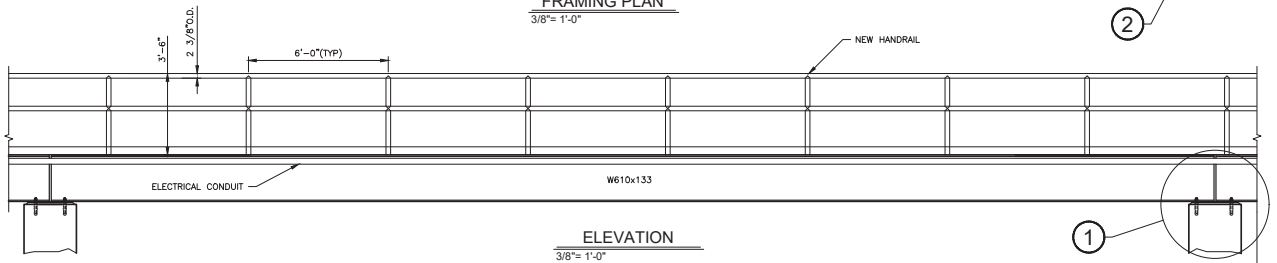
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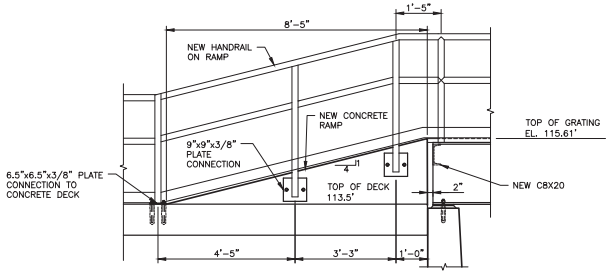
GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"



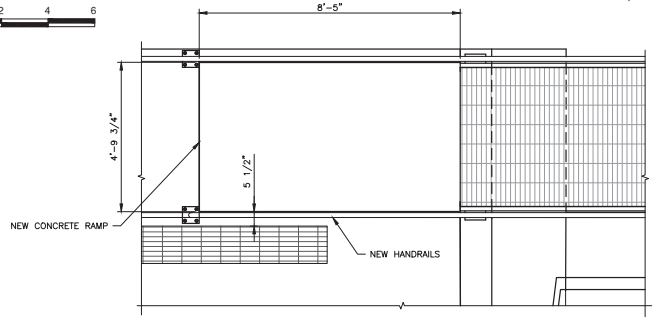
FRAMING PLAN
3/8"= 1'-0"



ELEVATION
3/8"= 1'-0"

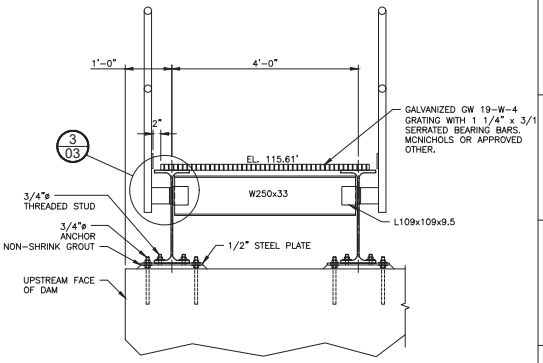


SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

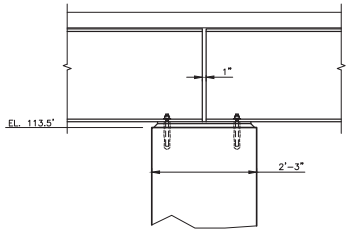




SLUICEWAY/WALKWAY TRANSITION PLAN
1/2"= 1'-0"

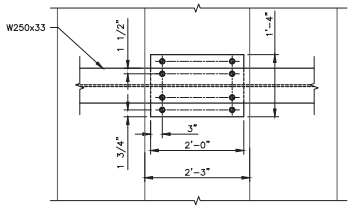


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"





DETAIL 2
3/4"= 1'-0"

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NOT FOR CONSTRUCTION

320-02

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STANDARD GUARD SYSTEMS DETAILS	H 0 0 1 H 0 1 6 9 0 0 0 0 0 1
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MECH ——— CONST ———

APPROVED

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SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
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DATE 2020-12-11
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

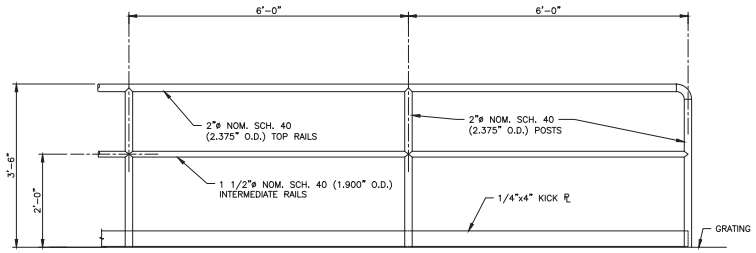
NEW STEEL
GRATED ACCESS PLATFORM

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 8 REV. C

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 8

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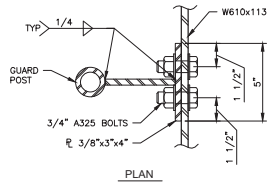


STEEL ACCESS PLATFORM TYPICAL HANDRAIL DETAIL

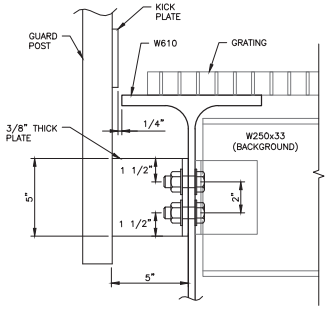
3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

320-03

Kleinschmidt

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REFERENCE DRAWINGS	DWG.NO.												

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MECH ——— CONST ———

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UNITS IMPERIAL

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DATE 2020-12-11

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RUTH FALLS

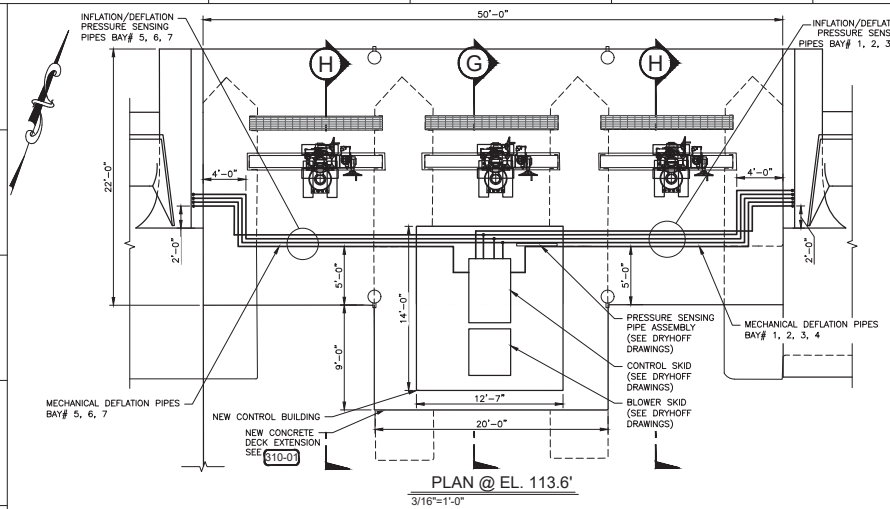
RUTH FALLS REFURBISHMENT PRJECT

NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS

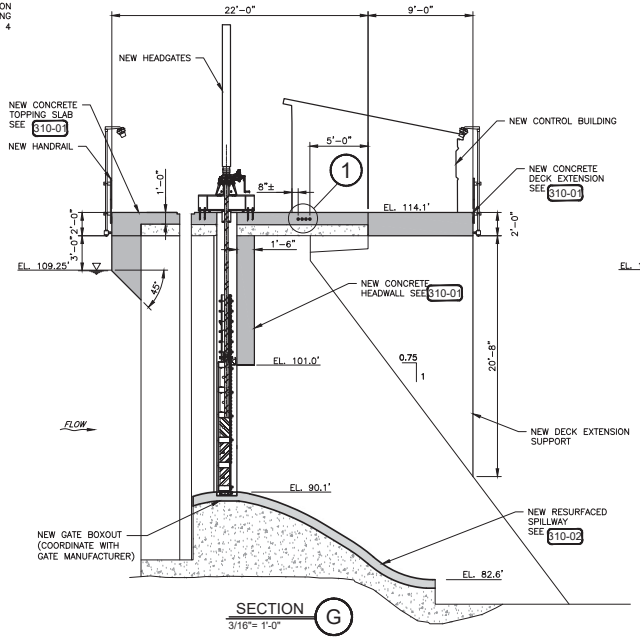
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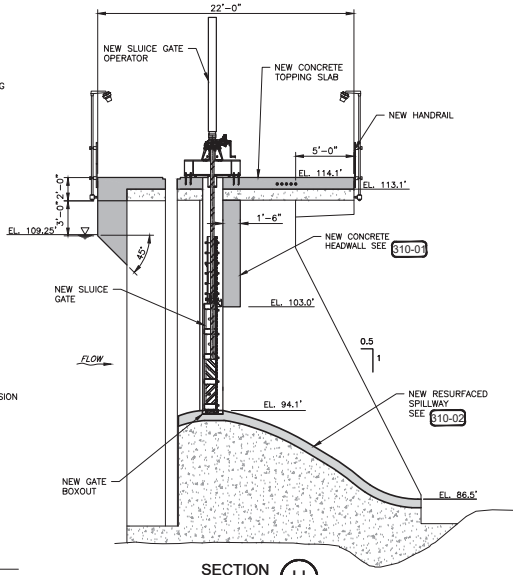
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PLAN @ EL. 113.6'
3/16"=1'-0"

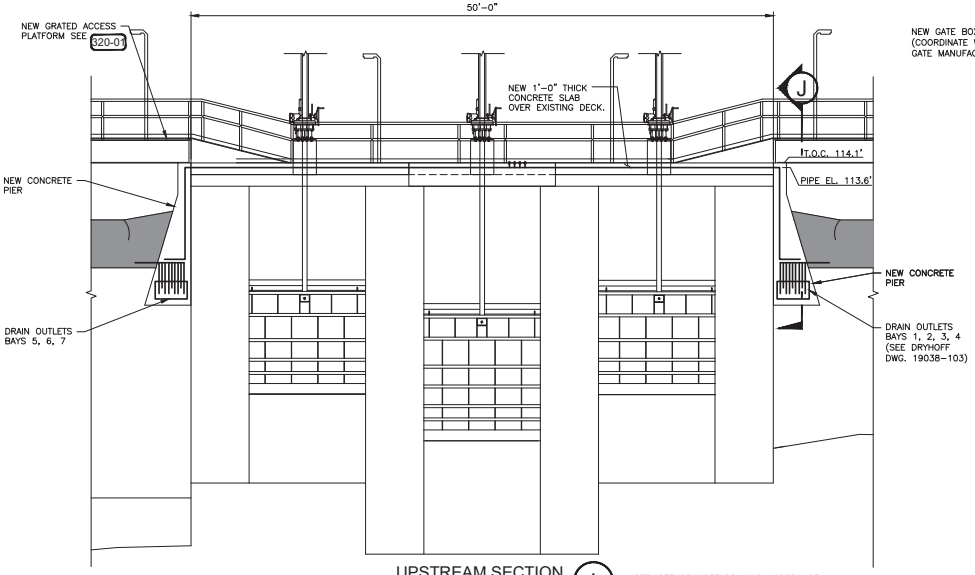


SECTION G
3/16"= 1'-0"



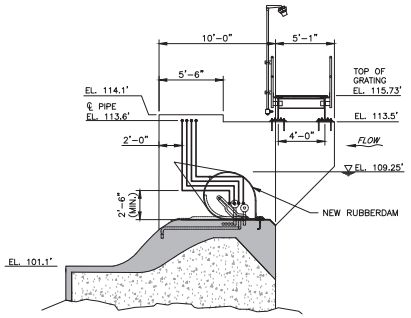
SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

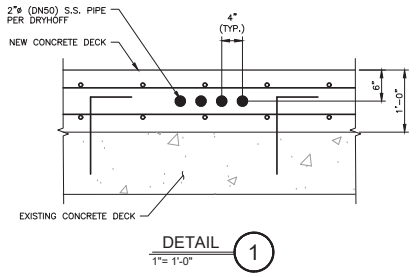


UPSTREAM SECTION I
3/16"= 1'-0"

NOTE: SEE DRYHOFF DRAWING 19038-103



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

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330-01

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DRYHOFF DRAWINGS 19038 PACKAGE NOV. 2019													
REFERENCE DRAWINGS	DWG.NO.												

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BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

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SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
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DATE 2020-12-11
W.O. XXXX

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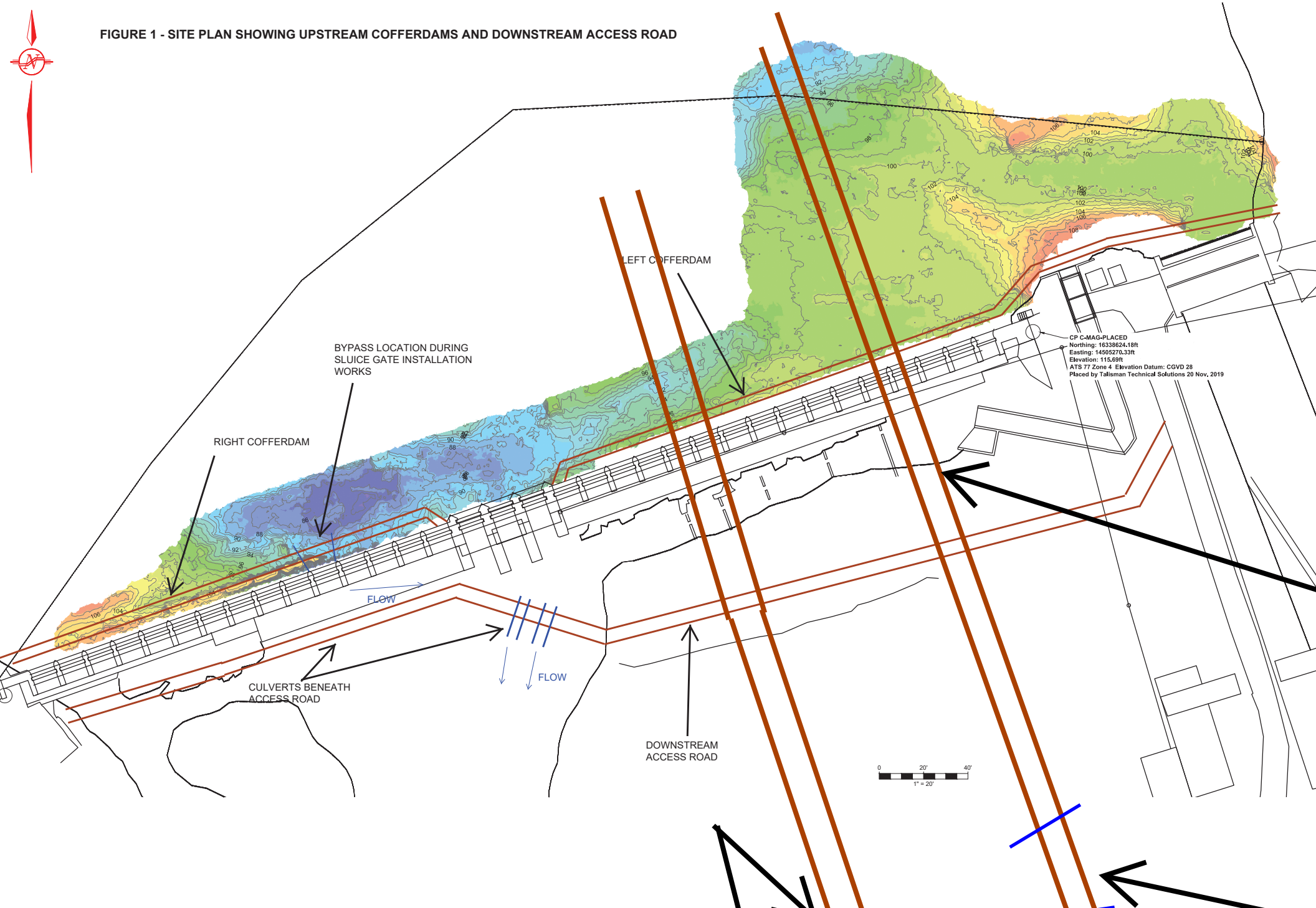
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

RUBBER DAM PIPING AT SLUICEWAY

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 0 REV. C

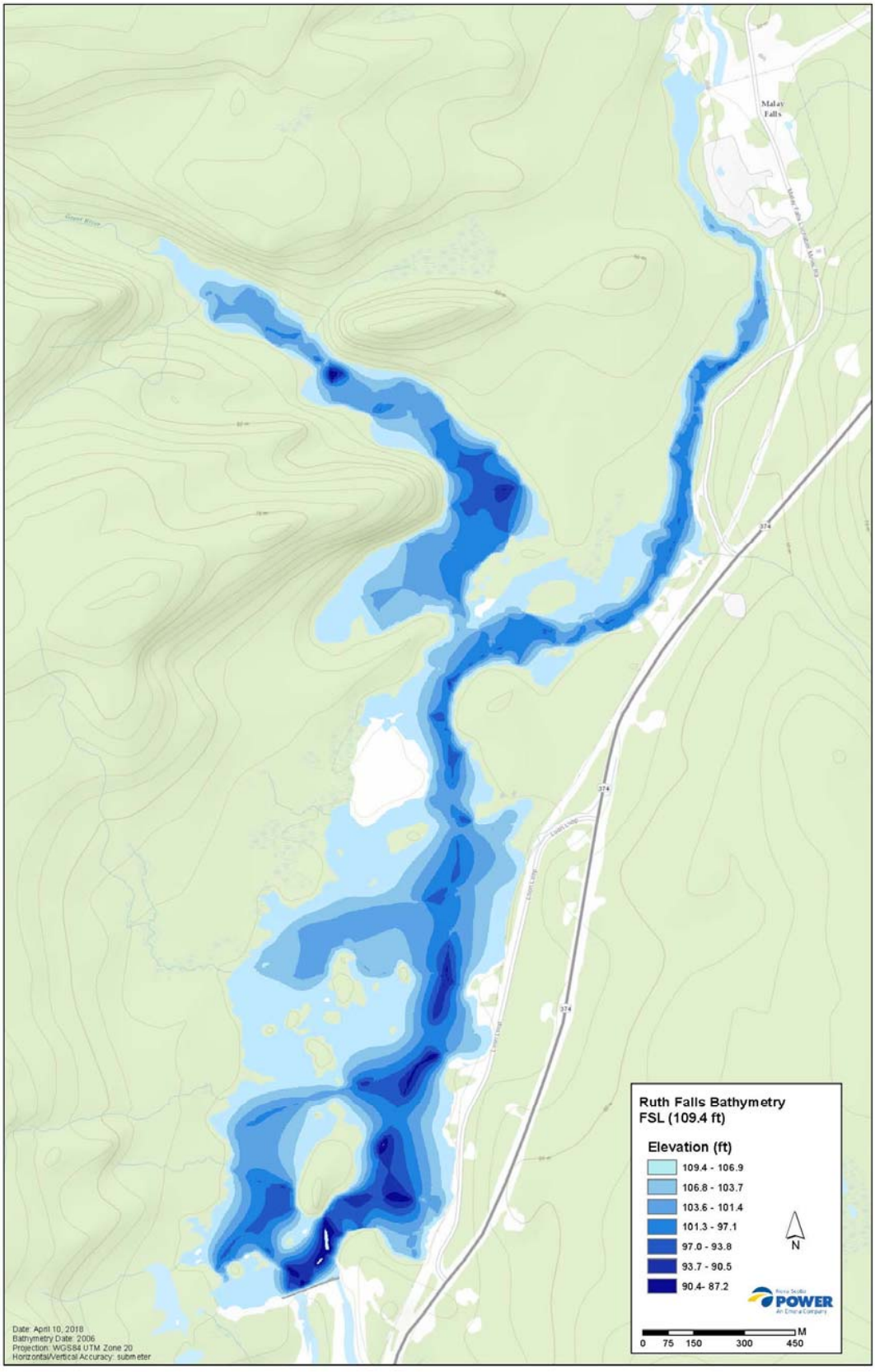
APPENDIX B – Proposed Water Management Structures

FIGURE 1 - SITE PLAN SHOWING UPSTREAM COFFERDAMS AND DOWNSTREAM ACCESS ROAD

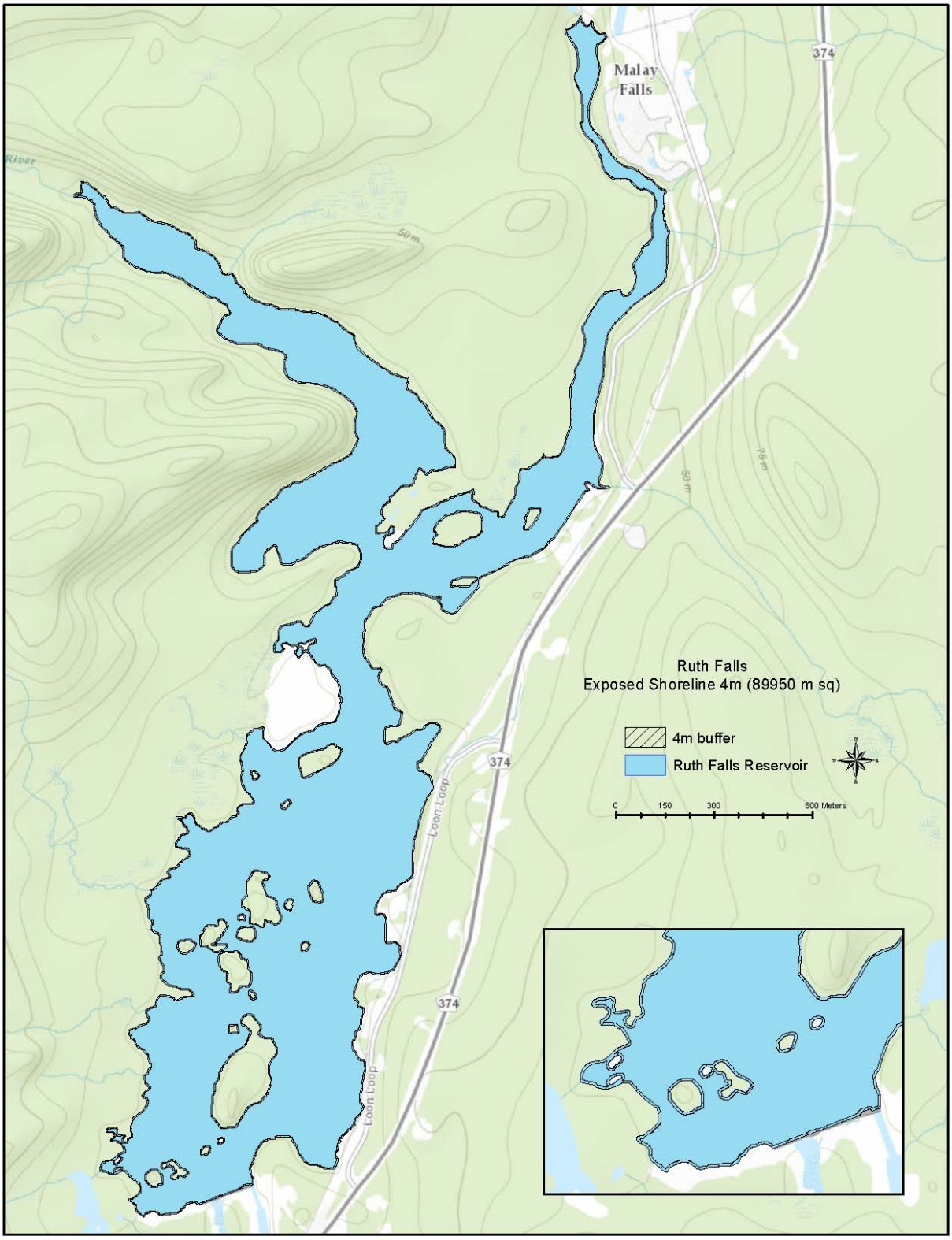


APPENDIX C – Bathymetry Mapping

Ruth Falls Dam Refurbishment
S 35(2)(b) Fisheries Act Authorization
Supporting Information #1
Monitoring Activities



Ruth Falls Dam Refurbishment
S 35(2)(b) Fisheries Act Authorization
Supporting Information #1
Monitoring Activities



Fisheries and Oceans Canada | Pêches et Océans Canada

Bedford Institute of Oceanography
1 Challenger Drive
P.O. Box 1006, Station P500
Dartmouth, Nova Scotia, B2Y 4A2

July 8, 2021

Our file Notre référence
19-HMAR-00549

Nova Scotia Power
Attention: Nadine Thomas
Environmental Scientist
PO Box 910
Halifax, NS B3J 2W5

Subject: Sheet Harbour Ruth Falls Headpond Dam Refurbishment – Application for a *Fisheries Act* Authorization – Incomplete or Inadequate

Dear Nadine Thomas:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) would like to acknowledge the receipt of your application for authorization under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* which was received on June 24, 2020 and supplemental information received on May 20, 2021. We understand that you were proposing to:

- Refurbish the dam located at Ruth Falls within the East River – Sheet Harbour Hydroelectric System, Halifax County, Nova Scotia. Work was proposed to include the drawdown of the headpond by 11.4 ft (3.4 m), replacement of 30 stop log bays, installation of an uncontrolled spillway, refacing concrete on the dam and spillways, and replacing the deep stop logs with a vertical lift gate. The work was anticipated to take 8-9 months and proposed to start in July 2021. During the construction period, the fish ladder would not be functional, reservoir operating requirements would not be maintained, and supplemental flows would not be provided. Water levels at Marshall Falls, upstream of Ruth Falls, would not be impacted by the activity.

Our review considered the following information:

- Fisheries and Oceans Canada Request for Review and attached information received via email from NS Power on December 2, 2019;
- Nova Scotia Environment Application for Approval and supporting documentation received December 27, 2019;
- Correspondence regarding additional information requested, received via email from NS Power on February 27, 2020;
- *Fisheries Act* Authorization application and supporting documents received via email from NSPI on June 24, 2020;
- Supplemental information requests received May 20, 2021; and

Fisheries and Oceans Canada | Pêches et Océans Canada

- Correspondence regarding changes to the scope of work and timelines, received via email from NS Power on July 6, 2021.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the *Aquatic Invasive Species Regulations*.

The aforementioned outcomes are prohibited unless authorized under their respective legislation and regulations.

Upon reviewing your application, the Program determined that some of the information and documentation set out in the *Authorizations Concerning Fish and Fish Habitat Protection Regulations* (the Regulations) has not been provided and as such, the application is incomplete or inadequate.

The following information and documentation is required in order for the application to be complete:

- As per communication from NS Power on July 6, 2021, the Program understands that the scope of work and timelines will change for the proposed project. Please provide a new Request for Review document to the Program that describes the revised scope of work and associated timelines.

Upon receipt of this outstanding information and documentation, the Program will notify you to confirm receipt. The Program will notify you as to whether the application is complete within a period of 60 days after receiving this outstanding information and documentation.

As changes to the scope of work and timelines are being proposed by the proponent, we are not providing comments the previous *Fisheries Act* Authorization application or supporting documents (including proposed monitoring plan) at this time.

If you have any questions, please contact Kelley Fraser at our Dartmouth office at 902-441-3671 or by email at kelley.fraser@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Kelley Fraser

Kelley Fraser
A/Senior Regulatory Reviews Biologist
Hydro and Flows

Nova Scotia POWER
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NOVA SCOTIA POWER INCORPORATED

SUPPORTING INFORMATION – APPLICATION FOR AUTHORIZATION - *FISHERIES ACT* –
RUTH FALLS DAM REFURBISHMENT
SHEET HARBOUR HYDRO SYSTEM

January 2022

Ruth Falls Dam Refurbishment
Application for Authorization – 34.4(2)(b) and 35(2)(b) Fisheries Act
Supporting Information

Nova Scotia POWER
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1.0 CONTACT INFORMATION

Nova Scotia Power Incorporated
Kailey Osborne
1223 Lower Water Street
Halifax, N.S.
B3J 3S8 (902) 266-2451
kailey.osborne@nspower.ca

2.0 DESCRIPTION OF PROPOSED WORK, UNDERTAKING OR ACTIVITY

NS Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2022. This work is necessary to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the spillway/sluiceway structures. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, two short concrete gravity bulkhead sections that abut either side of the spillway. There is currently a 15.2 m (50') long three-bay stoplog-controlled sluiceway section in the centre of the dam. The three-bay stop-log controlled sluiceway will be replaced with three screw-stem vertical lift gates in April 2022. The crest elevation of the spillway is 31.7 m (104') and stoplogs can be installed to an elevation of 33.3 m (109.3'). The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the power canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix A for mapping of the Sheet Harbour Hydro System and Appendix B for site photos.

The project involves the replacement of the existing 30 stoplog bays with seven (7) rubber dams, the replacement of the three (3) deep stoplog bays with vertical lift gates, and the construction of a free overflow spillway at the northwest (right end looking downstream) end of the dam. The first phase of the project will be to replace the three (3) deep stoplog bays with the vertical lift gates in the central portion of the dam and install the controls building. This work is tentatively scheduled for April/May of 2022 under a separate approval (2021-2840307-00). The installation of the vertical lift gates will provide improved water management throughout the main construction period.

The proposed refurbishment activities are broken up into two phases below, Phase 1 - the installation of the sluiceway gates (already approved under Approval 2021-2840307-00) and Phase 2 – the dam construction:

Phase 1 – Sluice gate installation:

- Installation of a bulkhead, exact method to be determined, to isolate the existing sluiceway section;

- Refurbishment of the original control building and existing low level sluiceway section with the removal of the stoplogs and replacing the stoplogs with three (3) low level sluice gates. The existing piers will remain in-place;
- Removal of bulkhead.

Phase 2 – Dam construction:

- Lowering of Ruth Falls Headpond approximately 18 feet;
- Dewatering of the Ruth Falls fishladder during the construction activities;
- Installation of temporary access for machinery on both the upstream and downstream sides of the dam, see below for more information on the access roads.
- Removal of the existing stoplog bays, piers, stoplog lifter and walkway;
- Reface the concrete on the crest and downstream slope of the spillway ogee sections;
- Installation of new rubber dam bladders on the crest of the ogee spillway sections;
- Construction of a free overflow spillway section at the right end of the dam;
- Installation of a new steel walkway for access across the dam;
- Removal of the temporary access road material;
- Watering up of the headpond to within normal operating levels.

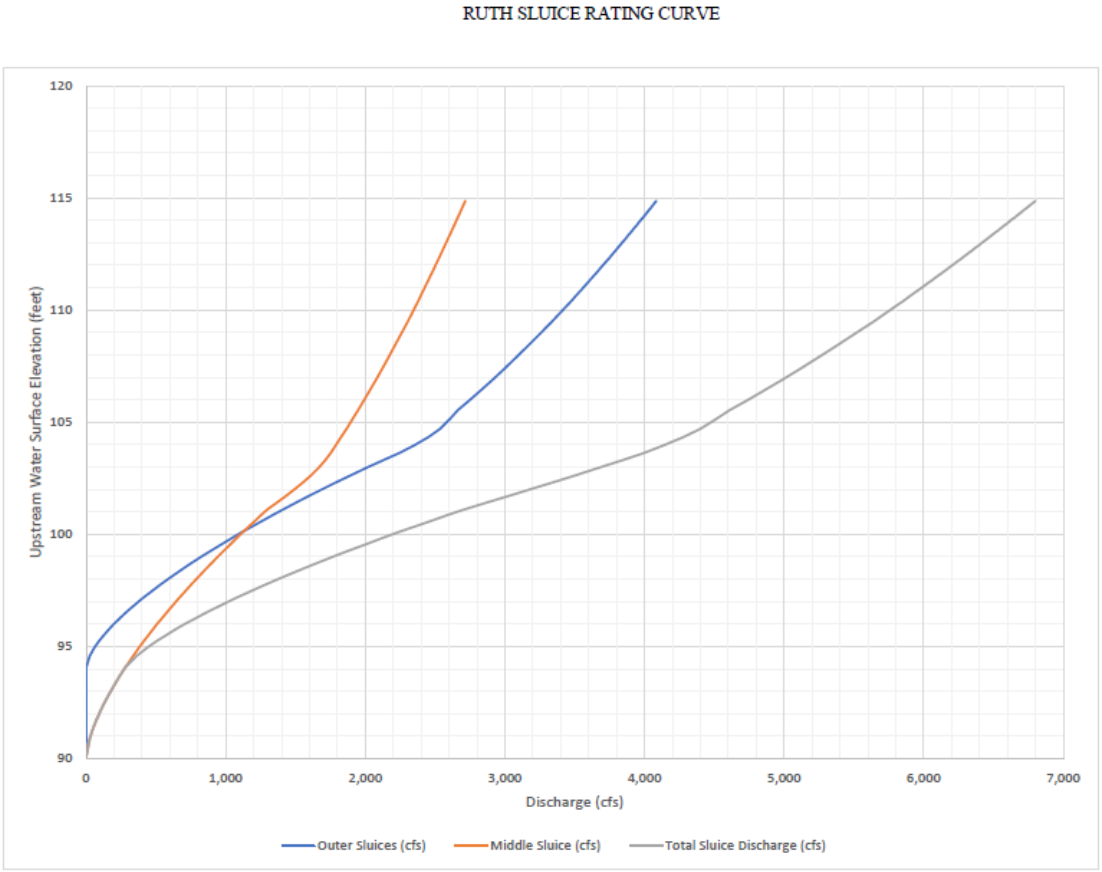
Following the completion of construction, discharge flows from the dam will not be changed or altered as a result of the Project. Operations will resume as normal once the headpond is back to within its normal operating levels.

The main construction works would begin in July 2022 and include the removal of the railings, log lifterand tracks, the demolition of the existing concrete deck, concrete piers, and chipping of the spillway crest and downstream face. Following the demolition, the spillway sections will be fitted with rebar, rubber dam piping and will be refaced with concrete on the crest and downstream slope of the spillway ogee section. New concrete piers will also be constructed between the rubber dams. Once the concrete has been resurfaced, the rubber dams will be installed and connected to the controls building which will have already been installed under approval 2021-2840307-00. The concrete retaining wall at the right end of the dam will also be replaced as part of the construction works. NS Power is anticipating an additional permanent instream footprint of approximately 60 m^2 (646 ft^2) on the downstream side of the dam to accommodate additional concrete requirements for ogee sections.

During normal operation, inflows in the reservoir are controlled by NS Power Hydro Operations. Water levels fluctuate between the full supply level of 33.7 m (110.5 ft), minimum supply level of 33.3 m (109.25 ft), and the low supply level of 27.5 m (90.1 ft). In order to complete work in dry conditions, the Project will include temporarily lowering the headpond and canal approximately 18 ft below the minimum operating level of 33.3 m (109.25') observed from April 1 – Nov 30 each year. To commence the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond

elevation from full supply level at 33.7 m (110.5 ft) to the minimum operating level of 33.3 m (109.25 ft). Once the headpond reaches an elevation of 33.3 m (109.25 ft), the drawdown will be controlled using the vertical lift deep sluice bay until the desired elevation of 27.7 m (91 ft) is achieved. The drawdown flow will be directed through areas that are part of the normal flowage channels. See flow curve below:

Figure 1: Ruth Sluice Rating Curve



Nova Scotia Environment (NSE) operating approval 2008-062826-01 stipulates annual environmental requirements associated with operations at Ruth Falls as follows:

- Year round: 35 cfs maintenance flow downstream of dam;
- April 1 – November 30: 6 cfs of 35 cfs maintenance flow provided to the fish ladder, 29 cfs provided to operate the louvers;
- April 1 – November 30: Minimum operating level of 33.3 m (109.4 ft.);
- May 15 – November 30: operation of the fish trap;
- Supplemental flows required June 15 – July 15 and September 26 – November 30 annually.

The required 35 cfs maintenance flow will be provided throughout construction via the sluiceway or spillway sections, as required. The remaining conditions will not be met, which will be addressed through a request for variance from the operating approval.

The approval also stipulates requirements for Marshall Falls (minimum elevation of 191.4' Apr 1 – Sept 1 and a year-round 45 cfs flow downstream of the dam). NS Power will maintain the 45 cfs flow release downstream of Marshall Falls via the Marshall Falls control gates. NS Power is requesting flexibility to the 191.4' elevation while remaining within normal operating levels to reduce uncontrolled spill in Malay Falls (downstream system of Marshall Falls) and eventually Ruth Falls during construction.

Temporary access for heavy machinery will be constructed on both the upstream and downstream sides of the dam. The upstream access roads will extend from the east and west shorelines towards the sluiceway. The access roads/cofferdams will be constructed using clean rockfill, see Appendix D-Proposed Water Management Structures.

Temporary access will also be constructed on the downstream side of the dam to access the right side of the dam. The rockfill access road will be equipped with a bridge that will be located over the discharge channel. The existing area just downstream of the dam consists of exposed bedrock and boulders. The water will flow downstream through the vertical lift sluiceway bay and under the temporary bridge., To reduce the need for a large structure required to satisfy the NS Watercourse Alteration Standard (requiring a bridge to have a width of 126 ft or 38.5 m), the contractor is proposing to make use of the storage capacity of the reservoir once drawn down, and install a bridge that is approximately 6 ft tall and 42 ft wide. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. If a heavy inlfux of water is expected, NS Power will notify the contractor and the bridge will be removed promptly to allow for excessive flow conditions that would be expected fro a 1:2 year return storm event. Appendix F – Monitoring Plan outlines the planned water management strategy.

Construction materials include; the rubber dam bladders and all associated parts and materials, concrete for free overflow spillway section, right retaining wall, piers, headwalls, and ogee refacing, the vertical slide gates, steel walkways and railings, and the components for the new control building. A list of other products to be used by the contractor will be submitted to NS Power prior to start of work for approval based on health, safety, and environmental parameters.

3.0 ENGINEERING SPECIFICATIONS

Engineering drawings for the proposed work are located in Appendix C.

4.0 PHASES AND SCHEDULE

The Project is expected to take approximately nine months starting mid July 2022 and ending by late March 2023. The Project and Environmental Description document submitted to NSE as part of the Watercourse Alteration Approval Application also outlines this timeframe. The work includes both the lowering and subsequent recharging of water in the headpond. The water level will be drawn down after July 10th, allowing time for fish eggs to hatch, and YoY Gaspereau to move downstream naturally or transported during fish rescue. Lowering the reservoir will occur after July 10th, and will take approximately 4 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream

erosion or scour is minimized and the possibility for entrainment of fish is low. Additional information regarding water management, erosion and sedimentation control, and environmental protection is described in the Monitoring Plan (Appendix F).

5.0 LOCATION

The Sheet Harbour Hydro System is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The hydro system has a drainage area of 573.9 km^2. Presently there are six (6) controlled reservoirs in the hydro system including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond, and Ruth Falls Headpond. The Sloane Reservoir is located near the headwaters of Seventeen Mile Stream, which passes through Anti Dam Reservoir and into Marshall Reservoir, then into the Malay Falls Headpond. The Malay Falls power canal conducts water from to the Malay Falls Generating Station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. The Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power.

Mapping, site photos, and engineering drawings are located in Appendices A, B, and C, respectively. The Property Identification Number for the Ruth Falls Dam is 40221673. GPS coordinates per coordination system NAD83, UTM Zone 20N are: 539,486 m Easting and 4,978,146 m Northing.

6.0 COMMUNITY

The Project site is located near the community of Sheet Harbour, HRM, Nova Scotia.

7.0 CONSULTATIONS

NS Power initiated Mi'kmaq engagement regarding the Ruth Falls Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant Project information with the KMKNO throughout 2018 providing six project updates, the project was then deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant Project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020.

NS Power presented the updated project information and design option to the KMKNO during the 2019 One Window meeting to discuss 2020 hydro capital projects. NS Power initiated engagement with the Millbrook Mi'kmaw community in January 2020 to provide an overview of the project and discuss next steps and approach to engagement for the project. This included working with the Mi'kmaw Conservation Group and the Millbrook Mi'kmaw community for a DFO Fisheries Act authorization offsetting project. In January 2020, NS Power initiated engagement with the Mi'kmaw Conservation Group to collaborate on an offsetting project. NS Power, in February and March 2020, continued

engagement with the Mi'kmaw Conservation Group, continuing discussions to identify an offsetting project with the group and the Millbrook Mi'kmaw community. NS Power participated in project meetings with the Millbrook Mi'kmaq community in January 2020 and summer 2021. The Millbrook community have expressed interested in Atlantic salmon and American eel; as such, a meeting is scheduled for January 2022 to further discuss American eel passage. NS Power will continue to engage the Millbrook Mi'kmaq community regarding the project. Weekly project manager communications will be available to the Millbrook Mi'kmaw community, as construction begins.

NS Power is planning to conduct public engagement for the Project with an Open House and provide local residents, along the Ruth Falls headpond, with relevant Project information and notification of the drawdown activities to conduct the Project. The public Open House and local resident communications will provide information in a timely manner about the Project, prior to drawdown activities and construction, increasing awareness and understanding of the Project scope, objectives, and timelines and addressing public areas of interest and potential concern.

8.0 DESCRIPTION OF FISH AND FISH HABITAT

The project site is located on the Ruth Falls Headpond in the NS Power Sheet Harbour Hydro System. Upstream of the dam is lake habitat while downstream of the dam is the East River of Sheet Harbour. The hydro system has been studied extensively as part of NS Power's hydro relicensing program. The most recent relicensing for Sheet Harbour was completed in 2018, during which various parameters including water quality and fish and fish habitat were studied. Qualitative and quantitative field studies were completed in the various reservoirs and streams of the hydro system. The 2018 Sheet Harbour Hydro System Relicensing Report was provided to DFO in 2018 and provides an indication of the fish species found in the system.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that higher returns will be observed in the East River over time. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system.

The Ruth Falls Headpond was sampled by NS Power in 2017 using gill nets, minnow traps and eel pots. Species found to be present in the headpond include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat is found in the area. Table 1 summarizes fish species caught in the headpond during 2017 surveys.

Table 1. Summary of fish sampled during the 2007 and 2017 Ruth Falls Reservoir surveys

Reservoir	Site #	Method	Species Caught	Number Caught	
				2007	2017
Ruth Falls	84	Minnow trap	Yellow perch	0	11
	85	Minnow trap	Yellow perch	0	12
	88	Minnow trap	Yellow perch	0	9
	89	Gill net	Brown bullhead	0	3

Reservoir	Site #	Method	Species Caught	Number Caught	
				2007	2017
			Speckled trout	3	3
			Unknown	1	0
			White sucker	7	13
			Yellow perch	2	7
	92	Eel pot	Brown bullhead	0	2
	94	Gill net	Alewife	0	3
			Brown bullhead	0	1
			Golden shiner	0	1
			Lake chub	0	1
			Speckled trout	1	3
			White sucker	2	21
			Yellow perch	0	9
	124	Eel pot	Brown bullhead	0	11
	125	Eel pot	American eel	6	1
			Brown bullhead	0	12
			Yellow perch	7	0
	126	Eel pot	American eel	4	0
			Brown bullhead	7	0
			White sucker	2	0
	128	Minnow trap	Yellow perch	8	5
	130	Minnow trap	Yellow perch	3	28

Fish sampling using an electrofisher was also conducted in stream sites located above the Ruth Falls Headpond on Grant River as well as one site located below the headpond on the East River of Sheet Harbour. Table 2 summarizes fish species captured during electrofishing surveys in 2006/7 and 2017.

Table 2. Summary of fish sampled during the 2006/2007 and 2017 stream electrofishing surveys

Location	Site #	Species	Number Caught	
			2006/7	2017
Grant River	43	American eel	2	4
		Brown bullhead	1	0
		Lake chub	0	7
		Pearl dace	4	0
		White sucker	0	1
	96	American eel	10	0
		Banded killfish	1	0
		Blacknose dace	1	0
		Lake chub	7	2
		Yellow perch	1	0
East River	68	American eel	2	0
		Lake chub	1	0

A physical fish habitat survey was also completed at all electrofishing sites. The substrate at Site 68 downstream of the Ruth Falls Dam was characterized by a mixture of boulder (50%), bedrock (40%), and cobble (10%). Habitat types observed were riffle (80%), smooth (10%) and rough (10%). Instream cover was noted as moderate while riparian vegetation included a canopy of 5% on the left bank and 0% on the right bank. A summary of physical characteristics of the downstream site (East River), as well as upstream sites on Grant River can be found in Table 3.

Table 3. Quantitative fish habitat data at stream sites near Ruth Falls in 2017.

Location	Area surveyed (m^2)	Gradient (%)	Flow m3/sec	Mean. water depth (m)	Max. water depth (m)	Mean velocity (m/s)	Max water velocity (m/s)
Grant River, site 43	254	1.28	-	0.19	0.24	-	-
Grant River, site 96	155	1.38	0.05	0.22	0.26	0.03	0.08
East River	203	1.32	-	0.36	0.46	-	-

Water quality sampling was performed at two sample sites in the Ruth Falls Headpond in 2017. pH in the headpond is considerably lower than reservoirs further upstream with a range of 4.32-5.14. Other water quality parameters measured were generally good. TDS is low, ranging from 9 mg/L to 12 mg/L, and conductivity ranges from 20 µS/cm to 23 µS/cm. Laboratory measurements of pH are considerably higher than in situ measurements, with values between 6.05 and 6.41. There are elevated metals concentrations in deeper waters, with exceedances of CCME FWAL guidelines for iron and zinc. Water quality measurements were taken at a site downstream of Ruth Falls in the East River of Sheet Harbour in 2017. pH was 4.94, dissolved oxygen was 10.23 mg/L, while conductivity was 20 µS/cm.

An ACCDC search of fish species at risk in the Sheet Harbour watershed identified American eel as threatened by COSEWIC while provincial rarity ranks of S3 was given to Alewife, Brook trout, and Lake trout; S2 to American eel; and S1 to Brook trout.

Inflows into the Ruth falls reservoir are controlled by NS Power Hydro Operations. Water levels can fluctuate between the full supply level of 33.7 m (110.5'), minimum supply level of 33.3 m (109.25'), and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.25') is observed from April 1 - Nov. 30 each year. As per the Sheet Harbour system Water Approval, a 35 cfs maintenance flow is provided downstream year-round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is set to accommodate downstream migration of all fish species found on the system. The fish ladder at Ruth Falls operates from May 15-November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 11 salmon have been captured since 2007 with no salmon being captured 2017 and 2018 and two in 2019.

9.0 DESCRIPTION OF EFFECTS ON FISH AND FISH HABITAT

The following water management strategies related to the Project have the potential to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat:

- The temporary drawdown of Ruth Falls Headpond, which could result in the temporary disruption of up to approximately 1.15 km^2 (115 hectares) of littoral zone habitat that fish species use for a portion of their life cycle (see Appendix A Bathymetry);

- The installation of a temporary bridge, cofferdams and access for machinery on both the upstream and downstream sides of the dam, resulting in a temporary instream footprint. The total estimated temporary instream footprint for control measures is 2,316 m^2.

- Death of fish due to entrainment and/or stranding from drawdown activities.

The Project will result in a permanent loss of fish habitat; however, based on the relatively small size (60 m^2), the Project will not be removing a critical piece of habitat from the ecosystem. The location immediately downstream of the dam, the bedrock substrate located in the area, and the lack of vegetation in the area. The temporary lowering of the reservoir approximately 18 feet will cause the biggest disruption; however, the potential effects of fish and fish habitat is low due to the following:

1. The drawdown is temporary and will not have a long-term effect on fish populations;
2. The headpond water level will be drawn down after spawning allowing time for eggs to hatch and YoY Gaspereau to move downstream naturally or transported during fish rescue. The drawdown is scheduled to occur no earlier than July 10th, 2022.
3. Measures will be put in place to ensure the safe upstream and downstream migration of fish during construction.
4. Preliminary data collected from ongoing monitoring for the Tusket Main Dam Refurbishment project drawdown in 2021 indicates that very little change to fish habitat has been observed

over an 8 month period, other than the temporary loss of available habitat as a direct result of the drawdown.

Project activities with the potential to impact fish and fish habitat have been identified and discussed in Table 4.

Table 4: Summary of potential effects on fish and fish habitat due to refurbishment of the Ruth Falls Main Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect
Temporary loss of fish habitat due to lowering reservoir beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.15 km^2 in Ruth Falls Headpond	High	Low
Temporary loss of fish habitat due to temporary installation of access road/crossings and cofferdams.	Localized: area immediately upstream and downstream of the dam	High	Low
Loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly downstream of the dam	High	Low
Fish mortality due to stranding when lowering reservoir.	Localized: Ruth Falls Headpond	Low	Low
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low
Potential downstream scour during drawdown of reservoir.	Localized: East River of Sheet Harbour	Low	Low
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High

There are no formal fisheries management objectives for the East River of Sheet Harbour; however, the streams and reservoirs are used for recreational fishing by the local community.

10.0 FISH PASSAGE

The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvre system is made up of a series of removeable louvres (vertical slats) designed by DFO installed at the upstream end of the Ruth Falls canal. The louvres prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance.

Fish move upstream via the fish ladder, which operates from May 15-November 1st annually with a flow of 6 cfs. Species found to be present in Ruth Falls Headpond from the 2017 relicensing survey outlined in Section 8 include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker, and yellow perch. This provides an indication of successful upstream migration using the fish ladder. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is set to accommodate downstream migration of all fish species found on the system.

In October 2010, NS Power conducted a study where over 150 American “silver” eels (sexually mature adults) were captured in the East River and implanted with individually identifiable PIT tags (passive). Thirty of the eels also received a surgically implanted active acoustic transmitter. The tagged fish were then released 4 km (2.49 miles) upstream of the louver guidance system. An array of acoustic receivers was placed along the watershed as well as in the harbour and the outer portion of the Sheet Harbour estuary to allow tracking of the downstream movement of the fish through the system.

The analysis of the data indicated that:

- All 30 acoustic tags were detected at Ruth Falls.
- Overall, close to 57% of the tracked eels reached the estuary:
    - 1/3 of the acoustically tagged fish were diverted through the bypass.
    - 40% of the fish that did not get diverted survived the turbines.

Overall, the study demonstrated that eels are being diverted through the bypass away from the canal; however, not all eels were diverted. NS Power has identified areas of potential improvements to the existing louvre system that may effectively improve the efficacy of the louvre system at bypassing eels downstream. See Appendix I – Downstream Eel Passage Study for further details.

NS Power will engage a professional engineering and fish passage consultant to perform an assessment on the existing louvre system and recommend modifications that will look to improve the functionality and effectiveness of bypassing eels around the power canal. The engineering company will be experienced in fish passage design and will evaluate the louvre system based on the effectiveness to by-pass American eel. The assessment will also include a desktop literature review of louvre systems in relation to eel by-pass and the proposed modifications will be required to meet USFWS Fish Passage Engineering Design Criteria. Modification to the system will be made based on the results of the engineer assessment. Modifications to the louvre system will be completed based on the scheduling of the hired engineering firm and Ruth Falls operation schedule. After the modifications have been made, NS Power will conduct a study to compare the results of the baseline study conducted in 2010 to the post modification louvre system. A similar method will be used where American eel will be captured and equipped with acoustic tags, released upstream and monitored for movement. NS Power expects that improvements made to the louvre system will be reflected in an increase in American eels being

diverted to the bypass pipe. The results of the post modification study will be submitted to DFO. Refer to the Monitoring Plan (Appendix F) for additional details.

11.0 MEASURES AND STANDARDS TO AVOID OR MITIGATE SERIOUS HARM TO FISH

NS Power recognizes DFO's mitigation hierarchy, which emphasizes that efforts must be made to prevent impact first and, where avoidance is not possible, efforts must be made to minimize impacts. Any residual impacts require authorization and must be addressed by offsetting measures. All materials stored on site shall be stored, handled and labeled according to Workplace Hazardous Materials Information System (WHMIS) regulations, as well as any other applicable federal or provincial regulation, if applicable. Product Safety Data Sheets (SDS) shall be available on site at all times. All construction material and debris will be stored in designated areas on NS Power property away from watercourses and wetlands and in a manner that will prevent materials from entering a watercourse, for example, in seacans and/or on containment, as required. Debris that requires disposal will be done so in accordance with application regulations and guidelines.

While working with and/or applying materials, measures will be taken to prevent any materials from entering the watercourse by applying materials in a controlled manner and containing excess material during application.

Table 5 summarizes the potential effects and mitigation measures to be employed to avoid direct or indirect impacts to fish and fish habitat. Therefore, no permanent impacts to the East River of Sheet Harbour or to Ruth Falls Headpond (beyond the 60 m^2 new dam footprint) in relation to its qualitative, chemical and physical characteristics are anticipated as a result of the Project for the new dam structure.

Table 5: Summary of potential impacts associated with the Project and mitigation measures to prevent or minimize impacts.

Potential Effect	Measure to Mitigate Serious Harm
Temporary loss of fish habitat (approximately 1.15 km^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the headpond approximately 18' is required in order to complete work in dry conditions and is a necessary step to facilitate the refurbishment of the Ruth Falls dam. Leaving the headpond within normal operating range as well as conducting a lesser drawdown to a higher elevation were both considered; however both would require substantial cofferdams and bulkheads to isolate work areas. It was determined that for the safety of NS Power and contractor staff during refurbishment and constructability of the new dam, a full drawdown to 91 ft was required. NS Power accepts that the drawdown of Ruth Headpond will result in a temporary HADD of fish habitat and is an impact that cannot be avoided. NS Power is proposing some mitigation to reduce the impact of the temporary drawdown on fish habitat: Lowering the headpond will occur in July and will take approximately 4 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Headpond coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NS Power will lower the headpond to 91ft to create dry conditions while still ensuring enough water is available to maintain a 35 cfs flow below the dam. In addition, offsetting as described in section 16 is considered appropriate mitigation to offset the temporary loss of habitat (1.15 km^2) during the 2022 season.
Temporary loss of fish habitat due to installation of access road/crossings and cofferdams.	The means for moving machinery from one side of the dam to the other will be via temporary bridge crossing downstream of the dam. Should 1:2 year return storm conditions arise, the temporary bridge installed downstream will be removed promptly by the contractor using an excavator or crane on site (refer to section 4.1 for details). Upstream, two cofferdams will be placed on either side of the sluiceway while leaving a space in the center for water to flow through and out through the vertical lift gates. The site can only be accessed from the east side. There is no access or potential to create access from the west side. Temporary access will be constructed using clean rockfill materials and totals an estimated temporary footprint of 2000 m2. On the upstream side, access roads will be placed after the headpond has been drawdown and a large portion (over70%) will be installed above 91 ft elevation. All materials will be removed following the work and the site remediated back to its original condition. Fish monitoring and rescue during cofferdam installation will be conducted by qualified individuals.
Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately downstream of the dam, which is primarily bedrock and does not provide spawning habitat or cover for fish, offsetting described in Section 16 is considered appropriate mitigation to offset serious harm.

Potential Effect	Measure to Mitigate Serious Harm
Fish mortality due to stranding when lowering headpond	In order to conduct work in dry conditions, the headpond will be lowered approximately 18' below the minimum operating level of 109.25' observed from April 1st to November 30th each year. The drawdown of the headpond will be monitored by qualified staff from NS Power Environmental Services to ensure no fish become stranded in pools or low spots. If stranded fish are found, qualified staff will capture the fish immediately and move them to deeper faster flowing water. NS Power has proposed a mechanism to evaluate and assess mortality as a result of stranding in the monitoring plan in Appendix F and has proposed offsetting measures to compensate for any mortality.
Fish Mortality due to entrainment during headpond lowering	In order to drawdown Ruth Headpond, the new vertical lift gates or deep stoplog bays will be used to discharge water gradually over a period of 4 days. A drawdown schedule is provided in the monitoring plan in Appendix F. The purpose of extending the drawdown for 4 days is to reduce potential for erosion, scour and reduce the likelihood and extent of potential entrainment of early life stage fish below the dam. Typically, Ruth Falls headpond can be lowered in 1 day. Gates / stoplogs will be opened gradually in order for water levels upstream to equalize and discharge downstream to remain within typical volumes and velocities observed at the dam during normal operation. NS Power is proposing entrainment monitoring to evaluate potential entertainment during the drawdown, and has proposed offsetting measures to compensate for any associated fish mortality.
Potential downstream scour during drawdown of reservoir.	NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 110.5 ft to the minimum operating level of 109.25 ft. Once the headpond reaches an elevation of 109.25 ft, the drawdown will be controlled using the vertical lift gate deep sluice bay. As the reservoir is lowered enough to make the canal non-operational, fish will be prevented from passing downstream through the bypass and therefore, will be passed through the vertical lift sluice gate bay. The drawdown will continue by using the vertical lift deep sluice bay to pass water while not exceeding 500 cfs at anytime during the drawdown. The drawdown will continue in this manner until the desired elevation of 91.0 ft is reached. NS Power is not anticipating any additional impacts with respect to erosion/scour or sedimentation during the drawdown as the discharge channel immediately downstream of the dam is comprised of bedrock and boulders. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NS Environment and Climate Change (ECC), and make necessary repairs in order to stabilize the area.
Inability to provide safe fish passage upstream and downstream during construction.	During construction, the fish ladder and fish bypass will be dewatered. The drawdown will be conducted in mid-July to avoid the upstream gaspereau migration season and allow fish to spawn and eggs to hatch. Once the headpond is drawn down, upstream and downstream migration will be provided via the deep stoplog bays/vertical lift gates located in the center of the dam. Continuous free water passage will be provided through the gate bays in order to maintain the desired construction elevation, provide downstream maintenance flows and maintain fish passage, depending on elevations and construction sequencing NS Power will determine with the contractor which gates/bays are opened to achieve this throughout construction.

Potential Effect	Measure to Mitigate Serious Harm
Inability to monitor for salmon while trap is out of service.	Given that the salmon trap is tied directly to operation of the fish ladder and the extremely low returns of salmon to the East River Sheet Harbour and absence of salmon caught in the trap for the last number of years, NS Power will not be operating the trap while the fish ladder is dewatered to accommodate construction in 2022. Fish passage will be provided through the verticle lift deep sluice bay as an alternate form of passage to the ladder, however salmon will not be counted. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request in 2022.
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15 – July 15 and September 26 – November 30. These flows are meant to simulate large rain events, which typically trigger salmon to move upstream. Since 2007, only 12 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018 and two in 2019. Salmon tend to prefer migrating to the West River of Sheet Harbour. NS Power will also be providing continuous water passage through the verticle lift deep sluice bays, the amounts of which will vary over the course of construction depending on inflows. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2022 season will cause serious harm to the salmon population. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request.
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NS Power's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. The successful contractor will be required to submit a site-specific erosion and sedimentation control plan prior to start of construction. Excavation is not required; therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The headpond will be monitored during dewatering for sediment and the rate of dewatering decreased as required.
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber	For better water management capabilities at the Ruth Falls Dam, the proposed refurbishment will include the installation of three new vertical lift gates in place of the existing stoplog controlled sluiceway bays (same dimensions). It will also include the replacement of the stoplog controlled overflow spillway section with rubber dam sections. As such, there will be some change in operation of the dam post-construction compared to existing operations. Currently, water is managed by pulling stoplogs either from the deep stoplog bays or overflow spillway sections of the dam.

Potential Effect	Measure to Mitigate Serious Harm
dam spillway.	Post-construction, the majority of water control will be done using the vertical lift gates, and rubber dams maintained at full supply elevation. There are two potential impacts to fish and fish habitat as a result of this: • Some loss of surface downstream passage for surface-oriented fish species, that would typically pass over top of the existing stoplog bays; • Potential changes to entrance conditions of the Ruth Falls fish ladder as a result of submerged discharge through the new gates (vs. surface overflow from stoplog bays). With respect to loss of some surface downstream passage, NS Power acknowledges that surface downstream passage will not be possible with the new vertical lift gates but also notes that surface passage is still present over top the newly installed rubber dams and free overflow section of the new dam structure. The newly installed rubber dams are remotely operated and are also able to deflate as required to pass additional water. With respect to potential impacts to entrance conditions of the Ruth Falls fish ladder as a result of the operation of the vertical lift gates, NS Power does not anticipate this change in flow to impact the ability for fish to sense the attraction flow from the fish ladder and find the fish ladder entrance. Currently, all discharge from the dam collects in the existing sluiceway channel immediately below the deep stoplog bays and this will not change as a result of the new dam operation. There may be some increase in velocity within the channel as a result of submerged flow during operation of the vertical lift gates, but this will be mostly concentrated to the centre of the new sluice structure as the middle gate will be operated first and in most circumstances (unless a significant return period event is expected). As with other dams, fish likely move upstream to the fish ladder entrance while hugging the shoreline of the downstream channel to avoid higher discharges in the centre of the channel, and this is not anticipated to change as a result of the new dam operation. NS Power is proposing post-construction monitoring of the Ruth Falls fish ladder for a period of two years, starting in spring 2023 to ensure the operation of the dam is not resulting in any impacts to the effectiveness of the fish ladder for upstream migration. NS Power does have the ability to make immediate modifications to dam operation using the vertical lift gates and rubber dams, if impacts are observed.

12.0 MONITORING MEASURES

Monitoring will be completed pre-construction, during and post-construction to ensure mitigation measures proposed for potential impacts identified in Table 5 are effective. NS Power has developed a monitoring plan (Appendix F), which outlines the following:

-Fish Rescue
-Tributary Monitoring
-Egg/larvae stranding
-Entrainment monitoring
-Vegetation transects
-Construction monitoring
-Wetland Monitoring
-Post-construction monitoring activities

A Project-specific environmental protection plan (EPP) will be developed to address all potential environmental risks associated with the Project and will include appropriate incident reporting procedures and key contacts. The Contractor will be required to review the EPP and provide training to all staff with respect to its contents.

13.0 CONTINGENCY MEASURES

Both upstream and downstream fish passage will be closely monitored throughout construction. Should issues arise, the situation will be immediately assessed and decisions made regarding alternate methods by the Contractor, Project Manager and Engineers, Environmental Services, and Hydro Operations. Should mitigation measures described in Section 10 prove to be ineffective, work will be stopped and issues reported to NS Power for resolution and reporting as required. By following the EPP, providing environmental orientation, providing appropriate supervision, conducting frequent inspections, and monitoring weather forecasts, it is not anticipated that there will be significant issues with the proposed mitigation. Contingency planning is also considered regarding water management. Should unexpected inflows be received, NS Power will implement contingencies to safely pass water. This may include the addition of sandbags on the upstream crest of the cofferdams to accommodate increased water levels. If extreme heavy rain or significant sustained inflows are forecasted, NS Power will develop a plan to accommodate the expected increased inflows and make adjustments to the construction activities. Details surrounding water management contingency measures can be found in Appendix F.

14.0 DEATH OF FISH AND HARMFUL ALTERATION, DISRUPTION, OR DESTRUCTION OF FISH HABITAT AFTER IMPLEMENTATION OF MEASURES AND STANDARDS

Table 6 provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Dam refurbishment.

Table 6: Residual Harm from Potential Impacts Associated with the Ruth Falls Dam Refurbishment

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Temporary loss of fish habitat (approximately 1.15 km^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the headpond approximately 18' is required in order to complete work in dry conditions and is a necessary step to facilitate the refurbishment of the Ruth Falls dam. Leaving the headpond within normal operating range as well as conducting a lesser drawdown to a higher elevation were both considered; however both would require substantial cofferdams and bulkheads to isolate work areas. It was determined that for the safety of NS Power and contractor staff during refurbishment and constructability of the new dam, a full drawdown to 91 ft was required. NS Power accepts that the drawdown of Ruth Headpond will result in a temporary HADD of fish habitat and is an impact that cannot be avoided. NS Power is proposing some mitigation to reduce the impact of the temporary drawdown on fish habitat: Lowering the headpond will occur in July and will take approximately 4 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Headpond coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NS Power will lower the headpond to 91ft to create dry conditions while still ensuring enough water is available to maintain a 35 cfs flow below the dam. In addition, offsetting as described in section 16 is considered appropriate mitigation to offset the temporary loss of habitat (1.15 km^2) during the 2022 season.	No residual harm anticipated, other than temporary direct loss. Offsetting proposed
Temporary loss of fish habitat due to installation of access road/crossings and cofferdams.	The means for moving machinery from one side of the dam to the other will be via temporary bridge crossing downstream of the dam. Should 1:2 year return storm conditions arise, the temporary bridge installed downstream will be removed promptly by the contractor using an excavator or crane on site (refer to section 4.1 for details). Upstream, two cofferdams will be placed on either side of the sluiceway while leaving a space in the center for water to flow through and out through the vertical lift gates. The site can only be accessed from the east side. There is no access or potential to create access from the west side. Temporary access will be constructed using clean rockfill materials and totals an estimated temporary footprint of 2000 m2. On the upstream side, access roads will be placed after the headpond has been drawdown and a large portion (over70%) will be installed above 91 ft elevation. All materials will be removed following the work and the site remediated back to its original condition. Fish monitoring and rescue during cofferdam installation will be conducted by qualified individuals.	No residual harm anticipated

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately downstream of the dam, which is primarily bedrock and does not provide spawning habitat or cover for fish, offsetting described in Section 16 is considered appropriate mitigation to offset serious harm.	Loss of 60 m^2 of fish habitat immediately below the Ruth Falls Dam
Fish mortality due to stranding when lowering headpond	In order to conduct work in dry conditions, the headpond will be lowered approximately 18' below the minimum operating level of 109.25' observed from April 1st to November 30th each year. The drawdown of the headpond will be monitored by qualified staff from NS Power Environmental Services to ensure no fish become stranded in pools or low spots. If stranded fish are found, qualified staff will capture the fish immediately and move them to deeper faster flowing water. NS Power has proposed a mechanism to evaluate and assess mortality as a result of stranding in the monitoring plan in Appendix F and has proposed offsetting measures to compensate for any mortality.	No residual harm anticipated
Fish Mortality due to entrainment during headpond lowering	In order to drawdown Ruth Headpond, the new vertical lift gates or deep stoplog bays will be used to discharge water gradually over a period of 4 days. A drawdown schedule is provided in the monitoring plan in Appendix F. The purpose of extending the drawdown for 4 days is to reduce potential for erosion, scour and reduce the likelihood and extent of potential entrainment of early life stage fish below the dam. Typically, Ruth Falls headpond can be lowered in 1 day. Gates / stoplogs will be opened gradually in order for water levels upstream to equalize and discharge downstream to remain within typical volumes and velocities observed at the dam during normal operation. NS Power is proposing entrainment monitoring to evaluate potential entertainment during the drawdown, and has proposed offsetting measures to compensate for any associated fish mortality.	No residual harm anticipated

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Potential downstream scour during drawdown of reservoir.	NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 110.5 ft to the minimum operating level of 109.25 ft. Once the headpond reaches an elevation of 109.25 ft, the drawdown will be controlled using the vertical lift gate deep sluice bay. As the reservoir is lowered enough to make the canal non-operational, fish will be prevented from passing downstream through the bypass and therefore, will be passed through the vertical lift sluice gate bay. The drawdown will continue by using the vertical lift deep sluice bay to pass water while not exceeding 500 cfs at anytime during the drawdown. The drawdown will continue in this manner until the desired elevation of 91.0 ft is reached. NS Power is not anticipating any additional impacts with respect to erosion/scour or sedimentation during the drawdown as the discharge channel immediately downstream of the dam is comprised of bedrock and boulders. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NS Environment and Climate Change (ECC), and make necessary repairs in order to stabilize the area.	No residual harm anticipated
Inability to provide safe fish passage upstream and downstream during construction.	During construction, the fish ladder and fish bypass will be dewatered. The drawdown will be conducted in mid-July to avoid the upstream gaspereau migration season and allow fish to spawn and eggs to hatch. Once the headpond is drawn down, upstream and downstream migration will be provided via the deep stoplog bays/vertical lift gates located in the center of the dam. Continuous free water passage will be provided through the gate bays in order to maintain the desired construction elevation, provide downstream maintenance flows and maintain fish passage, depending on elevations and construction sequencing NS Power will determine with the contractor which gates/bays are opened to achieve this throughout construction.	No residual harm anticipated
Inability to monitor for salmon while trap is out of service.	Given that the salmon trap is tied directly to operation of the fish ladder and the extremely low returns of salmon to the East River Sheet Harbour and absence of salmon caught in the trap for the last number of years, NS Power will not be operating the trap while the fish ladder is dewatered to accommodate construction in 2022. Fish passage will be provided through the verticle lift deep sluice bay as an alternate form of passage to the ladder, however salmon will not be counted. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request in 2022.	No residual harm anticipated

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15 – July 15 and September 26 – November 30. These flows are meant to simulate large rain events, which typically trigger salmon to move upstream. Since 2007, only 12 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018 and two in 2019. Salmon tend to prefer migrating to the West River of Sheet Harbour. NS Power will also be providing continuous water passage through the verticle lift deep sluice bays, the amounts of which will vary over the course of construction depending on inflows. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2022 season will cause serious harm to the salmon population. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request.	No residual harm anticipated
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NS Power's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. The successful contractor will be required to submit a site-specific erosion and sedimentation control plan prior to start of construction. Excavation is not required; therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The headpond will be monitored during dewatering for sediment and the rate of dewatering decreased as required.	No residual harm anticipated
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.	No residual harm anticipated
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled	For better water management capabilities at the Ruth Falls Dam, the proposed refurbishment will include the installation of three new vertical lift gates in place of the existing stoplog controlled sluiceway bays (same dimensions). It will also include the replacement of the stoplog controlled overflow spillway section with rubber dam sections. As such, there will be some change in operation of the dam post-construction compared to existing operations. Currently, water is managed by pulling stoplogs either from the deep stoplog bays or	No residual harm anticipated

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
to rubber dam spillway.	overflow spillway sections of the dam. Post-construction, the majority of water control will be done using the vertical lift gates, and rubber dams maintained at full supply elevation. There are two potential impacts to fish and fish habitat as a result of this: • Some loss of surface downstream passage for surface-oriented fish species, that would typically pass over top of the existing stoplog bays; • Potential changes to entrance conditions of the Ruth Falls fish ladder as a result of submerged discharge through the new gates (vs. surface overflow from stoplog bays). With respect to loss of some surface downstream passage, NS Power acknowledges that surface downstream passage will not be possible with the new vertical lift gates but also notes that surface passage is still present over top the newly installed rubber dams and free overflow section of the new dam structure. The newly installed rubber dams are remotely operated and are also able to deflate as required to pass additional water. With respect to potential impacts to entrance conditions of the Ruth Falls fish ladder as a result of the operation of the vertical lift gates, NS Power does not anticipate this change in flow to impact the ability for fish to sense the attraction flow from the fish ladder and find the fish ladder entrance. Currently, all discharge from the dam collects in the existing sluiceway channel immediately below the deep stoplog bays and this will not change as a result of the new dam operation. There may be some increase in velocity within the channel as a result of submerged flow during operation of the vertical lift gates, but this will be mostly concentrated to the centre of the new sluice structure as the middle gate will be operated first and in most circumstances (unless a significant return period event is expected). As with other dams, fish likely move upstream to the fish ladder entrance while hugging the shoreline of the downstream channel to avoid higher discharges in the centre of the channel, and this is not anticipated to change as a result of the new dam operation. NS Power is proposing post-construction monitoring of the Ruth Falls fish ladder for a period of two years, starting in spring 2023 to ensure the operation of the dam is not resulting in any impacts to the effectiveness of the fish ladder for upstream migration. NS Power does have the ability to make immediate modifications to dam operation using the vertical lift gates and rubber dams, if impacts are observed.	

15.0 HABITAT CREDIT

Habitat Credits will not be used as an offset for death of fish or the harmful alteration, disruption, or destruction of fish habitat as described in Sections 13 and 14.

16.0 OFFSETTING CREDIT

NS Power is proposing, in partnership with the Mi'kmaw Conservation Group (MCG) and the Nova Scotia Salmon Association (NSSA), a restoration project that is suitable for offsetting of serious harm for the Ruth Falls Dam refurbishment and the Sloane Reservoir Wing Dam 2 refurbishment project in conjunction. The amount of fish habitat permanently impacted due to infilling associated with the Sloane Wing Dam project is 900 m^2. The amount of habitat potentially impacted temporarily due to lowering of the headpond for the duration of the Ruth Falls project is approximately 1.15 km^2 applying a 3:1 ratio results in a maximum approximate offset of 5000 m^2. MCG has provided an offsetting plan to NS Power which outlines the proposed project. The project includes improvements to fish migration and fish habitat by restoring suitable instream and streambank habitat on the West River Sheet Harbour watershed. MCG will provide oversight and guidance on the project and will also collaborate with the Millbrook First Nations Community on the project in order to potentially engage community members to implement habitat offset work. Appendix G provides full offsetting plan details.

The following is a summary of project execution:

Year One (1): Finalize the footprint of the restoration area, conducting any pre-monitoring activities needed (incorporating any relevant and available data in the baseline), securing all permitting and permissions, and finalizing a post monitoring plan.

Year Two (2): Perform largescale restoration work within the middle section (between two previously restored areas by the NSSA) of the West River.

Year Three (3) through seven (7): Post monitoring of sites where offsetting work was completed. Post-offset monitoring will be completed in years three (3), five (5), and seven (7). A final report will be completed at the end of year seven (7).

NS Power has obtained a letter of credit for the offset project, which was estimated based on a 5:1 ratio for the Sloane project. This will be followed by submission of an offsetting plan once available. The amount of the letter of credit was estimated based on the cost for a previous offsetting plan developed by MCG for a project conducted at the Trenton Generating Station in 2019. The amount of the letter of credit will be adjusted once the cost for the offsetting project is finalized by MCG. A Letter of Credit for $62,000 is presented in Appendix H.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Reservoir Bathymetry
3. Ruth Falls Reservoir Location of Structures

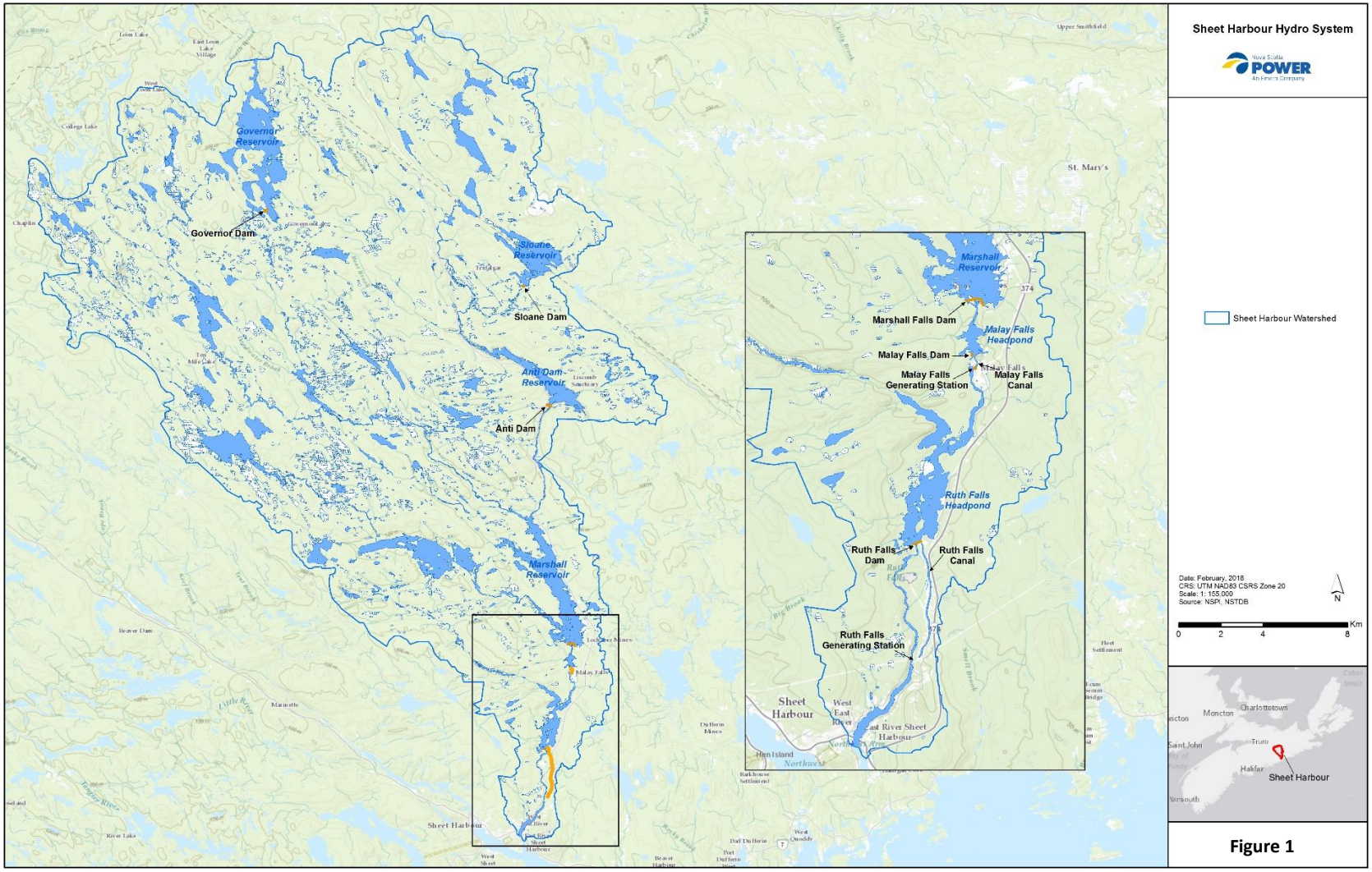

Sheet Harbour Hydro System
Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
Sheet Harbour Watershed
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1: 155,000
Source: NSPI, NSTDB
0 2 4 8 Km
Moncton
Charlottetown
Saint John
Truro
Halifax
Sheet Harbour

Figure 1

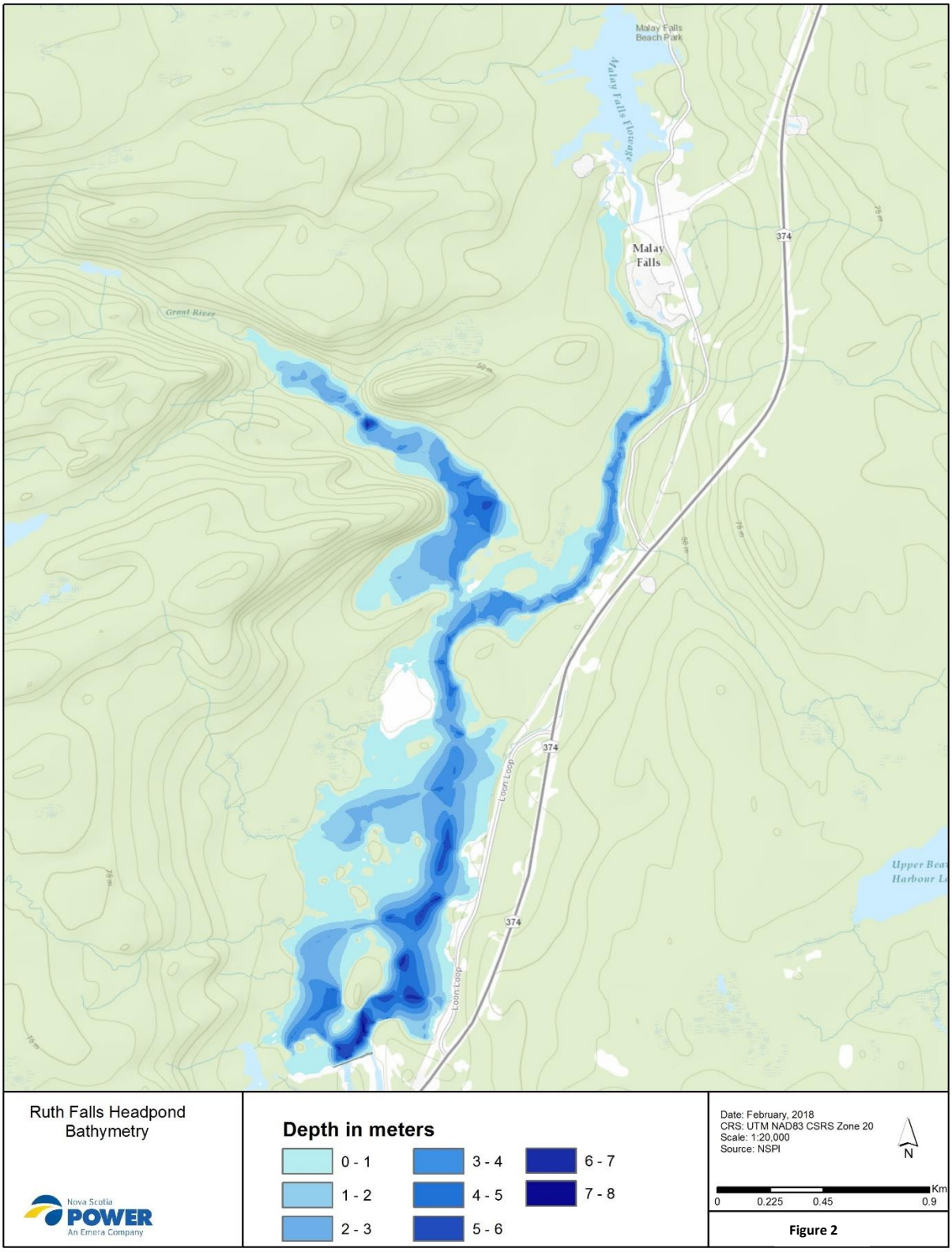

Malay Falls Beach Park
Malay Falls Flowage
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Bea
Harbour L
Ruth Falls Headpond Bathymetry
Nova Scotia POWER An Emera Company
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
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Km
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0.45
0.9

Figure 2

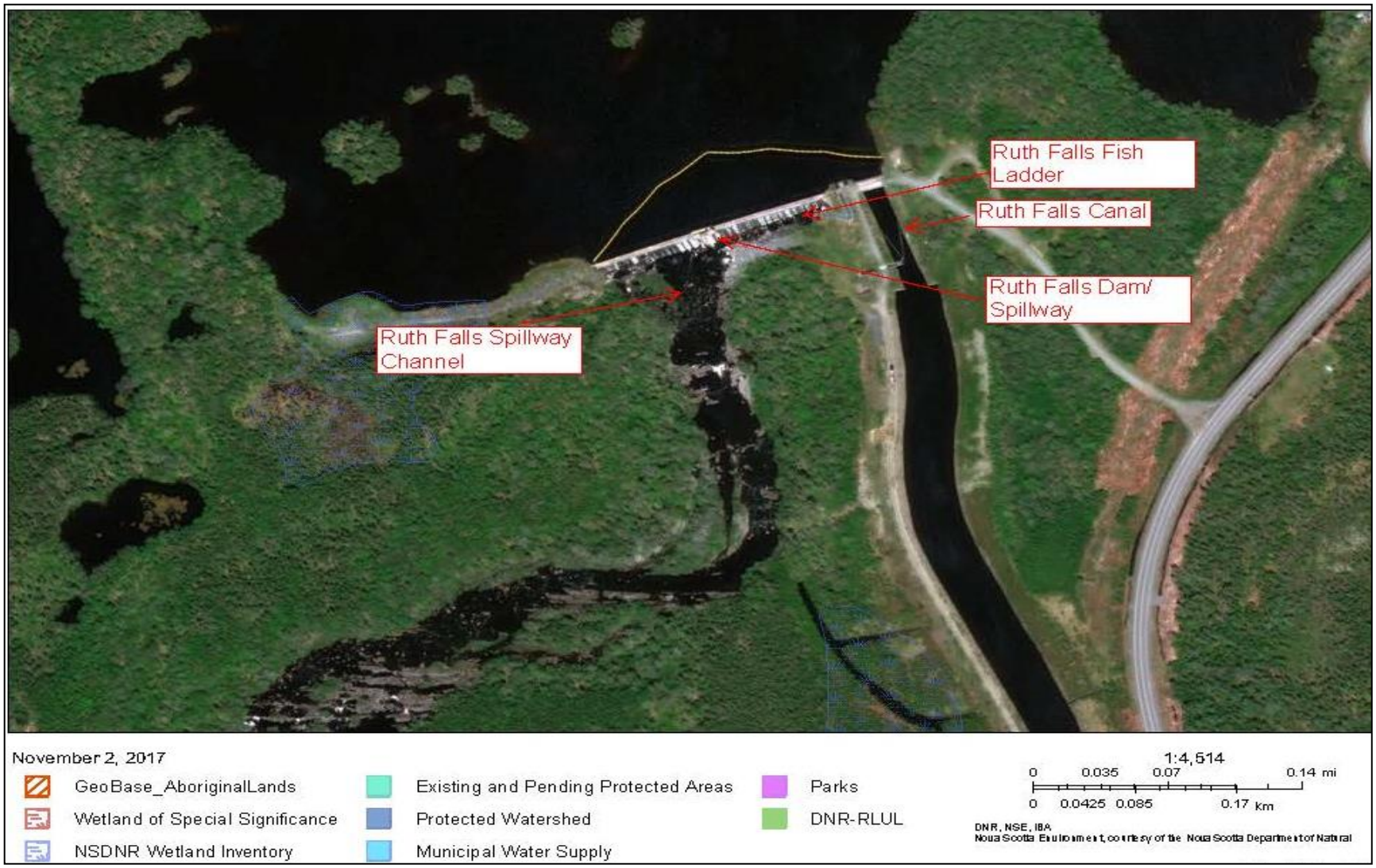


Figure 3. Ruth Falls Reservoir Location of Structures

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

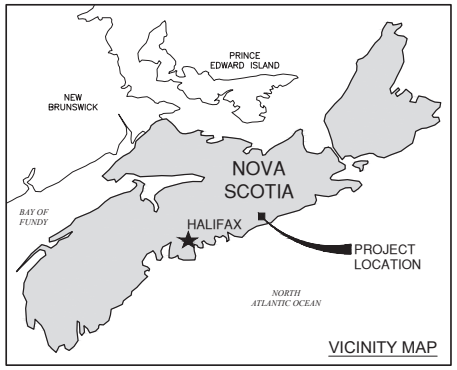
APPENDIX C – ENGINEERING DRAWINGS

DWG. NO. H096H1163100040

NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





Nova Scotia POWER An Emera Company

Kleinschmidt

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

J:\1890\018\Drawings\Working Drawings\1890-018-000-000.dwg
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REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

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MECH	CONST

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DATE 2020-12-11
W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

COVER SHEET

DWG.NO. H096H1163100040 REV. C

DWG. NO. H096H1163100041

DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-052
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-056
320-01	NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-057
320-02	NEW STEEL GRATED ACCESS PLATFORM	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-060

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DRAWING LIST

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DWG. NO. H096H1163100042

GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.
     - III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6–8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310–04 FOR EARTHWORK.

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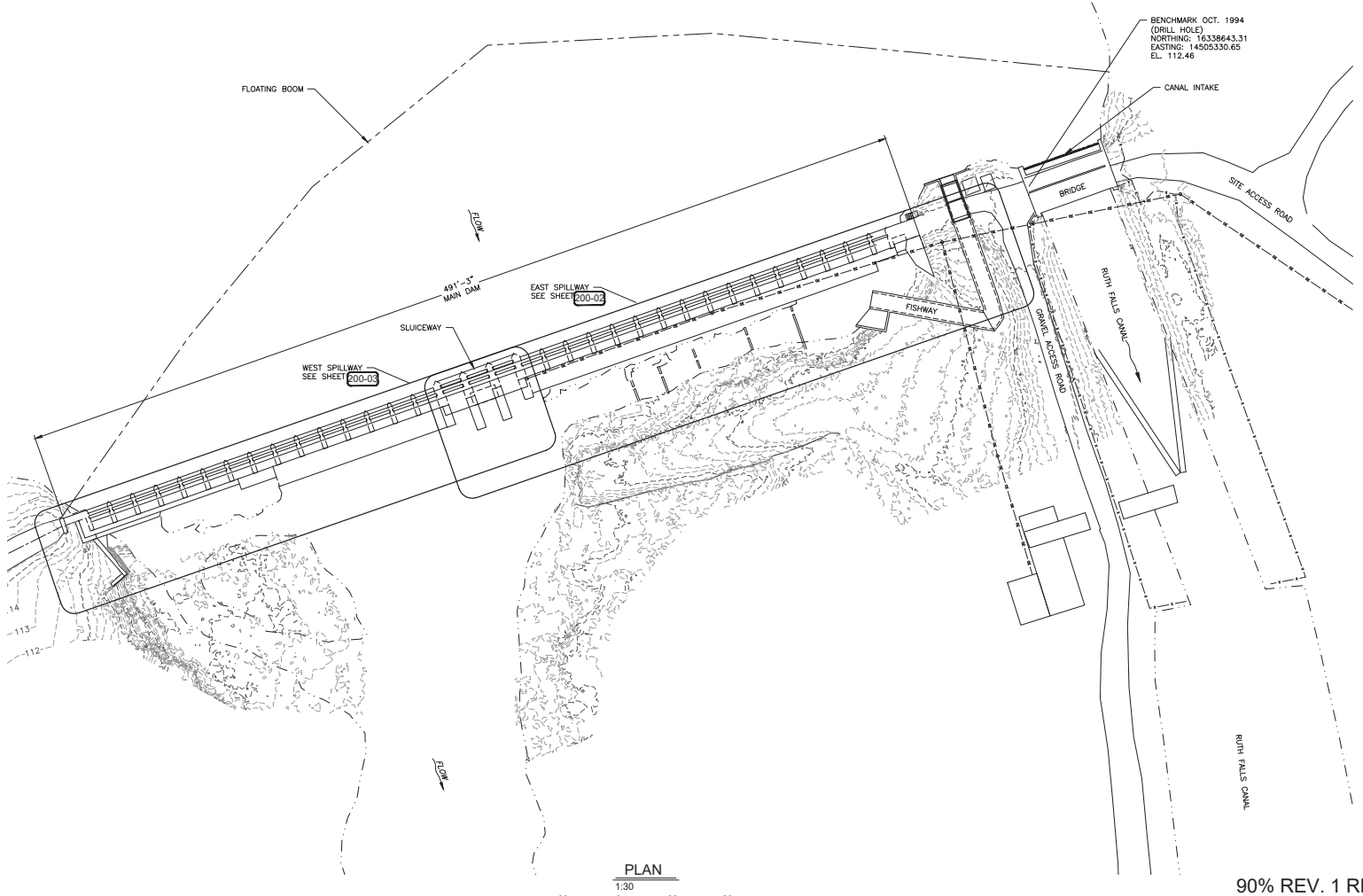
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GENERAL NOTES

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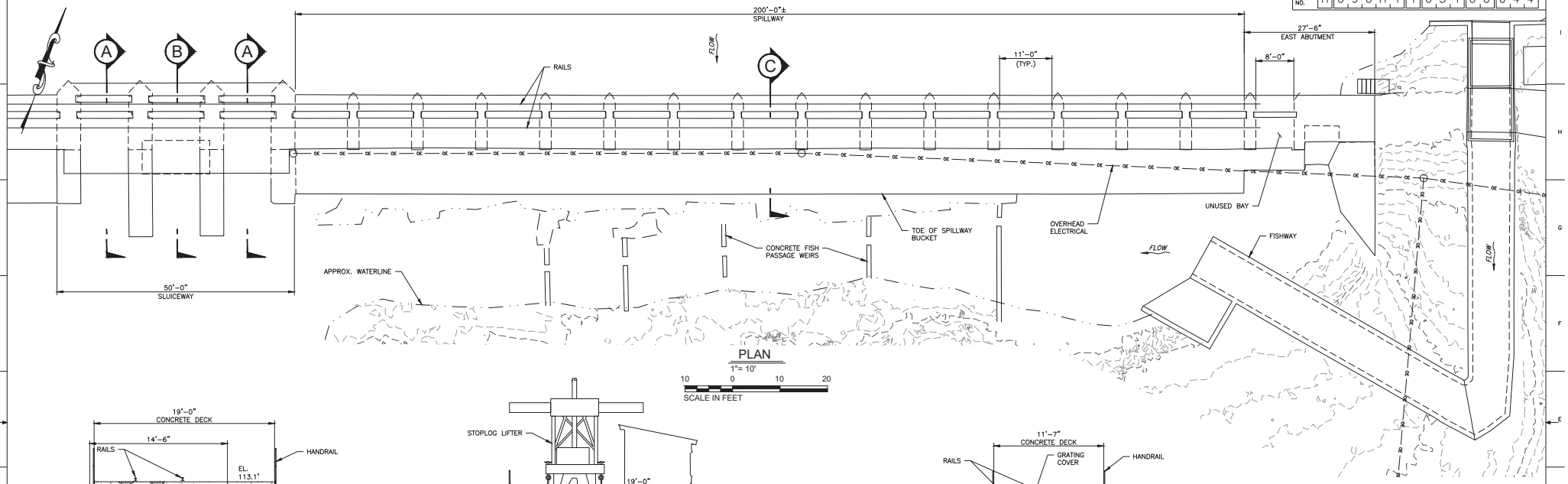
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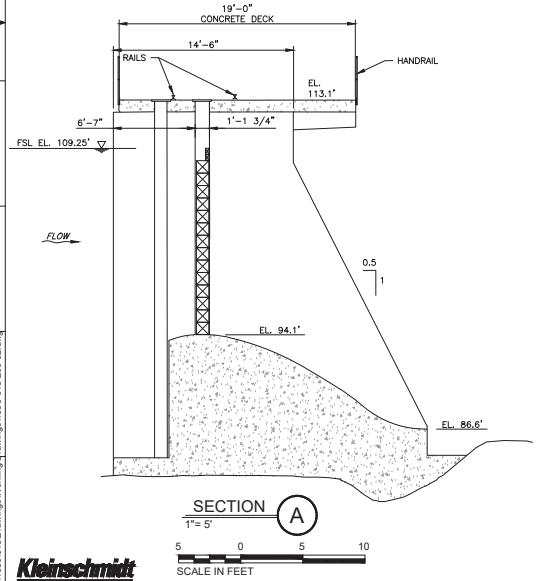
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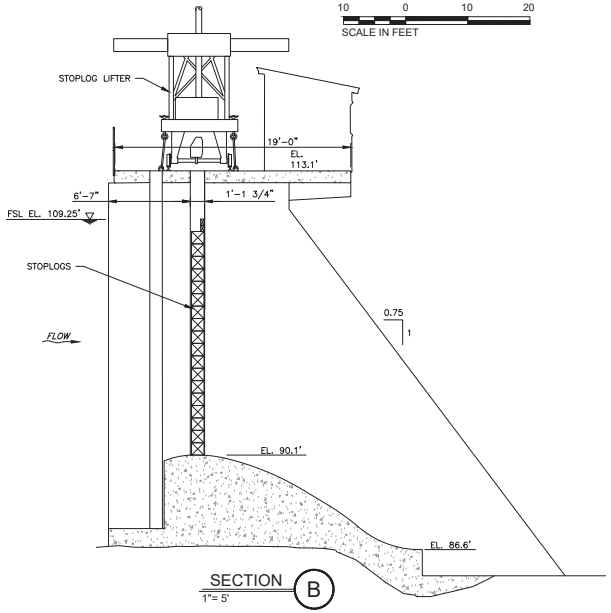
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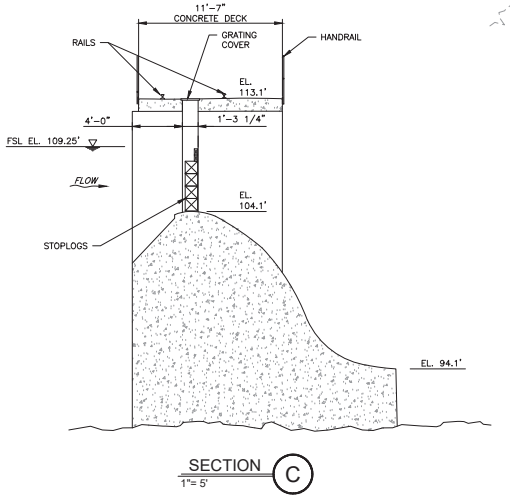
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SCALE IN FEET



SECTION A
1"= 5'



SECTION B
1"= 5'



SECTION C
1"= 5'

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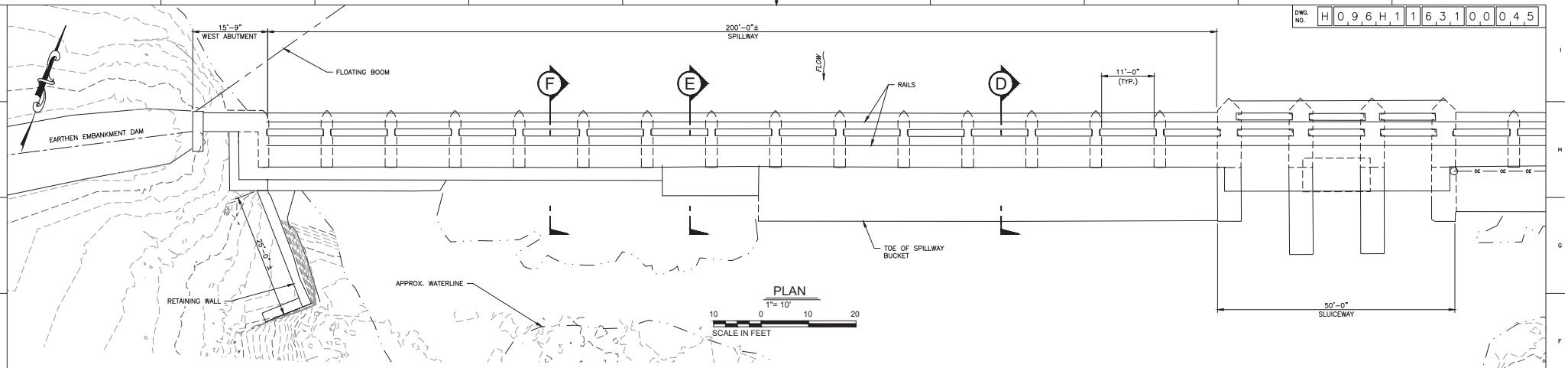
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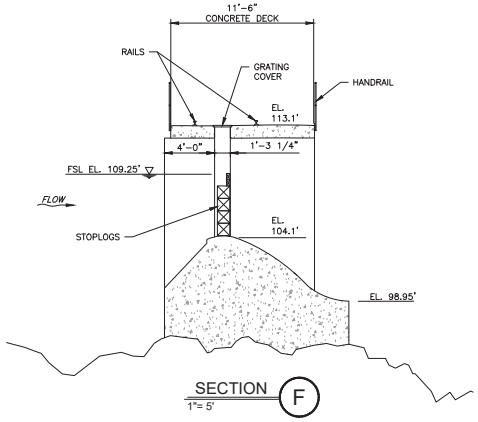
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PLAN AND SECTION

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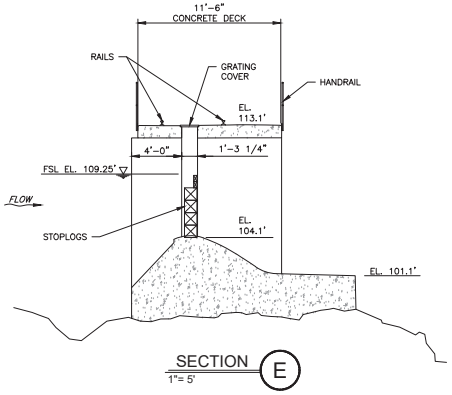
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PLAN
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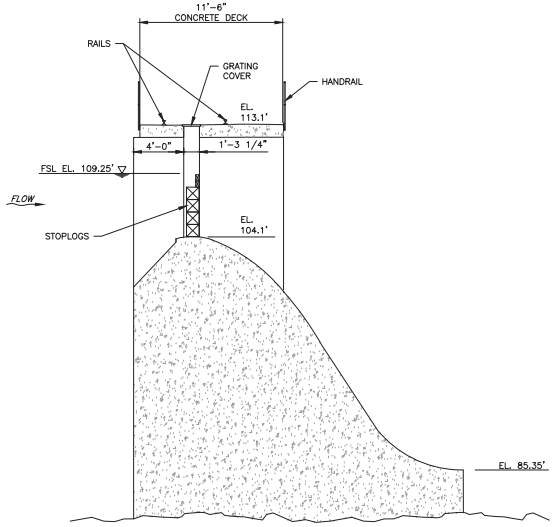


SECTION F
1"= 5'



SECTION E
1"= 5'

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SCALE IN FEET



SECTION D
1"= 5'

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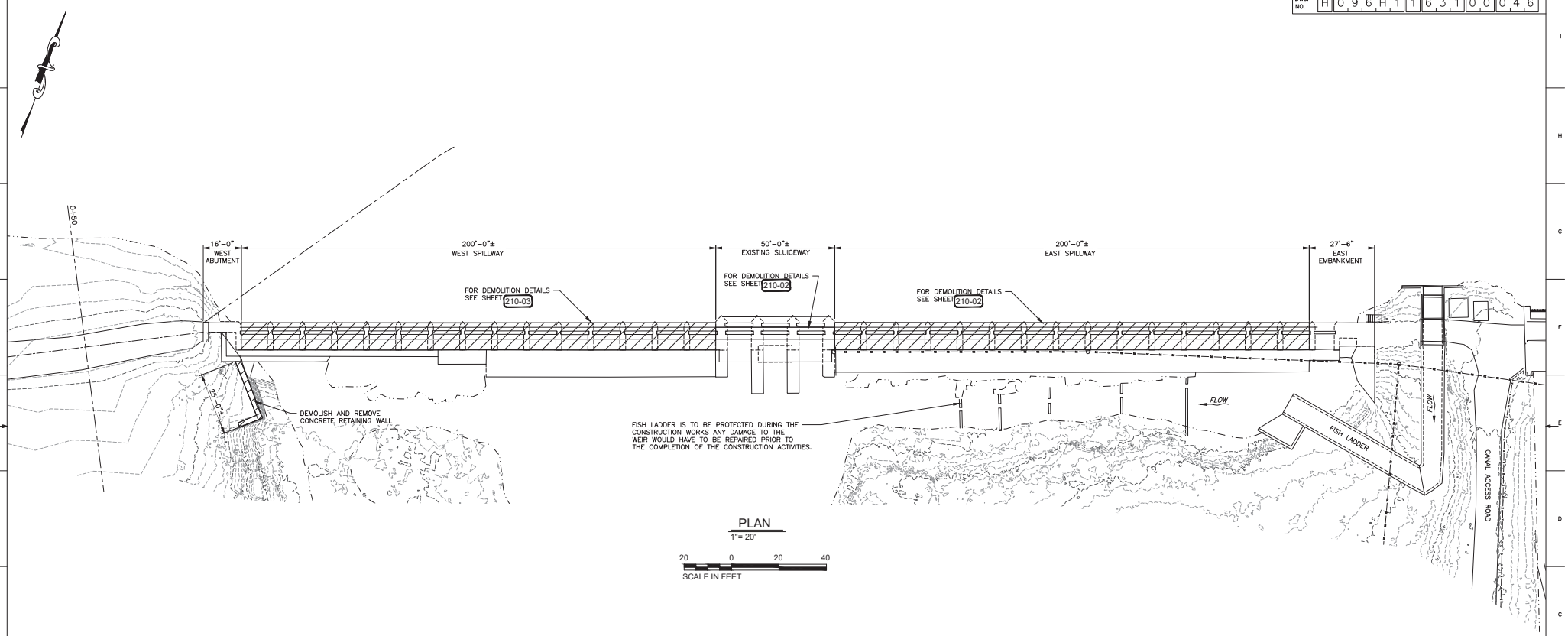
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EXISTING CONDITIONS WEST SPILLWAY
DAM PLAN AND SECTIONS

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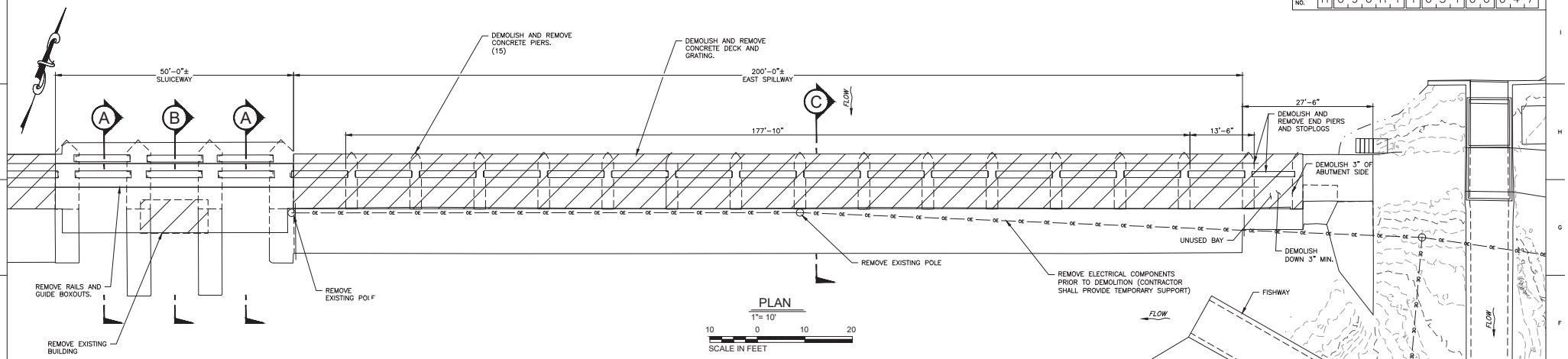
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RUTH FALLS REFURBISHMENT PROJECT

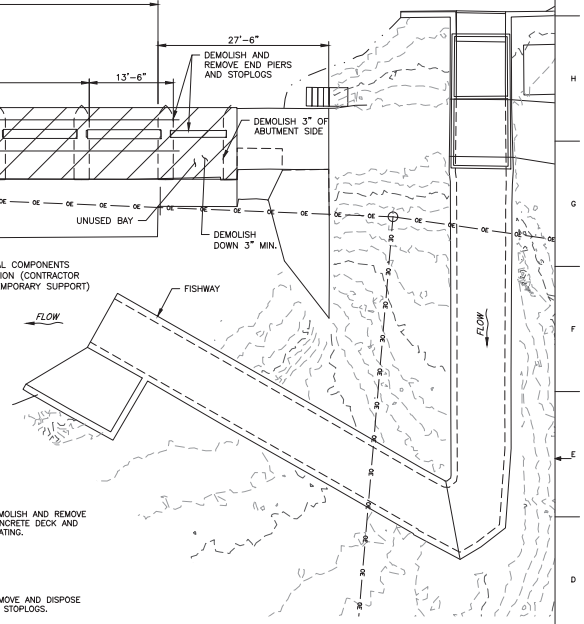
TEMPORARY CONDITIONS/DEMO PLAN

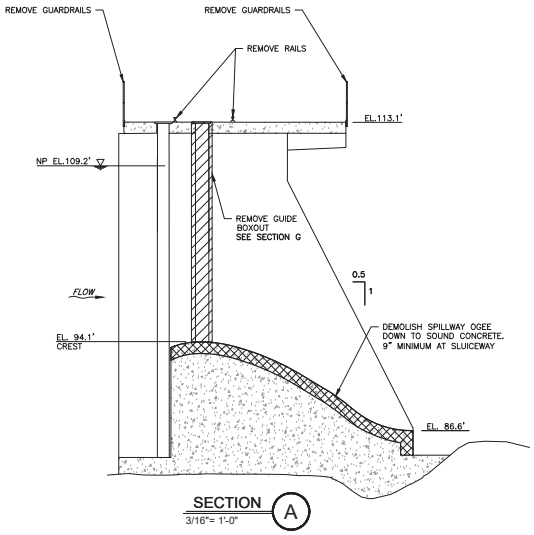
DWG.NO. H096H1163100046 REV. C

DWG. NO. H096H1163100047

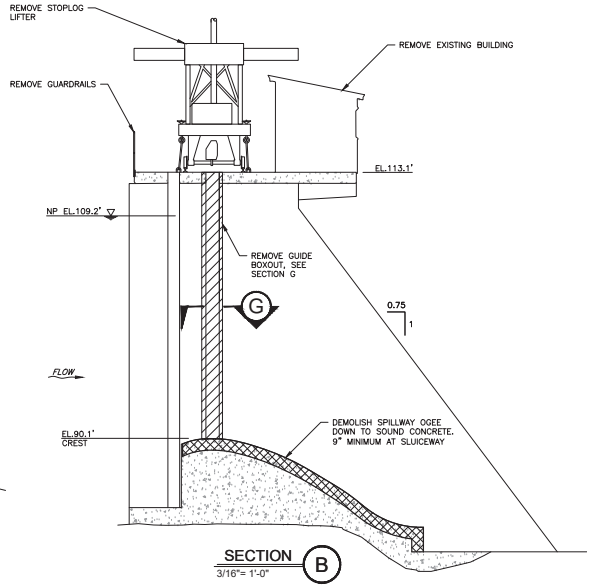


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

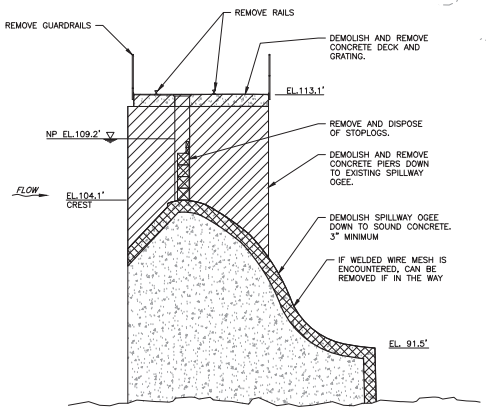




SECTION A
3/16"= 1'-0"

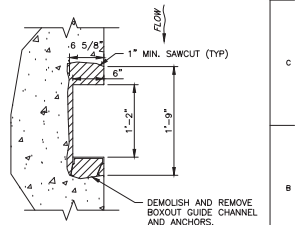


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

210-02

Kleinschmidt

J:\1890\018\Drawings\Working Drawings\1890-018-210-02-03.dwg

PRINTED: Dec. 9, 2020 - 2:56 PM

REFERENCE DESCRIPTION	A X X X X X X X X X X X X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H 0 9 5 H 1 1 6 7 0 0 0 3 2
REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-11
W.O.	XXXX

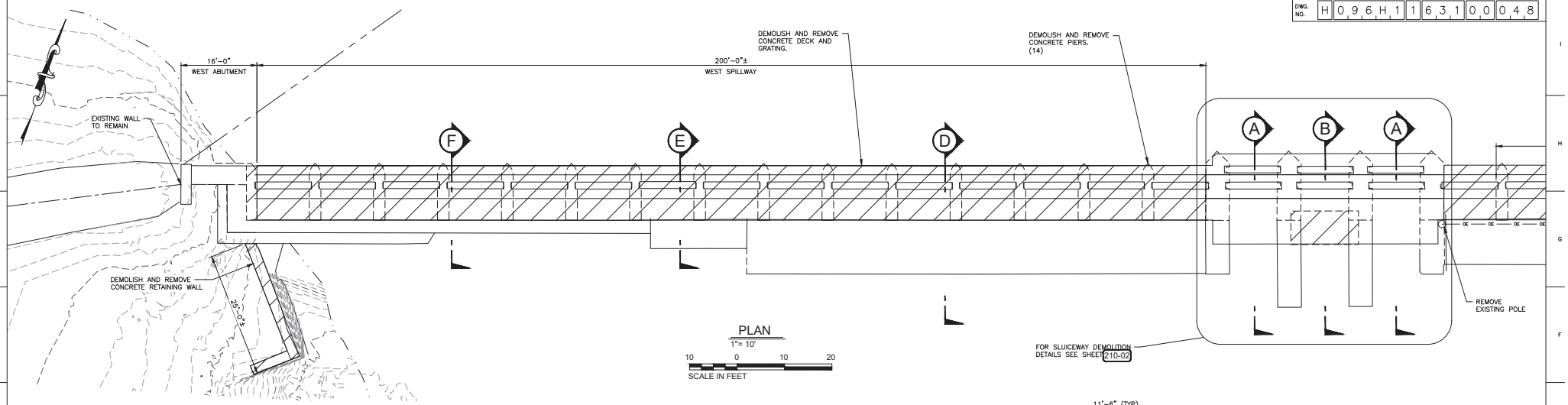
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

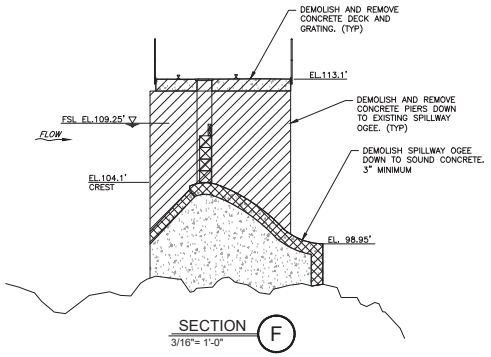
TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100047 REV. C

DWG. NO. H096H1163100048

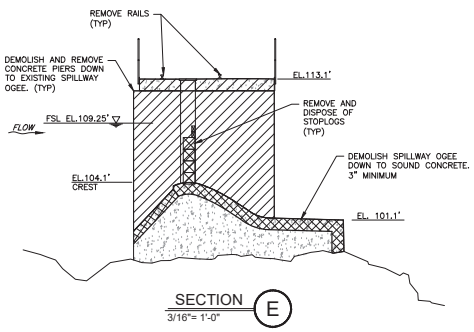


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

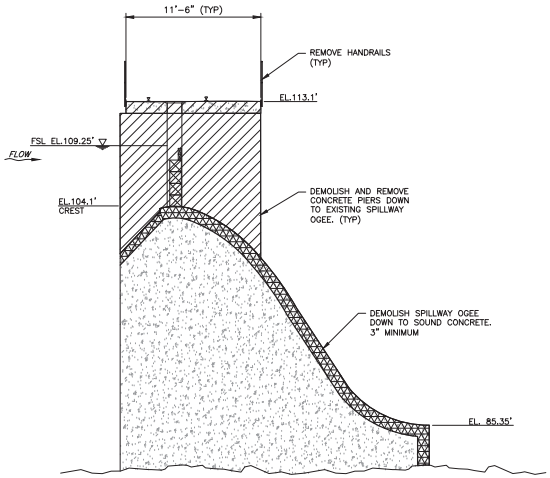


SECTION F
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION D
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

210-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY: _____ DATE: ____-__-__					

SEAL

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2020-12-11
W.O.	XXXX

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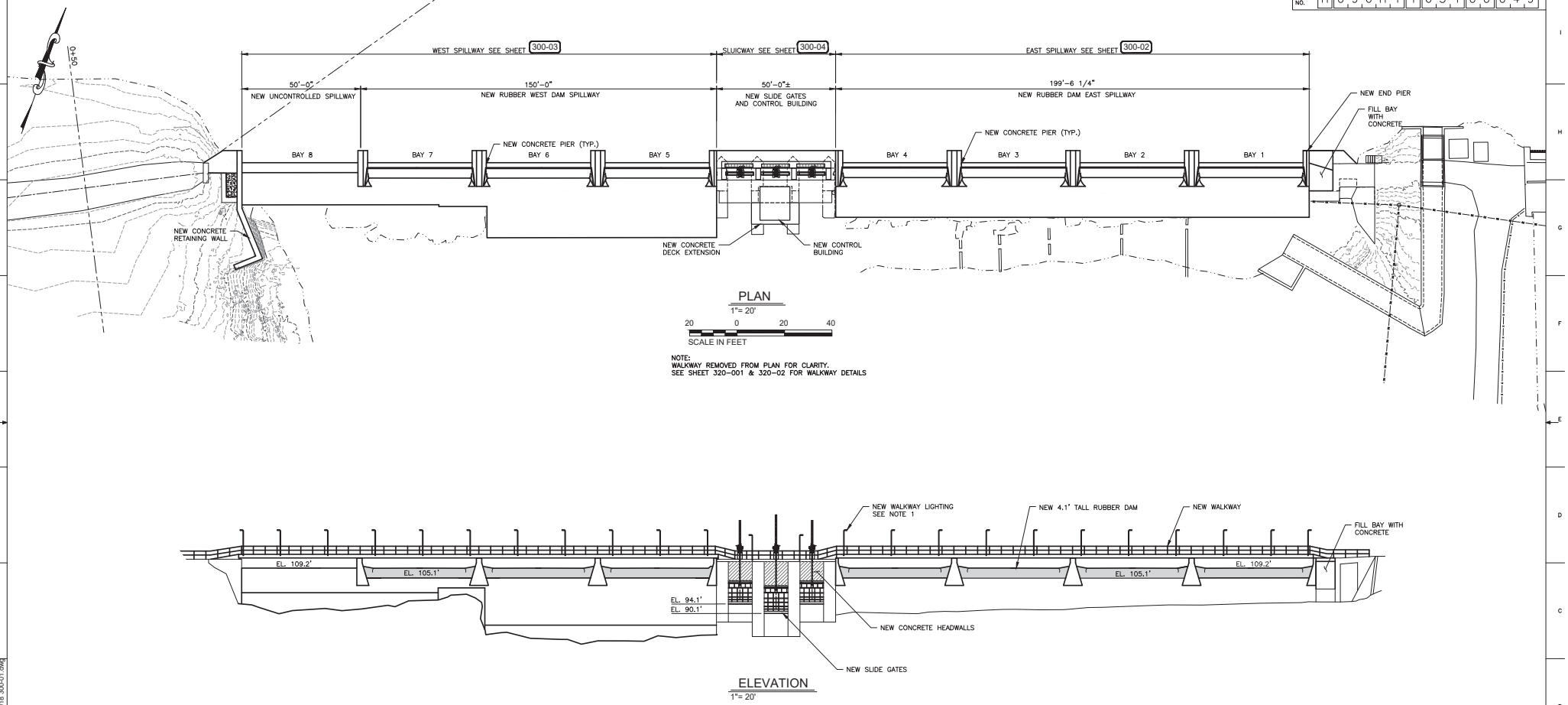
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. C

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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 9



NOTE:
1. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-01

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PRINTED: Dec. 9, 2020 - 3:37 PM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

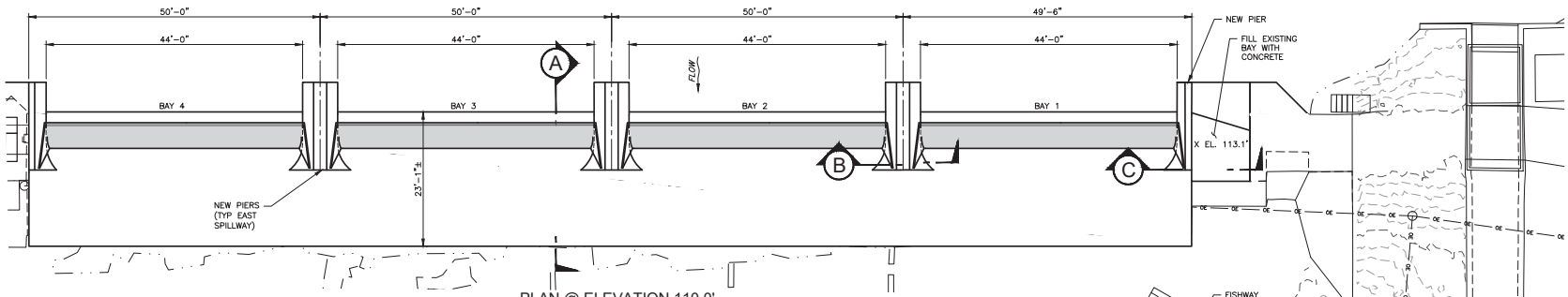
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

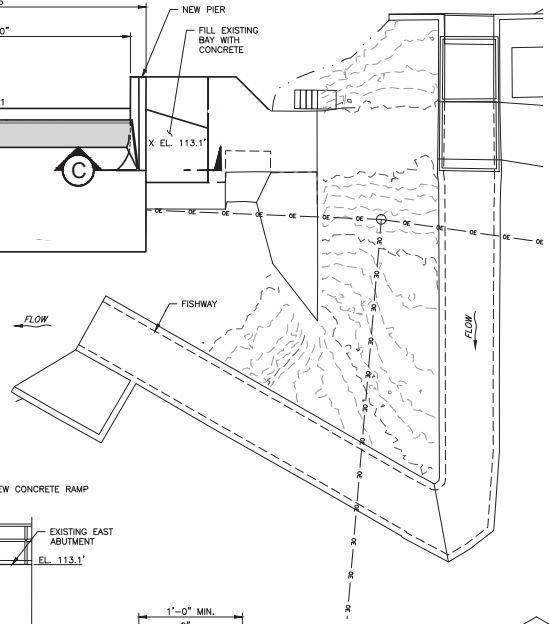
NEW CONDITIONS
DAM PLAN AND ELEVATION

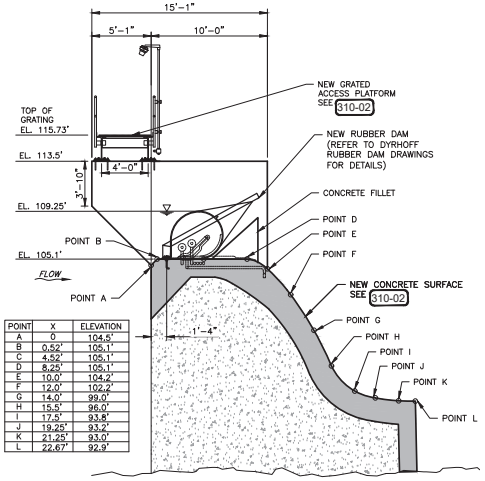
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 9 REV. C

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 0



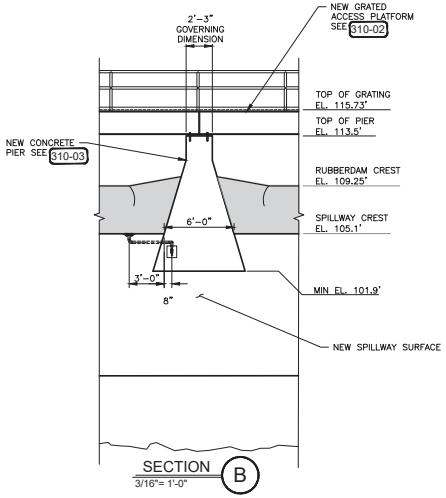
PLAN @ ELEVATION 110.0'
1"= 10'
10 0 10 20
SCALE IN FEET



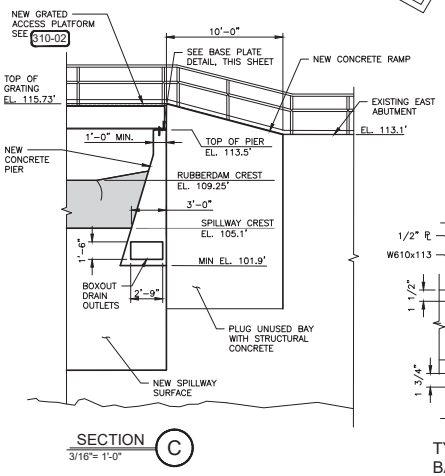


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5'	93.8'
J	19.25'	93.2'
K	21.25'	93.0'
L	22.67'	92.9'

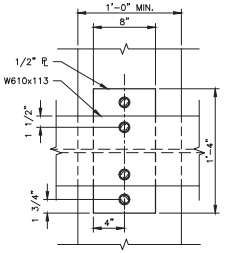
SECTION A
3/16"= 1'-0"
4 0 4 8 12
SCALE IN FEET



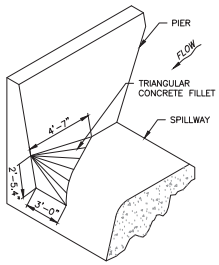
SECTION B
3/16"= 1'-0"



SECTION C
3/16"= 1'-0"



TYPICAL END PIER
BASE PLATE DETAIL
1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-11
W.O.	XXXX

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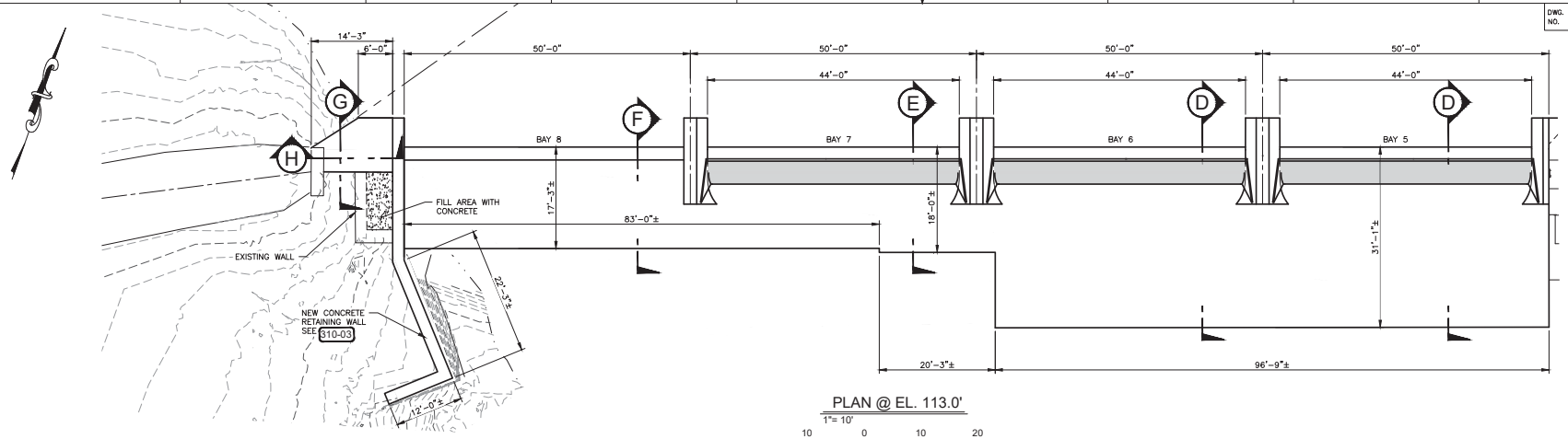
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

H 0 9 6 H 1 1 6 3 1 0 0 0 5 0 REV. C
DWG.NO.

PRINTED: Dec. 9, 2020 - 2:13 PM
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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 1

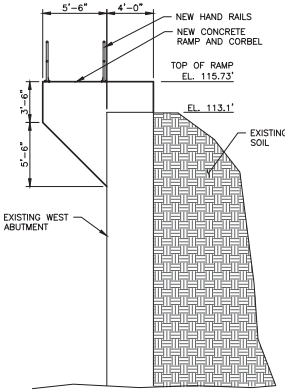


PLAN @ EL. 113.0'

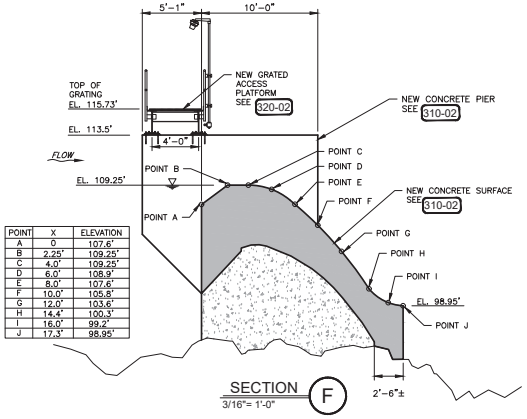
1"= 10'

SCALE IN FEET

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS

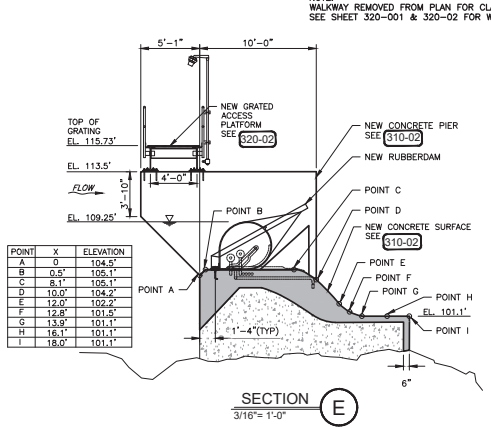


SECTION G
3/16"= 1'-0"



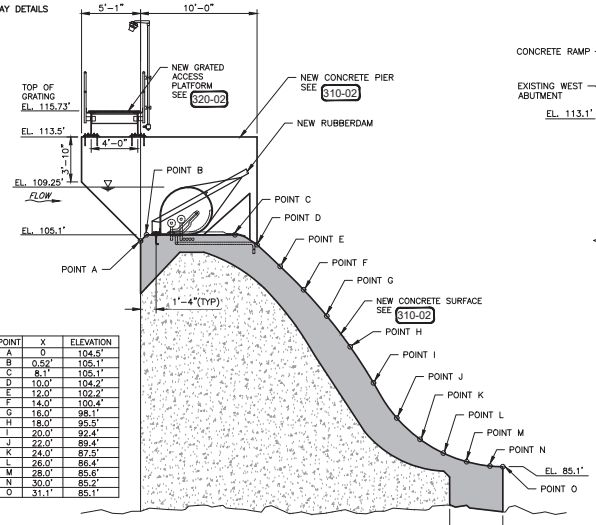
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

SECTION E
3/16"= 1'-0"

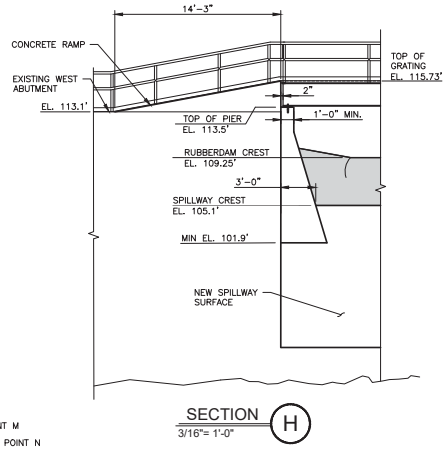


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET



SECTION H
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2020-12-11
W.O.	XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

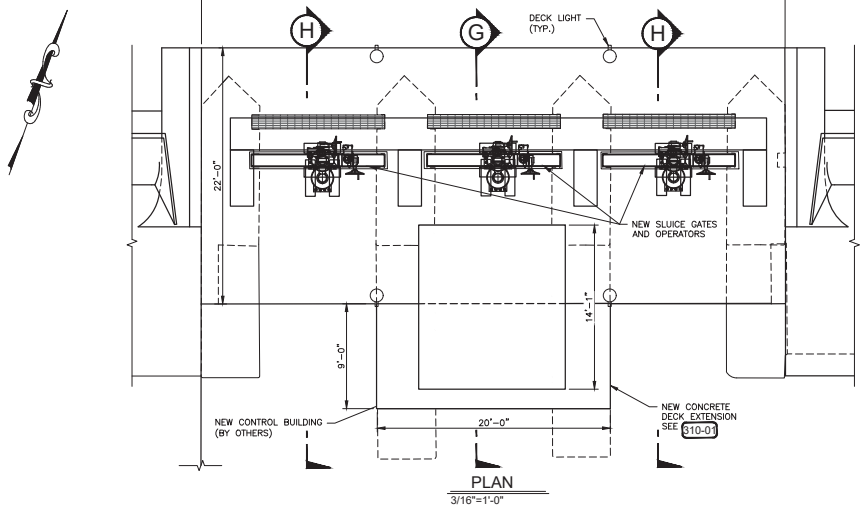
H 0 9 6 H 1 1 6 3 1 0 0 0 5 1 REV. C

DWG.NO.

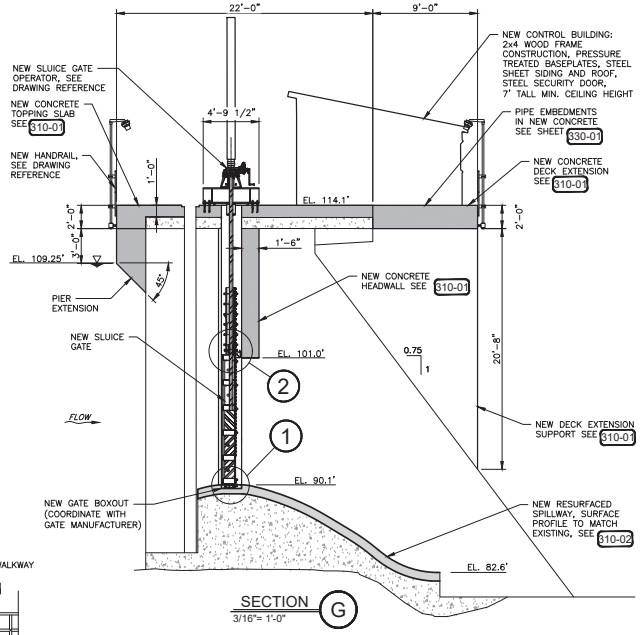
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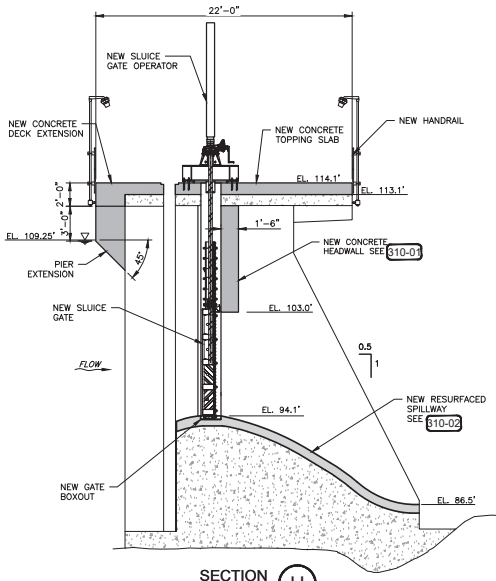
DWG. NO. H096H1163100052



PLAN
3/16"=1'-0"

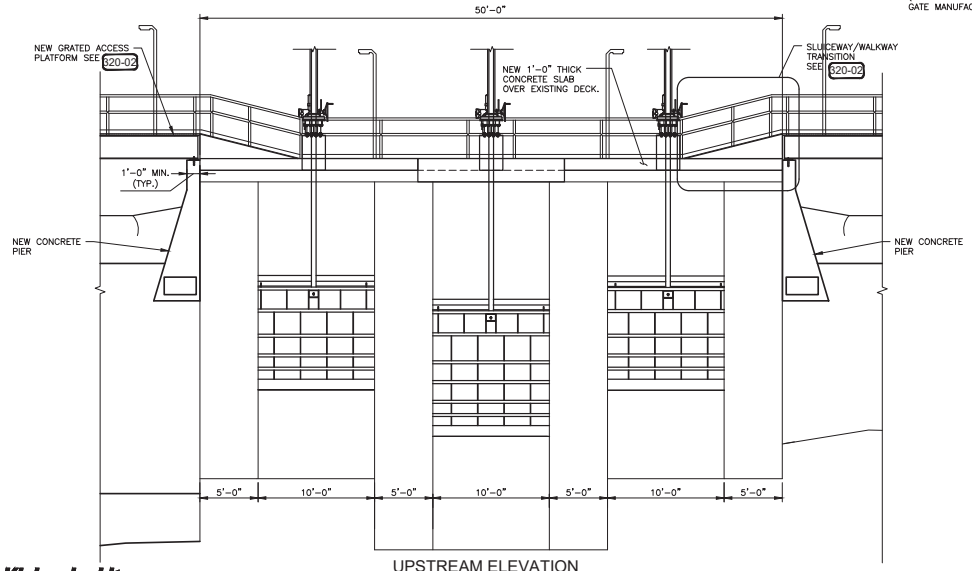


SECTION G
3/16"= 1'-0"

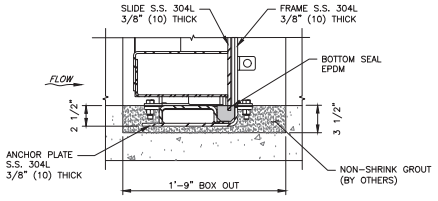


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

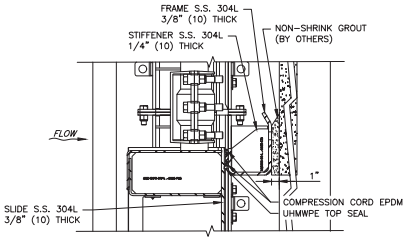


UPSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-04

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PRINTED: Dec. 9, 2020 - 3:43 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	0	1
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22														
REFERENCE DRAWINGS					DWG.NO.									

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL		E & I	
MECH		CONST	

APPROVED

DATE , ,

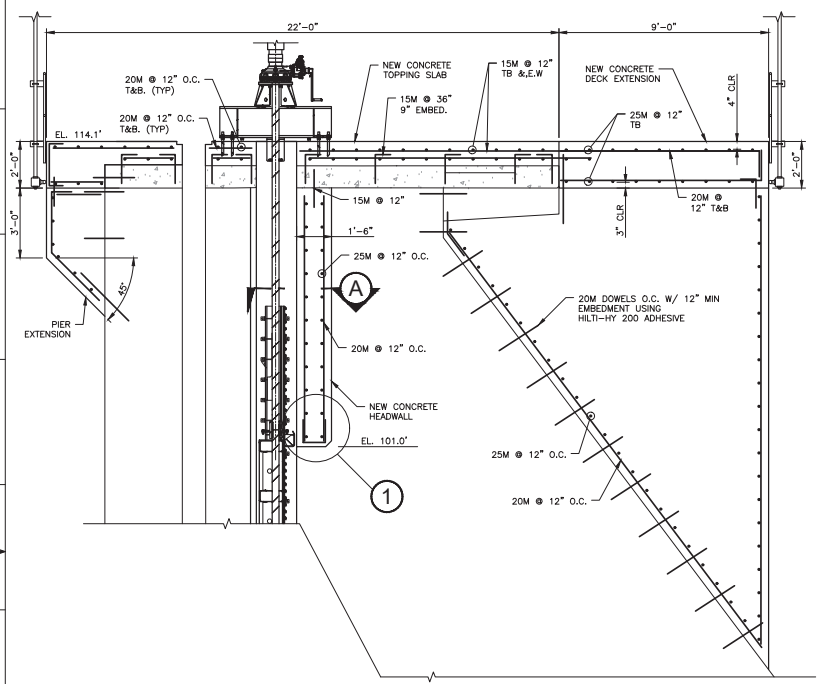
SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

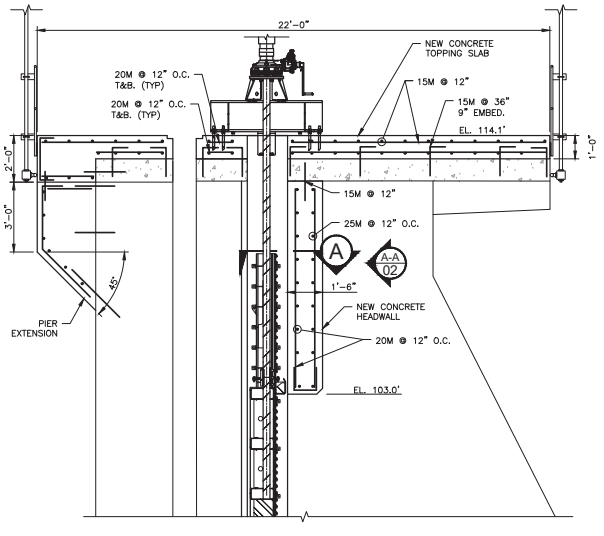
DWG.NO. H096H1163100052 REV. C



INNER SLUICEWAY DETAIL

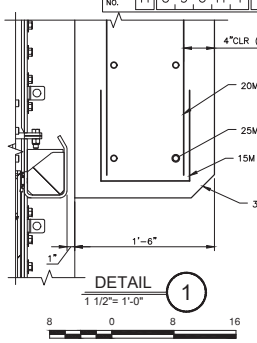
3/8"= 1'-0"

SCALE IN FEET



OUTER SLUICEWAY DETAIL

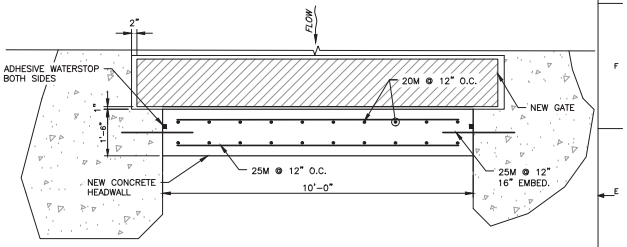
3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

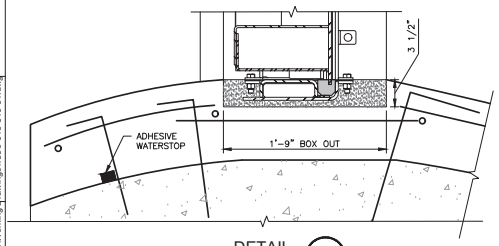
SCALE IN INCHES



SECTION A

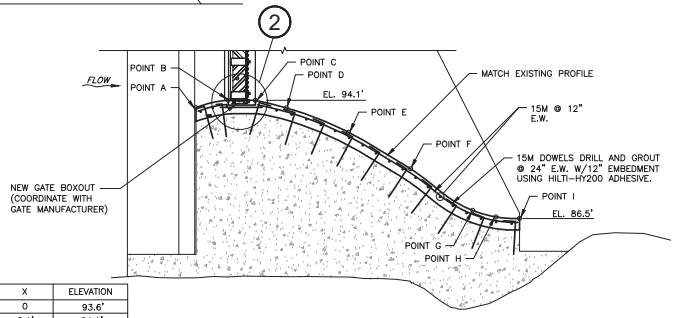
1/2"= 1'-0"

SCALE IN FEET



DETAIL 2

1 1/2"= 1'-0"

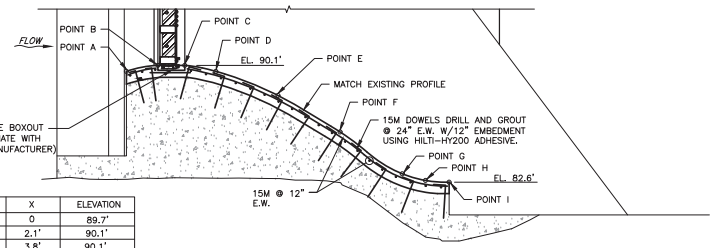


POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-01

J:\18900\018\Drawings\Working Drawings\1890-018 310-01.dwg
PRINTED: Dec. 18, 2020 - 8:42 AM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE		

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2020-12-18
W.O.	XXXX

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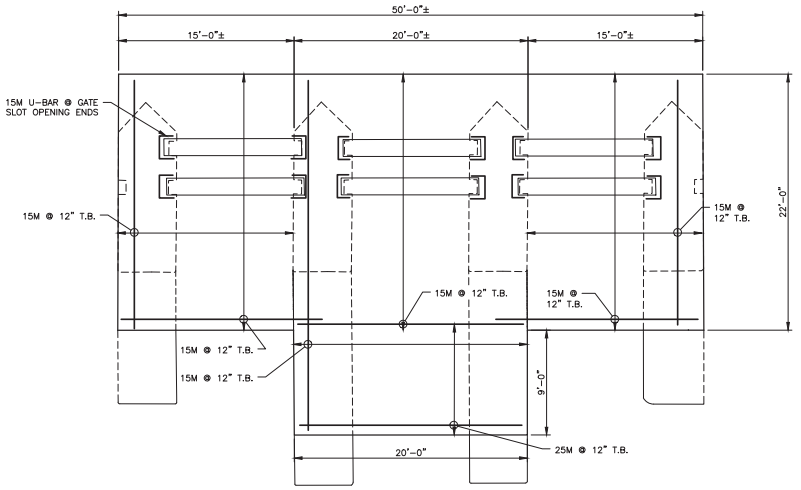
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100053 REV. C

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 4

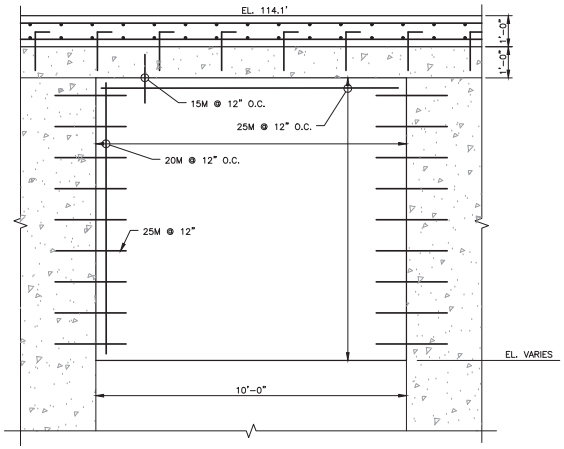


SLUICEWAY DECK REBAR PLAN

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

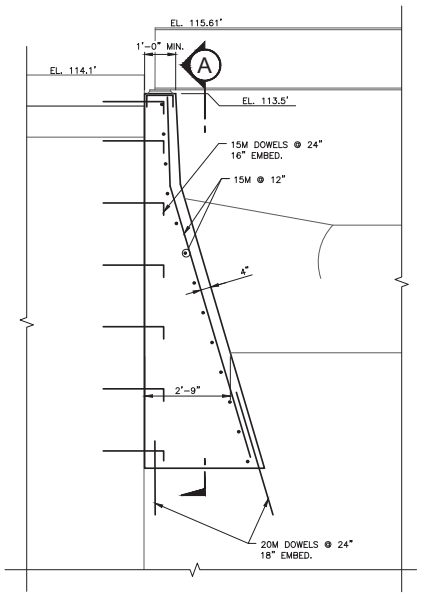


TYPICAL HEADWALL ELEVATION A-A 01

1/2"= 1'-0"

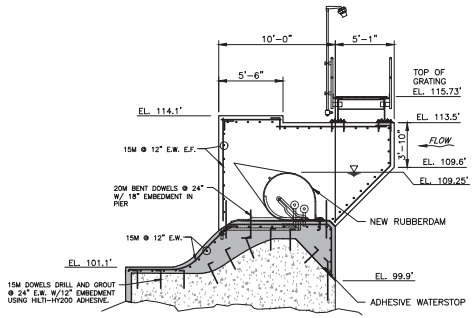
2 0 2 4

SCALE IN FEET



PIER TO SLUICEWAY REBAR DETAIL

1/2"= 1'-0"



SECTION A

3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED ——

CHECKED ——

DATE 2020-12-18

W.O. XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

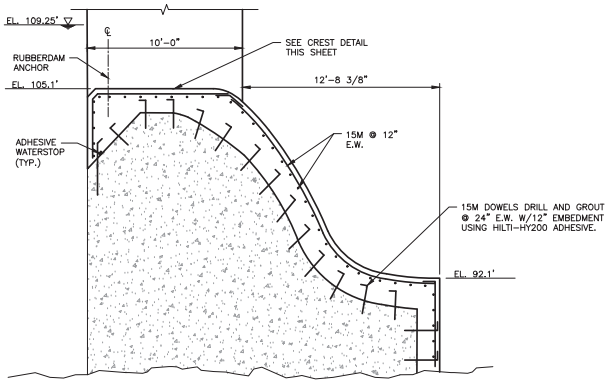
H 0 9 6 H 1 1 6 3 1 0 0 0 5 4 REV. C

DWG.NO.

PRINTED: Dec. 18, 2020 - 8:42 AM

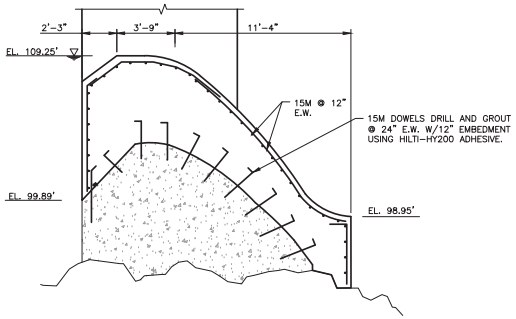
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DWG. NO. H096H1163100055



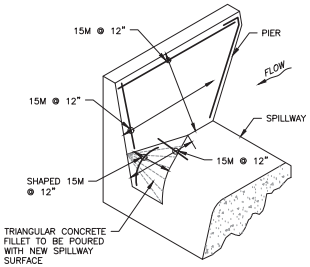
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



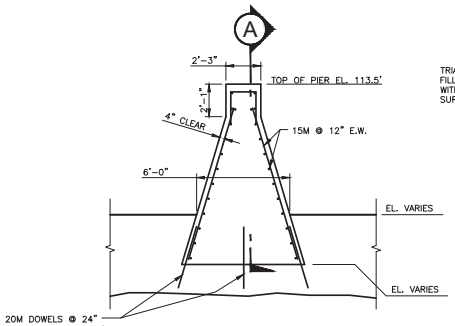
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

1/4"= 1'-0"



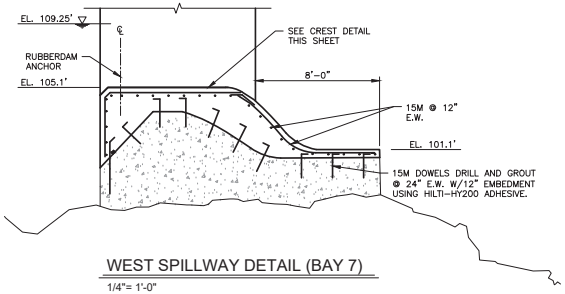
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



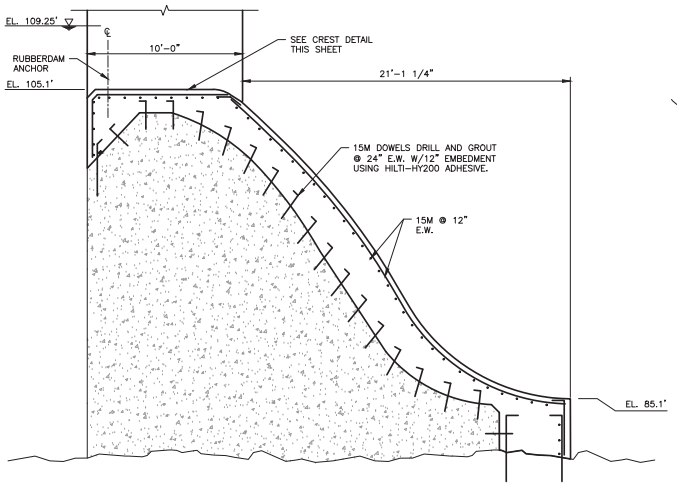
TYPICAL PIER DETAIL

1/4"= 1'-0"



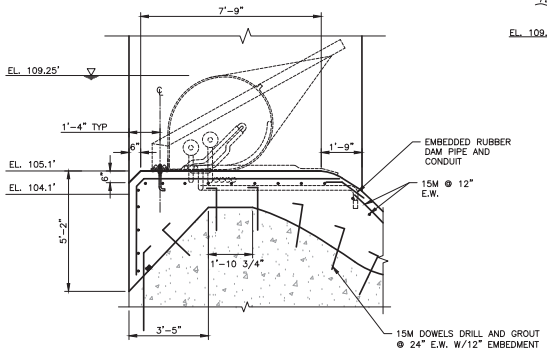
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



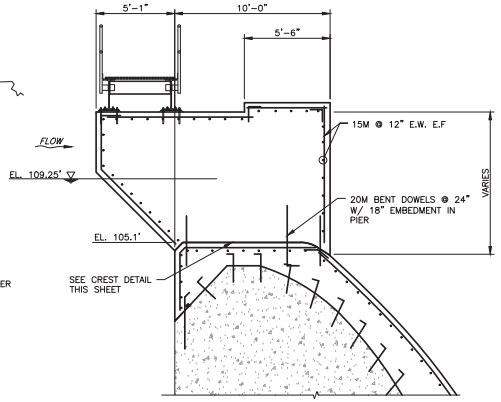
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION A

1/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-03

Kleinschmidt

J:\18900\018\Drawings\Working Drawings\18900-018 310-03.dwg

PRINTED: Dec. 18, 2020 - 8:42 AM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED ——

CHECKED ——

DATE 2020-12-18

W.O. XXXX

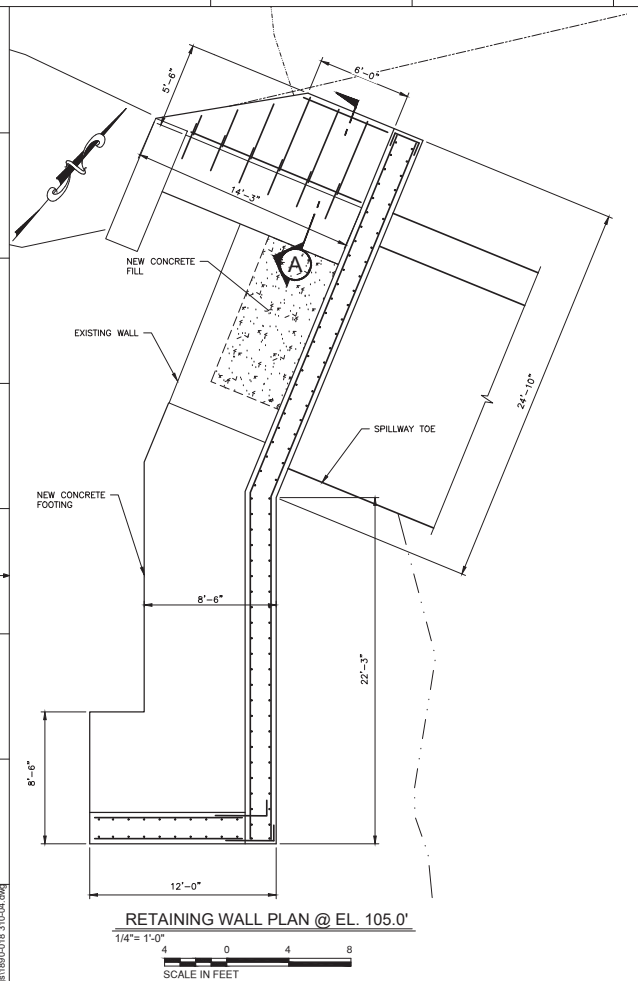
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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

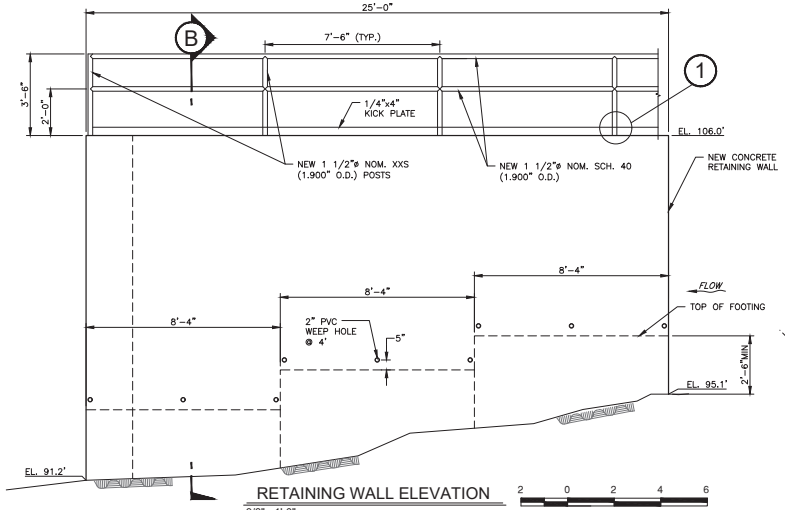
DWG.NO. H096H1163100055 REV. C



RETAINING WALL PLAN @ EL. 105.0'

1/4"= 1'-0"

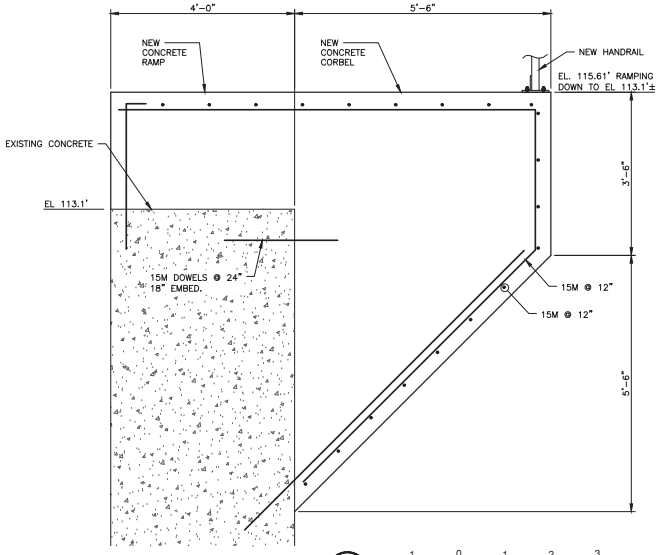
SCALE IN FEET



RETAINING WALL ELEVATION

3/8"= 1'-0"

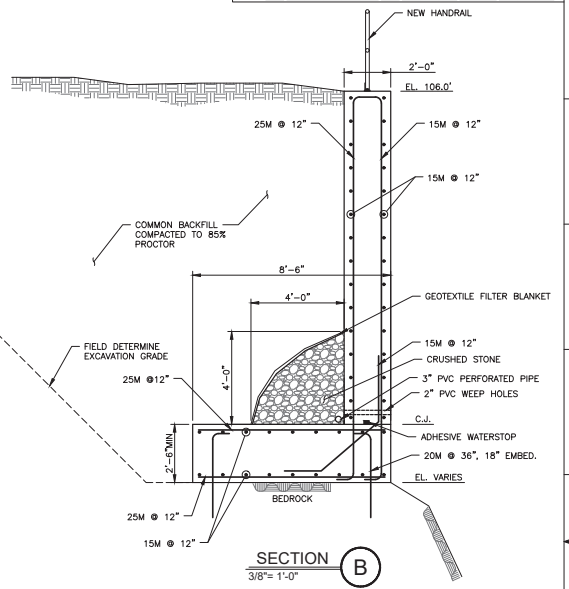
SCALE IN FEET



SECTION A

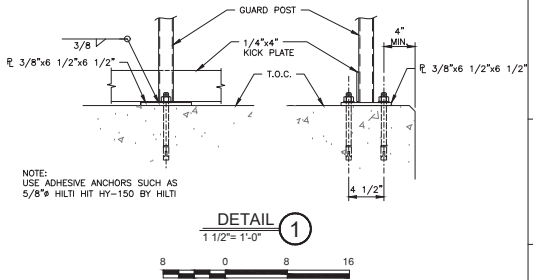
3/4"= 1'-0"

SCALE IN FEET



SECTION B

3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

8 0 8 16

SCALE IN INCHES

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-04

Kleinschmidt

J:\18900\018\Drawings\Working Drawings\18900-018 310-04.dwg

PRINTED: Dec. 18, 2020 - 8:41 AM

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REFERENCE DRAWINGS	DWG.NO.														

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

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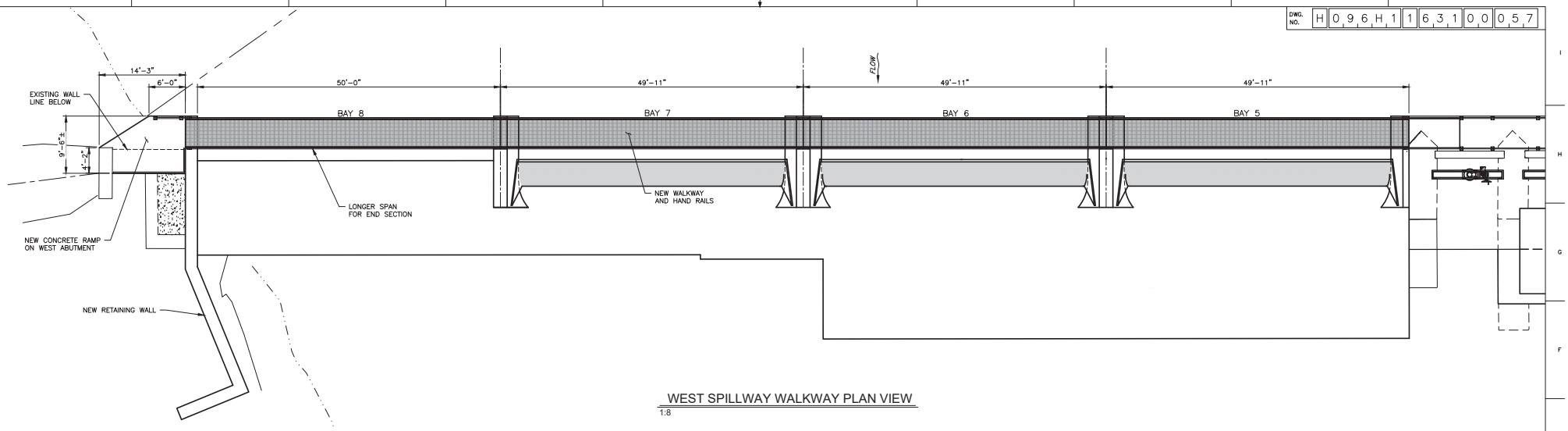
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

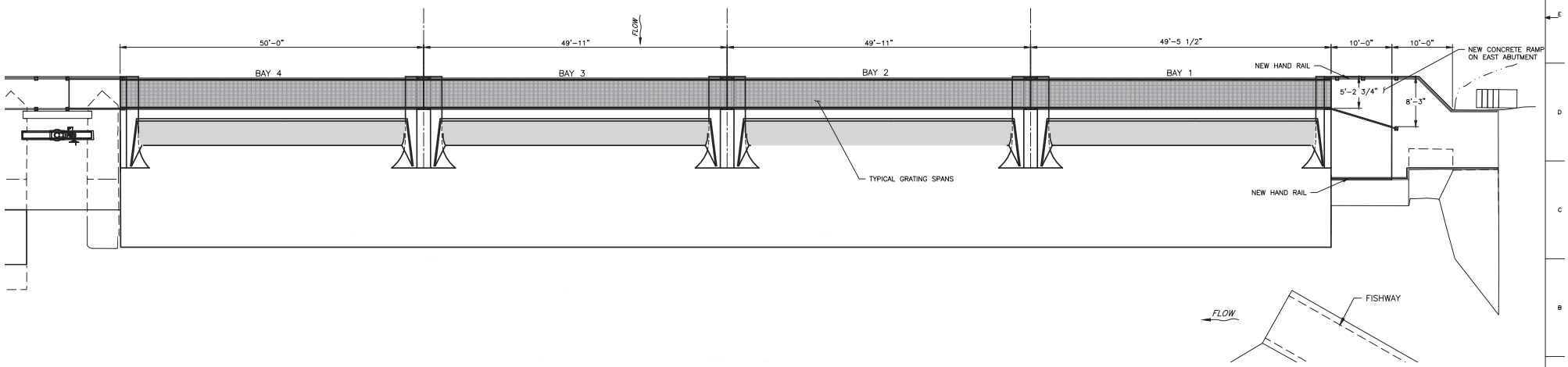
NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 6 REV. C

DWG. NO. H096H1163100057



WEST SPILLWAY WALKWAY PLAN VIEW
1:8



EAST SPILLWAY WALKWAY PLAN VIEW
1:8

8 0 8 16
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

320-01

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.														

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE , ,

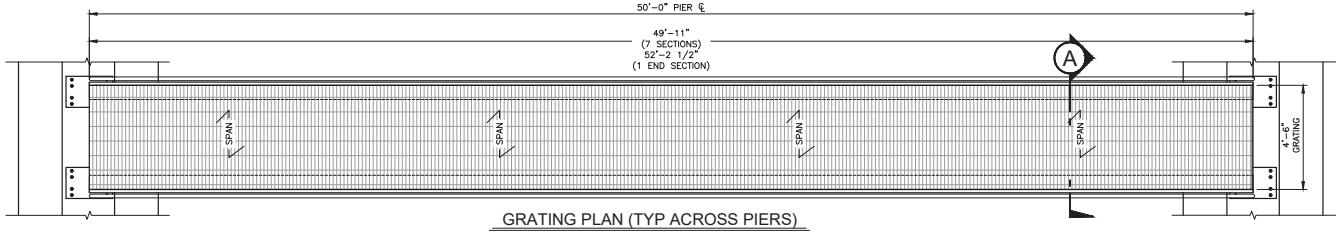
SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

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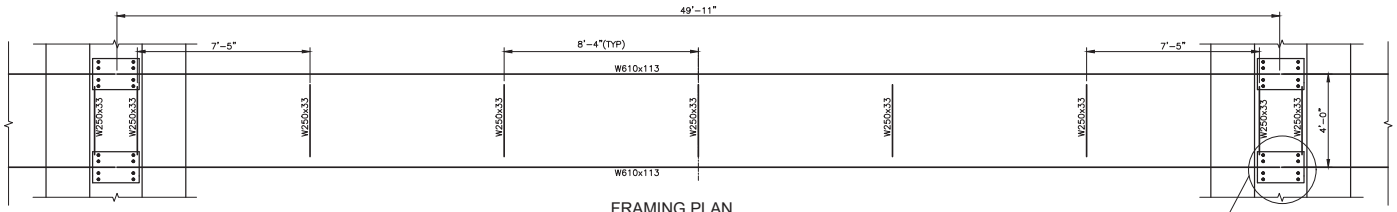
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT
NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW

DWG.NO. H096H1163100057 REV. C

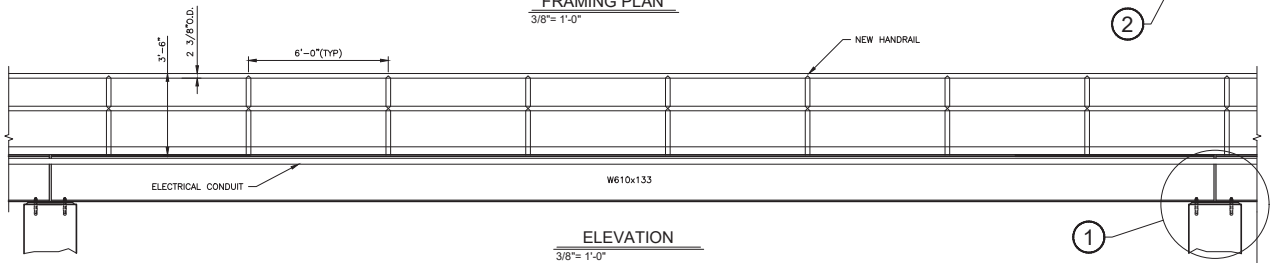
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GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"

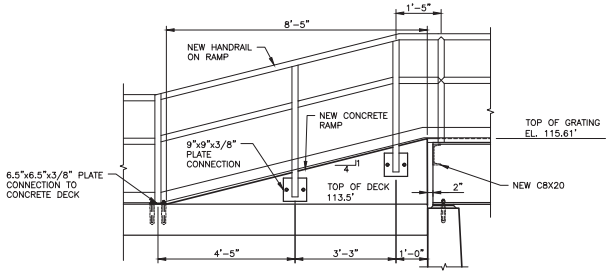


FRAMING PLAN
3/8"= 1'-0"

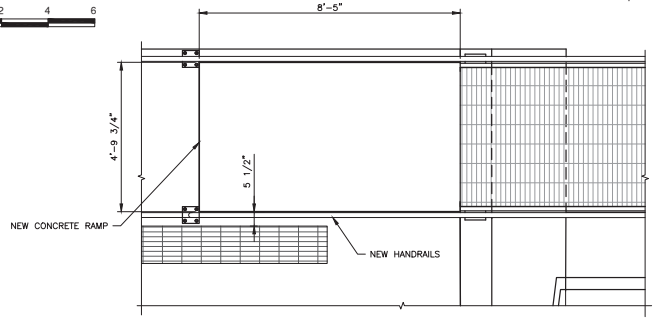


ELEVATION
3/8"= 1'-0"

2 0 2 4 6
SCALE IN FEET

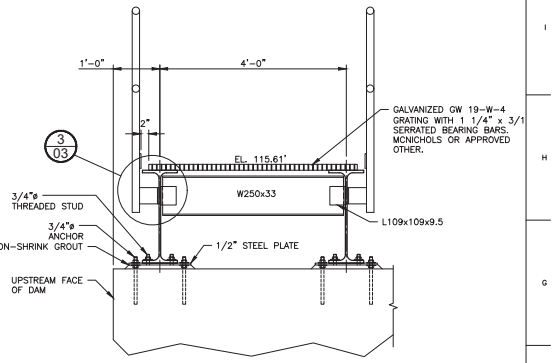


SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

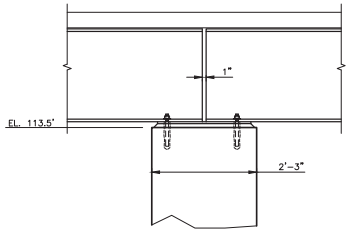


2 0 2 4
SCALE IN FEET

SLUICEWAY/WALKWAY TRANSITION PLAN
1/2"= 1'-0"

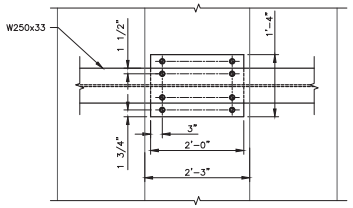


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

1 0 1 2 3
SCALE IN FEET



DETAIL 2
3/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

320-02

Kleinschmidt

J:\1890\018\Drawings\Working Drawings\1890-018_320-02.dwg

PRINTED: Dec. 9, 2020 - 2:43 P.M.

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REFERENCE DRAWINGS	DWG.NO.

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2020-12-11
W.O. XXXX

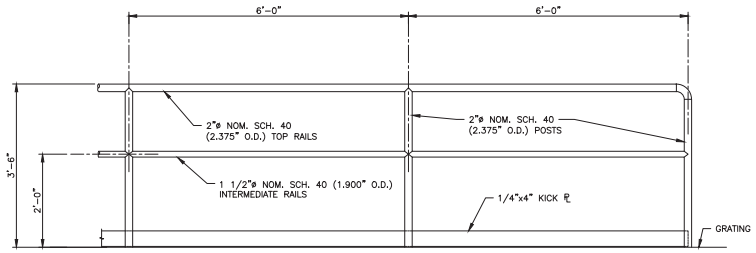
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW STEEL
GRATED ACCESS PLATFORM

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 8 REV. C

DWG. NO. H096H1163100059

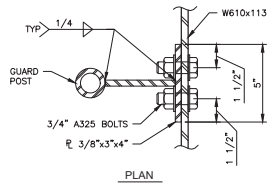


STEEL ACCESS PLATFORM TYPICAL HANDRAIL DETAIL

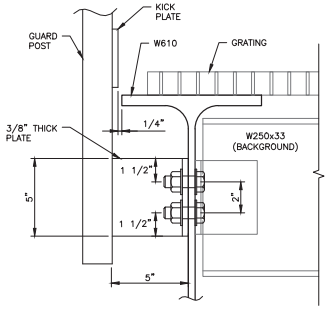
3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

320-03

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	1
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-11

W.O. XXXX

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RUTH FALLS

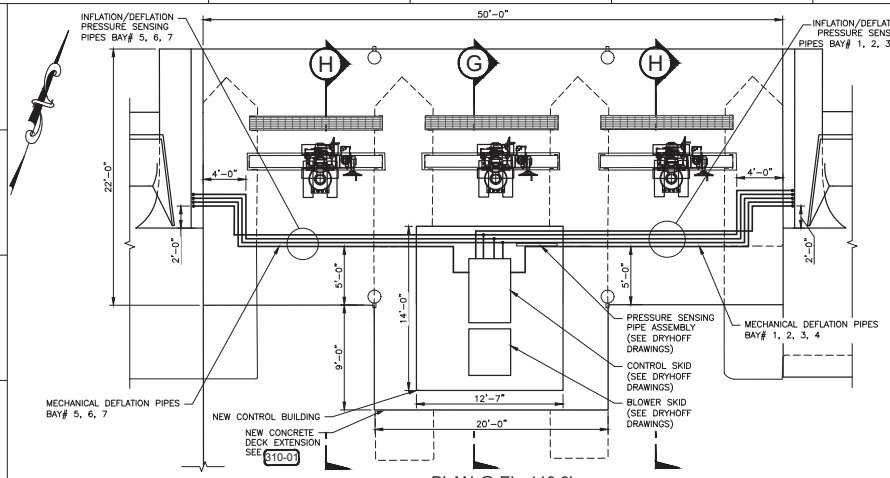
RUTH FALLS REFURBISHMENT PRJECT

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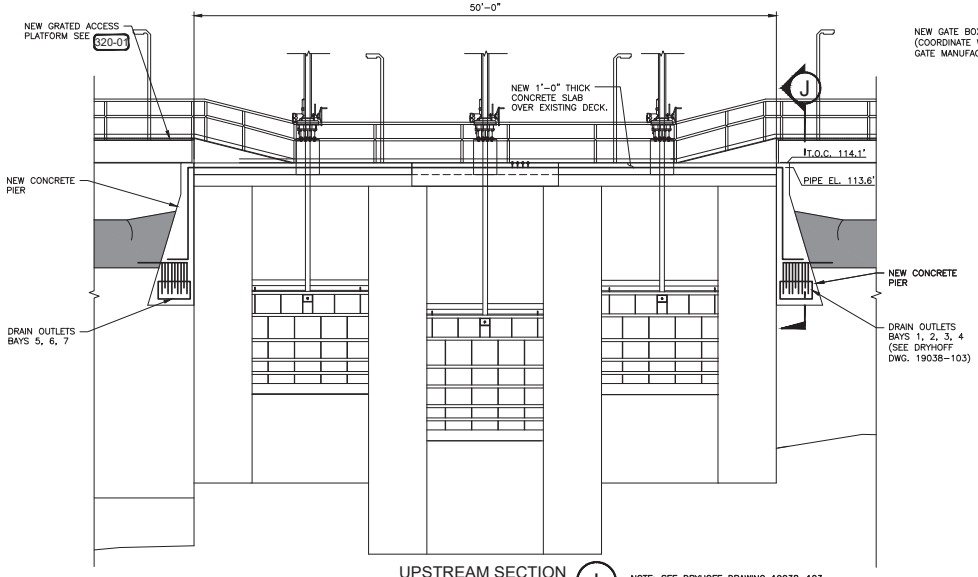
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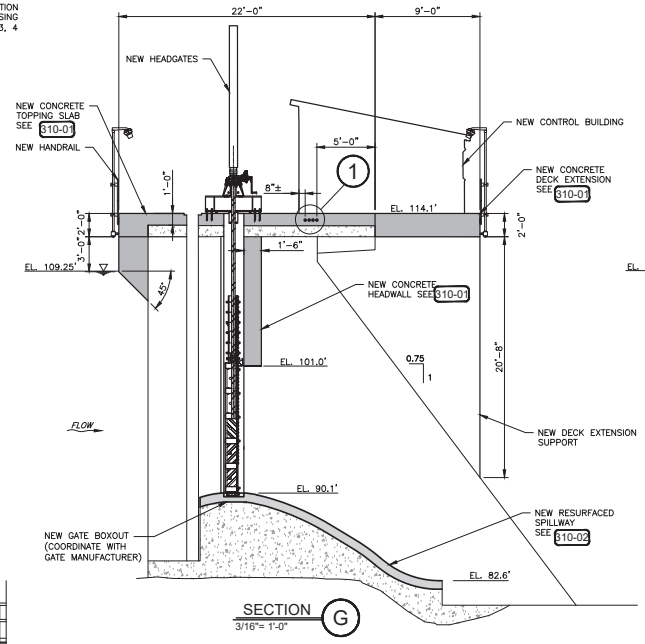


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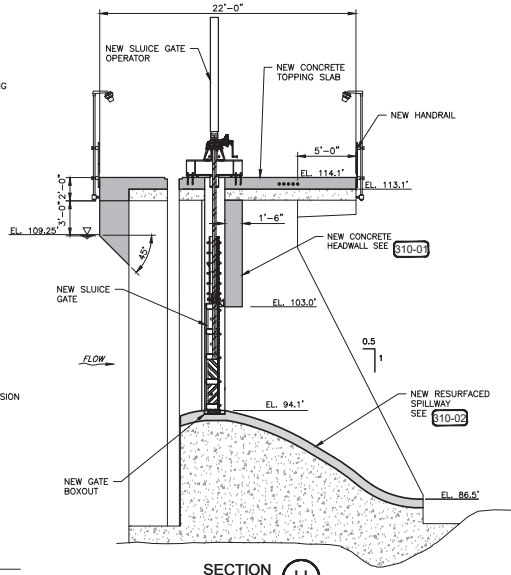


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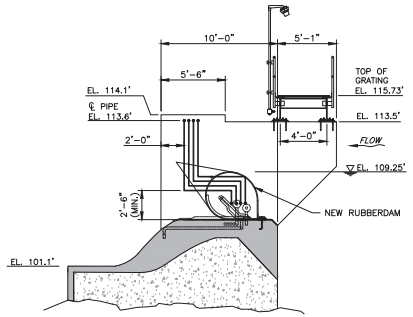


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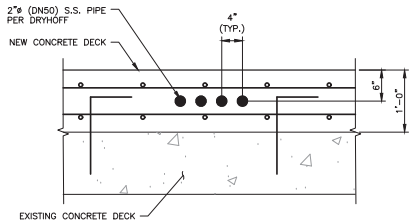


SECTION H
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SECTION J
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DETAIL 1
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NOT FOR CONSTRUCTION

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DEPARTMENTAL APPROVALS

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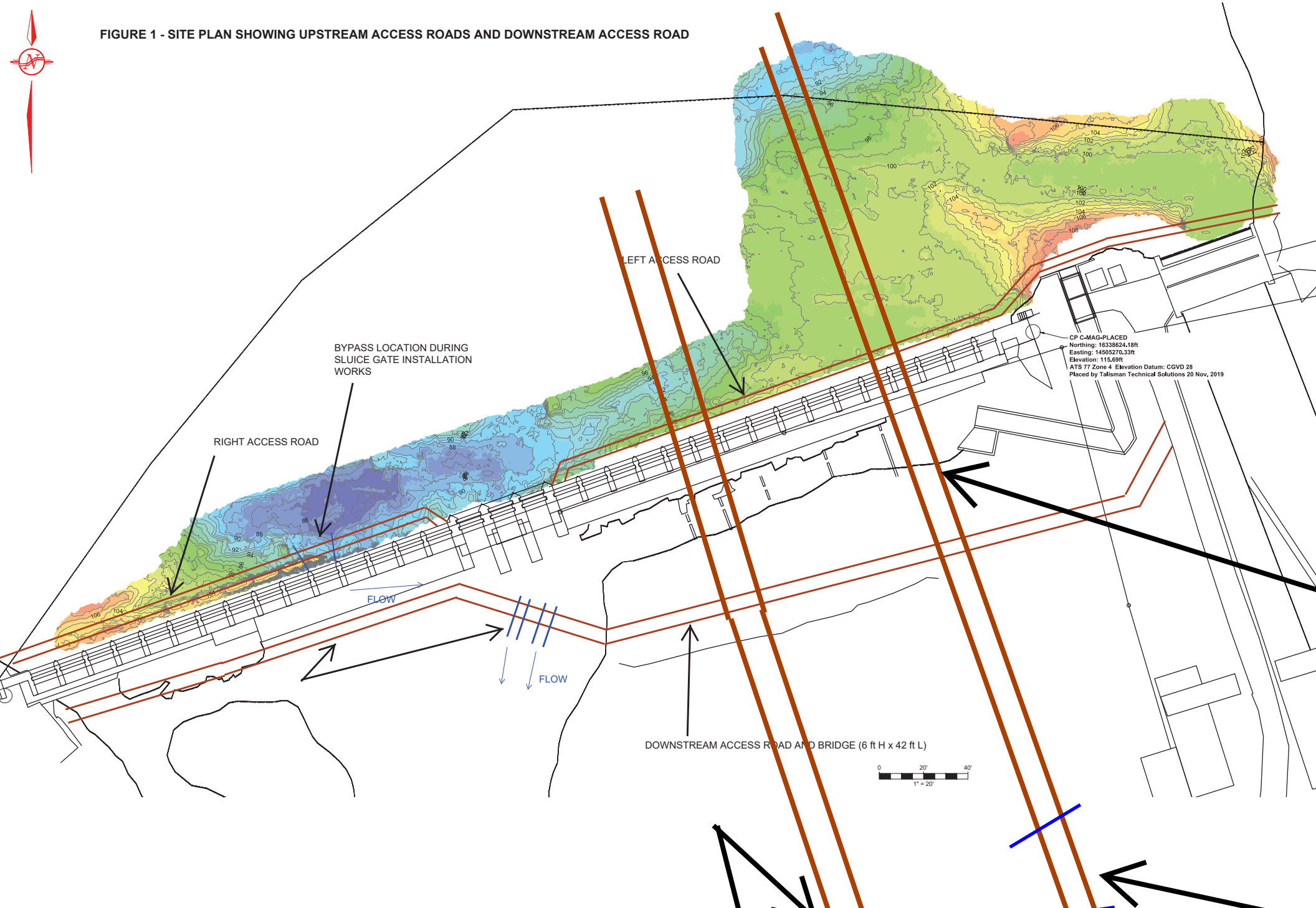
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

RUBBER DAM PIPING AT SLUICEWAY

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APPENDIX D – PROPOSED WATER MANAGEMENT STUCTURES

FIGURE 1 - SITE PLAN SHOWING UPSTREAM ACCESS ROADS AND DOWNSTREAM ACCESS ROAD



APPENDIX E – NSE WATERCOURSE ALTERATION APPLICATION – PROJECT AND ENVIRONMENTAL DESCRIPTION

PROJECT OVERVIEW

NS Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2022. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. The project involves refurbishing the main dam by replacing the existing stop log bays with rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section. Prior to main construction NS Power will be replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

Activities proposed for the Project include lowering the Ruth Falls Headpond and canal approximately 18 feet and dewatering the Ruth Falls fish ladder and downstream bypass during construction. Fish will be moved downstream via the sluiceway and/or spillway.

The Project is scheduled to take approximately 9 months to complete starting July 10th, 2022.

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel.

Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

2.0 CONSTRUCTION

Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the

concrete on the crest and downstream slope of the main dam ogee section. Prior to main construction NS Power will be replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

NS Power is anticipating an additional permanent instream footprint of approximately 60 m^2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections. The reservoir will be temporarily drawn down approximately 18 feet and a temporary cofferdam or bulkhead installed to isolate the existing sluiceway. The fish ladder and fish bypass will be dewatered. A fish conveyance system will be on hand should the need arise; however, NS Power does not anticipate migration during the drawdown period as the fish would have already moved upstream using the fish ladder.

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the centre, and two short concrete gravity bulkhead sections that abut either side of the spillway. Prior to main construction, the three-bay stoplog-controlled sluiceway will be replaced with a set of 3 screw-stem vertical lift gates. The crest elevation of the spillway is 31.7 m and stoplogs can be installed to an elevation of 33.3 m. The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Flow in the area is controlled by NS Power Hydro Operations. Water levels can fluctuate between the full supply level of 33.7 m (110.5') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.25') is observed from April 1 - Nov. 30 each year. As per NSE Approval, a 35 cfs maintenance flow is provided downstream year round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers.
This flow is set to accomodate downstream migration of all fish species found on the system.
The fish ladder at Ruth Falls operates from May 15-November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 9 salmon have been captured since 2007 and none since 2017.

The site will be surveyed prior to the construction works to ensure that the elevations are accurate with respect to the current configuration and the new design. Discrepancies noted between minimum operating levels of the reservoir (109.4ft and 109.2) are datum related, as there have been many datums used over the years, including different coordinate systems and local datums. The minimum operating levels of the reservoir based on our drawings and Dam Safety Reviews is noted to be 109.25 ft. This was likely a mistake in the number presented;

however, that will not impact the design. The current minimum operating level will remain unchanged with the new dam design.

2.2 Proposed Refurbishment Activities

The proposed refurbishment activities are broken up into two phases below, Phase 1 - the installation of the sluiceway gates (already approved under Approval 2021-2840307-00) and Phase 2 – the dam construction:

Phase 1 – Sluice gate installation:

- Installation of a bulkhead, exact method to be determined, to isolate the existing sluiceway section;
- Refurbishment of the existing low level sluiceway section with the removal of the stoplogs and replacing the stoplogs with three (3) low level sluice gates. The existing piers will remain in-place;
- Removal of bulkhead.

Phase 2 – Dam construction:

- Lowering of Ruth Falls Headpond approximately 18 feet;
- Dewatering of the Ruth Falls fishladder during the construction activities;
- Installation of temporary access for machinery on both the upstream and downstream sides of the dam, see below for more information on the access roads.
- Removal of the existing stoplog bays, piers, original control building, stoplog lifter and walkway;
- Reface the concrete on the crest and downstream slope of the spillway ogee sections;
- Installation of new rubber dam bladders on the crest of the ogee spillway sections;
- Construction of a free overflow spillway section at the right end of the dam;
- Installation of a new steel walkway for access across the dam;
- Removal of the temporary access road material;
- Watering up of the headpond to within normal operating levels.

2.3 Construction Schedule

The Project is expected to take nine months starting in mid-July 2022 and finishing in late March 2023. This includes both the lowering and subsequent recharging of water in the headpond.

3.0 REGULATORY PERMITS/APPROVALS

A Watercourse Alteration Approval is required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*. A separate request for review has been submitted to DFO to determine if a Fisheries Act Authorization is required.

4.0 ENVIRONMENTAL PROTECTION

4.1 Water Management

In order to expose the portions of the concrete dam to be refurbished, the Ruth Falls Headpond will be lowered approximately 18 ft from the 109.25 ft minimum operating level maintained April 1st to November 30th each year. The canal, fishladder, and fish bypass will be dewatered. A 35 cfs flow will also be maintained downstream of the dam. Supplemental flow required as part of the operating approval will not be provided during construction and the fish trap will not be operated.

During normal operation, inflows in the reservoir are controlled by NS Power Hydro Operations. Water levels fluctuate between the full supply level of 33.7 m (110.5 ft), minimum supply level of 33.3 m (109.25 ft), and the low supply level of 27.5 m (90.1 ft). In order to complete work in dry conditions, the Project will include temporarily lowering the headpond and canal approximately 18 ft below the minimum operating level of 33.3 m (109.25') observed from April 1 – Nov 30 each year. Dewatering activities will begin no earlier than July 10th, 2022. To commence the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 33.7 m (110.5 ft) to the minimum operating level of 33.3 m (109.25 ft). Once the headpond reaches an elevation of 33.3 m (109.25 ft), the drawdown will be controlled using the vertical lift deep sluice bay until the desired elevation of 27.7 m (91 ft) is achieved. The drawdown flow will be directed through areas that are part of the normal flowage channels.

If all three vertical lift gates were not able to be installed prior to the July 15th start date for the main construction project (separate approval 2021-2840307-00), it is anticipated that the two outer gates will be constructed first and will be able to manage the discharge from the headpond through the centre sluiceway bay. This option would not impact the discharge flows as there would be no change to how the water flows through the center sluice bay. In this situation, once the two outer gates are completed, the reservoir will be raised to an elevation of 95 ft and the centre gate will be isolated and constructed. Once the middle gate is constructed the elevation will be brought back down to 91 ft. It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will continue to be maintained and there will be no negative impacts the passage of the water should this situation occur.

Expected flows through the vertical lift sluice bay is expected to be much lower during construction. Following the drawdown of headpond, the remaining section of the downstream access for the site will be completed. To cross the existing spillway channel, clean rock material that is free of fines will be placed across the spillway to construct an access path, which will span the entire discharge channel. Based on the NS Watercourse Alteration sizing criteria, calculations were conducted in order to determine an appropriate bridge size capable of passing 1:2 year return storm conditions on the downstream side. To reduce the need for a large structure required to satisfy the NS watercourse Alteration Standard (requiring a bridge to have a width of 126 ft or 38.5 m), the contractor is proposing to make use of the storage capacity of

the reservoir once drawn down, and install a bridge that is approximately 6 ft tall and 42 ft wide. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. If a heavy influx of water is expected, NS Power will notify the contractor and the bridge will be removed promptly to allow for excessive flow conditions that would be expected for a 1:2 year return storm event. An excavator or crane will be available on-site during construction to remove the bridge promptly. As an additional measure, NS Power has the option to close the vertical lift sluice bay to hold back water from moving downstream. During the drawdown, the headpond will be lowered to an elevation of 91 ft, which allows for a 9 ft elevation increase should storm conditions arise. Equipment used during construction will be clean and fee of debris and all material will be removed in a responsible manner. Clean rock fill will be used, and geotextile / poly liner will be available to use should the need arise.

The flow downstream will be controlled in order to avoid scour and sedimentation. A fish conveyance system will be on hand should the need arise; however, NS Power does not anticipate migration during the drawdown period as the fish would have already moved upstream using the fish ladder. The 35 cfs maintenance flow and downstream fish passage will be provided through the sluiceway or via the concrete ogee sections as required. Once the headpond is lowered to 91ft, temporary access upstream and downstream of the dam will be installed in the dry.

Qualified NS Power personnel will be on site during the drawdown to monitor water quality (visual silt) and conduct a fish rescue for any isolated fish in the headpond and canal. The headpond will be subsequently recharged at a controlled rate and monitored for silt and fish issues.

4.2 Erosion and Sedimentation Control

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NS Power personnel monitoring for any visible water quality issues. NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

All access road material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

The removal of cofferdam material will take place with Ruth Falls Headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring.

4.3 Construction Material and Debris

Measures will be taken to prevent any materials used in the various work activities from entering the watercourse. All such materials will be applied in a controlled manner and any excess material will be contained during application. All construction debris will be stored on NS Power property or disposed to an approved landfill. Any debris that requires disposal will be done so in accordance with **NSE Construction and Demolition Debris Disposal Site Guidelines**.

4.4 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refuelling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. Oil spill contingency plans will be followed and spill kits maintained on-site, in the event a petroleum product spill occurs.

4.5 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

5.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Ruth Falls Headpond was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas is considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

6.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window Meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020. NS Power further presented the Project and design option with the KMKNO during the One Window meeting to discuss 2020 hydro capital projects. NS Power will continue engagement regarding the project with monthly project updates to the KMKNO and notifications regarding the permitting schedule for the submission of an NSE Watercourse Alteration application. Weekly project manager communications will be provided to the KMKNO, as construction begins, currently scheduled for July 2022 – March 2023.

APPENDIX F – MONITORING PLAN

Nova Scotia POWER
An Emera Company

Ruth Falls Dam Refurbishment Project

Fisheries Act Authorization Application

2022 Monitoring Plan

January 2022

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1.0 Introduction

This Addendum is to outline NS Power's proposed monitoring activities, and additional avoidance and mitigation measures for the Ruth Falls Dam Refurbishment Project (the Project) as well as to address DFO's request for additional information to support NS Power's application for authorization for the Project (DFO file 19-HMAR-00549). The following information is included:

i. Proposed water management plan (revised) and construction sequencing plan for the Project.

ii. Proposed monitoring activities associated with the drawdown of Ruth Falls Headpond including, entrainment monitoring, tributary monitoring, wetland monitoring, and post-construction monitoring.

iii. Proposed monitoring of construction activities in 2022.

The following construction activities are proposed for the Project:

i. Lowering of Ruth Falls Headpond from a full supply level (FSL) elevation of 110.5 ft (33.7 m) to elevation 91.0 ft (27.7 m). The majority of the drawdown will take place using the vertical lift gates, which will be installed prior to main construction, allowing for improved water management during main dam construction activities. Refer to Section 3.1 for more information on the drawdown methodology.

ii. During the lowering of Ruth Falls Headpond, the Ruth Falls fish ladder and downstream bypass will be non-operational. NS Power is proposing to complete the drawdown in mid July, after the upstream alewife migration and the majority of fish spawning windows. The fish ladder will be dewatered and a fish rescue conducted to move any stranded fish to the headpond . A fish rescue will also be conducted in the headpond and canal throughout the duration of the drawdown to monitor for stranded fish.

iii. Temporary access will be installed on both the upstream and downstream sides of the dam. The upstream access will consist of rockfill on both the east and west sides of the deep sluice gates, with the sluiceway channel opening being maintained. The downstream access will comprise a rockfill berm consisting a temporary bridge over the discharge channel from the sluiceway.

iv. Removal of the existing railings, controls building, stoplog lifter and electrical components.

v. Demolition of the existing concrete piers, walkway, and concrete facing on noted on the design drawings.

vi. Reface existing concrete on the crest and downstream slope of the dam ogee sections.

vii. Installation of new rubber dam bladders on the crest of the existing ogee spillway sections.

viii. Construction of a free overflow spillway section at the west end (right looking downstream) of the dam.

ix. Replacement of the west retaining wall, to the west of the free overflow spillway section.

x. Removal of temporary cofferdam/access path material.

xi. Watering up the headpond to normal operating levels.

NS Power has considered the potential environmental and archaeological risks associated with the lowering of Ruth Falls Headpond and believes that with implementing the mitigation measures discussed in the following sections of this application, the proposed approach will prove effective. This approach will also be safest for NS Power employees and contractors. NS Power has evaluated whether the use of bulkheads, barges, or work platforms would be an appropriate alternative, and has determined that these scenarios present significant safety risk, potential quality issues and scheduling risks to the Project. NS Power considers the lowering of the headpond to be the safest and most efficient solution to undertake the Project.

1.1 PROJECT SCHEDULE

Prior to commencing the dam construction portion of the project, the existing sluiceway structure, deep stoplog bays located in the central portion of the dam, will be replaced with screw stem vertical lift gates. No instream work or construction activities on the dam will take place until all required approvals are in place. The vertical lift gates are being installed under a separate approval (2021-2840307-00). This work is tentatively scheduled for April/May of 2022. If all three vertical lift gates were not able to be installed prior to the July 15th start date for the main construction project, it is anticipated that the two outer gates will be constructed first and will be able to manage the discharge from the headpond through the centre sluiceway bay. See section 3.4 – Water Management and Control for further details. In advance of main dam construction, a downstream access road and bridge will be installed no earlier than July 1, 2022. The installation of the downstream access road and bridge are not expected to hinder downstream activities.

Dam construction activities for the Project are anticipated to begin in mid-July with the drawdown of Ruth Falls headpond. Following the drawdown, construction of the temporary upstream access roads will take place, and work will begin on the existing dam and sluiceway structure with demolition of the deck and piers beginning from the east side of the dam. Chipping of the existing spillway surface will also be part of the demolition phase as well as the removal of the downstream retaining wall at the right abutment.

Following the demolition activities, the spillway overlay will begin with the installation of the rebar, embedded parts, and rubber dam air lines. Concrete will be placed to reform the spillway surface.

A free overflow concrete spillway section will be constructed at the right end of the dam. Once the concrete spillway surfaces and piers are complete, the installation of the seven (7) rubber bladders will begin. The rubber bladders are bolted in place with clamping plates attached to the embedded parts and the bladders are attached to the air lines. The rubber dam controls will be installed in the controls building.

Work is proposed to extend until March 2023 to accommodate shorter days, potential weather-related delays, and slower concrete curing during the winter months. NS Power will ensure that the headpond is raised to its normal operating level prior to the 2023 upstream alewife migration (April 1). A total construction period of approximately 9 months is anticipated.

2.0 Description of Effects on Fish and Fish Habitat

The following water management strategies related to the Project have the potential to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat:

- The temporary drawdown of Ruth Falls Headpond, which could result in the temporary disruption of up to approximately 0.09 km^2 of littoral zone habitat that fish species use for a portion of their life cycle;
- The installation of cofferdams and access for machinery on both the upstream and downstream sides of the dam, resulting in a temporary instream footprint. The total estimated temporary instream footprint for control measures is 2000 $m^{2.}$
- Death of fish due to entrainment and/or stranding from drawdown activities.

The Project activities that have been identified to have potential impacts to fish and/or fish habitat are discussed in Table 1.

Table 1: Summary of potential effects on fish and/or fish habitat due to refurbishment of the Ruth Falls Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect
Temporary loss of fish habitat due to lowering headpond beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.15km^2 in Ruth Falls Headpond	High	Low
Temporary loss of fish habitat due to temporary installation of access road/crossings and cofferdams.	Localized: area immediately above and below the dam	High	Low
Permanent loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly below the dam	High	Low
Fish mortality due to stranding when lowering reservoir.	Localized: Ruth Falls Headpond	Low	Low
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low
Potential downstream scour during drawdown of reservoir.	Localized: East River of Sheet Harbour	Low	Low

Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High

3.0 Proposed Avoidance and Mitigation Measures and Standards

3.1 DRAWDOWN SCHEUDLE

NS Power intends to approach the drawdown of Ruth Falls Headpond the same way as all previous drawdowns conducted on its various hydro systems. Based on operational experience and employing a gradual drawdown to minimize impacts to fish and fish habitat, the drawdown of the headpond to elevation 91.0 ft is anticipated to take approximately 4 days.

To commence the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 110.5 ft to the minimum operating level of 109.25 ft. Once the headpond reaches an elevation of 109.25 ft, the drawdown will be controlled using the vertical lift gate deep sluice bay. As the reservoir is lowered enough to make the canal non-operational, fish will be prevented from passing downstream through the bypass and therefore, will be passed through the vertical lift sluice gate bay. The drawdown will continue by using the vertical lift deep sluice bay to pass water while not exceeding 500 cfs at anytime during the drawdown. The drawdown will continue in this manner until the desired elevation of 91.0 ft is reached. It is anticipated that there will be leakage through the stoplogs during the drawdown; however, once the headpond reached elevation of 104.1ft, there will be no more leakage.

NS Power is not anticipating any additional impacts with respect to erosion/scour or sedimentation during the drawdown as the discharge channel immediately downstream of the dam is comprised of bedrock

and boulders. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NS Environment and Climate Change (ECC), and make necessary repairs in order to stabilize the area.

A spill in excess of 500 cfs is an extremely common occurrence at the Ruth Falls dam (equivalent of one generating unit). This is because the elevation of headpond is kept at a minimum of 109.25 ft for the majority of the year (April-November) for optimal operation of the fish ladder and louvers and there is negligible storage capacity in headpond. Hydro Operations has confirmed that spill in excess of 500 cfs is very common, and a spill in excess of 1,000 cfs (equivalent to both generating units running) is common with 6-12 occurrences annually.

Given the anticipated discharge through the dam, its very short duration, and methodical approach proposed for the drawdown, NS Power is not anticipating a high risk of entrainment of juvenile fish species. Given the potential for entrainment to occur, an entrainment study will be carried out during the drawdown by a qualified third-party contractor. The results of the study will be provided to DFO. See Section 4.5 for details surround the entrainment study.

3.2 FISH PASSAGE

To reduce the potential impact to fish and/or fish habitat, NS Power has revised the construction schedule to avoid lowering water levels, thus maintaining operation of the fish ladder during critical migration and spawning windows. By delaying the drawdown until after July 10th, access to and use of all accessible habitat upstream of Ruth Falls Dam remains available to migrating species, such as gaspereau for spawning, hatching, and subsequent growth until juveniles become mobile.

Atlantic salmon returns to the East River continue to remain extremely low. In 2020 throughout NS Power's operation of the salmon trap located in the Ruth Falls fishladder, one salmon was captured and released to the Ruth Falls Headpond on July 31st, 2020. NS Power provided 15 supplementary flow release events throughout the months of June, July, September, October, and November 2020. Thus, NS Power is anticipating low returns to continue. As a result, NS Power is not proposing further mitigation for Atlantic salmon.

NS Power is also committed to maintaining downstream fish passage. Throughout construction activities, water will be continuously passed downstream through the vertical lift sluice gates. The vertical lift sluice gates will remain open throughout construction providing opportunity for upstream passage to occur as the water will equalize on the downstream and upstream side. This will also allow NS Power to provide the required ecological maintenance flows in accordance with the Sheet Harbour Hydro System Water Approval.

While there is no fish passage upstream of the Ruth Falls Headpond on the Sheet Harbour Hydro System, NS Power understands that salmonid habitat is available on the Grant River Watershed, the confluence of which is located within the Ruth Falls Headpond. NS Power anticipates that at a construction elevation of 91.0', fish passage will be maintained into the Grant River. Through previous assessment of pre-inundation conditions of the East and Grant Rivers, in particular through review of historical mapping and aerial imagery during the Project archaeological assessment, there was historically fish passage from the East River into the Grant River prior to the construction of the Ruth Falls Dam. Natural river conditions are evident when examining NS Power bathymetry of the Ruth Falls Headpond completed in 2010. During the drawdown, NS Power will assess the headpond at the Grant River/East River confluence in particular, to determine whether any barriers to passage into Grant River are being observed; in the unlikely event that barriers are preventing passage, NS Power will notify DFO as well as ECC to discuss temporary measures, if required.

3.3 IMPROVEMENTS TO DOWNSTREAM EEL PASSAGE

The dam contains a louver/fish bypass system located in the canal for the downward migration of fish. The louvre system is made up of a series of removeable louvres (vertical slats) designed by DFO installed at the upstream end of the Ruth Falls canal. The louvres prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance.

In October 2010, NS Power conducted a study where over 150 American "silver" eels (sexually mature adults) were captured in the East River and implanted with individually identifiable PIT tags (passive). Thirty of the eels also received a surgically implanted active acoustic transmitter. The tagged fish were then released 4 km (2.49 miles) upstream of the louver guidance system. An array of acoustic receivers was placed along the watershed as well as in the harbour and the outer portion of the Sheet Harbour estuary to allow tracking of the downstream movement of the fish through the system.

The analysis of the data indicated that:

- All 30 acoustic tags were detected at Ruth Falls.
- Overall, close to 57% of the tracked eels reached the estuary:
    - 1/3 of the acoustically tagged fish were diverted through the bypass.
    - 40% of the fish that did not get diverted survived the turbines.

Overall, the study demonstrated that eels are being diverted through the bypass away from the canal; however, not all eels were diverted. NS Power has identified areas of potential improvements to the

existing louvre system that may effectively improve the efficacy of the louvre system at bypassing eels downstream. See Appendix H – Downstream Eel Passage Study for further details.

NS Power will engage a professional engineering and fish passage consultant to perform an assessment on the existing louvre system and recommend modifications that will look to improve the functionality and effectiveness of bypassing eels around the power canal. The engineering company will be experienced in fish passage design and will evaluate the louvre system based on the effectiveness to by-pass American eel. The assessment will also include a desktop literature review of louvre systems in relation to eel by-pass and the proposed modifications will be required to meet USFWS Fish Passage Engineering Design Criteria.

Modification to the system will be made based on the results of the engineer assessment. Modifications to the louvre system will be completed based on the scheduling of the hired engineering firm and Ruth Falls operation schedule. After the modifications have been made, NS Power will conduct a study to compare the results of the baseline study conducted in 2010 to the post modification louvre system. A similar method will be used where American eel will be captured and equipped with acoustic tags, released upstream and monitored for movement. NS Power expects that improvements made to the louvre system will be reflected in an increase in American eels being diverted to the bypass pipe. The results of the post modification study will be submitted to DFO

3.4 UPSTREAM ESCAPEMENT

NS Power will monitor upstream escapement at the Ruth Falls fish ladder using a camera installed in the fish ladder to inform the Harmful Alteration Disruption or Destruction (HADD) and death of fish and subsequent offsetting requirements. NS Power will install the camera and ensure video footage is functioning and acceptable for monitoring activities prior to mid-May, 2022. Between mid-Mayst and upon dewatering if the Ruth Falls fish ladder, NS Power will implement a daily inspection of the camera and footage to ensure it continues to be operational. This includes:

a. Check of camera placement and white board, ensuring no shifting or damage.
b. Check of ladder buckets, ensuring fish are moving freely, flows are appropriate and there are no obstructions.
c. Check of video system, ensuring video is on, reading properly, no obstructions or debris in and around the system and fish are clearly visible.
d. Check of last 24 hours of video footage for wildlife obstructions (spiders, webbing, insects) that may not be visible at the time of inspection.

Counts will be taken from video footage to inform upstream gasperau escapement, using established DFO methodology for estimating escapement on other systems (Tusket, Gaspereau). NS Power will also continue to operate the salmon trap and document salmon observation until the fish ladder is dewatered.

3.5 WATER MANAGEMENT AND CONTROL

Once the desired construction elevation of 91.0 ft is reached, work will begin on the temporary upstream access paths. NS Power had originally requested a drawdown level of 98'; however, upon careful review of the bathymetric study, the bathymetry modelling does not demonstrate a considerable difference between a reservoir level lowered to 98 ft or to 91 ft. In an effort to provide the safest and most reliable construction execution, lowering the reservoir to elevation 91 ft is preferable. To execute the most reliable construction schedule, this allowance of a reservoir level at 91 ft confidently allows the Contractor to safely execute all project works within one drawdown period.

Prior to the new sluice gate installation, the Ruth Falls Dam would have an overflow spill of approximately 350 cfs while at full supply elevation of 110.5 ft. The overflow spill would spill over the stoplog along the full length of the dam. From May to August 2021, overflow spill was approximately 350 cfs, this was due to a lack of generation a result of Ruth Falls switch gear refurbishment project.

The Ruth Falls Headpond has a storage volume of 2.3M cubic meters (1888 acre-ft) when at full supply level at elevation of 109.25 ft. As noted previously, the headpond will be lowered to elevation of 91 feet for construction. At 91 ft, the headpond will have a volume of .005M cubic meters (4 acre-ft).

Two access roads will be installed on the upstream side of the dam; one extending from the left abutment to the left end of the sluiceway, and one extending from the right abutment to the right end of the sluiceway. The access roads will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes using clean rock material that is free of fines. The left upstream access road will be 209 ft (64 m) long while the right upstream access road will be 343 ft (104.5 m) long. The estimated temporary instream footprint of the left access road is 576 ft^2 (535 m^2) while the right access road is 747 ft^2 (694 m^2). Using available bathymetry, approximately 74% of the upstream access road will be placed in the dry at an elevation of 91.0 ft.

The upstream cofferdams will serve primarily to provide access for machinery to complete refurbishment activities but also to divert water to the centre deep sluiceway section of the dam. While cofferdams are required to maintain dry work areas to some extent (namely to ensure water levels remain below the spillway section of the existing dam), all construction activities will be taking place on the existing dam structure. NS Power is not anticipating concerns related to the inability to maintain dry work areas similar to what has been observed on the Tusket main dam refurbishment project for these reasons.

It is expected that elevations in the headpond will fluctuate throughout construction due to inflows from Malay Falls as well as uncontrolled inflows from Grant River watershed. The use of these access roads will allow the headpond to rise to approximately elevation 99 ft before additional water control measures would be required, see Section 3.4 for a discussion on contingency planning should the elevation exceed 99 ft.

It is expected that at a minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, as well as required maintenance flows and spill over the Malay Falls rubber dams would be managed through the construction site. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power's Construction Project Management and Hydro System Superintendent.

To maintain water passage through the dam during construction, the water will be passed through the middle vertical lift gate deep sluice bay, which will be adjusted as required. The sill elevation of the middle sluice gate is 90.1 ft, whereas the sill elevation of the outer two gates is 94.1 ft. Therefore, at a headpond level lower than 94.1 ft, only the middle vertical lift gate deep sluice bay will be available to discharge flows.

The vertical lift gates will be installed prior to main construction providing improved water management during the project. If all three vertical lift gates were not able to be installed prior to the July 15th start date for the main construction project, it is anticipated that the two outer gates will be constructed first and will be able to manage the discharge from the headpond through the centre sluiceway bay. This option would not impact the discharge flows as there would be no change to how the water flows through the center sluice bay. In this situation, once the two outer gates are completed, the reservoir will be raised to an elevation of 95 ft and the centre gate will be isolated and constructed. Once the middle gate is constructed the elevation will be brought back down to 91 ft. It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will continue to be maintained and there will be no negative impacts the passage of the water should this situation occur.

The estimated maximum discharge flows through the gates are shown in Table 2:

Table 2 : Estimated Discharge Flow for the New Vertical Lift Gates

Reservoir El.	91 ft	93 ft	95 ft	97 ft	99 ft
Outer Gate 1	N/A	N/A	171 cfs	990 cfs	2,175 cfs
Outer Gate 2	N/A	N/A	171 cfs	990 cfs	2,175 cfs
Middle Gate	171 cfs	990 cfs	2,175 cfs	3,635 cfs	5,324 cfs
Totals	171 cfs	990 cfs	2,517 cfs	5,615 cfs	9,674 cfs

The two outer gates are identical in their dimensions; therefore, yield the same outflows. All gates were considered to be fully open for the purpose of these calculations. N/A – Sill elevation is above the headpond level.

Expected flows through the vertical lift sluice bay is expected to be much lower during construction, see Section 3.4 for contingency planning for higher inflows. Following the drawdown of headpond, the remaining section of the downstream access for the site will be completed. To cross the existing spillway channel, clean rock material that is free of fines will be placed across the spillway to construct an access path, which will span the entire discharge channel. Based on the NS Watercourse Alteration sizing criteria, calculations were conducted in order to determine an appropriate bridge size capable of passing 1:2 year return storm conditions on the downstream side. To reduce the need for a large structure required to satisfy the NS watercourse Alteration Standard (requiring a bridge to have a width of 126 ft or 38.5 m), the contractor is proposing to make use of the storage capacity of the reservoir once drawn down, and install a bridge that is approximately 6 ft tall and 42 ft wide. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. If a heavy influx of water is expected, NS Power will notify the contractor and the bridge will be removed promptly to allow for excessive flow conditions that would be expected for a 1:2 year return storm event. An excavator or crane will be available on-site during construction to remove the bridge promptly. As an additional measure, NS Power has the option to close the vertical lift sluice bay to hold back water from moving downstream. During the drawdown, the headpond will be lowered to an elevation of 91 ft, which allows for a 9 ft elevation increase should storm conditions arise. Equipment used during construction will be clean and fee of debris and all material will be removed in a responsible manner. Clean rock fill will be used, and geotextile / poly liner will be available to use should the need arise.

During the drawdown, water will pass through the gates and reduce the headpond level from 109.25 ft to 91 ft. Table 3 displays the decrease in flow velocities as the headpond elevation lowers over the course of the 4-day drawdown period.

Table 3: Estimated Flow Velocities Table

Time (day)	Beginning Elevation (ft)	Middle Sluice Opening (ft)	Discharge (cfs)	Velocity through gate(fps)	Downstream Velocity (fps)
0	109.2	1	211	21	2.4
0.5	108.8	1	209	21	2.4
1	108.0	1	204	20	2.4
1.5	107.2	1.5	300	20	2.8

2	106.0	1.5	289	19	2.8
2.5	104.9	1.5	279	18	2.7
3	103.0	1.5	260	17	2.6
3.5	101.0	2	319	16	2.9
4	96.0	2	236	12	2.5
4.5	91.0	2	33	5	1.3

3.6 CONTINGENCY PLANNING

The statistical flood peaks for the Ruth Falls headpond, taken from the 2008 Sheet Harbour Hydro System Flood Study, are presented in Table 4 below:

Table 4: Instantaneous Flood Peaks for the East River

Return period (years)	Instantaneous Flow Peaks (cfs)
2	5,850
5	8,340
10	10,130
20	11,940
50	14,430
100	16,420
1000	24,220

The instantaneous flood peaks outlined in Table 4 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

The primary means of water management for the Project is the lowering of Ruth Falls Headpond to elevation 91.0 ft. Prior to main construction, the vertical lift gates will be installed. Temporary upstream access roads will be installed to withstand a rise in the headpond to elevation 100 ft; however, it is unknown how much instantaneous inflow would result in a rise in the headpond elevation from 91.0 ft to over 100 ft as there is no storage curve for Ruth Falls Headpond, due to lack of storage. Should unexpected inflows be received, NS Power will implement contingencies to safely pass water. This may include the addition of sandbags on the upstream crest of the access roads to accommodate increased water levels. If extreme heavy rain or significant sustained inflows are forecasted, NS Power will develop a plan to accommodate the expected increased inflows and make adjustments during construction.

The new vertical lift gates will be used to pass water and have been designed to meet all applicable standards. As outlined in Section 3.5, To reduce the need for a large structure required to satisfy the NS

watercourse Alteration Standard (requiring a bridge to have a width of 126 ft or 38.5 m), a bridge that is approximately 6 ft tall and 42 ft wide will be installed. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. If a heavy influx of water is expected, NS Power will notify the contractor and the bridge will be removed promptly to allow for excessive flow conditions that would be expected for a 1:2 year return storm event. An excavator or crane will be available on-site during construction to remove the bridge promptly. As an additional measure, NS Power has the option to close the vertical lift sluice bay to hold back water from moving downstream. During the drawdown, the headpond will be lowered to an elevation of 91 ft, which allows for a 9 ft elevation increase should storm conditions arise. Should more significant sustained inflows or a higher return period flood event be forecasted, NS Power will develop a plan for additional contingency measures. Upstream access roads will consist of clean rockfill material; if in the event migration measures are required, the associated risk of sedimentation is extremely low.

If significant discharge is anticipated downstream of the dam, NS Power may make adjustments to the downstream temporary access road to accommodate the additional flows. This may involve the removal of access road material and prepping sections of the access road to allow water to pass safely beyond it. The downstream access road / bridge will comprise clean rockfill material and clean preformed concrete blocks. If in the event migration of material is observed, the associated risk of sedimentation is extremely low. NS Power will assess the access road material migration once water levels have receded. Since the headpond will be drawn down to 91.0 ft, NS Power has the ability to attenuate water in order to implement contingency measures, if necessary.

NS Power is not anticipating issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. NS Power project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

3.7 EROSION AND SEDIMENTATION CONTROL

NS Power is anticipating minimal impacts to the surrounding environment with respect to erosion, scour and associated sedimentation of watercourses. The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined above.

There will be some excavation of the right (west) abutment retaining wall that is scheduled for removal and replacement. During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time.

Pumps will be used to keep the retaining wall work area dry and silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas, as required. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the dam and the other is located north east of the dam, see Figure 1 below. Both areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.



Figure 1: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2021.

Silt fencing will also be used adjacent to the portion of the downstream access path that is on dry land, to capture sediment and prevent it from entering the spillway channel. As no excavation for the temporary access path is required, and material will be clean rockfill that is free of fines. NS Power is not anticipating a high risk of sediment transport as a result of construction, use and removal of the road. Silt fencing will be monitored periodically for sediment build up and will be cleaned, as necessary.

All access road / cofferdam material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill

cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

NS Power will evaluate the use of silt curtains downstream during the construction of the downstream access path, silt curtains are applicable for still or very slow moving water, but can assist in providing areas where silt-laden water can be pumped out using negative pressure.

The removal of clean rockfill material will take place with the headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring. The filling of the headpond will be completed using a combination of natural inflows, inflows from Malay Falls, and if there is insufficient inflow, some generation using Malay Generating Station. As such, the headpond is expected to be filled slowly in a controlled manner; NS Power will be on site to monitor for potential sedimentation as a result of re-watering activities.

The selected contractor for the Project will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1 – September 30) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of access road sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power will also require the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This will allow NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

4.0 2022 Drawdown Monitoring Activities

4.1 BACKGROUND

NS Power completes fish and fish habitat surveys as part of the Hydro Relicensing Program, which takes place on a 10-year cycle as part of the renewal of Hydro System Water Storage Approvals. The relicensing fish data collection is qualitative in nature; however, NS Power has two datasets for the Sheet Harbour Hydro System collected 10 years apart and some trends and observations can be drawn from that data. A list of commonly found fish species in the Sheet Harbour watershed is provided in Table 5, along with an indication of their presence during the previous relicensing.

Table 5: Fish Species present in the Sheet Harbour Watershed

Common Name	Scientific Name	NS POWER 2007	NS POWER 2017
Alewife	*Alosa pseudoharengus*		Confirmed
American eel	*Anguilla rostrata*	Confirmed	Confirmed
Banded killifish	*Fundulus diaphanous*	Confirmed	Confirmed
Blacknose dace	*Rhinichthys atratulus*	Confirmed	
Brown bullhead	*Ictalurus nebulosus*	Confirmed	Confirmed
Common shiner	*Luxilus cornutus*	Confirmed	Confirmed
Golden shiner	*Notemigonus crysoleucas*	Confirmed	Confirmed
Lake chub	*Couesius plumbeus*	Confirmed	Confirmed
Pearl dace	*Margariscus margarita*	Confirmed	
Speckled trout	*Salvelinus fontinalis*	Confirmed	Confirmed
Stickleback	*Pungitius*	Confirmed	Confirmed
White perch	*Morone americana*	Confirmed	Confirmed
White sucker	*Catastomus commersoni*	Confirmed	Confirmed
Yellow perch	*Perca flavescens*	Confirmed	Confirmed
Atlantic salmon*	*Salmo salar*		

* Atlantic salmon were not observed during 2007 and 2017 sampling; however, small returns of Atlantic salmon have been observed in the salmon trap operated at Ruth Falls.

4.2 FISH RESCUE

As outlined in Section 3.1, NS Power anticipates the drawdown of Ruth Falls Headpond to elevation 91.0' to take approximately 4 days. Fish rescue efforts will start at the same time as the drawdown. NS Power has extensive experience completing fish rescues on various hydro systems and handling and transferring fish to support past hydro projects and initiatives. NS Power will conduct the fish rescue using a team of two, led by an experienced field biologist, during daylight hours for the duration of the drawdown. The rescue team will be equipped with a boat, backpack electrofishing units, lip seines, dip nets and beach

seines. The team may need to travel on foot to certain areas that may not be accessible by boat. A fish rescue of the Ruth Falls fish ladder and power canal will also be conducted once the elevation is low enough to expose the canal invert; however, given the drawdown will be occurring through the vertical lift sluice bay and the louvers present in the canal are very effective in preventing fish from entering the canal, it is anticipated that there will be little to no fish in the canal to transfer.

Capture method will be determined on a per site basis, depending on water, sediment, and weather conditions. Fish will either be immobilized using electrofishing and transferred to buckets using the dip nets, then moved as quickly as possible to the main reservoir with the minimal amount of handling as possible,or herded toward the main reservoir using seining when electrofishing is not possible. Species of conservation concern, namely Atlantic salmon, alewife, American eel and speckled trout will be given special attention, with the goal of transferring these fish as quickly as possible to the main reservoir. Fish rescue efforts will be maintained until the level of the reservoir has reached its minimum. Shoreline observations will also identify any stranded fish which will be identified and counted.

Fish rescued will be identified to the species level, counted individually for larger species or estimated for smaller species, and any instances of mortalities will be recorded. In the interest of time, no morphometric information will be recorded. The data recorded during the fish rescue will be used to estimate the fish mortality caused by the drawdown.

Based on a long experience of conducting fish rescues across all hydro systems, NS Power estimates that approximately 10% of the number of fish/life stages greater than 10 cm and 20% of the fish/life stages smaller than 10 cm, are not successfully rescued. Acknowledging that not all stranding areas will be identified during the fish rescue, NS Power proposes to double these values and estimate total mortality resulting from the drawdown as follows:

$$=Total\ Fish\ Mortality = Sum\ (observed\ mortality\ for\ each\ species) + 0.2 * (number\ of\ fish\ rescued > 10cm) + 0.4 * (number\ of\ fish\ rescued < 10cm)$$

NS Power is expecting there to be continuous ongoing sources of inflows into Ruth Falls Headpond (Section 3.3); therefore, the risk of ongoing fish mortality as a result of stranding is low.

4.2.1 Tributary Monitoring

During the fish rescue, NS Power will conduct ground truthing to confirm any tributary locations on Ruth Falls Headpond using the results of a desktop exercise identifying tributaries depicted on 1:50,000 mapping. NS Power will also document any additional tributaries observed in the field not originally identified through the desktop exercise. NS Power will walk a portion of each tributary, if safe to do so, from the exit location into the reservoir on which it's located by field personnel, after 2 days of the

drawdown (50% complete) and again immediately after the drawdown is completed (after 4 days). Connectivity of each tributary to the reservoir on which it's located will be assessed for any restrictions; other observations, such as pools within the tributary that could act as thermal refuge for fish, and bank full width and depth of the tributary, will also be documented.

4.3 WATER QUALITY

The Ruth Falls Headpond is a relatively small, shallow headpond with depths of up to 26.2 ft (8 m) in the deepest parts. Water quality of the headpond is heavily influenced by inflows from the Grant River Watershed as well as by the East River and its tributaries.

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for the headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, the headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for the headpond, approximately 0.5 miles square (1.15 km^2) of total shoreline will be exposed as a result of a drawdown to 91.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.25 ft, with depths of less than 9.8 ft (3 m). At an elevation of 91.0 ft, the headpond will look similar to pre-inundation conditions of the East and Grant Rivers. It is unknown how the drawdown of approximately 18 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed; although, inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

As such, NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to November for temperature, dissolved oxygen, total suspended solids and turbidity.

The monitoring site for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth
- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

In addition, NS Power will install a temperature logger for continuous temperature monitoring, providing readings every hour. NS Power will use 23 degrees Celsius in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November.

4.4 EGG/LARVAE STRANDING

NS Power will monitor upstream escapement of gaspereau at the fish ladder using NS Power's video recording system; NS Power is intending to install a new system at the fish ladder in mid-May 2022 in order to capture the upstream gaspereau migration and also capture other species of fish moving up or down the ladder. NS Power will estimate upstream escapement using the system footage and accepted protocols developed by DFO. Anecdotally and based on historical observation, the gaspereau upstream migration run is generally later than other NS Power hydro facilities due to the more northern location.

This method of monitoring upstream escapement has been implemented at various hydro locations and has provided valuable data for fisheries management purposes. NS Power will continue to operate the camera system at the fish ladder post-construction.

The following assumptions will be used as base for the calculation of an egg/larvae mortality estimate:

- The bulk of the gaspereau upstream migration on the Sheet Harbour watershed occurs between May and June of each year, when temperatures increase above 10°C. NS Power will assume a sex ratio of 50%/50%. Gaspereau typically spawn within a few days of reaching their spawning grounds.
- Gaspereau fecundity has been documented as ranging from 10,000s to 100,000s of eggs per female. A review of the available literature suggests that gaspereau freshwater mortality is generally very high (30%-60% or more). NS Power will assume that 60% of the fish survive to spawn and the average fecundity is 150,000 eggs per surviving female.
- Gaspereau eggs typically hatch in 3 to 8 days depending on water temperature and resorption of the yolk-sac lasts 2-5 days. NS Power will assume that all female gaspereau entering Ruth Falls on or after June 15th will have eggs/larvae at risk of being stranded during the drawdown.

Based on these assumptions, the mortality estimate for eggs and larvae will be calculated as follows:

$$Egg\ mortality = N * SR * SV * F$$

Where:

N= Number of fish counted on or after July 1st at the Ruth Falls ladder

SR= Sex Ratio (assumed to be 50%)

SV= Survival Rate (assumed to be 60%)

F= Fecundity (assumed to be 150,000)

Given these assumptions: $Egg\ mortality = N * 22{,}500$

This number will then be compared to the overall estimated number of gaspereau eggs produced in Ruth Falls Headpond (using the same assumptions) to assess the impact of the drawdown on egg/larvae survival.

Anecdotally and based on historical observations, upstream gaspereau escapement into Ruth Falls Headpond is generally low as there are challenges downstream in the East River that prevent large numbers of gaspereau from reaching the base of the dam. Thus, NS Power is anticipating the number of gaspereau moving upstream after June 15th to be extremely low.

4.5 FISH ENTRAINMENT / DOWNSTREAM MONITORING

4.5.1 Overview

The drawdown of the Ruth Falls Headpond will be conducted gradually to avoid creating excessive flows, which will reduce the risk of entrainment of fish and other species downstream of the dam. It should be noted that NS Power regularly generates and opens the existing stop log bays for water management and maintenance purposes. To date, these activities have not been associated with known harm to fish species.

The objective of this monitoring program is to assess the abundance of the YoY gaspereau within the Ruth Falls headpond before the drawdown, monitor the entrainment of fish from the headpond during drawdown and characterize the aquatic habitat exposed during the drawdown. The focus of the monitoring is assumed to be early juvenile and juvenile fish species (all species); however, NS Power will also monitor for egg/larvae entrainment (note: this will be difficult to achieve in a quantitative way) as well as entrainment of adult fish species.

The timing of the drawdown will reduce the risk of stranded larvae/eggs as the YoY gapereau will be hatched prior to the commencement of the drawdown. There is still, however, the potential for the YoY gaspereau to become entrained while the reservoir water level is being lowered. As a result, NS Power has committed to completing entrainment monitoring using a contracted a third-party consultant.

4.5.2 Methods

A similar study was carried out during the drawdown for the Tusket Main Dam Refurbishment Project. The study involved two parts; the first was to determine the presence and density of YoY gaspereau in the Vaughn reservoir using towed bongo nets, and shoreline seines. The second component of the study was to gather information on the entrainment of fish through the Tusket Dam. This was carried out before, during and after the drawdown using static bongo nets, fyke nets and shoreline seines.

Based on results of the Tusket study, some entrainment is to be expected as a result of the drawdown. However, the East River watershed Ruth provides approximately 3 km of suitable freshwater habitat below the Ruth Falls dam and accordingly, NS Power considers that entrainment of juvenile and adult fish below the Ruth Falls dam does not necessarily constitute harm or loss of fish.

The study will follow the same methods as Tusket, which will include juvenile sampling to determine size classes / densities as well as entrainment to estimate abundance. The results of the Tusket study showed that all fish were found to be alive and in a healthy condition and that suitable habitat was also available to the fish downstream of the dam. Similarly, the Ruth Falls Headpond provides approximately 3 km of suitable freshwater habitat. Shoreline monitoring was also completed at Tusket, the results showing no observations of fish mortality.

4.5.3 Study Plan

The duration of the drawdown is scheduled to take 4 days starting no earlier than July 10, this will provide sufficient time for juvenile fish to move through the system. The planned late start date of the drawdown will provide time for juvenile fish to grow and increase their chance of survival during their downstream migration through avoiding entrainment.

The parameters of the study will be as follows:

- Monitoring will begin a day in advance of the start of the drawdown.
- Monitoring will take place throughout the 4 day drawdown.
- Monitoring will take place one day after the end of the drawdown.
- Implementing an adaptive approach to sampling frequency and duration based on the time required to retrieve/sample/redeploy the equipment, and the number of fish collected during one sampling window (i.e. increase sampling duration if catches are low). Details on sampling frequency and duration for each gear type will be provided in a field plan developed by the consultant. The field plan will be provided to DFO no later than March 31, 2022.
- A range of net/gear types will be used to capture different species and life stages, targeting egg/larvae, early juvenile and juvenile fish but also including gear types to capture adult fish. The

sampling equipment will be based on a DFO approved method and requests that this be incorporated into authorization terms and conditions, if received. The plan will include sampling and calculation methodology.

- For all other species, quantity of fish and life stage will be collected.
- Measuring flow rates at the mouth of the net immediately after the sampling period. This information will be combined with the measure of the opening of the net and the dimensions of the wetted area of the river to estimate the portion of river sampled at each deployment.

If the data permits, NS Power will use the information collected to estimate the total number of fish entrained and based on a review of the scientific literature, estimate the number of fish harmed or lost by the drawdown. If this cannot be achieved, NS Power acknowledges that DFO may default to precautionary assumptions for entrainment and associated mortality of different fish species to inform offsetting requirements of the Project.

4.6 LAKE HABITAT CHARACTERIZATION

4.6.1 Drone Surveys

NS Power will apply the following methodology to characterize the habitat in Ruth Falls Headpond during the drawdown.

A baseline drone survey, completed no earlier than 2 weeks prior to the start of drawdown, will be conducted using a drone-mounted high-resolution camera. The focus of the baseline drone survey will be to identify and delineate areas where aquatic and emergent vegetation are observed. NS Power anticipates that these areas will coincide with areas where riparian wetland habitat is present. The imagery will be used to identify and delineate shoreline habitat types and will help in identifying the best locations for the establishment of monitoring transects. Following this, NS Power will complete a drone survey no later than one week after the desired elevation is reached and then once again in November after the growing season. This time series will provide the basis for an assessment of the evolution of the shorelines of the lake during and after the drawdown.

A geographical information system (GIS) will be used to assess the amount of suitable habitat for fish species that is located in the Ruth Falls Headpond and monitor change within this habitat over time. The focus of the habitat characterization will be in areas that are dewatered during the drawdown. An estimate of the total area of change over time within the identified suitable habitat can be extracted from this exercise, which can be used to inform potential temporary HADD. NS Power would like to note that short term changes in observable features of the shoreline as a result of the drawdown does not necessarily constitute permanent harm to the habitat and requests further engagement with DFO on how

data collected with respect to changes in habitat characteristics will be used to inform offsetting requirements.

4.6.2 Monitoring Transects

Monitoring transects will also be completed once per month to supplement the drone surveys. One (1) monitoring transect will be selected on Ruth Falls Headpond. The position of the transect will not be located randomly but rather will be based on the analysis of the lake's shoreline drone surveys with the aim to monitor areas of greater ecological value (i.e. highest diversity). The location of the transects will be determined by analysis of the baseline drone survey.

The transect will be approximately 15 m wide and extend 15 m into the riparian zone from the bank edge, and 10 m into the littoral zone from the waterline, if safe to do so, see Figure 2 below. The shore zone, if present, lies between the littoral and riparian zones, and may include a beach and/or a bank face. Where both are present these are separated by a break in slope. The transects will be delineated with high-visibility stakes to be visible from the drone camera. Detailed GIS data will be recorded at each site.

Observations for the entire plot will be made from a boat and on foot. The dimensions of the riparian and littoral zones are based on Rowan et al. (2006) and were selected to capture the composition and diversity of features to be assessed and correspond to the field of view of the surveyor from an offshore station (Figure 2). The shore zone (especially beach width) will likely be of variable dimensions depending on the water level at the time of the survey.

A baseline transect will be conducted no earlier than 2 weeks prior to the start of the drawdown at the transect location chosen through the baseline drone survey. Subsequently, each transect will be surveyed once per month starting in July 2021 and extending to November 2021 to capture peak biomass windows. The surveys will include the identification and quantification of sediment classes, vegetation types and coverage of each within a transect zone. Comparison between sequential assessments will provide the ability to quantify any changes in vegetation coverage and identify changes in habitat types over time. Changes observed within habitats where transects are located will be assumed to apply to all suitable habitat identified on the lake, based on drone surveys.

Data collected during the monitoring transects, in combination with the drone surveys will be used to determine any potential impact within the identified suitable habitat from the drawdown. NS Power would like to note that short term changes to vegetative types and coverage or sediments as a result of the drawdown do not necessarily constitute permanent harm to the habitat.

NS Power will also complete a literature review of available scientific publications to supplement the drone survey and monitoring transects to qualify observed changes in vegetation, soils and overall habitat loss, if any, and assist in quantifying the temporal extent of impact.

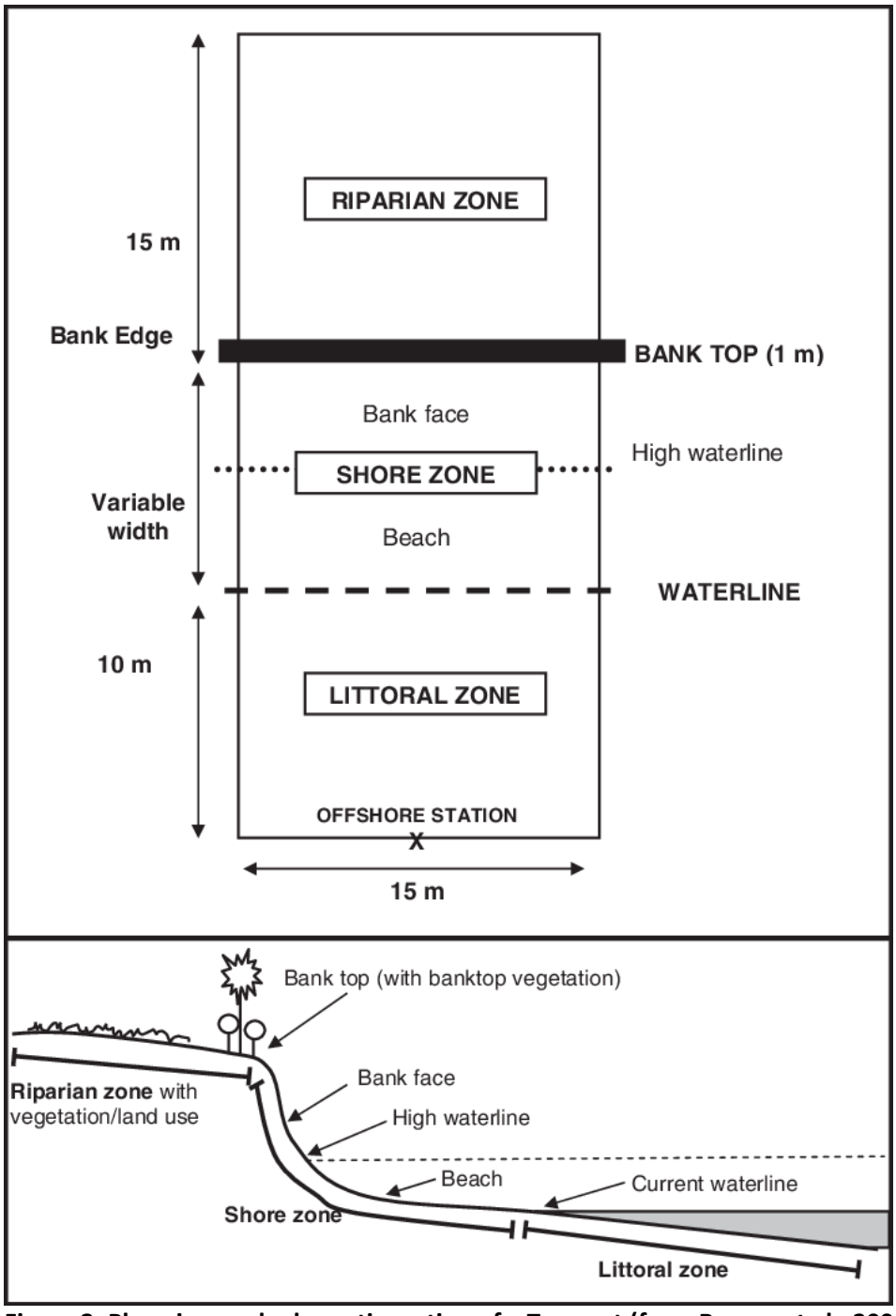


Figure 2: Plan view and schematic section of a Transect (from Rowan et al., 2006)

4.6.2.1 Sediment characterization

The sediment classes used for the identification of sediment types are described in Table 6. Percent coverage of each type of substrate will be determined within each zone, delineated, and documented with digital imagery.

Table 6: Classification of substrate types

Class	Size Range (mm)
Bedrock	Continuous rock
Boulder	>250
Rubble	130-250
Cobble	30-130
Gravel	2-30
Sand	0.06-2
Mud	0.06

4.6.2.2 Vegetation characterization

Observations for the entire plot are made from an 'offshore station', either from a boat or while standing in the water, not exceeding the maximum wading depth of 0.75 m, to ensure consistency between boat- and foot-based versions. The dimensions of the riparian and littoral zones were selected to capture the composition and diversity of features to be assessed and corresponds to the field of view of the surveyor from the offshore station. The shore zone, especially beach width, is of variable dimension depending on the water level at the time when the survey is carried out.

Vegetation characterization will be conducted in each zone of the transect. Identification of plant species/assemblage and percent coverage will be determined. Each type of vegetation will be delineated and documented with digital imagery. Identification of rare and protected species will be documented. Based on observations conducted during previous drawdowns, the current knowledge of the watershed, and the transient nature of this project, the drawdown is not expected to cause significant harm to the shoreline of the lake.

4.6.3 Wetlands

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey, see Figure 3 below. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was

not identified during the 2007 survey (Figure 4). For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond. Table 7 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 7: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. In examining the ACCDC search completed in 2017 for the previous relicensing of the Sheet Harbour Hydro System, 4 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond, see Figure 4. There are two records of Salted shell lichen (Coccocarpia palmicola) located in a wetland on the northwest portion of the headpond, which appears to be hydraulically connected by a small stream. Salted shell lichen is listed as secure within the NS General Status Rank. There are also two records of Ruby-crowned Kinglet (Regulus calendula) on the east side of the headpond along the Lochaber Mines Road. Ruby-crowned Kinglet is listed as Sensitive within the NS General Status Rank. Neither of these species are anticipated to be impacted by the drawdown of Ruth Falls Headpond.

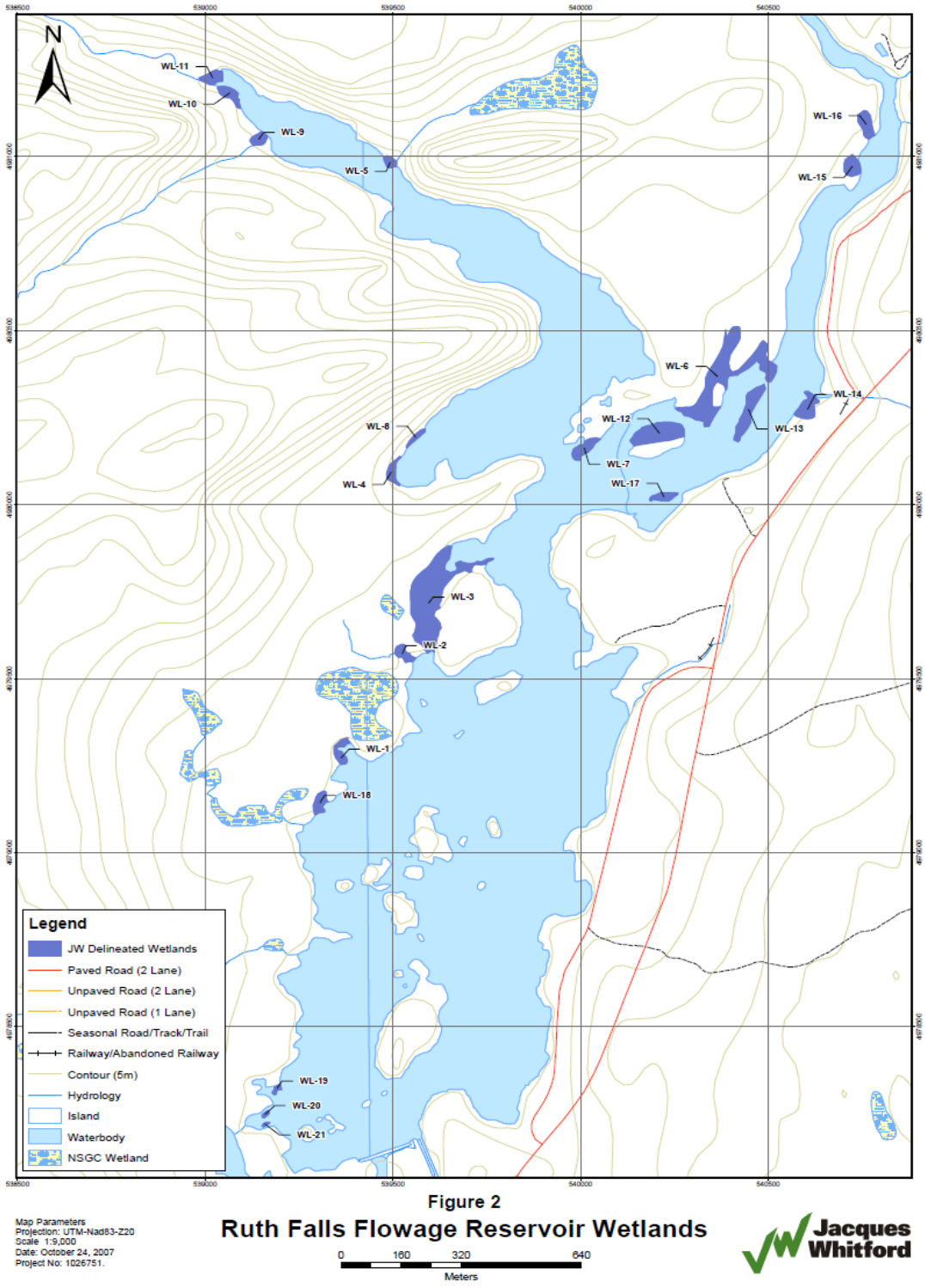


Figure 3: Mapped wetlands on Ruth Falls Headpond (2007).

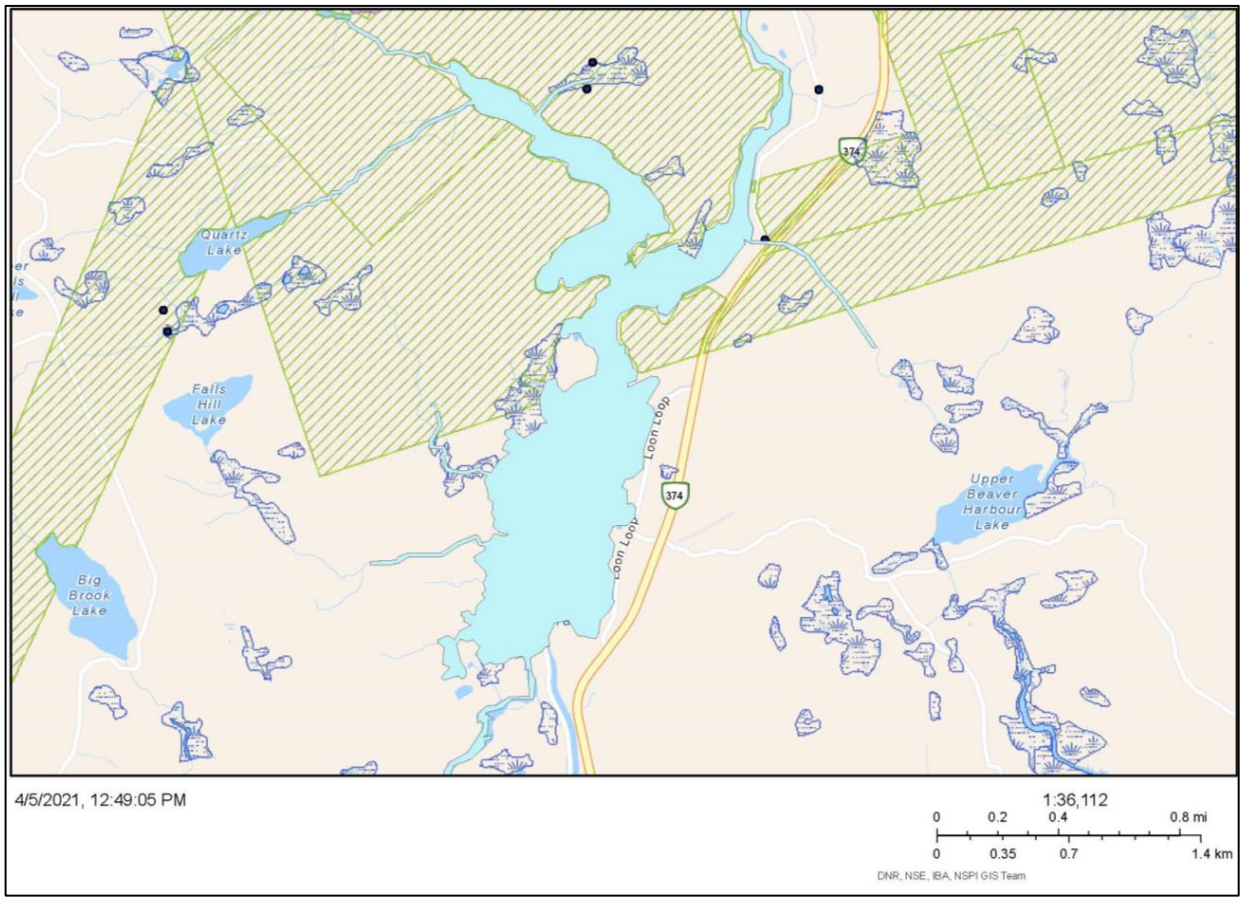


Figure 4: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a 9 month period is unknown.

4.6.3.1 Wetland Monitoring Plan

While no permanent long-term alterations to the wetlands on Ruth Falls Headpond are anticipated, NS Power proposes to contract a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project. NS Power has recently developed a wetland monitoring plan, working with a qualified consultant, for the

Tusket Main Dam Refurbishment Project, which involves a similar drawdown of the headpond and potential impacts to a similar density of littoral zone wetlands; this plan was reviewed and approved by ECC, thus NS Power is proposing to use this plan as a basis for monitoring at Ruth Falls. This includes:

- An updated desktop assessment, using an updated ACCDC search and available provincial data to verify potential wetland locations identified in the 2007 survey.
- Establishing monitoring stations on a select sample of wetlands. For the Tusket monitoring plan, 8 representative wetlands were chosen to establish monitoring stations.
- Baseline assessment, including wetland edge mapping, vegetation data collection, baseline functional assessment and baseline hydrological monitoring prior to the drawdown.
- Construction monitoring, including vegetation and hydrological monitoring while the reservoir is drawndown
- Post-construction monitoring, at minimum, will include monitoring immediately after refilling of Ruth Falls Headpond and again the following year. The length of post-construction monitoring will be determined in consultation with the NSE Wetland Specialist and will include monitoring for vegetation and hydrological conditions. NS Power understands that a post-construction monitoring program is typically 5 years, with a repeated functional assessment in the last year of monitoring.
- Fish and Fish habitat suitability assessment. This assessment will inform the selection of wetlands to be monitored and define methodology for assessing fish habitat and monitoring changes. The assessment may include a review of fish species within the reservoir, existing fish habitat, water quality conditions, wetland function to provide fish habitat, inherent wetland characteristics, including vegetative cover and hydrology and the potential hydrological changes within the bathymetry of reservoir as a result of drawdown.
- Fish habitat monitoring: Monitoring will include baseline monitoring of a desktop suitability assessment of wetland habitat, a review of fish sampling result and the collection of fish habitat data from suitable wetlands.

NS Power is requesting that a condition be added to the authorization which includes the submission of the wetland monitoring plan to DFO prior to March 31st, 2022. NS Power will develop a wetland post construction monitoring program by December 31, 2022 for submission to DFO.

4.7 REPORTING

NS Power will provide a report on 2022 drawdown monitoring activities by December 31, 2023, detailing results of the fish rescue survey and mortality estimates, estimates for loss of egg/larval stage fish due to stranding, results and estimates for downstream entrainment and results of the habitat assessment. The report will also include a summary of water quality surveys conducted as mandated by ECC.

5.0 Construction Monitoring

NS Power requires that the main civil contractor (or general contractor) develop a site-specific water management and erosion and sedimentation control plan that must align with NS Power's established water management and contingency plan as described in this document. The contractor plan will be reviewed by the Project Manager, Engineer and Environmental Lead to ensure the plan conforms with established design and constructability criteria and environmental standards. The contractor plan must also include details for regular inspection of control measures, water quality, as required, and machinery and processes for identifying and addressing deficiencies as well as reporting mechanisms for environmental incidents.

In addition to the contractor plan, NS Power develops a Project specific Environmental Protection Plan (EPP) which details NS Power's regulatory requirements, approval and authorization terms and conditions, and best practices that will be employed during construction. As part of NS Power's EPP, a regular inspection program is implemented in addition to the contractor inspection program, to evaluate contractor compliance to the contractor plan and to NS Power's EPP. Both the contractor's and NS Power's inspection program will extend throughout construction in 2022 and a summary report confirming all measures and standards as committed in this document and NS Power's supporting information document will be provided to DFO by December 31, 2023.

6.0 Post-Construction Monitoring

NS Power will monitor the operation of the new dam structure as part of its regular bi-annual dam inspection and maintenance program as well as weekly inspections conducted by Hydro Operations. NS Power does not anticipate any issues with erosion or scour downstream of the new dam structure. NS Power commits to the following:

- Develop a post-construction monitoring plan for dam operation outlining two years of planned monitoring activities. The post-construction monitoring plan will be provided to DFO no earlier than January 1, 2023.
- Conduct an Engineering assessment of the louvre system and monitor upgrades for period of two years. This includes an acoustic tracking study.
- Complete monitoring using the installed camera system on the fish ladder for two years.

7.0 Death of Fish/HADD after Avoidance and Mitigation Measures and Standards

Table 8 provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Dam refurbishment.

Table 8: Residual Harm from Potential Impacts Associated with the Ruth Falls Dam Refurbishment

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect	Measures to Mitigation Death of Fish/HADD	Potential Residual Death of Fish/HADD
Temporary loss of fish habitat (approximately 1.15 km^2) due to lowering of the headpond beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Localized: approx. 1.15 km^2 in Ruth Falls Headpond	High	Low	Refer to Section 4	No residual harm anticipated, other than temporary direct loss. Offsetting proposed
Temporary loss of fish habitat due to temporary installation of access road/crossings and cofferdams.	Localized: area immediately above and below the dam	High	Low	Refer to Section 3	No residual HADD anticipated
Permanent Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	Localized (~60 m^2) directly below the dam	High	Low	Area is extremely small (60 m2)	No residual HADD anticipated
Fish mortality due to stranding when lowering reservoir.	Localized: Ruth Falls Headpond	Low	Low	Refer to Section 3 and 4	No residual HADD anticipated
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low	Refer to Section 4	No residual HADD anticipated
Potential downstream scour during drawdown of reservoir.	Localized: East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated

Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	High	Refer to Section 3	No residual HADD anticipated

8.0 Offsetting Plan

NS Power is proposing, in partnership with the Mi'kmaw Conservation Group (MCG) and the Nova Scotia Salmon Association (NSSA), a restoration project that is suitable for offsetting of serious harm for the Ruth Falls Dam refurbishment and the Sloane Reservoir Wing Dam 2 refurbishment project in conjunction. The amount of fish habitat permanently impacted due to infilling associated with the Sloane Wing Dam project is 900 m^2. The amount of habitat potentially impacted temporarily due to lowering of the headpond for the duration of the Ruth Falls project is approximately 1.15 km^2 applying a 3:1 ratio results in a maximum approximate offset of 5000 m^2. MCG has provided an offsetting plan to NS Power which outlines the proposed project. The project includes improvements to fish migration and fish habitat by restoring suitable instream and streambank habitat on the West River Sheet Harbour watershed. MCG will provide oversight and guidance on the project and will also collaborate with the Millbrook First Nations Community on the project in order to potentially engage community members to implement habitat offset work.

The following is a summary of project execution:

Year One (1): Finalize the footprint of the restoration area, conducting any pre-monitoring activities needed (incorporating any relevant and available data in the baseline), securing all permitting and permissions, and finalizing a post monitoring plan.

Year Two (2): Perform largescale restoration work within the middle section (between two previously restored areas by the NSSA) of the West River.

Year Three (3) through seven (7): Post monitoring of sites where offsetting work was completed. Post-offset monitoring will be completed in years three (3), five (5), and seven (7). A final report will be completed at the end of year seven (7).

NS Power has obtained a letter of credit for the offset project, which was estimated based on a 5:1 ratio for the Sloane project. This will be followed by submission of an offsetting plan once available. The amount of the letter of credit was estimated based on the cost for a previous offsetting plan developed by MCG for a project conducted at the Trenton Generating Station in 2019. The amount of the letter of credit will be adjusted once the cost for the offsetting project is finalized by MCG. A Letter of Credit for $62,000 has been obtained.

APPENDIX G – OFFSETTING PLAN

MI'KMAW CONSERVATION GROUP
THE CONFEDERACY OF MAINLAND MI'KMAQ

Project Title:

Sheet Harbour Area Habitat Offsetting Initiative

Presented To:

Nadine Thomas, Environmental Scientist
Nova Scotia Power Incorporated

Contacts:

Project Manager/Organizational Contact:

Alyx MacDonald, MCG Operations Supervisor
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CMM Project Lead:

To be selected from available staff resources.

NSSA Project Lead

Edmund Halfyard, Research Scientist
Nova Scotia Salmon Association (NSSA)
Email: eddiehalyard@hotmail.com

Date:

Version 4: May 14th, 2021

Department of Aquatic Resource and Fisheries Management
The Confederacy of Mainland Mi'kmaq
57 Martin Crescent
P.O Box 1590
Truro NS, B2N, 5V3

1.0 The Confederacy of Mainland Mi'kmaq's Department of Aquatic Resource and Fisheries Management:

The Confederacy of Mainland Mi'kmaq (CMM):

The CMM is a tribal organization that has served its members since 1986 and currently employs a staff of one hundred (100+) employees. The Mission Statement for the CMM is *"To proactively promote and assist Mi'kmaw communities' initiatives toward self determination and enhancement of community."* The CMM provides programs and services to our eight member Mi'kmaw communities: Acadia, Annapolis Valley, Bear River, Glooscap, Millbrook, Pictou Landing, Paq'tnkek and Sipekne'katik First Nations. The CMM's Board of Directors is comprised of the Chiefs of our member communities.

The Department of Aquatic Resource and Fisheries Management's (DARFM) mission is to help promote the concept of Netukulimk within the Bay of Fundy and mainland Nova Scotia watersheds. DARFM provides the following programs to our member communities: Youth Mentorship/Capacity Building, Research, Education, Communications, Aquatic Resource Management, Ecosystem Health Assessment and, Habitat Restoration. Additionally, DARFM provides services for: commercial fisheries, scientific reviews, and sits on several review boards and technical committees. DARFM has applied for and received a variety of small and large funds and successfully delivered projects from the federal, provincial, and municipal levels as well as from the private sector.

Our staff have become more involved with fish habitat offsetting projects and associated monitoring activities. We have worked with various partners to build skills within our department and with our member communities. We continue to work with and sub-contract partner organizations to ensure our offset and industry focused monitoring activities are done to local industry standards. It is important to note that we try to ensure our affected member communities approve of and are made aware of the work we do. The Confederacy of Mainland Mi'kmaq and its Departments do not conduct consultation work on behalf of clients but instead provide programs and services and act as a technical resource for our member communities.

Previous Activities:

Stewiacke River: MCG has operated/maintained a Rotary Screw Trap (RST) for the past 5 years in the Stewiacke River, NS and performed marked-recapture studies to estimate the population of Atlantic salmon smolts. MCG has also conducted fish habitat assessments and electrofishing surveys in the Stewiacke River. In autumn 2017, MCG partnered with DFO on an acoustic telemetry study to determine spawning site selection of released Live Gene Bank adult salmon within the Stewiacke river watershed.

Shubenacadie River: During the 2016-2017 funding year MCG performed baseline monitoring for fish species throughout the entire river system. Activities included: CABIN studies, beach seining, fyke nets, and other sampling methodologies.

River Philip and East River: In the fall of 2016- 2018, the MCG team performed snorkel surveys in over 20 pools to count returning adult Atlantic salmon in the River Philip and the East River. In year one major pools were surveyed, while in year two MCG expanded the swims throughs to also surveyed small river sections.

River Restoration Work: The previous four summers (2014-2018) MCG installed and repaired in-stream fish habitat structures, removed barriers to fish passage, and restored riverbanks in the following waterbodies: McLellans Brook (East River), Barneys River, Smalls Brook, Indian Brook and several tributaries to the Stewiacke River.

2.0 Project Description

Background:

In early 2020 Nova Scotia Power Incorporated (NSPI) began discussions with Millbrook chief and council regarding two dam refurbishment projects in the Sheet Harbour Area (Ruth Falls Dam and Sloane Dam). NSPI and the CMM began discussions in spring of 2020 after Millbrook Chief and Council had recommended that the MCG aka DARFM should lead an offsetting project. DARFM has done limited work in the West River area so after discussions with NSPI it was decided that DARFM would reach out to the Nova Scotia Salmon Association (NSSA) as they are currently working on their West River acid rain mitigation project in the area. Once NSSA provided an offsetting plan DARFM followed up with Millbrook's consultation team regarding their initial thoughts on the project prior to submitting Draft 1 to NSPI. Unfortunately, due to delays in communication that were exacerbated by COVID-19 and other pressing matters this initial draft has been delayed in submission to NSPI and subsequently to their contacts at DFO. **Revised:** The Second Draft of this plan has been seen by the Millbrook Consultation team and no issues were found in the plan. NSPI met with Millbrook Chief and Council on April 20th and there was not indication of project changes required at this time.

Organization and Partners:

- **CMM/DARFM:** Will be the lead proponent of the project and will assist with project activities as listed in the below proposal and will lead the administrative / project management side of the project. DARFM team members will be the principle contact for the project and will provide updates as required. The DARFM will also be responsible for engaging Millbrook First Nation with this specific offsetting project.
- **Millbrook First Nation:** Millbrook community members will have opportunities to be engaged in and potentially hired on short contracts for this project. Millbrook fishers and interested community members will be provided opportunities to provide input into the project. Millbrook's consultation team will also stay updated on this project through update meetings and will help the CMM engage with community members of Beaver Dam and Sheet Harbour.
- **NSSA:** As a regional expert in large scale restoration the NSSA will lead the physical restoration work and plan the will help build capacity within the CMM/Millbrook to do this type of large-scale restoration work in the future. NSSA will also design the monitoring plan based off their final design.

Roles and Responsibilities:

- **Project Manager: Alyx MacDonald**
  - Will oversee the initial set up of the project.
  - Will oversee the project lead's management of the project.
  - Aid project lead with project delivery and reporting
- **Project Lead: TBD**
  - Oversee day to day activities for the project.
  - Liaise with Millbrook, NSSA and NSPI
  - Provide offset project updates to Millbrook community and NSPI.
- **Millbrook: TBD (Consultation team and community members)**
  - Assist with project activities (planning, monitoring, restoration)
  - Participate in meetings.
  - Receive training (types tbd).
  - Note: this will depend on community interest throughout the project.
- **NSSA Lead: Eddie Halfyard**
  - Responsible for overseeing restoration work.
  - Oversee all contractors necessary for the project (site design, instream restoration work, and monitoring plans)
- **Additional CMM Staff:**
  - Assist with monitoring and restoration activities.
  - Provide guidance and oversight.

3.0 Goal and Objectives:

Goal:

As part of a contract under NSPI the DARFM along with the NSSA will develop and implement an offsetting project for 5000m^2 on the West River Sheet Harbour watershed. The offset project relates to NSPI dam refurbishment projects at the Ruth Falls headpond and Sloane Reservoir. This project will improve fish migration and fish habitat by restoring suitable instream and streambank habitat. This will be a seven-year project that will actively engage Millbrook, NSSA, and the CMM (DARFM) in improving necessary Atlantic salmon and other significant fish habitat. Performing offset work on the main branch of the river between two previously restored sections will also greatly increase migration routes for salmon and will have a long-lasting effect that other smaller scale projects often cannot achieve. This river system has an at-risk population of Atlantic salmon so all parties involved in the project, feel a project at this level will be very beneficial to ongoing recovery efforts.

Year one (1) will focus on finalizing the footprint of the restoration area, conducting any pre-monitoring activities needed (incorporating any relevant and available data in the baseline), securing all permitting and permissions, and finalizing a post monitoring plan.

Year two (2) will focus on performing the largescale restoration work within the middle section (between two previously restored areas by the NSSA) of the West River. This will be the most intensive year of the project.

Years three (3) through **seven (7)** will consist of the post monitoring the sites where offsetting work was completed. Post-offset monitoring will be completed in years three (3), five (5), and seven (7). A final report will be completed at the end of year seven (7).

Objectives:

Objective 1: Meaningful engagement with Millbrook First Nation

Each year The CMM will allot money for hiring summer students or community members from Millbrook, pending interest in the project. Community members will have the opportunity to receive formal training (wilderness first aid, watercourse alteration, etc.) and job shadow NSSA and DARFM staff. Millbrook's consultation team has indicated that having The CMM and NSPI do a meaningful offset project and that they keep community members of Millbrook (especially those who live in the satellite communities of Sheet Harbour, Beaverdam engaged) in the process is of upmost importance.

Objective 2: Baseline monitoring and post-restoration monitoring:

The NSSA will utilize existing data to ensure there is adequate pre restoration monitoring completed and perform more work in partnership with the CMM if required. Based off the finalized pre-restoration monitoring work completed and results of the completed instream offsetting work the NSSA in partnership with the CMM and Millbrook will complete 3 years (years 3, 5, and 7) of post offset monitoring.

Objective 3: Aquatic habitat restoration

In year (1) the CMM will have several meetings with the NSSA to establish concrete design plans and timelines for the habitat offsetting work to be completed in year (2) of the project. The final offset sq meters will be based off direction from NSPI from their guidance from DFO, and the NSSA with assistance from the CMM will get revised estimates and timelines to complete offset work based off site surveys.

In year two (2) the NSSA will oversee the restoration oh fish habitat to be used for offsetting purposes by NSPI. More information on the current specifics of the restoration work and monitoring can be found in the appendix "Habitat Offsetting Proposal".

4.0 General workplan:

Year 1:

Objective 1: Meaningful engagement with Millbrook:

The CMM will meet with Millbrook's consultation team and with community members (as interested / directed) to ensure that there is proper engagement by the community in the project. The CMM will conduct site visits with the NSSA and invite Millbrook community members where possible.

Objective 2: Pre-offset baseline monitoring:

The pre-habitat offset monitoring work on the West River Sheet Harbour will focus on habitat characteristic monitoring. Due to the large size of this river and no previously established baseline study available to determine fish abundancy we will focus our pre and post offset monitoring on habitat characteristics. Water quality monitoring (beyond measuring temperature in pools) would also be ineffective as the river is heavily impacted by acidification and has an ongoing liming project which

would make for an unnatural baseline. Physical habitat monitoring will be able to show; improved migration pools, increased natural thalweg, establishment of riparian vegetation, and migration corridor improvement for salmonids.

A more formalized baseline monitoring plan will be developed with the NSSA's Fresh Water Biologist while they create the habitat offsetting design of the large-scale instream restoration. Below is an overview of the techniques and details that will be used in the pre-offset monitoring plan:

Monitoring strategy and techniques:

- Visualization:
  - Map will be created to show proposed monitoring sites and structure placements.
  - Site pictures taken at each survey site and structure site, including original orientation to allow for replication in post construction monitoring.
  - Will document presence of Atlantic salmon and other fish during surveys.
- General habitat surveys:
  - Land survey
  - Pool depth and sizes
  - Current thalweg location
  - Riparian vegetation
  - Substrate size and stream bed characteristics
- Cross sectional surveys
  - Details measured:
    - Wetted and bank full width.
    - Depth measurements taken along cross-section.
    - Thalweg location and depth.
    - Cross sectional profile (diagram)
    - Note: other information collected at sites will be suggested by freshwater biologist based upon initial habitat surveys of offset area.
  - Locations:
    - One (1) survey completed at each structure placement.
    - Two (2) surveys completed at each pool.
    - One (1) survey 15 m upriver of each structure placement.
    - One (1) survey 15 m down river of each structure placement.
    - One (1) to five (5) surveys above section restored.
      - Note: Downriver sites have already been restored and do not require surveys.
- Water Temperature:
  - Install water temperature loggers.
  - Note: number of loggers and sites will be determined based off offset design.

Objective 3: Aquatic habitat restoration:

- Planning, permitting and designs will be completed for the restoration work (being used as an offset) that will be completed in year 2.
  - Note: Design work may continue into year 2.

Year 2:

Objective 1: Meaningful engagement with Millbrook:

- The CMM's DARFM will continue meetings with Millbrook's consultation team and community members and will involve other key individuals as directed by Millbrook's Chief and Council or consultation team.
- There will be funds allotted to hire Millbrook community members on short term contracts or reimburse at a daily rate so that they can participate in the monitoring / restoration work or attend applicable training.

Objective 2: Baseline monitoring and post-restoration monitoring:

The freshwater biologist has indicated that from their desktop analysis and previous work upriver and downriver of this proposed site that the design width of this section of river is approximately 15.4m and the meander length is approximately 92 m. Currently this section of the river can be 30m+ in width, is shallow, and has degraded fish habitat. This is due to past land use, log driving and other anthropogenic effects on the river. The NSSA has restored sections down river and upriver from the proposed site, so this offset would help with fish migration, thalweg continuity, and provide a connected set of holding pools suitable for salmonids (especially Atlantic salmon).

Instream improvements will involve installing deflectors (used to assist with correcting meander pattern) and/or rock sills (used to promote pool creation) at design length intervals (approx. 92m) but may also include other instream construction techniques. A detailed site plan will be developed for review prior to proposed construction in year two (2). The plan will include maps and locations of structures, structure types, approximate dimensions, and pictures. The pre-offset monitoring report will include river structure details to coincide with the offset plan.

Objective 3: Atlantic salmon habitat restoration

Large scale restoration:

- The NSSA will lead the large-scale restoration work to be completed and will arrange the scheduling for their contractors (heavy machinery, freshwater habitat restoration consultant) to ensure the work is completed.
- The CMM will conduct site visits and have staff mentor to become more familiar with doing this larger scale restoration work.
- The CMM will coordinate having Millbrook community members involved in the project (where there is interest to do so) and will coordinate any necessary or applicable training for Millbrook community members.

Year 3-7:

Objective 1: Meaningful engagement with Millbrook:

- The CMM will continue to meet with Millbrook's consultation team and with interested community members, as well as continue to provide updates to the community when applicable or requested.
- Where possible Millbrook community member will have paid opportunities to assist post-restoration monitoring activities.

Objective 2: Post Restoration Monitoring

Post Monitoring:

The post-offset monitoring techniques will heavily mirror the techniques used in the pre-offset monitoring plan, the major difference being that in the post-offset there will be more focus on inspecting the structures and pools to ensure proper habitat creation and structural integrity. The project team (Millbrook, NSSA, and CMM) will utilize the established monitoring plan and maps to compare progress of habitat in 3 of the 5 years following completion of instream restoration (years 3, 5, and 7 of the proposed plan). Please note: these post-offset monitoring plans may change as the offset layout/plan is developed and initial monitoring is completed in year one (1).

Monitoring strategy and techniques:

- Visualization:
  - Site pictures taken at each survey site and structure site.
    - Pictures will be taken with the same orientation and matched with the map(s) established in year one (1)
  - Will document presence of Atlantic salmon and other fish during surveys.
- General habitat surveys:
  - Land survey
  - Pool depth and sizes
  - Current thalweg location
  - Riparian vegetation
  - Substrate size and stream bed characteristics
- Cross sectional surveys
  - Details measured:
    - Wetted and bank full widths.
    - Depth measurements taken along cross-section.
    - Thalweg location and depth
    - Cross sectional profile (diagram)
  - Locations:
    - Same as those established during year one (1)
- Structure surveys: (based off offset layout plan)
  - Note: Habitat Suitability Index surveys may be taken in this section of river (based upon recommendations from the project Fresh Water Biologist)

  - Surveys to ensure structures have stayed in place and are establishing positive habitat change.
    - Note: will document any changes or damage caused by ice or other extreme water events to the structures.
    - May use drones or other methods to document structures.
  - Document change in stream bank vegetation
  - Measurements taken to determine change to pools and stream meander.
  - Document presence of adult and or juvenile Atlantic salmon (and other salmonid / fish species) using habitat.
- Water Temperature:
  - Install water temperature loggers at similar sites as year one (1).
    - May need to alter sites due to changes in river habitat.

5.0 Project Timeline

Table 1: Project Deliverables and Timelines

Activities	Schedule
Continued discussions between the CMM, NSSA, NSPI, and DFO regarding offsetting project requirements.	April - June 2021
Continued updates and discussions between The CMM and Millbrook regarding the offsetting project.	Ongoing throughout project
Pre-offset monitoring	June – September 2021
Design of restoration work	Surveys: June – September 2021 Plan: Fall of 2021 (revisions possible in 2022)
Perform largescale instream restoration work. NSSA will lead this portion of the project.	June - September 2022
CMM staff and Millbrook Community members will be involved with mentoring from the NSSA on the restoration work and assisting with work and monitoring where applicable.	June - September 2022
Post-restoration Monitoring (3 years) Lead by NSSA in partnership with CMM and Millbrook	June- September 2023 & June- September 2025 & June- September 2027
Proposed reporting dates to NSPI.	Year 1: December 2021 Year 2: December 2022 Year 3: December 2023 Year 5: December 2025 Year 7: December 2027

6.0 Project Area:

Site Map Via NSSA:

Site Location: 45.9718°, -062.6383°

Nearest approximate address: 88 W River Rd, Mooseland, NS B0J 2J0

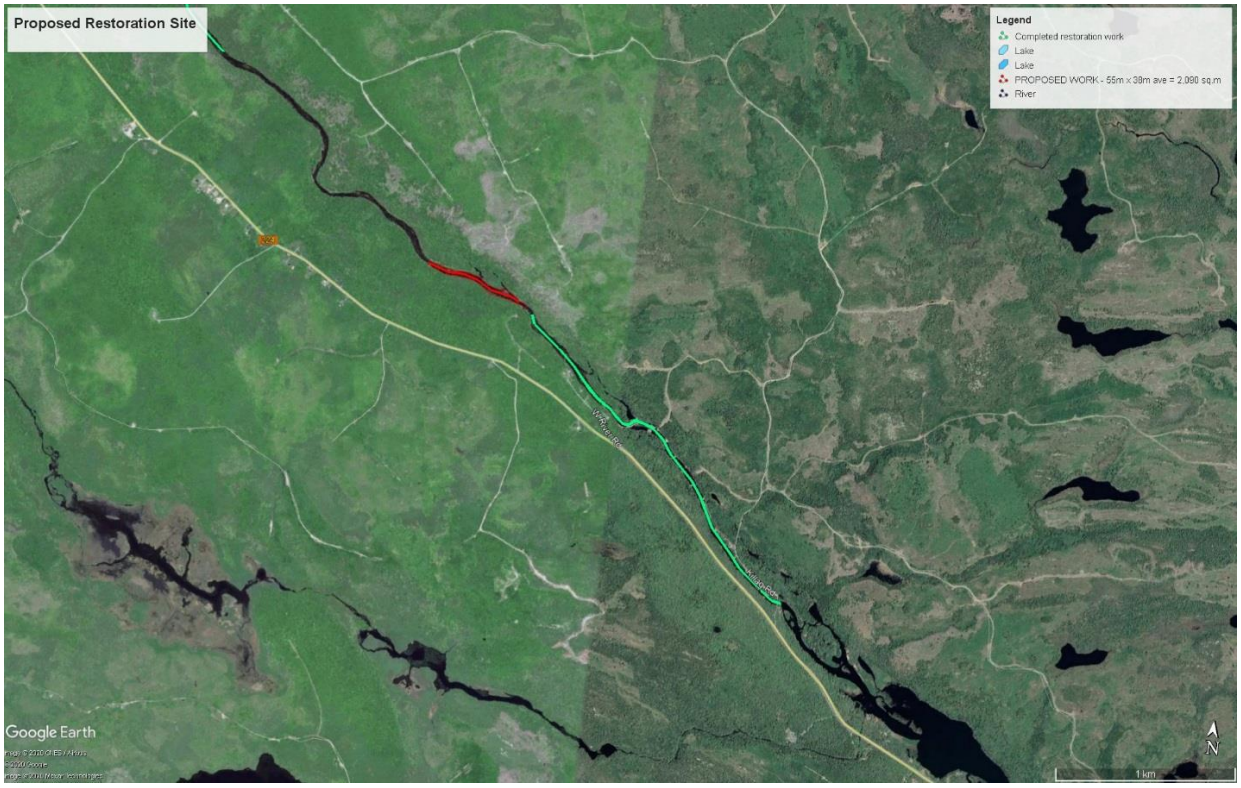


Figure 1 – Map of 20,090 m^2 of stream that requires habitat restoration (red), of which the lower section (total sq meter to be determined) would be targeted by this proposed work. Green areas were previously completed. See in appendix "Habitat Offsetting Proposal" for more details.

Larger View of project area:



Figure 2. Red marker indicates approximate area where restoration work will occur in comparison to the community of Sheet Harbour

7.0 Limitations:

The total budget and timelines will be dependent on continued discussions between NSPI, DFO, NSSA and the CMM (DARFM) regarding the offset requirements, as well as ensuring proper oversight and guidance on the work by Millbrook and all other required Mi'kmaw Communities.

There may be changes to the Species -At- Risk Act that could list this population of Atlantic salmon as endangered which could cause delays, or modifications to our plans based off DFO guidance and or regulations.

Restoration costs may change as the original estimates were based off work completed previously. Material and labour costs are highly variable. Costs will be discussed with NSPI during year 1 and 2 meetings to ensure costs are acceptable.

The estimates were also based upon an approximate 5000m^2 area to be offset. As mentioned in the appendix "Habitat Offsetting Proposal" there is 20,090m^2 of area that could utilize restoration work. Should the offset area be significantly larger, this project could be scaled, and the work done would be very similar to that prescribed in the appendix and within this document.

The CMM does not conduct consultation for proponents and will only be responsible for ensuring that Millbrook (and other parties as directed) are properly engaged in the offset project.

This project proposal plan is dated May 14, 2021, should significant changes be required this will be reflected in a revised offset plan or "change request" type document.

8.0 Budget Summary

Pre – Offset:

Year 1

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Salaries and Wages (Freshwater Biologist)	Amount to complete monitoring and restoration offset plans. $7,000 + HST	$8,050.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
Salaries and Wages (NSSA)	biologist (10 days @ $450/day) and a NSSA technician (15 days @ $350/day)	$9,750.00
Administration	15% of costs	$4,492.50
Total	All costs	$36,442.50

Offset:

Year 2

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Allotment for Millbrook (Salaries, training, and equipment)	Amount to reimburse Millbrook community member(s), money for training, and necessary equipment needed to assist with restoration and monitoring materials / supplies	$10,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$4,000.00
Salaries and Wages (NSSA)	biologist (10 days @ $450/day) and a NSSA technician (15 days @ $350/day)	$9,750.00
Salaries and Wages (Fresh water biologist)	site survey, design model, onsite structure layout and construction monitoring. $15,000 + HST	$17,250.00
Restoration Machinery and resource cost	$125,000 + tax for a large machinery contractor and rock materials	$143,750.00
Administration	15% of project activities	$29,235
Total	All costs	$224,135.50

Post-Offset Monitoring:

Year 3-5 (theses costs will incur yearly)

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
Salaries and Wages (NSSA)	biologist (10 days @ $450/day) and a NSSA technician (15 days @ $350/day)	$9,750.00
Administration	15% of costs	$3,585.00
Total	All costs	$27,485.00

Grand Total:

Project Total	Amount
Year 1	$36,442.50
Year 2	$224,135.50
Year 3	$27,485.00
Year 5	$27,485.00
Year 7	$27,485.00
Grand Total	$343,032.00

9.0 Closure

Accompanying Documents:

For more information on the proposed offsetting plan from NSSA see in the appendix "Habitat Offsetting Proposal"

Should there be any questions please contact:

Alyx MacDonald, B.Tech.

MCG Operations Supervisor

Department of Aquatic Resource and Fisheries Management

The Confederacy of Mainland Mi'kmaq

amacdonald@mikmawconservation.ca

http://cmmns.com/

www.mikmawconservation.ca

Office: 1.902.895.6385 Cell: 1.902.305.4122 Toll Free: 1.877.892.2424

Appendix:

See below NSSA's technical document which elaborates more on the restoration portion of the offset project which will be led by the NSSA. "Habitat Offsetting Proposal"

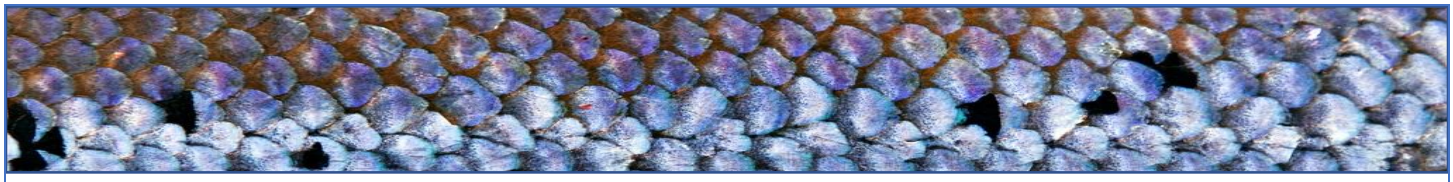


DRAFT OVERVIEW:

Habitat Offsetting Proposal

December 2020

www.nssalmon.ca



HABITAT PARTNERS:

Nova Scotia Salmon Association, Thaumas Environmental Consultants Ltd., Mi'kmaw Conservation Group (Confederacy of Mainland Mi'kmaw), Eastern Shore Wildlife Association

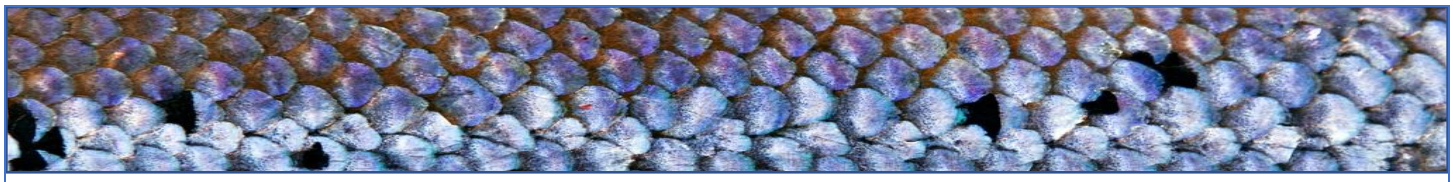
OBJECTIVE:

Detail an option for freshwater habitat restoration project to be considered for future offsetting projects.

OVERVIEW:

The Nova Scotia Salmon Association and its partners are committed to the recovery of Atlantic Salmon, nature fishes and we prescribe to the principles of biodiversity conservation. One area of freshwater conservation where we are particularly active is freshwater habitat restoration and planning. We are currently developing a regional restoration framework that focuses on priority areas, species and lays the foundation for addressing threats. Funded by both the federal and provincial governments, and in partnership with first nations, academics and many regional not-for-profit groups, this project aims to create watershed stewardship plans for eight priority watersheds along the Atlantic coast of Nova Scotia. The information contained within these plans will be identified by a combination of expert opinion and strategic planning that is currently underway. Here, we proposed continued freshwater habitat restoration in the West River (Sheet Harbour) which will directly contribute to the goals of this larger framework for restoration in the area to maximize the benefits to river ecology. Further, the West River is the site of Canada's largest acid rain mitigation project (https://www.nssalmon.ca/acid-rain-mitigation) which includes a substantial previous investment in instream physical habitat restoration. This proposed work will help work towards restoring the entirety of the lower main West River.

Specifically, we proposed work to improve the physical structure of the main branch West River, primarily to directly address the poor habitat conditions in this section but also to aid fish migration to the upper reaches or the watershed. The excellent gravel and cobble substrate in this main branch section will provide good spawning and rearing habitat for salmon and trout.



PROPOSED PROJECTS:

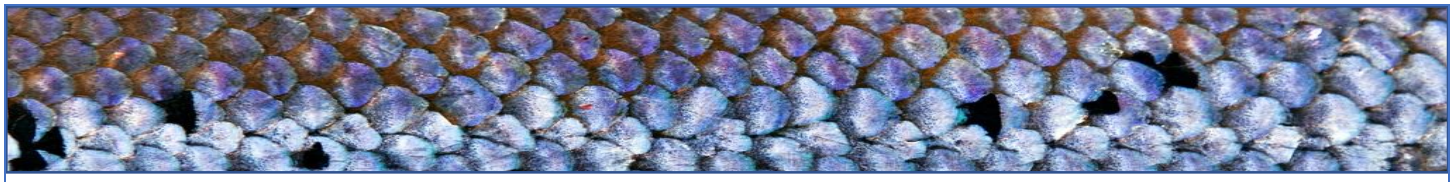
PROJECT #1: Main Branch, West River (Marinette)

Estimated area: 5,000 m^2 proposed in this work. Part of a larger 20,090 m^2 segment

Primary Issue: The main West River has been over-widened, straightened and has lost its natural pool-riffle-run sequence due to historic log driving and poor land use practices. This has resulted in poor habitat conditions for Atlantic Salmon.

Rationale for site selection: This area has been treated for the impacts of acid rain since 2005 by the Nova Scotia Salmon Association's lime doser project. Further, the physical habitat of the 2.2km immediately below this area has ben fully restored, as has a 1.9km segment beginning 1.8 km above this proposed site. Finally, the proposed site is located near a coldwater input that is important for coldwater-loving species like salmon and trout. This proposed section had previous work completed in 2018 to increase the ability for fish to migrate through this area, however additional work has been identified as necessary.

Proposed restoration actions: The goal of restoration is to encourage a narrowing of the stream to design width which will encourage proper fluvial energy transfer and, ultimately, will increase habitat diversity including the formation of pool habitat that is suitable for adult salmonids. The required work for the reach involved a series of paired rock deflectors to narrow the stream to design width of 15.6m, rock sills linking the tips of the rock deflectors to anchor the thalweg profile and encourage scouring of the thalweg to design depth (Figure 1). Further, habitat diversity structures such as root wads, other large woody debris and randomized boulder placement would increase the quality of this habitat.



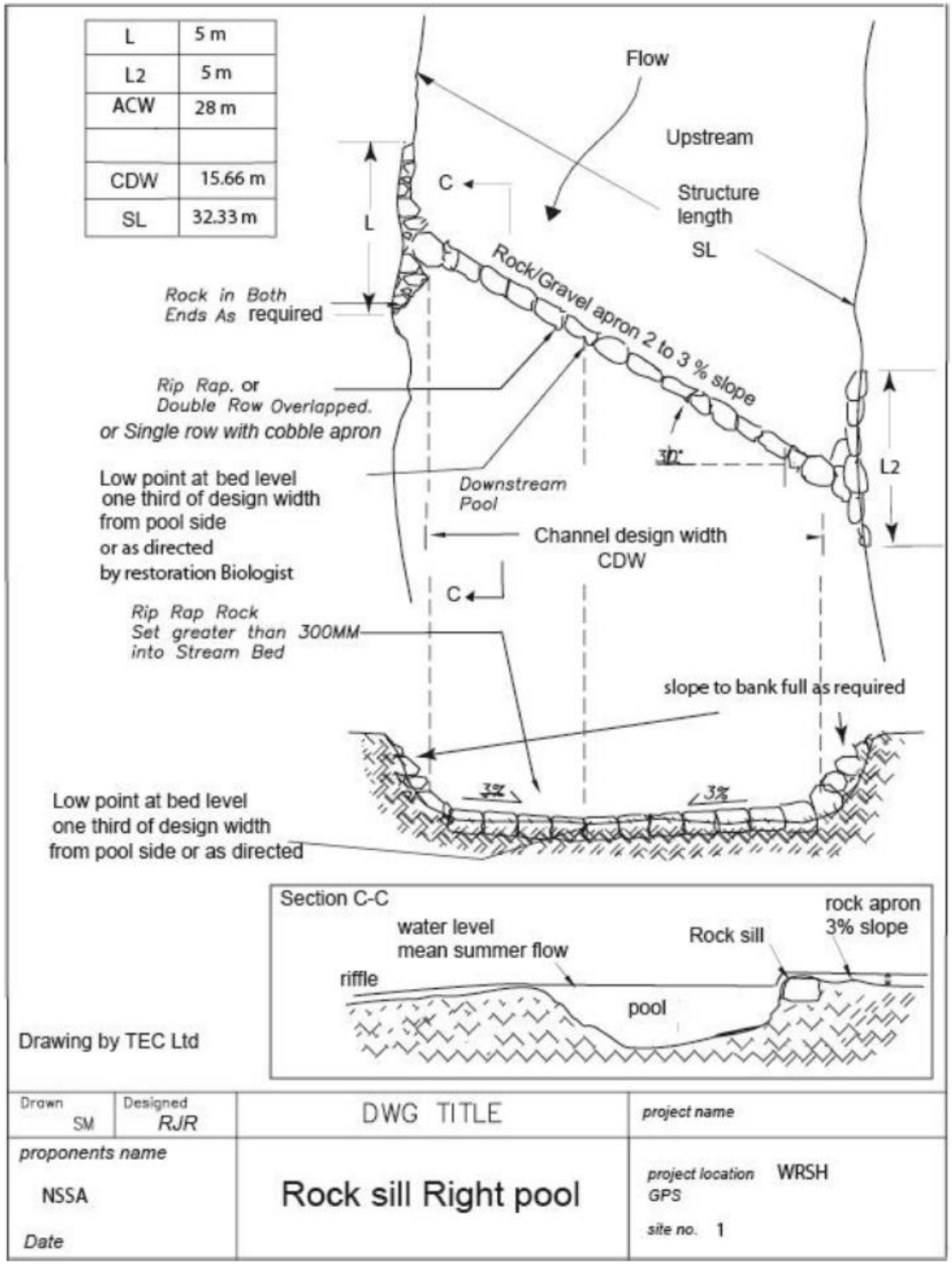
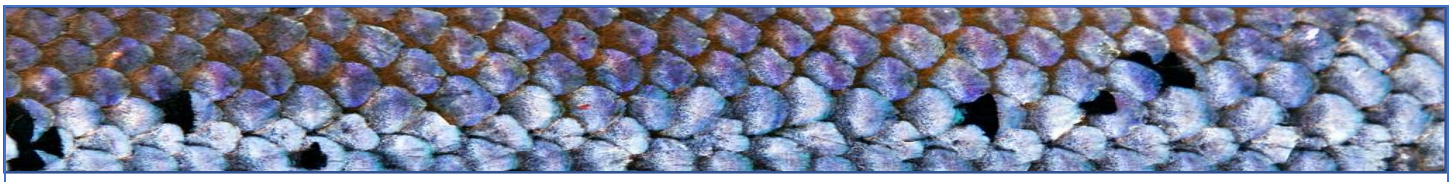


Figure 1 – Schematic of typical double-deflector plus rock sill habitat structure. Credit: Thaumas environmental consulting (R.J. Rutherford).





Figure 2 – Example of proposed work. Shown are two habitat structures spanning nearly 300m just downstream of the worksite proposed in this document. Pre-installation (top) and post-restoration (bottom). River runs from left to right. Post-install the river had a better-defined thalweg and a more appropriate proportion of pool habitat.



Estimated cost: Based on our 2016-2018 project in this area, we would estimate the total cost of completing this work to be approx. $125,000 + tax for a large machinery contractor and rock materials, approx. $22,000 for a qualified freshwater habitat restoration consultant (TEC) to do the site survey, design model, onsite structure layout and construction monitoring. NSSA coordination of the project would be $9,750 for a biologist (10 days @ $450/day) and a NSSA technician (15 days @ $350/day). Monitoring could be conducted by NSSA staff and from local Mi'kmaw community members as we have significant capacity and experience, however these costs are dependent on DFO-mandated monitoring requirements and these costs would need to be negotiated once the deliverables are outlined.

Site location: downstream end of reach, 45.9718°, -062.6383°

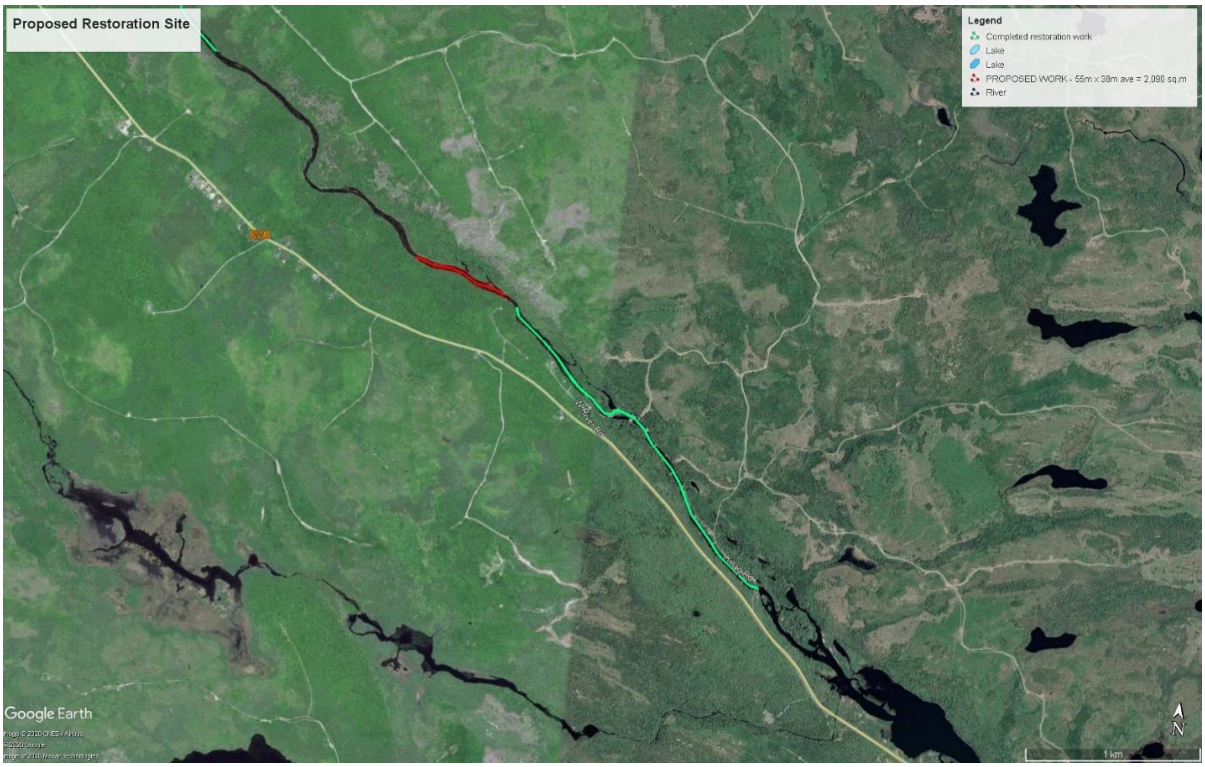


Figure 3 – Map of the proposed overall 20,090 m^2 area for habitat restoration (red), of which the lower 5,000m^2 would be targeted by this proposed work. Green areas were previously completed. Access to occur via a private road located off of highway #224.

APPENDIX H – COPY OF LETTER OF CREDIT



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Irrevocable Standby Letter of Credit No.: OSB62460GWS

Beneficiary:
Receiver General for Canada
on behalf of Fisheries and Oceans
Canada C/O Fisheries Protection
Program Fisheries and Oceans Canada Canada

Applicant:
Nova Scotia Power Incorporated
1223 Lower Water Street
Halifax, NS B3J 3S8 Canada

Date of Issue:
March 18, 2020

Date and Place of Expiry:
March 17, 2021 At our counter

Amount:
CAD 62,000.00 Sixty Two Thousand Canadian Dollars

Complete Beneficiary's name and address:
Receiver General for Canada on behalf of Fisheries and Oceans Canada
C/O Fisheries Protection Program
Fisheries and Oceans Canada
1 Challenger Drive,
Dartmouth, NS B2Y 4A2

Reference Number: DFO Referral File Numbers 19-W-549 and 20-HMAR-00017

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Pursuant to the request of our Customer, we, the Bank of Nova Scotia, Montreal Trade Service Centre hereby establish and give to you an Irrevocable Standby Letter of Credit (the "Credit") in your favor in the total amount of CAD62,000.00 (Sixty Two Thousand and 00/100 Canadian Dollars). The Credit may be drawn on, by you, at any time and from time to time upon written demand by you. We will honor any such demand made by you without inquiring whether you have a right as between yourself and our Customer to make such demand and without recognizing any claim, instructions, direction or notification to the contrary from the Customer.

The Bank of Nova Scotia

Provided, however, that you are to deliver to us at such time as a written demand for payment is made upon us, a certificate purported to be signed by you, agreeing and/or confirming that monies drawn pursuant to this Credit will be retained and used by you to meet our Customer's obligations in connection with offsetting and monitoring required for completions of capital projects on the Sheet Harbour Hydro System and Sloane Lake in 2020. The original Letter of Credit must also be presented at the time for endorsement of the claim paid and will be returned to you.

It is understood and agreed that the obligation of the undersigned under this Credit is an obligation to pay money only and that in no circumstances shall the undersigned be obliged to perform or cause to perform any of our Customer's actual obligations to you.

Conditions:

- The sum total of this Credit shall be reduced from time to time as advised by written notice given to this office from time to time by you.

- The Credit will continue until March 17, 2021 and will expire at our above mentioned office address at the close of banking business on that date.

- This Credit is irrevocable until that date.

- This Credit shall be deemed to be automatically extended for one year from the present or any future expiration date hereof, unless at least thirty (30) days before any such date we give you written notice that we elect not to consider this Credit renewed for any such additional period. Upon receipt by you of such notice, you may draw upon, accompanied by written certification, the amount to be retained and used by you to meet obligations incurred or to be incurred in connection with the Authorization.

However, our Credit will not be extended beyond December 31, 2025 (the 'Final Expiry Date').

- Partial drawings on this Credit are permitted in which case the letter of Credit will be reduced by the draw amount.

- Upon successful completion of Nova Scotia Power Incorporated responsibilities under the offsetting and monitoring conditions of the Authorization, as determined by Fisheries and Oceans Canada, the original Letter of Credit shall be returned to the Bank of Nova Scotia, Montreal Trade Service Centre, 1800 McGill College, 10th floor, Montreal, Quebec H3A 3K9 for cancellation.

- This Standby Letter of Credit will be effective on March 17, 2020.

- This Standby Letter of Credit is subject to the International Chamber of Commerce (ICC) Uniform Customs and Practices for Documentary Credits, 2007 Revision, ICC Publication No. 600.

Regards,

The Bank of Nova Scotia

FERNANDO MARTINEZ

Authorised Signature(s)

ORIGINAL

APPENDIX I – DOWNSTREAM EEL PASSAGE STUDY

Downstream Eel Passage Study

	PASSAGE ROUTE		
30 Total Fish		**No Turbine**	**Turbine**
Number	30	9	21
%		30.0	70.0

	RIVER ROUTE MORTALITY				CANAL / TURBINE ROUTE MORTALITY			
9 Fish		**Alive**	**Mortality Observed**		**21 Fish**		**Alive**	**Mortality Observed**
Number	9	9	0		Number	21	8	13
%		100.0	0.0		%		38.1	61.9

	TOTAL MORTALITY		
30 Total Fish		**Alive**	**Mortality Observed**
Number	30	17	13
%		56.7	43.3

February 4, 2022

Ms. Kailey Osborne
Nova Scotia Power Inc.
1223 Lower Water St.
Halifax, NS B3J 3S8

Dear Ms. Osborne,

Re: Wetland and Wetland Fish Habitat Monitoring Plan
Ruth Falls Reservoir, Sheet Harbour, NS

INTRODUCTION

Nova Scotia Power Inc. (NSPI) is planning to temporarily lower the headpond at the Ruth Falls Reservoir within the Sheet Harbour Hydroelectric System to accommodate refurbishments at the Ruth Falls Reservoir (the Project). Strum Consulting was retained by NSPI to develop a Wetland and Wetland Fish Habitat Monitoring Plan (the Plan) for the Project.

The objective of the Plan is to determine whether the function of wetlands located along the shore that are contiguous with the headpond are impacted as a result of the lowered water levels. Additionally, the Plan will assess the impact on potential fish habitat provided by these wetlands.

The Plan will outline the general principles and methodology by which the wetlands and fish habitat around the Ruth Falls headpond will be monitored, before and after the water level is altered.

PROJECT DETAILS

In order to accommodate refurbishments at the Ruth Falls Reservoir, the water level in the headpond will be dropped from a full supply level of 109.25 ft down to 91 ft. The headpond will remain lowered for a period of approximately 9 months while work is completed on the Reservoir.

Wetlands

Wetland delineation was completed along the shores of the Ruth Falls Reservoir during the *Vegetation Surveys at the Sheet Harbour Hydroelectric System* completed by Jacques Whitford (JW) in 2007 (JW, 2007). As a result of this delineation, 21 wetlands were identified that are contiguous with the headpond (Table 1; see attached figure).

Table 1. Wetlands identified at the Ruth Falls Reservoir (Jacques Whitford, 2007)

Wetland ID	Wetland Type
1	Treed shore bog
2	Treed shore bog
3	Treed shore bog
4	Shore bog
5	Shore bog
6	Treed shore bog/ floating bog
7	Shore bog
8	Shore bog
9	Shore bog
10	Shore bog
11	Shore bog
12	Shore bog
13	Shore bog
14	Shore bog
15	Treed shore bog/ treed shore swamp
16	Treed shore bog
17	Shore bog
18	Treed shore bog
19	Shore bog
20	Shore bog
21	Shore bog

Fish Sampling

Fish species data collected within the Sheet Harbour hydroelectric system will be provided to Strum by NSPI; historical data will be used to establish baseline conditions and inform fish habitat post-construction monitoring assessments.

WETLAND MONITORING

The wetlands, as identified by Jacques Whitford (2007), will provide the initial wetland assessment information; Strum will rely on this previously collected data to select and complete their assessment on six of these identified wetlands.

Wetland monitoring activities will consist of one pre-construction assessment and 5 years of post-construction monitoring. Pre-construction monitoring will be completed prior to the headpond being lowered to establish baseline conditions. Post-construction monitoring will begin after refurbishments are concluded and the Ruth Falls Reservoir water level has been returned to its pre-construction full supply level. The findings of the monitoring program will allow for an evaluation of the extent of any changes in wetland characteristics and function as a result of the lowered water levels within the headpond.

Wetland monitoring activities will be completed within six of the previously identified wetlands. The six wetlands to be monitored will be selected to provide a representative sample of the wetland types located around the headpond.

Methodology

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored will be delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up-to-date.

Vegetative monitoring will entail the assessment of vegetative composition and cover within quadrats along a transect. The linear transect will consist of a series of four 1 m x 1 m quadrats placed 5-10 m apart along the transect route. Percent cover of the herbaceous, shrub/sapling, and tree species within each quadrat will be assessed. The top right corner of each quadrat will be staked to ensure that the selected areas can be replicated for future monitoring events. Additionally, dominant plant species throughout the wetland, as identified along the transect, will be determined for each stratum based on the percentage of aerial cover. A general assessment will be made to determine overall plant health and note any species that appear to be unhealthy or dying.

Monitoring wells will also be installed manually within each of the six selected wetlands using a hand auger/shovel. A minimum of one monitoring well will be included per wetland. Water level measurements will be documented within each well.

Soil test pits will also be incorporated via manual installation (auger, shovel). Indicators of wetland hydrology will be noted, including soil saturation, water table level, and standing water. Soil type(s) within each test pit will also be identified and recorded.

Photographs will be taken of the wetland from a fixed location (identified via GPS) for comparison with future events. All monitoring methodology will be completed during pre-construction and post-construction monitoring events. Monitoring events will be conducted by a trained biologist and will take place within the growing season (June 1 – September 30) to capture the prime growth period for plants and assess dry season conditions. Subsequent monitoring events will be timed to coincide with previous years' assessment dates to allow data comparisons to be made with previous and future monitoring events.

A description of the monitoring parameters and assessment methodology for wetlands is provided in Table 2, below. All data gathering techniques will be replicated for each subsequent monitoring event.

Table 2. Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Methods of Assessment
Hydrology	Depth to groundwater will be measured in monitoring wells.
	Standing water depth measurements will be noted within the existing wetland (if applicable).
	Evidence of other positive indicators of hydrology (*e.g.*, drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.
	An assessment of the general hydrologic condition will be made.
Vegetation	Herbaceous vegetation assessments (as % cover) will be completed within plots along a vegetative transect throughout the wetland. Assessment of the potential changes in composition, species, and health will be evaluated. Photographs will be taken of each individual vegetation plot for comparison with future monitoring events. Any presence of non-native/exotic species will be noted during all surveys, and are addressed specifically in the WESP-AC assessment.
	General assessment of the above variables throughout the wetland will be completed.
	Dominant plant species throughout the wetland will be determined for each stratum based on the percentage of aerial cover.
	Photographs will be taken of the wetland from a fixed location for comparison with future monitoring events.
Soils	Soil type within test pits will be noted and recorded.
	Assessment of potential changes in soil conditions throughout the wetland habitat will be evaluated, including evidence of sedimentation and siltation.

Wetland Functional Assessments (WESP-AC)

WESP-AC will be completed during the pre-construction surveys and again during the Year 5 post-construction monitoring event to assess whether the function and values of the wetlands were changed as a result of the Project.

WETLAND FISH HABITAT MONITORING

Review of Fish Sampling Results

A review of all fish sampling conducted by NSPI will be completed for all data available prior to the commencement of monitoring. The review will involve data compilation of fish species and abundance, information related to migratory periods (including applicable date ranges and species types observed), and identified species' habitat requirements.

Desktop Fish Habitat Suitability Review

Prior to the commencement of monitoring, a desktop fish habitat suitability review will be completed to assess the quality of fish habitat provided by both the Ruth Falls Reservoir and the wetlands contiguous with the Reservoir's shoreline. This review will identify the wetlands that provide valuable fish habitat and inform the selection of wetlands for both wetland monitoring and wetland fish habitat monitoring, and may include the following:

- Accessibility to fish
- Provision of fish cover
- Provision of water quality control features
- Potential sources of food and nutrition
- Bathymetry and water depth of the reservoir
- Review of fish sampling results (see above)

Based on this assessment, the six wetlands that are most likely to provide suitable fish habitat will be selected for wetland and wetland fish habitat monitoring.

Assumptions for Fish Habitat Assessments

Fish habitat field surveys are to be modelled after the Ontario Ministry of Natural Resources Procedure (1991) for the Bay of Quinte. Given that the habitat assessments are taking place along the shoreline of a body of (relatively) still water, rather than along a watercourse, the application of flow assessments and fish habitat in streams is less transferable and resources such as the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt-a-stream, 2018), are not as applicable.

Given NSPI's ongoing fish monitoring at the Ruth Falls fish ladder, it is our assumption that fish are present in the Reservoir, and that there are fish that use the habitats to be surveyed. Therefore, minimizing damage and disruption to fish in sensitive situations, such as breeding, will take priority over the collection of any single data point. If fish breeding evidence is encountered during surveys, those effected data points may be omitted. NSPI may also want to consider structuring their work schedule around the known breeding periods of any species of conservation interest, including Atlantic salmon (*Salmo salar*).

Methodology for Fish Habitat Field Assessments

The requirements for the baseline and subsequent fish habitat monitoring are described below in detail, including the timing of each of the field and desktop components.

The initial baseline surveys for fish habitat identification and classification will be conducted by a trained biologist and will take place within the growing season (June 1 – September 30). The baseline surveys will be conducted at six different wetlands surrounding the Ruth Falls Reservoir, shortly before drawdown is to begin. The wetlands to be surveyed for fish habitat will be the same as the wetlands chosen for Wetland Monitoring; this will be done for both logistical purposes and to incorporate the consideration of fish habitat and details associated with water quality which will be collected during the WESP-AC assessments. The monitoring schedule will proceed as outlined in the Proposed Schedule and Reporting section of this Plan.

Following the procedure outlined in the Ontario Ministry of Natural Resources (1991) document, transects will be walked from the Open Lake inland, through the Lakeshore and into the backshore. General observations will be made, and specific parameters will be assessed for their likelihood to support fish habitat, as seen in Table 3, below.

Along the specific transects, the portions of each transect to be assessed will be defined as follows:

Open Lake (OL): Open Lake is the area that is completely inundated with water, and can be definitively considered fish habitat. There may be any combination of emergent, floating and submerged vegetation, though the water depth should be no more than 50 cm. The Open Lake area must also be connected to the main water body of the Reservoir so as to allow fish passage.

Lakeshore (LS): The Lakeshore (also known as the Foreshore) is the area that is generally above the current water level of the lake (Reservoir), but below the highwater line on an annual basis. This area might be considered fish habitat, though fish habitat should not be considered a requirement. There is wetland vegetation, with the potential for some aquatic vegetation, especially when in proximity to the Open Lake area. The point for the LS assessment should be where there is a transition from standing water to no standing water.

Backshore (BS): The Backshore is the area at least 30 m perpendicular inland to the shore's highwater line and it should not be saturated in water, though it can be wetland or upland. It is not considered fish habitat and should not be accessible to fish.

The parameters to be monitored at each portion of the transect (i.e., OL, LS and BS) are described in Table 3.

Table 3: Wetland Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Photos	OL, LS, BS	Photos will be taken of the substrate (where applicable), vegetation, surrounding habitat, and any other observations of note.
GPS	OL, LS, BS	GPS waypoints will be taken in order to accurately map results and track the movement of OL and LS waypoints based on de-watering activities.
Vegetation	OL, LS, BS	Any vegetation species within a 5 m radius will be recorded, and the relative abundance as a percent cover within each stratum within a 30 m radius will be estimated.
Aquatic vegetation	OL, LS	Any water-bound vegetation species will be noted within a 5 m radius and the relative abundance as a percent cover within a 30 m radius will be estimated.
Water Quality	OL, LS	Standard parameters including pH, conductivity, temperature, and dissolved oxygen will be measured using a YSI Multiparameter meter where open water is present and can be accessed safely. At the Lake Shore area, this may not be possible given differing water levels and vegetation constraints.
Substrate	OL, LS, BS	Substrate types and relative abundance will be noted, including bedrock, boulders, rubble, cobble, gravel, sand, detritus, and fines/muck/silt.

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Water Level/Depth	OL, LS	The depth or level of water compared to the substrate should be measured using a measuring device. The use of a piezometer for continuous measurement may be required in conjunction with, or as a replacement to, any monitoring wells installed within the wetlands to be monitored.

Given that the water level will significantly change during the drawdown, the transects where the assessment points are taken will remain the same, however, new assessment points will be added at each of the monitoring sites to reflect the changing OL and LS locations. The transect lines will still inform the placement of those points of assessment, however, if safety challenges prevent access to a specific location, the point will be moved to a nearby and comparable safe location, or omitted entirely if accessible and representative habitat is not present. Upon water levels rising to pre-construction levels (or as close as can be expected in post-construction conditions), the original assessment points will be resumed for all post-construction monitoring.

In all cases, the assessment points and transects will be chosen in order to best represent the surrounding habitats.

PROPOSED SCHEDULE AND REPORTING

Annual post-construction monitoring reports will be submitted to Nova Scotia Environment and Climate Change (NSECC) for the five years of post-construction monitoring. Vegetation results shall be provided in a cumulative table to allow for inter-annual comparison of data. Table 4 outlines the monitoring and reporting schedule for the Wetland Monitoring Program, while Table 5 outlines the monitoring and reporting schedule for the Wetland Fish Habitat Monitoring Program.

Table 4. Monitoring and Reporting Schedule for Wetland Monitoring

Monitoring Event		Wetland Monitoring	WESP-AC	Reporting Submission to NSECC
Pre-construction	Baseline	✓	✓	
Post-construction	Year 1	✓		✓
	Year 2	✓		✓
	Year 3	✓		✓
	Year 4	✓		✓
	Year 5	✓	✓	✓

Information collected from post-construction monitoring events will be compared with the baseline data collected during the pre-construction monitoring events and previous years' monitoring events to evaluate post-construction vegetation (e.g., wetland and vegetation present, invasion of exotic species, success of any re-vegetation, etc.), hydrology, and soils. After Year 5, potential long-term impacts to the wetlands will be assessed and required consultation with NSECC will take place.

Table 5. Monitoring and Reporting Schedule for Wetland Fish Habitat Monitoring

Monitoring Event		Fish Habitat Transect Monitoring	Desktop Review of Fish Data	Reporting Submission to NSECC & DFO
Pre-construction	Baseline	✓	✓	✓
During Construction*	1 week after drawdown	✓	✓	✓
	End of growing season during drawdown/construction	✓	✓	✓
Post Construction*	1 week after water level is restored	✓	✓	✓
	Year 1	✓	✓	✓
	Year 2	✓	✓	✓
	Year 3	✓	✓	✓
	Year 4	✓	✓	✓
	Year 5	✓	✓	✓

*Monitoring may be limited depending on the time of year when construction is to be completed, *i.e.,* if construction is completed in January, the first post-construction survey will not be completed before the growing season begins in June.

Information during post-construction monitoring will be used to inform reports submitted to NSECC and Fisheries and Oceans Canada (DFO) on an annual basis, while further consultation with each respective governing body may be required after the post-construction monitoring is completed.

If you have any questions, please contact us.

Thank you,

Angus Doane, BSc., MREM
Junior Environmental Scientist
adoane@strum.com

Natasha Myers, BSc., EP, PMP
Senior Environmental Scientist
nmyers@strum.com

REFERENCES

Jacques Whitford. 2007. *Report – Vegetation Surveys at the Sheet Harbour Hydroelectric System*. Project No. 1026751.

NSLC Adopt a Stream and Nova Scotia Salmon Association. 2018. *The Nova Scotia Fish Habitat Suitability Assessment – A Field Methods Manual Version 2.1.* pp. 1-46.

Ontario Ministry of Natural Resources. 1991. *Procedures Manual for Mapping Fish Habitat along the Nearshore Zone of the Bay of Quinte.* pp. 1-61.

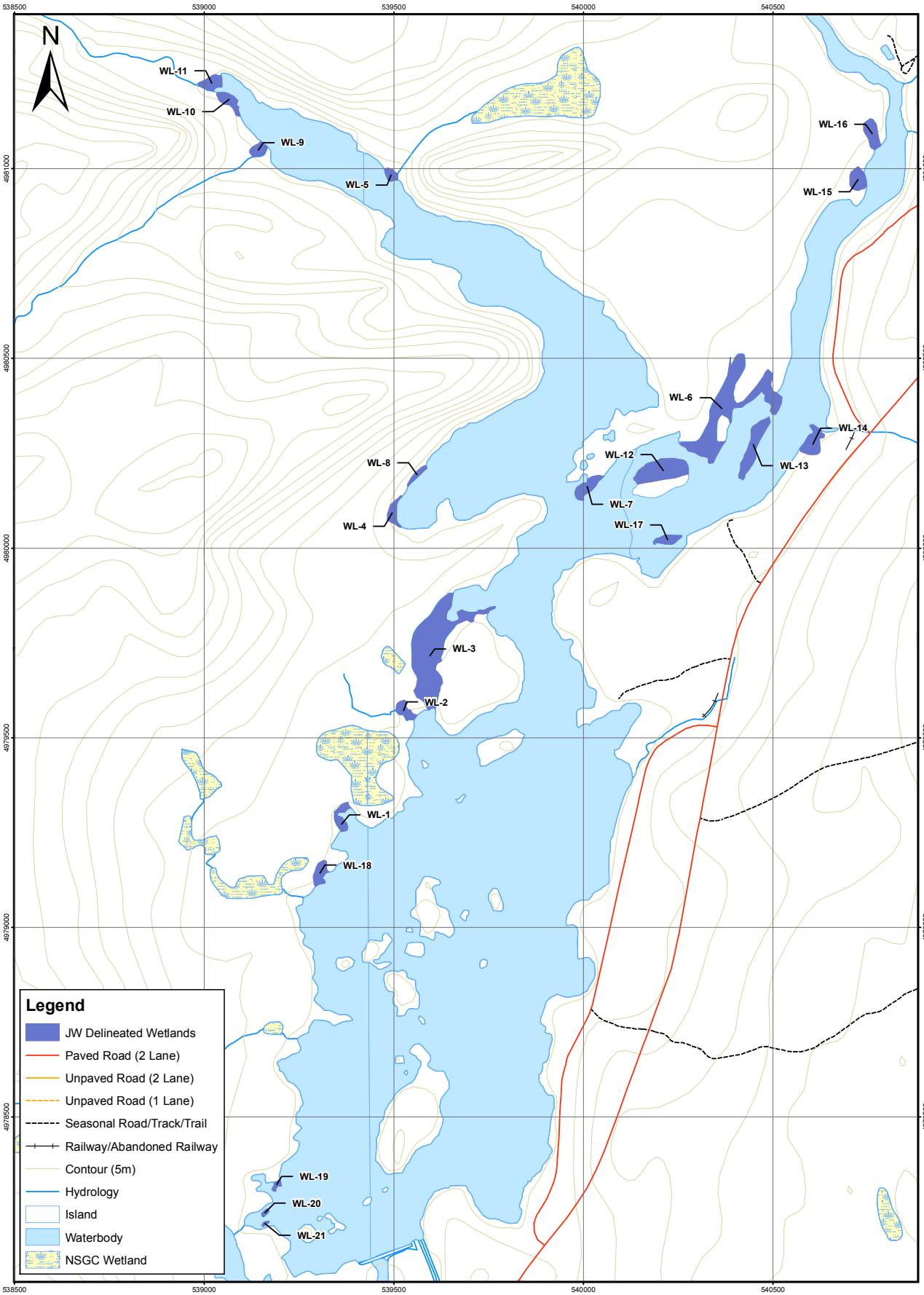


Figure 2

Ruth Falls Flowage Reservoir Wetlands

Map Parameters
Projection: UTM-Nad83-Z20
Scale 1:9,000
Date: October 24, 2007
Project No: 1026751.

0 160 320 640
Meters

Jacques Whitford

Stantec

Ruth Falls Dam Rebuild

DRAFT: Fish Entrainment Monitoring Program - Field Plan

March 24, 2022

Prepared for:
Nova Scotia Power Incorporated

Prepared by:

Stantec Consulting Ltd.
102-40 Highfield Park Drive
Dartmouth NS B3A 0A3

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Introduction
March 24, 2022

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by Nova Scotia Power Inc. (NS Power) to conduct fish entrainment monitoring as part of the Ruth Falls Rebuild Project (the Project). Specifically, Stantec is conducting a study of fish abundance in the reservoir upstream of the dam before the drawdown, and fish entrainment monitoring downstream of the dam during the 4-day reservoir drawdown period. The entrainment monitoring program will focus on gaspereau[1] and other incidental species.

Additionally, NS Power has retained the services of Aerovision Canada Inc (Aerovision) to conduct aerial drone surveys of the shoreline littoral zones to identify changes in habitat before and after the reservoir drawdown.

The following document outlines the Field Plan for the Fish Entrainment Monitoring Program that has been developed for the 2022 Ruth Falls drawdown.

2.0 BACKGROUND

The Ruth Falls Hydro System dam site (referred to as “the site”) is located 5 km north of the Town of Sheet Harbour, at latitude 44.95541° N and longitude -62.50016 ° W. The dam is located on the East River Sheet Harbour, downstream of Ruth Falls Flowage.

To allow maintenance and repair of the Ruth Falls Hydro System dam, NSPI plans to lower levels upstream in Ruth Falls Flowage by approximately 5.5 metres for several months in 2022. The drawdown will occur over a period of four days and is currently scheduled to start mid July 2022. The lowering of Ruth Falls Flowage will result in water levels returning to levels similar to historical pre-impoundment conditions.

3.0 FIELD PROGRAM

The following section outlines the proposed Fish Entrainment Monitoring Program that will be conducted during the 2022 drawdown of Ruth Falls flowage.

The objective of the field program was to assess the abundance of Young-of-the-year (YoY) gaspereau within the reservoir before the drawdown, monitor the entrainment of fish from the reservoir during the drawdown and characterize the aquatic habitat exposed during the reservoir drawdown. Stantec has

[1] For the purpose of this report gaspereau refers to two similar and related species: the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*).

been engaged to conduct the fish entrainment monitoring tasks, while Aerovision will collect aerial imagery within the reservoir at set intervals to allow NS Power to document changes to aquatic habitat.

Specifically, the objectives addressed in this field program are:

1. Provide relative density and size distributions of YOY gaspereau and other fish incidentally caught in the Ruth Falls Flowage before the drawdown.
2. Provide an estimate of the number and species of fish entrained during the Ruth Falls Flowage drawdown.
3. Collect baseline aerial imagery of the shoreline and nearshore at various stages of the Project to determine the change aquatic habitat within Ruth Falls Flowage.

A step-by-step work plan to accomplish these objectives is described below.

3.1 BASELINE FISH ABUNDANCE SURVEY - RUTH FALLS FLOWAGE

Prior to the drawdown a baseline fish abundance survey will be conducted in Ruth Falls Flowage. The baseline survey was developed to obtain a sample of YoY gaspereau to establish density, length and weight metrics within the reservoir.

The baseline fish abundance survey in Ruth Falls Flowage will be conducted within a week prior to the drawdown (i.e., early July). In July, it is anticipated that YoY gaspereau in Ruth Falls Flowage will be in the larval or juvenile stage with fork lengths measuring less than 30 mm. The larval stages are likely to disperse based on wind induced currents or water currents. Seining and modified ichthyoplankton tows were conducted in the Tusket Falls reservoir in late July 2021 prior to the scheduled drawdown of the reservoir. Seining was shown to be successful in capturing YoY gaspereau from the reservoir environment (Stantec 2021)[2]. As a result, the approach to collecting baseline data on YoY gaspereau will focus on the use of seines in the littoral environment. Sampling multiple locations is thought to produce the best probability of YoY gaspereau capture and result in a more robust morphometric dataset.

Up to ten locations within the littoral zone of Ruth Falls Flowage will be sampled over one night using a 3 mm mesh (1/8 inch) beach seine. The seine sweeps will be conducted parallel to shore for 10 m using a 10 m x 1.5 m seine with 1/8-inch (3 mm) mesh. The seine will be closed off by bringing the offshore end towards the shoreline. Seining will be conducted by two field personnel between the hours of 18:00 and 02:00. Seining locations will be selected based on suitable bathymetry, substrates, shoreline vegetation and access. To allow for efficient sampling, Stantec is proposing a spring site visit to identify potential sampling locations, details on the sampling locations will be forwarded to DFO when available, the preliminary target sampling areas are provided in Figure 3.1

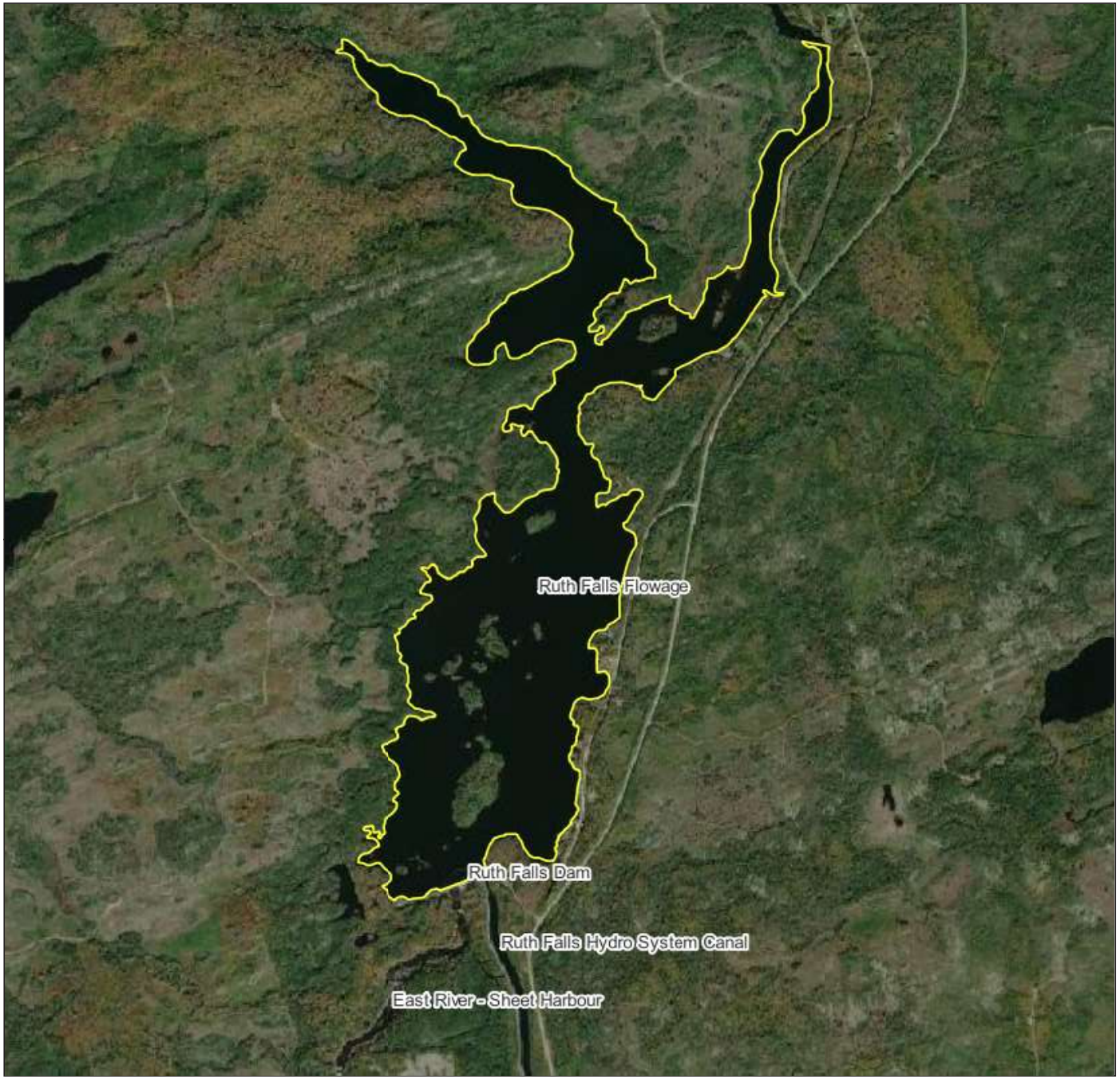
[2] Stantec Consulting Ltd. 2022. Tusket Dam Refurbishment: 2021 Fish Entrainment Summary Report

Fish Identification and Measurements

Fish retained in the seines will be enumerated, and a subset of up to 50 YoY gaspereau from each seine location will be measured and weighed. If large numbers of YoY gaspereau are captured (i.e., hundreds) a weighted subsample and batch weight will be used to estimate the number of fish captured. Other fish species collected during the seining will be identified and enumerated, with up to 50 individuals of each species weighed and measured per location.

3.1.1 Equipment

- Boat, outboard motor, and trailer
- Seine 1.5 m x 10 m
- Coolers for temporary fish storage, between collection and processing
- Fine mesh dip nets
- Scale (0.01 g resolution)
- Fish board (in mm)
- Camera
- Handheld GPS
- Data sheets or notebook
- Safety supplies (e.g., Personal Protective Equipment, boat kit, communication device, waders, personal floatation devices).



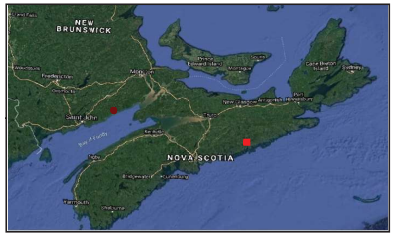
Stantec

Target Baseline Sampling Area

N

0 350 700
metres

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N



Project Location
Sheet Harbour
Nova Scotia

Client/Project TBD_001
NS Power - Ruth Falls Entrainment Monitoring Program

Figure No.
3.1

Title
Target YoY Gaspereau Baseline Sampling Area

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Field Program
March 24, 2022

3.2 FISH ENTRAINMENT MONITORING – EAST RIVER

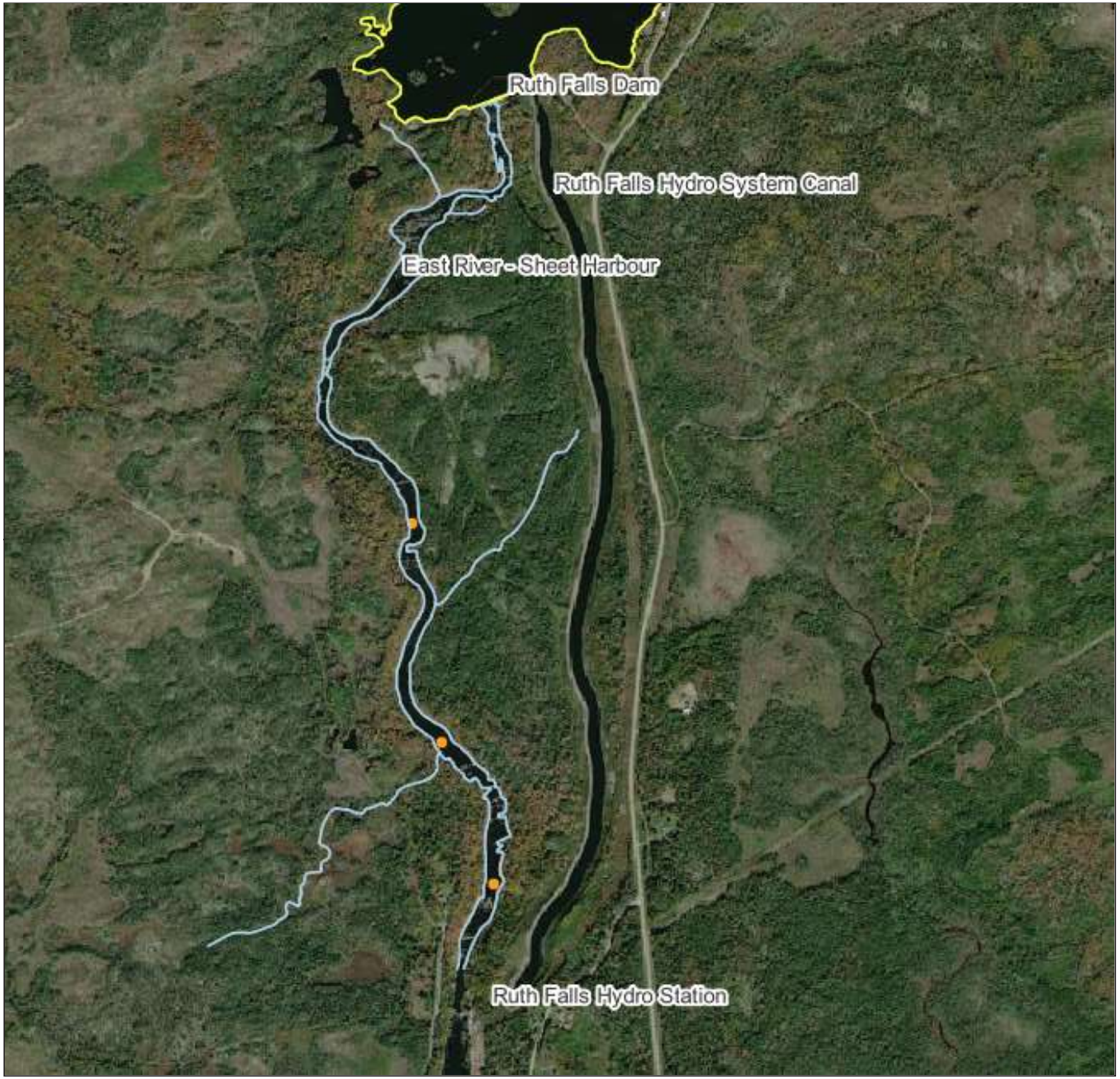
Monitoring of fish entrainment during the drawdown will be conducted downstream of the Ruth Falls Flowage dam in East River. Based on aerial imagery, East River downstream of the Ruth Falls Dam consists primarily of rapids and riffles. The flowing river characteristics (i.e., swift flows with large coarse or bedrock substrates) appear to lend itself more towards the use of a rotary screw trap (e.g., Smolt wheel) over fyke traps or seine nets, particularly during the higher flows expected during the drawdown. The rotary screw trap would be a 1.83 m to 2.44 m diameter drum covered with an aluminum wire mesh of 6 mm on square, similar to Figure 3.2. The drum and holding box are constructed of aluminum and attached to side pontoons which maintain the drum at the water's surface. The floating trap will be kept in place using anchors or an overhead shorefast cable.



Figure 3.2 Image of Rotary Screw Trap

There are several locations in the East River (Figure 3.2) which will be investigated for the suitability of installing a rotary screw trap. These areas are all upstream of the estuary and downstream of the Ruth Falls Dam. Additionally, very few tributaries feed into the East River below the Ruth Falls Dam, decreasing the probability that species caught by the trap during the entrainment will be from other watercourses and increasing the probability that species captured will be those entrained from Ruth Falls Flowage.

Monitoring of fish entrainment is proposed to start one day prior to the drawdown and continue until one day after drawdown is complete. Based on a four-day drawdown, sampling would be conducted over six days. The rotary screw trap expected to sample unselectively for fish continuously during the drawdown



Stantec

Target Baseline Sampling Area

East River Target Sampling Area

East River Fish Entrainment Sampling Locations

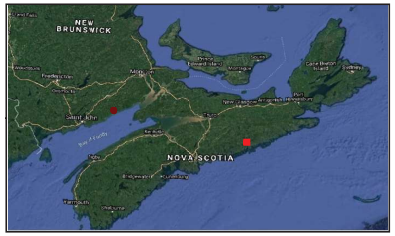
N

0 350 700

metres

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N



Project Location
Sheet Harbour
Nova Scotia

Client/Project TBD_001
NS Power - Ruth Falls Entrainment Monitoring Program

Figure No.
3.3

Title
Target Fish Entrainment Sampling Locations

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CI 50518 NSUARB IR-12 Attachment 8 Page 8 of 14

(i.e., 24 hours per day) and capture a proportion of all fish in the upper 1 to 1.5 m of the water column, the effective area of the water sampled depends on the drum diameter and depth of submergence. The use of the rotary screw trap will reduce the bias in entrainment estimates from sampling only select periods of the day and providing safer sampling conditions for field staff from increased flows during the drawdown.

During entrainment monitoring, the rotary screw trap will be checked twice daily, morning and evening, using a boat or ramp attached to the shoreline. During each check fish from the live well will be transferred into cooler(s) filled with freshwater and containing an airstone bubbler, debris in the live well will be removed, natural debris will be returned to the river and trash disposed of onshore. Water velocity will be measured upstream of the trap twice daily and paired with the effective sampling area to calculate a volume of water sampled. Wheel speed will be recorded twice daily during checks along with the overall drum revolution count.

Fish Identification and Measurements

Fish will be taken from each cooler, enumerated, and a subset of 100 YOY gaspereau from the trap will be measured for fork length (to the nearest mm) and weighed (to the nearest 0.1 g). Where greater than 100 fish are caught in the trap the subset of fish will include a random sample of 100 YoY gaspereau from the catch present, the remaining fish will be weighed as a batch and a weighted subsample will be used to estimate the total number of fish captured.

Other fish species collected in the tows or fyke nets will be identified and enumerated, with up to 50 individuals of each species weighed (to the nearest 0.1g) and length measured (to the nearest mm) per location. Once weight and lengths of the fish have been recorded the majority of fish will be released over the side of the boat in a similar location as their capture site. A subsample of large-bodied fish from the fyke net catch will be retained for a mark-recapture experiment described below.

Mark-Recapture Experiment

A mark-recapture experiment will be implemented to estimate capture probability for large-bodied fish caught in the rotary screw trap. A subsample of adult or appropriately sized YoY fish will be marked via fin clip and released upstream at a suitable location. Stantec is proposing to mark every 7th viable fish depending on catches. If catches of large-bodied fish are low proportionally more fish will be marked. Species targeted will include those present at the time of sampling and may include species such as: trout, brown bullhead, white perch, white sucker, yellow perch. Fish selected for marking will be anesthetized using clove oil, a portion of the fin will be clipped using scissors sterilized in 70% ethanol, and the fish will be moved to a recovery tank prior to release upstream of the sampling area. The release location will be determined in conjunction with NS Power to determine an area that is accessible and a safe distance downstream from the Ruth Falls Dam.

3.2.2 Equipment

- Boat, outboard motor and trailer
- Rotary Screw Trap
- Dip nets
- Coolers for temporary fish storage, anesthetization, recovery, and transport
- Air stone bubbler
- Scale (0.01 g resolution)
- Fish board (in mm)
- Clove oil
- Scissors
- 70% ethanol
- Camera
- Handheld GPS
- Data sheets or notebook
- Safety supplies (e.g., Personal Protective Equipment, boat kit, communication device, waders, personal floatation devices).

3.3 SHORELINE HABITAT CHARACTERIZATION

Aerial imagery will be collected within the reservoir at set intervals to allow NS Power to document changes to aquatic habitat. Aerial imagery collection will consist of three surveys conducted during the following periods:

- 1 survey within a period seven days prior to drawdown commencing (Early July 2022)
- 1 survey after the completion of the drawdown (August 2022)
- 1 survey conducted in November 2022.

Aerial imagery collection will be conducted by Aerovision within Ruth Falls Flowage using a fixed-wing remotely piloted aircraft system, RTK enabled with long endurance flight, and a 21MP camera. Transects will be conducted within the reservoir where photos will be collected along a predetermined flight path (as shown in Figure 3.4). The remotely piloted aircraft system will be operated at a height at an elevation between 122 and 213 m (400 to 700 ft) along a pre-programmed flight path, as shown in Figure 3.1. The imagery resulting from the flightpath will include complete coverage of a 30-m buffer on either side of the original high-water mark. Each image will be of sufficient resolution to delineate aquatic habitat types and extents, with a pixel resolution of 6.5 cm or less.

Following data capture, the imagery will be post-processed to produce a geo-referenced orthomosaic over the reservoir. Further discussion of deliverables will follow collection, to clarify desired formats, size, delivery method. The delineation of habitat types and extents will be performed by NS Power using GIS analysis.

Field Program
March 24, 2022



Figure 3.4 Sample Flight Path for Ruth Falls Flowage

4.0 REPORTING

The following section outlines the reporting commitments for the Ruth Falls Fish Entrainment Study

Field Reports

During the baseline fish abundance survey in Ruth Falls Flowage, fish capture data will be reported to DFO at the end of the baseline survey and every two days during the fish entrainment monitoring. If issues arise with the sampling methods, DFO will be informed of any variation from the methods described above.

Upon completion of the program a report summarizing the results of the 2022 fish entrainment study will be prepared for NS Power and submitted by December 30, 2021. This report will include information on the methods utilized in data collection and a summary of data from the baseline fish abundance survey and fish entrainment monitoring.

The baseline fish abundance survey data will be presented in terms of:

- the total number of fish caught by species,
- a summary of morphometric data (weight, length) by species, and
- the calculated densities by species for each seine.

The entrainment monitoring data will be presented in terms of:

- the total number of fish caught by species,
- a summary of morphometric data (weight, length) by species, and
- a daily entrainment estimate by species.

An entrainment estimate for YoY gaspereau will be calculated using the average fish densities (fish/ m^3) from the rotary screw trap and the daily discharge (m^3) through the dam as provided by NS Power. The capture probability for large-bodied fish utilized in the mark-recapture experiment will be estimated using a suitable population size estimate method (e.g., Peterson method). The total number of fish caught and recaptured in the rotary screw trap will be used to determine a capture probability to provide a daily estimate of fish entrainment.

5.0 PROJECT SCHEDULE

The proposed schedule for the 2022 Ruth Falls Entrainment Monitoring field program is outlined below.

- Preliminary Field Visit for Site Selection – May 2022
- Baseline Aerial Shoreline Surveys – Week of July 3, 2022
- Baseline Fish Abundance Survey – Week of July 3, 2022
- Ruth Falls Flowage Drawdown - July 10 to 14, 2022
- Fish Entrainment Monitoring – July 9 to 15, 2022
- Post-drawdown Aerial Shoreline Surveys – August 2022

6.0 CLOSURE

This plan has been prepared for the sole benefit of Nova Scotia Power Incorporated (NS Power). This report may not be relied upon by any other person or entity without the express written consent of Stantec Consulting Ltd.

Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Should additional information become available, Stantec Consulting Ltd. requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

We trust that the Fish Entrainment Study Field Plan is satisfactory for your purposes at this time. If you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Matt Steeves
2022.03.24
14:00:58 -03'00'

Matt Steeves, B.Sc.
Environmental Project Manager
Tel: (902) 620-0251
Matt.Steeves@stantec.com

REFERENCES

Daborn, G.R. and M.Brylinsky 2003. Fish Population Studies of the Avon Estuary, Pesaquid Lake and Lower Avon River. Acadia Centre for Estuarine Research Publication No. 76

O'Gorman, R. 1983. Distribution and abundance of larval fish in the nearshore waters of western Lake Huron. Journal of Great Lakes Research 9:14–22.

Fisheries and Oceans Canada | Pêches et Océans Canada

Bedford Institute of Oceanography
1 Challenger Drive
P.O. Box 1006, Station P500
Dartmouth, Nova Scotia, B2Y 4A2

May 5, 2022

Our file *Notre référence*
19-HMAR-00549

Nova Scotia Power
Attention: Kailey Osborne
Environmental Scientist
PO Box 910
Halifax, NS B3J 2W5

Subject: Sheet Harbour Ruth Falls Dam Refurbishment Phase 2 – Application for a *Fisheries Act* Authorization – Incomplete or Inadequate

Dear Kailey Osborne:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) would like to acknowledge the receipt of your application for authorization under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* which was received on June 24, 2020, along with additional supporting information submissions in 2021 and 2022. We understand that you propose to:

- Refurbish the dam located at Ruth Falls within the East River – Sheet Harbour Hydroelectric System, Halifax County, Nova Scotia. Phase 2 work is proposed to include the drawdown of the headpond by 18 ft (5.5 m), replacement of 30 stop log bays with seven rubber dams and a free overflow spillway section, and reface concrete on the dam and spillways.
- The work is anticipated to take 8 to 9 months to complete and proposed to occur from July 2022 to late March 2023.
- During the construction period, the Ruth Falls fish ladder will not be operational, reservoir operating requirements will not be maintained, and supplemental flows will not be provided. However, fish passage and ecological maintenance flows will be provided during the construction period via the newly installed vertical lift gates.
- Water levels at Marshall Falls, upstream of Ruth Falls, will not be impacted by the activity.

Fisheries and Oceans Canada | Pêches et Océans Canada

Our review considered the following information:

- Fisheries and Oceans Canada Request for Review and attached information, received via email from NS Power on December 2, 2019;
- Nova Scotia Environment Application for Approval and supporting documentation, received December 27, 2019;
- Correspondence regarding additional information requested, received via email from NS Power on February 27, 2020;
- *Fisheries Act* Authorization application and supporting documents, received via email from NS Power on June 24, 2020;
- Supplemental information, received via email May 20, 2021;
- Correspondence regarding changes to the scope of work and timelines, received via email from NS Power on July 6, 2021;
- Supporting Information (with updated scope and timeline and new breakdown into Phase 1 and Phase 2), received via email January 21, 2022;
- Wetland and Wetland Fish Habitat Report, Strum, dated February 4, 2022, received via email February 4, 2022;
- Project Environmental Description Addendum for NSECC, received via email February 14, 2022;
- Fish Entrainment Monitoring Program - Field Plan, Stantec, dated March 24, 2022, received via email March 31, 2022; and
- Meeting with NS Power on May 4, 2022.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the *Aquatic Invasive Species Regulations*.

The aforementioned outcomes are prohibited unless authorized under their respective legislation and regulations.

Upon reviewing your application, the Program determined that some of the information and documentation set out in the *Authorizations Concerning Fish and Fish Habitat Protection Regulations* (the Regulations) has not been provided and as such, the application is incomplete or inadequate.

Fisheries and Oceans Canada | Pêches et Océans Canada

On May 4, 2022, NS Power informed DFO that the Phase 1 works (i.e., replacement of stoplog bays with vertical lift gates and installation of a rubber dam control building) is proposed to occur during the drawdown proposed for Phase 2 works. DFO had previously provided a Letter of Advice (21-HMAR-00478) for the Phase 1 works. However, since the work, undertaking or activity associated with Phase 1 is now being proposed to occur along with the proposed work, undertaking or activity proposed for Phase 2, submit a revised application for *Fisheries Act* authorization that describes the revised construction scope and schedule along with any other proposed changes, as DFO now considers this to be one proposed project rather than two separate projects.

The revised application for *Fisheries Act* authorization is to be a complete standalone application that does not reference previous submissions and that includes*:

- a completed Application for Authorization under Paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* Form (http://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/authorization-autorisation-eng.html);
- the required information and documentation set out in the Authorizations Concerning Fish and Fish Habitat Protection Regulations (http://laws-lois.justice.gc.ca/eng/regulations/SOR-2013-191/page-1.html); and
- includes the information and documentation requirements described in the letter below based on review of your previous submissions to consider the application to be complete, along with a concordance table that provides the section and page numbers where each of the information requirements below are addressed along with other proposed changes to the proposed project.

*Note: DFO is currently in receipt of an irrevocable letter of credit; however, an additional letter of credit may be required after final review of the revised *Fisheries Act* authorization application and upon review of results from monitoring studies that are being proposed to inform deferred offsetting requirements associated with this project.

Main Document Ruth Falls Dam Refurbishment Application for Authorization, Supporting Information, dated January 2022

Fish Passage

- As previously requested in an email from DFO to Jenny LeBlanc on October 25, 2021, provide information on water management practices for current operations and for proposed operations after the infrastructure is upgraded. Include information on the timing, duration, and mechanism for spilling water at the dam under both existing and proposed operating scenarios.
- Provide available information on the effectiveness of existing upstream and downstream fish passage at the site for all species that are likely to be migrating in the area. Include more detailed information from the American Eel fish passage study that was conducted in 2010, including further details on the study methods, location where American Eel were released, the number of American Eel that migrated over the dam, the number that

were diverted by the lover system, and the number that traveled through the turbines and associated survival with each downstream passage route.

- Section 14, Table 6, Page 21 states:
    - *Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.* Correct the first column in Table 6 to reflect both upstream and downstream fish passage, as both are discussed.
- NS Power is proposing major refurbishment works for the dam that could influence upstream and downstream fish passage (e.g., changing from surface spill via stop logs to sub-surface spill via vertical lift gates). As stated in Table 6, there will likely be impacts to upstream and downstream fish passage after dam refurbishment works are complete. As noted in emails from DFO to Jenny LeBlanc on October 25, 2021 and December 16, 2021, and as discussed on the October 27, 2021 call with DFO and NS Power, fish passage improvements are to be integrated into the dam refurbishment work to ensure compliance with the fish and fish habitat protection provisions of the *Fisheries Act*, which includes ensuring the free passage of fish. Therefore, submit the following:
    - An assessment by a qualified professional on potential impacts to upstream and downstream fish passage for all species that are likely to be migrating in the area associated with the proposed infrastructure design and operations.
    - Describe proposed measures that will be implemented as part of the refurbishment works to avoid, mitigate or offset potentially harmful impacts to fish and fish habitat, including fish passage, associated with the refurbishment and future operation of the Ruth Falls Hydroelectric Development. For avoidance and mitigation measures, ensure to submit the following information and describe how these proposed fish passage measures meet established fish passage design criteria (e.g., USFWS Fish Passage Engineering Design Criteria) to allow DFO to assess whether proposed plans are sufficiently meeting fish passage requirements as per Section 34 of the *Fisheries Act*:
        - Provide an upstream fish passage plan for American Eel that includes detailed design drawings, proposed location for fish passage structures and rationale for siting structure(s) in this location, information on proposed operations, and proposed timing of installation.
        - Provide a downstream fish passage plan for fish species that are likely to be migrating downstream at the site. Submit detailed design drawings, the proposed location of structures and rationale, information on proposed operations, and proposed timing of installation for any new structures required to ensure the free passage of fish at the site. This includes proposed improvements to the louver system.

    - Describe post-construction monitoring that will be conducted to evaluate whether fish passage structures (upstream and downstream) are meeting the requirements of the *Fisheries Act*.
        - If this is to be completed in the post-construction monitoring plan to be submitted to DFO by January 1, 2023, then update the January 2022 Supplemental Information document to state this.
- Describe the purpose of the pipe which is located immediately below the Ruth Falls Fish ladder, shown in Photo 3 of the Request for Review, submitted by NS Power to the Program on December 2, 2019.

Construction

- Provide further information on the four day drawdown at Ruth Falls, including whether the discharge below the dam associated with the drawdown would exceed spill conditions at the dam under normal operations, and provide an alternative drawdown scenario for a eight or ten day drawdown, including time (day), beginning elevation (ft), gate opening (ft), discharge (cubic feet per second or cfs), velocity through gate (feet per second or fps), downstream velocity (fps), and whether discharge would exceed spill conditions at the dam under normal operations.
- Describe the construction sequence for how the temporary bridge will be constructed.
- Describe what materials the temporary bridge and abutments will be constructed with.
- Describe how long the temporary bridge will be in place.
- Describe how the temporary bridge will be removed during excessive flow conditions that would be expected from a 1:2 year return storm event.
- Provide an updated *Figure 1 – Site Plan Showing Upstream Access Roads and Downstream Access Roads* to show the temporary instream footprints for access roads and bridge, as described in the January 2022 Supporting Information (i.e., 2,316 m^2), and identify where the bridge is located on this drawing.
- Provide additional details related to the Construction Schedule, including a Gantt chart for the Phase 2 work listed in Section 2.0, page 2. Also, describe if the Phase 1 work (deep stoplog bay replacement with vertical lift gates), under NSECC Approval #2021-2840307-00 and DFO Letter of Advice# 21-HMAR-00478, will overlap with the proposed Phase 2 project components.
- Describe whether generation will occur to dewater the impoundment or during the construction period, and if so, describe how downstream fish passage will be provided during periods of generation to mitigate for turbine mortality.

Appendix F, Monitoring Plan

- Section 3.3, Pages 6-7 states, *NS Power has identified areas of potential improvements to the existing louvre system that may effectively improve the efficacy of the louvre system at*

bypassing eels downstream…NS Power will engage a professional engineering and fish passage consultant to perform an assessment on the existing louvre system and recommend modifications that will look to improve the functionality and effectiveness of bypassing eels around the power canal. The engineering company will be experienced in fish passage design and will evaluate the louvre system based on the effectiveness to by-pass American eel.

- Describe any improvements that have been made to-date, when they were implemented, whether they meet established fish passage design criteria (e.g., USFWS Fish Passage Engineering Design Criteria), and how they will be monitored to assess whether they are providing effective downstream passage for American Eel and other fish species likely to be migrating downstream on the system.
- If the identified areas for potential improvements have not been implemented to-date, describe the proposed improvements, when they will be implemented, whether they meet established fish passage design criteria (e.g., USFWS Fish Passage Engineering Design Criteria), and how they will be monitored to assess whether they will provide effective downstream fish passage for American Eel and other fish species likely to be migrating in the area.

- Section 4.6.2: Only one habitat characterization transect is proposed for the Ruth Falls Headpond. Please include a minimum of two transects.

Wetland and Wetland Fish Habitat Monitoring Plan, Strum, dated February 4, 2022

- Describe how the results from the six monitored wetlands will be extrapolated to other wetlands that are not being monitored as part of this study to inform offsetting requirements for fish habitat.
- Wetlands can provide both direct and indirect benefits to fish and fish habitat. Describe how wetlands providing indirect benefits to fish habitat will be assessed to determine offsetting requirements.
- Baseline surveys will take place between June 1-September 30, but it is important to note that fish habitat is provided outside of these timelines, and there may be greater habitat as lake levels are expected to rise outside of this proposed timeline. Please confirm that NS Power will use the ordinary high water mark (OHWM) to delineate fish habitat.
- For the assessments, describe the criteria that NS Power will be using to determine if a site is "direct fish habitat", "indirect fish habitat" or "not fish habitat".
- The backshore definition mentions it is considered “not fish habitat”. Describe if field studies will be conducted to confirm if this is accurate and whether indirect benefits to fish habitat are being considered in the backshore.
- Describe how NS Power will determine the duration of impacts to wetlands deemed to be fish habitat to inform offsetting requirements for this project (e.g., describe how long will it take for wetlands impacted by the drawdown to re-establish to their full

fish habitat functions). If this is to be part of the post-construction monitoring to be submitted later, state that in the plan.

Fish Entrainment Monitoring Program - Field Plan (Stantec, dated March 24, 2022)

- Section 3.2:
  - Describe the methods that will be used to estimate the number of fish that have been entrained downstream as a result of the drawdown (i.e., how the Rotary Screw Trap catch data will be used to estimate the abundance of different species of fish that moved downstream as a result of the drawdown) and provide equations describing how this will be calculated.
  - Describe how the sampling equipment will be modified or moved if low catches (including recaptures) occurs as a result of poor placement of the sampling equipment or changing water levels.
  - Describe how NS Power will monitor catch data and adjust sampling times to avoid fish mortality in the sampling gear (e.g., if large numbers of Gaspereau migrate downstream at night).
- Section 4.0, Entrainment Monitoring states results of the 2022 fish entrainment study will be prepared for NS Power and submitted by December 30, 2021. This is a typo and should be changed to December 31, 2022.
- Section 4.6.1, Appendix F, Monitoring Plan of the January 2022 submission states that drone surveys will be conducted in early July, no later than one week after the desired drawdown elevation is reached, and again in November after the growing season. Add the November survey to Section 5.0 of the entrainment study to be consistent with the Section 3.3 of the entrainment study, and Section 4.6.1 of the above January 2022 Monitoring Plan.

Upon receipt of this outstanding information and documentation, the Program will notify you to confirm receipt. The Program will notify you as to whether the application is complete within a period of 60 days after receiving this outstanding information and documentation.

If you have any questions, please contact Kelley Fraser at our Dartmouth office at 902-441-3671 or by email at kelley.fraser@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Wambolt, Michael

Digitally signed by Wambolt, Michael
Date: 2022.05.05 10:59:31 -03'00'

Michael Wambolt
A/ Manager Ecosystem Management-Regulatory Reviews

Cc: Melissa Douglas, Environment Inspector, NSECC

Response to DFO Incomplete Letter Dated May 5, 2022 - Concordance Table

DFO Information Request	Section in FAA Application	Additional Notes, if applicable
The revised application for *Fisheries Act* authorization is to be a complete standalone application that does not reference previous submissions and that includes*:		
Completed Application for Authorization under Paragraphs 34.4(2)(b) and 35(2)(b) of the Fisheries Act Form (http://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/authorization-autorisation-eng.html);	Submitted as separate document	
The required information and documentation set out in the Authorizations Concerning Fish and Fish Habitat Protection Regulations (http://laws-lois.justice.gc.ca/eng/regulations/SOR-2013-191/page-1.html);	All Sections of FAA	
Includes the information and documentation requirements described in the letter below based on review of your previous submissions to consider the application to be complete, along with a concordance table that provides the section and page numbers where each of the information requirements below are addressed along with other proposed changes to the proposed project.	Concordance table (this document)	
*Note: DFO is currently in receipt of an irrevocable letter of credit; however, an additional letter of credit may be required after final review of the revised *Fisheries Act* authorization application and upon review of results from monitoring studies that are being proposed to inform deferred offsetting requirements associated with this project.	Section 18.0. Appendix O	
Fish Passage		
As previously requested in an email from DFO to Jenny LeBlanc on October 25, 2021, provide information on water management practices for current operations and for proposed operations after the infrastructure is upgraded. Include information on the timing, duration, and mechanism for spilling water at the dam under both existing and proposed operating scenarios.	Section 6.0, Appendix G	
Provide available information on the effectiveness of existing upstream and downstream fish passage at the site for all species that are likely to be migrating in the area. Include more detailed information from the American Eel fish passage study that was conducted in 2010, including further details on the study methods, location where American Eel were released, the number of American Eel that migrated over the dam, the number that were diverted by the lover system, and the number that traveled through the turbines and associated survival with each downstream passage route.	Section 10.1, 12.2.1 Appendix F, G	
Section 14, Table 6, Page 21 states: Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway. Correct the first column in Table 6 to reflect both upstream and downstream fish passage, as both are discussed.	Section 16.0 Table 8	Corrected
NS Power is proposing major refurbishment works for the dam that could influence upstream and downstream fish passage (e.g., changing from surface spill via stop logs to sub-surface spill via vertical lift gates). As stated in Table 6, there will likely be impacts to upstream and downstream fish passage after dam refurbishment works are complete. As noted in emails from DFO to Jenny LeBlanc		

on October 25, 2021 and December 16, 2021, and as discussed on the October 27, 2021 call with DFO and NS Power, fish passage improvements are to be integrated into the dam refurbishment work to ensure compliance with the fish and fish habitat protection provisions of the Fisheries Act, which includes ensuring the free passage of fish. Therefore, submit the following:		
An assessment by a qualified professional on potential impacts to upstream and downstream fish passage for all species that are likely to be migrating in the area associated with the proposed infrastructure design and operations.	Section 12.2, Appendix H	
Describe proposed measures that will be implemented as part of the refurbishment works to avoid, mitigate or offset potentially harmful impacts to fish and fish habitat, including fish passage, associated with the refurbishment and future operation of the Ruth Falls Hydroelectric Development. For avoidance and mitigation measures, ensure to submit the following information and describe how these proposed fish passage measures meet established fish passage design criteria (e.g., USFWS Fish Passage Engineering Design Criteria) to allow DFO to assess whether proposed plans are sufficiently meeting fish passage requirements as per Section 34 of the Fisheries Act:	Section 12, 13, Appendix G,H,I,J	
Provide an upstream fish passage plan for American Eel that includes detailed design drawings, proposed location for fish passage structures and rationale for siting structure(s) in this location, information on proposed operations, and proposed timing of installation.	Section 12.2.3, Appendix D, J	
Provide a downstream fish passage plan for fish species that are likely to be migrating downstream at the site. Submit detailed design drawings, the proposed location of structures and rationale, information on proposed operations, and proposed timing of installation for any new structures required to ensure the free passage of fish at the site. This includes proposed improvements to the louver system.	Section 5.0, 6.0, 12.2.2, Appendix D, H, I	
Describe post-construction monitoring that will be conducted to evaluate whether fish passage structures (upstream and downstream) are meeting the requirements of the Fisheries Act. If this is to be completed in the post-construction monitoring plan to be submitted to DFO by January 1, 2023, then update the January 2022 Supplemental Information document to state this.	Appendix K, Q	Post-construction monitoring plan is provided in section 5.0 of the monitoring plan
Describe the purpose of the pipe which is located immediately below the Ruth Falls Fish ladder, shown in Photo 3 of the Request for Review, submitted by NS Power to the Program on December 2, 2019.	Section 2.0, 5.0,6.1, 10.1,12.0 Appendix B, D, G, I	Downstream bypass pipe is described in the listed sections, and appendices
Construction		
Provide further information on the four day drawdown at Ruth Falls, including whether the discharge below the dam associated with the drawdown would exceed spill conditions at the dam under normal operations, and provide an alternative drawdown scenario for a eight or ten day drawdown, including time (day), beginning elevation (ft), gate opening (ft), discharge (cubic feet per second or cfs), velocity through gate (feet per second or fps), downstream velocity (fps), and whether discharge would exceed spill conditions at the dam under normal operations.	Section 3.1, 3.2, 3.4, 3.5,	NSP is proposing an 8 day drawdown to allow the headpond to lower to 91 ft in a slow and controlled manner

Describe the construction sequence for how the temporary bridge will be constructed.	Section 3.3.1, 13.0 Appendix E	
Describe what materials the temporary bridge and abutments will be constructed with.	Section 3.3, 3.3.1, 3.5, 3.6	
Describe how long the temporary bridge will be in place.	Section 3.3.1, 5.0	
Describe how the temporary bridge will be removed during excessive flow conditions that would be expected from a 1:2 year return storm event.	Section 3.4, 15.0	
Provide an updated Figure 1 – Site Plan Showing Upstream Access Roads and Downstream Access Roads to show the temporary instream footprints for access roads and bridge, as described in the January 2022 Supporting Information (i.e., 2,316 m2), and identify where the bridge is located on this drawing.	Appendix E	
Provide additional details related to the Construction Schedule, including a Gantt chart for the Phase 2 work listed in Section 2.0, page 2. Also, describe if the Phase 1 work (deep stoplog bay replacement with vertical lift gates), under NSECC Approval #2021-2840307-00 and DFO Letter of Advice# 21-HMAR-00478, will overlap with the proposed Phase 2 project components.	Section 5.0	Phase 1 work under NSECC Approval #2021-2840307-00 and DFO Letter of Advice# 21-HMAR-00478 related to the control building is complete and not included as part of this application.
Describe whether generation will occur to dewater the impoundment or during the construction period, and if so, describe how downstream fish passage will be provided during periods of generation to mitigate for turbine mortality.	Section 3.2, 3.4	Generation will only occur to bring the water to the minimum operating level (109.25) if needed. After that generation will not occur until after the project is complete. Downstream fish passage will be provided through the center sluiceway bay during construction.
Monitoring Plan		
Section 3.3, Pages 6-7 states, NS Power has identified areas of potential improvements to the existing louvre system that may effectively improve the efficacy of the louvre system at bypassing eels downstream…NS Power will engage a professional engineering and fish passage consultant to perform an assessment on the existing louvre system and recommend modifications that will look to improve the functionality and effectiveness of bypassing eels around the power canal. The engineering company will be experienced in fish passage design and will evaluate the louvre system based on the effectiveness to by-pass American eel.		
Describe any improvements that have been made to-date, when they were implemented, whether they meet established fish passage design criteria (e.g., USFWS Fish Passage Engineering Design Criteria), and how they will be monitored to assess whether they are providing effective downstream passage for American Eel and other fish species likely to be migrating downstream on the system.	Section 12.2.2, Appendix I	Proposed improvements have not yet been made. Details can be found in the listed section and appendix.

If the identified areas for potential improvements have not been implemented to-date, describe the proposed improvements, when they will be implemented, whether they meet established fish passage design criteria (e.g., USFWS Fish Passage Engineering Design Criteria), and how they will be monitored to assess whether they will provide effective downstream fish passage for American Eel and other fish species likely to be migrating in the area.	Section 12.2.2, Appendix I, K,Q	
Section 4.6.2: Only one habitat characterization transect is proposed for the Ruth Falls Headpond. Please include a minimum of two transects.	Section 3.6.2 of Appendix K	
Wetland and Wetland Fish Habitat Monitoring Plan		
Describe how the results from the six monitored wetlands will be extrapolated to other wetlands that are not being monitored as part of this study to inform offsetting requirements for fish habitat.	Appendix M (on page 3)	
Wetlands can provide both direct and indirect benefits to fish and fish habitat. Describe how wetlands providing indirect benefits to fish habitat will be assessed to determine offsetting requirements.	Appendix M (on page 8)	
Baseline surveys will take place between June 1-September 30, but it is important to note that fish habitat is provided outside of these timelines, and there may be greater habitat as lake levels are expected to rise outside of this proposed timeline. Please confirm that NS Power will use the ordinary high water mark (OHWM) to delineate fish habitat.	Appendix M (on page 5)	
For the assessments, describe the criteria that NS Power will be using to determine if a site is "direct fish habitat", "indirect fish habitat" or "not fish habitat".	Appendix M (on page 6, 8)	
The backshore definition mentions it is considered “not fish habitat”. Describe if field studies will be conducted to confirm if this is accurate and whether indirect benefits to fish habitat are being considered in the backshore.	Appendix M (on page 8)	
Describe how NS Power will determine the duration of impacts to wetlands deemed to be fish habitat to inform offsetting requirements for this project (e.g., describe how long will it take for wetlands impacted by the drawdown to re-establish to their full fish habitat functions). If this is to be part of the post-construction monitoring to be submitted later, state that in the plan.	Appendix K (section 3.7.1)	NSP will conduct post-monitoring to evaluate the impacts caused by the drawdown of the headpond. Results of the monitoring will identify if negative impacts were caused and how long it takes for the wetlands to re-establish to their full fish habitat function therefore informing offsetting requirements.
Fish Entrainment Monitoring Program		
Describe the methods that will be used to estimate the number of fish that have been entrained downstream as a result of the drawdown (i.e., how the Rotary Screw Trap catch data will be used to estimate the abundance of different species of fish that moved downstream as a result of the drawdown) and provide equations describing how this will be calculated.	Appendix L (page 6)	

Describe how the sampling equipment will be modified or moved if low catches (including recaptures) occurs as a result of poor placement of the sampling equipment or changing water levels.	Appendix L (page 8)	If low catch occurs, the equipment can be moved to alternative location
Describe how NS Power will monitor catch data and adjust sampling times to avoid fish mortality in the sampling gear (e.g., if large numbers of Gaspereau migrate downstream at night).	Appendix L (page 7)	
Section 4.0, Entrainment Monitoring states results of the 2022 fish entrainment study will be prepared for NS Power and submitted by December 30, 2021. This is a typo and should be changed to December 31, 2022.	Appendix K (Section 3.8)	Corrected to December 31, 2025
Section 4.6.1, Appendix F, Monitoring Plan of the January 2022 submission states that drone surveys will be conducted in early July, no later than one week after the desired drawdown elevation is reached, and again in November after the growing season. Add the November survey to Section 5.0 of the entrainment study to be consistent with the Section 3.3 of the entrainment study, and Section 4.6.1 of the above January 2022 Monitoring Plan.	Appendix K (Section 3.3)	Corrected updated plan

NOVA SCOTIA POWER INCORPORATED

SUPPORTING INFORMATION – APPLICATION FOR AUTHORIZATION - *FISHERIES ACT* –
RUTH FALLS DAM REFURBISHMENT
SHEET HARBOUR HYDRO SYSTEM

July 2023

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1.0 CONTACT INFORMATION

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2.0 PROJECT OVERVIEW

NS Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2024. This work is necessary to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the spillway/sluiceway structures. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, two short concrete gravity bulkhead sections that abut either side of the spillway. There is currently a 15.2 m (50') long three-bay stoplog-controlled sluiceway section in the centre of the dam. The crest elevation of the spillway is 31.7 m (104') and stoplogs can be installed to an elevation of 33.3 m (109.3'). The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the power canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix A for mapping of the Sheet Harbour Hydro System and Appendix B for site photos.

NS Power has provided several iterations of the Ruth Falls Dam Refurbishment Project Fisheries Act Authorization Application (19-HMAR-00549) to DFO since the first request for review in December 2019. The scope and timeline of the project has been adjusted several times with a separate approval received for the refurbishment of the sluiceway/installation of the vertical lift gates and control building in advance of the main dam refurbishment under NSECC approval (and DFO Letter of Advice) 2021-2840307-00 in October of 2021. In 2022, NS Power made the decision to proceed with aspects of approval 2021-2840307-00 in June 2022, but not the sluiceway refurbishment. An amended approval was received in September 2022 (2021-2840307-01) excluding the sluiceway refurbishment/vertical lift gate scope, to complete the scope associated with the new control building. NS Power has provided a timeline of the regulatory process below:

Main Dam Refurbishment Application 19-HMAR-00549
NS Power Request for Review Submission December 2, 2019
DFO Request for Additional Information Received January 9, 2020
NS Power Additional Information Request Submission February 27, 2020
DFO Authorization Required Letter Received March 13, 2020
NS Power Initial FAO Application Submission June 24, 2020
DFO Incomplete Letter Received August 4, 2020

NS Power Updated Submission May 8, 2021
DFO Acknowledgement of Additional Information Received May 20, 2021
DFO Incomplete Letter Received July 8, 2021
NS Power Updated Submission January 21, 2022
DFO Incomplete Letter Received May 5, 2022
NS Power Update Letter Submission May 16, 2022

Vertical Lift Gate / Control Building Approval: NSECC Approval 2021-2840307-00
NS Power Initial Submission July 12, 2021
NSECC / DFO Letter of Advice Approval Received October 22, 2021
NS Power Amendment Submission July 11, 2022
NSECC Amended Approval Received September 5, 2022

Previous applications as noted above reference construction taking place in a phased approach, with phase I including new control building with Ruth Headpond at normal operating levels, and phase II including a drawdown of Ruth Headpond and refurbishment of the remaining dam structure. Phasing of construction is no longer required for the purposes of this application (2019-2638165-00). Work related to the control building was completed in 2022 under approval Approval 2021-2840307-00), which has been closed.

This document provides an updated project and environmental description to support NS Power's Fisheries Act Authorization 19-HMAR-00549 for the Project and supersedes previous iterations submitted to DFO. The information in this document is intended to address DFO's most recent incomplete letter, issued to NS Power on May 5, 2022. This project and environmental description is also intended to address all questions and information requests previously directed to NS Power in incomplete letters issued by DFO for application 19-HMAR-00549 as outlined above. Therefore, NS Power assumes that all previous incomplete letters are no longer relevant, and any remaining questions or information requests directed to NS Power through a new incomplete letter, if required.

Further, NS Power assumes that, given the information in this document has been provided to DFO several times and DFO has had adequate time to review and request additional information (as demonstrated through several incomplete letters for this application), that any further information requests will be pertaining only to new information that has not been previously reviewed by DFO.

3.0 DESCRIPTION OF PROPOSED WORK, UNDERTAKING OR ACTIVITY

3.1 Construction Activities

The project involves the replacement of the existing 30 stoplog bays with seven (7) rubber dams, the replacement of the three (3) deep stoplog bays with vertical lift gates, the construction of a free overflow spillway at the northwest end of the dam and refacing the concrete on the crest and downstream slope of the main dam ogee section. In conjunction with main dam refurbishments, improvements will be made to the upstream fishway, and downstream louvre system to make it more suitable for all fish species migrating around the dam to complete their lifecycle. The addition of an upstream eel pass will also be installed to support specific upstream passage for eels.

The Project is scheduled to take approximately 9 months to complete starting with the installation of the downstream access roads and temporary bridge in early July 2024. After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid July 2024. A new control building was constructed in the summer of 2022 under Approval 2021-2840307-00. This building is in place to support the new rubber dam system proposed as part of this application. The proposed construction activities are listed below:

Main Dam construction:

- Installation of downstream access road and temporary bridge (to start prior to drawdown activities) Downstream access roads will need to be in place in order to access the right side of the dam
- Lowering of Ruth Falls Headpond approximately 18 ft.
- Dewatering of the Ruth Falls fishladder and canal and fish rescue
- Installation of temporary access for machinery on the upstream side of the dam – access from the right side and the left side. The area in front of the sluiceway bays will remain open to allow water to pass through.
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
- Removal of the existing stoplogs from stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Improvements to the upstream fishway.
- Improvements to the existing downstream louvre system.
- Installation of an upstream eel ramp.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation.
- Contractor Demobilization from site.

Following the completion of construction, discharge flows from the dam will not be changed or altered as a result of the Project. Operations will resume as normal once the headpond is back to within its normal operating levels.

As indicated above, construction works would begin in July 2024 and include the removal of the railings, log lifter and tracks, the demolition of the existing concrete deck, concrete piers, and chipping of the spillway crest and downstream face. Following the demolition, the spillway sections will be fitted with rebar, rubber dam piping and will be refaced with concrete on the crest and downstream slope of the spillway ogee section. New concrete piers will also be constructed between the rubber dams. Once the concrete has been resurfaced, the rubber dams will be installed and connected to the controls building which will has already been installed under Approval 2021-2840307-00. The concrete retaining wall at the

right end of the dam will also be replaced as part of the construction works. NS Power is anticipating an additional permanent instream footprint of approximately 60 m^2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete; however, changes will be made to improve the efficiency of the fishway – these changes include the addition of weirs, and adjustments to existing weir and notch sizing.

Construction materials include; the rubber dam bladders and all associated parts and materials, concrete for free overflow spillway section, right retaining wall, piers, headwalls, and ogee refacing, the vertical slide gates, steel walkways and railings, and the components for the new control building. A list of other products to be used by the contractor will be submitted to NS Power prior to start of work for approval based on health, safety, and environmental parameters.

3.2 Drawdown

The reservoir will be temporarily drawn down approximately 18 feet, which serves as the primary method of isolating the existing dam structure for refurbishment activities. During the time the water is drawn down, the intent is to provide free passage of fish through the center sluice gate during construction as the canal and fish ladder will also be dewatered. The exception to this is when the center sluice gate will be under construction, which we anticipate to be 3-4 weeks during which time the water will be directed through either the west or east bay.

In an effort to provide the safest and most reliable construction execution during one drawdown period, lowering the reservoir to elevation 91 ft is required. A construction elevation of 91 ft (approximately 18 ft below minimum operating level of 109.25 ft) allows for the portions of the concrete dam to be refurbished to be fully exposed. The canal, fishladder, and downstream bypass will be dewatered and a fish rescue completed by qualified staff. The drawdown to 91 ft represents a difference in storage of approximately 2.295M cubic meters or 1884-acre-ft from full supply (2.3M m3 and 1888 acre-ft, respectively).

To complete the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 33.7 m (110.5 ft) (if required) to the minimum operating level of 33.3 m (109.25 ft). Once the headpond reaches an elevation of 33.3 m (109.25 ft) – the top of the spillway stoplogs - the drawdown will be controlled by removing the spillway stoplogs until an elevation of 31.7 m (104.1 ft) - the concrete spillway crest - is reached. After this point, the sluiceway bay stop logs will removed be until the desired elevation of 27.7 m (91 ft) is achieved. The drawdown flow will be directed through areas that are part of the normal flowage channels. At least one gate will remain open throughout construction to maintain lowered water elevations and provide a method of fish passage. Once the drawdown has reached 109.23 ft and the desired elevation of 27.7 m (91 ft) is reached) the Ruth Falls generating units will be non-operational until construction is complete and the headpond is recharged.

Table 1 displays the decrease in flow velocities as the headpond elevation lowers over the course of the 8-day drawdown period.

Table 1: Estimated Flow and Velocities for an 8-day drawdown of Ruth Falls Heapond

Time (day)	Beginning Elevation (ft)	Bays 1-15	Bays 16-30	Outer Sluice	Middle Sluice Opening (ft)	Total Discharge (cfs)	Velocity through each bay (fps)	Downstream Velocity (fps)
0	109.2	1	0	0	0	159	2.1	6.6
0.5	109.1	1	1	1	1	281	2.0	8.5
1	108.1	2	1	1	1	102	1.8	5.7
1.5	107.6	2	2	2	2	93	1.4	5.4
2	107.4	3	2	2	2	189	2.2	8.6
2.5	106.6	3	3	3	3	91	1.4	5.4
3	106.4	4	3	3	3	190	2.3	8.6
3.5	105.6	4	4	4	4	91	1.4	5.4
4	105.4	5	4	4	4	190	2.3	8.6
4.5	104.6	5	5	5	5	91	1.4	5.4
5	104.5	5	5	7	7	99	3.1	5.7
5.5	103.7	5	5	9	9	187	3.8	8.6
6	102.2	5	5	11	11	244	4.2	8.1
6.5	100.3	5	5	13	13	258	4.3	8.3
7	96.2	5	5	15	15	90	3.0	5.4
7.5	94.2	5	5	15	17	30	1.0	3.4
8	93.1	5	5	15	19	51	3.6	4.2
8.5	91.0	5	5	15	19			

The flow downstream will be controlled in order to avoid scour and sedimentation. The 35 cfs maintenance flow and downstream fish passage will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation to maintain flow. NS Power may not be able to provide the entire 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumps. Qualified NS Power personnel will be on site during the drawdown to monitor water quality (visual observations) and conduct a fish rescue for any isolated fish in the headpond and canal. Once the headpond level reaches 91 ft most of the canal will be dewatered. NS Power will drain the remaining water using the drain valve at the powerhouse. Following the completion of refurbishment activities, the headpond will be subsequently recharged at a controlled rate.

3.3 Temporary Structures

Prior to the drawdown taking place, a temporary rockfill downstream access road will be constructed using clean rock that is free of fines with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes. The downstream access road will be equipped with a temporary bridge that will be located over the spillway discharge channel (refer to Appendix E - Proposed Water Management Structures). The left downstream access road will be 351 ft (107 m) long while the right downstream access road will be 229 ft (78 m) long. The estimated temporary instream footprint of the left downstream access road is 10,530 ft^2 (978 m^2) while the right downstream access road is 6,870 ft^2 (638 m^2).

The temporary bridge will be approximately 4 ft tall, 42 ft long and 13 ft wide, and will be constructed to pass upwards of 3200 cfs (refer to Table 2 for details). The bridge will be constructed using steel beams that are removable using an excavator should additional if required if a large rain event is anticipated (refer to section 4.4). Ice build-up is not anticipated on the temporary access road as the water will be constantly flowing downstream. Excavators will be using the access roads on a continual basis during construction which will break up any ice that could accumulate. If significant ice accumulation was to occur, the ice could be removed physically by the contractor.

Following the completion of the drawdown to elevation 91 ft, two rockfill access roads will be constructed on the upstream side of the dam; one extending from the left abutment to the left end of the sluiceway, and one extending from the right abutment to the right end of the sluiceway. The access roads will be constructed to elevation 100.0 30.5 m) with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes using clean rock material that is free of fines. The left upstream access road will be 341 ft (104 m) long while the right upstream access road will be 223 ft (68 m) long. The estimated temporary instream footprint of the left access road is 10,230 ft^2 (950 m^2) while the right access road is 6,690 ft^2 (621 m^2). Using available bathymetry, approximately 74% of the upstream access road will be placed in the dry at an elevation of 91.0 ft. The upstream access roads will serve primarily to provide access for machinery to complete refurbishment activities. It should be noted that there are no cofferdams being constructed on the construction site that are required to hold back water; there is no requirement for construction to take place behind cofferdams, or to isolate work areas. Temporary access roads are being constructed of clean rockfill, and water will be allowed to equalize between the dam structure and roads.

All access roads will be developed to meet industry standards. This includes adhering to required crest width and height to accommodate machinery. The access roads are built to be held in place until removed and therefore, are capable of withstanding all four seasons changing weather and precipitation conditions. The access roads pose very low risk to the project and the environment. During construction the water will flow downstream through the sluiceway bay and under the temporary bridge, see Appendix E- Proposed Water Management Structures for more details.

3.3.1 Bridge Construction and Removal

Construction of the downstream bridge will take place in early July in advance of the drawdown. Construction will begin with the installation of the east downstream access road and placement of the east and west jersey barrier. Next, the contractor will use the east access road to drive across in order to place the 42 ft bridge upon the jersey barriers. Once the bridge is secured and in place – the contractor will drive across the bridge to transport rock material to build out the west side access road to meet up with the west shoreline. Once in place, the downstream access roads and bridge will allow for access to the west side of the site. Similar to other temporary structures used to support construction, the bridge

and downstream access roads will remain in place for the duration of construction (9 months). The removal of the downstream access (roads and bridge) will be the last temporary structures to be removed as all equipment and the west upstream access road will need to be removed prior to taking this out. The bridge will be removed in the opposite direction as it was installed. This would include the removal of the west side access road material, west jersey barrier, removal of bridge with excavator, and finally the removal of the east jersey barrier and access road.

3.4 Water Management

Once construction begins, the sluiceway bays at the centre of the dam will be worked on first as they act as the primary means of water management, with the deepest bay in the centre of the structure constructed during expected low flow periods (July and August). The sill elevation of the middle sluice gate is 90.1 ft, whereas the sill elevation of the outer two gates is 94.1 ft. Therefore, at a headpond level lower than 94.1 ft, only the middle vertical lift gate deep sluice bay will be available to discharge flows. To keep the centre bay as dry as possible during the four-week period needed to complete the work, a steel barrier will be placed in the notches of the sluiceway bay to divert water (which will then be pumped through the other sluiceway bays via pumps). During construction of the centre bay/gate, upstream fish passage may be temporarily affected as passage is not possible through the higher outer bays unless the headpond elevation was to rise to 94.1ft. Once the centre sluice bay/gate is completed, this bay will be used as the primary method of managing water through the construction site while the remaining outer bays are constructed. Once the entire sluiceway is operational, all three bays will be used to manage water. To manage a wider range of fluctuation caused by heavier precipitation which could occur during the drawdown, water will be passed through the open bay 8, where the new uncontrolled spillway is to be constructed. Existing concrete in bay 8 will be demolished to elevation 98 ft, and will be left open until the new uncontrolled spillway will be constructed toward the end of the construction window. Armour stone will be placed on the upstream side of the right downstream access road to reinforce the road from the impact of spill from bay 8, should water levels rise to above 98 ft. It is important to note that the headpond would need to rise by 7 ft (91 ft-98 ft) before the spillway would be available for passing water. The estimated discharge flows through the open sluice bays, bay 8 uncontrolled spillway opening, and the bridge opening are shown in Table 2 below.

Table 2 : Estimated Discharge Availability During Construction

Reservoir El.	91 ft	93 ft	95 ft	97 ft	99 ft	100 ft	101 ft	103 ft	104 ft
Outer Gate 1	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Outer Gate 2	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Middle Gate	35 cfs	180 cfs	390 cfs	650 cfs	940 cfs	1100 cfs	1270 cfs	1630 cfs	2025 cfs
Total Gate Discharge	**35 cfs**	**180 cfs**	**460 cfs**	**1010 cfs**	**1720 cfs**	**2120 cfs**	**2570 cfs**	**3510 cfs**	**4565 cfs**
Spillway (Crest – El 98ft)	**N/A**	**N/A**	**N/A**	**N/A**	**125 cfs**	**355 cfs**	**650 cfs**	**1400 cfs**	**840 cfs**

Total Discharge	35 cfs	180 cfs	460 cfs	1010 cfs	1845 cfs	2475 cfs	3220 cfs	4910 cfs	6405 cfs
Depth Under Bridge	0.2 ft	0.6 ft	1.1 ft	1.8 ft	2.5 ft	31. ft	**3.7 ft**	4.8 ft	4.6 ft

The two outer gates are identical in their dimensions; therefore, yield the same outflows. All gates were considered to be fully open for the purpose of these calculations. The spillway crest sits at 98ft, therefore will act as a contingency for passing additional flows.

It is expected that at a minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, water from intermittent precipitation events as well as required maintenance flows and spill over the Malay Falls rubber dams would be managed through the construction site which will result in water level fluctuations in Ruth Falls Headpond throughout construction. During the construction period, the Ruth Falls generating units will not be used. Temporary upstream access roads on the upstream side of the dam will be designed to an elevation of 100 ft. This allows for approximately 9 ft of water level fluctuation within the headpond during construction before the access roads would be submerged. The access roads will be constructed using clean rock free of fines. The roads are not intended to hold back water and it is expected that in the event of increased water elevations, work will be able to continue until the top of the access roads is reached (100 ft).

NS Power believes that by having 9 ft of headpond capacity available that work crews will have sufficient time to plan and remove any necessary equipment should the forecast warrant such planning. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. Refer to Section 3.5 - Contingency planning for more details.

It is also important to note that even with the new sluiceway and vertical lift gates under construction, NS Power still has the ability to use the open gate bays to pass water if an extreme precipitation event is forecasted. The scope of the sluiceway refurbishment includes only pepping the concrete bays for installation of the new vertical lift gates. Work on the sluiceway can be halted quickly and the bays stabilized to prepare for passage of water as required. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power's Construction Project Management and Hydro System Superintendent.

Fish will have the ability to move downstream and upstream through the sluice bay during construction, with the exception of when the centre sluice bay gate is under construction. The passive opening under the bridge will allow fish to move freely downstream. It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will be maintained throughout construction with the exception of the approximately 4 week window where the centre sluicebay is under construction, during which time water will be pumped around the centre bay construction area (through the outer sluiceway). A six inch pump will be used to discharge the flow through one of the other sluiceway bays. During construction of the centre gate, should inflows result in water levels to increase, the outer sluice bays will be operational once elevations reach 94.1 ft. At elevation 95 ft, the outer sluice bays can pass a total of 70 cfs, and up to 780

cfs if water levels were to raise to 99 ft. There would be no negative impacts to the passage of water during all scenarios.

Nova Scotia Environment (NSECC) operating approval 2008-062826-01 stipulates annual environmental requirements associated with operations at Ruth Falls as follows:

- Year round: 35 cfs maintenance flow downstream of dam;
- April 1 – November 30: 6 cfs of 35 cfs maintenance flow provided to the fish ladder, 29 cfs provided to operate the louvers;
- April 1 – November 30: Minimum operating level of 33.3 m (109.4 ft.);
- May 15 – November 30: operation of the fish trap;
- Supplemental flows required June 15 – July 15 and September 26 – November 30 annually.

The required 35 cfs maintenance flow will be provided throughout construction via the sluiceway as required – this will also provide downstream fish passage during construction. The remaining conditions will not be met, which will be addressed through a request for variance from the operating approval.

The approval also stipulates requirements for Marshall Falls (minimum elevation of 191.4' Apr 1 – Sept 1 and a year-round 45 cfs flow downstream of the dam). NS Power will maintain the 45 cfs flow release downstream of Marshall Falls via the Marshall Falls control gates. NS Power is requesting flexibility to the 191.4' elevation while remaining within normal operating levels to reduce uncontrolled spill in Malay Falls (downstream system of Marshall Falls) and eventually Ruth Falls during construction.

3.5 Contingency Planning

The hydrological information provided below references the Sheet Harbour system flood study, which was completed as part of NS Power's dam safety program in addition to the system dam safety reviews. Figure 1 below displays the Elevation – Storage Curve for Ruth Falls from Hatch's 2008 Flood Study.

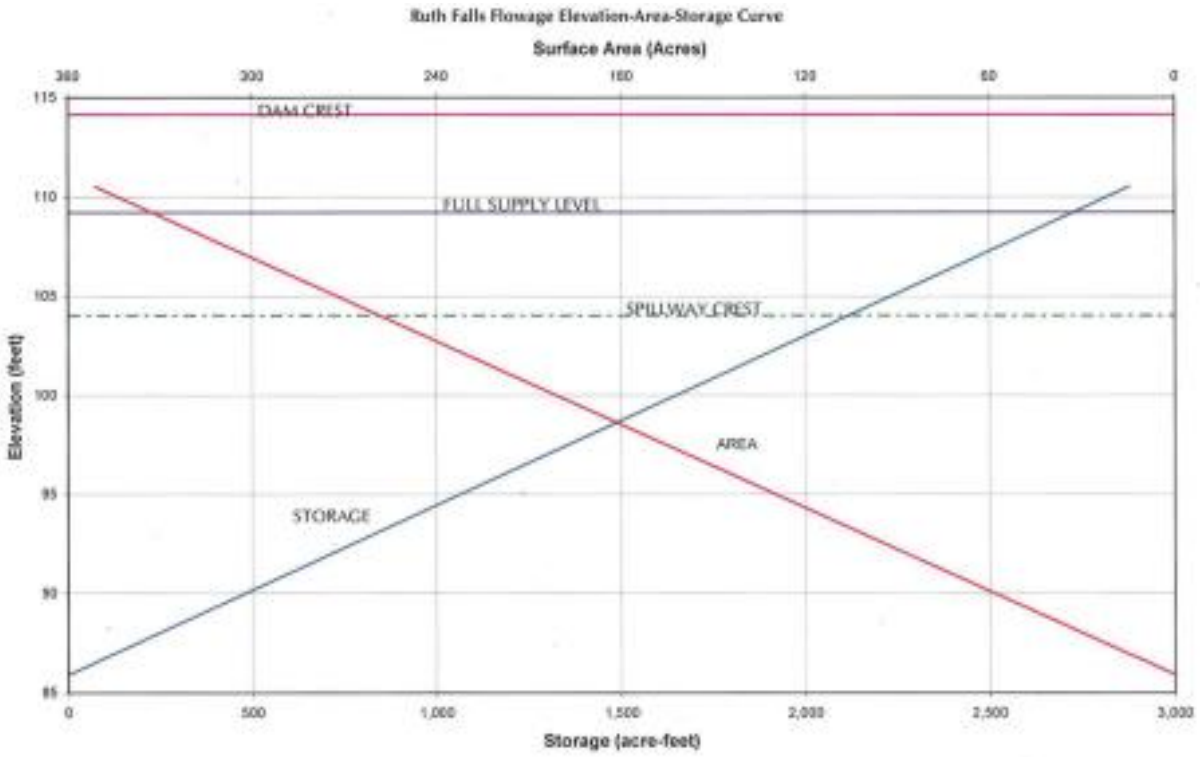


Figure 1: Elevation Storage Curve for Ruth Falls

The storage curve above indicates that there is 1150 Aft of available storage between El 100 (the crest of the upstream access road) and the middle (El 90) sluice, and 600 Aft of live storage between El 100 (the crest of the upstream access road) and the outer (El 94) sluices. This storage availability provides NS Power with sufficient time to remove construction equipment should water levels continue to rise after the headpond has been brought down to 91 ft.

The maximum mean annual flows for the Ruth Falls headpond was calculated using the 2008 Sheet Harbour Hydro System Flood Study. The discharge values were calculated using a 24-hour sub basin unit hydrograph for the Sheet Harbour hydro system and the 24-hour duration rainfall from Atmospheric Environmental Service, Rainfall Intensity-Duration Frequency Values for Shearwater Airport. Figures are presented in Table 3 below.

Table 3: Mean Annual Flood for the East River

Return period (years)	Maximum Mean Flow (cfs)
2	3,582
5	4,702
10	5,485
50	7,053
100	7,836

The maximum mean flows outlined in Table 6 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond. The water management plan for the Project has considered the ability to pass discharge associated with the mean annual floods for the East River associated with a 1:10 return period (equivalent to approximately 5,485 cfs). It is important to note that the gates and spillway are capable of passing approximately 6405 cfs if the headpond was to reach an elevation of 104 ft, this is just below the threshold a 1:50 return event. Contingency measures have been considered below for precipitation events that may occur resulting in higher discharge associated with a 1:10 return period event.

The following list outlines the sequence of events associated with increasing headpond elevations:

- At elevation 91 ft, the centre sluice bay can pass 35 cfs without any water level fluctuation. If water was to rise to an elevation of 94.1 the outside sluiceways would come into operation and the three bays would be capable of passing approximately 320 cfs.
- Between 94 ft and 97 ft, water would continue to pass through all three gates - discharging approximately 1010 cfs once 97 ft is reached.
- Once an elevation of 98 ft is reached, the concrete spillway (which will be prepped for construction of the new uncontrolled spillway section during the last phase of construction) will be available for passing additional water in addition to the three gates. At 99 ft, the gates and the spillway will be capable of discharging approximately 1845 cfs. The right downstream access road will be reinforced on the upstream side using large riprap to withstand any incoming spill from the spillway should this occur.
- At a headpond elevation of 100 ft, the top of the upstream access roads will begin to become submerged. Any machinery will need to be moved in advance of this; however, the access roads will be built to tolerate submersion. At this point, approximately 2475 cfs will be passing through the gates and the spillway. At 101 ft, it is anticipated that the water will be approaching the underside of the downstream bridge (water coming up to approximately 3.7 ft under a 4 ft bridge). At this point, the bridge will be removed using an excavator on site. This type of removal is expected to take approximately 4 hours.
- Once an elevation of 104 ft is reached, the gates and spillway will be discharging approximately 6405 cfs combined. The crest of the ogee section of the dam is situated at 104 ft. This discharge exceeds a 1:10 year return period for mean annual flows. Refer to Table 2 for more details.

NS Power operations and the contractor will be monitoring the water inflows and discharges throughout the construction activities and will be able to adjust to the changing conditions, as required, to ensure that the headpond levels are managed accordingly. Temporary upstream access roads will be installed to withstand a rise in the headpond to elevation 100 ft. The access rocks will be constructed using large rock free of fines making it permeable and able to pass water through without becoming compromised. At 101 ft the temporary bridge would need to be removed. Once elevations hit 104 ft, the water would begin to overtop the ogee section of the spillway causing work to halt until water levels recede. This is not anticipated to occur during the construction period as this would be approaching a 1:50 return period event.

Should high return period rain events (i.e. 1:10 year return period) be received during construction activities, the Ruth Falls Headpond can withstand an increase in water elevation to 104 ft, based on the discharge capacity of the sluice bays, spillway opening, and expected inflows during a 1:10 return period event (Table 3 – approximately 4,468 cfs). With all three sluice bays available and the spillway also passing water, approximately 6405 cfs can be passed at an elevation of 104 ft, (Table 2) During such an event, NS Power and the contractor would plan to shut down all construction activities. Keeping in mind that the reservoir would already be drawn down, inflows would be able to attenuate in the reservoir, essentially raising the level of the reservoir over time from 91 ft to 104 ft (13 ft differential). If extreme heavy rain or significant sustained flows are forecasted, which could result in water levels to exceed the 100 ft elevation, the construction infrastructure that can be quickly removed to meet the sluiceway width capacity are:

- The temporary work platforms and construction materials supporting gate installation
- The installed vertical gates if they are not fully operational at the time of the event
- The removal of temporary bridge
- Removal of any temporary formwork supporting the construction of the uncontrolled spillway section.

During the construction of bay 8, the uncontrolled spillway section, water management will be achieved using the operational sluiceway. If a high return period event is forecasted while the spillway is under construction, which would cause headpond elevations to rise above 98 ft work associated with the installation of the new spillway section would be paused until water levels recede. Concrete pouring will only proceed if no significant rainfall is forecasted.

The upstream access roads will be constructed in a manner as to not impact the discharge capacity of the sluiceway. Both upstream and downstream temporary access roads will be constructed with large rock material properly sloped, to safely flood and overtop if a return period event of high water levels are received. The temporary access roads will be constructed with clean rockfill material and no easily erodible material (such as clay, sandbags, filter fabric, plastic liner) will be used because there is no need for the access paths to hold back water (access roads are not cofferdams) If in the event migration of material is observed, the associated risk of sedimentation or debris being deposited downstream is extremely low. NS Power will assess the access road material migration once water levels have receded and develop plans for material removal in coordination with NSECC and DFO, if required.

3.6 Erosion and Sedimental Control Plan

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NS Power personnel monitoring for any visible water quality issues. NS Power is not anticipating any issues with erosion or scour when passing

the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. Bi-annual inspections and weekly checks are conducted downstream of the Ruth Falls Dam. Observations during the inspections and checks indicate that scour is not of concern when spilling in excess of 500 cfs.

NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

All access road material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined in Section 4.

There will be some excavation of the right (west) abutment retaining wall that is scheduled for removal and replacement. During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry and silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas, as required. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the dam and the other is located north east of the dam, see Figure 2 below. Both areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.

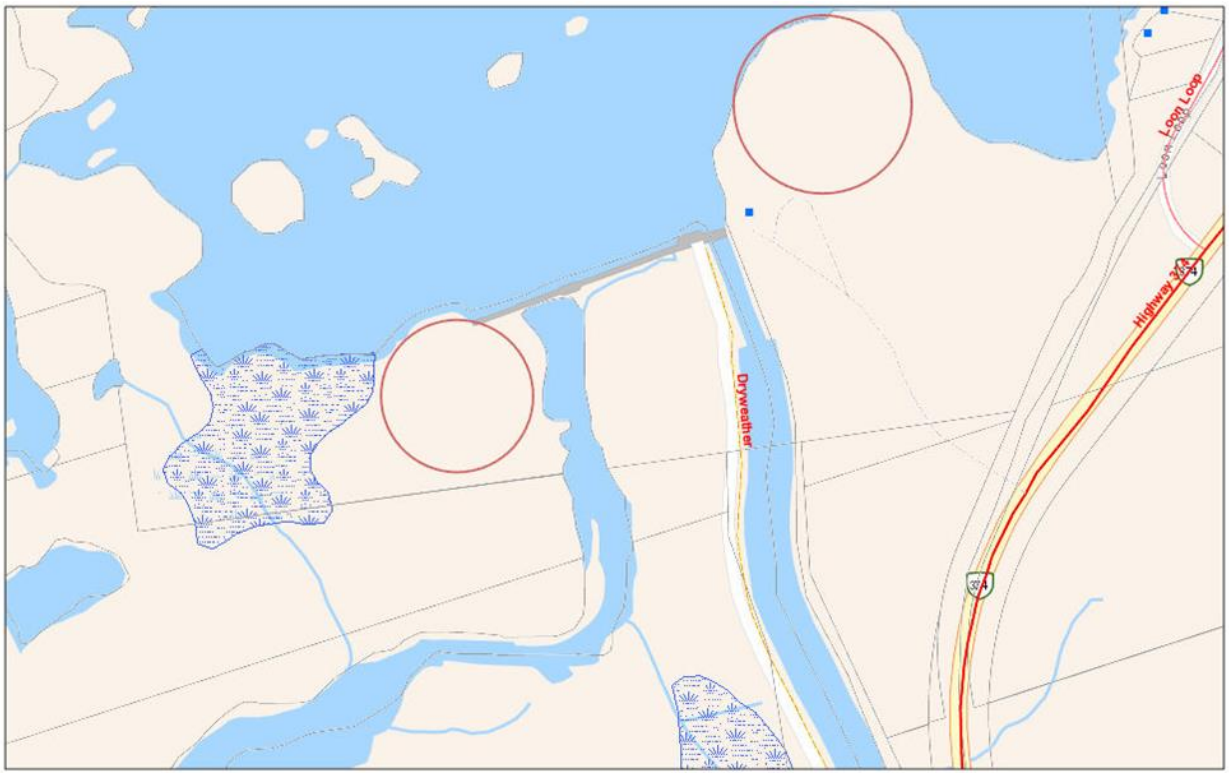


Figure 2: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2024.

The removal of access road material will take place with Ruth Falls Headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring.

The selected contractor for the Project will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1 – September 30) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of access road sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power will also require the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This will allow NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

4.0 ENGINEERING SPECIFICATIONS

Engineering drawings for the proposed work main dam refurbishments are provided in Appendix C. Engineer drawings related to improvements to upstream / downstream fish passage (fishway, louvre system and the proposed eel ramp) are provided in Appendix D.

5.0 CONSTRUCTION SCHEDULE

The Project is scheduled to take approximately 9 months to complete starting with the installation of the downstream access roads and temporary bridge in early July 2024. After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid July 2024. The work includes both the lowering and subsequent recharging of water in the headpond. The water level will be drawn down after July 10th, allowing time for fish eggs to hatch, and YoY Gaspereau to move downstream naturally or transported during fish rescue. Lowering the reservoir will occur after July 10th, and will take approximately 8 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the level of entrainment of fish is low.
The construction schedule is as follows:

- Installation of the downstream access roads and temporary bridge will commence two weeks prior to the start of the drawdown. This work is intended to be completed prior to the drawdown in preparation for main dam construction work to take place in mid-July after the lowering of Ruth Falls Headpond. Access to the right side of the dam will be provided by the downstream access roads connected by the temporary bridge.
- Construction activities associated with the sluiceway, main dam refurbishment, and improvements to fish passage will commence in mid-July after the lowering of Ruth falls headpond. The lowering of the Ruth Falls Headpond will commence no earlier than July 10th 2024 and will take place over the course of 8 days.
- After the water is at an elevation of 91 ft, construction activities will then begin with the installation of the upstream access roads. Once access is installed on the upstream side, demolition of the west retaining wall and removal of stoplogs, bay prep and installation of vertical lift gates will take place. NS Power will aim to complete the new sluice gates first in the low flow window of July-September. It is anticipated that each gate bay will take approximately 3-4 weeks to complete, and a total of 9-12 weeks to complete the entire sluice structure. This may be affected by weather should heavy inflows be required to be passed for a significant period of time.
- Next, refacing of the crest and downstream side of the dam including chipping, rebar, form work and dowels will take place. Improvements to the upstream fishway, concrete works on bay 1-8 and pier 1-9, and rubber dam installation will take place simultaneously.
- Relocation of the bypass pipe, installation of handrails, improvements to the louvre system and installation of the eel ramp will take place between October and December followed by the rubberdam commissioning / control set up and construction of the overflow spillway on the western side.
- Once all main construction works are complete – the contractor will remove the upstream access roads followed by the downstream access roads including the temporary bridge. The watering up of the Ruth Falls headpond is expected to take one day which will be complete by April 1, 2025.

Removal of all applicable environmental controls and final site clean-up will take place over the following weeks.

NS Power has developed a Gantt chart which outlines the detailed work schedule. Please note that the schedule may not be followed exactly as indicated and is subject to change. Refer to Figure 3 – Construction Sequencing Gantt Chart for full details.

ID	Task Name
1	Ruth Falls Dam Refurb Construction 2024-25
2	Mobilization
3	Existing Road Upgrades
4	Downstream Access Road Construction & Bridge Installation
5	Drawdown - Including Lowering of Ruth Falls Headpond approx 18ft
6	Waterdown of Ruth Falls Headpond, Fish Ladder, and Powerhouse Canal
7	Upstream Access Road Construction & Installation of temporary machinery
8	Retainning Wall demolition (West Side)
9	Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
10	Reface the concrete on the crest and downstream slope of the spillway ogee sections, Sluice Gates & Deck - (Chipping, Formwork, Rebar, Dowels)
11	Improvements to the upstream fishway
12	Concrete Works - Bay 1-8, Pier 1-9 - Formwork, Rebar, etc
13	Rubber Dam Installations, inbedded parts, piping and flanges
14	Relocation of Bypass pipe
15	Steel Walkway and Handrails Installations Bay 1-2
16	Improvements to the existing downstream louvre system
17	Steel Walkway and Handrails Installations Bay 3-4
18	Installation of an upstream eel ramp
19	Steel Walkway and Handrails Installations Bay 5-7
20	Full Rubber Dam Commissioning & Control Setup
21	Construction of a free overflow spillway section at the right end of the dam
22	Upstream Access Road Removal
23	Downstream Access Road Removal
24	Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation
25	Removal of Environmental Controls
26	Final Site Cleanup

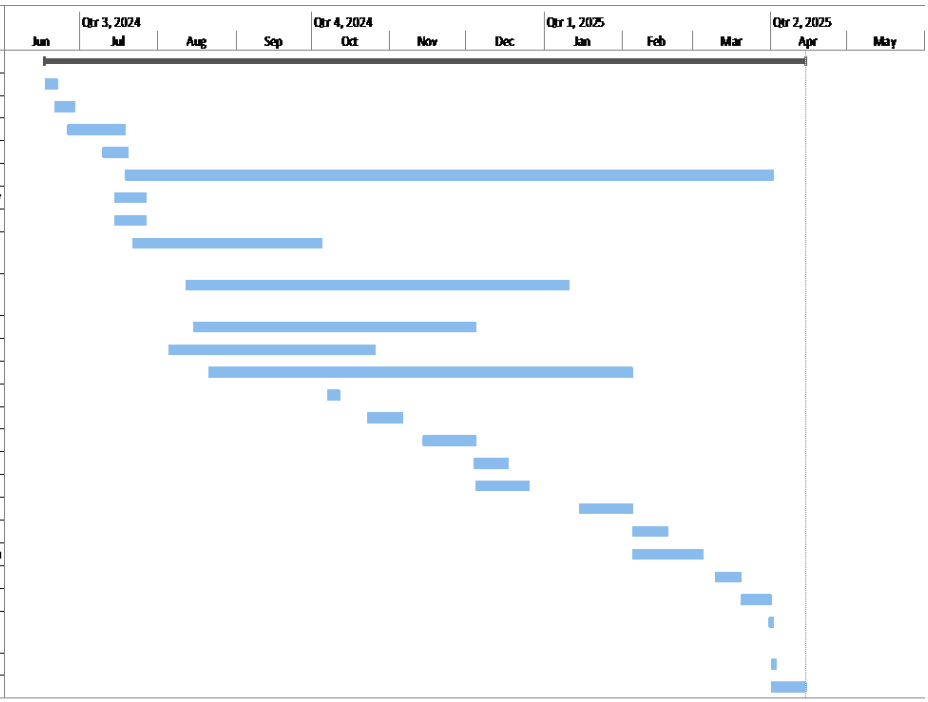


Figure 3 – Construction Sequencing Gantt Chart

To accomplish this scope and construction schedule, NS Power is requesting that the authorization, if received, permits instream work to December 31, 20223

6.0 CURRENT AND PROPOSED FACILITY OPERATION

In order to achieve improved water management capabilities at the Ruth Falls dam, the proposed refurbishment will include the installation of three new vertical lift gates in place of the existing stoplog controlled sluiceway bays. It will also include the replacement of the stoplog controlled overflow spillway section with rubber dam sections. In addition to the changes to the water control structures, NS Power is also proposing changes to the existing fish passage structures to support improved passage for species migrating beyond the dam. These changes include adjustments to the fishway, louvre system, and installation of a new eel ramp. As such, there will be some change in operation of the dam post-construction compared to existing operations.

6.1 Regular Operations

Inflows into the Ruth falls reservoir are controlled by NS Power Hydro Operations. Water levels can fluctuate between the full supply level of 33.7 m (110.5'), minimum supply level of 33.3 m (109.25'), and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.25') is observed from April 1 - Nov. 30 each year. As per the Sheet Harbour system Water Approval, a 35 cfs maintenance flow is provided downstream year-round in order to operate the Ruth Falls louvers and fish ladder. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers which is released downstream of the dam through a bypass pipe. Supplemental flows (simulating large rain events) are also provided annually from June 15 – July 15 and September 26 – November 30. Leakage through the stoplogs and sluiceway bay frames is something that occurs but is not accounted for as part of required maintenance flows. It is expected that the leakage accounts for approximately 65 cfs being released from the dam. When added to the required fish ladder (6 cfs) and louvre / bypass (29 cfs). It is estimated that 100 cfs is currently being released.

After refurbishments have taken place, NS Power will maintain the 35 cfs maintenance flow through the fish ladder and louvre / by-pass pipe, while also maintaining all required operating levels as outlined within the NSECC operating Approval (2008-062826-01). Changes to the configuration of the bypass pipe (which directs a minimum of 29 cfs from the canal to support downstream movement of fish) is proposed to be redirected to the top of the fishway. The 29 cfs will be maintained; however, the water will be released down through the fishway to provide additional water / attraction flow for fish moving up through the fishway – see details surrounding this design decision in Appendix G – Hydraulic modeling. The proposed fish passage improvements also include the installation of an eel ramp which will provide a method of upstream passage to juvenile eels. The ramp will require a constant stream of water passed over the substrate to facilitate eel movement, 5 cfs is proposed for this purpose.

To account for the lack of leakage from the new dam, an additional 65 cfs maintenance flow is being proposed to maintain similar conditions below the dam and to support upstream migration of fish using the fishway and proposed eel ramp. This flow will be released from the vertical lift gates in the center of the dam. When paired with the flow released from the fishway and louvre / bypass (total of 35 cfs), the eel ramp flow (5 cfs) - the proposed maintenance flow total will be approximately 105 cfs. See Appendix G – Hydraulic modeling results for details surrounding this decision.

6.2 Managing Excess Water

Currently, excess water is managed by pulling stoplogs either from the deep stoplog bays or overflow spillway sections of the dam. Post-construction, the majority of water control will be done using the vertical lift gates, and rubber dams maintained at full supply elevation. Should additional spill be required beyond the capacity of the vertical lift gates, the excess water would be released via the western spillway. If additional spilling is required beyond this, the western rubber dam would be deflated to release water and lastly the eastern rubberdam. Using the eastern rubberdam (which is situated above the fishway) would only be used in the most extreme rain event conditions. The upgraded fishway is designed to withstand spill from release of the above rubberdam if required. It is important to note that the amount of spill will not change as there is no change to the storage capacity or operational headpond elevation requirements. Table 3 below provides a summary of how the dam is currently operated as compared to how the dam will be operated post-refurbishment.

Table 3 – Current and Post-Refurbishment Operation

Activity / Structure	Current Operation	Post-Refurbishment Operation
Fish Ladder	Minimum of 6 cfs provided during the operating window of April 1 – November 30 annually	No change
Louvre System	Minimum of 29 cfs provided during the operating window of April 1 – November 30 annually	No change to flows. Adjustment to location of by-pass outlet pipe to top of fishway; therefore water will be released down through the fishway rather than existing location directly downstream of the dam
Eel Ramp	N/A	5 cfs will be provided during the operating window of April 1 – November 30 annually.
Fish Trap Operation	Operated during operating window of April 1 – November 30 annually	No change
Maintenance Flow	35 cfs (6 cfs from fish ladder and 29 cfs from louvre / bypass) provided during the operating window of April 1 – November 30 annually. * An additional Approximate 65 cfs unaccounted for through leakage.	New total maintenance flow of 105 cfs. This is a combination of the current 35 cfs from the fish ladder and louvre / bypass, 5 cfs from the eel ramp and 65 from the vertical lift gates during the operating widnow of April 1 – November 30 annually.
Spill	Released through stoplogs from deep stoplog bays or overflow spillway	No change to spill amount. Post-refurbishment spill be released in the following order: 1.Sluiceway bay / vertical lift gate 2. Western overflow spillway 3. Western rubberdam 4. Eastern rubberdam
Supplemental Flow	10 or more supplemental flow releases from June 15 to July 15 and September 26 to November 30 of greater than 50 cfs overnight for a minimum of 12 hours, and nightly when Atlantic Salmon are present. Stoplogs are removed to provide the releases.	No change to supplemental flow releases aside from the method that they are released which will be via the center sluiceway bays / vertical lift gates.

7.0 LOCATION

The Sheet Harbour Hydro System is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The hydro system has a drainage area of 573.9 km^2. Presently there are six (6) controlled reservoirs in the hydro system including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond, and Ruth Falls Headpond. The Sloane Reservoir is located near the headwaters of Seventeen Mile Stream, which passes through Anti Dam Reservoir and into Marshall Reservoir, then into the Malay Falls Headpond. The Malay Falls power canal conducts water from to the Malay Falls Generating Station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. The Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power.

Mapping, site photos, and engineering drawings are located in Appendices A, B, and C, respectively. The Property Identification Number for the Ruth Falls Dam is 40221673. GPS coordinates per coordination system NAD83, UTM Zone 20N are: 539,486 m Easting and 4,978,146 m Northing.

8.0 COMMUNITY

The Project site is located near the community of Sheet Harbour, HRM, Nova Scotia.

9.0 CONSULTATIONS

NS Power initiated Mi'kmaq engagement regarding the Ruth Falls Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant Project information with the KMK throughout 2018 providing six project updates, the project was then deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window meeting with KMK. NS Power continued to provide monthly Project updates and yearly One Window meeting updates throughout 2021-2023. NS Power also held a site visit to Ruth Falls on March 7th 2023 with KMK and DFO to discuss the current fish passage infrastructure.

NS Power initiated engagement with the Millbrook First Nation in January 2020 to provide an overview of the project and discuss next steps and approach to engagement for the project. This included working with the Mi'kmaw Conservation Group (MCG) and Millbrook for a DFO Fisheries Act authorization offsetting project. In January 2020, NS Power initiated engagement with MCG to collaborate on an offsetting project and in February and March 2020 NS Power continued engagement with the MCG and Millbrook. NS Power participated in project meetings with the Millbrook in January 2020 and summer 2021 and a site visit to Ruth Falls with Millbrook representatives in September 2021. Millbrook expressed interested in Atlantic salmon and American eel; as such, a meeting was held in January 2022 with Millbrook Director of Fisheries to discuss American eel passage. Following up on this meeting, NS Power shared the latest relicensing report pertaining to Ruth Falls and additional information about a previous eel mortality study completed at Ruth Falls. NS Power will continue to engage the Millbrook regarding the project and has offered to host a follow up site visit when Millbrook is available and interested. Weekly project manager communications will be available to the Millbrook as construction begins.

In August 2022 NSP met with the Maritime Aboriginal People's Council (MAPC) to discuss Ruth Falls Refurbishment Project. MAPC followed up with a letter asking for more information about archaeological reconnaissance during the drawdown, treatment of invasive species caught during stranding; and more information about the offsetting and monitoring plan. In November 2022 NSP provided a response that included archaeological plans, protocol for releasing stranded fish, and a commitment to share offsetting plans once submitted as part of the regulatory applications.

In terms of archaeology in the area, Boreas Heritage Consulting Inc. conducted an archaeological screening for the Ruth Falls Spillway Replacement in 2017 and followed up with archaeological subsurface testing in 2018. The subsurface testing did not exhibit archaeological resources. For the planned drawdown, the dewatered shoreline will be subjected to a full archaeological reconnaissance and surface collection once the elevation has reached its maximum drawdown level.

NS Power is planning to conduct public engagement for the Project with an Open House and provide local residents, along the Ruth Falls headpond, with relevant Project information and notification of the drawdown activities to conduct the Project. The public Open House and local resident communications will provide information in a timely manner about the Project, prior to drawdown activities and construction, increasing awareness and understanding of the Project scope, objectives, and timelines and addressing public areas of interest and potential concern.

10.0 DESCRIPTION OF FISH AND FISH HABITAT

The project site is located on the Ruth Falls Headpond in the NS Power Sheet Harbour Hydro System. Upstream of the dam is lake habitat while downstream of the dam is the East River of Sheet Harbour. The hydro system has been studied extensively as part of NS Power's hydro relicensing program. The most recent relicensing for Sheet Harbour was completed in 2018, during which various parameters including water quality and fish and fish habitat were studied. Qualitative and quantitative field studies were completed in the various reservoirs and streams of the hydro system. The 2018 Sheet Harbour Hydro System Relicensing Report was provided to DFO in 2018 and provides an indication of the fish species found in the system.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that higher returns will be observed in the East River over time. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system.

The Ruth Falls Headpond was sampled by NS Power in 2017 using gill nets, minnow traps and eel pots. Species found to be present in the headpond include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat is found in the area. Table 4 summarizes fish species caught in the headpond during 2017 surveys.

Table 4 - Summary of fish sampled during the 2007 and 2017 Ruth Falls Reservoir surveys

Reservoir	Site #	Method	Species Caught	Number Caught	
				2007	2017
Ruth Falls	84	Minnow trap	Yellow perch	0	11
	85	Minnow trap	Yellow perch	0	12
	88	Minnow trap	Yellow perch	0	9
	89	Gill net	Brown bullhead	0	3
			Speckled trout	3	3
			Unknown	1	0
			White sucker	7	13
			Yellow perch	2	7
	92	Eel pot	Brown bullhead	0	2
	94	Gill net	Alewife	0	3
			Brown bullhead	0	1
			Golden shiner	0	1
			Lake chub	0	1
			Speckled trout	1	3
			White sucker	2	21
			Yellow perch	0	9
	124	Eel pot	Brown bullhead	0	11
	125	Eel pot	American eel	6	1
			Brown bullhead	0	12
			Yellow perch	7	0
	126	Eel pot	American eel	4	0
			Brown bullhead	7	0
			White sucker	2	0
	128	Minnow trap	Yellow perch	8	5
	130	Minnow trap	Yellow perch	3	28

Fish sampling using an electrofisher was also conducted in stream sites located above the Ruth Falls Headpond on Grant River as well as one site located below the headpond on the East River of Sheet Harbour. Table 5 summarizes fish species captured during electrofishing surveys in 2006/7 and 2017.

Table 5 - Summary of fish sampled during the 2006/2007 and 2017 stream electrofishing surveys

Location	Site #	Species	Number Caught	
			2006/7	2017
Grant River	43	American eel	2	4
		Brown bullhead	1	0
		Lake chub	0	7
		Pearl dace	4	0
		White sucker	0	1
	96	American eel	10	0
		Banded killfish	1	0
		Blacknose dace	1	0

		Lake chub	7	2
		Yellow perch	1	0
East River	68	American eel	2	0
		Lake chub	1	0

A physical fish habitat survey was also completed at all electrofishing sites. The substrate at Site 68 downstream of the Ruth Falls Dam was characterized by a mixture of boulder (50%), bedrock (40%), and cobble (10%). Habitat types observed were riffle (80%), smooth (10%) and rough (10%). Instream cover was noted as moderate while riparian vegetation included a canopy of 5% on the left bank and 0% on the right bank. A summary of physical characteristics of the downstream site (East River), as well as upstream sites on Grant River can be found in Table 6.

Table 6 - Quantitative fish habitat data at stream sites near Ruth Falls in 2017.

Location	Area surveyed (m^2)	Gradient (%)	Flow m3/sec	Mean. water depth (m)	Max. water depth (m)	Mean velocity (m/s)	Max water velocity (m/s)
Grant River, site 43	254	1.28	-	0.19	0.24	-	-
Grant River, site 96	155	1.38	0.05	0.22	0.26	0.03	0.08
East River	203	1.32	-	0.36	0.46	-	-

Water quality sampling was performed at two sample sites in the Ruth Falls Headpond in 2017. pH in the headpond is considerably lower than reservoirs further upstream with a range of 4.32-5.14. Other water quality parameters measured were generally good. TDS is low, ranging from 9 mg/L to 12 mg/L, and conductivity ranges from 20 µS/cm to 23 µS/cm. Laboratory measurements of pH are considerably higher than in situ measurements, with values between 6.05 and 6.41. There are elevated metals concentrations in deeper waters, with exceedances of CCME FWAL guidelines for iron and zinc. Water quality measurements were taken at a site downstream of Ruth Falls in the East River of Sheet Harbour in 2017. pH was 4.94, dissolved oxygen was 10.23 mg/L, while conductivity was 20 µS/cm.

An ACCDC search of fish species at risk in the Sheet Harbour watershed identified American eel as threatened by COSEWIC while provincial rarity ranks of S3 was given to Alewife, Brook trout, and Lake trout; S2 to American eel; and S1 to Brook trout.

10.1 Eel Study

In 2009 and 2010, NSP completed tagging studies to assess the downstream movement of two migrating species at the Ruth Falls Dam: Atlantic salmon smolts and American eels. The intended outcome of the studies was to determine the efficiency of downstream fish passage using the existing louver diversion system which is situated at the beginning of the powerhouse canal. The louver system is designed to divert fish toward a bypass pipe which then carries fish through the pipe, eventually releasing them downstream of the dam in the original East River. Study details are provided in Appendix F –Eel Study Summary.

Upon review of both the 2009 and 2010 studies, NS Power has made certain assumptions:

- Both studies with very different techniques have similar efficiency estimates for the louvers for eel – approximately 30%.

- Based on 2009 study, the louvre system and associated bypass is very effective for pelagic species such as alewife and trout.
- The bypass may work marginally for eels - there was no way to determine the difference between an eel reporting downstream of the dam who traveled through the bypass pipe or who traveled over the spillway

10.2 Wetlands and Rare Species

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond. 6 of the 21 wetlands identified at the time of the survey from 2007 where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes.

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species, composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a 9 month period is unknown. NS Power has contracted a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project. Full details can be found in Appendix M- Wetland Monitoring Plan and Appendix K – Monitoring Plan.

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. An updated ACCDC search was completed in 2023 for the study area, there are no records of aquatic species of conservation concern or endangered species within the area. See Appendix P – ACCDC Report for full details.

11.0 DESCRIPTION OF EFFECTS ON FISH AND FISH HABITAT

The following water management strategies related to the Project have the potential to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat:

- The temporary drawdown of Ruth Falls Headpond, which could result in the temporary disruption of up to approximately 1.15 km^2 (115 hectares) of littoral zone habitat that fish species use for a portion of their life cycle (see Appendix A Bathymetry).

- The installation of a temporary bridge and access roads for machinery on both the upstream and downstream sides of the dam, resulting in a temporary instream footprint. The total estimated temporary instream footprint for control measures is 3,237 m^2. The footprint associated with the temporary structures within Ruth Headpond is already accounted for within the temporary drawdown of the Ruth Falls Reservoir. When the reservoir is reduced to 91 ft, the temporary structures will be placed upon the substrate which will be temporarily dry due to the drawdown (see MCG Offsetting plan in Appendix N for more details). The footprint associated with temporary structures downstream within the spillway channel is not considered valuable fish habitat due to the periodic nature of flow releases (although NS Power acknowledges fish use this area as a migration route to access habitat upstream of the dam). NS Power does not consider the temporary footprint to be a HADD as per the above rationale and the temporary nature of the footprint.
- Death of fish due to entrainment and/or stranding from drawdown activities.
- Negative impacts to upstream and downstream passage as a result of dam refurbishment, including:
    - Some loss of surface downstream passage for surface-oriented fish species, that would typically pass over top of the existing stoplog bays;
    - Potential changes to entrance conditions of the Ruth Falls fish ladder as a result of submerged discharge through the new gates (vs. surface overflow from stoplog bays).

The Project will result in a permanent loss of fish habitat; however, based on the relatively small size (60 m^2), the Project will not be removing a critical piece of habitat from the ecosystem. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete; however, changes will be made to improve the efficiency of the fishway – these changes include the addition of weirs, and adjustments to existing weir and notch sizing – see Section 15 Upstream Fishway Improvements for details on the proposed improvements. The temporary lowering of the reservoir approximately 18 feet will cause the biggest disruption; however, the potential effects of fish and fish habitat is low due to the following:

1. The drawdown is temporary and will not have a long-term effect on fish populations;
2. The headpond water level will be drawn down after spawning allowing time for eggs to hatch and YoY Gaspereau to move downstream naturally or transported during fish rescue. The drawdown is scheduled to occur no earlier than July 10th, 2024.
3. Measures will be put in place to facilitate downstream migration of fish during construction. During the time the water is drawn down, NS Power intends to provide free passage of fish through the center sluice gate during construction as the canal and fish ladder will also be dewatered. The exception to this is when the center sluice gate will be under construction, which we anticipate to be 3-4 weeks during which time the water will be directed through either the west or east bay. Upstream fish passage will not be available during the 2024 construction season after July 10th. As described above, improvements to the existing upstream fishway as proposed to take place during this timeframe.
4. Preliminary data collected from ongoing monitoring for the Tusket Main Dam Refurbishment project drawdown in 2021 indicates that very little change to fish habitat has been observed over an 8-month period, other than the temporary loss of available habitat as a direct result of the drawdown. No permanents impacts were reported.

Project activities with the potential to impact fish and fish habitat have been identified and discussed in Table 7.

Table 7 - Summary of potential effects on fish and fish habitat due to refurbishment of the Ruth Falls Main Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect
Temporary loss of fish habitat due to lowering reservoir beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.15 km^2 in Ruth Falls Headpond	High	Low
Temporary loss of fish habitat due to temporary installation of access road/crossings.	Localized: area immediately upstream and downstream of the dam	High	Low
Loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly downstream of the dam	High	Low
Fish mortality due to stranding when lowering reservoir.	Localized: Ruth Falls Headpond	Low	Low
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low
Potential downstream scour during drawdown of reservoir.	Localized: East River of Sheet Harbour	Low	Low
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High

There are no formal fisheries management objectives for the East River of Sheet Harbour; however, the streams and reservoirs are used for recreational fishing by the local community and traditional harvesting by the Mi'kmaw of NS.

12.0 ASSESSMENT OF FISH PASSAGE

DFO submitted a letter to NS Power dated May 5, 2022 indicating that this application remained incomplete. The letter outlined several questions regarding upstream and downstream fish passage that would need to be addressed as part of the Project. The DFO Incomplete letter states:

NS Power is proposing major refurbishment works for the dam that could influence upstream and downstream fish passage (e.g., changing from surface spill via stop logs to sub-surface spill via vertical lift gates). As stated in Table 6, there will likely be impacts to upstream and downstream fish passage after dam refurbishment works are complete. As noted in emails from DFO to Jenny LeBlanc on October 25, 2021 and December 16, 2021, and as discussed on the October 27, 2021 call with DFO and NS Power, fish passage improvements are to be integrated into the dam refurbishment work to ensure compliance with the fish and fish habitat protection provisions of the Fisheries Act, which includes ensuring the free passage of fish.

Of note, Table 6 references the potential for impact to passage as a result of the modification of the sluiceway, not a likely impact and the probability of this impact was noted to be low.

DFO has also specified in the incomplete letter the information required to be submitted as part of this application to ensure "compliance with the fish and fish habitat protection provisions of the *Fisheries Act*, as follows:

- Assessment by a qualified professional on potential impacts to upstream and downstream fish passage for all species that are likely to be migrating in the area associated with the proposed infrastructure design and operations.
- Describe proposed measures that will be implemented as part of the refurbishment works to avoid, mitigate or offset potentially harmful impacts to fish and fish habitat, including fish passage, associated with the refurbishment and future operation of the Ruth Falls Hydroelectric Development. For avoidance and mitigation measures, ensure to submit the following information and describe how these proposed fish passage measures meet established fish passage design criteria (e.g., USFWS Fish Passage Engineering Design Criteria) to allow DFO to assess whether proposed plans are sufficiently meeting fish passage requirements as per Section 34 of the Fisheries Act.
- Provide an upstream fish passage plan for American Eel that includes detailed design drawings, proposed location for fish passage structures and rationale for siting structure(s) in this location, information on proposed operations, and proposed timing of installation.
- Provide a downstream fish passage plan for fish species that are likely to be migrating downstream at the site. Submit detailed design drawings, the proposed location of structures and rationale, information on proposed operations, and proposed timing of installation for any new structures required to ensure the free passage of fish at the site. This includes proposed improvements to the louver system.

NS Power initiated various studies / assessments in order to satisfy this request and has been working to progress this work over the last 9 months. the following studies have been completed:

- An assessment by a qualified professional on potential impacts to upstream and downstream fish passage for all species that are likely to be migrating in the area associated with the proposed infrastructure design and operations. This includes:

- Assessment of existing fish passage conditions and recommendations for upgrades and improvements
- 3D hydraulic modelling of the study area below the dam – modelling was completed to assess flow conditions pre and post dam refurbishment and to evaluate whether the new dam operation will negatively impact upstream or downstream fish passage. Modelling was also completed to inform improvements to upstream and downstream passage.
- Upstream fish passage plan, including for American eel, including detailed design drawings.
- Downstream fish passage plan, including detailed design drawings.

The sections below address the requested items above in detail. This includes assessment results, summaries, and detailed designs. NS Power has provided the detailed designs for the proposed fishway improvements, downstream louvre improvements, and upstream eel ramp design in Appendix D

12.1 3D Hydraulic Modelling

NS Power engaged CBCL Ltd. And Thaumas Environmental to complete 3D hydraulic modeling to assess post-refurbishment hydraulic conditions. The objective of the modeling was to evaluate whether the refurbishment and subsequent operation of the new dam would result in negative impacts to fish and fish habitat downstream of the dam, namely impacts to upstream and downstream fish passage.

The following was completed as part of the 3D hydraulic modelling:

- Modelling of historical spill data to assess potential impacts to fish passage during various expected flow conditions (i.e. base flows – high flow spill conditions), as a result of the proposed refurbishment dam design operation.
- Modelling of existing ecological maintenance flows (as required in accordance with the Sheet Harbour Hydro System) and current estimated leakage rates (i.e. base flows) to evaluate whether ecological flows are sufficient for optimal fish passage, and modelling of different gate configurations to provide the ecological flows (i.e. gate openings).
- Modelling of passage conditions in the existing fish ladder and downstream bypass, and testing of a range of configurations to optimize upstream and downstream passage. Modelling results can be found in Appendix G.

The hydraulic modeling provides insight as to how the post-refurbishment design would impact the entrance conditions to the fishway and support fish as they migrate towards the dam. Specific considerations have been made to design and operations plans to allow for improved conditions below and at the fishway entrance. This includes designing for appropriate velocities which will allow for prolonged swimming and burst swimming for species looking to migrate upstream.

The following will be implemented to mitigate or avoid negative impacts to fish passage and optimize upstream and downstream passage, as supported by the 3D modelling exercise:

- The current downstream base flow condition, which is a combination of the required ecological flow of 35 cfs plus standard leakage rates through the dam (approximately 100 cfs total), will be maintained as the minimum ecological flow for optimal fish passage between April 1-November 30th.

- The current ecological flow for the upper technical (concrete) fish ladder and louver (downstream bypass) system (6 cfs and 29 cfs, respectively), will be maintained.
- Adjustments to attraction flow within the lower (non-technical) section of the fish ladder will be made (refer to section 5.2).
- Modifications to the lower (non-technical) section of the fish ladder will be made to improve upstream passage for all species (refer to Section 5.2).
- Modifications to the louver/downstream bypass system will be made to improve downstream passage for all species (refer to Section 5.2).
- The remaining base ecological flow (approximately 65 cfs) will be provided using the new vertical lift gates, with the use of the most easterly gate reduced or avoided to avoid sub-optimal flow conditions for upstream passage. Once the dam is constructed, the gate flow will be optimized to provide the best flow conditions for fish using a combination of all three gates, two gates, or just one gate to provide the maintenance flow. refer to Appendix G – Hydraulic Modeling Results for more information.
- Excessive spill will be avoided between May 1 - June 30th where possible. While expected to be infrequent as shown in the modelling, when required it is expected that the duration will be short (1-2 days) and therefore will not negatively affect upstream passage. Should spill be required, the excess water would be released using the vertical lift gates first before moving to the western spillway. If additional spilling is required beyond this, the western rubber dam would be deflated to release water and lastly the eastern rubberdam. Refer to Section 6.0 for operational considerations for the new dam.
- Supplemental flows (50 cfs) of 10 or more occurrences will be provided through the gates between the dates of June 15 to July 15 and September 26 to November 30 as per the Sheet Harbour Water Approval, unless otherwise recommended by DFO.

For full hydraulic modeling results and interpretation by Thaumus Environmental, please see Appendix G.

12.2 Professional Evaluation of Upstream and Downstream Fish Passage

In addition to 3D hydraulic modelling, NS Power contracted Wood and Thaumas Environmental consulting firms to complete an evaluation of existing upstream and downstream passage and recommend operational or structural modifications to improve fish passage, as required. Refer to Appendix H – Assessment of Upstream and Downstream Fish Passage for more details. Figure 4 shows a site overview of refurbishments associated with improvements to fish passage as described below.



Figure 4- Site diagram outlining refurbishments associated with upstream and downstream fish passage.

12.2.1 Upstream Fishway Improvements

Results of the 3D hydraulic modeling and professional evaluation determined that improvement to the lower non-technical section of the existing fishway should be made to improve passage for species migrating upstream to complete their lifecycle. The current fishway was originally designed for salmon; the proposed improvements will look to improve velocity and flow conditions to support other species such as gaspereau, which will in turn improve conditions for all species as the swimming capability of gaspereau is the limiting criteria for the fishway. The following improvements are proposed:

- Replace the existing lower non-technical fishway weirs with 11 new concrete weirs, including an additional weir immediately below the upper technical (concrete) fish ladder. The weir at the entrance to the fishway will be placed on a diagonal pointing south-west to provide improved entrance conditions.
- Relocate the louvre bypass outflow pipe to connect into the fishway to provide additional attraction flow through the fishway. The fishway currently provides a minimum of 6 cfs and the bypass pipe provided a minimum of 29 cfs making the new total coming down through the fishway 35 cfs.

The proposed improvement concept for the non-technical fishway was modelled to verify optimized flow conditions. Refer to Appendix G. Full detailed designs for the improvements to the fishway can be found in Appendix D.

Refer to Figure 5 below, Appendix H – Assessment of Upstream and Downstream Fish Passage and Appendix D - Fish Passage Engineer Designs for more details. These improvements will be made concurrently with the other proposed dam construction activities and are designed to exceed USFWS fish passage design criteria.

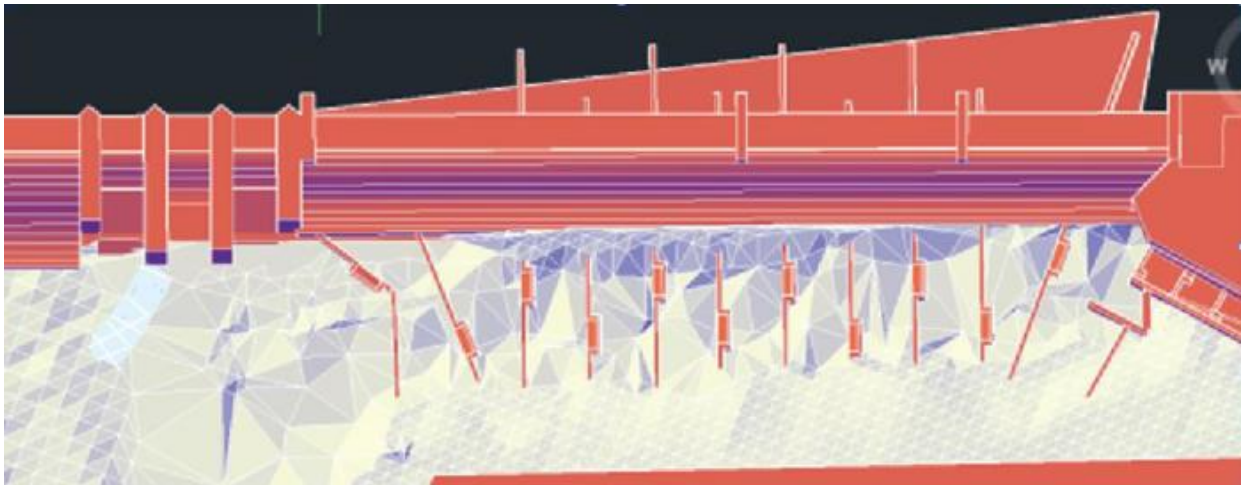


Figure 5 - Fishway Improvements – Layout of 11 weirs

NS Power is proposing post-construction monitoring of the Ruth Falls fishway for a period of two years, starting in spring 2025, to assess effectiveness of the proposed fishway improvements. Details can be found in Appendix K – Monitoring Plan and Appendix Q – Study Plan.

12.2.2 Downstream Louvre System Improvements

The assessment of downstream passage included looking at the existing infrastructure to evaluate the effectiveness of a louvre system at facilitating downstream passage for species that would be required to move downstream of the dam in order to complete their life cycle, and to assess the need for upgrades and general repairs. This included assessing whether the louvre system meets the US Fish and Wildlife Association (USFWA) Fish Passage Engineering Design Criteria. A design for proposed improvements were provided to address improvements identified within the assessment (refer to Appendix I – Louvre Assessment and Appendix D for detailed designs). Recommendations for improvement for downstream passage were made and proposed changes to the louver system are as follows:

- Repairs to the existing louvre slats may be required to ensure a complete system. These repairs will be identified when the water is drawdown and canal dewatered in July 2024. Anticipated repairs include replacing partially broken / damaged slats.
- Installation of a trap funnel to prevent upstream movement once fish have moved through the entrance of the bypass. Bottom orifices will also be installed in the stoplogs to support downstream migration. See Figure 6 for more details.
- A ramp is recommended to facilitate movement from the bottom of the water column towards the bypass pipe at the top of the water column. This would benefit those bottom dwelling species such as American eel, Brown bullhead, White suckers etc. by guiding the fish from the bottom to

the convergence of the slates in order to find the bypass pipe. Refer to Appendix D for detailed design of the new ramp.

- Realignment of the bypass outfall into the top of the non-technical lower fishway section. The plunge pool water depth will be designed to meet or exceed the USFW criteria for drops of all species and age classes at the site. See Appendix D – Fish Passage Designs to view the placement of the new bypass pipe.

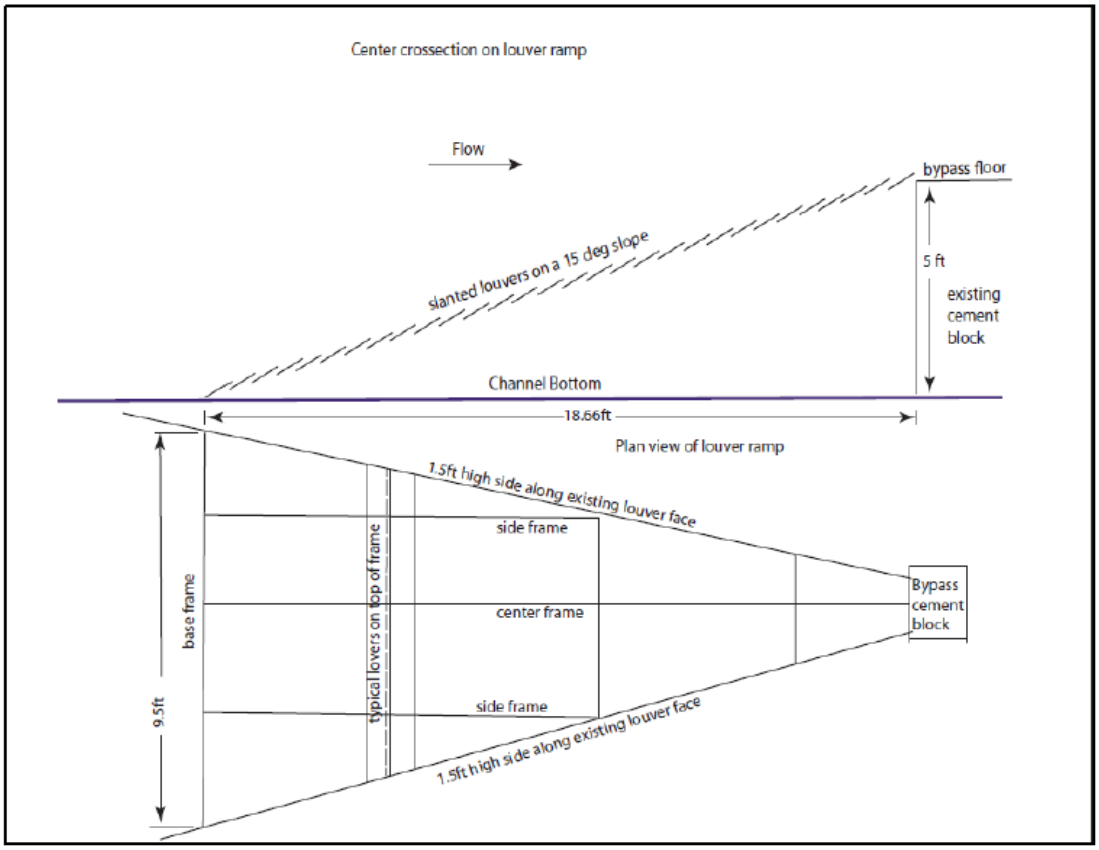


Figure 6- Cross-section view of proposed slanted ramp

Detailed designs of the louvre system improvements can be found in Appendix D. These improvements will be made concurrently with the other proposed dam construction activities.

Upon completion of the proposed improvements to the louvre system, NS Power is committed to completing an eel pit-tagging study to assess how the changes impact the downward migration of eels. The details can be found in Appendix K – Monitoring Plan and Appendix Q – Study Plan.

12.2.3 Upstream Eel Passage

NS Power engaged Wood and Thaumas Environmental to assess and design upstream eel passage to support the upstream migration of elvers and juvenile eels. It was determined through the evaluation that a separate stand-alone structure was required for effective upstream eel passage, beyond the existing fishway. As a result - an eel ramp is being proposed to facilitate upstream eel passage. See Appendix J - Upstream Eel Passage Assessment for full details.

The design consists of a metal enclosed box lined with a climbing substrate and equipped with pumped water to facilitate eel movement up the ramp. The placement of the eel ramp will sit on the outside of the upper technical (concrete) fishway – following the general outline of the fishway up to the headpond. The ramp will eventually cross over the fish ladder with the exit bring placed to the left side of the fish ladder exit at the headpond. A critical component of designing the eel ramp is ensuring the entrance conditions are suitable for eels to access the ramp. The conditions have been deemed suitable for eels to effectively access the eel ramp in the proposed location based on the results of the hydraulic modeling

results assessment (Appendix G). The ramp will be operated by passing a constant stream of water over the rubber substrate in order to support upstream movement of juvenile eels / elvers. Two hoses will be situated at the top of the ramp (near the exit). The first hose will direct water down the ramp and the other will be oriented upwards. The second hose will ensure the substrate is wet at the very top where the eels exit into the headpond. The hoses will be set to provide approximately 5 cfs which allows for a minimum of 1/8 inch of water to be provided across the flat sections of the ramp. The water can be adjusted to provide up to 70mm of water depth where needed. This was determined as a suitable amount of water by Thaumas Environmental. Adjustments to the amount of water may be needed once the ramp is in operation based on observations. The Eel ramp will be operated annually between April 1st and November 30th each year (following the same timeline as the fish ladder). The ramp will be installed concurrently to the proposed dam construction activities. See Figure 7 for more details regarding the eel ramp exterior.

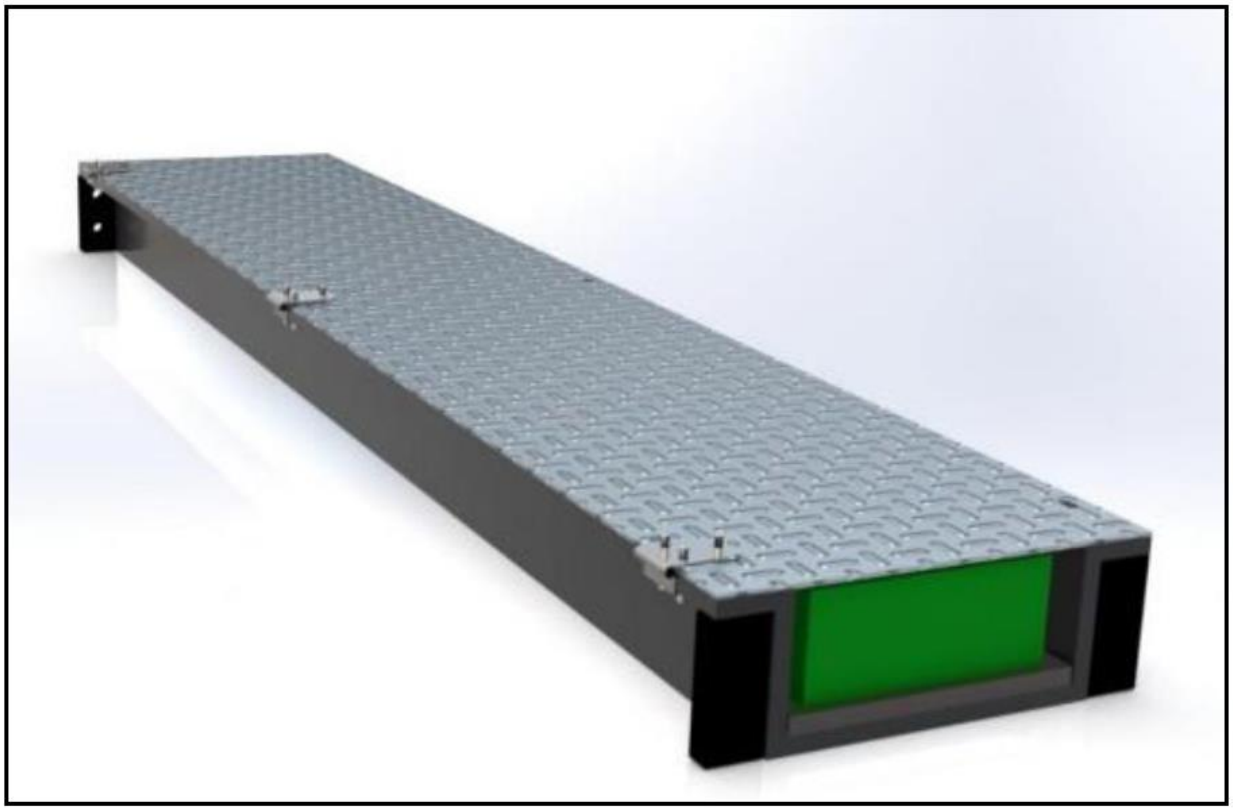


Figure 7 - Aquatic Eel Pass Box

The completion of this assessment and eel ramp designs will look to satisfy DFO's request from the May 5, 2022 Incomplete Letter indicating that a plan for American Eel that includes detailed design drawings, proposed location for fish passage structures and rationale for siting structure(s) in this location, information on proposed operations, and proposed timing of installation was to be provided. For detailed designs of the eel ramp – see Appendix D.

NS Power is committing to assessing the effectiveness of the proposed eel ramp as passing elvers / juvenile eels. Details surrounding the study plan can be found in Appendix K – Monitoring Plan and Appendix Q – Study Plan.

13.0 MEASURES AND STANDARDS TO AVOID OR MITIGATE SERIOUS HARM TO FISH

NS Power recognizes DFO's mitigation hierarchy, which emphasizes that efforts must be made to prevent impact first and, where avoidance is not possible, efforts must be made to minimize impacts. Any residual impacts require authorization and must be addressed by offsetting measures.

Table 7 summarizes the potential effects and mitigation measures to be employed to avoid direct or indirect impacts to fish and fish habitat. A monitoring plan to monitor and assess for residual impacts to fish and fish habitat after measures and standards in Table 7 have been applied can be found in Appendix K.

Table 7 - Summary of potential impacts associated with the Project and mitigation measures to prevent or minimize impacts

Potential Effect	Measure to Mitigate Serious Harm
Temporary loss of fish habitat (approximately 1.15 km^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the headpond approximately 18' is required in order to complete work in dry conditions and is a necessary step to facilitate the refurbishment of the Ruth Falls dam. Leaving the headpond within normal operating range as well as conducting a lesser drawdown to a higher elevation were both considered; however both would require substantial cofferdams and bulkheads to isolate work areas. It was determined that for the safety of NS Power and contractor staff during refurbishment and constructability of the new dam, a full drawdown to 91 ft was required. NS Power accepts that the drawdown of Ruth Headpond will result in a temporary HADD of fish habitat and is an impact that cannot be avoided. NS Power is proposing some mitigation to reduce the impact of the temporary drawdown on fish habitat: Lowering the headpond will occur in July and will take approximately 8 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Headpond coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NS Power will lower the headpond to 91ft to create dry conditions while still ensuring enough water is available to maintain a 35 cfs flow below the dam. In addition, offsetting as described in Section 18 is considered appropriate mitigation to offset the temporary loss of habitat (1.15 km^2) during the 2024 season.
Temporary loss of fish habitat due to installation of access road/crossings.	The means for moving machinery from one side of the dam to the other will be via temporary bridge crossing downstream of the dam. Should water levels rise beyond 101 ft during construction - the temporary bridge installed downstream will be removed promptly by the contractor using an excavator on site (refer to section 3.4). Upstream of the dam, two access roads will be placed on either side of the sluiceway while leaving a space in the center for water to flow through and out through the sluiceway bays. The site can only be accessed from the east side. There is no access or

	potential to create access from the west side; however, it will be accessible once the downstream access roads and bridge are installed. Temporary access will be constructed using clean rockfill materials and totals an estimated temporary footprint of 3,237 m2. This area in already accounted for from an offsetting perspective as the temporary access roads sit within the drawdown area. On the upstream side, access roads will be placed after the headpond has been drawn down and a large portion (over 70%) will be installed above 91 ft elevation. All materials will be removed following the work and the site remediated back to its original condition. Fish monitoring and rescue during access road installation will be conducted by qualified individuals.
Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately downstream of the dam, which is primarily bedrock and does not provide spawning habitat or cover for fish, NS Power does not consider this to represent a HADD.
Fish mortality due to stranding when lowering headpond	In order to conduct work in dry conditions, the headpond will be lowered approximately 18' below the minimum operating level of 109.25' observed from April 1st to November 30th each year. The drawdown of the headpond will be monitored by qualified staff from NS Power Environmental Services to ensure no fish become stranded in pools or low spots. A fish rescue by qualified staff will take place to capture the fish immediately and move them to deeper faster flowing water. NS Power has proposed a mechanism to evaluate and assess mortality as a result of stranding in the monitoring plan and has proposed offsetting measures to compensate for any mortality.
Fish Mortality due to entrainment during headpond lowering	In order to drawdown Ruth Headpond, the water will be gradually taken down over a period of 8 days. A drawdown schedule is provided section . The purpose of extending the drawdown over 8 days is to reduce potential for erosion, scour and reduce the likelihood and extent of potential entrainment of early life stage fish below the dam. Typically, Ruth Falls headpond can be lowered in 1 day. Stoplogs will be removed gradually in order for water levels upstream to equalize and discharge downstream to remain within typical volumes and velocities observed at the dam during normal operation. NS Power is proposing entrainment monitoring to evaluate potential entertainment during the drawdown, and has proposed offsetting measures to compensate for any associated fish mortality. See Appendix L- Entrainment Monitoring Plan for more details.
Potential downstream scour during drawdown of reservoir	NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 110.5 ft to the minimum operating level of 109.25 ft. Once the headpond reaches an elevation of 109.25 ft, the drawdown will be controlled using the stop logs in the sluiceway bays. As the reservoir is lowered enough to make the canal non-operational, fish will be prevented from passing downstream through the bypass and therefore, will be able to still move downstream through the sluiceway bays. The drawdown will continue while not exceeding 500 cfs at anytime during the drawdown. The drawdown will continue in this manner until the desired elevation of 91.0 ft is reached. NS Power is not anticipating any additional impacts with respect to erosion/scour or sedimentation during the drawdown as the discharge channel immediately downstream of the dam is comprised of bedrock and boulders. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NS Environment and Climate Change (ECC), and make necessary repairs in order to stabilize the area.
Inability to provide safe fish passage upstream	During construction, the fish ladder and fish bypass will be dewatered. The drawdown will be conducted in mid-July to avoid the upstream gaspereau migration

and downstream during construction	season and allow fish to spawn and eggs to hatch. Once the headpond is drawn down, upstream and downstream migration will be provided via the deep stoplog bays located in the center of the dam. Continuous free water passage will be provided through the gate bays in order to maintain the desired construction elevation, provide downstream maintenance flows and maintain fish passage. The 35 cfs maintenance flow will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation in order to maintain flow. NS Power may not be able to provide the entire 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumps.
Inability to monitor for salmon while trap is out of service	Given that the salmon trap is tied directly to operation of the fish ladder and the extremely low returns of salmon to the East River Sheet Harbour and absence of salmon caught in the trap for the last number of years, NS Power will not be operating the trap while the fish ladder is dewatered to accommodate construction in 2024. Fish passage will be provided through the sluice way bays as an alternate form of passage to the ladder, however salmon will not be counted. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request in 2024.
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15 – July 15 and September 26 – November 30. These flows are meant to simulate large rain events, which typically trigger salmon to move upstream. Since 2007, only 11 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018, two in 2019, and one 2020. None were captured in 2021 or 2022. Salmon tend to prefer migrating to the West River of Sheet Harbour. NS Power will also be providing continuous water passage through the sluiceway bays, the amounts of which will vary over the course of construction depending on inflows. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2024 season will cause serious harm to the salmon population. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request.
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NS Power's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. The successful contractor will be required to submit a site-specific erosion and sedimentation control plan prior to start of construction. Significant excavation is not required; therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The headpond will be monitored during dewatering for sediment and the rate of dewatering decreased as required.
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.
Potential effects on upstream and	

downstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway	As discussed within Section 12.1 - Hydraulic Modeling and Section 12.2.1 Fishway Improvements – improvements are proposed in order to improve the existing fishway to better accommodate all species looking to migrate upstream of the dam. The hydraulic modeling provided insight as to how the post-refurbishment design would impact the entrance conditions to the fishway. Specific considerations have been made to design and operations plans to allow for improved conditions below and at the fishway entrance. This includes designing for appropriate velocities to allow for prolonged swimming and burst swimming for species looking to migrate upstream. With respect to loss of some surface downstream passage, NS Power acknowledges that surface downstream passage will not be possible with the new vertical lift gates but also notes that surface passage is still present over top the newly installed rubber dams and free overflow section of the new dam structure, which are both constructed to current full supply level of the dam during April 1-November 30 (110.5 ft). The newly installed rubber dams are remotely operated and are also able to deflate as required to pass additional water. As noted in Section 12.2.2 - Louvre System Improvements, the changes to the louvre system will look to improve the efficiency of overall downstream passage. NS Power has committed to a post construction pit tagging study which will look to illustrate improved efficiency in the louvre system after the improvements are made. See Appendix K – Monitoring Plan for further details. NS Power is proposing post-construction monitoring of the Ruth Falls fishway for a period of two years, starting in spring 2025 to assess effectiveness of the proposed fishway improvements. NS Power is using the results of the hydraulic modeling in design and operational improvement decisions. NS Power does have the ability to make immediate modifications to dam operation, if impacts are observed.

14.0 MONITORING MEASURES

Monitoring will be completed pre-construction, during, and post-construction to ensure mitigation measures proposed for potential impacts identified in Table 12 are effective. NS Power has developed a Monitoring Plan (Appendix K), which outlines the following:

- Fish Rescue
- Entrainment Monitoring (further information provided as Appendix L)
- Fish habitat delineation
- Construction monitoring
- Wetland Monitoring (further information provided as Appendix M)
- Fishway Improvements Monitoring
- Louvre Improvements Monitoring
- Upstream eel passage Monitoring
- Post-construction monitoring activities

A Project-specific environmental protection plan (EPP) will be developed to address all potential environmental risks associated with the Project and will include appropriate incident reporting procedures and key contacts. The Contractor will be required to review the EPP and provide training to all staff with respect to its contents.

15.0 CONTINGENCY MEASURES

Should issues arise, the situation will be immediately assessed and decisions made regarding alternate methods by the Contractor, Project Manager, Engineers, Environmental Services, and Hydro Operations. Should mitigation measures prove to be ineffective, work will be stopped and issues reported to NS Power for resolution and reporting as required. By following the EPP, providing environmental orientation, providing appropriate supervision, conducting frequent inspections, and monitoring weather forecasts, it is not anticipated that there will be significant issues with the proposed mitigation. Contingency planning is also considered regarding water management. Should unexpected inflows be received, NS Power will implement contingencies to safely pass water. This includes the use of all three sluiceway bays and the spillway bay opening to pass additional water.

16.0 DEATH OF FISH AND HARMFUL ALTERATION, DISRUPTION, OR DESTRUCTION OF FISH HABITAT AFTER IMPLEMENTATION OF MEASURES AND STANDARDS

Table 8 below provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Dam refurbishment. No permanent impacts to the East River of Sheet Harbour or to Ruth Falls Headpond (beyond the 60 m^2 new dam footprint) in relation to its qualitative, chemical and physical characteristics are anticipated as a result of the Project for the new dam structure. There is a temporary direct loss of fish habitat as well as anticipated residual death of fish as a result of the drawdown. Compensation measures for these impacts have been proposed in Section 18.

Table 8 - Residual Harm from Potential Impacts Associated with the Ruth Falls Dam Refurbishment

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Temporary loss of fish habitat (approximately 1.15 km^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the headpond approximately 18' is required in order to complete work in dry conditions and is a necessary step to facilitate the refurbishment of the Ruth Falls dam. Leaving the headpond within normal operating range as well as conducting a lesser drawdown to a higher elevation were both considered; however both would require substantial cofferdams and bulkheads to isolate work areas. It was determined that for the safety of NS Power and contractor staff during refurbishment and constructability of the new dam, a full drawdown to 91 ft was required. NS Power accepts that the drawdown of Ruth Headpond will result in a temporary HADD of fish habitat and is an impact that cannot be avoided. NS Power is proposing some mitigation to reduce the impact of the temporary drawdown on fish habitat: Lowering the headpond will occur in July and will take approximately 8 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Headpond coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NS Power will lower the headpond to 91 ft to create dry conditions while still ensuring enough water is available to maintain a 35 cfs flow below the dam. In addition, offsetting as described in section 18 is considered appropriate mitigation to offset the temporary loss of habitat (1.15 km^2) during the 2024 season.	temporary direct loss. Offsetting proposed. Some residual harm anticipated
Temporary loss of fish habitat due to installation of access road/crossings.	The means for moving machinery from one side of the dam to the other will be via temporary bridge crossing downstream of the dam. Should water levels rise beyond 101 ft during construction - the temporary bridge installed downstream will be removed promptly by the contractor using an excavator on site (refer to section 3.4). Upstream of the dam, two access roads will be placed on either side of the sluiceway while leaving a space in the center for water to flow through and out through the sluiceway bays. The site can only be accessed from the east side. There is no access or potential to create access from the west side; however, it will be accessible once the downstream access roads and bridge are installed. Temporary access will be constructed using clean rockfill materials and totals an estimated temporary footprint of 3,237 m2. This area is already accounted for from an offsetting perspective as the temporary access roads sit within the drawdown area. On the upstream side, access roads will be placed after the headpond has been drawn down and a large portion (over 70%) will be installed above 91 ft elevation. All materials will be removed following the work and the site remediated back to its original condition. Fish monitoring and rescue during access road installation will be conducted by qualified individuals.	No residual harm anticipated

Loss of ~60 m² of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately downstream of the dam, which is primarily bedrock and does not provide spawning habitat or cover for fish, no residual harm is anticipated.	No residual harm anticipated
Fish mortality due to stranding when lowering headpond	In order to conduct work in dry conditions, the headpond will be lowered approximately 18' below the minimum operating level of 109.25' observed from April 1st to November 30th each year. The drawdown of the headpond will be monitored by qualified staff from NS Power Environmental Services to ensure no fish become stranded in pools or low spots. A fish rescue by qualified staff will take place to capture the fish immediately and move them to deeper faster flowing water. NS Power has proposed a mechanism to evaluate and assess mortality as a result of stranding in the monitoring plan in Appendix K and has proposed offsetting measures to compensate for any mortality.	Some residual harm anticipated. Offset proposed
Fish Mortality due to entrainment during headpond lowering	In order to drawdown Ruth Headpond, the water will be gradually taken down over a period of 8 days. A drawdown schedule is provided in Section 3.2. The purpose of extending the drawdown over 8 days is to reduce potential for erosion, scour and reduce the likelihood and extent of potential entrainment of early life stage fish below the dam. Typically, Ruth Falls headpond can be lowered in 1 day. Stoplogs will be removed gradually in order for water levels upstream to equalize and discharge downstream to remain within typical volumes and velocities observed at the dam during normal operation. NS Power is proposing entrainment monitoring to evaluate potential entertainment during the drawdown, and has proposed offsetting measures to compensate for any associated fish mortality. See Appendix L- Entrainment Monitoring Plan for more details.	Some residual harm anticipated. Offset proposed.
Potential downstream scour during drawdown of reservoir	NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 110.5 ft to the minimum operating level of 109.25 ft. Once the headpond reaches an elevation of 109.25 ft, the drawdown will be controlled using the stop logs in the sluiceway bays. As the reservoir is lowered enough to make the canal non-operational, fish will be prevented from passing downstream through the bypass and therefore, will be able to still move downstream through the sluiceway bays. The drawdown will continue while not exceeding 500 cfs at anytime during the drawdown. The drawdown will continue in this manner until the desired elevation of 91.0 ft is reached. NS Power is not anticipating any additional impacts with respect to erosion/scour or sedimentation during the drawdown as the discharge channel immediately downstream of the dam is comprised of bedrock and boulders. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NS Environment and Climate Change (ECC), and make necessary repairs in order to stabilize the area.	No residual harm anticipated
Inability to provide safe fish passage upstream and downstream	During construction, the fish ladder and fish bypass will be dewatered. The drawdown will be conducted in mid-July to avoid the upstream gaspereau migration season and allow fish to spawn and eggs to hatch. Once the headpond is drawn down, upstream and downstream	No residual harm anticipated

during construction	migration will be provided via the deep stoplog bays located in the center of the dam. Continuous free water passage will be provided through the gate bays in order to maintain the desired construction elevation, provide downstream maintenance flows and maintain fish passage. The 35 cfs maintenance flow will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation in order to maintain flow. NS Power may not be able to provide the entire 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumps.	
Inability to monitor for salmon while trap is out of service	Given that the salmon trap is tied directly to operation of the fish ladder and the extremely low returns of salmon to the East River Sheet Harbour and absence of salmon caught in the trap for the last number of years, NS Power will not be operating the trap while the fish ladder is dewatered to accommodate construction in 2024. Fish passage will be provided through the sluice way bays as an alternate form of passage to the ladder, however salmon will not be counted. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request in 2024.	No residual harm anticipated
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15 – July 15 and September 26 – November 30. These flows are meant to simulate large rain events, which typically trigger salmon to move upstream. Since 2007, only 11 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018, two in 2019, and one in 2020 .None were captured in 2021 or 2022. Salmon tend to prefer migrating to the West River of Sheet Harbour. NS Power will also be providing continuous water passage through the sluiceway bays, the amounts of which will vary over the course of construction depending on inflows. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2024 season will cause serious harm to the salmon population. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request.	No residual harm anticipated
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NS Power's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. The successful contractor will be required to submit a site-specific erosion and sedimentation control plan prior to start of construction. Significant excavation is not required; therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as	No residual harm anticipated

	required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The headpond will be monitored during dewatering for sediment and the rate of dewatering decreased as required.	
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.	No residual harm anticipated
Potential effects on upstream and downstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway	As discussed within Section 12.1 - Hydraulic Modeling and Section 12.2.1 Fishway Improvements – improvements are proposed in order to improve the existing fishway to better accommodate all species looking to migrate upstream of the dam. The hydraulic modeling provided insight as to how the post-refurbishment design would impact the entrance conditions to the fishway. Specific considerations have been made to design and operations plans to allow for improved conditions below and at the fishway entrance. This includes designing appropriate velocities to allow for prolonged swimming and burst swimming for species looking to migrate upstream. With respect to loss of some surface downstream passage, NS Power acknowledges that surface downstream passage will not be possible with the new vertical lift gates but also notes that surface passage is still present over top the newly installed rubber dams and free overflow section of the new dam structure, which are both constructed to current full supply level of the dam during April 1 - November 30 (110.5 ft). The newly installed rubber dams are remotely operated and are also able to deflate as required to pass additional water. As noted in Section 12.2.2 - Louvre System Improvements, the changes to the louvre system will look to improve the efficiency of overall downstream passage. NS Power has committed to a post construction pit tagging study which will look to illustrate improved efficiency in the louvre system after the improvements are made. See Appendix K – Monitoring Plan for further details. NS Power is proposing post-construction monitoring of the Ruth Falls fishway for a period of two years, starting in spring 2025 to assess effectiveness of the proposed fishway improvements. NS Power is using the results of the hydraulic modeling in design and operational improvement decisions. NS Power does have the ability to make immediate modifications to dam operation, if impacts are observed.	No residual harm anticipated

17.0 HABITAT CREDIT

Habitat Credits will not be used as an offset for death of fish or the harmful alteration, disruption, or destruction of fish habitat.

18.0 OFFSETTING CREDIT

NS Power is proposing, in partnership with the Mi'kmaw Conservation Group (MCG) and the Nova Scotia Salmon Association (NSSA), a restoration project that is suitable for offsetting of serious harm for the Ruth Falls Dam refurbishment as described in Table 13. MCG has provided an offsetting plan to NS Power which outlines the proposed project. The project includes improvements to fish migration and fish habitat by restoring suitable instream and streambank habitat on the West River Sheet Harbour watershed. MCG will provide oversight and guidance on the project and will also collaborate with the Millbrook First Nations Community on the project in order to potentially engage community members to implement habitat offset work. NS Power would like to note that the Ruth Falls Refurbishment Project is responsible for 2300 m^2 of the 5000 m^2 offset (2700 m^2 is attributed to the Sloane project) that was originally submitted. As these two projects are on different schedules, the portion of the offset associated with Ruth Falls will be progressing based on the below schedule as noted in the offsetting plan. It is NS Power's expectation that the two projects will not follow the same timeline or have the same requirements. As such, the attached offsetting plan is currently being adjusted to only include the offsetting for Ruth Falls at this time. The offsetting blocks are based on 1350 m^2 (structures spaced 90 m along the river and an offsetting width of 15 m). As such, 2 blocks are being proposed to offset Ruth Falls for a total of 2700 m^2. This will ensure the offset originally proposed is met or exceeded. Please see Appendix N - Offsetting Plan for details. NS Power will submit the updated Offsetting Plan containing information related to Ruth Falls only once received from MCG.

The following is a summary of project execution:

Year One (1): Finalize the footprint of the restoration area, conducting any pre-monitoring activities needed (incorporating any relevant and available data in the baseline), securing all permitting and permissions, and finalizing a post monitoring plan. The pre-monitoring report can be found in Appendix N. This work occurred in 2022.

Year Two (2): Complete second round of pre-monitoring. This work is proposed for 2023.

Year Three (3) Perform largescale restoration work within the middle section (between two previously restored areas by the NSSA) of the West River. This work is proposed for 2024.

Year Three (3) through seven (7): Post monitoring of sites where offsetting work was completed. Post-offset monitoring will be completed in years three (3), five (5), and seven (7). A final report will be completed at the end of year seven (7). This work is proposed for 2025, 2027, and 2029.

NS Power has obtained a letter of credit for the offset project for the value of $62,000. The amount of the letter of credit was originally estimated based on the cost for a previous offsetting plan developed by MCG for a project conducted at the Trenton Generating Station in 2019. The value put forward in the Letter of Credit has been deemed appropriate based on the total value of the proposed offsetting work put forward in Appendix N. A Letter of Credit for $62,000 is presented in Appendix O.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Reservoir Bathymetry
3. Ruth Falls Reservoir Location of Structures

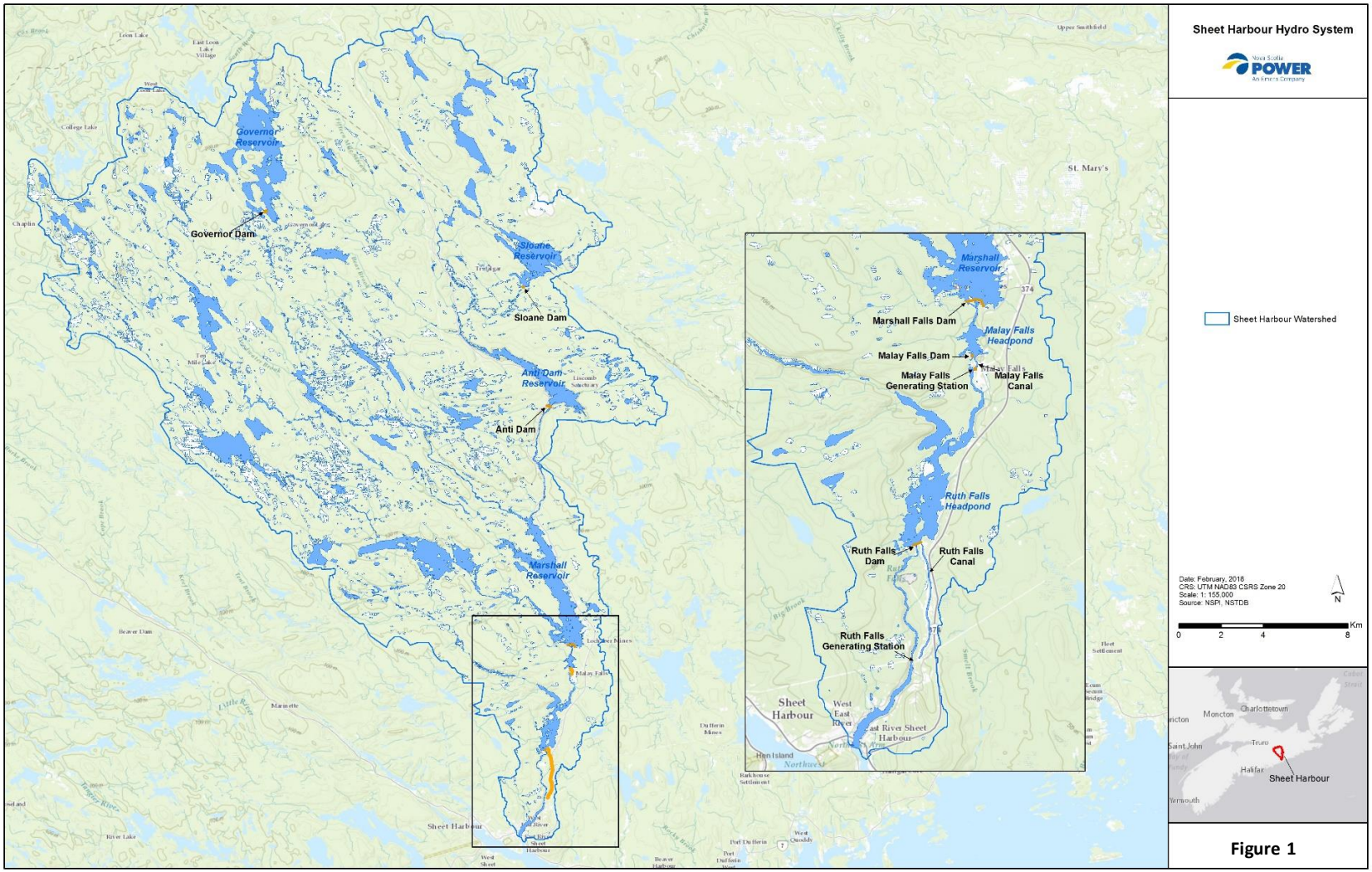

Sheet Harbour Hydro System
Nova Scotia POWER
An Emera Company
Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
Sheet Harbour Watershed
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1: 155,000
Source: NSPI, NSTDB
N
0 2 4 8 Km
Moncton
Charlottetown
Saint John
Truro
Halifax
Sheet Harbour

Figure 1

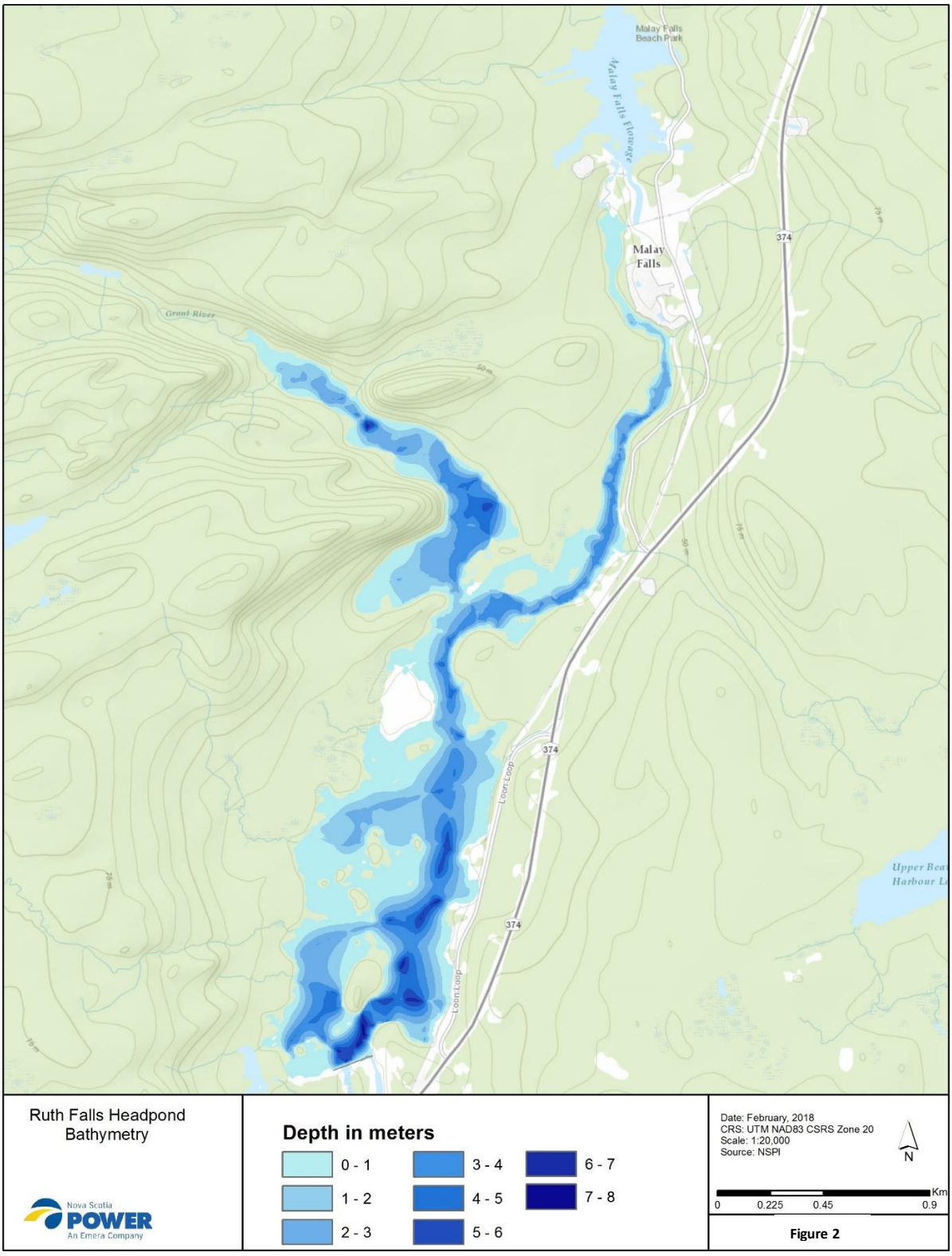

Malay Falls Beach Park
Malay Falls Tramway
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Bea
Harbour L
Ruth Falls Headpond Bathymetry
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
N
Km
0
0.225
0.45
0.9
Nova Scotia POWER
An Emera Company

Figure 2


Ruth Falls Fish Ladder
Ruth Falls Canal
Ruth Falls Dam/ Spillway
Ruth Falls Spillway Channel
November 2, 2017
GeoBase_AboriginalLands
Wetland of Special Significance
NSDNR Wetland Inventory
Existing and Pending Protected Areas
Protected Watershed
Municipal Water Supply
Parks
DNR-RLUL
1:4,514
0 0.035 0.07
0 0.0425 0.085 0.17 km
DNR, NSE, IBA
Nova Scotia Environment, courtesy of the Nova Scotia Departme

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

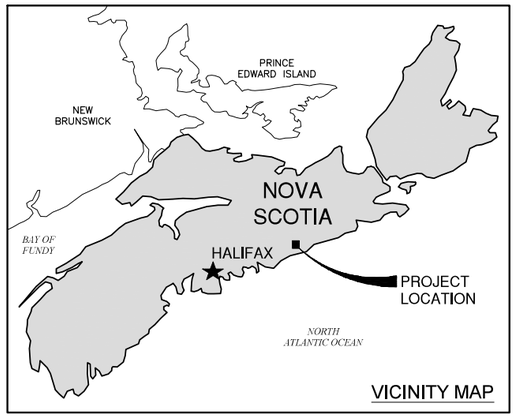
APPENDIX C – ENGINEERING DRAWINGS – DAM STRUCTURE

DWG. NO. H096H1163100040

NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

COVER SHEET

DWG.NO. H096H1163100040 REV. C

DWG. NO. H096H1163100041

DRAWING LIST					
SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-052
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-056
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320-02	NEW STEEL GRATED ACCESS PLATFORM	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-060

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DRAWING LIST

DWG.NO. H096H1163100041 REV. C

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CI 50518 NSUARB IR-12 Attachment 10 Page 62 of 591

GENERAL NOTES

1. GENERAL:

   A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.

   B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.

   C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.

2. SURVEY:

   A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.

   B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.

   C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.

   D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.

   E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT

3. DESIGN LOADS:

   A. NORMAL HEADPOND: EL. 109.25 FT

   B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS

   C. SEISMIC COEFFICIENT: 0.1g

   D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT

4. JOB CONDITIONS:

   A. SITE INFORMATION:

      I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.

   B. EXISTING UTILITIES:

      I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.

      II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.

      III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.

      IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.

5. QUALITY ASSURANCE:

   A. HORIZONTAL AND VERTICAL CONTROL:

      I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.

      II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.

   B. OWNER'S REPRESENTATIVE:

      I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.

      II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBRGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.

      III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.

      IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.

6. EROSION & SEDIMENT CONTROL:

   A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.

   B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.

   C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.

7. DEMOLITION:

   A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.

   B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.

   C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.

   D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.

   E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.

   F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.

8. MATERIALS:

   A. STEEL:

      I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.

      II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.

      III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.

      IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.

   B. CONCRETE:

      SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

      SURFACE PREP:

      I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.

      II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.

      III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.

      IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.

      V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

      SPECIFICATIONS:

      I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),

      II. MAX W/C RATIO 0.45

      III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.

      IV. AIR ENTRAINMENT 6–8%

      V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")

      VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")

      VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".

      VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.

      IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.

      X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.

      XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.

   C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT

      I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE

      II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.

      III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS

      IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.

9. SUBMITTALS:

   A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.

   B. EXCAVATION AND FILL PLAN:

      I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:

      - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
      - ACCESS TO EACH AREA.
      - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
      - EQUIPMENT TO BE USED IN EACH AREA.
      - MONITORING AND QUALITY CONTROL PROCEDURES.
      - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.

   C. DEWATERING PLAN:

      I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:

      - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
      - EQUIPMENT TO BE USED.
      - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
      - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.

   D. EMERGENCY SEEPAGE PLAN:

      I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:

      - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
      - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).

   E. WINTERIZATION PLAN:

      I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.

   F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:

      I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.

      - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
      - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.

   G. BORROW SOURCE(S):

      I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.

      - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.

   H. QUALITY CONTROL TESTING REPORTS:

      I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.

      - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
      - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.

10. EARTHWORK:

    A. SEE SHEET 310–04 FOR EARTHWORK.

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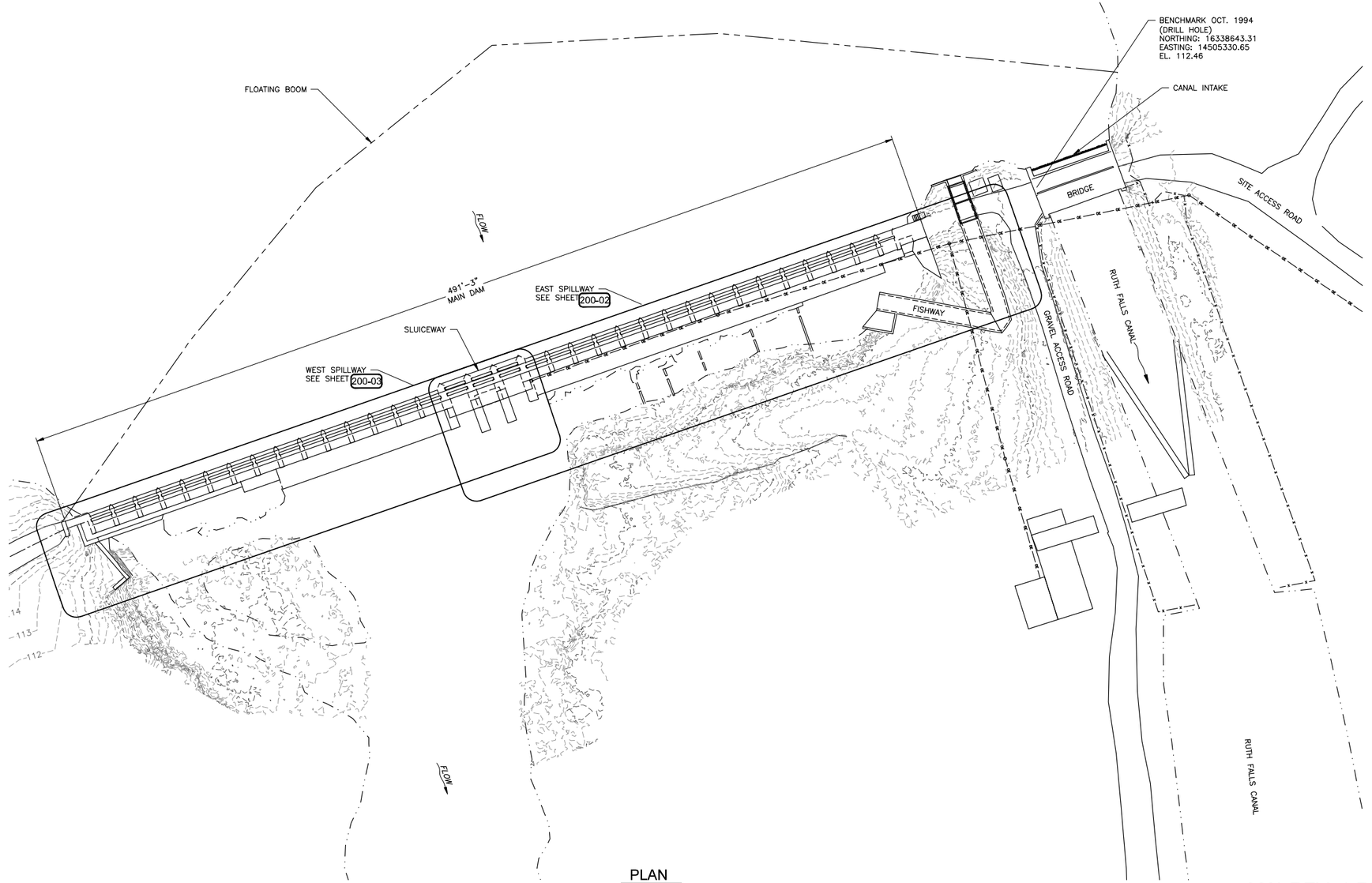
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GENERAL NOTES

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RUTH FALLS REFURBISHMENT PRJECT

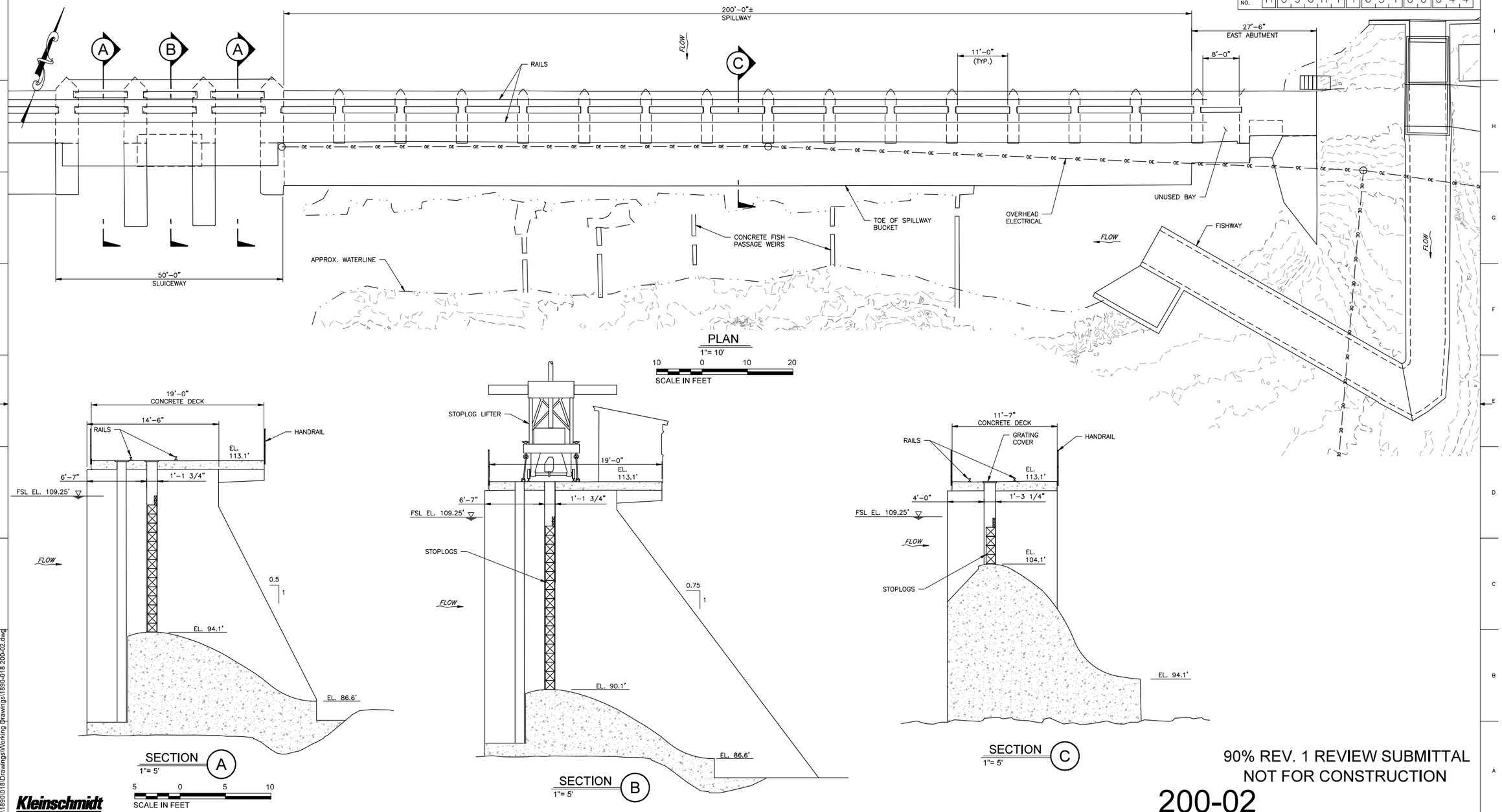
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PLAN
1"= 10'

10 0 10 20
SCALE IN FEET

SECTION A
1"= 5'

5 0 5 10
SCALE IN FEET

SECTION B
1"= 5'

SECTION C
1"= 5'

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RUTH FALLS REFURBISHMENT PRJECT

EXISTING CONDITIONS EAST SPILLWAY
PLAN AND SECTION

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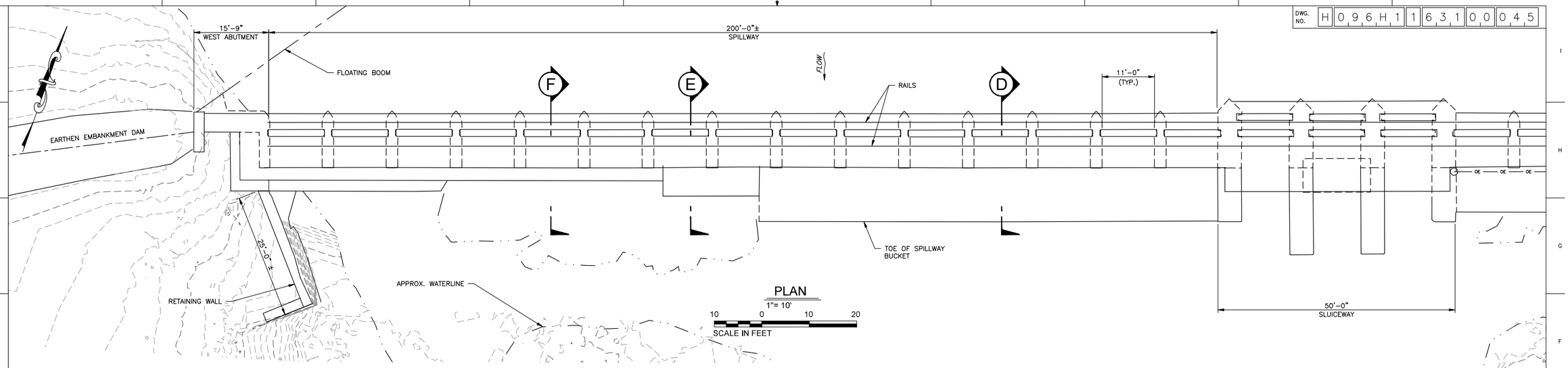
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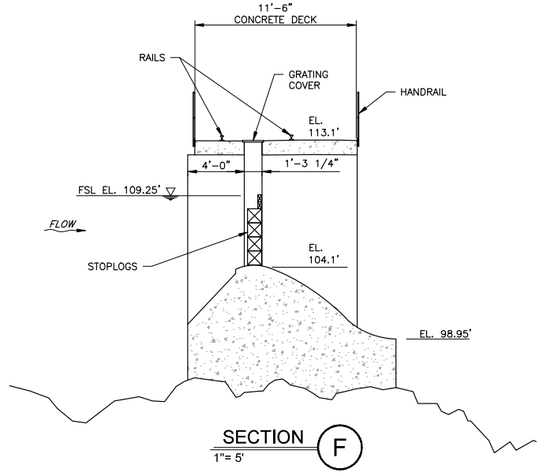
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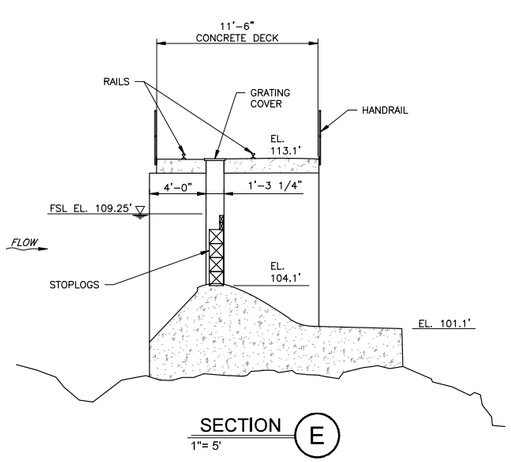
CI 50518 NSUARB IR-12 Attachment 10 Page 65 of 591

DWG. NO. H096H1163100045



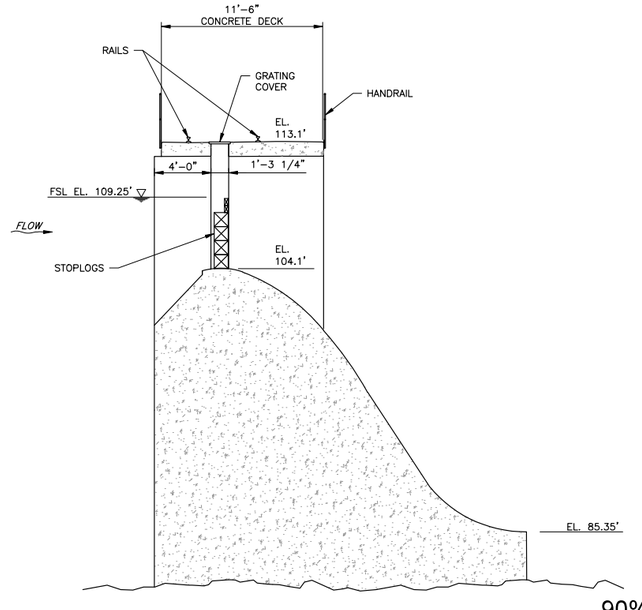


SECTION F
1"= 5'



SECTION E
1"= 5'

5 0 5 10
SCALE IN FEET



SECTION D
1"= 5'

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

200-03

J:\1890\0181\Drawings\Working Drawings\1890-018 200-03.dwg
PRINTED: Dec. 9, 2020 - 3:36 PM

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REFERENCE DRAWINGS	DWG.NO.											

REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

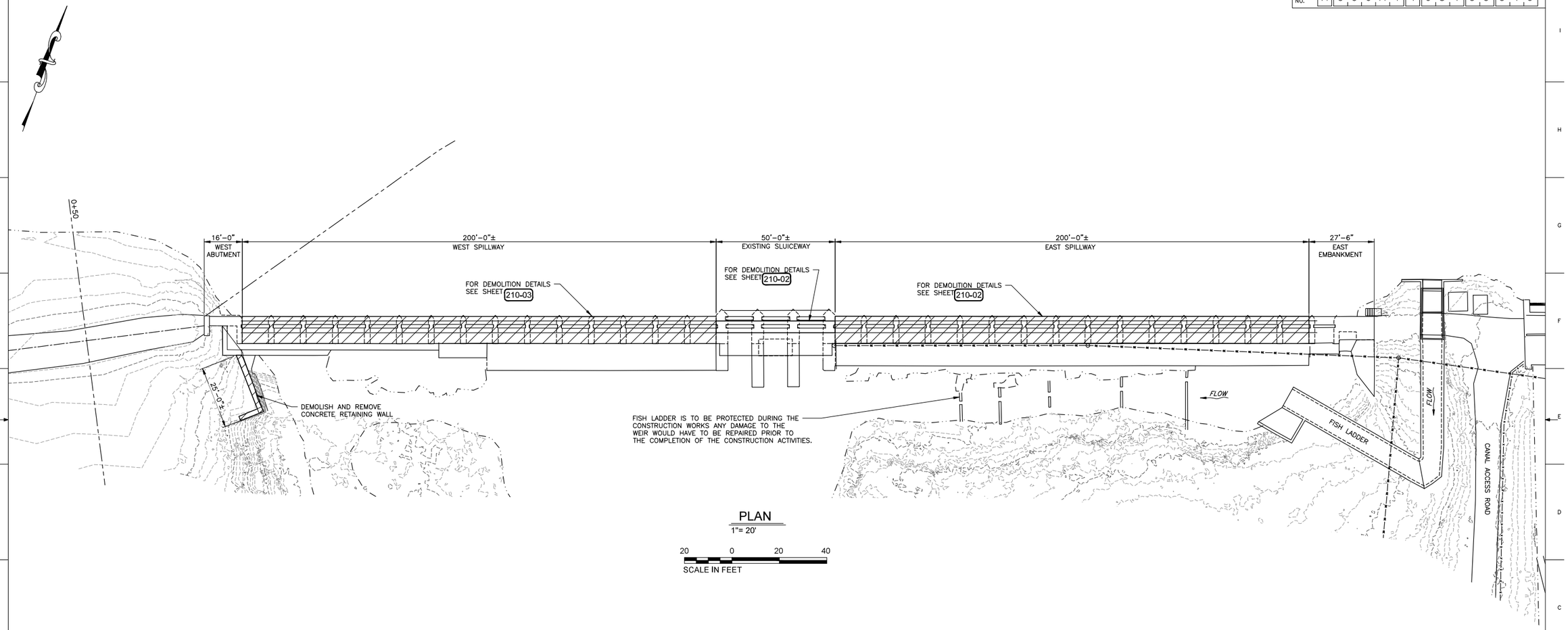
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS

DWG.NO. H096H1163100045 REV. C

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

CI 50518 NSUARB IR-12 Attachment 10 Page 66 of 591

DWG. NO. H096H1163100046



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

210-01

Kleinschmidt

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	-----	E & I	-----
MECH	-----	CONST	-----

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2020-12-11
W.O.	XXXX

Nova Scotia POWER An Emera Company energy everywhere.

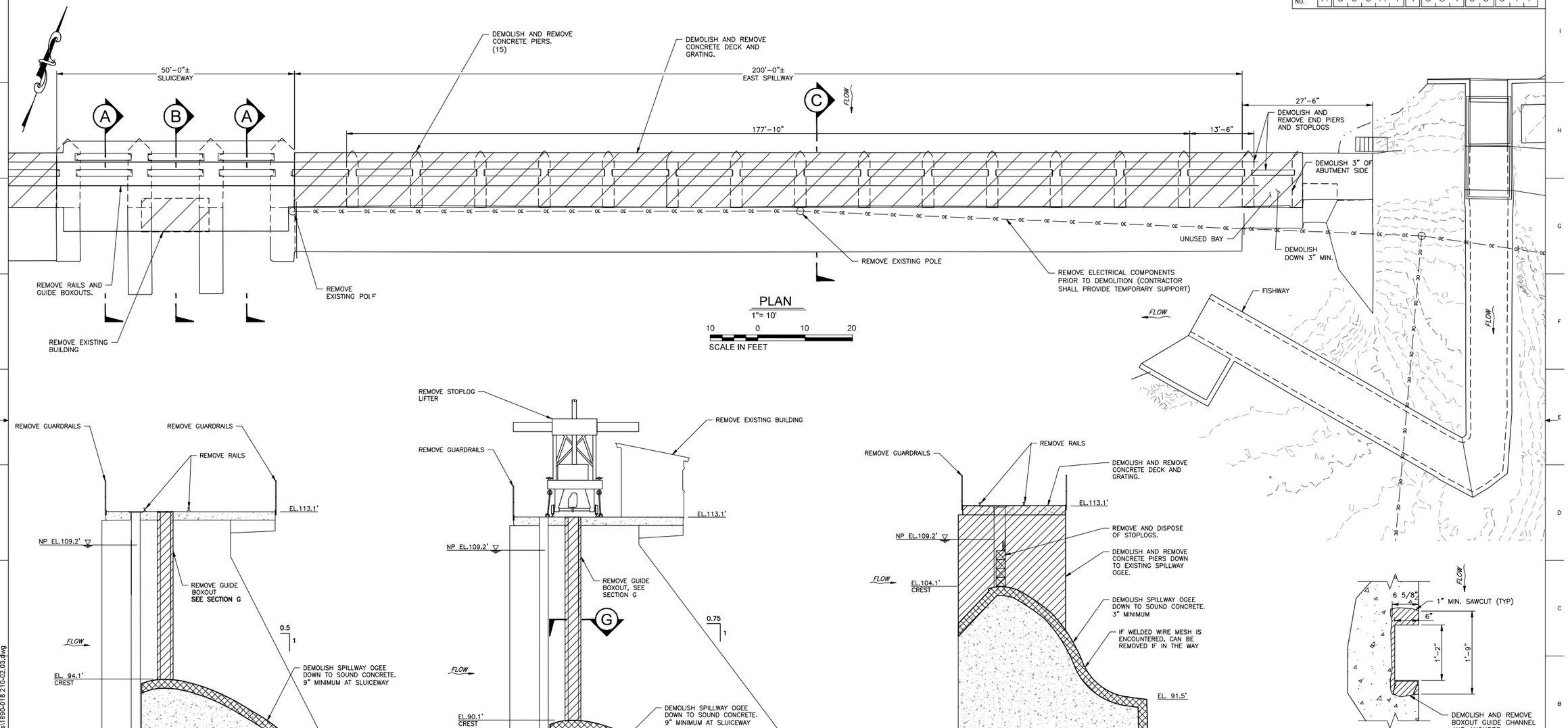
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO PLAN

DWG.NO. H096H1163100046 REV. C

DWG. NO. H096H1163100047



PLAN
1"= 10'

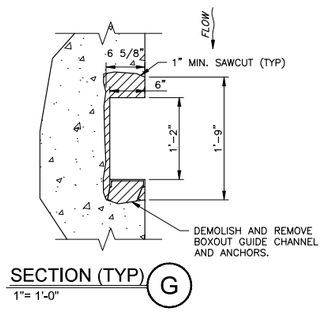
10 0 10 20
SCALE IN FEET

SECTION A
3/16"= 1'-0"

SECTION B
3/16"= 1'-0"

SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

210-02

Kleinschmidt

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RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———
MECH ——— CONST ———

APPROVED

DATE .

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED --
DATE 2020-12-11
W.O. XXXX

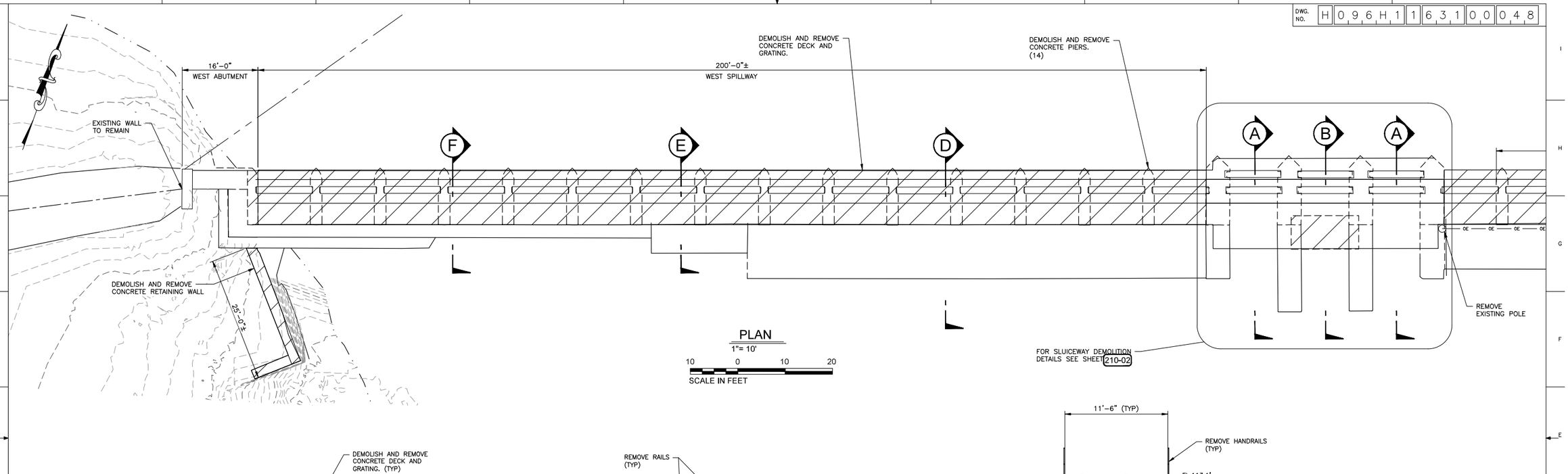
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

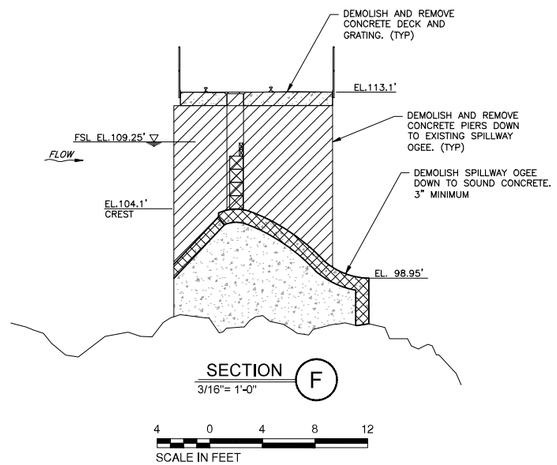
DWG.NO. H096H1163100047 REV. C

DWG. NO. H096H1163100048



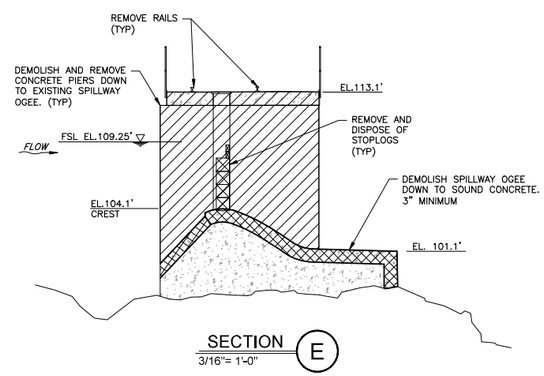
PLAN
1"= 10'

10 0 10 20
SCALE IN FEET

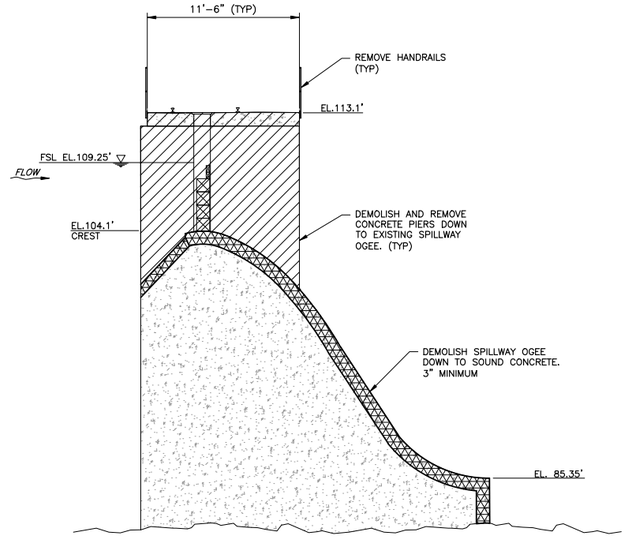


SECTION F
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION D
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

210-03

Kleinschmidt

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REFERENCE DRAWINGS	DWG.NO.														

REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

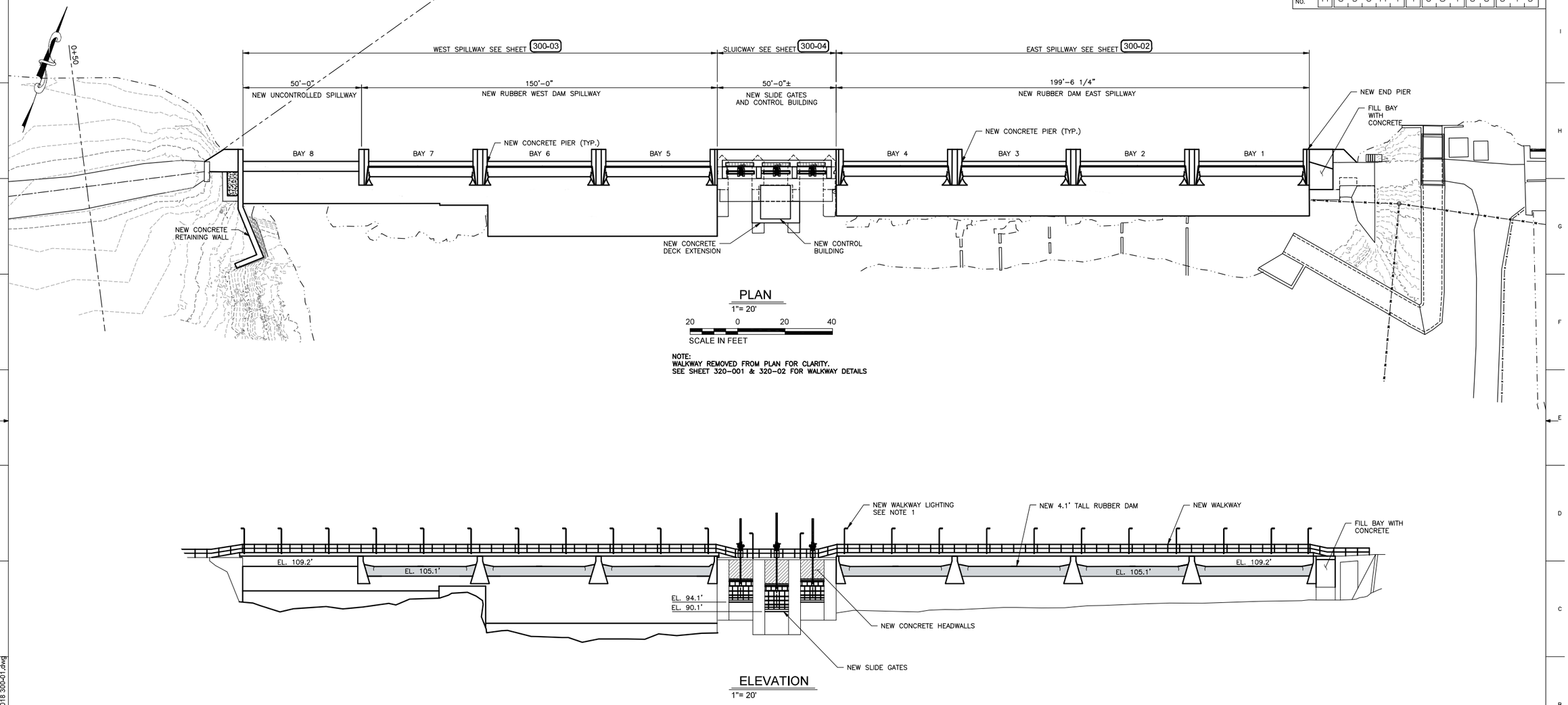
SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT
TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. C

DWG. NO. H096H11631000049



NOTE:
1. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

300-01

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.											

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____–__–__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	-----	E & I	-----
MECH	-----	CONST	-----

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	--
CHECKED	--
DATE	2020–12–11
W.O.	XXXX

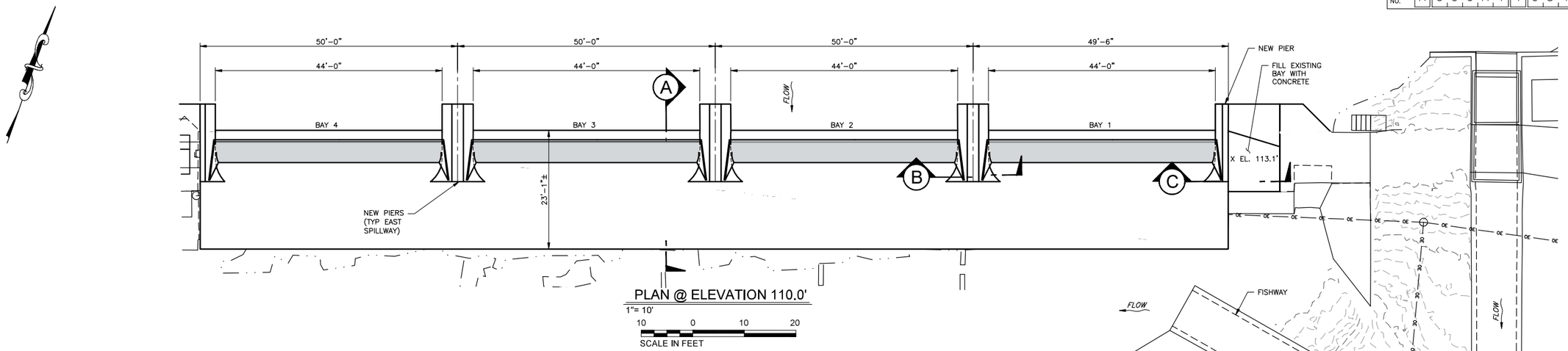
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW CONDITIONS
DAM PLAN AND ELEVATION

DWG.NO. H096H11631000049 REV. C

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DWG. NO. H096H1163100050

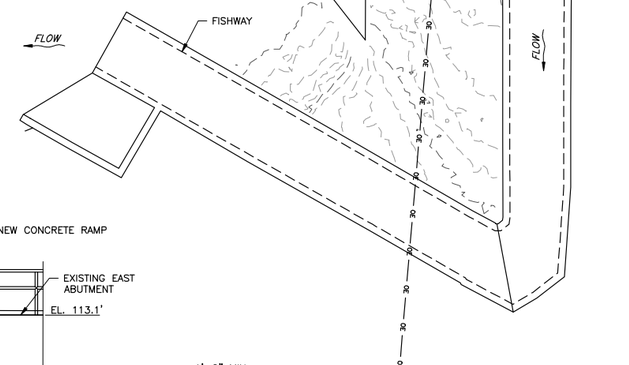


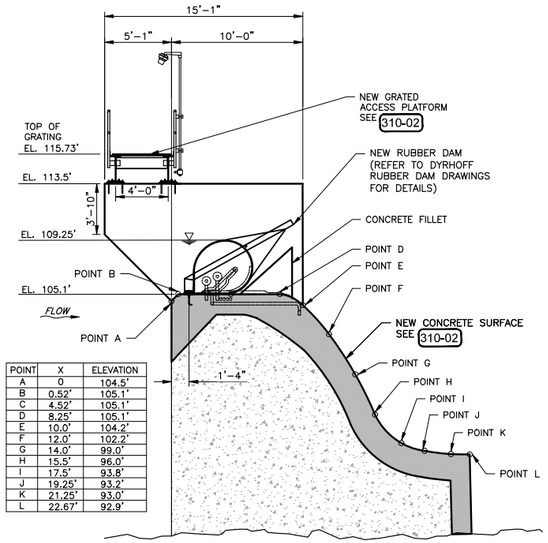
PLAN @ ELEVATION 110.0'

1"= 10'

10 0 10 20

SCALE IN FEET





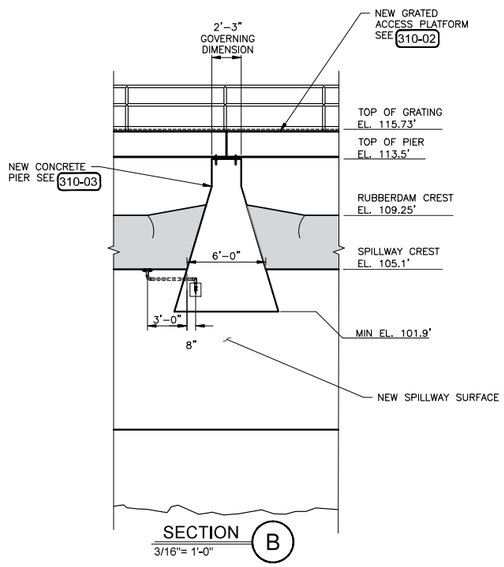
POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5	93.8'
J	19.25'	93.2'
K	21.25'	93.0'
L	22.67'	92.9'

SECTION A

3/16"= 1'-0"

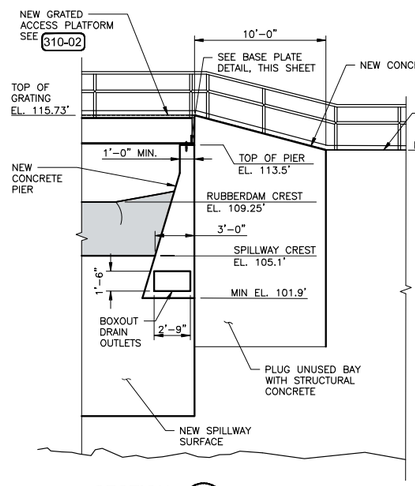
4 0 4 8 12

SCALE IN FEET



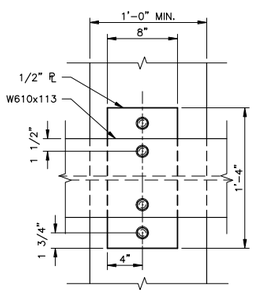
SECTION B

3/16"= 1'-0"



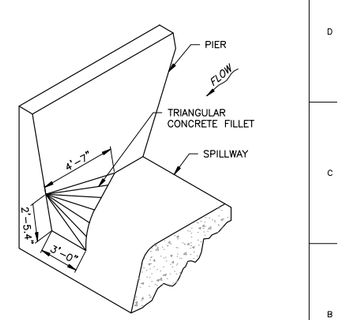
SECTION C

3/16"= 1'-0"



TYPICAL END PIER BASE PLATE DETAIL

1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.

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NOT FOR CONSTRUCTION

300-02

Kleinschmidt

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REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED

CHECKED

DATE 2020-12-11

W.O. XXXX

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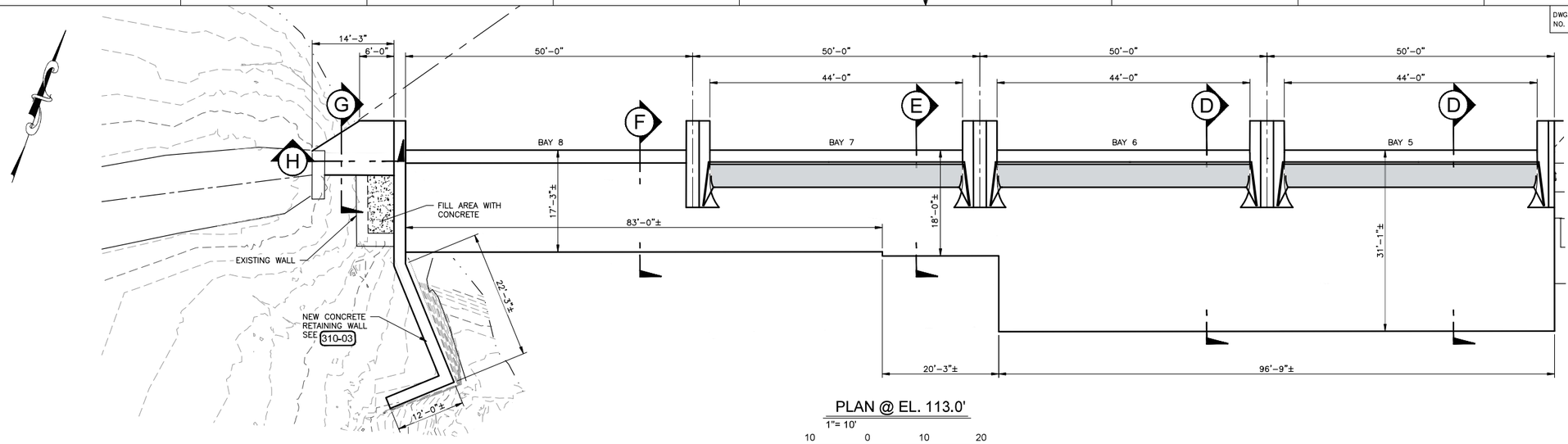
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

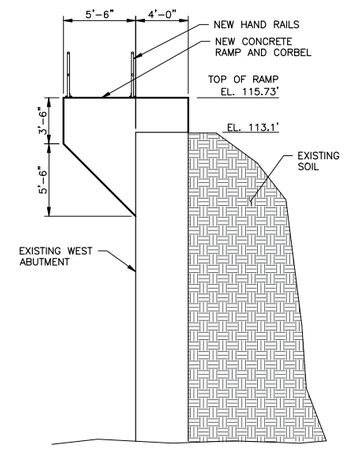
DWG.NO. H096H1163100050 REV. C

DWG. NO. H096H1163100051

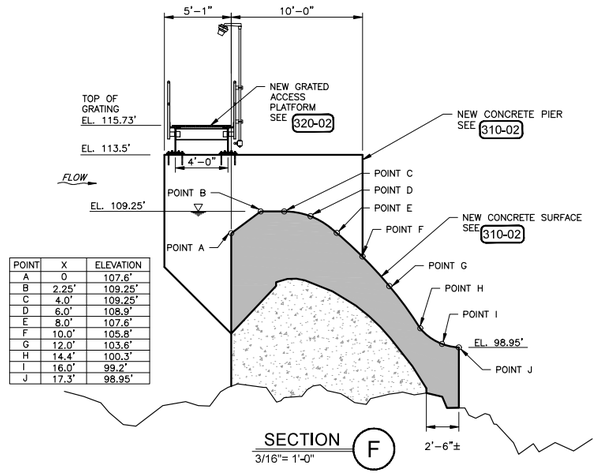


PLAN @ EL. 113.0'
1"= 10'
10 0 10 20
SCALE IN FEET

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS

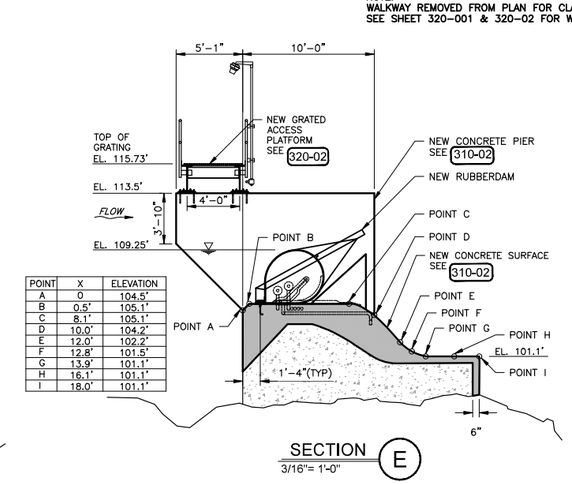


SECTION G
3/16"= 1'-0"



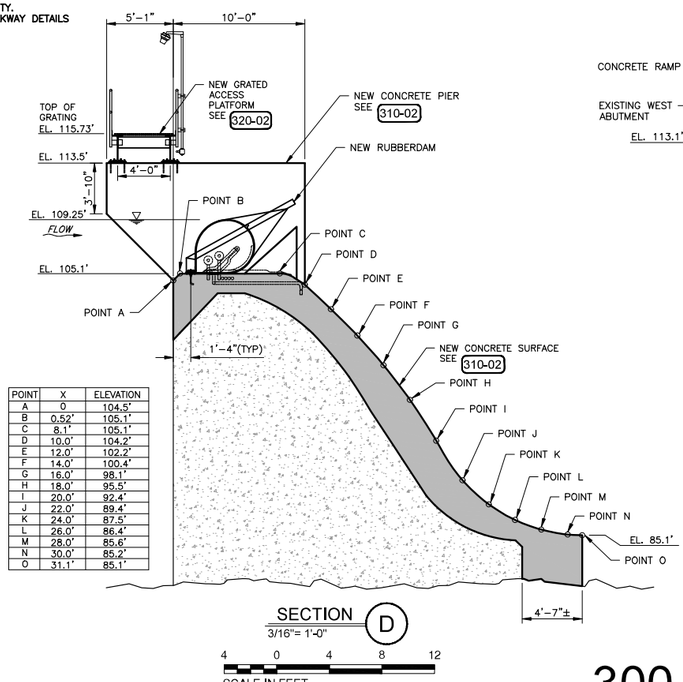
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

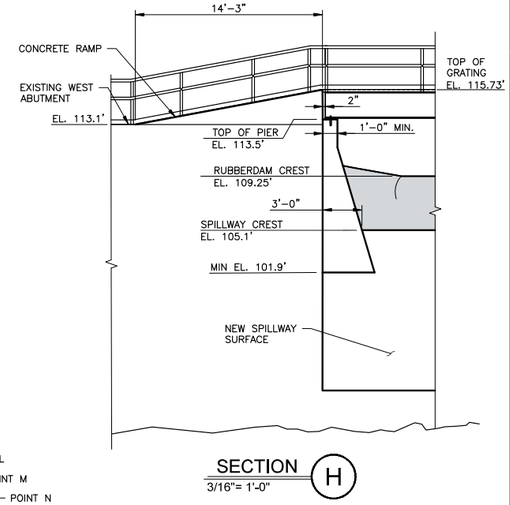
SECTION E
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION H
3/16"= 1'-0"

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Kleinschmidt

300-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

SEAL

DEPARTMENTAL APPROVALS

CIVIL ----- E & I -----
MECH ----- CONST -----
APPROVED
DATE .

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED --
DATE 2020-12-11
W.O. XXXX

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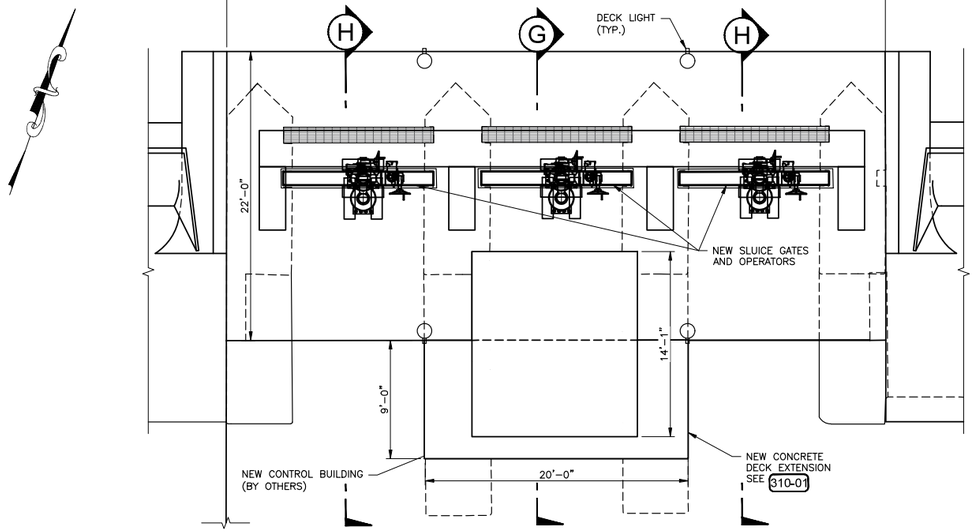
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

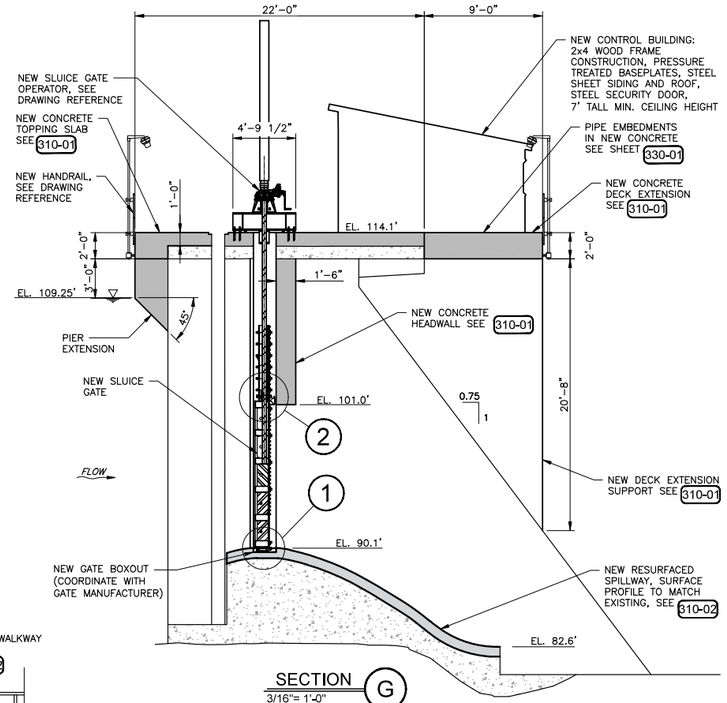
DWG.NO. H096H1163100051 REV. C

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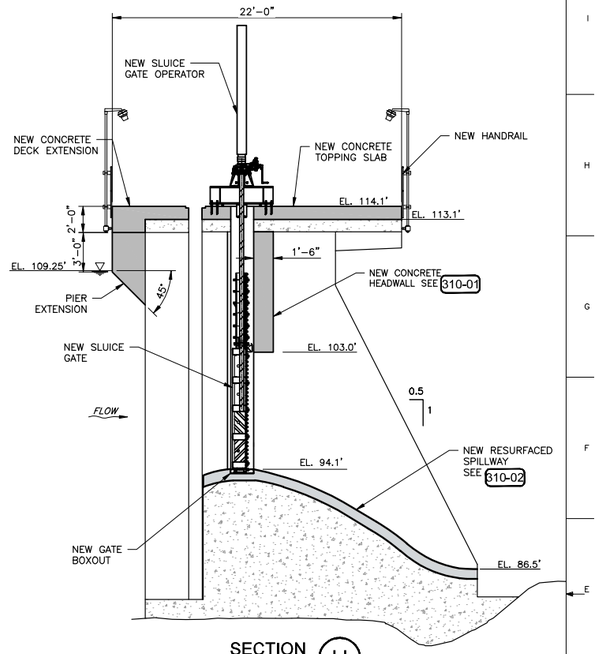
DWG. NO. H096H1163100052



PLAN
3/16"=1'-0"

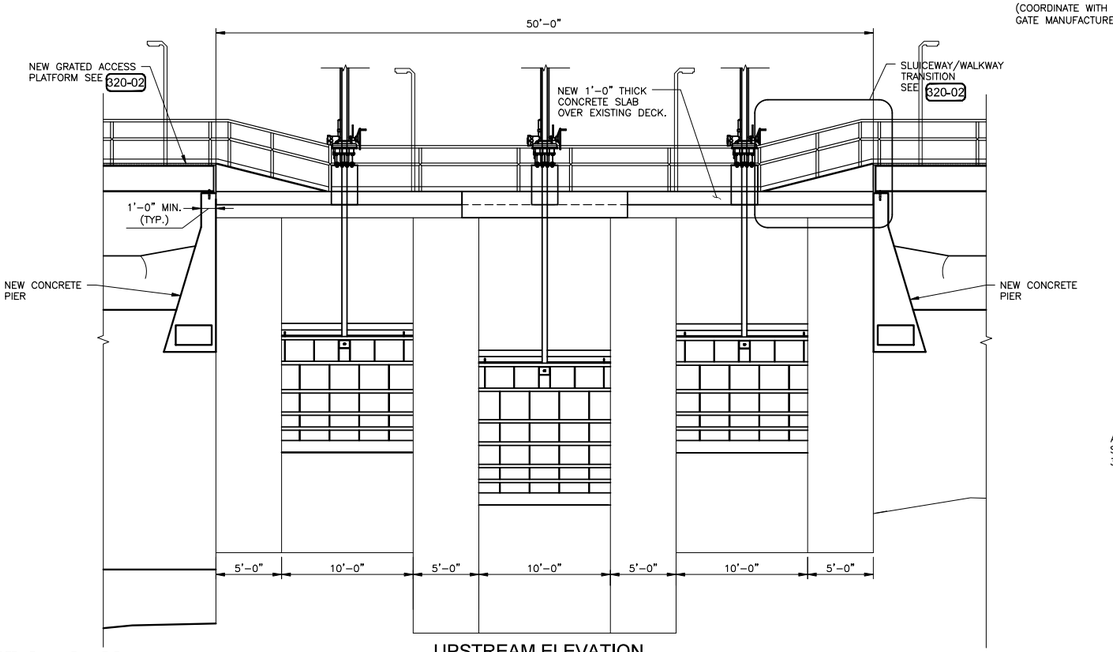


SECTION G
3/16"= 1'-0"

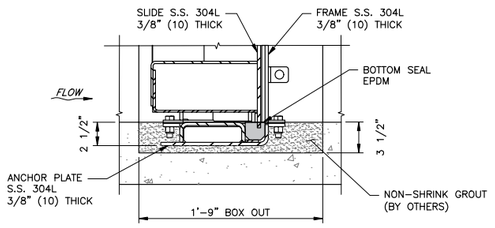


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

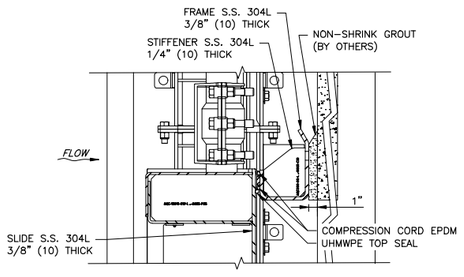


UPSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-04

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REFERENCE DESCRIPTION	A X X X X X X X X X X X X
STANDARD GUARD SYSTEMS DETAILS	H 0 0 1 H 0 1 6 9 0 0 0 0 1
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22	
REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2020-12-11
W.O.	XXXX

Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

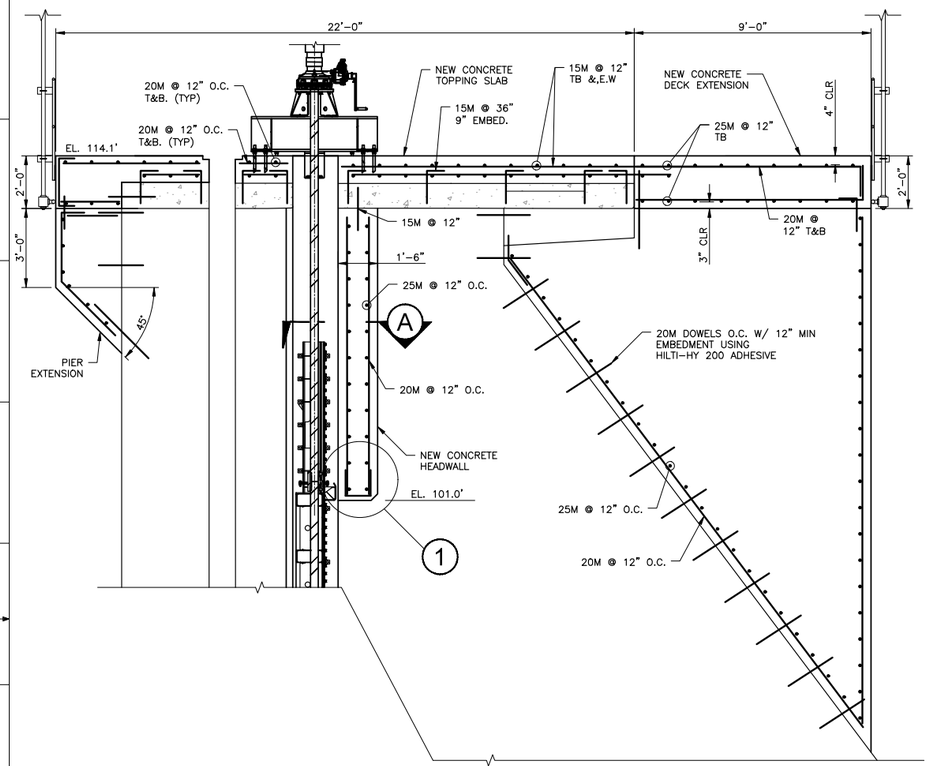
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

DWG.NO. H096H1163100052 REV. C

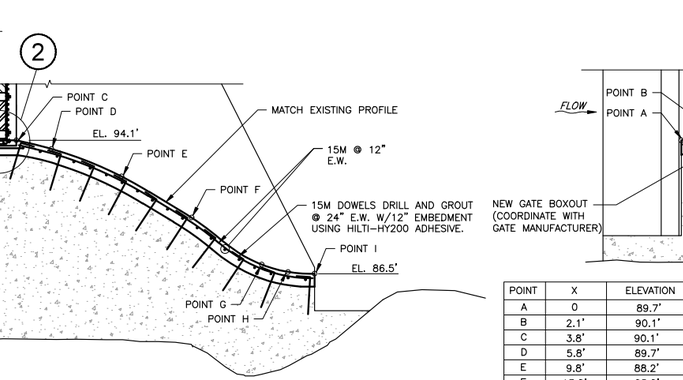
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DWG. NO. H096H1163100053

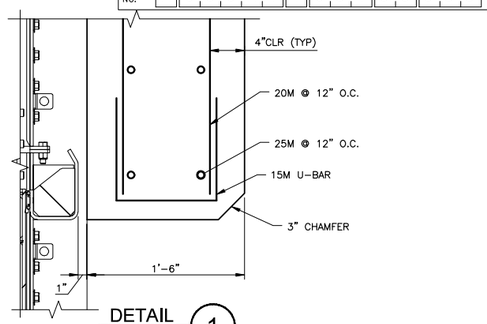


INNER SLUICEWAY DETAIL
3/8"= 1'-0"

2 0 2 4 6
SCALE IN FEET

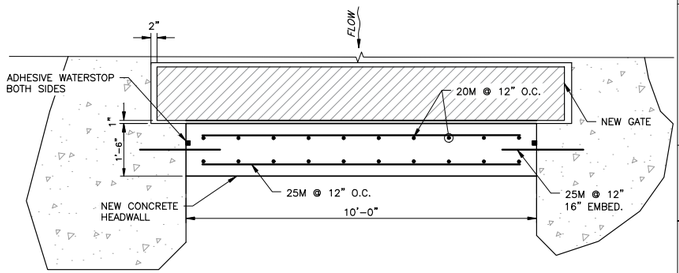


OUTER SLUICEWAY DETAIL
3/8"= 1'-0"



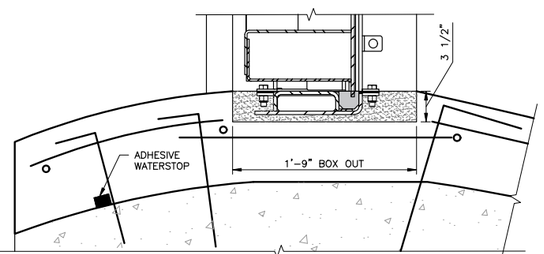
DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



SECTION A
1/2"= 1'-0"

2 0 2 4
SCALE IN FEET



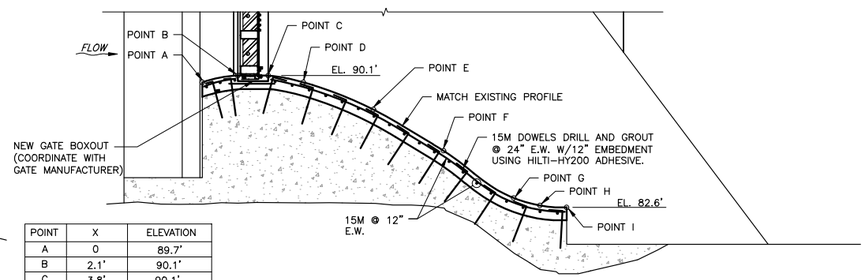
DETAIL 2
1 1/2"= 1'-0"

2

POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL
1/4"= 1'-0"

4 0 4 8
SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL
1/4"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-01

J:\1890\018\Drawings\Working Drawings\1890-018 310-01.dwg
PRINTED: Dec. 18, 2020 - 8:42 AM

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BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	-----	E & I	-----
MECH	-----	CONST	-----

APPROVED

DATE .

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED --
DATE 2020-12-18
W.O. XXXX

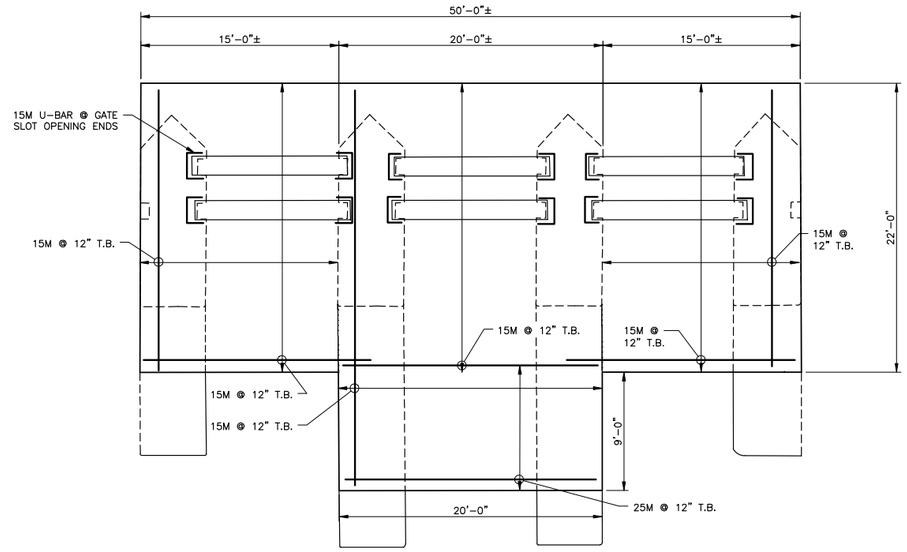
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONCRETE
SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100053 REV. C

DWG. NO. H096H1163100054

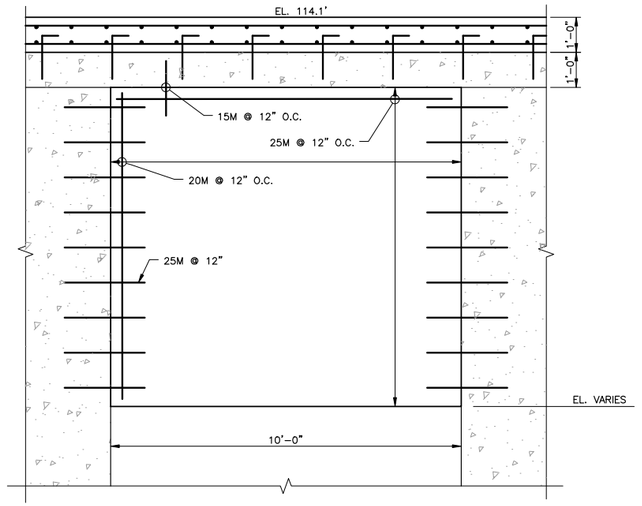


SLUICEWAY DECK REBAR PLAN

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

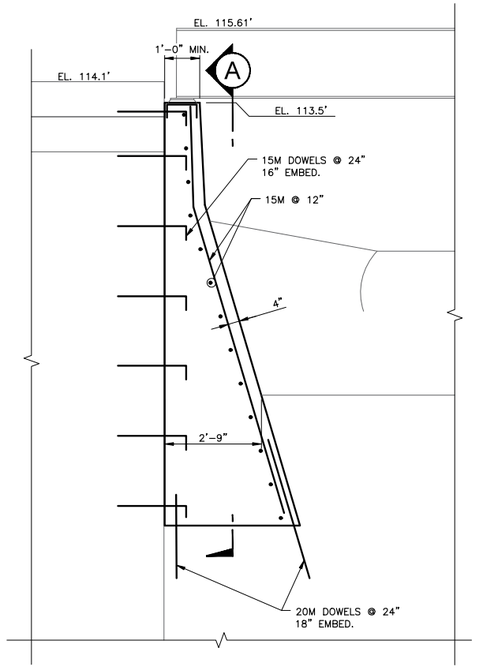


TYPICAL HEADWALL ELEVATION A-A 01

1/2"= 1'-0"

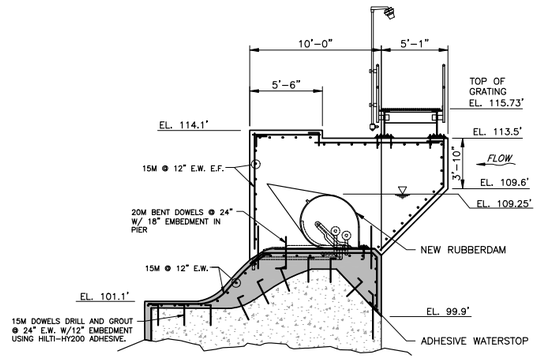
2 0 2 4

SCALE IN FEET



PIER TO SLUICEWAY REBAR DETAIL

1/2"= 1'-0"



SECTION A

3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
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310-02

Kleinschmidt

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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

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DEPARTMENTAL APPROVALS

CIVIL -----	E & I -----
MECH -----	CONST -----

APPROVED

DATE .

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED --
DATE 2020-12-18
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RUTH FALLS

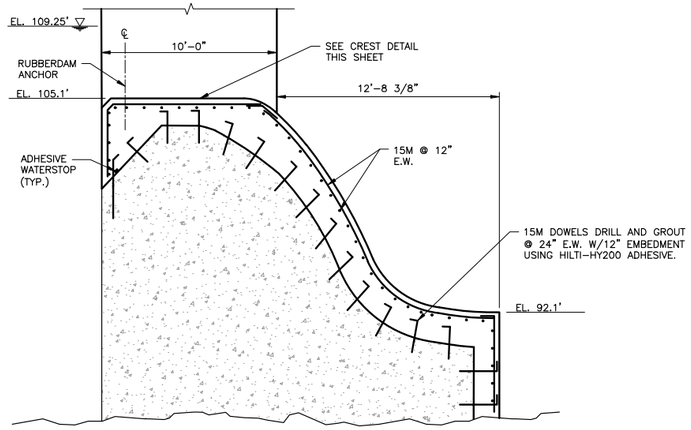
RUTH FALLS REFURBISHMENT PRJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100054 REV. C

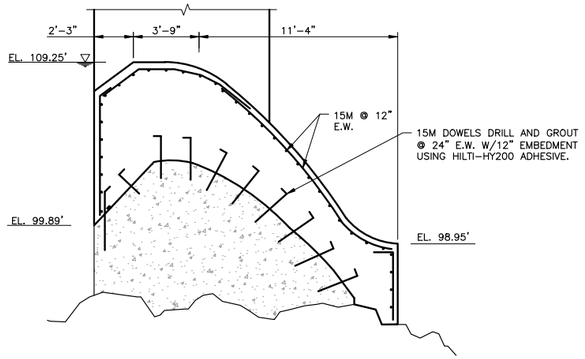
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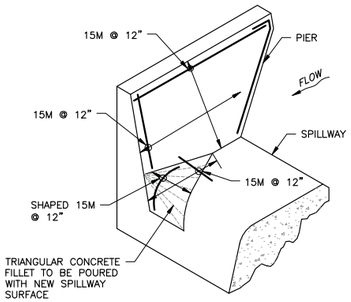
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



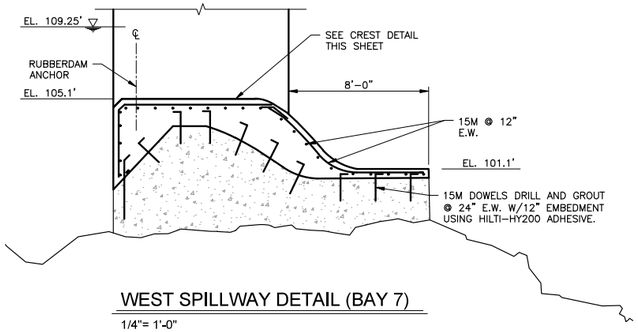
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

1/4"= 1'-0"



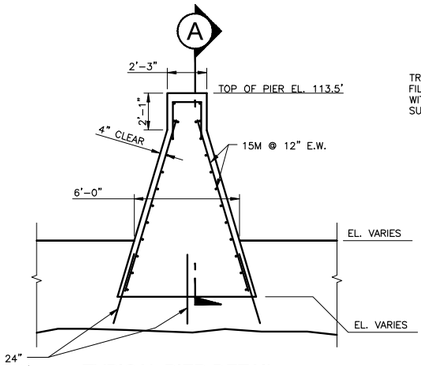
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



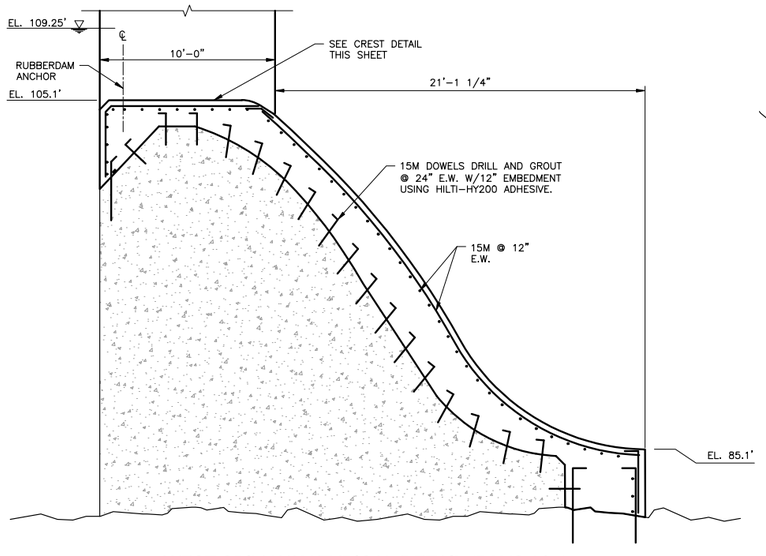
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



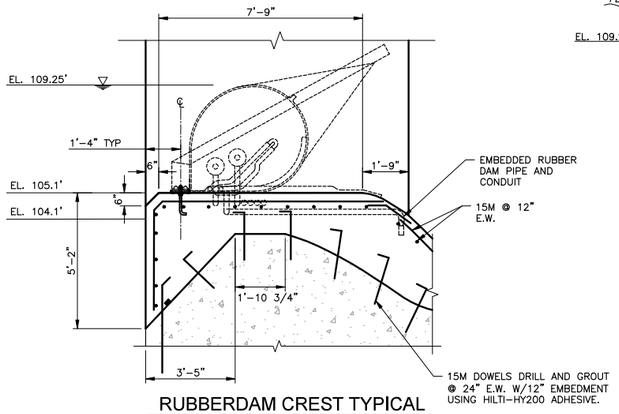
TYPICAL PIER DETAIL

1/4"= 1'-0"



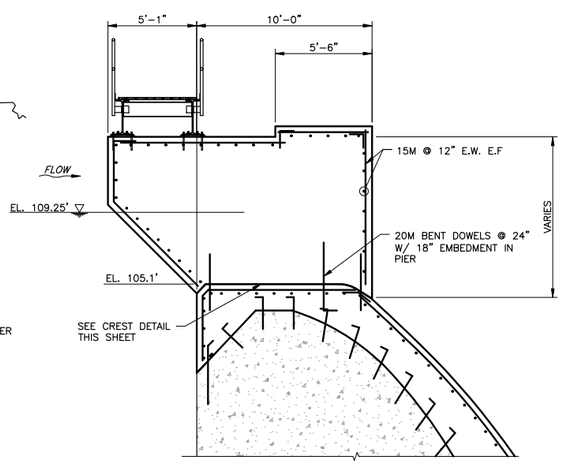
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION (A)

1/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
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310-03

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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

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DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
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CHECKED	__
DATE	2020-12-18
W.O.	XXXX

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RUTH FALLS

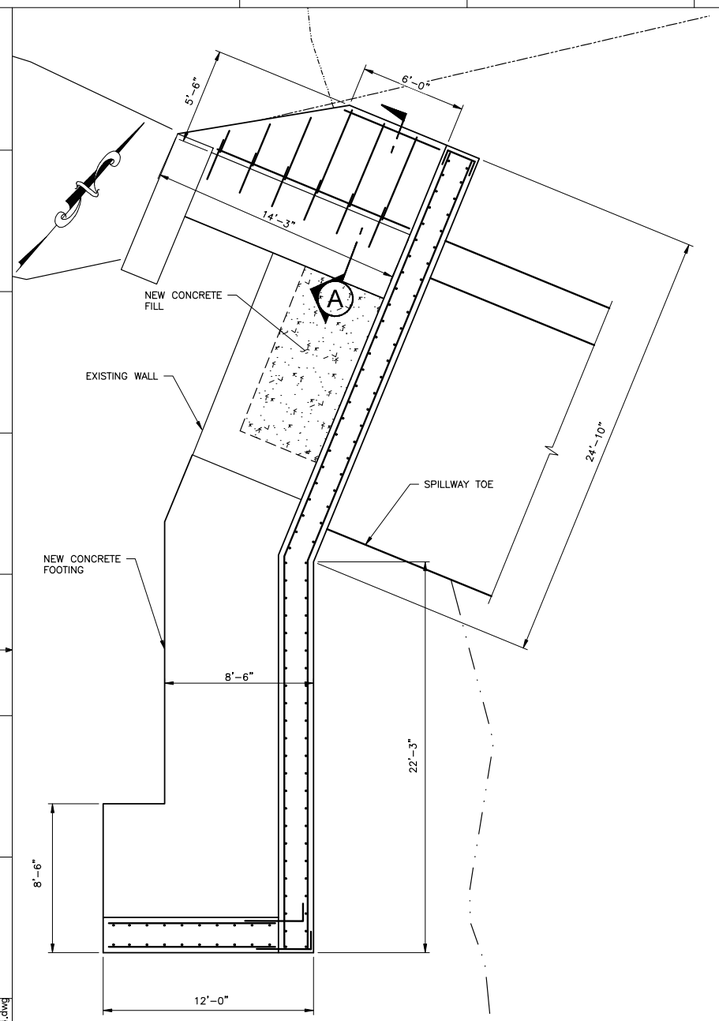
RUTH FALLS REFURBISHMENT PRJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

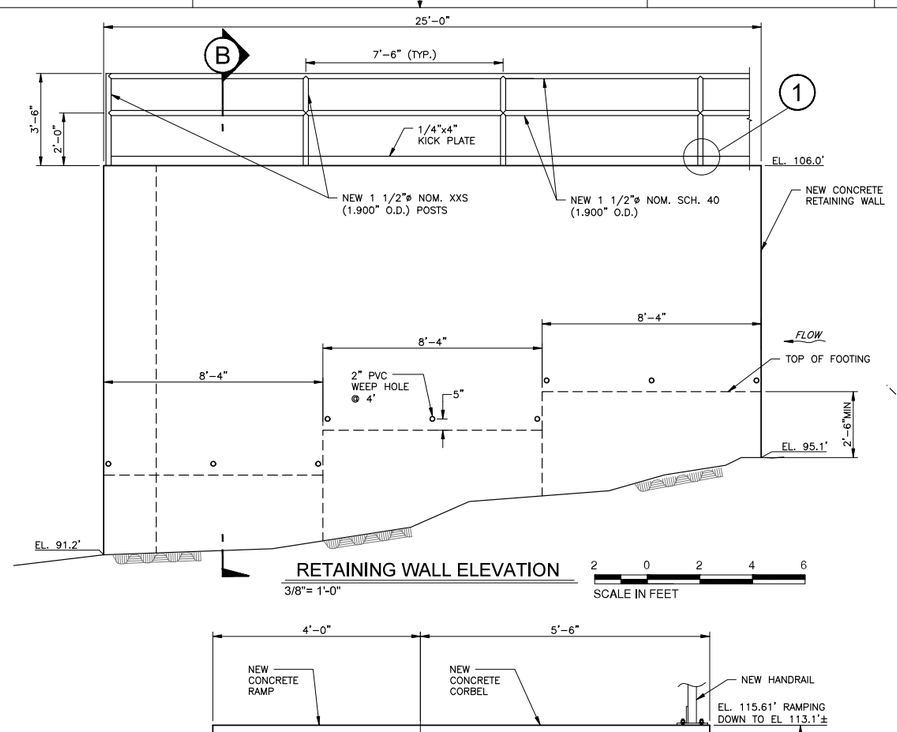
H096H1163100055 REV. C

DWG.NO.

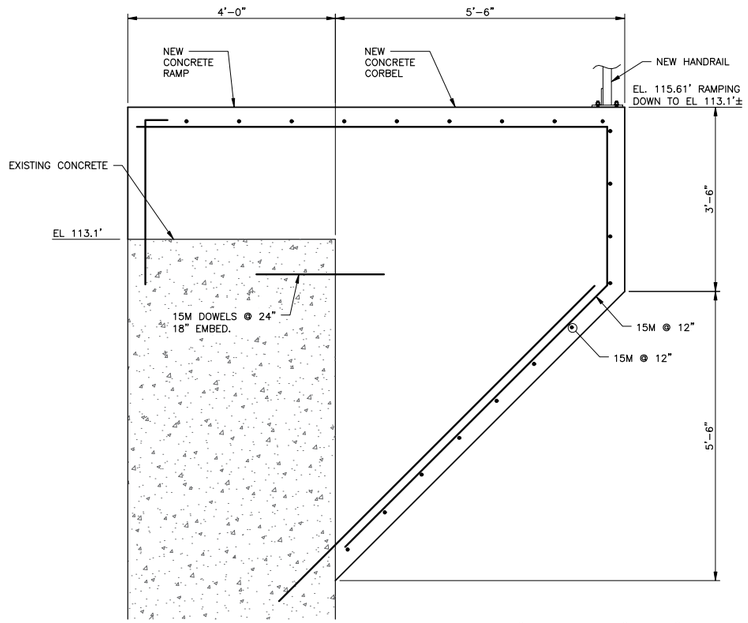
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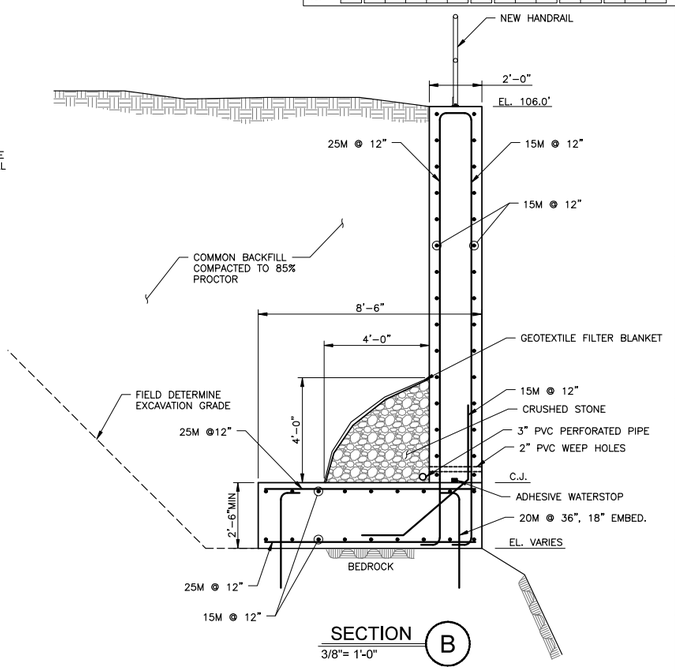
RETAINING WALL PLAN @ EL. 105.0'
1/4"= 1'-0"
4 0 4 8
SCALE IN FEET



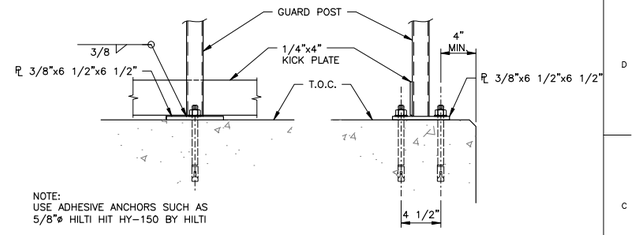
RETAINING WALL ELEVATION
3/8"= 1'-0"
2 0 2 4 6
SCALE IN FEET



SECTION A
3/4"= 1'-0"
1 0 1 2 3
SCALE IN FEET



SECTION B
3/8"= 1'-0"



DETAIL 1
1 1/2"= 1'-0"
8 0 8 16
SCALE IN INCHES

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310-04

Kleinschmidt

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REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

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DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED
DATE

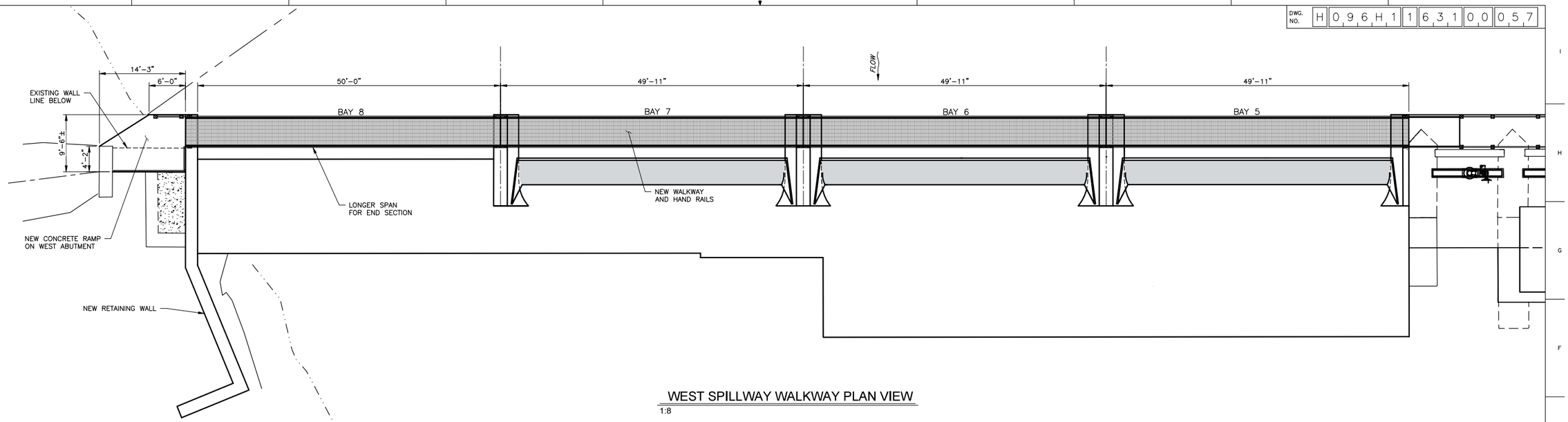
SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-18
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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW CONCRETE RETAINING WALL AND PIER DETAILS

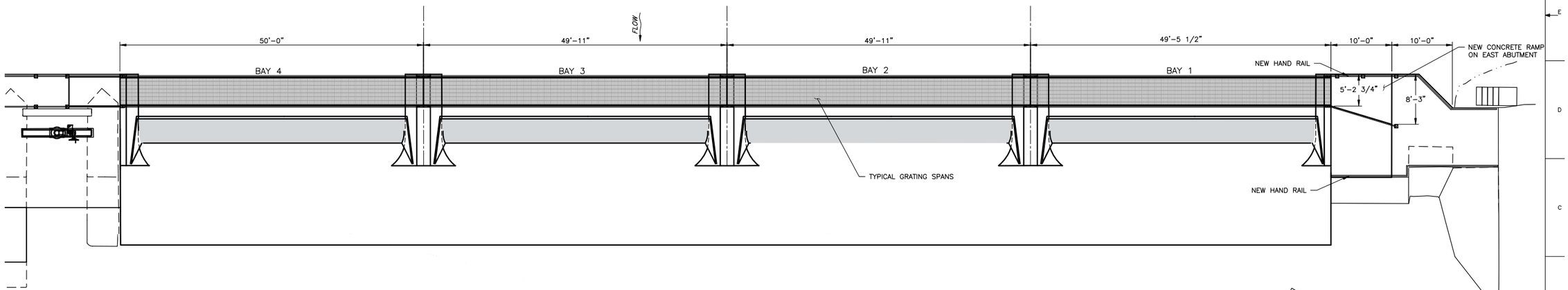
DWG.NO. H096H1163100056 REV. C

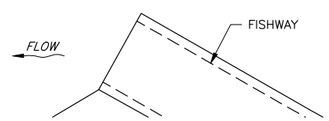
DWG. NO. H096H1163100057



WEST SPILLWAY WALKWAY PLAN VIEW

1:8





EAST SPILLWAY WALKWAY PLAN VIEW

1:8

8 0 8 16

SCALE IN FEET

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320-01

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BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED --

CHECKED --

DATE 2020-12-11

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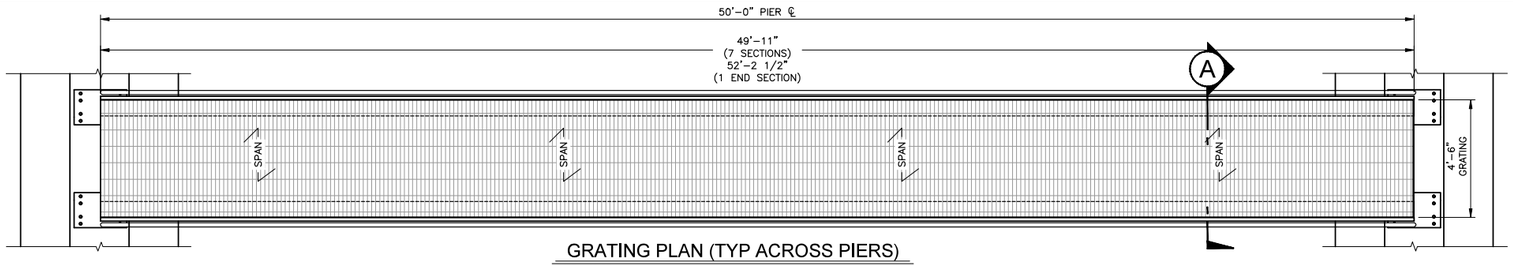
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

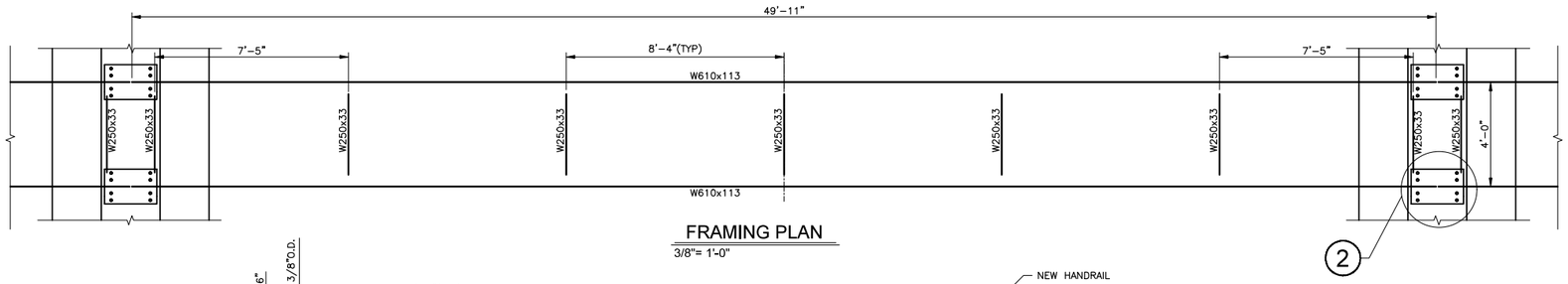
NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW

DWG.NO. H096H1163100057 REV. C

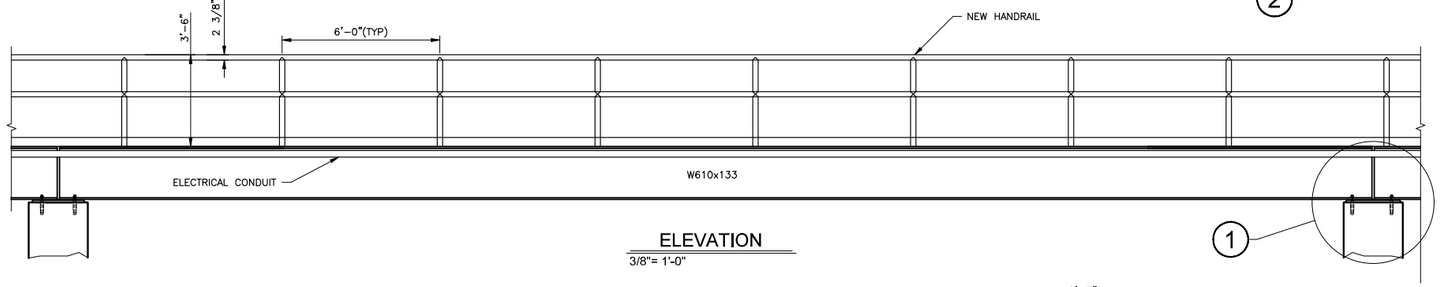
DWG. NO. H096H1163100058



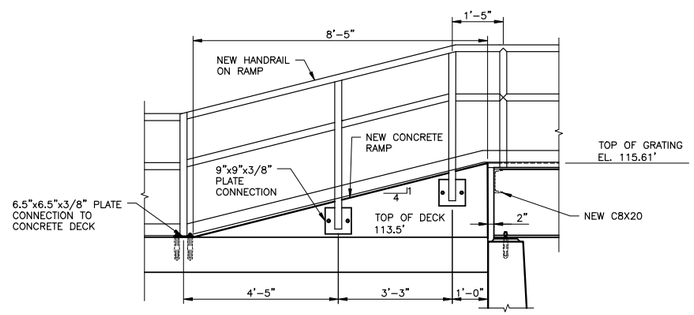
GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"

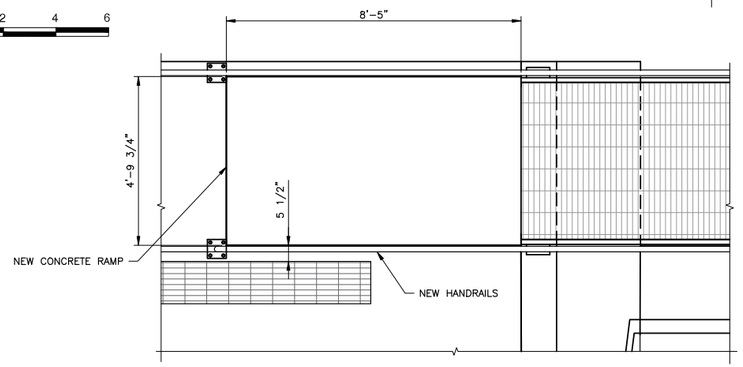


FRAMING PLAN
3/8"= 1'-0"



ELEVATION
3/8"= 1'-0"



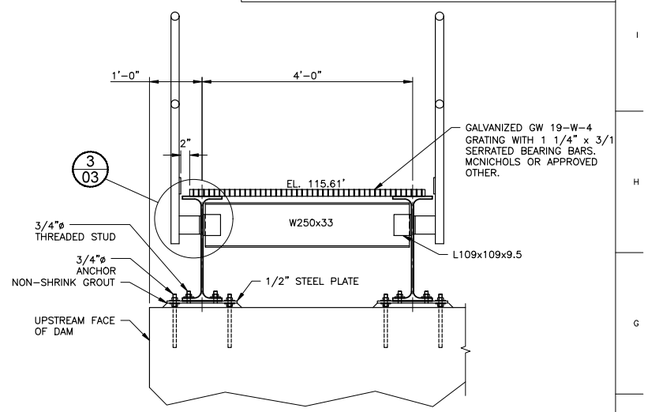


2 0 2 4 6
SCALE IN FEET

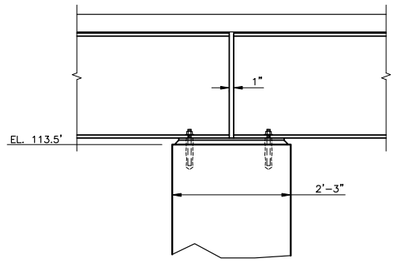
SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

2 0 2 4
SCALE IN FEET

SLUICEWAY/WALKWAY TRANSITION PLAN
1/2"= 1'-0"

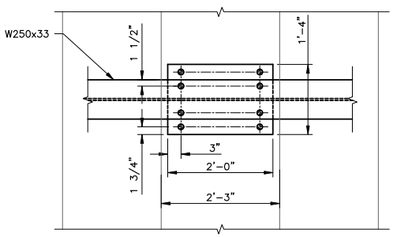


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

1 0 1 2 3
SCALE IN FEET



DETAIL 2
3/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

320-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	0	0	1
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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: _____

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CIVIL		E & I	
MECH		CONST	

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED

CHECKED

DATE 2020-12-11

W.O. XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

NEW STEEL
GRATED ACCESS PLATFORM

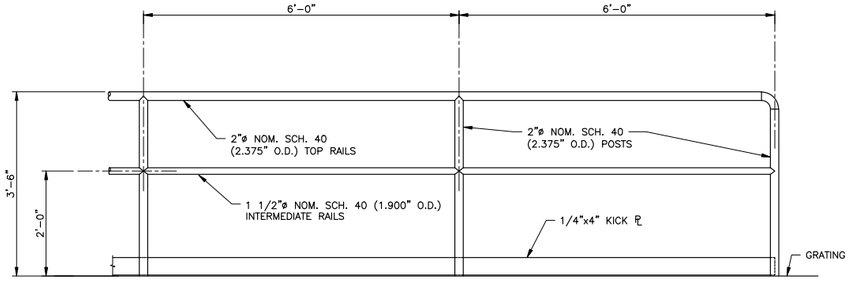
DWG.NO. H096H1163100058 REV. C

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DWG. NO. H096H1163100059

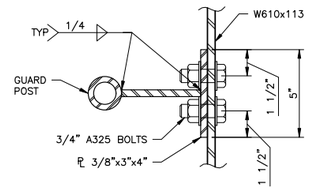


STEEL ACCESS PLATFORM TYPICAL HANDRAIL DETAIL

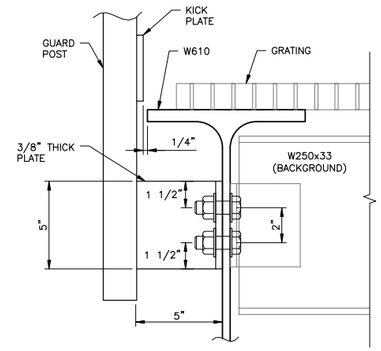
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1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

320-03

Kleinschmidt

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REFERENCE DESCRIPTION	A XXXXX XXXXXX
STANDARD GUARD SYSTEMS DETAILS	H001H0 16900001
REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

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Nova Scotia POWER An Emera Company energy everywhere.

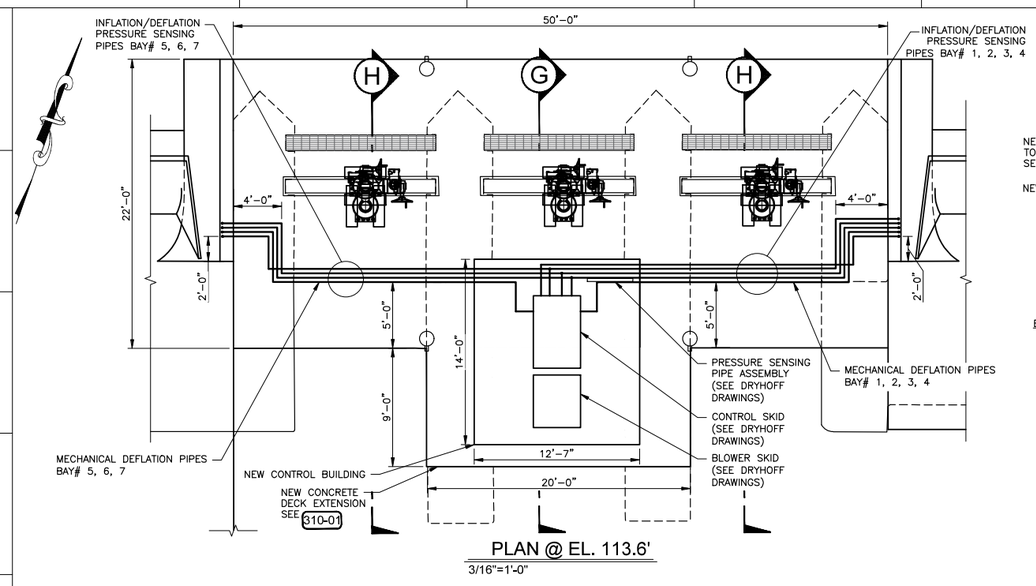
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

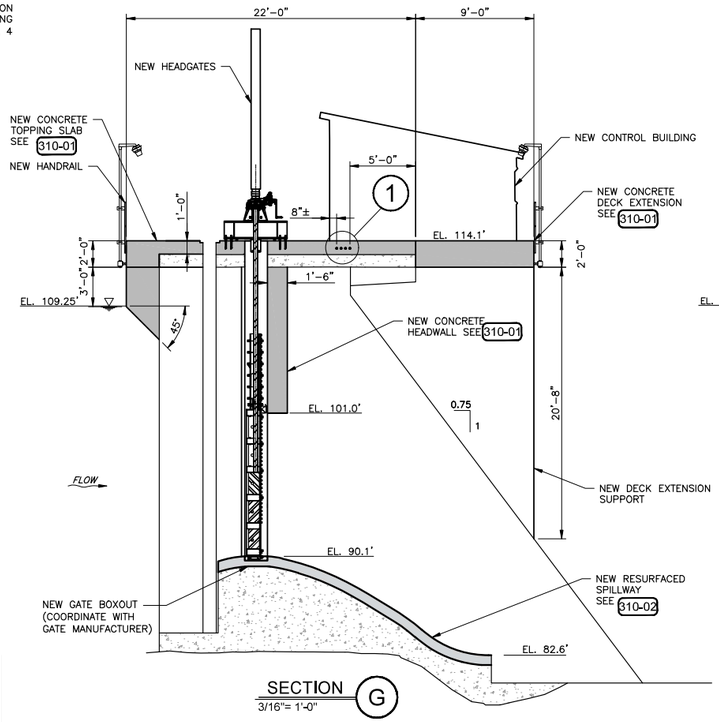
NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS

DWG.NO. H096H1163100059 REV. C

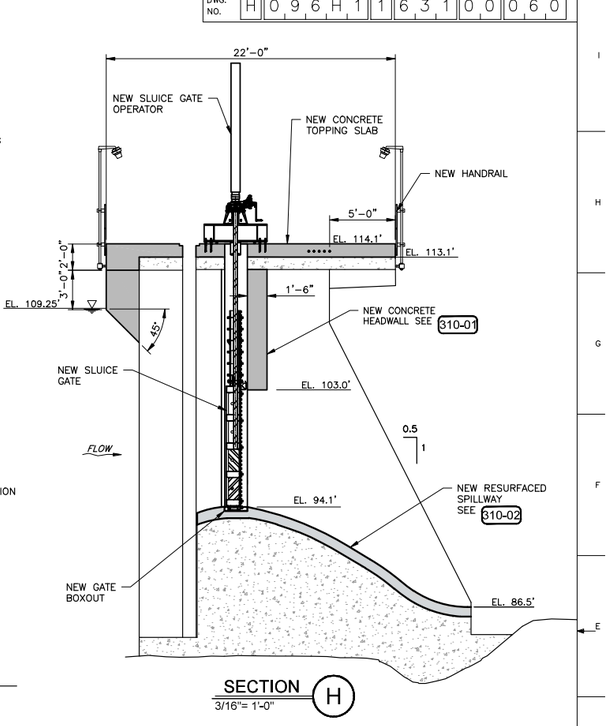
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PLAN @ EL. 113.6'
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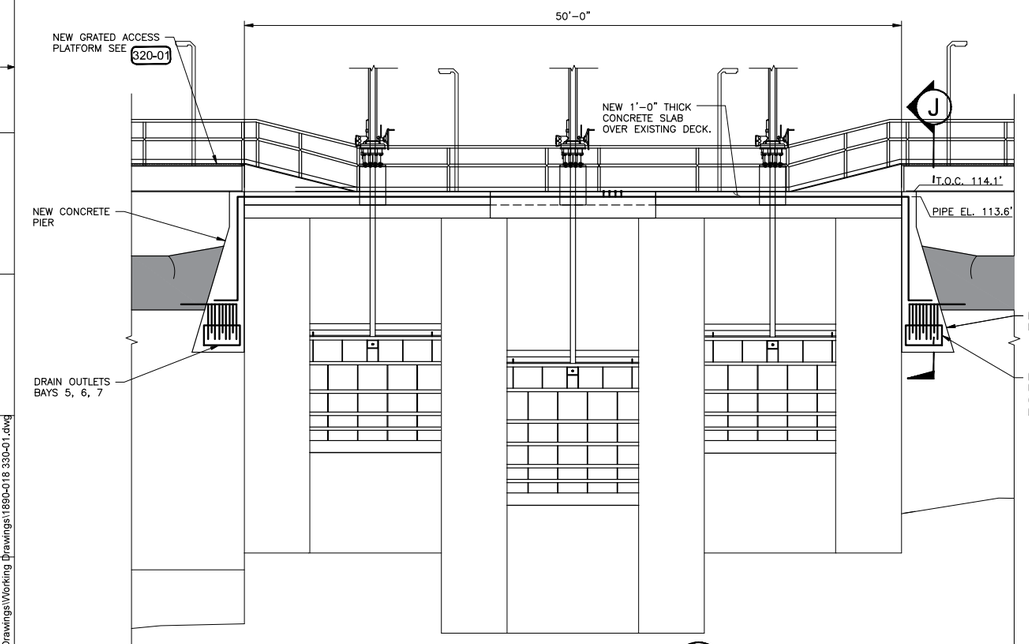


SECTION G
3/16"= 1'-0"



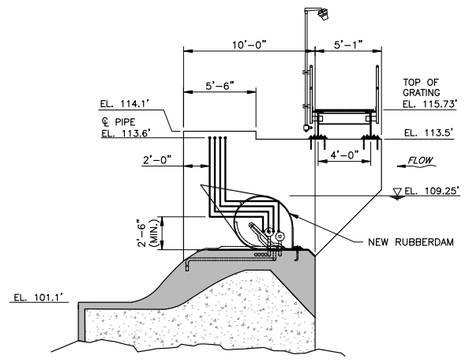
SECTION H
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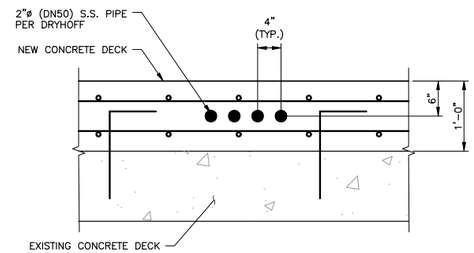


UPSTREAM SECTION I
3/16"= 1'-0"

NOTE: SEE DRYHOFF DRAWING 19038-103



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

330-01

Kleinschmidt

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REFERENCE DRAWINGS	DWG.NO.												

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
RUBBER DAM PIPING AT SLUICEWAY

DWG.NO. H096H1163100060 REV. C

APPENDIX D – ENGINEERING DRAWINGS – FISH PASSAGE

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,1

RUTH FALLS

FISHWAY MODIFICATIONS

Nova Scotia POWER An Emera Company

LIST OF DRAWINGS		
NOVA SCOTIA POWER DWG NO.	DRAWING TITLE	ISSUE / REVISION
H-096H1-1-620-00-011	FISHWAY MODIFICATIONS – COVER SHEET	A
H-096H1-1-620-00-012	FISHWAY MODIFICATIONS – GENERAL NOTES	A
H-096H1-1-620-00-013	FISHWAY MODIFICATIONS – EXISTING CONDITIONS, GENERAL ARRANGEMENT	A
H-096H1-1-620-00-014	FISHWAY MODIFICATIONS – EXISTING CONDITIONS, FISHWAY – PLAN	A
H-096H1-1-620-00-016	FISHWAY MODIFICATIONS – GENERAL ARRANGEMENT PLAN	A
H-096H1-1-620-00-017	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – PLAN AND SECTIONS	A
H-096H1-1-620-00-018	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – CROSS SECTIONS	A
H-096H1-1-620-00-019	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – SECTIONS AND DETAILS	A
H-096H1-1-620-00-020	FISHWAY MODIFICATIONS – FISH BYPASS – PLAN AND SECTIONS	A
H-096H1-1-620-00-021	FISHWAY MODIFICATIONS – FISH BYPASS – SECTIONS AND DETAILS	A
H-096H1-1-620-00-022	FISHWAY MODIFICATIONS – UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	A
H-096H1-1-620-00-023	FISHWAY MODIFICATIONS – UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS	A



PROJECT LOCATION

0 50 100
Kilometres

ISSUED FOR PERMIT

2023-05-05

PRELIMINARY
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REFERENCE DRAWINGS	DWG.NO.

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Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

COVER SHEET

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DWG. NO. H096H1 1 6200 0012

GENERAL NOTES

1. DRAWINGS ARE NOT TO BE SCALED. ONLY FIGURED DIMENSIONS TO BE FOLLOWED.
2. ALL DIMENSIONS ARE IN FEET AND INCHES UNLESS NOTED OTHERWISE.
3. ELEVATIONS ARE SHOWN IN FEET.
4. ELEVATIONS SHOWN ARE TO CGVD 2013. TOPOGRAPHIC SURVEY INFORMATION IS BASED ON FIELD SURVEY PERFORMED BY TALISMAN TECHNICAL SOLUTIONS IN NOVEMBER, 2022.
5. COORDINATES AND ELEVATIONS SHOWN ARE TO THE NOVA SCOTIA CONTROL COORDINATE SYSTEM, WGS72, MODIFIED TRANSVERSE MERCATOR, ZONE 5.
6. DESIGN BASED ON INFORMATION RECEIVED TO DATE. DESIGN TO BE CONFIRMED PRIOR TO CONSTRUCTION.
7. REFER TO THE PROJECT SPECIFICATIONS. IF THERE IS A CONTRADICTION BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, THE MORE STRINGENT OF THE TWO SHALL APPLY IN CONSULTATION WITH THE OWNER AND ENGINEER.
8. THE CONTRACTOR SHALL VERIFY ALL CONDITIONS AND MEASUREMENTS AT THE SITE AND REPORT TO THE ENGINEER ANY DISCREPANCIES OR UNSATISFACTORY CONDITIONS WHICH MAY ADVERSELY AFFECT THE PROPER COMPLETION OF THE PROJECT BEFORE PROCEEDING WITH WORK.
9. THE CONTRACTOR IS TO ASSUME FULL RESPONSIBILITY FOR THE INTEGRITY OF THE STRUCTURE DURING CONSTRUCTION.
10. ELEVATION OF BEARING SURFACES TO BE CONFIRMED IN THE FIELD. REPORT ANY DISCREPANCIES TO ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
11. THE CONTRACTOR TO STORE AND HANDLE ALL MATERIALS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND OWNER'S INSTRUCTIONS.
12. THE CONTRACTOR TO REINSTATE ALL AREAS AFFECTED BY NEW CONSTRUCTION TO THEIR ORIGINAL CONDITION TO THE SATISFACTION OF THE ENGINEER.
13. SHOP DRAWING(S) AND DETAILS OF CONCRETE MIX DESIGN TO BE SUBMITTED TO ENGINEER FOR REVIEW. SHOP DRAWINGS TO BE STAMPED AND SIGNED BY A PROFESSIONAL ENGINEER LICENSED IN THE PROVINCE OF NOVA SCOTIA, CANADA. SHOP DRAWINGS WILL BE REVIEWED AND RETURNED TO CONTRACTOR WITHIN 14 DAYS.
14. SUBMIT ERECTION/SHOP DRAWINGS INDICATING DETAILS AND INFORMATION NECESSARY FOR ASSEMBLY AND ERECTION PURPOSES.
15. SUBSTITUTION REQUESTS FOR ALTERNATIVE PRODUCTS OR METHODS MUST BE APPROVED IN WRITING BY THE STRUCTURAL ENGINEER PRIOR TO USE. CONTRACTOR SHALL PROVIDE, AT THEIR EXPENSE, CALCULATIONS DEMONSTRATING THAT THE SUBSTITUTED PRODUCT MEETS OR EXCEEDS THE PERFORMANCE CAPACITIES OF THE SPECIFIED PRODUCT.
16. ALL PRODUCTS TO BE INSTALLED AS PER MANUFACTURER'S INSTRUCTIONS.
17. WORK SHALL CONFORM TO THE NATIONAL BUILDING CODE OF CANADA AND ITS SUPPLEMENTS, AND THE NOVA SCOTIA BUILDING CODE.
18. MINIMUM REQUIRED BEARING CAPACITY OF 3000 PSF UNDER ALL CONCRETE STRUCTURES.
19. FOUNDATIONS BEARING SURFACE TO BE APPROVED BY ENGINEER PRIOR TO PLACING CONCRETE.
20. ENGINEERED FILL TO BE AN IMPORTED, WELL GRADED MATERIAL (GRANULAR A) FREE OF DEBRIS, ORGANIC OR DELETERIOUS MATERIAL. IT SHALL NOT CONTAIN ROCKS OR LUMPS OVER 4 INCHES IN GREATEST DIMENSION AND IT SHALL CONTAIN NOT MORE THAN 8% PASSING THE 200mm SIEVE. ENGINEERED FILL SHALL BE PLACED IN MAX 6 INCH LIFTS AND COMPACTED TO 98% SPMDD.

CONCRETE NOTES

1. UNLESS OTHERWISE SHOWN, THESE NOTES ARE TYPICAL FOR ALL CONCRETE DRAWINGS.
2. FOR CONCRETE SPECIFICATIONS, REFER TO THE RUTH FALLS FISHWAY MODIFICATIONS PROJECT TECHNICAL SPECIFICATION". IF THERE IS A CONTRADICTION BETWEEN THE DRAWINGS AND SPECIFICATIONS, THE MORE STRINGENT OF THE TWO SHALL APPLY.
3. CONCRETE MATERIALS, TESTING AND WORKMANSHIP TO CONFORM CSA STANDARDS A23.1/A23.2, LATEST EDITION.
4. CONCRETE TO MEET THE FOLLOWING PERFORMANCE CRITERIA:
   a. 28 DAY MINIMUM COMPRESSIVE STRENGTH OF 30 MPa
   b. DURABILITY AND CLASS OF EXPOSURE: F-1
   c. ONLY USE AGGREGATE THAT IS NON-REACTIVE. AGGREGATE SUSCEPTIBLE TO AAR IS NOT PERMITTED.
5. CONCRETE COVER ON REINFORCING STEEL: (UNLESS NOTED OTHERWISE)
   a. EXPOSED TO FLOWING WATER: 4 INCHES
   b. EXPOSED TO WATER: 3 INCHES
   c. CAST AGAINST FILL OR BEDROCK: 3 INCHES
   d. CAST AGAINST FORMS: 2 INCHES
6. WATERSTOPS:
   a. TYPE 1: HYDROTITE CJ 0725 HYDROPHILIC WATERSTOP. INSTALL IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. MAINTAIN A MINIMUM EDGE DISTANCE TO CONCRETE OF 4" UNLESS NOTED OTHERWISE.
   b. TYPE 2: LEAKMASTER HYDROPHILIC WATERSTOP ADHESIVE MANUFACTURED BY HYDROTITE. INSTALL IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
   c. ALL WATERSTOPS TO BE MADE CONTINUOUS
7. CONCRETE TO BE PLACED IN THE DRY.
8. USE HIGH FREQUENCY VIBRATOR TO PLACE ALL CONCRETE. VIBRATION SHALL BE IN ACCORDANCE WITH CSA A23.1 / A23.2.
9. PROVIDE ACCURATE RECORDS OF POURED CONCRETE ITEMS INDICATING DATE AND TIME, LOCATION OF POUR, QUALITY, AIR TEMPERATURE AND TEST SAMPLES.
10. MIX, DELIVER TO SITE OF WORK AND DISCHARGE CONCRETE WITHIN 120 MINUTES MAXIMUM AFTER BATCHING.
11. INSPECTION AND TESTING OF CONCRETE AND CONCRETE MATERIALS WILL BE CARRIED OUT BY TESTING LABORATORY DESIGNATED BY OWNER.
12. REINFORCING STEEL TO BE DEFORMED NEW BILLET STEEL WITH A MINIMUM YIELD STRENGTH OF 400 MPa. REINFORCING STEEL TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS INCLUDING, BUT NOT LIMITED TO:
    a. CSA G30.18 — CARBON STEEL BARS FOR CONCRETE REINFORCEMENT
    b. CSA G40.20./G40.21 — GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL/STRUCTURAL QUALITY STEEL.
13. REINFORCING STEEL TO BE FREE OF LOOSE MILL SCALE, LOOSE RUST AND FOREIGN MATERIAL.
14. UNLESS NOTED OTHERWISE REINFORCING STEEL TO BE SPLICED AS FOLLOWS:
    a. ALL SPLICES TO BE TENSION LAP SPLICES, CLASS "B".
    b. NO MORE THAN 50% OF THE REINFORCING TO BE SPLICED AT ANY GIVEN LOCATION U.N.O.
15. ALL REINFORCEMENT BENDS TO BE STANDARD BENDS UNLESS NOTED OTHERWISE.
16. DO NOT FIELD BEND REINFORCEMENT EXCEPT WHERE INDICATED OR AUTHORIZED BY ENGINEER. WHEN FIELD BENDING IS AUTHORIZED, BEND WITHOUT HEAT, APPLYING SLOW AND STEADY PRESSURE. REPLACE BARS WHICH DEVELOP CRACKS OR SPLITS.
17. REINFORCING STEEL, EMBEDDED PARTS, ANCHOR RODS, DOWELS ETC. TO BE SECURED IN POSITION PRIOR TO PLACING CONCRETE.
18. SET ANCHOR RODS, SLEEVES AND OTHER MISCELLANEOUS ITEMS EMBEDDED IN CONCRETE AS SHOWN ON DRAWING. IF INSERTS CANNOT BE LOCATED AS SPECIFIED, OBTAIN APPROVAL BEFORE PLACING.
19. CAST-IN-PLACE ANCHORS SHALL BE HELD SECURELY IN POSITION WITH TEMPLATES.
20. REINFORCING STEEL TO BE INSPECTED BY THE ENGINEER PRIOR TO CLOSING THE FORMS.
21. ENSURE COVER TO REINFORCEMENT IS MAINTAINED DURING CONCRETE POUR/PLACEMENT.
22. ALL EXPOSED CORNERS SHALL HAVE A MINIMUM CHAMFER OF 1", UNLESS NOTED OTHERWISE.
23. GROUT TO BE SIKAGROUT – 212 HP, OR BASF MASTERFLOW 928, OR APPROVED EQUIVALENT.

CONCRETE FORMING NOTES

1. CONCRETE FORMWORK TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS. INCLUDING, BUT NOT LIMITED TO:
   a. CSA S269.1 — FALSEWORK AND FORMWORK
   b. CSA O86 — ENGINEERING DESIGN IN WOOD
   c. CSA A23.1/A23.2 — CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION
   d. CSA O121 — DOUGLAS FIR PLYWOOD
   e. CSA O153 — POPLAR PLYWOOD
   f. CSA O151 — CANADIAN SOFTWOOD PLYWOOD
2. FORMWORK MATERIALS TO BE WOOD AND WOOD PRODUCT MATERIALS CONFORMING TO CSA O121, CSA-O86 AND CSA O153, LATEST EDITIONS.
3. FORM LINER MATERIAL TO BE PLYWOOD CONFORMING TO CSA O151.
4. FORM RELEASE AGENT: NON-TOXIC, BIODEGRADABLE, LOW VOC.
5. BEFORE PLACEMENT OF CONCRETE, FORMWORK SHALL BE CLEANED IN ACCORDANCE WITH CSA A23.1/A23.2, LATEST EDITION.

STEEL NOTES

1. STRUCTURAL STEEL TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS. INCLUDING, BUT NOT LIMITED TO:
   a. CSA S16 DESIGN OF STEEL STRUCTURES
   b. CSA G40.20/G40.21 GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL/STRUCTURAL QUALITY STEEL
   c. CSA G164 HOT DIP GALVANIZING OF IRREGULARLY SHAPED ARTICLES
   d. CSA W48 FILLER METALS AND ALLIED MATERIALS FOR METAL ARC WELDING
   e. CSA W59 WELDED STEEL CONSTRUCTION
2. ERECT STRUCTURAL STEEL AS INDICATED AND IN ACCORDANCE WITH CSA-S16 AND IN ACCORDANCE WITH REVIEWED ERECTION DRAWINGS.
3. FIELD CUTTING OR ALTERING STRUCTURAL MEMBERS TO THE APPROVAL OF THE ENGINEER.
4. CLEAN WITH A MECHANICAL BRUSH AND TOUCH UP SHOP PRIMER TO BOLTS, WELDS AND BURNED OR SCRATCHED SURFACES AT COMPLETION OF ERECTION.
5. FABRICATOR TO DESIGN CONNECTION DETAILS.
6. DESIGN DETAILS AND CONNECTIONS IN ACCORDANCE WITH REQUIREMENTS OF CSA-S16 TO RESIST FORCES, MOMENTS, SHEARS AND ALLOW FOR MOVEMENTS INDICATED.
7. MATERIALS:
   a. STRUCTURAL STEEL IN ACCORDANCE WITH CSA G40.20/G40.21 GRADE 350W.
   b. ANCHOR RODS IN ACCORDANCE WITH CSA G40.20/G40.21 GRADE 300W UNLESS NOTED OTHERWISE.
   c. STRUCTURAL BOLTS IN ACCORDANCE WITH ASTM F3125/F3125M, GRADE A325M, GALVANIZED.
   d. NUTS SHALL BE HEAVY HEX NUTS IN ACCORDANCE WITH ASTM A563, GALVANIZED.
   e. WASHERS SHALL BE HEAVY DUTY HARDENED WASHERS IN ACCORDANCE WITH ASTM F436/F436M, GALVANIZED.
   f. WELDING MATERIALS IN ACCORDANCE WITH CSA W48 AND CSA W59, BY A COMPANY CERTIFIED BY THE CANADIAN WELDING BUREAU UNDER THE REQUIREMENTS OF CSA W47.1 (DIVISION 1 OR DIVISION 2).
   g. SHOP PAINT PRIMER IN ACCORDANCE WITH CISC/CPMA 2-75 SOLVENT REDUCIBLE ALKYD, GREY.
   h. HOT DIP GALVANIZING IN ACCORDANCE WITH ASTM A123/A123M AND ASTM A153/A153M.
8. FABRICATE STRUCTURAL STEEL IN ACCORDANCE WITH CSA-S16 AND IN ACCORDANCE WITH REVIEWED SHOP DRAWINGS.
9. CLEAN, PREPARE SURFACES AND SHOP PRIME STRUCTURAL STEEL IN ACCORDANCE WITH CSA-S16 EXCEPT WHERE MEMBERS TO BE ENCASED IN CONCRETE.
10. APPLY PAINT AND OTHER COATINGS UNDER COVER, ON DRY SURFACES IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
11. UNLESS NOTED OTHERWISE, ALL STRUCTURAL STEEL, INCLUDING HANDRAILS AND BASE PLATES SHALL BE GALVANIZED.
12. GRATING TO BE SECURED TO SURFACE OF CONCRETE USING HOLD DOWN CLIPS.

ENVIRONMENTAL NOTES

1. ALL CONSTRUCTION SHALL BE DONE IN THE DRY CONDITION.
2. MEASURES SHALL BE TAKEN TO PREVENT MATERIALS SUCH AS FRESH CONCRETE, CEMENT AND CONSTRUCTION DEBRIS FROM ENTERING ANY WATERCOURSE. ALL CONSTRUCTION DEBRIS AND DEMOLISHED MATERIALS WILL BE DISPOSED OF IN ACCORDANCE WITH NSECC WASTE DISPOSAL SITE REGULATIONS.
3. ALL EQUIPMENT AND MACHINERY OPERATED ON OR NEAR A BODY OF WATER WILL BE MECHANICALLY SOUND WITH NO LEAKING FUEL TANKS OR HYDRAULIC CONNECTIONS. FUEL STORAGE, REFUELING AND LUBRICATION SHALL BE COMPLETED IN ACCORDANCE WITH THE SITE'S ENVIRONMENTAL PROTECTION PLAN. MACHINERY AND EQUIPMENT WILL BE STORED ABOVE FLOOD WATER LEVELS.
4. ALL WORK OPERATIONS WILL BE CONDUCTED WITH MEASURES TAKEN TO CAUSE A MINIMUM OF SILTATION AND DISRUPTION TO ADJACENT AND DOWNSTREAM AREAS.

ABBREVIATIONS

ABUT.	ABUTMENT
APPROX.	APPROXIMATE
BP	BASEPLATE
C/L, ℄	CENTERLINE
C/C	CENTER TO CENTER
C.J	CONTROL JOINT
C/W	COMPLETE WITH
COL.	COLUMN
D/S	DOWNSTREAM
DIA.	DIAMETER
DWG	DRAWING
EL.	ELEVATION
EQ	EQUAL
EW	EACH WAY
FDN	FOUNDATION
FIN.	FINISHED
HOR.	HORIZONTAL
I.W.O.	IN WAY OF
O.A.L.	OVERALL LENGTH
O.D.	OUTSIDE DIAMETER
LG	LONG
MIN	MINIMUM
MAX	MAXIMUM
PL	PLATE
HORIZ.	PROJECTION
R	RADIUS
REINF.	REINFORCEMENT
REF	REFERENCE
REQ'D	REQUIRED
STIFF.	STIFFENER
THK	THICK
T.D.	TOP OF
TOC	TOP OF CONCRETE
TOG	TOP OF GRATING
TOS	TOP OF STEEL
T&B	TOP AND BOTTOM
TYP.	TYPICAL
U/S	UPSTREAM
UNO	UNLESS NOTED OTHERWISE
VERT.	VERTICAL
WP	WORKING POINT

PRELIMINARY
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DATE MAY 2023

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DATE 2023-05-03
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Nova Scotia POWER An Emera Company
RUTH FALLS
FISHWAY MODIFICATIONS
GENERAL NOTES

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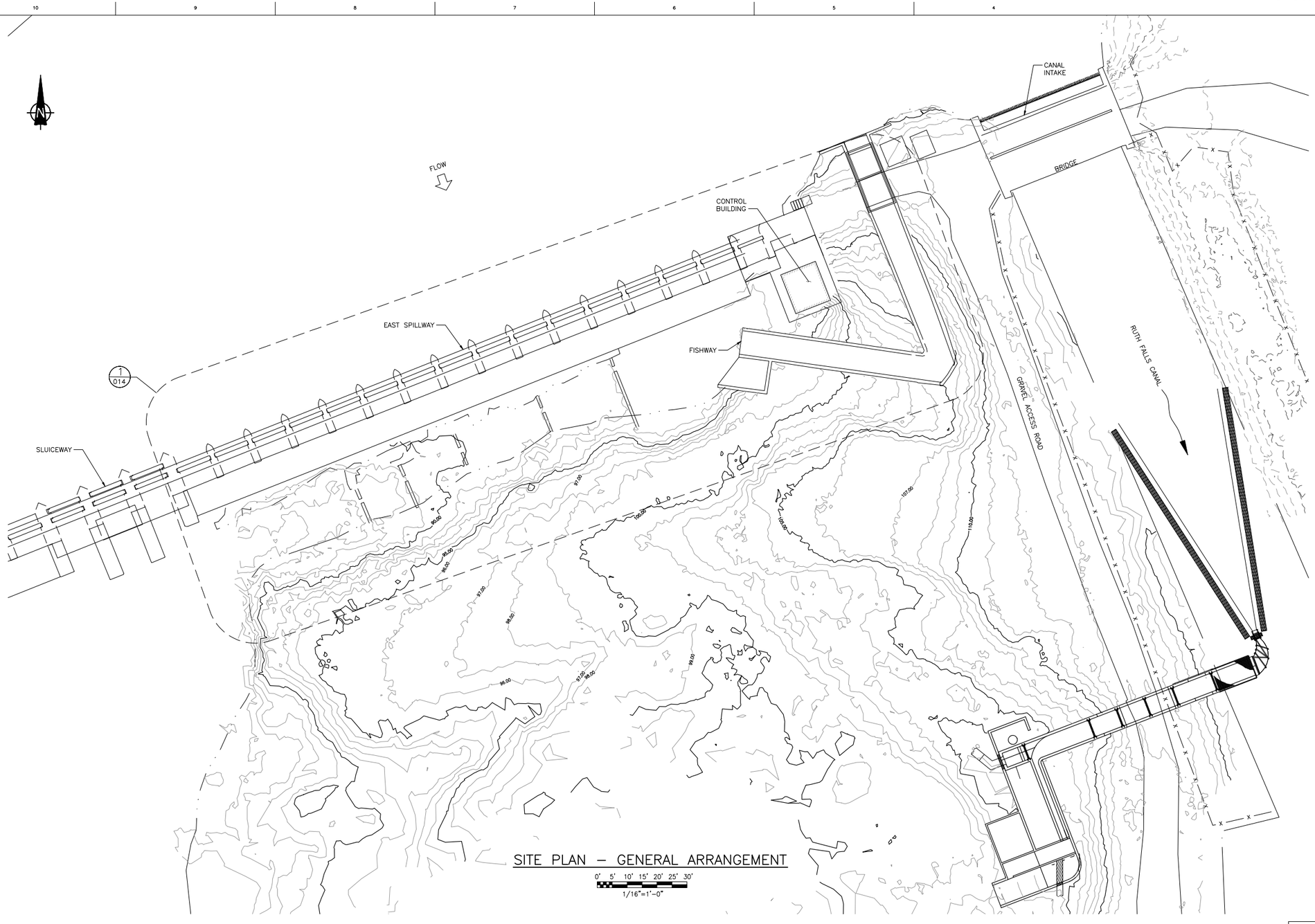
EXISTING CONDITIONS – GENERAL ARRANGEMENT	H096H1 1 6200 0013
REFERENCE DRAWINGS	DWG.NO.

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DWG. NO. H096H1-1-6200-0013

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



SITE PLAN – GENERAL ARRANGEMENT

0' 5' 10' 15' 20' 25' 30'

1/16"=1'-0"

PRELIMINARY
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EXISTING CONDITIONS FISHWAY – PLAN	H096H1-1-6200-00-014
GENERAL NOTES	H096H1-1-6200-00-012
REFERENCE DRAWINGS	DWG.NO.

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A	ISSUED FOR PERMIT DATE: 2023-06-05					

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DATE	MAY 2023	

JOB No. 254103

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W.O.	

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

EXISTING CONDITIONS
GENERAL ARRANGEMENT

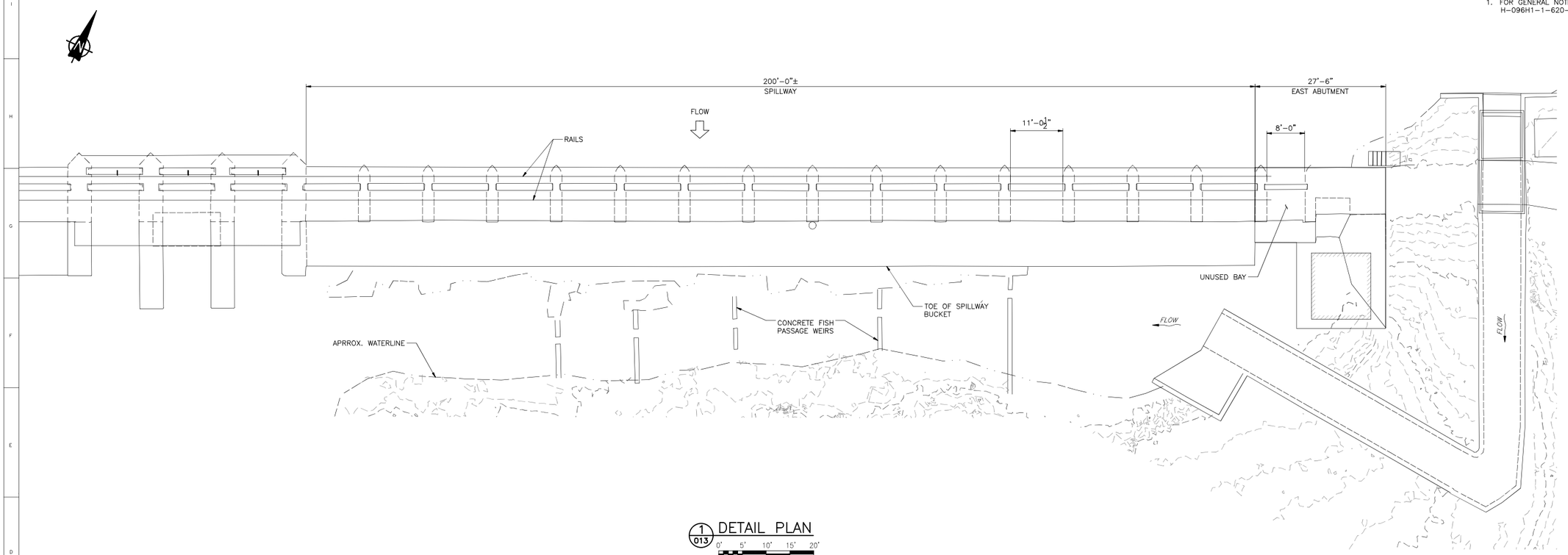
H096H1-1-6200-00-013 REV. B

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

DWG. NO. H096H1116200001.4

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



1/013 DETAIL PLAN

0' 5' 10' 15' 20'

3/32"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

EXISTING CONDITIONS – GENERAL ARRANGEMENT	H096H1116200001.3
GENERAL NOTES	H096H1116200001.2
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
A	DS	CIVIL	MECH	E & I	CONST	ENVIRO

ISSUED FOR PERMIT
DATE: 2023-05-05

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE MAY 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

EXISTING CONDITIONS
FISHWAY – PLAN

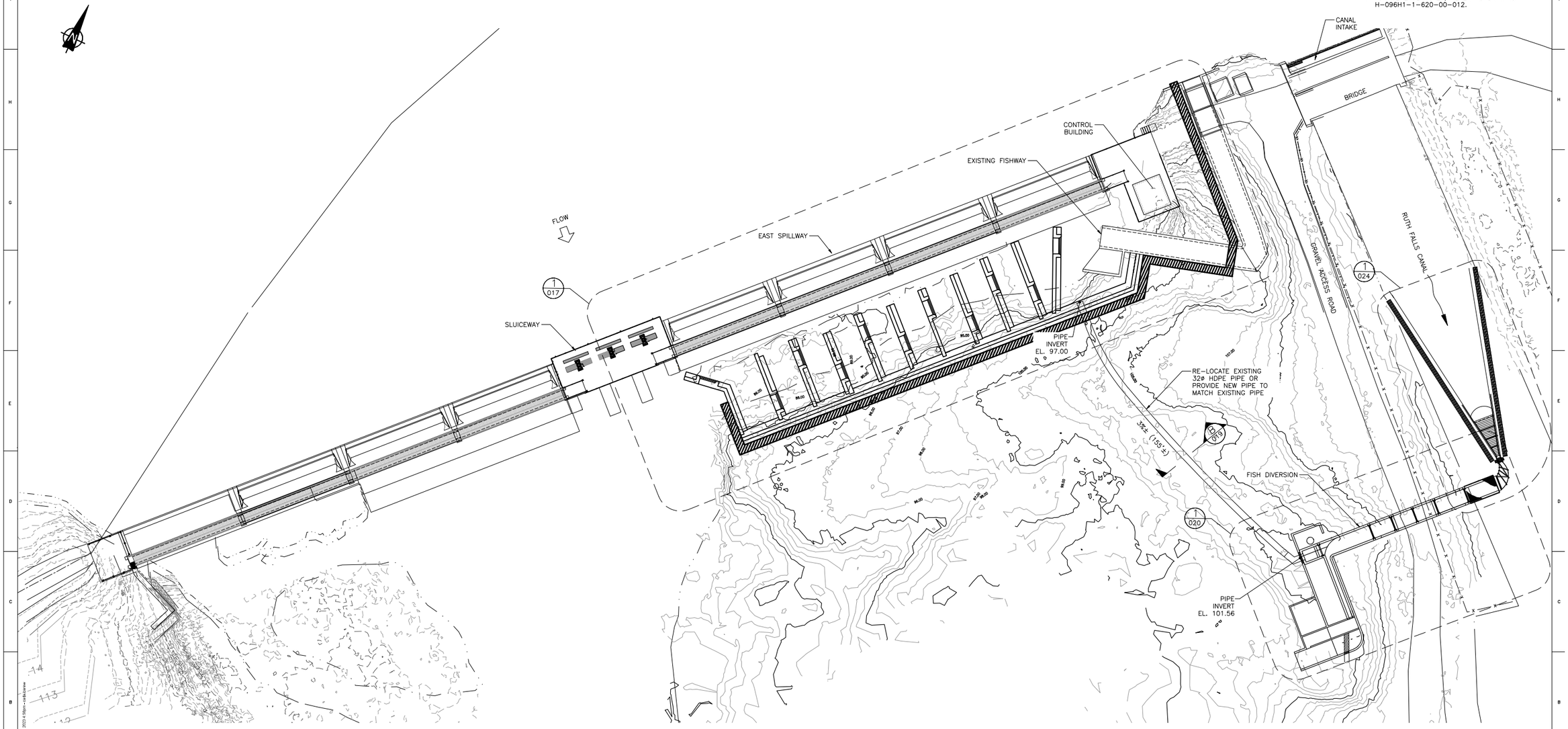
H096H1116200001.4 REV. A

\\Pwdx\Wp\Fa\PJ\Projects\PP254103\10 CAD\DWFiles\096H1-1-620-00-014.dwg • By: May. 05, 2023 11:51am • cadfx.ctb/acmew

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,6

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



PLAN

0 5' 10' 20' 40'

1"=20'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

DOWNSTREAM EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,4
FISH BYPASS – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,0
CHANNEL FISHWAY – SECTIONS AND DETAILS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,9
CHANNEL FISHWAY – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,7
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
B						
RE-ISSUED FOR PERMIT DATE: 2023-06-15						
A						
ISSUED FOR PERMIT DATE: 2023-06-05						

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST
APPROVED	
DATE	MAY 2023

JOB No. 254103

REFERENCE NO.	
SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	AT/CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

GENERAL ARRANGEMENT PLAN

H 0,9,6,H,1 1 6,2,0 0,0 0,1,6 REV. B

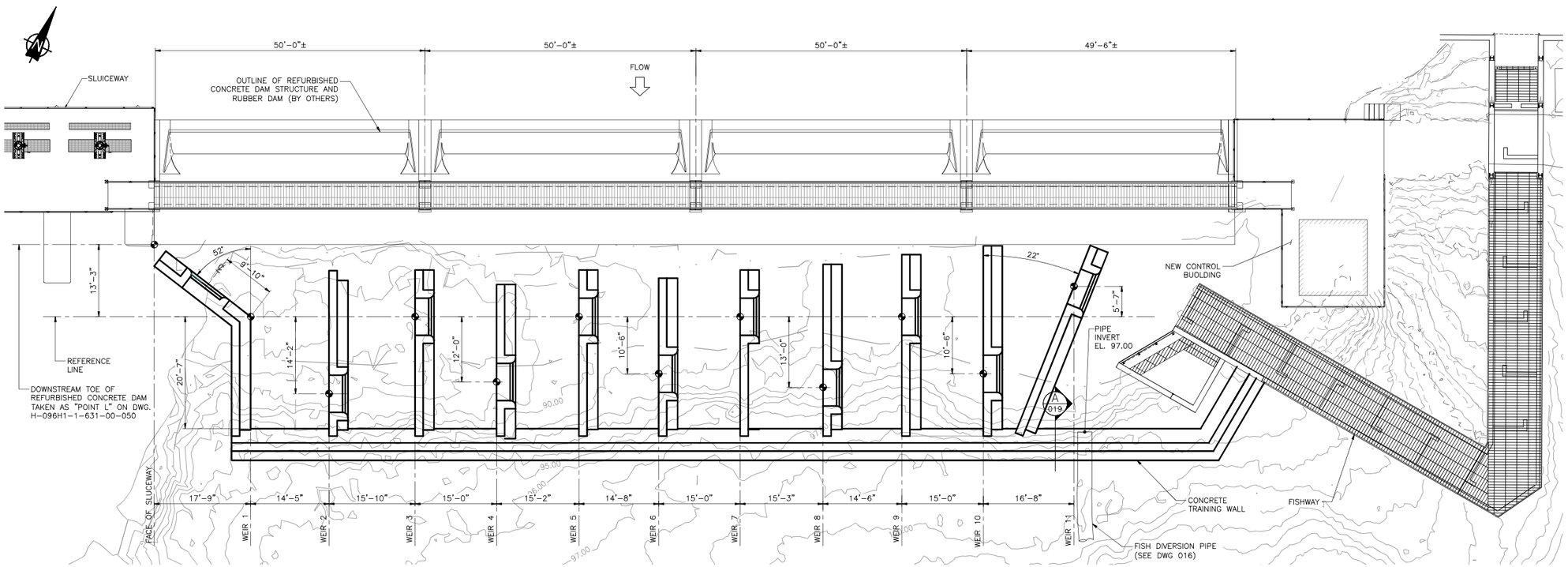
X:\PDS\253\03 CAD\STRH 096H1 620\00-016.dwg -Plot- Jan 15, 2023 4:56pm - caleb.screw

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,7

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. FOR DIMENSIONS OF WEIRS IN CHANNEL FISHWAY SEE DWG. 018 AND 019.

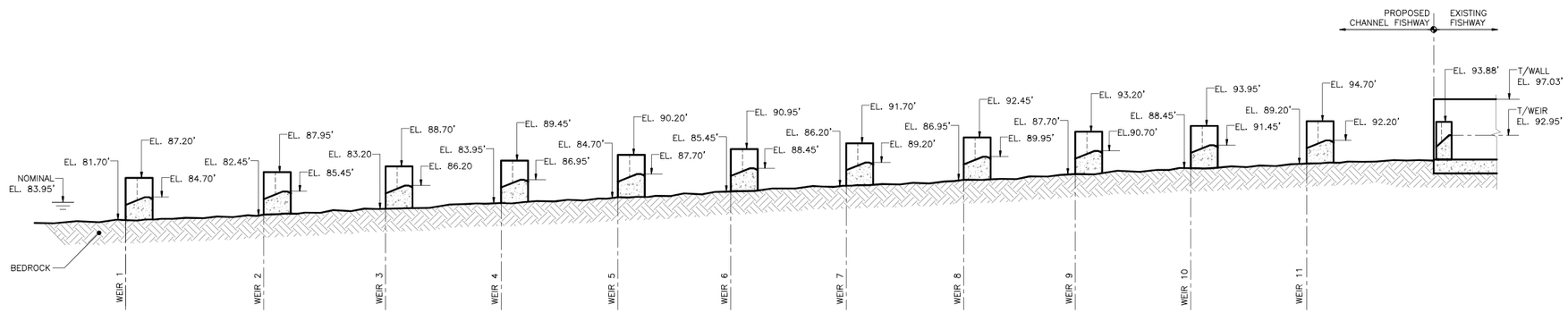


1 / 016 PLAN

0 2' 5' 10' 20'

1"=10'-0"

NOTE:
EEL PASSAGE NOT SHOWN FOR CLARIFY
(SEE DRAWING 022 FOR DETAILS)



DEVELOPED SECTION

0' 5' 10' 15'

1/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EAST SPILLWAY PLAN AND SECTIONS	H 0,9,6,H,1 1 6,3,1 0,0 0,5,0
UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,2
CHANNEL FISHWAY – SECTIONS AND DETAILS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,9
CHANNEL FISHWAY – CROSS SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,8
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
A						

ISSUED FOR PERMIT
DATE: 2023-05-05
CC. EO AC

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	

APPROVED

DATE MAY 2023

REFERENCE NO.

SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN AT/CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

wood.
Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

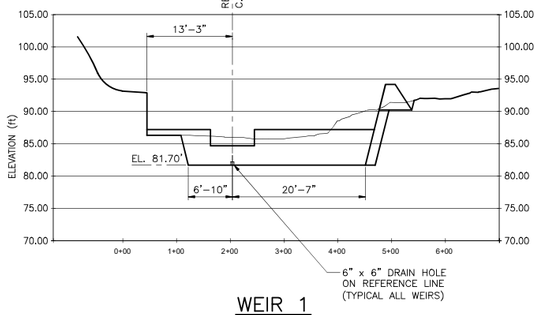
CHANNEL FISHWAY – PLAN AND SECTIONS

H 0,9,6,H,1 1 6,2,0 0,0 0,1,7 REV. A

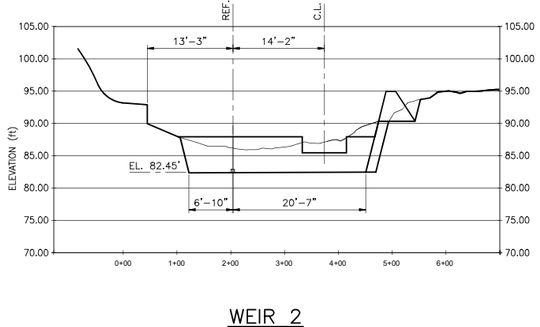
\\Public\1SKFILES\Projects\PO54103\10 CAD\DWGs\ 016H1-1 620 00 017.dwg -- Plan, May 05, 2023 12:51pm -- clarke.crowe

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

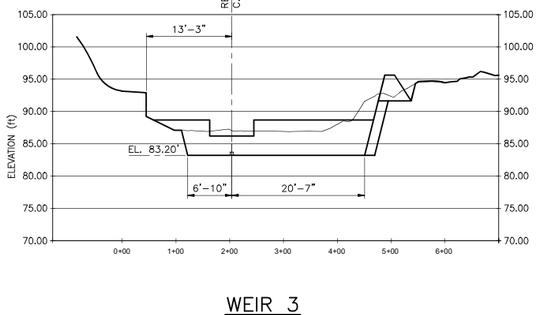
DWG. H096H1162000018



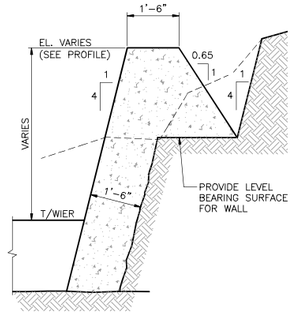
WEIR 1



WEIR 2



WEIR 3

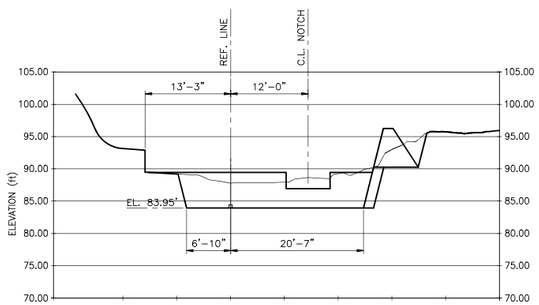


TYP. CONCRETE TRAINING WALL DETAIL

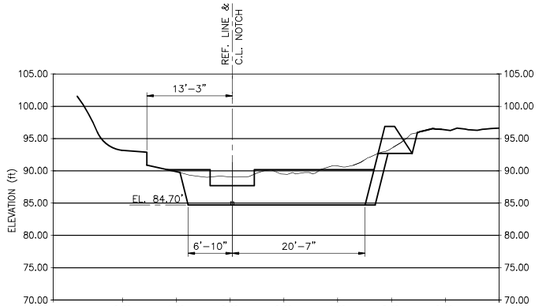
0' 1' 2' 3' 4'
1/2"=1'-0"

NOTES:

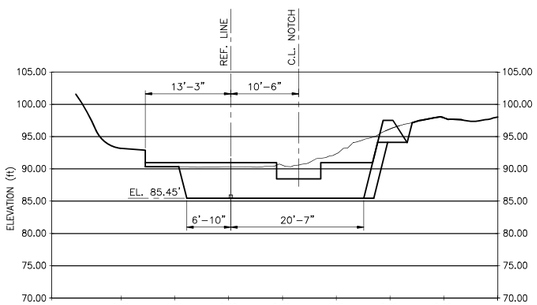
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



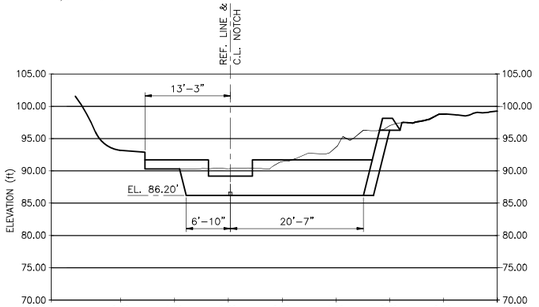
WEIR 4



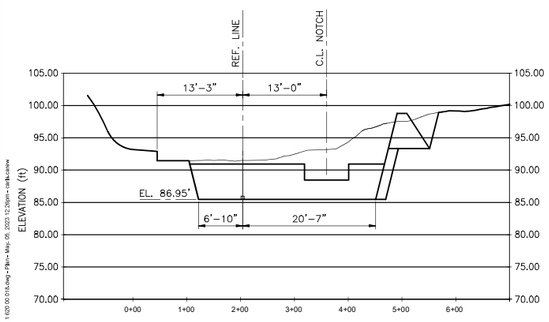
WEIR 5



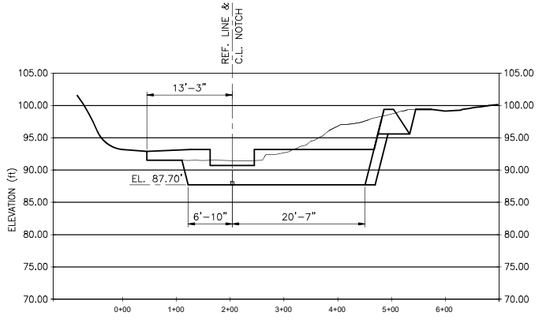
WEIR 6



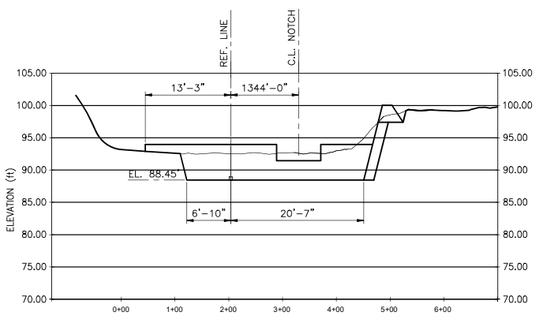
WEIR 7



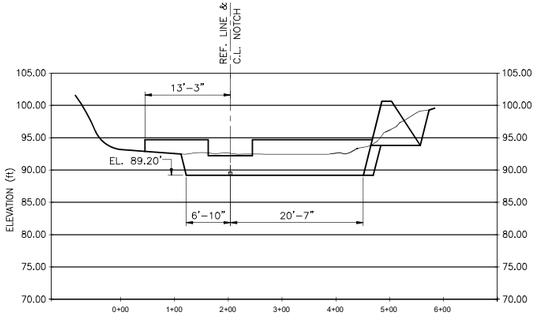
WEIR 8



WEIR 9



WEIR 10



WEIR 11

PRELIMINARY
NOT FOR CONSTRUCTION

GENERAL NOTES	H096H1162000012
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
A						
ISSUED FOR PERMIT DATE: 2023-05-05						

SEAL

DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

JOB No. 254103

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

CHANNEL FISHWAY – CROSS SECTIONS

SCALE	3/32"=1'-0"
UNITS	Imperial
DESIGNED	EO
DRAWN	AT
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

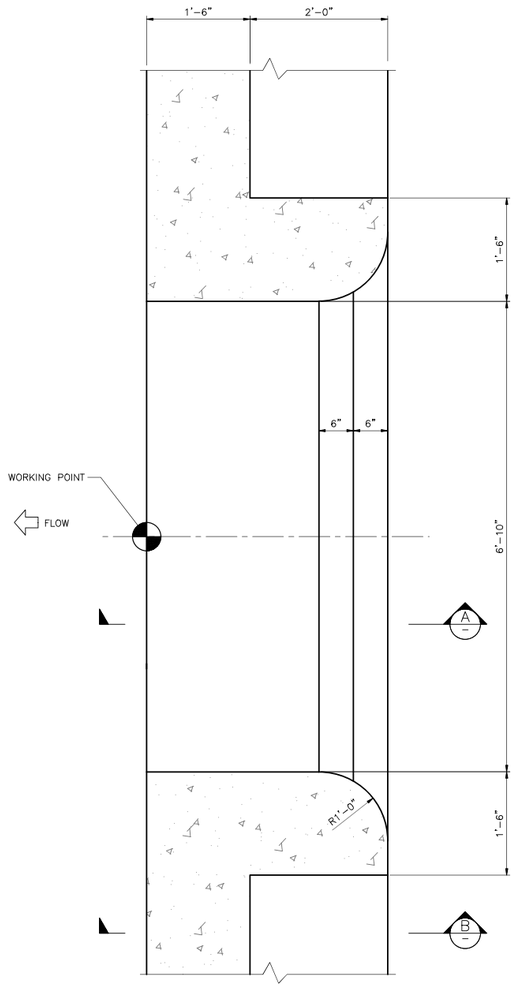
H096H1162000018 REV. A

W:\Active\P254103\Projects\P254103\03 CAD\ISSUED\H096H1162000018.dwg - Plot: May. 05, 2023 12:29pm - cstrickland

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,9

NOTES:

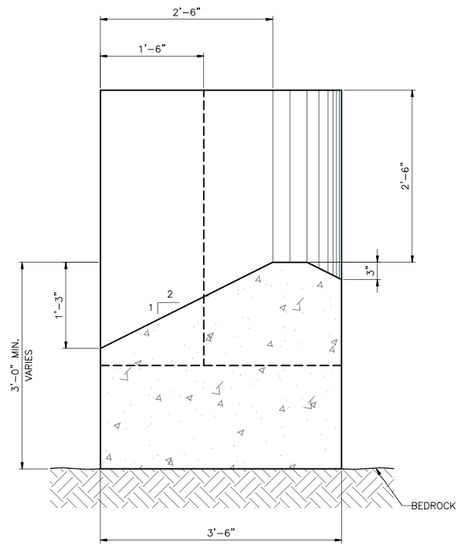
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



TYPICAL WEIR PLAN DETAIL

0' 1' 2' 3'

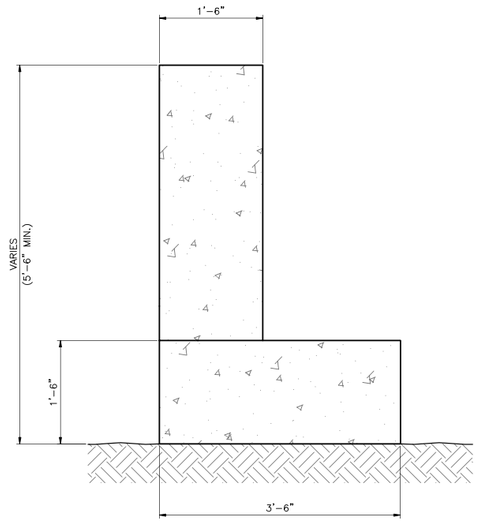
1"=1'-0"



A SECTION

0' 1' 2' 3'

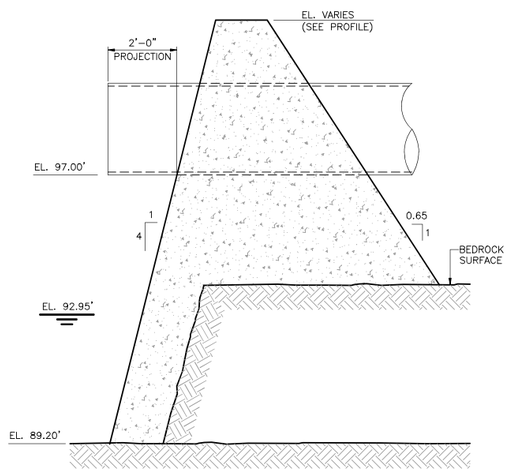
1"=1'-0"



B SECTION

0' 1' 2' 3'

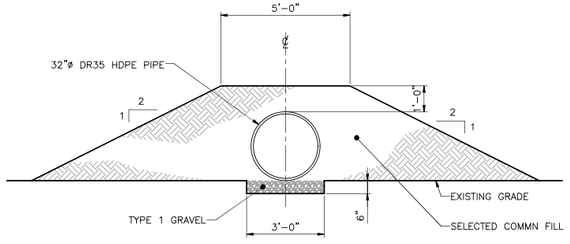
1"=1'-0"



A 017 SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"



B 016 SECTION

0' 1' 2' 3' 4' 5'

3/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

CHANNEL FISHWAY – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,7
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
A						

ISSUED FOR PERMIT
DATE: 2023-05-06
M. EO AC

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE MAY 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN AT/CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

wood.

Nova Scotia POWER
An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

CHANNEL FISHWAY – SECTIONS AND DETAILS

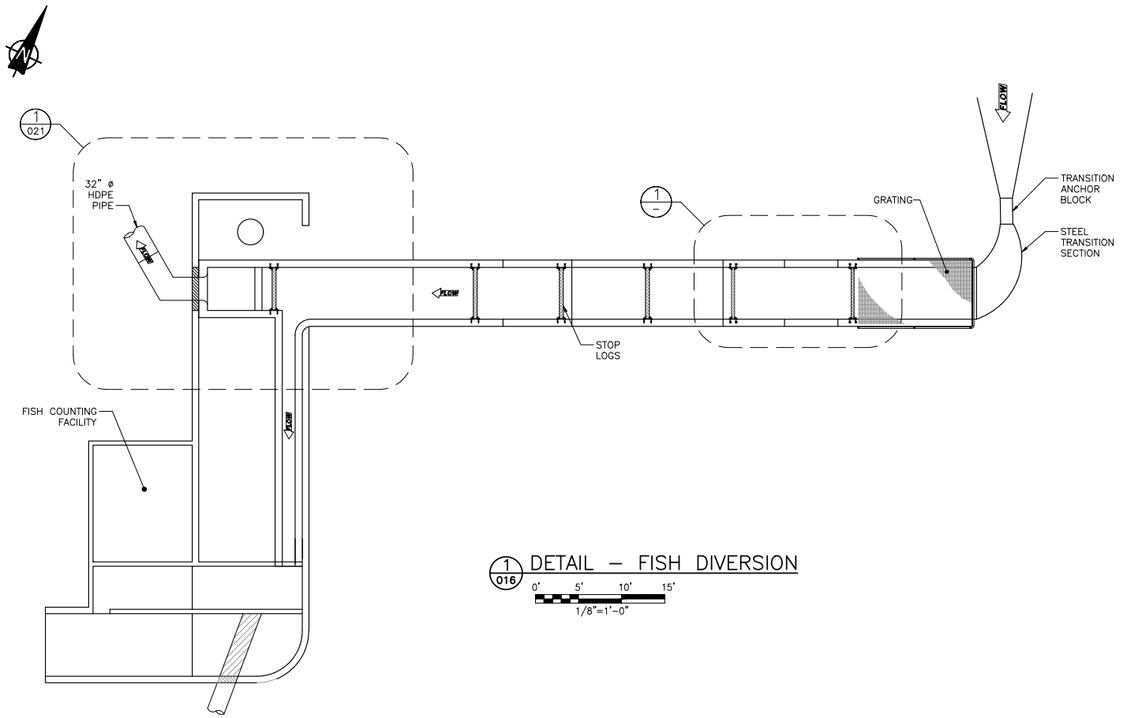
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\\Whsk3191FJUF3.SAProjects\WP254103\10 CAD\STRW 0961H1 1 6620 00 0119.dwg • Plot: May 05, 2023 12:20pm • cadkuczerw

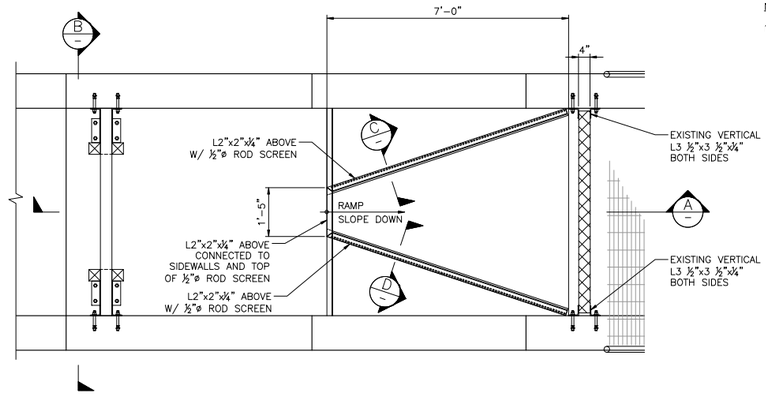
DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,2,0

NOTES:

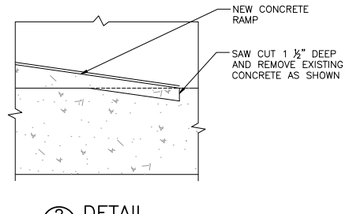
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



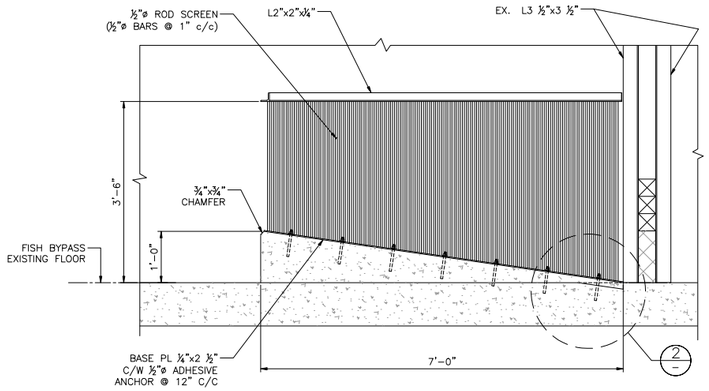
1/016 DETAIL – FISH DIVERSION
0' 5' 10' 15'
1/8"=1'-0"



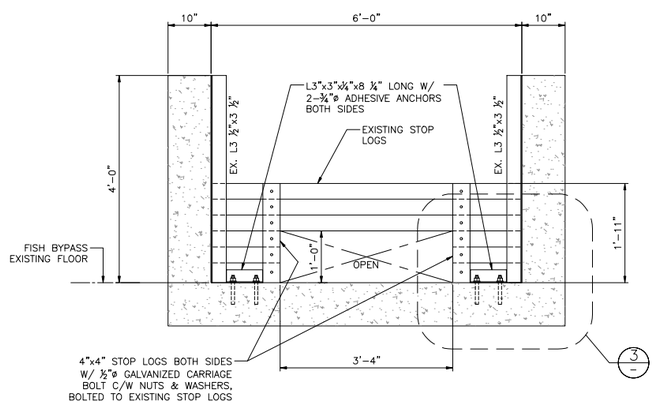
1/– DETAIL PLAN
0' 1' 2' 3' 4'
1/2"=1'-0"



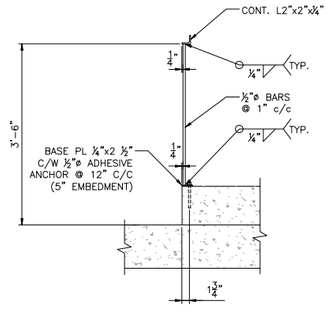
2/– DETAIL
0" 6" 12" 24"
1-1/2"=1'-0"



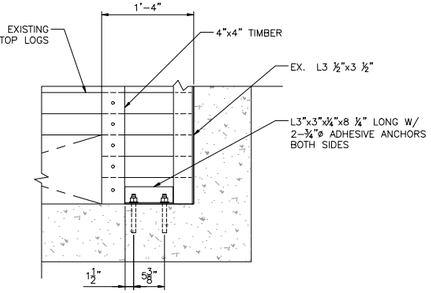
A/– SECTION
0' 1' 2' 3'
3/4"=1'-0"



B/– SECTION (TYPICAL ALL 6 STOP LOG LOCATIONS)
0' 1' 2' 3'
3/4"=1'-0"



C/– SECTION (AS SHOWN)
D/– SECTION (OPP. HAND)
0' 1' 2' 3'
3/4"=1'-0"



3/– DETAIL
0' 1' 2' 3'
1"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

JOB No. 254103

FISH BYPASS– PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,1
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
B						
RE-ISSUED FOR PERMIT DATE: 2023-06-13						
A						
ISSUED FOR PERMIT DATE: 2023-05-05						

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE MAY 2023

REFERENCE NO.

SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN AT/CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

FISH BYPASS – PLAN AND SECTIONS

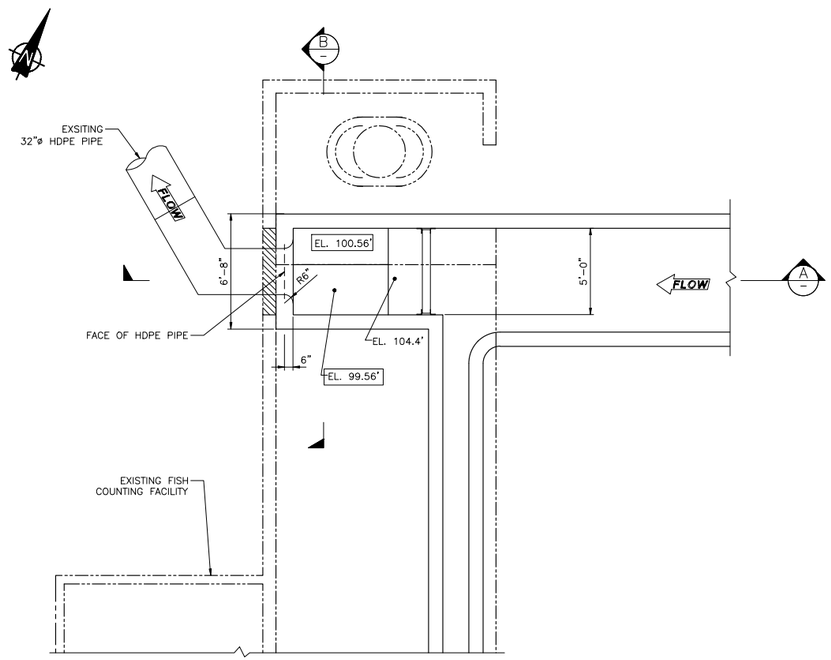
H 0,9,6,H,1 1 6,2,0 0,0 0,2,0 REV. B

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

DWG. NO. H096H1162000021

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.

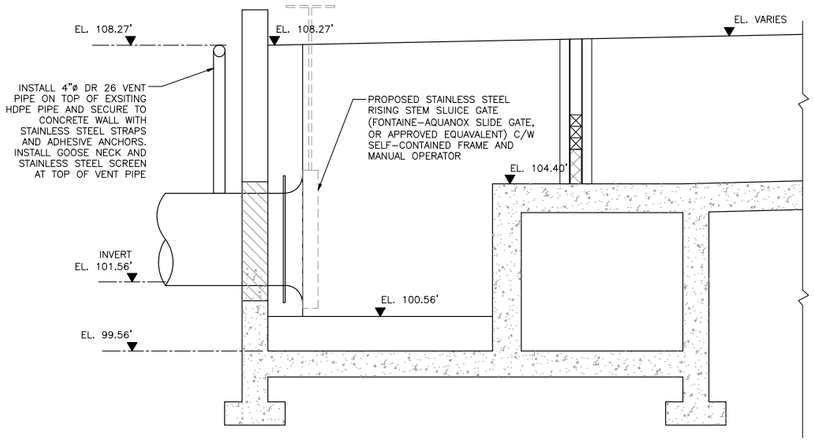


1/020 DETAIL PLAN

0' 1' 5' 10'

1/4"=1'-0"

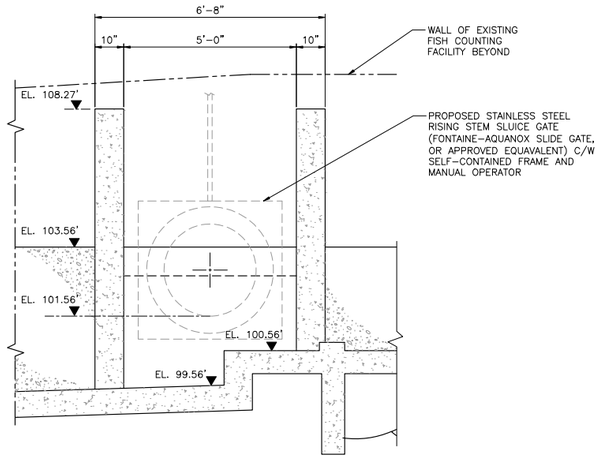
(ACCESS PLATFORM NOT SHOWN FOR CLARITY)



A SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"



B SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

FISH BYPASS – PLAN AND SECTIONS	H096H1116200020200
GENERAL NOTES	H096H1116200001200

REV.	DS	CIVIL	MECH	E & I	CONST	ENVIRO
B						
RE-ISSUED FOR PERMIT DATE: 2023-06-13						
lc. EO AC						
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ISSUED FOR PERMIT DATE: 2023-05-05						

SEAL

DEPARTMENTAL APPROVALS

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APPROVED

DATE MAY 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

FISH BYPASS – SECTIONS AND DETAILS

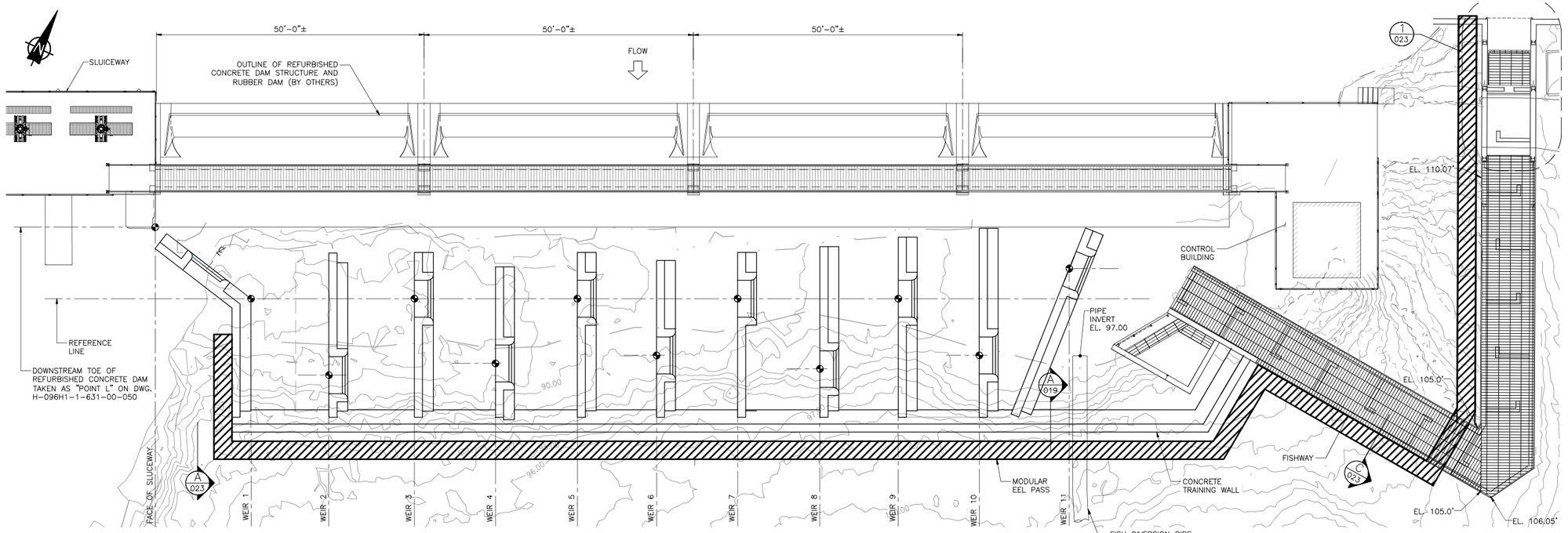
DWG. NO. H096H1162000021 REV. B

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

DWG. NO. H096H1-1-6200-0022

NOTES:

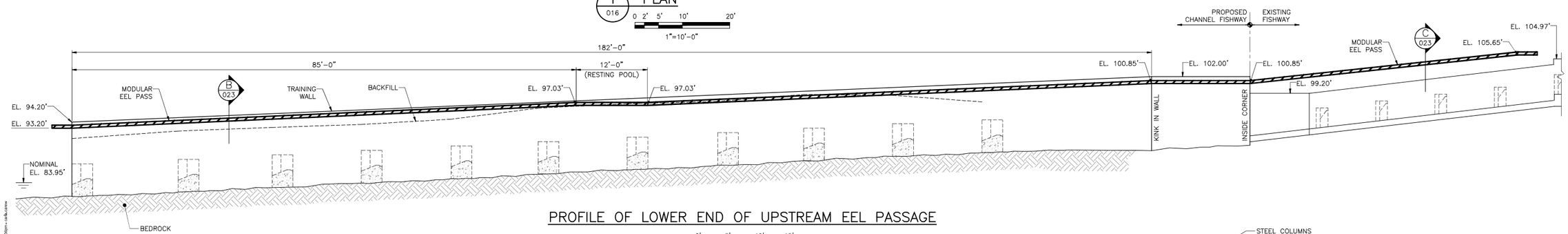
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. FOR DIMENSIONS OF CHANNEL FISHWAY, SEE DRAWING H-096H1-1-620-00-017.



1 016 PLAN

0 2' 5' 10' 20'

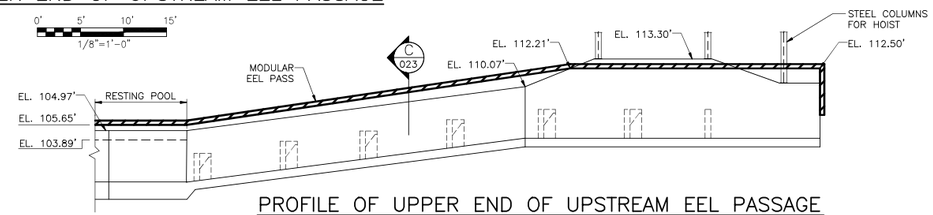
1"=10'-0"



PROFILE OF LOWER END OF UPSTREAM EEL PASSAGE

0' 5' 10' 15'

1/8"=1'-0"



PROFILE OF UPPER END OF UPSTREAM EEL PASSAGE (FAR SIDE OF FISHWAY)

0' 5' 10' 15'

1/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

EAST SPILLWAY PLAN AND SECTIONS	H096H1-1-6310-0050
UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS	H096H1-1-6200-0023
CHANNEL FISHWAY – PLAN AND SECTIONS	H096H1-1-6200-0017
GENERAL ARRANGEMENT PLAN	H096H1-1-6200-0016
GENERAL NOTES	H096H1-1-6200-0012
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
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ISSUED FOR PERMIT
DATE: 2023-05-06
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DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

JOB No. 254103

REFERENCE NO.

wood.

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RUTH FALLS
FISHWAY MODIFICATIONS

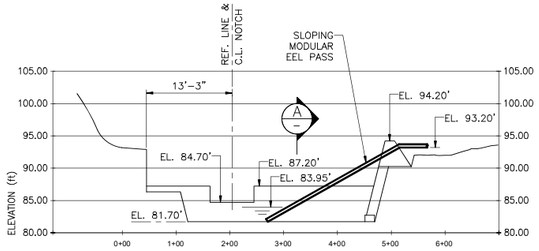
UPSTREAM EEL PASSAGE – PLAN AND SECTIONS

SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	AT/CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

H096H1-1-6200-0022 REV. A

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

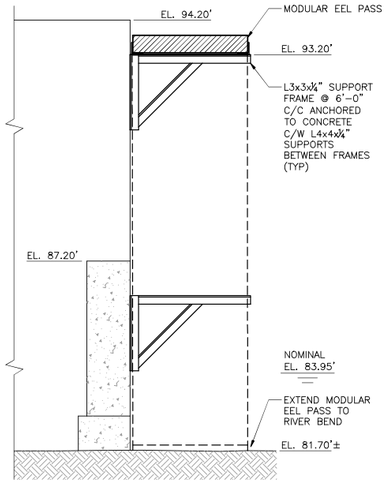
DWG. H096H1-1-6200-0023



A 022 SECTION

0' 5' 10' 15' 20'

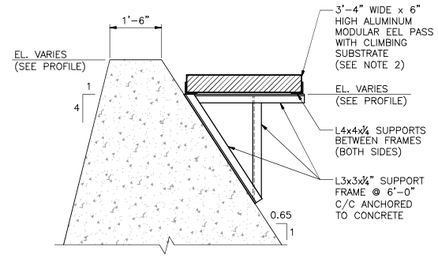
3/32"=1'-0"



A – SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

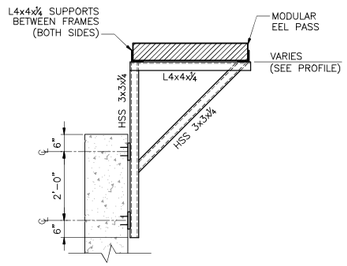


B 022 SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

(TYPICAL ALONG TRAINING WALL)



C 022 SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. MODULAR EEL PASS TO CONSIST OF 6" HIGH ALUMINUM TROUGH WITH HINGED LOCKABLE COVER (SEE FIGURE 1), (EXCEPT NO COVER AT DOWNSTREAM END WHERE EEL PASS IS SUBMERGED) C/W CLIMBING SUBSTRATE. CLIMBING SUBSTRATE TO BE HIGH DENSITY CO-POLYMER MANUFACTURED BY AQUATIC CONTROL ENGINEERING OR BERRY AND ESCOTT ENGINEERING. (SEE FIGURE 2)

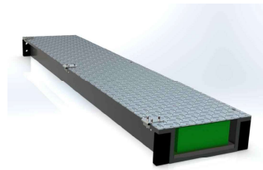
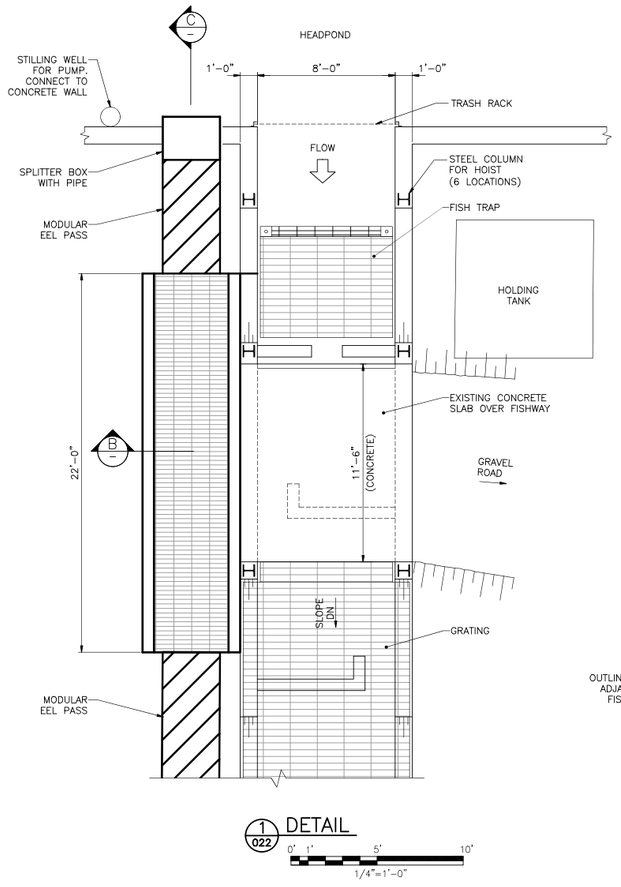


FIGURE 1



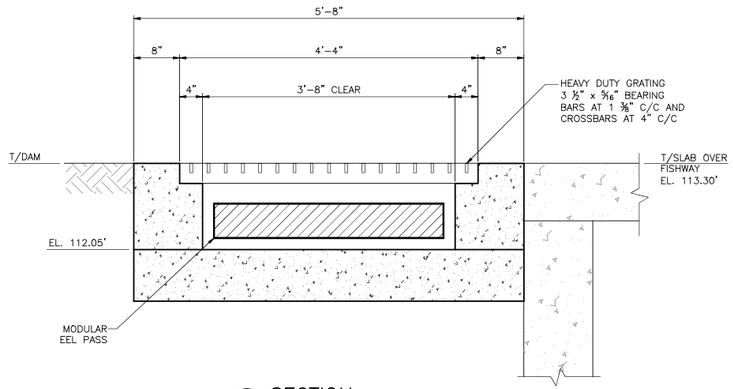
FIGURE 2



1 022 DETAIL

0' 1' 5' 10'

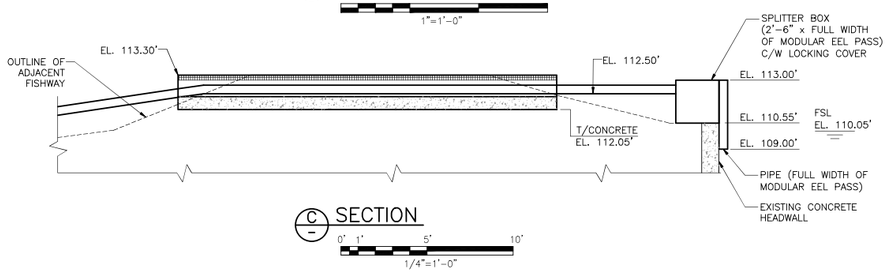
1/4"=1'-0"



B – SECTION

0' 1' 2' 3'

1"=1'-0"



C – SECTION

0' 1' 5' 10'

1/4"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	H096H1-1-6200-0022
GENERAL NOTES	H096H1-1-6200-0012
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	ENVIRO
A						
ISSUED FOR PERMIT DATE: 2023-05-05						

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

JOB No. 254103

SCALE	3/32"=1'-0"
UNITS	Imperial
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.

Nova Scotia POWER An Emera Company

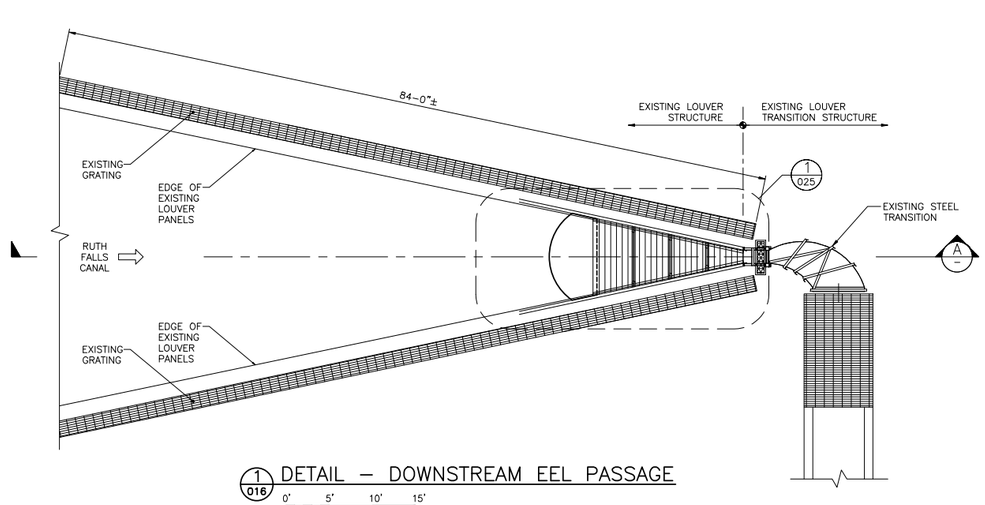
RUTH FALLS
FISHWAY MODIFICATIONS

UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS

H096H1-1-6200-0023 REV. A

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

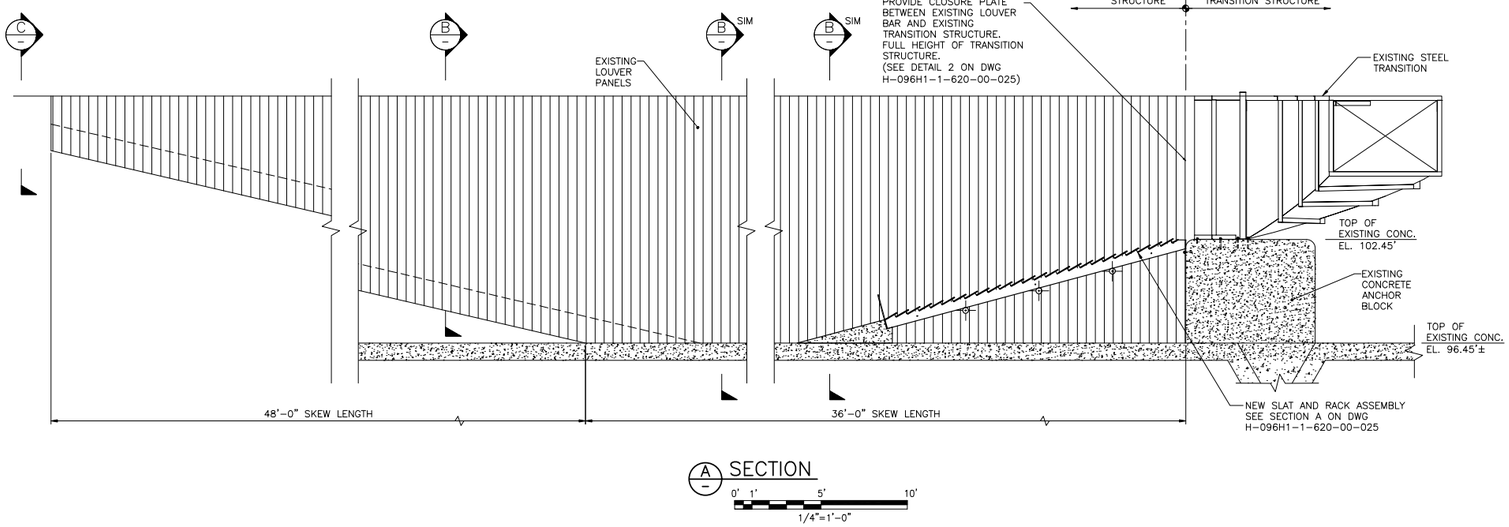
DWG. NO. H096H1162000002400



1/016 DETAIL – DOWNSTREAM EEL PASSAGE

0' 5' 10' 15'

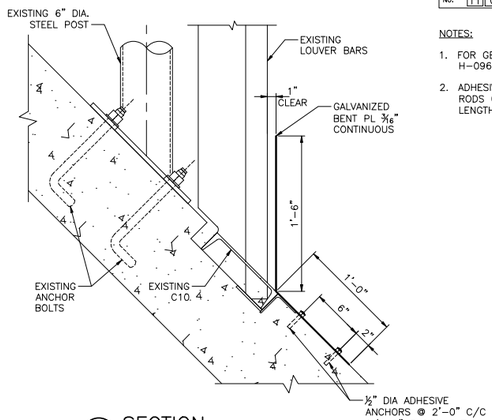
1/8"=1'-0"



A SECTION

0' 1' 5' 10'

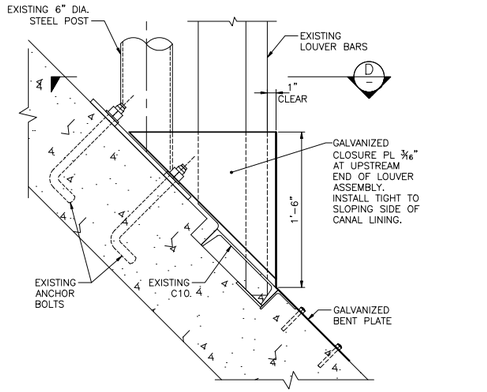
1/4"=1'-0"



B SECTION

0" 6" 12" 24"

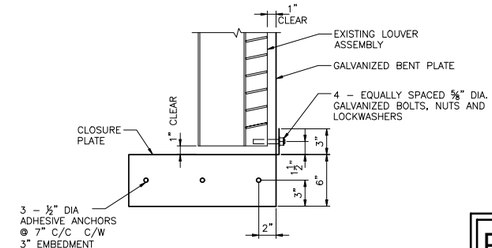
1-1/2"=1'-0"



C SECTION

0" 6" 12" 24"

1-1/2"=1'-0"



D SECTION

0" 6" 12" 24"

1-1/2"=1'-0"

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. ADHESIVE ANCHORS TO BE HAS-R 316SS ANCHOR RODS C/W HIT-RE 500 V3 EPOXY. SIZE AND LENGTH AS INDICATED.

PRELIMINARY
NOT FOR CONSTRUCTION

EEL PASSAGE – SECTIONS AND DETAILS	H096H1162000002500
GENERAL ARRANGEMENT PLAN	H096H1162000001600
GENERAL NOTES	H096H1162000001200

REV.	DS	CIVIL	MECH	E & I	CONST	ENVIRO
A						
REV.	DS	CIVIL	MECH	E & I	CONST	ENVIRO

ISSUED FOR PERMIT
DATE: 2023-06-13
M. EO AC

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	JUNE 2023	

JOB No. 254103

REFERENCE NO.	
SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-06-13
W.O.	

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

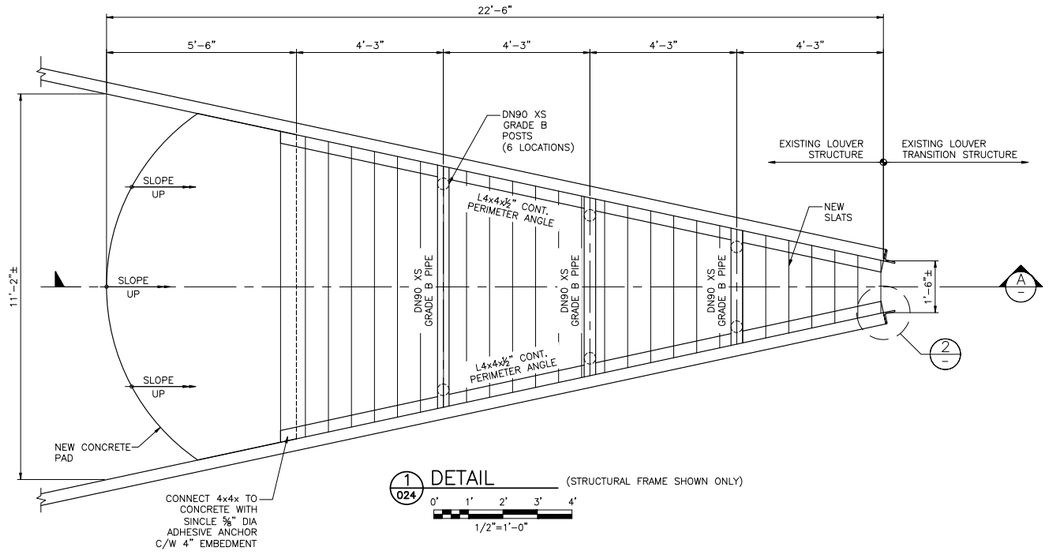
DOWNSTREAM EEL PASSAGE
PLAN AND SECTIONS

H096H1162000002400 REV. A

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,2,5

NOTES:

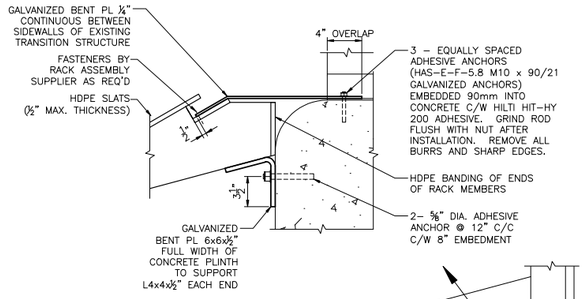
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. ADHESIVE ANCHORS TO BE HAS-R 316SS ANCHOR RODS C/W HIT-RE 500 V3 EPOXY. SIZE AND LENGTH AS INDICATED.

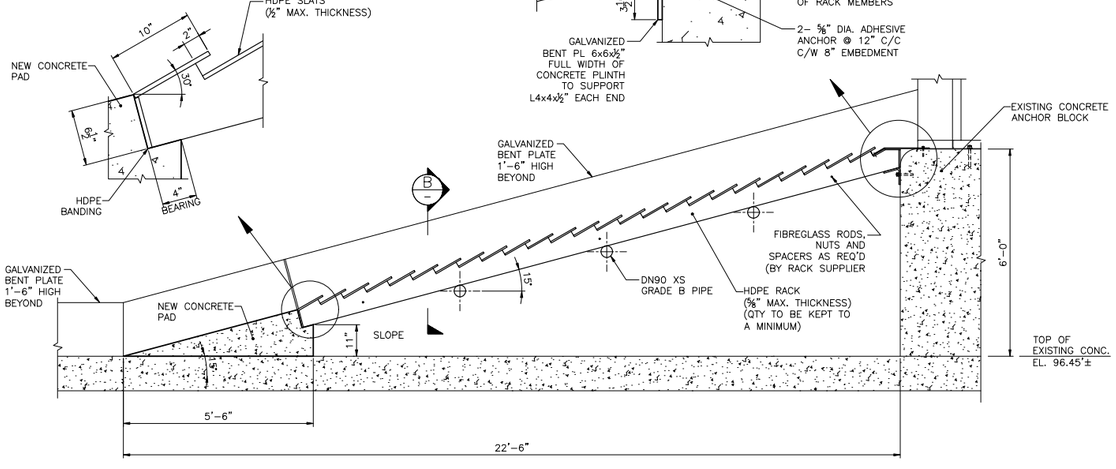


1/024 DETAIL (STRUCTURAL FRAME SHOWN ONLY)

0' 1' 2' 3' 4'

1/2"=1'-0"

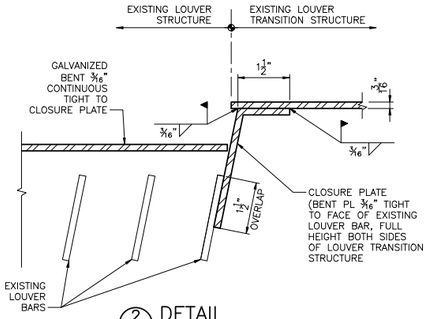




A SECTION

0' 1' 2' 3' 4'

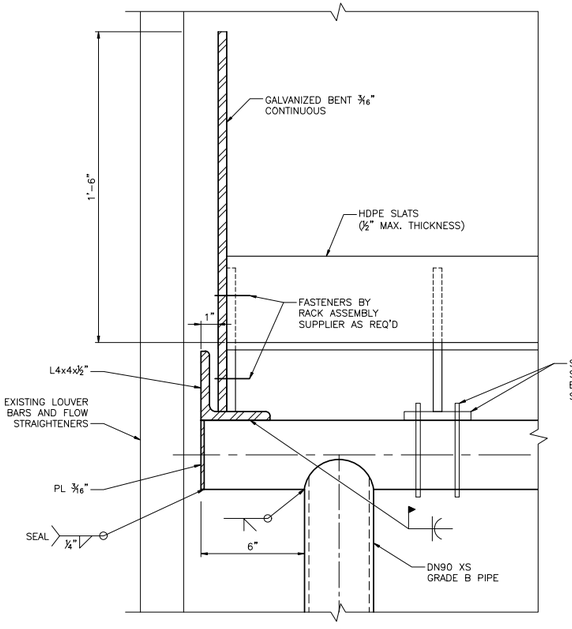
1/2"=1'-0"

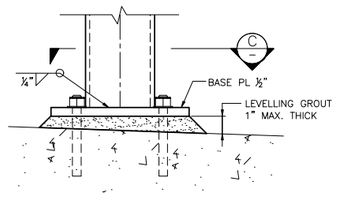


2 DETAIL

0" 1" 2" 3" 4"

6"=1'-0"

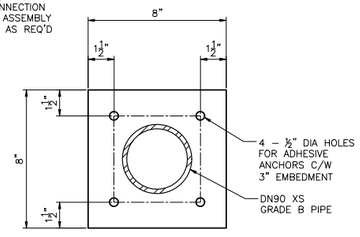




B SECTION

0" 6" 9" 12"

3"=1'-0"



C SECTION (6 LOCATIONS)

0" 6" 9" 12"

3"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,4
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV.	DS	CIVIL	MECH	E & I	CONST	ENVIRO.
A	EO					

ISSUED FOR PERMIT
DATE: 2023-06-13
M. EO AC

SEAL

DEPARTMENTAL APPROVALS

CIVIL | E. & I | MECH | CONST

APPROVED

DATE JUNE 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN CC
CHECKED AC
CHECKED EO
DATE 2023-06-13
W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

DOWNSTREAM EEL PASSAGE SECTIONS AND DETAILS

H 0,9,6,H,1 1 6,2,0 0,0 0,2,5 REV. A

APPENDIX E PROPOSED WATER MANAGEMENT STUCTURES

SITE PLAN SHOWING UPSTREAM AND DOWNSTREAM ACCESS ROADS AND BRIDGE

FOOTPRINT OF TEMPORARY STRUCTURES

LEFT DOWNSTREAM ACCESS ROAD: 10,530 SQ FT (978 SQ M)

RIGHT DOWNSTREAM ACCESS ROAD: 6,870 SQ FT (638 SW M)

TEMPORARY BRIDGE: 546 SQ FT (50 SQ M)

RIGHT UPSTREAM ACCESS ROAD: 6,690 SQ FT (621 SQ M)

LEFT UPSTREAM ACCESS ROAD: 10,230 SQ (950 SQ M)

TOTAL: 34,866 SQ FT (3,237 SQ M)

LEFT ACCESS ROAD 341 FT (104 M) LONG

RIGHT ACCESS ROAD 223 FT (68 M) LONG

TEMPORARY BRIDGE 42 FT (13 M) LONG

PRIMARY FLOW CHANNEL

RIGHT DOWNSTREAM ACCESS ROAD 229 FT (70 M) LONG

NOTE: THIS SECTION OF THE ACCESS ROAD WILL BE CONSTRUCTED ON EXPOSED BEDROCK, WHICH WILL BE DRY ONCE THE RESERVOIR IS DRAWN DOWN.

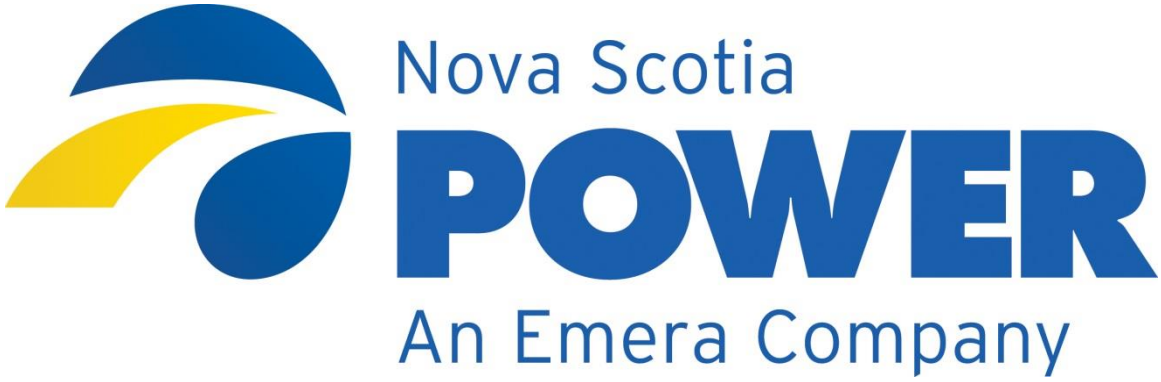
LEFTDOWNSTREAM ACCESS ROAD 351 FT (107 M) LONG

NOTE: THIS SECTION OF THE ACCESS ROAD WILL BE CONSTRUCTED DOWNSTREAM OF THE EXISTING ROCKFILL THAT IS SUPPORTING THE ATTRACTION FLOW DISCHARGE PIPE. THIS AREA IS NOT PART OF THE DISCHARGE CHANNEL.

CP C-MAG-PLACED
Northing: 16338624.18ft
Easting: 14505270.33ft
Elevation: 115.69ft
ATS 77 Zone 4 Elevation Datum: CGVD 28
Placed by Talisman Technical Solutions 20 Nov. 2019

0 20' 40'
1" = 20'

APPENDIX F – EEL STUDY SUMMARY



2009 / 2010 American Eel Study Summary
Ruth Falls Downstream Louvre System

TABLE OF CONTENTS

1.0 STUDY OVERVIEW 2
2.0 LOUVRE SYSTEM 2
3.0 STUDY DETAILS 3
3.1 2010 Study Results 5
3.2 Study Assumptions 8
4.0 CONCLUSION 8

1.0 STUDY OVERVIEW

In 2009 and 2010, NSP completed tagging studies to assess the downstream movement of two migrating species at the Ruth Falls Dam: Atlantic salmon smolts and American eels. The intended outcome of the studies was to determine the efficiency of downstream fish passage using the existing louvre diversion system which is situated at the beginning of the powerhouse canal. The louvre system is designed to divert fish toward a bypass pipe which then carries fish through the pipe, eventually releasing them downstream of the dam in the original East River.

In 2009 salmon smolts and American eels were assessed using pit tags, and based on the findings, a second year of study was conducted focusing on the survival rate of seaward migrating American eel. The 2010 study showed that of 30 acoustic tagged silver stage eels, 33% used the existing bypass or spillway (10 eels), 40% of the remainder (7 eels) were detected below the powerhouse and considered to have survived passage through the turbines for a total successful passage rate of 57%. The remainder were not accounted for in the study and assumed to have been killed.

Based on the acoustic data of the 2010 study, NSP identified that 70% of the eels were able to evade the louvres. Additionally, approximately 40% of the eels that went through the turbine reported at the gate downstream. These animals were identified as having survived but were not recaptured to assess heath status.

2.0 LOUVRE SYSTEM

The louvre system at the Ruth Falls Dam was originally installed in 1966 as a downstream bypass and counting facility for the passage of Atlantic salmon smolts. The louvre system is a series of vertical slats arranged in a V pattern across the intake canal. Each leg of the V is approximately 50 ft long and orientated 12 degrees to the approach flow with a fish bypass located downstream at the vertex. The louvre bars are approximately 2 inches apart and extend from the bottom of the canal to a top walkway deck at elevation 114.0 ft. Every sixth bar (12 inches) has a flow straightener extending from the bar in an arc that forces flow to exit the louvres parallel with the canal. The fish bypass is located at the vertex of the louvre V array.

The louvres have been modified on numerous occasions since they were installed in 1966. Major changes were undertaken during the rebuild of the louvre bypass exit and monitoring shed operations in 2005. Other changes include switching the bottom outlet pipe to a top outlet pipe as it was determined that it would be a better suit for salmon smolts and other pelagic species who typically swim in the upper part of the water column. Figure 1 shows the current design facing upstream toward the Ruth Falls Headpond.

Figure 1: Current Ruth Falls Downstream Louvre System



3.0 STUDY DETAILS

The assessment of fish passage and the efficiency of the louvre diversion system was conducted over 2 years – the first taking place in 2009 and the second in 2010. In May 2009 NSP assessed efficiency for salmon smolts and in late September and October for American eels using pit tags and Pit tag antennas installed in the bypass. The study was limited to tracking the fish travelling through the bypass.

In 2009:

- 1082 eels were identified using the bypass
- NSP tagged 148 eels, released them upstream the below Malay Falls dam, and detected 40 travelling through the bypass representing 30% efficiency, assuming all remaining eels entered the canal (worst case scenario). This is likely an underestimate as the pit tag passive detections are not as reliable as acoustic detections.
- NSP also identified alewife (2143), speckled trout (53), yellow perch (10), white sucker (9) and even a salmon over a period of 46 days. This data also illustrates the low number of non migratory species using the bypass.

Based on this information NSP decided to conduct a more robust study in 2010 specifically focused on eels survival using acoustic tags. This study was focused on assessing the number of eels successfully migrating to sea rather than the effectiveness of the bypass at diverting eels away from the canal. The receiver setup deployed (Figure 4) didn't allow for distinguishing between a fish that used the louvre bypass and a fish that went over the spillway, as they would both end up in the river. In 2010 the study was conducted using acoustic receivers, this allowed for a broader range of transmitting throughout the watershed. Figure 2 shows one of the acoustic receivers used.

Figure 2: Example of receiver set up used in 2010 study



3.1 2010 Study Results

The October 2010 study was designed to assess successful outmigration of American eel. The details and results of the 2010 study including receiver and release locations are described below:

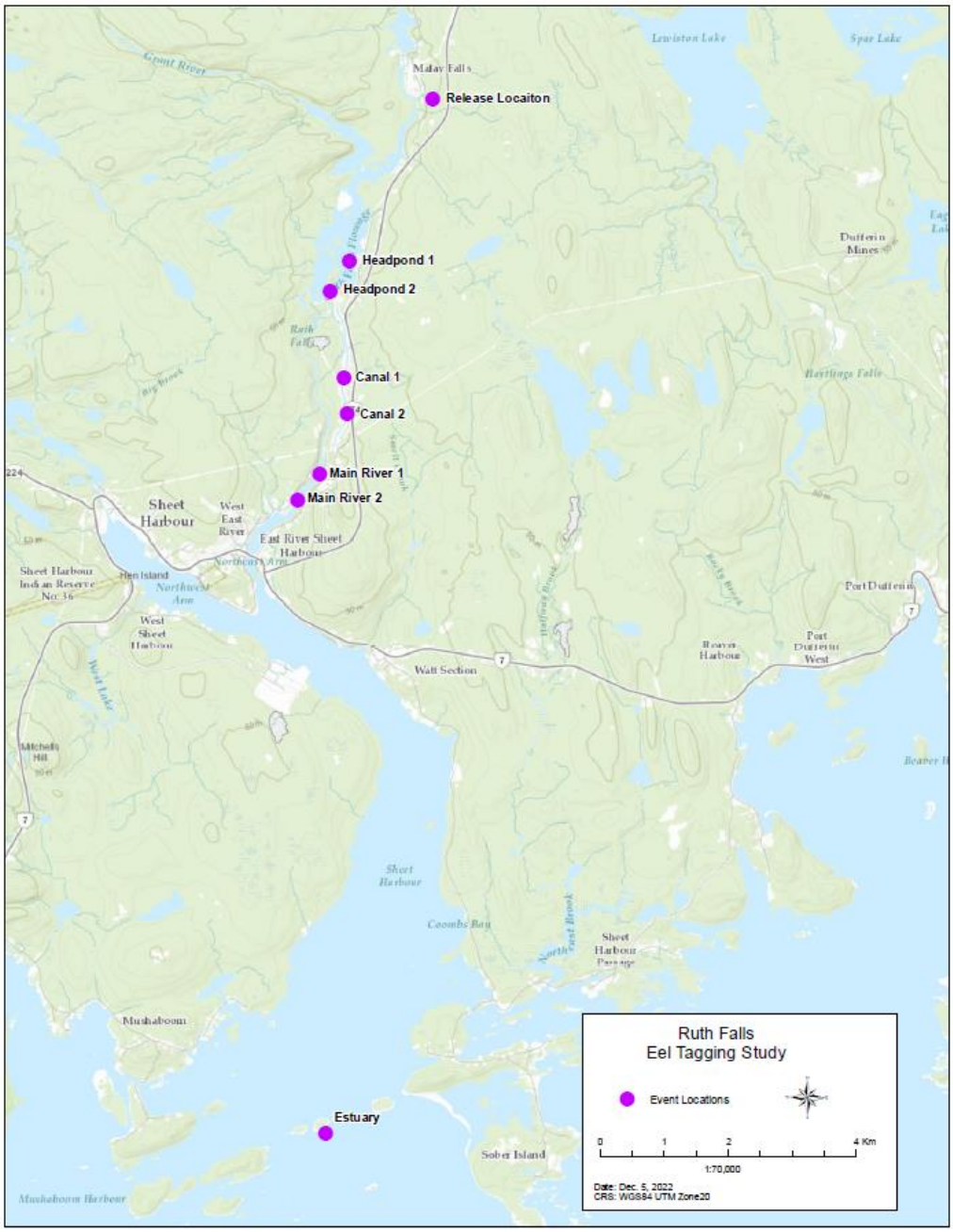
American eels were captured as they travelled through the bypass. These eels were identified as mature silver (migrating) eels. DFO science conducted the surgeries implanting the pit and acoustic tags:

- On October 7, 2010: 181 eels were measured and weighed.
- On October 12, 2010: 64 eels were measured and weighed and received a pit tag; 32 eels were also surgically implanted with an acoustic transmitter.
- On October 15, 2010: 55 eels were measured and weighed and received a pit tag.
- On October 19, 2010: 318 eels travelled through the bypass; none were tagged.
- All fish tagged on October 12, 2010 were released on October 13, 2010 at 15:23 below Malay falls (lat 44.983415; lon -62.478809) Shown on Map in Figure 4 below.
- Six receivers were deployed to track the movement of eels as they migrated back down the watershed (see table below for coordinates).
- Two receivers were placed in the headpond above the canal entry and spillway, they were installed so that they could detect fish approaching either structure.
- Two receivers were placed in the canal downstream of the louvres.
- Two receivers were placed in the main body of the river below the confluence of the river and the tailrace.
- One receiver was placed in the estuary, approximately 12 kilometers below the confluence.

Figure 3: Receiver and Release Location Chart

Receiver location	Lat	Lon
Headpond1	44.96078	-62.4955
Headpond2	44.95658	-62.4993
Canal1	44.94423	-62.4967
Canal2	44.93929	-62.4962
Main River1	44.93088	-62.5017
Main River2	44.92724	-62.5061
Estuary	44.83831	-62.5013

Figure 4: Receiver and Release Location Map



Upon completing the study, the following results were concluded:

- 30 eels were tagged; all eels successfully reported to the receivers in the headpond.
- 9 eels reported to the receivers in the river and the estuary and assumed to have survived. This means that all 9 eels travelled either over either over the spillway or used the louvre bypass. The exit to the bypass is situated directly below the dam – this is the reason there was no feasible way to distinguish between eels traveling over the spillway or using the louvres.
- 21 eels circumvented the louvre system and entered the canal.
    - 8 reported to the river and estuary receivers; assumed to have survived.
    - 13 last reported in the canal but did not report to the river or the estuary and are assumed to have died from turbine interaction.

Figure 4: Study Result Breakdown

	PASSAGE ROUTE		
30 Total Fish		No Turbine	Turbine
Number	30	9	21
%		30.0	70.0

	RIVER ROUTE MORTALITY				CANAL / TURBINE ROUTE MORTALITY			
9 Fish		Alive	Mortality Observed		21 Fish		Alive	Mortality Observed
Number	9	9	0		Number	21	8	13
%		100.0	0.0		%		38.1	61.9

	TOTAL MORTALITY		
30 Total Fish		Alive	Mortality Observed
Number	30	17	13
%		56.7	43.3

3.2 Study Assumptions

The study had the following assumptions:

- An eel that did not report past a receiver was assumed to have died upstream of that receiver
- Eels that were detected in the estuary were assumed to have survived and successfully migrated to sea.
- Eels that were identified as having survived were not recaptured to assess heath status.

4.0 CONCLUSION

Upon review of both the 2009 and 2010 studies, NSP has made certain assumptions:

- Both studies with very different techniques have similar efficiency estimates for the louvres – approximately 30%.
- Based on 2009 study, the louvre system and associated bypass is very effective for pelagic species such as alewife and trout.
- The bypass may work marginally for eels - there was no way to determine the difference between an eel reporting downstream of the dam who traveled through the bypass pipe or who traveled over the spillway

As a result, NSP recognizes that improvements are needed to the louvre and bypass system to make it suitable for eels and other bottom dwelling fish species. It is recognized that the system is old and may have damage including broken slats and other damage which could decrease efficiency. It is also understood that additional improvements may be required to guide eels towards the upward bypass pipe in the top of the water column.

APPENDIX G – HYDRAULIC MODELING RESULTS



Ruth Falls Dam Refurbishment

3D Modelling and Fish Passage Assessment

Nova Scotia POWER
An Emera Company

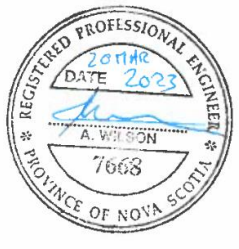
FINAL REPORT ver.2

CBCL

Project 221107.00 • 20th March 2023

2	FINAL REPORT ver.2	A Wilson / M Browne	20-Mar-2023	Y Zhang / C Jardine
1	FINAL REPORT	A Wilson / M Browne	13-Mar-2023	Y Zhang / C Jardine
0	DRAFT REPORT	A Wilson / M Browne	22-Feb-2023	Y Zhang / C Jardine
Rev.	Issue	Reviewed By:	Date	Issued By:

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Project No. 221107.00

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Appendices

A FIGURE 1
B THAUMAS CONSULTANTS REPORT

1 HYDROTECHNICAL ASSESSMENT

1.1 Background

This report addresses the request made by Nova Scotia Power (NSP) by email on the 8th February, 2022, and following discussions. An excerpt is presented below to present the requested scope of work:

We have determined a need for 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post-refurbishment downstream conditions. The main refurbishments include the installation of vertical lift gates in the center section of the dam which will replace the existing stop log bay. Another big change includes the installation of a new rubber dam. We are looking to know how changes in flow releases from the vertical lift gates (and rubber dam) could impact the downstream area – specifically the entrance conditions to the fish ladder.

The following information was discussed with NSP and was used to support the assessment:

- *Historic operation of the gates at the former structure*
- *Proposed operation of the gates at the proposed structure*
- *Flow measurements and discharge curves available at the gates*
- *Maintenance flow schedules during the year*
- *Fishway release flow schedules during the year*
- *Geometry of the proposed structure (IFC drawings)*
- *Bathymetry of the tailrace, from several site surveys*

1.2 Flow Assessment

Spill flow data was available from 2015 to 2022. The full timeseries of the spill flow data is presented below in Figure 1:

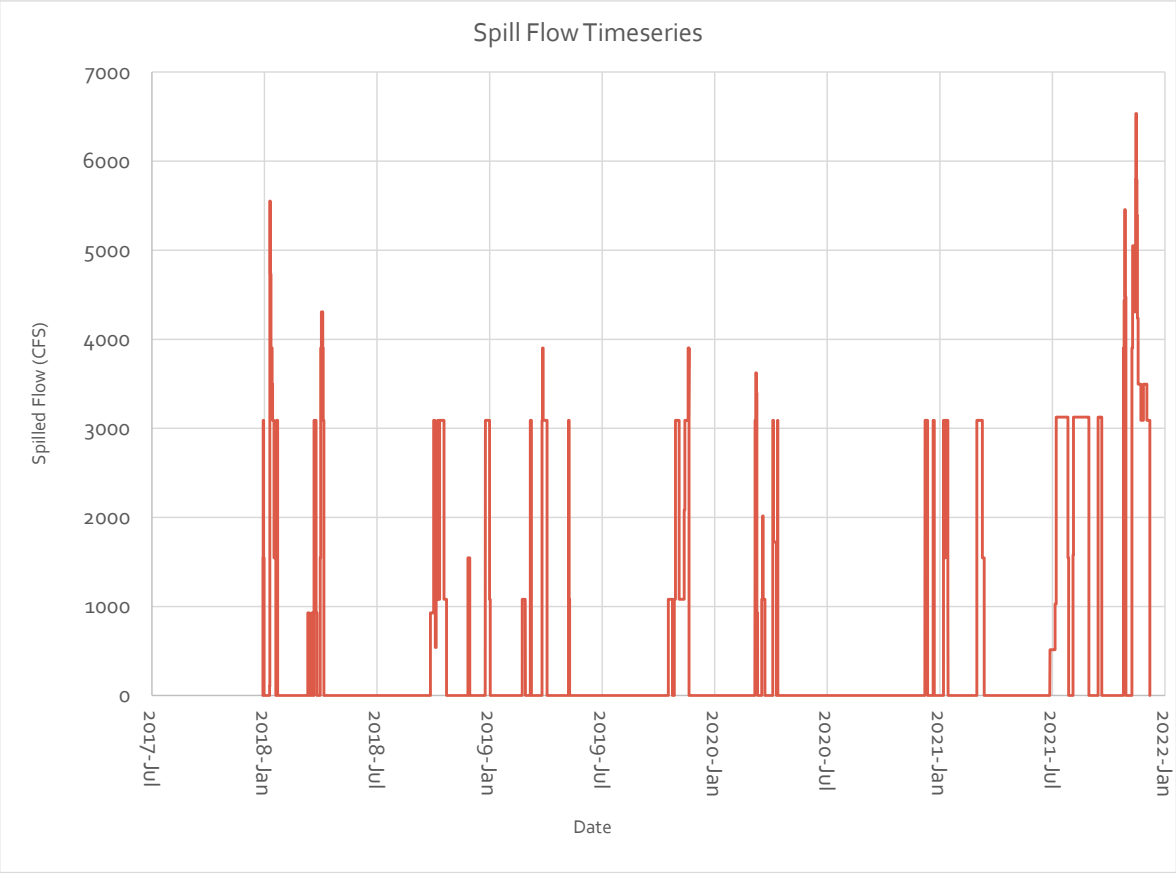


Figure 1: Spill flow Timeseries from 2015 to 2022 at the Ruth Falls Dam

As shown on the figure, spills are rather infrequent at this site. Spills increased in 2021 and 2022 due to construction activity at the dam, which has resulted in more frequent spills than would typically be seen at the site. Those years were therefore removed from the data to allow the assessment to be more representative of typical conditions. The results were also separated into seasonal time spans, to provide seasonal data that would be representative of fish migration windows. The following months were used to represent the various seasons:

Spring: May, June, July

Summer: August, September

Fall: October, November

Winter: December, January, February, March, April

Figure 2 shows the results of the flow duration curve analysis, presented as days during which the flows would be present during the various seasons.

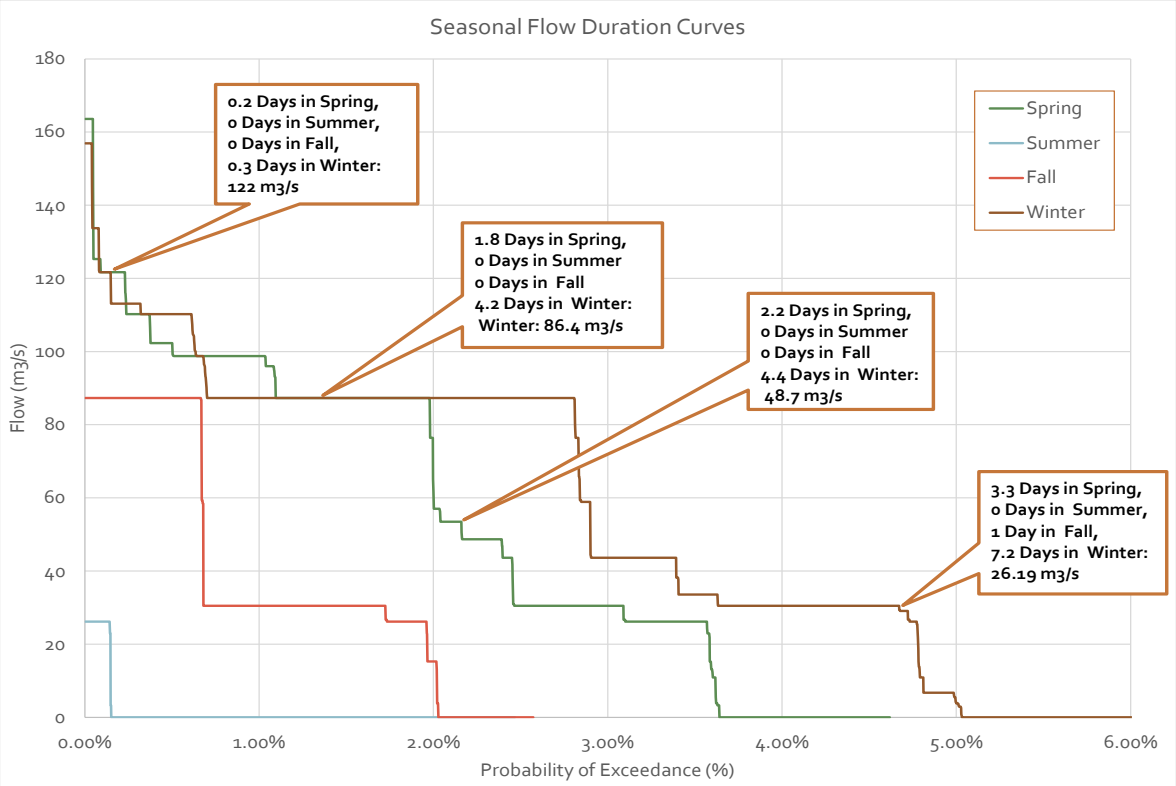


Figure 2: Seasonal Flow Duration Curves at Ruth Falls

Typically, the spills are released fairly evenly between the 3 gates, so the flow scenarios used in model include the 4 flows identified in Figure 2, all released evenly through the 3 gates.

The current structure has leakage through the stop logs, as well as through the existing gate frames. NSP measured the flows downstream of the dam, and obtained a value of 100.2 cfs. Part of this flow is from the fishway (6 cfs) and part of it is from the louvres pipe outflow (29 cfs), leaving 65 cfs as leakage through the structure. From the modelling results (see below) and the interpretation of those results for fish passage (see Thaumas Consultants report), the current flows are estimated to provide suitable conditions for fish passage in the natural river channel downstream of the dam. Higher flows produce higher velocities, especially at the rock sills, which leave no area of low velocity in the river for the passage of fish. Therefore, it was concluded that providing 65 cfs from the gates in the proposed conditions would result in the optimal conditions for fish passage.

Nevertheless, the attraction flows and existing weir configurations were not optimal for fish passage, so the weirs downstream of the fishway were re-configured in the model to improve both attraction flows and velocities for fish passage. The following steps were taken following the various model tests:

1. Existing weir configurations and louvres outflow configurations were modelled and resulted in poor attraction flows (see Figure 3)
2. The louvres outflow was moved to the last fishway to attempt to improve attraction flows towards the most downstream fish passage weir, which resulted in an improvement in attraction flows, but still no suitable passage through the weirs
3. The fish passage weirs were redesigned with the intent of providing approximately 20 cm drops, and a flow of 35 cfs, by also moving the louvres outflow beside the outlet of the fishway. The new weirs were sized to provide 23 cm drops at each pool, with a sufficient distance between the weir, and the last weir was rotated to point at 45 degrees downstream, the opening being on the south side of the weir. A rock diversion weir was also tested to evaluate its use in orienting the gate flows away from the weir attraction flows. The results of this are seen in Figure 4.
4. The same scenario was tested, but without the rock diversion just downstream of the gate (see Figure 5). It was found that with or without the rock diversion, flows from the gates would create back currents towards the last weir, disrupting the attraction flows.
5. The last weir was modified to have its notch on the north (dam) side, to join with the circulating flows from the gates. To achieve this, one weir had to be removed from the set, to maintain the alternating configuration of the notches. This is shown in Figure 6. The results show an improvement, but the strong currents circulating from the gate flows still disrupt the attraction flows.
6. The distribution of flows from the various gates was tested, to produce a more even guiding flow towards the fish passage weir, and minimize the current flowing back upstream. A range of distributions were tested, and the optimal configuration was achieved with a flow distribution of 20 cfs from the west gate, 40cfs from the centre gate, and 5 cfs from the east gate. The flow is highest from the centre gate because the centre gate ogee spillway is lower than the others. The velocity of the water is therefore much reduced, and the flow released enters the river at a lower elevation, where its energy is significantly more dissipated. It is noted that in practice, as the flows and velocity patterns at the gates and downstream may be slightly different than in the model, it is expected that some field verification and gate adjustment will be needed once the dam is completed, to obtain the desired fish passage goals. The gate settings may therefore be different than noted here, while still delivering a total of 65cfs. The results for this scenario are shown the figures S1-1 to S7-13.

For the last geometric configuration (point 5 above), results are shown below for a range of flow scenarios. These include the following:

- S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

- S2: 6 cfs from the fishway, 29 cfs from the louvres outfall, 165 cfs from the gates
- S3: 6 cfs from the fishway, 29 cfs from the louvres outfall, 925 cfs from the gates
- S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates
- S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates
- S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates
- S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

It is noted that the flow values in cfs for scenarios 3 to 7 correspond to the 4 spill flow values shown in Figure 2 above.

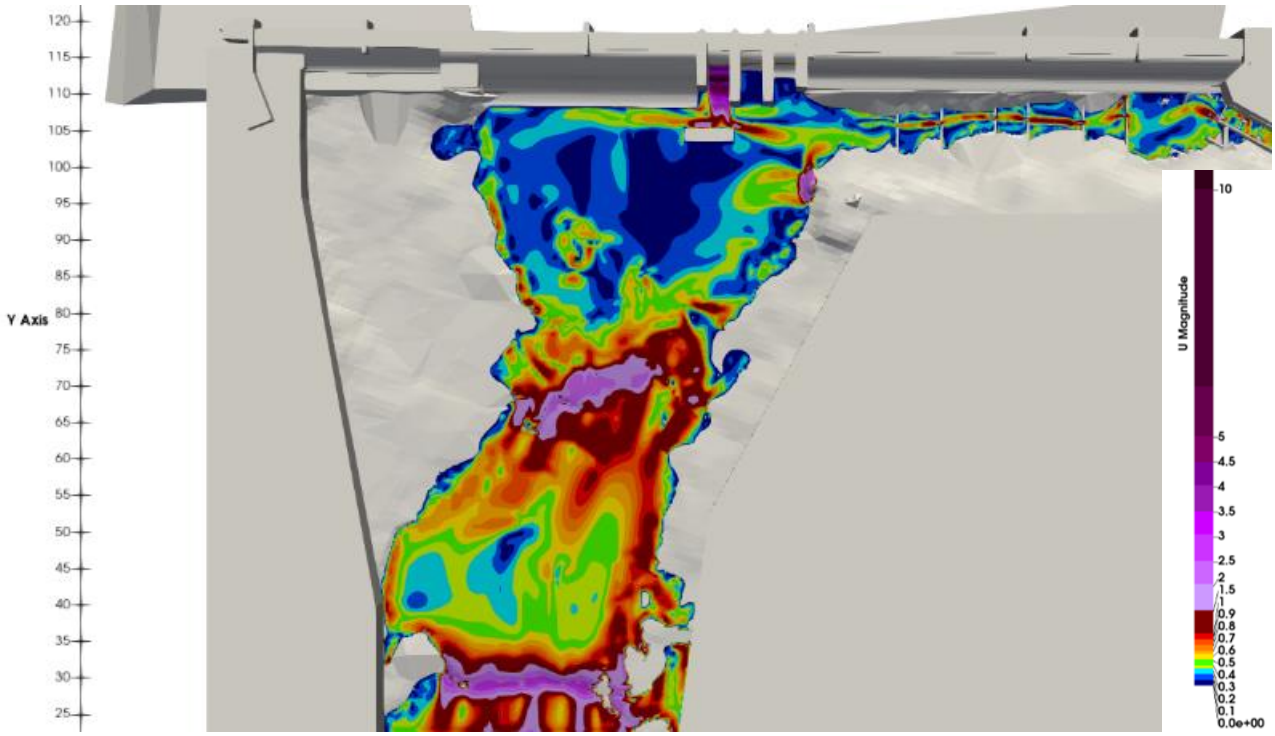


Figure 3: Existing Weir and louvres outflow configuration

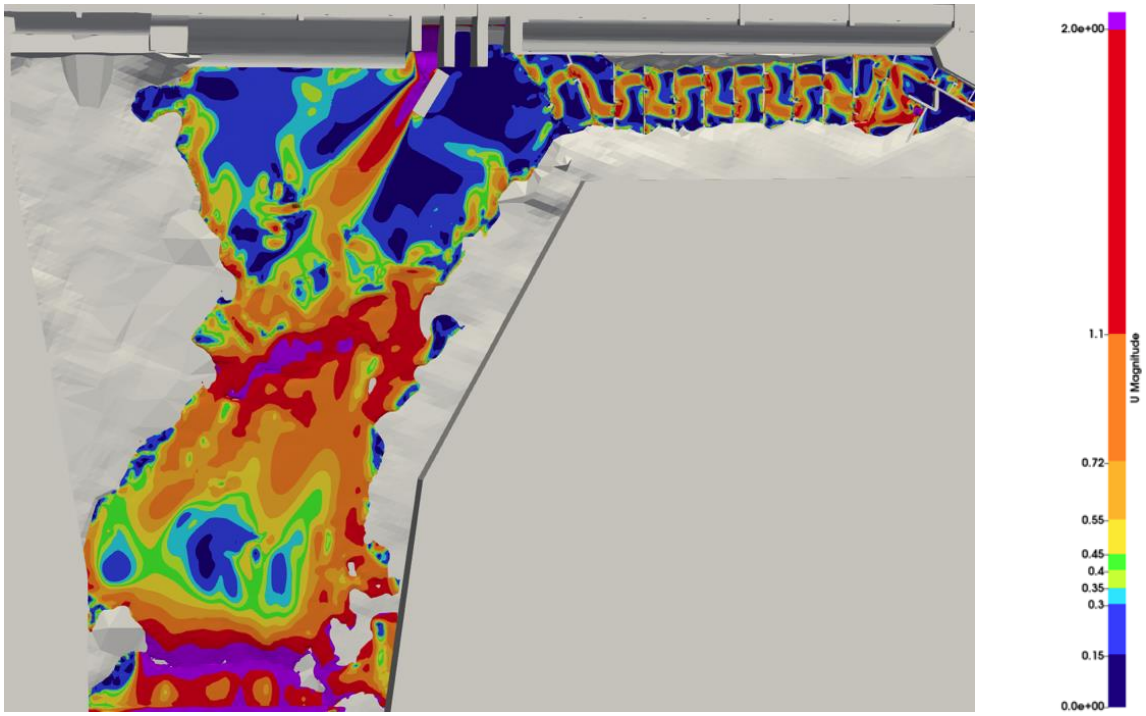


Figure 4: re-Designed Weir and louvres outflow configuration – with Rock Diversion

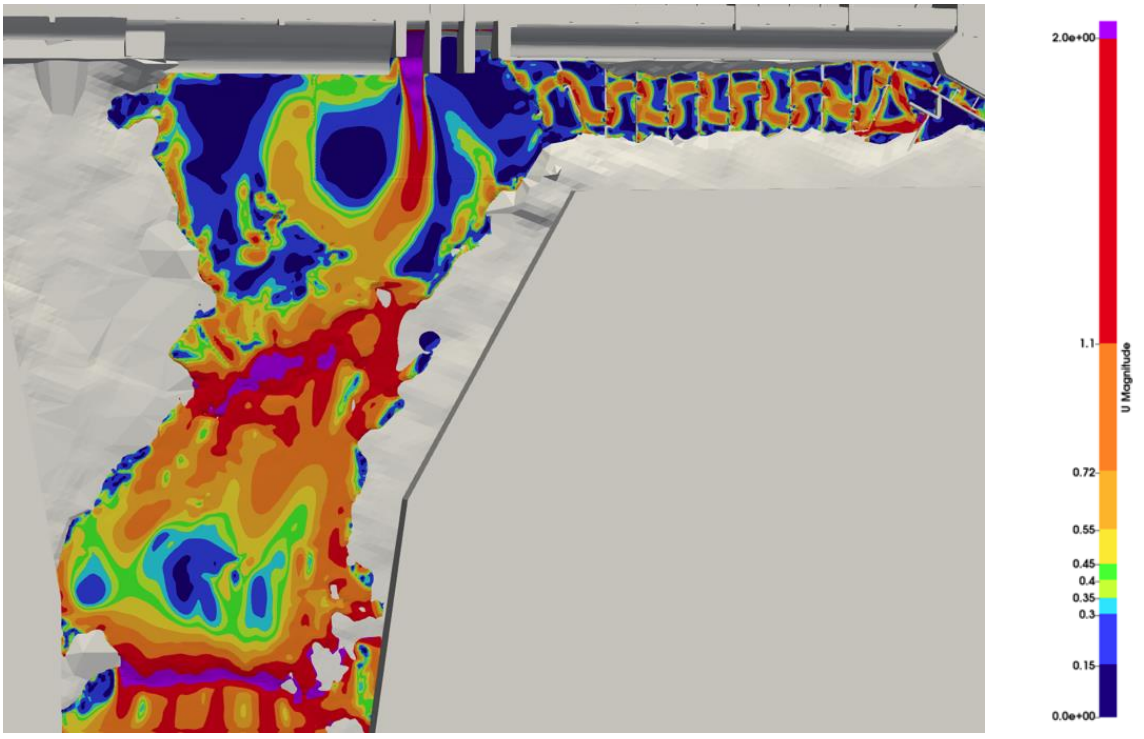


Figure 5: re-Designed Weir and louvres outflow configuration – No Rock Diversion

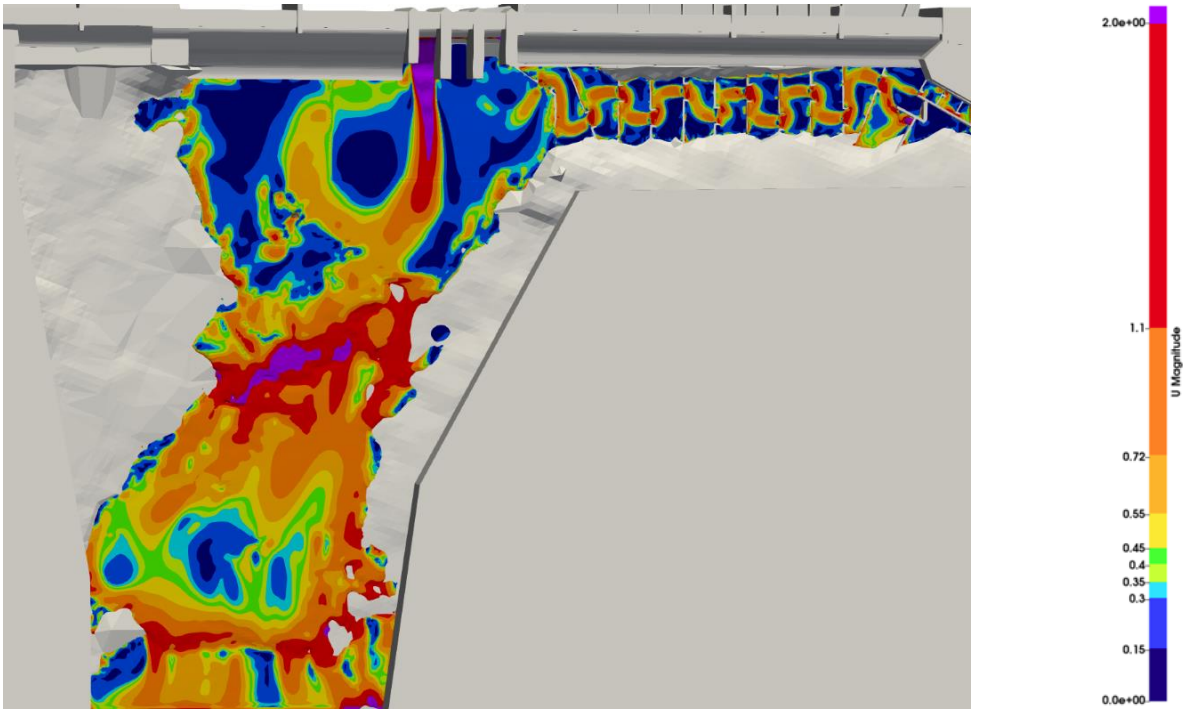


Figure 6: re-Designed Weir and louvres outflow configuration- last weir on Dam Side

1.3 3D CFD Modelling

Once the details of the geometry were fully available and completely understood, a geometric model of the proposed structure (fully constructed), together with the fishway and downstream channel was assembled in Civil3D. The extent of the modelled downstream channel was defined based on expected turbulence patterns, to make sure that the extents of the downstream influence of the fishway flows and attraction flows are included. This is important since the fish need to be able to sense the attraction flows and be guided to the fishway. Once the geometric model was completed in Civil3D, it was be exported to the 3D modelling software.

The modelling software used is OpenFoam, which has the highest recognition for Computational Fluid Dynamics (CFD) modelling in the scientific community. It was developed at Imperial College, London, is open source, and is supported by a community of users that provide technical support and additional tools to the model. CBCL has several years of experience working with this model and has developed workflows from model assembly to data extraction.

Once the geometry was set up in the model, the water levels and flows at the boundaries were set up. These were set depending on the various flow scenarios described above. The results of the modelling then allows the interpretation of fish passage quality for each species during the entire year.

1.4 Modelling Results

Each scenario (S1 to S7) contains 13 figures. Both plan views of the velocity magnitude, as well as cross-sections at regular intervals, with velocity vectors, are shown in panoramic views.

- **Figure 1 to Figure 3**: present the plan view of the water surface, mid-surface, as well as the view taken from the bottom to show the velocities along the bottom.
- **Figure 4 to Figure 8**: panoramic views of entire study domain and close-up views for the fishway area and the river channel; the vectors have a uniform length and are not scaled by velocities. Vectors are coloured by velocity magnitude.
- **Figure 9 to Figure 13**: focus on the bottom velocities (from the geometry bottom to 0.2m above it); vectors are generated only for a depth of 0.2m from the bottom and the vectors have a uniform length and are coloured by velocity magnitude.

The colour scale has been adjusted based on Bob Rutherford's request to show details from 0 to 2m/s, and only one colour for all velocities above 2m/s. The intervals between the cross sections are given in the titles for each figure.

1. Model Results of Scenario S1 with 65 cfs from the gates

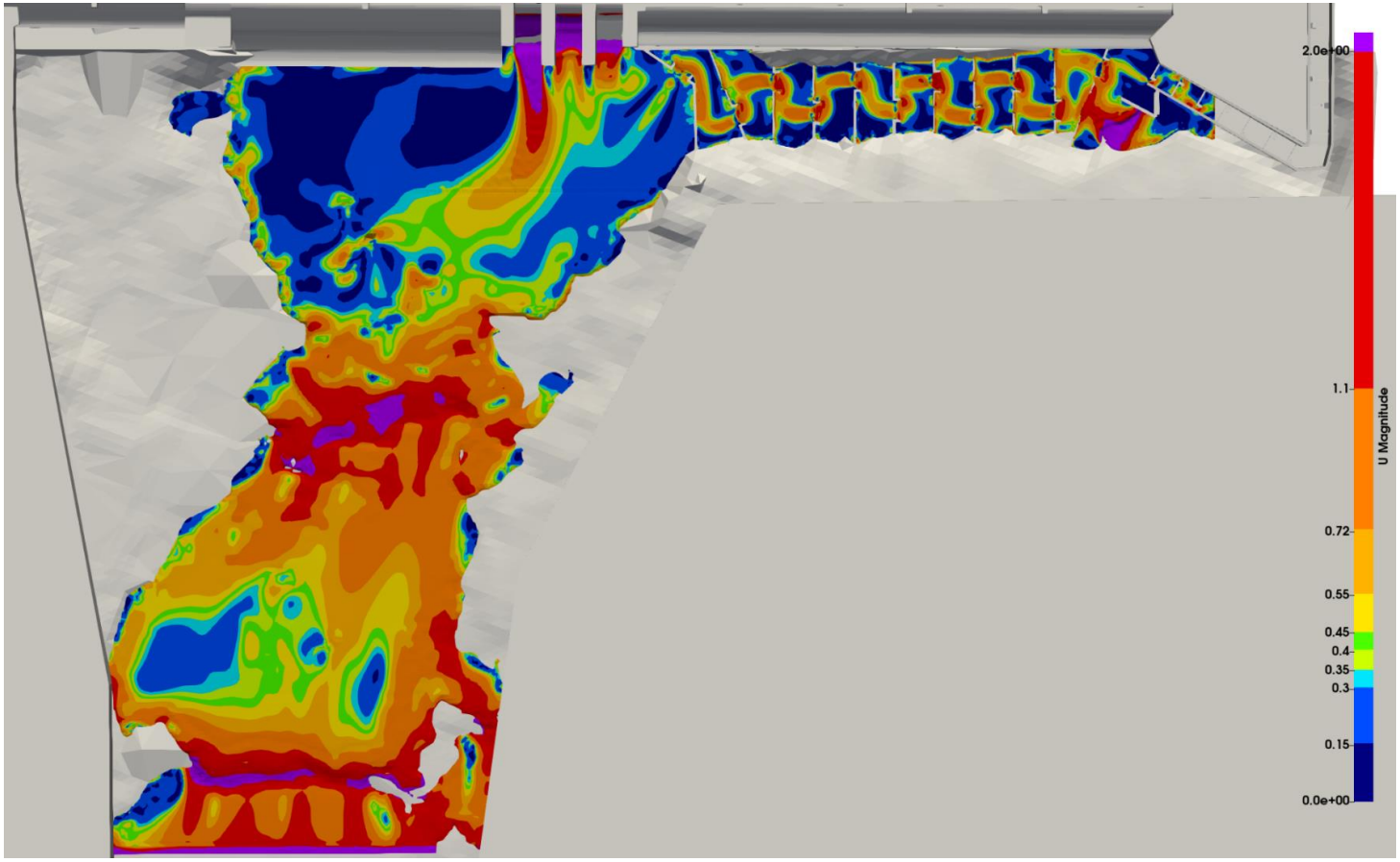


Figure S1-1: Plan view of the Water Surface Velocities

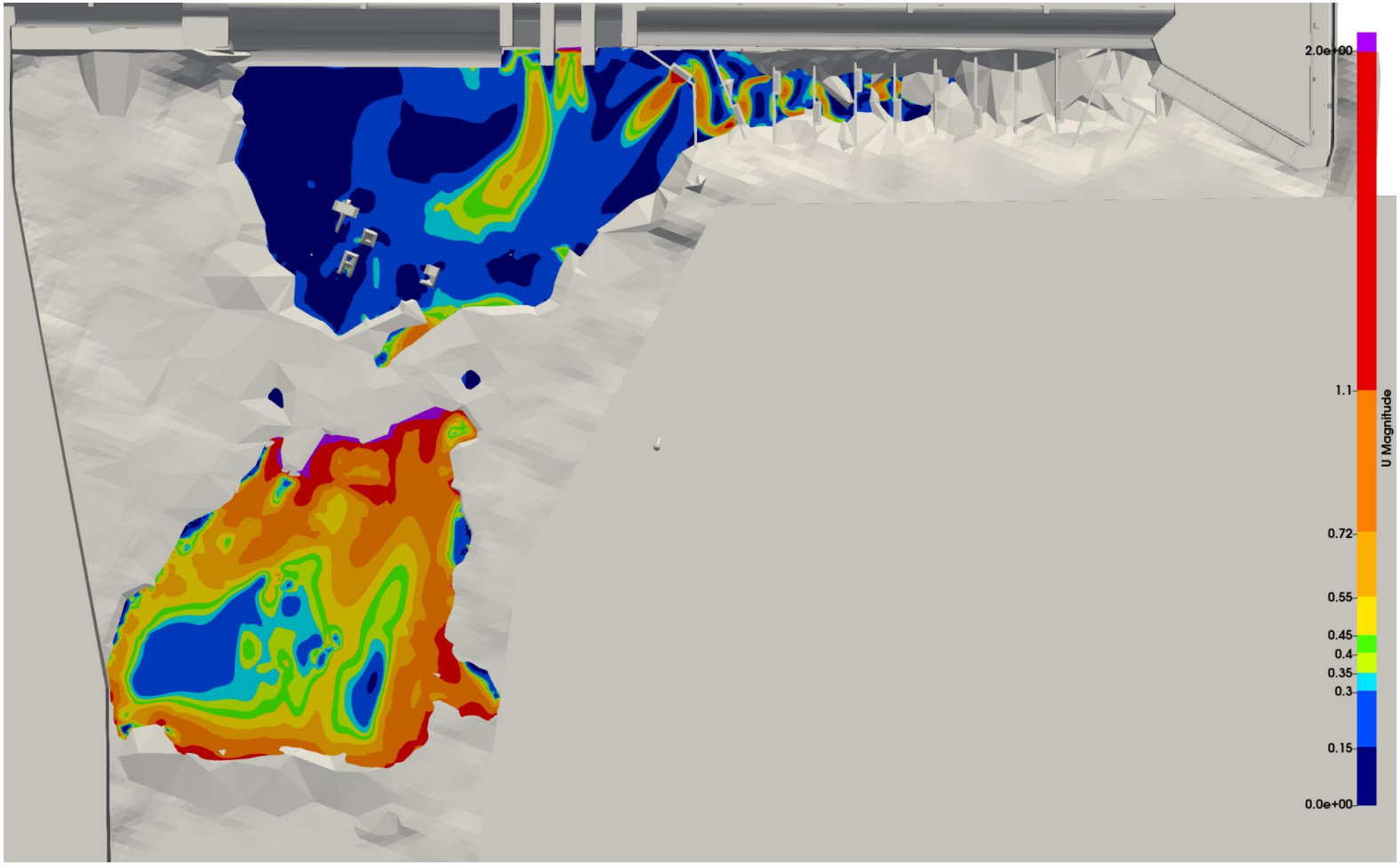


Figure S1-2: Plan view of the Mid-Surface Velocities

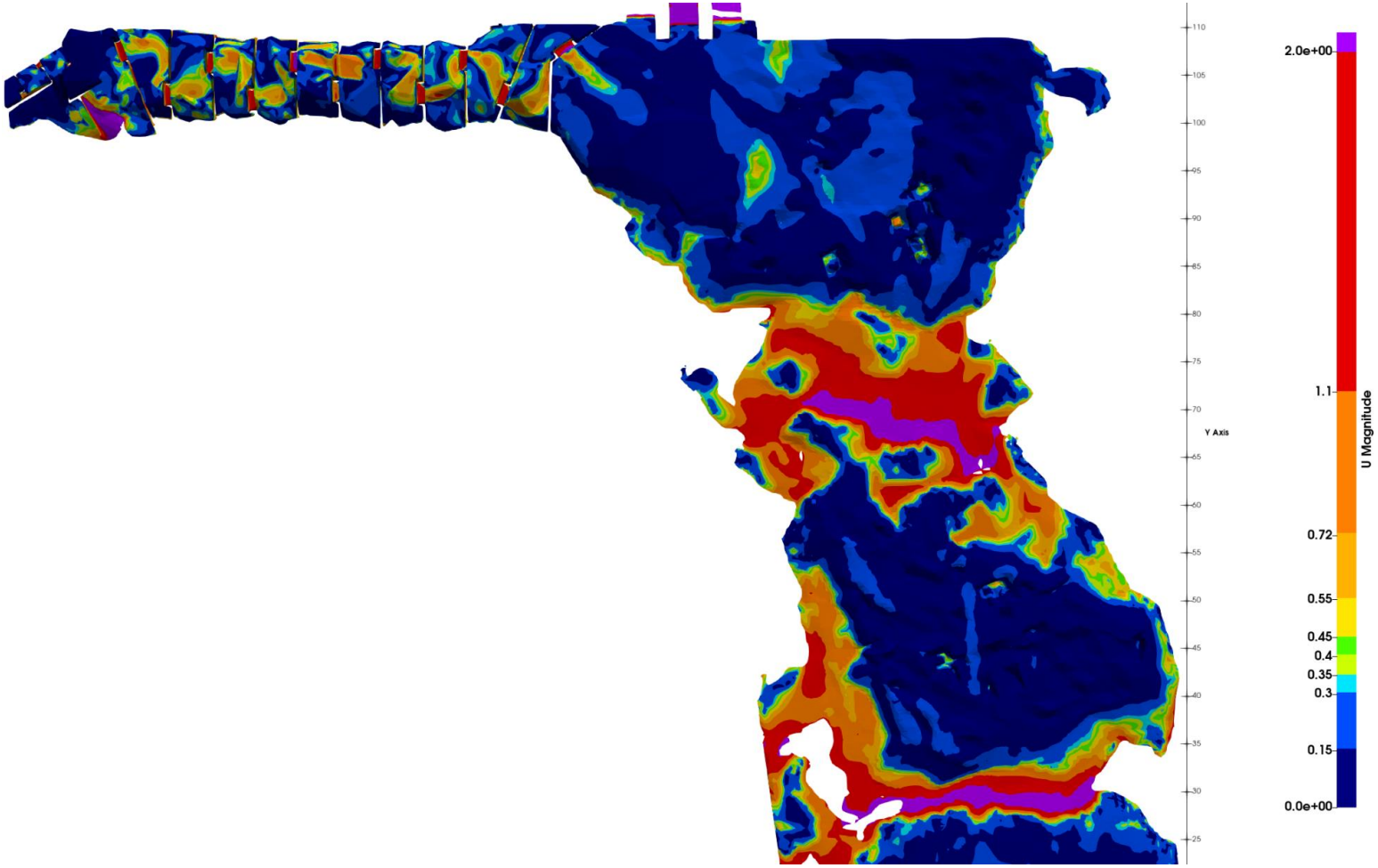


Figure S1-3: View of the Bottom Velocities

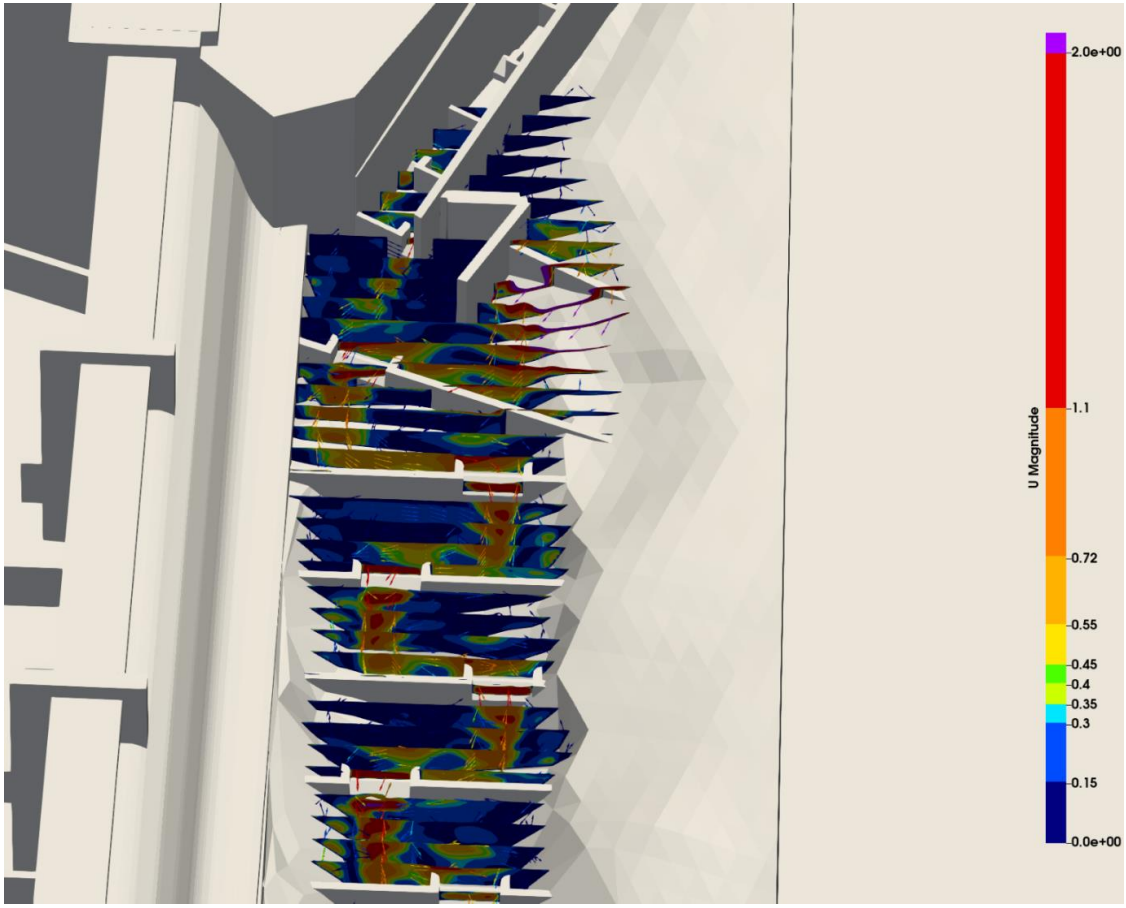


Figure S1-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

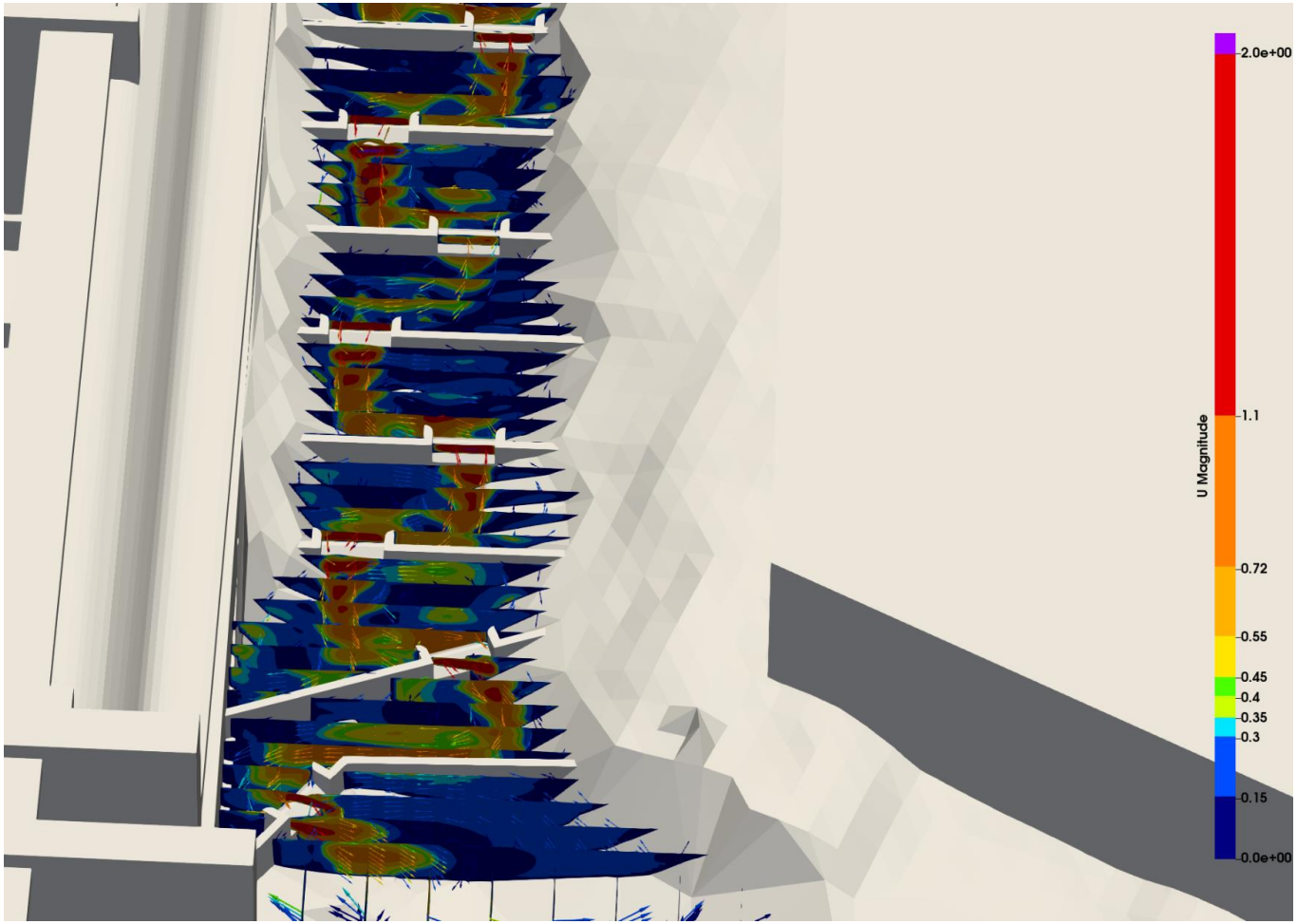


Figure S1-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

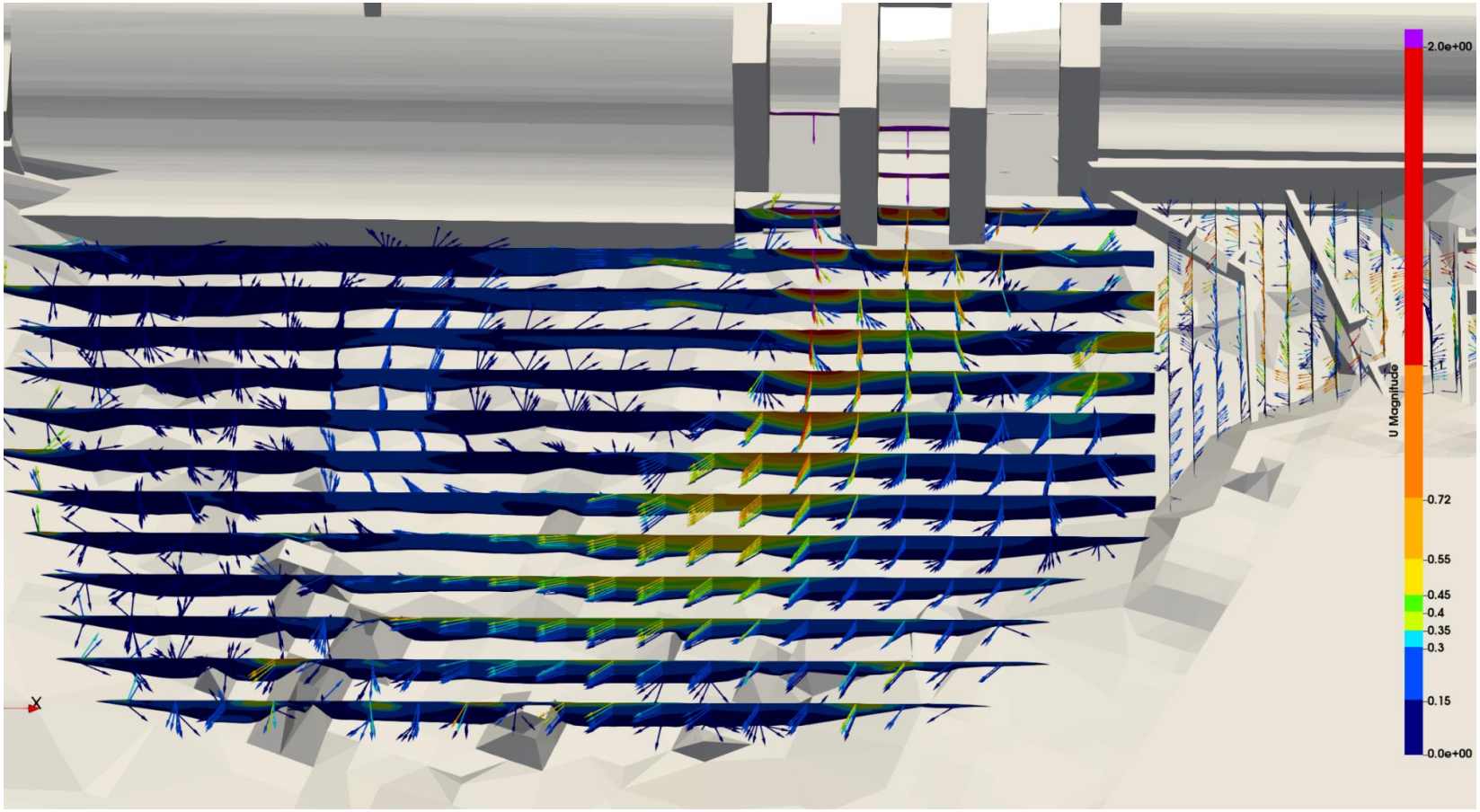


Figure S1-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

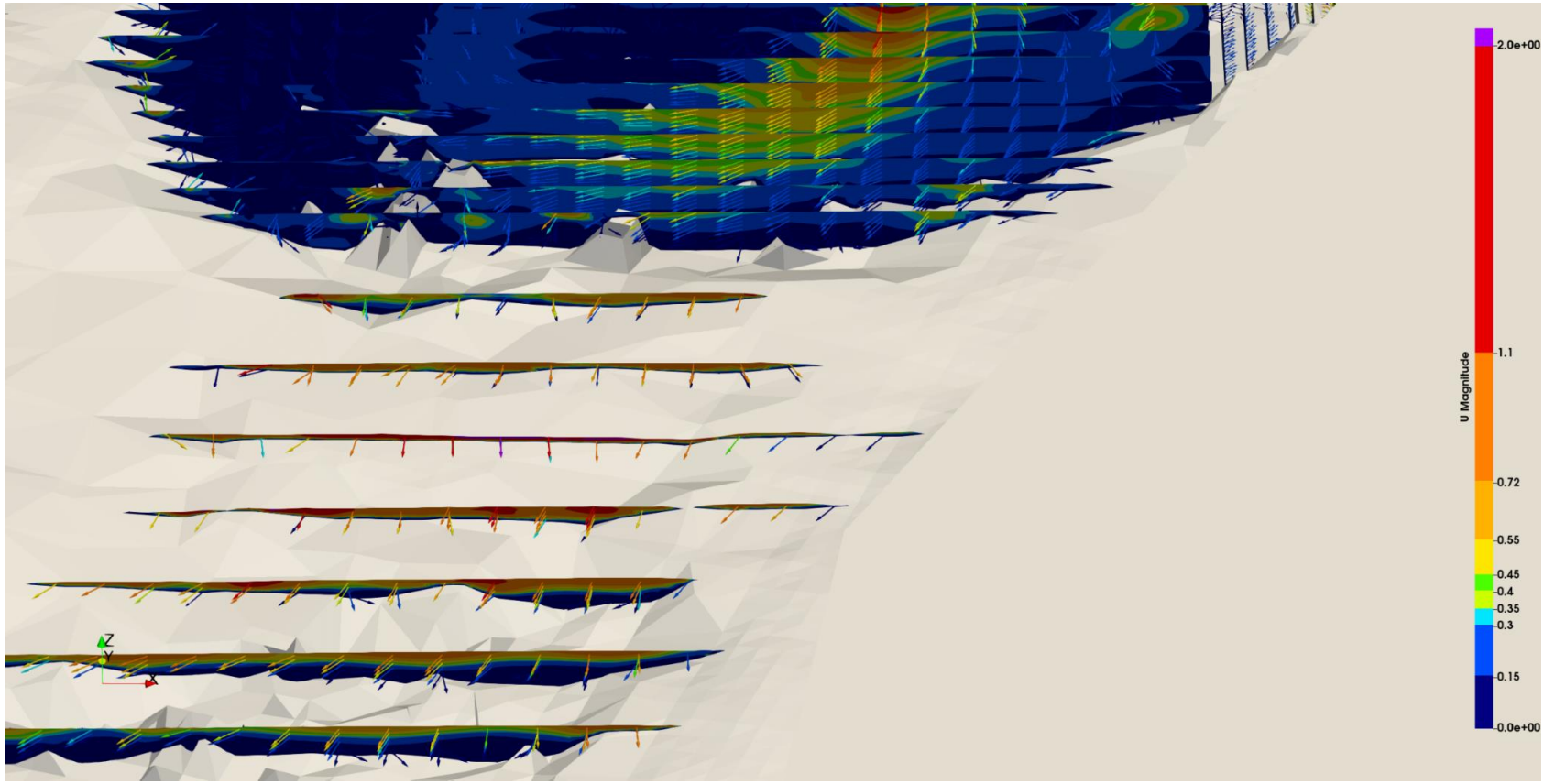


Figure S1-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction



Figure S1-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

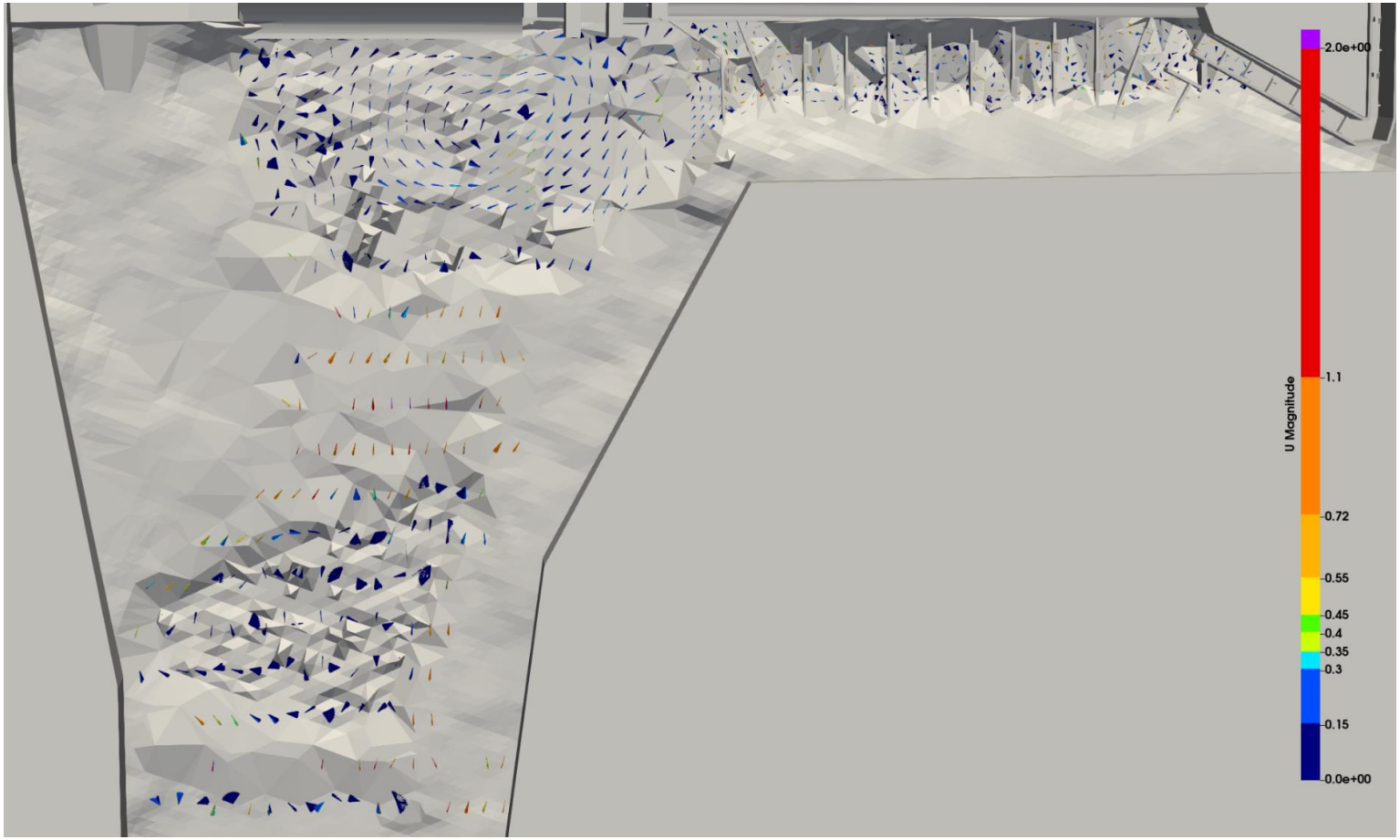


Figure S1-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

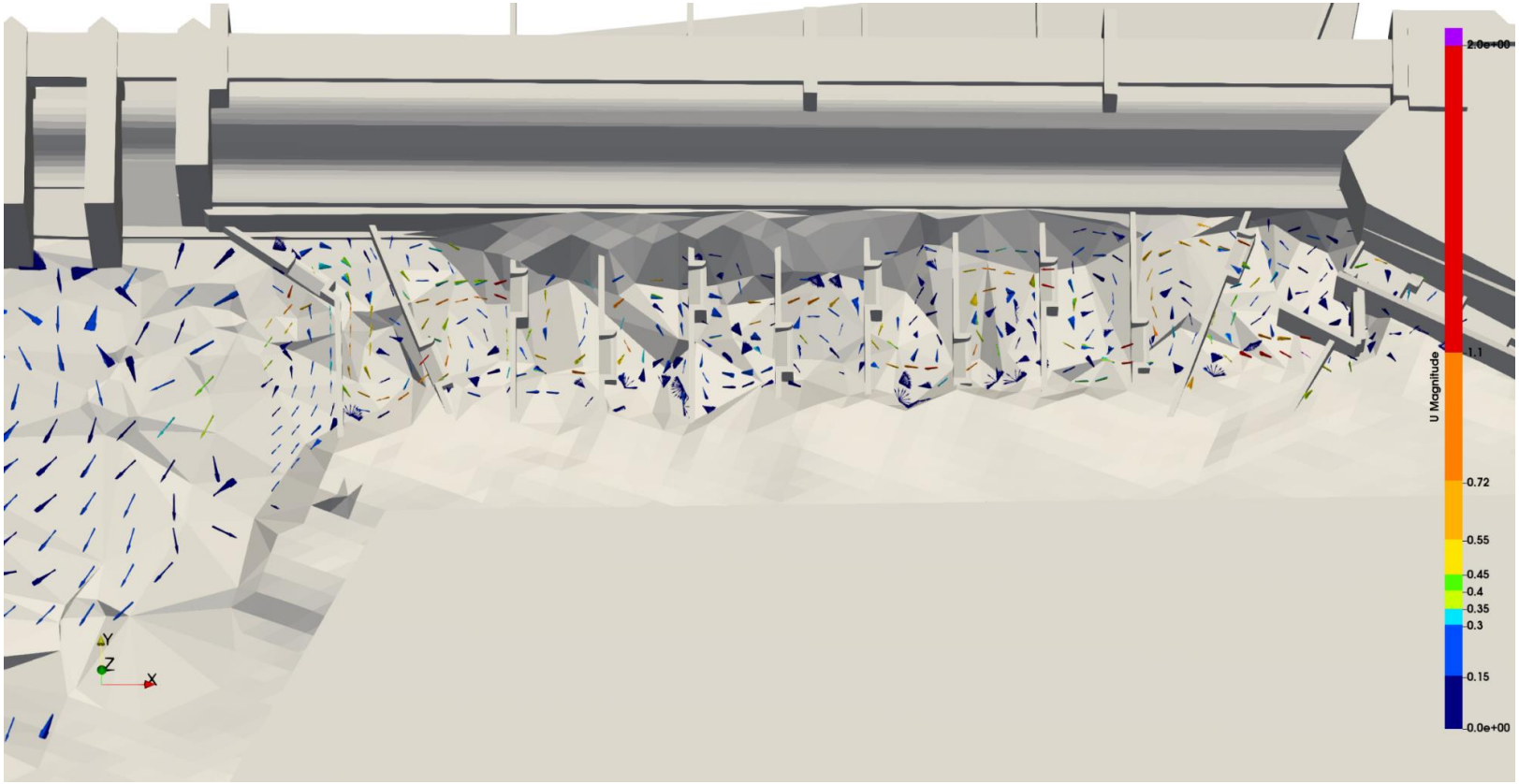


Figure S1-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

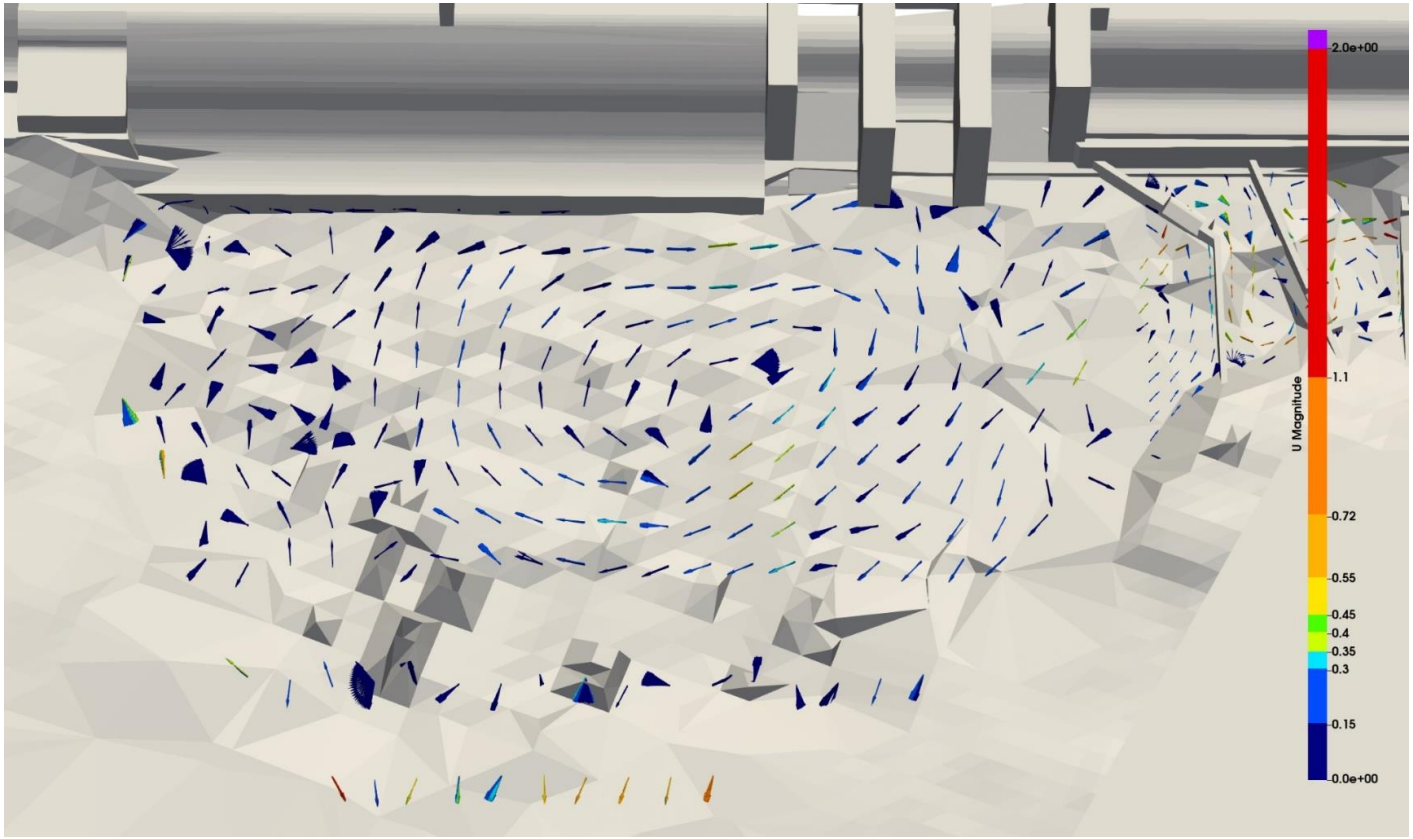


Figure S1-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

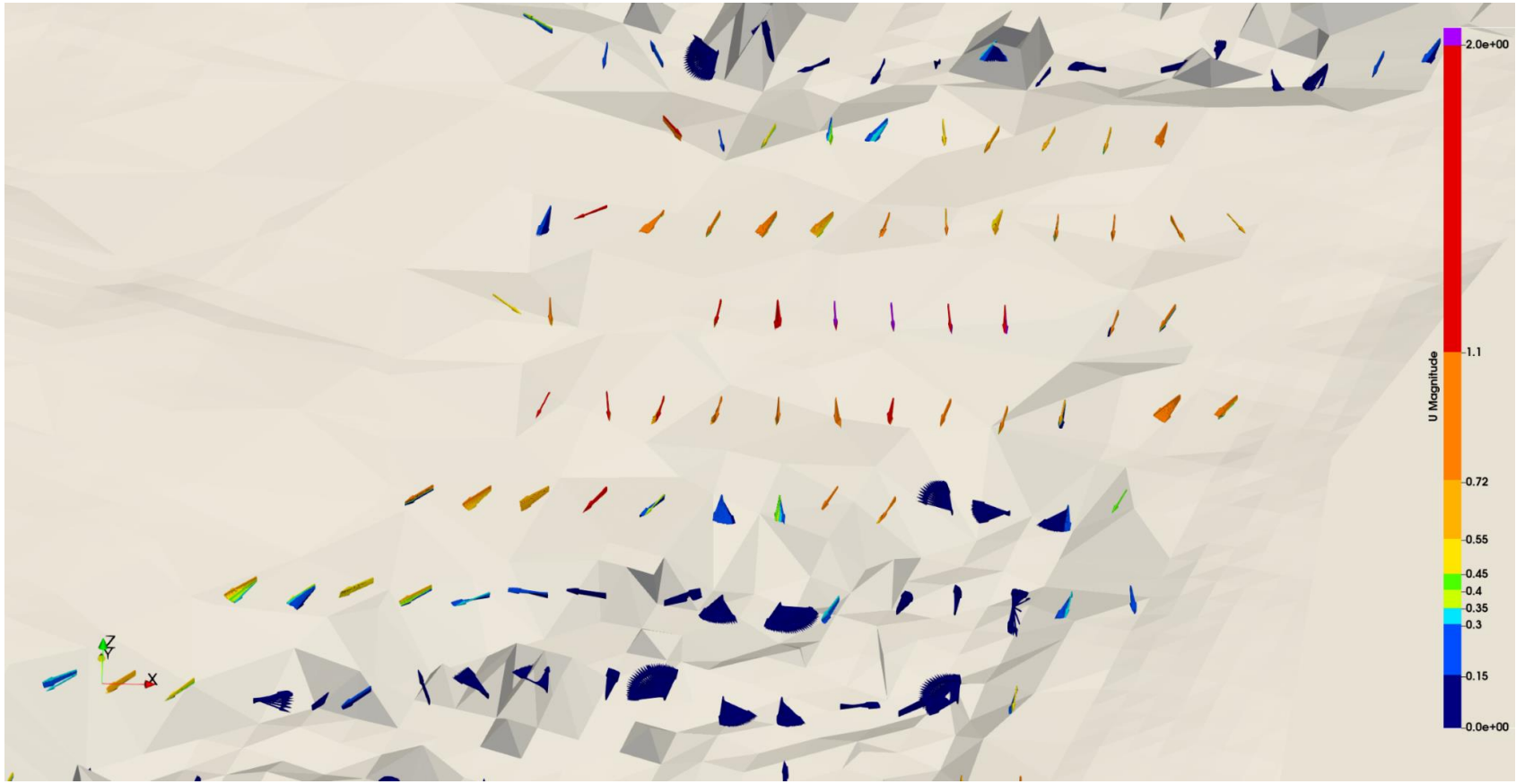


Figure S1-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

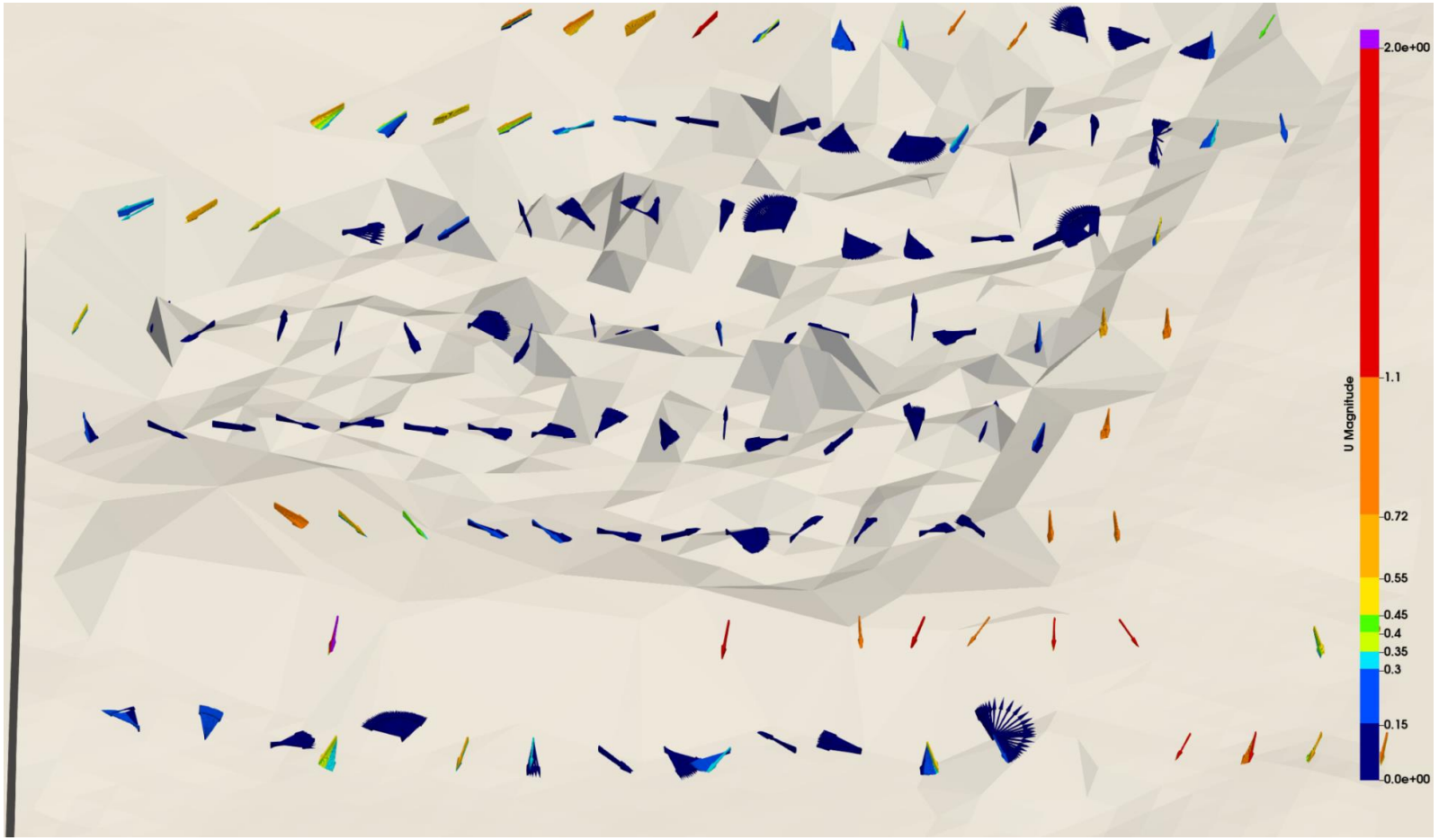


Figure S1-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2. Model Results of Scenario S2 with 165 cfs from the gates

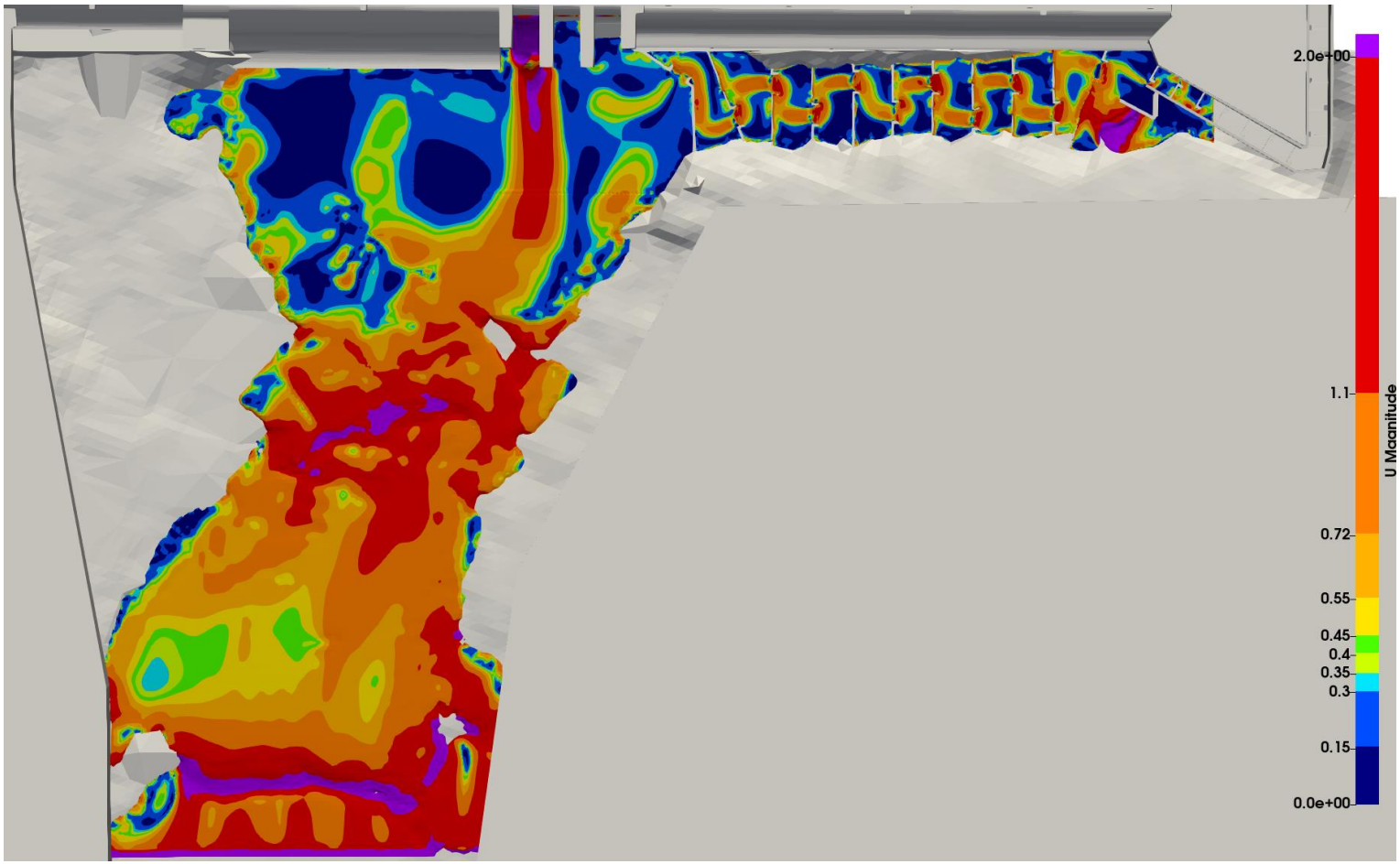


Figure S2-1: Plan view of the Water Surface Velocities

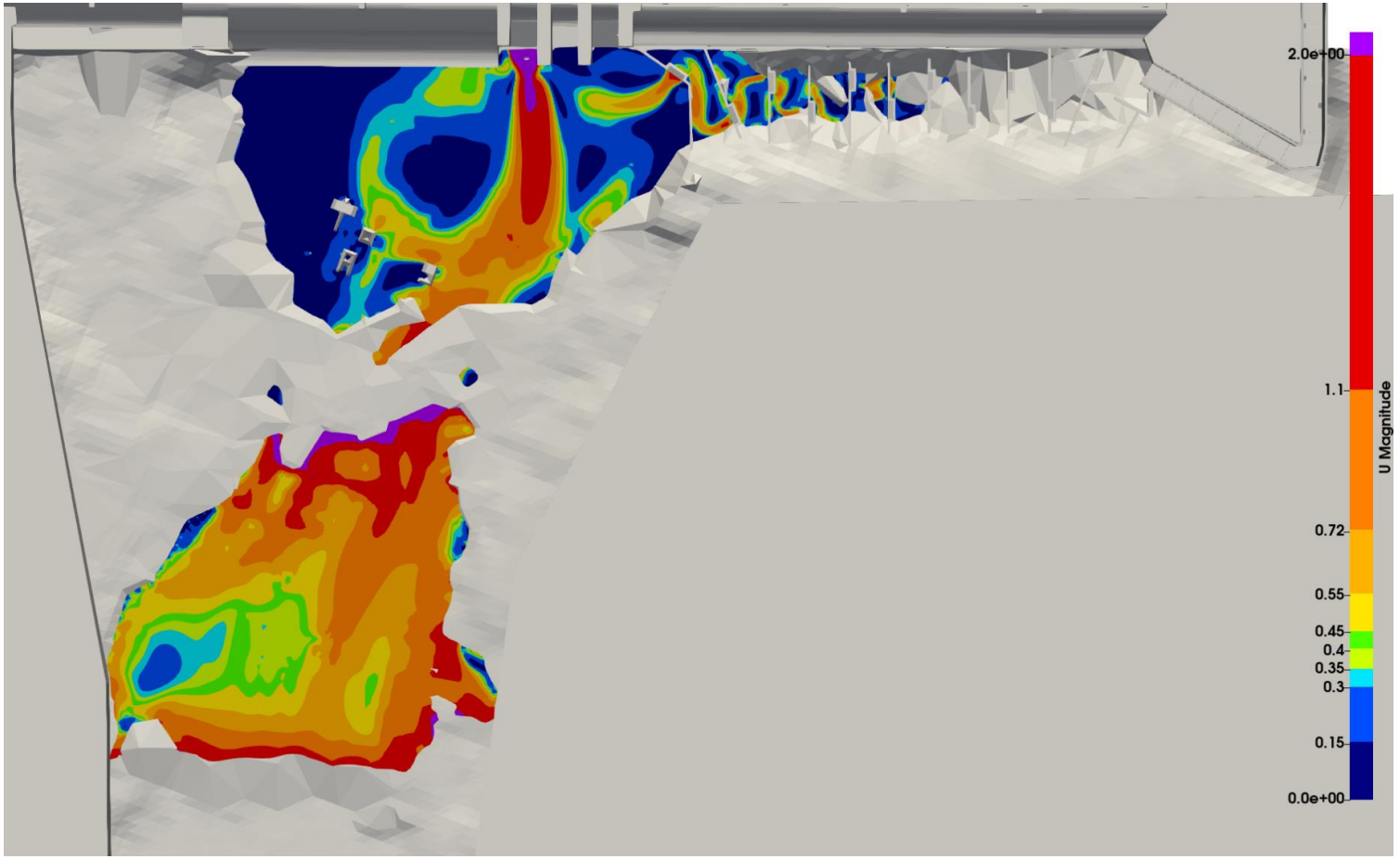


Figure S2-2: Plan view of the Mid-Surface Velocities

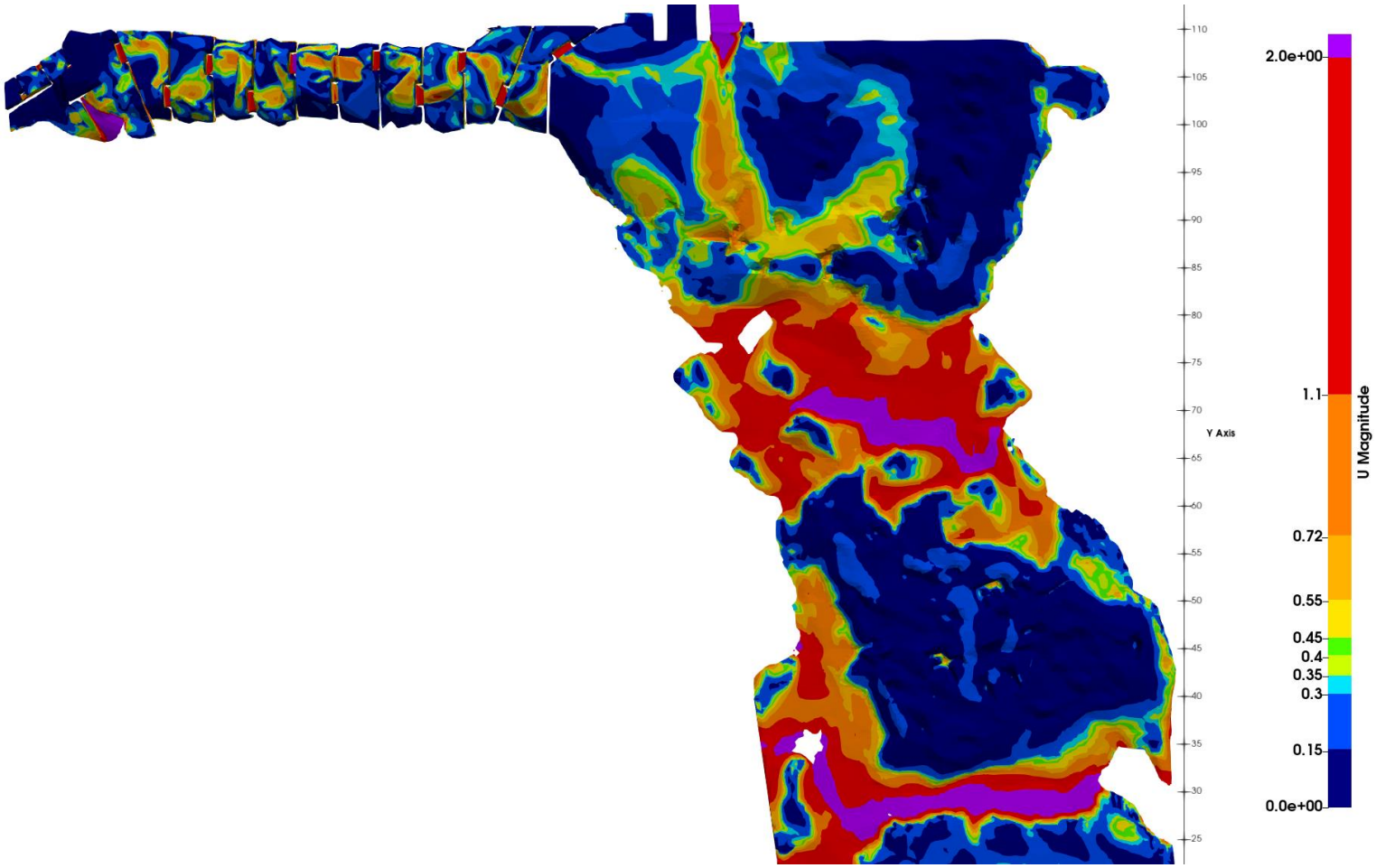


Figure S2-3: View of the Bottom Velocities

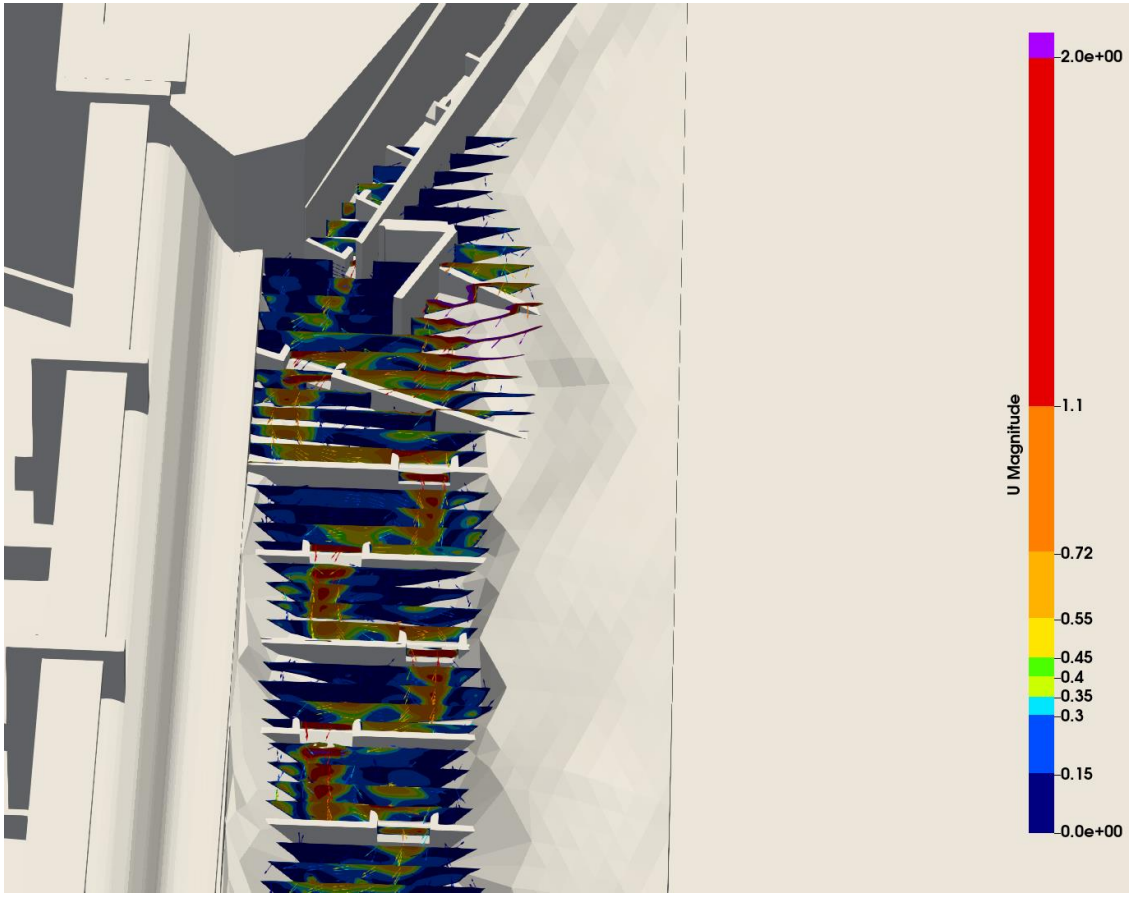


Figure S2-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

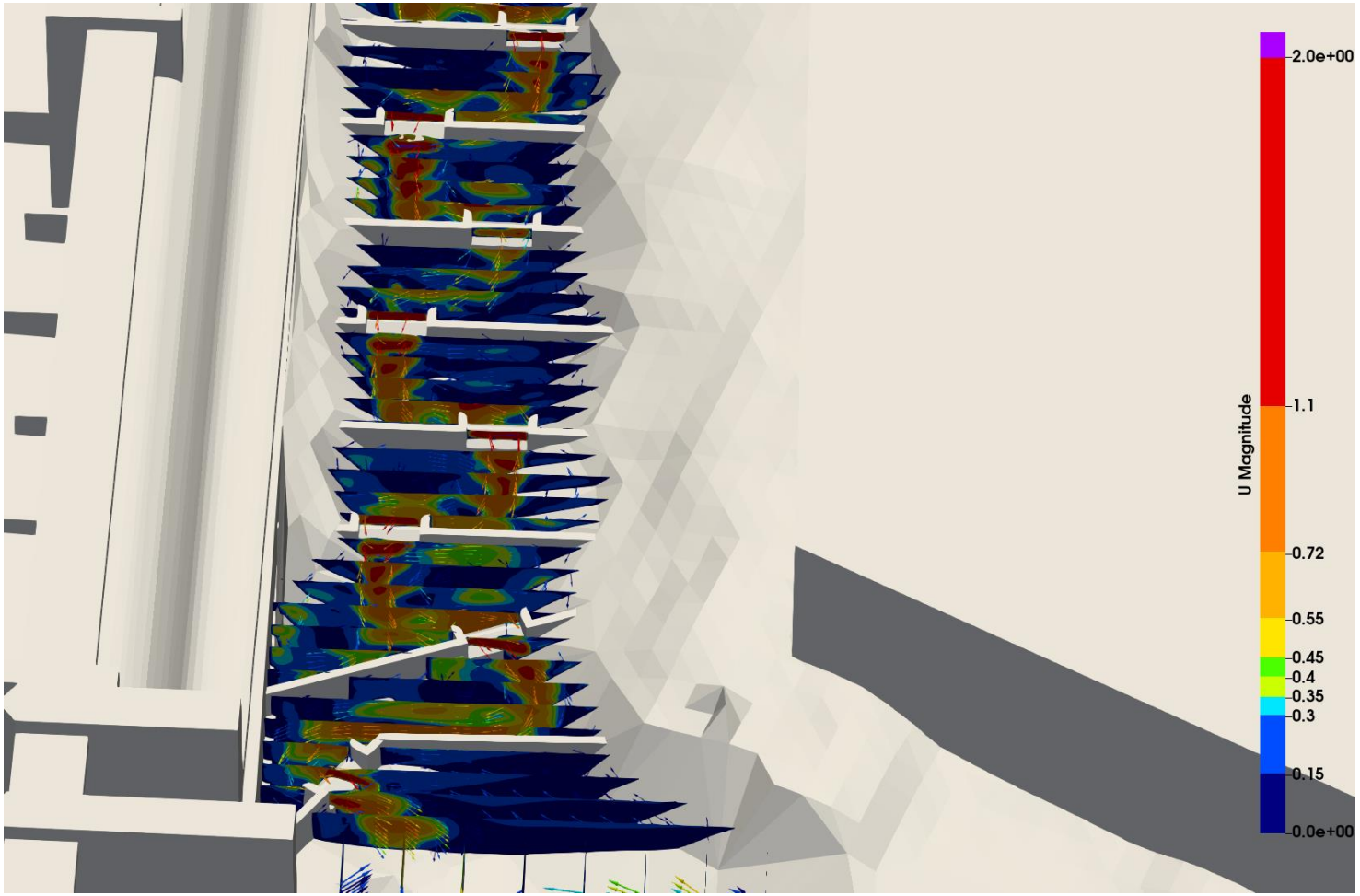


Figure S2-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

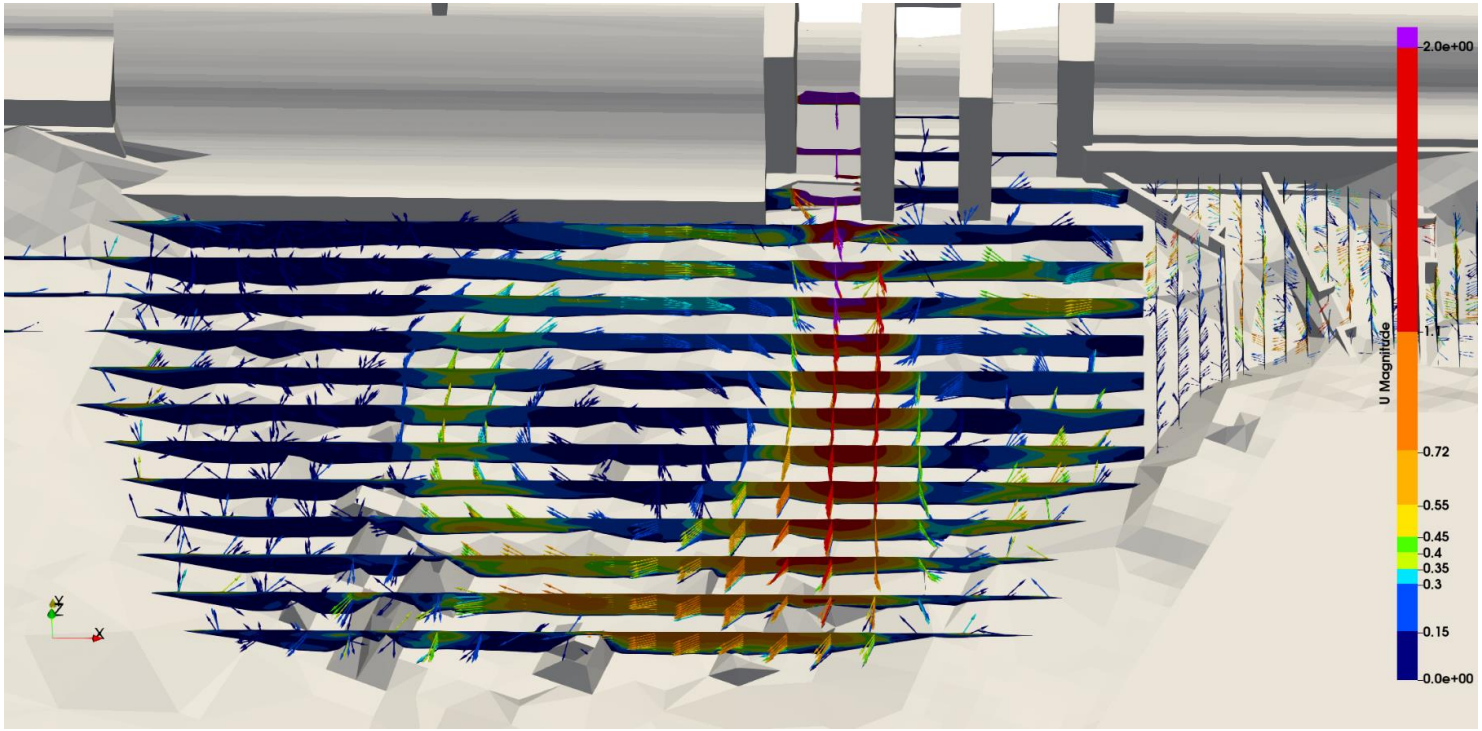


Figure S2-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

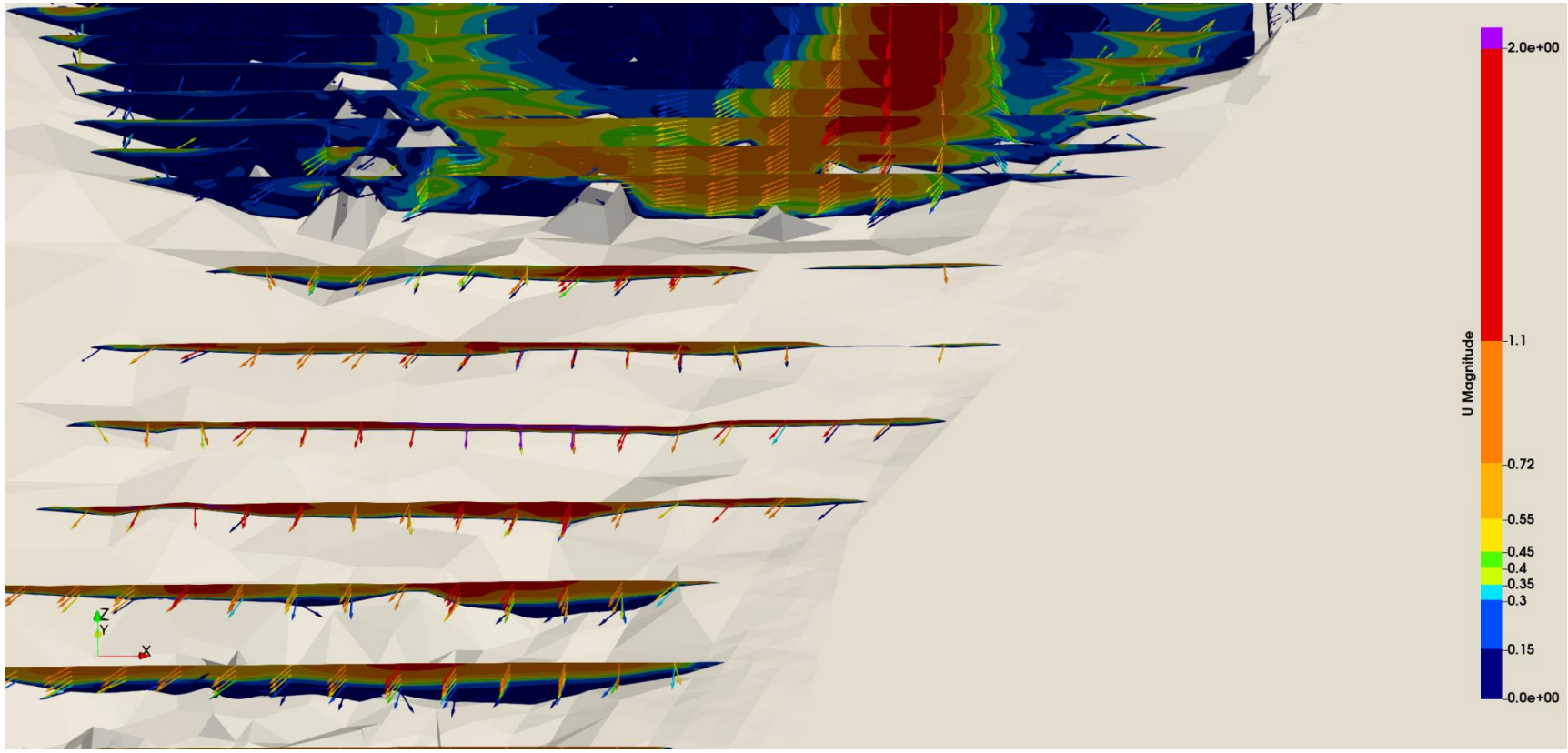


Figure S2-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

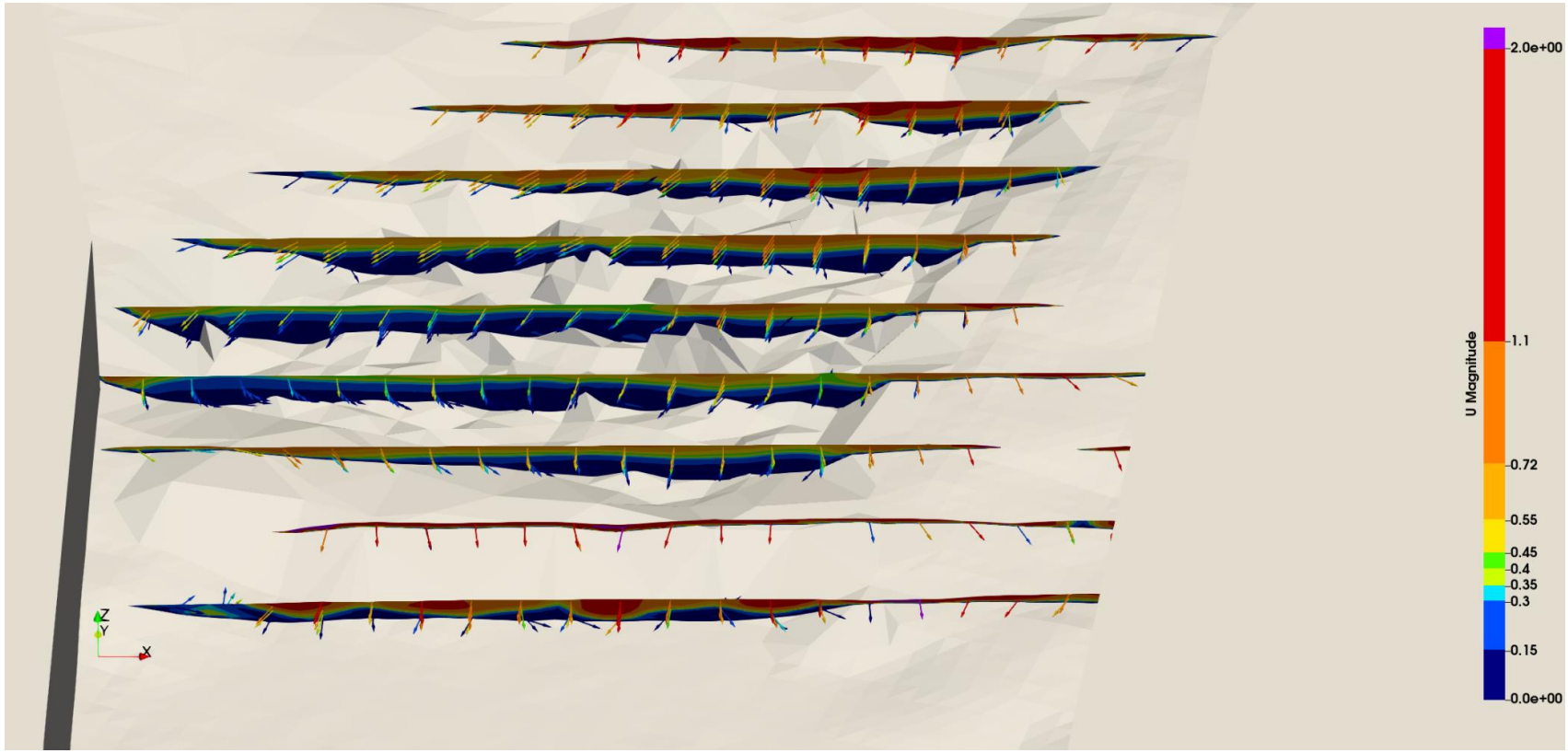


Figure S2-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

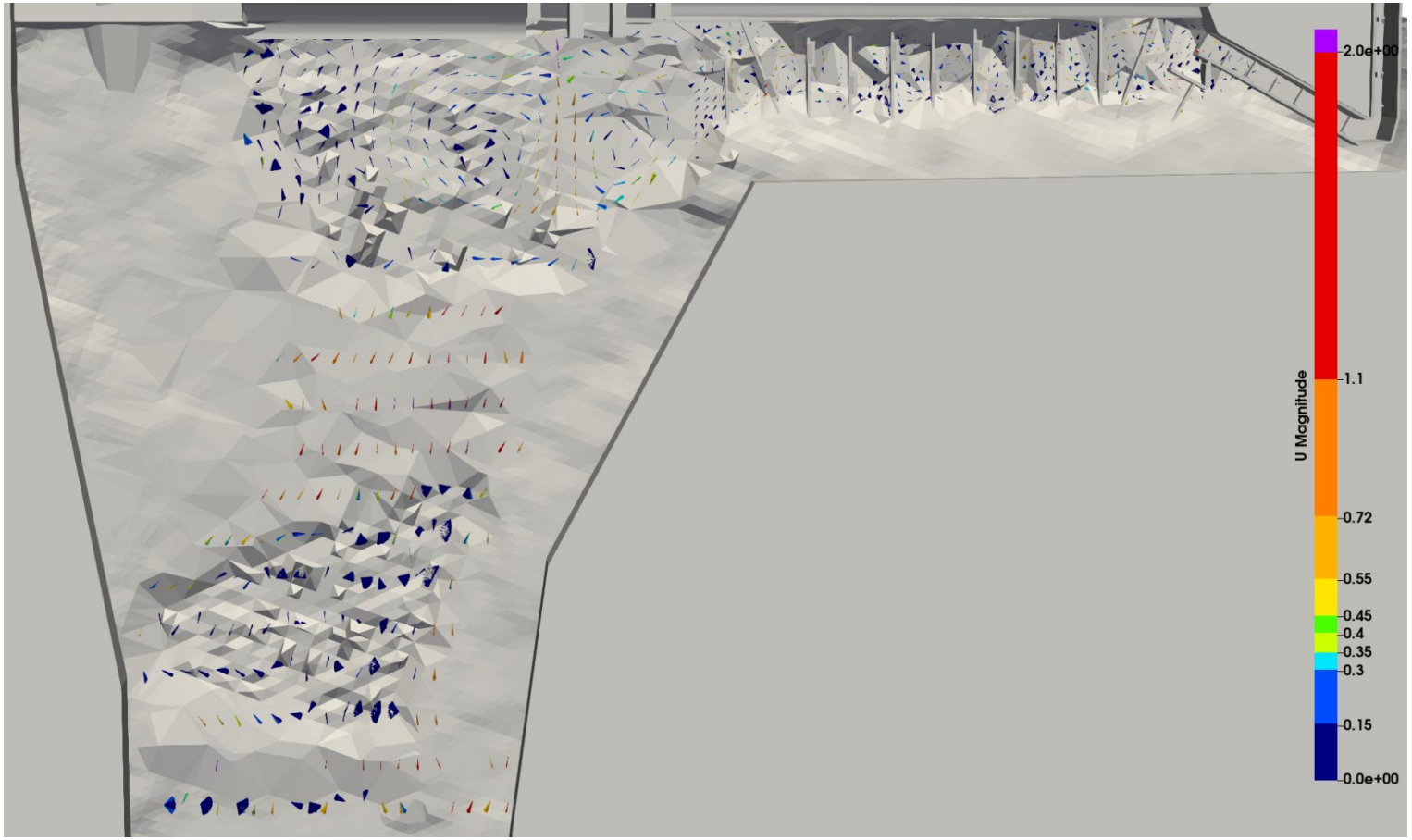


Figure S2-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

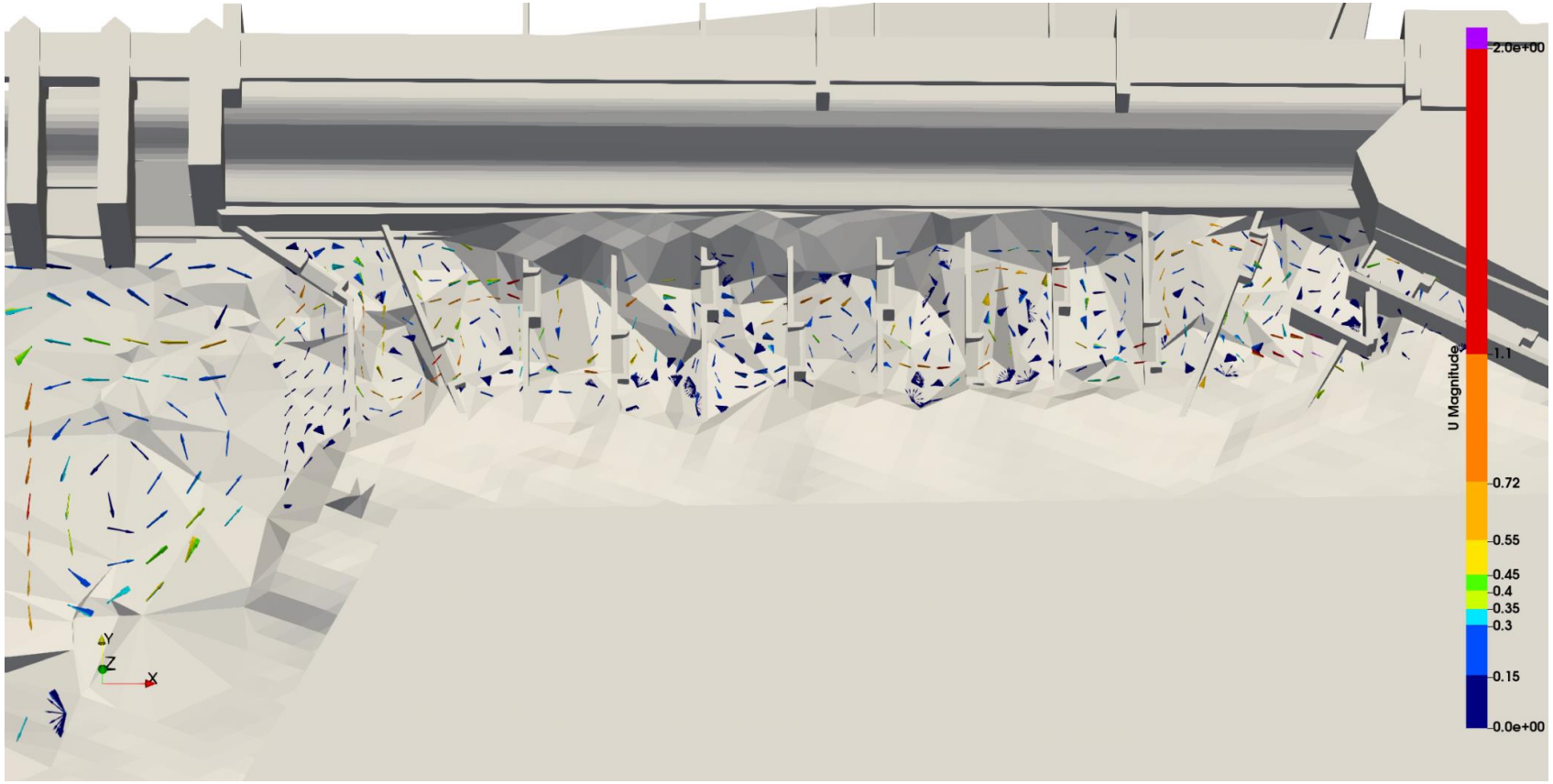


Figure S2-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

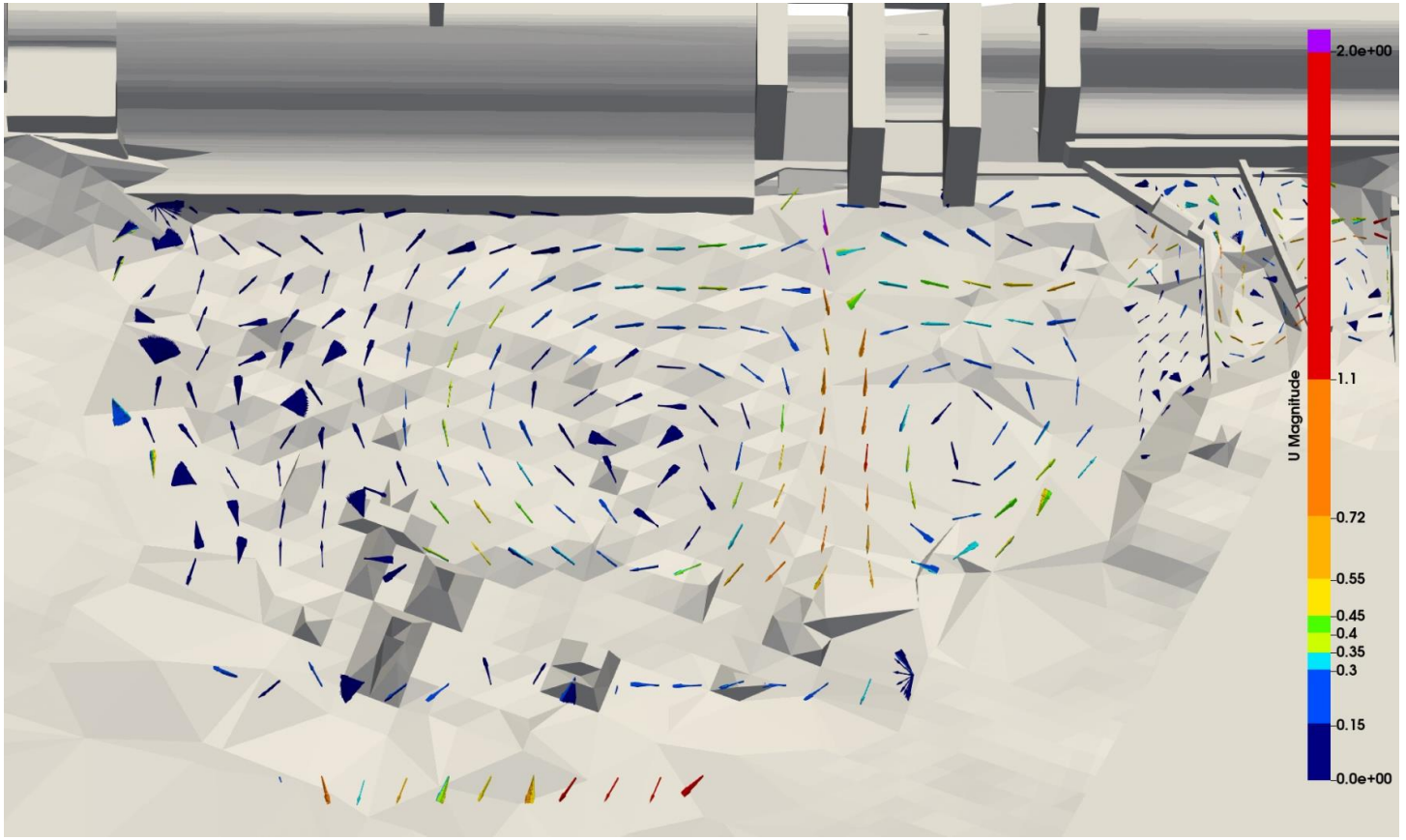


Figure S2-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

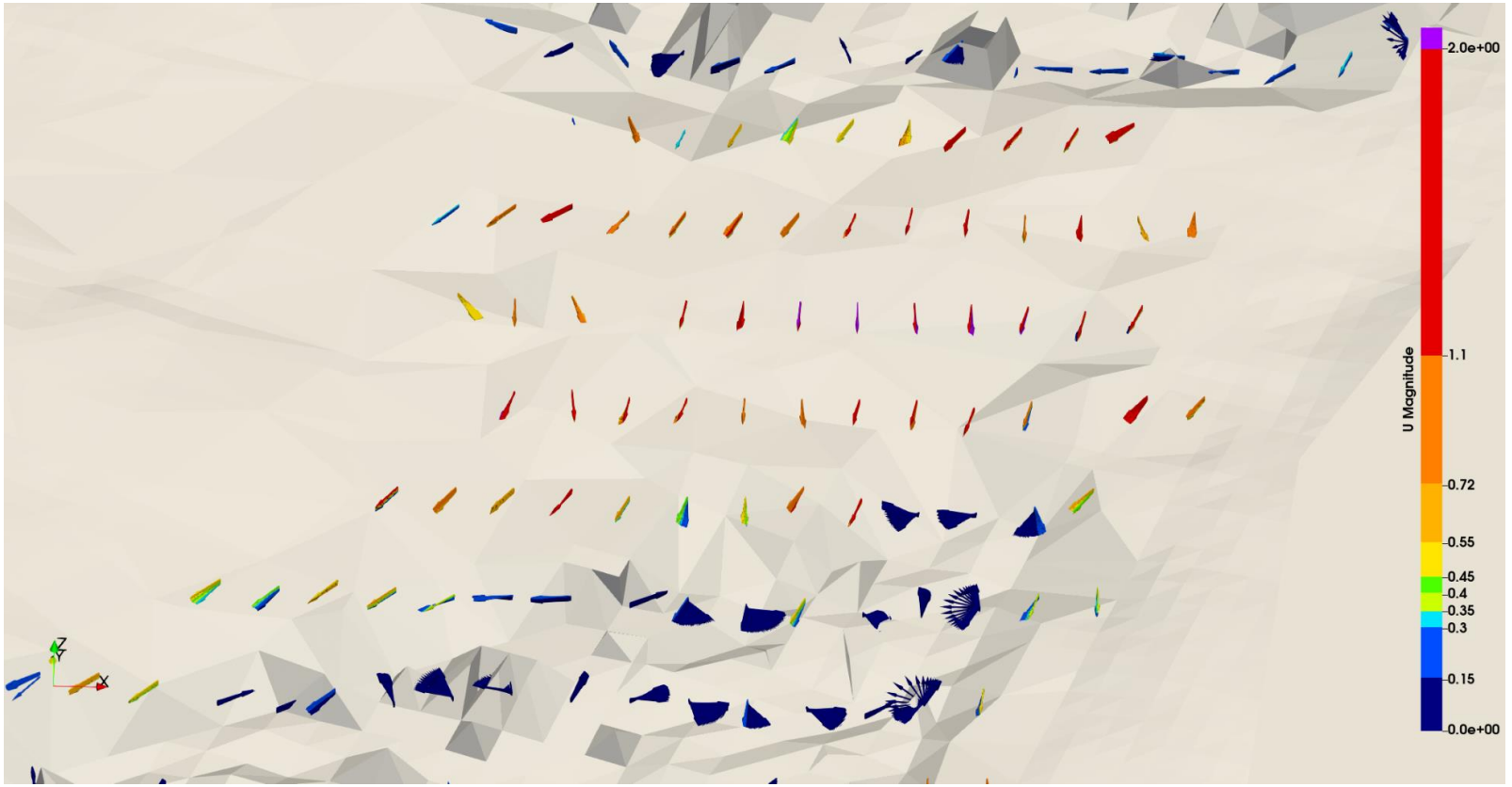


Figure S2-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

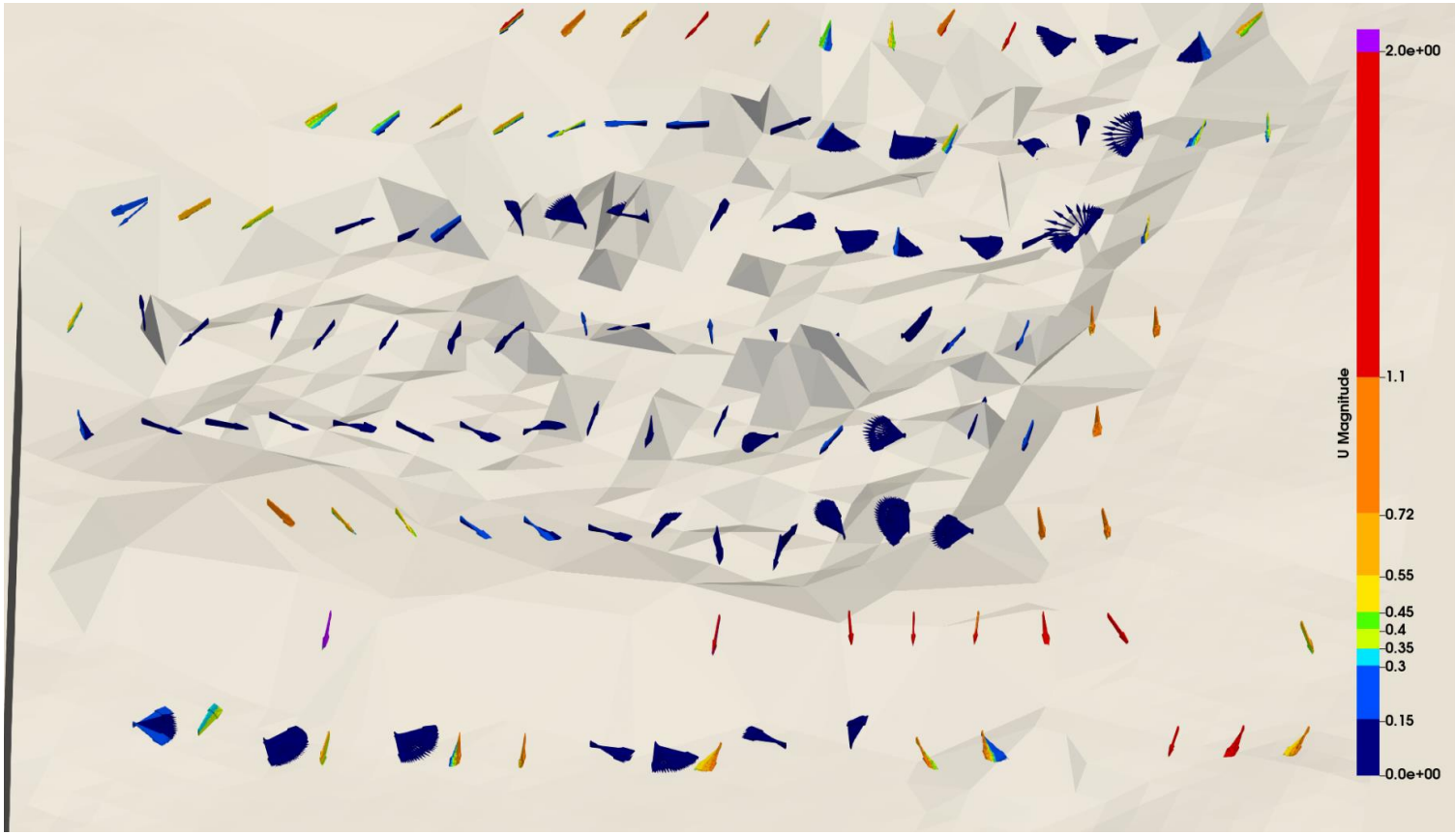


Figure S2-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

3. Model Results of Scenario S3 with 925 cfs from the gates

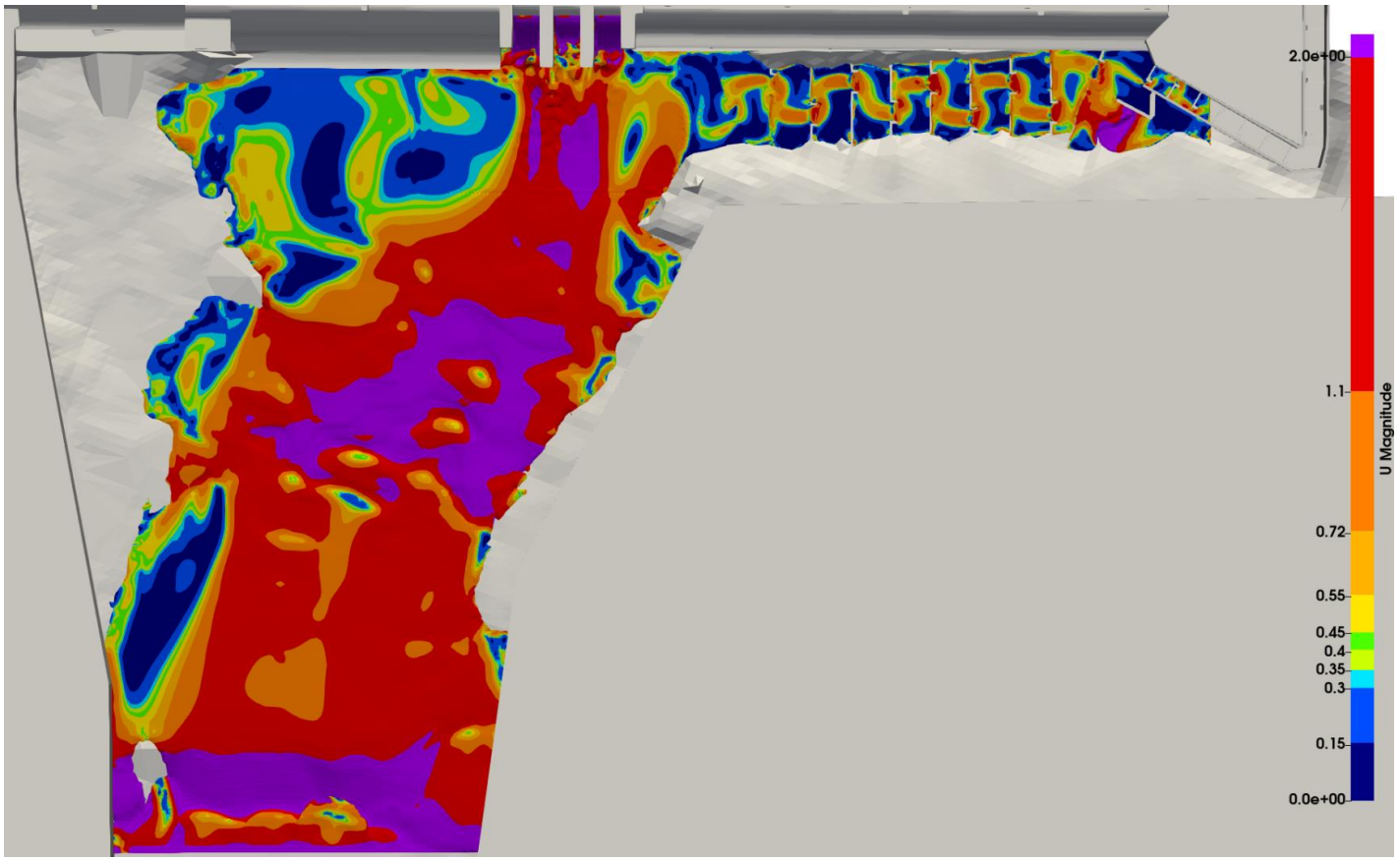


Figure S3-1: Plan view of the Water Surface Velocities

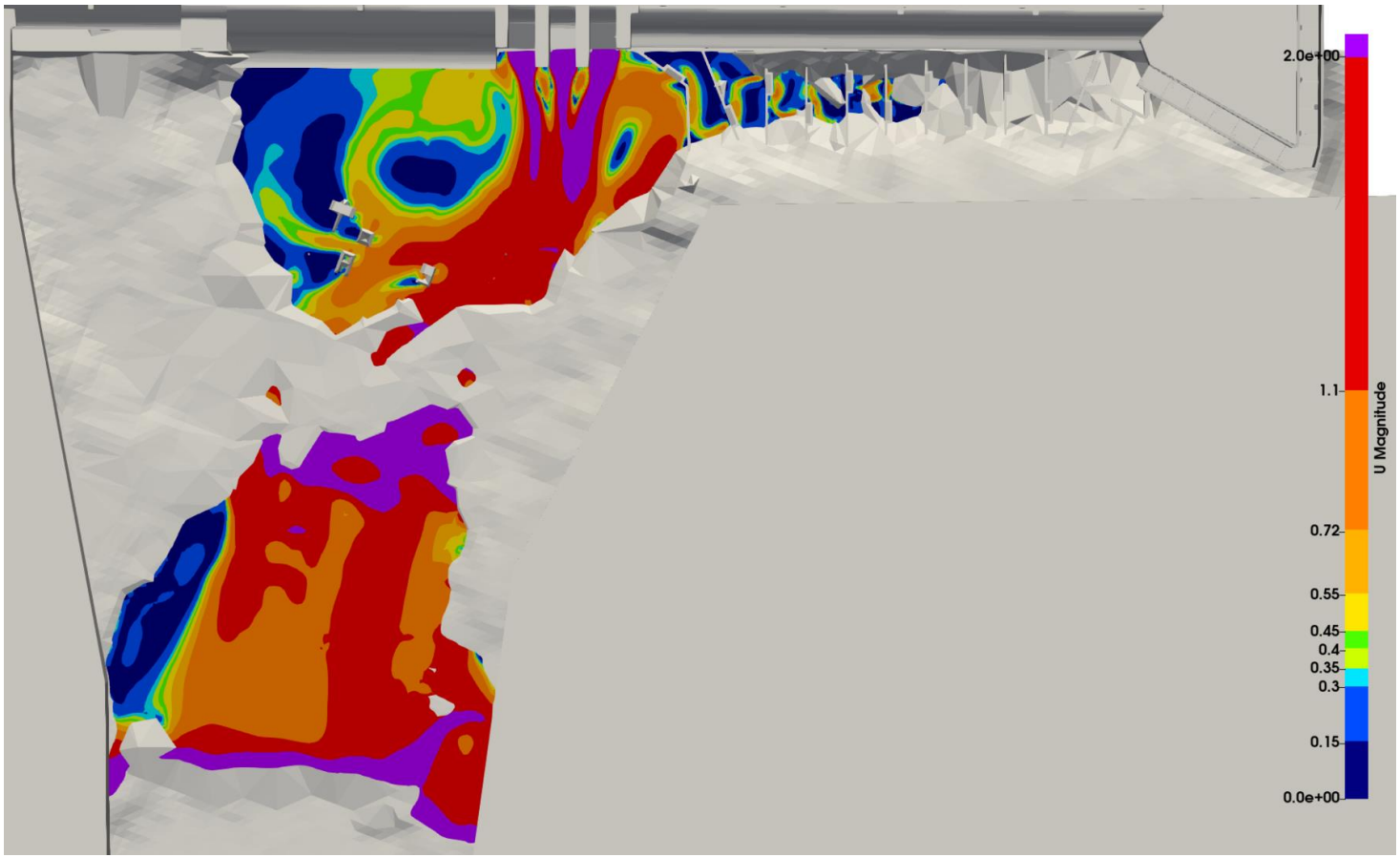


Figure S3-2: Plan view of the Mid-Surface Velocities

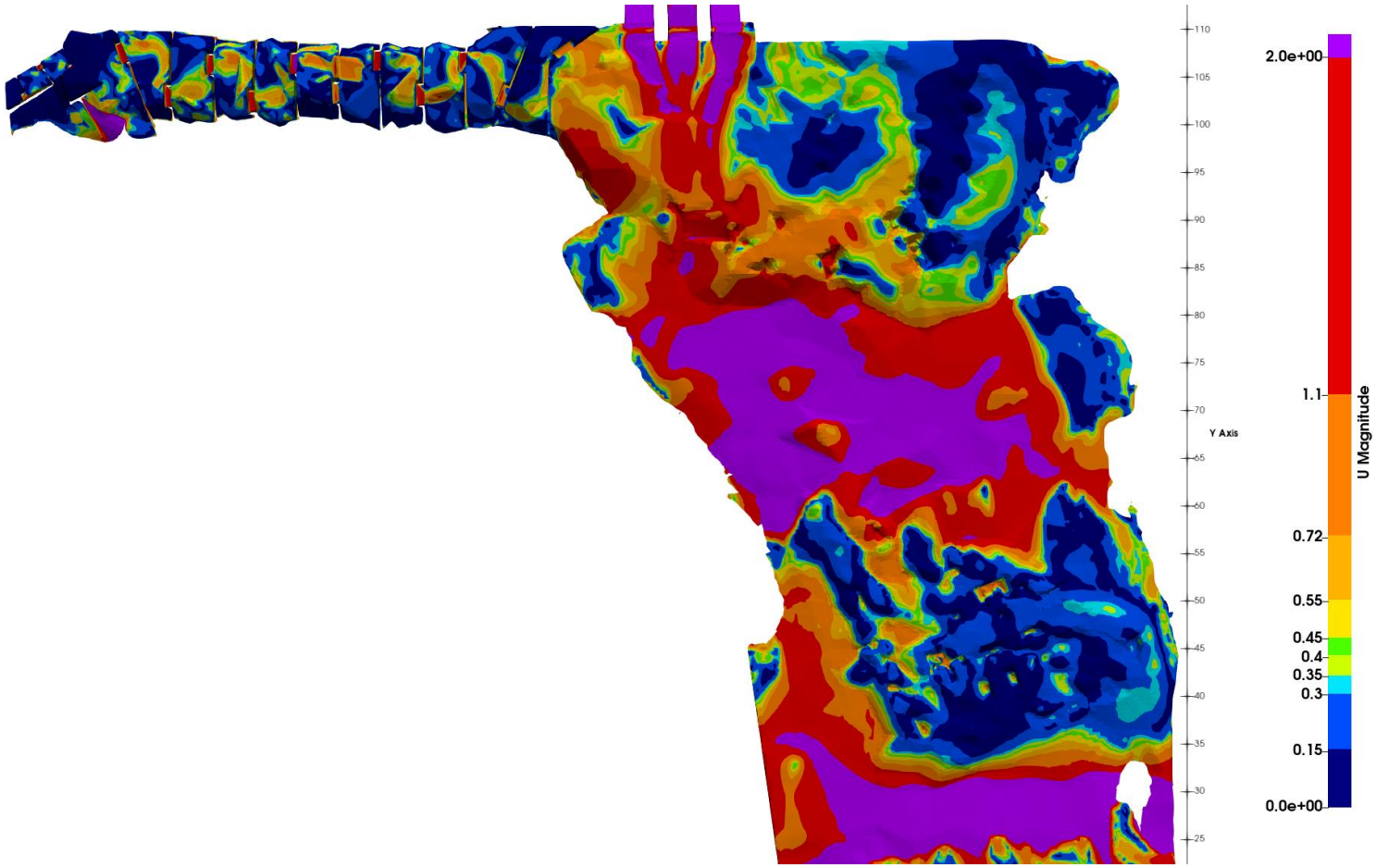


Figure S3-3: View of the Bottom Velocities

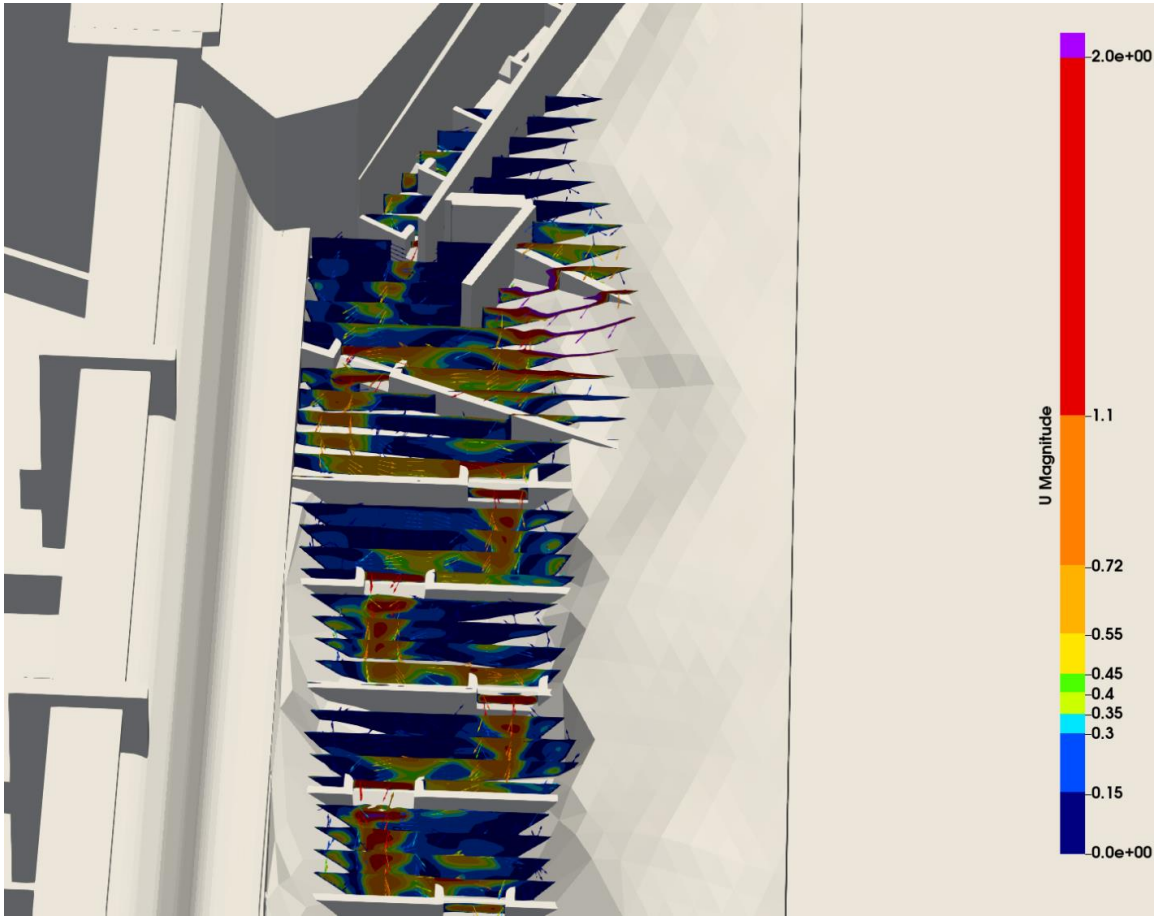


Figure S3-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

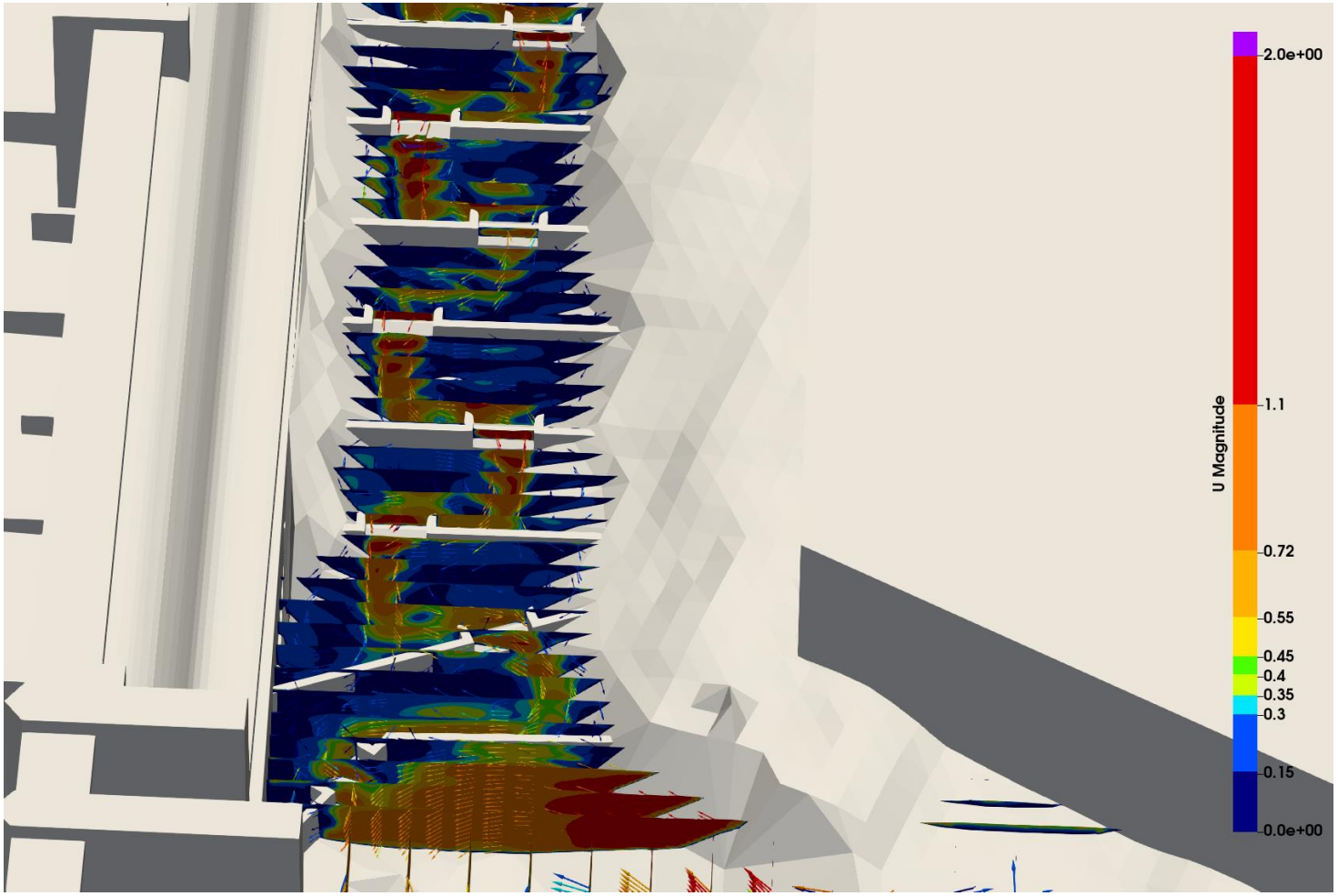


Figure S3-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

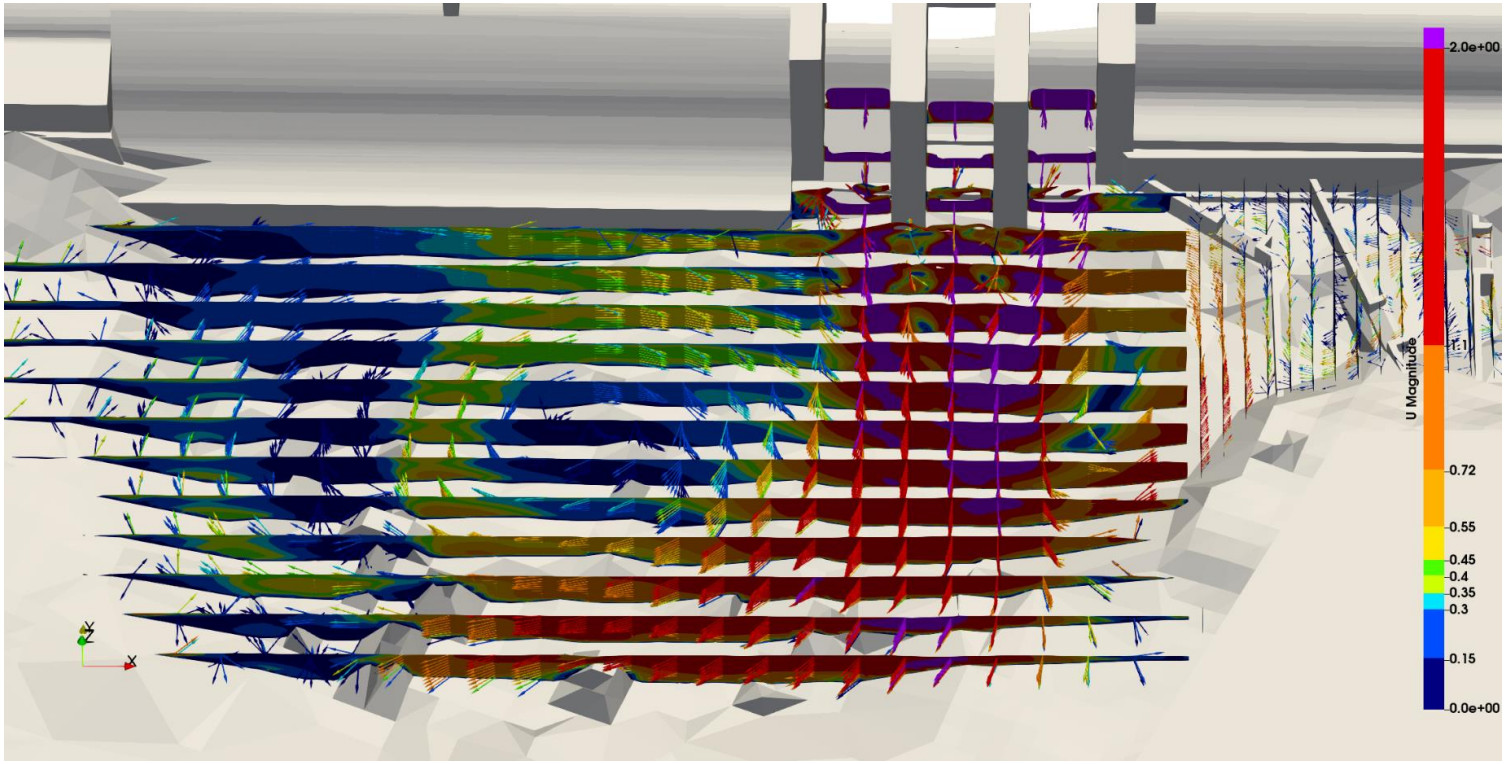


Figure S3-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

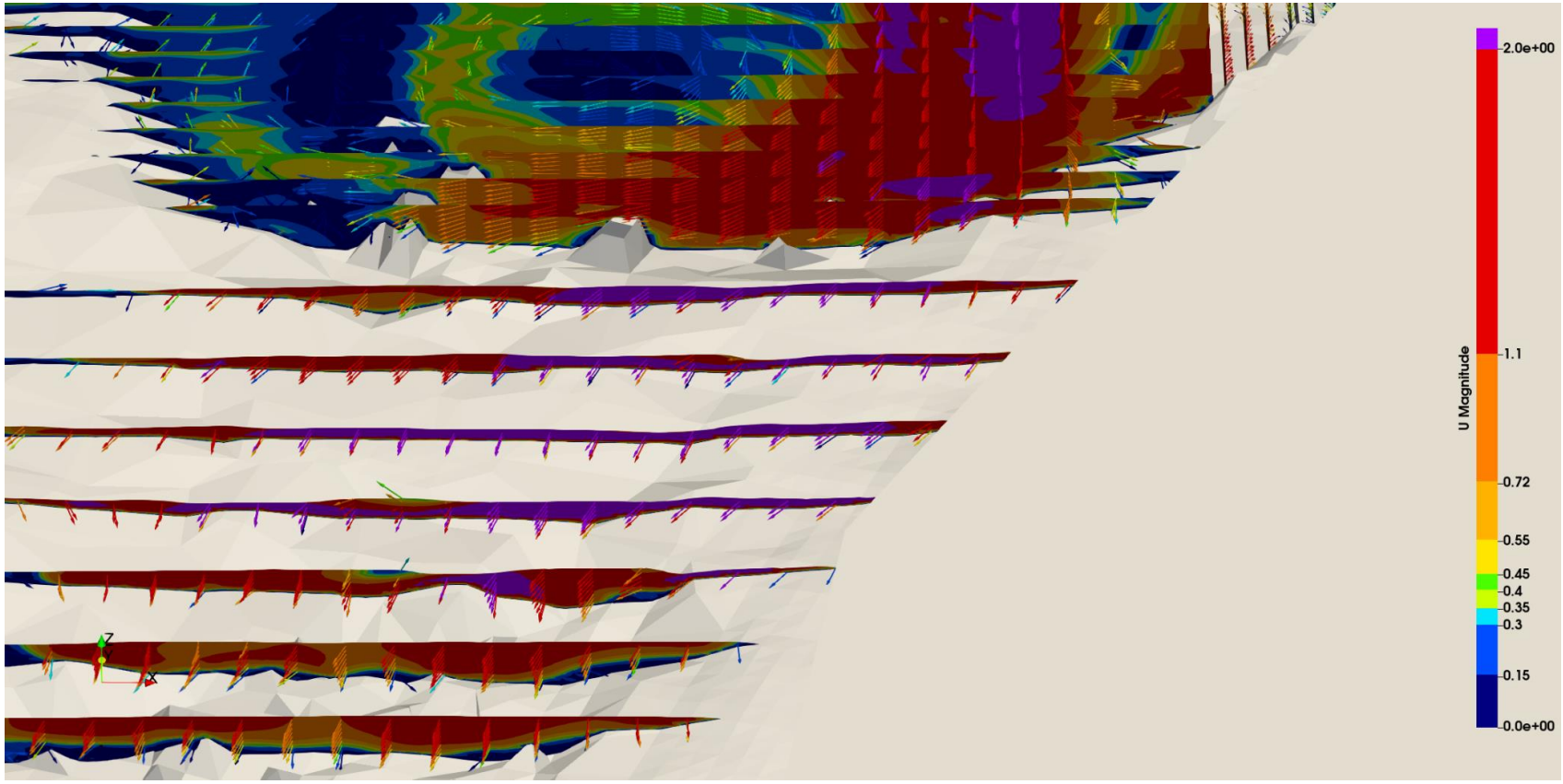


Figure S3-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

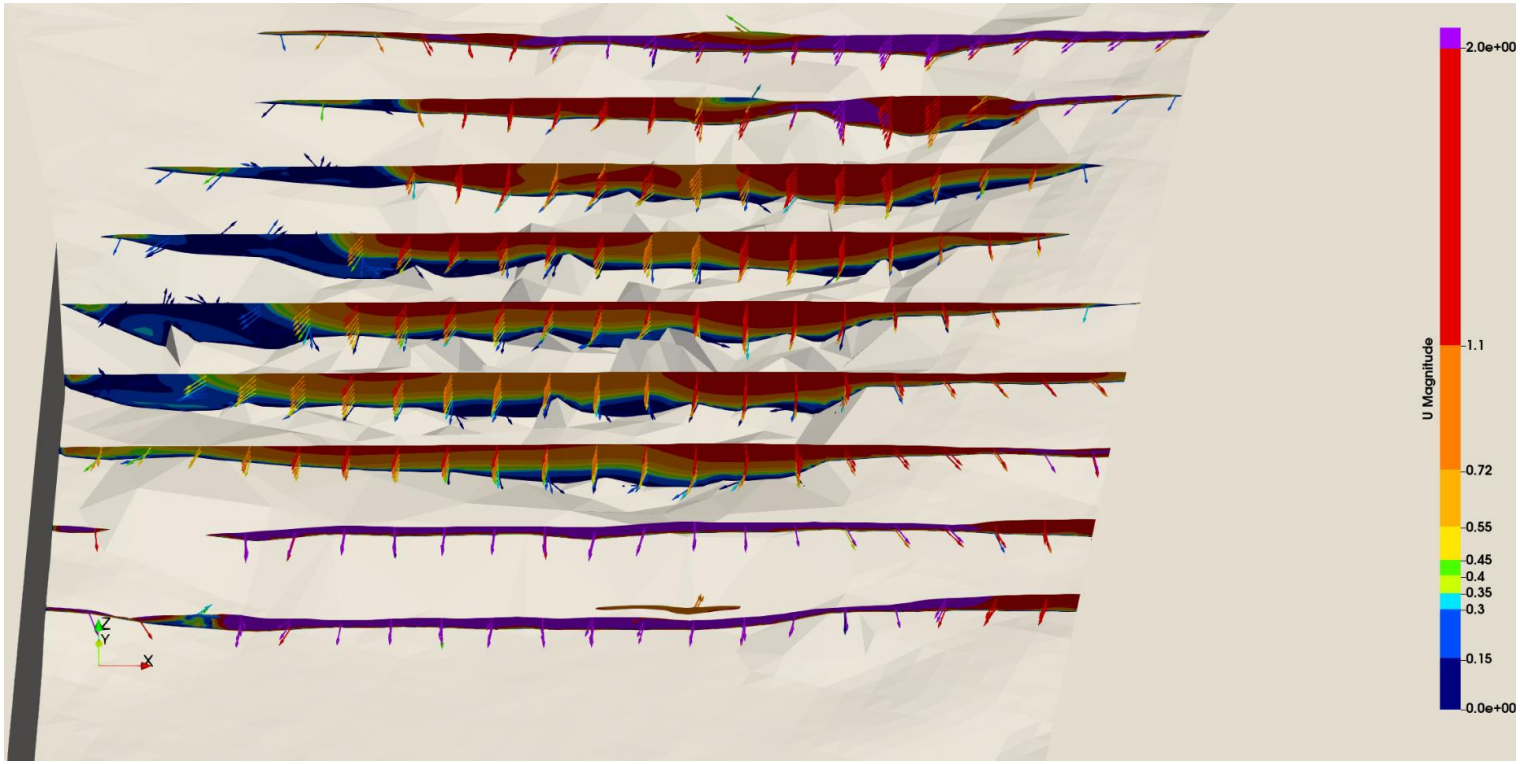


Figure S3-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

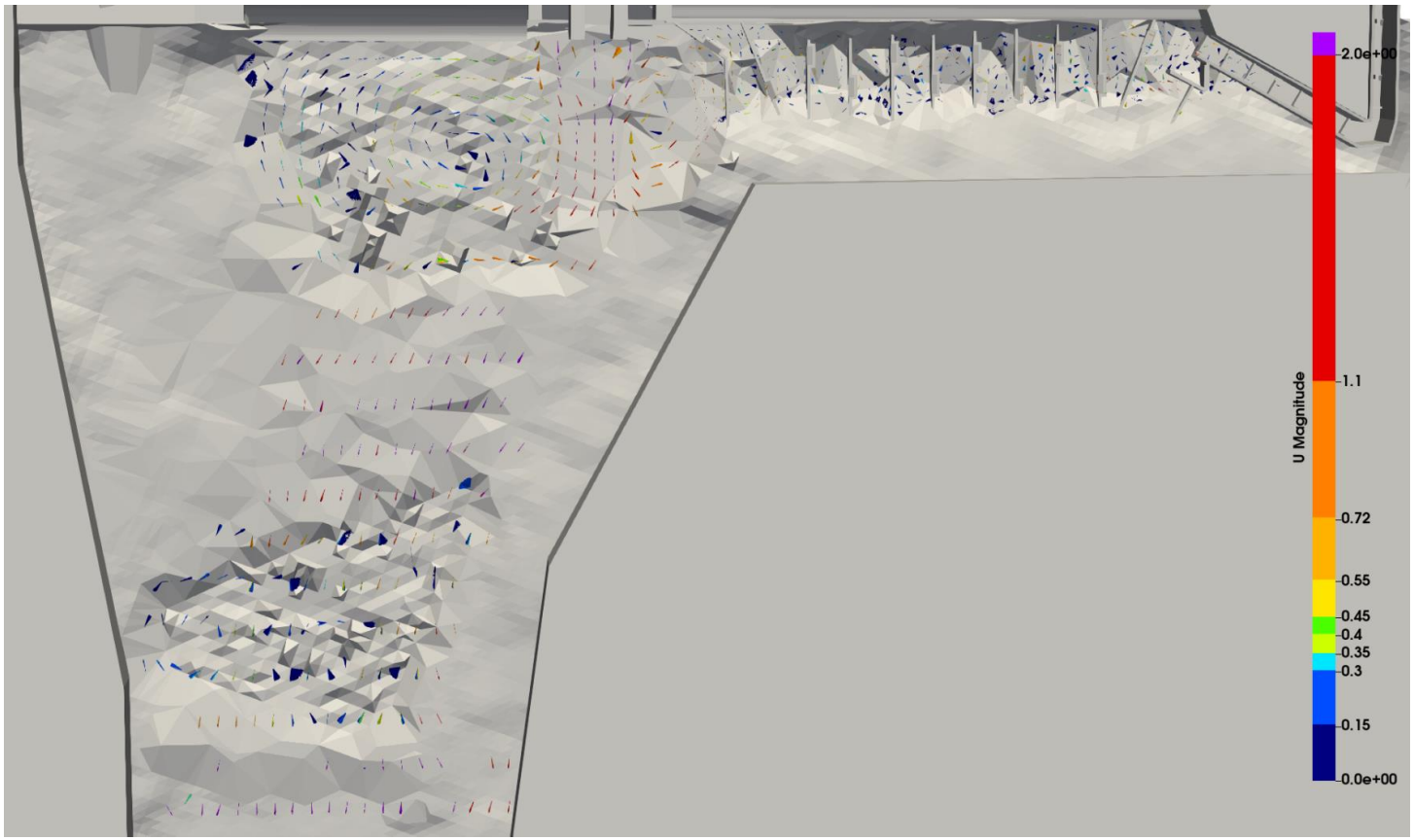


Figure S3-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

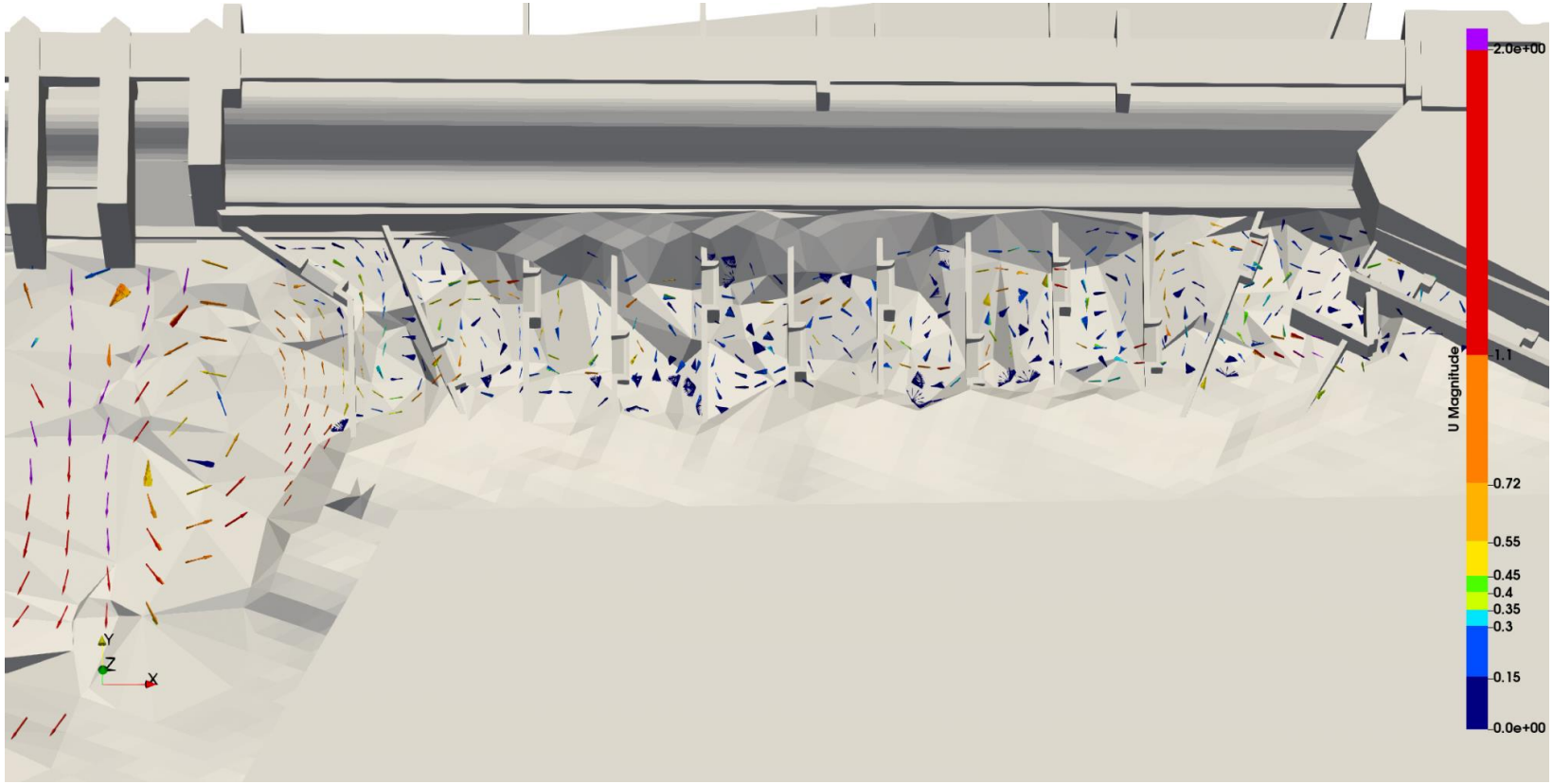


Figure S3-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

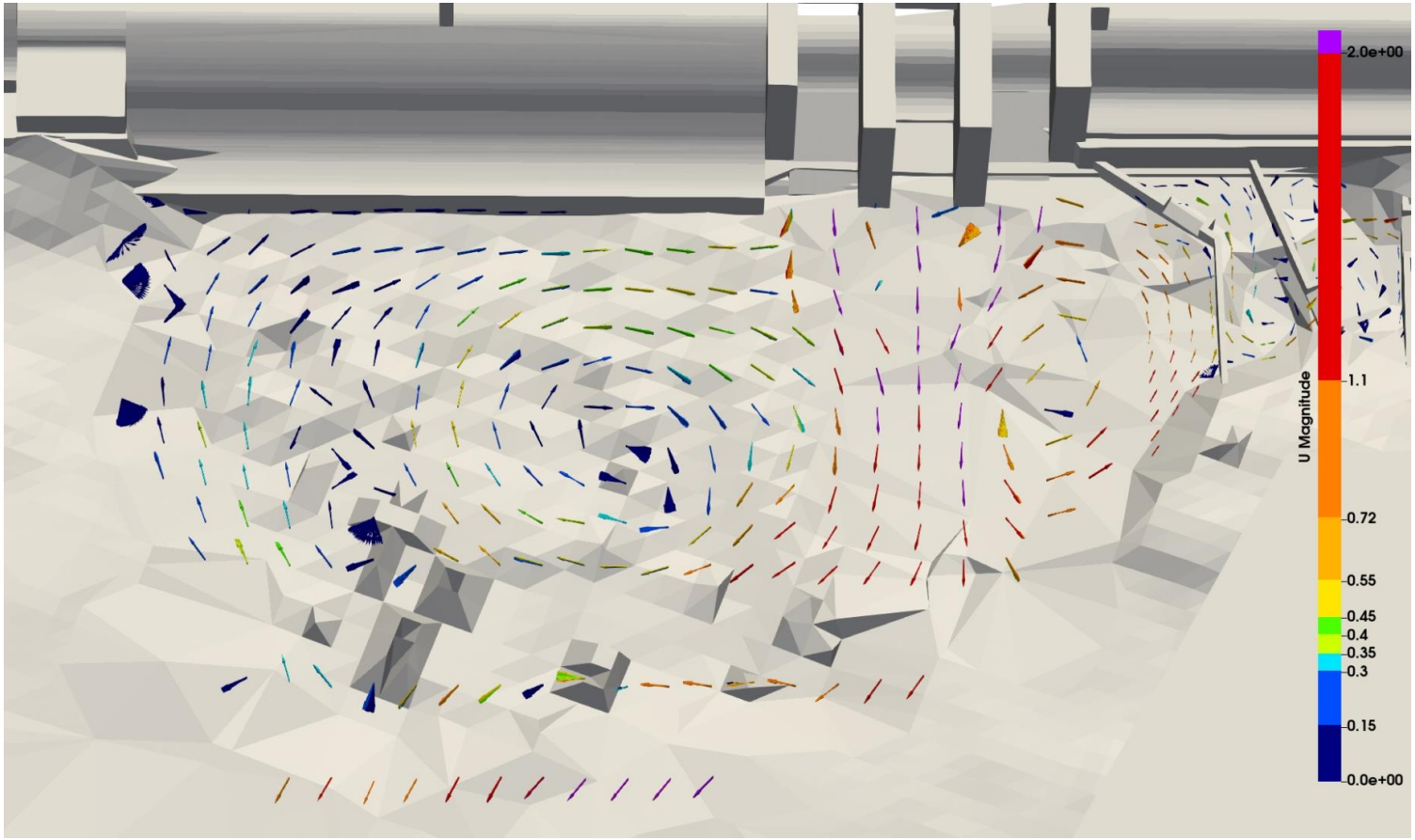


Figure S3-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

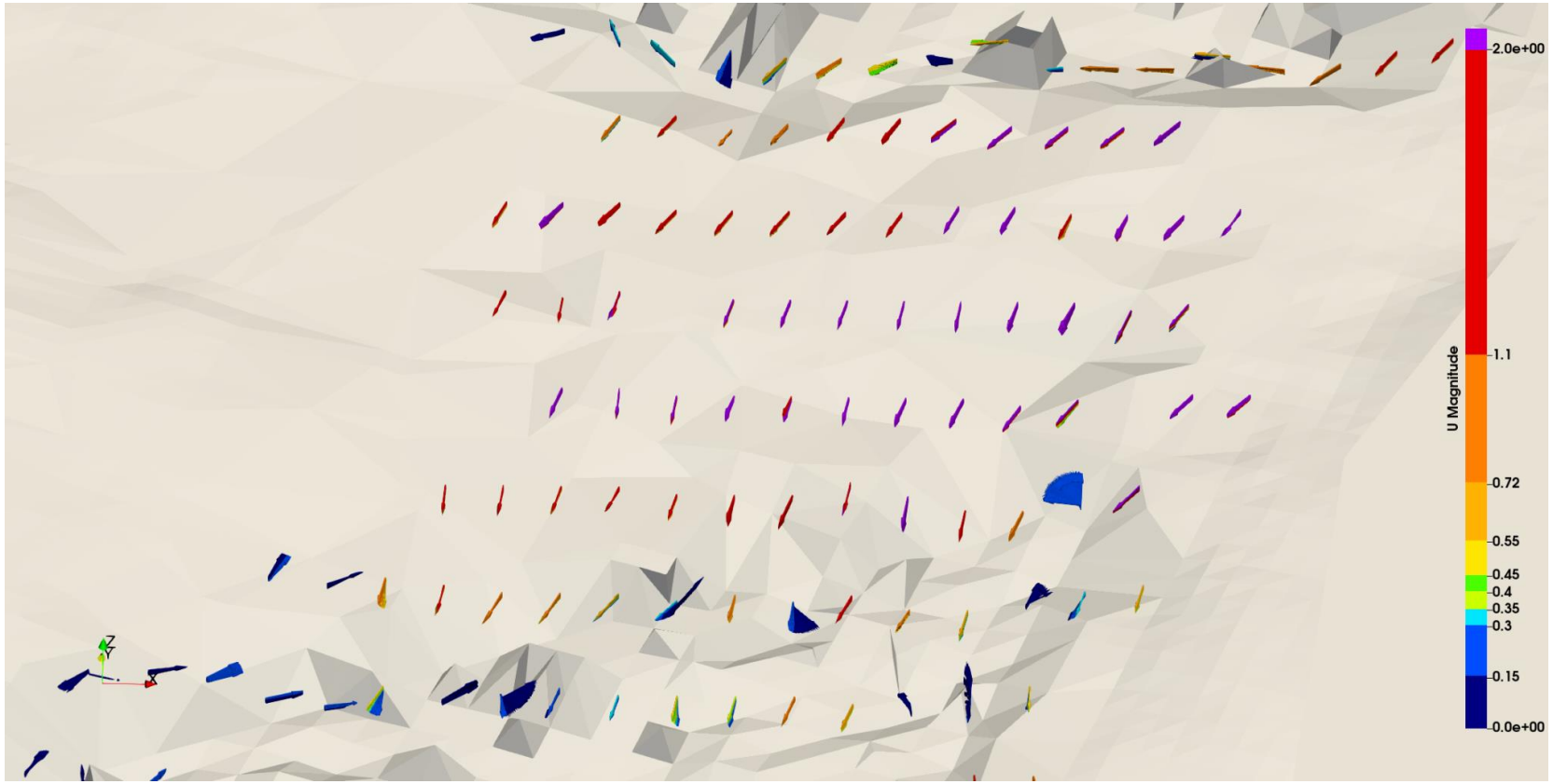


Figure S3-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

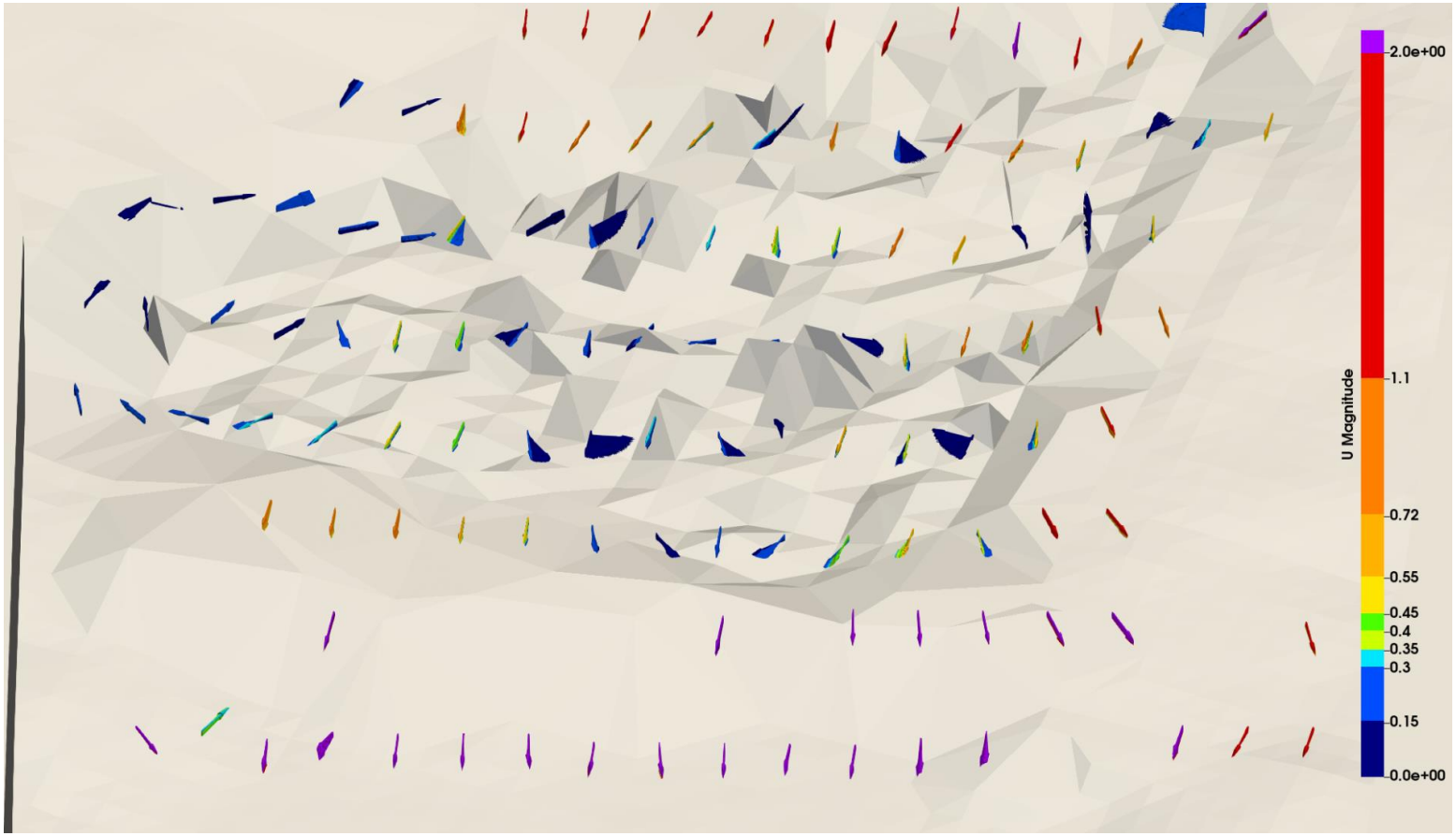


Figure S3-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

4. Model Results of Scenario S4 with 1720 cfs from the gates

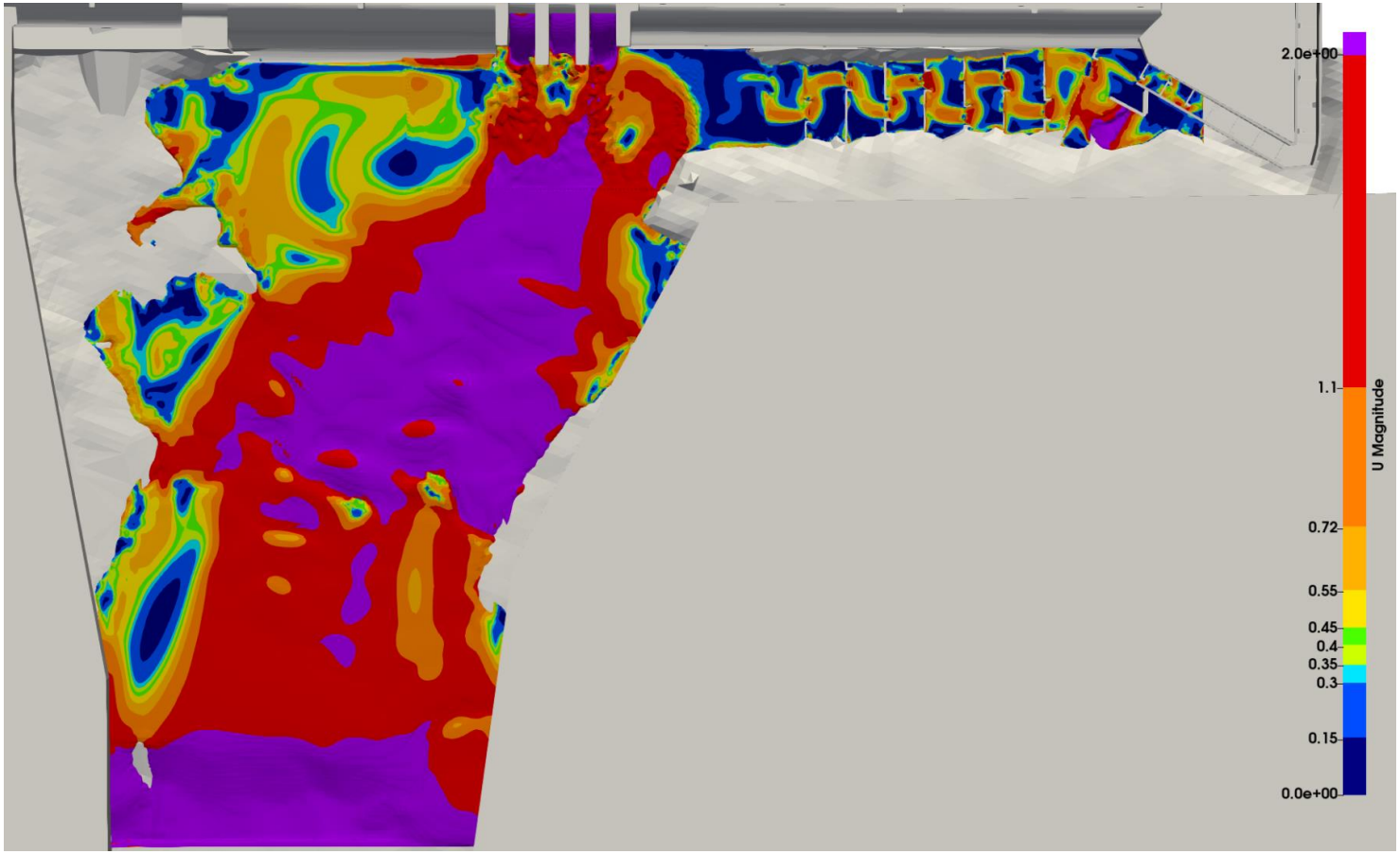


Figure S4-1: Plan view of the Water Surface Velocities

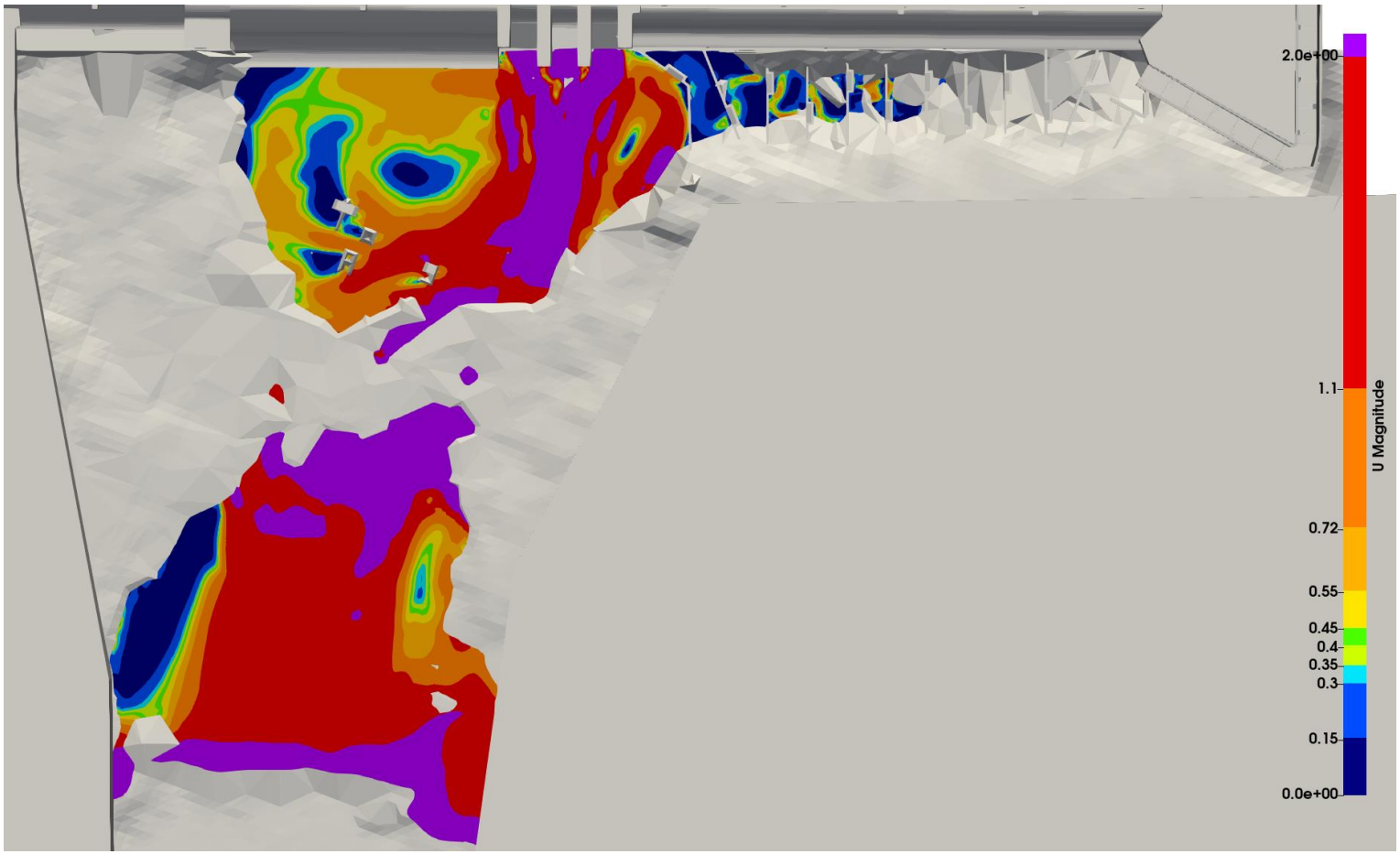


Figure S4-2: Plan view of the Mid-Surface Velocities

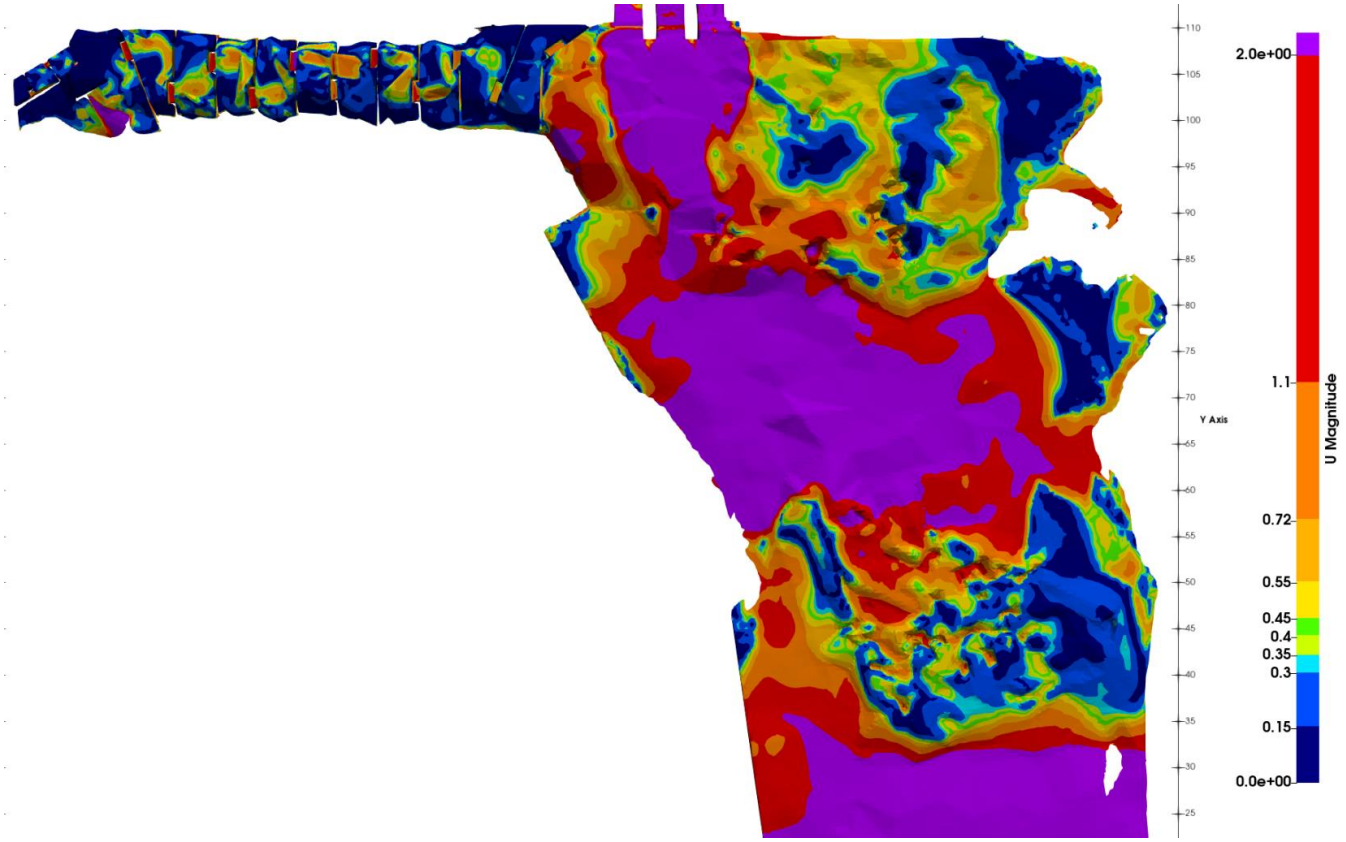


Figure S4-3: View of the Bottom Velocities

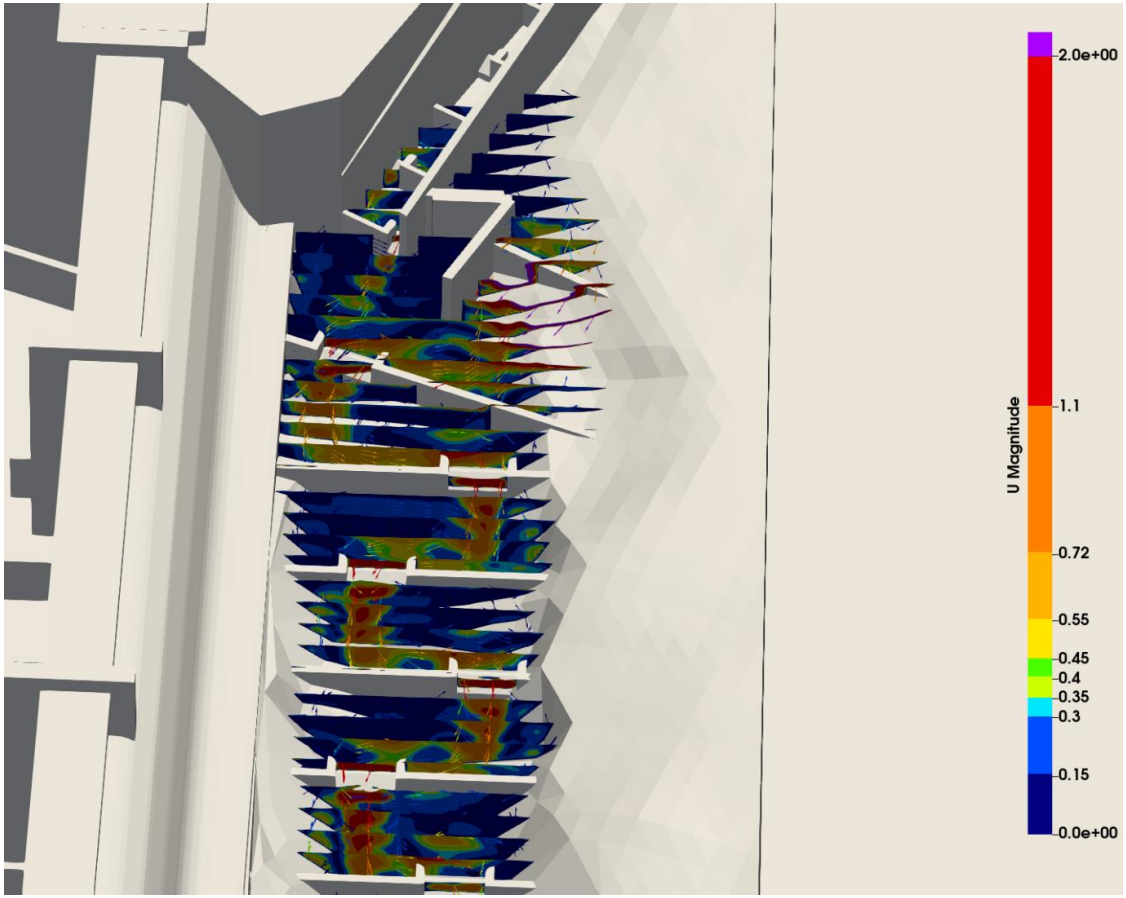


Figure S4-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

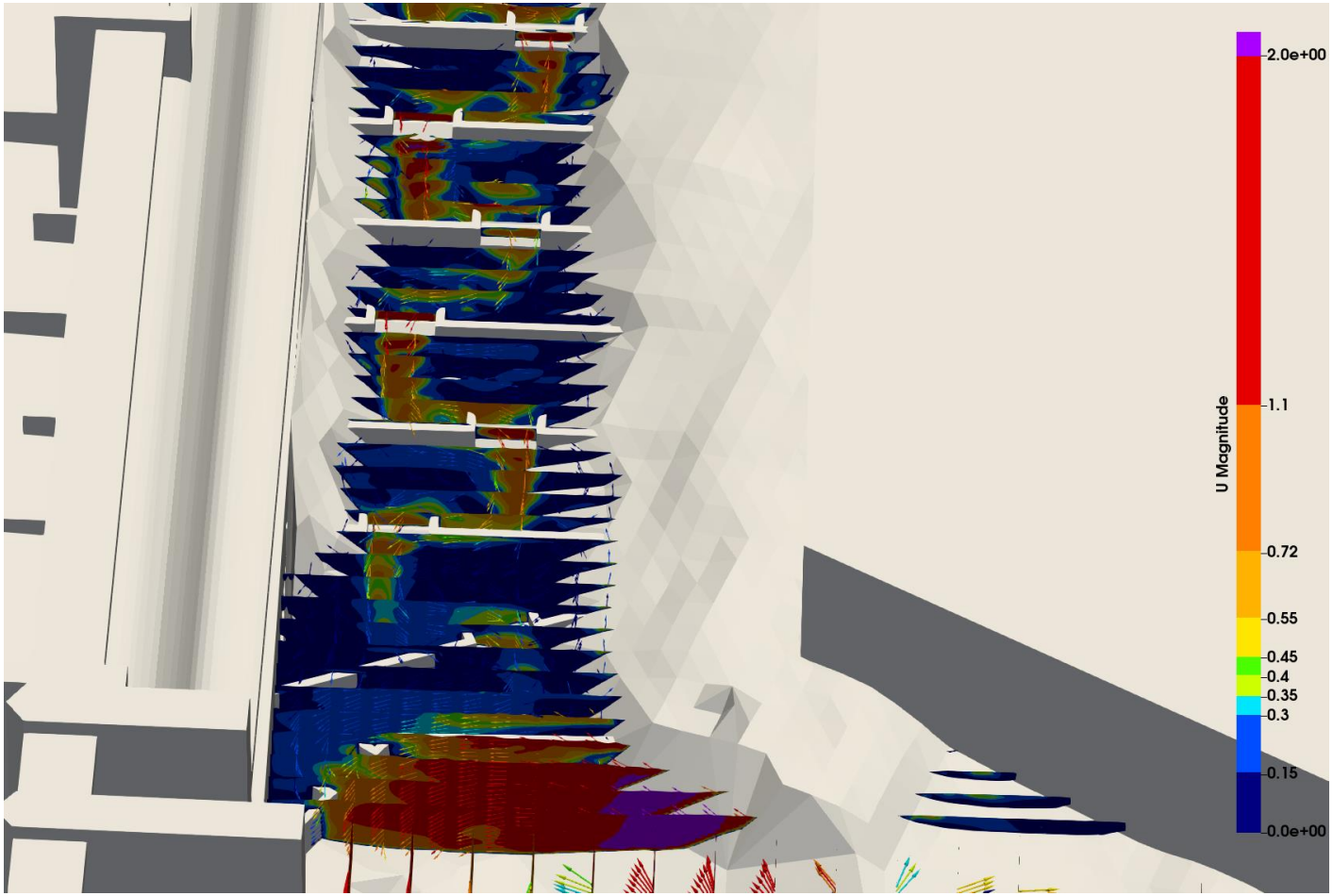


Figure S4-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

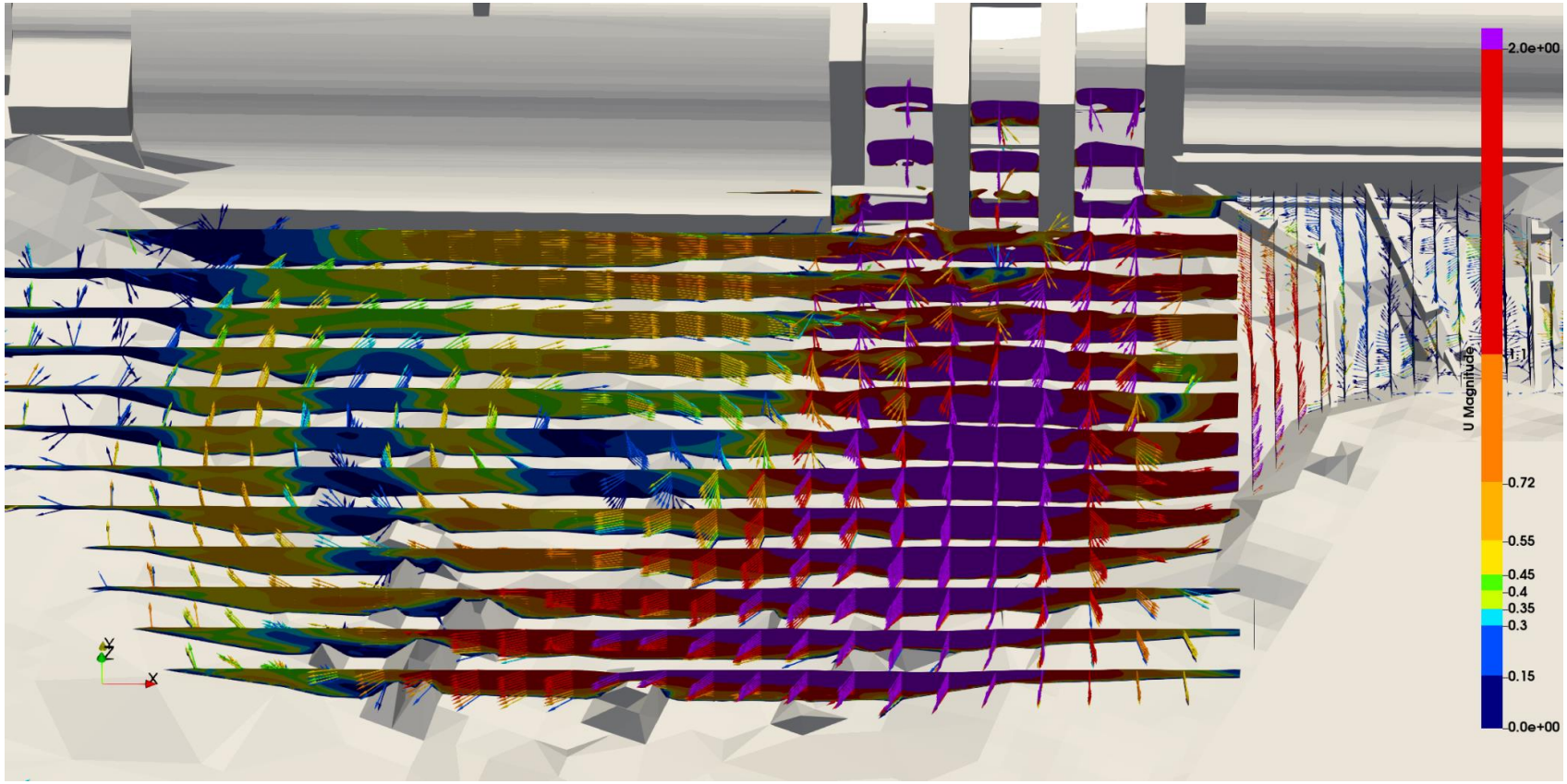


Figure S4-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

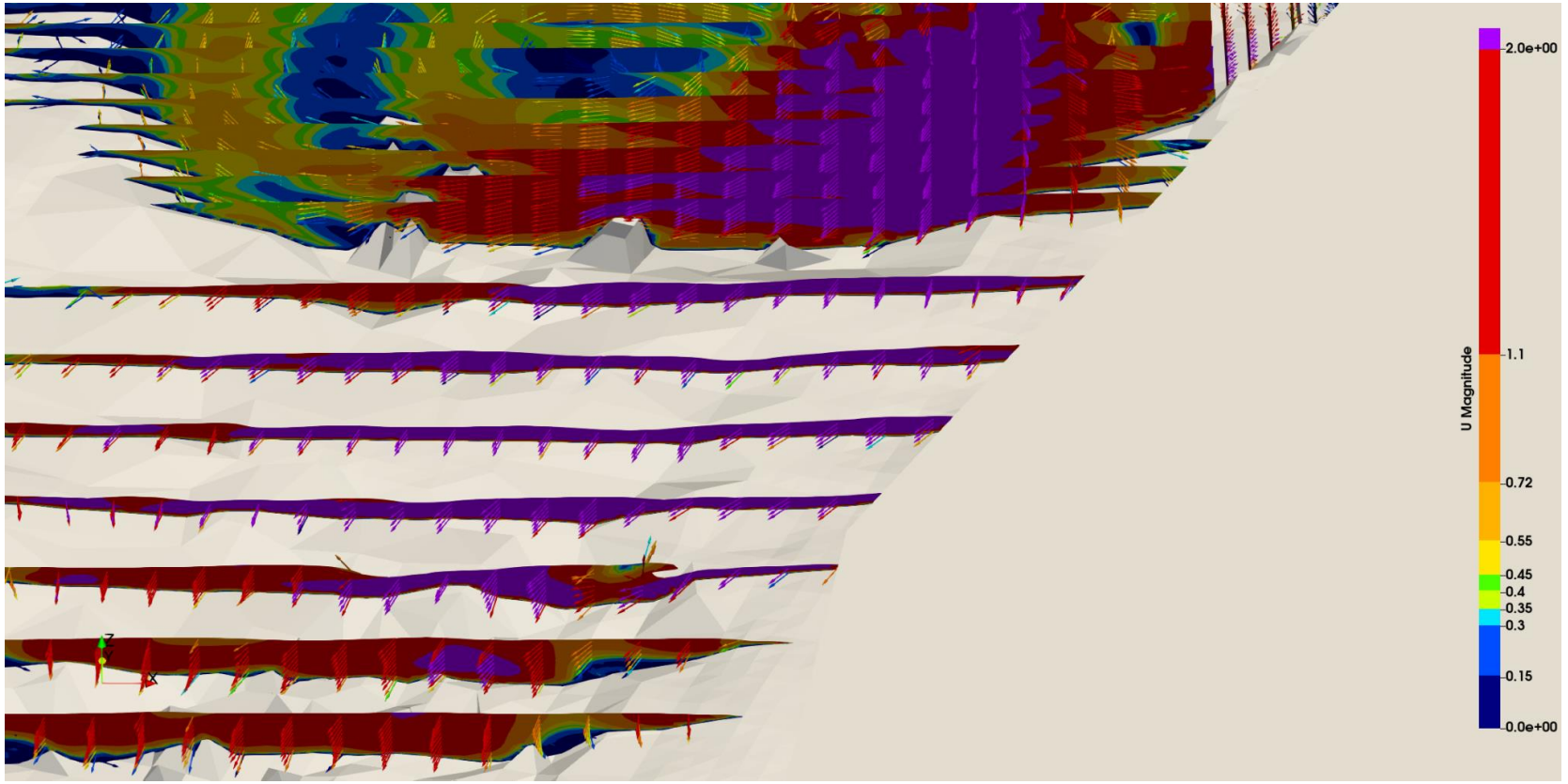


Figure S4-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

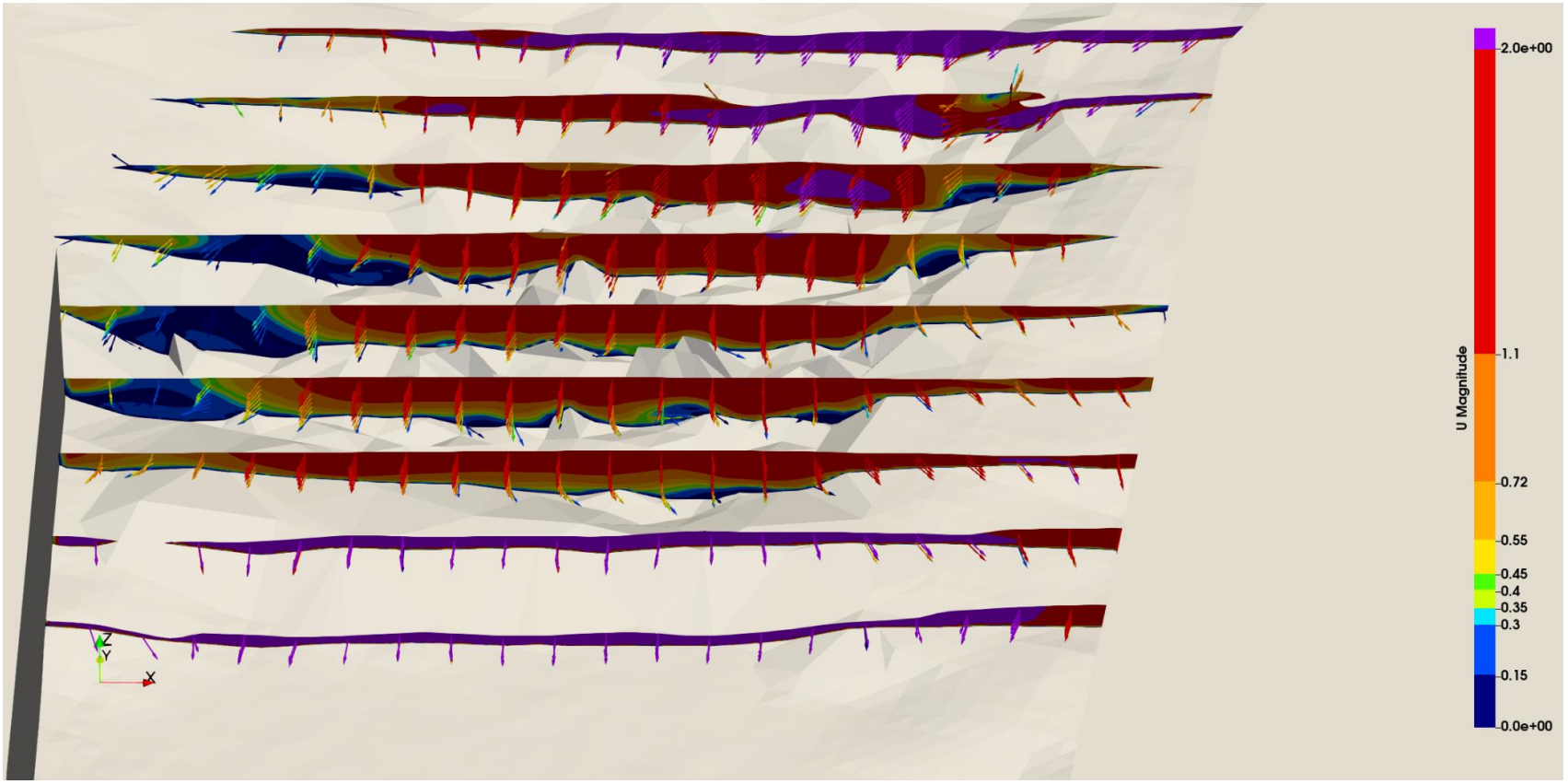


Figure S4-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

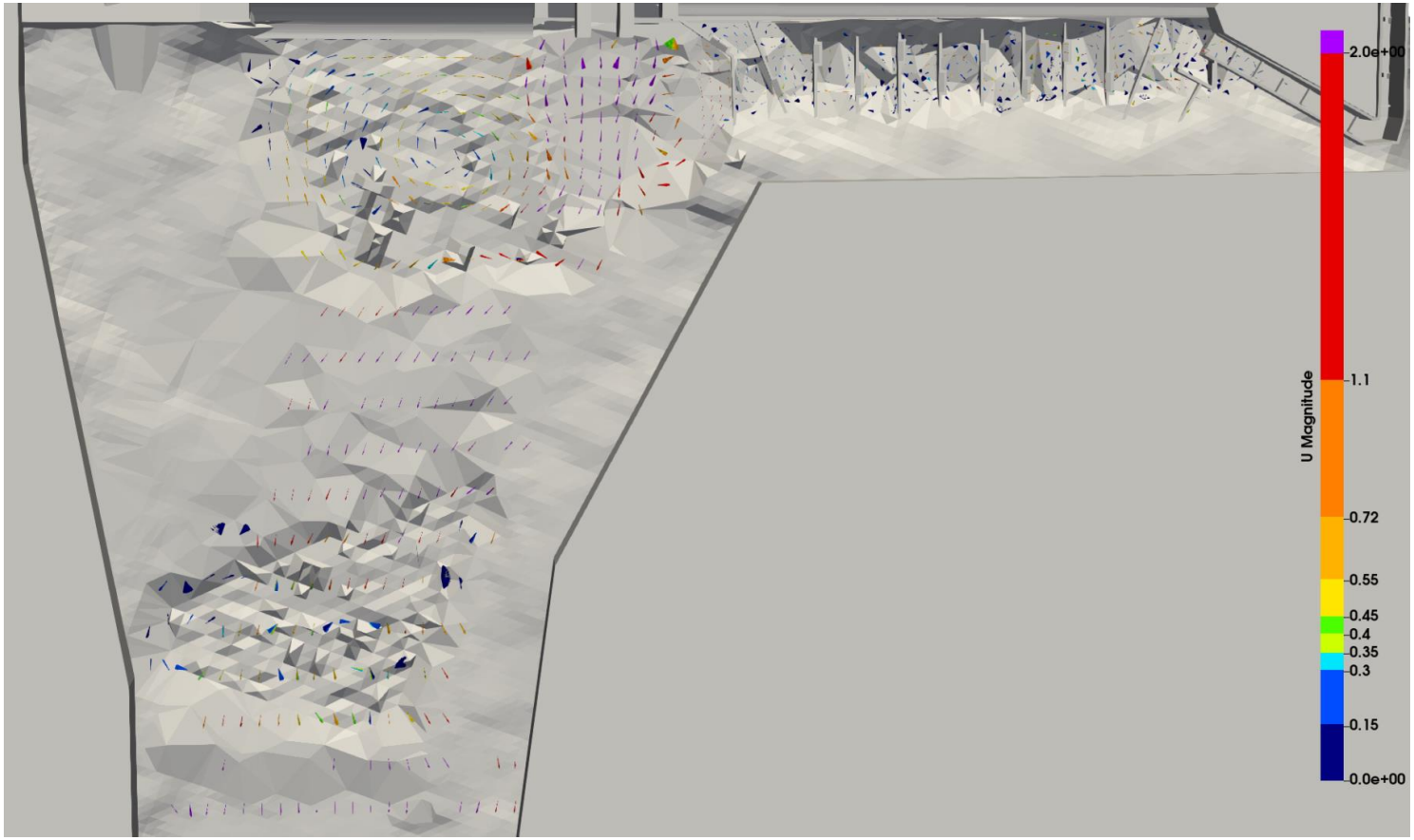


Figure S4-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

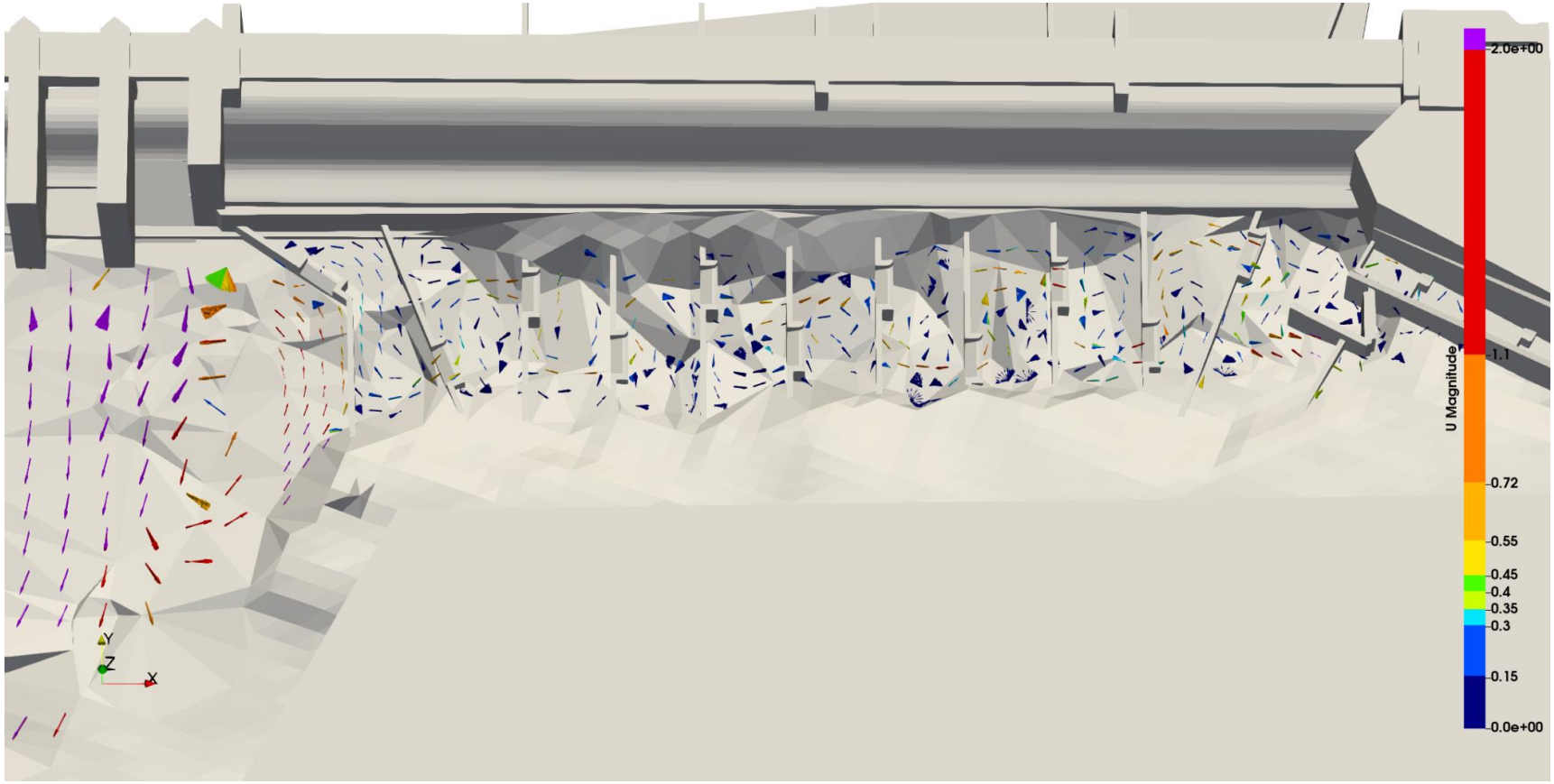


Figure S4-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

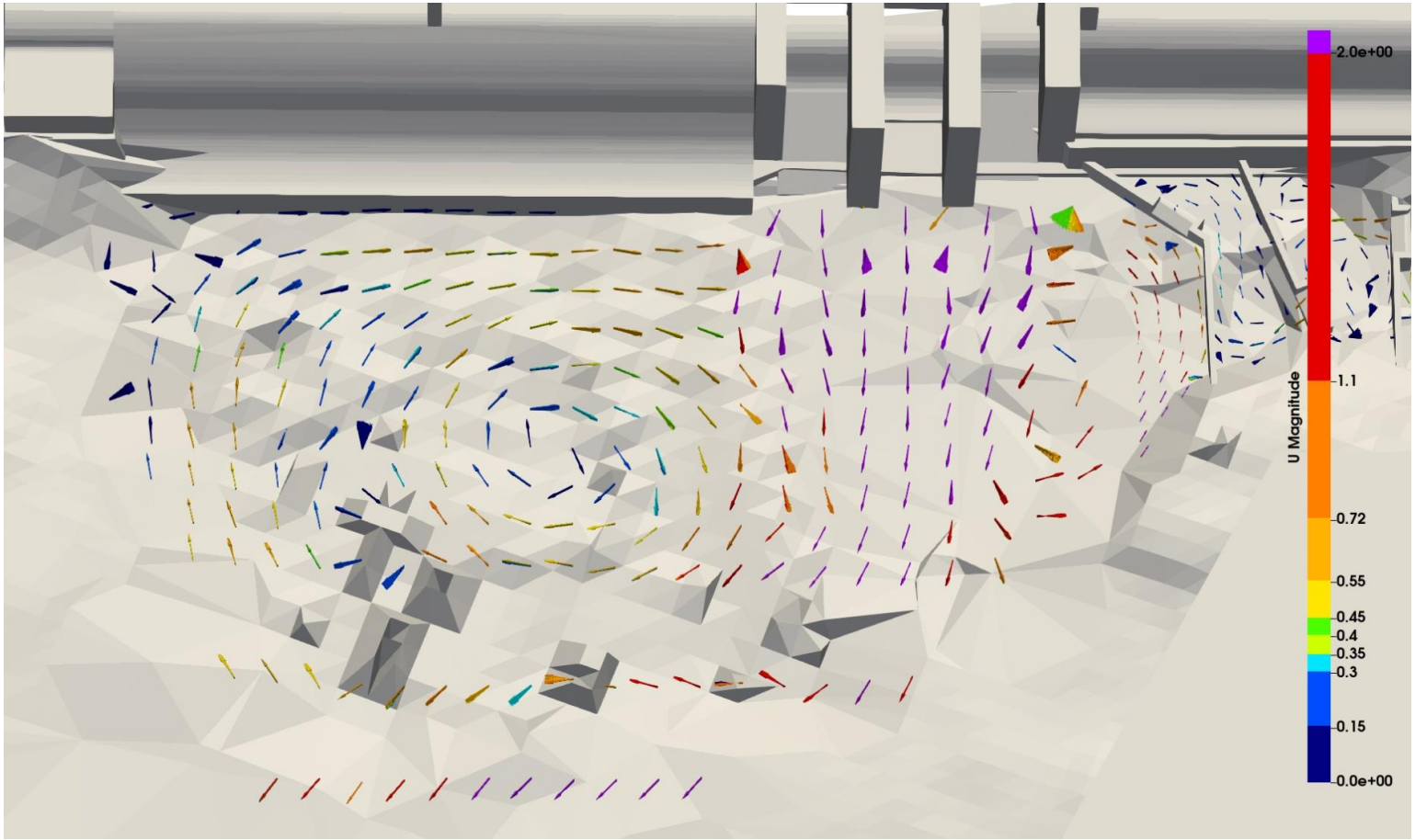


Figure S4-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

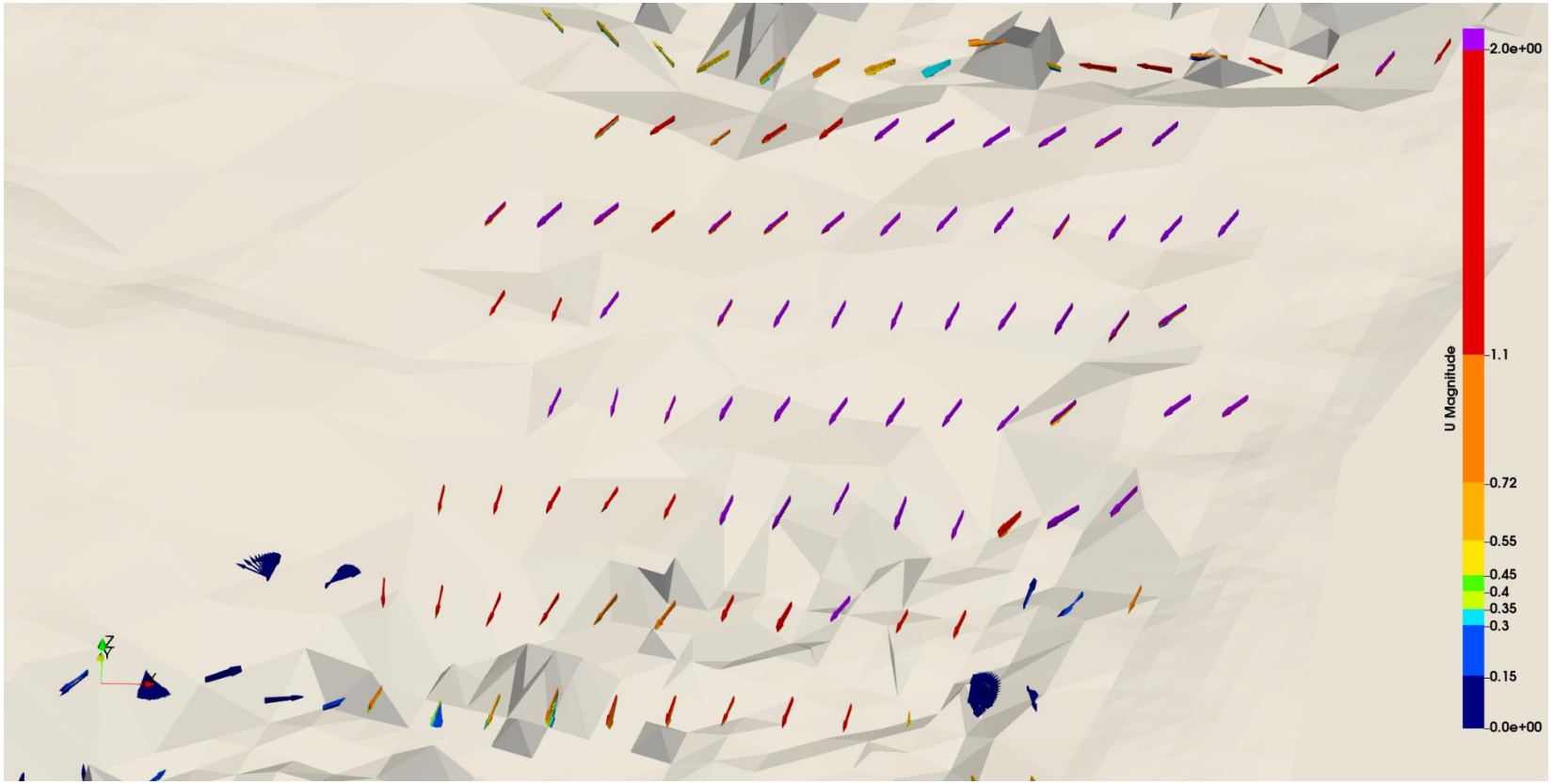


Figure S4-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

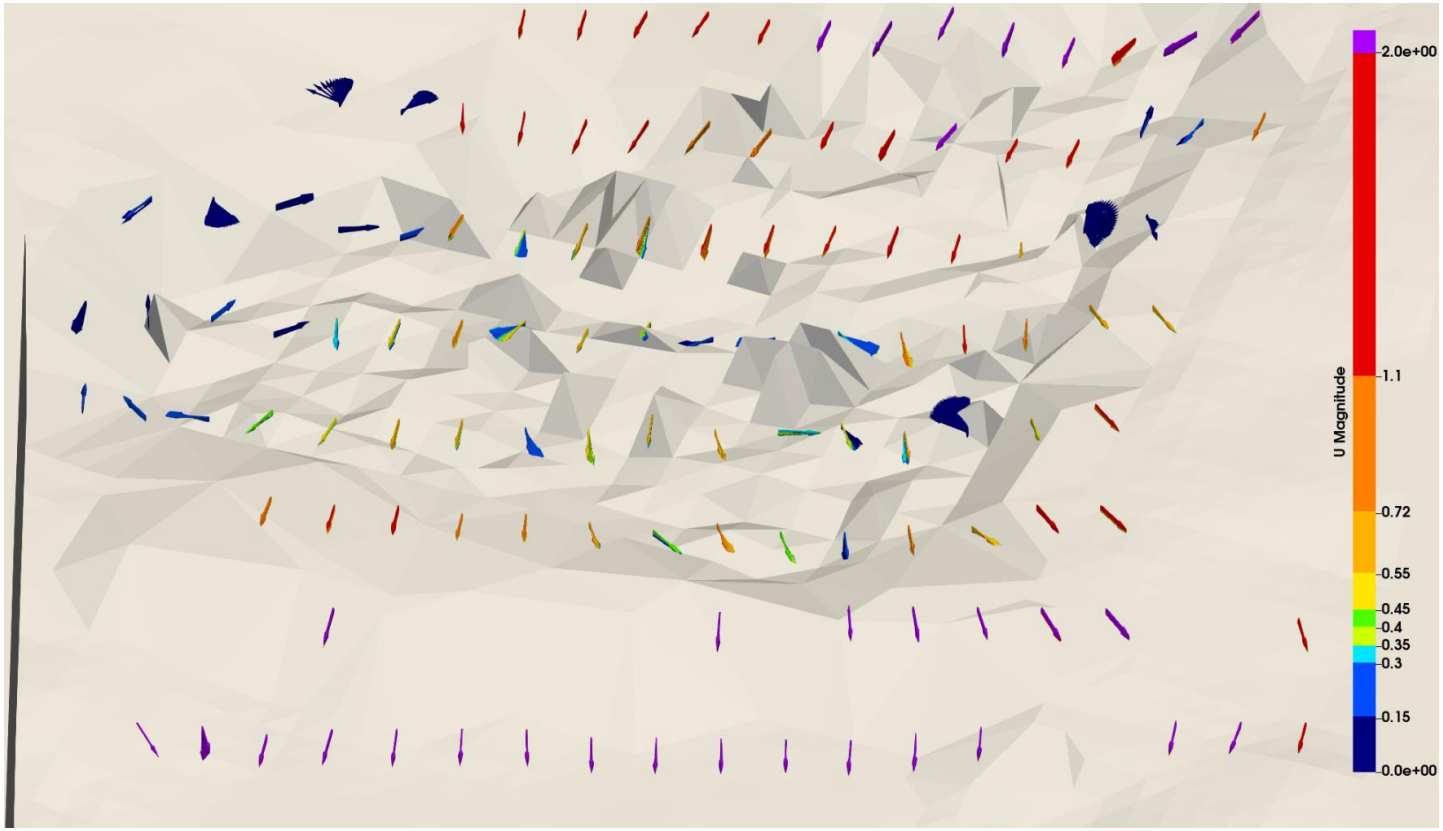


Figure S4-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

5. Model Results of Scenario S5 with 3051 cfs from the gates

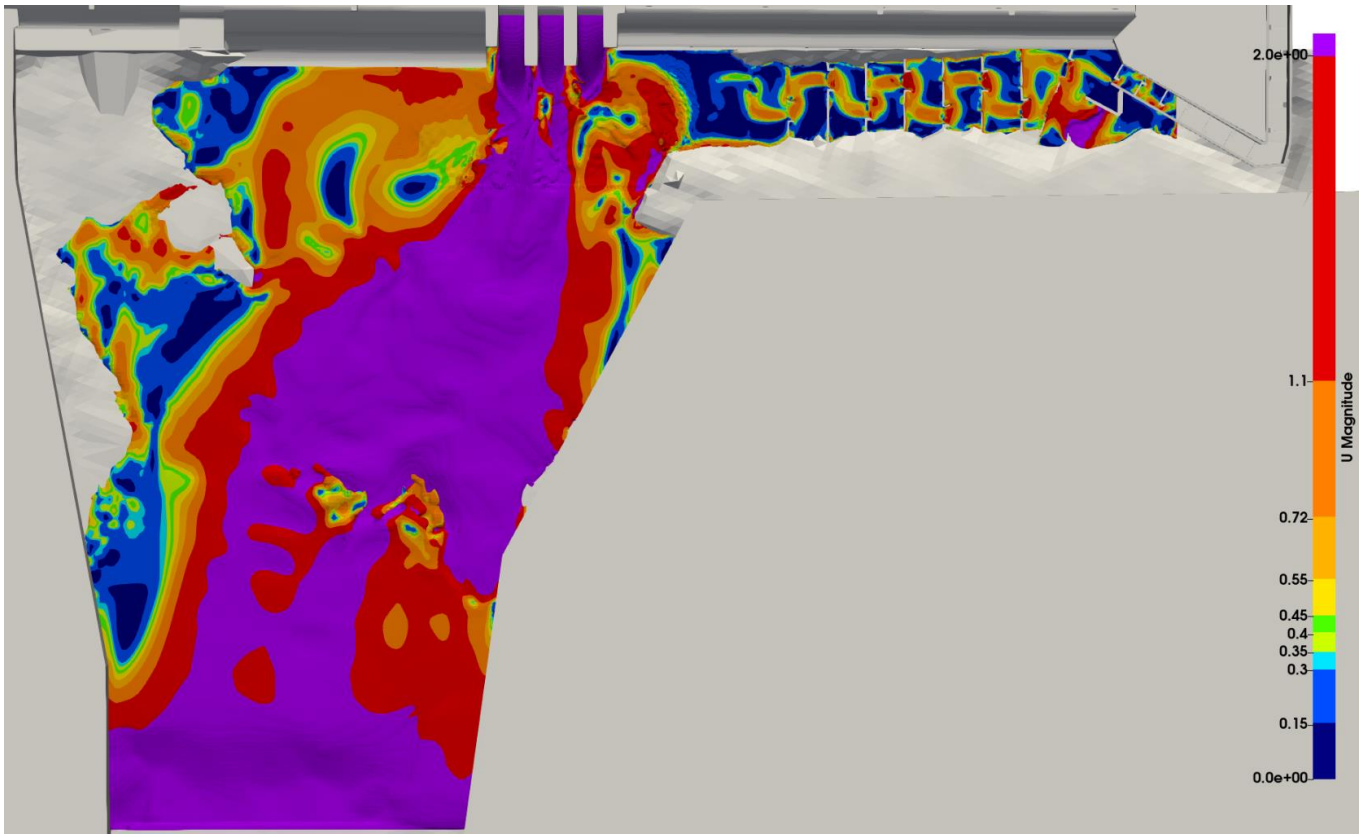


Figure S5-1: Plan view of the Water Surface Velocities

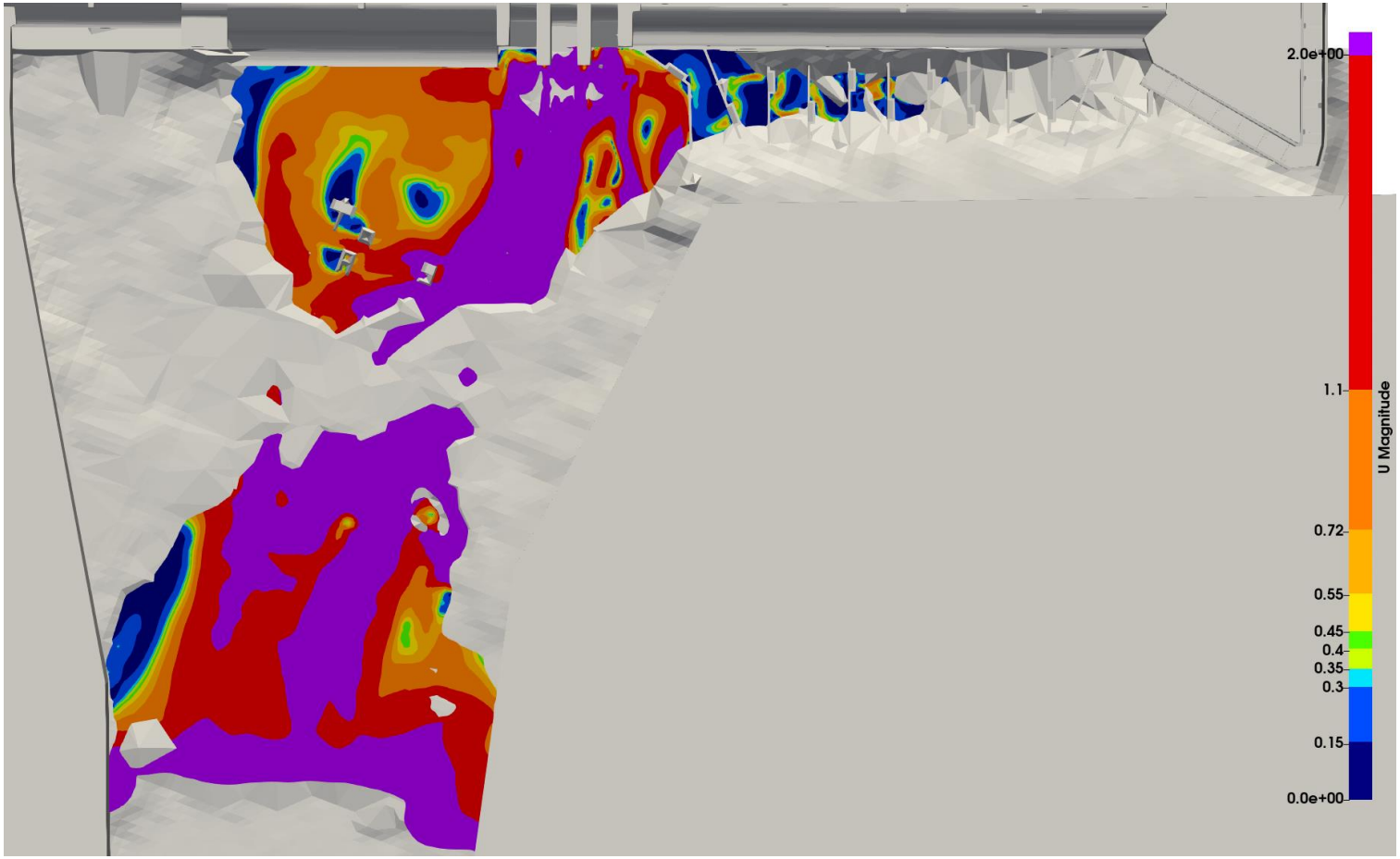


Figure S5-2: Plan view of the Mid-Surface Velocities

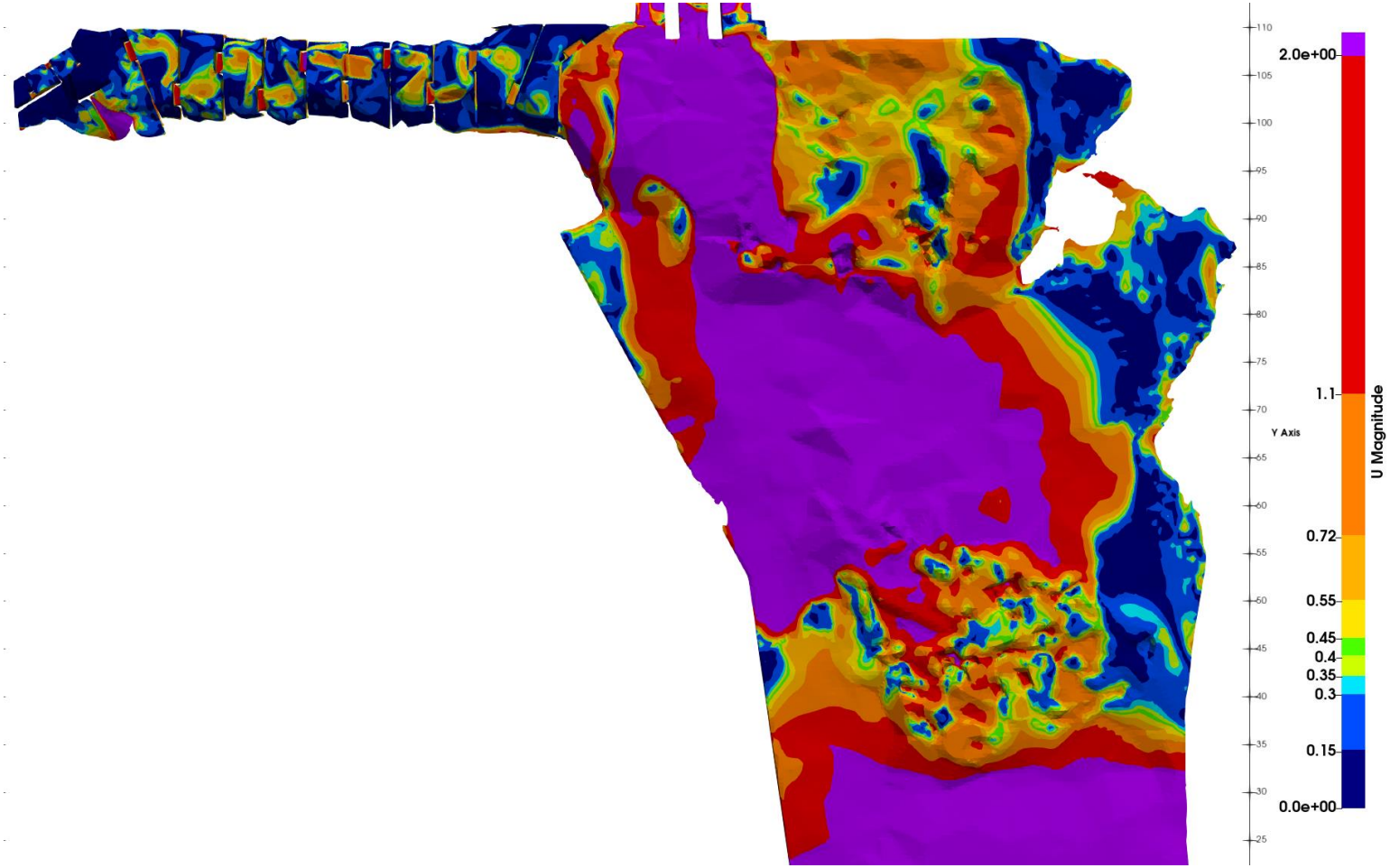


Figure S5-3: View of the Bottom Velocities

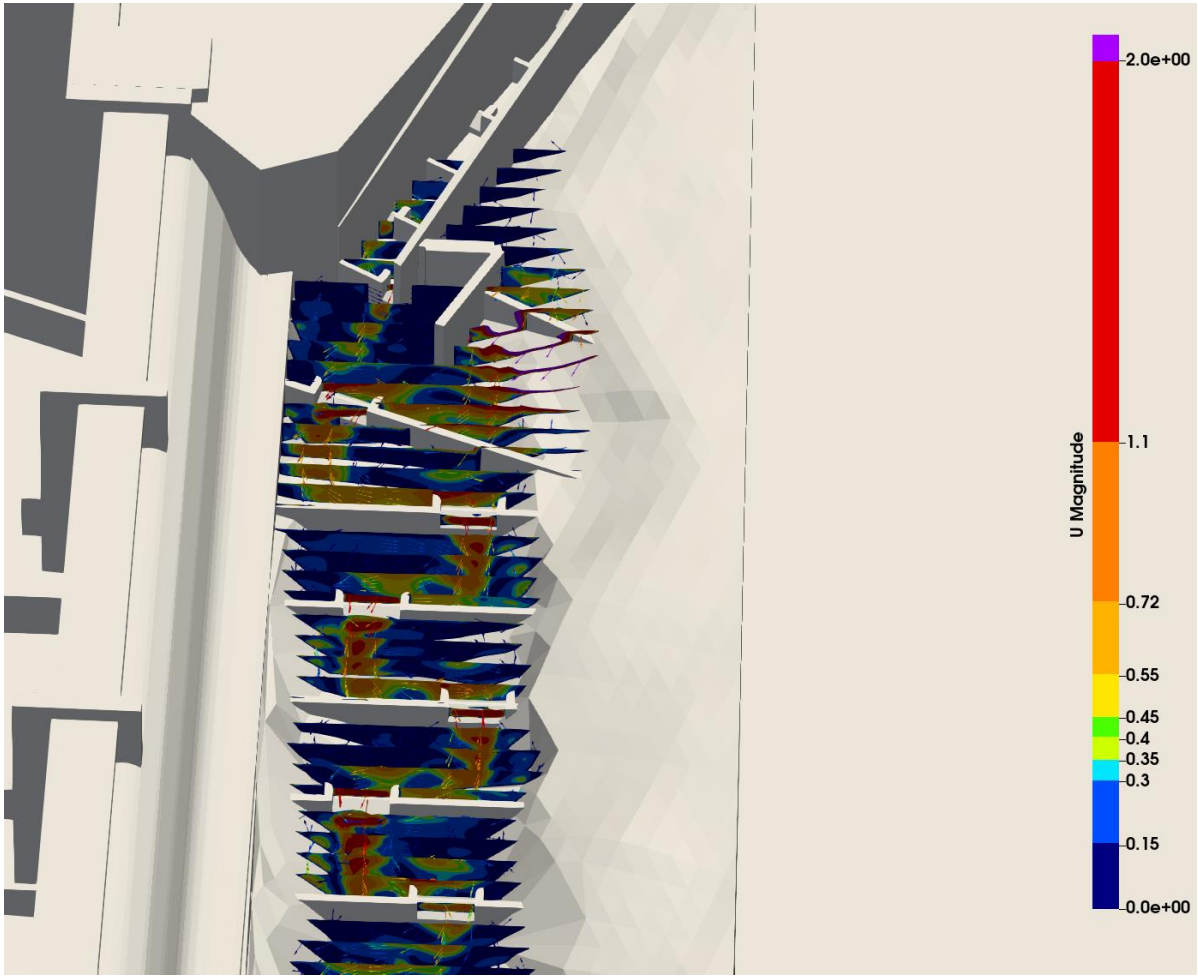


Figure S5-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

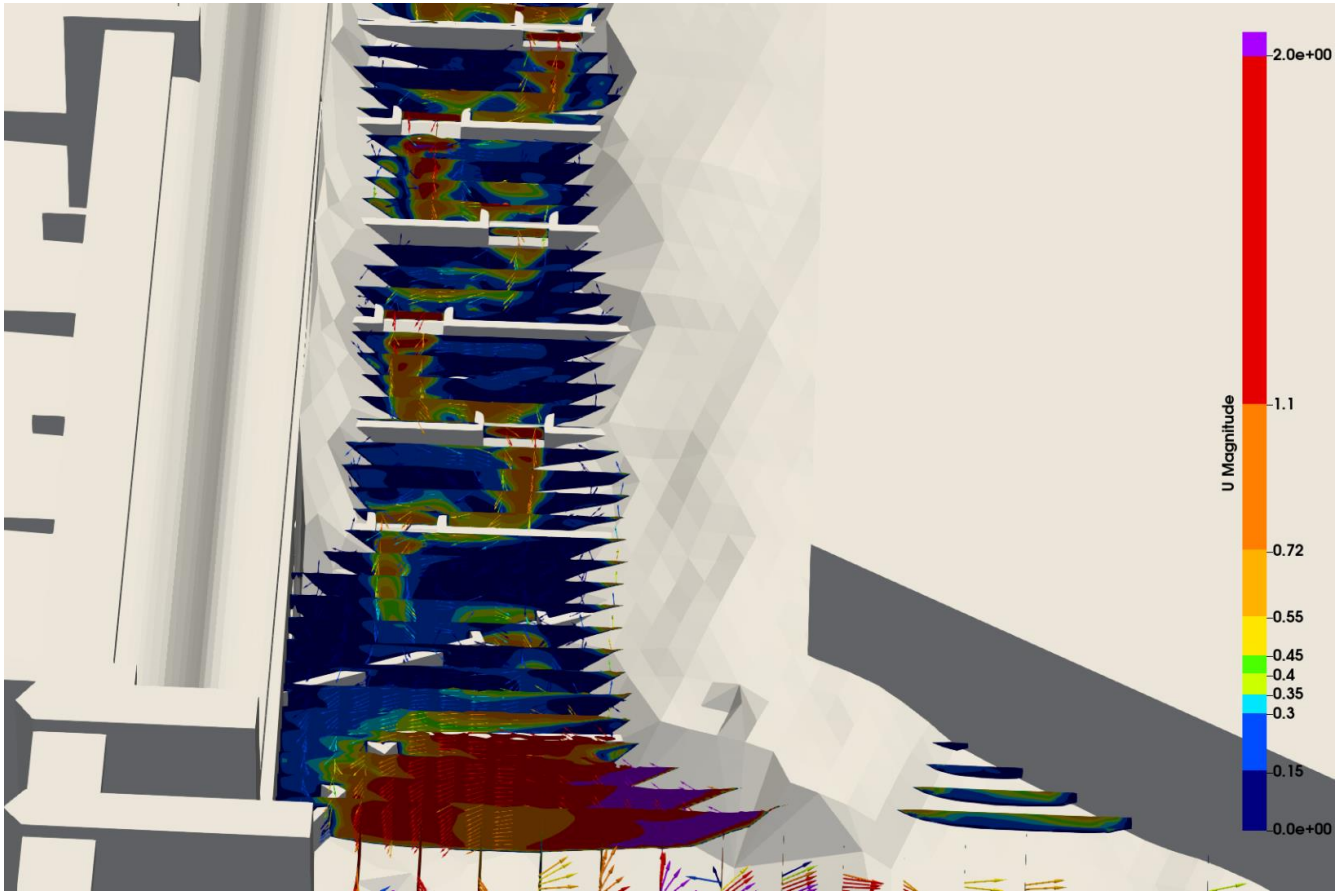


Figure S5-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

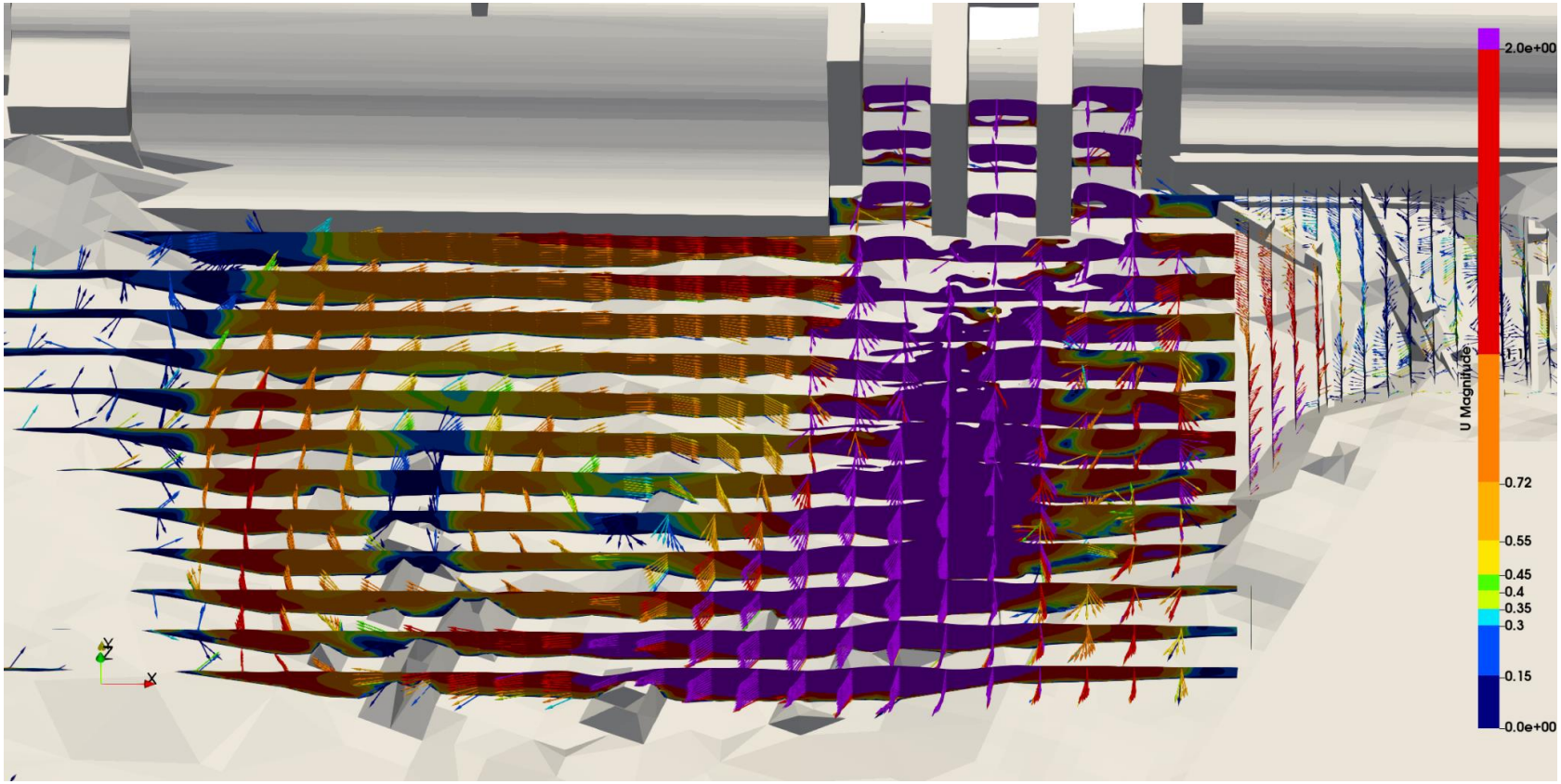


Figure S5-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

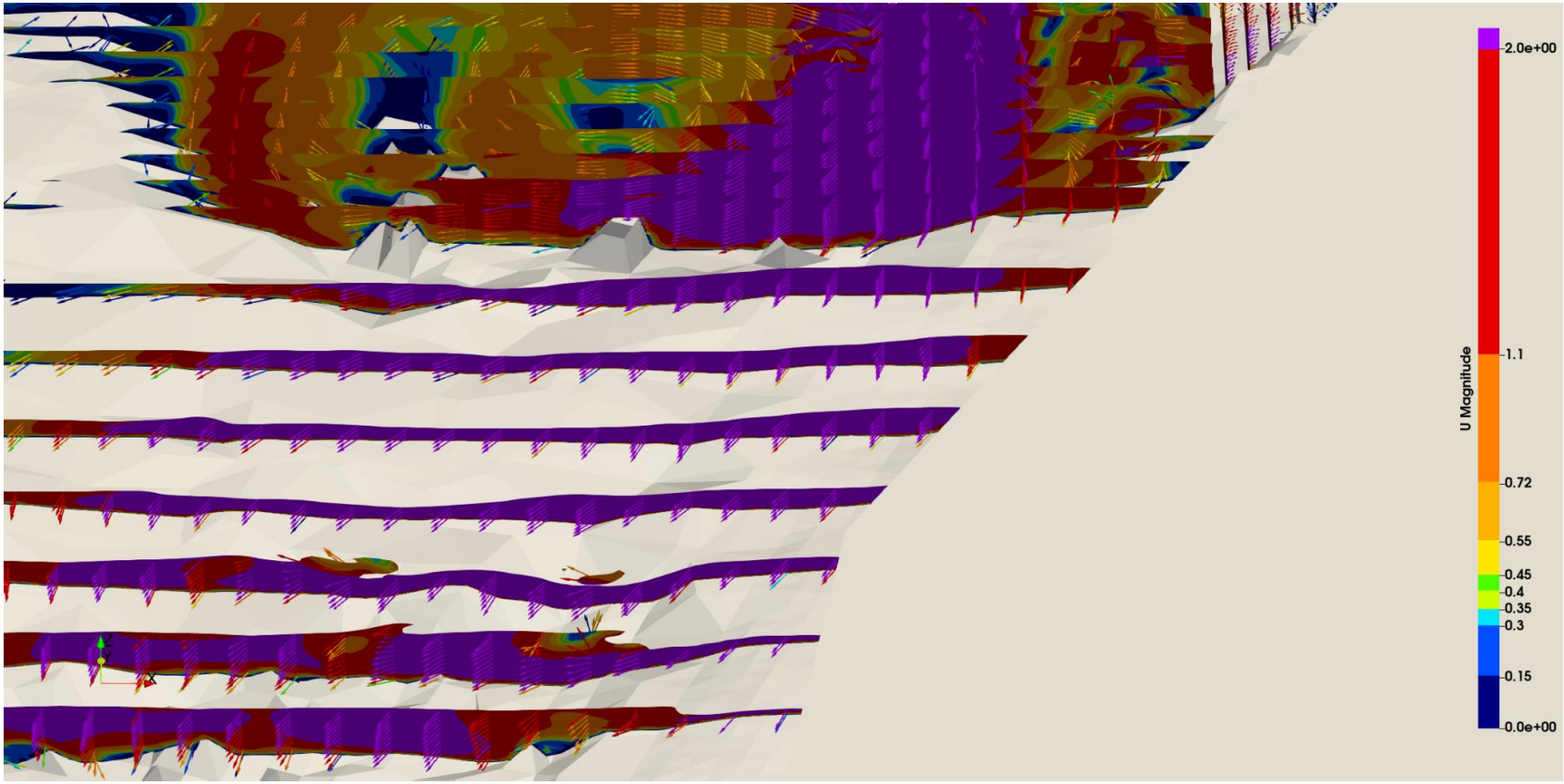


Figure S5-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

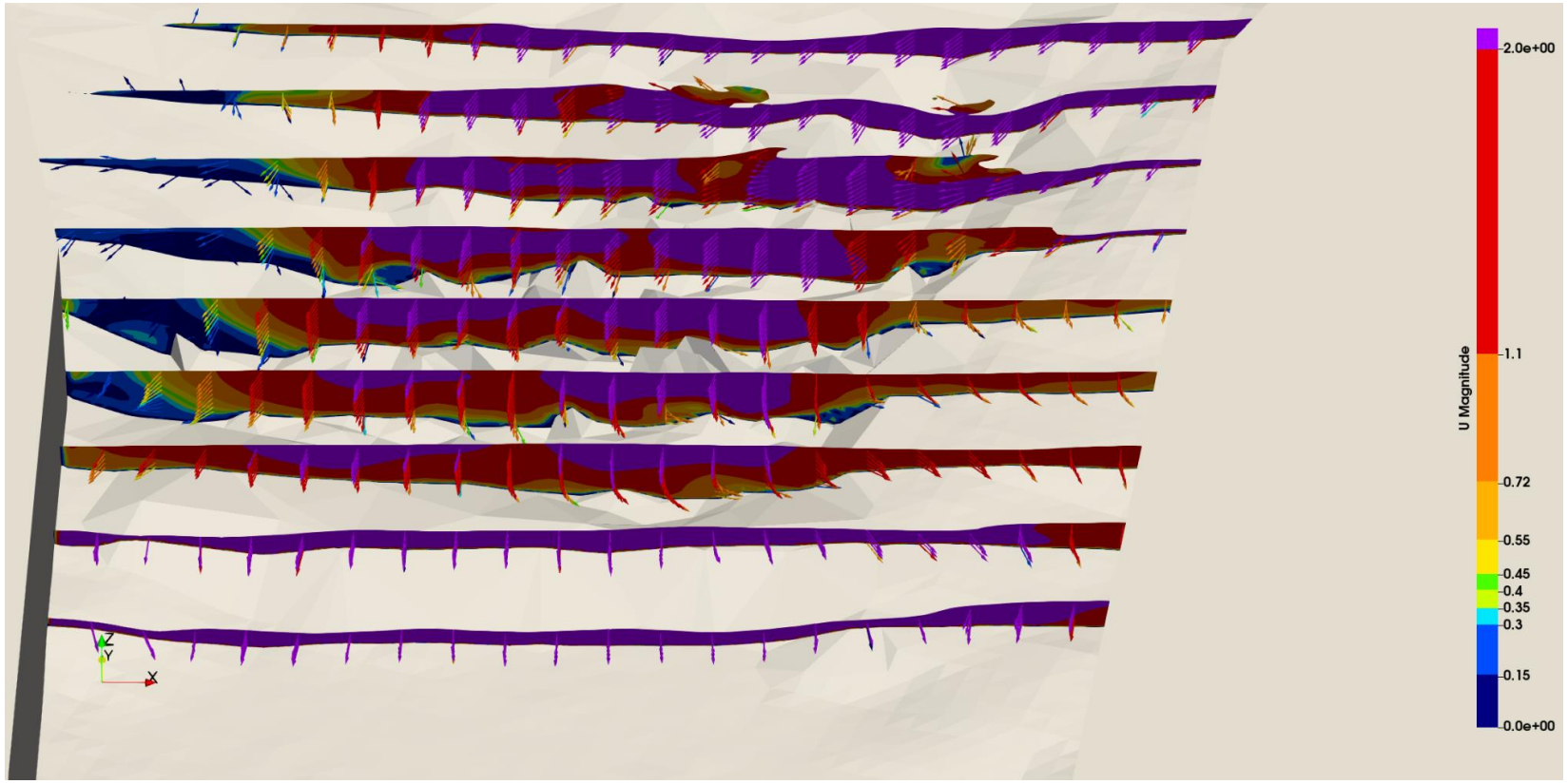


Figure S5-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

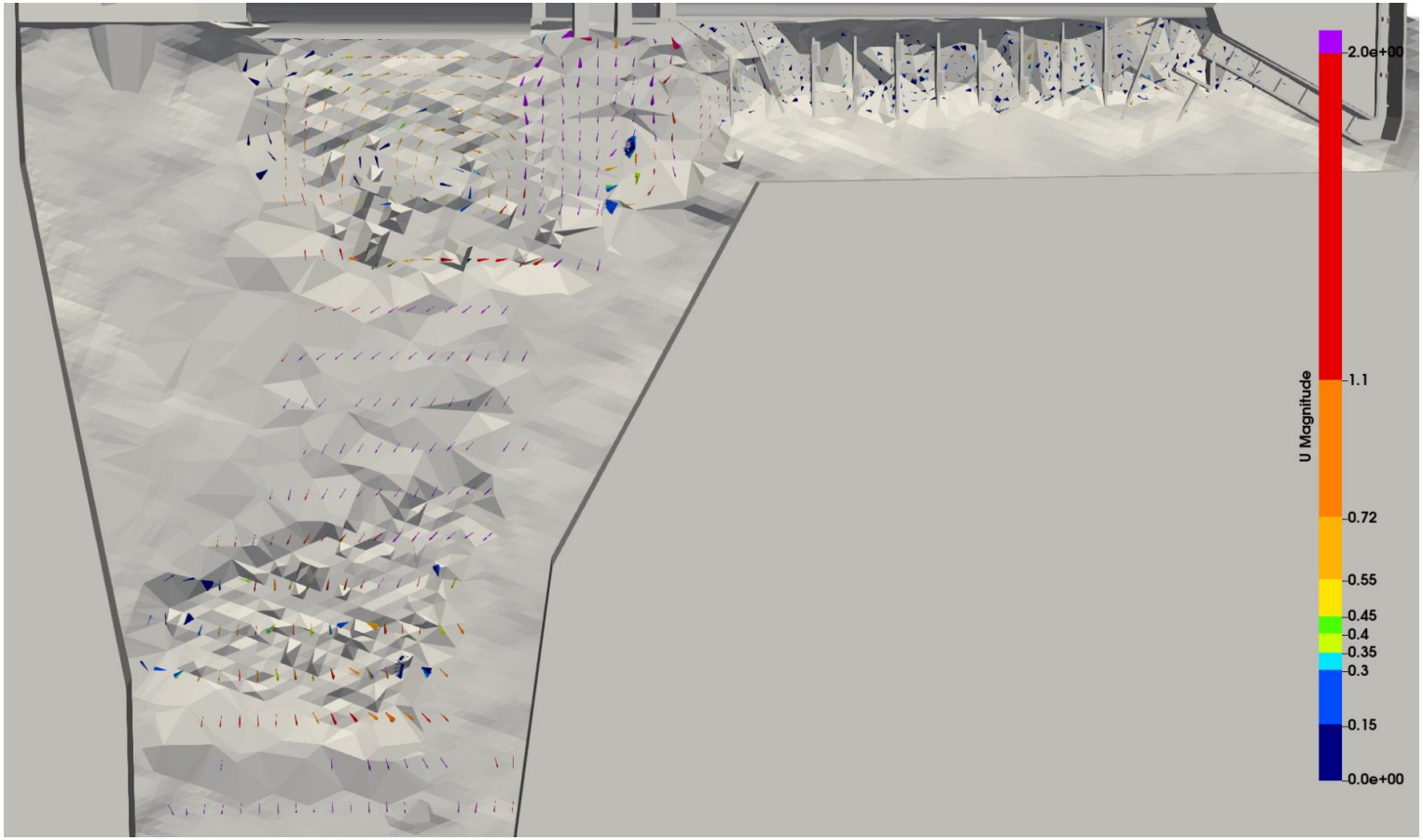


Figure S5-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

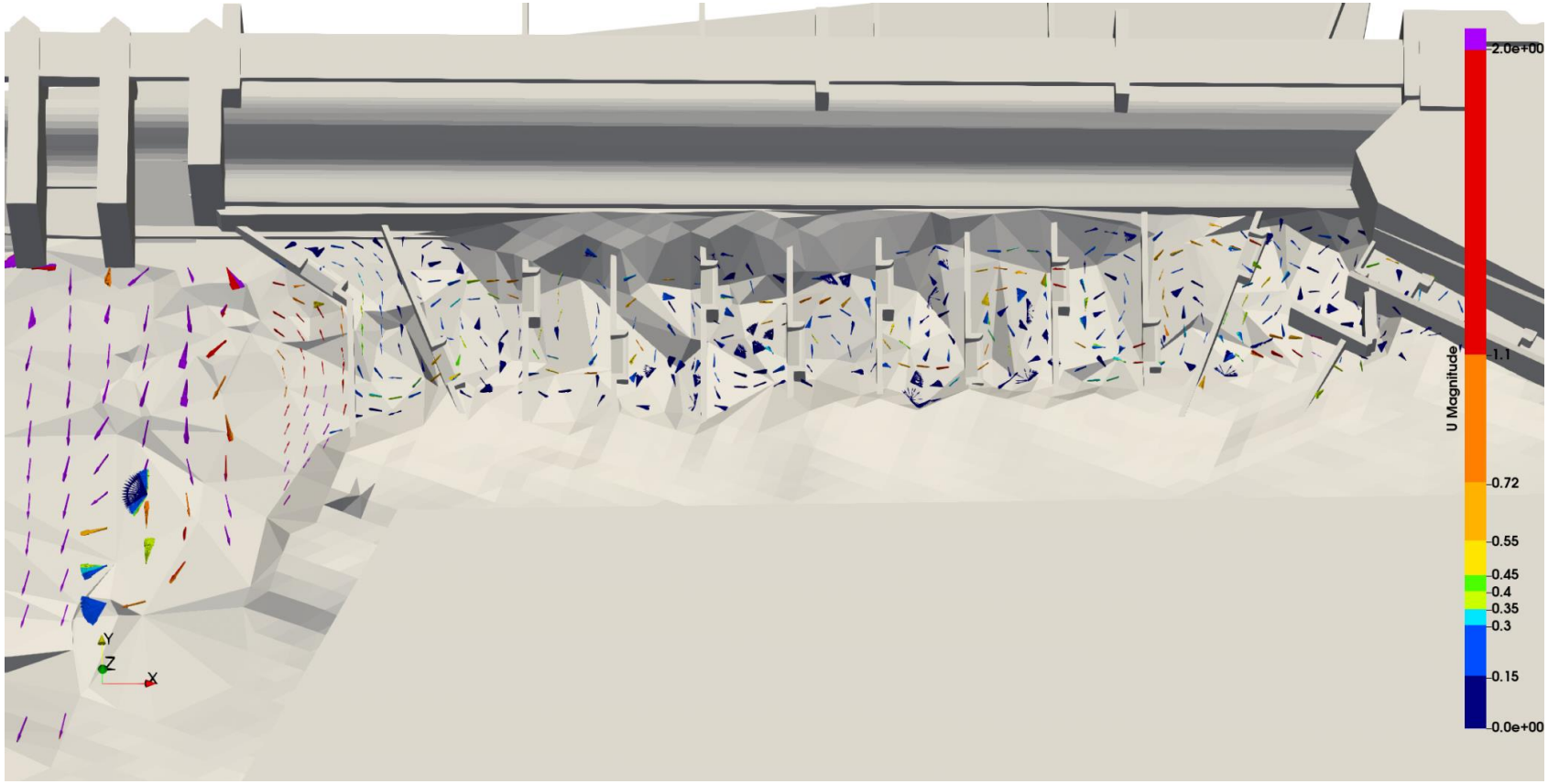


Figure S5-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

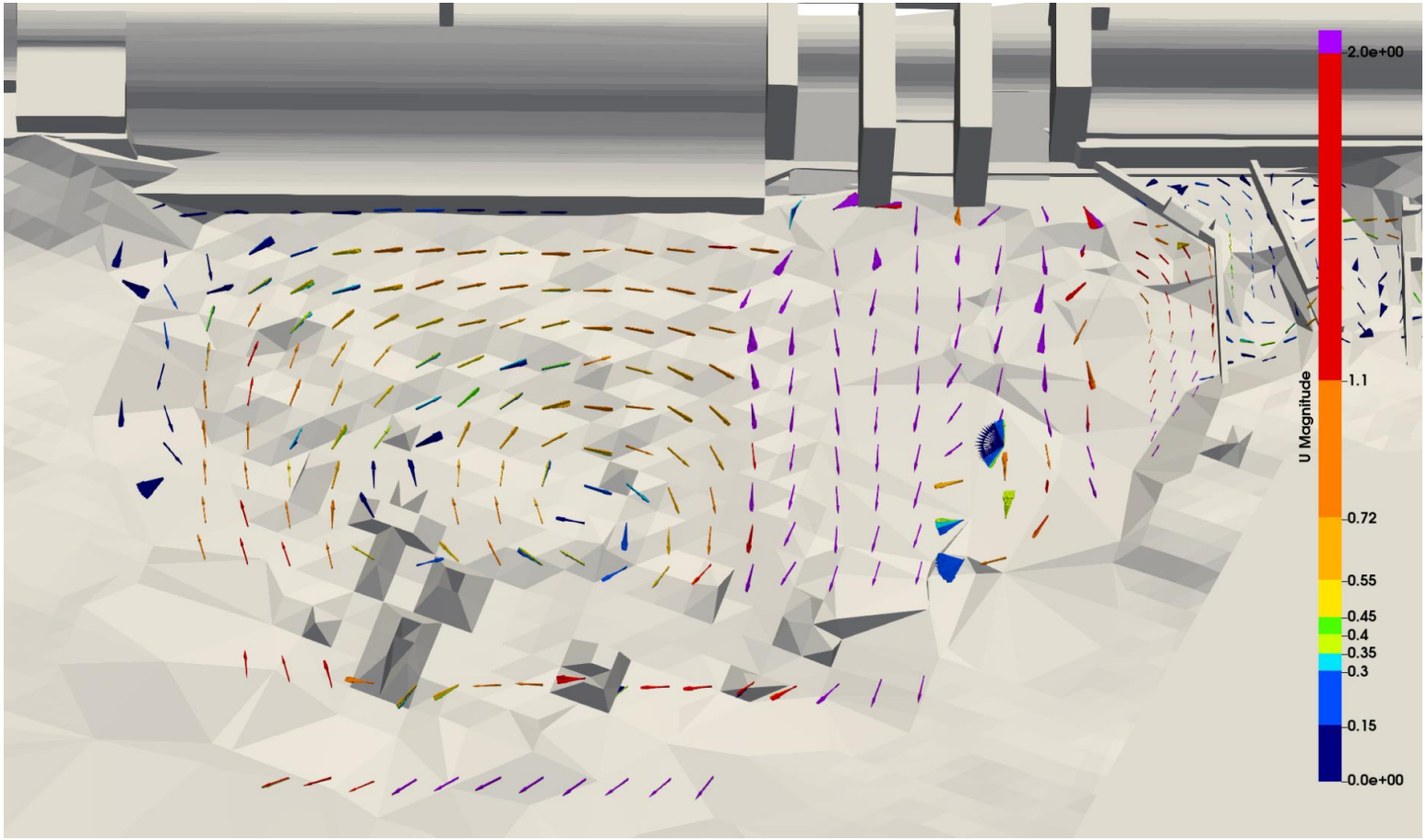


Figure S5-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

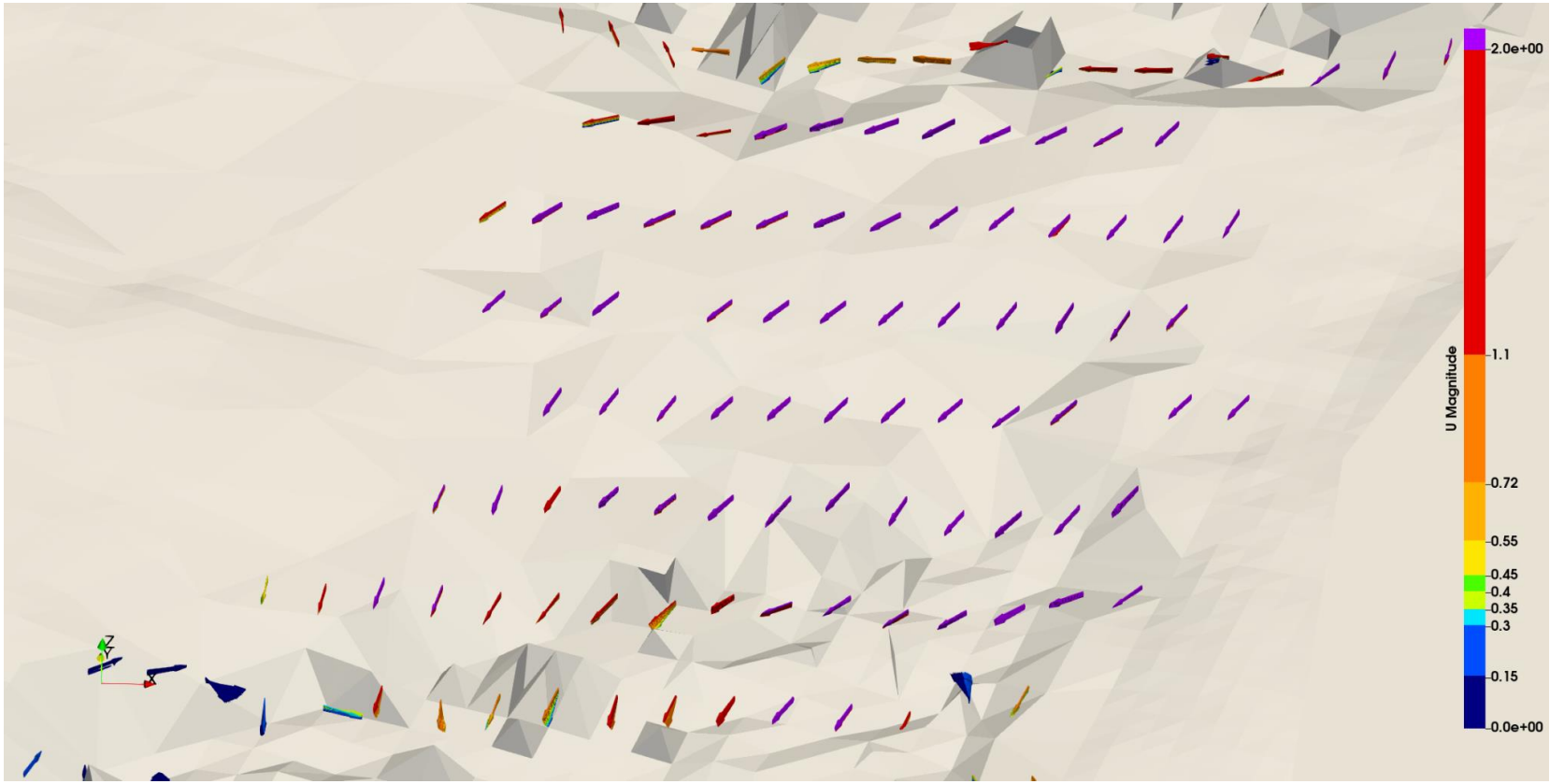


Figure S5-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

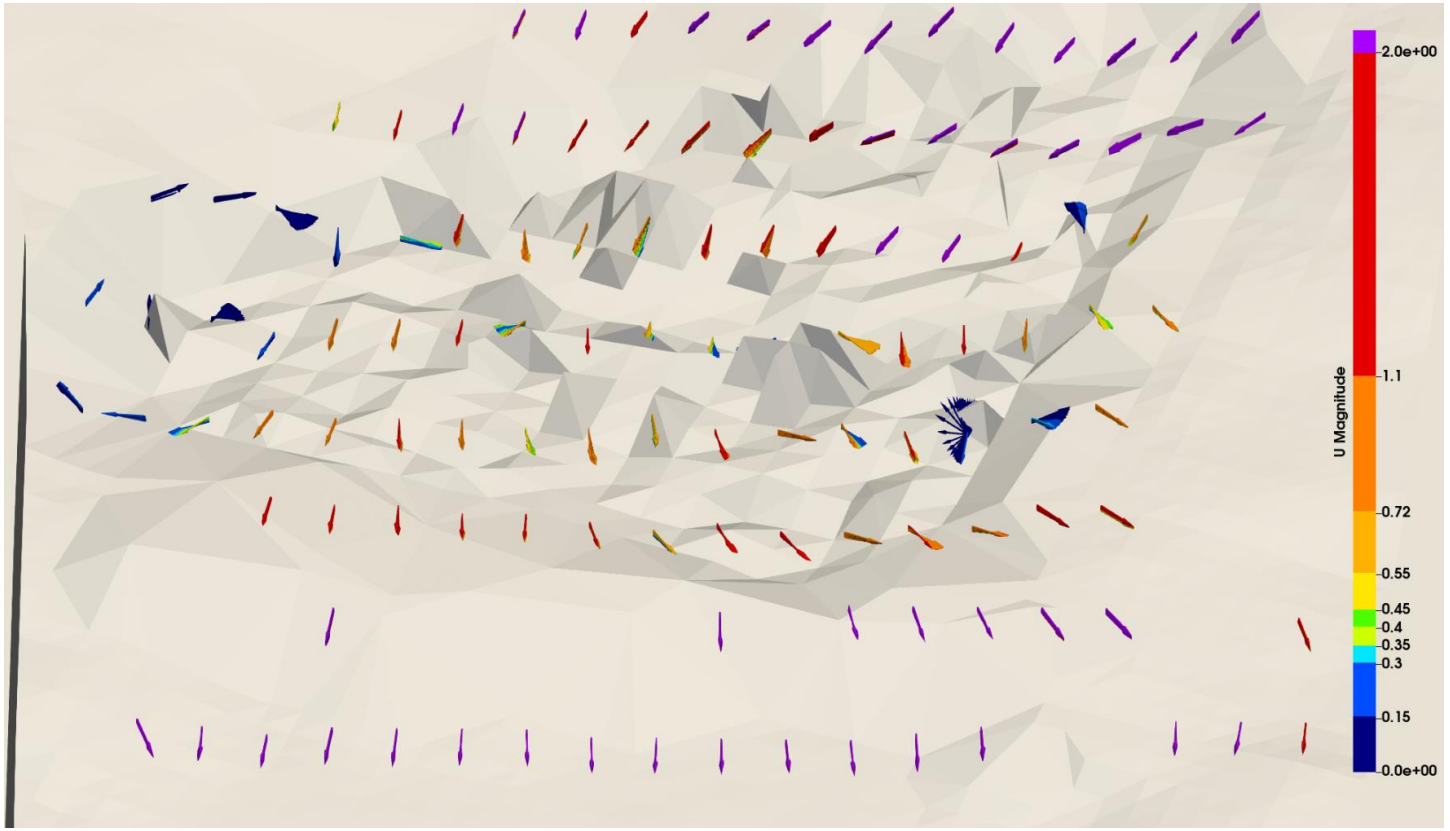


Figure S5-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

6. Model Results of Scenario S6 with 4308 cfs from the gates

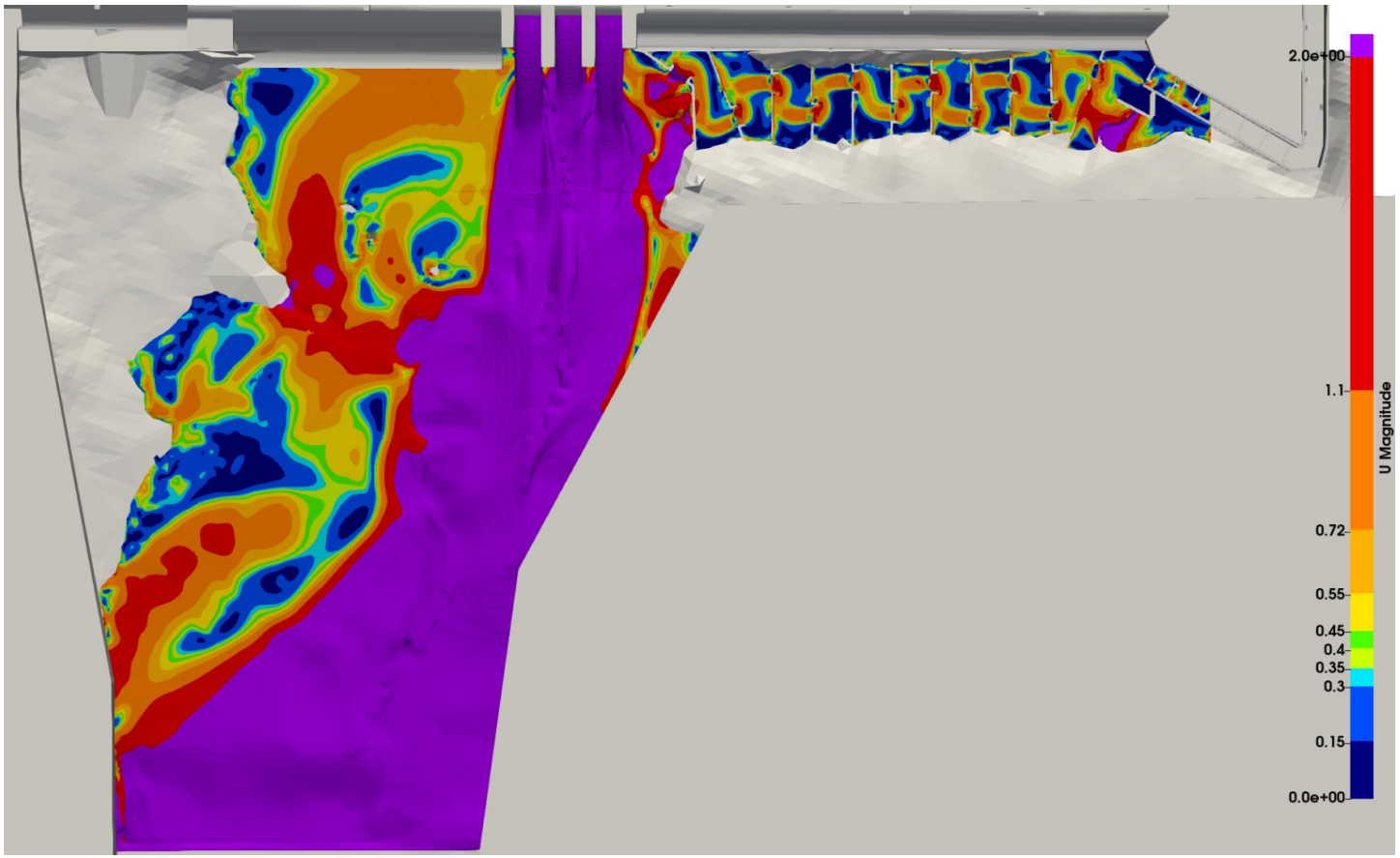


Figure S6-1: Plan view of the Water Surface Velocities

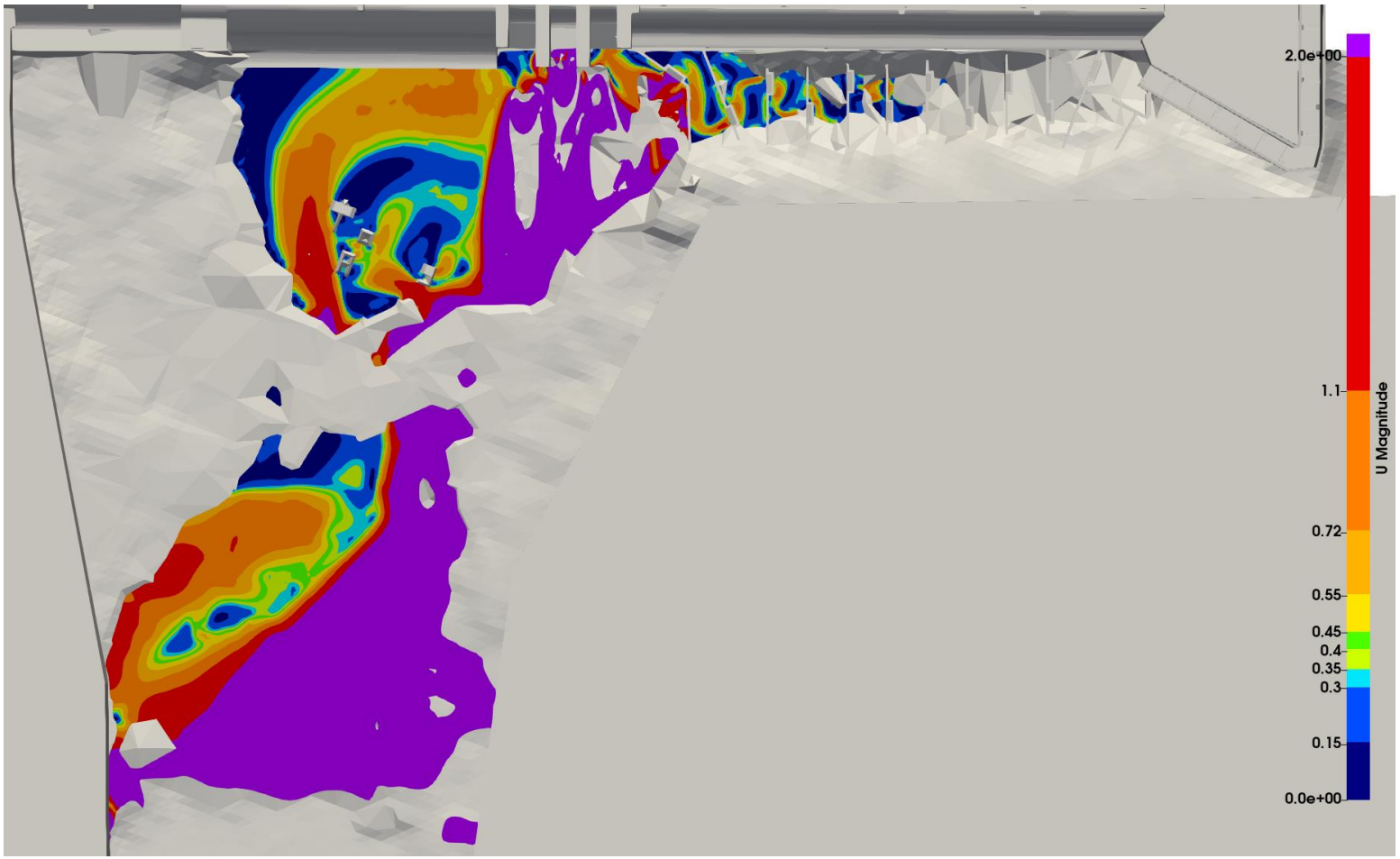


Figure S6-2: Plan view of the Mid-Surface Velocities

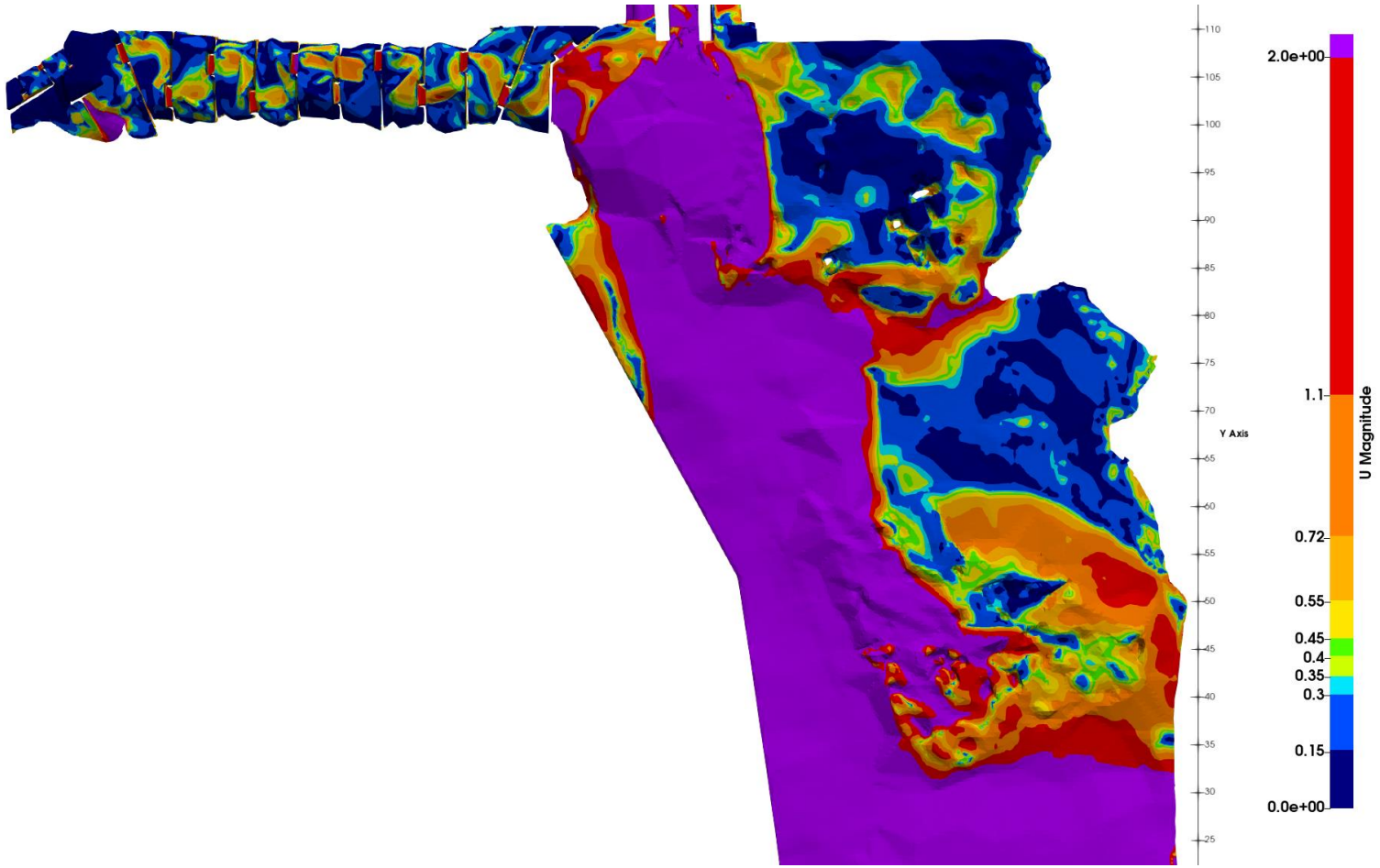


Figure S6-3: View of the Bottom Velocities

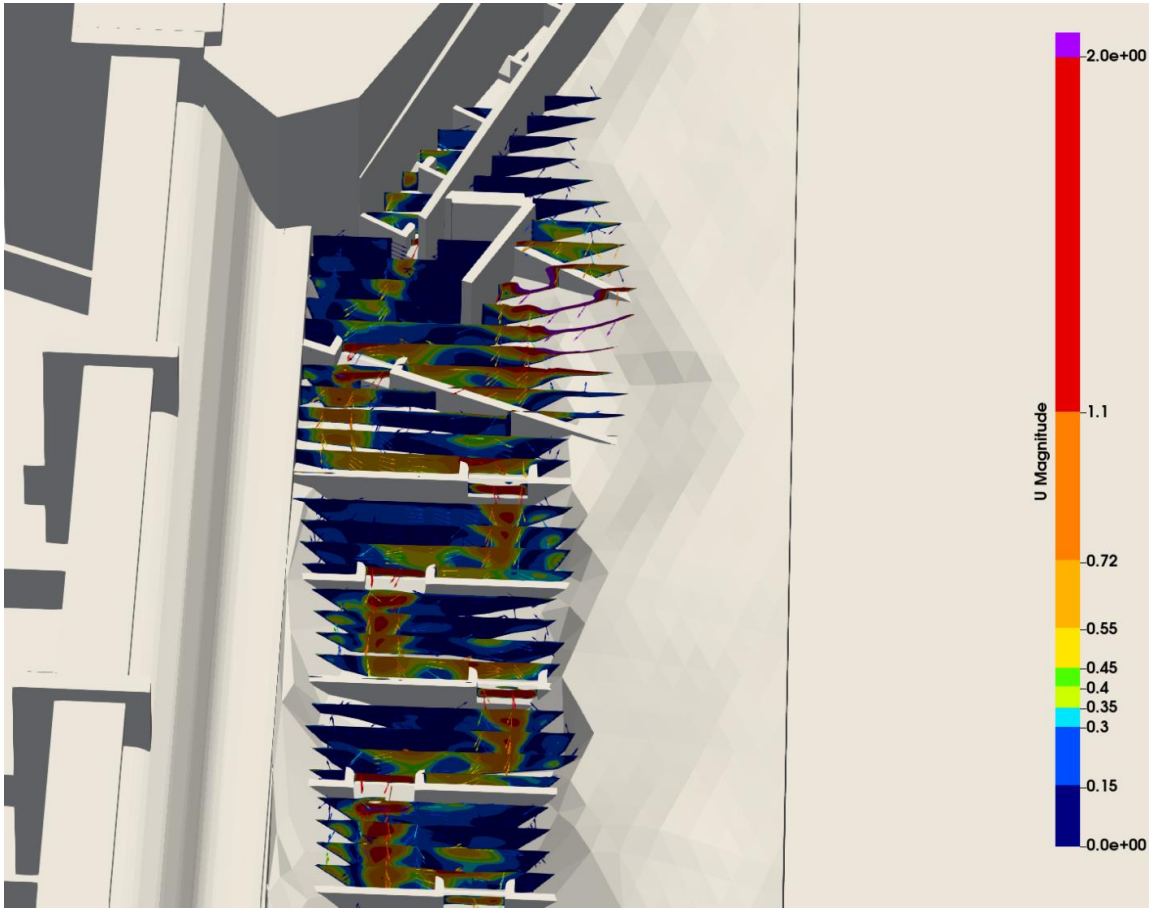


Figure S6-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

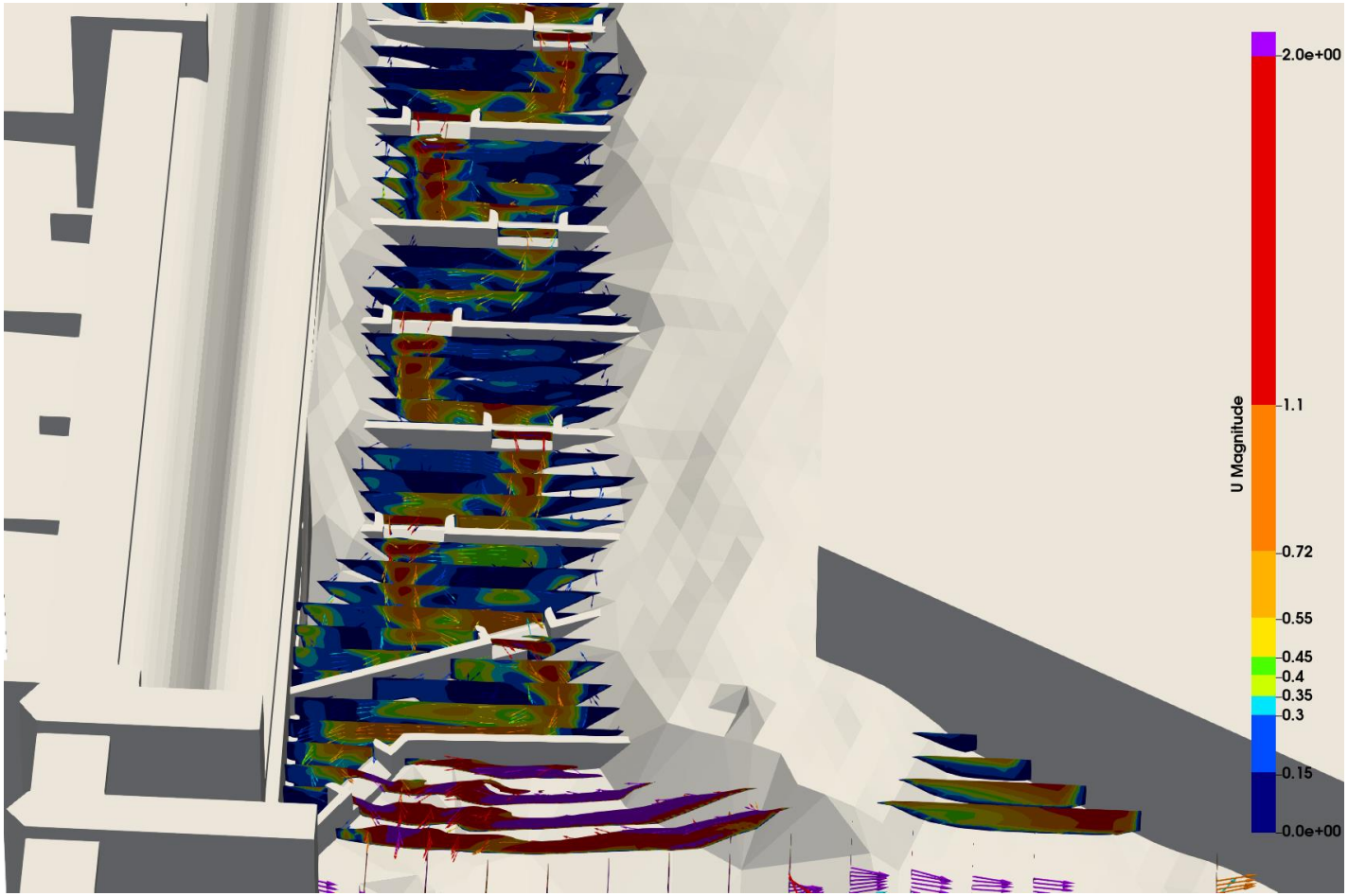


Figure S6-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

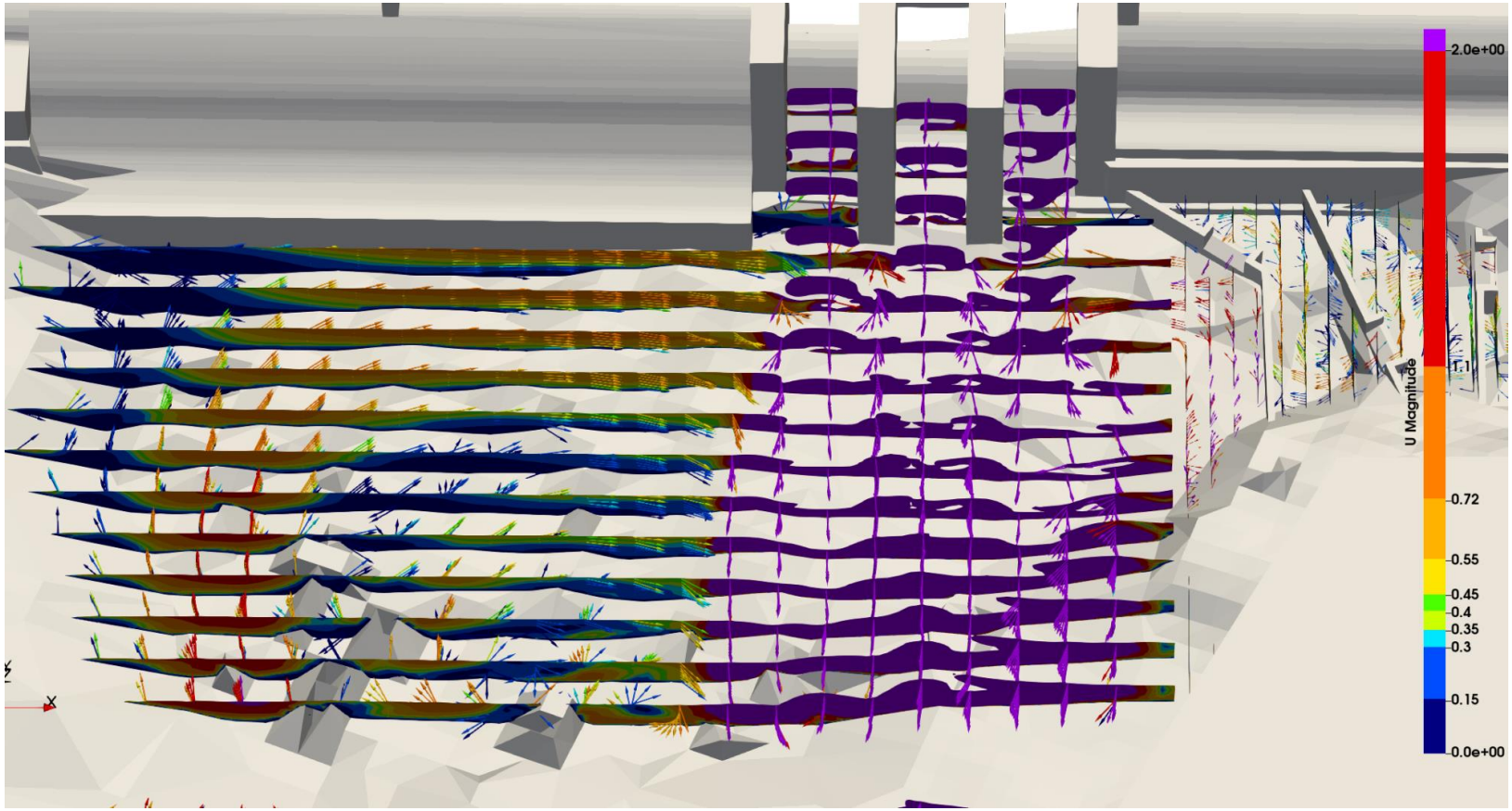


Figure S6-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

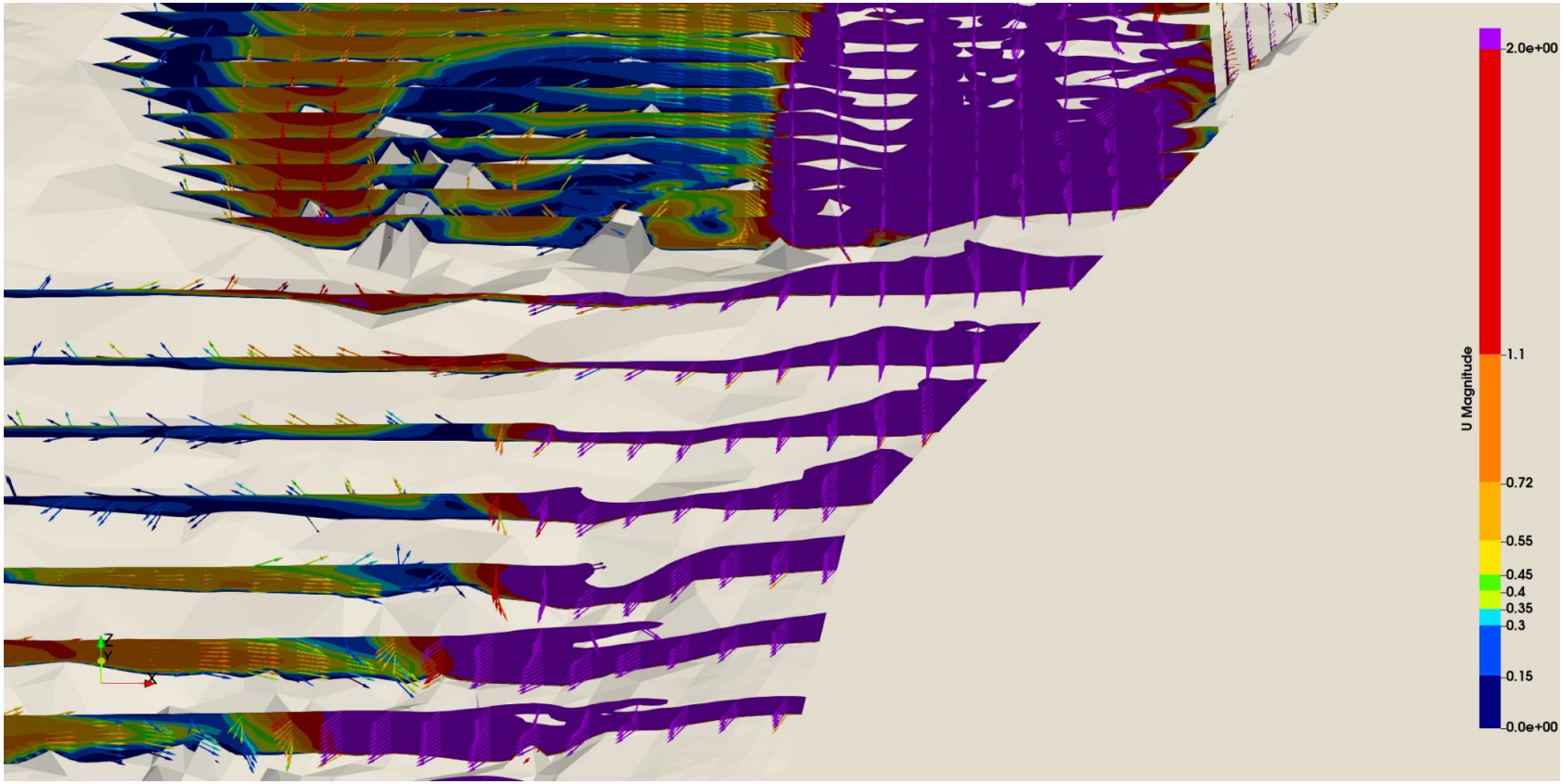


Figure S6-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

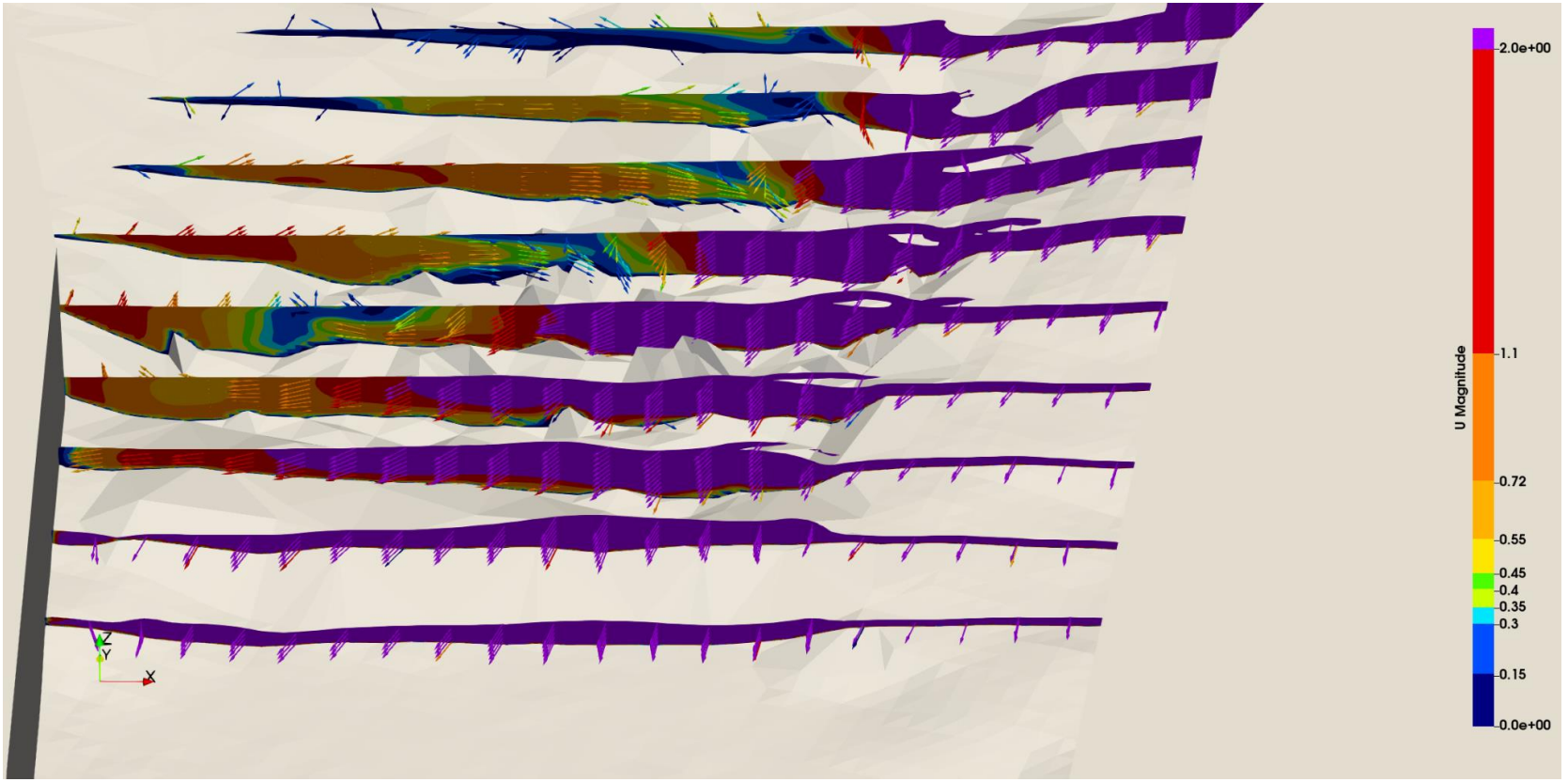


Figure S6-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

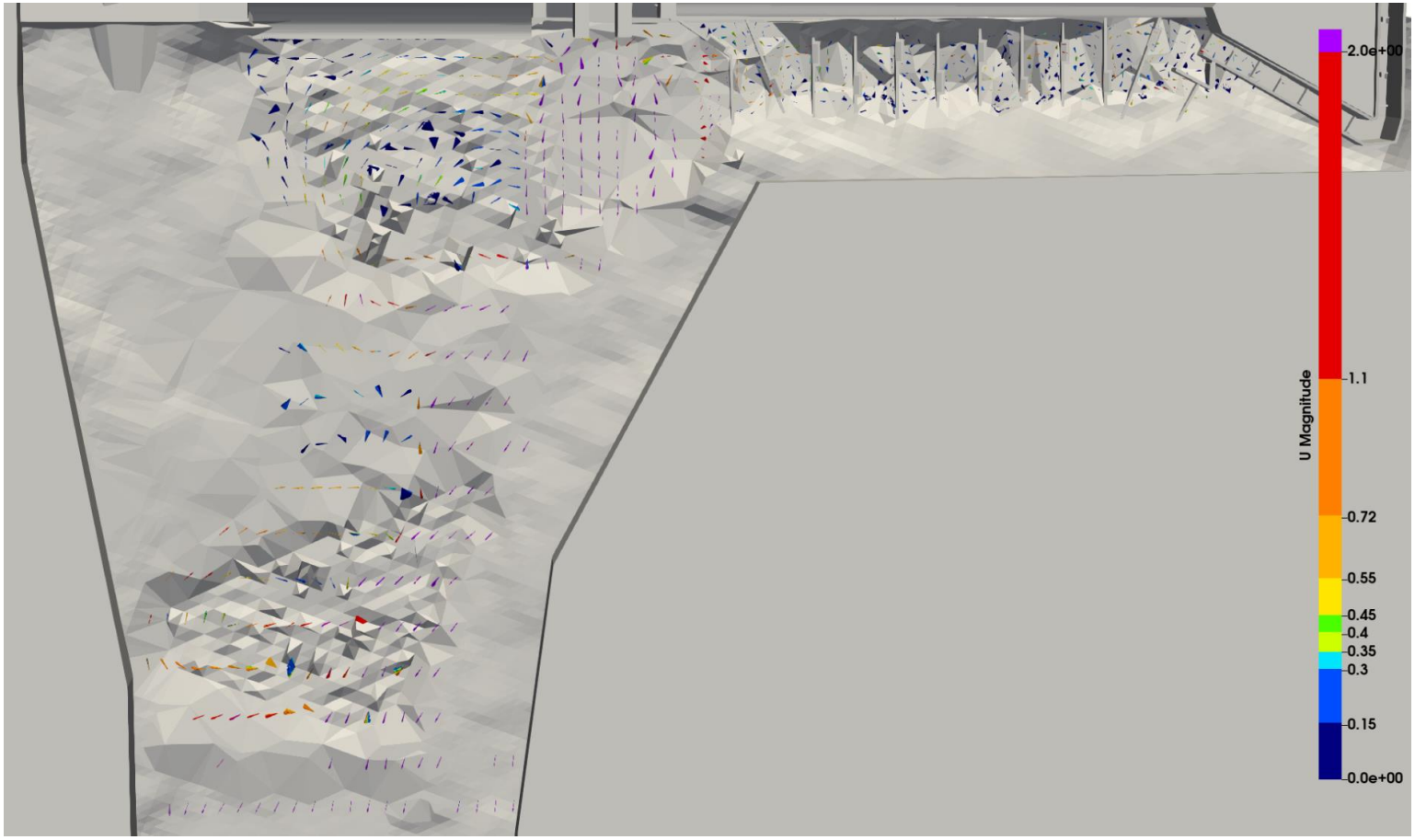


Figure S6-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

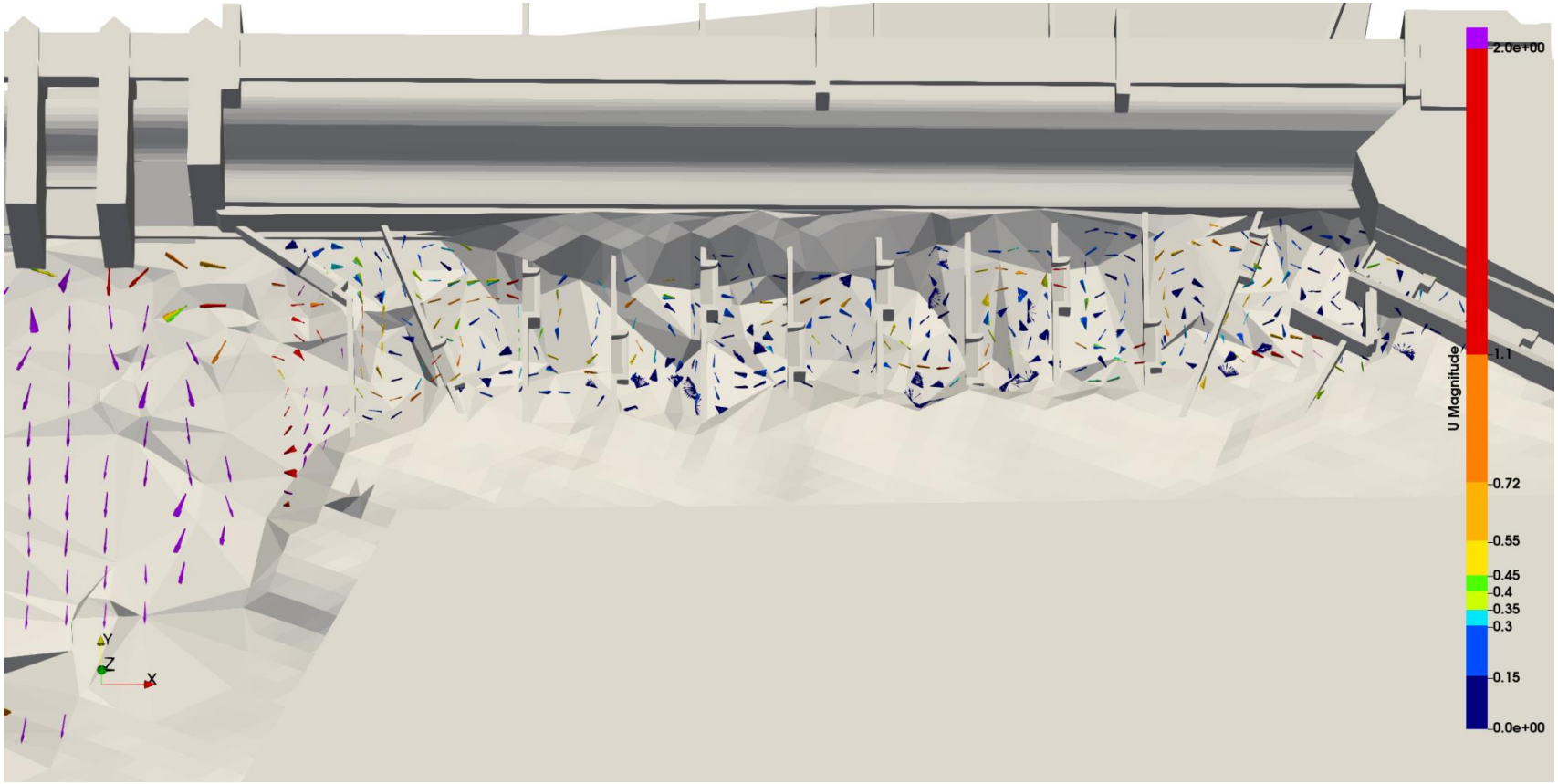


Figure S6-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

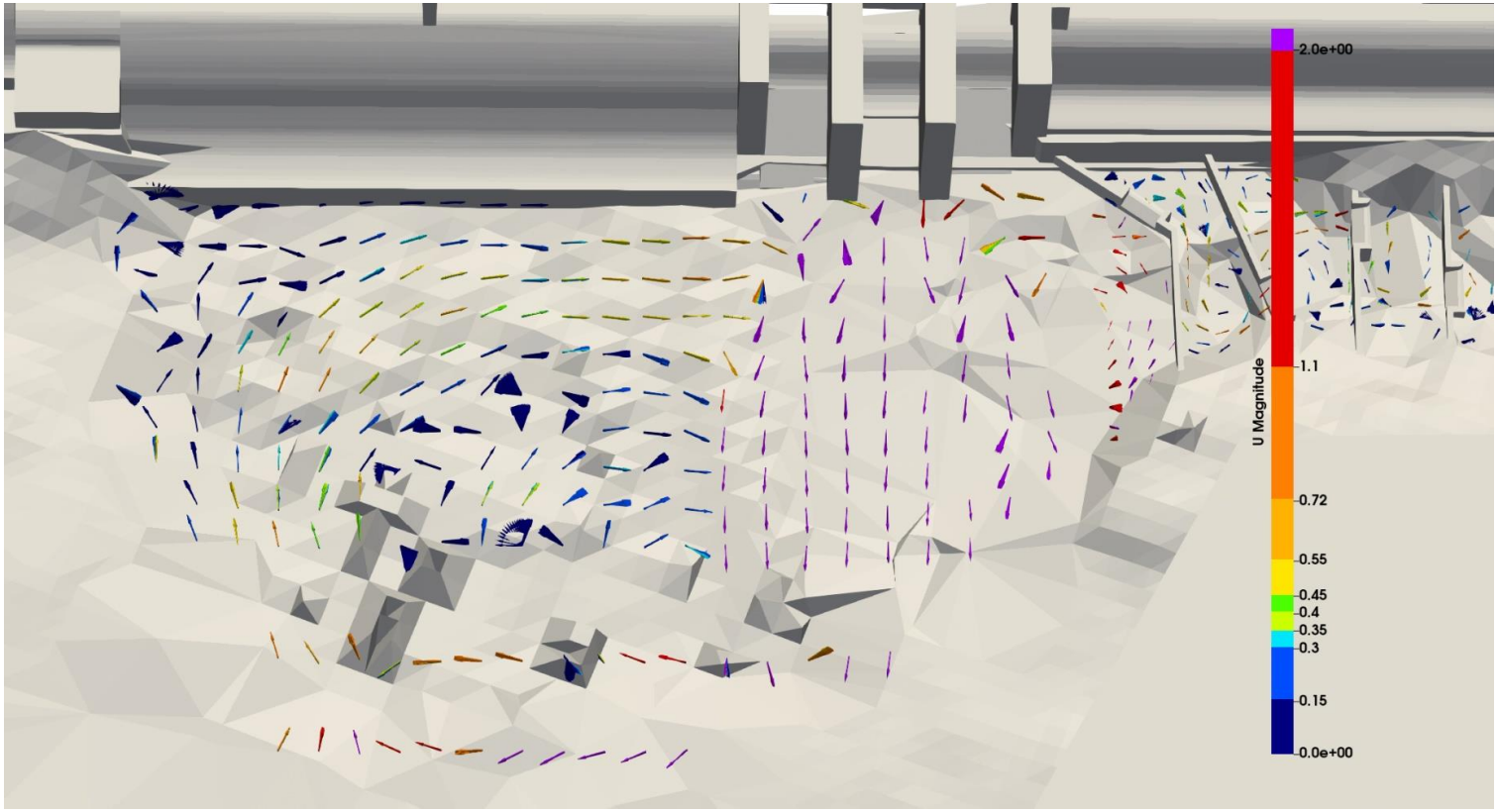


Figure S6-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

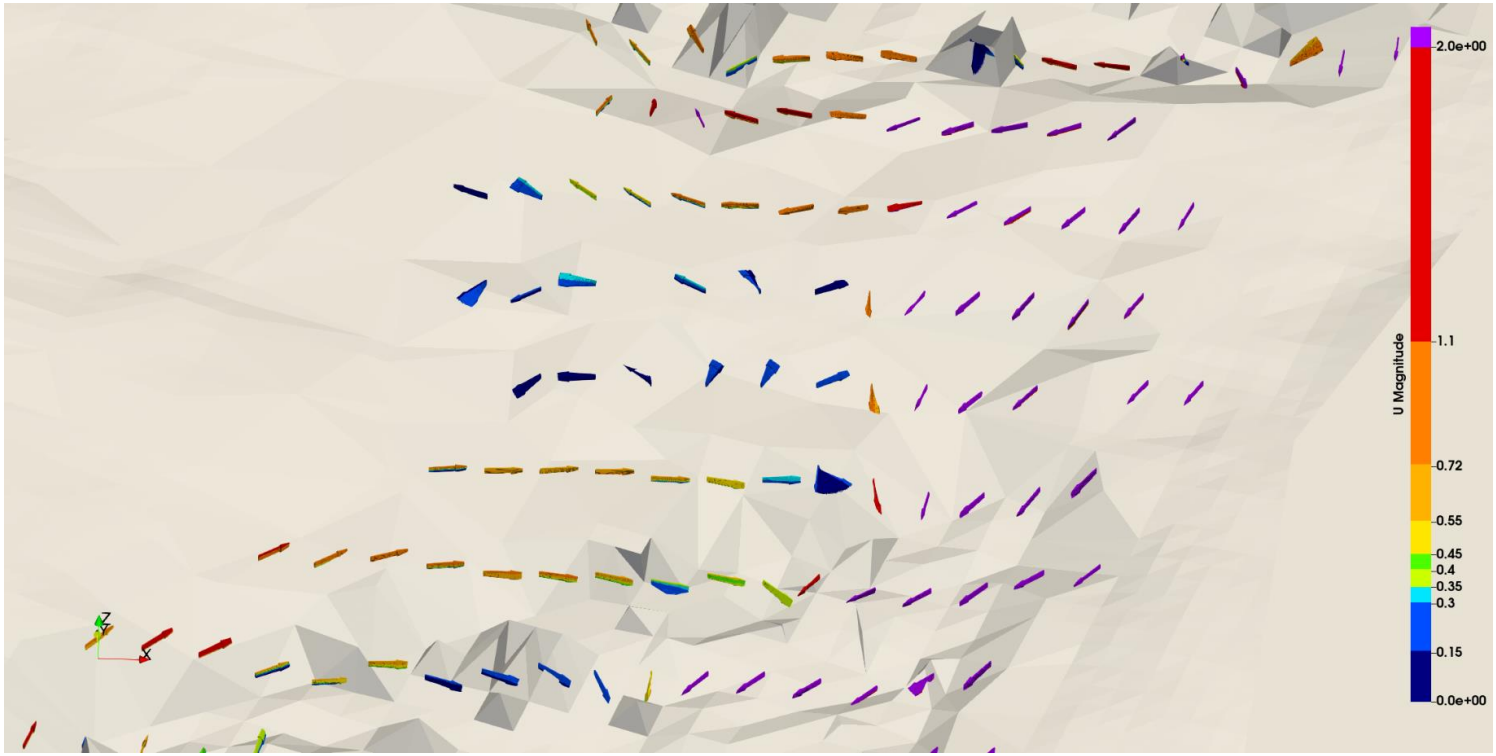


Figure S6-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

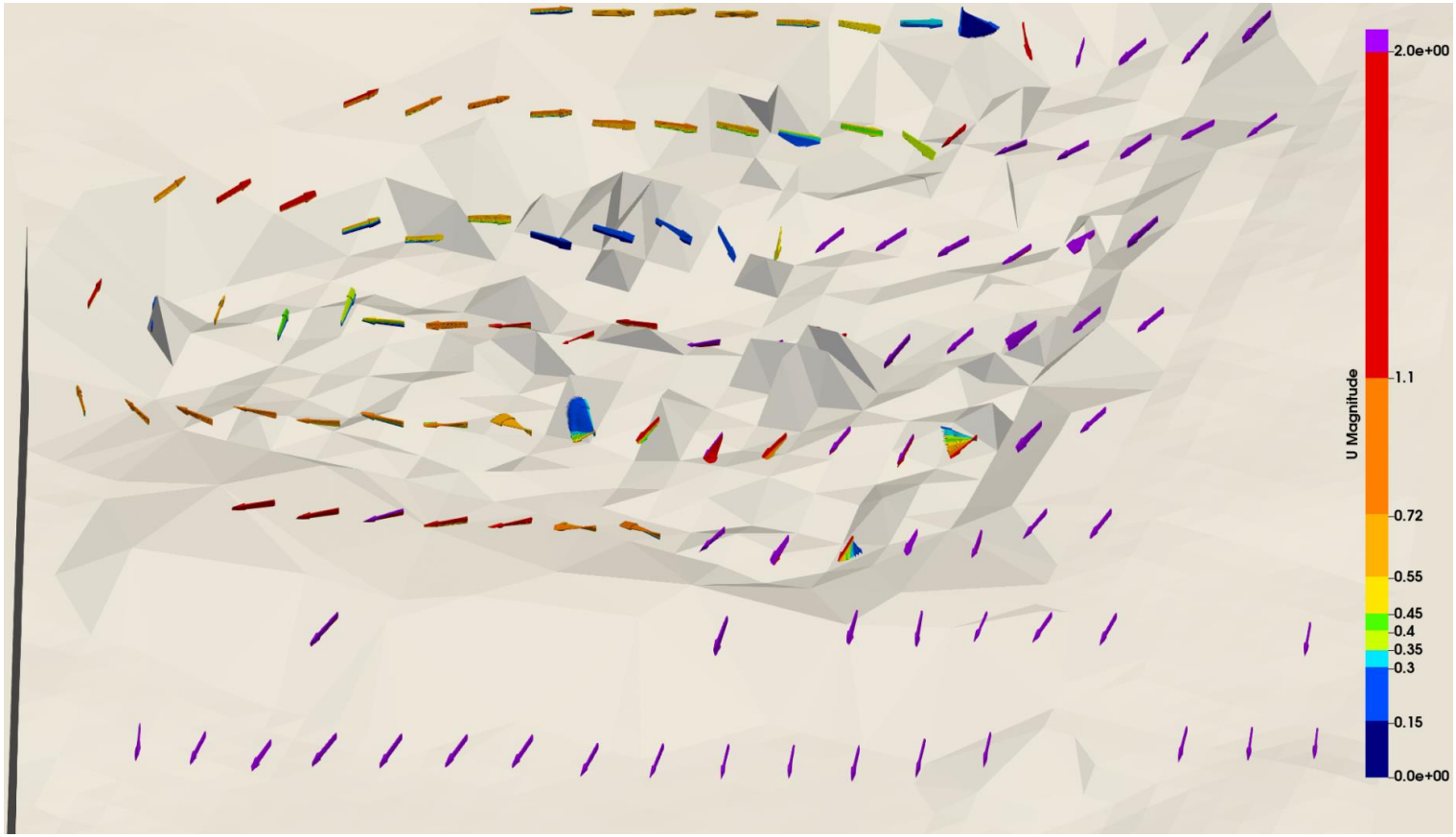


Figure S6-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

7. Model Results of Scenario S7 with 0 cfs from the gates

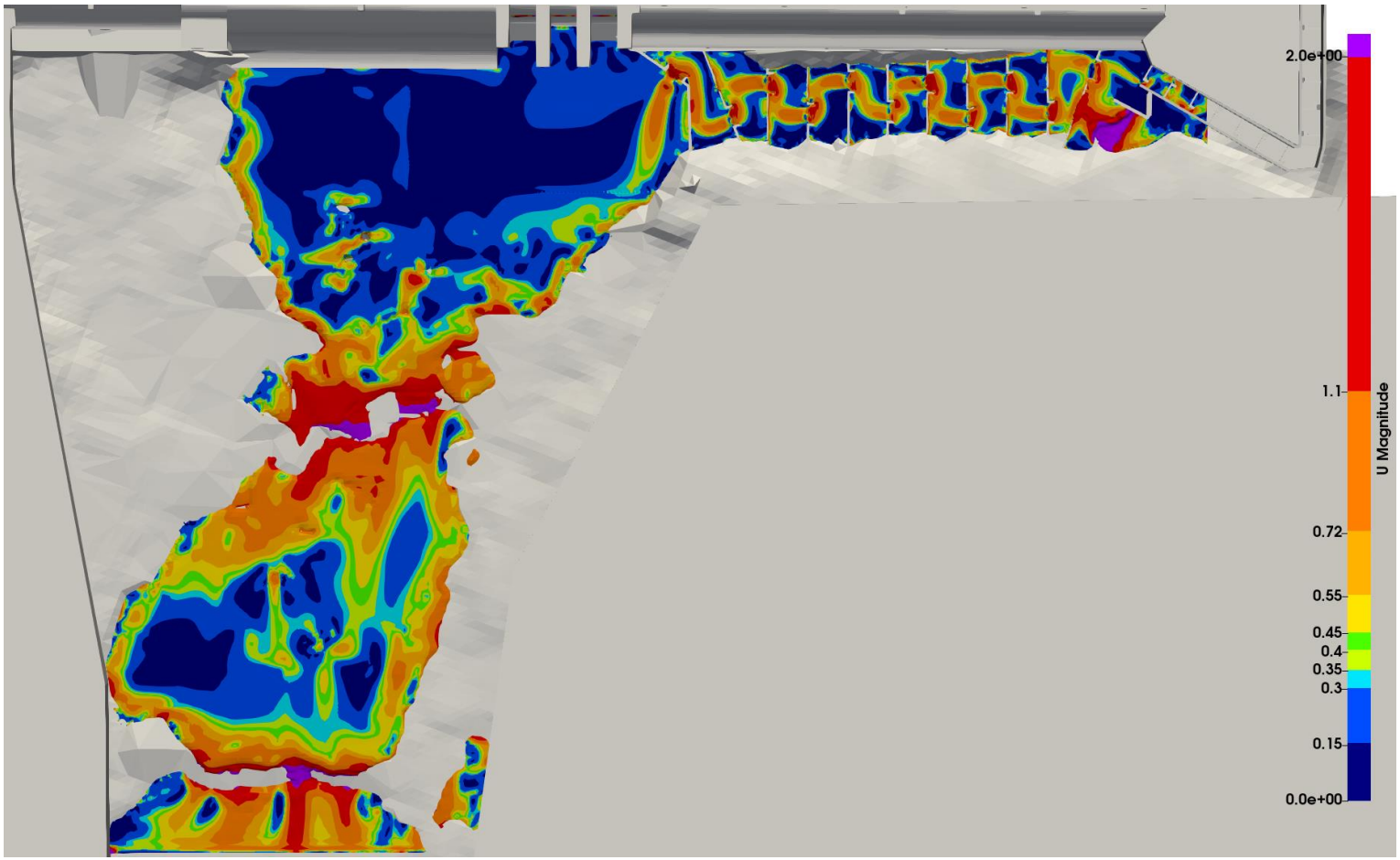


Figure S7-1: Plan view of the Water Surface Velocities

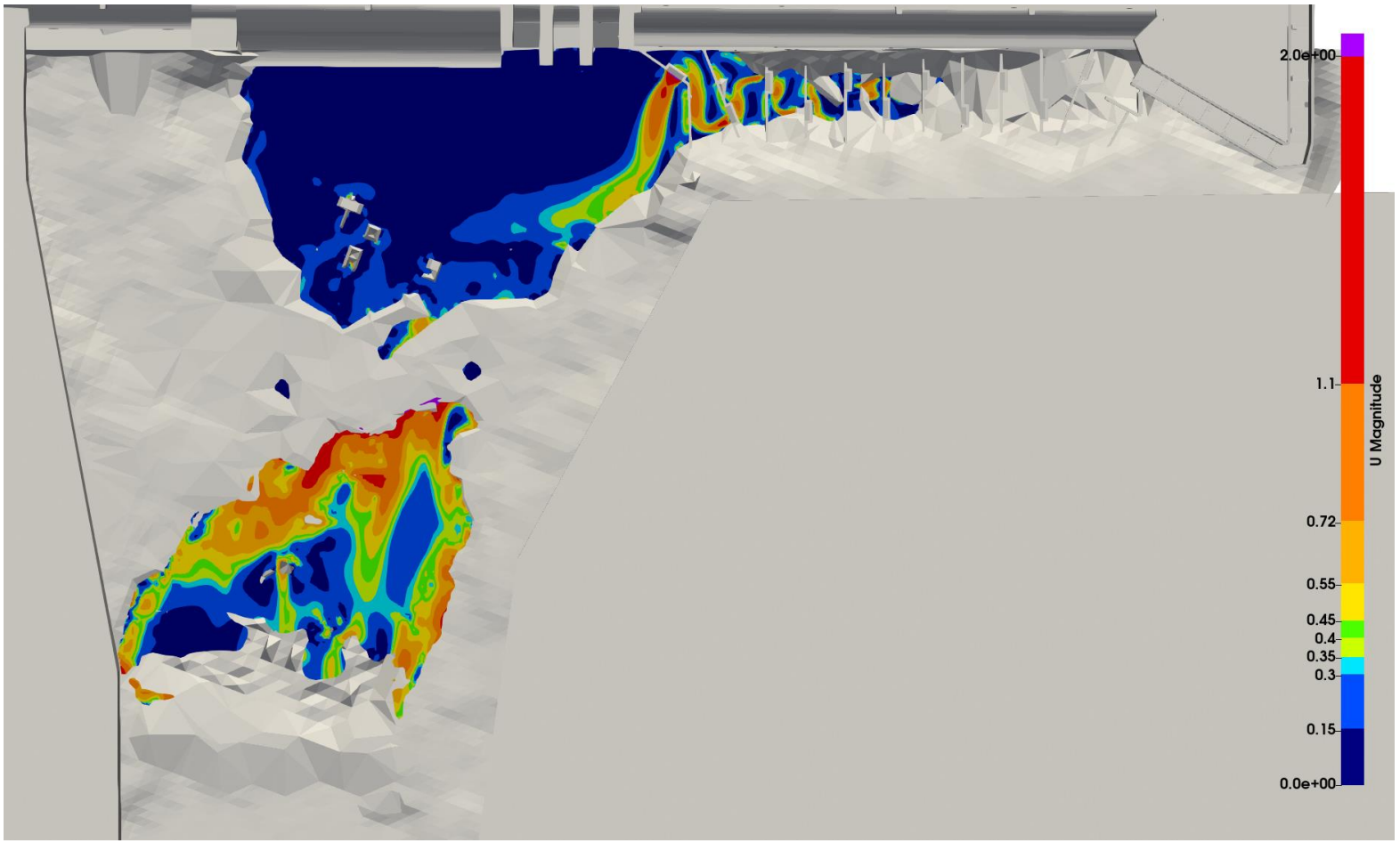


Figure S7-2: Plan view of the Mid-Surface Velocities

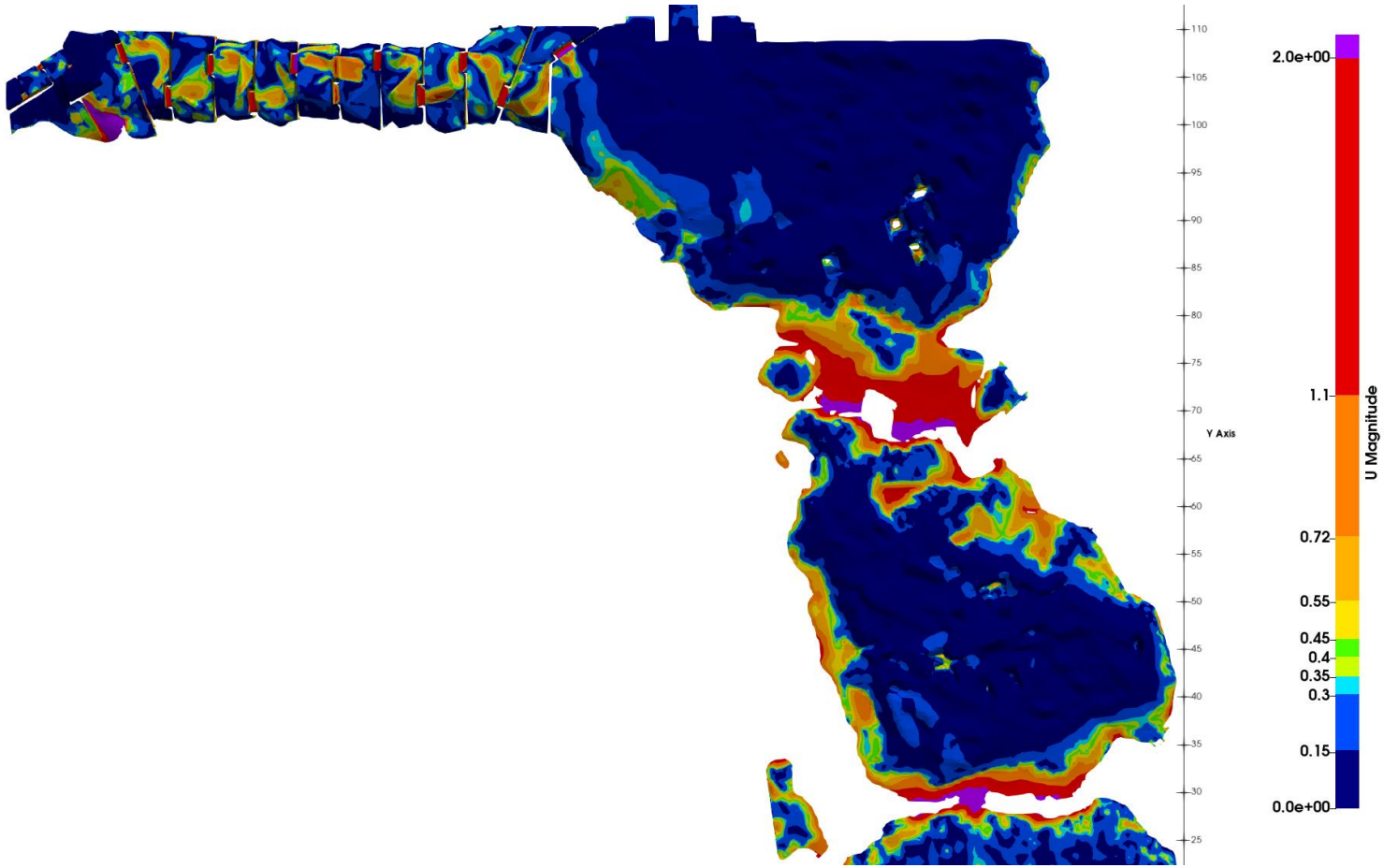


Figure S7-3: View of the Bottom Velocities

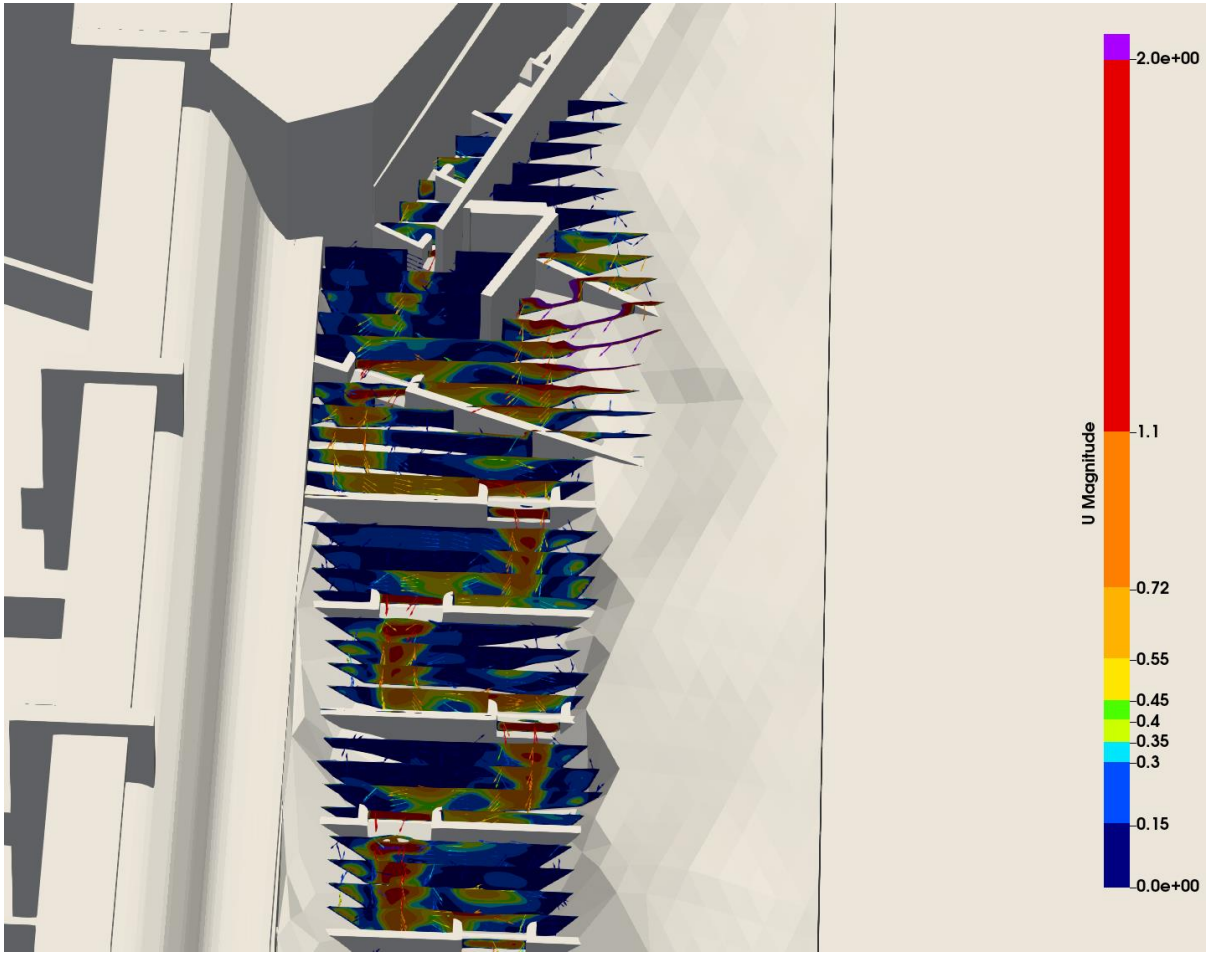


Figure S7-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

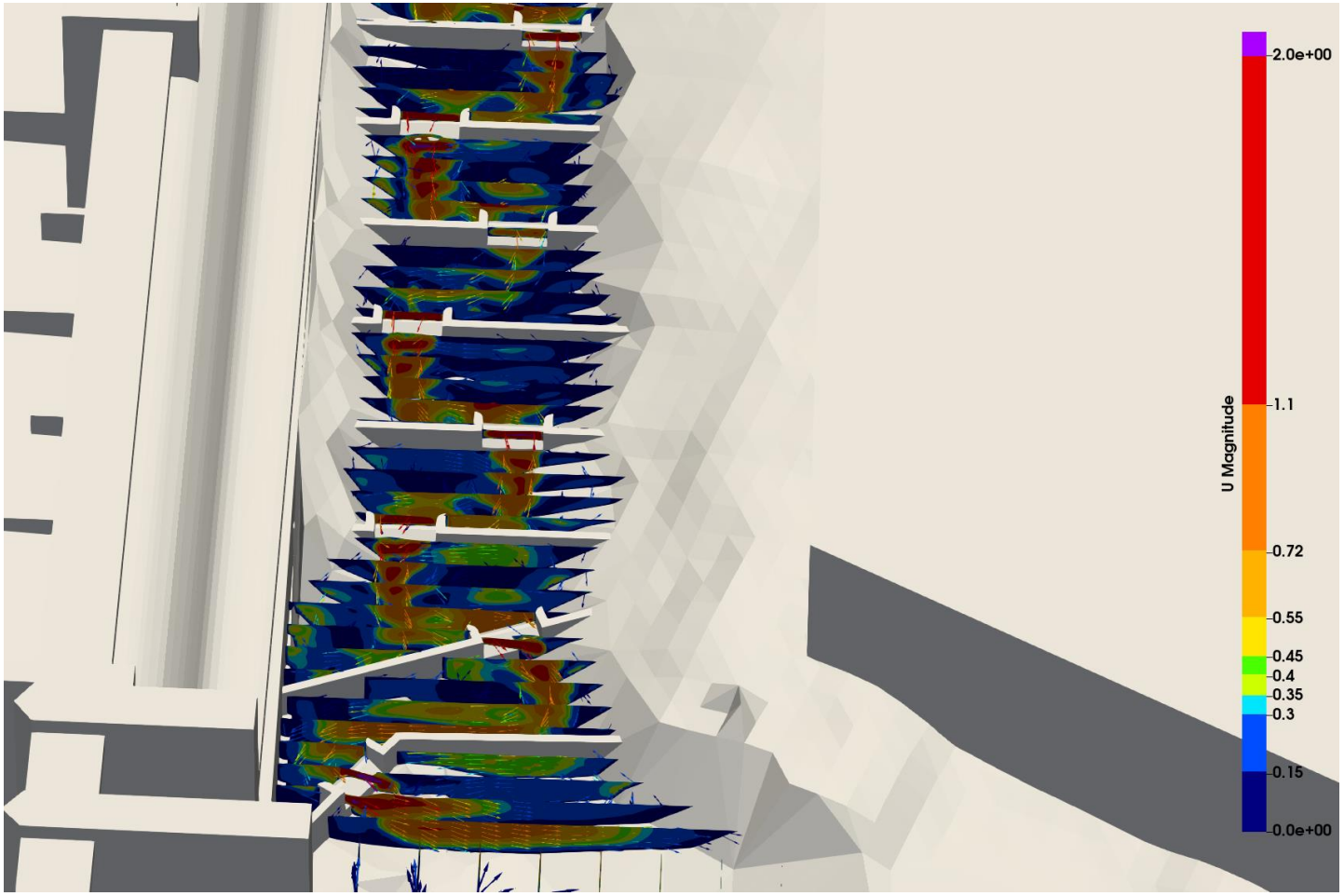


Figure S7-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

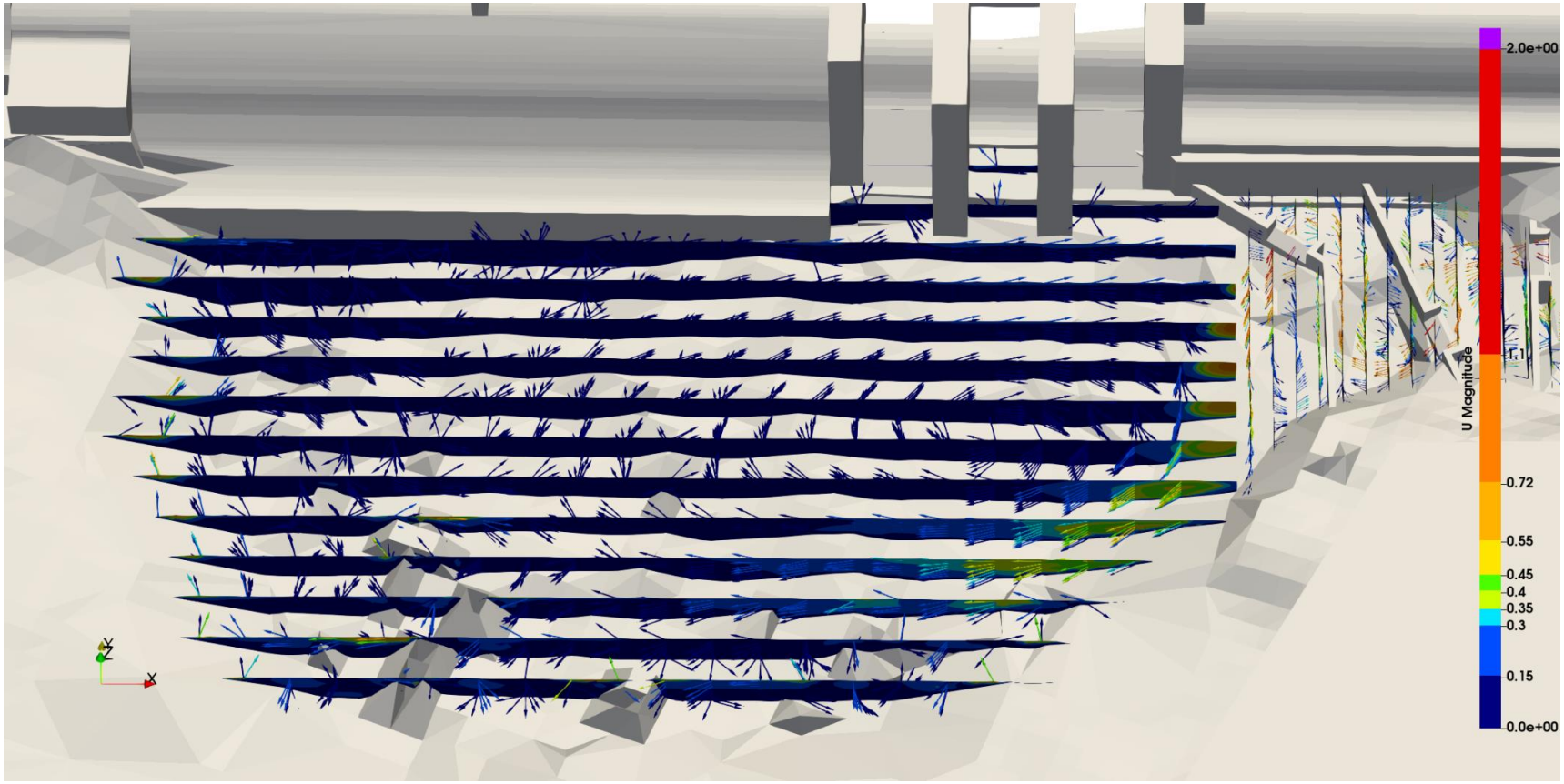


Figure S7-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

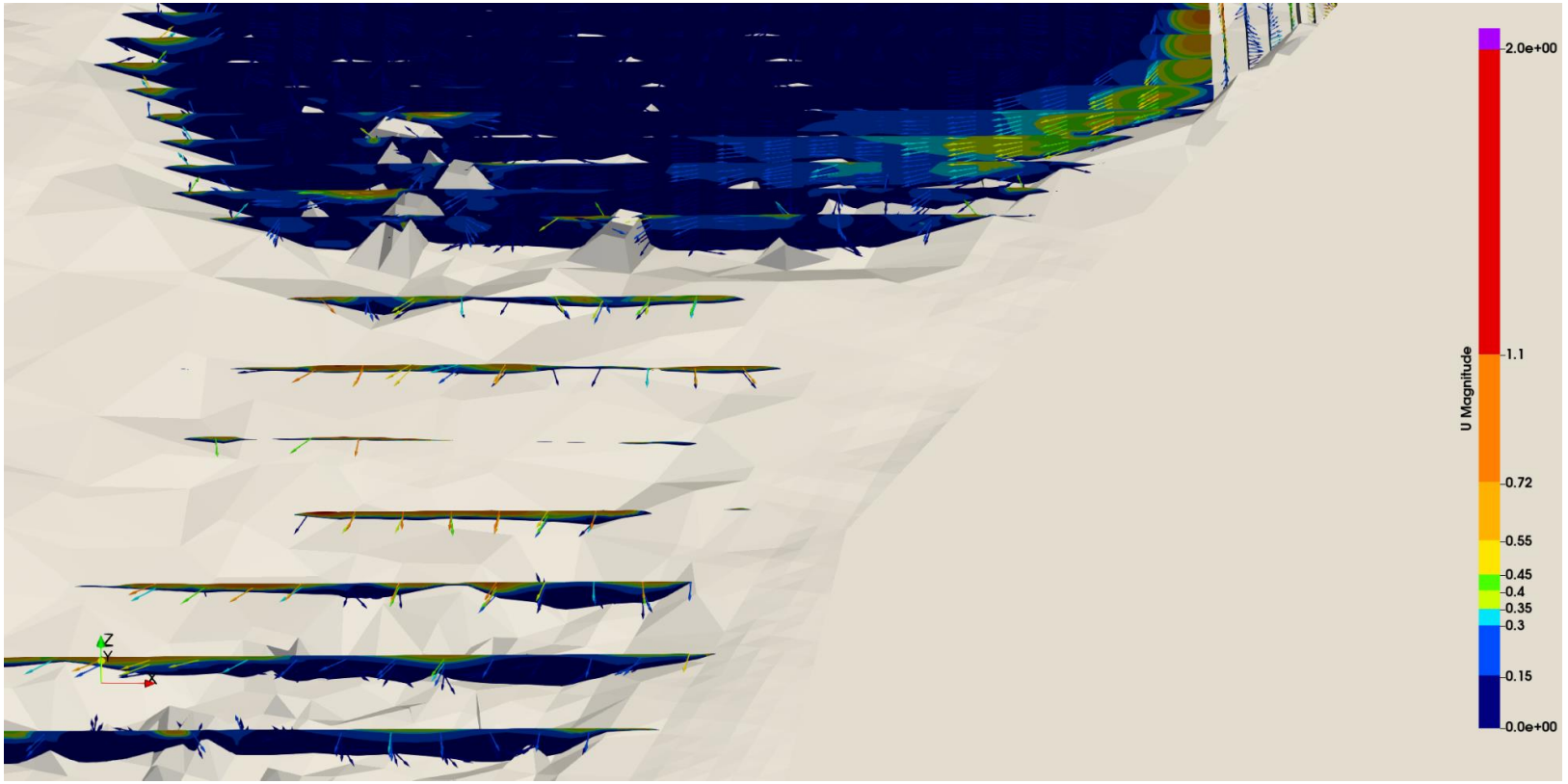


Figure S7-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

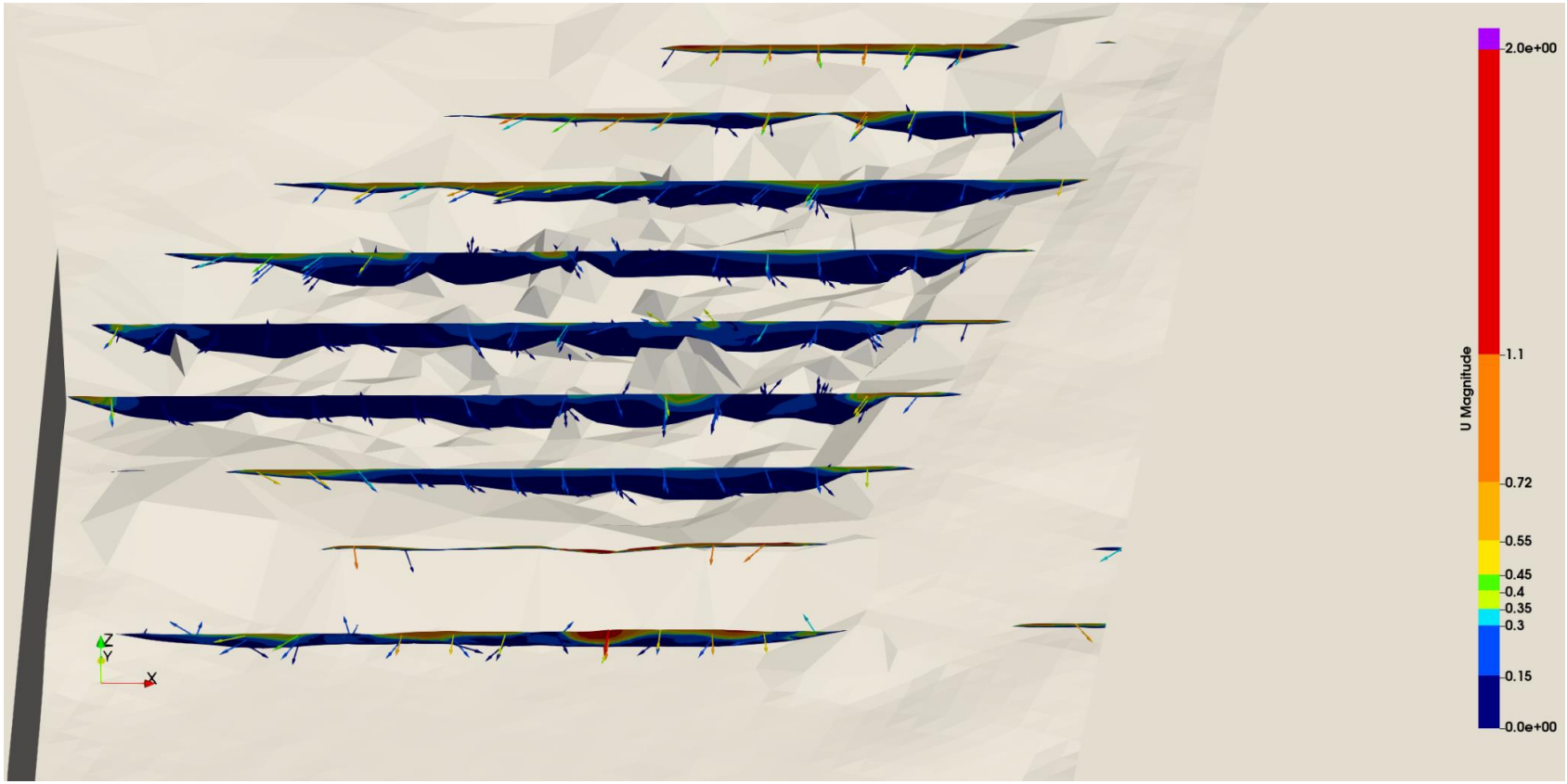


Figure S7-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

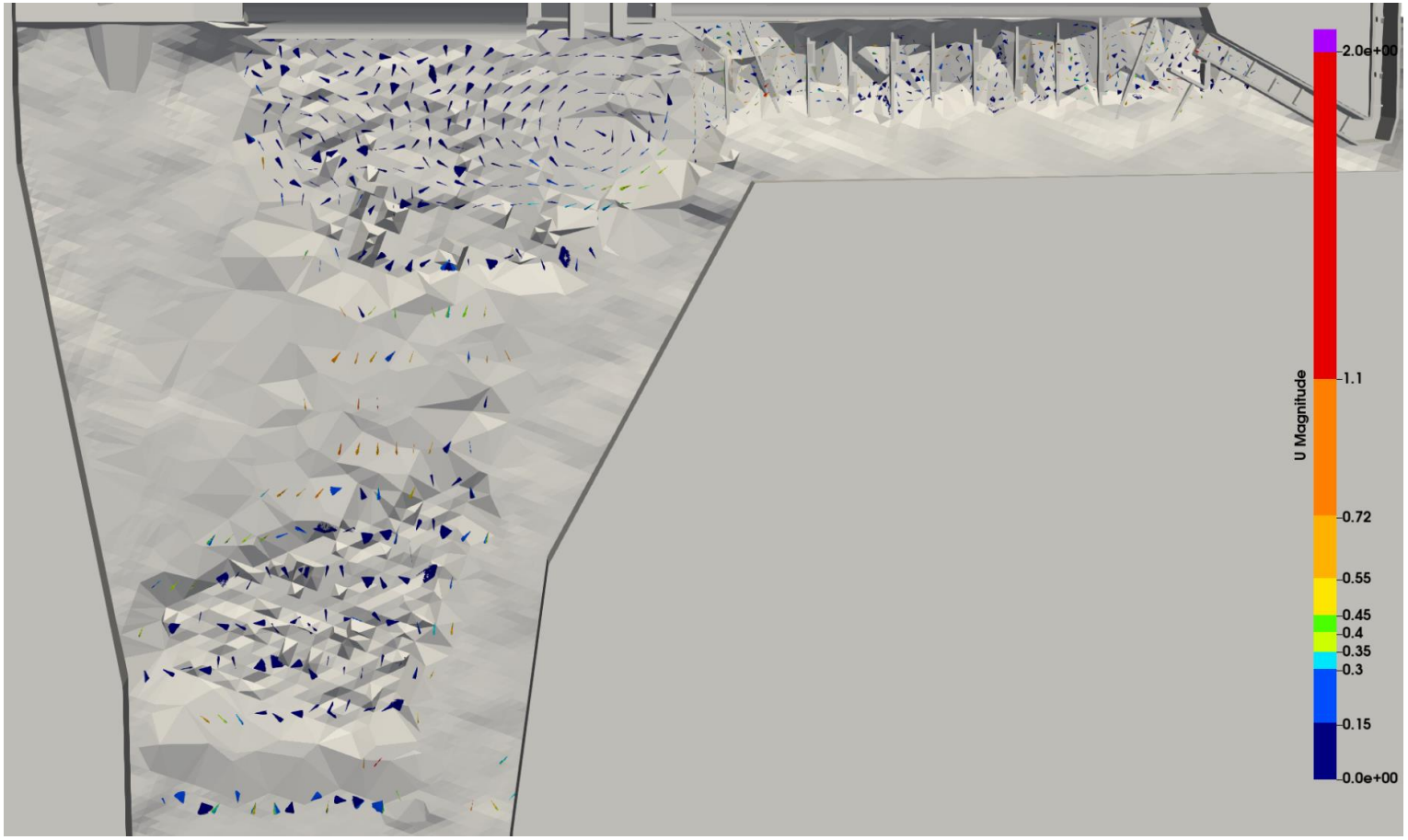


Figure S7-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

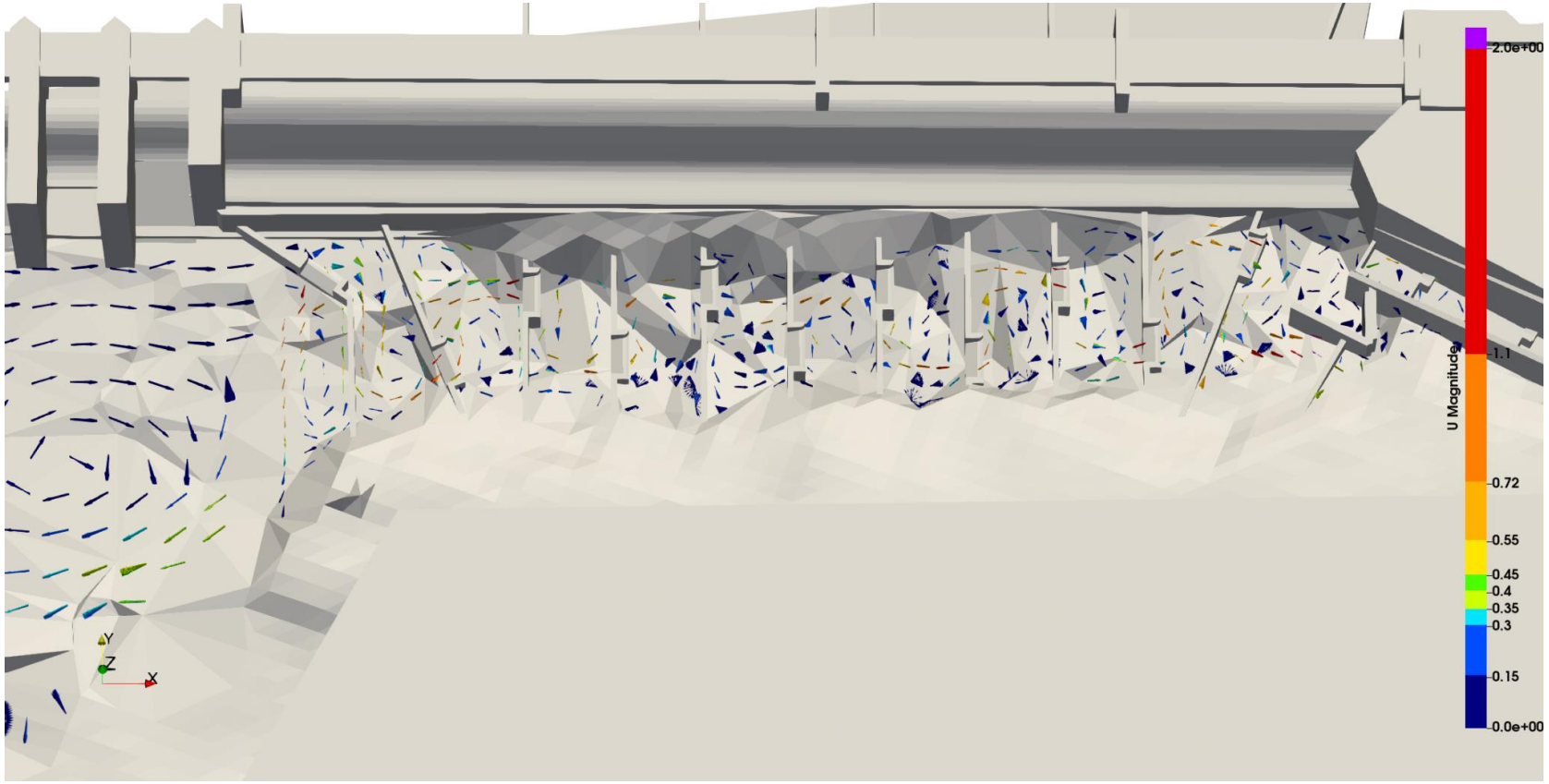


Figure S7-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

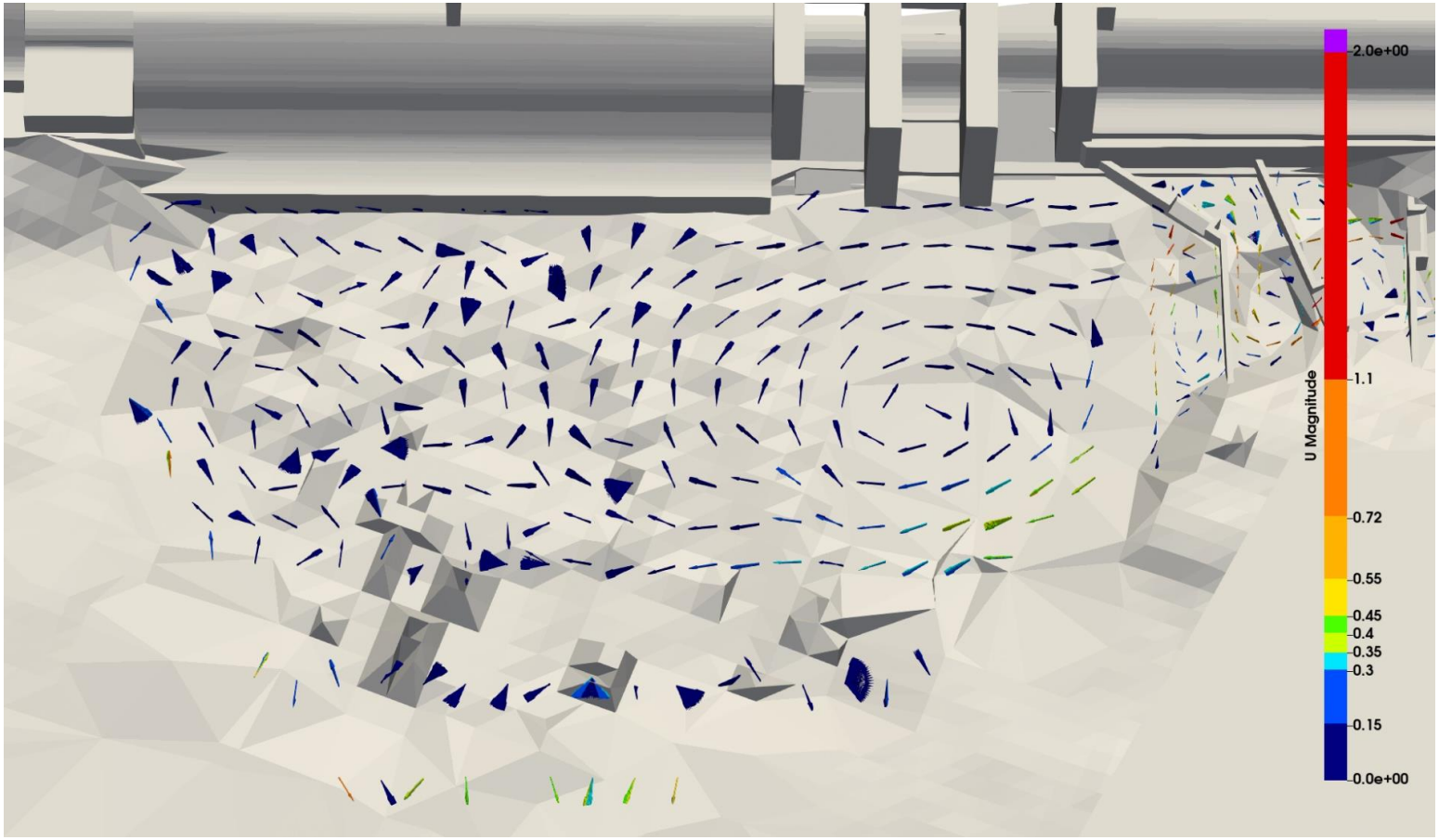


Figure S7-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

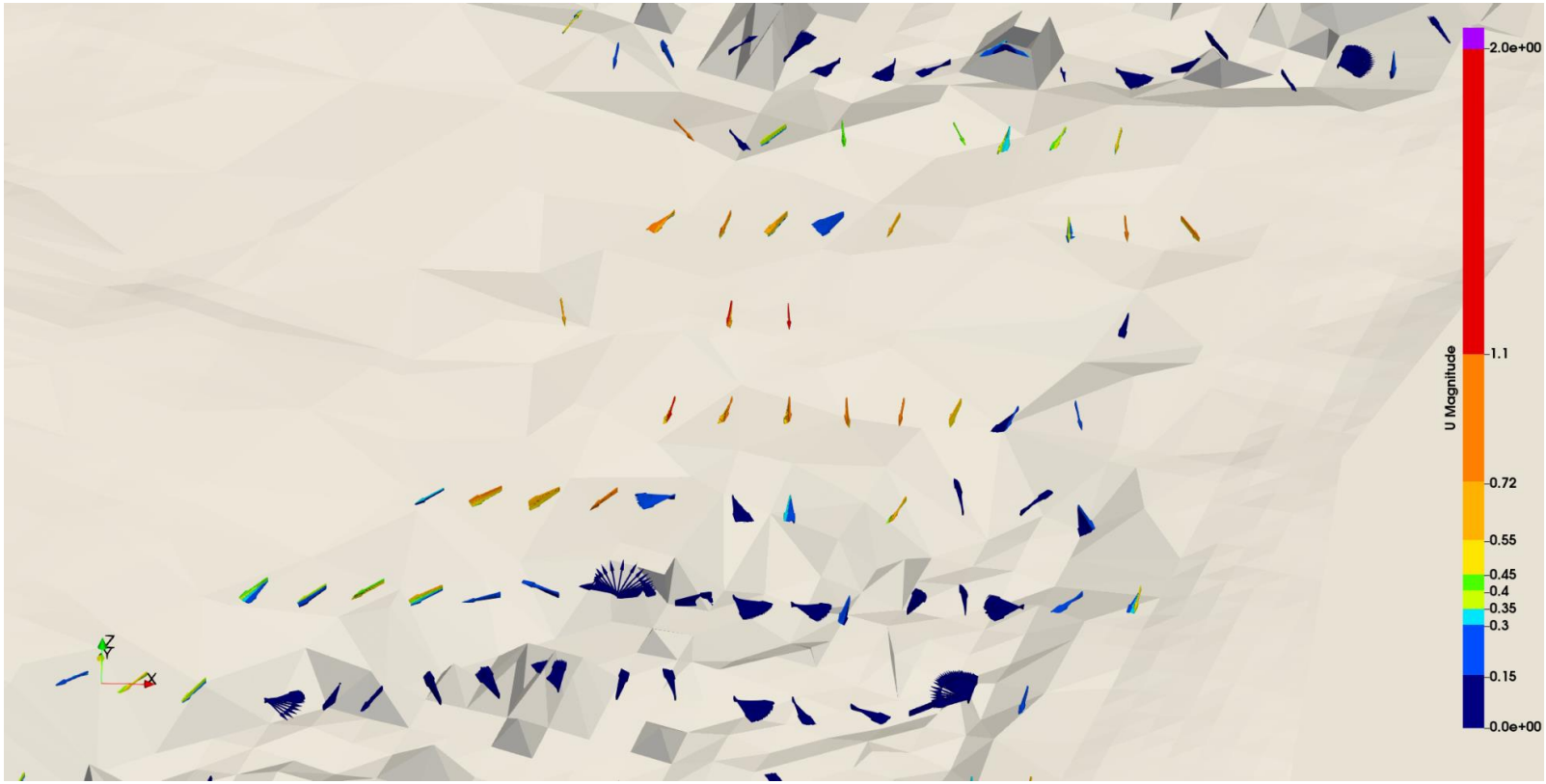


Figure S7-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

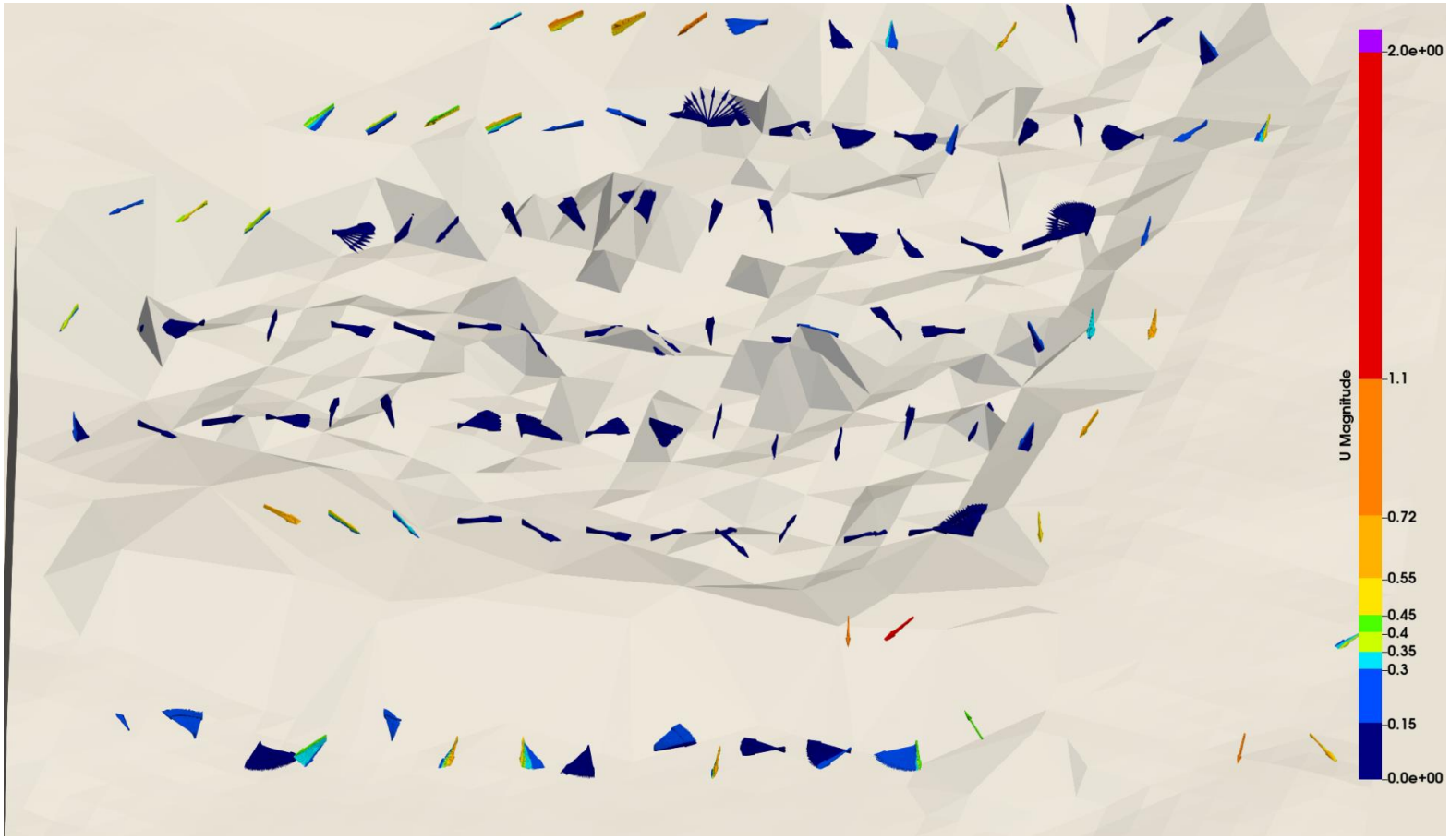


Figure S7-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2 Ruth Falls Dam – River Fish Passage Modelling: Summary of Thaumas Environmental Consultants Ltd. Report

2.1 Introduction

Nova Scotia Power (NSP) has requested that CBCL Limited (CBCL) conduct 3D Computational Fluid Dynamics (CFD) hydraulic modelling (3D modelling) for the post-refurbished downstream conditions and proposed changes at the Ruth Falls Dam in Sheet Harbour, Nova Scotia (Appendix A: Figure 1). The main refurbishments and changes that were modelled by CBCL and evaluated by Thaumas Environmental Consultants Ltd (Thaumas) are shown in Table 1 and Appendix A: Figure 1).

Table 1: Proposed Refurbishments and Changes to the Ruth Falls Dam and Explanations

#	Proposed Refurbishment / Change	Explanation
1	Replacement of the existing stop log bay with three vertical lift gates in the center of the dam and the flows distributed between the gates.	The current stop logs are leaking and are difficult to adjust to maintain the headpond within a narrow depth range.
2	Installation of a new rubber dam.	Large inflatable rubber cylinders will be replacing the existing stoplog sections, on top of the concrete spillway of the refurbished dam, to replace the existing stop logs and stop all leakage.
3	Eleven new fish passage weirs in the fishway channel section at the toe of the dam.	The existing seven fishway weir configuration has varying drops and pool sizes and does not provide adequate fish passage. The weirs will be replaced with 23 cm drops and notches sized to accommodate the louvre flow for additional fishway attraction flow.

#	Proposed Refurbishment / Change	Explanation
4	Fishway entrance	The notch in the entrance weir is located to the dam side of the fishway channel and aligned to direct its flow along the edge of the gate flows.
5	Louvres flow and bypass pipe relocated	The louvre flow will be relocated to the upper end of the fishway channel to provide additional attraction flow to the fishway.
6	Removal of rock flow diversion at gate three	A rock outcrop in front of gate three will be removed so the flow is directed down river vs. along the toe of the dam.
7	Riverbed bathymetry was flattened in the model just below the fishway and the three spill gates	To remove flow obstructions along the bottom, which disrupt favourable velocity patterns for fish passage.

The modelling was requested to determine if the proposed changes to the refurbished dam would affect fish passage in the river, at the entrance to the fishway, and in the lower channel section of the fishway. At the request of NSP, CBCL performed the CFD 3D modelling with the OpenFoam[1] modelling software. Thaumas evaluated and reviewed the computer modelling for fish passage and provided a report entitled, "Ruth Falls Dam – River Fish Passage Modelling". The following sections are a high-level summary of the Thaumas report and the full Thaumas report is provided in Appendix B.

2.2 Literature and Background Review

Thaumas conducted a background review of the current operating conditions, fish passage facilities at Ruth Falls, and fish swimming abilities and behaviour for the species present at the site. Thaumas found that the Ruth Falls concrete fishway currently passes fish well, based on the modelling and observations, and does not need any modification. Currently, the normal operating conditions of the dam provide approximately 100 cubic feet per second (cfs) of flow to the river below the dam. The licence requirements for the facility requires a minimum fishway flow of 6 cfs, and a minimum louvre flow of 29 cfs. These flows are supplemented by the stoplog leakage providing an additional flow of 65 cfs, for an approximate total flow of 100 cfs. The results of the fish passage background review indicated that these current flow requirements allow satisfactory upstream passage of most fish species; however, the depth over the river's rock sills would need additional flow to provide a water depth of at least 38 cm on the river's rock sills for multi-sea year Salmon passage.

The current operating licence also requires 10 or more supplemental flows from June 15 to July 15 and September 26 to November 30 of greater than 50 cfs overnight for a minimum of 12 hours, and nightly when Atlantic Salmon are present. The location of this release

[1] Open-source Field Operation and Manipulation is a 3D Computational Fluid Dynamics model.

must be immediately below the dam. The supplemental flow events are intended to complement significant high flow events (i.e., ≥ 24 mm of rain in 24 hours) and to attract Atlantic Salmon to migrate upstream to the fish ladder by providing migration flow depth over the river's rock sills.

As part of the literature review, Thaumas evaluated the swimming speeds, swimming endurance, orientation to flows, and behaviours of the fish species found at the site that want to migrate past the dam. The species assessed cover the full range of swimming abilities of all fish species present and include:

- Gaspereau (Alewife and Blueback Herring)
- Brook Trout (20 cm Total Length (TL))
- Atlantic Salmon (Salmon Grilse[2], multi-sea-year Salmon)
- American Eels (Elver 6 cm TL, yellow 20 cm TL, yellow 60 cm TL)

A summary of migration times and cues, size range and the assessed sizes is provided in Table 2. Lake species found in the reservoir that do not need to migrate past the dam to complete their life cycles were not specifically evaluated but their abilities fall within the range of the assessed species (i.e., Yellow Perch, Brown Bullhead, White Sucker, Golden Shiner, and Lake Chub).

Table 2: Migration Times and Cues and Size of Selected Fish Species

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
Gaspereau	March until Fall, upstream Spring Run: Mid-April to Late June; downstream till fall	- temperature - flow velocity - water depth - orientation to flows - behaviour - swimming ability & endurance	20-35	25
Brook Trout	Year Round & Fall spawning	- flow - temperature - water depth - orientation to flows - behaviour - swimming ability & endurance	20-55	20
Atlantic Salmon - Grilse	Spring, Summer, and Fall	- river migration - velocity - temperature	45-60	50

[2] Salmon that have only been to sea for one year

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
		- water depth - behaviour - swimming ability & endurance		
Atlantic Salmon – Multi-Sea-Year	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	75-105	100[3]
American Eel Elvers	Mid-March - June	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	6	6
American Eel Yellow 20 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	20	20
American Eel Yellow 60 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	60	60

[3] Larger size was assessed to ensure larger salmon can pass.

2.3 Proposed Scenarios Based on 3D Model Results

Using the OpenFOAM model results, Thaumas, evaluated the routes the fish are anticipated to select in the river below the dam based on their swimming abilities and endurance, required water depth, flow direction, and behaviour to plot routes they could use against the river flow velocities and depths before having to rest. Scenarios were evaluated to find the optimal conditions between the interaction of the fishway attraction flow and the gate flow, to attract the fish to the fishway entrance. The revised lower channel section of the fishway, with its new 11 weirs, the louvre flows of 35 cfs, and the upper concrete fishway section, was also assessed. Seven different flow scenarios from the gates (Scenarios 1-7) (Table 3) were assessed. Details of each flow scenario can be found in the detailed report (Section 3D model results; Appendix B). Under all scenarios the fishway flow and louvre flows remain consistent at the minimum required flow. Changes in flows arise from the gates or the required supplementary flows released from the gates[4]. The supplementary flow events were not modelled during the evaluation. Thaumas considered fish passage downstream of the gates to be occurring mainly within the Scenarios 1 and 2. Since the current operating licence requires supplementary flows of 50 cfs, flow events under Scenario 1 would be approximately 150 cfs in total during those events, which would fall in between Scenario 1 at 100 cfs and Scenario 2 at 200 cfs, which as stated above are the flows where fish passage occurs.

Table 3: Flows Scenarios Evaluated and Considered for Fish Passage

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Current Scenario (for comparison)	6	29	65	50	100-150**
Fishway	6	29	n/a	n/a	35
Scenario 1	6	29	65	n/a	100
Scenario 2	6	29	165	n/a	200
Scenario 3	6	29	925	n/a	960
Scenario 4	6	29	1720	n/a	1755
Scenario 5	6	29	3051	n/a	3086
Scenario 6	6	29	4308	n/a	4343

[4] Proposed Supplementary flows can be defined as 10 or more supplementary flows of 50 cfs that occur from June 15 to July 15 and September 26 to November 30.

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Scenario 7	6	29	0	n/a	35
Required Supplementary Flow (not modelled but considered)	6	29	65	50	150

Table Notes:
n/a = not applicable
* Supplementary flows can be defined as 10 or more supplementary flows of >50 cfs that occur from June 15 to July 15 and September 26 to November 30 and each night when salmon are detected.
**150 cfs would only occur during supplementary flows.

2.4 Fish Passage Routes Based on 3D Modelling

The swimming ability and water depth requirements, plus a behaviour evaluation for each of the listed species and size classes, was used to evaluate fish passage routes in the river approaches to the dam and the lower channel fishway section for all the modelled flow scenarios using the details in the 3D model.

The Fish Protection Tools for Swim Distance, Velocity, and Water Depths were used to calculate the swim distance and percentage of fish that could physically pass in each scenario through various routes in the river below the dam. The percent potential passage categories based on swimming ability included the following:

- 97.5% - Always pass fish and will sustain fish populations.
- 87.5% - Acceptable fish passage and will sustain fish populations.
- 50% - Satisfactory fish passage, may not be enough passage to sustain the population for some species.
- 12.5% - Poor fish passage, will not sustain fish populations.
- 2.5% - Unlikely passage, will not sustain fish populations.

When the swim distance, based on velocities encountered before access to a resting area, fell between categories, the lower percent category was used. The potential estimated percent passage of the selected fish species is based on the model results for the best route evaluated for fish passage (see Table 4).

Table 4: Estimated % ability of the selected fish species to pass through the river section modeled to the fishway entrance based on the best routes found in the Evaluated Model Scenarios

Scenario	Gaspereau	Brook Trout*	Grilse Salmon	Multi-Sea-Year Salmon	American Eel - Elver	American Eel – Yellow 20 cm	American Eel – Yellow 60 cm
New Lower Section of the Fishway	97.5%	97.5%	97.5%	97.5%	< 2.5%	97.5%	97.5%
Eel Pass	n/a	n/a	n/a	n/a	97%	97%	n/a
Scenario 1	97.5%	50%	87.5%	97.5%	< 2.5%	12.5%	87.5%
Scenario 2	50%	12.5%	50%	97.5%	< 2.5%	< 2.5%	12.5%
Scenario 3	None	None	12.5%	50%	None	None	None
Scenario 4	None	None	None	None	None	None	None
Scenario 5	None	None	None	None	None	None	None
Scenario 6	None	None	None	None	None	None	None
Scenario 7	None	None	None	None	None	None	None

Table Notes:
*Based on 20cm TL trout, the % passage for larger sea run trout may be higher but was not evaluated.
n/a = not applicable

2.5 Proposed Scenario

Based on the evaluation of the OpenFOAM model results, Scenario 1, with 6 cfs from the upper fishway and 29 cfs from the louvres (combining to provide 35cfs at the fishway entrance), and an additional 65cfs from the gates, provides the best conditions for upstream fish passage in the river up to the dam and the best attraction to the fishway entrance for all modelled species.

This scenario provides the best passage for Eels compared to the other proposed scenarios. Elvers are shown as having poor passage in all scenarios due to the scale of the bathymetry and flow modelling for these very small eels, that require only a very shallow flow. It is expected that the elvers and very young yellow stage eels will preform much better at moving up the river than the modelling shows, as they move between rocks on the bottom and along the shallow low velocity flows along the bank.

The pool and weir fishway will pass the larger eels but the velocities and distances in the notches exceed the passage ability of the elvers and smaller eels. For this reason, the addition of an Eel pass is proposed for American Eels to provide passage past the dam for

all upstream migrating age classes of eels. The best location for an American Eel pass is depicted on Figure 1 in Appendix A.

This scenario provides a minimum passage depth over the river's rock sills for the multi-sea-year Salmon so it is likely they will choose not to pass until the water level is deeper during the supplemental flow releases. Under Scenario 1, the 10 or more nighttime supplemental flow releases from June 15 to July 15 and September 26 to November 30, of 50 cfs, as currently provided under the licence, are required and are best released from the three gates. The number and timing of the supplemental flows provides the attraction and water depths over the river's rock sills the Salmon need, while still providing passage for the other species during the day and on the other nights.

Table 5: Proposed Scenario Based on Estimated Fish Passage of Selected Fish Species

Scenario	Fishway Flow (cfs)	Louvre Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow (cfs) (≥10 Events)	Total Flow (cfs)
Scenario 1 with Eel Pass	6	29	65	50	100-150*

Table Notes: *150 cfs would only occur during supplementary flows.

2.6 Closure

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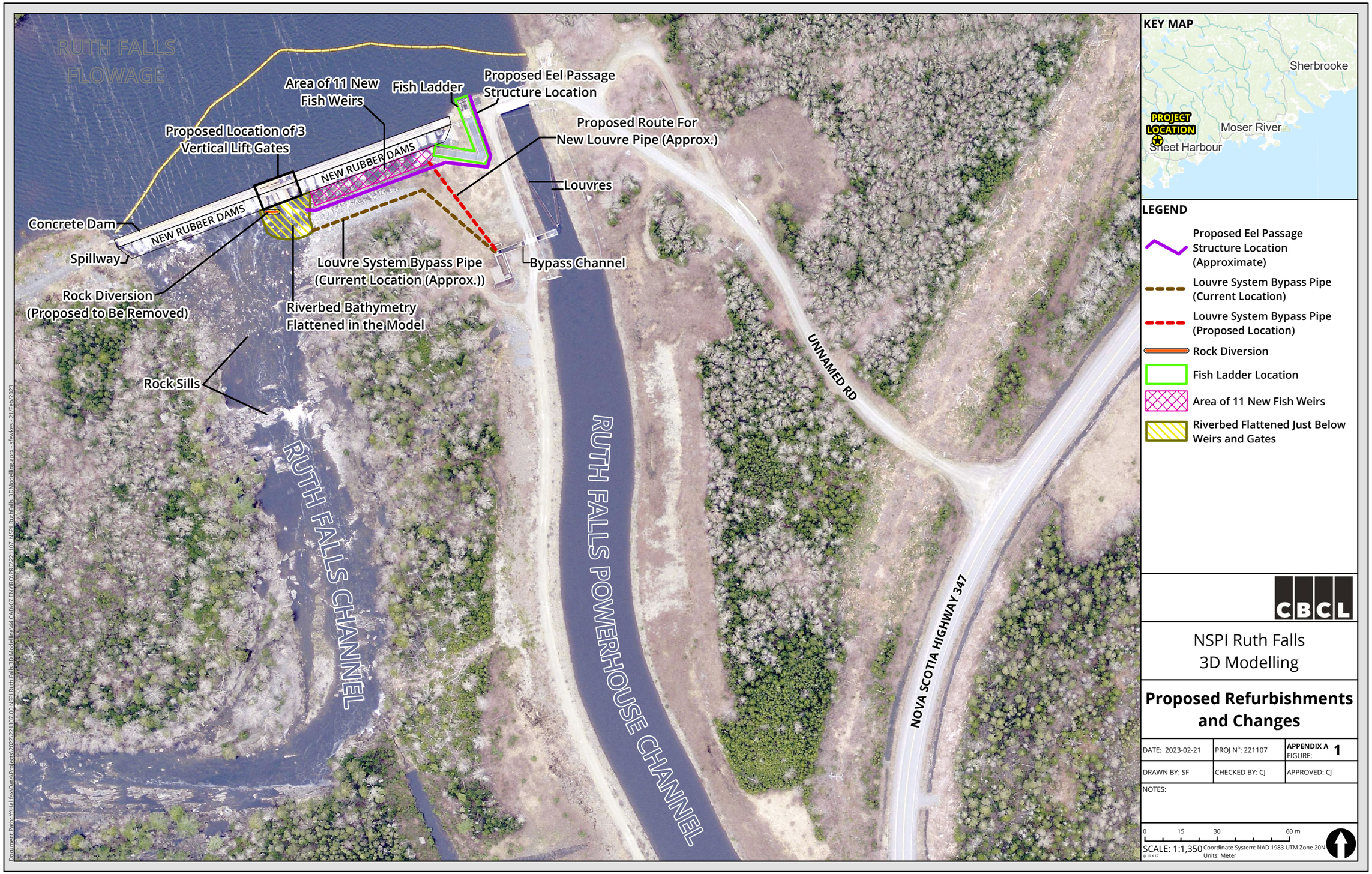
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APPENDIX A

Figure 1


RUTH FALLS FLOWAGE
Area of 11 New Fish Weirs
Fish Ladder
Proposed Eel Passage Structure Location
Proposed Location of 3 Vertical Lift Gates
NEW RUBBER DAMS
NEW RUBBER DAMS
Proposed Route For New Louvre Pipe (Approx.)
Louvres
Concrete Dam
Spillway
Rock Diversion (Proposed to Be Removed)
Louvre System Bypass Pipe (Current Location (Approx.))
Bypass Channel
Riverbed Bathymetry Flattened in the Model
Rock Sills
UNNAMED RD
RUTH FALLS CHANNEL
RUTH FALLS POWERHOUSE CHANNEL
NOVA SCOTIA HIGHWAY 347
KEY MAP
Sherbrooke
PROJECT LOCATION
Moser River
Sheet Harbour
LEGEND
Proposed Eel Passage Structure Location (Approximate)
Louvre System Bypass Pipe (Current Location)
Louvre System Bypass Pipe (Proposed Location)
Rock Diversion
Fish Ladder Location
Area of 11 New Fish Weirs
Riverbed Flattened Just Below Weirs and Gates
CBCL
NSPI Ruth Falls 3D Modelling
Proposed Refurbishments and Changes
DATE: 2023-02-21
PROJ N°: 221107
APPENDIX A FIGURE: 1
DRAWN BY: SF
CHECKED BY: CJ
APPROVED: CJ
NOTES:
0 15 30 60 m
SCALE: 1:1,350 @ 11 x 17
Coordinate System: NAD 1983 UTM Zone 20N
Units: Meter
Document Path: X:\Halifax\Data\Projects\2022\221107.00 NSPI Ruth Falls 3D Modelling\44 CAD\07 ENVRO\PRO\221107 NSPI RuthFalls 3DModelling.aprx - sfewkes - 21/Feb/2023

APPENDIX B

Thaumas Consultants Report

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Ruth Falls Dam – River Fish Passage Modeling

THAUMAS ENVIRONMENTAL CONSULTANTS FEBUARY 10, 2023

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Introduction

Nova Scotia Power Inc has requested 3D hydraulic modeling to be completed at the Ruth Falls dam East River Sheet Harbour for the purpose of assessing post-refurbishment downstream river flow conditions. The main refurbishments to the dam include the installation of vertical lift gates in the center section of the dam which will replace the existing stoplog bays. The change also includes the installation of a new rubber dam along the other stoplog spillways. The modeling is to assess how changes in flow releases from the vertical lift gates and rubber dam would impact fish passage in the river area downstream of the dam and specifically the entrance conditions to the fish ladder. The lower section of the fish ladder is changed to improve fish passage and operate effectively with the changes in the refurbished dam (Thaumas 2023 a, b, c) and these new fishway conditions have also been modeled.

The 3D modeling has been done by CBCL and the results provided in their memo dated January 27th, 2023, titled "NSPI Ruth Falls 3D Modelling Model Results with new fish passage weirs pointing south-west, louvres flow relocated, with no rock flow diversion and bathymetry flattened just below weirs and gates, and flows distributed between the 3 main gates." The model results were also provided in electronic format for further fish passage route computer analysis.

The fish route plots are drawn on plots provided in this CBCL memo.

Ruth Falls Fish Passage Background

Fishway Layout and Operation

The Ruth Falls concrete fishway passes fish well based on the modeling and observations and does not need any modifications. Measurements taken showed some pools had a slightly larger drop than others, but this is due to either plugged drain holes or materials built up in the pool, is well within the proper operating range of depth, and this will be fixed when the fishway is dewatered. The notch width is 1.75 ft, with a typical water depth of 1ft over the crest of the notches. The pool size is 8 ft wide by 10 ft long with a sloping floor, containing a water depth of 2 ft at the upstream end and 3 ft at the downstream end. There is a range of velocities in the notches with the maximum velocity of 1.2m/sec (3.9 ft/sec). The EDF in the pools is 1.8 (ft-lb/s-ft3) and the fishway flow is 6 cfs Velocities are lower at the bottom and especially in the corners of the notch as the water level in the pool below backs the water level up to the crest of the weir for a combination plunging and streaming flow which is better for fish passage. This notch design is very good for fish passage and the operating depth range at or a few inches above 1 ft must be maintained.

Current flow requirements

The current fishway and flows were modeled with the minimum depth over the concrete fishway notches of 1 ft, the minimum fishway flow of 6 cfs, the minimum louvre flow of 29 cfs, and the stoplog leakage and spill of 65 cfs. Some of the stoplog leakage increases the flow in the lower fishway channel section but the amount is not known and was included in the gate release as the new dam will not have any leakage along this part of the dam.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events when the Ruth Falls headpond elevation is at 33.3 m (109.4ft). These supplemental flow events are scheduled to complement significant inflow events, where a significant inflow event is defined as greater than or equal to 24 mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. A supplemental flow event is defined as release of water exceeding 50 cfs immediately downstream from the discharge point for a minimum of 12 hours released overnight. These flows are intended to attract salmon out of the tide and to migrate upstream. These supplementary flows are not modeled and would fall between the modeled current flows of a minimum of 6cfs from the fishway, 29 cfs from the louvre outfall, 65cfs from the gates for a total of 100cfs and the modeled flows of 200cfs.

Refurbished Dam Layout and Operation

The plans for the dam refurbishment were used to identify where there will be fish passage issues, where changes may need to be made to the flow requirements and flow patterns to provide good fish passage following the refurbishment.

Changes to the flow pattern

The current fishway flow does not provide significant attraction flows on it own. The stoplog leakage along the fishway channel at the toe of the dam does not add enough flow to significantly improve attraction, and this leakage equivalent can not be provided through the new rubber dam spills. The design of the fishway channel that runs along the toe of the dam was designed for salmon but does not meet the proper design criteria even for them with inline small size notches, pools with various lengths, widths, and depths, plus flow over the lower weirs even in low flow, and excessive pool turbulence when additional flow is added from the spillways to provide entrance attraction. This section of the fishway is poor, so a redesign is needed with additional flow.

The fishway channel weirs will be replaced by 11 new weirs that will handle the fishway flows plus the louvre flows. This provides a good flow of (35cfs) at the fishway entrance to attract fish under various gate releases (Thaumas 2023 a).

The gate flows are released at different depths with the two outside gates releasing at the river surface water level, parallel to the surface, so there are high velocities across the surface in the river but not at depth. The center gate releases deeper in the river and affects velocities right to the bottom where the salmon, trout, and eels swim and at mid water where the migrating gaspereau swim in this depth of water. This flow energy dissipates quickly in the deeper water vs the other two gates that show high velocities across the surface.

To provide a consistent downstream flow and minimize the back eddies, especially in front of the fishway, the flow has been distributed between the three gates. Various combinations were modeled, and the best was 20 cfs from the west gate, 40 cfs from the deeper center gate, and 5

cfs from the east gate closest to the fishway. The rock in front of the west gate will be removed and the bathymetry in front of the fishway has been smoothed.

This combination of flows will need to be checked when operational to get the best balance of flows from the gates as the bathymetry in the area is not very detailed so the model only gives a good indication of the flows and velocities but may not be giving the best combination of gate flows.

The fish passage migration routes are predicted based on the swimming abilities, distance against the velocity, behaviour, and required water depth for Gaspereau, Brook trout, Salmon grilse, multi-sea-year Salmon, and American eels. These species requirements span the upstream passage requirements for all the species that need to migrate up past the dam to complete their life cycle.

The fishway operation is the same under all scenarios. It is only the gate flows that change.

Fish Swimming Performance Background

Loss of habitat connectivity due to built structures is among the greatest threats to freshwater fish populations. Re-establishing river connectivity through fishways can be an effective and cost-efficient method of enhancing the watershed's productivity, but many are unsuccessful due to flow patterns in the tailrace, location of the fishway entrance, poor attraction flows without suitable velocities, and within the fishway due to excessive turbulence due to low pool volumes, high velocities and low water depths in the notches, and poor notch design, that are not suitable for migration and resting for all the species that require passage.

A good understanding of swimming performance and behavioural response to hydraulic conditions for all the species present is needed to assess fish passage and migration conditions in the following locations: the river below to determine where the fish will approach the dam, near the dam face for fish searching for the fishway, and in the immediate area around the fishway entrance for attraction and entrance conditions.

Ideally a fishway including the entrance attraction flow in the river should allow fish to continue their upstream and downstream migration with no delay, added risk of predation, or extra energy expenditure compared to the natural migratory route, and without reducing fitness due to stress, disease, or injury (Castro-Santos, 2009). Evaluation of fish pass effectiveness is largely dependent on determining attraction, for example the percent of migrating fish in the dam tailrace that are able to find the fishway entrance without delay, the proportion of fish that approach the fishway and enter, and the proportion of the fish which successfully ascend/descend and the related efficiencies and length of delay (Castro-Santos, 2009; Bunt, 2012).

It has long been recognised that the success of mitigation measures to maintain freshwater connectivity are dependent on a good understanding of fish swimming ability (Brett, 1964). Water velocities exceeding the capability of the individual species and related fish size will prevent passage, therefore this is the main ecological metric accounted for in fishway design

(Clay, 1995). Fishway length, slope, dimensions of pools, water depths, weir, the design of slots and orifices, and the frequency and size of resting pools all have to be determined based on the resultant water velocity and depth and the ability of fish to move upstream (Clay, 1995; USFWS, 2019). Perhaps most importantly, the fishway entrance and its attraction flow must be located properly with a strong enough flow to be detected by fish within the dam tailrace without excluding weak swimming species (Weaver, 1963).

Literature Background

Despite a long history of research into fish swimming abilities (Katopodis & Williams, The development of fish passage research in a historical context, 2012), fishway attraction and passage efficiencies remain highly variable (Bunt, 2012; Noonan, 2012). As swimming ability depends on fish species and life stage (Katopodis & Gervais, 2012), where there has been historically a bias towards designing fish passes for strong swimming salmonids on their spawning migration, which has been widely blamed for low efficiencies for other species and life stages (Petts, 1989; Mallen-Cooper, 2007; Katopodis and Williams, 2012; Foulds and Lucas, 2013).

The widespread swim chamber methodologies used to quantify swimming ability have also come under recent criticism. Several studies have shown that data obtained in swim chambers can underestimate swimming ability and result in conservative fishway and migration flow velocities, which can be a problem for upstream passage route determination and attraction to fishway entrances. These studies are also limited by the size of fish studied and the water temperature, so swimming ability is often extrapolated from younger life stages but seldom reflect the temperature effects both positive and negative. Oxygen levels in the water are also critical but not reported in most the swimming tests. Also, fish muscle function is related to water temperature (Brett and Glass 1973; Bernatchez 1985) which has a strong influence on both swimming ability and fish behaviour which are not fully accounted for in these studies. (Plaut, 2001; Peake, 2004a; Peake and Farrell, 2006; Tudorache *et al.*, 2011; Castro-Santos and Haro, 2006). It has also been shown that the habitat the fish is reared in, fast flowing stream vs a lake or pond, affects their swimming ability and endurance (Jones P. E. 2020).

Basing designs on swimming ability alone has resulted in a lack of consideration of a fish's behavioural response to the hydraulic conditions they experience, which may improve, prevent, limit, or delay passage (Castro- Santos and Haro, 2008; Castro-Santos, T. (2005; Enders *et al.*, 2017; Rice *et al.*, 2010; Williams *et al.*, 2012). Fish behaviour including preferred migration velocities they swim against and swimming depth; orientation to the bed and banks; and the use of currents and turbulence patterns they use to ride upstream reducing energy expenditure while for some species, maintaining a preferred ground speed, all need to be considered but not well studied if at all for the species present at this site.

The Biology of Fish Swimming Abilities

Fish swimming behaviour uses different speeds that have been classified into four modes based on the muscles activated and the relationship between speed and endurance. The four modes are sprint, burst, prolonged and sustained swimming (Beamish, 1978; Nelson *et al*., 2002).

Sustained speed (also known as continuous or cruising) can be maintained for long periods, primarily using energy derived from aerobic processes to power red muscles (Brett *et al*., 1958), and is used for holding, resting, and routine movements. Water velocities in structures and rivers below a fish's maximum sustained speed are passable regardless of the distance covered. This is often recommended for very long culverts, fishway pools, at the approach to fish screens, and for resting areas (Peake *et al.*, 1997). During laboratory tests a time limit of 200 minutes (recommended by Brett, 1967) is often used in endurance tests, after which time it is assumed, fish are swimming at sustained speeds. However, 60, 100, and 120-minute-long trials are also common (McDonald *et al*., 1998).

Prolonged swimming uses both aerobic and anaerobic processes to power red and white muscle fibres, with an increasing contribution from the white muscle at higher velocities. Prolonged speeds are those resulting in fatigue following a swimming duration between 20 seconds to 200 minutes (Brett, 1964). These intermediate speeds are regularly used during ascent of fishways and culverts (Bunt *et al.*, 1999). Swimming at prolonged speeds is also reflected in a gait change for many fish species, whereby more white muscle fibres are used, and anaerobic processes must be increased (Peake and Farrell, 2004). The prolonged speed that fish can swim at decreases rapidly as the time increases, so the velocity that fish must swim against and the time to make it through the river flows or fishway before reaching a resting area, must both be considered. Also, the condition of the fish, how fatigued they are approaching the fishway, and the availability and size of resting areas upon exiting must be considered.

Burst swimming is powered by anaerobic metabolic processes and contraction of white muscle fibres. This high-speed swimming can only be maintained for a short time before a rest period is required for glycogen resynthesis and removal of muscle lactate (Wilson and Egginton, 1994). Burst speeds are usually defined as speeds that result in fatigue within 20 seconds (Beamish, 1978). Short duration, high swimming speeds are essential for predator escape, prey capture and passage through short velocity barriers. Passage success at sluices, pool and weir, vertical slot, and orifice fishways is determined by burst swimming ability (Russon *et al.*, 2011).

Sprint swimming refers to very high speeds that are maintained for only 1 to 5 seconds (Nelson *et al*., 2002, Castro-Santos, 2005). Sprint speed can be used for very short high velocity sites but is normally just used for predator escape and is not recommended for fish migration design, even in very short sections of flow.

Prolonged, burst, and sprint swim speeds can be combined with a glide behaviour. A burst swim speed in a high velocity flow so that the fish is moving faster than its usual ground speed can be followed by a glide, where they continue upstream, but their ground speed slows until the next burst and glide movement. This is used in turbulent flows, in streams with a stepped pool structure, or in baffled fishways where the velocity is high at a baffle and lower or even moving upstream above it.

Critical swimming speed (U_{crit}) is a special category of prolonged swimming first introduced by Brett (1964). The protocol is carried out on fish enclosed in a swim tunnel respirometer, during which the fish are forced to swim against a particular water velocity for a set time interval. Water velocity (and therefore swimming speed) is then increased by a set increment until the individual fails to swim for an entire time interval. Critical swimming speed is calculated as the sum of the ultimate velocity attained and a fraction of the velocity increment proportional to the time spent swimming at the final velocity relative to the full-time interval (Hammer 1995). Although U_{crit} has often been used to estimate maximum sustained speed, it has also been defined as the highest swimming speed that a fish can maintain for a period equal in magnitude to the time interval used in the test (Peake et al. 1997c). Time intervals as low as 2 min, and as high as 60 min are used in these trials, although values greater than 20 min are most common. Critical swimming speed separates the sustained and prolonged performance swim speeds, and it is therefore considered the best available metric for establishing water velocity criteria for fish passage.

The time limits commonly applied to define swimming modes during performance studies (i.e., sprint < 5 sec, burst < 20 sec, prolonged > 20 sec and < 200 sec, sustained > 200 min;) are somewhat arbitrary values. The transitions do not occur at discrete time intervals and are variable between species. Some species move seamlessly between the different modes while others show definite changes in swim speed and gait.

As swimming speed increases the energy derived from anaerobic processes increases. The use of anaerobic energy stores leads to physiological effects, which must be reversed following exercise, through increased oxygen consumption (known as postexercise oxygen consumption). The anaerobic cost of swimming can therefore be studied by evaluating EPOC (excess post-exercise oxygen consumption) and the time needed for oxygen consumption to return to resting levels (Peake and Farrell, 2004). This recovery time after fatigue can be one or more hours (Lee *et al*., 2003; Reidy *et al*., 1995), therefore, fish swimming endurance at a test velocity can also depend on previous exercise intensity (Jain and Farrell, 2003). The migration conditions in the river below the dam needs to be considered as the fish approach the dam, the time spent searching for the fishway entrance, and where they have been able to find suitable resting areas to rest and recover from this exercise before using the fishway.

Water velocities exceeding the fish swimming capability will prevent passage, therefore it is the main ecological metric accounted for in fish pass design guidance (Clay, 1995, FAO and DVWK, 2002). Also, the attraction flow must be strong enough to be detected by fish within the barrier's tailrace flows without excluding weak swimming species (Weaver, 1963). However, other factors such as water temperature, fish condition including both how well fed they are and if they have been recently fatigued, body condition, age, behaviour with respect to the reason for migration such as spawning, feeding, or habitat selection, and physical parameters such as the orientation to velocities, shoreline, substrate, swimming depth, reaction to turbulence both positive and negative, tidal levels, current patterns, and light conditions all are important factors affecting fish swimming ability and behaviour.

Fish Swimming Behavior

Fish have five swim behaviours they use to try to maintain their ground speed while migrating upstream. The five modes can be combined so that the fish use the least effort possible.

Mode one is to swim against a preferred migration velocity that is, for example, approximately 1 to 1.5 body lengths per second for gaspereau, which would be 0.30 m/sec to 0.4 m/sec. This is a velocity range used by most species but varies a bit from species to species. It is a bit higher for the larger salmonids, and slower for most benthic species and smaller species.

Mode two is to use upstream currents along the side of faster flows, both swimming and riding up on them to maintain a preferred ground speed. If the flow is faster than their preferred ground speed, they tend to turn and face into the current instead of riding on it. This is an issue in back eddy flows and in downstream passage locations.

Mode three is to use the vortices, which are small clockwise and counter-clockwise eddies found along both sides of a faster flow moving through slower flowing water. In Karman Gate (Liao 2017) swim behaviour, fish swim along vortices of approximately 1 to 1.5 body lengths, using the side of the vortices that are headed upstream to make upstream migration easier, but they will use smaller and larger horizontal vortices as well. Fish can be seen swimming in these circulation patterns along the side of faster currents.

Mode four is maintaining their preferred ground speed and adjusting their swimming speed along the route as the currents change. To do this they will use sustained, prolonged, burst and glide, burst, and even sprint speeds if needed, but anything more than low prolonged speed, normally used for migration, shortens the distance they can swim before resting.

Mode five is to school. In this mode they create their own turbulence to aid in swimming. The lead fish keep changing but they are still orienting to the flow and physical parameters.

For mode one, when fish are swimming against a constant velocity, a maximum distance needed between resting areas can be estimated. The estimate is conservative as all the other modes save energy and allow the fish to swim further before resting. Fish can switch easily between modes and combine modes as the conditions along the route change. The swim ability modeling has been conservative.

As fish are migrating upstream or downstream, they orient to physical features, such as the banks, the bottom, the water surface, as well as light intensity and direction using sight and adjusting to currents or turbulence using the lateral line. They also orient to chemical cues such as water temperature, salinity, acidity, and the chemical ion makeup that distinguishes individual rivers due to the geology and recent land use using their olfactory and lateral line senses.

Schooling Behavior

Schools of fish adjust in numbers of fish and shape, both in width and depth, to match conditions. This often puts fish deeper and shallower than the depths noted below. The schools are a predator avoidance technique as well as for swimming assistance, so they can be very large and come in a continuous stream when the fish numbers are high. As an example, early and late in the migration run the numbers are small and the upstream movement for gaspereau occurs in the early morning and at dusk in otherwise ideal route conditions (Alcott 2021). Schools at this time can be as small as 3 or 4 fish. When they are running strong, the highest rate of passage or greatest numbers of fish are migrating in the afternoon to early evening. The fishing weirs use the gaspereau's orientation to the physical stream profile and flows to guide them to the dipping station location (Peake 2008) using a guide wall, which is a simulated diagonal riffle creating shallower and faster flow that the fish avoid and lead along to the upstream end. Individual species behaviours will be noted below.

Passage Depth

The next thing to consider is the depth the fish are swimming at, as the flow velocity and patterns change with depth and fish also need a minimum depth for safe passage, which for most fish is a minimum of 1/3 the body length, although a water depth of two body depths is often recommended. Alewife, for example, move up and down in the water column with the light level. Typically, in deep water, if they are not crowded, they swim with their dorsal fins at the secchi disc depth (the point where a white object disappears), which changes with the light level. So, they will be deeper in the sunlight and shallower in the early morning, evening, and at night. In shallow water they swim at mid water. Other species such as trout and salmon orient to the bottom in shallow water and eels always orient to the bottom no matter what the depth is, in rivers, lakes, and estuaries. This behaviour is likely due to a combination of a need for cover from predators and the light level to see for orientation. However, they will all make short term movements into other water depths.

All species, if they are crowded by a migration restriction, such as approaching an obstruction like a dam, can fill the water column. If there are not suitable holding or resting areas providing enough space for each fish, some will fall back. Also, in a crowded environment fish have trouble orienting to flows as they are blocked by other fish. This over crowding often happens in fishway pools where they are trying to rest or orient to the flows, or when there is a change in light levels, all creating a passage barrier which should be avoided.

Upstream and downstream fish passage routes are complex to plot as the fish behaviour and response to conditions is variable, but general routes and bounds can be established.

Fish Swimming Speeds and Behaviours by Species

Based on the available literature and fish swim speed models, criteria have been developed to guide the assessment of fish passage in the river and the lower fishway. The fish size selected is the mean size of the smallest spawning adults and the velocity and endurance are set for the fish's ability to successfully pass 97.5% of the time for a fish of this size. This means excellent passage potential for larger individuals and lower passage potential for the smallest individuals in a population.

Gaspereau

This group includes Alewife and Blueback Herring. Adult Alewife are usually 25-35 cm, and Blueback Herring are often 20 cm (Scott & Scott, 1988). They are present in the tide from late March until Fall. They begin running into the river mid to late April, when river water temperatures are above 9°C, and end in late June (Jessop 2003). They are expected to run at dawn and dusk in the early and late run times and peak in the late afternoon early evening during the main run, but it can be any time of the day (Alcott 2021). Timing is mainly driven by water temperature. They use visual and lateral line cues to orient upstream in water with all velocities less than 0.30 m/sec and in turbulent or back eddy flows.

For their size gaspereau are better swimmers for short distances than the salmonids but do have issues with currents hitting them from the side that the salmonids don't, something we must watch for where the currents come a right angle, or the side turbulence/circulation pattern velocity is high. The model does not show these small circulation patterns but clearly shows the flows from the fishway and gates. While they can swim a bit faster than salmonids of the same size, they have less endurance so the distance they can swim against a current is less.

Table 1: Swimming Speeds by Time for 250 mm gaspereau in m/sec (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 + seconds
97.5	3.19	1.82	0.723	0.614	0.465	0.299
87.5	3.49	2.00	0.792	0.673	0.529	0.327
50.0	3.97	2.27	0.901	0.765	0.579	0.332

Brook trout

Sea trout that overwintered in the estuary will follow eels, and gaspereau into the river on feeding runs and will go back and forth following the food supply, staying in the estuary when the river temperature is >20°C. There is a spawning run in the fall following the fall rains with spawning in mid October to mid November depending on flows and water temperatures. They can move from the estuary to freshwater several times a year and may stay in the freshwater. Adults range in size from 20cm to 55cm, with a mean length of 35 cm (MacMillan & Madden, 2007).

Table 2: Swimming Speeds by Time for 350 mm Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.64	1.20	0.672	0.608	0.511	0.388
87.5	2.22	1.57	0.883	0.789	0.671	0.510
50.0	3.27	2.31	1.300	1.18	0.988	0.751

There are also resident Brook trout that are generally smaller and may also need to pass upstream at the dam for spawning or feeding runs. The criteria for the smaller resident trout are the same as for the generally larger sea run Brook trout but this assessment focuses on the smaller trout averaging 20 cm in length.

The length assessed for swimming capabilities was 200 mm. Trout rest in velocities of < 0.2 m/sec and hold in velocities of 0.2 - 0.3 m/sec (Tudorache 2011). Their preferred migration velocity is 0.3 to 0.4 m/sec, which 20 cm long trout can swim against for 16 m (Katopodis 2016).

Table 3: Swimming Speeds by Time for 200 mm long Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Atlantic salmon

Salmon may come out of the tide at any time of the year if the water is under 20˚C and there is a good flow. There are spring, summer, and fall runs, with the latter being the spawning run. They wait in the tide until water temperatures are generally between 9°C and 20˚C and flows are high enough to provide a water depth > 2 body depths in shallow reaches of the river. Normally they will move upstream at dawn and dusk, but it can be at any time of day. Spawning runs can continue till freeze up or late December.

Salmon use freshwater cues to migrate upstream and strongly orient to the flow. Salmon will need velocities under 0.2 m/sec for resting and can hold oriented to the flow in velocities of 0.2 – 0.4 m/sec.

Salmon are strong swimmers and can go long distances between resting areas. The ability of Atlantic salmon to swim for long distances against relatively strong currents, makes it easy for them to go up the fishways. It also gives them an advantage navigating the eddies and fast flows present in the tailwater. They have a good chance of navigating the currents, finding the fishway, and swimming up it before needing to rest.

Grilse

Atlantic salmon Grilse range in size from 450 mm to 600 mm in length and 500 mm was used for assessment. They have a preferred migration velocity 0.4 to 0.5 m/sec, which they can swim against for 110 m (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016).

Table 4: Swimming Speeds by Time for 500 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	2.11	1.49	0.84	0.759	0.639	0.458
87.5	2.78	1.96	1.10	0.998	0.839	0.637
50.0	4.09	2.89	1.63	1.47	1.24	0.938

Atlantic salmon multi sea year

The larger multi sea year Atlantic salmon are 850 mm to 1050 mm long (Reid 2012). The length assessed for swimming ability was 1000 mm. They have a preferred migration velocity of 0.4 - 0.55 m/sec, which they can swim against for 340 m (Katopodis 2016).

Sufficient water depth over the bedrock sills in this river is an issue for multi-year Salmon at Ruth Falls, especially in the lower flows.

Table 5: Swimming Speeds by Time for 1000 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	3.26	2.30	1.30	1.17	0.985	0.78
87.5	4.29	3.03	1.70	1.54	1.29	0.983
50.0	6.30	4.46	2.51	2.27	1.90	1.45

American Eels

American eels live in both the estuary and the freshwater. Access to the freshwater is needed as most of the females develop in freshwater habitats. Some of the eels will move in and out of the estuary several times during their life.

The eel tiles that are proposed to be used contain two different sizes of pegs. The smaller pegs have a space of 17.5 mm between them and will pass elver and yellow stage eels up to 25 cm long. The larger pegs have a space of 29.6 mm between them and can accommodate eels up to around 44 cm long, based on a body depth to length ratio of 0.068 cm (Berry & Escott Ltd., 2020). The larger eels are capable of swimming up through the main fishway.

Yellow stage eels and silver stage eels and lamprey require downstream passage. They travel on the bottom with occasional movements up the water column.

American eel elvers 60 mm long

Elvers will begin their upstream migration in mid March. They will use the eel pass. They have a swimming ability of 0.11 m/sec for 60 sec, which results in very short distances between resting areas. They tend to use upstream currents along the edges of rivers to aid passage.

Table 6: Swimming Speeds by Time for 60 mm long American Eel Elvers in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.367	0.221	0.0948	0.0817	0.0634	0.0423
87.5	0.456	0.274	0.118	0.102	0.0787	0.0526
50.0	0.621	0.373	0.160	0.138	0.107	0.0716

Yellow stage American eel (200 mm)

Yellow stage American eels do not move around until water temperatures are above 12°C. The eel pass has a section suitable for the passage of yellow stage eels under 45 cm long. 20 cm long eels have swimming speeds of 0.35 m/sec for 60 sec and they travel very short distances at a time.

Table 7: Swimming Speeds by Time for200 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.836	0.503	0.216	0.186	0.144	0.0964
87.5	1.04	0.625	0.268	0.231	0.179	0.120
50.0	1.41	0.850	0.365	0.315	0.244	0.163

Yellow stage American eel (600 mm)

These eels will be too big for the eel pass, but they do have a strong swimming ability 0.87 m/sec for 60 sec and modeling shows they can pass though the fishway near the bottom surface or along the edge of the notches. They prefer to travel short distances at a time which would be limiting. They also use the drain hole orifices at the bottom of the baffles.

Table 8:Swimming Speeds by Time for 600 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.77	1.07	0.457	0.394	0.306	0.204
87.5	2.2	1.32	0.568	0.490	0.380	0.254
50.0	3.0	1.80	0.774	0.667	0.517	0.345

Lake Species

The following species were found in the reservoir above the dam and do not need to pass to complete their lifecycles.

Yellow Perch

Yellow perch are freshwater fish but may be found in brackish water up to 10 ppt. they use a wide range of habitats from large lakes to ponds to slow moving sections of rivers or the upper estuaries. They are most abundant in open water of lakes with moderate amount of vegetation.

They spawn in the spring in from mid April to early May along the shallow shoreline of lakes or in the tributaries. They live up to 9 years and are 200 mm to 300 mm when caught by angers (Scott & Crossman, 1973).

Brown Bullhead

The Brown bullhead is a freshwater fish that lives in lakes and ponds but may venture into brackish water. They spawn in late spring or early summer in shallow water along the shoreline of lakes and ponds. Most adults are between 250 mm to 300 mm long (Scott & Crossman, 1973).

White Sucker

White suckers generally live in warm, shallow lakes and tributary rivers of larger lakes. They are bottom feeders and have been known to live for up to 15 years, reaching sexual maturity at age 5-8. In the spring, they begin migrating to spawn when daily water temperatures stay above 10°C. They often move out of the lake to spawn in tributary streams with shallow water and gravel bottoms, but they sometimes spawn on the lake margins. They move off the spawning

grounds 10-14 days later. The young begin to migrate into the lake about a month after spawning beginning when they are around 15 mm in length (Scott & Crossman, 1973).

The sizes of White suckers are difficult to determine as they grow at different rates depending on sex and location. A 200 mm average size was used for the assessment which is typical of the spawners seen on the eastern shore.

White suckers do not need to pass by the dam to complete their lifecycle, but they are strong enough swimmers that they should be able to get up the fishway if they choose to or accidentally go down the downstream bypass.

Table 9: Swimming Speeds by Time for 200 mm long White Sucker in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Minnow Species

Minnow species do not need to pass the dam to complete their lifecycle. Both minnow species identified were found in the reservoir above the dam and will spawn on the margins of the lake.

Golden Shiner

The Golden shiner, (*Notemigonus crysoleucas)*, has an average length of 76 – 127 mm and has a golden colouration. It is a lake fish, and moves in schools in weedy, shallow areas. Spawning occurs when water temperatures reach 20°C over filamentous algae or aquatic vegetation (Scott & Crossman, 1973).

Lake Chub

Lake chub (Couesius plumbeus) are a freshwater fish found in lakes, ponds, and streams. They move from the lakes to streams in early spring to spawn usually in April. They are a large minnow that can reach 150mm in length and even larger if they have been in brackish water. Average length of an adult is 10 cm (Scott & Crossman, 1973).

Table 10: Swimming Speeds by Time for a 100 mm long minnow in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.773	0.546	0.307	0.278	0.234	0.177

87.5	1.02	0.718	0.404	0.365	0.307	0.233
50.0	1.49	1.06	0.594	0.537	0.452	0.343

Summary of Passage Metrics for all Species

Figure 1: Swim distance vs. water velocity for the species present shows how far each of the species requiring passage below the dam can swim over a range of water velocities (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020). For this graph average fish sizes were used and swim distances are those at which 97.5% of fish of that size will be able to achieve.

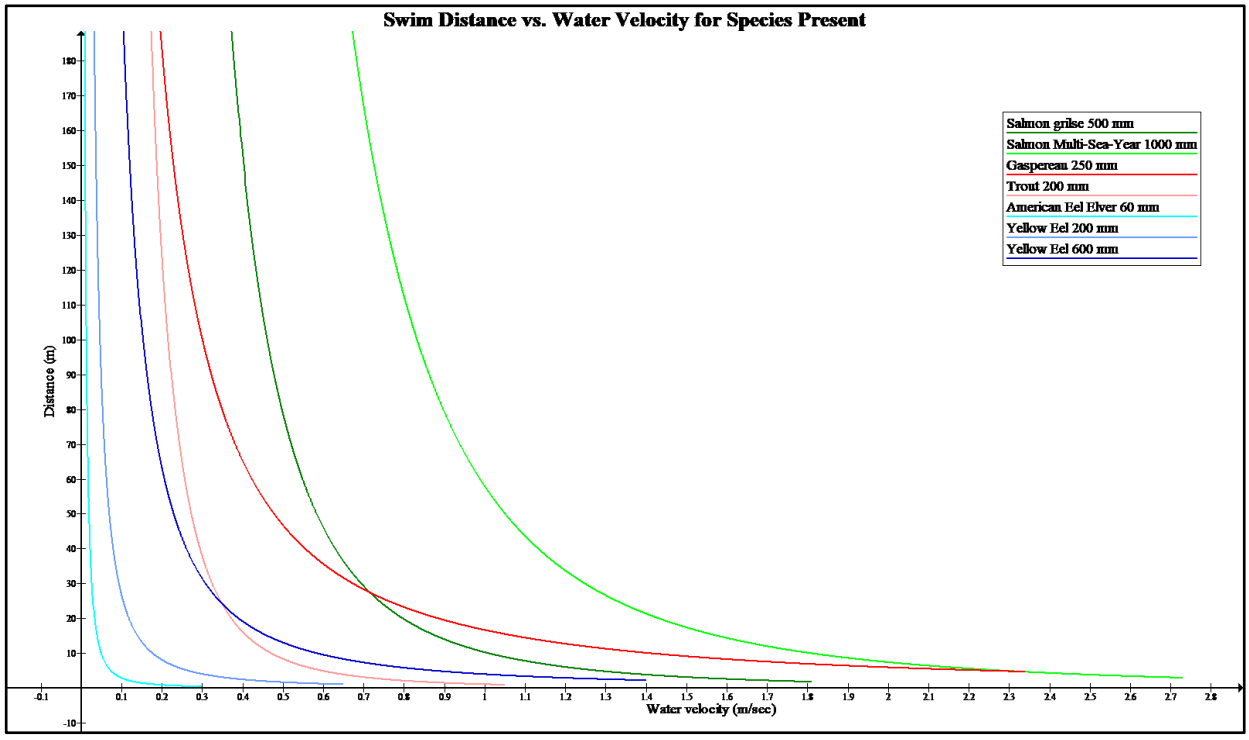


Figure 1: Swim distance vs. water velocity for the species present at 97.5% passage

Table *11* shows the same information for swim distance vs. velocity as in written form above, with categories for distances matching those from the modeling. The table also shows the body depth of the fish and the minimum depth required for passage, based on the largest of each species. The body depth is taken from US Fish Passage Engineering Design Criteria (2019), but the minimum passage depth was taken as 1/3 of the length of the largest fish size to accommodate extended dorsal and ventral fins. Eels are the exception to this, as they have a small body depth for their length. Ideally, the eels would have three times the body depth for safe, comfortable passage (US Fish and Wildlife Service, 2019).

Table 11: Distance before resting for each modeling category at 97.5% passage (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Species	Gaspereau	Trout	Salmon Grilse	Salmon Multi-Sea-Year	American Eel Elver	Yellow Stage American Eel	Yellow Stage American Eel
Average Size (cm)	25	20	50	100	6	20	60
max size (cm)	35	55	60	105	7	45	100
Max body depth (cm)	8	14	13	23	0.5	3	7
Depth required for passage (cm)	12	18	20	35	0.5	3	7
Velocity range (m/sec)	Distance before resting (m)						
0 – 0.15	Resting	Resting	Resting	Resting	1 – 3	15 – 30	Resting
0.15 – 0.3	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	< 1	5 – 15	30 – 100
0.3 – 0.35	80 – 100	25 - 40	225 – 355	>620	No passage	3 – 5	25 – 30
0.35 – 0.4	65 – 80	15 – 25	150 – 225	>620	No passage	3	20 – 25
0.4 – 0.45	55 – 65	10 – 15	110 – 150	>620	No passage	2	15 – 20
0.45 – 0.55	40 – 55	6 – 10	60 – 110	340 – 620	No passage	1	10 – 15
0.55 – 0.72	25 – 40	3 – 6	25 – 60	155 – 340	No passage	< 1	7 – 10
0.72 – 1.1	15 – 25	< 3	10 - 25	45 – 155	No passage	No passage	3 – 7
1.1 - 2	5 – 15	No passage	1.5 - 10	7 – 45	No passage	No passage	No passage
>2	Limited passage	No passage	No passage	Limited passage	No passage	No passage	No passage

3D model results

NSPI requested 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post dam refurbishment downstream flow patterns and velocities as they relate to fish passage. The main refurbishments include the installation of vertical lift gates in the center 3 gate section of the dam which will replace the existing stoplog bays and the installation of new rubber dams along the spillways adjacent to the lower section of the fishway that runs along the toe of the dam. The changes will affect the fishway operation and entrance conditions including the river routes to the fishway for migrating fish.

The diagram of velocities 20 cm from the bottom was used to display the fish migration routes below the dam, as this route best represents the velocities that fish will be traveling though. These velocities are most representative of the mid water velocities that gaspereau will be swimming through and they are the velocities that trout and salmon will be moving through along the bottom. Eels will be traveling directly on the bottom and will find areas with slower moving water as they have a small body depth so can move between cobbles and small boulders on the bottom.

All the fish swimming abilities and behaviours described above have been taken into consideration in determining the migration routes.

Fish migration routes were determined directly from the computer model using all the available models to get a detailed picture of the routes. This included point depths, velocities, and flow direction along the routes. These detailed 3D assessments were transposed on the diagrams.

There are two shallow bedrock sills that fish must pass over to get to the area below the dam. These sills have shallow fast flows that present passage problems for weaker swimming fish, especially as the flows increase below the dam. The first sill is located at around 30 m on the Y Axis of the diagrams and the second sill is located between 65 m and 75 m. Generally, the river flows are very shallow and fast over the sills and become faster as the flow increases. Depth in the dark blue areas is up to 1 m deep and the depth over the rock outcrop sills is shallow except for the one channel near the left bank (looking downstream) which is used by most fish for migration due to both a suitable depth and a passable velocity. The most downstream rock sill shown in the plots may have better passage opportunities than it appears because the velocities and depth here may not be correct since the model's bathymetry is cut off on both banks and the lower end of all models does not have the effect of the downstream bathymetry backwater effect. Further downstream in the river there are several other bedrock sills. Passage over these sills is unknown, so the percentage of fish attempting passage from the mouth of the river that reach the dam is unknown.

The Fish Protection Tools Swim Distance and Velocity tool was used to calculate distances and percentage of fish that have the ability pass along certain routes (Di Rocco, 2020; Katopodis C. a., 2016). The estimates are given in levels for 97.5%, 87.5%, 50%, 12.5%, and 2.5% passage. When swim distance was between levels, the lower passage percentage was used. Passage rates are very conservative, as fish may use other swim modes to decrease energy expenditure, or they may find small eddies behind and between boulders.

The Fishway Flows

The upper, concrete section of the fishway has been designed to operate with 1 ft of water over the crests of the notches with the water level in the pool below equal to the elevation of the notch crest. The velocity in the notches ranges from 1.0 ft/sec (0.3 m/sec) at the bottom up to 4 ft/sec (1.2 m/sec) at mid to surface depth. These velocities are passable by all the species needing to pass using burst or sprint speed over this short distance. Part of the reason for the lower velocities at the bottom is that the water level in the pool below the notch is backed up to at least the level of the notch crest above it when operating with at least 1 ft of water depth. When the notch depth is higher the velocities at the bottom decrease as the notch is further backwatered.

The flow depth in the channel portion of the fishway is now designed to carry 35 cfs at a depth of 1 ft and 9 inches in the notches, backwatered by 1 ft, for drops of 9 inches. This provides easier passage for fish, with a range of velocities in the notches from 1 ft/sec to 6 ft/sec (0.3 – 1.8 m/sec). The pools have good resting areas and a range of velocities for migration.

Fishway attraction velocities extend from the surface to the bottom in the range most fish seek for upstream migration and this is combined with a strong flow along the side of the gate flows to orient fish toward the fishway.



Figure 2: Fishway and entrance area velocities

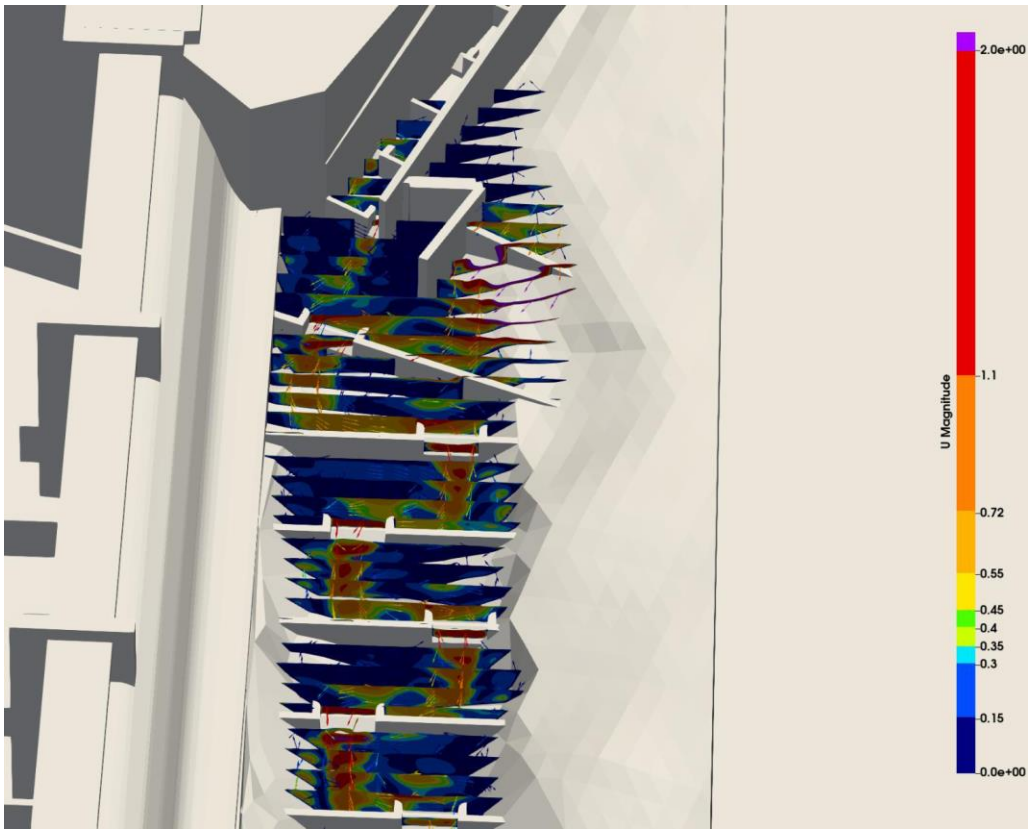


Figure 3: Cross section view of the fishway flows

The velocities in the notches of the concrete fishway are shown in Figures 4 and 5. The maximum velocity shows in the red but is just a maximum of 1.2 m/sec. In the pools, faded out in these screen shots you see the resting areas in the blue and a current through the pool for the fish to follow notch to notch. These velocities are within the swimming ability of all the migratory species with the exception of the smallest eels.

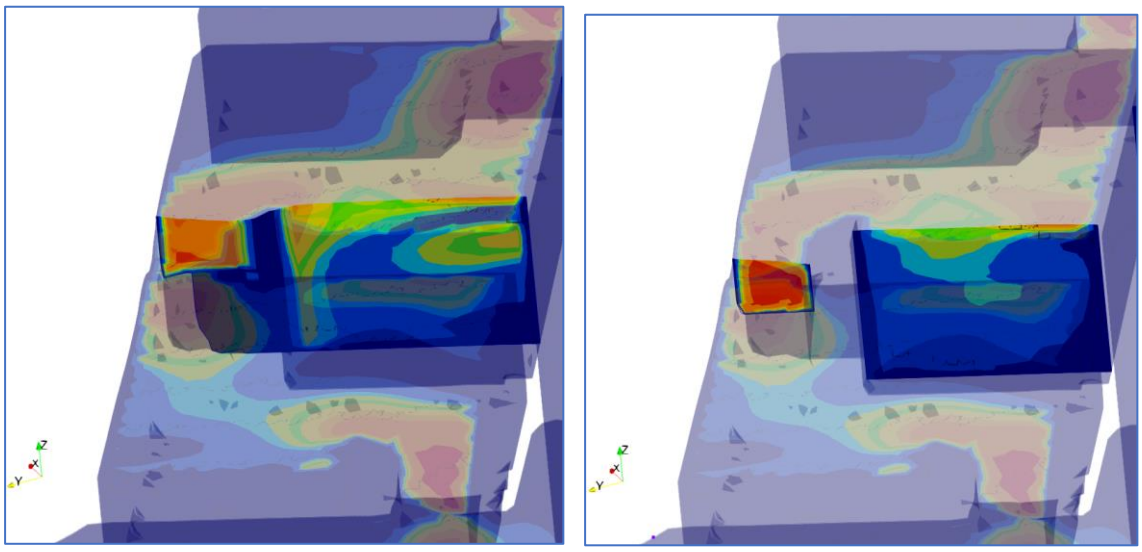


Figure 4: Velocity at top of notch (left); velocity at 23 cm down (right) showing the max notch velocity.

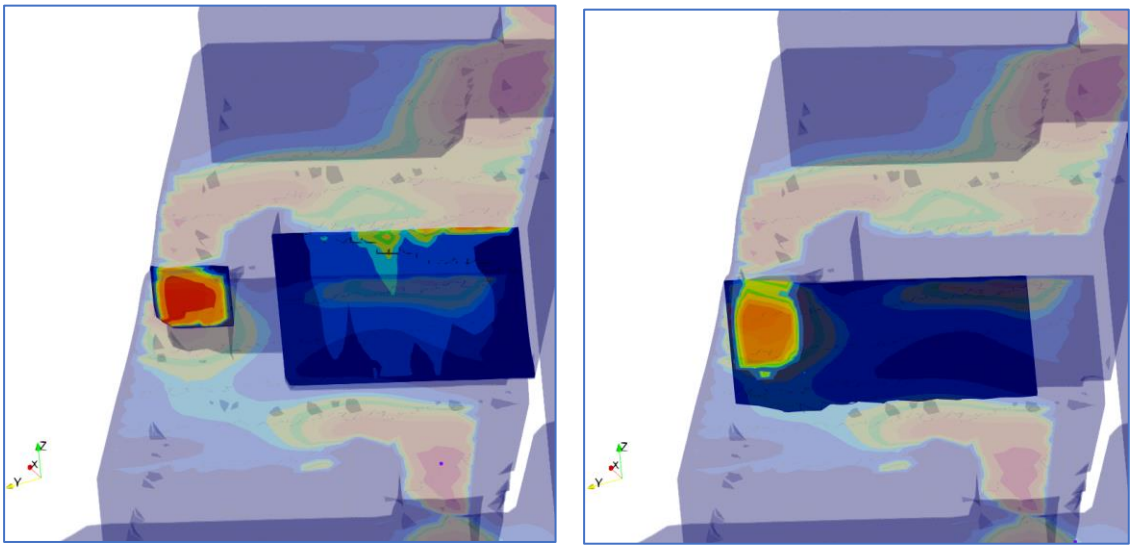


Figure 5: Velocity 46 cm down in notch (left); velocity as notch enters the pool (right)

The velocities in the notches of the channel fishway, shown in Figure 6, with a flow of 35 cfs have a similar pattern to the other fishway but with velocities in the cross sections mid way along the notch range from 1.8 m/sec in the center to 0.8 m/sec along the sides and bottom. Providing good fish passage for all the migratory species except the smallest eels. There are large resting areas and a flow pattern through the pools that has migration velocities.

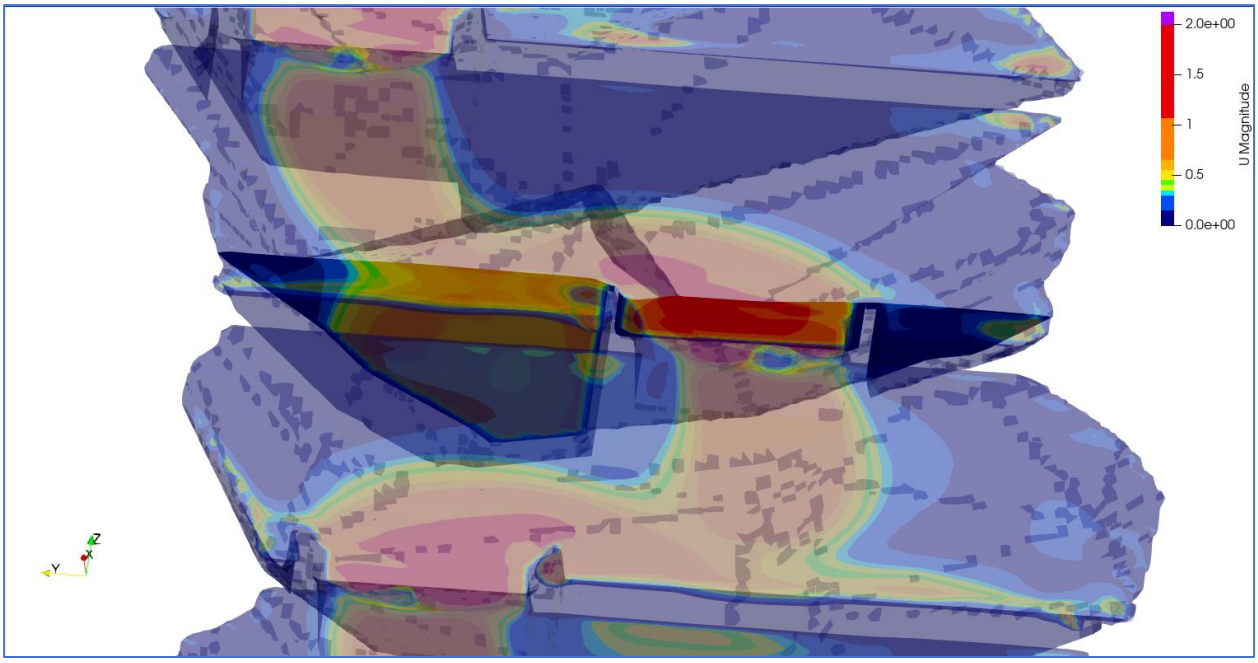


Figure 6 The velocities in the notches of the channel fishway section with 35 cfs flow.

S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

This flow scenario has the best passage for gaspereau, trout, grilse, and eels, but has barely enough water depth for the larger salmon.

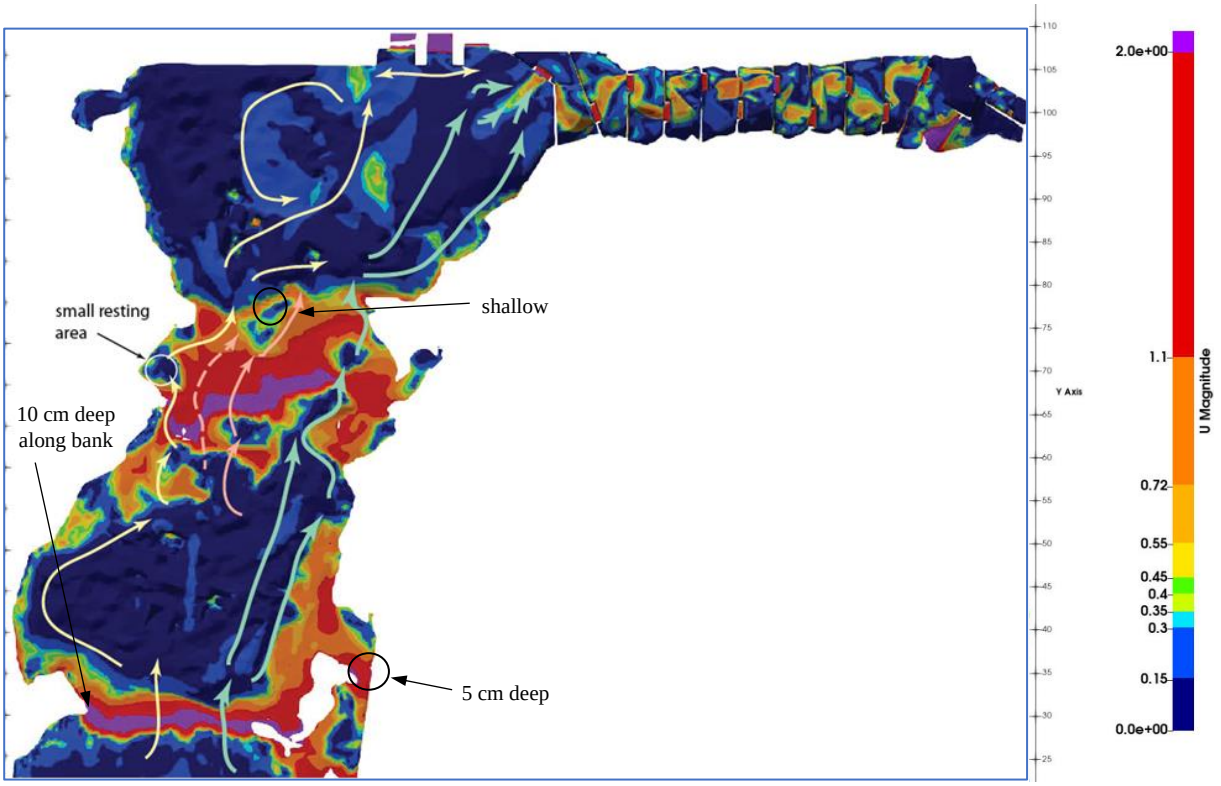


Figure 7: S1 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

The route marked with green arrows follows the main thalweg of the river and will be the most used route for gaspereau as it is the easiest. Using this route fish can avoid velocities greater than 2 m/sec over the first sill by traveling through the deepest channel, where the water is around 30 cm deep, and the velocities are the slowest at depth in this cross-section. Since the distance to get over the sill is less than 5 m 97.5% of gaspereau should make it over. Then they can rest before attempting to go over the second sill, which has lower velocities, under 1.1 m/sec, but the distance fish must swim before resting is much longer, around 20 m. This is within the swimming ability of gaspereau.

The yellow route is the next best route, but limited numbers of gaspereau will be able to use it due to the small size of the resting area on the right bank. Using this resting area, the fish won't have to go more than 10 m in dark orange and reds, which is well within the swimming abilities for the distance involved of 97.5% of gaspereau. Once the resting area fills up fish may fall back.

The route marked with orange arrows is at the edge of how far gaspereau can go without resting. There is 20 m of fast water, with velocities ranging from 0.55 m/sec – 2.0 m/s. Only the strongest fish will choose this route, passing 50% of 250 mm gaspereau. Some may fall back and choose another route.

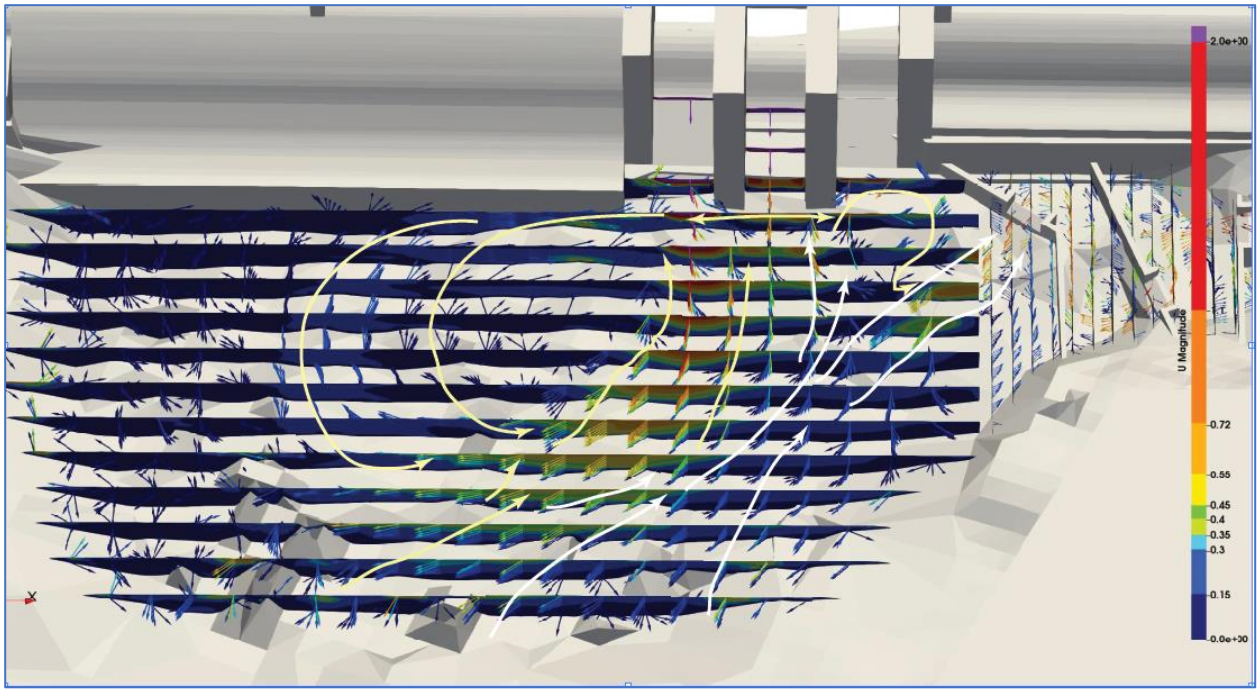


Figure 8: A close up of the routes for gaspereau below the dam with cross-sections spaced at 5 m

It is expected that the gaspereau will gather in the resting areas below the dam for some time to rest before seeking the fishway to move further upstream. The velocities just below the dam are well within swimming abilities of gaspereau and they can choose their preferred velocity to follow. Those on the left bank will easily find the fishway, as the new fishway entrance has good attraction velocities throughout the water column. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross under the main flow to find the fishway or will not have to go too far downstream to be able to cross the surface flow, as velocities near the streambed are well within swimming abilities. The main migration route is in white. The yellow areas the fish will be delayed looking for the fishway.

Trout

Trout are much smaller than the salmon so have a weaker swimming ability. They will have a hard time getting through the fast flows on the bedrock sills. About 50% of 200 mm trout will be able to pass through the green route, 12.5% through the yellow route, and 2.5% through the orange route. Larger Sea Trout will have better passage success. The main route is the white arrows in fig 9 with delays if they take the other routes as they have to search for the fishway.

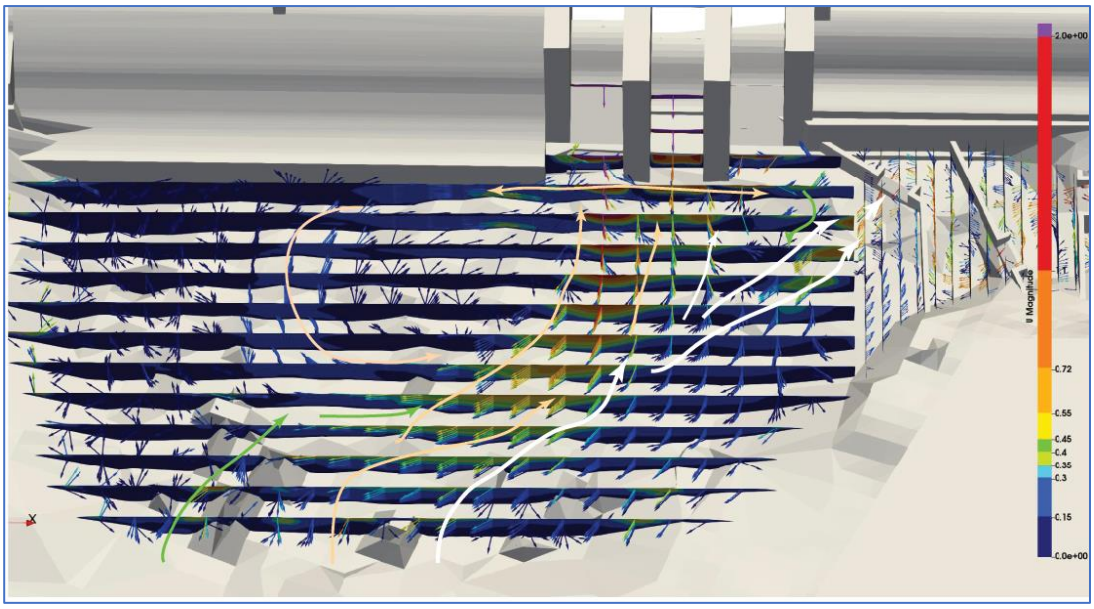


Figure 9: A close up of the routes for trout below the dam with cross-sections spaced at 5 m

Salmon Grilse

Grilse will follow the same routes as gaspereau, the green route will have 87.5% passage, the yellow route will have 50% passage, and the orange line will have 50% passage.

Multi-sea-year-salmon

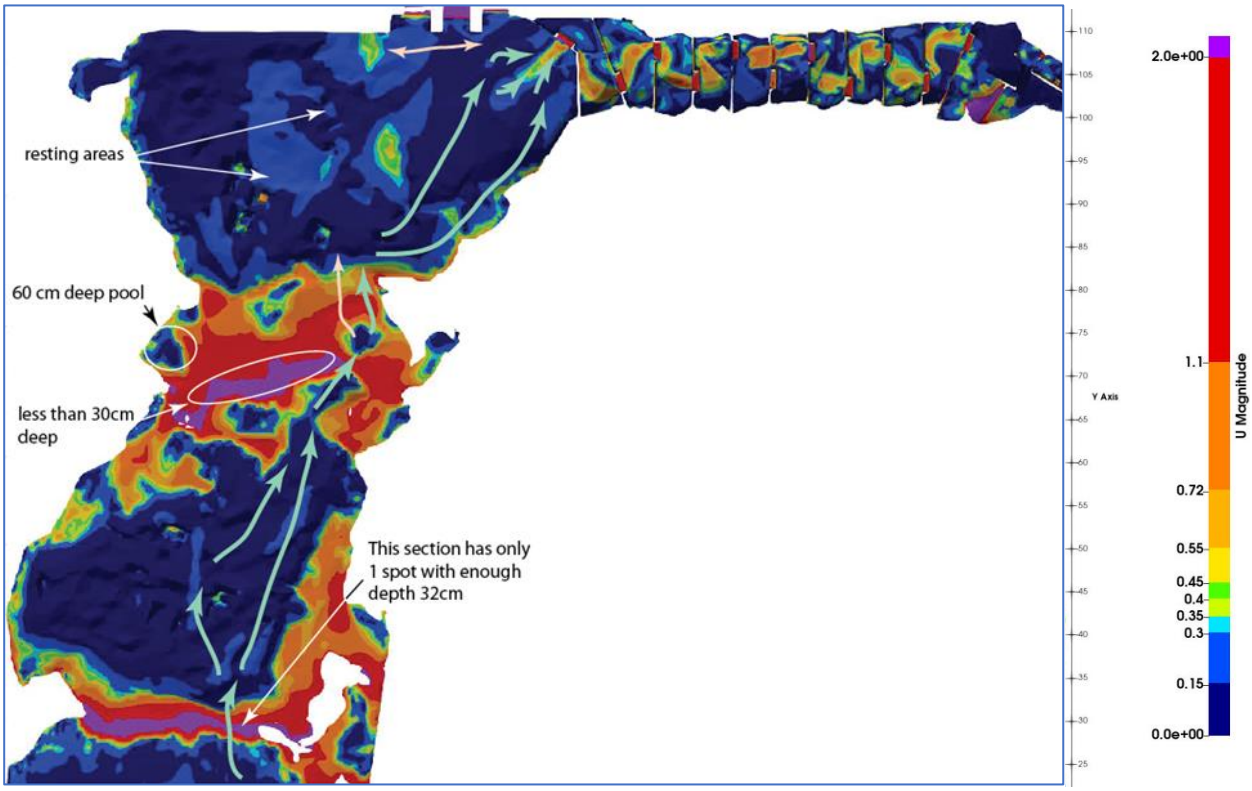


Figure 10:S1 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

The route through the deeper main channel is the only one with enough depth for multi-sea-year salmon to pass. This route has areas with a minimum depth as low as 32 cm. They are strong swimmers and will not have any issues with water velocities on this route.

In the pool below the dam, both lines here are well within swimming abilities of salmon. Those on the left bank will easily find the fishway. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross the main flow to find the fishway. At these flows Salmon will not have to go too far downstream to be able to cross the flow, as velocities near the streambed are well within their swimming abilities.

American eel

Elvers

Elvers can only navigate in the dark blue and medium blue colors (<0.3 m/sec). Velocities over the bedrock sills are too high for them to navigate.

Yellow stage eels

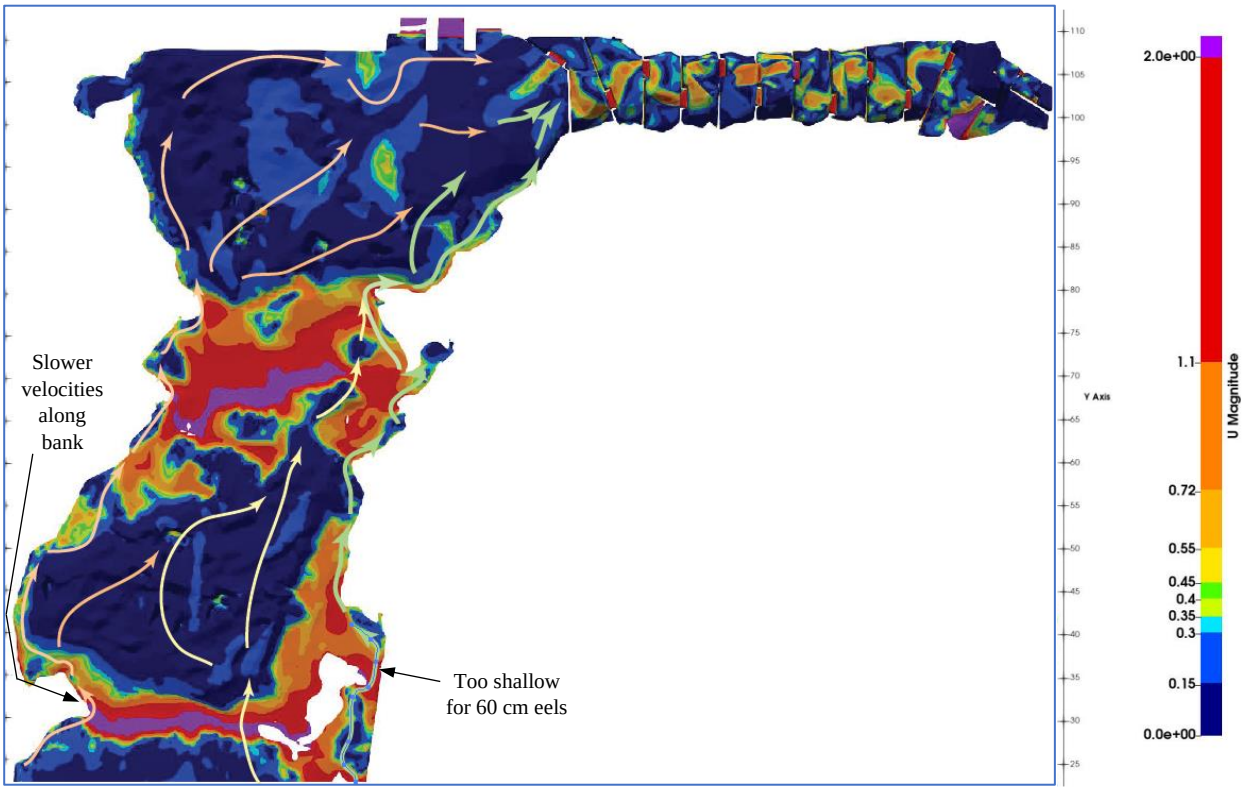


Figure 11: S1 routes for yellow stage eels shown on velocities 0.2 m from the bottom.

The yellow stage eels will be oriented to the bottom. They can navigate comfortably in the blue colors and can't go more than a few meters in higher velocities, so eels will struggle with the high velocities over the two sills but will find large resting areas in between and at the base of the dam to recover. For 97.5% passage they can't navigate in the dark orange, red, and purple colors. The passage rates derived from the model for 20 cm long eels would be very low, varying form 2.5% - 12.5% passage for the different routes, while passage for 60 cm eels would be close to 90%. Actual passage rates may be higher as eels can use small eddies between and behind boulders and large cobble for resting that are not shown within the level of detail of the model.

The orange route that goes up the right bank (looking downstream) from the dam and uses the low velocity water on the river margins, that are mostly under 0.3 m/sec. The eels will need to navigate through some faster water getting around the edge of the first bedrock sill. There is 4.5 m of fast water on the edge of the sill in the dark orange to red coloring, providing passage for the strongest 12.5% of 20 cm eels and 87.5% of 60 cm eels. This route along the right bank margin has around 10 cm of water in it at the shallowest of places, giving enough depth for both sizes of eels. There is a large resting area after the first sill where eels can spread out and rest before continuing along the right bank margins in low velocity water. At the point where the stream narrows near the large pool at the base of the dam there is another short area with higher velocities. In this area the eels can continue along the side and will need to swim through 1.5 m of water with velocities in the light to dark orange range. This short section will pass 87.5% of 20 cm eels and 97.5% of 60 cm eels.

There is a large resting area on the right side of the spill flows where eels can gather before heading towards the fishway. The velocities on the bottom are low, so eels will be able to pass under the spill flow towards the fishway. Eels over 10 cm will be able to go up the main fishway, but eels up to 50 cm long may choose to use the eel pass.

The yellow route goes through the thalweg. Using the deepest area over the first sill lowers the distance that the eels must travel through the fast moving water to 4 m. Velocities over the sill are up to 1.7 m/sec, which is too fast for most 20 cm eels. Passage over this sill will be 2.5% for 20 cm eels and 50% for 60 cm eels. Once eels are over the sill there is a large slow area for resting, where the eels will follow upstream along the bottom. There is some fast water again going over the second sill. Here, there is a deeper channel where the eels will be traveling that stays over 30 cm deep with slower velocities on the bottom. In deeper areas there is a good depth of slow moving water with a velocity under 0.15 m/sec, but in areas where the channel is shallower than 50 cm eels may experience higher velocities of up to 1.1 m/sec for up to 5 m. This section will pass 2.5% of 20 cm eels and 87.5% of 60 cm eels.

The green route follows along the margins of the left bank, looking downstream. One section, about 10 m up along the route is only 4 cm deep so 20 cm eels will fit but 60 cm eels would be partially out of water. In this route eels must swim 5 m through velocities between 0.7 m/sec and 2 m/sec, passing 12.5% of 20 cm eels and 87.5% of 60 cm eels. The route continues along the left bank margins. There are a few places larger eels may have to come further into the main flow velocity to get enough depth. They may have to enter velocities in the range of 0.45 m/sec - 0.72 m/sec for a few meters at a time. The larger yellow stage eels should be able to handle these velocities. There is a narrow area before the large pool at the base of the dam with velocities in between 0.7 m/sec and 2 m/sec along the left bank margin. This area will pass 12.5% of 20 cm eels and 87.5% of 60 cm eels.

From there eels will enter a large resting area and will be able to follow the flow to the fishway.

S2: 6 cfs from the fishway, 29 cfs from the louvre outfall, 165 cfs from the gates

This scenario has worse passage for gaspereau, trout, grilse, and eels, due to higher velocities, but better passage for multi-sea-year salmon, as the water depth increases.

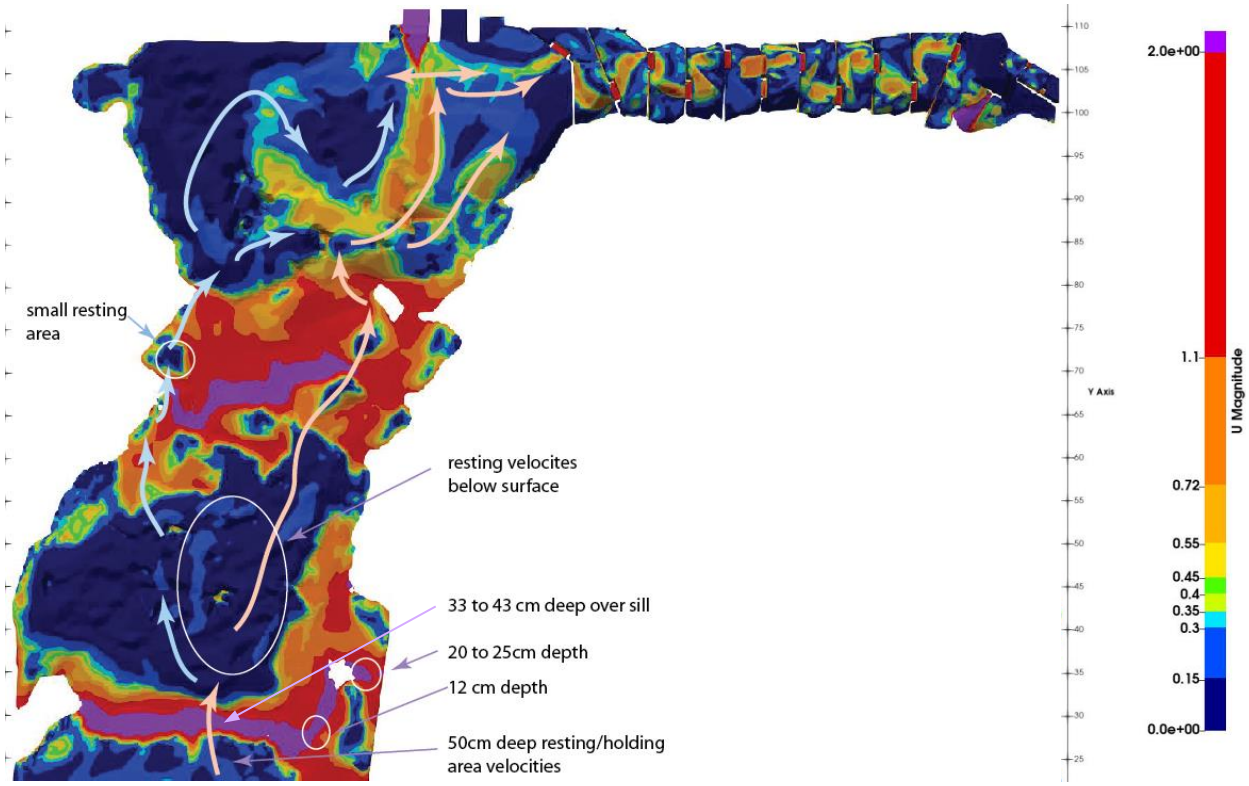


Figure 12: S2 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

Using the orange route gaspereau will have 12.5% passage overall. Over the first sill there is 5.5 m where the gaspereau must pass through velocities of up to 2.5 m/sec. 87.5% can pass over the first sill. Then they enter resting velocities present under the surface flows where they can recover. Over the second sill there are 35 m of fast velocities, mostly under 1.1 m/sec but with a short section with velocities up to 1.5 m/sec, that the gaspereau must pass through, giving 12.5% passage, due to the length of the section.

Using the blue route gaspereau will have 50% passage, but the size of the resting pool will limit the numbers that can use the route. After passing over the first sill, the gaspereau can rest and then head towards the right bank, looking downstream. They must pass through water velocities in the 0.55 m/sec – 1.1 m/sec range for 10 m, then pass through 7 m of water at velocities up to 1.5 m/sec, before reaching a small resting pool. From the resting pool it is another 10 m through velocities of up to 1.1 m/sec before the fish reach a larger resting area. This route will have 50% passage if there is room to rest in the small pool and 2.5% passage once the pool fills up.

There are other routes around the first sill, but none that offer better then 12.5% passage.

Trout

20 cm Trout will have poor overall passage in these flows. Using either route the passage will be 12.5%. On the blue route, once the resting pool is full of fish the passage will be reduced and will be 2.5%.

Salmon Grilse

Grilse will have around 50% passage using either route. They will not need to use the resting pool on the right bank.

Multi-sea-year salmon

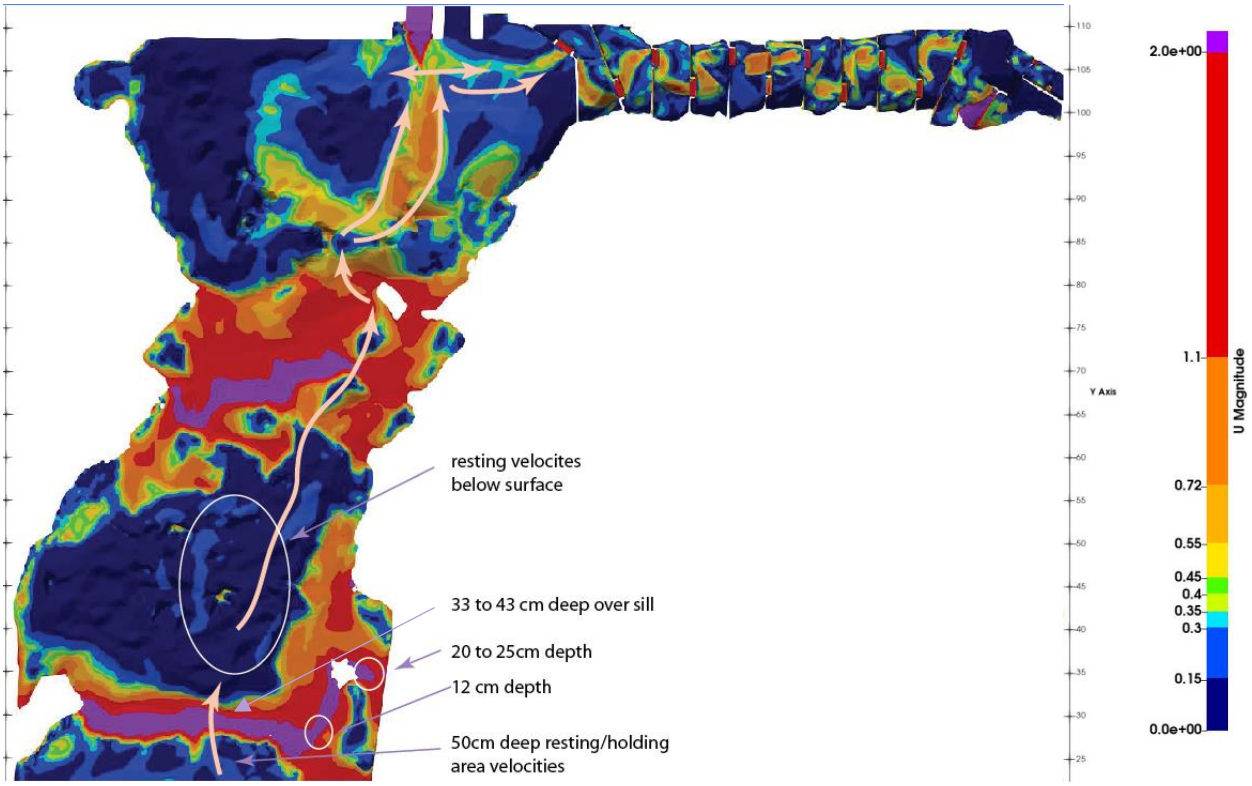


Figure 13: S2 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

There is enough depth in the main channel for multi-sea-year salmon, with 45 cm over the first sill in the thalweg. The velocities going over the first sill are less than 2.5 m/sec. Multi-sea-year salmon are strong swimmers and should be able to overcome these velocities since the distance is only 4.5 m in the high velocities. The salmon can rest after going over the high velocities at the first sill. Then they will continue 35 m through mainly dark orange with a short section of red to the resting areas below the dam. 97.5% of multi-sea-year salmon should be able to swim against these velocities.

American eel

Elvers

The water velocities over the sills are too fast for elvers. Any passage will be along the very edge in shallow areas or back eddies.

Yellow stage eels

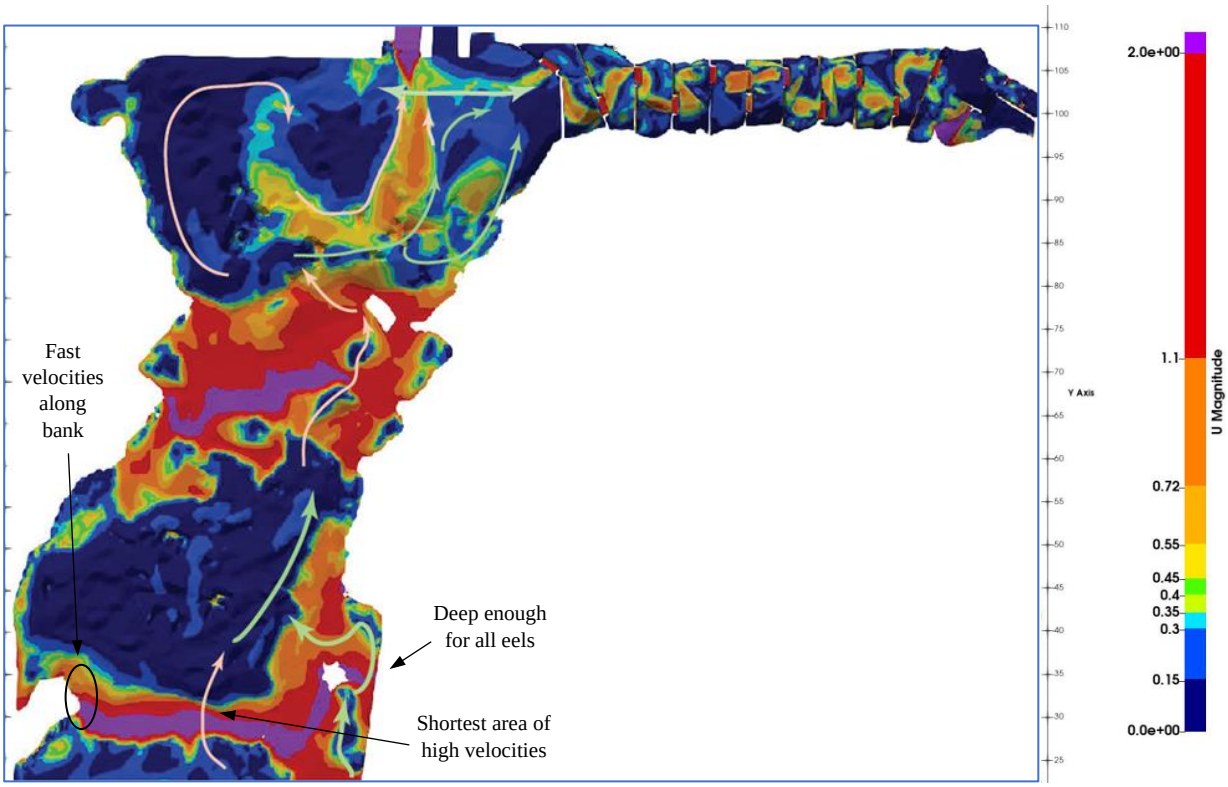


Figure 14: S2 routes for yellow stage eels on velocities 0.2 m from the bottom

Some yellow stage eels will be able to navigate up to the fishway with 165 cfs of spill, but there are areas of fast velocity that will prevent the majority from being able to get past. The velocities will prevent the smaller 20 cm long eels from getting up, but a small number of larger eels will be able to get up. Both routes will pass 12.5% of 60 cm yellow stage eels.

S3: 6 cfs from the fishway, 29 cfs from the louvre outfall, 925 cfs from the gates

At these flows the resting areas in the middle of the channel are almost gone, but there are some eddies with resting velocities that form on the right bank, looking downstream, for fish that are strong enough swimmers to make it over the first sill. Velocities over the first sill are too high for gaspereau, trout, and eels. There will be limited passage for Salmon.

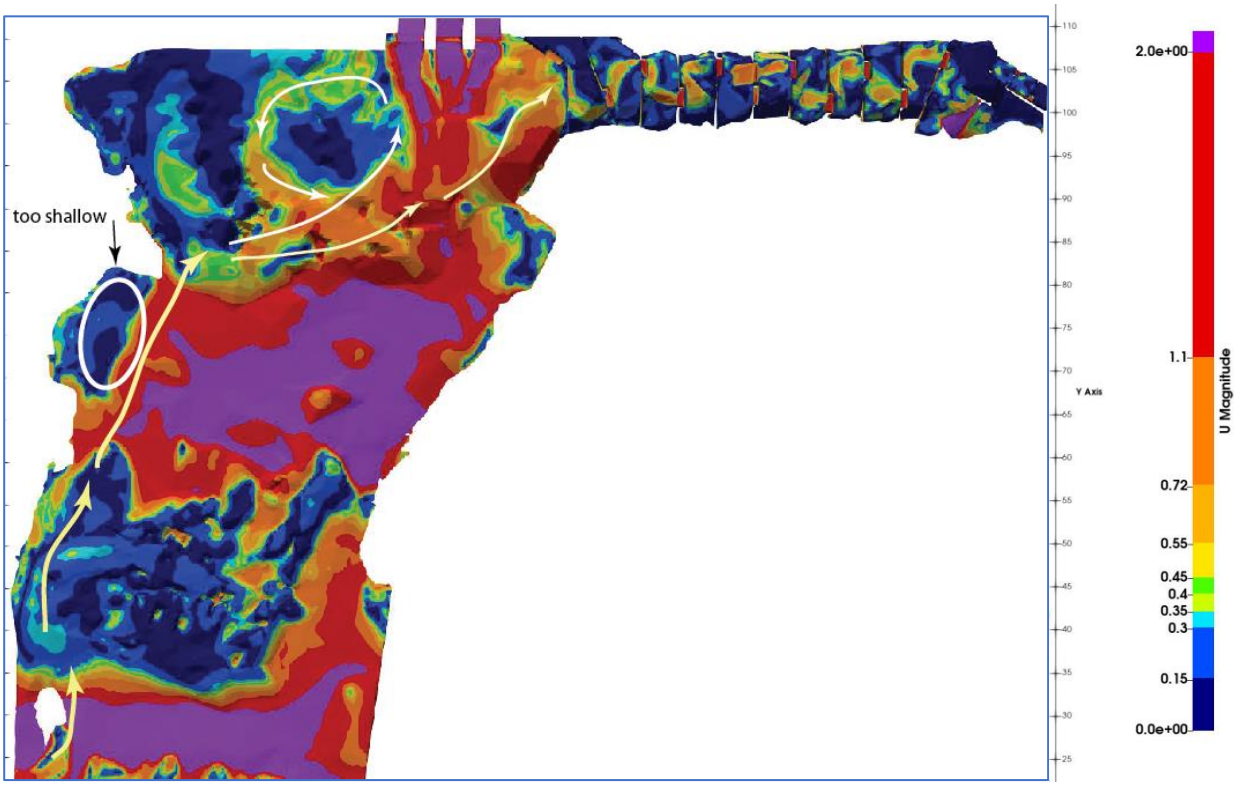


Figure 15: S3 routes for salmon on velocities 0.2 m from the bottom

Salmon Grilse

Grilse will have 12.5% passage.

multi-sea-year Salmon

Multi-Sea-Year salmon will have 50% passage to the dam. Over the first sill fish must pass through water with velocities up to 2.5 m/sec for 20 m in the model, but with unknown distance from the downstream resting areas this may be limiting. Over the second sill fish must pass 30 m of water in velocities up to 2 m/sec which should be passable if they rest between the sills.

S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates

Velocities are too high for passage.

S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates

Velocities are too high for passage.

S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates

Velocities are too high for passage.

S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

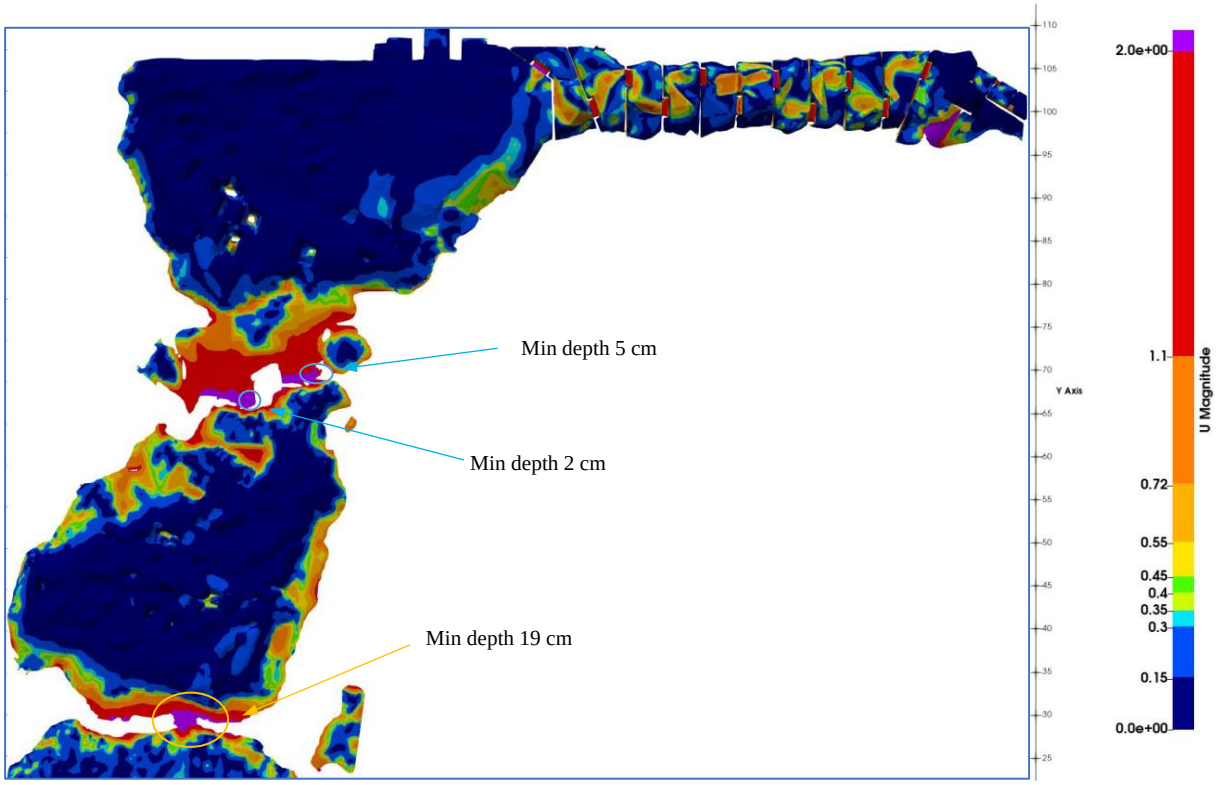


Figure 16: S7 velocities 0.2 m from the bottom

There is no passage in this scenario. The deepest area for passage over the second sill is only 5 cm deep, which is too shallow for gaspereau, trout, salmon, and larger yellow eels. Elvers and smaller yellow stage eels would have enough depth to pass, but the velocities over the sills are too high.

Conclusion

The fishways and eel pass will provide good passage for the fish that make it up the river to the dam. Attraction flow to the fishway is good with a volume of 35 cfs of attraction flow against a gate flow of 65 cfs in the first scenario, which is normal operations. The addition of 50 cfs supplementary flows as required should provide enough depth of water over the sills for all salmon as the flows are just slightly to shallow for the multi sea year salmon without these additional flows. The duration of the supplementary flows at 12 hours each is good as it allows for better passage of the other species in between. Care should be taken in using this flow all the time when salmon are present as it would limit the passage of other species.

The fishway /louvre flow of 35 cfs is not sufficient to provide fish passage in the river below the dam. This has not been an issue due to the leakage of at least 65 cfs from the stoplogs. However, the new dam will not have this leakage so the 65 cfs should be provided to the river through the gates on an ongoing basis.





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APPENDIX H – ASSESSMENT OF UPSTREAM AND DOWNSTREAM FISH PASSAGE

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To: Kailey Osborne, BMgmt, EP
Environmental Scientist
Nova Scotia Power

January 31, 2023

Re: Ruth Falls Fish Passage Assessment

Introduction

Nova Scotia Power (NSPI) has requested an assessment of the existing downstream and upstream passage and a concept design be developed for changes needed to improve passage and to work with the proposed refurbished dam at Ruth Falls. The detailed engineering drawings will follow based on the recommendations of this concept design and review by NSPI and the regulatory government departments. This report gives an overview of the upstream fish passage and modifications and refers to the more detailed reports for the downstream passage louver upgrade, upstream fishway passage and eel pass, and the in-river fish passage routes and related issues.

Upstream passage

The fishway at Ruth Falls dam is a pool and weir fishway with two distinct sections.

The upper section is a concrete fishway with 1 ft drops between pools, the pools are 8 ft wide by 10 ft long, each pool is 2 ft deep at the top end and 3 ft deep and the downstream end with a sloping floor. There is a fish trap in the top pool then six pools down to a large corner resting pool that turns the fishway approximately 135 degrees to the right followed by 6 more pools for an overall drop of 13ft. The notches are 3 ft 3inches wide and against the outside wall in an alternating pattern. The top inside corner of the notch is curved on a 6-inch radius. The notch crest has a 4inch flat area at the upper end dropping on a 2H:1V slope over 2 ft for a drop of 1ft. Running with 1ft of water at the crest of the notches, the water level in the pools below is at the crest of the notch above. The fishway is required to be run at 12 inches of flow over the crest of the notches. Water flow is approximately 5.56cfs with this type of notch with the 1ft depth in the notch with the sloping backwatered apron verses the 6cfs that would be the flow from a sharp crested weir. So, some small variation of the flow above the 1ft depth is acceptable.

This upper section is a concrete fishway connects to a **channel fishway** section running along the toe of the dam that is cut into bedrock with concrete weirs across the channel each taking a portion of the head drop to the river. The drop through this section is 8.35ft with nominal river

level and the drop is taken up on 7 weirs. The first weir is located approximately 35 ft downstream of the concrete fishway then the weirs are spaced at 20, 25, 15, 25, 20, and 20ft apart. These fishway channel weirs currently have various drops on the weirs ranging from 1.63 ft to 1.17 ft and notches 1.75 wide and 1.67 deep. The three lower weirs have a 1V:2H sloping floor in the notch, the upper 4 weirs have level floors in their notches. Under the 5.6cfs fishway flow these notches run full. These weirs do get additional flow from the leakage through the stoplog sections in the adjacent spillway, but the amount is not known. From observations this leakage backs the water up on the lower notches so the flow is over the weirs but has no effect on the uppermost notch. The upper weir does not properly back the water up on the notch in the entrance to the concrete fishway which should be higher up to the notch crest height.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events of 50cfs are released immediately downstream from the discharge point for a minimum of 12 hours released overnight, when Ruth Falls headpond elevation is at 33.3m (109.4ft). These supplemental flow events are scheduled to complement natural significant inflow events, where a significant inflow event is defined as greater than or equal to 24mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. These flows are intended to attract salmon out of the tide and to migrate upstream. When salmon have been caught in the fishway trap these flows are to continue nightly. This flow of a total river flow of 150cfs has not been modeled.

When the new dam is built there will be no leakage or additional flow available for this channel section of the fishway.

Pool and Wier fishway design background

Pool-and-weir fishways are very sensitive to water level fluctuations at both the upstream and downstream ends.

In these fishways, low tailwater levels will result in a high drop out the entrance notch increasing velocities and reducing or eliminating the backwatering of the notch which is important for fish passage. High tailwater levels will lead to drowning of the fishway entrance and, consequently, poor fish attraction flows with low velocities. The entrances are often supplied with additional attraction flow, and this aids entrance attraction flow conditions during fluctuating water levels.

Changes in the upstream water level affects the turbulence conditions in the fishway pools. High water levels increase flows through the fishway reducing or eliminating fish resting areas due to turbulence in the pools limiting fish passage. A very low upstream water level will result in low discharges and very shallow or no water depths in the notches passable by the fish. The water surface in the pool below the notch should be equal or above the crest of the notch. With low flows, shallower depths in the notches than designed for, drops the pool water surface below the crest of the notch making fish passage more difficult. Water depth should also be at least 1/3 the

body length of the fish requiring passage. So, the 1ft depth is the minimum for multi-sea year salmon.

It is very important that the fishways operate with the flows and drops between pools they were designed for with very little water level fluctuation. Any fluctuation should be above the design water depth for the notches.

Fishways at most NSPI sites are designed as what has been termed "salmon" fishways as historically the fishways were designed only for anadromous salmon on their spawning migration as this was the focus in the Department of Fisheries and Oceans (DFO) and was the Salmon section of the Science Branch the fishway engineers were in who developed the designs and provided the federal *Fisheries Act* approval. That is the case for this fishway. What makes them "salmon "fishways is the turbulence in the pools which is created as the notch flow velocity dissipates the energy of the drop as it reaches the pool bottom, upwells on the downstream weir, turning back and across the pool upwelling on the side opposite the upstream notch then down the next notch. So, the drop between pools, the volume of flow, and pool size length, width and depth that make up the water volume in the pool are important when looking at passing species and age classes other than the upstream migration of salmon spawners. The various species deal with the turbulence in the pools differently and most require more frequent resting areas than the salmon. Salmon also arrived in relatively small numbers, moved though the fishway quickly not needing to rest in these relatively short fishways in Nova Scotia. Gaspereau are at the other extreme arriving in large numbers and requiring resting areas while passing through these fishways. Crowding in the pools is also an issue that can slow down or even stop passage so the fishway has to take the numbers of fish at a given time into the design consideration.

This basic "salmon" design was then copied with some minor modifications to dimensions for other salmonid species, gaspereau, and in a few cases smelt. This was done by designing the fishways to operate with a lower drop between pools generally 8 to 9 inches for gaspereau and 6 inches for smelt while maintaining the 8ft wide x10ft long x 2 to 3 ft deep pools. These lower drops between pools lowered the velocity some in the notches while still backwatering the notches, but mainly by reducing the flow volume so there was less energy to dissipate resulting in less turbulence in the pools and in turn more resting areas. The flow volume can be reduced by narrowing the notches where the pool turbulence is too high, which also allows for them to be backwatered more improving passage. The burst or sprint swim speeds for the short distance through the notches are greater than the velocities with the one-foot drop between pools for all migratory species but the gaspereau and smelt do not have the endurance the salmon have, so need those resting areas in the pools provided by the lower flow volume into the same pool size. The same is true for the smaller and weaker swimming fish species. It is that greater energy dissipation in the pools for the volume of water dropping into the pool that makes the distinction between fishway types. The lower drops still maintained the notch design including having the pool water surface level at least equal to the notch crest but work better for all fish species if backwatered preferably by a minimum of 2 inches or 20% of the notch depth above the crest. This design feature changes the flow in the notch from a fully plunging flow if there was no

backwater on the notch slope, to one that is a combination of plunging and streaming flow. This improves passage for all species. It also introduces the flow deeper in the pool below and that increases the energy dissipation resulting in lower turbulence and velocity in the pools and more resting area.

The Ruth Falls upper concrete fishway

At Ruth Falls the water elevation in the pool below the notch is designed to be at the level of the notch crest when there is a 1ft deep flow in the notch. This is the proper operational water depth for this fishway and is acceptable for the passage of all the major species.

This concrete fishway should be operated with a 1ft of flow depth or slightly above through the notches to meet the design criteria. If it is observed during monitoring that the pools do not provide enough resting area for the number of weaker swimming fish present then the notches can be narrowed from the wall side to reduce the fishway flow while maintaining the notch depth and pool volume there by reducing the pool turbulence providing more resting are for gaspereau, smelt, suckers etc. while keeping the notch operating within parameters. The modeling of the fishway and the operation with 1 ft water depth in the notches, and observations of the flow patterns, confirm the turbulence in the pools is good providing resting areas and needs no adjustment with the expected numbers of fish.

The lower fishway channel and entrance

The current attraction to the fishway entrance is poor with the louver flow at a minimum of 29cfs coming out at right angles to the river flow and the water from the spillway aligned with the river flow boxing in the 5.6 cfs fishway flow. This is causing the fish to collect either downstream of the louver flow or on the right side of the gate flow missing the flow from the fishway. It is not known what the current flow is out of the channel section of the fishway is as in addition to the 5.6cfs of the concrete fishway flow it collects additional flow from the stop log spillways along its right side. When the fishway is run at 1 ft deep and a flow of 5.6cfs plus the leakage and additional supplemental flow of 50cfs it is more competitive with the other flows but still boxed in. This large supplemental flow overtopping the weirs creates very turbulent pools between the weirs and is particularly bad at the narrow weirs with shorter, shallower pools. With the new dam these additional flows, both the stoplog leakage and the supplemental 50cfs flow, will be eliminated from this part of the fishway and relocated to the spill gates.

Eel passage past the dam is possible as indicated by the population upstream but they must pass through the existing fishways to get upstream. This is limited to the larger eels that can swim through the fishway velocities.

Changes to provide improved fish passage at the refurbished dam

To provide attraction flow from the fishway and eliminate the larger flow from the louvers, just downstream of the fishway entrance, the louver flow will be realigned to the top of the fishway channel as described within the downstream passage report. This will provide a combined

fishway minimum flow of 5.6cfs with a minimum louver flow of 29cfs for a total at least 34.6 as attraction flow at the fishway's river entrance. To properly accommodate this flow in the fishway channel, the 7 existing weirs are to be replaced by 11 new weirs each with a 0.75 water drop, 11ft wide by 1.75 deep notches with sloping on at 2H:1V, backwaterd over the crests of the notches by 1ft. Pools between the weirs will be at least 4ft deep with the notches are running at 1.75 depth over the crest of the notches, and a weir width of 25 ft bank to bank. The modeling of the flow pattern and velocities in the pools and notches has shown that this design will provide easy passage though this section of the fishway for the fish including resting areas in each pool.

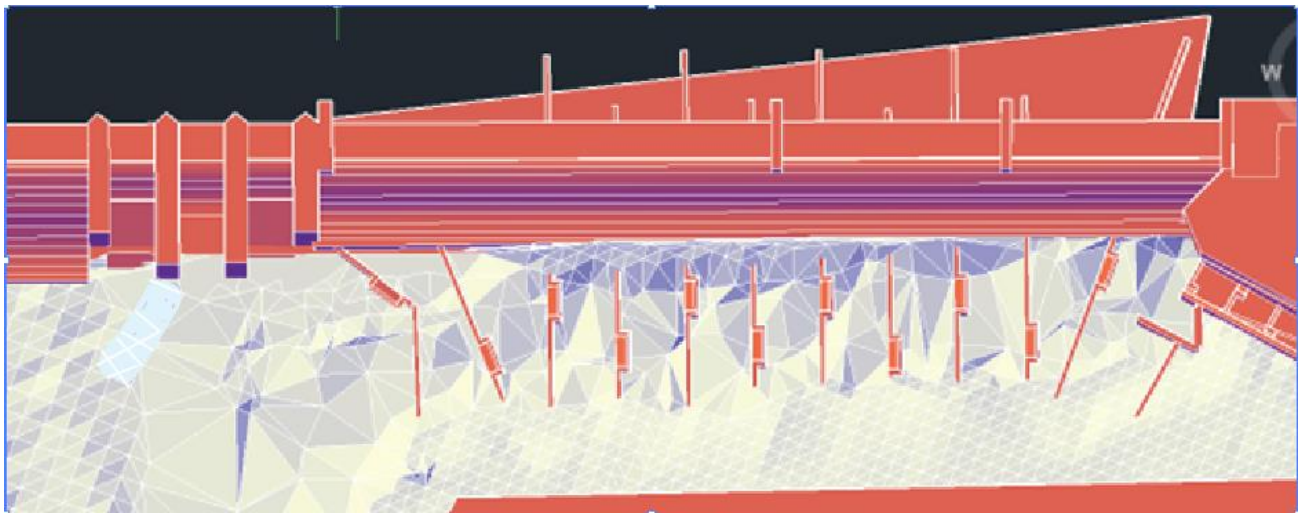


Figure 1: The layout of the 11 channel fishway weirs

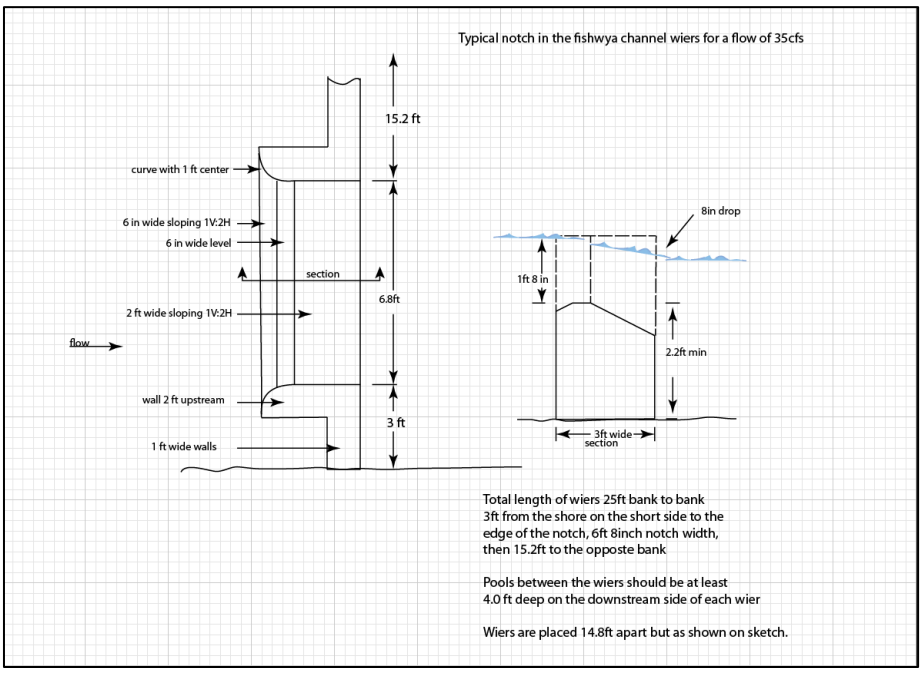


Figure 2: Design details of the notches in the channel fishway weirs

It is preferable to have the fishway entrance flow at least 10% to 15 % of the river flow, if possible, to attract the fish. The upper concrete fishway flow of 5.6cfs provides 16% of the combined fishway and louver flow in a small area where the two flows meet at the top of the fishway channel with its new baffles. At the entrance to the fishway at the river the percentage will vary depending on the flow from the gates but at the minimum flow of 65cfs from the gates the fishway flow will be up to 39% of the total flow. During higher river flows they could go as high as 390 cfs and still meet the 10% criteria.

Additional fish passage for eels

One species that cannot use the fishway effectively are the smaller American eels. Having the louver flow moved to the fishway as attraction flow, the river flow currents will lead the majority of the eels to the downstream corner of the lowest fishway notch. The upstream eel pass entrance is to be located at the downstream corner of the fishway entrance. See eel pass report for more details.

Eels tend to be smaller near the tide and Ruth Falls is close to the tide, so designs have to accommodate the 0+ year class. There are some challenging natural sections for these young eels in the river below the dam but there are likely locations along the bottom or along the shore they can use for migration over these natural sections particularly under low flows. For this reason, an eel pass is designed to provide this passage for the smaller eels. The lower channel fishway with its drowned weirs and the concrete fishway when the weirs are backwatered with 1 ft of flow allow eels larger than 15cm long to use their burst speed over the notches along the bottom and especially in the bottom corners of the notches where the velocity is lower. Passage is also available through the 3-inch diameter drain hole in each weir. Details regarding the eel pass are outlined within the upstream eel passage report.

Downstream passage

The diadromous fish need to come back down past the dam at some point in their life cycle and resident species may choose to migrate down seeking suitable habitat. Some may come back down through the fishway or exit through the gate flows, but it is expected most will follow the power cannel flow and be led through the louvers. The louvers are currently of the best designs used to date for downstream passage but there are a few improvements that can be made at this site. Eels travel along the bottom and do not guide well with currents at louvers so a solid wall fitting tight to the bottom is needed guide them to the exit. Bottom outlets are best for eels, or they need to be led up to the surface outlet. To do this a slated ramp is to be installed to lead them up. See the louver report for eel behaviour and design requirements for downstream passage.

For all fish the velocity into the louver exit is good but below their burst speeds. Then they reach a series of partial barrier stop log sections that they have to go up and over. As a partial barrier these sections will cause many of the fish to return back upstream. To prevent movement back up and out of the louvers a trap funnel will be installed, and the stop log sections will become

orifices vs the overflow weirs in the concrete transition channel. This will ensure quick passage through a barrier free transition channel to the louver outflow pipe. See the downstream passage louver report for more details.

Louve pipe outlet is designed to discharge into pool sized to dissipate the energy from the head drop through the piped section and then the vertical drop into the top pool of the channel fishway section. The pipe can come down from the end of the louver system's concrete transition channel on a 3% slope which leaves a 6.45ft drop into the 4ft deep pool. This stays within the USFW guideline for safe downstream passage.

Summary

This completes the full loop of fish passage from the upstream river passage routes, the fishway sections and the downstream louver system discharging between the two fishway sections to provide good attraction flow to the fishway at the river.

Figure 3 provides a diagram of the location of the proposed changes. To the left of the figure and running along the toe of the spillway with its rubber dams are the series of 11 new fishway weirs in the fishway channel. These weirs are designed to have velocities and water depths for passage for all species and to carry both the concrete fishway flow and the louver flow. Above that is the existing concrete fishway which meets design standards for a good fishway. Running alongside of these fishway sections, as a blue line in Figure 3, is an eel pass for the smaller life stages of eel. This eel pass is a design that is commonly used in Europe and around the world. This completes the upstream passage. Downstream passage is through the fishway and gates but primarily through the louvers in the power canal. The louvers with their solid wall along the bottom, guide ramp to the outlet, and swimming depth passage through the transition channel to the outlet pipe removes the existing partial barriers to downstream passage for all species. They then complete the journey down the lower portion of the fishway to the river.

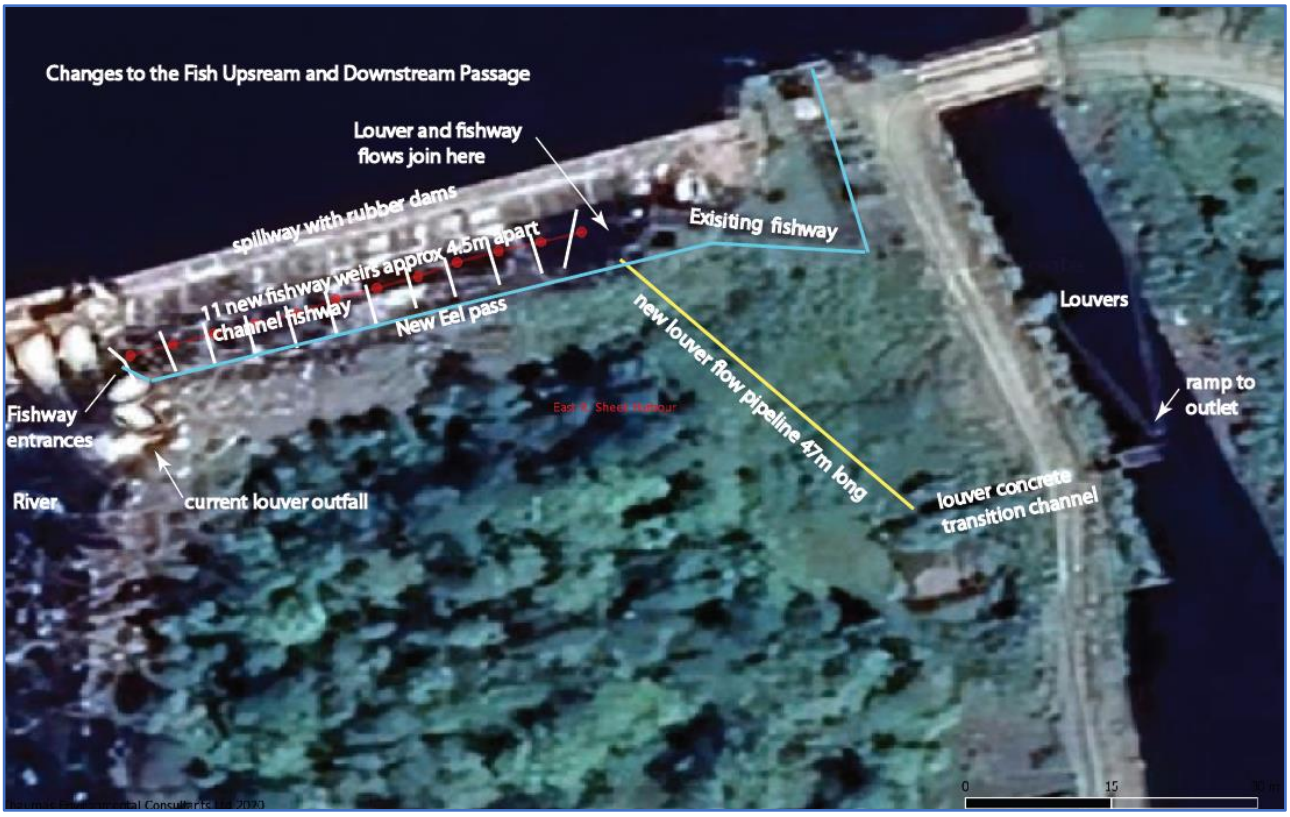


Figure 3: The overall layout of the fish passage facilities

Conclusion

Fish passage that meets or exceeds modern fish passage criteria will be provided for all species that need to migrate past the Ruth Falls dam to complete the life cycle with a few modifications to the existing fish passage facilities.

The new dam will eliminate the spill along the lower channel portion of the fishway and this required changes to be made to provide good attraction flow to the fishway entrance at the river. To provide this attraction flow the louver flow carrying the fish downstream will be diverted into the top of the channel section of the fishway. The existing 7 weirs with various head drops and notch designs will be replaced by 11 weirs with large, drowned notches to carry the additional flow without over topping. This will provide good passage for all the required fish species.

The additional eel pass will provide the latest eel pass design for upstream passage of elvers and small yellow stage eels.

The downstream passage already has a set of well-designed louvers, but the efficiency has been compromised for the benthic species, eels and suckers, by raising the outlet 5 ft above the bottom. A sloping ramp to lead the fish up to the outlet combined with walls along the bottom of

the louvers will greatly improve efficiency. The passage was further hindered by stoplog overflow weirs in the outlet transition channel combined with the slower bottom and mid water velocities the fish could swim against to return to the power canal. These have been replaced by a trap funnel to limit fish from returning upstream and orifice openings in the stop logs to remove these barriers and maintain the velocity through to the pipe. Returning the fish through the pipe diversion shortens the length and the overall drop brings this flow in halfway up the fishway. Taking the fish down the fishway will help those returning to find the fishway entrance.



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APPENDIX I – DOWNSTREAM LOUVRE ASSESSEMENT

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January 31, 2023

Re: Concept Design Report -Downstream Passage of Silver Stage Eels at Ruth Falls Dam – Draft

1. Introduction

Nova Scotia Power Inc (NSPI) requested a condition assessment of the louver system which forms a part of the fish diversion structure at the upstream end (entrance) of the power canal at Ruth Falls Dam. NSPI also requested a concept design of improvements to the louver system to increase it effectiveness in bypassing silver stage American Eels (*Anguilla rostrata*).

2. Site Visit

On May 31, 2022, Thaumas Environmental and Wood Canada Limited (Wood) visited the fish diversion louvers at the entrance to the Ruth Falls power canal in Sheet Harbour, NS. The purpose of the site visit was to determine the current configuration of the louvers and the overall fish management infrastructure at the site. It was also an opportunity to understand how the louvers are currently functioning, and to assess what opportunities there are for improving downstream American silver eel (*Anguilla rostrata*) passage at the site. A second visit to assess the condition of the louvers for damage to the louvers and attachment to the bottom was not done as the headpond was not drawn down as originally planned in 2022. It is noted we do not know what the condition of the louvers were during the 2009/ 2010 eel passage study conducted by NSPI. Another site visit was undertaken on October 20th, 2022, to check the flow volume through the louvers and to take a second look at the overall configuration.

3. History of the Fish Diversion Louvers

The louvers were originally installed in 1966 as a downstream bypass and counting facility for the passage of Atlantic salmon smolts. The louvers have been modified several times since then to improve smolt passage based on studies on smolt behaviour and passage rates from 1967 to 1971. In 2005 Nova Scotia Power contracted Alden Research Laboratory, Inc. to assess the louvers and provide an Engineering and Biological Assessment Ruth Falls Fish Deflection Facility, authored by Gregory Allen (Allen 2005).

Major changes were undertaken during the rebuild of the louver bypass exit and monitoring shed operations based on Nova Scotia Power plans dated in 2006.

Initially the louvers had a bottom outlet pipe. However, it was found that the migrating salmon smolts were concentrated in the upper 4.5 ft of the water column so the louver exit / bypass entrance was changed to provide a surface outlet that used less water and improved surface velocities and attraction for the smolt. The bottom outlet pipe was reportedly filled with concrete as part of that modification.

The powerhouse intake canal is located adjacent to the dam's east abutment. The louver facility is located about 75 ft downstream of the canal entrance. The intake canal was reconstructed and widened in 2000 downstream of the louvers to improve the conveyance capacity of the canal to the powerhouse to its original design flow rate. The original intake canal where the louvers are located is approximately 42 ft wide at the top bank, a bottom width of 14 ft, and bank slopes at 1:1 (H:V). Downstream of the louvers the canal widens to a top width of approximately 100 ft and a 25 ft bottom width. The louvers are shown in Figure1.



Figure 1: Looking downstream at the louvers May 31, 2022

4. Description of the Louvers

As shown in Figures 2 and 3, the louvers are arranged in a V pattern across the intake canal and consist of steel bars orientated perpendicular to the flow. Each leg of the V is approximately 50 ft long and orientated 12 degrees to the approach flow with a fish bypass located downstream at the vertex. As shown in Figure 4, the louver bars are 2 inches apart and extend from the bottom of the canal to a top walkway deck at elevation 114.0 ft. Every sixth bar (12 inches) has a flow straightener extending from the bar in an arc that forces flow to exit the louvers parallel to the

canal. The fish bypass is located at the vertex of the louver V array. As previously noted, the original bypass entrance design extended the full depth of the intake canal. Testing conducted in the late 1960's suggested optimizing the entrance design by blocking off the lower 5 ft creating a surface bypass and increasing the bypass velocity. The bypass entrance is 18 inches wide with an invert at El. 104.0 ft. (Allen et al 2005). The 2006 modifications built a new bypass entrance with the bottom 5ft closed off by a concrete block that supports a metal bypass with 18-inch-wide vertical opening curving 90 degrees and widening to 6 ft wide and 4 ft deep into a concrete channel. The operating water depth in the channel is 2 ft at 29 cfs minimum flow. This channel incudes the diversion to the monitoring shed and ends with the inlet to a 32-inch diameter pipe that carries the flow to the river where it drops into the river just downstream of the fishway entrance and at right angles to the spill gates.



Figure 2: Looking upstream at the louvers May 31,2022

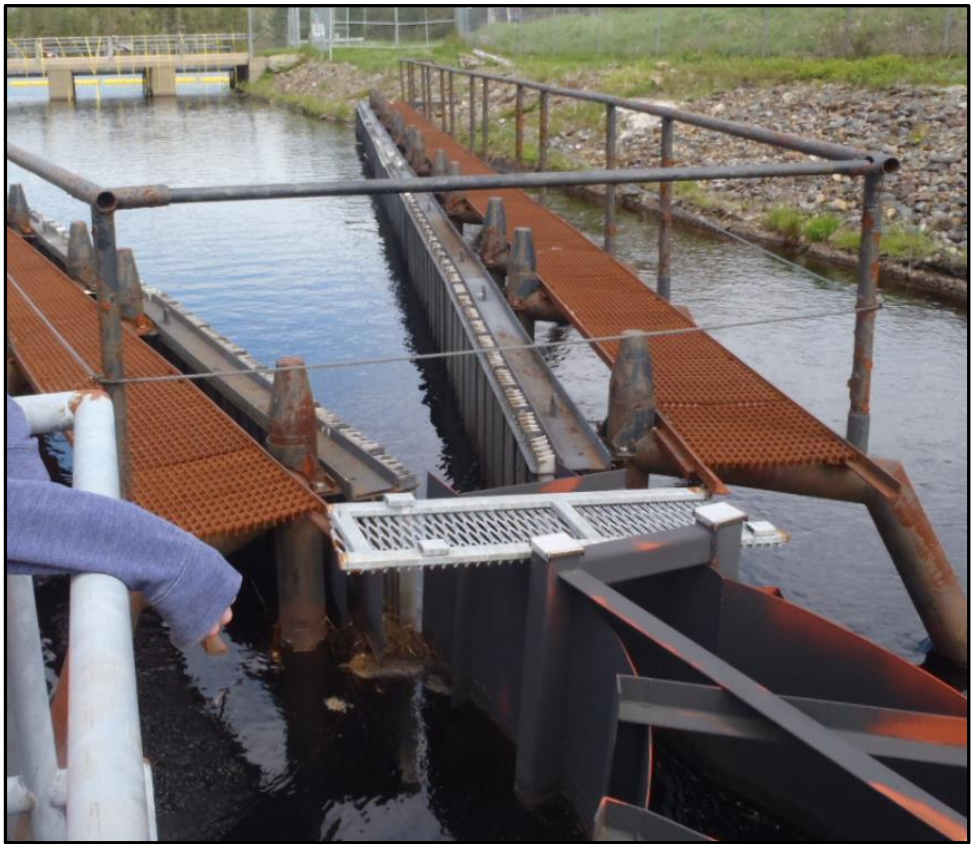


Figure 3: Looking at the louver /Bypass connection gap May 31, 2022

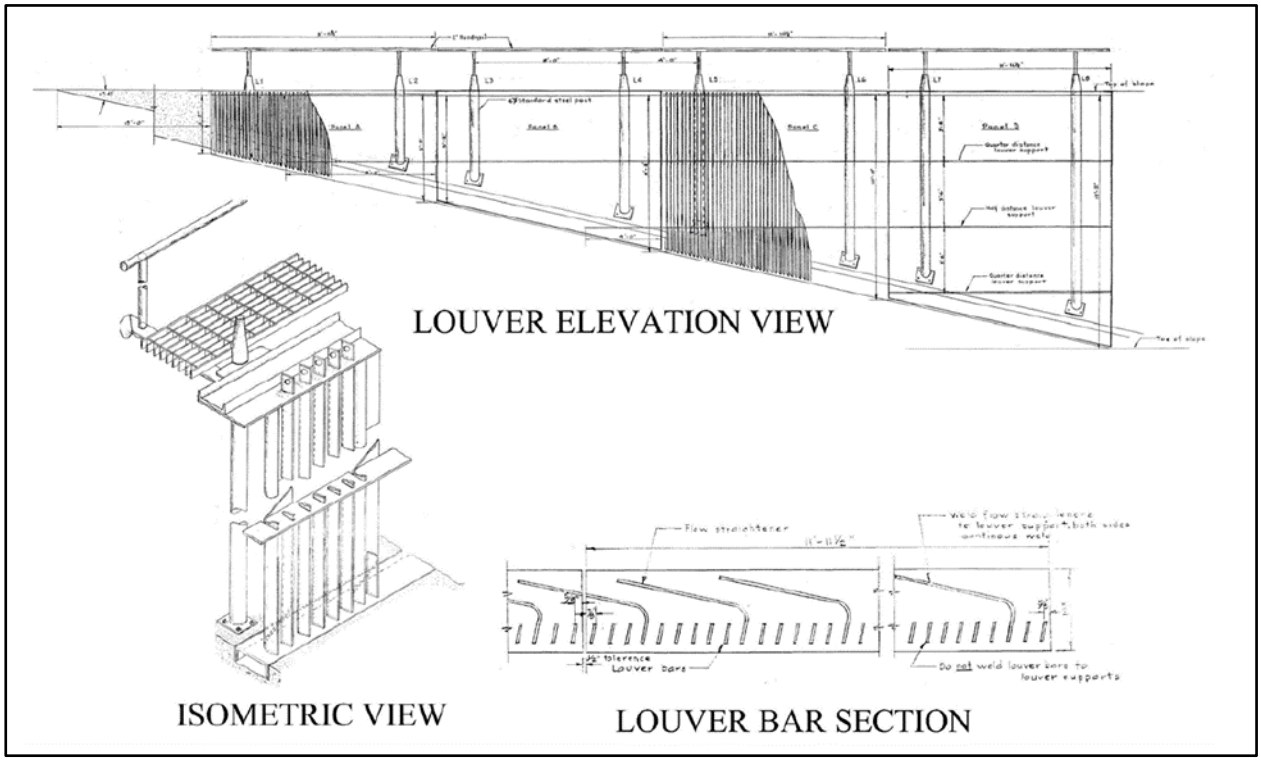


Figure 4: DFO Louver design from Ducharme 1972

Louvers can be very effective at guiding all fish including eels to a bypass if properly designed (Beck 2020) and modeling conducted at the Alden Research Laboratory (Allen 2005). Guiding angle is very important and (Amaral 2003) found a 15-degree angle to the flow was better than a 45-degree angle. In Ruth Falls the angle is even better at 12 degrees to the flow. The effectiveness for most species was very high when the flow velocities were good, and they are at Ruth Falls (Allen 2005) so eel fish guidance efficiency (FGE) should be in the 90% range.

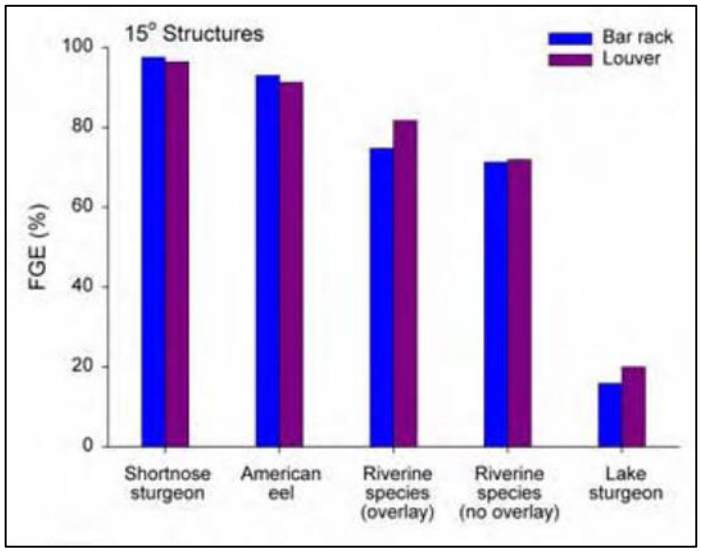


Figure 5: from Amaral 2003

The one thing that is missing at Ruth Falls that they found added efficiency for eel guidance is a barrier along the bottom (termed overlay). Figure 6 shows the difference they found with and without the barrier along the bottom.

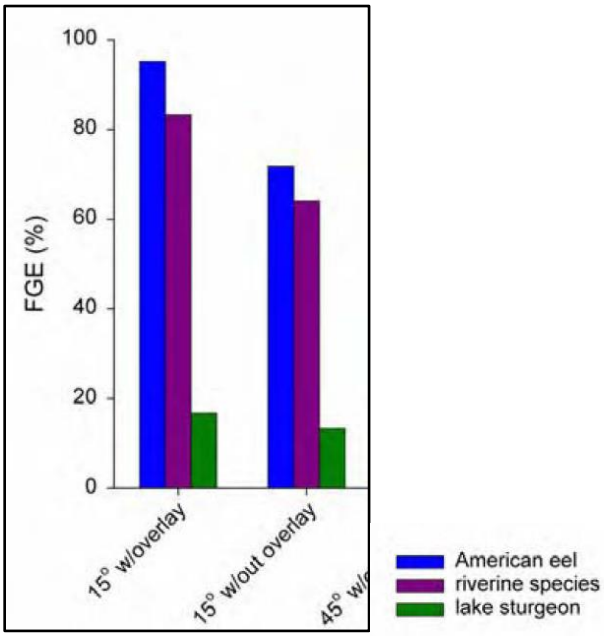


Figure 6: from Amaral 2003

So, since the basic design is good we need to look at how it is working and how it can be upgraded to work better.

5. American Eel (*Anguilla rostrata*) Silver Stage Downstream Passage

With the recent focus on the American eel, NSPI has been asked to review potential options for improving the effectiveness of the louvers to bypass downstream migrating silver stage American eels.

NSPI studies in 2010 indicated that of 30 acoustic tagged silver stage eels released above the headpond, all reached the dam, 21 (70%) were detected in the power canal downstream of the louvers, of those 8 were detected down river, and another 9 detected downstream either used the louver bypass, the fishway, or the spillway, for survival of 56.7%. There is no information on the detection efficiency of the receivers in the river below the powerhouse and this is especially important as the assumption of mortality rates is not sound if the detection rate was low as those not detected were assumed to be mortalities. This river section likely required two recorders in this channel on opposite sides to get a high detection rate. The observed results for the louvers efficiency are poor as 21 of 30 were below the louvers in the power canal at one point in their migration.

Eels are known to actively search for a downstream passage route near the bottom of the water column in forebays of structures such as hydropower stations and navigate by following the walls and bed of the headpond or power canal until the reach a barrier then they venture higher in the water column looking for a way downstream (Piper 2015) (Brown 2009) (Haro 2000). Consequently, bypass location will influence the ability of eels to find the bypass entrance. Flow is one of the main drivers for the downstream spawning migration and thus providing an attractive flow at the entrance to the bypass increases the likelihood of eels successfully locating the entrance and subsequently entering. However, they do not necessarily follow the greatest flow past a dam (Piper 2015). Understanding the swimming capabilities and behaviour of emigrating eels at a particular site is essential to ensure that they enter the bypass eventually encounter water velocities that exceed their burst swimming speed, hence preventing them from swimming upstream against bypass flow or a restriction that prevents them from moving back upstream (Baker 2019). The louvers at Ruth Falls provide the attraction flow velocities and the bypass velocities at their burst swimming ability without any sudden acceleration, and so just meets requirements for eel downstream passage based on the Alden modeling (Allen et al 2005) and supported by velocity readings taken during the October 2022 site visit and modeled for the bypass entrance. However, the bypass channel then widens, and velocities change to levels that would allow them to move back upstream. The drops over the stop logs that control the flow in the upper part of the concrete bypass channel are approximately 4 inches which allows the eels to move back upstream and out of the bypass. These 6 stop log weirs are 21 inches high with 4 inches of water over them in a 6 ft wide concrete channel leading to the pipe that carries the flow to the river. They create a series of partial barriers for eels traveling on the bottom which would lead them to use search behaviour that could result in an upstream movement back out of the bypass. Also, the flow velocity over the weirs in the channel is well within the eel swimming ability so they could move upstream back into the louvers in the power canal.

Silver eels travel on the bottom of the watercourse with occasional movements up in the water column. They tend to spend considerable time migrating near the bottom and are often insensitive to velocity changes until they encounter an obstruction, e.g., a physical guidance or exclusion device. Deep bypasses tend to be more effective than surface bypasses for downstream migrant eels (Gosset et al. 2005) (Russon et al. 2010). Movements up in the water column are common at dams and in lakes where the bottom velocities are low and do not provide an indication of downstream direction. These movements do allow some of the eels to find surface bypasses, spill over spillways, or spill under gates but can also attract them to leakage from stoplog sections.

The current design of the louvers, extending to the bottom of the power canal and with the vast majority of the flow past the dam through the canal, provides good attraction and velocities along the bottom (1 to 2 ft/sec). The physical visual behavioural barrier and the water turbulence along the louvers should be effectively leading the eels to the bypass. Full-depth guidance structures like this one can potentially guide all fish species regardless of migration depth (Linnansaari 2017). Louvers are behavioural devices, so it is critical that fish efficiently enter the bypass and do not delay or hold at any partial barrier. However, the surface outlet is 5 ft above the bottom so the eels would tend to collect at the bottom until individuals chose to move up in the water column or numbers build up so those at the top come in contact with the bypass opening and flow. With this dead-end bottom passage causing crowding, many would move back upstream or just to the sides and find their way through the louvers or seek other ways downstream through the fishway or via the spill. As previously noted, this behavior aligns with the findings of NSPI's acoustic tagging study and staff observations with 70% of the eels in the power canal below the louvers while large numbers appear in a mass at the louver vertex. Passage would have been better for the eels with the original bottom outlet, this would not be as good for the fish swimming up in the water column like the target salmon smolts.

Extensive laboratory studies were conducted by EPRI to determine if louver arrays could be employed to guide various riverine fishes and the catadromous American eel (EPRI 2001). The louvers at Ruth Falls meet or exceed the best configurations studied except they found better results if an inclined plane was used to bring eels and benthic species of fish to the surface outlet and a solid wall is placed along the sides at the bottom 1 ft of the louvers. It is also unclear what the bypass-to-louver approach velocity ratio is currently. The ratio should be 1.5 or slightly greater. The current flow through the bypass is 32cfs as set by 4inch high stoplogs so there is a slight change above and below this number as logs are removed or added with headpond fluctuation. Velocity in the bypass notch is calculated to be in the 5.0 to 6.0 ft / second range. We do not have direct measurement of the velocity along the louvers, but the Alden report (Allen et al 2005) set it at 3.1 to 3.4ft/sec depending on generation levels. This gives a ratio of 1.6 to 1.78 which is very good. The United States Bureau of Reclamation (USBR 2006) gives a general design value of 1.1−1.5 for louver bypass systems for all fish species and these louvers meet that guide without acceleration that would cause the fish to avoid passage. This velocity drops when the fish enter the concrete channel with 4 to 4.5 ft /sec with a 4 inch drop over the stoplogs and no bottom flow which acts as a barrier at each of six stoplog sections.

To ensure silver stage eel downstream passage, particular attention needs to be paid to the velocity along the face of the louvers near the bottom of the canal to get it in the right range that will lead the eels to the outlet. We have not been able to check this and are relying on

the Alden modeling (Allen et al 2005) that indicates the velocities are good for guiding the eels to the bypass both at the bottom and along the louvers. Observations made by the NSPI staff have seen large numbers of eels at the bypass entrance, so the louvers are effective at leading them to this location.

The louvers need to be checked along the bottom to see if there are any gaps in the louvers at or near the bottom that the eels may have been passing through in the earlier study. This could not be checked as the headpond was not drawn down this past summer but can be checked and repaired during dam construction.

There needs to be a design change to lead the eels to the existing surface outlet.

There are several modifications required to improve passage efficiency.

5.1 Lead the Eels to the Surface Outlet and Remove All Barriers Delaying Passage.

The surface outlet is just 5 ft above the bottom but for eels traveling on the bottom, in fact usually in close contact with the bottom, this becomes a barrier and causes the eels to begin a search behaviour to find a way past the barrier at the bottom. They would search for an opening with a current to follow. This behaviour would also include rising to find the bypass outlet, but this would involve a significant delay and the search behaviour would include movement through the louvers. Since the eels orient to the bottom, and they need to find the outlet quickly, providing a bottom structure to follow up to the bypass opening simulates the natural outlet from a lake or pond providing an easy to find the downstream route reducing the crowding.

The design shown in Figures 7 and 8 are for a proposed sloping ramp on a 15-degree slope up to the bypass with 1.5ft high sides of the ramp (Amaral 2003) to prevent the eels from moving to and through the louvers as the numbers build up in the narrowing exit area. The ramp is made of (steel or HDPE) plates 10 inches wide on an additional 15-degree slope (30-degrees to the horizontal) overlapping so that there is just a 2-inch opening between them (a 7-inch spacing along the ramp). This meets the best configuration for slope and openings tested by EPRI (EPRI 2001). Similar ramps are used at Garvin's Falls Project and Holyoke Dam louvers in New England. This ramp could be solid but using the angled plate will allow any fish that find themselves under the ramp to move up and follow the ramp to the louver outlet.

To rise the 5 ft, the ramp will extend out into the louvers by 18.66 ft with an upstream end width of 9.5ft and a width at the bypass entrance of 1.5ft. Migrating eels will follow up the ramp which will appear to them to be a solid bottom. The velocities along the ramp will be ideal for downstream passage. If fish that go through the louvers and return ending up under the ramp, they will be able to come up through the openings. There is no loss of habitat with this design and debris build up is not an issue vs fine mesh excluding screening.

A 1ft to 1.5 ft high solid barrier along the full length of the louvers, where the existing louvers meets the bottom of the canal, is needed to guide eels and benthic fish following the bottom to the vortex and the ramp.

There is currently a gap along the sides where the louvers meet the bypass as seen in Figure 3. It is not known if this extends to the bottom but needs to be closed as it is large enough to allow eel

passage as well as other species at a critical point where the water is accelerating and there is a change in the structure.

There is also a gap where the louvers meet the shoreline as can be seen in Figure 1 and these should be blocked off.

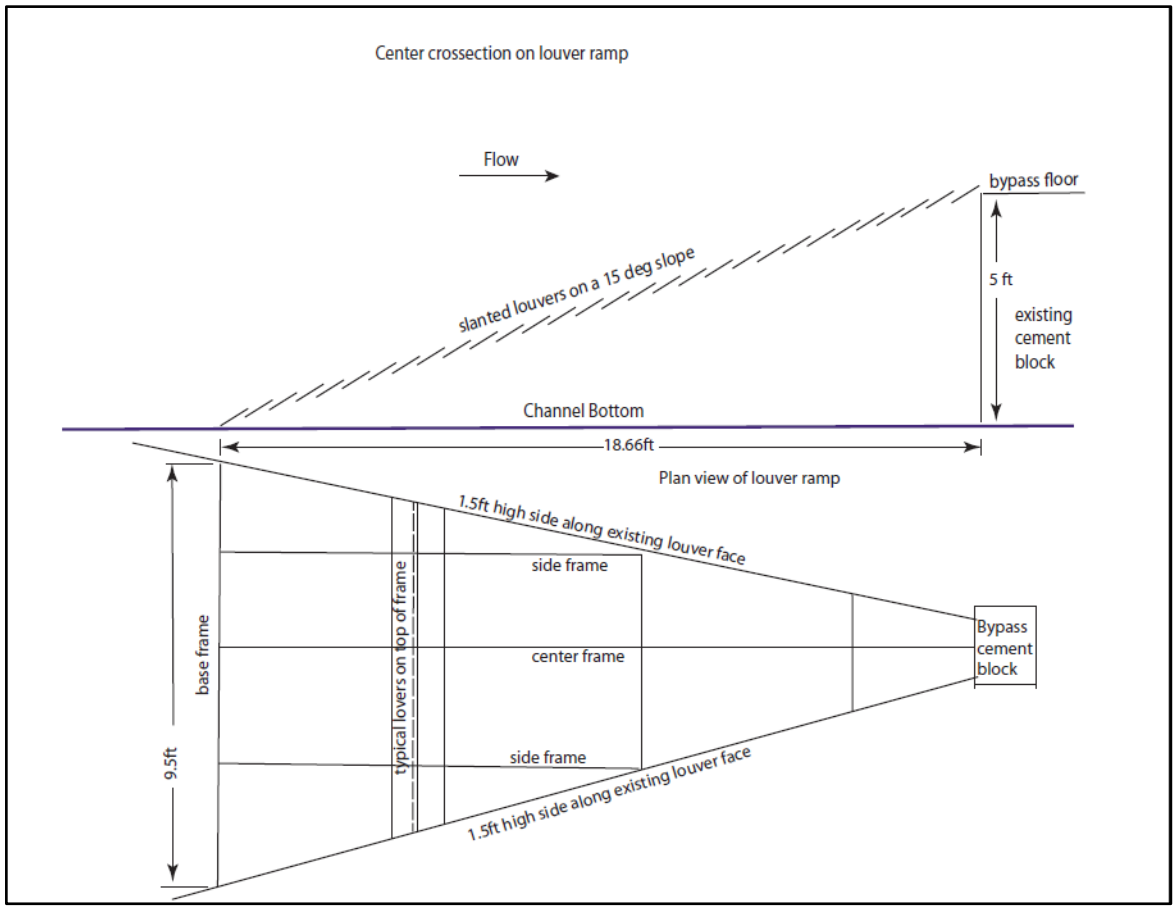


Figure 7: Longitudinal cross section (top) and plan view (bottom)

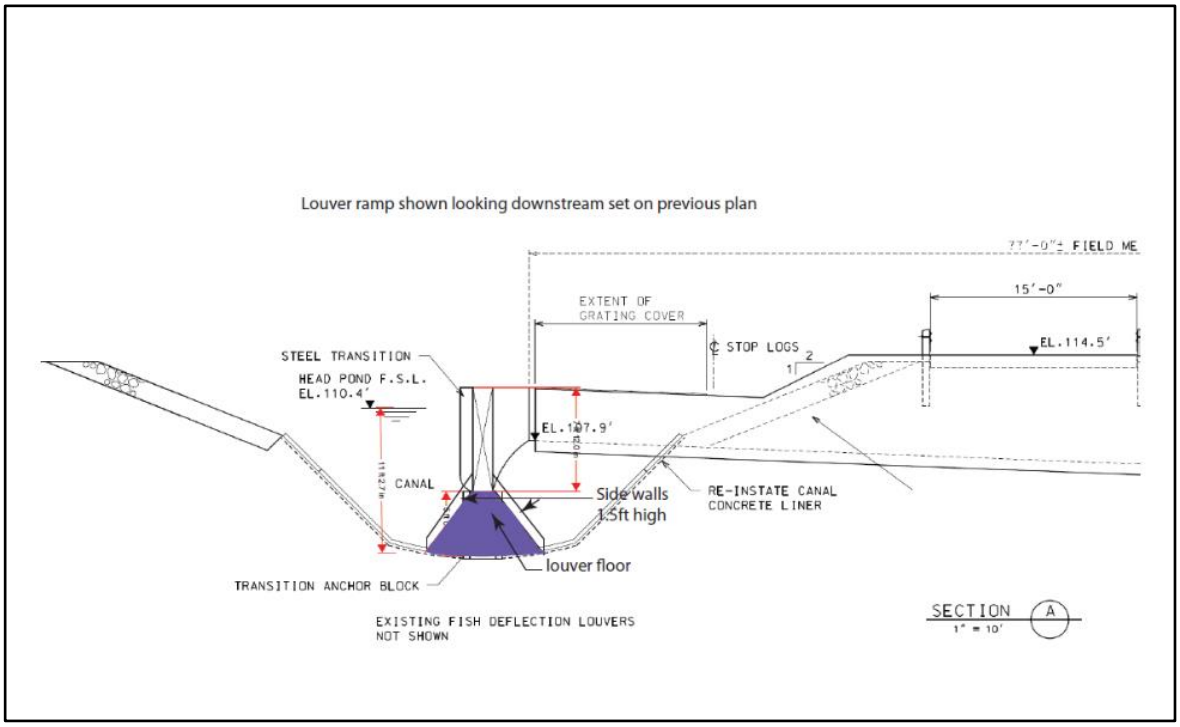


Figure 8: End View Looking Downstream

5.2 Keep the Fish in the Bypass Channel and Improve Downstream Passage

In the concrete channel, it is proposed that a trap funnel be installed at the most upstream stop log guide. This funnel would narrow the opening to 1.25ft and lead the eels and fish up 1ft to create a trap preventing them from easily returning upstream as shown in Figure 9. Then each of the 6 stop log sections that currently present partial barriers to all species will be modified to have a bottom orifice to carry the majority of the flow with an opening of 1 ft high by 3.32 ft wide as shown in Figure 10. The orifices will provide good downstream passage at the bottom for all species and eliminate the series of resting pool areas currently in place that slow eel and all other species migration and encourage them to find another way downstream.

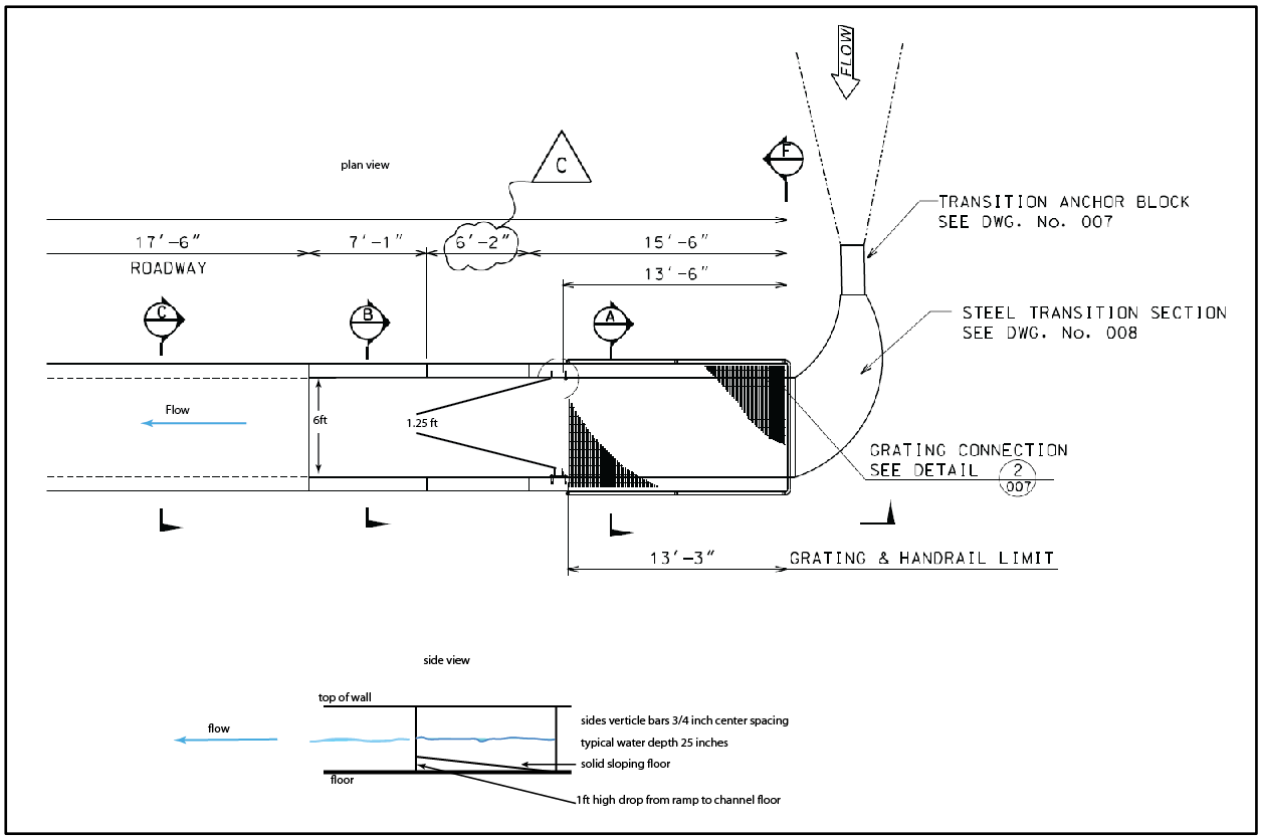


Figure 9: Trap funnel in the bypass concrete channel

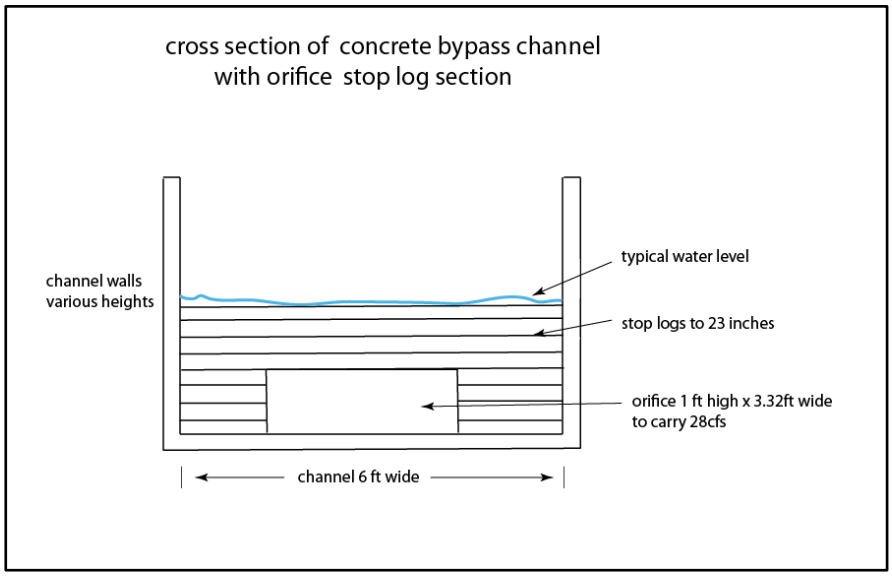


Figure 10: Typical stop log section with orifice

5.3 The Transition from the Bypass Channel to the Pipe

The next problem location is where the cement channel connects to the pipe to the river. This is a very turbulent pool as the flow drops over the stop logs down to a bottom the outlet pipe. To reduce this turbulence and possible harm to the fish, the orifice in the stoplog section entrance to

this pool will lower the drop and a surface mounted slide gate will be installed so that the flow to the pipe can be adjusted to back up water partially filling this pool and dissipating the energy in the flow. The slide gate will allow for adjustment to the water depth in the pool and allow for any future changes in louver water flow. The pipe will need an air vent to balance the pressures in the pipe.

5.4
The louver pipe is to be realigned to enter the fishway between the upper section, the concrete fishway, and the lower section, the channel fishway that enters the river. This is to provide additional attraction flow to the fishway entrance replacing the stoplog leakage currently entering the lower channel fishway section which will no longer be available with the new dam. This louver flow will discharge into the pool between the two fishway sections. The pipe will be realigned to come down from the end of the louver concrete channel on a 3% slope toward the fishway which will leave a 6.45ft drop into the 4ft deep pool just to the left of the counting bypass holding area at the downstream end of the concrete fishway. This overall drop from the 32-inch diameter pipe with the design flows stays within the USFW guideline for safe downstream passage.

6. Conclusions
    1) The installation of a ramp and bottom walls along the louver will greatly improve entrance conditions for eel and other benthic species traveling along the bottom. This option would provide passage for yellow stage eels throughout the year, silver stage eels in the fall, as well as all other species or individual fish that may be swimming deeper than the bypass inlet during downstream habitat migration or seasonal spawning movements. The Alden Research Laboratory modeled flow conditions at this site, with this addition, will provide good downstream passage for the silver stage American eels and all fish species.

    2) It is important that the louver bypass entrance is designed to keep the fish from returning upstream once they enter, so either velocities have to be above their burst/sprint swimming speeds or as proposed a trap funnel to prevent most upstream movement and bottom orifices in the stop logs to provide quick downstream migration.

        The flow in the bypass entrance is just at the sprint speed of the large eels and most species. It could be adjusted by removing stop logs at the second set of stop logs to increase the flow to ensure velocities are high enough to prevent a return upstream, but this would increase the acceleration of the flow above 1m/sec/m guideline for downstream passage at the bypass entrance and the fish would startle and go back upstream. This would also require at least 40cfs which will increase velocities in the fishway channel, where the louver flow is needed for attraction water to the upstream fishway and create velocities and turbulence at those weirs that would not be good for good passage of upstream migrating fish.

        So, stoplogs with orifices will provide the required flow at or just above the minimum of 29cfs and the orifices will provide rapid downstream movement rather than the surface overflow partial barriers.

3) The bypass pipe outfall drop to the river and plunge pool as currently operating meets the drop and depth requirements to ensure it is safe for the eels and all other species and life stages. When it is realigned to the top of the fishway channel the drop to the plunge pool and this pool's water depth exceed the USFW criteria for drops of all species and age classes at the site.

4) We were not able to conduct a condition assessment of the louver system to see if there were damaged louvers or other openings along the bottom that would allow eels to pass through rather than leading along the louvers. Such a condition assessment and repairs will be carried out when the channel is dewatered for the dam construction. A solid wall along this bottom will correct any potential issue of louvers damaged at the bottom but all bent or otherwise damage louvers must be repaired.

5) Additional eel passage monitoring studies are recommended following the modifications suggested above. When these studies are done it is suggested that some eels be released in the channel downstream of the power canal trash racks and some above to determine the effect of the trash racks on passage and calculated louver efficiency. There are suggestions in the literature (Piper 2015) that a portion of the migrating eels would be deterred by the trash racks and seek other ways downstream. Receivers should also be placed in the fishway as the bars on the trap allow for eels to pass downstream and by any gate openings to see if they are using other routes. The current dam has leakage and some spill from stop log sections high on the dam that may have provided an attraction and possible downstream passage for eels. The new dam will have minimal leakage, but it will have bottom outlets in the spill gates that will be very attractive to the eels for downstream passage being both a concentrated flow and at the bottom. This route and the fishway should monitor for downstream passage in future studies.

6) The louvers are the best downstream passage design to guide fish to a surface outlet. There are some weaknesses in the current design for benthic species like the eels and the retaining fish in the bypass channel. The modifications proposed here will correct these weaknesses. The modifications will greatly improve eel downstream passage and passage for all other species as well bringing the system up to new standards.



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APPENDIX J – UPSTREAM EEL PASSAGE ASSESSMENT

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January 31, 2023

Re: Concept Design Report - Upstream Eel Passage at the Proposed Refurbished Dam at Ruth Falls

1. Introduction

NSPI requested a concept design be developed for upstream eel passage at the proposed refurbished dam at Ruth Falls. This is an update of the November 2020 report.

2. Eel Behaviour

American eel (Anguilla rostrata) elvers migrate upstream from the ocean in the spring and can continue until fall. The older yellow eels may move repeatedly, irregularly, or seasonally, between freshwater and marine habitat and may continue to move upstream for several years after entering freshwater (Jessop, B.M., 2003). They tend to swim along the bottom but do swim up into the water column occasionally. They have average swimming ability but have strong burst or sprint swimming speeds (Langdon, S.A., 2000). Small eels can climb wet surfaces if they are rough or covered with algae or moss and do pass through some technical fishways particularly pool and weir design where there is a skim of water over algae or moss-covered weirs. They normally move at night but can be seen at any time-of-day swimming short distance of a few meters at a time through the higher velocities to resting areas and congregating in very low velocity areas. Eels start migration behaviours at temperatures above 10^0 C. Therefore, the eel pass will need to operate whenever the water temperatures are at or above 10^0 C to accommodate these movements. (Haro, A. 2013) (Shepard, S.L. 2015)

3. Modern Eel Passes

Generally, technical upstream fishways, such as fish ladders and fish lifts, are ineffective at passing juvenile eels. Therefore, specialized eel pass structures are required to provide a path for them over the dam (Vowles,2015) (Padgett 2020). Larger eels can use typical pool and weir fishways of the design currently in place at Ruth Falls and are often found living in them.

Modern eel passes consist of linear metal, plastic, or wooden channels lined with climbing substrate, and equipped with a pumped water flow and, in some cases, additional attraction water. Eels utilize the wetted substrate to propel themselves up the ramp. In this case, a metal enclosed box similar to that shown in figure 3 is used to protect the eels from predators and keep the pass dark. The entrance is uncovered to allow entrance between high and low tail water levels expected for durations of more than a couple of days at a time so neither short term extreme water levels need to be accommodated.

4. Eel Pass at Ruth Falls

4.1 General

A modern eel pass will be an effective option for upstream passage of eels at the re-constructed Ruth Falls dam. The location of the eel pass entrance at Ruth Falls is dependent on the flow patterns along the bottom below the refurbished dam under the various spill flow regimes.

4.2 Flow Conditions

Hydraulic modeling was used to identify flow patterns, velocities, and depths, downstream of the dam that support fish passage (including eels) under various flow scenarios. The results of this flow modelling have been used to determine the best location for the eel pass entrance which must be located at the most upstream point that the elvers and young yellow stage eels can reach. (Solomon, D. J. 2004) (Watz J. 2019)

The modeling shows the eels will have the ability to move along both banks and along the bottom, across the whole river where the uneven bottom creates low velocities and resting areas every few meters. These areas are coloured blue on Figure 1. There was a general bathymetry of the river bottom below the dam in the physical model, so it does not show this fine scale roughness the eels use to travel along the bottom and along the banks. However, the main travel routes will be along the banks as they move short distance using burst speed between the cobbles and boulders.

The eels will come up along both banks in the dark blue-coloured currents. Both banks will have generally equal numbers of eels as the passage is divided by the naturally high velocities across bedrock sills in the river below which they cannot cross due to the smooth bedrock surfaces. Along both banks there is cobble and boulder substrate and shallow flows the eels will use. Along the left bank they continue upstream to large blues are they can rest before following slow currents to the fishway entrance. Those coming up the right bank also come into the blue area suitable for resting and follow the bottom currents toward the gates and over to the fishway. Most of those coming up this right bank will distribute through the rearing area so that the majority are expected to be following the flow from the fishways as it joins the gate flows diagonally across this area and has an influence along the bottom.

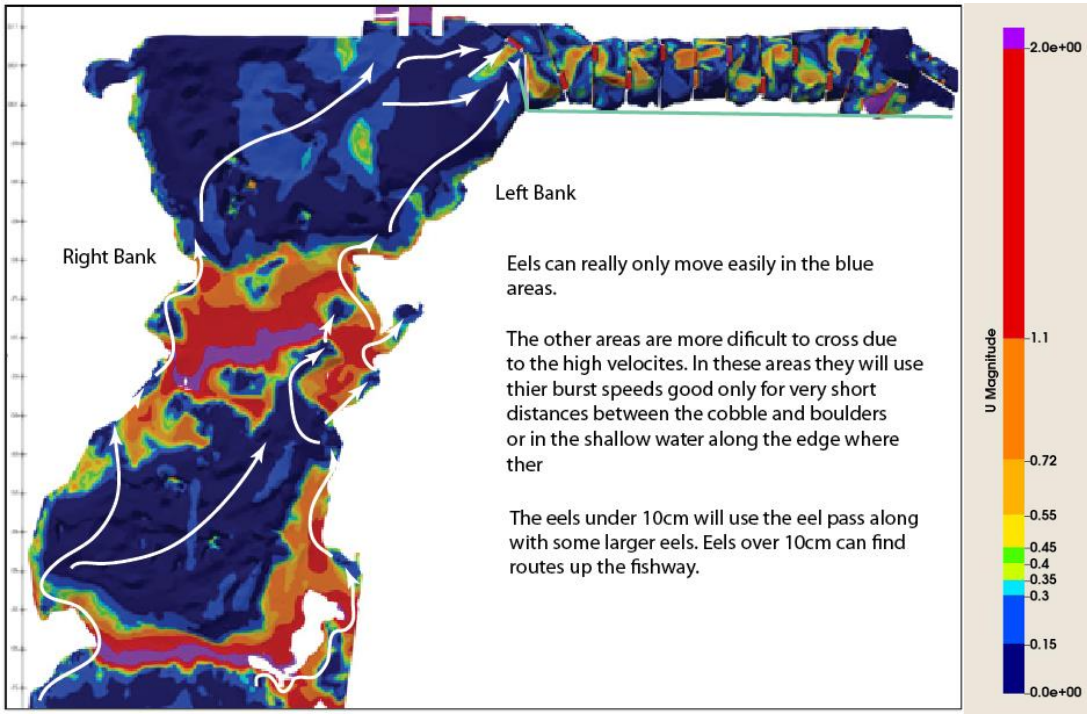


Figure 1: Bottom flow patterns (coloured by velocity) below the refurbished dam.

4.3 Concept Design

As previously noted, for upstream eel passage at the refurbished Ruth Falls dam, it is recommended to use a modern eel pass. The modern eel pass will consist of a covered linear metal, plastic or wooden channel lined with climbing substrate, and equipped with pumped water. The features / modifications of the suggested option are:

1) Louver flow going down a re-designed baffled fishway channel along the toe of the dam

2) Removal of the boulder in front of the spill gate to allow this flow to move straight downstream or be directed more to the right bank and smoothing of the bathymetry in front of the fishway entrance toward the gate flow.

3) The distribution of the gate flow between the three gates in a, 20, 40, 5cfs distribution to reduce the back eddies and provide currents that leads the eels and other fish to the fishway or as needed based on observation following the dam refurbishment.

The flow modelling shows the most appropriate location for eel pass entrance will be immediately downstream of the fishway channel lowest outlet notch on the left bank.

The eel pass, shown as a green line in Figure 2, is the most appropriate route under all scenarios that were considered. It is the only good location of the entrance segment. As shown in Figure 2, the lower segment will rise quickly to the height of the bank and then run on a very low slope to the corner of the concrete fishway. From there, it will turn to run along the left wall of the fishway to the head pond.

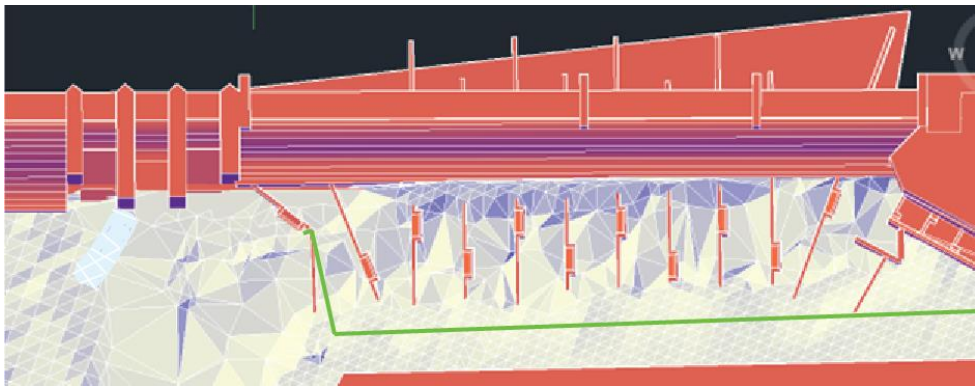


Figure 2: Eel Pass Route

The pass will be enclosed and use eel tiles by Aquatic control, https://www.aquaticcontrol.co.uk/products/eel-passes or Barry and Escott https://www.berryescott.co.uk/eel-tiles, and follow the USFW engineering guide for slope, climb heights and distances between resting areas, water supply design and drop into the head pond. Typical photos of an eel pass using the proposed design are shown as figures 3 to 6.

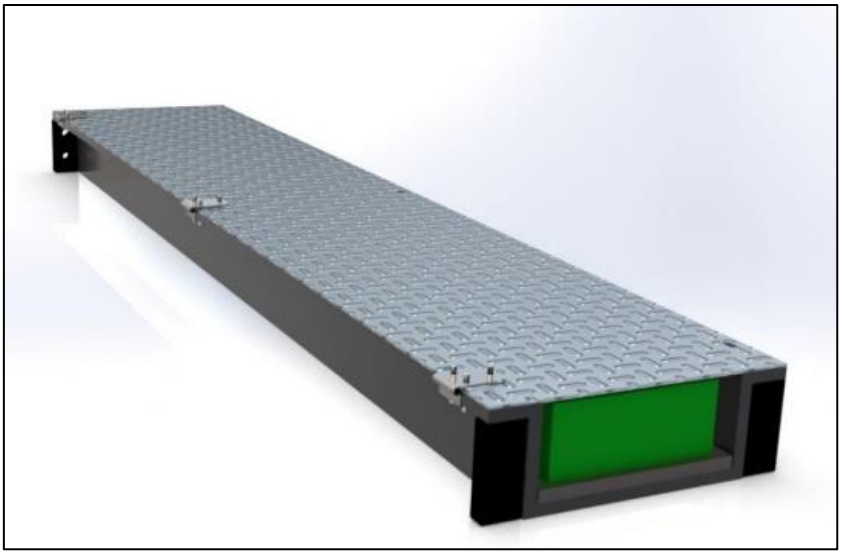


Figure 3: Aquatic enclosed eel pass box



Figure 4: Barry Escott eel boards for elvers and small yellow stage eels. good for eels 50mm to 500mm+ long



Figure 5: A typical design of an enclosed eel pass



Figure 6: An eel using the peg style substrate.

4.4 Design Criteria

To meet the USFW service recommendations, the final design will include:

- Construction Materials:
  - Ramps, pools, and supporting structural elements will be built of rust-resistant metal (typically aluminum) or UV-stable plastic for permanent facilities
- Cover:
  - To minimize predation, a fully secured, opaque cover on the entire unsubmerged length of ramp (and resting sections) the cover will remain open at the entrance below high-water level to allow entry at the water surface.
- Entrance:
  - The following specifications apply to the lower most end of the eel ramp:
    - The entrance will be matched to the surface upon which it rests; this may necessitate shaping the entrance lip to meet an irregular bedrock surface or providing a level sill upon which the entrance invert may rest and will be designed to the specific site chosen.
    - The final location of the entrance will be determined upon completion of the as built fishway and river bottom.
    - The entrance will be uncovered up to the maximum tailwater elevation so that eels may enter at any depth.
    - The entrance will be assessed for the need to be equipped with fencing, netting or other material to guard against predation by birds and carnivorous mammals.
- Climbing substrate:
  - Will run down through the entrance to the minimum tailwater elevation
- Exit: the following specifications apply to the upstream terminal end of the eel ramp:
  - Elevation: the ramp will be well above the fluctuations in headpond levels

- Location: the exit is situated at the head pond between the fishway exit and the utility shed away from turbine intakes, spill gates, and spillways and other structures that may entrain eels.

- Ramp: the following specifications apply to the sloped ramp channel:
  - Height: 6 in. high sidewalls.
  - Width: two tiles wide 3ft 4in wide
  - Length: dependent on slope; uninterrupted runs (i.e., without resting/turning pool) of sloped ramp will not exceed 10 vertical feet; total sloped length without resting pools will be less than 100 feet.
  - Slope: slopes will be 45 degrees or less on the entrance section of the ramp. The second section is very low slope then a 10% slope along the fishway.
  - Depth of Water: ramp will always remain wetted across the surface; depth is dependent on ramp width, flow, slope and influenced by substrate; 1/8 in. of water should be maintained across a flat ramp; flows can be adjusted to provide water depths up to 70mm were needed.
- Resting Section: the following specifications apply to the resting area in the ramp. Turns in the ramp layout will serve as resting pools designed to this standard:
  - Placement: a minimum of one horizontal resting section (resting pool) per 10 vertical feet of ramp.
  - Width: equal to ramp width.
  - Length: equal to the pool width, or longer.
  - Depth of Water: at least 1 inch of water should be maintained in resting pools; to accommodate uniform depth, the resting pools floors may need to be level and deeper than ramp sections to which they are connected.

5. Conclusions

1) The young eels cannot effectively use the pool and weir fishway and require an eel pass to facilitate passage.
2) A modern eel pass will be used at Ruth Falls, following the alignment shown in Figures 1 and 2.
3) The entrance will be on the downstream side, adjacent to the fishway that will provide attraction flow and on the adjacent bank below the low water level.
4) The design criteria for eel passes are set out in the USFW 2019 “Fish Passage Engineering Design Criteria” and will be followed in the detailed engineering design using tiles that have been specifically designed for eels 2 inches (5cm) and up to a size that can use the pool and weir fishway.



Bob Rutherford
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APPENDIX K – MONITORING PLAN

Ruth Falls Dam Refurbishment Project

Fisheries Act Authorisation Application

2024 Monitoring Plan

July 2023

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1.0 Introduction

This monitoring plan outlines NS Power's proposed monitoring activities, and additional avoidance and mitigation measures for the Ruth Falls Dam Refurbishment Project (the Project) as well addresses DFO's request for additional information dated May 5,2022 to support NS Power's application for authorization for the Project (DFO file 19-HMAR-00549). The following information is included:

- Proposed monitoring activities associated with the drawdown of Ruth Falls Headpond including, entrainment monitoring, wetland monitoring, and post-construction monitoring.
- Proposed monitoring of construction activities in 2024.

The following construction activities are proposed for the Project:

- Installation of downstream access road and temporary bridge (to start prior to drawdown activities) Downstream access roads will need to be in place in order to access the right side of the dam
- Lowering of Ruth Falls Headpond approximately 18 ft.
- Dewatering of the Ruth Falls fishladder and canal and fish rescue
- Installation of temporary access for machinery on the upstream side of the dam – access from the right side and the left side. The area in front of the sluiceway bays will remain open to allow water to pass through.
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
- Removal of the existing stoplogs from stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Improvements to the upstream fishway.
- Improvements to the existing downstream louvre system.
- Installation of an upstream eel ramp.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation.
- Contractor Demobilization from site.

NS Power has considered the potential environmental and archaeological risks associated with the lowering of Ruth Falls Headpond and believes that with implementing the mitigation measures discussed in the following sections of this application, the proposed approach will prove effective. This approach will also be safest for NS Power employees and contractors. NS Power has evaluated whether the use of bulkheads, barges, work platforms or larger cofferdams would be an appropriate alternative and has determined that these scenarios present significant safety risk, potential quality issues and scheduling risks to the Project. NS Power considers the lowering of the headpond to be the safest and most efficient solution to undertake the Project.

1.1 PROJECT SCHEDULE

The Project is scheduled to take approximately 9 months to complete starting with the installation of the downstream access roads and temporary bridge starting in late June 2024 (refer to the project schedule Gantt chart in section 5.0 Construction Schedule of the Supporting Information document) After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid July 2024. The work includes both the lowering and subsequent recharging of water in the headpond. The water level will be drawn down after July 10th, allowing time for fish eggs to hatch, and YoY Gaspereau to move downstream naturally or transported during fish rescue. Lowering the reservoir will occur after July 10th, and will take approximately 8 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low.

The construction schedule is as follows:

- Installation of the downstream access roads and temporary bridge will commence in elate June 2024. This work is intended to be completed prior to the drawdown in preparation for main dam construction work to take place in mid-July after the lowering of Ruth Falls Headpond. Access to the right side of the dam will be provided by the downstream access roads connected by the temporary bridge.

- Construction activities associated with the sluiceway, main dam refurbishment, and improvements to fish passage will commence in mid-July with the lowering of Ruth falls headpond. The lowering of the Ruth Falls Headpond will commence no earlier than July 10th 2024 and will take place over the course of 8 days.

- After the water is at an elevation of 91 ft, construction activities will then begin with the installation of the upstream access roads. Work on the main dam refurbishment, sluiceway bays, and improvements to fish passage will continue simultaneously as construction progresses, however NS Power will aim to complete the new sluice gates first in the low flow window of July-September. It is anticipated that each gate bay will take approximately 3-4 weeks to complete, and a total of 9-12 weeks to complete the entire sluice structure. This may be affected by weather should heavy inflows be required to be passed for a significant period of time.

- Remaining dam refurbishment and upgrades to existing fish passage structures will then continue with all temporary control structures and access paths removed and Ruth Falls Headpond returned to normal operation April 1st, 2025. The focus will be on completing dam refurbishments and upgrades to the louvre system (while the canal is dewatered) to ensure the dam and fish passage structures are operational by April 1st. In the event that there is not enough time to complete the improvements to the upstream fishway during the drawdown, NS Power commits to completing the work during the next construction season (avoiding upstream migration timing) in 2025. This would not require the headpond to be drawdown – cofferdams would be used to isolate the fishway while the work takes place.

2.0 Description of Effects on Fish and Fish Habitat

The following water management strategies related to the Project have the potential to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat:

- The temporary drawdown of Ruth Falls Headpond, which could result in the temporary disruption of up to approximately 1.15 km^2 (115 hectares) of littoral zone habitat that fish species use for a portion of their life cycle (see Appendix A Bathymetry)
- The installation of a temporary bridge and access roads for machinery on both the upstream and downstream sides of the dam, resulting in a temporary instream footprint. The total estimated temporary instream footprint for control measures is 3,237 m^2. The footprint associated with the temporary structures within Ruth Headpond is already accounted for within the temporary drawdown of the Ruth Falls Reservoir. When the reservoir is reduced to 91 ft, the temporary structures will be placed upon the substrate which will be temporarily dry due to the drawdown (see MCG Offsetting plan in Appendix N for more details). The footprint associated with temporary structures downstream within the spillway channel is not considered valuable fish habitat due to the periodic nature of flow releases (although NS Power acknowledges fish use this area as a migration route to access habitat upstream of the dam). NS Power does not consider

the temporary footprint to be a HADD as per the above rationale and the temporary nature of the footprint.

- Death of fish due to entrainment and/or stranding from drawdown activities.
- Negative impacts to upstream and downstream passage as a result of dam refurbishment, including:
    - Some loss of surface downstream passage for surface-oriented fish species, that would typically pass over top of the existing stoplog bays;
    - Potential changes to entrance conditions of the Ruth Falls fish ladder as a result of submerged discharge through the new gates (vs. surface overflow from stoplog bays).

The Project will result in a permanent loss of fish habitat; however, based on the relatively small size (60 m^2), the Project will not be removing a critical piece of habitat from the ecosystem. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete; however, changes will be made to improve the efficiency of the fishway – these changes include the addition of weirs, and adjustments to existing weir and notch sizing – see Section 15 Upstream Fishway Improvements for details on the proposed improvements. The temporary lowering of the reservoir approximately 18 feet will cause the biggest disruption; however, the potential effects of fish and fish habitat is low due to the following:

1. The drawdown is temporary and will not have a long-term effect on fish populations;
2. The headpond water level will be drawn down after spawning allowing time for eggs to hatch and YoY Gaspereau to move downstream naturally or transported during fish rescue. The drawdown is scheduled to occur no earlier than July 10th, 2024.
3. Measures will be put in place to facilitate downstream migration of fish during construction. During the time the water is drawn down, NS Power intends to provide free passage of fish through the center sluice gate during construction as the canal and fish ladder will also be dewatered. The exception to this is when the center sluice gate will be under construction, which we anticipate to be 3-4 weeks during which time the water will be directed through either the west or east bay. Upstream fish passage will not be available during the 2024 construction season after July 10th. As described above, improvements to the existing upstream fishway as proposed to take place during this timeframe.
4. Preliminary data collected from ongoing monitoring for the Tusket Main Dam Refurbishment project drawdown in 2021 indicates that very little change to fish habitat has been observed over an 8-month period, other than the temporary loss of available habitat as a direct result of the drawdown. No permanents impacts were reported.

Project activities with the potential to impact fish and fish habitat have been identified and discussed in Table 1.

Table 1: Summary of potential effects on fish and/or fish habitat due to refurbishment of the Ruth Falls Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect
Temporary loss of fish habitat due to lowering headpond beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.5 km^2 in Ruth Falls Headpond	High	Low
Temporary loss of fish habitat due to temporary installation of access roads	Localized: area immediately above and below the dam	High	Low
Permanent loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly below the dam	High	Low
Fish mortality due to stranding when lowering headpond.	Localized: Ruth Falls Headpond	Low	Low
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low
Potential downstream scour during drawdown of headpond.	Localized: East River of Sheet Harbour	Low	Low
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High

There are no formal fisheries management objectives for the East River of Sheet Harbour; however, the streams and reservoirs are used for recreational fishing by the local community and traditional harvesting by the Mi'kmaw of NS.

3.0 2024 Drawdown Monitoring Activities

3.1 BACKGROUND

Based on operational experience, the drawdown of the headpond to elevation 91.0 ft is expected to take 1-2 days, however the drawdown has been extended to 8 days to reduce potential impacts to fish and fish habitat. NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly, in a controlled manner, to ensure upstream and downstream erosion or scour is minimized.

NS Power completes fish and fish habitat surveys as part of the Hydro Relicensing Program, which takes place on a 10-year cycle as part of the renewal of Hydro System Water Storage Approvals. The relicensing fish data collection is qualitative in nature; however, NS Power has two datasets for the Sheet Harbour Hydro System collected 10 years apart and some trends and observations can be drawn from that data. A list of commonly found fish species in the Sheet Harbour watershed is provided in Table 2, along with an indication of their presence during the previous relicensing.

Table 2: Fish Species present in the Sheet Harbour Watershed

Common Name	Scientific Name	NSPI 2007	NSPI 2017
Alewife	*Alosa pseudoharengus*		Confirmed
American eel	*Anguilla rostrata*	Confirmed	Confirmed
Banded killifish	*Fundulus diaphanous*	Confirmed	Confirmed
Blacknose dace	*Rhinichthys atratulus*	Confirmed	
Brown bullhead	*Ictalurus nebulosus*	Confirmed	Confirmed
Common shiner	*Luxilus cornutus*	Confirmed	Confirmed
Golden shiner	*Notemigonus crysoleucas*	Confirmed	Confirmed
Lake chub	*Couesius plumbeus*	Confirmed	Confirmed
Pearl dace	*Margariscus margarita*	Confirmed	
Speckled trout	*Salvelinus fontinalis*	Confirmed	Confirmed
Stickleback	*Pungitius*	Confirmed	Confirmed
White perch	*Morone americana*	Confirmed	Confirmed
White sucker	*Catastomus commersoni*	Confirmed	Confirmed
Yellow perch	*Perca flavescens*	Confirmed	Confirmed
Atlantic salmon*	*Salmo salar*		

* Atlantic salmon were not observed during 2007 and 2017 sampling; however, small returns of Atlantic salmon have been observed in the salmon trap operated at Ruth Falls.

3.2 FISH RESCUE

NS Power anticipates the drawdown of Ruth Falls Headpond to elevation 91.0' to take approximately 8 days to mitigate the effects of stranding on fish present in the headpond at the time of the drawdown.

Fish rescue efforts will start at the same time as the drawdown. NS Power has extensive experience completing fish rescues on various hydro systems and handling and transferring fish to support past hydro projects and initiatives. NS Power will conduct the fish rescue using a team of two, led by an experienced field biologist, during daylight hours for the duration of the drawdown. The rescue team will be equipped with a boat, backpack electrofishing units, lip seines, dip nets and beach seines. The team may need to travel on foot to certain areas that may not be accessible by boat. A fish rescue of the Ruth Falls fish ladder and power canal will also be conducted once the elevation is low enough to expose the canal invert; however, given the drawdown will be occurring through the lower level stoplog bays and the louvers preventing fish from entering the canal, it is anticipated that there will be limited amounts of fish in the canal to transfer.

Capture method will be determined on a per site basis, depending on water, sediment, and weather conditions. Fish will either be immobilized using electrofishing and transferred to buckets using the dip nets, then moved as quickly as possible to the main reservoir with the minimal amount of handling as possible, or herded toward the main reservoir using seining when electrofishing is not possible. Species of conservation concern, namely Atlantic salmon, alewife, American eel and speckled trout will be given special attention, with the goal of transferring these fish as quickly as possible to the main reservoir. Fish rescue efforts will be maintained until the level of the reservoir has reached its minimum. Shoreline observations will also identify any stranded fish which will be identified and counted.

Fish rescued will be identified to the species level, counted individually for larger species or estimated for smaller species, and any instances of mortalities will be recorded. In the interest of time, no morphometric information will be recorded. The data recorded during the fish rescue will be used to estimate the fish mortality caused by the drawdown.

Based on a long experience of conducting fish rescues across all hydro systems, NS Power estimates that approximately 10% of the number of fish/life stages greater than 10 cm and 20% of the fish/life stages smaller than 10 cm, are not successfully rescued. Acknowledging that not all stranding areas will be identified during the fish rescue, NS Power proposes to double these values and estimate total mortality resulting from the drawdown as follows:

$$=Total\ Fish\ Mortality = Sum\ (observed\ mortality\ for\ each\ species) + 0.2 * (number\ of\ fish\ rescued > 10cm) + 0.4 * (number\ of\ fish\ rescued < 10cm)$$

NS Power is expecting there to be continuous ongoing sources of inflows into Ruth Falls Headpond therefore, the risk of ongoing fish mortality as a result of stranding is low.

3.3 TRIBUTARY MONITORING

During the fish rescue, NS Power will conduct ground truthing to confirm any tributary locations on Ruth Falls Headpond using the results of a desktop exercise identifying tributaries depicted on 1:50,000 mapping. NS Power will also document any additional tributaries observed in the field not originally identified through the desktop exercise. NS Power will walk a portion of each tributary, if safe to do so, from the exit location into the reservoir on which it's located by field personnel, after 4 days of the drawdown (50% complete) and again immediately after the drawdown is completed (after 8 days). Connectivity of each tributary to the reservoir on which it's located will be assessed for any restrictions; other observations, such as pools within the tributary that could act as thermal refuge for fish, and bank full width and depth of the tributary, will also be documented.

3.4 WATER QUALITY

The Ruth Falls Headpond is a relatively small, shallow headpond with depths of up to 26.2 ft (8 m) in the deepest parts. Water quality of the headpond is heavily influenced by inflows from the Grant River Watershed as well as by the East River and its tributaries.

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for the headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, the headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for the headpond, approximately 1.15 km^2) of total shoreline will be exposed as a result of a drawdown to 91.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.25 ft, with depths of less than 9.8 ft (3 m). At an elevation of 91.0 ft, the headpond will look similar to pre-inundation conditions of the East and Grant Rivers. It is unknown how the drawdown of approximately 11 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed; although, inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

As such, NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the

Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to October for temperature, dissolved oxygen, total suspended solids and turbidity.

Monitoring sites for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth
- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

NS Power will use 23 degrees Celsius in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November.

3.5 TRIBUTARY MONITORING FISH ENTRAINMENT / DOWNSTREAM MONITORING

The drawdown of the Ruth Falls Headpond will be conducted gradually to avoid creating excessive flows, which will reduce the risk of entrainment of fish and other species downstream of the dam. It should be noted that NS Power regularly generates and opens the existing stop log bays for water management and maintenance purposes. To date, these activities have not been associated with known harm to fish species.

The objective of this monitoring program is to assess the abundance of the YoY gaspereau within the Ruth Falls headpond before the drawdown, monitor the entrainment of fish from the headpond during drawdown and characterize the aquatic habitat exposed during the drawdown. The focus of the monitoring is assumed to be early juvenile and juvenile fish species (all species); however, NS Power will also monitor for egg/larvae entrainment (note: this will be difficult to achieve in a quantitative way) as well as entrainment of adult fish species.

The timing of the drawdown will reduce the risk of stranded larvae/eggs as the YoY gapereau will be hatched prior to the commencement of the drawdown. There is still; however, the potential for the YoY gaspereau to become entrained while the reservoir water level is being lowered. As a result, NS Power has committed to completing entrainment monitoring using a contracted a third-party consultant.

A detailed Juvenile Gaspereau and Entrainment Study Plan has been included within the main application.

A similar study was carried out during the drawdown at the Tusket Dam. The study involved two parts; the first was to determine the presence and density of YoY gaspereau in the Vaughn reservoir using towed bongo nets, and shoreline seines. The second component of the study was to gather information on the entrainment of fish through the Tusket Dam. This was carried out before, during and after the drawdown using static bongo nets, fyke nets and shoreline seines.

Based on results of the Tusket study, some entrainment is to be expected as a result of the drawdown. However, the East River watershed Ruth provides approximately 3 km of suitable freshwater habitat below the Ruth Falls dam and accordingly, NSP considers that entrainment of juvenile and adult fish below the Ruth Falls dam does not necessarily constitute harm or loss of fish.

The study will follow the same methods as Tusket, which will include juvenile sampling to determine size classes / densities as well as entrainment to estimate abundance. The results of the Tusket study showed that all fish were found to be alive and in a healthy condition and that suitable habitat was also available to the fish downstream of the dam. Similarly, the Ruth Falls Headpond provides approximately 3 km of suitable freshwater habitat. Shoreline monitoring was also completed at Tusket, the results showing no observations of fish mortality.

3.5.1 Study Plan

The duration of the drawdown is scheduled to take 8 days starting no earlier than July 10.The planned late start date of the drawdown will provide time for juvenile fish to grow and increase their chance of survival during their downstream migration through avoiding entrainment.

The parameters of the study will be as follows:

- Monitoring will begin a day in advance of the start of the drawdown.
- Monitoring will take place throughout the 8 day drawdown.
- Monitoring will take place one day after the end of the drawdown.
- Implementing an adaptive approach to sampling frequency and duration based on the time required to retrieve/sample/redeploy the equipment, and the number of fish collected during one sampling window (i.e. increase sampling duration if catches are low). Details on sampling frequency and duration for each gear type is provided within the entrainment monitoring plan found in the main application.
- A range of net/gear types will be used to capture different species and life stages, targeting egg/larvae, early juvenile and juvenile fish but also including gear types to capture adult fish such (rotary screw trap, bongo nets, fyke nets etc).
- For all other species, quantity of fish and life stage will be collected.

- Measuring flow rates at the mouth of the net immediately after the sampling period. This information will be combined with the measure of the opening of the net and the dimensions of the wetted area of the river to estimate the portion of river sampled at each deployment.

If the data permits, NS Power will use the information collected to estimate the total number of fish entrained and based on a review of the scientific literature, estimate the number of fish harmed or lost by the drawdown. If this cannot be achieved, NS Power acknowledges that DFO may default to precautionary assumptions for entrainment and associated mortality of different fish species to inform offsetting requirements of the Project.

3.6 TRIBUTARY MONITORING LAKE HABITAT CHARACTERIZATION

3.6.1 Drone Surveys

NS Power will apply the following methodology to characterize the habitat in Ruth Falls Headpond during the drawdown.

A baseline drone survey, completed within 1 week of the drawdown will be conducted using a drone-mounted high-resolution camera. The focus of the baseline drone survey will be to identify and delineate areas where aquatic and emergent vegetation are observed. NS Power anticipates that these areas will coincide with areas where riparian wetland habitat is present. The imagery will be used to identify and delineate shoreline habitat types and will help in identifying the best locations for the establishment of monitoring transects. Following this, a drone survey will be completed no later than one week after the desired elevation is reached and then once again in November after the growing season. This time series will provide the basis for an assessment of the evolution of the shorelines of the lake during and after the drawdown.

A geographical information system (GIS) will be used to assess the amount of suitable habitat for fish species that is located in the Ruth Falls Headpond and monitor change within this habitat over time. The focus of the habitat characterization will be in areas that are dewatered during the drawdown; suitable habitat will be assumed to be located within the littoral zone of the headpond, have little to no slope and demonstrate high diversity and/or density of emergent and aquatic vegetation. An estimate of the total area of change over time within the identified suitable habitat can be extracted from this exercise, which can be used to inform potential temporary HADD.

3.6.2 Monitoring Transects

Monitoring transects will also be completed once per month to supplement the drone surveys. Two (2) monitoring transect will be selected on Ruth Falls Headpond. The position of the transects will not be located randomly but rather will be based on the analysis of the lake's shoreline drone surveys with the aim to monitor areas of greater ecological value (i.e. highest diversity). The location of the transects will be determined by analysis of the baseline drone survey.

The transects will be approximately 15 m wide and extend 15 m into the riparian zone from the bank edge, and 10 m into the littoral zone from the waterline, if safe to do so, see Figure 1 below. The shore zone, if present, lies between the littoral and riparian zones, and may include a beach and/or a bank face. Where both are present these are separated by a break in slope. The transects will be delineated with high-visibility stakes to be visible from the drone camera. Detailed GIS data will be recorded at each site.

Observations for the entire plot will be made from a boat and on foot. The dimensions of the riparian and littoral zones are based on Rowan et al. (2006) and were selected to capture the composition and diversity of features to be assessed and correspond to the field of view of the surveyor from an offshore station (Figure 2). The shore zone (especially beach width) will likely be of variable dimensions depending on the water level at the time of the survey.

The baseline transects will be conducted within 1 week of the start of the drawdown at the locations chosen through the baseline drone survey. Subsequently, each transect will be surveyed once per month starting in July 2024 and extending to November 2024 to capture peak biomass windows. The surveys will include the identification and quantification of sediment classes, vegetation types and coverage of each within a transect zone. Comparison between sequential assessments will provide the ability to quantify any changes in vegetation coverage and identify changes in habitat types over time. Changes observed within habitats where transects are located will be assumed to apply to all suitable habitat identified on the lake, based on drone surveys.

Data collected during the monitoring transects, in combination with the drone surveys will be used to determine any potential impact within the identified suitable habitat from the drawdown. NS Power would like to note that short term changes to vegetative types and coverage or sediments as a result of the drawdown do not necessarily constitute permanent harm to the habitat.

NS Power will also complete a literature review of available scientific publications to supplement the drone survey and monitoring transects to qualify observed changes in vegetation, soils and overall habitat loss, if any, and assist in quantifying the temporal extent of impact.

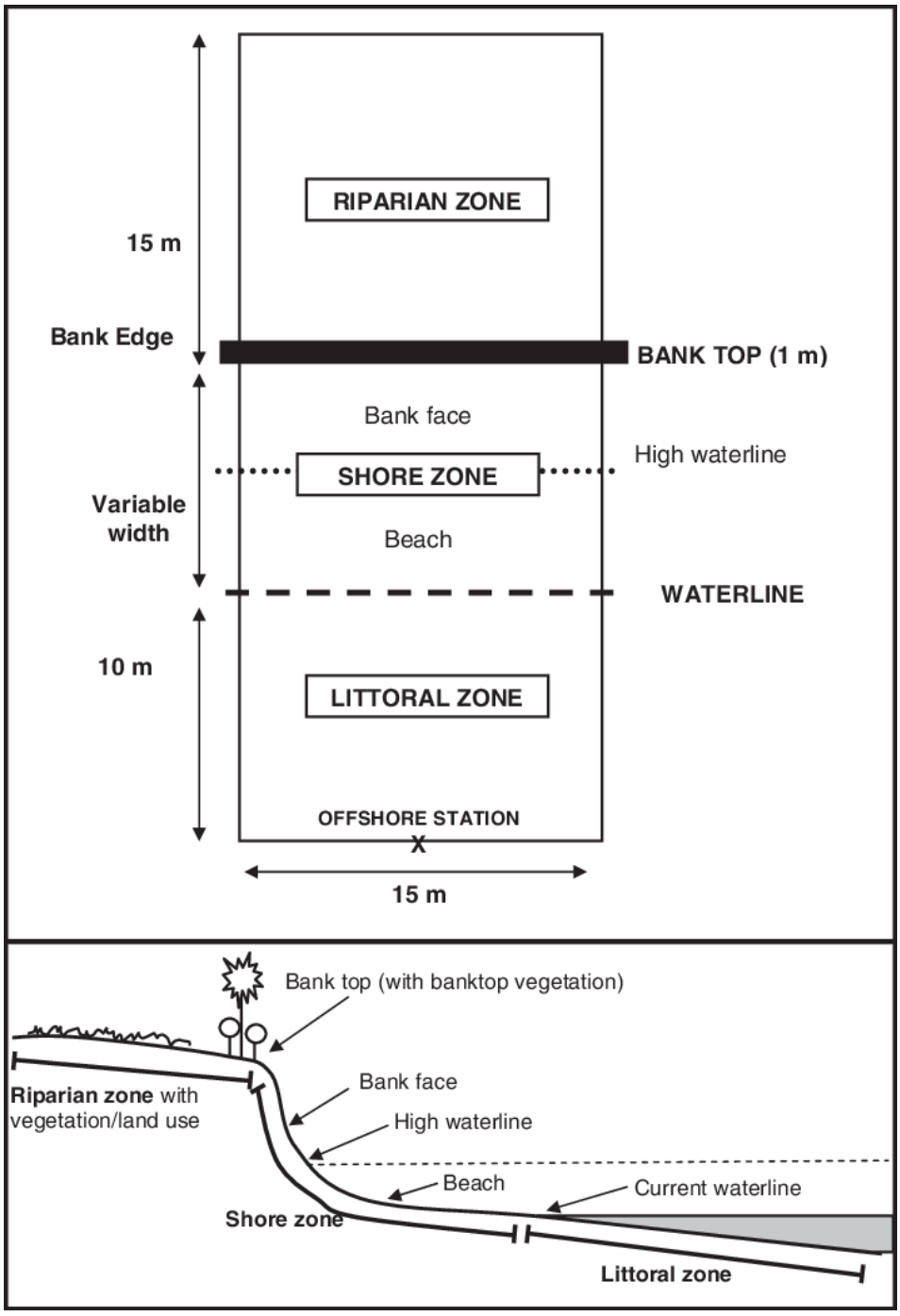


Figure 1: Plan view and schematic section of a Transect (from Rowan et al., 2006)

3.6.2.1 Sediment characterization

The sediment classes used for the identification of sediment types are described in Table 3. Percent coverage of each type of substrate will be determined within each zone, delineated, and documented with digital imagery.

Table 3: Classification of substrate types

Class	Size Range (mm)
Bedrock	Continuous rock
Boulder	>250
Rubble	130-250
Cobble	30-130
Gravel	2-30
Sand	0.06-2
Mud	0.06

3.6.2.2 Vegetation Characterization

Observations for the entire plot are made from an 'offshore station', either from a boat or while standing in the water, not exceeding the maximum wading depth of 0.75 m, to ensure consistency between boat- and foot-based versions. The dimensions of the riparian and littoral zones were selected to capture the composition and diversity of features to be assessed and corresponds to the field of view of the surveyor from the offshore station. The shore zone, especially beach width, is of variable dimension depending on the water level at the time when the survey is carried out.

Vegetation characterization will be conducted in each zone of the transect. Identification of plant species/assemblage and percent coverage will be determined. Each type of vegetation will be delineated and documented with digital imagery. Identification of rare and protected species will be documented. Based on observations conducted during previous drawdowns, the current knowledge of the watershed, and the transient nature of this project, the drawdown is not expected to cause significant harm to the shoreline of the lake.

3.7 WETLANDS

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified

during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond.

Table 4 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 4: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond. Wetlands 3,5,6,15,17,19 are highlighted as they have been selected for Wetland Monitoring as described below.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. An updated ACCDC search (Appendix P) was completed in 2023 for the study area, 3 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond, see Figure 2. There are 14 records of Salted shell lichen (*Coccocarpia palmicola*). Salted shell lichen is listed as secure within the NS General Status Rank and has a Provincial Rarity Rank of S3S4. There is one record of Canada Warbler (*Cardellina canadensis*) which is listed as endangered within the NS General Status Rank and has a Provincial Rarity Rank of S3B. There was also one record of Boreal Chickadee *(Poecile hudsonicus*) that was noted, this species has a Provincial Rarity Rank of S3B. As per Figure 2 below, all records are not located in the immediate area of the Ruth Falls Headpond. As a result, none of the species listed above are anticipated to be impacted by the drawdown activities. See Appendix P – ACCDC report in the Supporting Information document for full details.

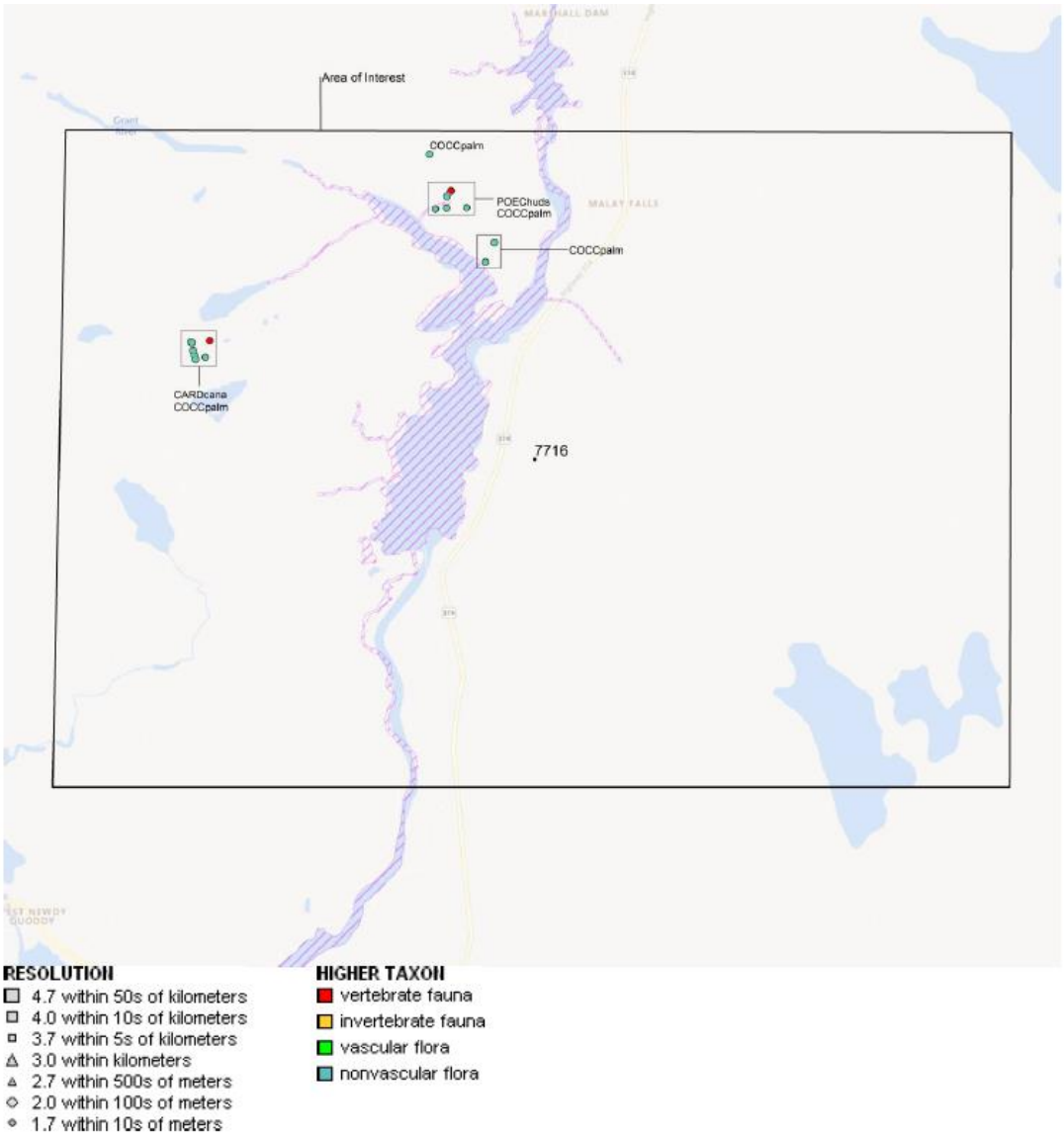


Figure 2: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points (2023)

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a 9 month period is unknown.

Six wetlands have been selected for monitoring. Figure 3 displays the mapped wetland on the Ruth Falls Headpond, with the six wetlands to be monitored labeled. Wetland locations to be monitored include wetlands WL3, WL5, WL6, WL15, WL17 and WL19 which are described in Table 4.

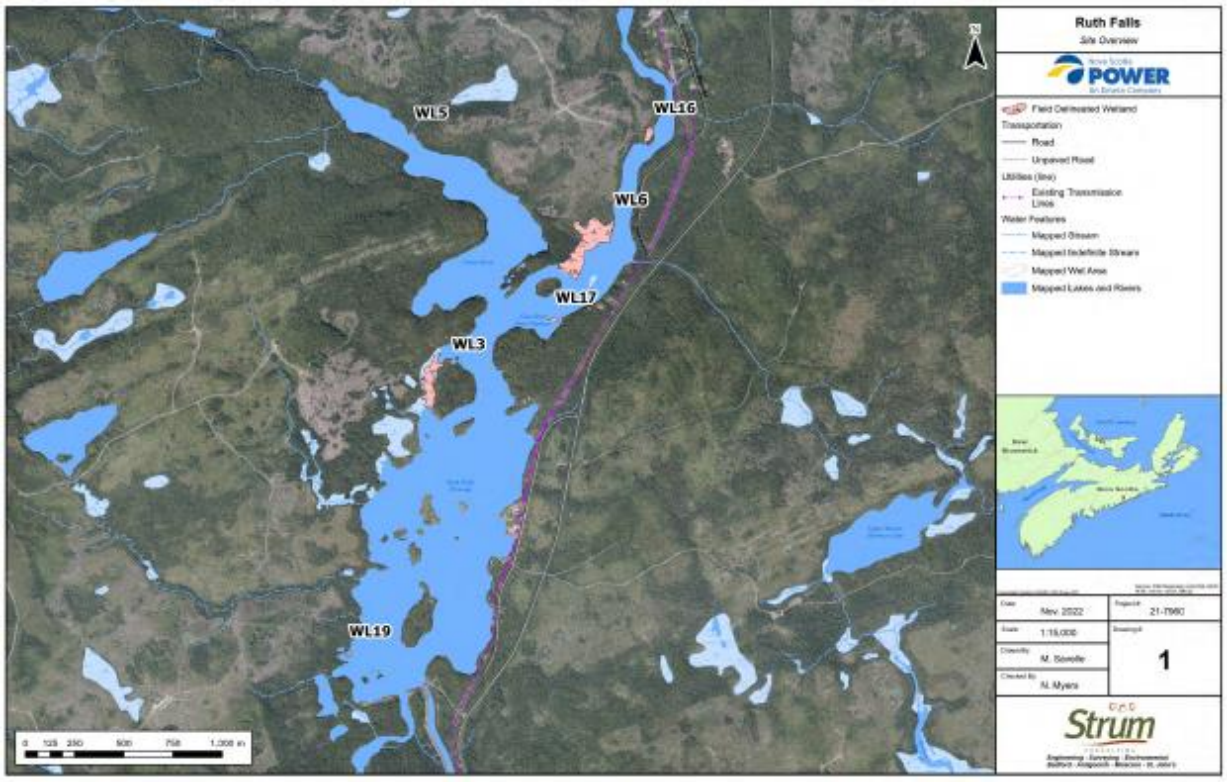


Figure 3: Mapped wetlands on Ruth Falls Headpond. Proposed Wetland Monitoring locations

3.7.1 Wetland Monitoring

While no permanent long-term alterations to the wetlands on Ruth Falls Headpond are anticipated, NS Power proposes to contract a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project.

NS Power developed a wetland monitoring plan, working with a qualified consultant, for the Tusket Main Dam Refurbishment Project, which involved a similar drawdown in 2021 of the headpond and potential impacts to a similar density of littoral zone wetlands; this plan was reviewed and approved by NSECC. Year one of post wetland monitoring is complete with the results suggesting there were temporary impacts during the drawdown period; however, there were minimal impacts to permanent wetland function / habitat. NS Power is proposing to use this plan as a basis for monitoring at Ruth Falls. Full details can be found in Appendix M- Wetland Monitoring Plan. This plan includes:

- An updated desktop assessment, using an updated ACCDC search (2023) and available provincial data to verify potential wetland locations identified in the 2007 survey.
- Establishing monitoring stations on the select sample of wetlands. Wetland locations to be monitored include wetlands WL3, WL5, WL6, WL15, WL17 and WL19 (Table 4).
- Baseline assessment, including wetland edge mapping, vegetation data collection, baseline functional assessment and baseline hydrological monitoring prior to the drawdown. Baseline monitoring was completed in July 2022. Results of the monitoring are included in the monitoring plan.
- Construction monitoring, including vegetation and hydrological monitoring while the reservoir is drawn down
- Post-construction monitoring, at minimum, will include monitoring immediately after refilling of Ruth Falls Headpond and again the following year. The length of post-construction monitoring will be determined in consultation with the NSECC Wetland Specialist and will include monitoring for vegetation and hydrological conditions. NS Power understands that a post-construction monitoring program is typically 5 years, with a repeated functional assessment in the last year of monitoring.
- Fish and Fish habitat suitability assessment. This assessment helps inform the selection of wetlands to be monitored and define methodology for assessing fish habitat and monitoring changes. The assessment includes a review of fish species within the reservoir, existing fish habitat, water quality conditions, wetland function to provide fish habitat, inherent wetland characteristics, including vegetative cover, accessibility, potential sources of food and nutrition, hydrology, and the potential hydrological changes within the bathymetry of reservoir as a result of drawdown.
- Fish habitat monitoring: Monitoring includes baseline monitoring of a desktop suitability assessment of wetland habitat, a review of fish sampling result and the collection of fish habitat data from the selected monitoring wetlands.
- Reporting schedule and frequency

3.8 REPORTING

NS Power will provide a report on 2024 drawdown monitoring activities by December 31, 2025, detailing results of the fish rescue survey and mortality estimates, results and estimates for downstream entrainment and results of the habitat assessment. The report will also include a summary of water quality surveys conducted as mandated by NSECC.

Reporting for wetland monitoring will be in accordance to the wetland monitoring plan in Appendix M.

4.0 Construction Monitoring

NS Power requires that the main civil contractor (or general contractor) develop a site-specific water management and erosion and sedimentation control plan that must align with NS Power's established water management and contingency plan as described in this document. The contractor plan will be reviewed by the Project Manager, Engineer and Environmental Lead to ensure the plan conforms with established design and constructability criteria and environmental standards. The contractor plan must also include details for regular inspection of control measures, water quality, as required, and machinery and processes for identifying and addressing deficiencies as well as reporting mechanisms for environmental incidents.

In addition to the contractor plan, NS Power develops a Project specific Environmental Protection Plan (EPP) which details NS Power's regulatory requirements, approval and authorization terms and conditions, and best practices that will be employed during construction. As part of NS Power's EPP, a regular inspection program is implemented in addition to the contractor inspection program, to evaluate contractor compliance to the contractor plan and to NS Power's EPP. Both the contractor's and NS Power's inspection program will extend throughout construction in 2024 and a summary report confirming all measures and standards as committed in this document and NS Power's supporting information document #2 will be provided to DFO by December 31, 2025.

5.0 Post-Construction Monitoring

5.1 OVERVIEW

Once construction is complete, NS Power will monitor the operation of the new dam structure as part of its regular bi-annual dam inspection and maintenance program as well as weekly inspections conducted by Hydro Operations. The new dam structure and associated fish passage improvement are expected to have positive impacts on migration. NS Power will complete post-construction monitoring to evaluate the effectiveness of the improved fish passage structures and overall operation of the new dam. The following sections outline specific monitoring measures for the various aspects of the project. The monitoring program will be in place for two years after construction is complete.

5.2 FISH LADDER

NS Power will complete monitoring activities associated with changes to the Ruth Falls Dam after construction is complete, including the improvements made to the fish ladder which includes the adjustment of weir sizing, notch depth and the additional attraction flow through the bottom non-technical fishway. These activities are as follows:

- NS Power will engage Innovasea to install and operate one AI camera placed at the exit of the Ruth Falls fish ladder. The camera will be in operation between April 1 and June 15 in 2025, and 2026.
- NS Power will complete daily visual observations (daily inspections between April 1 and June 15, in 2025 and 2026) of the fish ladder entrance and the downstream area to look for signs of negative impacts to upstream fish passage. Daily inspections will be completed mostly by Hydro Operations staff or supporting consultants; to properly capture any potential negative impacts to fish migration as a result of the fish ladder improvements. Specific parameters for observation in the downstream area include flow disturbances, fish milling, spawning behavior, etc. Daily spill and maintenance flows will also be recorded. In addition to daily inspections, qualified Environmental Services (ES) staff will be on site weekly to observe the downstream area and provide a more thorough observation of any negative fish passage impacts.
- Engage and retain a fish passage specialist to provide support in assessing fish passage effectiveness.

NS Power will coordinate with the Project consulting fish passage professional to complete the following:

- On site assessment of the fish ladder once gaspereau are observed in the downstream area and migration begins, expected to be in early April.
- Assessment of the fish ladder throughout gaspereau migration – NS Power proposes to take an adaptive approach to subsequent site visits depending on assessment results and effectiveness of fish passage. The fish passage professional will remain on retainer with NS Power and is able to conduct a site visit relatively quickly.
- NS Power will provide an email summary of the assessments made by the fish passage professional to DFO, as well as any immediate flow adjustments made, or other action taken within 72 hours of the completion of an assessment.

If in collaboration with DFO and the qualified professional it is determined that contingency measures are required to improve upstream passage through the fish ladder, the following will be implemented within 72 hours of the notification of the target not being met, or observe negative impact by NS Power:

- ES qualified staff will conduct an immediate assessment of the fish ladder if negative fish passage impacts are observed during daily inspections (within 24 hours of observing the impact). NS Power will notify DFO of the observation and plan to correct, initiate a site visit by the fish passage professional, or implement contingency measures also within 24 hours.)
- If the assessment by the fish passage professional indicates the observed issue is internal to the fish ladder, NS Power will, in agreement with DFO, adjust flows in attempt to improve passage.
- If no improvements are observed, and structural issues are suspected, NS power will work with eh qualified fish passage specialist to assess which improvements could be required.

5.3 LOUVRE SYSTEM

Upon completion of the proposed improvements to the louvre system, NS Power is committed to completing a tagging study to assess how the changes impact the downward migration of eels. The results of this study will be used to inform successful improvements to the louvre system. A similar baseline study was conducted in 2010 which will be used to compare the results and demonstrate improvements to the louvres being able to convert all species away from the powerhouse to the bypass pipe. Sampling for alewife will also be completed to assess the effectiveness of the louvre system for diverting pelagic fish. The study will be conducted in 2025.

Should there be no improvement in efficiency for eels as a result of the study when compared to the 2010 study results, NS power will work with the qualified Fish Passage Specialist to assess additional improvements to the louvre system which could include the adjustment of flows and other structural adjustments.

5.4 UPSTREAM EEL RAMP MONITORING

The eel ramp will require monitoring and maintenance to ensure it is operating as designed. Operations will complete weekly checks on the eel ramp to ensure it is free of debris by opening up the locked box surrounding the ramp substrate and cleaning out any unwanted debris while checking for damage. The checks will also ensure the ramp is in proper working order and functioning as designed. This will include checking the hose and water level output. The eel ramp will follow the same operating timeframe as the fish ladder (April 1 to November 30) each year. The structure will include a trap which will enable NS Power to quantify the daily number of elvers ascending the ladder. This method is similar to the elver sampling conducted on the East River Chester (index river). During upstream migration season in 2025 (April – June) NS Power will complete a study to assess the abundance of elvers using the ladder. NS Power will place a fyke net near the entrance to the ramp and compare counts in the nets to the counts found

in the trap. This will provide insight into the effectiveness of the ramp at passing elvers. If low numbers of elvers are noted in the trap compared to those found in the fyke net, NS Power will work with the fish passage specialist to adjust flows to try to facilitate movement.

It is important to note that during the first year of operation after the improvements are made to fish passage (fishway, louvre system, and the new eel ramps), it is likely that some small adjustments may be needed to ensure the structures are operating optimally.

5.5 REPORTING

A post-construction monitoring report will be provided to DFO by January 1 of each of 2026 and 2027

Reporting will include:

- Results of upstream escapement monitoring.
- Results of daily and weekly inspections.
- Results of any formal assessment completed by the consulting and fish passage specialist.
- Maintenance flow records.
- Any adjustments made to the flows (fish ladder, louvre system or eel ramp)
- Any structural adjustments to fish passage (fish ladder, louvre system, or eel ramp)
- Any adjustments made to maintenance flows (65cfs through the vertical lift gates).

6.0 Death of Fish/HADD after Avoidance and Mitigation Measures and Standards

Table 8 provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Dam refurbishment.

Table 8: Residual Harm from Potential Impacts Associated with the Ruth Falls Dam Refurbishment

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect	Measures to Mitigate Death of Fish/HADD	Potential Residual Death of Fish/HADD
Temporary loss of fish habitat due to lowering headpond beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.5 km² in Ruth Falls Headpond	High	Low	Refer to Section 3	Residual HADD anticipated – temporary loss of fish habitat, to be quantified through monitoring
Temporary loss of fish habitat due to temporary installation of access roads	Localized: area immediately above and below the dam	High	Low	Refer to Section 2 and 3	No residual HADD anticipated
Permanent loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m²) directly below the dam	High	Low	Area is extremely small (60 m2)	No residual HADD anticipated
Fish mortality due to stranding when lowering headpond.	Localized: Ruth Falls Headpond	Medium	Low	Refer to Section 3 and 4	Residual death of fish anticipated, to be quantified through monitoring
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low	Refer to Section 3	Quantified through entrainment study
Potential downstream scour during drawdown of headpond.	Localized: East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated

Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High	Improvements to louvre system to support improved downstream passage	No residual HADD anticipated

APPENDIX L – ENTRAINMENT STUDY PLAN

Stantec

Ruth Falls Dam Rebuild

Fish Entrainment Monitoring Program - Field Plan

January 31, 2023

Prepared for:
Nova Scotia Power Incorporated

Prepared by:

Stantec Consulting Ltd.
102-40 Highfield Park Drive
Dartmouth NS B3A 0A3

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Introduction
November 12, 2022

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by Nova Scotia Power Inc. (NS Power) to conduct fish entrainment monitoring as part of the Ruth Falls Rebuild Project (the Project). Specifically, Stantec is conducting a study of fish abundance in the reservoir upstream of the Ruth Falls dam before the drawdown, and fish entrainment monitoring downstream of the dam during the planned 4-day reservoir drawdown period. The entrainment monitoring program will focus on gaspereau[1] and other incidental species.

Additionally, NS Power has retained the services of Aerovision Canada Inc (Aerovision) to conduct aerial drone surveys of the shoreline littoral zones to identify changes in habitat before and after the reservoir drawdown.

The following document outlines the Field Plan for the Fish Entrainment Monitoring Program that has been developed for the Ruth Falls drawdown.

2.0 BACKGROUND

The Ruth Falls Hydro System dam site (referred to as “the site”) is located 5 km north of the Town of Sheet Harbour, at latitude 44.95541° N and longitude -62.50016 ° W. The dam is located on the East River (Sheet Harbour), downstream of Ruth Falls Flowage.

To allow maintenance and repair of the Ruth Falls Hydro System dam, NSPI plans to lower levels upstream in Ruth Falls Flowage by approximately 5.5 metres for nine months in 2024. The drawdown will occur over a period of ten days and is currently scheduled to start mid July 2024. The lowering of Ruth Falls Flowage will result in water levels returning to levels similar to historical pre-impoundment conditions.

3.0 FIELD PROGRAM

The following section outlines the proposed Fish Entrainment Monitoring Program that will be conducted during the 2024 drawdown of Ruth Falls flowage.

The objective of the field program was to assess the abundance of Young-of-the-year (YoY) gaspereau within the reservoir before the drawdown, monitor the entrainment of fish from the reservoir during the drawdown and characterize the aquatic habitat exposed during the reservoir drawdown. Stantec has

[1] For the purpose of this report gaspereau refers to two similar and related species: the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*).

been engaged to conduct the fish entrainment monitoring tasks, while Aerovision will collect aerial imagery within the reservoir at set intervals to allow NS Power to document changes to aquatic habitat.

Specifically, the objectives addressed in this field program are:

1. Provide relative density and size distributions of YoY gaspereau and other fish incidentally caught in the Ruth Falls Flowage before the drawdown.
2. Provide an estimate of the number and species of fish entrained during the Ruth Falls Flowage drawdown.
3. Collect baseline aerial imagery of the shoreline and nearshore at various stages of the Project to determine the change aquatic habitat within Ruth Falls Flowage.

A step-by-step work plan to accomplish these objectives is described below.

3.1 BASELINE FISH ABUNDANCE SURVEY - RUTH FALLS FLOWAGE

Prior to the drawdown a baseline fish abundance survey will be conducted in Ruth Falls Flowage. The baseline survey was developed to obtain a sample of YoY gaspereau to establish density, length and weight metrics within the reservoir.

The baseline fish abundance survey in Ruth Falls Flowage will be conducted approximately a week prior to the drawdown (i.e., early July). In July, it is anticipated that YoY gaspereau in Ruth Falls Flowage will be in the juvenile stage with fork lengths measuring less than 30 mm. Gaspereau of this size are likely to disperse based on wind induced currents or water currents. For a separate drawdown monitoring program on the Tusket River, seining and modified ichthyoplankton tows were conducted in the Tusket Reservoir in July 2021. Seining was shown to be successful in capturing YoY gaspereau from the reservoir environment, while the ichthyoplankton tows were only marginally successful in the reservoir, but shown to be more successful in the downstream riverine environment.(Stantec 2022). As a result, the approach to collecting baseline data on YoY gaspereau will focus on the use of seines in the littoral environment. Sampling multiple locations is thought to produce the best probability of YoY gaspereau capture and result in a more robust morphometric dataset.

Up to 10 locations within the littoral zone of Ruth Falls Flowage will be sampled over one night using a 3 mm mesh (1/8 inch) beach seine. The seine sweeps will be conducted parallel to shore for 10 m using a 10 m x 1.5 m seine with 1/8-inch (3 mm) mesh, this will cover approximately 100 m^2 of habitat per seine. The seine will be closed off by bringing the offshore end towards the shoreline. Seining will be conducted by two field personnel between the hours of 18:00 and 02:00. The exact shoreline seining locations will be selected based on suitable bathymetry, substrates, shoreline vegetation and access. The target sampling area is provided in Figure 3.1.

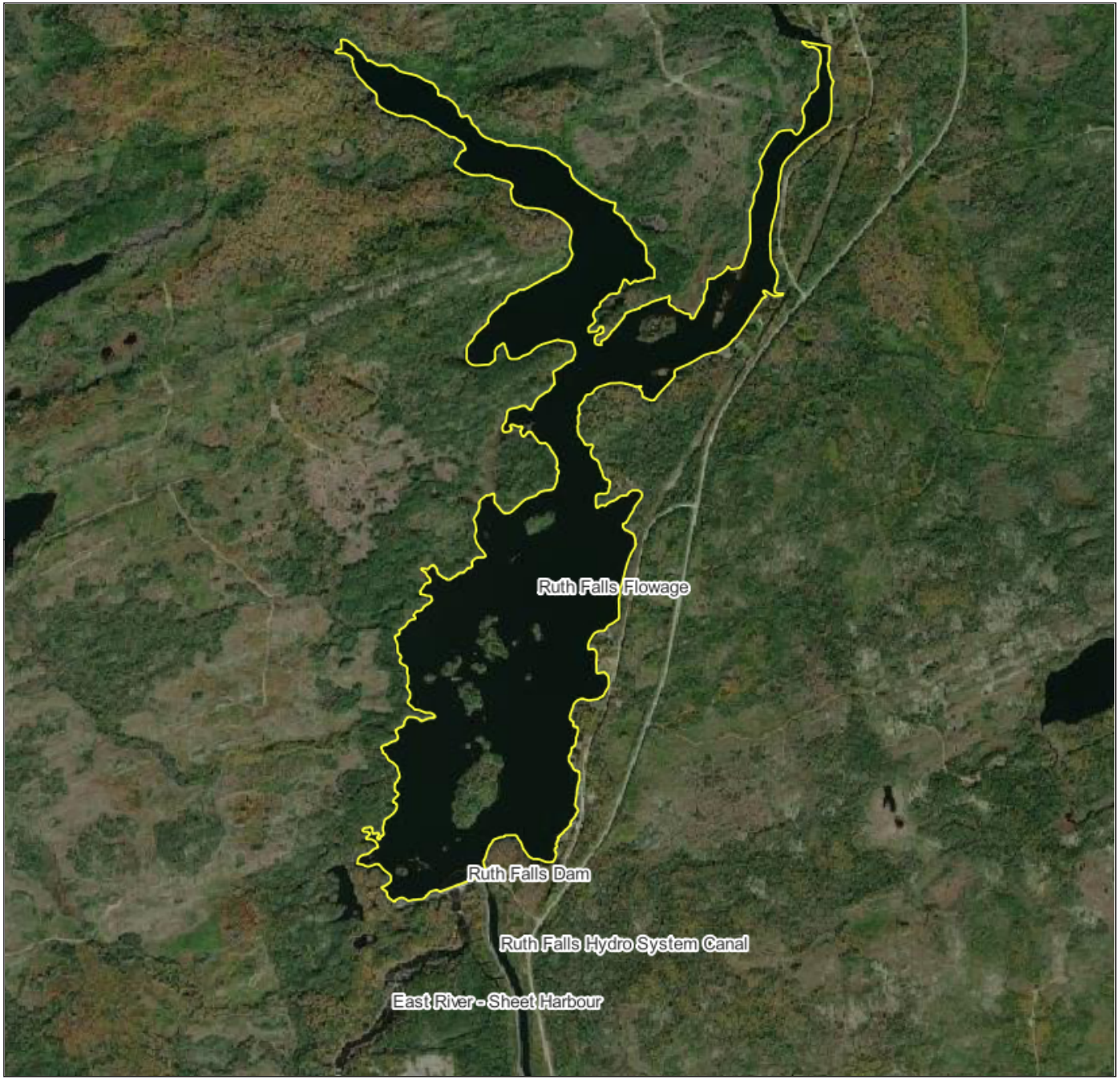
Fish Identification and Measurements

At each sampling location fish from the seine will be released into a cooler filled with freshwater and containing an airstone bubbler. Fish will be taken from each cooler, enumerated, and a subset of up to 50 YoY gaspereau from each net will be measured for fork length (to the nearest mm) and weighed (to the nearest 0.1 g). Where greater than 50 fish are caught in each net the subset of fish will include a random sample of juvenile gaspereau from the catch present. If large numbers of juvenile gaspereau are captured (i.e., in the hundreds) the entire sample will be weighed along with a subsample of 50 fish. The average weight per fish from the subsample will be used to estimate the total number of fish captured.

Other fish species collected in the sample will be identified and enumerated, with up to 25 individuals of each species weighed (to the nearest 0.1 g) and length measured (to the nearest mm) per location. Once weight and lengths of the fish have been recorded the majority of fish will be released in a similar location as their capture site.

3.1.1 Equipment

- Boat, outboard motor, and trailer
- Seine 1.5 m x 10 m
- Coolers for temporary fish storage, between collection and processing
- Fine mesh dip nets
- Scale (0.1 g resolution)
- Fish board (in mm)
- Camera
- Handheld GPS
- Data sheets or notebook
- Safety supplies (e.g., Personal Protective Equipment, boat kit, communication device, waders, personal floatation devices).



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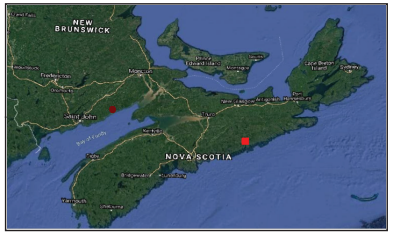
Target Baseline Sampling Area

N

0 350 700 metres

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N



Project Location
Sheet Harbour
Nova Scotia

Client/Project TBD_001
NS Power - Ruth Falls Entrainment Monitoring Program

Figure No.
3.1

Title
Target YoY Gaspereau Baseline Sampling Area

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3.2 FISH ENTRAINMENT MONITORING – EAST RIVER

Monitoring of fish entrainment during the drawdown will be conducted downstream of the Ruth Falls Flowage dam in East River. A preliminary assessment based on aerial imagery indicated the habitats in the East River downstream of the Ruth Falls Dam consists primarily of rapids and riffles. The flowing river characteristics (i.e., swift flows with large coarse or bedrock substrates) appeared to lend itself more towards the use of a rotary screw trap (e.g., Smolt wheel) over fyke traps or seine nets, particularly during the higher flows expected during the drawdown. It was noted that very few tributaries feed into the East River below the Ruth Falls Dam, decreasing the probability that species caught by the trap during the entrainment will be from other watercourses and increasing the probability that species captured will be those entrained from Ruth Falls Flowage.

In June 2022, Stantec was accompanied by NS Power representatives to evaluate the East River for suitable rotary screw trap locations (Figure 3.2). The area assessed was located between the powerhouse and the Ruth Falls Dam. The suitability of habitat for the installation of a rotary screw trap was assessed based on depth, accessibility, thalweg position, presence of suitable anchor points, and distance from the Ruth Falls Dam. Based on the field assessment there were no suitable locations identified for the placement of a rotary screw trap. There were however locations identified that were suitable for the use of fyke nets. As a result, the proposed approach is similar to that used in the Tusket River, during the drawdown in 2021 and further described below.

YoY Gaspereau Monitoring

Two locations (Approximately 1/3 and 2/3 of the wetted width) will be selected for monitoring YoY gaspereau using ichthyoplankton nets (bongo nets) with a 1/8-inch mesh (3 mm) mesh, similar to the method conducted during the 2021 YoY monitoring project on the Tusket River. The 3-mm mesh for the net is anticipated to be the most appropriate mesh size for the size classes of juvenile gaspereau present during the drawdown. The 3-mm mesh size was successful in capturing YoY Gaspereau during the monitoring conducted on the Tusket River in 2021 (Stantec 2022).

The location for the entrainment monitoring was selected based on the field assessment conducted in June 2022 (Figure 3.2). At each location the bongo nets will be oriented facing into the flow so that fish moving downstream would be entrained in the net. The nets will be positioned in the thalweg for 10-minute periods, at each location at least three times per day, and up to five times per day (early morning, morning, afternoon, evening, and late evening). The time of day samples are collected will be slightly varied each day to cover a range of times between 06:00 and 21:00. Due to safety concerns regarding working downstream of the dam during a release, monitoring of entrainment will occur between the hours of 06:00 and 21:00. NS Power acknowledges we are not able to sample throughout the full 24-hour period, which may result in some bias in entrainment estimates.

A mechanical flow meter attached to the bongo nets will record flow through the net to calculate the volume of water sampled. The catch in each net divided by the flow through the net during the sampling period will be used to determine the density (fish/m^3) of juvenile gaspereau. An estimate of abundance

will be calculated from the average daily cross-sectional fish density (fish/m^3) and the daily discharge (m^3) through the dam as provided by NS Power.

Fyke-Net Monitoring

Fyke nets will be used during entrainment monitoring to assess other species and life stages of fish which may be entrained by the drawdown. Stantec proposes to set three fyke nets with ¼ inch mesh (6 mm) in suitable locations within the river downstream of the dam. The approximate locations are shown in Figure 3.2 with the exact deployment method and locations to be identified by the field staff on site based on water levels and current velocities during the drawdown. The nets will be set in the morning and checked periodically during the day based on catch rates. Stantec will evaluate conditions on-site to determine the feasibility of setting nets overnight, if excessive mortalities are recorded following overnight sets, the overnight effort will be reduced to limit mortalities. NS Power acknowledges that sampling throughout the full 24-hour period may not be possible, which may result in some bias in entrainment estimates.

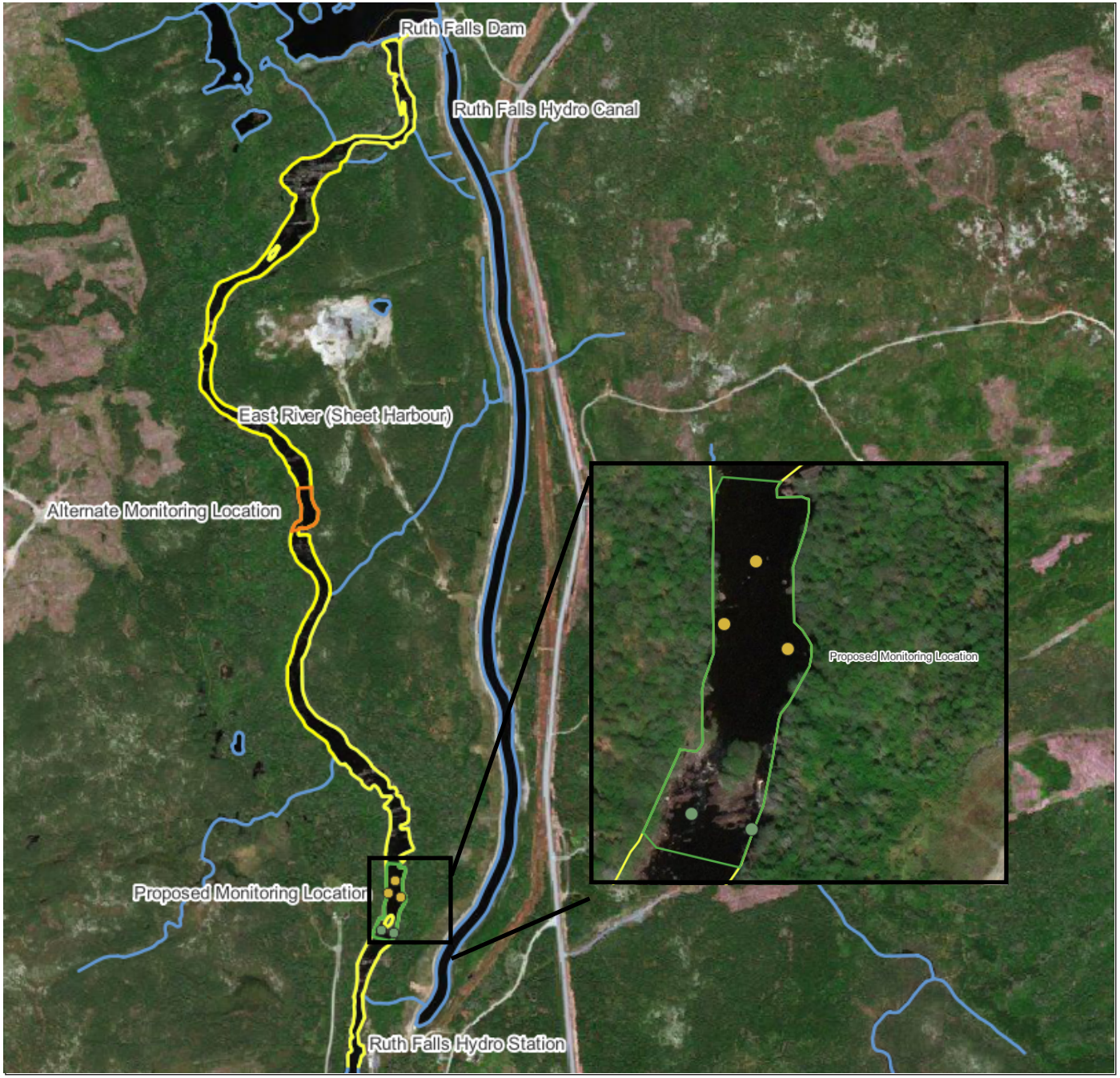
Fish Identification and Measurements

At each YoY gaspereau monitoring location fish from the cod-end of the bongo net will be released into a cooler filled with freshwater and containing an airstone bubbler. Fish will be taken from each cooler, enumerated, and a subset of 50 YOY gaspereau from each net will be measured for fork length (to the nearest mm) and weighed (to the nearest 0.1 g). Where greater than 50 fish are caught in each net the subset of fish will include a random sample of juvenile gaspereau from the catch present. If large numbers of juvenile gaspereau are captured (i.e., in the hundreds) the entire sample will be weighed along with a subsample of 50 fish. The average weight per fish from the subsample will be used to estimate the total number of fish captured.

Other fish species collected in the bongo or fyke nets will be identified and enumerated, with up to 25 individuals of each species weighed (to the nearest 0.1 g) and length measured (to the nearest mm) per location. Once weight and lengths of the fish have been recorded the majority of fish will be released in a similar location as their capture site. A subsample of fish from the fyke net catch will be retained for a mark-recapture experiment described below.

Mark-Recapture Experiment

A mark-recapture experiment will be implemented to estimate capture probability for fish caught in the fyke nets. A subsample of adult or juvenile fish will be marked via fin clip and released upstream at a suitable location. Stantec is proposing to mark all viable fish depending on catches. Species targeted will include those present at the time of sampling and may include large-bodied species such as: smallmouth bass, white perch, white sucker, yellow perch. Fish selected for marking will be anesthetized using clove oil, a portion of the fin will be clipped using scissors sterilized in 70% ethanol, and the fish will be moved to a recovery tank prior to release upstream of the sampling area. The release location will be determined in conjunction with NS Power to determine an area that is accessible and a safe distance downstream from the Tusket Dam.



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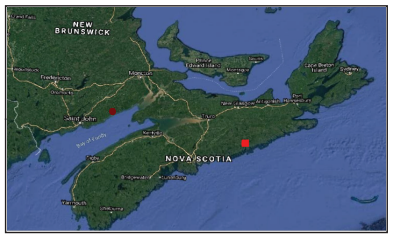
- Proposed Study Area
- Proposed Monitoring Location
- Alternate Monitoring Location
- Proposed Fyke Net Locations
- Proposed Bongo Net Locations

N

0 350 700 metres

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N



Project Location
Sheet Harbour
Nova Scotia

Client/Project TBD_001
NS Power - Ruth Falls Entrainment Monitoring Program

Figure No.
3.2

Title
Target Fish Entrainment Sampling Locations

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3.2.2 Equipment

- Boat, outboard motor and trailer
- Rotary Screw Trap
- Dip nets
- Coolers for temporary fish storage, anesthetization, recovery, and transport
- Air stone bubbler
- Scale (0.1 g resolution)
- Fish board (in mm)
- Clove oil
- Scissors
- 70% ethanol
- Camera
- Handheld GPS
- Data sheets or notebook
- Safety supplies (e.g., Personal Protective Equipment, boat kit, communication device, waders, personal floatation devices).

3.3 SHORELINE HABITAT CHARACTERIZATION

Aerial imagery will be collected within the reservoir at set intervals to allow NS Power to document changes to aquatic habitat. Aerial imagery collection will consist of three surveys conducted during the following periods:

- 1 survey within a period seven days prior to drawdown commencing (Early July 2024)
- 1 survey after the completion of the drawdown (August 2024)
- 1 survey conducted in November 2024.

Aerial imagery collection will be conducted by Aerovision within Ruth Falls Flowage using a fixed-wing remotely piloted aircraft system, RTK enabled with long endurance flight, and a 21MP camera. Transects will be conducted within the reservoir where photos will be collected along a predetermined flight path (as shown in Figure 3.4). The remotely piloted aircraft system will be operated at a height at an elevation between 122 and 213 m (400 to 700 ft) along a pre-programmed flight path, as shown in Figure 3.1. The imagery resulting from the flightpath will include complete coverage of a 30-m buffer on either side of the original high-water mark. Each image will be of sufficient resolution to delineate aquatic habitat types and extents, with a pixel resolution of 6.5 cm or less.

Following data capture, the imagery will be post-processed to produce a geo-referenced orthomosaic over the reservoir. Further discussion of deliverables will follow collection, to clarify desired formats, size, delivery method. The delineation of habitat types and extents will be performed by NS Power using GIS analysis.



Figure 3.3 Sample Flight Path for Ruth Falls Flowage

4.0 REPORTING

During the baseline fish abundance survey in Ruth Falls Flowage, fish capture data will be reported to DFO at the end of the baseline survey and every two days during the fish entrainment monitoring. If issues arise with the sampling methods, DFO will be informed of any variation from the methods described above.

Upon completion of the program a report summarizing the results of the fish entrainment study will be prepared for NS Power and submitted by December 30, 2024. This report will include information on the methods utilized in data collection and a summary of data from the baseline fish abundance survey and fish entrainment monitoring.

The baseline fish abundance survey data will be presented in terms of:

- the total number of fish caught by species,
- a summary of morphometric data (weight, length) by species, and
- the calculated densities by species for each seine.

The entrainment monitoring data will be presented in terms of:

- the total number of fish caught by species,
- a summary of morphometric data (weight, length) by species, and
- a daily entrainment estimate by species.

An entrainment estimate for YoY gaspereau will be calculated using the average fish densities (fish/m^3) from the rotary screw trap and the daily discharge (m^3) through the dam as provided by NS Power. The capture probability for large-bodied fish utilized in the mark-recapture experiment will be estimated using a suitable population size estimate method (e.g., Peterson method: N=MC/R, where N = population estimate, M = number of marked individuals, C = number of captured individuals, and R = number of recaptured individuals) with confidence intervals based on binomial confidence limits as suggested in Seber (1982). The total number of fish caught and recaptured in the fyke nets will be used to determine a capture probability to provide a daily estimate of fish entrainment.

5.0 PROJECT SCHEDULE

The proposed schedule for the 2024 Ruth Falls Entrainment Monitoring field program is outlined below.

- Preliminary Field Visit for Site Selection (Completed) - June 2022
- Baseline Aerial Shoreline Surveys – Early July 2024
- Baseline Fish Abundance Survey – Early July 2024
- Ruth Falls Flowage Drawdown – Mid July 2024
- Fish Entrainment Monitoring – Mid July 2024
- Post-drawdown Aerial Shoreline Surveys – Late July 2024

6.0 CLOSURE

This plan has been prepared for the sole benefit of Nova Scotia Power Incorporated (NS Power). This report may not be relied upon by any other person or entity without the express written consent of Stantec Consulting Ltd.

Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Should additional information become available, Stantec Consulting Ltd. requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

We trust that the Fish Entrainment Study Field Plan is satisfactory for your purposes at this time. If you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

DRAFT

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Environmental Project Manager
Tel: (902) 620-0251
Matt.Steeves@stantec.com

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APPENDIX M – WETLAND MONITORING PLAN

December 14, 2022

Ms. Kailey Osborne
Nova Scotia Power Inc.
1223 Lower Water St.
Halifax, NS B3J 3S8

Dear Ms. Osborne,

Re: Wetland and Wetland Fish Habitat Monitoring Plan
Ruth Falls Reservoir, Sheet Harbour, NS

INTRODUCTION

Nova Scotia Power Inc. (NSPI) is planning to temporarily lower the headpond at the Ruth Falls Reservoir (the Reservoir) within the Sheet Harbour Hydroelectric System to accommodate refurbishments (the Project). Strum Consulting was retained by NSPI to develop a Wetland and Wetland Fish Habitat Monitoring Plan (the Plan) for the Project.

The objective of the Plan is to determine whether the function of wetlands located along the shore that are contiguous with the headpond are impacted as a result of the lowered water levels. Additionally, the Plan will assess the impact on potential fish habitat provided by these wetlands.

The Plan will outline the general principles and methodology by which the wetlands and fish habitat around the Ruth Falls headpond will be monitored, before and after the water level is altered. Baseline wetland monitoring results will also be included for reference.

PROJECT DETAILS

To accommodate refurbishments at the Ruth Falls Reservoir, the water level in the headpond will be dropped from a full supply level of 109.25 ft down to 91 ft. The headpond will remain lowered for a period of approximately 9 months while work is completed on the Reservoir.

Wetlands

Initial wetland delineation was undertaken along the shores of the Reservoir during the *Vegetation Surveys at the Sheet Harbour Hydroelectric System* completed by Jacques Whitford (JW) in 2007 (JW, 2007). As a result of this delineation, 21 wetlands were identified that are contiguous with the headpond (Table 1; see Drawing 1, Attachment A).

Table 1: Wetlands identified at the Ruth Falls Reservoir (Jacques Whitford, 2007)

Wetland ID	Wetland Type
1	Treed shore bog
2	Treed shore bog
3	**Treed shore bog**
4	Shore bog
5	**Shore bog**
6	**Treed shore bog/floating bog**
7	Shore bog
8	Shore bog
9	Shore bog
10	Shore bog
11	Shore bog
12	Shore bog
13	Shore bog
14	Shore bog
15	**Treed shore bog/treed shore swamp**
16	Treed shore bog
17	**Shore bog**
18	Treed shore bog
19	**Shore bog**
20	Shore bog
21	Shore bog

Fish Sampling

Fish species data collected within the Sheet Harbour hydroelectric system was provided to Strum by NSPI; this historical data, including bathymetry information for the Ruth Falls headpond as well as fish and fish habitat assessment information from the Sheet Harbour Hydro System Relicensing Report (Nova Scotia Power, 2018), was used to establish baseline conditions and will assist in developing fish habitat post-construction monitoring assessments.

WETLAND MONITORING

The wetlands, as identified by JW (2007), provided the initial wetland assessment information; Strum has relied on this previously collected data to select and complete a monitoring assessment on six of these identified wetlands. The six wetlands **bolded** in Table 1 (Wetlands 3, 5, 6, 15, 17, and 19) are those selected for monitoring. Criteria for selection considered distribution throughout the reservoir and representation of different (spatial) areas and various wetland types. The criteria also included screening to ensure that hydrological source, landform, and location within a respective catchment area were represented throughout the Reservoir.

Wetland monitoring activities will consist of four baseline assessments (two of which were completed in July and September 2022), one pre-construction assessment, a minimum of one assessment during

drawdown (pending seasonality and timing of construction), and 5 years of post-construction monitoring. Pre-construction monitoring will be completed prior to the headpond being lowered to establish baseline conditions. Post-construction monitoring will begin after refurbishments are concluded and the Reservoir water level has been returned to its pre-construction full supply level. The findings of the monitoring program will allow for an evaluation of the extent of any changes in wetland characteristics and function as a result of the lowered water levels within the headpond.

Methodology

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored was delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up to date, and to establish the current biodiversity of the existing habitat.

Vegetative monitoring will entail an assessment of vegetative composition and cover within quadrats along a transect. The linear transect will consist of a series of four 1 m x 1 m quadrats placed 5-10 m apart along the transect route. Percent cover of the herbaceous, shrub/sapling, and tree species within each quadrat will be assessed. The top right corner of each quadrat will be staked to ensure that the selected areas can be replicated for future monitoring events. Additionally, dominant plant species throughout the wetland, as identified along the transect, will be determined for each stratum based on the percentage of vegetative cover. A general assessment will be made to determine overall plant health and note any species that appear to be unhealthy or dying. Vegetative biodiversity will be considered throughout the monitoring timeline to establish whether there is a change in species composition for vegetation plots assessed.

To aid in the extrapolation of data between the wetlands monitored and those that are not, standardized placement of monitoring wells and vegetation plots within wetlands has been conducted. This will ensure consistency throughout the data set, as well as across the different wetland types.

- Monitoring wells were installed halfway between (1) a point on the upland edge of the wetland furthest from open water, and (2) the nearest open water.
- Vegetation plots were positioned between the monitoring well and the water's edge in a line, spaced 5-10 m apart. Where sufficient distance between the monitoring well and the water's edge wasn't available, the plots were positioned towards the upland edge, maintaining the linear distribution.

During initial delineation, soil test pits were incorporated via manual installation (auger, shovel). Indicators of wetland hydrology were noted, including soil saturation, water table level, and standing water. Soil type(s) within each test pit were identified and will be monitored as the wetlands are re-assessed for function during the 5 years post-construction assessments. Subsequent monitoring activities will follow this same approach.

Photographs will be taken of the wetland from a fixed location (identified via GPS) for comparison with future events. All monitoring methodology will be completed during pre-construction and post-construction monitoring events. Initial monitoring events were conducted by a trained biologist and took place within the growing season (June 1 – September 30) to capture the prime growth period for

plants and assess dry season conditions. Subsequent monitoring events will be timed to coincide with previous years' assessment dates to allow data comparisons to be made with previous and future monitoring events. Given the uncertainty of the timing of drawdown, subsequent monitoring events will be timed to best reflect the changing conditions, while also considering the growing season and previously obtained baseline data to accurately assess any changes to vegetative biodiversity.

A description of the monitoring parameters and assessment methodology for wetlands is provided in Table 2, below. All data gathering techniques will be replicated for each subsequent monitoring event.

Table 2: Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Methods of Assessment
Hydrology	Depth to groundwater will be measured in monitoring wells.
	Standing water depth measurements will be noted within the existing wetland (if applicable).
	Evidence of other positive indicators of hydrology (*e.g.*, drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.
	An assessment of the general hydrologic condition will be made.
Vegetation	Herbaceous vegetation assessments (as % cover) will be completed within plots along a vegetative transect throughout the wetland. Assessment of the potential changes in composition, species, and health will be evaluated. Photographs will be taken of each individual vegetation plot for comparison with future monitoring events. Any presence of non-native/exotic species will be noted during all surveys, and are addressed specifically in the WESP-AC assessment.
	General assessment of the above variables throughout the wetland will be completed.
	Dominant plant species throughout the wetland will be determined for each stratum based on the percentage of aerial cover. Changes to biodiversity will be monitored over time through identification of species composition.
	Photographs will be taken of the wetland from a fixed location for comparison with future monitoring events.
Soils	Soil type within test pits will be noted and recorded.
	Assessment of potential changes in soil conditions throughout the wetland habitat will be evaluated, including evidence of sedimentation and siltation.

Wetland Functional Assessments (WESP-AC)

WESP-AC was completed during initial baseline pre-construction surveys and will be replicated during the Year 5 post-construction monitoring event to assess whether the function and relative values of the wetlands were changed as a result of the Project.

WETLAND FISH HABITAT MONITORING

Review of Fish Sampling Results

A review of fish sampling conducted by NSPI was completed for all data available prior to the commencement of monitoring. The review involved data compilation of fish species and abundance,

information related to migratory periods (including applicable date ranges and species types observed) and identified species' habitat requirements.

Desktop Fish Habitat Suitability Review

Prior to the commencement of monitoring, a desktop fish habitat suitability review was completed to assess the quality of fish habitat provided by both the Ruth Falls Reservoir and the wetlands contiguous with the Reservoir's shoreline. This review was used to help identify the wetlands that provide valuable fish habitat and inform the selection of wetlands for both wetland monitoring and wetland fish habitat monitoring, and included the following:

- Accessibility to fish
- Provision of fish cover
- Provision of water quality control features
- Potential sources of food and nutrition
- Bathymetry and water depth of the reservoir
- Review of fish sampling results

Based on this assessment, the six wetlands selected were considered most likely to provide a variety of suitable fish habitat for wetland fish habitat monitoring (in addition to meeting the requirements of the wetland monitoring selection criteria).

Assumptions for Fish Habitat Assessments

Fish habitat field surveys are to be modelled after the Ontario Ministry of Natural Resources Procedure (1991) for the Bay of Quinte. Given that the habitat assessments are taking place along the shoreline of a body of (relatively) still water, rather than along a watercourse, the application of flow assessments and fish habitat in streams is less transferable and resources such as the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt-a-stream, 2018), are not as applicable.

Given NSPI's ongoing fish monitoring at the Ruth Falls fish ladder, it is assumed that fish are present in the Reservoir, and that there are fish that use the habitats being surveyed. Therefore, minimizing damage and disruption to fish in sensitive situations, such as breeding, will take priority over the collection of any single data point. If fish breeding evidence is encountered during surveys, those effected data points may be omitted to prevent disturbance during these sensitive periods. NSPI may also want to consider structuring their work schedule around the known breeding periods of any species of conservation interest, including Atlantic salmon (*Salmo salar*).

Wetlands will be monitored for function and fish habitat during the summer months, though they are likely to provide fish habitat year-round. In this instance, the Ordinary High-Water Mark (OHWM) has been defined as the ordinary high-water level within the Reservoir under normal operating conditions. Given that NSPI has some control over water levels, the OHWM is assumed to be the average of the highest operating-condition water levels. This means that water levels during flood conditions in the spring are not considered as the high-water level for the purpose of this assessment. The delineation of fish habitat occurred during initial baseline surveys with consideration given to the OHWM (as

defined herein), further surveys during drawdown and post construction will assess the current conditions at those times and be compared to the baseline conditions.

Methodology for Fish Habitat Field Assessments

The requirements for the baseline and subsequent fish habitat monitoring are described below in detail, including the timing of each of the field and desktop components.

The initial baseline surveys for fish habitat identification and classification were conducted by trained biologists and took place within the growing season on July 4-5, and again on September 6, 2022. The initial baseline surveys were conducted at the six selected wetlands surrounding the Ruth Falls Reservoir. The six wetlands were surveyed for both wetland function and characteristics as well as wetland fish habitat to incorporate the consideration of fish habitat and details associated with water quality. Upon completion of baseline studies, the monitoring schedule will proceed as outlined in the Proposed Schedule and Reporting section of this Plan.

Following the procedure outlined in the Ontario Ministry of Natural Resources (1991) document, transects will be walked from the Open Lake inland, through the Lakeshore and into the backshore for all subsequent monitoring events. This will align with the program that was completed during the baseline studies. General observations will be made, and specific parameters will be assessed for their likelihood to support fish habitat, as seen in Table 3, below.

Along the transects, the portions of each transect to be assessed will be defined as follows:

Open Lake (OL): Open Lake is the area that is completely inundated with water, and can be definitively considered direct fish habitat. There may be any combination of emergent, floating, and submerged vegetation, though the water depth should be no more than 50 cm. The Open Lake area must also be connected to the main water body of the Reservoir to allow fish passage.

Lakeshore (LS): The Lakeshore (also known as the Foreshore) is the area that is generally above the current water level of the lake (Reservoir), but below the highwater line (during flood conditions) on an annual basis. This area might be considered direct fish habitat, though indirect fish habitat should not be considered a requirement. There is wetland vegetation, with the potential for some aquatic vegetation, especially when in proximity to the Open Lake area. The point for the LS assessment should be where there is a transition from standing water to no standing water.

Backshore (BS): The Backshore is the area at least 30 m perpendicular inland to the shore's highwater line and it should not be saturated in water, though it can be wetland or upland. It is not considered fish habitat and should not be accessible to fish.

The parameters to be monitored at each portion of the transect (i.e., OL, LS and BS) are described in Table 3.

Table 3: Wetland Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Photos	OL, LS, BS	Photos will be taken of the substrate (where applicable), vegetation, surrounding habitat, and any other observations of note.
GPS	OL, LS, BS	GPS waypoints will be taken to accurately map results and track the movement of OL and LS waypoints based on de-watering activities.
Vegetation	OL, LS, BS	Relevant vegetation within a 5 m radius will be recorded, and the relative abundance within each stratum within a 30 m radius will be estimated.
Aquatic vegetation	OL, LS	Any water-bound vegetation species will be noted within a 5 m radius and the relative abundance as a percent cover within a 30 m radius will be estimated.
Water Quality	OL/LS	Standard parameters including pH, conductivity, temperature, and dissolved oxygen will be measured using a YSI Multiparameter meter where open water is present and can be accessed safely. At the Lake Shore area, this may not be possible given differing water levels and vegetation constraints but it will be captured where feasible.
Substrate	OL, LS, BS	Substrate types and relative abundance will be noted, including bedrock, boulders, rubble, cobble, gravel, sand, detritus, and fines/muck/silt.
Water Level/Depth	OL, LS	The depth or level of water compared to the substrate should be measured using a measuring device. The use of a piezometer for continuous measurement may be required in conjunction with, or as a replacement to, any monitoring wells installed within the selected wetlands to be monitored.

Given that the water level will significantly change during drawdown, the transects where the assessment points are taken will remain the same, however, new assessment points will be added at each of the monitoring sites to reflect the changing OL and LS locations. The transect lines will still inform the placement of those points of assessment, however, if safety challenges prevent access to a specific location, the point will be moved to a nearby and comparable safe location, or omitted entirely if accessible and representative habitat is not present. Upon water levels rising to pre-construction levels (or as close as can be expected in post-construction conditions), the original assessment points will be resumed for all post-construction monitoring, to the best ability of the biologist conducting surveys.

Fish habitat will be classified as it is defined in Table 4, for the purpose of determining the extent to which any given habitat might contribute to fish habitat, either directly, indirectly, or not at all.

Table 4: Criteria to determine habitat

Habitat Type	Location(s)	Definition
Direct	Open Lake, Lakeshore (possible)	"…Water frequented by fish…on which fish depend on…to carry out their life processes including spawning grounds and nursery, rearing, food supply, and migration areas" (Federal Fisheries Act, Section 34.1).
Indirect	Lakeshore	Areas where fish might pass, but are not necessarily reliant upon (the areas) for life processes, areas that may be temporarily inundated, temporarily flowing (ephemeral), or where some direct habitats draw important resources from.
Not Fish Habitat*	Backshore, Lakeshore (possible)	Areas not accessible to fish, including upland areas, water that is too warm/cold (species specific). In this instance, Backshore Areas are the primary concern and will be assumed as the standard for "not fish habitat".

*Note that some nearshore environments may also qualify as "not fish habitat" dependent on factors such as vegetation and water quality. This will be further assessed as a component of the wetland and fish habitat monitoring program.

In all cases, the assessment points and transects will be chosen to best represent the surrounding habitats.

Baseline Monitoring Results

Initial baseline monitoring was conducted on July 4-5, and September 6, 2022. All wetlands were accessed via boat over the Reservoir, and each wetland was accessed successfully, as locations provided by the JW (2007) were confirmed. Each wetland was assessed using WESP-AC functional assessment protocols (Attachment B – WESP-AC Forms) and delineated to establish current boundaries. Once this delineation and functional assessment was complete, the installation of monitoring wells and vegetation plots were done according to the methodologies outlined above. One wetland (WL17) was assessed as an island of wetland habitat within the reservoir, and thus had no associated upland habitat directly adjacent, nor any "Back Shore" for the purposes of fish habitat monitoring. Results from the vegetation plots and monitoring wells can be seen in Attachment C – Wetland Monitoring Data.

Detailed information obtained for each of the selected wetlands during initial baseline monitoring assessments can be found in Drawings 2-7, Attachment A.

Wetland delineation and characterization from initial baseline studies agree overall with the JW (2007) study, though the water's edge where the wetlands are contiguous with the Reservoir has changed slightly, given the variable water levels and weather impacts. Wetland types were confirmed, and fish habitat characteristics were assessed.

Wetland Fish Habitat assessment results are included in Attachment D – Fish Habitat Assessment Data. Fish habitat assessments were conducted after delineation to ensure that boundaries could be used to inform the placement of the transect that was travelled for wetland fish habitat assessment.

Given constraints surrounding accessibility, water quality measurements were only collected at LS locations for each of the wetlands surveyed.
As outlined above, each wetland (aside from WL17 – an island) had a distinctly observable upland edge where "Back Shore" measurements were collected. Significant forestry impacts exist on many of the properties that surround the reservoir, though there is generally a riparian buffer separating the water's edge from those heavily forested areas. Details on habitat for each wetland is outlined in Table 5, as a combination of both initial baseline surveys and general observations.

Table 5: Wetland Fish Habitat - Baseline Observations

Wetland	Open Lake	Lakeshore	Backshore
Wetland 3	Permanently flooded with abundant large woody debris and moderate floating and emergent vegetation. No fish observed, though rocky (primarily rubble) substrate suggests positive attributes to fish habitat. Quite shallow – 25 m offshore there are emergent boulders. Direct fish habitat.	Some overhanging vegetation. Shoreline is quite distinct, though there is slightly more emergent vegetation. Under normal operating conditions should be considered Indirect Fish Habitat.	Spruce dominated forest with clear signs of previous forestry management present. No evidence of watercourses or significant surface flow nearby.
Wetland 5	Permanently flooded with some rocky and woody debris. Substrate slopes away from the wetland edge quite quickly to deep water. Direct fish habitat is present in shaded areas closer to the shoreline, both adjacent to the wetland and further along the shore. Direct fish habitat.	Ephemeral brook flowing along the southeast boundary of the wetland providing cooler water inputs from the forested area upstream for Indirect Fish Habitat.	Young to moderate aged coniferous forest present in all nearby upland, except along lakeshore.
Wetland 6	Plenty of submerged and emergent woody debris and boulders, as well as moderate emergent vegetation. Fish observed. Direct fish habitat.	A poorly defined channel flows out of the wetland near the location of water quality measurements, but no flow was present during baseline monitoring events. Rocky substrate (rubble) with significant silt on top. Indirect fish habitat.	Young-mid aged softwood dominated forest. Appears to have been previously impacted by forestry operations.
Wetland 15	Appears to be permanently flooded with very little vegetation or emergent debris. Appears to drop-off to deeper water quite quickly. Direct fish habitat.	Small ephemeral outflow with boulders and overhanging vegetation present at location of water quality measurements, though the ground level of the wetland is significantly higher than water levels. Indirect fish habitat	Clearcut present approximately 25 m inshore from wetland/upland edge. No signs of waterflow over land, though some small ditches of water are present due to forestry impacts.

Wetland	Open Lake	Lakeshore	Backshore
Wetland 17	Quite shallow all around the wetland (an island), with abundant emergent and aquatic vegetation. Fairly rocky substrate, though some silt on top as well. No deep water for ~5 m in all directions surrounding the wetland. Direct fish habitat.	Shoreline habitats varied from rocky and muddy to fully vegetated. Vegetation remains consistent across the land/water boundary. Indirect fish habitat	No Backshore present. It is suspected that the entire wetland could flood during highwater conditions outside of the flood season.
Wetland 19	Permanently flooded with gravel and sand substrate present on the east side of the wetland, fish observed, and clear signs of Direct Fish Habitat. West side of wetland bordering on small cove has muck/mud substrate and is very shallow providing poor fish habitat.	No clear inflow/outflow present, with the western border of the wetland being contiguous with the open water, while the eastern border having a proper border. Indirect fish habitat on all on sides.	Backshore is young softwood with relatively few undergrowth species. No signs of waterflow overland, nor signs of flooding at any time.

All instances included passage through the Open Water by boat, where observations on habitat and substrate were made. Backshore conditions (where available) included similar species distributions throughout the Reservoir, though the impacts of forestry on those habitats is well established.

During future monitoring events, the locations of water quality measurements (Lakeshore during baseline monitoring), Open Water, and Lakeshore are likely to change, sometimes in a significant way. Pre-construction and post-construction monitoring locations are expected to remain consistent, as outlined above, although during construction there is anticipated to be differing amounts of change at each wetland, considering their positions within the Reservoir. These differences will be noted and aid in the comparison of fish habitat quality and abundance between baseline, during construction, and post-construction conditions.

With fish being observed at both WL6 and WL19, as well as the confirmed presence of fish crossing the dam and spillway at the south end of the Reservoir, it is understood that under current conditions, each of the wetlands monitored provides some level of fish habitat, as well as indirect benefits to fish habitat.

PROPOSED SCHEDULE AND REPORTING

Annual post-construction monitoring reports will be submitted to Nova Scotia Environment and Climate Change (NSECC) for the five years of post-construction monitoring. Vegetation results shall be provided in a cumulative table to allow for inter-annual comparison of data. Table 6 outlines the monitoring and reporting schedule for the Wetland Monitoring Program, while Table 7 outlines the monitoring and reporting schedule for the Wetland Fish Habitat Monitoring Program.

Table6: Monitoring and Reporting Schedule for Wetland Monitoring

Monitoring Event		Wetland and Wetland Fish Habitat Monitoring	WESP-AC	Reporting Submission to NSECC
Pre-construction	Baseline	✓	✓	
During Construction		✓		Memo
Post-construction	Year 1	✓		✓
	Year 2	✓		✓
	Year 3	✓		✓
	Year 4	✓		✓
	Year 5	✓	✓	✓

Information collected from post-construction monitoring events will be compared with the baseline data collected during the pre-construction monitoring events and previous years' monitoring events to evaluate post-construction vegetation (e.g., wetland and vegetation present, invasion of exotic species, success of any re-vegetation, etc.), hydrology, and soils. After Year 5, potential long-term impacts to the wetlands will be assessed, a follow up WESP-AC program will be completed, and required consultation with NSECC will take place.

Table 7: Monitoring and Reporting Schedule for Wetland Fish Habitat Monitoring

Monitoring Event		Fish Habitat Transect Monitoring	Desktop Review of Fish Data	Reporting Submission to NSECC & DFO
Baseline		✓	✓	✓
Pre-construction	1 week before drawdown	✓	✓	✓
During Construction*	1 week after drawdown	✓	✓	✓
	End of growing season during drawdown/construction	✓	✓	✓
Post Construction*	1 week after water level is restored	✓	✓	✓
	Year 1	✓	✓	✓
	Year 2	✓	✓	✓
	Year 3	✓	✓	✓
	Year 4	✓	✓	✓
	Year 5	✓	✓	✓

*Monitoring may be limited depending on the time of year when construction is to be completed, *i.e.,* if construction is completed in January, the first post-construction survey will not be completed before the growing season begins in June.

Information during post-construction monitoring will be used to inform reports submitted to NSECC and Fisheries and Oceans Canada (DFO) on an annual basis, while further consultation with each respective governing body may be required after the post-construction monitoring is completed.

CLOSURE

Thank you for the opportunity to develop this Wetland and Wetland Fish Habitat Monitoring Plan. If you have any questions, please contact us.

Thank you,

Angus Doane, BSc., MREM
Environmental Scientist
adoane@strum.com

Natasha Myers, BSc., EP, PMP
Senior Environmental Scientist
nmyers@strum.com

REFERENCES

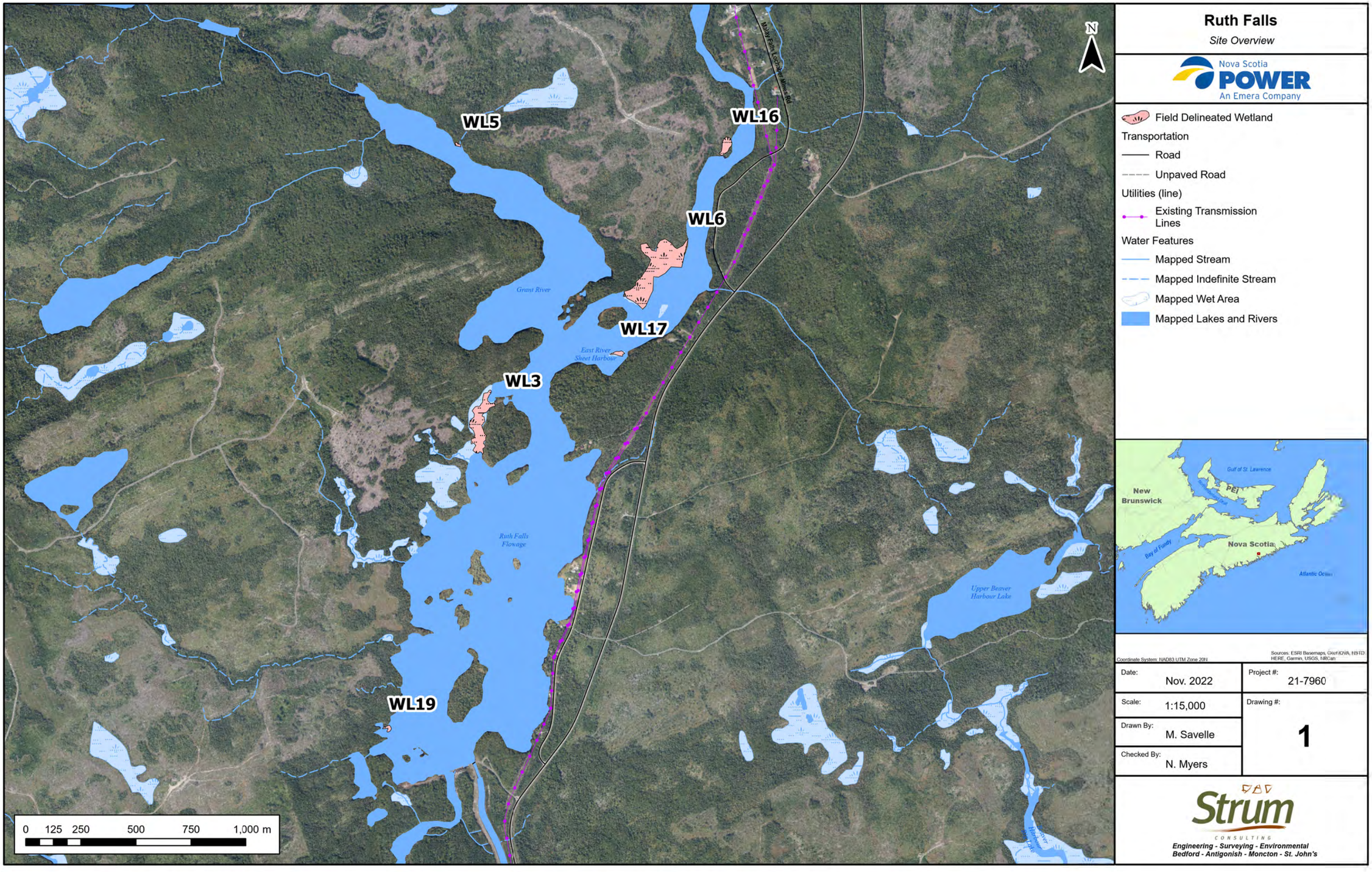
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ATTACHMENT A
DRAWINGS



Ruth Falls

Site Overview

Nova Scotia POWER
An Emera Company

- Field Delineated Wetland

Transportation
- Road
- Unpaved Road

Utilities (line)
- Existing Transmission Lines

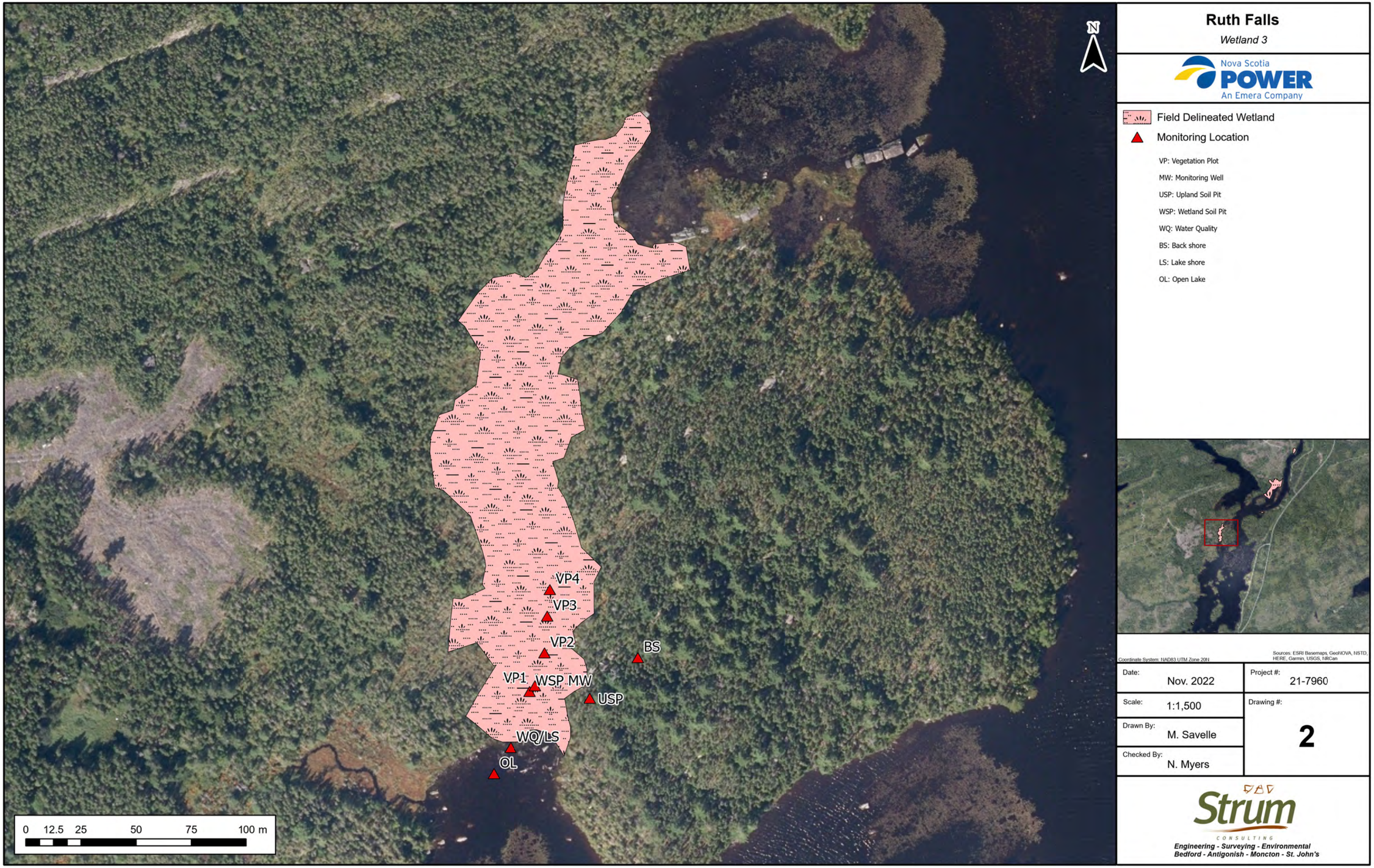
Water Features
- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area
- Mapped Lakes and Rivers

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoEYE, IGN, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:15,000	Drawing #: 1
Drawn By: M. Savelle	
Checked By: N. Myers	

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Bedford - Antigonish - Moncton - St. John's



Ruth Falls

Wetland 3

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:1,500	Drawing #: 2
Drawn By: M. Savelle	
Checked By: N. Myers	

Strum CONSULTING
Engineering - Surveying - Environmental
Bedford - Antigonish - Moncton - St. John's



Ruth Falls

Wetland 5

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

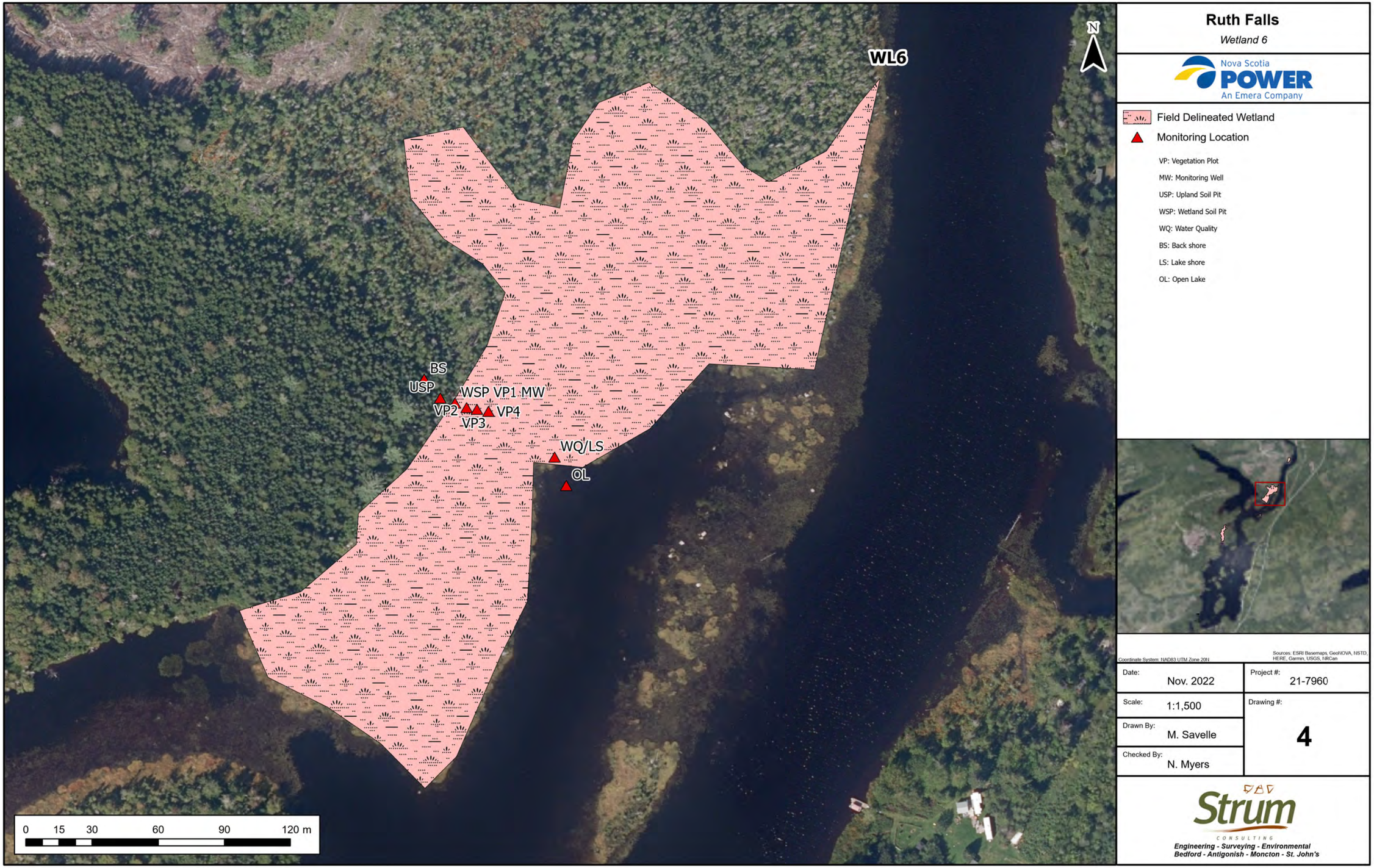
VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 3
Drawn By: M. Savelle	
Checked By: N. Myers	

Strum CONSULTING
Engineering - Surveying - Environmental
Bedford - Antigonish - Moncton - St. John's



Ruth Falls

Wetland 6

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:1,500	Drawing #: 4
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 16

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

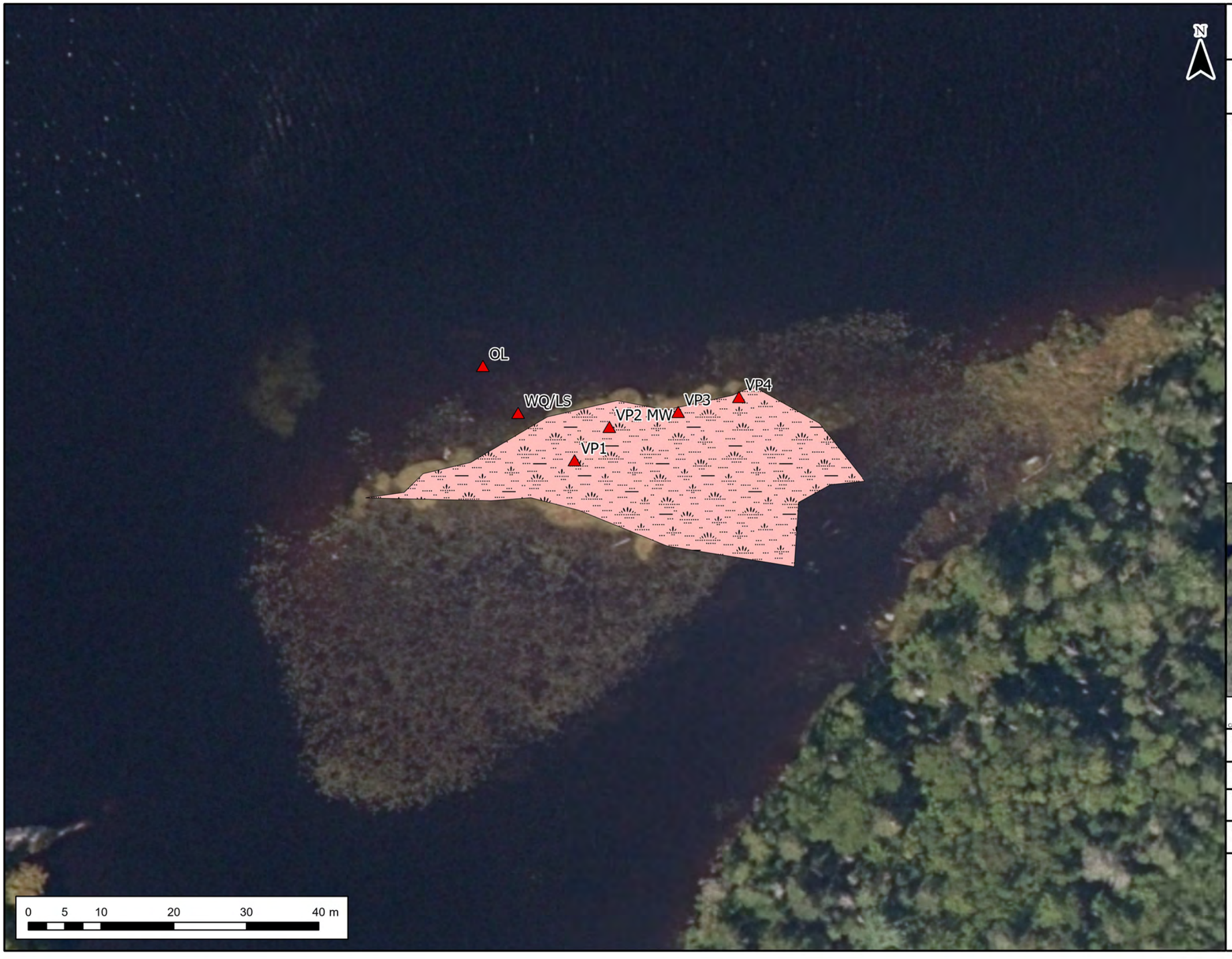
Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 5
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 17

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake



Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 6
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 19

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 7
Drawn By: M. Savelle	
Checked By: N. Myers	

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ATTACHMENT B
WESP-AC FORMS

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 3
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.96946
Longitude (decimal degrees):	-62.49768
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	1.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	1.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100%
What percent (approx.) of the **AA** were you able to visit?	100%
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	1	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

	A	B	C	D	E
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	5-Jul-22		Site Identifier: Ruth Falls WL 3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	0	
15			B1.	0	
16			B2.	0	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	0	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	1	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	0	
85			100-1000 sq. m.	1	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	1	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.		
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	0	
243			2-5%.	1	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	0	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL 3**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	7
			Stressor subscore=	0.58

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	0
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	2
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	3
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	3
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	8
			Stressor subscore=	0.67

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL3

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.96946 & -62.49768

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	7.98	Higher	7.86	Higher	7.90	3.48
Stream Flow Support (SFS)	1.60	Moderate	2.55	Moderate	1.29	1.70
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	4.30	Moderate	3.12	Moderate	5.56	1.53
Phosphorus Retention (PR)	2.09	Lower	2.77	Higher	5.05	2.15
Nitrate Removal & Retention (NR)	10.00	Higher	5.14	Moderate	10.00	5.14
Carbon Sequestration (CS)	4.69	Moderate			7.42	
Organic Nutrient Export (OE)	8.86	Higher			5.79	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.77	Lower	5.89	1.66
Amphibian & Turtle Habitat (AM)	2.22	Lower	4.20	Moderate	4.29	5.22
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.51	Moderate	10.00	Higher	5.67	10.00
Pollinator Habitat (POL)	7.48	Moderate	6.67	Moderate	6.20	6.67
Native Plant Habitat (PH)	5.82	Moderate	6.18	Moderate	6.22	6.18
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			8.89	Higher		4.71
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			9.42	Higher		4.70
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	7.98	Higher	7.86	Higher	7.90	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	7.64	Higher	4.41	Moderate	8.50	4.04
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	8.29	Higher	1.83	Lower	5.79	1.41
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.33	Lower	2.52	Moderate	2.57	3.13
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.04	Higher	8.81	Higher	6.13	8.81
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			9.16	Higher		4.71

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	62.68937601	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	33.64974214	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	15.16699195	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.362856423	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	62.02430846	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 5
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981186°
Longitude (decimal degrees):	-62.499067°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.031765
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	0.031765
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		"Adjacent" means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	0	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	1	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the **center** of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	

	A	B	C	D	E
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	

	A	B	C	D	E
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands. Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	1	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11			*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*		
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	1	
15			B1.	0	
16			B2.	0	
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		Deciduous shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the tree/shrubs is <95% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM

	A	B	C	D	E
18			coniferous trees (may include tamarack) taller than 3 m.	2	the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	1	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do not comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% of the woody canopy cover in the AA or >5% of the wooded areas (if any) along its upland edge (perimeter). The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation taller than 1 m nor the vegetation shorter than that comprise >70% of the vegetated part of the AA. They each comprise 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (diameter >20 cm) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces longer than 2 m and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	

	A	B	C	D	E
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of open water that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and SKIP to F41 (Floating Algae & Duckweed).	0	Open water is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is open (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	

	A	B	C	D	E
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's water edge length that is nearly flat (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage of the emergent vegetation cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		Emergent vegetation is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. SKIP to F38.	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of emergent vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and SKIP to F42.(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of dead wood and undercut banks is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore by water depths >1 m on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the least permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where surface water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by most of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into herbaceous vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into herbaceous vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into tree trunks and/or shrub stems but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly indirect path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	1	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			Evident from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			Likely based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	1	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL5**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL5

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981186° & -62.499067°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.12	Higher	7.88	Higher	8.75	3.49
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	3.02	Moderate	7.22	1.48
Phosphorus Retention (PR)	1.85	Lower	3.04	Higher	4.91	2.36
Nitrate Removal & Retention (NR)	10.00	Higher	5.56	Moderate	10.00	5.56
Carbon Sequestration (CS)	6.58	Higher			8.31	
Organic Nutrient Export (OE)	5.34	Moderate			3.49	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.23	Lower	5.89	1.37
Amphibian & Turtle Habitat (AM)	0.44	Lower	3.88	Moderate	3.36	4.95
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	5.59	Moderate	10.00	Higher	4.86	10.00
Pollinator Habitat (POL)	6.61	Moderate	6.67	Moderate	5.48	6.67
Native Plant Habitat (PH)	3.44	Lower	5.67	Moderate	5.28	5.67
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			7.71	Higher		4.37
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.41	Higher		4.22
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.12	Higher	7.88	Higher	8.75	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.11	Higher	4.71	Moderate	8.80	4.34
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.65	Higher	0.16	Lower	5.34	0.91
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	0.27	Lower	2.33	Moderate	2.01	2.97
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	5.91	Moderate	8.72	Higher	5.34	8.72
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.06	Higher		4.29

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	71.88945608	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	38.22502401	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	1.193241535	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	0.617343402	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	51.55843686	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	WESP-AC version 2
Site Name:	Ruth Falls Wetland 6
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.975436°
Longitude (decimal degrees):	-62.487924°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	3.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	3.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.				
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	

	A	B	C	D	E
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. **This will be true for most** assessments done with WESP-AC.	0	
92	OF17	Flood Damage from **Non-tidal** Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do **not** show Flood Zone or Flood Risk areas (**or no such mapping has been done locally**) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is **no infrastructure** vulnerable to river flooding unrelated to tidal storm surges.	0	

	A	B	C	D	E
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	

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122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]

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151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*				
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	2	
19			deciduous trees taller than 3 m.	2	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>each comprise</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	1	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	0	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	0	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	1	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter **>10 cm**, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL6**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5

Soil or Sediment Alteration *Within the Assessment Area*				
In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
Leveling or other grading not to the natural contour.				
Tillage, plowing (but excluding disking for enhancement of native plants).				
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
Excavation.				
Ditch cleaning or dredging in or adjacent to the wetland.				
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL6

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.975436° & -62.487924°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.29	Higher	7.86	Higher	8.88	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	2.17	Moderate	7.22	1.06
Phosphorus Retention (PR)	1.59	Lower	1.88	Moderate	4.74	1.46
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.42	Higher			8.24	
Organic Nutrient Export (OE)	5.30	Moderate			3.47	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	7.88	Higher	1.03	Lower	6.71	1.80
Amphibian & Turtle Habitat (AM)	2.42	Lower	4.49	Moderate	4.39	5.46
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.34	Moderate	10.00	Higher	6.39	10.00
Pollinator Habitat (POL)	7.31	Moderate	6.67	Moderate	6.06	6.67
Native Plant Habitat (PH)	5.32	Moderate	6.37	Moderate	6.02	6.37
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			9.23	Higher		4.80
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.26	Higher		4.15
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.29	Higher	7.86	Higher	8.88	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.06	Higher	4.01	Moderate	8.77	3.75
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.59	Higher	0.68	Lower	4.63	1.20
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.45	Lower	2.69	Moderate	2.64	3.28
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.00	Higher	8.84	Higher	6.27	8.84
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.74	Higher		4.47

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	72.99984688	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	32.28886351	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	3.821786962	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.916235569	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	61.84993183	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 15
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981144
Longitude (decimal degrees):	-62.483722°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.271124 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	100
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]

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146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to **blank**.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to **blank** (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank** (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to **blank**.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	1	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*				
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	1	
15			B1.	0	
16			B2.	0	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	1	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	1	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	1	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	1	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	1	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	1	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	1	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	1	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	1	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	1	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	1	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	0	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	0	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	1	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL15**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	0
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	0
			Sum=	3
			Stressor subscore=	0.25

		Data
S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	1
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	3
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	0
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	5
			Stressor subscore=	0.42

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL15

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981144 & -62.483722°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
Stream Flow Support (SFS)	1.03	Lower	0.00	Lower	0.83	0.00
Water Cooling (WC)	5.00	Moderate	0.00	Lower	3.33	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	1.80	Moderate	10.00	0.88
Phosphorus Retention (PR)	3.64	Moderate	2.14	Moderate	6.02	1.67
Nitrate Removal & Retention (NR)	10.00	Higher	10.00	Higher	10.00	10.00
Carbon Sequestration (CS)	3.60	Moderate			6.90	
Organic Nutrient Export (OE)	5.91	Moderate			3.86	
Anadromous Fish Habitat (FA)	4.13	Higher	2.71	Moderate	2.71	1.72
Resident Fish Habitat (FR)	5.10	Moderate	2.75	Moderate	2.77	1.72
Aquatic Invertebrate Habitat (INV)	7.52	Higher	7.08	Higher	6.56	5.06
Amphibian & Turtle Habitat (AM)	5.13	Moderate	7.18	Higher	5.81	7.67
Waterbird Feeding Habitat (WBF)	8.65	Higher	10.00	Higher	6.59	10.00
Waterbird Nesting Habitat (WBN)	8.33	Higher	10.00	Higher	6.04	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.39	Moderate	10.00	Higher	6.43	10.00
Pollinator Habitat (POL)	7.64	Moderate	6.67	Moderate	6.33	6.67
Native Plant Habitat (PH)	3.23	Lower	6.48	Moderate	5.19	6.48
Public Use & Recognition (PU)			1.47	Moderate		1.31
Wetland Sensitivity (Sens)			10.00	Higher		5.14
Wetland Ecological Condition (EC)			3.04	Lower		6.67
Wetland Stressors (STR) (higher score means more stress)			5.56	Moderate		2.85
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.41	Higher	7.32	Higher	9.12	7.09
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.20	Higher	4.72	Moderate	5.11	3.37
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.46	Higher	8.26	Higher	5.69	8.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.86	Higher	8.86	Higher	6.21	8.86
WETLAND CONDITION (EC)			3.04	Lower		6.67
WETLAND RISK (average of Sensitivity & Stressors)			7.78	Higher		4.00

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	48.9801358	Moderate
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	61.55144868	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	29.24667855	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	61.64799552	Moderate
HABITAT SUPERGROUP - TRANSITION HABITAT	60.79392506	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 17
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.972398°
Longitude (decimal degrees):	-62.489619°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.083111 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	1	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	0	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	1	
55			>5 km.	0	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	1	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

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145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*				
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	0	
27			those species together do **not** comprise > 50% of such cover.	1	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	1	
75			Intermediate (1 - 10% of vegetated part of the AA).	0	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	1	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	1	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	1	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	1	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	1	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	1	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	1	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	1	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	1	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	1	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	1	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	1	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	1	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

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206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	1	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	1	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	1	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	1	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.5	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	50	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	1	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	0	
276			25-50%.	0	
277			>50%.	1	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	1	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL17**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	3
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	3
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	9
			Stressor subscore=	0.75

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	1
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	1
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	1
Fertilizers applied to lawns, ag lands, or other areas in the CA.	1
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	1
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	1
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL17

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.972398° & -62.489619°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.11	Lower	7.86	Higher	3.52	3.48
Stream Flow Support (SFS)	6.28	Higher	4.77	Moderate	5.06	3.17
Water Cooling (WC)	5.29	Higher	6.88	Higher	3.53	3.73
Sediment Retention & Stabilisation (SR)	4.87	Moderate	9.79	Higher	5.99	4.79
Phosphorus Retention (PR)	3.90	Moderate	9.11	Higher	6.18	7.08
Nitrate Removal & Retention (NR)	1.77	Lower	10.00	Higher	4.05	10.00
Carbon Sequestration (CS)	4.09	Moderate			7.13	
Organic Nutrient Export (OE)	9.02	Higher			5.90	
Anadromous Fish Habitat (FA)	7.15	Higher	3.46	Moderate	4.68	2.20
Resident Fish Habitat (FR)	7.50	Higher	3.36	Moderate	4.07	2.10
Aquatic Invertebrate Habitat (INV)	6.14	Higher	6.57	Higher	6.00	4.78
Amphibian & Turtle Habitat (AM)	6.05	Moderate	4.53	Moderate	6.29	5.49
Waterbird Feeding Habitat (WBF)	8.51	Higher	10.00	Higher	6.48	10.00
Waterbird Nesting Habitat (WBN)	9.88	Higher	10.00	Higher	7.16	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	0.00	Lower	0.00	Lower	0.00	0.00
Pollinator Habitat (POL)	0.00	Lower	0.00	Lower	0.00	0.00
Native Plant Habitat (PH)	6.37	Higher	0.00	Lower	6.44	0.00
Public Use & Recognition (PU)			3.52	Moderate		2.71
Wetland Sensitivity (Sens)			3.92	Lower		3.29
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			10.00	Higher		5.46
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.11	Lower	7.86	Higher	3.52	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	4.26	Moderate	9.82	Higher	6.49	8.65
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.85	Higher	6.48	Moderate	5.56	4.34
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.85	Higher	8.14	Higher	6.45	7.98
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	4.25	Moderate	0.00	Lower	4.29	0.00
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			6.96	Higher		4.37

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	16.54837478	Low
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	41.82872928	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	50.87397482	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	71.97293334	High
HABITAT SUPERGROUP - TRANSITION HABITAT	0	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 19
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.957041°
Longitude (decimal degrees):	-62.502964°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.056483
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	1	

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31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

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56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

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145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

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1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	1	
61			50-95% of the vegetated part of the AA.	0	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.4	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	40	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL19**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL19

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.957041° & -62.502964°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	8.62	Higher	7.86	Higher	8.38	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	5.73	Moderate	2.04	Moderate	6.67	1.00
Phosphorus Retention (PR)	3.04	Moderate	1.50	Moderate	5.65	1.17
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.47	Higher			8.26	
Organic Nutrient Export (OE)	7.44	Moderate			4.87	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	6.20	Higher	0.74	Lower	6.02	1.64
Amphibian & Turtle Habitat (AM)	2.27	Lower	4.15	Moderate	4.31	5.18
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.36	Moderate	10.00	Higher	5.54	10.00
Pollinator Habitat (POL)	6.27	Moderate	6.67	Moderate	5.20	6.67
Native Plant Habitat (PH)	6.07	Moderate	5.80	Moderate	6.32	5.80
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			8.38	Higher		4.56
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			7.91	Higher		3.98
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	8.62	Higher	7.86	Higher	8.38	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.15	Higher	3.92	Moderate	8.82	3.69
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.43	Moderate	0.49	Lower	4.37	1.09
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.36	Lower	2.49	Moderate	2.59	3.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.30	Moderate	8.74	Higher	6.01	8.74
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			8.14	Higher		4.27

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	67.73492558	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	31.9930733	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	2.671992164	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.390130046	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	55.07618538	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

ATTACHMENT C
WETLAND MONITORING DATA

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

Table 1A. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 3

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	35	
Soil Type			
Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Eriophorum virginicum*	Tawny Cotton-Grass		30	
	Glyceria striata	Fowl Manna Grass	20		
	Carex spp.	Carex	50		
	Rhynchospora spp.	Beaksedge		25	
	Sarracenia purpurea	Pitcher Plant	10	10	
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex stipata	Awlfruit Sedge		30	
Shrubs	*Alnus incana*	Grey Alder		5	
	Spiraea alba	Meadowsweet	10		
	Chamaedaphne calyculata	Leatherleaf	40	40	
	Ilex mucronata	Mountain Holly	5	5	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	15	25	
Osmunda cinnamomea	Cinnamon Fern	30	30	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	40		
Maianthemum canadense	False Lily of the Valley	40		
Vaccinium oxycoccus	Bog Cranberry	10	25	
Eriophorum virginicum	Tawny Cotton-Grass		30	
Solidago spp.	Goldenrod		10	
Oclemena nemoralis	Bog Aster		10	
Calamagrostis canadensis	Blue Joint		15	
Carex magellanica	Boreal Bog Sedge		10	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Chamaedaphne calyculata	Leatherleaf	30	30	
Myrica gale	Sweetgale	15	15	
Ledum groenlandicum	Labrador tea	15	15	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Osmunda cinnamomea*	Cinnamon Fern	25	25	
	Sarracenia purpurea	Pitcher Plant	10		
	Maianthemum canadense	False Lily of the Valley	40		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Carex stipata	Awlfruit Sedge		25	
	Oclemena nemoralis	Bog Aster		15	
	Drosera rotundifolia	Round-leaved Sundew		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
	Smilacina trifolia	Three-leaved false Solomon's seal	10	30	
	Carex spp.	Carex	40		
	Eriophorum virginicum	Tawny Cotton-Grass		25	
Shrubs	*Myrica gale*	Sweetgale	30		
	Chamaedaphne calyculata	Leatherleaf	35		
	Kalmia angustifolia	Lambkill	25		
	Ilex mucronata	Mountain Holly		15	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	10	20	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	20		
Maianthemum canadense	False Lily of the Valley	20		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Rhynchospora spp.	Beaksedge		15	
Vaccinium oxycoccus	Bog Cranberry	10	20	
Platanthera psycodes	Lesser Purple Fringed Orchid	5		
Ledum groenlandicum	Labrador tea	15	25	
Chamaedaphne calyculata	Leatherleaf	25	30	
Kalmia angustifolia	Lambkill	15	15	
Ilex mucronata	Mountain Holly	5	10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1B. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 5

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	N	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	4	27	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	
Preceeding 5 Day Precipitation* (mm)	2	2	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Coptis trifolia*	Goldthread	30	40	
	Cornus canadensis	Bunchberry	10	15	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Carex trisperma	Three seeded sedge	25		
	Vaccinium oxycoccus	Bog Cranberry	40	40	
	Carex spp.	Carex	30		
	Oclemena nemoralis	Bog Aster	5		
	Ajuga reptans	Bugleweed		15	
	Carex trisperma	Three seeded sedge		40	
	Linnaea borealis	Twinflower		15	
Shrubs					
Trees	*Abies balsamea*	Balsam Fir	15	25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Coptis trifolia	Goldthread	10	20	
Cornus canadensis	Bunchberry	10	20	
Sarracenia purpurea	Pitcher Plant	15	25	
Oclemena nemoralis	Bog Aster	5	20	
Iris versicolor	Norther Blue Flag	5	5	
Linnaea borealis	Twinflower	10	25	
Carex spp.	Carex	30		
Carex trisperma	Three seeded sedge		40	
Ilex mucronata	Mountain Holly	10	15	
Myrica gale	Sweetgale	30	30	
Spiraea alba	White Meadowsweet	10	15	
Acer rubrum	Red Maple	5	5	

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Calamagrostis canadensis*	Blue Joint	10	40	
	Solidago rugosa	Rough Goldenrod	5		
	Rubus pubescens	Dwarf Red Blackberry	20		
	Vaccinium oxycoccus	Bog Cranberry	15	40	
	Oclemena nemoralis	Bog Aster		15	
	Rubus hispidus	Swamp Dewberry			
Shrubs	*Viburnum nudum*	Wild Raisin		30	
	Spiraea tomentosa	Steeplebush		15	
	Chamaedaphne calyculata	Leatherleaf	20	25	
Trees	*Picea rubens*	Red Spruce	5		

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex grayi	Gray's Sedge	10		
Chamaedaphne calyculata	Leatherleaf	50		
Sarracenia purpurea	Pitcher Plant	10	10	
Solidago rugosa	Rough Goldenrod	5		
Drosera rotundifolia	Round-leaved Sundew	2	10	
Oclemena nemoralis	Bog Aster		25	
Carex trisperma	Three seeded sedge	20	35	
Myrica gale	Sweetgale	5		
Chamaedaphne calyculata	Leatherleaf		75	
Iris versicolor	Norther Blue Flag		20	
Ledum groenlandicum	Labrador tea		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1C. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 6

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	3	0	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Smilacina trifolia*	Three-leaved false Solomon's seal	30	25	
	Carex spp.	Carex	15		
	Grass spp.	Grass	20		
	Calla spp.	Calla	10	15	
	Dulichium arundinaceum	Three-way Sedge		25	
	Sarracenia purpurea	Pitcher Plant		5	
	Carex trisperma	Three seeded sedge		20	
	Carex magellanica ssp. irrigua	Boreal Bog Sedge		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	35	35	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Symphyotrichum puniceum	Swamp Aster	30		
Calamagrostis canadensis	Blue Joint	25	25	
Sarracenia purpurea	Pitcher Plant	10	20	
Carex spp.	Carex	15		
Grass spp.	Grass	20		
Drosera rotundifolia	Round-leaved Sundew		10	
Thelypteris palustris	Marsh Fern	25	30	
Oclemena nemoralis	Bog Aster		30	
Eriophorum virginicum	Tawny Cotton-Grass		20	
Rhynchospora spp.	Beaksedge		20	
Dulichium arundinaceum	Three-way Sedge		35	
Alnus incana	Grey Alder	25	25	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	40		
	Grass spp.	Grass	10		
	Drosera rotundifolia	Round-leaved Sundew	5		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Rhynchospora spp.	Beaksedge		40	
	Dulichium arundinaceum	Three-way Sedge		15	
	Sarracenia purpurea	Pitcher Plant		15	
	Carex trisperma	Three seeded sedge		30	
	Carex sparganioides	Bur Reed Sedge		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	30	
	Ledum groenlandicum	Labrador tea	10	10	
	Ilex mucronata	Mountain Holly		10	
	Myrica gale	Sweetgale	10		
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Osmunda cinnamomea	Cinnamon Fern	5	20	
Drosera rotundifolia	Round-leaved Sundew	5	15	
Smilacina trifolia	Three-leaved false Solomon's seal	10		
Vaccinium oxycoccus	Bog Cranberry	5		
Carex spp.	Carex	60		
Rhynchospora spp.	Beaksedge		60	
Eriophorum virginicum	Tawny Cotton-Grass		35	
Dulichium arundinaceum	Three-way Sedge		15	
Sarracenia purpurea	Pitcher Plant		15	
Calamagrostis canadensis	Blue Joint		10	
Ledum groenlandicum	Labrador tea	10	20	
Chamaedaphne calyculata	Leatherleaf	30	20	
Kalmia angustifolia	Lambkill		10	
Picea mariana	Black Spruce	5	10	None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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REDACTED (CONFIDENTIAL INFORMATION REMOVED)

Table 1D. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 15

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	6	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	20		
	Oclemena nemoralis	Bog Aster	5	10	
	Dulichium arundinaceum	Three-way Sedge		40	
	Drosera rotundifolia	Round-leaved Sundew		10	
	Vaccinium oxycoccus	Bog Cranberry		10	
	Carex trisperma	Three seeded sedge		20	
Shrubs	*Myrica gale*	Sweetgale	60	25	
	Chamaedaphne calyculata	Leatherleaf		60	
	Viburnum nudum	Wild Raisin		25	
Trees	*Viburnum nudum*	Wild Raisin		25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex trisperma	Three seeded sedge	50		
Vaccinium oxycoccus	Bog Cranberry	10		
Osmunda cinnamomea	Cinnamon Fern	15	25	
Eriophorum virginicum	Tawny Cotton-Grass		15	
Drosera rotundifolia	Round-leaved Sundew		10	
Myrica gale	Sweetgale	30	40	
Chamaedaphne calyculata	Leatherleaf	5	25	
Ledum groenlandicum	Labrador tea		20	
Ilex mucronata	Mountain Holly		5	
Picea mariana	Black Spruce	10	10	
Acer rubrum	Red Maple	20		

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Cornus canadensis*	Bunchberry	5	25	
	Carex trisperma	Three seeded sedge	10		
	Vaccinium oxycoccus	Bog Cranberry	5	15	
	Carex trisperma	Three seeded sedge		20	
	Osmunda cinnamomea	Cinnamon Fern	15	20	
	Eriophorum virginicum	Tawny Cotton-Grass		20	
Shrubs	*Ledum groenlandicum*	Labrador tea	5	20	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf		25	
	Ilex mucronata	Mountain Holly		5	
Trees	*Picea mariana*	Black Spruce	25	30	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Thelypteris palustris	Marsh Fern	15		
Carex trisperma	Three seeded sedge	15	20	
Calamagrostis canadensis	Blue Joint		15	
Oclemena nemoralis	Bog Aster	5	5	
Osmunda cinnamomea	Cinnamon Fern		20	
Cornus canadensis	Bunchberry	10	20	
Vaccinium oxycoccus	Bog Cranberry		20	
Myrica gale	Sweetgale	50	50	
Acer rubrum	Red Maple	40	20	
Picea mariana	Black Spruce		5	
Ledum groenlandicum	Labrador tea	5	10	
Chamaedaphne calyculata	Leatherleaf		20	
Ilex mucronata	Mountain Holly	5		
Ilex mucronata	Mountain Holly		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

Strum CONSULTING

Table 1E. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 17

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Depth to Water (cm)	5	10	

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	Baseline (July 2022)	Baseline (September 2022)	Notes
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

Soil Type
Histosol (A1)

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Drosera rotundifolia	Round-leaved Sundew	15	25	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	40	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	60	75	
Zantedeschia aethiopica	Calla Lily	10		
Drosera rotundifolia	Round-leaved Sundew	10	15	
Chamaedaphne calyculata	Leatherleaf	20	30	
Alnus incana	Grey Alder	20	20	
Picea mariana	Black Spruce	30	30	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Zantedeschia aethiopica	Calla Lily	10		
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex oligosperma	Few-seeded Sedge		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	25	25	
	Picea mariana	Black Spruce	15	25	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	40	40	
Zantedeschia aethiopica	Calla Lily	5		
Drosera rotundifolia	Round-leaved Sundew	15		
Grass spp.	Grass	15		
Carex sparganioides	Bur Reed Sedge		25	
Carex oligosperma	Few-seeded Sedge		15	
Chamaedaphne calyculata	Leatherleaf	20	35	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

Table 1F. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 19

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	Y	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	9	3	September Note: Well cracked off.
Soil Type			
Histosol (A1), Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	30	15	
	Eriophorum virginicum	Tawny Cotton-Grass		25	
	Carex trisperma	Three seeded sedge			
Shrubs	*Ledum groenlandicum*	Labrador tea	40	60	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf	25	25	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Vaccinium oxycoccus	Bog Cranberry	15	25	
Carex spp.	Carex	15		
Calla spp.	Calla	15		
Drosera rotundifolia	Round-leaved Sundew	15		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Myrica gale	Sweetgale	20	60	
Chamaedaphne calyculata	Leatherleaf	40	15	
Larix laricina	Tamarack	25		
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Oclemena nemoralis*	Bog Aster	15	25	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Calla spp.	Calla	15		
	Carex spp.	Carex	25		
	Osmunda cinnamomea	Cinnamon Fern		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Ledum groenlandicum*	Labrador tea	10	10	
	Myrica gale	Sweetgale	80	60	
	Picea mariana	Black Spruce	25	20	
	Vaccinium angustifolium	Lowbush Blueberry		15	
	Ilex mucronata	Mountain Holly	10		
Trees	*Picea mariana*	Black Spruce	25	25	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex spp.	Carex	25		
Calla spp.	Calla	15		
Oclemena nemoralis	Bog Aster	10	40	
Carex diandra	Lesser Tussock-Sedge		25	
Rhododendron canadense	Rhodora	25	25	
Myrica gale	Sweetgale	30	30	
Chamaedaphne calyculata	Leatherleaf	25		
Picea mariana	Black Spruce	40	40	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

ATTACHMENT D
FISH HABITAT ASSESSMENT DATA

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 3		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	11:00	13:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	23
Water Temperature (degC)	23.5	22.0
pH	5.10	5.40
Conductivity (mS/m)	0.04	0.005
TDS (mg/L)	20	20
DO (%)	85	80.6
DO (mg/L)	7.6	7.75
Average Depth (m)	0.6	0.30
Hydroperiod (Flooded (semi) Permanently?)	Permanently flooded	Permanently flooded
Connectivity to Lake	Inflow	Inflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	Med (10-50%)	Med (10-50%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	Med	Med
Notes	Plenty of submerged logs and rocks. Lots of macrophytic veg. Mucky substrate, plenty of brownish detritus.	Macrophytes and woody debris provide decent cover for fish, though water is warm. Edge of Lake. Silt on rocks. Excess woody debris.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 5		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	13:15	12:23
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	21	15.5
pH	4.93	5.09
Conductivity (mS/m)	0.09	0.04
TDS (mg/L)	30	40
DO (%)	93.9	80.6
DO (mg/L)	9.05	7.05
Average Depth (m)	0.5	0.10
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck:25%, Gravel:50%, Rubble:25%	Gravel and Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Clear
Vegetation/Debris Cover/Shade	Trace	Abundant
Probability of Fish Presence	High	Med
Notes	Small stream/trickle inflow at southeast end of WL (appears to be spring fed). Fish seen off weltand edge. No signs of fish habitat upstream/upland. Extensive cover/shade near inflow, primarily open/unshaded elsewhere.	No flow in stream, though area is well shaded with clear water.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 6		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	15:30	11:30
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	28	21.3
pH	4.89	5.26
Conductivity (mS/m)	0.05	0.07
TDS (mg/L)	30	30
DO (%)	77	23.1
DO (mg/L)	5.7	2.19
Average Depth (m)	0.5	0.2
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Semi-permanently Flooded
Connectivity to Lake	Inflow	Outflow
Deep Open Water Present Nearby?	Shallow Open Water	No
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck and Rubble	Muck and Gravel
Turbidity (or other water characteristisc)	Slightly Cloudy	Cloudy
Vegetation/Debris Cover/Shade	None	None
Probability of Fish Presence	High	Low
Notes	Juvenile American Eels spotted durring delineation. Very little shadded water, some areas "in-land" that could be accessible to fish seasonally.	High amount of metals suspended on water surface. Area appears to be poor habitat if at all. Water is stagnant.

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Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 15		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	12:15	11:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	22.8	20.9
pH	5.4	6.12
Conductivity (mS/m)	0.21	0.05
TDS (mg/L)	30	160
DO (%)	93	93.7
DO (mg/L)	7.51	8.43
Average Depth (m)	0.5	
Hydroperiod (Flooded (semi) Permanently?)	Semi-permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Med(10-50%)	Low(<10%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Clear	Slightly Cloudy
Vegetation/Debris Cover/Shade	None	Trace
Probability of Fish Presence	High	Med
Notes	Dead trees/snags in water.	Lake edge near outflow of watland. Some lily pads present. Woody debris.

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Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 17		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	9:36	10:41
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	20	19
Water Temperature (degC)	21.7	20.3
pH	5.45	7.39
Conductivity (mS/m)	0.05	0.72
TDS (mg/L)	20	40
DO (%)	97.2	80.7
DO (mg/L)	9.03	7.27
Average Depth (m)	0.5	0.5
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Thoughflow	Throughflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	High(>50%)	Med(10-50%)
Substrate(s)	Muck	Gravel and Silt
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	High	Med
Notes	Entire island is wetland. Lily pads all around the perimeter. "Sheltered" coves along island edge. Seems like great fish nursery area.	Lake Edge.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 19		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	12:15	13:45
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	25.5	23.5
pH	5.36	5.67
Conductivity (mS/m)	0.04	0.04
TDS (mg/L)	20	30
DO (%)	103.0	105.8
DO (mg/L)	8.42	8.76
Average Depth (m)	0.5	0.40
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Throughflow	Lake Edge
Deep Open Water Present Nearby?	Shallow Open Water	Yes 5m
Macrophyte (% cover)	Low(<10%)	Low(<10%)
Substrate(s)	Gravel	Gravel and Rubble
Turbidity (or other water characteristisc)	Clear	Clear
Vegetation/Debris Cover/Shade	Moderate	Trace on NW side
Probability of Fish Presence	High	High
Notes	Fish observed at lake side pt. Wetland is a peninsula, open water side has excellent habitat. Cove side has mostly muck substrate with some debris/emergent veg.	

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APPENDIX N – OFFSETTING PLAN

Offsetting Plan for Nova Scotia Power's Sheet Harbour Dam Refurbishment Projects

Prepared on:
May 14, 2021

Updated on:
February 24, 2023

MI'KMAW CONSERVATION GROUP
THE CONFEDERACY OF MAINLAND MI'KMAQ

The Confederacy of Mainland Mi'kmaq
52 Legends Avenue
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Project Title:

Sheet Harbour Area Habitat Offsetting Initiative

Presented To:

Kailey Osborne, Environmental Scientist
Nova Scotia Power Incorporated

Contacts:

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CMM Project Lead:

To be selected from available staff resources.

NSSA Project Lead

Edmund Halfyard, Research Scientist
Nova Scotia Salmon Association (NSSA)
Email: eddiehalyard@hotmail.com

Date:

February 24, 2023

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Presented To: ii
Contacts: ii
Date: ii
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1.0 The Confederacy of Mainland Mi'kmaq's (CMM's) Department of Aquatic Resource and Fisheries Management (DARFM)

Introduction

The CMM is a tribal organization that has served its members since 1986 and currently employs a staff of one hundred (100+) employees. The Mission Statement for the CMM is *"To proactively promote and assist Mi'kmaw communities' initiatives toward self determination and enhancement of community."* The CMM provides programs and services to our eight member Mi'kmaw communities: Acadia, Annapolis Valley, Bear River, Glooscap, Millbrook, Pictou Landing, Paq'tnkek and Sipekne'katik First Nations. The CMM's Board of Directors is comprised of the Chiefs of our member communities.

The Department of Aquatic Resource and Fisheries Management's (DARFM's) mission is to help promote the concept of Netukulimk within the Bay of Fundy and mainland Nova Scotia watersheds. DARFM provides the following programs to our member communities: Youth Mentorship/Capacity Building, Research, Education, Communications, Aquatic Resource Management, Ecosystem Health Assessment and, Habitat Restoration. Additionally, DARFM provides services for commercial fisheries, scientific review, and department staff also sit on several review boards and technical committees. DARFM has applied for and received a variety of both small and large funding programs and has successfully delivered projects from the federal, provincial, and municipal levels as well as from the private sector.

The department has become increasingly more involved in fish habitat offsetting projects and associated monitoring activities. We have worked with various partners to build skills within our department and our member communities. We continue to work with, and sub-contract, partner organizations to ensure our offset and industry-focused monitoring activities are done to local industry standards. It is important to note that we try to ensure our affected member communities approve of and are made aware of the work we do. The CMM and its Departments do not conduct consultation work on behalf of clients but instead provide programs and services and act as a technical resource for our member communities.

Previous Activities Undertaken by the CMM

Stewiacke River: MCG has operated/maintained a Rotary Screw Trap (RST) for the past 5 years in the Stewiacke River, NS and performed marked-recapture studies to estimate the population of Atlantic salmon smolts. MCG has also conducted fish habitat assessments and electrofishing surveys in the Stewiacke River. In autumn 2017, MCG partnered with DFO on an acoustic telemetry study to determine spawning site selection of released Live Gene Bank adult salmon within the Stewiacke river watershed.

Shubenacadie River: During the 2016-2017 funding year MCG performed baseline monitoring for fish species throughout the entire river system. Activities included: CABIN studies, beach seining, fyke nets, and other sampling methodologies.

River Philip and East River: In the fall of 2016- 2018, the MCG team performed snorkel surveys in over 20 pools to count returning adult Atlantic salmon in the River Philip and the East River. In year one major pools were surveyed, while in year two MCG expanded the swims throughs to also surveyed small river sections.

River Restoration Work: The previous four summers (2014-2018) MCG installed and repaired in-stream fish habitat structures, removed barriers to fish passage, and restored riverbanks in the following waterbodies: McLellans Brook (East River), Barneys River, Smalls Brook, Indian Brook and several tributaries to the Stewiacke River.

2.0 Project Description

Background:

In early 2020 Nova Scotia Power Incorporated (NSPI) began discussions with Millbrook chief and council regarding two dam refurbishment projects in the Sheet Harbour Area (Ruth Falls Dam and Sloane Dam). NSPI and the CMM began discussions in Spring of 2020 after Millbrook Chief and Council had recommended that the MCG/DARFM lead an offsetting project. DARFM has done limited work in the West River area so after discussions with NSPI it was decided that DARFM would reach out to the Nova Scotia Salmon Association (NSSA) as they are currently working on their West River acid rain mitigation project in the area. Once NSSA provided an offsetting plan DARFM followed up with Millbrook's consultation team regarding their initial thoughts on the project prior to submitting Draft 1 to NSPI.

Revised (2021): The Second Draft of this plan has been seen by the Millbrook Consultation team and no issues were found in the plan. NSPI met with Millbrook Chief and Council on April 20th and there was no indication of project changes required at this time.

Revised (2023): Updates to the plan include the addition of a second year of pre-monitoring and expansion of pre-monitoring activities to include thermal imagery. The offset will occur in Year 3 and three years of post-monitoring will follow.

Organization and Partners

- **CMM/DARFM:** Will be the lead proponent of the project and will assist with project activities as listed in the below proposal and will lead the administrative / project management side of the project. DARFM team members will be the principle contact for the project and will provide updates as required. The DARFM will also be responsible for engaging Millbrook First Nation with this specific offsetting project.
- **Millbrook First Nation:** Millbrook community members will have opportunities to be engaged in and potentially hired on short contracts for this project. Millbrook fishers and interested community members will be provided opportunities to provide input into the project. Millbrook's consultation team will also stay updated on this project through update meetings and will help the CMM engage with community members of Beaver Dam and Sheet Harbour.
- **NSSA:** As a regional expert in large scale restoration the NSSA will lead the physical restoration work and plan the will help build capacity within the CMM/Millbrook to do this type of large-scale restoration work in the future. NSSA will also design the monitoring plan based off their final design.

3.0 Roles and Responsibilities:

- **Project Manager: Stephen Williams**
  - Will oversee the initial set up of the project.
  - Will oversee the project lead's management of the project.
  - Aid project lead with project delivery and reporting.
- **Project Lead: TBD**
  - Oversee day to day activities for the project.
  - Liaise with Millbrook, NSSA and NSPI
  - Provide offset project updates to Millbrook community and NSPI.
- **Millbrook: TBD (Consultation team and community members)**
  - Assist with project activities (planning, monitoring, restoration)
  - Participate in meetings.
  - Receive training (types tbd).
  - Note: this will depend on community interest throughout the project.
- **NSSA Lead: Eddie Halfyard**
  - Responsible for overseeing restoration work.
  - Oversee all contractors necessary for the project (site design, instream restoration work, and monitoring plans)
- **Additional CMM Staff:**
  - Assist with monitoring and restoration activities.
  - Provide guidance and oversight.

4.0 Goal and Objectives

Goal

As part of a contract under NSPI the DARFM, along with the NSSA, will develop and implement an offsetting project for 5000m^2 on the West River Sheet Harbour watershed. The offset project relates to NSPI dam refurbishment projects at the Ruth Falls headpond and Sloane Reservoir. This project will improve fish migration and fish habitat by restoring suitable instream and streambank habitat. This will be an eight-year project that will actively engage Millbrook, NSSA, and the CMM (DARFM) in improving necessary Atlantic salmon and other significant fish habitat. Performing offset work on the main branch of the river between two previously restored sections will also greatly increase migration routes for salmon and will have a long-lasting effect that other smaller scale projects often cannot achieve. In addition to these restorations, the upper West River Sheet Harbour has been the subject of a liming project since 2005 to mitigate the effects of freshwater acidification that has impacted many river systems in the southwestern and eastern parts of the province. A second lime doser was installed in the Killag River (a major tributary of the West River) in 2016[1]. This river system has an at-risk population of Atlantic salmon (*Salmo salar*) so all parties involved in the project, feel a project at this level will be very beneficial to ongoing recovery efforts.

Year 1 (2022) will focus on engagement sessions with project partners (NSSA and Millbrook First Nation) and the development of site plans. Pre-monitoring activities, recruitment, and training of Millbrook community members to assist with monitoring the installation of the restoration structures as well as assist with post-monitoring duties will also occur in year 1.

Year 2 (2023) will involve pre-monitoring activities and recruitment and training of additional Millbrook community members, as needed, to assist with monitoring the installation of the restoration structures as well as assist with post-monitoring duties.

Year 3 (2024) will focus on performing the largescale restoration work within the middle section (between two previously restored areas by the NSSA) of the West River. This year will incur the greatest costs.

Years 4 through 8 (2025, 2027, and 2029) will consist of the post monitoring the sites where offsetting work was completed. Post-offset monitoring will be completed in years 4, 6 and 8. A final report will be completed at the end of year 7.

[1] Nova Scotia Salmon Association. (n.d.). *Acid Rain Mitigation*. Retrieved September 29, 2022, from https://www.nssalmon.ca/acid-rain-mitigation

Overarching Objectives

Objective 1: Meaningful engagement with Millbrook First Nation
In year 1, the CMM will recruit and train interested community members to assist with project deliverables (e.g., monitoring restoration activities and being engaged in post-restoration environmental monitoring). Training opportunities will include safety and technical training (swiftwater rescue training, watercourse alteration certification, etc.) and they will also have the opportunity to job shadow CMM and NSSA staff. In years 3 through 8 the CMM will hire 1 – 3 community members from Millbrook First Nation, and/or its satellite communities in Sheet Harbour and/or Beaver Dam, to assist with monitoring the installation of restoration structures as well as any post-monitoring work. Millbrook's consultation team has stated that engaging community members in a meaningful offset project is of high importance with respect to this project.

Objective 2: Baseline monitoring and post-restoration monitoring:
Staff from the CMM will review any relevant literature to determine what baseline information is presently available, if any. Next, CMM staff will perform pre-monitoring assessments following established protocols. Based off the finalized pre-restoration monitoring work completed and results of the completed instream offsetting work the CMM in partnership with NSSA and Millbrook will complete 3 years (years 4, 6 and 8) of post-offset monitoring.

Objective 3: Aquatic habitat restoration
In Year 1, the CMM will have several meetings with the NSSA and Millbrook to develop a concrete design plan and establish timelines for the habitat offsetting work to be completed in year three of the project. The final offset area (m^2) will be based off direction from NSPI from their guidance from DFO, and the NSSA with assistance from the CMM will get revised estimates to complete offset work based off site surveys. This area is anticipated to be approximately 5000 m^2; however, there is approximately 20,000 m^2 of habitat that would benefit from a restoration in this area.

In year three the NSSA will oversee the restoration of fish habitat to be used for offsetting purposes by NSPI. More information on the current specifics of the restoration work and monitoring can be found in Appendix I.

5.0 General Workplan

Year 1 (2022):

Objective 1: Meaningful engagement with Millbrook

- The CMM's DARFM will meet with Millbrook's consultation team and community members and will involve other key individuals as directed by Millbrook's Chief and Council or consultation team

Objective 2: Pre-offset baseline monitoring:

- The pre-habitat offset monitoring work on the West River Sheet Harbour will involve performing habitat suitability assessments following established field methods[2]. While estimates of the size of the West River salmon smolt migration exist[3], there appeared to be a gap in data over the past decade. Due to the large size of the river and a lack of recent studies which determine fish abundancy, pre- and post-monitoring efforts will be focused on habitat characteristics and channel morphologies which are anticipated to be impacted most by the restorations (e.g., substrate composition, bankfull and wetted widths, thalweg depth, water temperature, etc.). Water quality monitoring (excluding temperature monitoring) is anticipated to provide little insight with respect to baseline or natural conditions due to the ongoing liming project and as such will not be a primary focus of the environmental monitoring component. It is anticipated that physical habitat monitoring will be able to show: an increase in the number of natural pools and the retention of cold water refugia, establishment of a defined natural thalweg, and establishment of a natural meander pattern.
- The freshwater biologist has indicated that, from their desktop analysis and previous work upriver and downriver of this proposed site, the design width of this section of river is approximately 15.6 m and the meander length is approximately 94 m. Currently this section of the river can be in excess of 30 m in width, is shallow, particularly during the summer months, and has degraded fish habitat. This is due to past land use, historical log driving activities and other anthropogenic effects on the river. The NSSA has restored sections down- and upriver from the proposed site, so this offset would help with fish migration, thalweg continuity, and provide a connected set of holding pools suitable for salmonids (especially Atlantic salmon). Below is an overview of the techniques and details that will be used in the pre-offset monitoring plan:

    - Visualization:
        - Map created to show monitoring sites and proposed structure placements
        - Site pictures taken at each survey site and structure site, including original orientation to allow for replication in post construction monitoring
        - Will document presence of Atlantic salmon and other fish during surveys

    - Pre-Monitoring Habitat Suitability Index (HSI) Assessments
        - Number of transects will depend on calculated bankfull width and approximate size of proposed restoration area
        - Channel measurements
        - Substrate composition assessment
        - Assessment of instream cover
        - Riparian characteristics (dominant vegetation, % stream shade, etc.)

[2] Nova Scotia Salmon Association, Adopt a Stream. (2018). *A Field Methods Manual Nova Scotia Freshwater Fish Habitat Suitability Index Assessment NSHSI Version 2.1.*
[3] Halfyard, E. A., & Ferguson, G. (2009). *Assessment of the 2009 West River, Sheet Harbour Atlantic salmon smolt migration*. Nova Scotia Salmon Association.

- Benthic macroinvertebrate surveys
- Wetted depth measurements
- Thalweg depth measurements

Year 2 (2023):

Objective 1: Meaningful engagement with Millbrook

- The CMM's DARFM will continue to meet with Millbrook's consultation team and community members to provide project updates and will involve other key individuals as directed by Millbrook's Chief and Council or consultation team.
- There will be funds allotted to hire Millbrook community members on short term contracts or reimburse at a daily rate so that they can participate in the monitoring work and/or attend applicable training opportunities.

Objective 2: Pre-offset baseline monitoring:

- Pre-offset baseline monitoring will include the repetition of Habitat Suitability Index (HSI) assessments described in Year 1 as well as the following:
  - Characterization of the thermal profile of the river pre-restoration by carrying out thermal drone surveys of the restoration site during low flow.
  - Characterization of temporal changes in water temperature during the summer by installing approximately 10 water temperature loggers throughout the study area. Effort will be made to evaluate both surface and depth temperatures.

Year 3 (2024):

Objective 1: Meaningful engagement with Millbrook:

- The CMM will continue to meet with Millbrook's consultation team and with interested community members, as well as continue to provide updates to the community when applicable or requested.
- Where possible Millbrook community member will have paid opportunities to assist with restoration activities.

Objective 2: Aquatic Habitat Restoration Planning

- All activities associated with planning and structure design will be completed for the restoration work (being used as an offset). Instream improvements will involve installing deflectors (used to assist with correcting meander pattern) and/or rock sills (used to promote pool creation) at design length intervals (approx. 94 m) but may also include other instream construction techniques. A detailed site plan will be developed for review prior to proposed construction. The plan will include maps and locations of structures, structure types, approximate dimensions, and pictures.

Objective 3: Installation of restoration structures

- The NSSA will lead the large-scale restoration work to be completed and will arrange the scheduling for their contractors (heavy machinery operators, freshwater habitat restoration consultant) to ensure the work is completed.
- The CMM will conduct site visits and have staff involved in mentorship opportunities to become more familiar with doing large-scale restoration work.
- The CMM will coordinate having Millbrook community members involved in the project (where there is interest to do so) and will coordinate any necessary or applicable training for Millbrook community members.

Years 4-8 (2025, 2027, and 2029):

Objective 1: Meaningful engagement with Millbrook:

- There will be funds allotted to hire Millbrook community members on short term contracts or reimburse at a daily rate so that they can participate in the monitoring work and/or attend applicable training.

Objective 2: Post-restoration monitoring

- The post-offset monitoring techniques will heavily mirror the techniques used in the pre-offset monitoring plan, the major difference being that in the post-offset there will be more focus on inspecting the structures and pools to ensure proper habitat creation and structural integrity. The project team (Millbrook, NSSA, and CMM) will utilize the established monitoring plan and maps to compare progress of habitat in 3 of the 5 years following completion of instream restoration (years 4, 6, and 8 of the proposed plan). Please note: these post-offset monitoring plans may change as the offset layout/plan is developed and initial monitoring is completed.

<u>Monitoring strategy and techniques:</u>

- Visualization:
    - Site pictures taken at each survey site and structure site.
        - Pictures will be taken with the same orientation and matched with the map(s) established in year 1
    - Will document presence of Atlantic salmon and other fish during surveys.

- Post-Monitoring Habitat Suitability Index (HSI) Assessments
    - Number of transects will depend on calculated bankfull width and size of proposed restoration area
    - Channel measurements
    - Substrate composition assessment
    - Assessment of instream cover
    - Riparian characteristics (dominant vegetation, % stream shade, etc.)
    - Benthic macroinvertebrate surveys
    - Wetted depth measurements
    - Thalweg depth measurements

- Water Temperature
    - Water temperature will be monitored using a handheld multimeter and water temperature loggers (approximately 10 units) will be deployed throughout the study area in a similar manner to that described in Year 2
    - In the final year of post-monitoring, a thermal profile of the river post-restoration will be acquired using a thermal drone and will be compared to the pre-restoration profile of the same area

- Structure surveys: (based off offset layout plan)
    - Surveys to ensure structures have stayed in place and are establishing positive habitat change.
        - Note: will document any changes or damage caused by ice or other extreme weather events to the structures
        - May use drones or other methods to survey structures
    - Measurements taken to determine change to pools and stream meander.

- Document presence of adult and or juvenile Atlantic salmon (and other salmonid / fish species) using habitat

6.0 Project Timeline

Table 1 Project deliverables and associated timelines

Activities	Schedule
Continued discussions between the CMM, NSSA, NSPI, and DFO regarding offsetting project requirements.	April 2022 to October 2022
Continued updates and discussions between The CMM and Millbrook regarding the lifespan of offsetting project.	Ongoing throughout project
Pre-offset monitoring	June – September 2022 & June – September 2023
Design of restoration work	Surveys: June 2022 – June 2024
Perform largescale instream restoration work. NSSA will lead this portion of the project.	June – September 2024
CMM staff and Millbrook Community members will receive mentorship from the NSSA on the restoration work and assisting with work and monitoring where applicable.	June - September 2024
Post-restoration Monitoring (3 years) Lead by NSSA in partnership with CMM and Millbrook	June- September 2025 & June- September 2027 & June – September 2029
Proposed reporting dates to NSPI.	Year 1: December 2022 Year 2: December 2023 Year 3: December 2024 Year 4: December 2025 Year 6: December 2027 Year 8: December 2029

7.0 Project Area

Site Map Via NSSA

Site Location: 45.9718, -62.6383

Nearest approximate address: 88 W River Rd, Mooseland, NS B0J 2J0

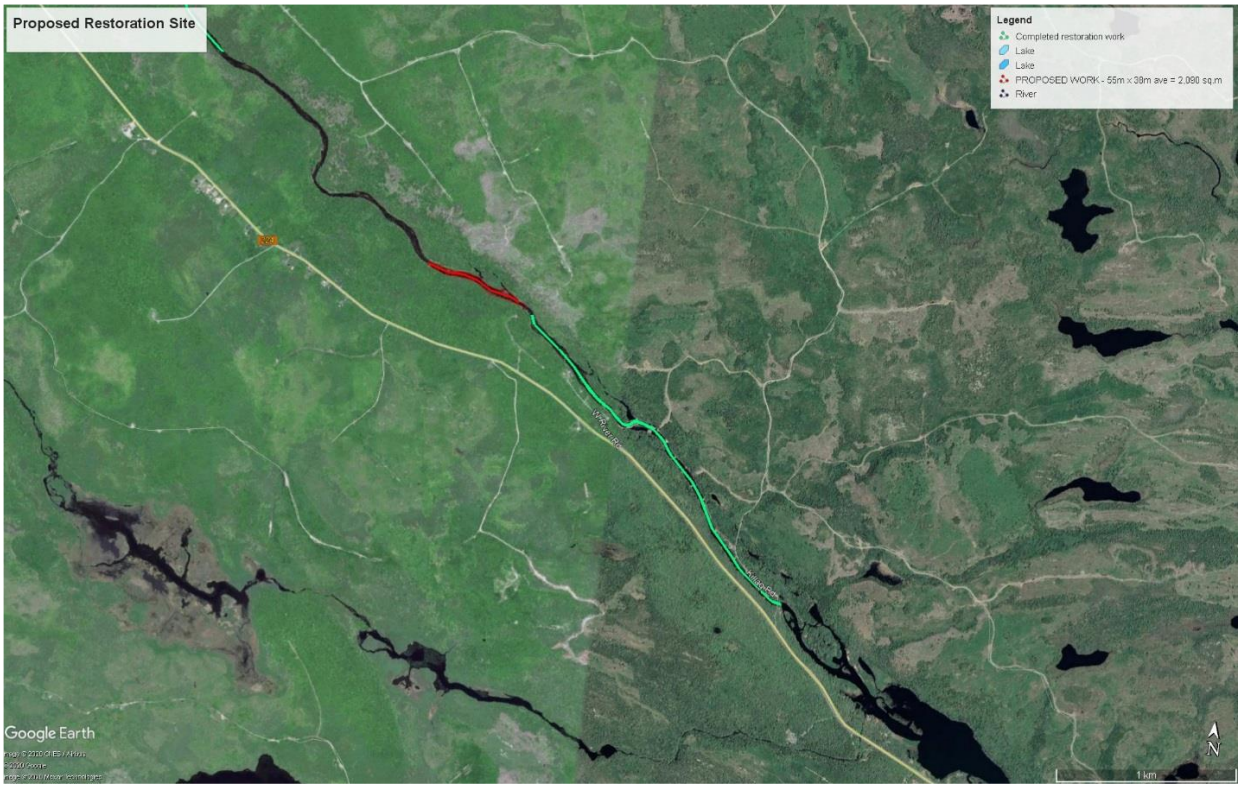


Figure 1 Map of 20,900 m^2 of stream that requires habitat restoration (red), of which the lower section (total sq meter to be determined) would be targeted by this proposed work. Green areas were previously completed. See in Appendix I. *Note: there is a discrepancy between the size of the red area reported in the legend and the caption. The legend should read: 550 m x 38 m = 20,900 m^2.*

Larger View of project area



Figure 2 Red marker indicates approximate area where restoration work will occur in comparison to the community of Sheet Harbour.

8.0 Limitations:

The total budget and timelines will be dependent on continued discussions between NSPI, DFO, NSSA and the CMM (DARFM) regarding the offset requirements, as well as ensuring proper oversight and guidance on the work by Millbrook and all other required Mi'kmaw Communities.

There may be changes to the Species-At-Risk Act that could list this population of Atlantic salmon as endangered which could cause delays, or modifications, to our plans based off DFO guidance and or regulations.

Restoration costs may change as the original estimates were based off work completed previously. Material and labour costs are highly variable. Costs will be discussed with NSPI during year 1 and 2 meetings to ensure costs are acceptable.

The estimates were also based upon an approximate 5000 m^2 area to be offset. Should the offset area be significantly larger, this project could be scaled (see Appendix I), and the work done would be very similar to that prescribed in the appendix and within this document.

The CMM does not conduct consultation for proponents and will only be responsible for ensuring that Millbrook (and other parties as directed) are properly engaged in the offset project.

This project proposal plan is dated February 23, 2024, should significant changes be required this will be reflected in a revised offset plan or "change request" type document.

9.0 Budget Summary

Pre – Offset

Table 2 Year 1 (2022) Budget

Category	Description	Amount
Salaries and Wages (the CMM)	Project Manager (70 hrs @ $80/hr = $ 5,600) Field technicians (3 x technicians for 21 hrs @ $45/hr = $2,835)	$8,435.00
Training	Environmental monitoring-related training opportunities for community members engaged in monitoring activities. Examples include swiftwater rescue training, and NS watercourse alteration training	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$1,500.00
NSSA Professional Services	Project management support and thermal drone survey	$5,000.00
Administration	15% of costs*	$4,585.59
Total	All costs	$21,520.59

*Calculated based on previous budget draft of $25,985.00 + admin

Table 3 Year 2 (2023) budget

Category	Description	Amount
Salaries and Wages (the CMM)	Project Manager (70 hrs @ $80/hr = $ 5,600) Field technicians (3 x technicians for 21 hrs @ $45/hr = $2,835)	$8,435.00
NSSA Professional Services	Project management support and thermal drone survey	$5,000.00
Training	Environmental monitoring-related training for CMM and community members to implement monitoring program	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook community members	$1,500.00
Administration	15% of costs	$2,988.53
Total	All costs	$19,923.53

Offset

Table 4 Year 3 (2024) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Allotment for Millbrook (Salaries, training, and equipment)	Amount to reimburse Millbrook community member(s), money for training, and necessary equipment needed to assist with restoration and monitoring materials / supplies	$8,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$4,000.00
Salaries and Wages (NSSA)	Biologist (10 days @ $450/day) and a NSSA field technician (15 days @ $350/day)	$9,750.00
Salaries and Wages (Fresh water biologist)	Preparation of final site survey, design model, onsite structure layout and construction monitoring	$20,000.00
Professional Services (Construction contractor)	Large machinery contractor and rock materials	$165,312.50
Administration	15% of costs	$38,331.62
Total	All costs	$255,544.12

Post – Offset

Table 5 Year 4 (2025) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
NSSA Professional Services	Biologist (8 days @ $450/day) and a NSSA technician (12 days @ $350/day)	$7,800.00
Administration	15% of costs	$3,873.53
Total	All costs	$25,823.53

Table 6 Year 6 (2027) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
NSSA Professional Services	Biologist (8 days @ $450/day) and a NSSA technician (12 days @ $350/day)	$7,800.00
Administration	15% of costs	$3,873.53
Total	All costs	$25,823.53

Table 7 Year 8 (2029) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
NSSA Professional Services	Biologist (8 days @ $450/day), NSSA technician (12 days @ $350/day), and thermal drone survey ($5,000)	$12,800.00
Administration	15% of costs	$4,255.26
Total	All costs	$31,205.26

Table 8 Total Project Budget (all years)

Project Total	Amount
Year 1	$21,520.59
Year 2	$19,923.53
Year 3	$255,544.12
Year 4	$25,823.53
Year 6	$25,823.53
Year 8	$31,205.26
Grand Total	$379,840.56

10.0 Contact Information

Should there be any questions please contact:

Stephen Williams, MASc

Manager of Habitat and Impact Assessment

Department of Aquatic Resource and Fisheries Management

The Confederacy of Mainland Mi'kmaq

swilliams@mikmawconservation.ca

http://cmmns.com/

www.mikmawconservation.ca

Office: 1.902.895.6385 Cell: 1.902.324.3830 Toll Free: 1.877.892.2424

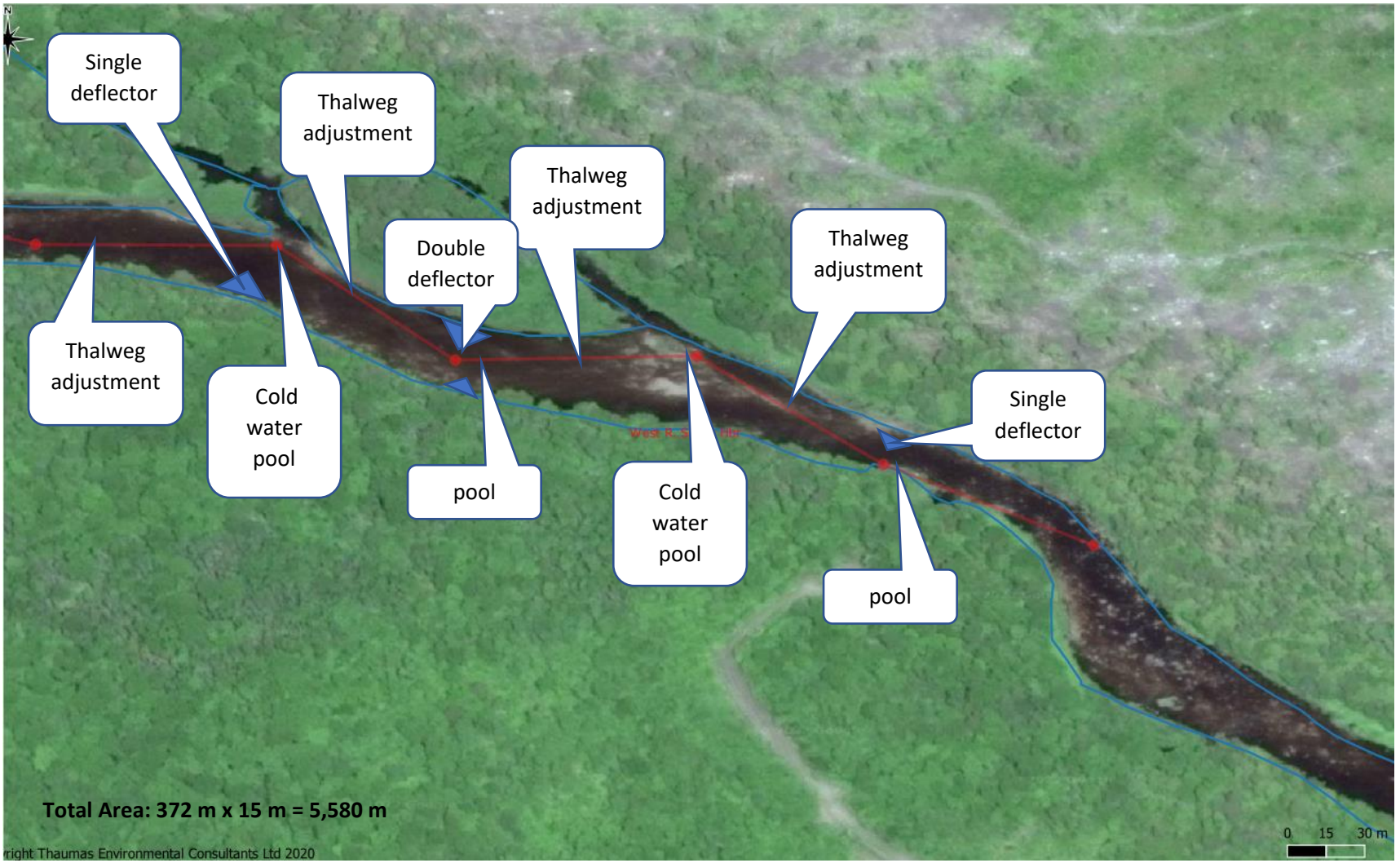
The Confederacy of Mainland Mi'kmaq

MI'KMAW CONSERVATION GROUP
THE CONFEDERACY OF MAINLAND MI'KMAQ

Appendix I NSSA - Habitat Offsetting Proposal

See attached document titled “Appendix I - NSSA West River Habitat Offsetting Considerations”.

Appendix II Habitat Restoration Site Design



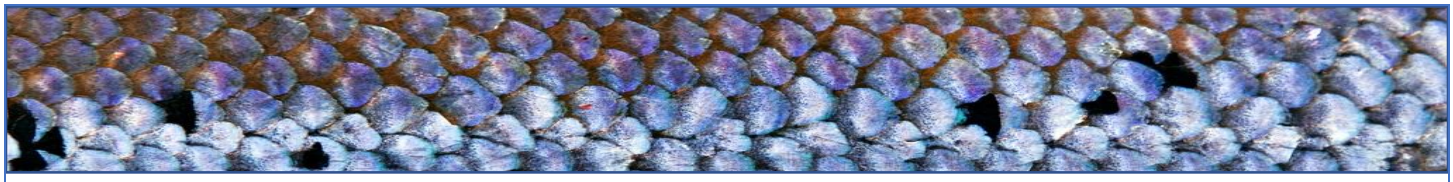


DRAFT OVERVIEW:

Habitat Offsetting Proposal

December 2020

www.nssalmon.ca



HABITAT PARTNERS:

Nova Scotia Salmon Association, Thaumas Environmental Consultants Ltd., Mi'kmaw Conservation Group (Confederacy of Mainland Mi'kmaw), Eastern Shore Wildlife Association

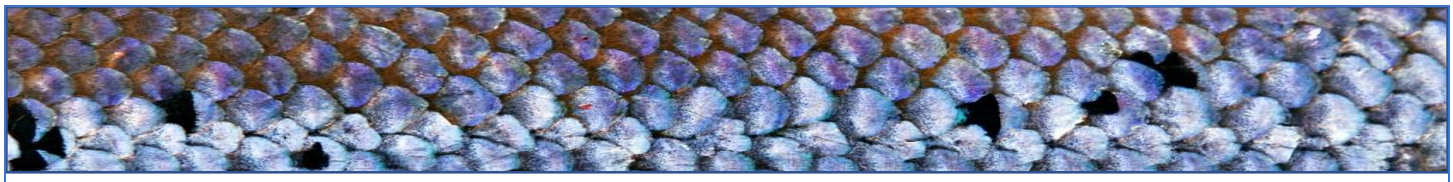
OBJECTIVE:

Detail an option for freshwater habitat restoration project to be considered for future offsetting projects.

OVERVIEW:

The Nova Scotia Salmon Association and its partners are committed to the recovery of Atlantic Salmon, nature fishes and we prescribe to the principles of biodiversity conservation. One area of freshwater conservation where we are particularly active is freshwater habitat restoration and planning. We are currently developing a regional restoration framework that focuses on priority areas, species and lays the foundation for addressing threats. Funded by both the federal and provincial governments, and in partnership with first nations, academics and many regional not-for-profit groups, this project aims to create watershed stewardship plans for eight priority watersheds along the Atlantic coast of Nova Scotia. The information contained within these plans will be identified by a combination of expert opinion and strategic planning that is currently underway. Here, we proposed continued freshwater habitat restoration in the West River (Sheet Harbour) which will directly contribute to the goals of this larger framework for restoration in the area to maximize the benefits to river ecology. Further, the West River is the site of Canada's largest acid rain mitigation project (https://www.nssalmon.ca/acid-rain-mitigation) which includes a substantial previous investment in instream physical habitat restoration. This proposed work will help work towards restoring the entirety of the lower main West River.

Specifically, we proposed work to improve the physical structure of the main branch West River, primarily to directly address the poor habitat conditions in this section but also to aid fish migration to the upper reaches or the watershed. The excellent gravel and cobble substrate in this main branch section will provide good spawning and rearing habitat for salmon and trout.



PROPOSED PROJECTS:

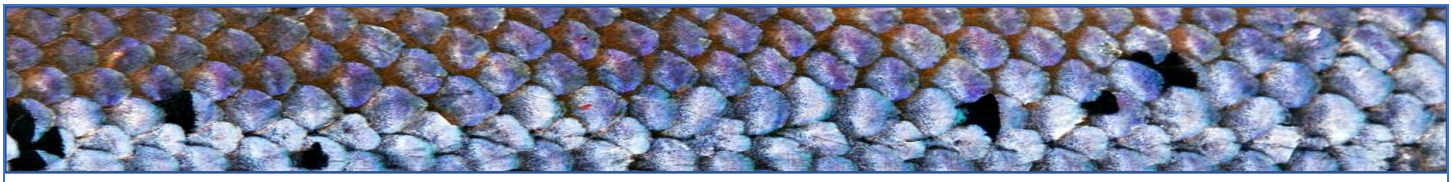
PROJECT #1: Main Branch, West River (Marinette)

Estimated area: 5,000 m^2 proposed in this work. Part of a larger 20,090 m^2 segment

Primary Issue: The main West River has been over-widened, straightened and has lost its natural pool-riffle-run sequence due to historic log driving and poor land use practices. This has resulted in poor habitat conditions for Atlantic Salmon.

Rationale for site selection: This area has been treated for the impacts of acid rain since 2005 by the Nova Scotia Salmon Association's lime doser project. Further, the physical habitat of the 2.2km immediately below this area has ben fully restored, as has a 1.9km segment beginning 1.8 km above this proposed site. Finally, the proposed site is located near a coldwater input that is important for coldwater-loving species like salmon and trout. This proposed section had previous work completed in 2018 to increase the ability for fish to migrate through this area, however additional work has been identified as necessary.

Proposed restoration actions: The goal of restoration is to encourage a narrowing of the stream to design width which will encourage proper fluvial energy transfer and, ultimately, will increase habitat diversity including the formation of pool habitat that is suitable for adult salmonids. The required work for the reach involved a series of paired rock deflectors to narrow the stream to design width of 15.6m, rock sills linking the tips of the rock deflectors to anchor the thalweg profile and encourage scouring of the thalweg to design depth (Figure 1). Further, habitat diversity structures such as root wads, other large woody debris and randomized boulder placement would increase the quality of this habitat.



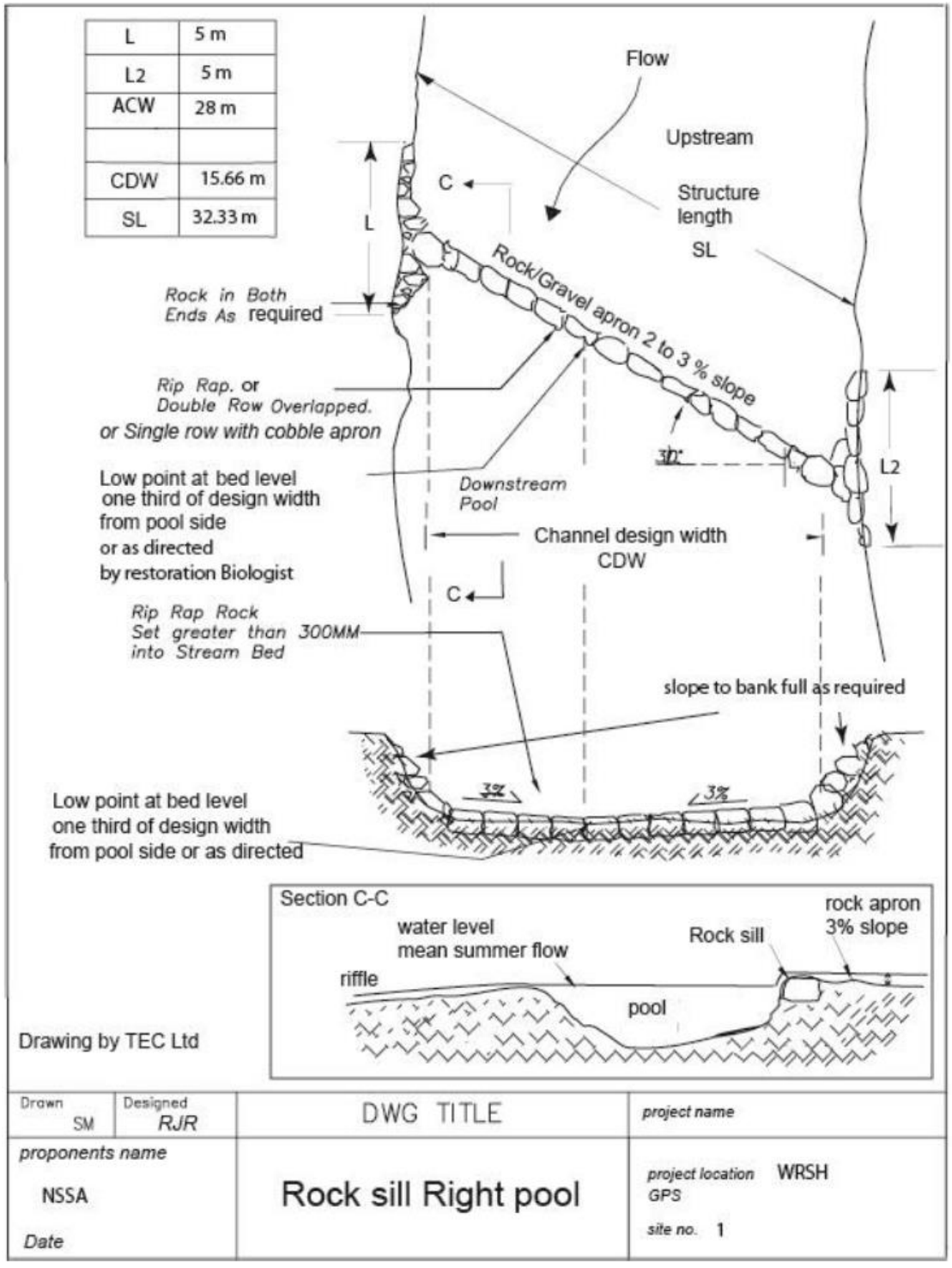
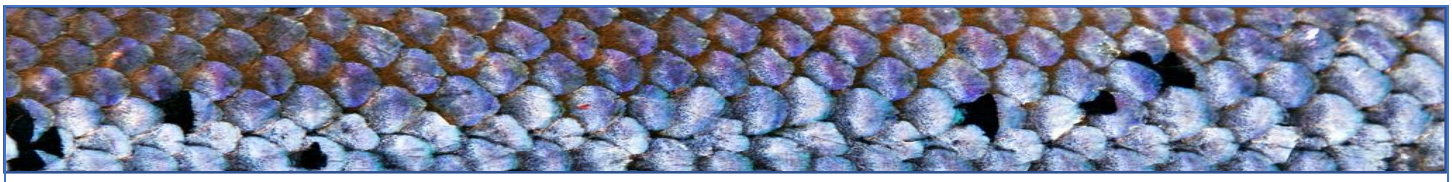


Figure 1 – Schematic of typical double-deflector plus rock sill habitat structure. Credit: Thaumas environmental consulting (R.J. Rutherford).





Figure 2 – Example of proposed work. Shown are two habitat structures spanning nearly 300m just downstream of the worksite proposed in this document. Pre-installation (top) and post-restoration (bottom). River runs from left to right. Post-install the river had a better-defined thalweg and a more appropriate proportion of pool habitat.



Estimated cost: Based on our 2016-2018 project in this area, we would estimate the total cost of completing this work to be approx. $125,000 + tax for a large machinery contractor and rock materials, approx. $22,000 for a qualified freshwater habitat restoration consultant (TEC) to do the site survey, design model, onsite structure layout and construction monitoring. NSSA coordination of the project would be $9,750 for a biologist (10 days @ $450/day) and a NSSA technician (15 days @ $350/day). Monitoring could be conducted by NSSA staff and from local Mi'kmaw community members as we have significant capacity and experience, however these costs are dependent on DFO-mandated monitoring requirements and these costs would need to be negotiated once the deliverables are outlined.

Site location: downstream end of reach, 45.9718°, -062.6383°

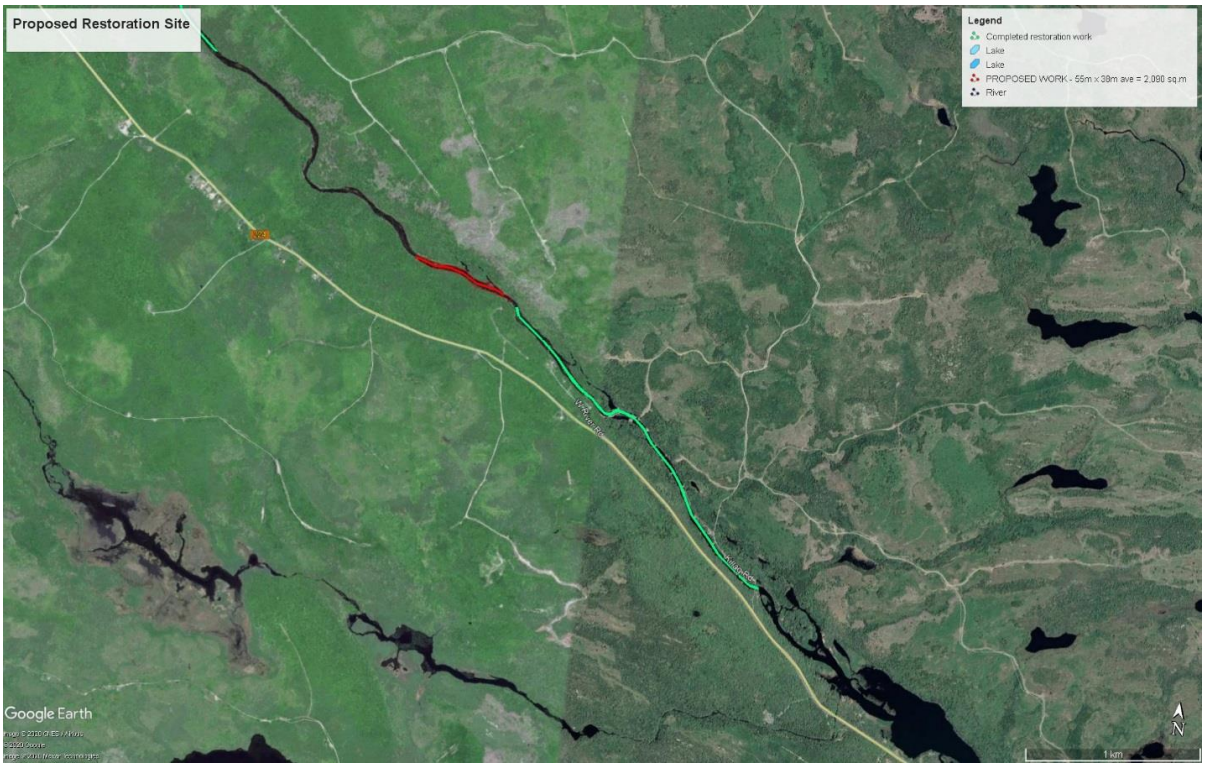


Figure 3 – Map of the proposed overall 20,090 m^2 area for habitat restoration (red), of which the lower 5,000m^2 would be targeted by this proposed work. Green areas were previously completed. Access to occur via a private road located off of highway #224.

Sheet Harbour Area Offsetting Project

West River Sheet Harbour Pre-Monitoring Report

Prepared by: Stephen Williams

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1.0 Project Description and Overview of West River Sheet Harbour Site

An approximately 5000 m^2 offsetting project was prescribed for the Ruth Falls Main Dam Refurbishment and Sloane Dam Rip Rap Stabilization projects. The Confederacy of Mainland Mi'kmaq's (the CMM's) Department of Aquatic Resources and Fisheries Management (DARFM) in collaboration with the Nova Scotia Salmon Association (NSSA) and Millbrook First Nation has proposed to restore an area of West River Sheet Harbour upstream of a previously restored section to increase aquatic connectivity and promote the recovery of Atlantic salmon (*Salmo salar*) in the region.

West River Sheet Harbour is located in eastern Nova Scotia in Halifax County and represents a total catchment area of approximately 262 km^2. The West River watershed is characterized by relatively flat terrain and is divided into three main components: the Killag River in the north, Lake Alma and Little River in the south, and the main stem of the West River in the middle. Historically, the river was utilized by the logging industry and its hydrology has been subject to anthropogenic impacts[1]. These impacts have left the river vulnerable to low water levels which disrupt fish passage as well as produce lethal water temperatures for salmonids in the summer. The West River contains at least 11 fish species of which Atlantic Salmon, Brook trout (*Salvelinus fontinalis*) and American eel (*Anguilla rostrata*) represent the most important from a recreational and commercial perspective.

The rivers of eastern NS, including West River Sheet Harbour, are among the most acidic in Canada (excluding point source areas) due to a combination of increased SO_4^{-2} deposition and surface water concentration, poor soil buffering capacity, and the presence of natural organic acids (NOAs)[2]. At low pH, toxic forms of aluminum can occur which are harmful to the health of fish species like salmonids. In the West River, pH values in the range of 4.4 to 4.7 have been observed prior to intervention[3]. To mitigate the impacts of low pH, lime dosing has been active in the watershed since 2005[4] and salmon smolt production has been observed to have increased more than three-fold since then[5]. The NSSA has also engaged in several habitat restoration projects in the West River including the restoration of 400 m of habitat in 2016 and an additional 1200 m in 2017[5]. The establishment of natural riffle/pool patterns as a result of the restoration was observed within a year of implementing the project[5].

[1] Hindar, A. (2001). Recommended liming strategies for salmon rivers in Nova Scotia, Canada.
[2] Clair, T. A., Dennis, I. F., Scruton, D. A., & Gilliss, M. (2007). Freshwater acidification research in Atlantic Canada: a review of results and predictions for the future. *Environmental Reviews*, *15*(NA), 153-167.
[3] Lacroix, G. L., & Knox, D. (2005). Acidification status of rivers in several regions of Nova Scotia and potential impacts on Atlantic salmon.
[4] Halfyard, E. A. (2008). *Initial results of an Atlantic salmon river acid mitigation program*. Masters' thesis, Acadia University.
[5] NSSA Adopt A Stream. (2018). *West river sheet hrb: NSSA adopt a stream*. West River Sheet Harbour. Retrieved September 29, 2022, from http://adoptastream.ca/groups-and-projects/west-river-sheet-Hrb



Figure 1 Rock deflectors installed by the Nova Scotia Salmon Association in 2016 in West River Sheet Harbour to promote the establishment of natural river features and restore fish habitat. Image credits: NSSA Adopt A Stream. (2018). West river sheet hrb: NSSA adopt a stream. West River Sheet Harbour. Retrieved September 29, 2022, from http://adoptastream.ca/groups-and-projects/west-river-sheet-Hrb.



Figure 2 Aerial view, taken in 2022, of restoration structures installed by the Nova Scotia Salmon Association in 2016.

2.0 Methods

2.1 Site Description

The proposed restoration area had approximate upstream and downstream coordinates of 44°58'22.836" N, 62°38'32.9352" W, and 44°58'16.338" N, 62°38'15.0144" W, respectively. The drainage area at the location was approximately 196 km^2. Both banks were forested throughout this section with a mixture of both deciduous and coniferous trees, except for a small area where a seasonal cottage was situated and the land had been clear cut. Grass and shrubs typically dominated the water's edge, and the forest canopy offered no stream shade during much of the day. During the summer, the area experienced low water levels and exposed boulders could be seen scattered throughout the channel. Access to the site was provided by way of a private driveway to the cottage referenced above followed by a short descent over the water-facing area of the property which was clear cut. No natural pools were observed within the study area. In the 24 hours preceding the pre-monitoring assessment the area experienced light rain with a total accumulation of 19.8 mm being recorded[6]. During the day of the assessment, the weather was predominantly overcast in the morning and a mix of sun and cloud in the afternoon. A total rainfall accumulation of 14. 8 mm was recorded.

Before setting out for a field habitat assessment, bankfull width was calculated based on watershed size and annual runoff. The formula used to calculate bankfull width of a healthy system was:

[1] $$\text{Calculated Bankfull} = (3.397)*(A*R/1200)^{0.2891}$$

where *A* is the watershed area in km^2 and *R* is the mean annual runoff of the watershed in mm. For the West River Sheet Harbour the mean annual runoff of the watershed was determined to be 1200 mm[6]. Bankfull width is calculated before visiting the field, as a point of reference because many streams and rivers in Nova Scotia are widened due to degradation.

2.2 Habitat Assessments

[6] Canada, E. and C. C. (2022). *Historical Data*. climate.weather.gc.ca. Retrieved October 7, 2022, from https://climate.weather.gc.ca/climate_data/hourly_data_e.html?hlyRange=1999-09-13%7C2022-10-10&dlyRange=2000-08-01%7C2022-10-10&mlyRange=2000-08-01%7C2007-07-01&StationID=30668&Prov=NS&urlExtension=_e.html&searchType=stnName&optLimit=yearRange&StartYear=1840&EndYear=2022&selRowPerPage=25&Line=0&searchMethod=contains&txtStationName=Malay%2BFalls&timeframe=1&time=LST&Year=2022&Month=9&Day=20#

Habitat suitability index (HSI) assessments were carried out following guidance from the Nova Scotia Fish Habitat Suitability Index Assessment (NSHSI) Protocol Version 2.1[7]. Nova Scotia Salmon Association's (NSSA's) Adopt-a-Stream (AAS) program developed this assessment protocol to standardize fish habitat assessment in rivers and streams in Nova Scotia. The assessment index specifically incorporates methodology and thresholds that accurately identify Brook trout (*Salvelinus fontinalis*) habitat according to established United States Fish and Wildlife service techniques adapted for Nova Scotia rivers, and Atlantic salmon (*Salmo salar)* habitat according to relevant scientific literature. Each HSI was divided into three evenly spaced transects. Channel measurements, including bankfull and wetted widths, wetted depths, thalweg depth, and floodplain measurements were recorded. Substrate composition and fish cover were also assessed.

[7] Nova Scotia Salmon Association, Adopt a Stream. (2018). *A Field Methods Manual Nova Scotia Freshwater Fish Habitat Suitability Index Assessment NSHSI Version 2.1.*
http://adoptastream.ca/sites/default/files/The%20Nova%20Scotia%20Fish%20Habitat%20Assessment%20Protocol-%20June%202018.pdf

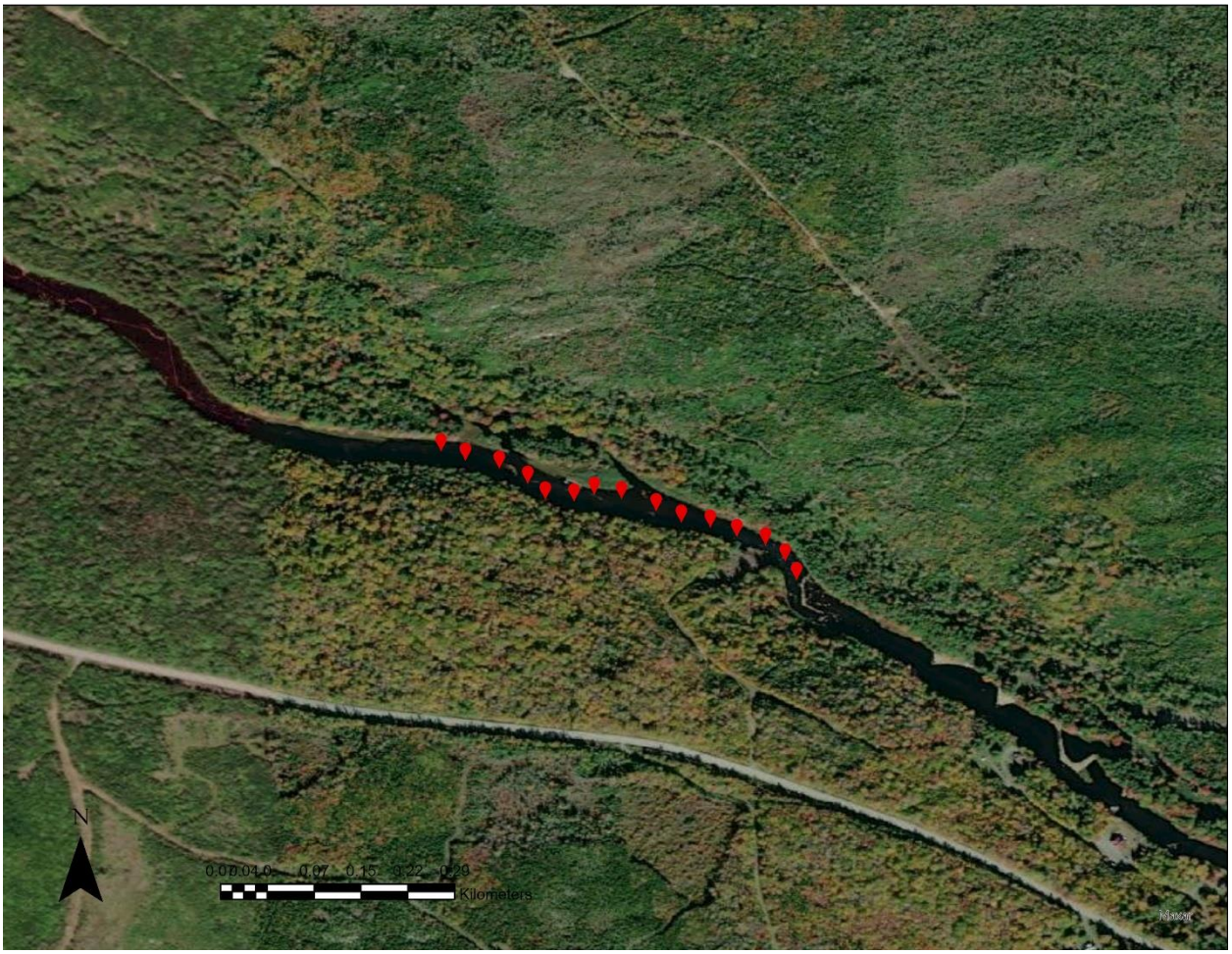


Figure 3 Locations of HSI transects in West River Sheet Harbour.

2.2.1 Water Quality

Water quality parameters were recorded at each of the five HSI sites using a YSI Professional Plus multi-meter. Recorded water quality parameters included temperature (°C), pH, conductivity (µS/cm), total dissolved solids (TDS; mg/L), and dissolved oxygen (mg/L).

2.2.2 Cross-section Setup

For each HSI, three transects were established by running a tape measure perpendicular to the flow and anchoring it at bankfull width on either side of the river. Measurements were taken working from the left to right side of the river. Bankfull level was determined by observing for features such as major inflection points, erosion/scour lines, changes in sediment, and/or changes in vegetation. Bankfull height was determine as the distance from the water line to the height of the bank. Wetted width was

determined by noting the total proportion of the bankfull width which was covered in water. Wetted depths were determined by taking water depth measurements at ¼, ½, and ¾ the wetted width using a meter stick. The thalweg was identified visually and the thalweg depth, as well as its location within the channel cross-section, was recorded. If present, pools were noted and their average dimensions were recorded. The proportion of the pool which could be used for cover by fish was also approximated and recorded. The width of the left and right floodplains was also recorded by measuring the distance from the riverbank to the border of sloped land.

2.2.3 Substrate and Cover

A 0.5 m x 0.5 m quadrat was employed to determine substrate composition. The quadrat was divided into 20 squares with equal area such that each square represented 5% of the total quadrat area. Substrate composition was determined at ¼, ½, and ¾ of the wetted width. In general, the substrate size classes were divided into five main categories: fines (0 – 0.7 cm), gravel (0.71 – 6.0 cm), cobble (6.01 – 40 cm), boulder (>40 cm), and bedrock. Embeddedness, which is the degree to which larger boulder, cobble, and gravel substrate is surrounded by finer sand and silt material which fills spaces between individual rocks, was also determined by observing a small number of substrate along the transect for stain lines which indicates what proportion of the substrate is anchored in fine material. Unembedded cover was determined by observing for aquatic vegetation, large woody debris (LWD), undercut banks and large rocks, and estimating the number of juvenile and adult fish which could conceal themselves beneath. Estimations were made by walking the transect and using wooden dowels cut to 10 cm and 20 cm lengths to estimate the number of juvenile and adult fish, respectively, which could be concealed under the structures listed above. A 30 cm band on either side of the transect line was selected as the reference area when performing the cover survey.

2.2.4 Riverbanks and Riparian Areas

Riverbank stability was determined by estimating the percentage of rooted vegetation or stable rocky ground for the entire site (3 transects). Evidence of erosion was also noted and could include such things as undercut and/or collapsed banks, an obvious lack of soil, exposed tree roots, and/or fallen trees and shrubs. Riparian vegetation was also assessed by estimating the proportion of trees, shrubs, and grasses, as well as bare soil. A vegetation index was calculated using the following calculation:

[2] $$\text{Vegetation Index} = 2(\%\ \text{shrubs}) + 1.5(\%\ \text{grasses and sedges}) + (\%\ \text{trees}) + 0(\%\ \text{bare ground})$$

Stream shade was determined by evaluating canopy coverage created by riparian vegetation which would help maintain cool water temperatures during the summer months. To estimate stream shade,

the approximate proportion of the HSI site which would be covered from the midday sun (10:00 am to 2:00 pm) by canopy was recorded.

2.2.4 Benthic Macroinvertebrates

An evaluation of benthic macroinvertebrate presence was made using a rapid method commonly referred to as the rock grab. Briefly, three rocks were selected at random within the HSI site boundaries and macroinvertebrates were identified with respect to the order in which they belonged. The total e number of individuals was recorded. The list below was referenced for the purpose of benthic macroinvertebrate surveys.

Table 1 Indicator taxa (Modified Hilsenhoff Index, Kilgour, 1998).

Sensitive	Tolerant
Caddisflies (Trichoptera)	Midges (Chironomidae)
Mayflies (Ephemeroptera)	Aquatic earthworms (Oligochaeta)
Stoneflies (Plecoptera)	Leeches (Hirudinea)
Beetles (Coleoptera)	Sowbugs (Isopoda)
Fishflies, alderflies (Megaloptera)	Snails, limpets (Gastropoda)

2.3 Thermal Drone Survey

A drone equipped with visible and thermal imagery capabilities performed aerial surveys over the proposed restoration site on September 30th, 2022, to establish baseline thermal conditions and pre-restoration site imagery.

3.0 Results

3.1 Calculated Bankfull Width and Stream Order

Using an approximate watershed area of 196.4 km^2 and equation 1, a calculated bankfull width of 15.6 m was derived. Transects were spaced at 2 x the bankfull width such that transects were spaced 31.2 m apart yielding a site length of 93.6 m (approximately 1 meander sequence). The first transect was established at the first upstream riffle from the most upstream restoration structure below the study area at approximately 44°58'16.338" N, 62°38'15.0144" W. Stream order at the site was determined to be 4th order using the Strahler system.

Table 2 Assessment transect coordinates.

Assessment ID	Start Time	Coordinates		
		T1	T2	T3
WRSH1	10:20	44°58'16.338" N 62°38'15.0144" W	44°58'17.2884" N 62°38'15.5868" W	44°58'18.0912" N 62°38'16.5840" W
WRSH2	11:35	44°58'18.5196" N 62°38'18.0276" W	44°58'18.984" N 62°38'19.3596" W	44°58'19.2324" N 62°38'20.8248" W
WRSH3	14:46	44°58'19.812" N 62°38'22.092" W	44°58'20.4276" N 62°38'23.8416" W	44°58'20.6436" N 62°38'25.2132" W
WRSH4	15:32	44°58'20.3124" N 62°38'26.232" W	44°58'20.3988" N 62°38'27.6792" W	44°58'21.198" N 62°38'28.5648" W
WRSH5	16:12	44°58'21.9576" N 62°38'29.9976" W	44°58'22.3608" N 62°38'31.7076" W	44°58'22.836" N 62°38'32.9352" W

3.2 Water Quality

Water temperature increased with air temperature during the day. A maximum water temperature of 18.9°C was observed at the site. The pH values observed were consistent with that reported in literature for the area. Dissolved oxygen levels were observed to be suitable for aquatic biota[8] (table 3).

Table 3 Water quality data for select parameters.

Assessment ID	Air Temperature† (°C)	Water Temperature (°C)	pH	Conductivity (µS/cm)	TDS (mg/L)	Dissolved Oxygen (mg/L)
WRSH1	19.5	14.4	6.05	36.0	29.3	9.9
WRSH2	19.0	15.0	5.28	36.1	29.3	10.2
WRSH3	21.2 (27.0)	17.9	6.24	37.4	28.0	10.0
WRSH4	20.2 (25.0)	18.6	6.57	37.9	27.95	9.5
WRSH5	20.2 (25.0)	18.9	6.73	37.8	27.95	9.4

†Malay Falls Weather Station, humidex in parentheses

[8] Canadian Council of Ministers of the Environment. (n.d.). *Canadian Water Quality Guidelines for the Protection of Aquatic Life*. CCME.ca. Retrieved September 28, 2022, from https://ccme.ca/en/resources#

3.3 Cross-section Morphology

The channel was over-widened in this section. This observation was made by comparing the calculated bankfull width to the bankfull width determined in the field. The calculated bankfull width was 15.6 m and values observed in the field ranged from 26.5 m to 47.2 m. The widest bankfull widths were observed near the confluence of a tributary where channel consolidation was lacking. Floodplain measurements were variable but often exceeded 10 m (table 4).

Table 4 Channel and floodplain measurements. Values represent the average of three transects.

Assessment ID	Average Heights and Widths			Average Floodplain Widths	
	Bankfull Width (m)	Bankfull Height (cm)	Wetted Width (m)	Left (m)	Right (m)
WRSH1	26.5	65.0	21.3	5.3	>10
WRSH2	31.1	65.3	24.0	6.5	5.4
WRSH3	47.2	77.7	44.8	>10	7.6
WRSH4	43.9	70.7	33.5	>10	6.7
WRSH5	41.9	36.7	39.0	4.5	>10

With the exception of the thalweg, wetted depths generally did not exceed 30 cm (table 5). Thalweg depths ranged between 31 and 54 cm in depth. No natural pools were observed within the study area.

Table 5 Depth measurements. Values represent the average of three transects.

Assessment ID	Average Wetted Depths			Average Thalweg Depth (cm)
	¼ Width (cm)	½ Width (cm)	¾ Width (cm)	
WRSH1	28.8	28.0	11.5	35.0
WRSH2	14.0	21.0	21.7	37.0
WRSH3	9.2	2.5	7.2	43.0
WRSH4	17.2	12.8	5.1	31.0
WRSH5	31.0	8.3	34.3	54.0

3.4 Substrate Composition and Cover

Substrate within the area was generally characterized by cobble and boulder. Exposed bedrock was not observed within the study area. Fines contributed little to total substrate amounts and the proportion of gravel ranged between 5 and 33% (table 6).

Table 6 Substrate composition. Values represent the average of three transects.

Assessment ID	Habitat Type Sequence	Average Substrate Size (%)				
		Fines	Gravel	Cobble	Boulder	Bedrock
WRSH1	riffle, run, run	0	5.0	19.4	75.6	0
WRSH2	run, run, run	0.6	22.2	46.1	31.1	0
WRSH3	run, run, run	4.5	27.2	52.2	16.1	0
WRSH4	run, riffle, run	1.1	33.3	51.1	14.5	0
WRSH5	run, run, riffle	0.6	18.9	51.1	29.4	0

Embeddedness varied between 5 and 40 % (table 7). Instream cover was suboptimal for both parr and juvenile salmonids with the exception of WRSH5 which had suitable cover for juvenile salmonids.

Table 7 Embeddedness and instream cover.

Assessment ID	% Embedded			10 cm Instream Cover			20 cm Instream Cover		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
WRSH1	30	20	20	67	55	32	17	18	7
WRSH2	10	20	40	11	9	51	2	2	0
WRSH3	10	5	20	30	42	27	6	6	9
WRSH4	40	25	30	8	26	28	0	4	4
WRSH5	40	20	40	65	70	40	21	11	4

The Confederacy of Mainland Mi'kmaq

3.5 Riverbank and Riparian Area

Trees, shrubs, and grasses appeared in varying proportions and there was no exposed soil observed (table 8). There was no evidence of erosion or ice scarring on either bank. There was no stream shade during midday which was likely a contributing factor to warm water temperatures in the area.

Table 8 Percentages of riparian vegetation types and vegetation index (VI).

Assessment ID	VI	% Trees		% Shrubs		% Grass		% Bare Soil		% Erosion		% Stable Ground		% Stream Shade
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	
WRSH1	155	45	35	45	55	10	10	0	0	0	0	100	100	0
WRSH2	150	35	35	35	35	30	30	0	0	0	0	100	100	0
WRSH3	144	15	45	25	10	60	45	0	0	0	0	100	100	0
WRSH4	145	20	45	35	10	45	45	0	0	0	0	100	100	0
WRSH5	141	15	45	15	10	70	45	0	0	0	0	100	100	0

3.6 Benthic Macroinvertebrates

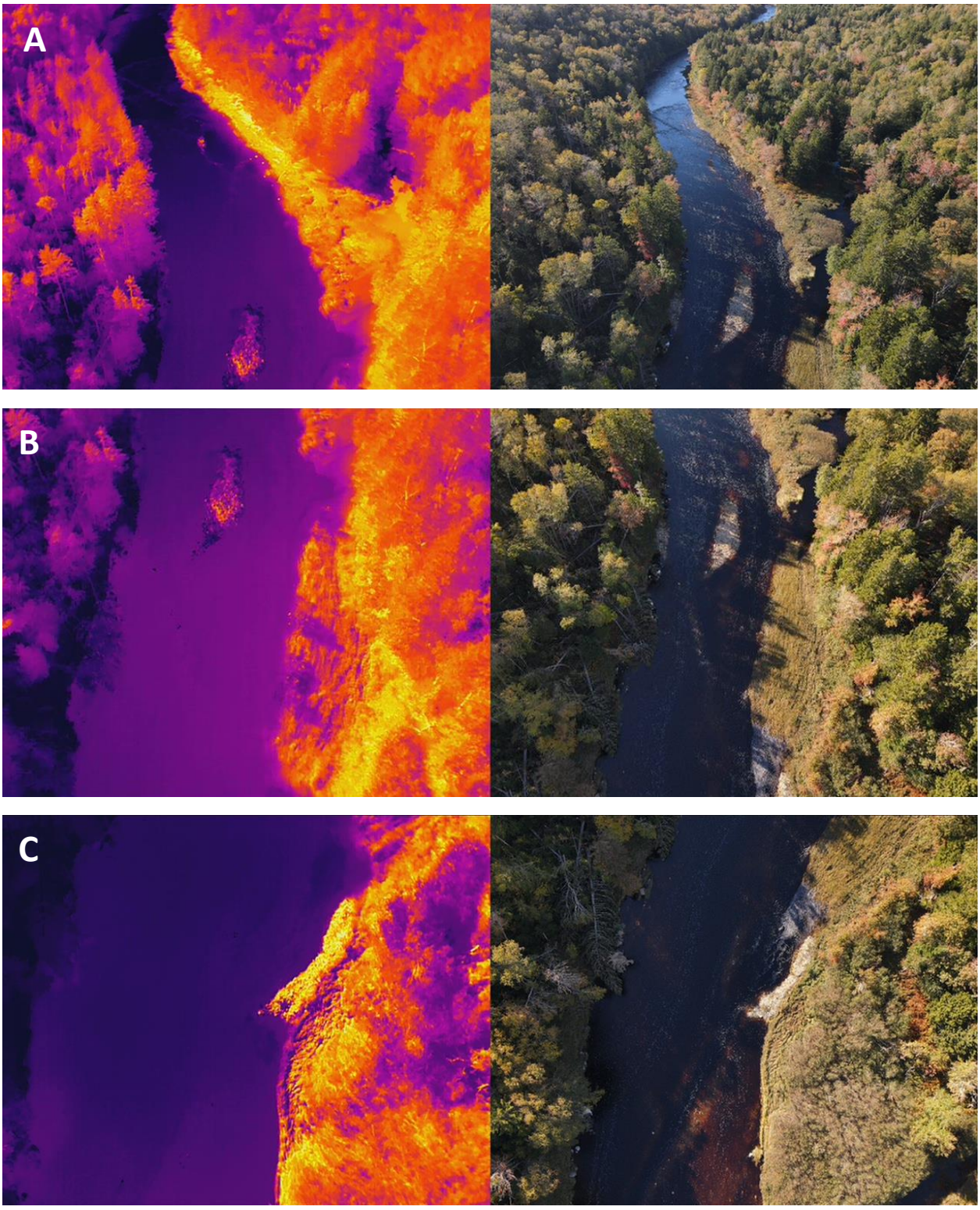
Benthic macroinvertebrate observations were dominated by stoneflies and caddisflies at all assessments. Caddisflies were often identified by their cases. Both taxa are considered to be sensitive. Water pennies (family Psephenidae) were the only coleopterans observed during assessments.

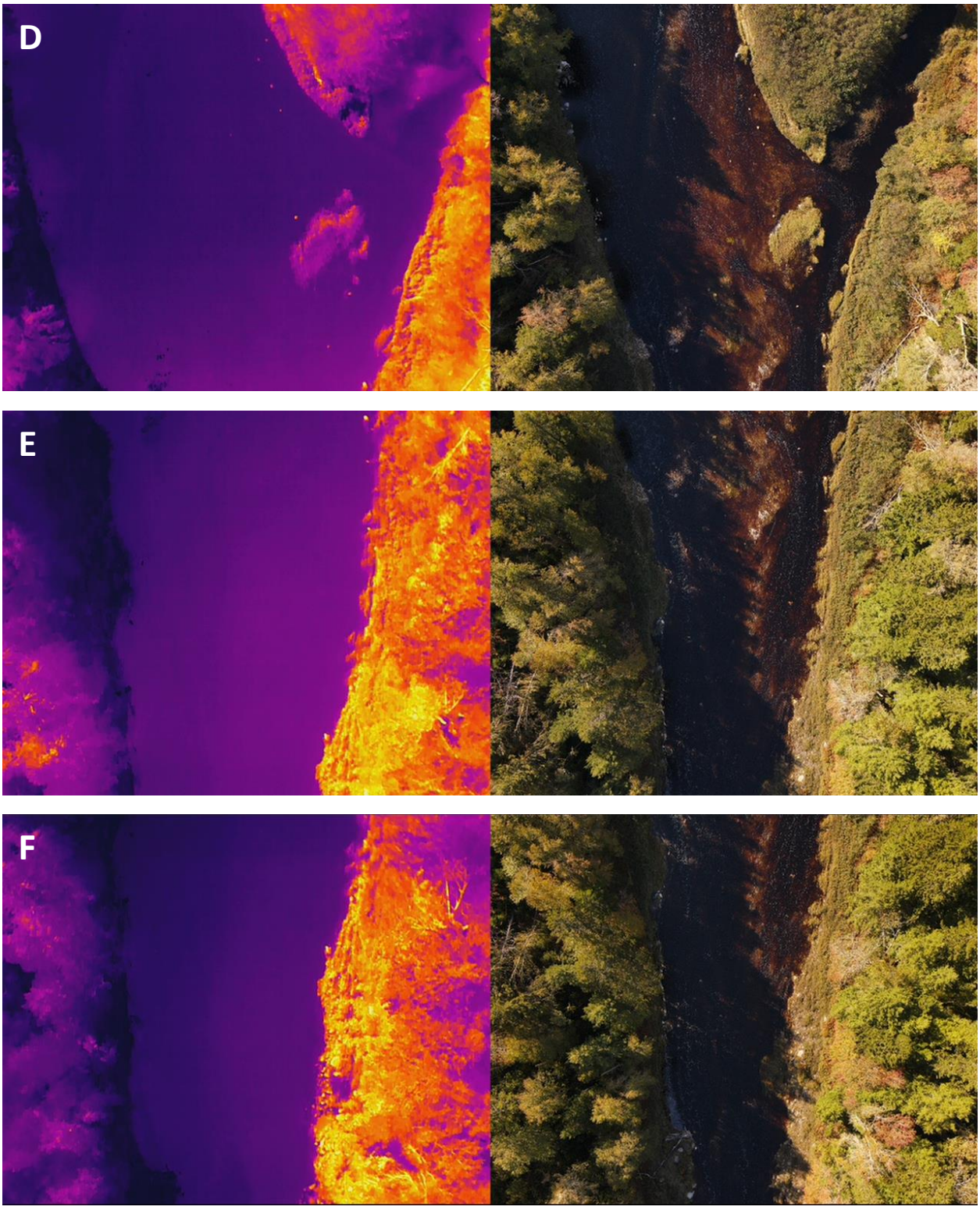
Table 9 Benthic macroinvertebrates observations.

Assessment ID	Midges (Chironomidae)	Beetles (Coleoptera)	Mayflies (Ephemeroptera)	Stoneflies (Plecoptera)	Caddisflies (Trichoptera)
WRSH1	0	0	0	2	24
WRSH2	0	0	0	3	23
WRSH3	0	1	0	8	0
WRSH4	1	3	1	6	24
WRSH5	0	1	1	2	2

3.7 Thermal Drone Survey

Poor thermal contrast observed within the proposed restoration site was likely the result of high water levels, the time of year, and the influence of riparian shading. However, the visible images collected simultaneously will be useful in determining the degree to which the river channel changes over time as a result of the restoration.


A
B
C


D
E
F

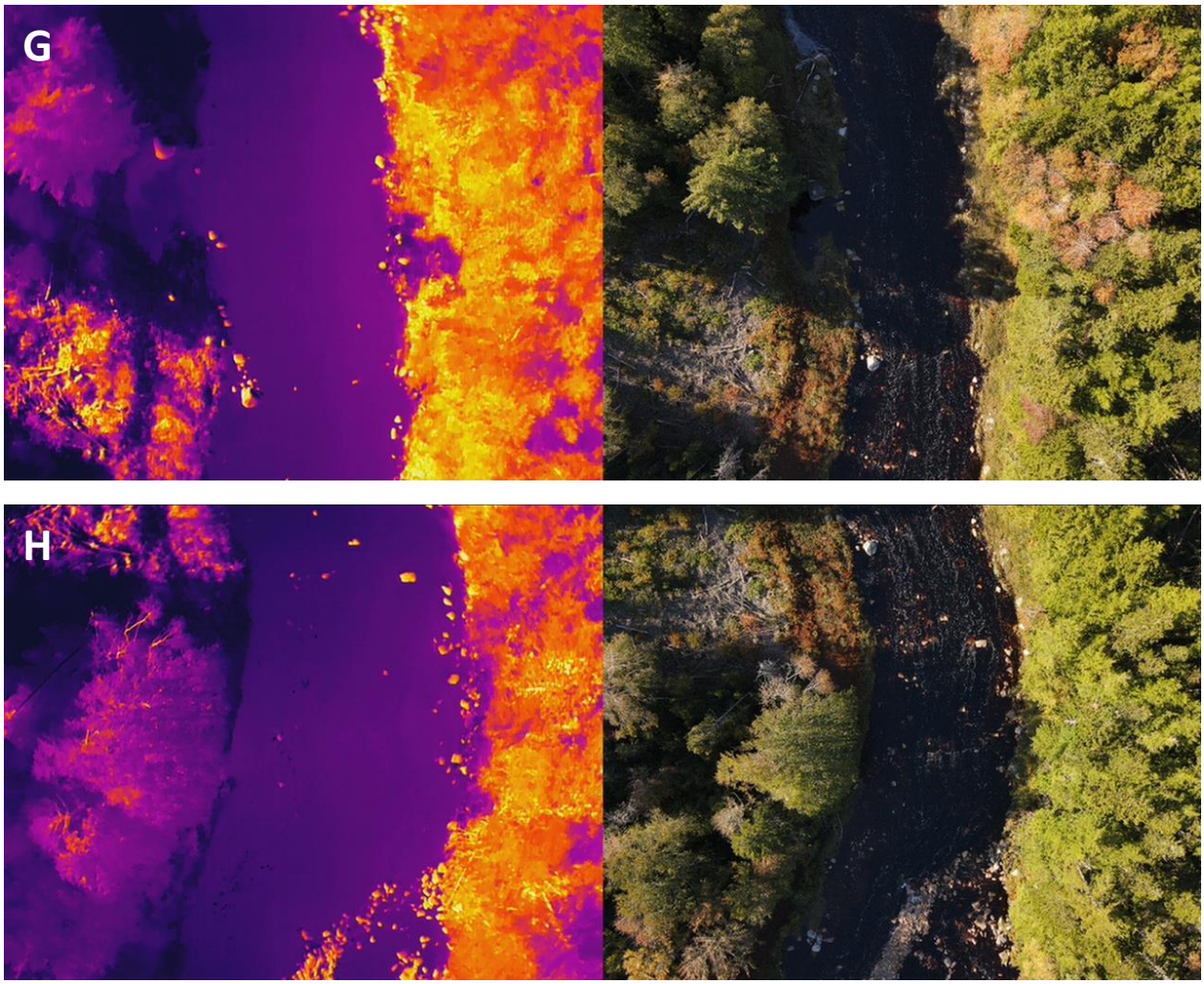


Figure 4 A - H Thermal (left) and visible (right) imagery of the site of a proposed restoration in West River Sheet Harbour. Images are ordered upstream to downstream such that 4A is the most upstream image and 4H is the most downstream image.

4.0 Summary

Habitat assessments following an established protocol were completed in West River Sheet Harbour at the site of a proposed restoration project on September 21st, 2022. Many ecosystem features that support healthy salmonid habitat, such as pools, instream cover, and sufficient thalweg depths were lacking or in poor condition. The channel was observed to be significantly over-widened in this area which likely contributed to shallow water levels which in turn were vulnerable to elevated water temperatures during the summer. With the exception of pH, water quality appeared to be suitable for aquatic biota, and sensitive benthic macroinvertebrate taxa were observed within the study area. Unfortunately, a thermal image survey of the area did not identify thermal contrast to any degree; however, visible images acquired from the survey established baseline river conditions to which post-restoration comparisons can be made. With these factors taken into consideration, the present site represents a good candidate to benefit from the implementation of instream habitat restoration structures.

Appendix I - Site Images

See attached document.

APPENDIX O – COPY OF LETTER OF CREDIT



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We must receive your written notice of a claim for damage or delay, including perishable and spoilage damage claims due to late or delayed delivery, within 21 days after we deliver your shipment and in the case of loss, shortage, mis-delivery, nondelivery, misinformation or failure to provide information, within 90 days after we accept the shipment for carriage. The right to claim damages against us shall be extinguished unless an action is brought within two years from the date of delivery of the shipment or from the date on which the shipment should have been delivered or from the date on which the carriage stopped. Within 90 days after you have notified us of your claim, it must be documented by sending us all relevant information regarding your claim. FedEx is not obligated to act on any claim until all transportation charges have been paid. The claim amount may not be deducted from these charges. 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Insofar as any provisions contained or referred to in this Agreement may be contrary to any applicable laws, government regulations, orders or requirements, such other provisions shall remain in effect as a part of this Agreement to the extent that they are not overridden. The invalidity or unenforceability of any provisions of this Agreement shall not affect any other part hereof. The parties expressly agree that this Agreement be drawn up in the English language. FEDERAL EXPRESS CANADA LTD., Head Office, 5985 Explorer Drive, Mississauga, ON L4W 5K6.

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Irrevocable Standby Letter of Credit No.: OSB62460GWS

Beneficiary:
Receiver General for Canada
on behalf of Fisheries and Oceans
Canada C/O Fisheries Protection
Program Fisheries and Oceans Canada Canada

Applicant:
Nova Scotia Power Incorporated
1223 Lower Water Street
Halifax, NS B3J 3S8 Canada

Date of Issue:
March 18, 2020

Date and Place of Expiry:
March 17, 2021 At our counter

Amount:
CAD 62,000.00 Sixty Two Thousand Canadian Dollars

Complete Beneficiary's name and address:
Receiver General for Canada on behalf of Fisheries and Oceans Canada
C/O Fisheries Protection Program
Fisheries and Oceans Canada
1 Challenger Drive,
Dartmouth, NS B2Y 4A2

Reference Number: DFO Referral File Numbers 19-W-549 and 20-HMAR-00017

We hereby authorize you to draw upon the Bank of Nova Scotia, Montreal Trade Service Centre, 1800 McGill College, 10th floor, Montreal, Quebec H3A 3K9 for the account of our Customer, Nova Scotia Power Incorporated, up to the sum total of CAD62,000.00 (Sixty Two Thousand and 00/100 Canadian Dollars) available on demand as follows:

Pursuant to the request of our Customer, we, the Bank of Nova Scotia, Montreal Trade Service Centre hereby establish and give to you an Irrevocable Standby Letter of Credit (the "Credit") in your favor in the total amount of CAD62,000.00 (Sixty Two Thousand and 00/100 Canadian Dollars). The Credit may be drawn on, by you, at any time and from time to time upon written demand by you. We will honor any such demand made by you without inquiring whether you have a right as between yourself and our Customer to make such demand and without recognizing any claim, instructions, direction or notification to the contrary from the Customer.

The Bank of Nova Scotia

Provided, however, that you are to deliver to us at such time as a written demand for payment is made upon us, a certificate purported to be signed by you, agreeing and/or confirming that monies drawn pursuant to this Credit will be retained and used by you to meet our Customer's obligations in connection with offsetting and monitoring required for completions of capital projects on the Sheet Harbour Hydro System and Sloane Lake in 2020. The original Letter of Credit must also be presented at the time for endorsement of the claim paid and will be returned to you.

It is understood and agreed that the obligation of the undersigned under this Credit is an obligation to pay money only and that in no circumstances shall the undersigned be obliged to perform or cause to perform any of our Customer's actual obligations to you.

Conditions:

- The sum total of this Credit shall be reduced from time to time as advised by written notice given to this office from time to time by you.

- The Credit will continue until March 17, 2021 and will expire at our above mentioned office address at the close of banking business on that date.

- This Credit is irrevocable until that date.

- This Credit shall be deemed to be automatically extended for one year from the present or any future expiration date hereof, unless at least thirty (30) days before any such date we give you written notice that we elect not to consider this Credit renewed for any such additional period. Upon receipt by you of such notice, you may draw upon, accompanied by written certification, the amount to be retained and used by you to meet obligations incurred or to be incurred in connection with the Authorization.

However, our Credit will not be extended beyond December 31, 2025 (the 'Final Expiry Date').

- Partial drawings on this Credit are permitted in which case the letter of Credit will be reduced by the draw amount.

- Upon successful completion of Nova Scotia Power Incorporated responsibilities under the offsetting and monitoring conditions of the Authorization, as determined by Fisheries and Oceans Canada, the original Letter of Credit shall be returned to the Bank of Nova Scotia, Montreal Trade Service Centre, 1800 McGill College, 10th floor, Montreal, Quebec H3A 3K9 for cancellation.

- This Standby Letter of Credit will be effective on March 17, 2020.

- This Standby Letter of Credit is subject to the International Chamber of Commerce (ICC) Uniform Customs and Practices for Documentary Credits, 2007 Revision, ICC Publication No. 600.

Regards,

The Bank of Nova Scotia

FERNANDO MARTINEZ

Authorised Signature(s)

ORIGINAL

APPENDIX P – ACCDC REPORT

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 7716: Ruth Falls Watershed, NS

Prepared 6 June 2023
by J. Pender, Conservation Data Analyst

CONTENTS OF REPORT

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- 1.1 Data List
- 1.2 Restrictions
- 1.3 Additional Information
- Map 1: Buffered Study Area

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- 2.1 Flora
- 2.2 Fauna
- Map 2: Flora and Fauna

3.0 Special Areas
- 3.1 Managed Areas
- 3.2 Significant Areas
- Map 3: Special Areas

4.0 Rare Species Lists
- 4.1 Fauna
- 4.2 Flora
- 4.3 Location Sensitive Species
- 4.4 Source Bibliography

5.0 Rare Species within 100 km
- 5.1 Source Bibliography



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
RuthFallsWatNS_7716ob.xls	Rare or legally-protected Flora and Fauna in your study area
RuthFallsWatNS_7716ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
RuthFallsWatNS_7716ff_py.xls	Rare Freshwater Fish in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney
Senior Scientist / Executive Director
(506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko
Zoologist
(506) 364-2660
john.klymko@accdc.ca

Data Management, GIS
James Churchill
Conservation Data Analyst / Field Biologist
(902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Financial Manager / Executive Assistant
(506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

Western: Sarah Spencer
(902) 541-0081
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-0816
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Harrison Moore
(902) 497-4119
Harrison.Moore@novascotia.ca

Eastern: Maureen Cameron-MacMillan
(902) 295-2554
Maureen.Cameron-MacMillan@novascotia.ca

Eastern: Elizabeth Walsh
(902) 563-3370
Elizabeth.Walsh@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

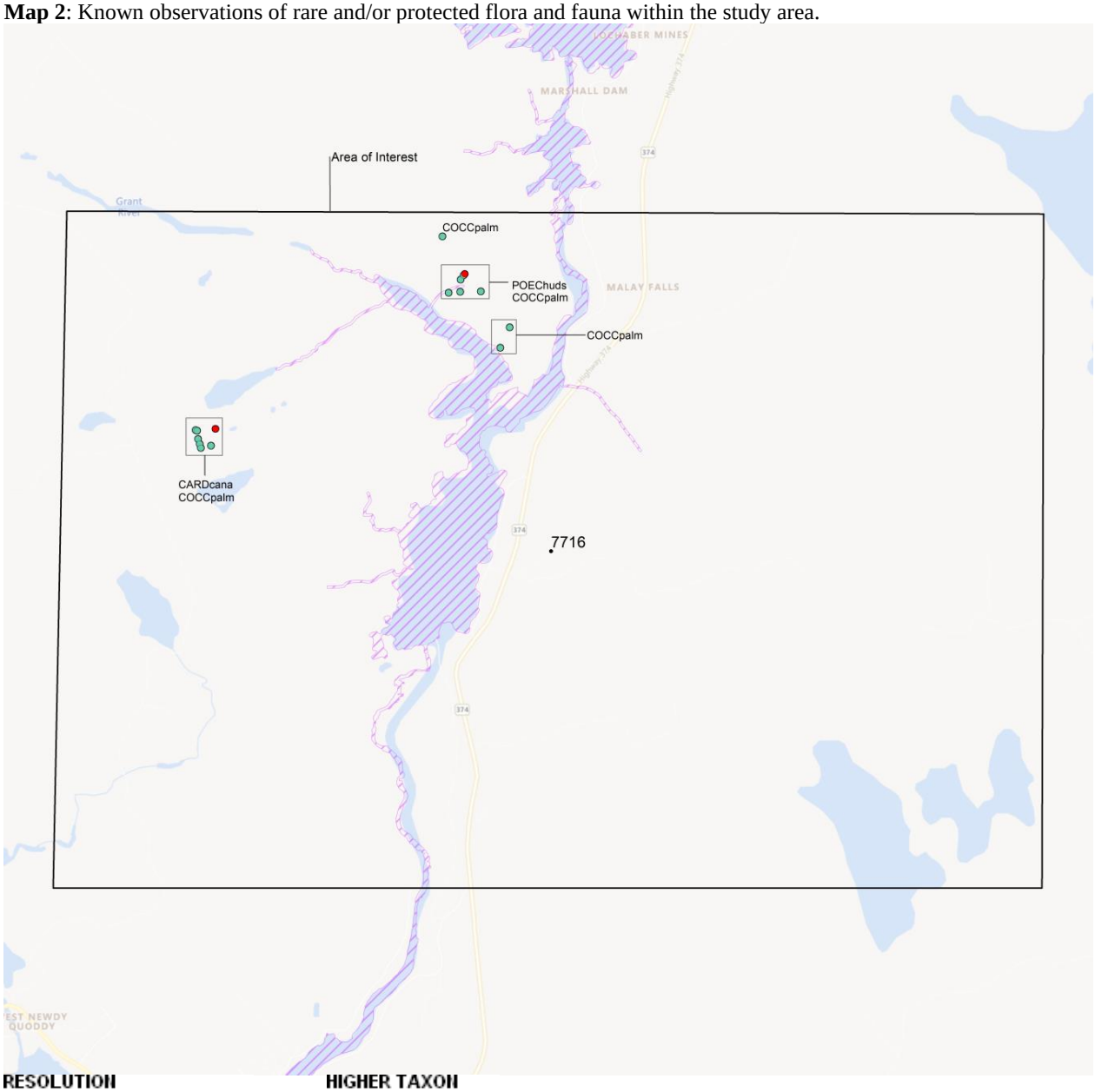
2.1 FLORA

The study area contains no records of vascular and 14 records of 1 nonvascular flora (Map 2 and attached: *ob.xls), excluding 'location-sensitive' species.

2.2 FAUNA

The study area contains 2 records of 2 vertebrate and no records of invertebrate fauna (Map 2 and attached data files - see 1.1 Data List), excluding 'location-sensitive species'. Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.

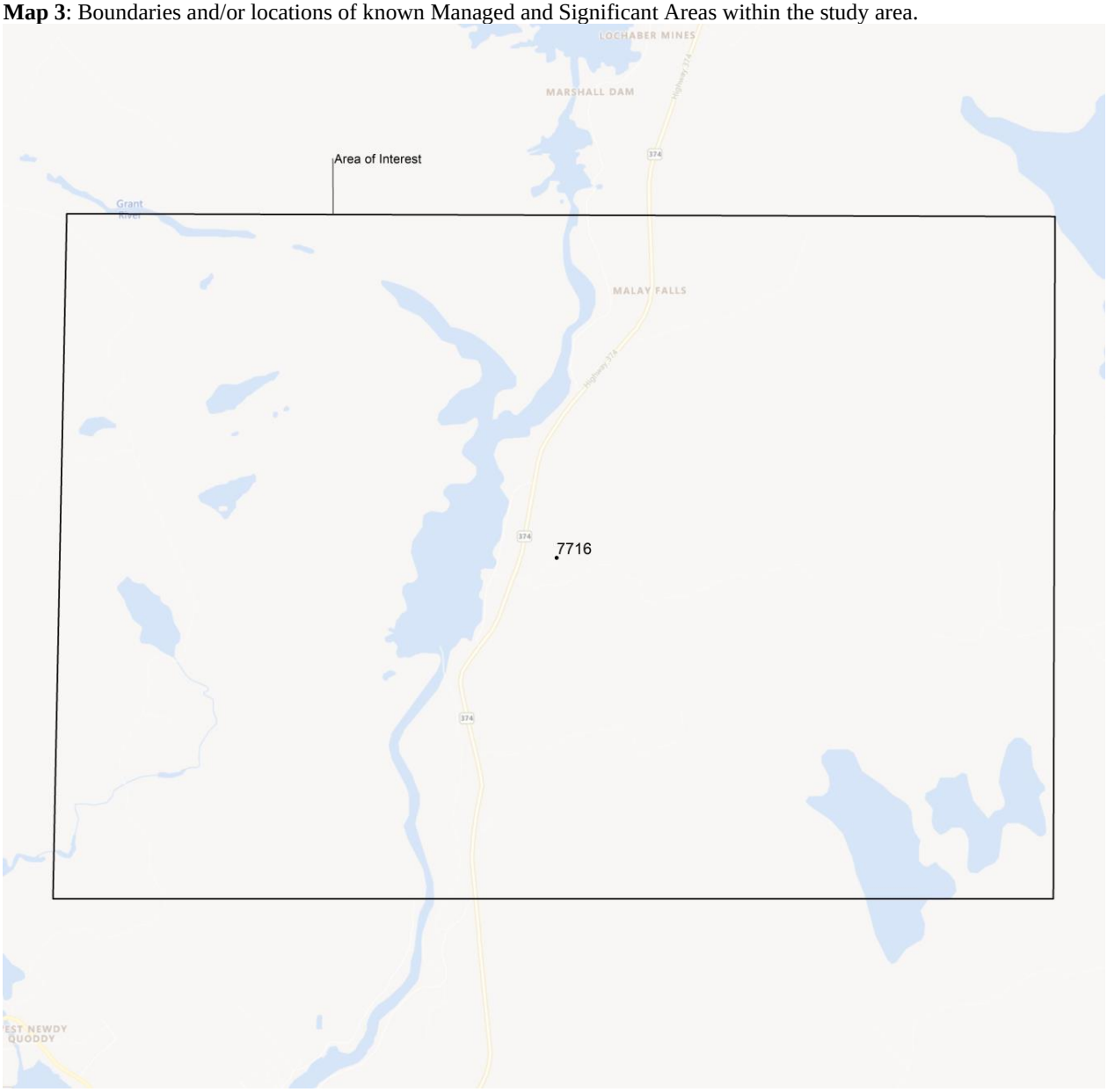


3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified no managed areas in the vicinity of the study area (Map 3).

3.2 SIGNIFICANT AREAS
The GIS scan identified no biologically significant sites in the vicinity of the study area (Map 3).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	14	1.8 ± 0.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	1	3.0 ± 0.0
A	*Poecile hudsonicus*	Boreal Chickadee				S3	1	2.5 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species "location sensitive". Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with "YES".

Nova Scotia

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Fraxinus nigra	Black Ash		Threatened	No
Emydoidea blandingii	*Blanding's Turtle - Nova Scotia pop.*	Endangered	Endangered	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.		Vulnerable	No
Bat hibernaculum or bat species occurrence		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
12	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database [as of 2018-03]. Mersey Tobeatic Research Institute.
4	Neily, T.H. 2017. Nova Scotia lichen records. Mersey Tobeatic Research Institute.
1	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 36085 records of 156 vertebrate and 1362 records of 64 invertebrate fauna; 4288 records of 234 vascular and 2565 records of 122 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including “location-sensitive” species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	51	33.9 ± 0.0	NS
A	*Myotis septentrionalis*	Northern Myotis	Endangered	Endangered	Endangered	S1	3	42.0 ± 0.0	NS
A	*Perimyotis subflavus*	Tricolored Bat	Endangered	Endangered	Endangered	S1	4	75.5 ± 0.0	NS
A	*Emydoidea blandingii*	Blanding's Turtle	Endangered	Endangered	Endangered	S1	1	96.1 ± 0.0	NS
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy population	Endangered	Endangered		S1	18	53.1 ± 0.0	NS
A	*Salmo salar pop. 6*	Atlantic Salmon - Nova Scotia Southern Upland population	Endangered			S1	43	6.2 ± 0.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus subspecies	Endangered	Endangered	Endangered	S1B	993	13.7 ± 0.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	74	11.9 ± 0.0	NS
A	*Morone saxatilis pop. 2*	Striped Bass - Bay of Fundy population	Endangered			S2S3B,S2S3N	2	74.8 ± 0.0	NS
A	*Icteria virens*	Yellow-Breasted Chat	Endangered	Endangered		SNA	21	55.8 ± 0.0	NS
A	*Lamna nasus*	Porbeagle Shark	Endangered			SNR	1	93.1 ± 1.0	NS
A	*Lasiurus cinereus*	Hoary Bat	Endangered			SUB, S1M	2	72.2 ± 0.0	NS
A	*Lasionycteris noctivagans*	Silver-haired Bat	Endangered			SUB,S1M	1	90.0 ± 0.0	NS
A	*Colinus virginianus*	Northern Bobwhite	Endangered	Endangered			2	66.2 ± 0.0	NS
A	*Asio flammeus*	Short-eared Owl	Threatened	Special Concern		S1B	9	67.9 ± 7.0	NS
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2	8514	25.7 ± 1.0	NS
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2B	966	14.4 ± 1.0	NS
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Endangered	S2S3B,S1M	733	8.2 ± 7.0	NS
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S2S3M	34	71.9 ± 0.0	NS
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened			S2S3N	2	74.1 ± 0.0	NS
A	*Hydrobates leucorhous*	Leach's Storm-Petrel	Threatened			S3B	73	14.6 ± 7.0	NS
A	*Tringa flavipes*	Lesser Yellowlegs	Threatened			S3M	575	18.2 ± 0.0	NS
A	*Anguilla rostrata*	American Eel	Threatened			S3N	71	9.5 ± 0.0	NS
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened		SHB	2	87.4 ± 0.0	NS
A	*Melanerpes lewis*	Lewis's Woodpecker	Threatened	Threatened		SNA	2	97.1 ± 0.0	NS
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened		SUB	2	93.3 ± 0.0	NS
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	36	35.8 ± 7.0	NS
A	*Salmo salar pop. 12*	Atlantic Salmon - Gaspe - Southern Gulf of St. Lawrence population	Special Concern			S1	31	61.6 ± 50.0	NS
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Special Concern	Threatened	Threatened	S1?B	11	55.9 ± 7.0	NS
A	*Passerculus sandwichensis princeps*	Ipswich Sparrow	Special Concern	Special Concern		S1B	32	19.0 ± 0.0	NS
A	*Bucephala islandica*	Barrow's Goldeneye	Special Concern	Special Concern		S1N,SUM	31	70.2 ± 0.0	NS
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	246	8.2 ± 7.0	NS
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S2S3M	7	62.8 ± 0.0	NS
A	*Morone saxatilis pop. 1*	Striped Bass - Southern Gulf of St. Lawrence population	Special Concern			S2S3N	1	86.9 ± 1.0	NS
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern population	Special Concern	Special Concern	Endangered	S2S3N,SUM	53	9.1 ± 2.0	NS
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	211	27.5 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Endangered	S3B	1048	5.9 ± 7.0	NS
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	1020	3.0 ± 0.0	NS
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Special Concern	Threatened	S3B	368	6.8 ± 7.0	NS
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Special Concern	Threatened	S3B	1001	5.9 ± 7.0	NS
A	*Dolichonyx oryzivorus*	Bobolink	Special Concern	Threatened	Vulnerable	S3B	636	36.4 ± 7.0	NS
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	630	5.9 ± 7.0	NS
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern		S3N,SUM	12	12.9 ± 0.0	NS
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	768	5.9 ± 7.0	NS
A	*Phocoena phocoena*	Harbour Porpoise	Special Concern			S4	6	15.7 ± 0.0	NS
A	*Phocoena phocoena pop. 1*	Harbour Porpoise - Northwest Atlantic Population	Special Concern			S4	1	91.9 ± 1.0	NS
A	*Chrysemys picta*	Painted Turtle	Special Concern	Special Concern		S4	26	59.8 ± 0.0	NS
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern	Special Concern		S4	117	57.8 ± 10.0	NS
A	*Calidris subruficollis*	Buff-breasted Sandpiper	Special Concern	Special Concern		SNA	5	71.9 ± 0.0	NS
A	*Zonotrichia querula*	Harris's Sparrow	Special Concern			SNA	1	90.9 ± 0.0	NS
A	*Anarhichas lupus*	Atlantic Wolffish	Special Concern	Special Concern		SNR	1	87.3 ± 0.0	NS
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1?B,SUN,SUM	18	68.7 ± 0.0	NS
A	*Fulica americana*	American Coot	Not At Risk			S1B	43	62.9 ± 0.0	NS
A	*Chlidonias niger*	Black Tern	Not At Risk			S1B	4	69.6 ± 0.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk		Vulnerable	S1B,SUM	11	53.4 ± 0.0	NS
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S2?B,SUM	12	51.5 ± 0.0	NS
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3	3	40.7 ± 100.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S3	21	31.6 ± 5.0	NS
A	*Megaptera novaeangliae*	Humpback Whale	Not At Risk			S3	1	89.3 ± 0.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	388	5.9 ± 7.0	NS
A	*Sialia sialis*	Eastern Bluebird	Not At Risk			S3B	44	45.1 ± 0.0	NS
A	*Buteo lagopus*	Rough-legged Hawk	Not At Risk			S3N	7	68.9 ± 0.0	NS
A	*Accipiter gentilis*	Northern Goshawk	Not At Risk			S3S4	108	12.2 ± 0.0	NS
A	*Glaucomys volans*	Southern Flying Squirrel	Not At Risk			S3S4	1	40.1 ± 0.0	NS
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4	3	93.7 ± 2.0	NS
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	159	15.0 ± 0.0	NS
A	*Calidris canutus rufa*	Red Knot rufa subspecies	E,SC	Endangered	Endangered	S2M	108	59.8 ± 0.0	NS
A	*Calidris canutus*	Red Knot	E,SC	E,T		S2M	7	77.3 ± 0.0	NS
A	*Morone saxatilis*	Striped Bass	E,SC			S2S3B,S2S3N	11	66.8 ± 0.0	NS
A	*Gadus morhua*	Atlantic Cod	E,SC,DD			SNR	4	59.3 ± 0.0	NS
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S1B,S1N	10	23.1 ± 0.0	NS
A	*Alces alces americana*	Moose			Endangered	S1	126	8.7 ± 0.0	NS
A	*Alces alces*	Moose				S1	7	15.3 ± 0.0	NS
A	*Picoides dorsalis*	American Three-toed Woodpecker				S1?	4	35.0 ± 7.0	NS
A	*Uria aalge*	Common Murre				S1?B	6	31.1 ± 0.0	NS
A	*Passerina cyanea*	Indigo Bunting				S1?B,SUM	22	35.0 ± 7.0	NS
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1B	1	96.9 ± 7.0	NS
A	*Oxyura jamaicensis*	Ruddy Duck				S1B	20	74.5 ± 7.0	NS
A	*Gallinula galeata*	Common Gallinule				S1B	7	68.3 ± 0.0	NS
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	9	70.9 ± 7.0	NS
A	*Mimus polyglottos*	Northern Mockingbird				S1B	30	56.8 ± 7.0	NS
A	*Toxostoma rufum*	Brown Thrasher				S1B	9	67.9 ± 7.0	NS
A	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S4M	785	17.9 ± 0.0	NS
A	*Calidris minutilla*	Least Sandpiper				S1B,S4M	484	26.5 ± 0.0	NS
A	*Anas acuta*	Northern Pintail				S1B,SUM	58	35.0 ± 7.0	NS
A	*Vireo gilvus*	Warbling Vireo				S1B,SUM	13	36.2 ± 0.0	NS
A	*Vespertilionidae sp.*	bat species				S1S2	87	3.7 ± 0.0	NS
A	*Pooecetes gramineus*	Vesper Sparrow				S1S2B,SUM	19	15.7 ± 0.0	NS
A	*Vireo philadelphicus*	Philadelphia Vireo				S2?B,SUM	37	8.2 ± 7.0	NS
A	*Alca torda*	Razorbill				S2B	7	62.8 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Fratercula arctica*	Atlantic Puffin				S2B	4	15.0 ± 7.0	NS
A	*Empidonax traillii*	Willow Flycatcher				S2B	18	35.0 ± 7.0	NS
A	*Molothrus ater*	Brown-headed Cowbird				S2B	102	5.9 ± 7.0	NS
A	*Spatula clypeata*	Northern Shoveler				S2B,SUM	25	65.7 ± 7.0	NS
A	*Mareca strepera*	Gadwall				S2B,SUM	39	42.8 ± 7.0	NS
A	*Piranga olivacea*	Scarlet Tanager				S2B,SUM	20	36.1 ± 0.0	NS
A	*Calidris alba*	Sanderling				S2N,S3M	392	17.9 ± 0.0	NS
A	*Martes americana*	American Marten			Endangered	S2S3	1	69.9 ± 0.0	NS
A	*Asio otus*	Long-eared Owl				S2S3	25	31.7 ± 0.0	NS
A	*Rallus limicola*	Virginia Rail				S2S3B	21	73.8 ± 7.0	NS
A	*Rissa tridactyla*	Black-legged Kittiwake				S2S3B	3	76.0 ± 0.0	NS
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	198	12.6 ± 0.0	NS
A	*Phalacrocorax carbo*	Great Cormorant				S2S3B,S2S3N	107	13.0 ± 0.0	NS
A	*Cathartes aura*	Turkey Vulture				S2S3B,S4S5M	60	25.4 ± 0.0	NS
A	*Setophaga pinus*	Pine Warbler				S2S3B,S4S5M	43	43.9 ± 0.0	NS
A	*Bucephala clangula*	Common Goldeneye				S2S3B,S5N,S5M	297	6.2 ± 0.0	NS
A	*Icterus galbula*	Baltimore Oriole				S2S3B,SUM	72	7.5 ± 7.0	NS
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	49	67.0 ± 0.0	NS
A	*Numenius phaeopus*	Whimbrel				S2S3M	24	29.7 ± 0.0	NS
A	*Numenius phaeopus hudsonicus*	Whimbrel				S2S3M	102	33.3 ± 0.0	NS
A	*Phalaropus fulicarius*	Red Phalarope				S2S3M	4	62.8 ± 0.0	NS
A	*Perisoreus canadensis*	Canada Jay				S3	530	5.9 ± 7.0	NS
A	*Poecile hudsonicus*	Boreal Chickadee				S3	911	2.5 ± 0.0	NS
A	*Spinus pinus*	Pine Siskin				S3	461	5.9 ± 7.0	NS
A	*Salvelinus fontinalis*	Brook Trout				S3	78	5.3 ± 0.0	NS
A	*Salvelinus namaycush*	Lake Trout				S3	2	30.0 ± 0.0	NS
A	*Pekania pennanti*	Fisher				S3	8	35.5 ± 7.0	NS
A	*Calcarius lapponicus*	Lapland Longspur				S3?N,SUM	9	15.3 ± 0.0	NS
A	*Spatula discors*	Blue-winged Teal				S3B	104	7.5 ± 7.0	NS
A	*Charadrius vociferus*	Killdeer				S3B	446	5.9 ± 7.0	NS
A	*Tringa semipalmata*	Willet				S3B	1179	5.9 ± 7.0	NS
A	*Sterna paradisaea*	Arctic Tern				S3B	76	9.0 ± 0.0	NS
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	75	6.8 ± 7.0	NS
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	175	5.9 ± 7.0	NS
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	475	5.9 ± 7.0	NS
A	*Alosa pseudoharengus*	Alewife				S3B	30	14.4 ± 0.0	NS
A	*Somateria mollissima*	Common Eider				S3B,S3M,S3N	994	5.9 ± 7.0	NS
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S4M	922	7.5 ± 7.0	NS
A	*Falco sparverius*	American Kestrel				S3B,S4S5M	318	5.9 ± 7.0	NS
A	*Gallinago delicata*	Wilson's Snipe				S3B,S5M	610	6.5 ± 0.0	NS
A	*Setophaga striata*	Blackpoll Warbler				S3B,S5M	166	5.9 ± 7.0	NS
A	*Cardellina pusilla*	Wilson's Warbler				S3B,S5M	123	5.9 ± 7.0	NS
A	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M	124	5.9 ± 7.0	NS
A	*Setophaga tigrina*	Cape May Warbler				S3B,SUM	215	3.6 ± 0.0	NS
A	*Branta bernicla*	Brant				S3M	1	87.0 ± 0.0	NS
A	*Pluvialis squatarola*	Black-bellied Plover				S3M	645	30.8 ± 0.0	NS
A	*Arenaria interpres*	Ruddy Turnstone				S3M	245	18.4 ± 0.0	NS
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	663	17.9 ± 0.0	NS
A	*Calidris melanotos*	Pectoral Sandpiper				S3M	89	53.4 ± 0.0	NS
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	441	41.8 ± 0.0	NS
A	*Chroicocephalus ridibundus*	Black-headed Gull				S3N	71	13.7 ± 0.0	NS
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	149	6.8 ± 7.0	NS
A	*Loxia curvirostra*	Red Crossbill				S3S4	163	5.9 ± 7.0	NS
A	*Botaurus lentiginosus*	American Bittern				S3S4B,S4S5M	290	6.5 ± 0.0	NS
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M	560	5.9 ± 7.0	NS
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	755	5.9 ± 7.0	NS
A	*Leiothlypis peregrina*	Tennessee Warbler				S3S4B,S5M	566	5.9 ± 7.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Passerella iliaca*	Fox Sparrow				S3S4B,S5M	115	10.5 ± 0.0	NS
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5M,S5N	336	12.5 ± 0.0	NS
A	*Calidris maritima*	Purple Sandpiper				S3S4N	60	22.3 ± 10.0	NS
A	*Lanius borealis*	Northern Shrike				S3S4N	3	45.0 ± 0.0	NS
A	*Morus bassanus*	Northern Gannet				SHB	56	15.0 ± 0.0	NS
A	*Aythya americana*	Redhead				SHB	13	53.0 ± 0.0	NS
A	*Leucophaeus atricilla*	Laughing Gull				SHB	12	26.4 ± 0.0	NS
A	*Progne subis*	Purple Martin				SHB	6	35.0 ± 7.0	NS
A	*Eremophila alpestris*	Horned Lark				SHB,S4S5N,S5M	17	15.0 ± 7.0	NS
I	*Bombus bohemicus*	Ashton Cuckoo Bumble Bee	Endangered	Endangered	Endangered	S1	24	52.9 ± 5.0	NS
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2?B,S3M	532	11.4 ± 0.0	NS
I	*Bombus suckleyi*	Suckley's Cuckoo Bumble Bee	Threatened			SH	2	76.4 ± 5.0	NS
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Threatened	S3	11	50.8 ± 0.0	NS
I	*Bombus terricola*	Yellow-banded Bumble Bee	Special Concern	Special Concern	Vulnerable	S3	84	4.2 ± 0.0	NS
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle	Special Concern		Endangered	SH	5	72.8 ± 2.0	NS
I	*Gomphurus ventricosus*	Skillet Clubtail	Special Concern	Endangered		SH	1	82.7 ± 0.0	NS
I	*Erora laeta*	Early Hairstreak				S1	1	98.0 ± 1.0	NS
I	*Pachydiplax longipennis*	Blue Dasher				S1	11	85.1 ± 0.0	NS
I	*Polygonia comma*	Eastern Comma				S1?	8	90.0 ± 0.0	NS
I	*Polygonia satyrus*	Satyr Comma				S1?	5	74.3 ± 5.0	NS
I	*Euphyes bimacula*	Two-spotted Skipper				S1S2	2	46.3 ± 0.0	NS
I	*Boloria chariclea*	Arctic Fritillary				S1S2	1	95.6 ± 2.0	NS
I	*Somatochlora brevicincta*	Quebec Emerald				S1S2	1	70.5 ± 0.0	NS
I	*Tharsalea dospassosi*	Maritime Copper				S2	12	88.3 ± 1.0	NS
I	*Satyrium acadica*	Acadian Hairstreak				S2	9	81.7 ± 2.0	NS
I	*Neurocordulia michaeli*	Broad-tailed Shadowdragon				S2	26	36.1 ± 0.0	NS
I	*Coenagrion resolutum*	Taiga Bluet				S2	2	89.8 ± 1.0	NS
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	114	22.8 ± 0.0	NS
I	*Pantala hymenaea*	Spot-Winged Glider				S2?B	7	40.1 ± 1.0	NS
I	*Nymphalis l-album*	Compton Tortoiseshell				S2S3	17	63.0 ± 0.0	NS
I	*Aglais milberti*	Milbert's Tortoiseshell				S2S3	18	68.6 ± 2.0	NS
I	*Lanthus vernalis*	Southern Pygmy Clubtail				S2S3	8	36.2 ± 0.0	NS
I	*Somatochlora kennedyi*	Kennedy's Emerald				S2S3	2	88.3 ± 1.0	NS
I	*Stylurus scudderi*	Zebra Clubtail				S2S3	4	62.5 ± 0.0	NS
I	*Alasmidonta undulata*	Triangle Floater				S2S3	24	39.5 ± 0.0	NS
I	*Strophiona nitens*	Chestnut Bark Long-horned Beetle				S3	1	98.9 ± 0.0	NS
I	*Psephenus herricki*	Herrick's Water Penny Beetle				S3	1	53.6 ± 0.0	NS
I	*Carabus serratus*	Serrated Ground Beetle				S3	1	94.1 ± 0.0	NS
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	1	89.2 ± 0.0	NS
I	*Chrysochus auratus*	Dogbane Leaf Beetle				S3	2	51.5 ± 0.0	NS
I	*Naemia seriata*	Seaside Lady Beetle				S3	4	63.8 ± 0.0	NS
I	*Elateroides lugubris*	Sapwood Ship-timber Beetle				S3	1	99.9 ± 0.0	NS
I	*Chilocorus stigma*	Twice-stabbed Lady Beetle				S3	3	79.3 ± 0.0	NS
I	*Myzia pullata*	Streaked Lady Beetle				S3	4	85.7 ± 0.0	NS
I	*Monochamus marmorator*	Balsam Fir Sawyer				S3	3	51.7 ± 0.0	NS
I	*Trachysida aspera*	Rough Flower Longhorn Beetle				S3	1	89.2 ± 0.0	NS
I	*Astylopsis sexguttata*	Six-speckled Long-horned Beetle				S3	2	91.3 ± 0.0	NS
I	*Satyrium calanus*	Banded Hairstreak				S3	29	70.5 ± 2.0	NS
I	*Callophrys lanoraieensis*	Bog Elfin				S3	4	22.1 ± 1.0	NS
I	*Strymon melinus*	Gray Hairstreak				S3	1	97.8 ± 1.0	NS
I	*Ophiogomphus mainensis*	Maine Snaketail				S3	14	36.1 ± 0.0	NS
I	*Ophiogomphus rupinsulensis*	Rusty Snaketail				S3	55	36.1 ± 0.0	NS

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I	*Epitheca princeps*	Prince Baskettail				S3	9	85.4 ± 0.0	NS
I	*Somatochlora forcipata*	Forcipate Emerald				S3	3	88.3 ± 1.0	NS
I	*Enallagma vernale*	Vernal Bluet				S3	2	66.7 ± 0.0	NS
I	*Polygonia interrogationis*	Question Mark				S3B	117	14.9 ± 0.0	NS
I	*Cecropterus pylades*	Northern Cloudywing				S3S4	26	45.2 ± 0.0	NS
I	*Amblyscirtes hegon*	Pepper and Salt Skipper				S3S4	32	37.6 ± 0.0	NS
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	3	18.6 ± 0.0	NS
I	*Argynnis aphrodite*	Aphrodite Fritillary				S3S4	23	65.3 ± 100.0	NS
I	*Polygonia faunus*	Green Comma				S3S4	19	39.0 ± 0.0	NS
I	*Oeneis jutta*	Jutta Arctic				S3S4	3	39.5 ± 0.0	NS
I	*Aeshna clepsydra*	Mottled Darner				S3S4	10	26.8 ± 1.0	NS
I	*Aeshna constricta*	Lance-Tipped Darner				S3S4	15	55.5 ± 1.0	NS
I	*Boyeria grafiana*	Ocellated Darner				S3S4	9	21.4 ± 1.0	NS
I	*Gomphaeschna furcillata*	Harlequin Darner				S3S4	10	66.7 ± 0.0	NS
I	*Erythrodiplax berenice*	Seaside Dragonlet				S3S4	6	78.8 ± 0.0	NS
I	*Nannothemis bella*	Elfin Skimmer				S3S4	6	43.5 ± 0.0	NS
I	*Sympetrum danae*	Black Meadowhawk				S3S4	4	55.9 ± 1.0	NS
I	*Amphiagrion saucium*	Eastern Red Damsel				S3S4	2	63.9 ± 0.0	NS
I	*Sphaerophoria pyrrhina*	Violaceous Globetail				SH	1	75.0 ± 5.0	NS
I	*Icaricia saepiolus*	Greenish Blue				SH	2	70.1 ± 2.0	NS
I	*Polygonia gracilis*	Hoary Comma				SH	2	68.6 ± 2.0	NS
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1	30	9.6 ± 0.0	NS
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	545	4.2 ± 0.0	NS
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened	Threatened	Threatened	S1	14	24.8 ± 0.0	NS
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	23	52.1 ± 1.0	NS
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	27	10.0 ± 0.0	NS
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S3	7	4.5 ± 0.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen	Threatened			S3	8	25.4 ± 0.0	NS
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	194	6.0 ± 0.0	NS
N	*Sclerophora peronella (Atlantic pop.)*	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S3S4	28	14.0 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	16	18.5 ± 1.0	NS
N	*Fissidens exilis*	Pygmy Pocket Moss	Not At Risk			S3	5	68.7 ± 0.0	NS
N	*Chaenotheca servitii*	Flexuous Golden Stubble	Data Deficient			S1	1	24.6 ± 1.0	NS
N	*Sematophyllum demissum*	a Moss				S1	1	90.2 ± 2.0	NS
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				S1	1	24.3 ± 0.0	NS
N	*Scytinium schraderi*	Wrinkled Jellyskin Lichen				S1	1	87.7 ± 0.0	NS
N	*Lichina confinis*	Marine Seaweed Lichen				S1	2	20.5 ± 2.0	NS
N	*Polychidium muscicola*	Eyed Mossthorns Woollybear Lichen				S1	1	38.3 ± 0.0	NS
N	*Bryoria nitidula*	Tundra Horsehair Lichen				S1	2	96.6 ± 0.0	NS
N	*Hypogymnia hultenii*	Powdered Honeycomb Lichen				S1	18	18.0 ± 0.0	NS
N	*Jubula pennsylvanica*	a liverwort				S1?	1	46.4 ± 0.0	NS
N	*Tortula obtusifolia*	a Moss				S1?	3	40.3 ± 0.0	NS
N	*Scytinium intermedium*	Forty-five Jellyskin Lichen				S1?	1	92.4 ± 4.0	NS
N	*Sematophyllum marylandicum*	a Moss				S1S2	2	87.5 ± 6.0	NS
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	1	34.9 ± 0.0	NS
N	*Haplocladium microphyllum*	Tiny-leaved Haplocladium Moss				S1S2	1	88.9 ± 5.0	NS
N	*Placidium squamulosum*	Limy Soil Stipplescale Lichen				S1S2	1	41.5 ± 6.0	NS
N	*Cladonia labradorica*	Labrador Lichen				S1S2	1	71.2 ± 0.0	NS
N	*Peltigera ponojensis*	Pale-bellied Pelt Lichen				S1S2	1	62.9 ± 0.0	NS

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N	*Parmotrema reticulatum*	Netted Ruffle Lichen				S1S2	1	88.5 ± 0.0	NS
N	*Solorina spongiosa*	Blinking Owl Lichen				S1S2	7	78.7 ± 0.0	NS
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1S2	22	11.1 ± 0.0	NS
N	*Acarospora sinopica*	a cracked lichen				S1S3	2	96.6 ± 0.0	NS
N	*Xylopsora friesii*	a Lichen				S1S3	2	93.6 ± 0.0	NS
N	*Peltigera neckeri*	Black-saddle Pelt Lichen				S1S3	2	49.9 ± 0.0	NS
N	*Stereocaulon intermedium*	Pacific Brain Foam Lichen				S1S3	1	99.1 ± 0.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2	1	95.2 ± 30.0	NS
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S2	2	86.5 ± 3.0	NS
N	*Sphagnum subnitens*	Lustrous Peat Moss				S2	1	40.2 ± 2.0	NS
N	*Nephroma arcticum*	Arctic Kidney Lichen				S2	1	96.5 ± 1.0	NS
N	*Nephroma resupinatum*	a lichen				S2	3	69.7 ± 5.0	NS
N	*Placynthium flabellosum*	Scaly Ink Lichen				S2	1	59.2 ± 17.0	NS
N	*Riccardia multifida*	Delicate Germanderwort				S2?	2	41.9 ± 0.0	NS
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S2?	2	75.7 ± 2.0	NS
N	*Drepanocladus polygamus*	Polygamous Hook Moss				S2?	2	21.4 ± 0.0	NS
N	*Kiaeria starkei*	Starke's Fork Moss				S2?	1	50.5 ± 10.0	NS
N	*Philonotis marchica*	a Moss				S2?	2	72.0 ± 0.0	NS
N	*Platydictya jungermannioides*	False Willow Moss				S2?	3	70.0 ± 0.0	NS
N	*Saelania glaucescens*	Blue Dew Moss				S2?	1	95.9 ± 0.0	NS
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2?	2	92.2 ± 5.0	NS
N	*Oxyrrhynchium hians*	Light Beaked Moss				S2S3	2	56.7 ± 25.0	NS
N	*Moelleropsis nebulosa*	Blue-gray Moss Shingle Lichen				S2S3	61	7.0 ± 0.0	NS
N	*Moelleropsis nebulosa ssp. frullaniae*	Blue-gray Moss Shingle Lichen				S2S3	3	23.2 ± 0.0	NS
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S2S3	17	20.6 ± 0.0	NS
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2S3	8	35.9 ± 0.0	NS
N	*Usnea rubicunda*	Red Beard Lichen				S2S3	4	35.0 ± 0.0	NS
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S2S3	7	10.0 ± 0.0	NS
N	*Usnocetraria oakesiana*	Yellow Band Lichen				S2S3	1	98.9 ± 0.0	NS
N	*Cetraria muricata*	Spiny Heath Lichen				S2S3	1	77.2 ± 1.0	NS
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	1	24.8 ± 0.0	NS
N	*Cladonia mateocyatha*	Mixed-up Pixie-cup				S2S3	1	99.7 ± 5.0	NS
N	*Chaenotheca gracilenta*	a lichen				S2S3	1	93.7 ± 0.0	NS
N	*Scytinium tenuissimum*	Birdnest Jellyskin Lichen				S2S3	15	40.3 ± 0.0	NS
N	*Parmelia fertilis*	Fertile Shield Lichen				S2S3	6	23.2 ± 0.0	NS
N	*Hypotrachyna minarum*	Hairless-spined Shield Lichen				S2S3	1	45.9 ± 0.0	NS
N	*Parmeliopsis ambigua*	Green Starburst Lichen				S2S3	5	50.7 ± 0.0	NS
N	*Racodium rupestre*	Rockhair Lichen				S2S3	1	100.0 ± 1.0	NS
N	*Fuscopannaria sorediata*	a Lichen				S2S3	11	19.3 ± 0.0	NS
N	*Stereocaulon condensatum*	Granular Soil Foam Lichen				S2S3	5	69.3 ± 0.0	NS
N	*Physcia subtilis*	Slender Rosette Lichen				S2S3	1	53.0 ± 0.0	NS
N	*Dimelaena oreina*	Golden Moonglow Lichen				S2S3	1	94.5 ± 0.0	NS
N	*Cladonia coccifera*	Eastern Boreal Pixie-cup Lichen				S2S3	4	25.1 ± 1.0	NS
N	*Ephemerum serratum*	a Moss				S3	2	70.9 ± 0.0	NS
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S3	3	70.9 ± 0.0	NS
N	*Anomodon tristis*	a Moss				S3	3	16.5 ± 0.0	NS
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3	3	26.3 ± 0.0	NS
N	*Rostania occultata*	Crusted Tarpaper Lichen				S3	2	43.5 ± 0.0	NS
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	10	4.2 ± 0.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S3	5	68.9 ± 2.0	NS

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N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	100	10.0 ± 0.0	NS
N	*Scytinium lichenoides*	Tattered Jellyskin Lichen				S3	29	23.2 ± 1.0	NS
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S3	1	78.0 ± 3.0	NS
N	*Nephroma bellum*	Naked Kidney Lichen				S3	5	51.1 ± 0.0	NS
N	*Placynthium nigrum*	Common Ink Lichen				S3	2	21.6 ± 10.0	NS
N	*Platismatia norvegica*	Oldgrowth Rag Lichen				S3	2	41.2 ± 0.0	NS
N	*Ephebe lanata*	Waterside Rockshag Lichen				S3	2	38.3 ± 0.0	NS
N	*Phaeophyscia adiastola*	Powder-tipped Shadow Lichen				S3	1	93.9 ± 0.0	NS
N	*Phaeophyscia pusilloides*	Pompom-tipped Shadow Lichen				S3	10	71.3 ± 0.0	NS
N	*Peltigera collina*	Tree Pelt Lichen				S3	21	12.3 ± 0.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3?	1	97.9 ± 0.0	NS
N	*Elodium blandowii*	Blandow's Bog Moss				S3?	2	83.5 ± 3.0	NS
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S3?	1	28.7 ± 0.0	NS
N	*Sphagnum riparium*	Streamside Peat Moss				S3?	2	19.0 ± 0.0	NS
N	*Cladonia stygia*	Black-footed Reindeer Lichen				S3?	5	28.1 ± 0.0	NS
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S3S4	1	93.0 ± 3.0	NS
N	*Encalypta ciliata*	Fringed Extinguisher Moss				S3S4	1	96.7 ± 2.0	NS
N	*Encalypta procera*	Slender Extinguisher Moss				S3S4	9	89.2 ± 0.0	NS
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	1	95.9 ± 0.0	NS
N	*Splachnum ampullaceum*	Cruet Dung Moss				S3S4	2	12.6 ± 0.0	NS
N	*Tomentypnum nitens*	Golden Fuzzy Fen Moss				S3S4	1	40.4 ± 2.0	NS
N	*Schistidium agassizii*	Elf Bloom Moss				S3S4	2	38.2 ± 0.0	NS
N	*Hylocomiastrum pyrenaicum*	a Feather Moss				S3S4	1	95.3 ± 0.0	NS
N	*Bryoria pseudofuscescens*	Mountain Horsehair Lichen				S3S4	1	99.3 ± 1.0	NS
N	*Enchylium tenax*	Soil Tarpaper Lichen				S3S4	7	67.8 ± 0.0	NS
N	*Sticta fuliginosa*	Peppered Moon Lichen				S3S4	51	9.5 ± 0.0	NS
N	*Arctoparmelia incurva*	Finger Ring Lichen				S3S4	69	48.3 ± 0.0	NS
N	*Scytinium teretiusculum*	Curly Jellyskin Lichen				S3S4	6	52.1 ± 0.0	NS
N	*Leptogium acadiense*	Acadian Jellyskin Lichen				S3S4	12	8.3 ± 0.0	NS
N	*Scytinium subtile*	Appressed Jellyskin Lichen				S3S4	10	11.1 ± 0.0	NS
N	*Cladonia floerkeana*	Gritty British Soldiers Lichen				S3S4	1	96.7 ± 0.0	NS
N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	1	71.1 ± 0.0	NS
N	*Heterodermia speciosa*	Powdered Fringe Lichen				S3S4	16	9.7 ± 0.0	NS
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3S4	41	10.2 ± 0.0	NS
N	*Melanohalea olivacea*	Spotted Camouflage Lichen				S3S4	2	68.5 ± 0.0	NS
N	*Parmeliopsis hyperopta*	Gray Starburst Lichen				S3S4	3	81.0 ± 1.0	NS
N	*Parmotrema perlatum*	Powdered Ruffle Lichen				S3S4	2	25.7 ± 0.0	NS
N	*Peltigera hymenina*	Cloudy Pelt Lichen				S3S4	2	12.3 ± 1.0	NS
N	*Sphaerophorus fragilis*	Fragile Coral Lichen				S3S4	5	37.6 ± 0.0	NS
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	813	1.8 ± 0.0	NS
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	6	28.4 ± 3.0	NS
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	65	10.0 ± 0.0	NS
N	*Evernia prunastri*	Valley Oakmoss Lichen				S3S4	9	65.4 ± 0.0	NS
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	59	6.0 ± 0.0	NS
P	*Clethra alnifolia*	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S2	1	91.2 ± 0.0	NS
P	*Juglans cinerea*	Butternut	Endangered	Endangered		SNA	7	67.6 ± 0.0	NS
P	*Fraxinus nigra*	Black Ash	Threatened		Threatened	S1S2	407	46.1 ± 14.0	NS
P	*Liatris spicata*	Dense Blazing Star	Threatened	Threatened		SNA	3	87.5 ± 0.0	NS
P	*Floerkea proserpinacoides*	False Mermaidweed	Not At Risk			S2S3	3	72.2 ± 7.0	NS
P	*Betula minor*	Dwarf White Birch				S1	1	55.2 ± 0.0	NS
P	*Cochlearia tridactylites*	Limestone Scurvy-grass				S1	10	23.6 ± 0.0	NS
P	*Lobelia spicata*	Pale-Spiked Lobelia				S1	1	97.2 ± 7.0	NS
P	*Hudsonia tomentosa*	Woolly Beach-heath				S1	6	76.2 ± 7.0	NS
P	*Ribes americanum*	Wild Black Currant				S1	2	77.3 ± 5.0	NS

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P	*Persicaria careyi*	Carey's Smartweed				S1	1	62.6 ± 3.0	NS
P	*Phytolacca americana*	Common Pokeweed				S1	1	92.8 ± 0.0	NS
P	*Montia fontana*	Water Blinks				S1	1	95.5 ± 1.0	NS
P	*Salix myrtillifolia*	Blueberry Willow				S1	1	55.1 ± 0.0	NS
P	*Salix serissima*	Autumn Willow				S1	2	54.8 ± 0.0	NS
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S1	1	93.2 ± 1.0	NS
P	*Carex alopecoidea*	Foxtail Sedge				S1	3	92.9 ± 0.0	NS
P	*Carex garberi*	Garber's Sedge				S1	4	67.9 ± 0.0	NS
P	*Carex plantaginea*	Plantain-Leaved Sedge				S1	4	48.0 ± 0.0	NS
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S1	1	90.6 ± 1.0	NS
P	*Carex tincta*	Tinged Sedge				S1	2	92.9 ± 0.0	NS
P	*Carex viridula var. saxilittoralis*	Greenish Sedge				S1	4	22.6 ± 0.0	NS
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	6	83.8 ± 0.0	NS
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	18	80.5 ± 0.0	NS
P	*Scirpus atrovirens*	Dark-green Bulrush				S1	1	70.2 ± 0.0	NS
P	*Iris prismatica*	Slender Blue Flag				S1	2	49.9 ± 7.0	NS
P	*Juncus vaseyi*	Vasey Rush				S1	1	69.0 ± 0.0	NS
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	1	99.6 ± 7.0	NS
P	*Elymus hystrix*	Spreading Wild Rye				S1	4	52.0 ± 1.0	NS
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	1	38.6 ± 5.0	NS
P	*Adiantum pedatum*	Northern Maidenhair Fern				S1	2	76.1 ± 0.0	NS
P	*Botrychium lunaria*	Common Moonwort				S1	10	77.1 ± 2.0	NS
P	*Solidago hispida*	Hairy Goldenrod				S1?	2	26.7 ± 7.0	NS
P	*Carex pensylvanica*	Pennsylvania Sedge				S1?	2	69.1 ± 3.0	NS
P	*Allium schoenoprasum*	Wild Chives				S1?	1	93.8 ± 0.0	NS
P	*Allium schoenoprasum var. sibiricum*	Wild Chives				S1?	1	80.1 ± 7.0	NS
P	*Sanicula odorata*	Clustered Sanicle				S1S2	4	67.5 ± 0.0	NS
P	*Ageratina altissima*	White Snakeroot				S1S2	2	88.1 ± 7.0	NS
P	*Proserpinaca intermedia*	Intermediate Mermaidweed				S1S2	1	64.1 ± 0.0	NS
P	*Anemone virginiana var. alba*	Virginia Anemone				S1S2	5	72.2 ± 5.0	NS
P	*Parnassia parviflora*	Small-flowered Grass-of-Parnassus				S1S2	1	92.2 ± 1.0	NS
P	*Carex haydenii*	Hayden's Sedge				S1S2	3	72.4 ± 0.0	NS
P	*Platanthera huronensis*	Fragrant Green Orchid				S1S2	1	70.5 ± 10.0	NS
P	*Carex vacillans*	Estuarine Sedge				S1S3	5	15.0 ± 0.0	NS
P	*Zizia aurea*	Golden Alexanders				S2	42	41.3 ± 1.0	NS
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S2	2	87.9 ± 0.0	NS
P	*Rudbeckia laciniata*	Cut-Leaved Coneflower				S2	7	50.9 ± 0.0	NS
P	*Hudsonia ericoides*	Pinebarren Golden Heather				S2	142	90.6 ± 2.0	NS
P	*Desmodium canadense*	Canada Tick-trefoil				S2	20	62.0 ± 0.0	NS
P	*Anemonastrum canadense*	Canada Anemone				S2	6	76.0 ± 0.0	NS
P	*Hepatica americana*	Round-lobed Hepatica				S2	23	52.6 ± 1.0	NS
P	*Ranunculus sceleratus*	Cursed Buttercup				S2	24	73.9 ± 0.0	NS
P	*Comandra umbellata*	Bastard's Toadflax				S2	36	91.1 ± 5.0	NS
P	*Gratiola neglecta*	Clammy Hedge-Hyssop				S2	6	58.6 ± 0.0	NS
P	*Dirca palustris*	Eastern Leatherwood				S2	5	77.1 ± 1.0	NS
P	*Carex gynocrates*	Northern Bog Sedge				S2	2	55.0 ± 0.0	NS
P	*Carex pellita*	Woolly Sedge				S2	10	39.0 ± 10.0	NS
P	*Carex livida*	Livid Sedge				S2	13	40.6 ± 0.0	NS
P	*Juncus greenei*	Greene's Rush				S2	4	87.6 ± 1.0	NS
P	*Luzula spicata*	Spiked Woodrush				S2	1	84.0 ± 0.0	NS
P	*Allium tricoccum*	Wild Leek				S2	9	72.3 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Lilium canadense*	Canada Lily				S2	98	38.5 ± 0.0	NS
P	*Cypripedium parviflorum var. pubescens*	Yellow Lady's-slipper				S2	25	84.1 ± 0.0	NS
P	*Cypripedium reginae*	Showy Lady's-Slipper				S2	29	41.3 ± 1.0	NS
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	9	72.3 ± 7.0	NS
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S2	12	58.6 ± 0.0	NS
P	*Bromus latiglumis*	Broad-Glumed Brome				S2	28	47.1 ± 0.0	NS
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S2	19	50.7 ± 0.0	NS
P	*Elymus wiegandii*	Wiegand's Wild Rye				S2	14	50.7 ± 0.0	NS
P	*Festuca subverticillata*	Nodding Fescue				S2	2	92.8 ± 1.0	NS
P	*Sparganium hyperboreum*	Northern Burreed				S2	2	71.8 ± 0.0	NS
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	9	76.3 ± 1.0	NS
P	*Crataegus submollis*	Quebec Hawthorn				S2?	3	77.5 ± 7.0	NS
P	*Carex peckii*	White-Tinged Sedge				S2?	3	70.1 ± 0.0	NS
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S2S3	1	64.6 ± 0.0	NS
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2S3	14	51.5 ± 0.0	NS
P	*Bidens hyperborea*	Estuary Beggarticks				S2S3	1	88.5 ± 1.0	NS
P	*Erigeron philadelphicus*	Philadelphia Fleabane				S2S3	3	39.8 ± 5.0	NS
P	*Lactuca hirsuta*	Hairy Lettuce				S2S3	1	69.8 ± 7.0	NS
P	*Impatiens pallida*	Pale Jewelweed				S2S3	3	64.0 ± 7.0	NS
P	*Caulophyllum thalictroides*	Blue Cohosh				S2S3	49	46.4 ± 0.0	NS
P	*Boechera stricta*	Drummond's Rockcress				S2S3	4	69.9 ± 0.0	NS
P	*Stellaria humifusa*	Saltmarsh Starwort				S2S3	5	31.3 ± 0.0	NS
P	*Oxybasis rubra*	Red Goosefoot				S2S3	5	29.5 ± 2.0	NS
P	*Hypericum majus*	Large St John's-wort				S2S3	2	92.0 ± 7.0	NS
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	3	88.6 ± 1.0	NS
P	*Empetrum atropurpureum*	Purple Crowberry				S2S3	3	91.9 ± 7.0	NS
P	*Euphorbia polygonifolia*	Seaside Spurge				S2S3	7	80.0 ± 2.0	NS
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S2S3	8	49.3 ± 0.0	NS
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	4	40.7 ± 5.0	NS
P	*Oenothera fruticosa ssp. tetragona*	Narrow-leaved Evening Primrose				S2S3	3	72.2 ± 7.0	NS
P	*Polygala polygama*	Racemed Milkwort				S2S3	1	94.2 ± 1.0	NS
P	*Polygonum aviculare ssp. buxiforme*	Box Knotweed				S2S3	2	72.5 ± 0.0	NS
P	*Polygonum oxyspermum ssp. raii*	Ray's Knotweed				S2S3	1	90.7 ± 1.0	NS
P	*Polygonum oxyspermum*	Sharp-fruit Knotweed				S2S3	1	99.1 ± 0.0	NS
P	*Rumex triangulivalvis*	Triangular-valve Dock				S2S3	1	60.6 ± 0.0	NS
P	*Primula mistassinica*	Mistassini Primrose				S2S3	17	49.3 ± 1.0	NS
P	*Anemone quinquefolia*	Wood Anemone				S2S3	21	46.0 ± 0.0	NS
P	*Caltha palustris*	Yellow Marsh Marigold				S2S3	13	76.8 ± 0.0	NS
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S2S3	1	92.9 ± 1.0	NS
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	4	83.8 ± 5.0	NS
P	*Salix pellita*	Satiny Willow				S2S3	3	58.9 ± 0.0	NS
P	*Tiarella cordifolia*	Heart-leaved Foamflower				S2S3	223	48.6 ± 7.0	NS
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S2S3	3	56.1 ± 0.0	NS
P	*Boehmeria cylindrica*	Small-spike False-nettle				S2S3	3	76.4 ± 0.0	NS
P	*Carex adusta*	Lesser Brown Sedge				S2S3	7	31.4 ± 5.0	NS
P	*Carex comosa*	Bearded Sedge				S2S3	2	88.1 ± 0.0	NS
P	*Carex houghtoniana*	Houghton's Sedge				S2S3	1	69.1 ± 1.0	NS
P	*Carex hystericina*	Porcupine Sedge				S2S3	2	93.1 ± 0.0	NS
P	*Eleocharis ovata*	Ovate Spikerush				S2S3	3	77.5 ± 0.0	NS
P	*Scirpus pedicellatus*	Stalked Bulrush				S2S3	7	53.1 ± 0.0	NS
P	*Vallisneria americana*	Wild Celery				S2S3	3	60.7 ± 1.0	NS
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S2S3	2	69.5 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Spiranthes casei*	Case's Ladies'-Tresses				S2S3	1	44.5 ± 1.0	NS
P	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses				S2S3	3	60.5 ± 0.0	NS
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2S3	22	63.4 ± 0.0	NS
P	*Potamogeton friesii*	Fries' Pondweed				S2S3	2	74.8 ± 5.0	NS
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	4	61.3 ± 5.0	NS
P	*Botrychium simplex*	Least Moonwort				S2S3	2	58.8 ± 0.0	NS
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	4	73.8 ± 7.0	NS
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S3	3	40.9 ± 2.0	NS
P	*Angelica atropurpurea*	Purple-stemmed Angelica				S3	1	54.6 ± 0.0	NS
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S3	1	71.2 ± 5.0	NS
P	*Hieracium robinsonii*	Robinson's Hawkweed				S3	3	75.1 ± 0.0	NS
P	*Senecio pseudoarnica*	Seabeach Ragwort				S3	35	5.9 ± 7.0	NS
P	*Symphyotrichum boreale*	Boreal Aster				S3	3	80.1 ± 7.0	NS
P	*Symphyotrichum undulatum*	Wavy-leaved Aster				S3	2	98.5 ± 7.0	NS
P	*Symphyotrichum ciliolatum*	Fringed Blue Aster				S3	19	47.4 ± 0.0	NS
P	*Betula michauxii*	Michaux's Dwarf Birch				S3	44	7.6 ± 7.0	NS
P	*Betula pumila*	Bog Birch				S3	3	54.8 ± 0.0	NS
P	*Cardamine parviflora*	Small-flowered Bittercress				S3	4	26.3 ± 0.0	NS
P	*Palustricodon aparinoides*	Marsh Bellflower				S3	27	49.8 ± 0.0	NS
P	*Mononeuria groenlandica*	Greenland Stitchwort				S3	51	57.3 ± 7.0	NS
P	*Sagina nodosa*	Knotted Pearlwort				S3	14	22.5 ± 0.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S3	7	20.9 ± 0.0	NS
P	*Stellaria longifolia*	Long-leaved Starwort				S3	11	50.1 ± 0.0	NS
P	*Ceratophyllum echinatum*	Prickly Hornwort				S3	3	52.2 ± 0.0	NS
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S3	112	50.6 ± 1.0	NS
P	*Viburnum edule*	Squashberry				S3	3	77.5 ± 0.0	NS
P	*Empetrum eamesii*	Pink Crowberry				S3	13	91.9 ± 7.0	NS
P	*Vaccinium uliginosum*	Alpine Bilberry				S3	3	96.7 ± 1.0	NS
P	*Halenia deflexa*	Spurred Gentian				S3	1	43.4 ± 1.0	NS
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	1	51.1 ± 0.0	NS
P	*Epilobium strictum*	Downy Willowherb				S3	3	76.6 ± 5.0	NS
P	*Polygala sanguinea*	Blood Milkwort				S3	21	7.8 ± 3.0	NS
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S3	12	40.9 ± 0.0	NS
P	*Plantago rugelii*	Rugel's Plantain				S3	7	53.0 ± 0.0	NS
P	*Samolus parviflorus*	Seaside Brookweed				S3	14	83.5 ± 1.0	NS
P	*Pyrola minor*	Lesser Pyrola				S3	1	85.1 ± 0.0	NS
P	*Anemone virginiana*	Virginia Anemone				S3	29	63.8 ± 1.0	NS
P	*Cephalanthus occidentalis*	Common Buttonbush				S3	8	93.6 ± 0.0	NS
P	*Galium labradoricum*	Labrador Bedstraw				S3	79	40.2 ± 0.0	NS
P	*Salix pedicellaris*	Bog Willow				S3	55	40.2 ± 0.0	NS
P	*Salix sericea*	Silky Willow				S3	1	85.6 ± 1.0	NS
P	*Lindernia dubia*	Yellow-seeded False Pimperel				S3	11	62.3 ± 0.0	NS
P	*Laportea canadensis*	Canada Wood Nettle				S3	37	47.1 ± 0.0	NS
P	*Pilea pumila*	Dwarf Clearweed				S3	5	67.2 ± 6.0	NS
P	*Viola nephrophylla*	Northern Bog Violet				S3	8	41.3 ± 1.0	NS
P	*Carex bebbii*	Bebb's Sedge				S3	6	71.0 ± 0.0	NS
P	*Carex castanea*	Chestnut Sedge				S3	38	48.8 ± 0.0	NS
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	6	51.3 ± 0.0	NS
P	*Carex eburnea*	Bristle-leaved Sedge				S3	34	68.4 ± 0.0	NS
P	*Carex hirtifolia*	Pubescent Sedge				S3	33	47.2 ± 0.0	NS
P	*Carex lupulina*	Hop Sedge				S3	29	50.0 ± 0.0	NS
P	*Carex rosea*	Rosy Sedge				S3	16	45.9 ± 4.0	NS
P	*Carex swanii*	Swan's Sedge				S3	3	87.0 ± 0.0	NS
P	*Carex tenera*	Tender Sedge				S3	4	71.4 ± 1.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Carex tribuloides*	Blunt Broom Sedge				S3	11	48.5 ± 5.0	NS
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	1	75.6 ± 0.0	NS
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S3	8	54.5 ± 0.0	NS
P	*Eriophorum gracile*	Slender Cottongrass				S3	4	73.8 ± 7.0	NS
P	*Schoenoplectus americanus*	Olney's Bulrush				S3	1	84.0 ± 0.0	NS
P	*Cypripedium parviflorum*	Yellow Lady's-slipper				S3	23	59.4 ± 0.0	NS
P	*Neottia bifolia*	Southern Twayblade				S3	97	13.3 ± 0.0	NS
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	142	20.6 ± 1.0	NS
P	*Platanthera hookeri*	Hooker's Orchid				S3	1	88.6 ± 0.0	NS
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S3	4	67.9 ± 7.0	NS
P	*Piptatheropsis canadensis*	Canada Ricegrass				S3	7	62.6 ± 3.0	NS
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3	11	53.4 ± 1.0	NS
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	4	47.7 ± 0.0	NS
P	*Potamogeton zosteriformis*	Flat-stemmed Pondweed				S3	13	25.8 ± 7.0	NS
P	*Dryopteris fragrans*	Fragrant Wood Fern				S3	5	44.4 ± 0.0	NS
P	*Sceptridium dissectum*	Dissected Moonwort				S3	4	54.4 ± 1.0	NS
P	*Polypodium appalachianum*	Appalachian Polypody				S3	10	45.6 ± 0.0	NS
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	2	70.4 ± 0.0	NS
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S3?	23	24.4 ± 0.0	NS
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3?	4	60.3 ± 1.0	NS
P	*Bidens vulgata*	Tall Beggarticks				S3S4	6	52.9 ± 0.0	NS
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3S4	38	72.8 ± 0.0	NS
P	*Hieracium paniculatum*	Panicled Hawkweed				S3S4	7	76.0 ± 0.0	NS
P	*Bidens beckii*	Water Beggarticks				S3S4	11	54.9 ± 0.0	NS
P	*Packera paupercula*	Balsam Groundsel				S3S4	78	62.4 ± 0.0	NS
P	*Vaccinium boreale*	Northern Blueberry				S3S4	8	30.6 ± 1.0	NS
P	*Vaccinium cespitosum*	Dwarf Bilberry				S3S4	54	36.1 ± 0.0	NS
P	*Vaccinium corymbosum*	Highbush Blueberry				S3S4	8	87.4 ± 0.0	NS
P	*Fagus grandifolia*	American Beech				S3S4	519	21.8 ± 0.0	NS
P	*Bartonia virginica*	Yellow Bartonia				S3S4	1	85.6 ± 7.0	NS
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3S4	2	37.6 ± 1.0	NS
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3S4	1	69.2 ± 2.0	NS
P	*Persicaria pensylvanica*	Pennsylvania Smartweed				S3S4	13	15.5 ± 1.0	NS
P	*Fallopia scandens*	Climbing False Buckwheat				S3S4	31	46.2 ± 0.0	NS
P	*Rumex pallidus*	Seabeach Dock				S3S4	2	56.6 ± 0.0	NS
P	*Pyrola asarifolia*	Pink Pyrola				S3S4	7	43.6 ± 0.0	NS
P	*Endotropis alnifolia*	alder-leaved buckthorn				S3S4	161	40.4 ± 1.0	NS
P	*Amelanchier spicata*	Running Serviceberry				S3S4	4	20.5 ± 0.0	NS
P	*Crataegus succulenta*	Fleshy Hawthorn				S3S4	1	93.8 ± 0.0	NS
P	*Fragaria vesca ssp. americana*	Woodland Strawberry				S3S4	63	39.3 ± 0.0	NS
P	*Fragaria vesca*	Woodland Strawberry				S3S4	11	18.4 ± 0.0	NS
P	*Galium aparine*	Common Bedstraw				S3S4	20	14.4 ± 0.0	NS
P	*Geocaulon lividum*	Northern Comandra				S3S4	17	6.0 ± 5.0	NS
P	*Limosella australis*	Southern Mudwort				S3S4	6	46.0 ± 5.0	NS
P	*Ulmus americana*	White Elm				S3S4	52	33.9 ± 0.0	NS
P	*Verbena hastata*	Blue Vervain				S3S4	114	53.2 ± 0.0	NS
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S3S4	9	58.3 ± 0.0	NS
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3S4	9	95.2 ± 0.0	NS
P	*Triglochin gaspensis*	Gasp ├⌐ Arrowgrass				S3S4	18	20.3 ± 0.0	NS
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	3	71.7 ± 0.0	NS
P	*Juncus subcaudatus*	Woods-Rush				S3S4	16	41.0 ± 1.0	NS
P	*Luzula parviflora ssp. melanocarpa*	Black-fruited Woodrush				S3S4	3	36.1 ± 0.0	NS
P	*Goodyera repens*	Lesser Rattlesnake-plantain				S3S4	1	20.6 ± 0.0	NS
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	4	58.4 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Platanthera obtusata*	Blunt-leaved Orchid				S3S4	7	15.6 ± 0.0	NS
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3S4	19	61.4 ± 0.0	NS
P	*Alopecurus aequalis*	Short-awned Foxtail				S3S4	8	71.9 ± 0.0	NS
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3S4	98	37.2 ± 0.0	NS
P	*Koeleria spicata*	Narrow False Oats				S3S4	9	62.5 ± 0.0	NS
P	*Equisetum pratense*	Meadow Horsetail				S3S4	9	68.2 ± 0.0	NS
P	*Diphasiastrum complanatum*	Northern Ground-cedar				S3S4	5	28.9 ± 0.0	NS
P	*Diphasiastrum sitchense*	Sitka Ground-cedar				S3S4	2	46.1 ± 1.0	NS
P	*Huperzia appressa*	Mountain Firmoss				S3S4	4	82.6 ± 5.0	NS
P	*Sceptridium multifidum*	Leathery Moonwort				S3S4	4	63.5 ± 0.0	NS
P	*Botrychium matricariifolium*	Daisy-leaved Moonwort				S3S4	4	78.4 ± 0.0	NS
P	*Viola canadensis*	Canada Violet				SH	1	72.2 ± 7.0	NS
P	*Greeneochloa coarctata*	Small Reedgrass				SH	1	98.2 ± 6.0	NS

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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150	Pepper, C. 2013. 2013 rare bird and plant observations in Nova Scotia. , 181 records.
148	Bryson, I. 2013. Nova Scotia rare plant records. CBCL Ltd., 180 records.
144	Bryson, I.C. 2020. Nova Scotia flora and lichen observations 2020. Nova Scotia Environment, 139 recs.
143	Newell, R.E. 2005. E.C. Smith Digital Herbarium. E.C. Smith Herbarium, Irving Biodiversity Collection, Acadia University, Web site: http://luxor.acadiau.ca/library/Herbarium/project/. 582 recs.

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139	Klymko, J. 2018. Maritimes Butterfly Atlas database. Atlantic Canada Conservation Data Centre.
135	Neily, T.H. & Pepper, C. 2020. Nova Scotia SMP lichen surveys 2020. Mersey Tobeatic Research Institute.
131	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
110	Blaney, C.S.; Mazerolle, D.M. 2012. Fieldwork 2012. Atlantic Canada Conservation Data Centre, 13,278 recs.
109	Toms, B. 2018. Bat Species data from www.batconservation.ca for Nova Scotia. Mersey Tobeatic Research Institute, 547 Records.
96	Klymko, J.J.D. 2012. Insect fieldwork & submissions, 2011. Atlantic Canada Conservation Data Centre. Sackville NB, 760 recs.
95	Cameron, R.P. 2009. Cyanolichen database. Nova Scotia Environment & Labour, 1724 recs.
92	Cameron, R.P. 2011. Lichen observations, 2011. Nova Scotia Environment & Labour, 731 recs.
91	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-03-18]. Mersey Tobeatic Research Institute.
87	McNeil, J.A. 2018. Wood Turtle records, 2018. Mersey Tobeatic Research Institute, 68 recs.
78	Staicer, C. & Bliss, S.; Achenbach, L. 2017. Occurrences of tracked breeding birds in forested wetlands. , 303 records.
78	Staicer, C. 2021. Additional compiled Nova Scotia Species at Risk bird records, 2005-2020. Dalhousie University.
76	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
73	Belliveau, A.G. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 10695 recs.
71	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
70	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
70	Munro, Marian K. Tracked lichen specimens, Nova Scotia Provincial Museum of Natural History Herbarium. Atlantic Canada Conservation Data Centre. 2019.
68	Nussey, Pat & NCC staff. 2019. AEI tracked species records, 2016-2019. Chapman, C.J. (ed.) Atlantic Canada Conservation Data Centre, 333.
67	Amirault, D.L. & McKnight, J. 2003. Piping Plover Database 1991-2003. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
66	Toms, Brad & Pepper, Chris; Neily, Tom. 2022. Nova Scotia lichen database [as of 2022-04]. Mersey Tobeatic Research Institute.
65	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
63	Hagerman, Christianne. 2022. Wisqoq and Eastern White Cedar field work. E.C. Smith Herbarium, Acadia University.
61	Richardson, Leif. 2018. Maritimes Bombus records from various sources. Richardson, Leif.
57	Birds Canada. 2022. Maritimes Swiftwatch project data for 2022. Pers. comm., 155 records.
57	Gallop, John. 2023. Species at Risk and Species of Conservation Interest records. McCallum Environmental.
55	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
54	MacDonald, E.C. 2018. Piping Plover nest records from 2010-2017. Canadian Wildlife Service.
54	Manthorne, A. 2014. MaritimesSwiftwatch Project database 2013-2014. Bird Studies Canada, Sackville NB, 326 recs.
53	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
53	iNaturalist. 2018. iNaturalist Data Export 2018. iNaturalist.org and iNaturalist.ca, Web site: 11700 recs.
53	Mazerolle, D.M. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 13515 recs.
50	MacDonald, E.C. 2018. CWS Piping Plover Census, 2010-2017. Canadian Wildlife Service, 672 recs.
49	Neily, T.H. & Pepper, C.; Toms, B. 2015. Nova Scotia lichen location database [as of 2015-02-15]. Mersey Tobeatic Research Institute, 1691 records.
49	Staicer, Cindy. 2022. 2021 Landbird Species at Risk observations. Dalhousie University.
49	Staicer, Cindy. 2023. 2022 SAR Bird field occurrences from the Landbirds at Risk Project, NS. Dalhousie University, 446 records.
48	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
46	Canadian Wildlife Service, Dartmouth. 2010. Piping Plover censuses 2007-09, 304 recs.
46	LaPaix, R.W.; Crowell, M.J.; MacDonald, M.; Neily, T.D.; Quinn, G. 2017. Stantec Nova Scotia rare plant records, 2012-2016. Stantec Consulting.
46	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
44	iNaturalist. 2020. iNaturalist butterfly records selected for the Maritimes Butterfly Atlas. iNaturalist.
43	Bryson, I. 2020. Nova Scotia and Newfoundland rare species observations, 2018-2020. Nova Scotia Environment.
42	Pulsifer, M.D. 2002. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 369 recs.
41	Benjamin, L.K. 2012. NSDNR fieldwork & consultant reports 2008-2012. Nova Scotia Dept Natural Resources, 196 recs.
40	Nova Scotia Nature Trust. 2013. Nova Scotia Nature Trust 2013 Species records. Nova Scotia Nature Trust, 95 recs.
38	Benjamin, L.K. (compiler). 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 15 spp, 224 recs.
36	Porter, C.J.M. 2014. Field work data 2007-2014. Nova Scotia Nature Trust, 96 recs.
35	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
33	Neily, T.H. 2010. Erioderma Pedicellatum records 2005-09. Mersey Tobiatic Research Institute, 67 recs.
31	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
31	Hubley, Nicole. 2022. Monarch (Danaus plexippus) records submitted to MTRI from the 2021 field season. Mersey Tobeatic Research Institute.
31	Mersey Tobetic Research Institute. 2021. 2020 Monarch records from the MTRI monitoring program. Mersey Tobetic Research Institute, 72 records.
29	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
28	Pepper, Chris. 2012. Observations of breeding Canada Warbler's along the Eastern Shore, NS. Pers. comm. to S. Blaney, Jan. 20, 28 recs.
27	Chapman-Lam, C.J. 2022. Atlantic Canada Conservation Data Centre 2021 botanical fieldwork. Atlantic Canada Conservation Data Centre, 15099 recs.
26	Belliveau, A.G. 2021. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2021. E.C. Smith Herbarium.
26	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
25	Ogden, J. NS DNR Butterfly Collection Dataset. Nova Scotia Department of Natural Resources. 2014.
24	Archibald, D.R. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 213 recs.
24	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.

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23	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
23	Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Part I, macrolepidoptera. Proceedings of the Nova Scotian Institute of Science, 23(3), 161-375.
23	LaPaix, Rich. 2022. Rare species observations, 2018-2022. Nova Scotia Nature Trust.
23	Popma, T.M. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 113 recs.
23	Staicer, Cindy. 2023. 2022 SAR Bird ARU occurrences. Dalhousie University, 379 records.
22	Cameron, R.P. 2018. Degelia plumbea records. Nova Scotia Environment.
20	Belliveau, A.G. 2020. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2019, 2020. E.C. Smith Herbarium.
20	Chapman, C.N. (Cody). 2020. Nova Scotia Black Ash (Fraxinus nigra) field observations by Confederacy of Mainland Mi'kmaq. Forestry Program, Confederacy of Mainland Mi'kmaq.
20	Haughian, Sean. 2021. Update to lichen data from 2017-2021. Nova Scotia Museum.
20	Wilhelm, S.I. et al. 2019. Colonial Waterbird Database. Canadian Wildlife Service.
19	Chapman, C.J. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 11171 recs.
19	Hall, R.A. 2001. S.. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 178 recs.
19	Klymko, J.J.D.; Robinson, S.L. 2012. 2012 field data. Atlantic Canada Conservation Data Centre, 447 recs.
18	Bell, G. 2018. Moose, bat and bird records from Goldboro LNG Project, NS, Environmental Assessment. Amec Foster Wheeler.
18	Feltham, Carter. 2022. Monarch (Danaus plexippus) and Milkweed MTRI records from the 2022 Field Season. Mersey Tobeatic Research Institute.
18	Neily, T.H. 2012. 2012 Erioderma pedicellatum records in Nova Scotia.
18	Powell, B.C. 1967. Female sexual cycles of Chrysemy spicta & Clemmys insculpta in Nova Scotia. Can. Field-Nat., 81:134-139. 26 recs.
17	Hall, R.A. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 189 recs.
15	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
15	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
15	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
15	Westwood, A., Staicer, C. 2016. Nova Scotia landbird Species at Risk observations. Dalhousie University.
14	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS, 88 recs.
14	Cameron, R.P. 2014. 2013-14 rare species field data. Nova Scotia Department of Environment, 35 recs.
14	Churchill, J.L. 2019. Atlantic Canada Conservation Data Centre Fieldwork 2019. Atlantic Canada Conservation Data Centre.
14	Gilhen, J. 1984. Amphibians & Reptiles of Nova Scotia, 1st Ed. Nova Scotia Museum, 164pp.
14	McNeil, Jeffie. 2023. 2022 Turtle Records. Mersey Tobeatic Research Institute.
14	Rock, J. 2020. Atlantic Canada Piping Plover field surveys: Nesting pairs by beach, 2018-2020. Environment and Climate Change Canada - Canadian Wildlife Service, 216 records.
14	Taylor, B.R., and Tam, J.C. 2012. Local distribution of the rare plant Triosteum aurantiacum in northeastern Nova Scotia, Canada. Rhodora, 114(960): 366-382.
14	Toms, Brad. 2022. Non-Lichen Observations from Lichen SMP and NCC Property Searches. Mersey Tobeatic Research Institute.
13	Cameron, R.P. 2017. 2017 rare species field data. Nova Scotia Environment, 64 recs.
13	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2014.
13	Ogden, K. Nova Scotia Museum butterfly specimen database. Nova Scotia Museum. 2017.
13	Robinson, S.L. 2015. 2014 field data.
12	Cameron-MacMillan, Maureen. 2020. Northern Goshawk Nests in Eastern Nova Scotia, as of November, 2020. Nova Scotia Department of Lands and Forestry.
12	Chapman, C.J. 2019. Atlantic Canada Conservation Data Centre 2019 botanical fieldwork. Atlantic Canada Conservation Data Centre, 11729 recs.
12	Chaput, G. 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-14. 39 recs.
12	Neily, T.H. 2019. Tom Neily NS Bryophyte records (2009-2013). T.H. Neily, Atlantic Canada Conservation Data Centre, 1029 specimen records.
12	White, S. 2018. Notable species sightings, 2016-2017. East Coast Aquatics.
11	Benjamin, L.K. 2011. NSDNR fieldwork & consultant reports 1997, 2009-10. Nova Scotia Dept Natural Resources, 85 recs.
11	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
11	NS DNR. 2017. Black Ash records from NS DNR Permanent Sample Plots (PSPs), 1965-2016. NS Dept of Natural Resources.
11	Patrick, Allison. 2021. Animal and plant records from NCC properties from 2019 and 2020. Nature Conservancy Canada.
11	Phinney, Lori; Toms, Brad; et. al. 2016. Bank Swallows (Riparia riparia) in Nova Scotia: inventory and assessment of colonies. Merset Tobeiatc Research Institute, 25 recs.
10	Cameron, R.P. 2013. 2013 rare species field data. Nova Scotia Department of Environment, 71 recs.
10	Neily, T.H. 2013. Email communication to Sean Blaney regarding Listera australis observations made from 2007 to 2011 in Nova Scotia. , 50.
10	Richardson, D., Anderson, F., Cameron, R, McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (Anzia colpodes). COSEWIC.
9	Cameron, R.P. 2005. Erioderma pedicellatum unpublished data. NS Dept of Environment, 9 recs.
9	Cameron, R.P. 2006. Erioderma pedicellatum 2006 field data. NS Dept of Environment, 9 recs.
9	McNeil, J.A. 2016. Blandings Turtle (Emydoidea blandingii), Eastern Ribbonsnake (Thamnophis sauritus), Wood Turtle (Glyptemys insculpta), and Snapping Turtle (Chelydra serpentina) sightings, 2016. Mersey Tobeatic Research Institute, 774 records.
9	Webster, R.P. Atlantic Forestry Centre Insect Collection, Maritimes butterfly records. Natural Resources Canada. 2014.
8	Manthorne, A. 2019. Incidental aerial insectivore observations. Birds Canada.
8	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
8	Patrick, A.; Horne, D.; Noseworthy, J. et. al. 2017. Field data for Nova Scotia and New Brunswick, 2015 and 2017. Nature Conservancy of Canada.
7	Cameron, B. 2006. Hepatica americana Survey at Scotia Mine Site in Gays River, and Discovery of Three Yellow-listed Species. Conestoga-Rovers and Associates, (a consulting firm), october 25. 7 recs.
7	Cameron, R.P. 2012. Rob Cameron 2012 vascular plant data. NS Department of Environment, 30 recs.
7	Hill, N.M. 1994. Status report on the Long's bulrush Scirpus longii in Canada. Committee on the Status of Endangered Wildlife in Canada, 7 recs.
7	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-05-25]. Mersey Tobeatic Research Institute, 668 recs.

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7	O'Neil, S. 1998. Atlantic Salmon: Northumberland Strait Nova Scotia part of SFA 18. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-08. 9 recs.
7	Robinson, S.L. 2011. 2011 ND dune survey field data. Atlantic Canada Conservation Data Centre, 2715 recs.
7	Whittam, R.M. 1999. Status Report on the Roseate Tern (update) in Canada. Committee on the Status of Endangered Wildlife in Canada, 36 recs.
6	Anderson, Frances; Neily, Tom. 2010. A Reconnaissance Level Survey of Calciphilous Lichens in Selected Karst Topography in Nova Scotia with Notes on Incidental Bryophytes. Mersey Tobeatic Research Institute.
6	Gallop, John. 2021. Sheet Harbour rare lichen observations. McCallum Environmental.
6	Hall, R. 2008. Rare plant records in old fieldbook notes from Truro area. Pers. comm. to C.S. Blaney. 6 recs, 6 recs.
6	Richardson, D., Anderson, F., Cameron, R, Pepper, C., Clayden, S. 2015. Field Work Report on the Wrinkled Shingle lichen (Pannaria lurida). COSEWIC.
5	Benjamin, L.K. 2009. Boreal Felt Lichen, Mountain Avens, Orchid and other recent records. Nova Scotia Dept Natural Resources, 105 recs.
5	Blaney, C.S. 2020. Sean Blaney 2020 field data. Atlantic Canada Conservation Data Centre, 4407 records.
5	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
5	Edsall, J. 2007. Personal Butterfly Collection: specimens collected in the Canadian Maritimes, 1961-2007. J. Edsall, unpubl. report, 137 recs.
5	Hughes, Cory. 2020. Atlantic Forestry Centre Coccinella transversoguttata collections. Canadian Forest Service, Atlantic Forestry Centre.
5	McNeil, J.A. 2020. Snapping Turtle and Eastern Painted Turtle records, 2020. Mersey Tobeatic Research Institute.
5	Plissner, J.H. & Haig, S.M. 1997. 1996 International piping plover census. US Geological Survey, Corvallis OR, 231 pp.
5	Towell, C. 2014. 2014 Northern Goshawk and Common Nighthawk email reports, NS. NS Department of Natural Resources.
5	Walker, J. 2017. Bird inventories at French River, NS, and Memramcook, NB, for Nature Conservancy of Canada. Pers. comm. to AC CDC.
5	White, S. 2019. Notable species sightings, 2018. East Coast Aquatics.
5	Whittam, R.M. 1997. Status Report on the Roseate Tern (Sterna dougallii) in Canada. Committee on the Status of Endangered Wildlife in Canada, 5 recs.
4	Bredin, K.A. 2002. NS Freshwater Mussel Fieldwork. Atlantic Canada Conservation Data Centere, 30 recs.
4	Chapman-Lam, C.J. 2021. Atlantic Canada Conservation Data Centre 2020 botanical fieldwork. Atlantic Canada Conservation Data Centre, 17309 recs.
4	Clayden, S.R. 2005. Confidential supplement to Status Report on Ghost Antler Lichen (Pseudevernia cladonia). Committee on the Status of Endangered Wildlife in Canada, 27 recs.
4	Frittaion, C. 2012. NSNT 2012 Field Observations. Nova Scotia Nature Trust, Pers comm. to S. Blaney Feb. 7, 34 recs.
4	Klymko, J. Dataset of butterfly records at the New Brunswick Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2016.
4	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database Update. Mersey Tobeatic Research Institute, 14 recs.
4	O'Neil, S. 1998. Atlantic Salmon: Eastern Shore Nova Scotia SFA 20. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-10. 4 recs.
4	Olsen, R. Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
3	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
3	Basquill, S.P. 2012. 2012 rare vascular plant field data. Nova Scotia Department of Natural Resources, 37 recs.
3	Basquill, S.P., Porter, C. 2019. Bryophyte and lichen specimens submitted to the E.C. Smith Herbarium. NS Department of Lands and Forestry.
3	Blaney, C.S. Miscellaneous specimens received by ACCDC (botany). Various persons. 2001-08.
3	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
3	Brunelle, P.-M. (compiler). 2010. ADIP/MDDS Odonata Database: NB, NS Update 1900-09. Atlantic Dragonfly Inventory Program (ADIP), 935 recs.
3	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
3	e-Butterfly. 2018. Selected Maritimes butterfly records from 2016 and 2017. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
3	Hill, N. and D. Patriquin. 2013. 2013 rare plant observations in Williams Lake Backlands area. Fern Hill Institute of Plant Conservation, Berwick, Nova Scotia, 3 records.
3	Klymko, J. Butterfly records at the Nova Scotia Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2017.
3	Mersey Tobeatic Research Institute. 2022. Nova Scotia Bobolink observations. pers. comm. to J. Churchill.
3	Neily, T.H. 2016. Email communication (May 6, 2016) to Sean Blaney regarding Fissidens exilis observations made in 2016 in Nova Scotia. Pers. Comm., 3 recs.
3	Neily, T.H. Tom Neily NS Sphagnum records (2009-2014). T.H. Neily, Atlantic Canada Conservation Data Centre. 2019.
2	Basquill, S.P. 2012. 2012 Bryophyte specimen data. Nova Scotia Department of Natural Resources, 37 recs.
2	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
2	Belliveau, A. 2013. Rare species records from Nova Scotia. Mersey Tobeatic Research Institute, 296 records. 296 recs.
2	Blaney, C.S. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 6719 recs.
2	Cameron, B. 2005. C. palmicola, E. pedicellatum records from Sixth Lake. Pers. comm. to C.S. Blaney. 3 recs, 3 recs.
2	Cameron, R.P. 2012. Additional rare plant records, 2009. , 7 recs.
2	Chapman, Cody. Unreported Species at Risk Records across Nova Scotia. Chapman, Cody, 5 records.
2	Hill, N. 2003. Floerkea proserpinacoides at Heatherdale, Antigonish Co. 2002. , Pers. comm. to C.S. Blaney. 2 recs.
2	Hill, Nick. 2021. Fraxinus nigra observations at Marshy Hope. Fern Hill Institute of Plant Conservation.
2	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
2	McAlpine, D.F. New Brunswick Museum bee specimens. New Brunswick Museum. 2013.
2	McNeil, J.A. 2019. Snapping Turtle records, 2019. Mersey Tobeatic Research Institute.
2	Nature Conservancy of Canada. 2022. NCC Field data for Nova Scotia. Nature Conservancy of Canada.
2	Neily, T.H.; Smith, C.; Whitman, E. 2011. NCC Logging Lake (Halifax Co. NS) properties baseline survey data. Nature Conservancy of Canada, 2 recs.
2	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
2	Standley, L.A. 2002. Carex haydenii in Nova Scotia. , Pers. comm. to C.S. Blaney. 4 recs.
2	Whittam, R.M. et al. 1998. Country Island Tern Restoration Project. Canadian Wildlife Service, Sackville, 2 recs.
1	Amiro, Peter G. 1998. Atlantic Salmon: Inner Bay of Fundy SFA 22 & part of SFA 23. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-12. 4 recs.
1	Bagnell, B.A. 2001. New Brunswick Bryophyte Occurrences. B&B Botanical, Sussex, 478 recs.
1	Basquill, S.P. 2011. Field observations & specimen collections, 2010. Nova Scotia Department of Natural Resources, Pers. comm. , 8 Recs.

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1	Belliveau, A.G. 2014. Plant Records from Southern and Central Nova Scotia. Atlantic Canada Conservation Data Centre, 919 recs.
1	Belliveau, A.G. E.C. Smith Herbarium Specimen Database 2019. E.C. Smith Herbarium, Acadia University. 2019.
1	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
1	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
1	Boyne, A.W. & Grecian, V.D. 1999. Tern Surveys. Canadian Wildlife Service, Sackville, unpublished data. 23 recs.
1	Brach, A.R. 2019. Correspondence to Sean Blaney regarding Calamagrostis cinnoides specimen from Halifax NS. pers. comm., Harvard University Herbaria, 1 record.
1	Bruce, J. 2014. 2014 Wood Turtle email report, Nine Mile River, NS. NS Department of Natural Resources.
1	Calhoun, J.C. Butterfly records databased at the McGuire Center for Lepidoptera and Biodiversity. Calhoun, J.C. 2020.
1	Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.
1	Clayden, S.R. 2006. Pseudevernia cladonia records. NB Museum. Pers. comm. to S. Blaney, Dec, 4 recs.
1	COSEWIC (Committee on the Status of Wildlife in Canada). 2013. COSEWIC Assessment and Status Report on the Eastern Waterfan Peltigera hydrothyria in Canada. COSEWIC, 46 pp.
1	Daury, R.W. & Bateman, M.C. 1996. The Barrow's Goldeneye (Bucephala islandica) in the Atlantic Provinces and Maine. Canadian Wildlife Service, Sackville, 47pp.
1	Docherty, Joanne. 2022. Phone call to John Klymko about Danaus plexippus observation in Nova Scotia. Personal communication.
1	Doucet, D.A. 2009. Census of Globally Rare, Endemic Butterflies of Nova Scotia Gulf of St Lawrence Salt Marshes. Nova Scotia Dept of Natural Resources, Species at Risk, 155 recs.
1	Eastman, A. 2019. Snapping Turtle observation at Brookfield, Colchester Co. NS. Halifax Field Naturalists Nova Scotia Nature Archive Facebook Page, 1 record.
1	Envirosphere Consultants Ltd., Strum. 2023. SAR records from three Environmental Assessments in Nova Scotia. Envirosphere Consultants Ltd., Strum, 48 records.
1	Golder Associates Ltd. 2021. Black Ash location from Goff's Quarry Expansion Environment Assessment, 2017. Golder Associates Ltd., 1 record.
1	Haughian, S.R. 2018. Description of Fuscopannaria leucosticta field work in 2017. New Brunswick Museum, 314 recs.
1	Heron, J. 2022. Bombus records communicated to J. Klymko over email in autumn 2022. Pers. comm.
1	Hill, N.M. 2021. Observation of Carex haydenii and black ash near Marshy Hope and Ponhook Lake. pers. comm.
1	Holder, M.L.; Kingsley, A.L. 2000. Kinglsey and Holder observations from 2000 field work.
1	Jacques Whitford Ltd. 2003. Cananda Lily location. Pers. Comm. to S. Blaney. 2pp, 1 rec, 1 rec.
1	Klymko, J. Henry Hensel's Butterfly Collection Database. Atlantic Canada Conservation Data Centre. 2016.
1	Lautenschlager, R.A. 2010. Miscellaneous observations reported to ACCDC (zoology). Pers. comm. from various persons, 2 recs.
1	MacKinnon, D.; Wright, P.; Smith, D. 2014. 2014 Common Tern email report, Eastern Passage, NS. NS Department of Environment.
1	McAlpine, D.F. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB, 241 recs.
1	McKendry, Karen. 2016. Rare species observations, 2016. Nova Scotia Nature Trust, 19 recs.
1	NatureServe Canada. 2018. iNaturalist Butterfly Data Export . iNaturalist.org and iNaturalist.ca.
1	Neily, P.D. Plant Specimens. Nova Scotia Dept Natural Resources, Truro. 2006.
1	Neily, T.H. & Pepper, C.; Toms, B. 2019. Boreal Felt Lichen Observation, April 2019. Mersey Tobeatic Research Institute.
1	Neily, T.H. & Pepper, C.; Toms, B. 2019. Boreal Felt Lichen Observation, January 2019. Mersey Tobeatic Research Institute, 1 rec.
1	Neily, T.H. 2013. Email communication to Sean Blaney regarding Agalinis paupercula observations made in 2013 in Nova Scotia. , 1 rec.
1	Payzant, P. 2018. Satyr Comma record from Bible Hill, NS. https://novascotiabutterflies.ca.
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1	Robinson, C.B. 1907. Early intervale flora of eastern Nova Scotia. Transactions of the Nova Scotia Institute of Science, 10:502-506. 1 rec.
1	Sabine, D.L. Bombus terricola specimens in Dwayne Sabine's personal collection. pers. comm. 2022.
1	Sabine, M. 2016. NB DNR staff incidental Black Ash observations. New Brunswick Department of Natural Resources.
1	Skevington, Jeffrey H. 2020. Syrphid records used for the Field Guide to the Flower Flies of Northeastern North America. Canadian National Collection of Insects.
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Data Dictionary

Revised: May 15, 2023

I. Biodiversity Database

The following fields of data may be included (and may or may not be populated) in occurrence records.
Text fields are 255 char max. (and may truncate text).

TAXONOMY		
Field	***Type***	***Definition***
MCODE	TXT	8 character 'Museum Code' (1 to 4 = genus, 5 to 8 = sp+ssp)
ELCODE	TXT	Unique Identifier of taxon
SCINAME	TXT	Global Scientific Name of taxon
COMNAME	TXT	English Common Name of taxon
NOMCOMMUN	TXT	French Common Name
LOCATION		
Field	***Type***	***Definition***
SURVEYSITE	TXT	General locality of occurrence
DIRECTIONS	TXT	Specific locality: e.g. bearings and distance from enduring landmark
SUBNAT	TXT	Province/State: 2 character ISO code
COCODE	TXT	County Code (2 chars for province + 4 chars for county name)
MAPCODE	TXT	Map number: NTS identifier in Canada
UTME20	INT	Easting in UTM Zone 20
UTMN20	INT	Northing in UTM Zone 20
LONDEC	DEC	Decimal Longitude
LATDEC	DEC	Decimal Latitude
LOCUNCM	INT	Horizontal precision in metres
PREC	DEC	Precision in metres by power of 10 (e.g. 3 = 10 to the 3rd = 1000 m = 1 km):

prec	***common speech***	***example***	***unit size***	***literal range***
6.0	within province	province	1000.0 km	562.3 - 1778.3 km
5.7	in part of province	'NW NB'	500.0 km	281.2 - 889.1 km
5.0	within in county	county	100.0 km	56.2 - 177.8 km
4.7	within 50s of kilometres		50.0 km	28.1 - 88.9 km
4.0	within 10s of kilometres	BBA grid	10.0 km	5.6 - 17.8 km
3.7	within 5s of kilometres		5.0 km	2.8 - 8.9 km
3.0	within kilometres	topo grid	1.0 km	0.6 - 1.8 km
2.7	within 500s of metres		500.0 m	281.2 - 889.1 m
2.0	within 100s of metres	ball field	100.0 m	56.2 - 177.8 m
1.7	within 50s of metres		50.0 m	28.1 - 88.9 m
1.0	within 10s of metres	boxcar	10.0 m	5.6 - 17.8 m
0.7	within 5s of metres		5.0 m	2.8 - 8.9 m
0.0	***NOT USED***	pace	1.0 m	0.6 - 1.8 m
-1.0	within 10s of centimetres	fingernail	0.1 m	0.1 - 0.2 m

RARITY / STATUS		
Field	***Type***	***Definition***
NRANK	TXT	National Rarity Rank of taxon (in Canada)
NPROT	TXT	National Protection Status of taxon (i.e., COSEWIC in Canada)
NPROTSAR	TXT	National Protection Status of taxon (i.e., SARA in Canada):

code	***Rank and short definition***
X	Extinct in Canada and elsewhere
XT	Extirpated in Canada but surviving elsewhere
E	Endangered in Canada
T	Threatened in Canada
V	Vulnerable in Canada
SC	Special Concern in Canada
DD	Data Deficient: data inadequate for assessment
NAR	Not At Risk in Canada

SRANK — TXT — Subnational (Provincial) Rarity Rank of taxon:

code	***Rank and short definition***
SX	Extinct or extirpated in province
SH	Historically occurring but currently undetected in province
S1	Extremely rare in province
S2	Rare in province

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		S3	Uncommon in province
		S4	Widespread, common and apparently secure in province
		S5	Widespread, abundant and demonstrably secure in province
		SE	Exotic in province
		SA	Accidental, infrequent and outside of range within province
		SNA	Ranking not applicable in province
		SNR	Not yet assessed in province
SPROT	TXT	Provincial Legal Protection Status	
		code	***Rank and short definition***
		Endangered	Facing imminent extirpation or extinction
		Threatened	Likely to become endangered if limiting factors are not reversed
		Vulnerable (NS)	Special concern because of characteristics that make it particularly sensitive to human activities or natural events
		Special Concern (NB)	May become a threatened or endangered species because of a combination of biological characteristics and identified threats
		Extirpated	No longer exists in the wild in the Province but exists in the wild outside of the Province
		Extinct	No longer exists
IUCN	TXT	International Union of Conservation Naturalists rarity rank:	
		code	***Rank and short definition***
		EX	Extinct: no individuals remaining
		EW	Extinct in the Wild: only captive or naturalised survivors
		CR	Critically Endangered: extreme risk of extinction in wild
		EN	Endangered: high risk of extinction in wild
		VU	Vulnerable: high risk of endangerment in wild
		NT	Near Threatened: likely to become endangered soon
		LC	Least Concern: lowest risk, widespread and abundant
		DD	Data Deficient: data inadequate for assessment
		NE	Not Evaluated, not yet assessed against criteria
OBSERVATION			
Field	***Type***	***Definition***	
OBSERVER	TXT	Individual(s) that observed the taxon	
OBDATE	TXT	Date of observation (YYYY MM DD)	
OBDATA	TXT	Concatenation of fields below, relating to observation	
OBEVID	TXT	Type of evidence (e.g., specimen, photo)	
OBCOUNT	TXT	Number of individuals at location	
OBABUN	TXT	Relative rarity of taxon at location, e.g. 'common', 'scattered'	
OBSIZE	TXT	Size of individual	
SIZE	TXT	Size of occurrence 'patch' (in m^2, ha or acres)	
OBDESC	TXT	Details of specimen appearance or conditions	
OBPHEN	TXT	Lifestage of individual (e.g., bud, flowering)	
OBSEX	TXT	Male/female if relevant	
OBACTIV	TXT	Activity of individual when observed (e.g., nesting, crossing road)	
OBASSP	TXT	Other taxa associated with the observation	
NOTETAX	TXT	Identifier's note on taxonomic issues	
GENDESC	TXT	Concatenation of fields below, relating to site	
HABITAT	TXT	Habitat characterization of location	
ECODIST	NUM	National Ecological Framework EcoDistrict identifier	
WSCODE	TXT	Quaternary Watershed identifier	
GENCOM	TXT	General Comments: concatenation of Notes (NOTE1, NOTE2, NOTE3)	
COLLECTION			
Field	***Type***	***Definition***	
CITATION	TXT	Primary source of data	
DATA MANAGEMENT			
Field	***Type***	***Definition***	
IDNUM	TXT	AC CDC record Unique ID	
EDITION	TXT	Last editor's initials and date (YYYY MM DD)	

II. Managed and Biologically Significant Areas (MSA) Database

The following fields of data may be included (and may or may not be populated) for Managed and Biologically Significant Areas.

IDENTITY AND DESCRIPTION		
Field	***Type***	***Definition***
msaGIS	INT	Unique GIS feature identifier
msaCode	TXT	Unique identifier for the MSA feature
msaClass	TXT	Whether the MSA feature is a Managed Area (MA) or biologically Significant Area (SA)

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msaName	TXT	MSA feature name
msaNameFr	TXT	MSA feature name (French)
description	TXT	Description of the MSA feature
notes	TXT	Additional notes about the MSA feature
JURISDICTION / OWNERSHIP		
Field	***Type***	***Definition***
localJuris	TXT	Mandated agency with jurisdiction over property
owner	TXT	Property owner
ownerCom	TXT	Details of multiparty arrangements
ownerDate	TXT	Date of property possession
CLASSIFICATION		
Field	***Type***	***Definition***
protStat	TXT	Activities permitted or restricted (when known)
legalAct	TXT	Title of enabling legislation
legalDate	TXT	Year of enabling legislation
estabDate	TXT	Year of site designation
aichit11	TXT	Whether the site counts towards the Aichi Target 11 and Canada Target 1 biodiversity targets (yes or no)
oecm	TXT	Other effective area-based conservation means (yes or no)
iucnCat	TXT	IUCN protected area category. For complete category descriptions, visit https://www.iucn.org/theme/protected-areas/about/protected-area-categories. Features categorized as "YES" are sites which meet the standard definition of a protected area, but the category of protection has not yet been determined and features categorized as "N/A" are other area-based conservation measures or sites that do not meet the protected area definition (2018 Canadian Protected and Conserved Areas Database (CPCAD) User Manual).
msaType	TXT	MSA feature type:

group	***Designation***
Conservation	Conservation Area
	Conservation Easement
	Fee-Simple Ownership by Environmental Non-Governmental Conservation Organization
	Land Trust Property
	Natural Area
	Nature Preserve
	Nature Reserve
	Nature Reserve and Conservation Easement
	Nature Trail
	Other Effective Area-Based Conservation Measure
	Privately Owned Conservation Area
	Privately Owned Natural Area
	Protected Area
	Protected Beach
	Protected Natural Area
	Provincially Owned Natural Area
	To be determined
Heritage	Heritage River
	Museum
	National Historic Event
	National Historic Site
	Provincial Heritage Site
	Provincial Historic Site
	Provincial Historic/Heritage Park
	UNESCO World Heritage Site
Parks	Municipal Park
	National Park
	Nature Park
	Park
	Privately Owned Park
	Provincial Park
	Provincial Park Beach
Wilderness	Ecological Reserve
	Environmentally Sensitive Area
	Significant Ecological Area
	Significant Ecological Area/International Biological Program
	Wilderness Area
	Wilderness Reserve
Wildlife	Eastern Habitat Joint Venture
	Important Bird Area (IBA)
	Marine Protected Area
	Migratory Bird Sanctuary
	National Wildlife Area
	Privately Owned Wildlife Management Area
	Provincial Wildlife Management Area

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			Wildlife Management Area
			Wildlife Park
			Wildlife Refuge
			Wildlife Reserve
			Wildlife Sanctuary
		Other	Education Area
			Experimental Area
			Federal Corrections Facility
			Fossil Site
			International Biological Program
			Memorial Site
			Other Managed Area
			RAMSAR Wetland Site
			Special Management Area
			Water Supply Area
			Watershed

LOCATION AND SPATIAL ATTRIBUTES		
Field	***Type***	***Definition***
subnat	TXT	Two-letter jurisdiction code (NB, NS, PE, NF, LB)
location	TXT	Directions to the MSA feature
biome	TXT	Whether an MSA feature falls within the terrestrial (T) or marine (M) environment
mapCode	TXT	The National Topographic System (NTS) map square the centre of the MSA feature falls within
coCode	TXT	Provincial county code (2 chars for province + 4 chars for county name)
latDec	DEC	Latitude of the centre of the MSA feature
lonDec	DEC	Longitude of the centre of the MSA feature
utmE20	INT	Easting of the centre of the MSA feature (NAD83 UTM Zone 20N)
utmN20	INT	Northing of the centre of the MSA feature (NAD83 UTM Zone 20N)
extentN	DEC	Northern extent of the MSA feature
extentS	DEC	Southern extent of the MSA feature
extentE	DEC	Eastern extent of the MSA feature
extentW	DEC	Western extent of the MSA feature
areaHa	DEC	Area of the polygon (ha)
SOURCE ATTRIBUTES		
Field	***Type***	***Definition***
sourceId	TXT	Unique ID of the MSA feature in the source dataset
jurisId	TXT	Unique ID of the MSA feature in the original dataset
srcFeatType	TXT	Whether the feature was a point (PT) or polygon feature (PY) in the source dataset. True boundaries of point MSA features are not known. Points have been buffered by 15m to be included in this MSA database
url	TXT	Associated website holding additional information about the source feature or database
bestSource	TXT	Unique identifier for the source database
citation	TXT	Primary source of data
edition	TXT	Initials and date (YYYY MM DD) pertaining to the last edit to the MSA feature

APPENDIX Q – STUDY PLAN

Sheet Harbour Hydro System
Ruth Falls Fish Passage Studies

Study Plan
July 2023

Prepared by Nova Scotia Power Inc.

1.0 Introduction

The Sheet Harbour Hydro System is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The hydro system has a drainage area of 573.9 km2. Presently there are six (6) controlled reservoirs in the hydro system including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond, and Ruth Falls Headpond. The Sloane Reservoir is located near the headwaters of Seventeen Mile Stream, which passes through Anti Dam Reservoir and into Marshall Reservoir, then into the Malay Falls Headpond. The Malay Falls power canal conducts water from to the Malay Falls Generating Station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. Fish passage on the Sheet Harbour Hydro System is facilitated by a total of six downstream fishways, one upstream fish ladder and a trap and truck arrangement at Ruth Falls. Fishways facilitating the downstream passage of fish species are located at Antidam Dam, Marshall Dam, Malay Falls Dam (2), Ruth Falls Dam and Ruth Falls louvers and bypass. The DFO requirements for flow releases and fish passage were designed with Atlantic salmon as the target species. Upstream fish passage for Atlantic salmon beyond Ruth Falls is provided through the trap and truck program. The trap and truck program utilizes a fish trap below Ruth Falls to capture adult salmon migrating upstream. Requirements are that the first 50 fish captured are placed into Ruth Falls Headpond where they have access to habitat on Grant River. Any fish surplus to this would be trapped and trucked to upstream locations determined by DFO. This was a DFO sponsored protocol designed to assess and support the salmon population.

Nova Scotia Power Inc. (NSPI) conducted several tagging studies in 2009 and 2010 to assess the effectiveness of the Ruth Falls louver system to divert fish away from the intake canal and return them to the main body of the river. These studies showed that the louver system in its current configuration is very effective at diverting pelagic species (incl. results), but much less for American eels (incl. results). As part of the Sheet Harbour Hydro System relicensing process, the Department of Fisheries and Oceans (DFO) requested that NSPI design and implement effective upstream and downstream fish passage at the Ruth Falls dam and conduct studies to assess their effectiveness. NSPI recruited the services of a recognized subject matter expert to assess the existing fish ladder and bypass setup and provide a cost-effective strategy to achieve effective upstream and downstream passage for migratory fish species, including American eels.

May 2009 NSP assessed efficiency for salmon smolts and in late September and October for American eels using pit tags and Pit tag antennas installed in the bypass. The study was limited to tracking the fish travelling through the bypass.

In 2009:

- 1082 eels were identified using the bypass
- NSP tagged 148 eels, released them upstream the below Malay Falls dam, and detected 40 travelling through the bypass representing 30% efficiency, assuming all remaining eels entered the canal (worst case scenario). This is likely an underestimate as the pit tag passive detections are not as reliable as acoustic detections.

- NSP also identified alewife (2143), speckled trout (53), yellow perch (10), white sucker (9) and even a salmon over a period of 46 days. This data also illustrates the low number of non migratory species using the bypass.

The October 2010 study was designed to assess successful outmigration of American eel. The details and results of the 2010 study including receiver and release locations are described below: American eels were captured as they travelled through the bypass. These eels were identified as mature silver (migrating) eels. DFO science conducted the surgeries implanting the pit and acoustic tags:

- On October 7, 2010: 181 eels were measured and weighed.
- On October 12, 2010: 64 eels were measured and weighed and received a pit tag; 32 eels were also surgically implanted with an acoustic transmitter.
- On October 15, 2010: 55 eels were measured and weighed and received a pit tag.
- On October 19, 2010: 318 eels travelled through the bypass; none were tagged.
- All fish tagged on October 12, 2010 were released on October 13, 2010 at 15:23 below Malay falls (lat 44.983415; lon -62.478809) Shown on Map in Figure 4 below.
- Six receivers were deployed to track the movement of eels as they migrated back down the watershed (see table below for coordinates).
- Two receivers were placed in the headpond above the canal entry and spillway, they were installed so that they could detect fish approaching either structure.
- Two receivers were placed in the canal downstream of the louvres.
- Two receivers were placed in the main body of the river below the confluence of the river and the tailrace.
- One receiver was placed in the estuary, approximately 12 kilometers below the confluence.

Full study details can be found in Appendix F – Eel Study Summary.

The recommended designs consist of significant modification and upgrade of the existing louver diversion system that would prevent most eels from entering the intake canal, as well as modifications to the existing fish ladder to increase attraction flow and modify the baffles to improve passage for alewife. An elver ladder will also be installed near the existing fish ladder to take advantage of the attraction flow. NS Power is committed to monitoring passage as it relates to dam operation. Details can be found in Appendix K – Monitoring Plan and Appendix R – Post-Construction Monitoring Plan.

NSPI is committed to implementing the proposed upgrades to the fish ladder and diversion system. This document provides an overview of the proposed study and monitoring program designed to (1) monitor the upstream migration of alewife and (2) monitor the upstream migration of elvers, and (3) assess the effectiveness of the modified louver system at diverting alewife, American eels and other resident species back to the main river.

No changes have been made to the fish ladder and louver system since 2010, therefore NSPI proposes to conduct the assessment studies following the completion of the modifications and will assume that the data collected to date represent the current efficiency of the ladder and bypass. Construction of Ruth Falls is expected to commence in July 2024 with the drawdown of the Ruth Falls Headpond. Improvements to downstream and upstream fish passage and main dam refurbishments will take place over the course of 9 months – with the recharging on the headpond occurring prior to March 2025. As such, NSPI intends to complete post-construction studies to assess the improvements after construction is complete.

2.0 Proposed 2024 Sheet Harbour Studies and Monitoring Programs

2.1 Species of interest

The data collected by NSPI over the past 20 years indicates that three migratory species are present in the watershed: alewife, Atlantic salmon, and American eels. However, the number of salmon present is extremely low, and would not be sufficient to conduct a reliable study. Furthermore, the fish ladder was designed to pass salmon and the assessment of the downstream passage was conducted with salmon and showed very high efficacy. This was confirmed by the results of the Hydraulic Modeling (Appendix G). NSPI will therefore focus the proposed studies and monitoring programs on alewife and American eels. It will be assumed that the results obtained for alewife can be extrapolated (with caution) to other pelagic species, such as salmon and trout. The ability of these species to overcome barriers is greater than that of alewife.

2.2 Upstream migration monitoring

It is worth noting here that up to 15 sets of falls are located upstream on the East River between the Hydro generating station tailrace and the Ruth Falls dam. These natural outcroppings of bedrock represent a partial barrier to alewife upstream passage, especially in periods of high flow.

Alewife

Previous monitoring studies and observations from NSPI personnel suggest that the East River alewife run consists likely of a few thousand fish; however, this is only a qualitative statement. NS Power will work with Innovasea to install two cameras in the fish ladder (one at the exit of the ladder and another at the entrance) and use AI technology to count the fish as they move through the ladder. Having two cameras installed will allow for efficiency rates to be established. A similar AI fish monitoring program has been used at Whiterock and Tusket with success. The cameras will be installed in early April to monitor the run until the end of June 2025. Daily checks of the cameras will be completed to ensure they are in good working order. Visual Observations of the fishladder will also take place daily during the run timeframe to capture any negative impacts on the fish ladder as a result of dam refurbishments.

Elvers

A new elver ramp will be installed as part of the fish ladder upgrades. The structure will be designed to include a trap which will enable NSPI to quantify the daily number of elvers ascending the ladder. This method is similar to the elver sampling conducted on the East River Chester (index river). Abundance of elvers will be measured by

wet weight, following a calibration made on the measure of a representative number of individual fish (likely 50-100; elver size is usually similar). Daily counts will take place during upstream migration season starting April 1 to June 15.

Eels use several tropisms to guide their upstream migration. Studies have shown that elvers have the ability to recognize and will preferentially select fish passage areas that have been previously used by eels. It is therefore likely and expected that a new elver ladder will not show its optimal efficiency until a chemical signature becomes detectable to the fish. This was also the case for the East River Chester elver ladder trap. NS Power will look to assess efficiency by installing a fyke net below the eel ramp and compare number of eels found in the nets to those in the sampling box.

2.3 Downstream monitoring

Study design

Downstream monitoring of migrating alewife and American eels will be conducted using High Resolution (HR) acoustic tags and hydrophones. Hydrophones are proposed to be deployed in the headpond (4), the entrance to the intake canal upstream of the louver (2), the intake canal downstream of the louver (2), and in the river downstream of the hydro plant tailrace (2) to monitor for the presence of tagged fish as they migrate down the watershed - see Figure 1and Figure 2 for details. The final configuration will be discussed and optimized with the equipment manufacturer. The headpond hydrophones will have overlapping detection ranges to create a positioning array which will help determine the path of any tagged fish in the Ruth Falls headpond.



Figure 1 Proposed hydrophone deployment locations in headpond and intake canal entrance upstream of louvres



Figure 2 Proposed hydrophone deployment locations downstream of louvres and downstream of tailrace confluence

Similar to the studies conducted in 2009 and 2010, NSPI proposed to use the bypass facility to catch sample fish. The bypass flow will be redirected through the holding facility. Captured fish will be transferred to a holding cage

placed in flowing water until processed. The selection of the most adequate location for the holding cage(s) will be based on the following considerations: safety, access, proximity to river, flow, sheltered location, etc. Fish will be held for the shortest practical duration. If required, fish will be anesthetized using either clove oil (80-100 mg/L) or Tricaine methane-sulfonate/MS-222 (100-200 mg/L) which are the most used anesthetics for fish. Once anesthetized, each fish will be measured and weighed. The use of internal and/or external tags is currently under review by NSPI and the tag manufacturer to determine the least invasive/most effective technique to track the fish. In the case of internal tags, a small incision will be performed approximately one inch above the anus and a High Resolution (HR) V3 or V7 acoustic transmitter (Innovasea) will be surgically implanted in the abdominal cavity of the fish. In the case of external tags, tracking devices are attached to a short tether which is implanted under the skin in the area of the dorsal fin. The external tags are typically smaller in size and have a smaller range and life expectancy. Bycatch information will also be recorded, including fish species, number and approximate size. Depending on the type of transmitter/receiver selected for the study, tagged fish might need be released in small batches to avoid the risk of signal collisions.

The Sheet Harbour hydro plant will be generating during the study to provide the flow in the intake canal. Timing of releases will be coordinated with the Sheet Harbour Hydro Superintendent to ensure normal operating conditions and generation.

Alewife

Sampling for alewife will start in August to coincide with downstream migration. Alewife should be manipulated as little as possible and held for only a short period. Fifty alewife will be tagged with a V3 high resolution transmitter programmed to send a transmission every two seconds. For each fish, length, weight and general status will be recorded. A similar technique was used at Whiterock with great success.

The fish will then be returned to the in-flow holding cage and allowed to recover. Recovered fish will then be released at the entrance to the canal.

American eels

Sampling for mature adult eels (silver) will start in September to coincide with a period of low barometric pressure and steady rain. Eels typically travel at night, therefore the trap will be operated and monitored overnight. Thirty eels will be anesthetized and tagged with a V3/V7 high resolution transmitter programmed to send a transmission every two seconds. For each fish, length, weight, sex and general status will be recorded. Depending on the number of eels captured and the sex ratio observed, NSPI will endeavor to tag fish with a variety of sizes and a balanced sex ratio.

The fish will then be returned to the in-flow holding cage and allowed to recover. Recovered fish will then be released at the entrance to the canal.

2.4 Data analysis and reporting

Depending on the environmental conditions, hydrophones will be recovered at least four weeks after the final fish release to ensure that all tagged fish have completed their downstream movement past the Ruth Falls dam. The exact date will depend on the timing of the American eel migration but will likely occur around the end of October. Acoustic data will be retrieved and analysed for the detections of tags.

Comparison of the data from each receiver will allow to determine for each species, the number of fish that were successfully diverted through the bypass, the number of fish that circumvented the louver system, the number of fish that returned to the headpond and the number of fish that completed their migration.

If the number of fish circumventing the louver system is high enough, a mortality rate for that species could be estimated.

NSPI will provide a report on the findings of the 2025 studies to DFO by May 1, 2026

2.5 In the case of a VPS array

Following the recovery of the hydrophones at the end of the downstream fish passage study, data will be downloaded and shared with Innovasea to perform the data processing. This process is proprietary and typically takes several weeks to complete. NS Power will then analyze the data and report on the findings.

The characterization of the behaviour of the fish through the Sheet Habour reservoir and through the generating plant during their downstream migration back to sea will be based on the reconstruction of fish movements using the acoustic Innovasea Positioning System (VPS). An analysis of the reconstructed track will help inform the behaviour of the alewife and eels as they approach the Ruth Falls dam.

NSPI will provide a report on the findings of the 2025 studies to DFO by May 1, 2026.

Fisheries and Oceans Canada | Pêches et Océans Canada

Bedford Institute of Oceanography
1 Challenger Drive
P.O. Box 1006, Station P500
Dartmouth, Nova Scotia B2Y 4A2

September 11, 2023

Our file *Notre référence*
19-HMAR-00549

Nova Scotia Power
Attention: Kailey Osborne
Environmental Scientist
PO Box 910
Halifax, NS B3J 2W5

Subject: Sheet Harbour Ruth Falls Dam Refurbishment Phase 2 – Application for a *Fisheries Act* Authorization – Incomplete or Inadequate

Dear Kailey Osborne:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) would like to acknowledge the receipt of your application for authorization under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* which was received on June 24, 2020, along with additional supporting information submissions in 2021, 2022, and 2023. We understand that you have divided the work associated with the proposed Project into two Phases and this letter is related to Phase 2. Phase 1 involved the installation of a new control building for the rubber dam and this work was completed in the summer of 2022. DFO provided a Letter of Advice (LOA) for Phase 1.

For Phase 2, we understand that you propose to:

- Refurbish the dam located at Ruth Falls within the East River – Sheet Harbour Hydroelectric System, Halifax County, Nova Scotia. Phase 2 work is proposed to include the drawdown of the headpond by 18 ft (5.5 m), replacement of 30 stop log bays with seven rubber dams and a free overflow spillway section, and reface concrete on the dam and spillways.
- The work is anticipated to take 8 to 9 months to complete and proposed to occur from July 2024 to late March 2025.
- During the construction period, the Ruth Falls fish ladder will not be operational, reservoir operating requirements will not be maintained, and supplemental flows will not be provided. However, fish passage and ecological maintenance flows will be provided during the construction period via the newly installed vertical lift gates.

- Water levels at Marshall Falls, upstream of Ruth Falls, will not be impacted by the activity.

Our review considered the following information:

- Fisheries and Oceans Canada Request for Review and attached information, received via email from NS Power on December 2, 2019;
- Nova Scotia Environment Application for Approval and supporting documentation, received December 27, 2019;
- Correspondence regarding additional information requested, received via email from NS Power on February 27, 2020;
- *Fisheries Act* Authorization application and supporting documents, received via email from NS Power on June 24, 2020;
- Supplemental information, received via email May 20, 2021;
- Correspondence regarding changes to the scope of work and timelines, received via email from NS Power on July 6, 2021;
- Supporting Information (with updated scope and timeline and new breakdown into Phase 1 and Phase 2), received via email January 21, 2022;
- Wetland and Wetland Fish Habitat Report, Strum, dated February 4, 2022, received via email February 4, 2022;
- Project Environmental Description Addendum for NSECC, received via email February 14, 2022;
- Fish Entrainment Monitoring Program - Field Plan, Stantec, dated March 24, 2022, received via email March 31, 2022;
- Meeting with NS Power on May 4, 2022;
- Site visit to the Ruth Falls dam on March 7, 2023; and
- *Fisheries Act* Authorization application and supporting documents, received via email from NS Power on July 14, 2023.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the *Aquatic Invasive Species Regulations*.

The aforementioned outcomes are prohibited unless authorized under their respective legislation and regulations.

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Upon reviewing your application, the Program determined that some of the information and documentation set out in the *Authorizations Concerning Fish and Fish Habitat Protection Regulations* (the Regulations) has not been provided and as such, the application is incomplete or inadequate.

The revised application for *Fisheries Act* authorization is to be a complete standalone application that does not reference previous submissions and that includes:

- a completed Application for Authorization under Paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* Form (http://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/authorization-autorisation-eng.html);
- the required information and documentation set out in the Authorizations Concerning Fish and Fish Habitat Protection Regulations (http://laws-lois.justice.gc.ca/eng/regulations/SOR-2013-191/page-1.html)*; and
- includes the information and documentation requirements described in the letter below based on review of your previous submissions to consider the application to be complete, along with a concordance table that provides the section and page numbers where each of the information requirements below are addressed along with other proposed changes to the proposed project.

*Note: The letter of credit previously provided as part of this application expired on March 21, 2021. Therefore, a new irrevocable letter of credit issued by a recognized Canadian financial institution, or another equivalent financial guarantee, including a performance bond, is required to cover the costs of implementing offsetting plans.

The following information and documentation is required in order for the application to be complete:

Description of Proposed Work, Undertaking or Activity

- Provide further information on the drawdown at Ruth Falls to describe whether the discharge below the dam associated with the drawdown would exceed spill conditions at the dam that occur under normal operations, and if so, by what extent.

Current and Proposed Facility Operation

- Provide further information on the low supply level of 27.5 m (90.1') and how that elevation factors into water management (e.g., does NS Power operate to the low supply level of 27.5 m (90.1') during the Nov. 30 – April 1 time period annually?).
- Provide the vertical lift gate opening value(s) that will provide 65 cfs to the East River Sheet Harbour downstream of the dam, and describe which gate(s) is/are being proposed for providing these flows.

Eel Study

- It is noted that NS Power completed tagging studies to assess the downstream movement of Atlantic Salmon smolts and American Eel at the Ruth Falls Dam in 2009 and 2010. Results are provided for American Eel, but not Atlantic Salmon. Provide results from the Atlantic Salmon monitoring, including efficiency of downstream passage and survival.
- NS Power notes, "Based on 2009 study, the louvre system and associated bypass is very effective for pelagic species such as alewife and trout." Provide fish passage efficiency results to support this statement, as the catch data cited in the document only provides information on the number of fish caught by species during the monitoring period and does not support the statement that the bypass is "very effective for pelagic species."

Description of Effects on Fish and Fish Habitat

- NS Power notes, "Measures will be put in place to facilitate downstream migration of fish during construction. During the time the water is drawn down, NS Power intends to provide free passage of fish through the center sluice gate during construction as the canal and fish ladder will also be dewatered. The exception to this is when the center sluice gate will be under construction, which we anticipate to be 3-4 weeks during which time the water will be directed through either the west or east bay. Upstream fish passage will not be available during the 2024 construction season after July 10th." Clarify the last sentence, as NS Power notes that fish passage will be provided through the centre sluice gate or via the deep stoplog bays located in the center of the dam elsewhere throughout the application, and provide further information on proposed gate openings (e.g., proposed gates, amount gates will be open, gate opening relative to drawdown water level elevation, etc.).
- Qualified fish passage professional to assess and describe whether there will be any obstructions (e.g., sills, rock ledges, excessive velocities, gate opening amounts, etc.) or gate opening restrictions to upstream or downstream fish passage through proposed gates that will be used during the drawdown period fish species likely to be migrating on the East River.

Downstream Louvre System Improvements

- NS Power notes, "Upon completion of the proposed improvements to the louvre system, NS Power is committed to completing an eel pit-tagging study to assess how the changes impact the downward migration of eels. The details can be found in Appendix K – Monitoring Plan and Appendix Q – Study Plan." Reference is only made to American Eel in the main body of the application (Section 12.2.2), and Appendix K and Q reference tagging of American Eel and Alewife. Update the main body of the text to note American Eel and Alewife will be assessed, and provide detailed monitoring methods on how downstream fish passage will be assessed for other fish species and life stages, including but not limited to juvenile Gaspereau (Alewife and Blueback Herring), that are likely to be migrating on the system.

Proposed Fish Ladder Improvements

- Provide detailed design drawing of the existing upper technical fishway.

- Provide the proposed water depth over each weir and the drops between each weir in the existing upper technical fish ladder. Measurements to be taken at the base of each notch.
- Provide detailed design drawing of the inlet to the existing upper technical fish ladder.
- Provide detailed profile of weirs 10 and 11 in proposed/updated lower fish ladder.

Appendix K, Monitoring Plan

- NS Power states, "the East River watershed Ruth provides approximately 3 km of suitable freshwater habitat below the Ruth Falls dam and accordingly, NSP considers that entrainment of juvenile and adult fish below the Ruth Falls dam does not necessarily constitute harm or loss of fish." It is important to note that juvenile Alewives will be entrained from preferred lentic rearing habitat into high gradient lotic habitat or estuarine marine habitat prematurely; therefore, juvenile survival is reasonably assumed to be lower than if those fish remained in their preferred lentic rearing habitat. As a result, DFO will be taking a precautionary approach and requiring NS Power to initially propose offsetting for at least 50 % of juvenile Alewives and potentially other fish species entrained from the reservoir. DFO will require further offsetting if monitoring results are inconclusive or assumptions on survival are not validated by scientific literature. Provide further offsetting for estimated death of fish associated with entrainment mortality as part of your application. Offsetting can be later adjusted or offsetting credits can be applied to another NS Power project if monitoring results clearly demonstrate results different from those proposed in the application.
- NS Power states, "NS Power will engage Innovasea to install and operate one AI camera placed at the exit of the Ruth Falls fish ladder. The camera will be in operation between April 1 and June 15 in 2025, and 2026." Provide a summary of the data that will be provided as part of this AI camera system, including what species will be detected and how counts or estimates of fish passing through the fishway will be obtained. Also clarify if 1 or 2 cameras will be installed as Appendix Q references the installation of 2 Innovasea cameras (i.e., one at the exit and one at the entrance of the ladder).
- NS Power states upstream fish passage monitoring and daily inspections will occur between April 1 and June 15 in 2025 and 2026. This monitoring range should be expanded if fish migrations are observed to be occurring beyond this time period. Please update the text to reflect this adjustment.
- NS Power states, "Upon completion of the proposed improvements to the louvre system, NS Power is committed to completing a tagging study to assess how the changes impact the downward migration of eels. The results of this study will be used to inform successful improvements to the louvre system. A similar baseline study was conducted in 2010 which will be used to compare the results and demonstrate improvements to the louvres being able to convert all species away from the powerhouse to the bypass pipe. Sampling for alewife will also be completed to assess the effectiveness of the louvre system for diverting pelagic fish. The study will be conducted in 2025." No reference is made to juvenile Gaspereau or other fish species that are likely to be migrating on the system, therefore, update the plan to include how other species will be assessed.
    - NS Power will be required to implement avoidance and mitigation measures at Ruth Falls to avoid (and possibly offset) the death of fish associated with hydroelectric operations. As previous monitoring of the Ruth Falls louvers has

shown them to be ≤ 30 % effective at diverting out-migrating silver American Eel from the power canal, and turbine survival rates of approximately 62% were estimated, NS Power will need to make and demonstrate significant fish passage improvements to avoid the death of fish or further mitigation could be required by the Department, including additional offsetting, power generation shut-downs, or significant infrastructure upgrades.

Wetland and Wetland Fish Habitat Monitoring Plan, Strum, dated December 14, 2022

- Wetlands can provide both direct and indirect benefits to fish and fish habitat. Describe how wetlands providing indirect benefits to fish habitat will be assessed to determine offsetting requirements.
- The backshore definition mentions it is considered "not fish habitat". Describe if field studies will be conducted to confirm if this is accurate and whether indirect benefits to fish habitat are being considered in the backshore.
- Describe in the wetland monitoring plan (Appendix M) and the Monitoring Plan (Appendix K) how NS Power will determine the duration of time wetlands deemed to be fish habitat will be impacted by the drawdown to inform offsetting requirements for this project (i.e., describe how long will it take wetlands impacted by the drawdown to re-establish to their full fish habitat functions).

Fish Entrainment Monitoring Program - Field Plan (Stantec, dated January 31, 2023)

- The plan references 4-day and 10-day reservoir drawdown periods, whereas a 8-day drawdown period is referenced elsewhere throughout the application. Update the study plan to reflect the correct proposed drawdown period, and proofread the document and correct other errors to ensure consistency with the application and proposed plans (e.g., correct river, correct equipment, etc.)
- The plan states, "An entrainment estimate for YoY gaspereau will be calculated using the average fish densities (fish/m^3) from the rotary screw trap and the daily discharge (m^3) through the dam as provided by NS Power." However, earlier in the report it is noted that no suitable locations were identified for the installation of a rotary screw trap and proposes the use of bongo nets and methods associated with that equipment. The plan also acknowledges bias in entrainment estimates with only sampling during the 0600-2100 time period. Update the plan to reflect how entrainment estimates will be obtained using proposed sampling equipment and how bias will be addressed from not sampling the catch during overnight hours (e.g., 2100 – 0600 hrs).
- Section 3.2, page 6. Describe in the study plan how the sampling equipment will be modified or moved if low catches occur as a result of poor placement of the sampling equipment or changing water levels.

Appendix Q - Ruth Falls Fish Passage Studies

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- In this Appendix, NS Power notes that two cameras will be installed in the fish ladder (i.e., at entrance and exit), however, only 1 camera is referenced earlier in the application. Correct this discrepancy in the document.
- The plan references tagging adult Alewife and American Eel. Describe how the effectiveness of the louvers for juvenile Gaspereau and other fish species will be assessed.

Upon receipt of this outstanding information and documentation, the Program will notify you to confirm receipt. The Program will notify you as to whether the application is complete within a period of 60 days after receiving this outstanding information and documentation.

If you have any questions, please contact Kelley Fraser at our Dartmouth office at 902-441-3671 or by email at kelley.fraser@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Levy, Alexander
Digitally signed by Levy, Alexander
Date: 2023.09.11 10:41:51 -03'00'

Alex Levy
Section Head, Freshwater Development
Ecosystem Management-Regulatory Reviews

Cc: Erik Van Lunen, Environment Inspector, NSECC

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SUPPORTING INFORMATION – APPLICATION FOR AUTHORIZATION - *FISHERIES ACT* – RUTH FALLS DAM REFURBISHMENT SHEET HARBOUR HYDRO SYSTEM

December 2023

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1.0 CONTACT INFORMATION

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2.0 PROJECT OVERVIEW

Nova Scotia (NS) Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2024. This work is necessary to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the spillway/sluiceway structures. The reservoir is contained by a 190 m (620 ft) long earthfill embankment and a 150 m (490 ft) long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, two short concrete gravity bulkhead sections that abut either side of the spillway. There is currently a 15.2 m (50 ft) long three-bay stoplog-controlled sluiceway section in the centre of the dam. The crest elevation of the spillway is 31.7 m (104 ft) and stoplogs can be installed to an elevation of 33.3 m (109.3'). The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the power canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix A for mapping of the Sheet Harbour Hydro System and Appendix B for site photos.

NS Power has provided several iterations of the Ruth Falls Dam Refurbishment Project Fisheries Act Authorization Application (19-HMAR-00549) to DFO since the first request for review in December 2019. The scope and timeline of the project has been adjusted several times with a separate approval received for the refurbishment of the sluiceway/installation of the vertical lift gates and control building in advance of the main dam refurbishment under Nova Scotia Department of Environment and Climate Change (NSECC) approval (and Department of Fisheries and Oceans (DFO) Letter of Advice) 2021-2840307-00 in October 2021. In June 2022, NS Power made the decision to proceed with aspects of approval 2021-2840307-00, but not the sluiceway refurbishment. An amended approval was received in September 2022 (2021-2840307-01) excluding the sluiceway refurbishment/vertical lift gate scope - to complete the scope associated with the new control building. A timeline of the regulatory process is provided below:

Main Dam Refurbishment Application 19-HMAR-00549

- NS Power Request for Review Submission December 2, 2019
- DFO Request for Additional Information Received January 9, 2020
- NS Power Additional Information Request Submission February 27, 2020
- DFO Authorization Required Letter Received March 13, 2020
- NS Power Initial Fisheries Act Authorization (FAA) Application Submission June 24, 2020
- DFO Incomplete Letter Received August 4, 2020

- NS Power Updated Submission May 8, 2021
- DFO Acknowledgement of Additional Information Received May 20, 2021
- DFO Incomplete Letter Received July 8, 2021
- NS Power Updated Submission January 21, 2022
- DFO Incomplete Letter Received May 5, 2022
- NS Power Update Letter Submission May 16, 2022
- NS Power Updated Submission June 24, 2023
- DFO Incomplete Letter Received September 11, 2023

Vertical Lift Gate / Control Building Approval: NSECC Approval 2021-2840307-00

- NS Power Initial Submission July 12, 2021
- NSECC / DFO Letter of Advice Approval Received October 22, 2021
- NS Power Amendment Submission July 11, 2022
- NSECC Amended Approval Received September 5, 2022

Previous applications as noted above reference construction taking place in a phased approach, with phase I including new control building with Ruth Headpond at normal operating levels, and phase II including a drawdown of Ruth Headpond and refurbishment of the remaining dam structure. Phasing of construction is no longer required for the purposes of this application (2019-2638165-00). Work related to the control building was completed in 2022 under approval Approval 2021-2840307-00, which has been closed.

This document provides an updated project and environmental description to support NS Power's Fisheries Act Authorization 19-HMAR-00549 for the Project and supersedes previous iterations submitted to DFO. The information in this document is intended to address DFO's most recent incomplete letter, issued to NS Power on September 11, 2023. This project and environmental description is also intended to address all questions and information requests previously directed to NS Power in incomplete letters issued by DFO for application 19-HMAR-00549 as outlined above. Therefore, NS Power assumes that all previous incomplete letters are no longer relevant, and any remaining questions or information requests will be directed to NS Power through a new incomplete letter, if required.

Further, NS Power assumes that, given the information in this document has been provided to DFO several times and DFO has had adequate time to review and request additional information (as demonstrated through several incomplete letters for this application), any further information requests will be pertaining only to new information that has not been previously reviewed by DFO.

3.0 DESCRIPTION OF PROPOSED WORK, UNDERTAKING OR ACTIVITY

3.1 Construction Activities

The project involves the replacement of the existing 30 stoplog bays with seven (7) rubber dams, the replacement of the three (3) deep stoplog bays with vertical lift gates, the construction of a free overflow spillway at the northwest end of the dam and refacing the concrete on the crest and downstream slope of the main dam ogee section. In conjunction with main dam refurbishments, improvements will be made to the upstream fishway, and downstream louvre system to make it more suitable for all fish species

migrating around the dam to complete their lifecycle. The addition of an upstream eel pass will also be installed to support specific upstream passage for eels.

The Project is scheduled to take approximately nine (9) months to complete starting with the installation of the downstream access roads and temporary bridge in early July 2024. After the water is drawn down, the installation of upstream access roads will take place; main dam construction will commence in mid July 2024. A new control building was constructed in the summer of 2022 under Approval 2021-2840307-00. This building is in place to support the new rubber dam system proposed as part of this application. The proposed Main Dam construction activities are listed below:

- Installation of downstream access road and temporary bridge (to start prior to drawdown activities), Downstream access roads will need to be in place in order to access the right side of the dam;
- Lowering of Ruth Falls Headpond approximately 18 ft;
- Dewatering of the Ruth Falls fishladder and canal and fish rescue;
- Installation of temporary access for machinery on the upstream side of the dam – access from the right and the left side. The area in front of the sluiceway bays will remain open to allow water to pass through;
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates;
- Removal of the existing stoplogs from stoplog bays, piers, stoplog lifter and walkway;
- Reface the concrete on the crest and downstream slope of the spillway ogee sections;
- Installation of new rubber dam bladders on the crest of the ogee spillway sections;
- Construction of a free overflow spillway section at the right end of the dam;
- Installation of a new steel walkway for access across the dam;
- Improvements to the upstream fishway;
- Improvements to the existing downstream louvre system;
- Installation of an upstream eel ramp;
- Removal of the temporary access road material;
- Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation;
- Contractor Demobilization from site;

Following the completion of construction, discharge flows from the dam will not be changed or altered as a result of the Project. Operations will resume as normal once the headpond is back to within its normal operating levels.

Construction works would begin in July 2024 and include the removal of the railings, log lifter and tracks, the demolition of the existing concrete deck, concrete piers, and chipping of the spillway crest and downstream face. Following the demolition, the spillway sections will be fitted with rebar and rubber dam piping, and will be refaced with concrete on the crest and downstream slope of the spillway ogee section. New concrete piers will also be constructed between the rubber dams. Once the concrete has been

resurfaced, the rubber dams will be installed and connected to the controls building which will has already been installed under Approval 2021-2840307-00. The concrete retaining wall at the right end of the dam will also be replaced as part of the construction works. NS Power is anticipating an additional permanent instream footprint of approximately 60 m^2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete; however, changes will be made to improve the efficiency of the fishway – these changes include the addition of weirs, and adjustments to existing weir and notch sizing.

Construction materials include: the rubber dam bladders and all associated parts and materials, concrete for free overflow spillway section, right retaining wall, piers, headwalls, and ogee refacing, the vertical slide gates, steel walkways and railings, and the components for the new control building. A list of other products to be used by the contractor will be submitted to NS Power prior to start of work for approval based on health, safety, and environmental parameters.

3.2 Drawdown

The reservoir will be temporarily drawn down approximately 18 ft, which serves as the primary method of isolating the existing dam structure for refurbishment activities. During the time the water is drawn down, NS Power intends to provide free downstream passage of fish through the center sluice gate during construction as the canal and fish ladder will also be dewatered. The exception to this is when the center sluice gate will be under construction, which we anticipate bring 3-4 weeks during which time the water will be directed through either the west or east bay. Upstream fish passage will not be provided during construction.

In an effort to provide the safest and most reliable construction execution during one drawdown period, lowering the reservoir to elevation 91 ft is required. A construction elevation of 91 ft (approximately 18 ft below minimum operating level of 109.25 ft) allows for the portions of the concrete dam which will be refurbished to be fully exposed. The canal, fishladder, and downstream bypass will be dewatered and a fish rescue completed by qualified staff. The drawdown to 91 ft represents a difference in storage of approximately 2.295M m3 or 1884-acre-ft from full supply (2.3M m3 and 1888 acre-ft, respectively). NS Power does not operate the headpond to a low supply level of 27.5 m (90.1 ft) between the dates of November 30 – April 1 annually, as such, the drawdown is proposed outside of normal operating conditions to accommodate a safe and reliable work environment for construction to take place.

To complete the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level of 33.7 m (110.5 ft) to the minimum operating level of 33.3 m (109.25 ft) if required. Once the headpond reaches an elevation of 33.3 m (109.25 ft) – the top of the spillway stoplogs - the drawdown will be controlled by removing the spillway stoplogs until an elevation of 31.7 m (104.1 ft) - the concrete spillway crest - is reached. After this point, the sluiceway bay stop logs will removed be until the desired elevation of 27.7 m (91 ft) is achieved. The drawdown flow will be directed through areas that are part of the normal flowage channels. At least one gate will remain open throughout construction to maintain lowered water elevations and provide a method of downstream fish passage. Once the drawdown has reached 109.23 ft and the desired elevation of 27.7 m (91 ft) is reached) the Ruth Falls generating units will be non-operational until construction is complete and the headpond is recharged.

Table 1 displays the decrease in flow velocities as the headpond elevation lowers over the course of the 8-day drawdown period.

Table 1: Estimated Flow and Velocities for an 8-day drawdown of Ruth Falls Heapond

Time (day)	Beginning Elevation (ft)	Bays 1-15	Bays 16-30	Outer Sluice	Middle Sluice Opening (ft)	Total Discharge (cfs)	Velocity through each bay (fps)	Downstream Velocity (fps)
0	109.2	1	0	0	0	159	2.1	6.6
0.5	109.1	1	1	1	1	281	2.0	8.5
1	108.1	2	1	1	1	102	1.8	5.7
1.5	107.6	2	2	2	2	93	1.4	5.4
2	107.4	3	2	2	2	189	2.2	8.6
2.5	106.6	3	3	3	3	91	1.4	5.4
3	106.4	4	3	3	3	190	2.3	8.6
3.5	105.6	4	4	4	4	91	1.4	5.4
4	105.4	5	4	4	4	190	2.3	8.6
4.5	104.6	5	5	5	5	91	1.4	5.4
5	104.5	5	5	7	7	99	3.1	5.7
5.5	103.7	5	5	9	9	187	3.8	8.6
6	102.2	5	5	11	11	244	4.2	8.1
6.5	100.3	5	5	13	13	258	4.3	8.3
7	96.2	5	5	15	15	90	3.0	5.4
7.5	94.2	5	5	15	17	30	1.0	3.4
8	93.1	5	5	15	19	51	3.6	4.2
8.5	91.0	5	5	15	19			

The flow downstream will be controlled to avoid scour and sedimentation. The 35 cfs maintenance flow and downstream fish passage will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation to maintain flow. NS Power may not be able to provide the entire 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumps. Qualified NS Power personnel will be on site during the drawdown to monitor water quality (visual observations) and conduct a fish rescue of any isolated fish in the headpond and canal. Once the headpond level reaches 91 ft most of the canal will be dewatered. NS Power will drain the remaining

water using the drain valve at the powerhouse. Following the completion of refurbishment activities, the headpond will be subsequently recharged at a controlled rate.

Review of the Ruth Falls 2018-2022 spill data indicates that under normal operations, spill at the dam is a result of removing 1 or 2 stoplogs from 15 or 30 spillway bays resulting in discharges ranging from 175 cfs to 990 cfs. During large rainfall events additional water is discharged by removing boards from the sluices. The maximum discharge during the drawdown is 281 cfs; therefore, the drawdown discharges would not exceed spill conditions that occur under normal operations.

3.3 Temporary Structures

Prior to the drawdown taking place, a temporary rockfill downstream access road will be constructed using clean rock that is free of fines with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes. The downstream access road will be equipped with a temporary bridge located over the spillway discharge channel (refer to Appendix E - Proposed Water Management Structures). The left downstream access road will be 351 ft (107 m) long while the right downstream access road will be 229 ft (78 m) long. The estimated temporary instream footprint of the left downstream access road is 10,530 ft^2 (978 m^2) while the right downstream access road is 6,870 ft^2 (638 m^2).

The temporary bridge will be approximately 4 ft tall, 42 ft long and 13 ft wide, and will be constructed to pass upwards of 3200 cfs (refer to Table 2 for details). The bridge will be constructed using steel beams that are removable using an excavator if required, such as if a large rain event is anticipated. Ice build-up is not anticipated on the temporary access road as the water will be constantly flowing downstream. Excavators will be using the access roads on a continual basis during construction which will break up any ice that could accumulate. If significant ice accumulation was to occur, the ice could be removed physically by the contractor.

Following the completion of the drawdown to elevation 91 ft, two rockfill access roads will be constructed on the upstream side of the dam; one extending from the left abutment to the left end of the sluiceway, and one extending from the right abutment to the right end of the sluiceway. The access roads will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes using clean rock material that is free of fines. The left upstream access road will be 341 ft (104 m) long while the right upstream access road will be 223 ft (68 m) long. The estimated temporary instream footprint of the left access road is 10,230 ft^2 (950 m^2) while the right access road is 6,690 ft^2 (621 m^2). Using available bathymetry, approximately 74% of th75YKe upstream access road will be placed in the dry at an elevation of 91.0 ft. The upstream access roads will serve primarily to provide access for machinery to complete refurbishment activities. It should be noted that there no cofferdams are required to be constructed on the construction site to hold back water; there is no requirement for construction to take place behind cofferdams, or to isolate work areas. Temporary access roads are being constructed of clean rockfill, and water will be allowed to equalize between the dam structure and roads.

All access roads will be developed to meet industry standards. This includes adhering to required crest width and height to accommodate machinery. The access roads are built to be held in place until removed and therefore, are capable of withstanding all weather and precipitation conditions anticipated during all four seasons. The access roads pose very low risk to the project and the environment. During construction

the water will flow downstream through the sluiceway bay and under the temporary bridge, see Appendix E- Proposed Water Management Structures for more details.

3.3.1 Bridge Construction and Removal

Construction of the downstream bridge will take place in early July in advance of the drawdown. Construction will begin with the installation of the east downstream access road and placement of the east and west jersey barrier. Next, the contractor will use the east access road to drive across in order to place the 42 ft bridge upon the jersey barriers. Once the bridge is secured and in place – the contractor will drive across the bridge to transport rock material to build out the west side access road to meet up with the west shoreline. Once in place, the downstream access roads and bridge will allow for access to the west side of the site. Similar to other temporary structures used to support construction, the bridge and downstream access roads will remain in place for the duration of construction nine (9) months. The removal of the downstream access (roads and bridge) will be the last temporary structures to be removed as all equipment and the west upstream access road will need to be removed prior to taking this out. The bridge will be removed in the opposite direction as it was installed. This includes the removal of the west side access road material, west jersey barrier, removal of bridge with excavator, and finally the removal of the east jersey barrier and access road.

3.4 Water Management

Once construction begins, the sluiceway bays at the centre of the dam will be worked on first as they act as the primary means of water management. The deepest bay in the centre of the structure construction is planned during expected low flow periods (July and August). The sill elevation of the middle sluice gate is 90.1 ft, whereas the sill elevation of the outer two gates is 94.1 ft. Therefore, at a headpond level lower than 94.1 ft, only the middle vertical lift gate deep sluice bay will be available to discharge flows. To keep the centre bay as dry as possible during the four-week period needed to complete the work, a steel barrier will be placed in the notches of the sluiceway bay to divert water (which will then be pumped through the other sluiceway bays via pumps). Once the centre sluice bay/gate is completed, this bay will be used as the primary method of managing water through the construction site while the remaining outer bays are constructed. Once the entire sluiceway is operational, all three bays will be used to manage water. To manage a wider range of water level fluctuation caused by heavier precipitation which could occur during the drawdown, water will be passed through the open bay 8, where the new uncontrolled spillway is to be constructed. Existing concrete in bay 8 will be demolished to elevation 98 ft, and will be left open until the new uncontrolled spillway will be constructed toward the end of the construction window. Armour stone will be placed on the upstream side of the right downstream access road to reinforce the road from the impact of spill from bay 8, should water levels rise to above 98 ft. It is important to note that the headpond would need to rise by 7 ft (from 91 ft to 98 ft) before the spillway would be available for passing water. The estimated discharge flows through the open sluice bays, bay 8 uncontrolled spillway opening, and the bridge opening are shown in Table 2 below.

Table 2 : Estimated Discharge Availability During Construction

Reservoir El.	91 ft	93 ft	95 ft	97 ft	99 ft	100 ft	101 ft	103 ft	104 ft
Outer Gate 1	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Outer Gate 2	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Middle Gate	35 cfs	180 cfs	390 cfs	650 cfs	940 cfs	1100 cfs	1270 cfs	1630 cfs	2025 cfs
Total Gate Discharge	**35 cfs**	**180 cfs**	**460 cfs**	**1010 cfs**	**1720 cfs**	**2120 cfs**	**2570 cfs**	**3510 cfs**	**4565 cfs**
Spillway (Crest – El 98ft)	**N/A**	**N/A**	**N/A**	**N/A**	**125 cfs**	**355 cfs**	**650 cfs**	**1400 cfs**	**840 cfs**
Total Discharge	**35 cfs**	**180 cfs**	**460 cfs**	**1010 cfs**	**1845 cfs**	**2475 cfs**	**3220 cfs**	**4910 cfs**	**6405 cfs**
Depth Under Bridge	0.2 ft	0.6 ft	1.1 ft	1.8 ft	2.5 ft	31. ft	**3.7 ft**	4.8 ft	4.6 ft

The two outer gates are identical in their dimensions; therefore, yield the same outflows. All gates were considered to be fu lly open for the purpose of these calculations. The spillway crest sits at 98ft, and will act as a contingency for passing additional flows.

It is expected that at a minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, water from intermittent precipitation events as well as required maintenance flows and spill over the Malay Falls rubber dams would be managed through the construction site which will result in water level fluctuations in Ruth Falls Headpond throughout construction. During the construction period, the Ruth Falls generating units will not be used. Temporary upstream access roads on the upstream side of the dam will be designed to an elevation of 100 ft. This allows for approximately 9 ft of water level fluctuation within the headpond during construction before the access roads would be submerged. The access roads will be constructed using clean rock free of fines. The roads are not intended to hold back water and it is expected that in the event of increased water elevations, work will be able to continue until the top of the access roads is reached (100 ft).

NS Power believes that by having 9 ft of headpond capacity available, work crews will have sufficient time to plan and remove any necessary equipment should the weather forecast warrant such planning. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. Refer to Section 3.5 - Contingency planning for more details.

It is also important to note that even with the new sluiceway and vertical lift gates under construction, NS Power still can still the open gate bays to pass water if an extreme precipitation event is forecasted. The scope of the sluiceway refurbishment includes only pepping the concrete bays for installation of the new vertical lift gates. Work on the sluiceway can be halted quickly and the bays stabilized to prepare for passage of water as required. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power's Construction Project Management and Hydro System Superintendent.

Fish will have the ability to move downstream through the sluice bay during construction, with the exception of when the centre sluice bay gate is under construction. The passive opening under the bridge will allow fish to move freely downstream. It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will be maintained throughout construction with the exception of the approximately 4 week window where the centre sluicebay is under construction, during which time water will be pumped around the centre bay construction area (through the outer sluiceway). A six-inch pump will be used to discharge the flow through one of the other sluiceway bays. During construction of the centre gate, should inflows result in increased water levels, the outer sluice bays will be operational once elevations reach 94.1 ft. At elevation 95 ft, the outer sluice bays can pass a total of 70 cfs, and up to 780 cfs if water levels were to raise to 99 ft. There would be no negative impacts to the passage of water during all scenarios.

NSECC operating approval 2008-062826-01 stipulates annual environmental requirements associated with operations at Ruth Falls as follows:

- Year round: 35 cfs maintenance flow downstream of dam;
- April 1 – November 30: 6 cfs of 35 cfs maintenance flow provided to the fish ladder, 29 cfs provided to operate the louvers;
- April 1 – November 30: Minimum operating level of 33.3 m (109.4 ft.);
- May 15 – November 30: operation of the fish trap;
- Supplemental flows required June 15 – July 15 and September 26 – November 30 annually.

The required 35 cfs maintenance flow will be provided throughout construction via the sluiceway – this will also provide downstream fish passage during construction. The remaining conditions will not be met, which will be addressed through a request for variance from the operating approval.

The approval also stipulates requirements for Marshall Falls (minimum elevation of 191.4 ft between April 1 and September 1 and a year-round 45 cfs flow downstream of the dam). NS Power will maintain the 45 cfs flow release downstream of Marshall Falls via the Marshall Falls control gates. NS Power is requesting flexibility to the 191.4 ft elevation while remaining within normal operating levels to reduce uncontrolled spill in Malay Falls (downstream system of Marshall Falls) and eventually Ruth Falls during construction.

3.5 Contingency Planning

The hydrological information provided below references the Sheet Harbour system flood study, which was completed as part of NS Power's dam safety program in addition to the system dam safety reviews. Figure 1 below displays the Elevation – Storage Curve for Ruth Falls from Hatch's 2008 Flood Study.

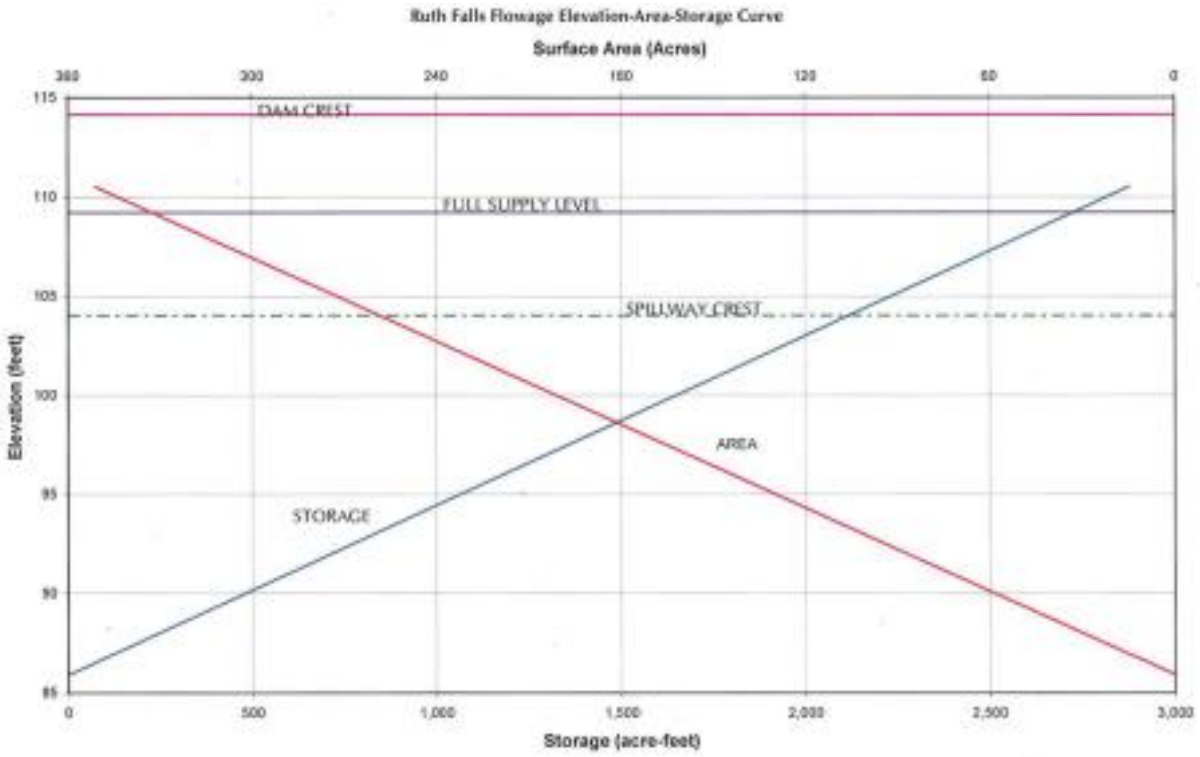


Figure 1: Elevation Storage Curve for Ruth Falls

The storage curve above indicates that there is 1150 Aft of available storage between elevation (El) 100 (the crest of the upstream access road) and the middle (El 90) sluice, and 600 Aft of live storage between El 100 (the crest of the upstream access road) and the outer (El 94) sluices. This storage availability provides NS Power with sufficient time to remove construction equipment should water levels continue to rise after the headpond has been brought down to 91 ft.

The maximum mean annual flows for the Ruth Falls headpond were calculated using the 2008 Sheet Harbour Hydro System Flood Study.The discharge values were calculated using a 24-hour sub basin unit hydrograph for the Sheet Harbour hydro system and the 24-hour duration rainfall from Atmospheric Environmental Service, Rainfall Intensity-Duration Frequency Values for Shearwater Airport. Results are presented in Table 3 below.

Table 3: Mean Annual Flood for the East River

Return period (years)	Maximum Mean Flow (cfs)
2	3,582
5	4,702
10	5,485
50	7,053
100	7,836

The maximum mean flows outlined in Table 3 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond. The water management plan for the Project has considered the ability to pass discharge associated with the mean annual floods for the East River associated with a 1:10 return period (equivalent to approximately 5,485 cfs). It is important to note that the gates and spillway are capable of passing approximately 6405 cfs if the headpond was to reach an elevation of 104 ft, this is just below the threshold a 1:50 return event. Contingency measures have been considered below for precipitation events that may occur resulting in higher discharge associated with a 1:10 return period event.

The following list outlines the sequence of events associated with increasing headpond elevations:

- At elevation 91 ft, the centre sluice bay can pass 35 cfs without any water level fluctuation. If water was to rise to an elevation of 94.1 ft the outside sluiceways would come into operation and the three bays would be capable of passing approximately 320 cfs;
- Between 94 ft and 97 ft, water would continue to pass through all three gates - discharging approximately 1010 cfs once 97 ft is reached;
- Once an elevation of 98 ft is reached, the concrete spillway (which will be prepped for construction of the new uncontrolled spillway section during the last phase of construction) will be available for passing additional water in addition to the three gates. At 99 ft, the gates and the spillway will be capable of discharging approximately 1845 cfs. The right downstream access road will be reinforced on the upstream side using large riprap to withstand any incoming spill from the spillway should this occur;
- At a headpond elevation of 100 ft, the top of the upstream access roads will begin to become submerged. Any machinery will be moved in advance of this; however, the access roads will be built to tolerate submersion. At this point, approximately 2475 cfs will be passing through the gates and the spillway. At 101 ft, it is anticipated that the water will be approaching the underside of the downstream bridge (water coming up to approximately 3.7 ft under a 4 ft bridge). At this point, the bridge will be removed using an excavator on site. This type of removal is expected to take approximately 4 hours;
- Once an elevation of 104 ft is reached, the gates and spillway will be discharging approximately 6405 cfs combined. The crest of the ogee section of the dam is situated at 104 ft. This discharge exceeds a 1:10 year return period for mean annual flows. Refer to Table 2 for more details;

NS Power operations and the contractor will be monitoring the water inflows and discharges throughout the construction activities and will be able to adjust to the changing conditions, as required, to ensure that the headpond levels are managed accordingly. Temporary upstream access roads will be installed to withstand a rise in the headpond to elevation 100 ft. The access roads will be constructed using large rock free of fines making it permeable and able to pass water through without becoming compromised. At 101 ft the temporary bridge would need to be removed. Once elevations hit 104 ft, the water would begin to overtop the ogee section of the spillway causing work to halt until water levels recede. This is not anticipated to occur during the construction period as this would be approaching a 1:50 return period event.

Should high return period rain events (i.e. 1:10 year return period) occur during construction activities, the Ruth Falls Headpond can withstand an increase in water elevation to 104 ft, based on the discharge capacity of the sluice bays, spillway opening, and expected inflows during a 1:10 return period event (Table 3 – approximately 4,468 cfs). With all three sluice bays available and the spillway also passing water, approximately 6405 cfs can be passed at an elevation of 104 ft, (Table 2) During such an event, NS Power and the contractor would plan to shut down all construction activities. Keeping in mind that the reservoir would already be drawn down, inflows would be able to attenuate in the reservoir, raising the level of the reservoir over time from 91 ft to 104 ft (13 ft differential). In the event of heavy rain or significant sustained flows forecasts, potentially resulting in water levels exceeding 100 ft elevation, the construction infrastructure can be quickly removed to meet the sluiceway width capacity:

- The temporary work platforms and construction materials supporting gate installation,
- The installed vertical gates if they are not fully operational at the time of the event,
- The removal of temporary bridge, and
- Removal of any temporary formwork supporting the construction of the uncontrolled spillway section.

During the construction of bay 8, the uncontrolled spillway section, water management will be achieved using the operational sluiceway. If a high return period event potentially causing headpond elevations to rise above 98 ft is forecasted while the spillway is under construction, work associated with the installation of the new spillway section would be paused until water levels recede. Concrete pouring will only proceed if no significant rainfall is forecasted.

The upstream access roads will be constructed in a manner as to not impact the discharge capacity of the sluiceway. Both upstream and downstream temporary access roads will be constructed with large rock material properly sloped, to safely flood and overtop if a return period event of highwater levels occurs. The temporary access roads will be constructed with clean rockfill material and no easily erodible material (such as clay, sandbags, filter fabric, plastic liner) will be used because there is no need for the access paths to hold back water (i.e, the access roads are not cofferdams) If in the event migration of material is observed, the associated risk of sedimentation or debris being deposited downstream is extremely low. NS Power will assess the access road material migration once water levels have receded and develop plans for material removal in coordination with NSECC and DFO, if required.

3.6 Erosion and Sedimental Control Plan

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NS Power personnel monitoring for any visible water quality issues. NS Power is not anticipating any issues with erosion or scour when passing

the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. Bi-annual inspections and weekly checks are conducted downstream of the Ruth Falls Dam. Observations during the inspections and checks indicate that scour is not of concern when spilling in excess of 500 cfs.

NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

All access road material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined in Section 4.

There will be some excavation of the right (west) abutment retaining wall that is scheduled for removal and replacement. During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry, and silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas, as required. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the dam and the other is located northeast of the dam, see Figure 2 below. Both areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.

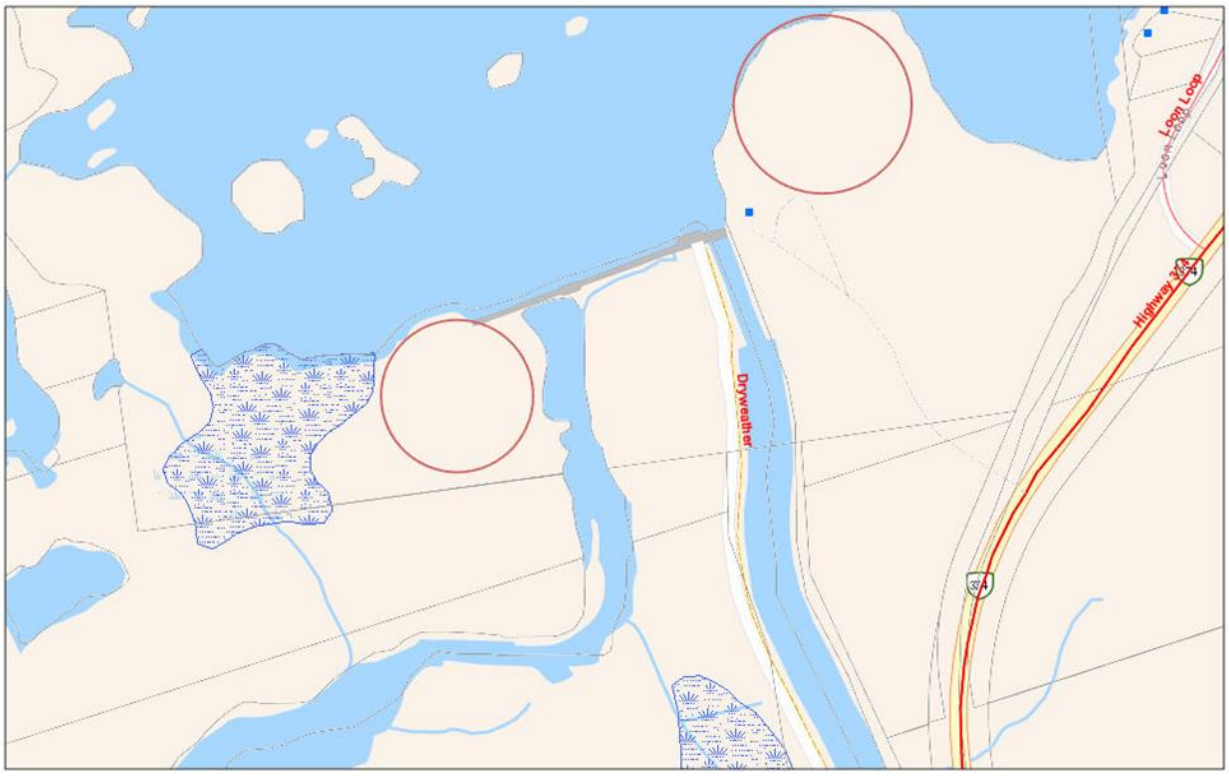


Figure 2: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2024.

The removal of access road material will take place with Ruth Falls Headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring.

The selected contractor for the Project will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1st to September 30th) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of access road sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power will also require the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This will allow NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

4.0 ENGINEERING SPECIFICATIONS

Engineering drawings for the proposed work main dam refurbishments are provided in Appendix C. Engineer drawings related to improvements to upstream / downstream fish passage (fishway, louvre system and the proposed eel ramp) are provided in Appendix D.

5.0 CONSTRUCTION SCHEDULE

The Project is scheduled to take approximately nine (9) months to complete starting with the installation of the downstream access roads and temporary bridge in early July 2024. After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid July 2024. The work includes both the lowering and subsequent recharging of water in the headpond. The water level will be drawn down after July 10th, allowing time for fish eggs to hatch, and young of year (YoY) Gaspereau to move downstream naturally or be transported during fish rescue. Lowering the reservoir will occur after July 10th, and will take approximately eight (8) days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the level fish entrainment is low. The construction schedule is as follows:

- Installation of the downstream access roads and temporary bridge will commence two (2) weeks prior to the start of the drawdown. This work is intended to be completed prior to the drawdown in preparation for main dam construction work to take place in mid-July after the lowering of Ruth Falls Headpond. Access to the right side of the dam will be provided by the downstream access roads connected by the temporary bridge;
- Construction activities associated with the sluiceway, main dam refurbishment, and improvements to fish passage will commence in mid-July after the lowering of Ruth falls headpond. The lowering of the Ruth Falls Headpond will commence no earlier than July 10th, 2024, and will take place over the course of eight (8) days;
- After the water is at an elevation of 91 ft, construction activities will then begin with the installation of the upstream access roads. Once access is installed on the upstream side, demolition of the west retaining wall and removal of stoplogs, bay prep and installation of vertical lift gates will take place. NS Power will aim to complete the new sluice gates first in the low flow window of July-September. It is anticipated that each gate bay will take approximately 3-4 weeks to complete, and a total of 9-12 weeks to complete the entire sluice structure. This may be affected by weather should heavy inflows be required to be passed for a significant period of time;
- Next, refacing of the crest and downstream side of the dam including chipping, rebar, form work and dowels will take place. Improvements to the upstream fishway, concrete works on bay 1-8 and piers 1-9, and rubber dam installation will take place simultaneously.
- Relocation of the bypass pipe, installation of handrails, improvements to the louvre system and installation of the eel ramp will take place between October and December followed by the rubberdam commissioning / control set up and construction of the overflow spillway on the western side; and,
- Once all main construction works are complete, the contractor will remove the upstream access roads followed by the downstream access roads including the temporary bridge. The watering up of the Ruth Falls headpond is expected to take one day which will be complete by April 1st, 2025.

Removal of all applicable environmental controls and final site clean-up will take place over the following weeks.

NS Power has developed a Gantt chart which outlines the detailed work schedule. Please note that the schedule may not be followed exactly as indicated and is subject to change. Refer to Figure 3 – Construction Sequencing Gantt Chart for full details.

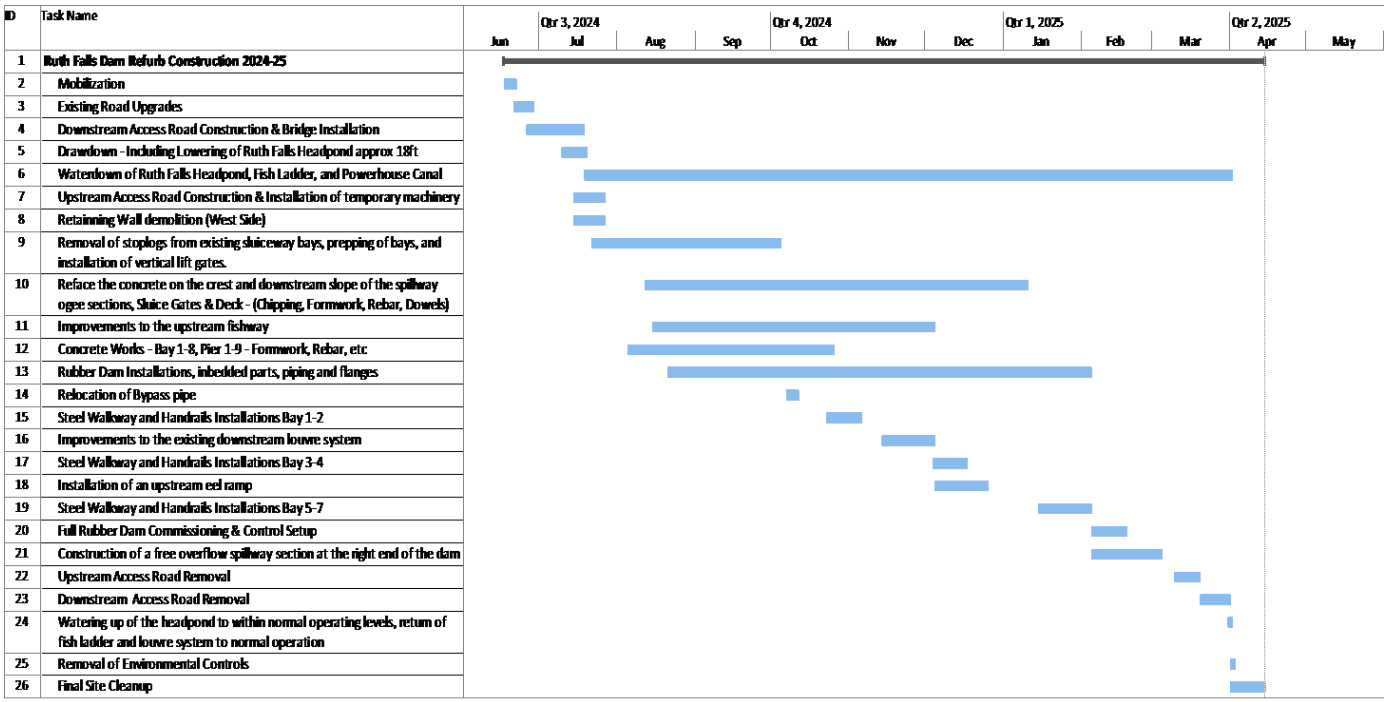


Figure 3 – Construction Sequencing Gantt Chart

To accomplish this scope and construction schedule, NS Power is requesting that the authorization, if received, permits instream work until December 31st, 2025.

6.0 CURRENT AND PROPOSED FACILITY OPERATION

In order to achieve improved water management capabilities at the Ruth Falls dam, the proposed refurbishment will include the installation of three new vertical lift gates in place of the existing stoplog controlled sluiceway bays. It will also include the replacement of the stoplog controlled overflow spillway section with rubber dam sections. In addition to the changes to the water control structures, NS Power is also proposing changes to the existing fish passage structures to support improved passage for species migrating beyond the dam. These changes include adjustments to the fishway, louvre system, and installation of a new eel ramp. As such, there will be some change in operation of the dam post-construction compared to existing operations, as discussed below.

6.1 Regular Operations

Inflows into the Ruth Falls reservoir are controlled by NS Power Hydro Operations. Water levels can fluctuate between the full supply level of 33.7 m (110.5 ft), minimum supply level of 33.3 m (109.25 ft), and the low supply level of 27.5 m (90.1 ft). A minimum operating level of 33.3 m (109.25 ft) is observed from April 1st to November 30th each year. As per the Sheet Harbour system Water Approval, a 35 cfs maintenance flow is provided downstream year-round in order to operate the Ruth Falls louvers and fish ladder. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers which is released downstream of the dam through a bypass pipe. Supplemental flows (simulating large rain events) are also provided annually from June 15th to July 15th and September 26th to November 30th. Leakage through the stoplogs and sluiceway bay frames is something that occurs but is not accounted for as part of required maintenance flows. It is expected that the leakage accounts for approximately 65 cfs being released from the dam. When added to the required fish ladder (6 cfs) and louvre / bypass (29 cfs). It is estimated that 100 cfs is currently being released.

After refurbishments have taken place, NS Power will maintain the 35 cfs maintenance flow through the fish ladder and louvre / by-pass pipe, while also maintaining all required operating levels as outlined within the NSECC operating Approval (2008-062826-01). Changes to the configuration of the bypass pipe (which directs a minimum of 29 cfs from the canal to support downstream movement of fish) is proposed to be redirected to the top of the fishway. The 29 cfs will be maintained; however, the water will be released down through the fishway to provide additional water / attraction flow for fish moving up through the fishway – see details surrounding this design decision in Appendix G – Hydraulic Modeling Results. The proposed fish passage improvements also include the installation of an eel ramp which will provide a method of upstream passage to juvenile eels. The ramp will require a constant stream of water passed over the substrate to facilitate eel movement, 5 cfs is proposed for this purpose.

To account for the lack of leakage from the new dam, an additional 65 cfs maintenance flow is being proposed to maintain similar conditions below the dam and to support upstream migration of fish using the fishway and proposed eel ramp. This flow will be released from the vertical lift gates in the center of the dam. When paired with the flow released from the fishway and louvre / bypass (total of 35 cfs), the eel ramp flow (5 cfs) - the proposed maintenance flow total will be approximately 105 cfs. See Appendix G – Hydraulic modeling results for details surrounding this decision.

NS Power evaluated the releasing of the 65 cfs through a combination of three (3) gates; however, when using this approach, the center gate would only be open 2 in and each of the outer gates 1 in. NS Power expects that this scenario would be very challenging from an operational perspective as the small opening is expected to clog with debris. When using one (1) gate to release the 65 cfs, the gate would be open approximately 5 in (outer gates) or 4 in (center gate). As such, NS Power is proposing to use the most westerly gate to release the maintenance flow; however, this can be adjusted if required once the dam is in operation.

6.2 Managing Excess Water

Currently, excess water is managed by pulling stoplogs either from the deep stoplog bays or overflow spillway sections of the dam. Post-construction, the majority of water control will be done using the vertical lift gates, and rubber dams maintained at full supply elevation. Should additional spill be required beyond the capacity of the vertical lift gates, the excess water would be released via the western spillway. If additional spilling is required beyond this, the western rubber dam would be deflated to release water; lastly, the eastern rubberdam would be deflated. Using the eastern rubberdam (which is situated above the fishway) would only be used in the most extreme rain event conditions. The upgraded fishway is designed to withstand spill from release of the above rubberdam if required. It is important to note that the amount of spill will not change as there is no change to the storage capacity or operational headpond elevation requirements. Table 4 below provides a summary of how the dam is currently operated as compared to how the dam will be operated post-refurbishment.

Table 4 – Current and Post-Refurbishment Operation

Activity / Structure	Current Operation	Post-Refurbishment Operation
Fish Ladder	Minimum of 6 cfs provided during the operating window of April 1st to November 30th annually	No change
Louvre System	Minimum of 29 cfs provided during the operating window of April 1st to November 30th annually	No change to flows. Adjustment to location of by-pass outlet pipe to top of fishway; therefore water will be released down through the fishway rather than existing location directly downstream of the dam
Eel Ramp	N/A	5 cfs will be provided during the operating window of April 1st to November 30th annually.
Fish Trap Operation	Operated during operating window of April 1st to November 30th annually	No change
Maintenance Flow	35 cfs (6 cfs from fish ladder and 29 cfs from louvre / bypass) provided during the operating window of April 1st to November 30th annually. * An additional approximate 65 cfs unaccounted for through leakage.	New total maintenance flow of 105 cfs. This is a combination of the current 35 cfs from the fish ladder and louvre / bypass, 5 cfs from the eel ramp and 65 from the vertical lift gates during the operating widnow of April 1st to November 30th annually. NS Power is proposing to release the 65 cfs from the most western gate which represents an approximate 5 inch gate opening.

Spill	Released through stoplogs from deep stoplog bays or overflow spillway	No change to spill amount. Post-refurbishment spill be released in the following order: 1. Sluiceway bay / vertical lift gate 2. Western overflow spillway 3. Western rubberdam 4. Eastern rubberdam
Supplemental Flow	10 or more supplemental flow releases from June 15 to July 15 and September 26 to November 30 of greater than 50 cfs overnight for a minimum of 12 hours, and nightly when Atlantic Salmon are present. Stoplogs are removed to provide the releases.	No change to supplemental flow releases aside from the method that they are released which will be via the center sluiceway bays / vertical lift gates.

7.0 LOCATION

The Sheet Harbour Hydro System is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The hydro system has a drainage area of 573.9 km^2. Presently there are six (6) controlled reservoirs in the hydro system including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond, and Ruth Falls Headpond. The Sloane Reservoir is located near the headwaters of Seventeen Mile Stream, which passes through Anti Dam Reservoir and into Marshall Reservoir, then into the Malay Falls Headpond. The Malay Falls power canal conducts water from to the Malay Falls Generating Station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. The Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power.

Mapping, site photos, and engineering drawings are located in Appendices A, B, and C, respectively. The Property Identification Number for the Ruth Falls Dam is 40221673. Global Positioning System (GPS) coordinates in North American Satum of 1983 (NAD83), Universal Transverse Mercato (UTM) Zone 20N are: 539,486 m Easting and 4,978,146 m northing.

8.0 COMMUNITY

The Project site is located near the community of Sheet Harbour, HRM, Nova Scotia.

9.0 CONSULTATIONS

NS Power initiated Mi'kmaq engagement regarding the Ruth Falls Dam project with the Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO) in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant Project information with the KMK throughout 2018 providing six project updates, the project was then deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window meeting with KMK. NS Power continued to provide monthly Project updates and yearly One Window meeting updates throughout 2021-2023. NS Power also held a site visit to Ruth Falls on March 7th 2023 with KMK and DFO to discuss the current fish passage infrastructure.

NS Power initiated engagement with the Millbrook First Nation in January 2020 to provide an overview of the project and discuss next steps and approach to engagement for the project. This included working with the Mi'kmaw Conservation Group (MCG) and Millbrook for a DFO Fisheries Act authorization offsetting project. In January 2020, NS Power initiated engagement with MCG to collaborate on an offsetting project and in February and March 2020 NS Power continued engagement with the MCG and Millbrook. NS Power participated in project meetings with the Millbrook First Nation in January 2020 and summer 2021, and completed a site visit to Ruth Falls with Millbrook representatives in September 2021. Millbrook First Nation expressed interested in Atlantic salmon and American eel; as such, a meeting was held in January 2022 with Millbrook First Nation Director of Fisheries to discuss American eel passage. Following up on this meeting, NS Power shared the latest relicensing report pertaining to Ruth Falls and additional information about a previous eel mortality study completed at Ruth Falls. NS Power will continue to engage the Millbrook First Nation regarding the project and has offered to host a follow up site visit when Millbrook First Nation are available and interested. Weekly project manager communications will be available to the Millbrook First Nation as construction begins.

In August 2022 NS Power met with the Maritime Aboriginal People's Council (MAPC) to discuss Ruth Falls Refurbishment Project. MAPC followed up with a letter asking for more information about archaeological reconnaissance during the drawdown, treatment of invasive species caught during stranding; and more information about the offsetting and monitoring plan. In November 2022 NS Power provided a response that included archaeological plans, protocol for releasing stranded fish, and a commitment to share offsetting plans once submitted as part of the regulatory applications.

In terms of archaeology in the area, Boreas Heritage Consulting Inc. conducted an archaeological screening for the Ruth Falls Spillway Replacement in 2017 and followed up with archaeological subsurface testing in 2018. The subsurface testing did not exhibit archaeological resources. For the planned drawdown, the dewatered shoreline will be subjected to a full archaeological reconnaissance and surface collection once the elevation has reached its maximum drawdown level.

NS Power is planning to conduct public engagement for the Project with an Open House and provide local residents, along the Ruth Falls headpond, with relevant Project information and notification of the drawdown activities to conduct the Project. The public Open House and local resident communications will provide information in a timely manner about the Project - prior to drawdown activities and construction, increasing awareness and understanding of the Project scope, objectives, and timelines and addressing public areas of interest and potential concern.

10.0 DESCRIPTION OF FISH AND FISH HABITAT

The project site is located on the Ruth Falls Headpond in the NS Power Sheet Harbour Hydro System. Upstream of the dam is lake habitat while downstream of the dam is the East River of Sheet Harbour. The hydro system has been studied extensively as part of NS Power's hydro relicensing program. The most recent relicensing for Sheet Harbour was completed in 2018, during which various parameters including water quality and fish and fish habitat were studied. Qualitative and quantitative field studies were completed in the various reservoirs and streams of the hydro system. The 2018 Sheet Harbour Hydro System Relicensing Report was provided to DFO in 2018 and provides an indication of the fish species found in the system.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and which may result in higher returns in the East River over time. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system.

The Ruth Falls Headpond was sampled by NS Power in 2017 using gill nets, minnow traps and eel pots. Species found to be present in the headpond include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat is found in the area. Table 5 summarizes fish species caught in the headpond during 2017 surveys.

Table 5 - Summary of fish sampled during the 2007 and 2017 Ruth Falls Reservoir surveys

Reservoir	Site #	Method	Species Caught	Number Caught	
				2007	2017
Ruth Falls	84	Minnow trap	Yellow perch	0	11
	85	Minnow trap	Yellow perch	0	12
	88	Minnow trap	Yellow perch	0	9
	89	Gill net	Brown bullhead	0	3
			Speckled trout	3	3
			Unknown	1	0
			White sucker	7	13
			Yellow perch	2	7
	92	Eel pot	Brown bullhead	0	2
	94	Gill net	Alewife	0	3
			Brown bullhead	0	1
			Golden shiner	0	1
			Lake chub	0	1
			Speckled trout	1	3
			White sucker	2	21
			Yellow perch	0	9
	124	Eel pot	Brown bullhead	0	11
	125	Eel pot	American eel	6	1

			Brown bullhead	0	12
			Yellow perch	7	0
	126	Eel pot	American eel	4	0
			Brown bullhead	7	0
			White sucker	2	0
	128	Minnow trap	Yellow perch	8	5
	130	Minnow trap	Yellow perch	3	28

Fish sampling using an electrofisher was also conducted in stream sites located above the Ruth Falls Headpond on Grant River as well as one site located below the headpond on the East River of Sheet Harbour. Table 6 summarizes fish species captured during electrofishing surveys in 2006/7 and 2017.

Table 6 - Summary of fish sampled during the 2006/2007 and 2017 stream electrofishing surveys

Location	Site #	Species	Number Caught	
			2006/7	**2017**
Grant River	43	American eel	2	4
		Brown bullhead	1	0
		Lake chub	0	7
		Pearl dace	4	0
		White sucker	0	1
	96	American eel	10	0
		Banded killfish	1	0
		Blacknose dace	1	0
		Lake chub	7	2
		Yellow perch	1	0
East River	68	American eel	2	0
		Lake chub	1	0

A physical fish habitat survey was also completed at all electrofishing sites. The substrate at Site 68 downstream of the Ruth Falls Dam was characterized by a mixture of boulder (50%), bedrock (40%), and cobble (10%). Habitat types observed were riffle (80%), smooth (10%) and rough (10%). Instream cover was noted as moderate while riparian vegetation included a canopy of 5% on the left bank and 0% on the right bank. A summary of physical characteristics of the downstream site (East River), as well as upstream sites on Grant River can be found in Table 7.

Table 7 - Quantitative fish habitat data at stream sites near Ruth Falls in 2017.

Location	Area surveyed (m^2)	Gradient (%)	Flow m3/sec	Mean. water depth (m)	Max. water depth (m)	Mean velocity (m/s)	Max water velocity (m/s)
Grant River, site 43	254	1.28	-	0.19	0.24	-	-
Grant River, site 96	155	1.38	0.05	0.22	0.26	0.03	0.08
East River	203	1.32	-	0.36	0.46	-	-

Water quality sampling was performed at two sample sites in the Ruth Falls Headpond in 2017. pH in the headpond is considerably lower than reservoirs further upstream with a range of 4.32-5.14. Other water quality parameters measured were generally good. Total Dissolved Solids (TDS) is low, ranging from 9 mg/L to 12 mg/L, and conductivity ranges from 20 µS/cm to 23 µS/cm. Laboratory measurements of pH are considerably higher than in situ measurements, with values between 6.05 and 6.41. There are elevated metals concentrations in deeper waters, with exceedances of Canadian Council of Ministers of the Environment(CCME) Freshwater Aquatic Life (FWAL) guidelines for iron and zinc. Water quality measurements were taken at a site downstream of Ruth Falls in the East River of Sheet Harbour in 2017. pH was 4.94, dissolved oxygen was 10.23 mg/L, while conductivity was 20 µS/cm.

An Atlantic Canada Conservation Data Centre (ACCDC) search of fish species at risk in the Sheet Harbour watershed identified American eel as threatened by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) while provincial rarity ranks of S3 was given to Alewife, Brook trout, and Lake trout; S2 to American eel; and S1 to Brook trout.

10.1 Eel and Salmon Study

In 2009 and 2010, NS Power completed tagging studies to assess the downstream movement of two migrating species at the Ruth Falls Dam: Atlantic salmon smolts and American eels. The intended outcome of the studies was to determine the efficiency of downstream fish passage using the existing louver diversion system which is situated at the beginning of the powerhouse canal. The louver system is designed to divert fish toward a bypass pipe which then carries fish through the pipe, eventually releasing them downstream of the dam in the original East River. Study details are provided in Appendix F –Eel and Salmon Study Summary.

Upon review of both the 2009 and 2010 studies, NS Power has made certain assumptions:

- Both studies with very different techniques have similar efficiency estimates for the louvers for eel – approximately 30%;
- Based on 2009 salmon smolt study, the louvre system and associated bypass is effective for pelagic species. The study showed that when the approach velocity is sufficient, the louvres were over 90% effective at diverting salmon smolts. NS Power is also of the opinion that the bypass system is likely effective foremost other migratory pelagic species such as gaspereau; and,
- The bypass may work marginally for eels - there was no way to determine whether the difference between an eel identified downstream of the dam who traveled through the bypass pipe or traveled over the spillway

10.2 Wetlands and Rare Species

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. A total of twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond. Six (6) of the 21 wetlands identified at the time of the survey from 2007 where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are

shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may have water level fluctuations similar to natural lakes.

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown nine (9) months, NS Power is not anticipating long term impact to species, composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a nine (9) month period is unknown. NS Power has contracted a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project. Full details can be found in Appendix M-Wetland Monitoring Plan and Appendix K – Monitoring Plan.

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present at Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. An updated ACCDC search was completed in 2023 for the study area, there are no records of aquatic species of conservation concern or endangered species within the area. See Appendix P – ACCDC Report for full details.

11.0 DESCRIPTION OF EFFECTS ON FISH AND FISH HABITAT

The following water management strategies related to the Project have the potential to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat:

- The temporary drawdown of Ruth Falls Headpond, which could result in the temporary disruption of up to approximately 1.15 km^2 (115 hectares) of littoral zone habitat that fish species use for a portion of their life cycle (see Appendix A Bathymetry);
- Death of fish due to entrainment and/or stranding from drawdown activities; and,
- The installation of a temporary bridge and access roads for machinery on both the upstream and downstream sides of the dam, resulting in a temporary instream footprint. The total estimated temporary instream footprint for control measures is 3,237 m^2. The footprint associated with the temporary structures within Ruth Headpond is already accounted for within the temporary drawdown of the Ruth Falls Reservoir. When the reservoir is reduced to 91 ft, the temporary structures will be placed upon the substrate which will be temporarily dry due to the drawdown. The footprint associated with temporary structures downstream within the spillway channel is not considered valuable fish habitat due to the periodic nature of flow releases (although NS Power acknowledges fish use this area as a migration route to access habitat upstream of the dam). NS Power does not consider the temporary footprint to be a HADD as per the above rationale and the temporary nature of the footprint;
- Temporary impact to upstream fish passage during construction. Upstream passage will not be available upon the start of the drawdown and extending until the following April 2025. NS Power does not consider this to negatively affect fish and fish habitat. The deferral of the drawdown to after July 10th avoids impact to upstream fish passage for spring migrating species (alewife, elvers)

and downstream passage of any salmonid parr and smolts. The lack of upstream passage throughout the summer and fall will prevent any adult salmon from migrating upstream. However, there have been no salmon observed in the trap in the last two years, and only 1 observed since 2017. Therefore, it is not likely that this species will be negatively affected by the lack of upstream passage and should not be considered in the application of avoidance/mitigation measures for this project.

- Negative impacts to upstream and downstream passage as a result of dam refurbishment, including:
    - Some loss of surface downstream passage for surface-oriented fish species, that would typically pass over top of the existing stoplog bays; and,
    - Potential changes to entrance conditions of the Ruth Falls fish ladder as a result of submerged discharge through the new gates (vs. surface overflow from stoplog bays).

The Project will result in a permanent loss of fish habitat; however, based on the relatively small size (60 m^2), the Project will not be removing a critical piece of habitat from the ecosystem. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete; however, changes will be made to improve the efficiency of the fishway – these changes include the addition of weirs, and adjustments to existing weir and notch sizing – see Section 12.2.1 Upstream Fishway Improvements for details on the proposed improvements. The temporary lowering of the reservoir approximately 18 feet will cause the biggest disruption; however, the potential effects of fish and fish habitat is low due to the following:

1. The drawdown is temporary and will not have a long-term effect on fish populations;
2. The headpond water level will be drawn down after spawning allowing time for eggs to hatch and YoY Gaspereau to move downstream naturally or transported during fish rescue. The drawdown is scheduled to occur no earlier than July 10th, 2024;
3. Measures will be put in place to facilitate downstream migration of fish during construction. During the time the water is drawn down, NS Power intends to provide free passage of fish through the center sluice gate during construction as the canal and fish ladder will also be dewatered. The exception to this is when the center sluice gate will be under construction, which we anticipate being 3-4 weeks during which time the water will be directed through either the west or east bay. Upstream fish passage will not be available during the 2024 construction season after July 10th. As described above, improvements to the existing upstream fishway as proposed to take place during this timeframe;
4. Preliminary data collected from ongoing monitoring for the Tusket Main Dam Refurbishment project drawdown in 2021 indicates that very little change to fish habitat has been observed over an eight (8) month period, other than the temporary loss of available habitat as a direct result of the drawdown. No permanents impacts were reported.

NS Power engaged a qualified fish passage professional to evaluate whether or not there were any obstructions to fish moving downstream during the headpond drawdown period. Upstream fish passage will not be available during construction, and as such, was not assessed. Previous modeling in the river below the dam showed that with 100cfs flow the shallowest rock outcrop below the dam would have water depths varying for 20cm to 30cm along most of the width. This will be sufficiently deep and has associated velocities of 2.5 ft/sec to 3 ft/sec for downstream passage of the fish leaving the headpond

during drawdown. There will be times at the end of the drawdown and during the summer when river flow drops below 100cfs and water depths on this rock outcrop will be shallower; however, this is seen as a natural run of the river variation. As a result, the fish passage professional is of the opinion that there are no significant obstructions to fish successfully moving downstream during the drawdown due to the sufficient water depths and acceptable velocities. A rock ledge exists adjacent to the downstream side of one of the gates at the centre of the dam; however, with the amount of water being put through during the drawdown period there is minimal risk of injury as the flow depth is well over this rock.

Project activities with the potential to impact fish and fish habitat have been identified and discussed in Table 8.

Table 8 - Summary of potential effects on fish and fish habitat due to refurbishment of the Ruth Falls Main Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect
Temporary loss of fish habitat due to lowering reservoir beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.15 km^2 in Ruth Falls Headpond	High	Low
Temporary loss of fish habitat due to temporary installation of access road/crossings.	Localized: area immediately upstream and downstream of the dam	High	Low
Loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly downstream of the dam	High	Low
Fish mortality due to stranding when lowering reservoir.	Localized: Ruth Falls Headpond	Low	Low
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low
Potential downstream scour during drawdown of reservoir.	Localized: East River of Sheet Harbour	Low	Low
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High

sluiceway and stoplog controlled to rubber dam spillway.			

There are no formal fisheries management objectives for the East River of Sheet Harbour; however, the streams and reservoirs are used for recreational fishing by the local community and traditional harvesting by the Mi'kmaw of NS.

12.0 ASSESSMENT OF FISH PASSAGE

DFO submitted a letter to NS Power dated May 5th, 2022 indicating that this application remained incomplete. The letter outlined several questions regarding upstream and downstream fish passage that would need to be addressed as part of the Project. The DFO Incomplete letter states:

NS Power is proposing major refurbishment works for the dam that could influence upstream and downstream fish passage (e.g., changing from surface spill via stop logs to sub-surface spill via vertical lift gates). As stated in Table 6, there will likely be impacts to upstream and downstream fish passage after dam refurbishment works are complete. As noted in emails from DFO to Jenny LeBlanc on October 25, 2021 and December 16, 2021, and as discussed on the October 27, 2021 call with DFO and NS Power, fish passage improvements are to be integrated into the dam refurbishment work to ensure compliance with the fish and fish habitat protection provisions of the Fisheries Act, which includes ensuring the free passage of fish.

Of note, Table 7 references the potential for impact to passage as a result of the modification of the sluiceway, not a likely impact and the probability of this impact was noted to be low.

DFO also specified in the Incomplete Letter the information required to be submitted as part of this application to ensure "compliance with the fish and fish habitat protection provisions of the *Fisheries Act*, as follows:

- Assessment by a qualified professional on potential impacts to upstream and downstream fish passage for all species that are likely to be migrating in the area associated with the proposed infrastructure design and operations.
- Describe proposed measures that will be implemented as part of the refurbishment works to avoid, mitigate or offset potentially harmful impacts to fish and fish habitat, including fish passage, associated with the refurbishment and future operation of the Ruth Falls Hydroelectric Development. For avoidance and mitigation measures, ensure to submit the following information and describe how these proposed fish passage measures meet established fish passage design criteria (e.g., United States Fish and Wildlife Service (USFWS) Fish Passage Engineering Design Criteria to allow DFO to assess whether proposed plans are sufficiently meeting fish passage requirements as per Section 34 of the Fisheries Act.
- Provide an upstream fish passage plan for American Eel that includes detailed design drawings, proposed location for fish passage structures and rationale for siting structure(s) in this location, information on proposed operations, and proposed timing of installation.

- Provide a downstream fish passage plan for fish species that are likely to be migrating downstream at the site. Submit detailed design drawings, the proposed location of structures and rationale, information on proposed operations, and proposed timing of installation for any new structures required to ensure the free passage of fish at the site. This includes proposed improvements to the louver system.

NS Power initiated various studies / assessments in order to satisfy this request and has been working to progress this work over since May 2022. The following studies have been completed:

- An assessment by a qualified professional on potential impacts to upstream and downstream fish passage for all species that are likely to be migrating in the area associated with the proposed infrastructure design and operations. This includes:
- Assessment of existing fish passage conditions and recommendations for upgrades and improvements, and
- 3D hydraulic modelling of the study area below the dam – modelling was completed to assess flow conditions pre and post dam refurbishment and to evaluate whether the new dam operation will negatively impact upstream or downstream fish passage. Modelling was also completed to inform improvements to upstream and downstream passage.
- Upstream fish passage plan, including for American eel, including detailed design drawings; and
- Downstream fish passage plan, including detailed design drawings.

The sections below address the requested items above in detail. This includes assessment results, summaries, and detailed designs. NS Power has provided the detailed designs for the proposed fishway improvements, downstream louvre improvements, and upstream eel ramp design in Appendix D.

12.1 3D Hydraulic Modelling

NS Power engaged CBCL Ltd. and Thaumas Environmental to complete 3D hydraulic modeling to assess post-refurbishment hydraulic conditions. The objective of the modeling was to evaluate whether the refurbishment and subsequent operation of the new dam would result in negative impacts to fish and fish habitat downstream of the dam, namely impacts to upstream and downstream fish passage.

The following was completed as part of the 3D hydraulic modelling:

- Modelling of historical spill data to assess potential impacts to fish passage during various expected flow conditions (i.e. base flows – high flow spill conditions), as a result of the proposed refurbishment dam design operation.
- Modelling of existing ecological maintenance flows (as required in accordance with the Sheet Harbour Hydro System) and current estimated leakage rates (i.e. base flows) to evaluate whether ecological flows are sufficient for optimal fish passage, and modelling of different gate configurations to provide the ecological flows (i.e. gate openings); and,
- Modelling of passage conditions in the existing fish ladder and downstream bypass, and testing of a range of configurations to optimize upstream and downstream passage. Modelling results can be found in Appendix G.

The hydraulic modeling provides insight as to how the post-refurbishment design would impact the entrance conditions to the fishway and support fish as they migrate towards the dam. Specific

considerations have been made to design and operations plans to allow for improved conditions below and at the fishway entrance. This includes designing for appropriate velocities which will allow for prolonged swimming and burst swimming for species looking to migrate upstream.

The following will be implemented to mitigate or avoid negative impacts to fish passage and optimize upstream and downstream passage, as supported by the 3D modelling exercise:

- The current downstream base flow condition, which is a combination of the required ecological flow of 35 cfs plus standard leakage rates through the dam (approximately 100 cfs total), will be maintained as the minimum ecological flow for optimal fish passage between April 1st to November 30th;
- The current ecological flow for the upper technical (concrete) fish ladder and louver (downstream bypass) system (6 cfs and 29 cfs, respectively), will be maintained;
- Adjustments to attraction flow within the lower (non-technical) section of the fish ladder will be made;
- Modifications to the lower (non-technical) section of the fish ladder will be made to improve upstream passage for all species;
- Modifications to the louver/downstream bypass system will be made to improve downstream passage for all species;
- The remaining base ecological flow (approximately 65 cfs) will be provided using the new vertical lift gates, with the use of the most easterly gate reduced or avoided to avoid sub-optimal flow conditions for upstream passage. NS Power evaluated the releasing of the 65 cfs through a combination of three gates; however, when using all three gates, the center gate would only be open 2 in and each of the outer gates 1 in. NS Power expects that this scenario would be very challenging from an operational perspective as the small opening is expected to clog with debris. When using one gate to release the 65 cfs, the gate would be open approximately 5 in (outer gates) or 4 in (center gate). As such, NS Power is proposing to use the most westerly gate to release the maintenance flow; however, this can be adjusted if required once the dam is in operation;
- Once the dam is constructed, the gate flow will be optimized to provide the best flow conditions for fish using a combination of all three gates, two gates, or just one gate to provide the maintenance flow. refer to Appendix G – Hydraulic Modeling Results for more information;
- Excessive spill will be avoided between May 1st - June 30th where possible. While expected to be infrequent as shown in the modelling, when this is required, it is expected that the duration will be short (1-2 days) and will not negatively affect upstream passage. Should spill be required, the excess water would be released using the vertical lift gates first before moving to the western spillway. If additional spilling is required beyond this, the western rubber dam would be deflated to release water and lastly the eastern rubberdam. Refer to Section 6.0 for operational considerations for the new dam; and,
- Supplemental flows (50 cfs) of 10 or more occurrences will be provided through the gates between the dates of June 15th to July 15th and September 26th to November 30th as per the Sheet Harbour Water Approval, unless otherwise recommended by DFO.

For full hydraulic modeling results and interpretation by Thaumus Environmental, please see Appendix G.

12.2 Professional Evaluation of Upstream and Downstream Fish Passage

In addition to 3D hydraulic modelling, NS Power contracted Wood and Thaumas Environmental consulting firms to complete an evaluation of existing upstream and downstream passage and recommend operational or structural modifications to improve fish passage, as required. Refer to Appendix H – Assessment of Upstream and Downstream Fish Passage for more details. Figure 4 shows a site overview of refurbishments associated with improvements to fish passage as described below.



Figure 4- Site diagram outlining refurbishments associated with upstream and downstream fish passage.

12.2.1 Upstream Fishway Improvements

Results of the 3D hydraulic modeling and professional evaluation determined that improvement to the lower non-technical section of the existing fishway should be made to improve passage for species migrating upstream to complete their lifecycle. The current fishway was originally designed for salmon; the proposed improvements will aim to improve velocity and flow conditions to support other species such as gaspereau. This will, in turn, improve conditions for all species as the swimming capability of gaspereau is the limiting criteria for the fishway. The following improvements are proposed:

- Replace the existing lower non-technical fishway weirs with 11 new concrete weirs, including an additional weir immediately below the upper technical (concrete) fish ladder. The weir at the entrance to the fishway will be placed on a diagonal pointing south-west to provide improved entrance conditions; and

- Relocate the louvre bypass outflow pipe to connect into the fishway to provide additional attraction flow through the fishway. The fishway currently provides a minimum of 6 cfs and the bypass pipe provided a minimum of 29 cfs making the new total coming down through the fishway 35 cfs.

The upper technical fishway will remain unchanged – see Appendix D – Fish Passage Improvement Designs for the drawing details. The drop between pools in the upper technical fishway is 1 ft 2 inches with the depth of water at the lower end of the apron on each notch being 1 ft 3 inches when the operational water depth level at the crest of the notch is 1 ft.

The proposed improvement concept for the non-technical fishway was modelled to verify optimized flow conditions. Refer to Appendix G. Full detailed designs for the improvements to the fishway can be found in Appendix D.

Refer to Figure 5 below, Appendix H – Assessment of Upstream and Downstream Fish Passage and Appendix D - Fish Passage Engineer Designs for more details. These improvements will be made concurrently with the other proposed dam construction activities and are designed to exceed USFWS fish passage design criteria.

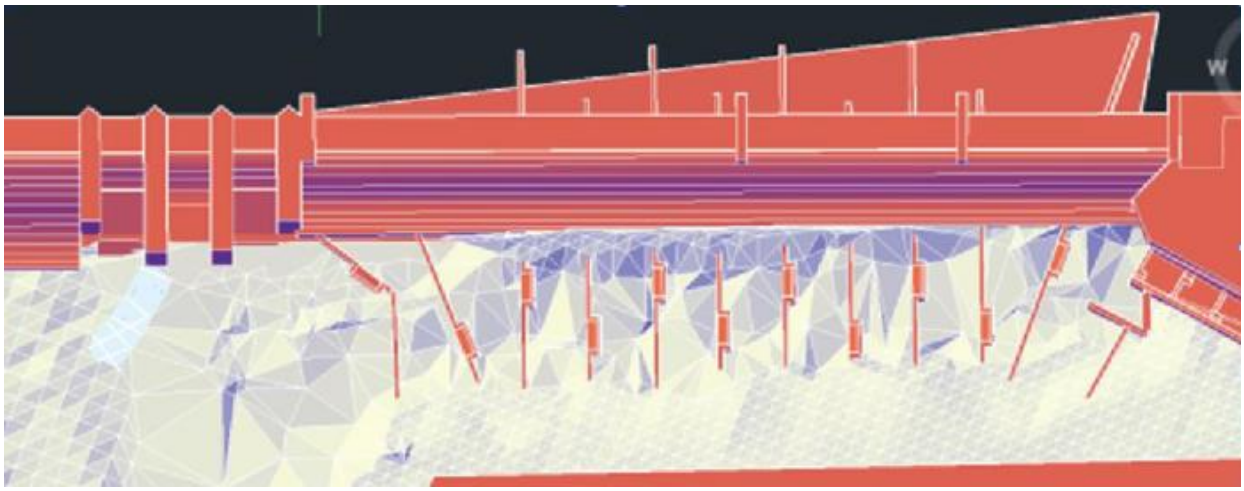


Figure 5 - Fishway Improvements – Layout of 11 weirs

NS Power is proposing post-construction monitoring of the Ruth Falls fishway for a period of two years, starting in spring 2025, to assess effectiveness of the proposed fishway improvements. Details can be found in Appendix K – Monitoring Plan and Appendix Q – Study Plan.

12.2.2 Downstream Louvre System Improvements

The assessment of downstream passage included looking at the existing infrastructure to evaluate the effectiveness of a louvre system at facilitating downstream passage for species that would be required to move downstream of the dam in order to complete their life cycle, and to assess the need for upgrades and general repairs. This included assessing whether the louvre system meets the USFWA Fish Passage

Engineering Design Criteria. A design for proposed improvements was provided to address improvements identified within the assessment (refer to Appendix I – Louvre Assessment and Appendix D for detailed designs). Recommendations for improvement for downstream passage were made and proposed changes to the louver system are as follows:

- Repairs to the existing louvre slats may be required to ensure a complete system. These repairs will be identified when the water is drawdown and canal dewatered in July 2024. Anticipated repairs include replacing partially broken / damaged slats;
- Installation of a trap funnel to prevent upstream movement once fish have moved through the entrance of the bypass. Bottom orifices will also be installed in the stoplogs to support downstream migration. See Figure 6 for more details;
- A ramp is recommended to facilitate movement from the bottom of the water column towards the bypass pipe at the top of the water column. This would benefit those bottom dwelling species such as American eel, Brown bullhead, White suckers etc. by guiding the fish from the bottom to the convergence of the slates in order to find the bypass pipe. Refer to Appendix D for detailed design of the new ramp;
- Realignment of the bypass outfall into the top of the non-technical lower fishway section. The plunge pool water depth will be designed to meet or exceed the USFW criteria for drops of all species and age classes at the site. See Appendix D – Fish Passage Designs to view the placement of the new bypass pipe;

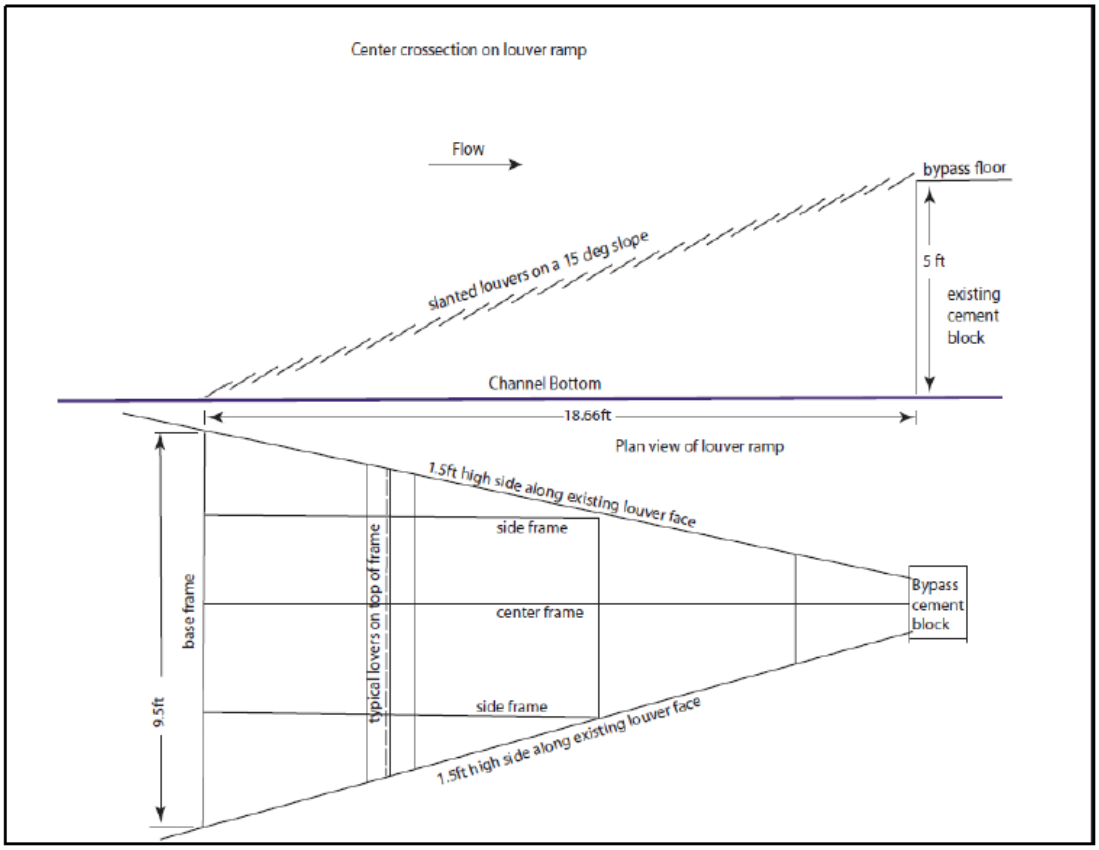


Figure 6- Cross-section view of proposed slanted ramp

Detailed designs of the louvre system improvements can be found in Appendix D. These improvements will be made concurrently with the other proposed dam construction activities.

Upon completion of the proposed improvements to the louvre system, NS Power is committed to completing an eel pit-tagging study to assess how the changes impact the downward migration of eels. The details can be found in Appendix K – Monitoring Plan and Appendix Q – Study Plan.

12.2.3 Upstream Eel Passage

NS Power engaged Wood and Thaumas Environmental to assess and design upstream eel passage to support the upstream migration of elvers and juvenile eels. It was determined through the evaluation that a separate stand-alone structure was required for effective upstream eel passage, beyond the existing fishway. As a result - an eel ramp is being proposed to facilitate upstream eel passage. See Appendix J - Upstream Eel Passage Assessment for full details.

The design consists of a metal enclosed box lined with a climbing substrate and equipped with pumped water to facilitate eel movement up the ramp. The placement of the eel ramp will sit on the outside of the upper technical (concrete) fishway – following the general outline of the fishway up to the headpond. The ramp will eventually cross over the fish ladder with the exit bring placed to the left side of the fish ladder exit at the headpond. A critical component of designing the eel ramp is ensuring the entrance conditions are suitable for eels to access the ramp. The conditions have been deemed suitable for eels to effectively access the eel ramp in the proposed location based on the results of the hydraulic modeling

results assessment (Appendix G). The ramp will be operated by passing a constant stream of water over the rubber substrate in order to support upstream movement of juvenile eels / elvers. Two hoses will be situated at the top of the ramp (near the exit). The first hose will direct water down the ramp and the other will be oriented upwards. The second hose will ensure the substrate is wet at the very top where the eels exit into the headpond. The hoses will be set to provide approximately 5 cfs which allows for a minimum of 1/8 in of water to be provided across the flat sections of the ramp. The water can be adjusted to provide up to 70mm of water depth where needed. This was determined as a suitable amount of water by Thaumas Environmental. Adjustments to the amount of water may be needed once the ramp is in operation based on observations. The Eel ramp will be operated annually between April 1st and November 30th (following the same timeline as the fish ladder). The ramp will be installed concurrently to the proposed dam construction activities. See Figure 7 for more details regarding the eel ramp exterior.

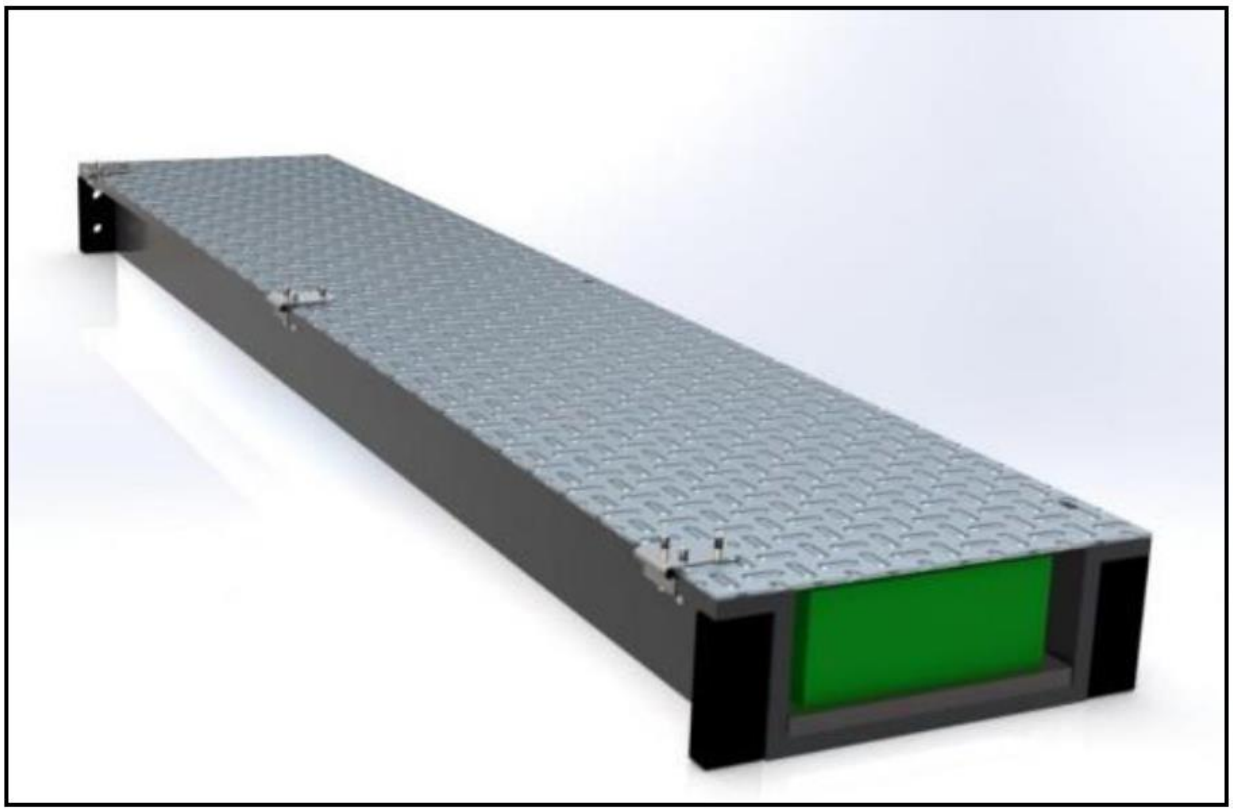


Figure 7 - Aquatic Eel Pass Box

The completion of this assessment and eel ramp designs will look to satisfy DFO's request from the May 5, 2022 Incomplete Letter indicating that a plan for American Eel that includes detailed design drawings, proposed location for fish passage structures and rationale for siting structure(s) in this location, information on proposed operations, and proposed timing of installation was to be provided. For detailed designs of the eel ramp – see Appendix D.

NS Power is committing to assessing the effectiveness of the proposed eel ramp as passing elvers / juvenile eels. Details surrounding the study plan can be found in Appendix K – Monitoring Plan and Appendix Q – Study Plan.

13.0 MEASURES AND STANDARDS TO AVOID OR MITIGATE SERIOUS HARM TO FISH

NS Power recognizes DFO's mitigation hierarchy, which emphasizes that efforts must be made to prevent impact first and, where avoidance is not possible, efforts must be made to minimize impacts. Any residual impacts require authorization and must be addressed by offsetting measures.

Table 9 summarizes the potential effects and mitigation measures to be employed to avoid direct or indirect impacts to fish and fish habitat. A monitoring plan to monitor and assess for residual impacts to fish and fish habitat after measures and standards in Table 9 have been applied can be found in Appendix K – Monitoring Plan.

Table 9 - Summary of potential impacts associated with the Project and mitigation measures to prevent or minimize impacts

Potential Effect	Measure to Mitigate Serious Harm
Temporary loss of fish habitat (approximately 1.15 km^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the headpond approximately 18 ft is required in order to complete work in dry conditions and is a necessary step to facilitate the refurbishment of the Ruth Falls dam. Leaving the headpond within normal operating range as well as conducting a lesser drawdown to a higher elevation were both considered; however both would require substantial cofferdams and bulkheads to isolate work areas. It was determined that for the safety of NS Power and contractor staff during refurbishment and constructability of the new dam, a full drawdown to 91 ft was required. NS Power accepts that the drawdown of Ruth Headpond will result in a temporary HADD of fish habitat and is an impact that cannot be avoided. NS Power is proposing some mitigation to reduce the impact of the temporary drawdown on fish habitat: Lowering the headpond will occur in July and will take approximately 8 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Headpond coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NS Power will lower the headpond to 91ft to create dry conditions while still ensuring enough water is available to maintain a 35 cfs flow below the dam. In addition, offsetting as described in Section 18 is considered appropriate mitigation to offset the temporary loss of habitat (1.15 km^2) during the 2024 season.
Temporary loss of fish habitat due to installation of access road/crossings.	Machinery will be moved from one side of the dam to the other the via temporary bridge crossing downstream of the dam. Should water levels rise beyond 101 ft during construction - the temporary bridge installed downstream will be removed promptly by the contractor using an excavator on site (refer to Section 3.4). Upstream of the dam, two access roads will be placed on either side of the sluiceway while leaving a space in the center for water to flow through and out through the sluiceway bays. The site can only be accessed from the east side. There is no access or potential to create access from the west side; however, it will be accessible once the downstream access roads and bridge are installed. Temporary access will be constructed using clean rockfill materials and totals an estimated temporary footprint of 3,237 m2. This area in already accounted for from an offsetting perspective as the

	temporary access roads sit within the drawdown area. On the upstream side, access roads will be placed after the headpond has been drawn down and a large portion (over 70%) will be installed above 91 ft elevation. All materials will be removed following the work and the site remediated back to its original condition. Fish monitoring and rescue during access road installation will be conducted by qualified individuals.
Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately downstream of the dam, which is primarily bedrock and does not provide spawning habitat or cover for fish, NS Power does not consider this to represent a HADD.
Fish mortality due to stranding when lowering headpond	In order to conduct work in dry conditions, the headpond will be lowered approximately 18 ft below the minimum operating level of 109.25 ft observed from April 1st to November 30th each year. The drawdown of the headpond will be monitored by qualified staff from NS Power Environmental Services to ensure no fish become stranded in pools or low spots. A fish rescue will be completed by qualified staff to capture the fish immediately and move them to deeper faster flowing water. NS Power has proposed a mechanism to evaluate and assess mortality as a result of stranding in the monitoring plan and has proposed offsetting measures to compensate for any mortality.
Fish Mortality due to entrainment during headpond lowering	In order to drawdown Ruth Headpond, the water will be gradually taken down over a period of 8 days. A drawdown schedule is provided section 3.2. The purpose of extending the drawdown over 8 days is to reduce potential for erosion, scour and reduce the likelihood and extent of potential entrainment of early life stage fish below the dam. Typically, Ruth Falls headpond can be lowered in 1 day. Stoplogs will be removed gradually in order for water levels upstream to equalize and discharge downstream to remain within typical volumes and velocities observed at the dam during normal operation. NS Power is proposing entrainment monitoring to evaluate potential entertainment during the drawdown, and has proposed offsetting measures to compensate for any associated fish mortality in Appendix N. See Appendix L-Entrainment Monitoring Plan for more details.
Potential downstream scour during drawdown of reservoir	NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 110.5 ft to the minimum operating level of 109.25 ft. Once the headpond reaches an elevation of 109.25 ft, the drawdown will be controlled using the stop logs in the sluiceway bays. As the reservoir is lowered enough to make the canal non-operational, fish will be prevented from passing downstream through the bypass and therefore, will be able to still move downstream through the sluiceway bays. The drawdown will continue while not exceeding 500 cfs at anytime during the drawdown. The drawdown will continue in this manner until the desired elevation of 91.0 ft is reached. NS Power is not anticipating any additional impacts with respect to erosion/scour or sedimentation during the drawdown as the discharge channel immediately downstream of the dam is comprised of bedrock and boulders. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NSECC, and make necessary repairs in order to stabilize the area.
Inability to provide safe fish passage upstream and downstream during construction	During construction, the fish ladder and fish bypass will be dewatered. The drawdown will be conducted in mid-July to avoid the upstream gaspereau migration season and allow fish to spawn and eggs to hatch. Once the headpond is drawn down, downstream fish passage will be provided via the deep stoplog bays located in the center of the dam. Upstream fish passage will not be provided during construction. Continuous free water passage will be provided through the gate bays

	in order to maintain the desired construction elevation, provide downstream maintenance flows and maintain downstream fish passage. The 35 cfs maintenance flow will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation in order to maintain flow. NS Power may not be able to provide 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumps.
Inability to monitor for salmon while trap is out of service	Given that the salmon trap is tied directly to operation of the fish ladder and the extremely low returns of salmon to the East River Sheet Harbour and absence of salmon caught in the trap for the last number of years, NS Power will not be operating the trap while the fish ladder is dewatered to accommodate construction in 2024NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request in 2024.
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15th – July 15th and September 26th – November 30th. These flows are meant to simulate large rain events, which typically trigger salmon to move upstream. Since 2007, only 11 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018, two in 2019, and one 2020. None were captured in 2021 or 2022. Salmon tend to prefer migrating to the West River of Sheet Harbour. NS Power will also be providing continuous water passage through the sluiceway bays, the amounts of which will vary over the course of construction depending on inflows. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2024 season will cause serious harm to the salmon population. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request.
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NS Power's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. The successful contractor will be required to submit a site-specific erosion and sedimentation control plan prior to start of construction. Significant excavation is not required; therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The headpond will be monitored during dewatering for sediment and the rate of dewatering decreased as required.
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.
Potential effects on upstream and downstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog	As discussed within Section 12.1 - Hydraulic Modeling and Section 12.2.1 Fishway Improvements – improvements are proposed in order to improve the existing fishway to better accommodate all species looking to migrate upstream of the dam. The hydraulic modeling provided insight as to how the post-refurbishment design would impact the entrance conditions to the fishway. Specific considerations have been made to design and operations plans to allow for improved conditions below and at

controlled to rubber dam spillway	the fishway entrance. This includes designing for appropriate velocities to allow for prolonged swimming and burst swimming for species looking to migrate upstream. With respect to loss of some surface downstream passage, NS Power acknowledges that surface downstream passage will not be possible with the new vertical lift gates but also notes that surface passage is still present over top the newly installed rubber dams and free overflow section of the new dam structure, which are both constructed to current full supply level of the dam during April 1-November 30 (110.5 ft). The newly installed rubber dams are remotely operated and are also able to deflate as required to pass additional water. As noted in Section 12.2.2 - Louvre System Improvements, the changes to the louvre system will look to improve the efficiency of overall downstream passage. NS Power has committed to a post construction pit tagging study which will look to illustrate improved efficiency in the louvre system after the improvements are made. See Appendix K – Monitoring Plan for further details. NS Power is proposing post-construction monitoring of the Ruth Falls fishway for a period of two years, starting in spring 2025 to assess effectiveness of the proposed fishway improvements. NS Power is using the results of the hydraulic modeling in design and operational improvement decisions. NS Power does have the ability to make immediate modifications to dam operation, if impacts are observed.

14.0 MONITORING MEASURES

Monitoring will be completed pre-construction, during, and post-construction to ensure mitigation measures proposed for potential impacts identified in Table 9 are effective. NS Power has developed a Monitoring Plan (Appendix K), which outlines the following:

- Fish Rescue,
- Entrainment Monitoring (further information provided as Appendix L),
- Fish habitat delineation,
- Construction monitoring,
- Wetland Monitoring (further information provided as Appendix M),
- Fishway Improvements Monitoring,
- Louvre Improvements Monitoring,
- Upstream eel passage Monitoring, and
- Post-construction monitoring activities.

A Project-specific environmental protection plan (EPP) will be developed to address all potential environmental risks associated with the Project and will include appropriate incident reporting procedures and key contacts. The Contractor will be required to review the EPP and provide training to all staff with respect to its contents.

15.0 CONTINGENCY MEASURES

Should issues arise, the situation will be immediately assessed, and decisions made regarding alternate methods by the Contractor, Project Manager, Engineers, Environmental Services, and Hydro Operations.

Should mitigation measures prove to be ineffective, work will be stopped and issues reported to NS Power for resolution and reporting as required. By following the EPP, providing environmental orientation, providing appropriate supervision, conducting frequent inspections, and monitoring weather forecasts, it is not anticipated that there will be significant issues with the proposed mitigation. Contingency planning is also considered regarding water management. Should unexpected inflows be received, NS Power will implement contingencies to safely pass water. This includes the use of all three sluiceway bays and the spillway bay opening to pass additional water.

16.0 DEATH OF FISH AND HARMFUL ALTERATION, DISRUPTION, OR DESTRUCTION OF FISH HABITAT AFTER IMPLEMENTATION OF MEASURES AND STANDARDS

Table 10 below provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Dam refurbishment. No permanent impacts to the East River of Sheet Harbour or to Ruth Falls Headpond (beyond the 60 m^2 new dam footprint) in relation to its qualitative, chemical, and physical characteristics are anticipated as a result of the Project for the new dam structure. There is a temporary direct loss of fish habitat as well as anticipated residual death of fish as a result of the drawdown. Compensation measures for these impacts have been proposed in Section 18.

Table 10 - Residual Harm from Potential Impacts Associated with the Ruth Falls Dam Refurbishment

Potential Effect	Measure to Mitigate Serious Harm	Potential Residual Serious Harm to Fish
Temporary loss of fish habitat (approximately 1.15 km^2) due to lowering of the reservoir beyond the minimum operating level observed from April 1 – Nov. 30 annually.	Lowering the headpond approximately 18 ft is required in order to complete work in dry conditions and is a necessary step to facilitate the refurbishment of the Ruth Falls dam. Leaving the headpond within normal operating range as well as conducting a lesser drawdown to a higher elevation were both considered; however both would require substantial cofferdams and bulkheads to isolate work areas. It was determined that for the safety of NS Power and contractor staff during refurbishment and constructability of the new dam, a full drawdown to 91 ft was required. NS Power accepts that the drawdown of Ruth Headpond will result in a temporary HADD of fish habitat and is an impact that cannot be avoided. NS Power is proposing some mitigation to reduce the impact of the temporary drawdown on fish habitat: Lowering the headpond will occur in July and will take approximately 8 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low. A flow of 45 cfs from Malay Falls will continue to flow through Ruth Falls Headpond coupled with natural inflows from Grant River and other sources will provide enough water for salmon and sea trout to spawn in Grant River. NS Power will lower the headpond to 91 ft to create dry conditions while still ensuring	Temporary direct loss. Offsetting proposed. Some residual harm anticipated

	enough water is available to maintain a 35 cfs flow below the dam. In addition, offsetting as described in section 18 is considered appropriate mitigation to offset the temporary loss of habitat (1.15 km^2) during the 2024 season.	
Temporary loss of fish habitat due to installation of access road/crossings.	Machinery will be moved from one side of the dam to the other via temporary bridge crossing downstream of the dam. Should water levels rise beyond 101 ft during construction - the temporary bridge installed downstream will be removed promptly by the contractor using an excavator on site (refer to Section 3.4). Upstream of the dam, two access roads will be placed on either side of the sluiceway while leaving a space in the center for water to flow through and out through the sluiceway bays. The site can only be accessed from the east side. There is no access or potential to create access from the west side; however, it will be accessible once the downstream access roads and bridge are installed. Temporary access will be constructed using clean rockfill materials and totals an estimated temporary footprint of 3,237 m2. This area is already accounted for from an offsetting perspective as the temporary access roads sit within the drawdown area. On the upstream side, access roads will be placed after the headpond has been drawn down and a large portion (over 70%) will be installed above 91 ft elevation. All materials will be removed following the work and the site remediated back to its original condition. Fish monitoring and rescue during access road installation will be conducted by qualified individuals.	No residual harm anticipated
Loss of ~60 m^2 of fish habitat in the East River of Sheet Harbour	The amount of new footprint has been optimized to meet stability requirements for the dam. Given the habitat loss is immediately downstream of the dam, which is primarily bedrock and does not provide spawning habitat or cover for fish, no residual harm is anticipated.	No residual harm anticipated
Fish mortality due to stranding when lowering headpond	In order to conduct work in dry conditions, the headpond will be lowered approximately 18 ft below the minimum operating level of 109.25 ft observed from April 1st to November 30th each year. The drawdown of the headpond will be monitored by qualified staff from NS Power Environmental Services to ensure no fish become stranded in pools or low spots. A fish rescue by qualified staff will take place to capture the fish immediately and move them to deeper faster flowing water. NS Power has proposed a mechanism to evaluate and assess mortality as a result of stranding in the monitoring plan in Appendix N and has proposed offsetting measures to compensate for any mortality.	Some residual harm anticipated. Offset proposed
Fish Mortality due to entrainment during headpond lowering	In order to drawdown Ruth Headpond, the water will be gradually taken down over a period of 8 days. A drawdown schedule is provided in Section 3.2. The purpose of extending the drawdown over 8 days is to reduce potential for erosion, scour and reduce the likelihood and extent of potential entrainment of early life stage fish below the dam. Typically, Ruth Falls headpond can be lowered in 1 day. Stoplogs will be removed gradually in order for water levels upstream to equalize and discharge downstream to remain within typical volumes and velocities observed at the dam during normal operation. NS Power is proposing entrainment monitoring to evaluate potential entertainment during the drawdown, and has proposed offsetting	Some residual harm anticipated. Offset proposed.

	measures to compensate for any associated fish mortality in Appendix N. See Appendix L- Entrainment Monitoring Plan for more details.	
Potential downstream scour during drawdown of reservoir	NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 110.5 ft to the minimum operating level of 109.25 ft. Once the headpond reaches an elevation of 109.25 ft, the drawdown will be controlled using the stop logs in the sluiceway bays. As the reservoir is lowered enough to make the canal non-operational, fish will be prevented from passing downstream through the bypass and therefore, will be able to move downstream through the sluiceway bays. The drawdown will continue while not exceeding 500 cfs at anytime during the drawdown. The drawdown will continue in this manner until the desired elevation of 91.0 ft is reached. NS Power is not anticipating any additional impacts with respect to erosion/scour or sedimentation during the drawdown as the discharge channel immediately downstream of the dam is comprised of bedrock and boulders. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will slow the drawdown in order to prevent further damage, as well as report the occurrence to NSECC, and make necessary repairs in order to stabilize the area.	No residual harm anticipated
Inability to provide safe fish passage upstream and downstream during construction	During construction, the fish ladder and fish bypass will be dewatered. The drawdown will be conducted in mid-July to avoid the upstream gaspereau migration season and allow fish to spawn and eggs to hatch. Once the headpond is drawn down, downstream migration will be provided via the deep stoplog bays located in the center of the dam. Upstream fish passage will not be provided during construction. Continuous free water passage will be provided through the gate bays in order to maintain the desired construction elevation, provide downstream maintenance flows and maintain doenstream fish passage. The 35 cfs maintenance flow will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation in order to maintain flow. NS Power may not be able to provide the entire 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumps.	No residual harm anticipated
Inability to monitor for salmon while trap is out of service	Given that the salmon trap is tied directly to operation of the fish ladder and the extremely low returns of salmon to the East River Sheet Harbour and absence of salmon caught in the trap for the last number of years, NS Power will not be operating the trap while the fish ladder is dewatered to accommodate construction in 2024. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request in 2024.	No residual harm anticipated

Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released	Restrictions to water management required in order to conduct work in dry conditions do not allow for release of supplemental flows provided annually from June 15th – July 15th and September 26th – November 30th. These flows are meant to simulate large rain events, which typically trigger salmon to move upstream. Since 2007, only 11 salmon have moved upstream into Ruth Falls. There were no salmon observed in 2017 and 2018, two in 2019, and one in 2020 .None were captured in 2021 or 2022. Salmon tend to prefer migrating to the West River of Sheet Harbour. NS Power will also be providing continuous water passage through the sluiceway bays, the amounts of which will vary over the course of construction depending on inflows. Given the low numbers of salmon observed in the East River of Sheet Harbour, it is not expected that the lack of supplemental flows for the 2024 season will cause serious harm to the salmon population. NS Power will seek a variance to the Sheet Harbour Water Approval to permit this request.	No residual harm anticipated
Effects to fish and fish habitat due to sedimentation of the river from construction activities	NS Power's best practices for erosion and sedimentation controls will be employed to prevent sedimentation transport into the river and reservoir. The successful contractor will be required to submit a site-specific erosion and sedimentation control plan prior to start of construction. Significant excavation is not required; therefore, sedimentation from exposed slopes is not likely. Temporary access for machinery will be constructed using geotextiles and clean rockfill materials. All work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Erosion and sedimentation control devices such as silt fencing, mulch, straw, hay and/or geotextile will be employed as required. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e. settling areas or silt bags) before reaching a watercourse. Weather conditions will be monitored and proactive steps taken as required to prevent erosion and sedimentation issues, particularly during the fall when larger precipitation events can occur. The headpond will be monitored during dewatering for sediment and the rate of dewatering decreased as required.	No residual harm anticipated
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site.	No residual harm anticipated
Potential effects on upstream and downstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway	As discussed within Section 12.1 - Hydraulic Modeling and Section 12.2.1 Fishway Improvements – improvements are proposed in order to improve the existing fishway to better accommodate all species looking to migrate upstream of the dam. The hydraulic modeling provided insight as to how the post-refurbishment design would impact the entrance conditions to the fishway. Specific considerations have been made to design and operations plans to allow for improved conditions below and at the fishway entrance. This includes designing appropriate velocities to allow for prolonged swimming and burst swimming for species looking to migrate upstream.	No residual harm anticipated

	With respect to loss of some surface downstream passage, NS Power acknowledges that surface downstream passage will not be possible with the new vertical lift gates but also notes that surface passage is still present over top the newly installed rubber dams and free overflow section of the new dam structure, which are both constructed to current full supply level of the dam during April 1st - November 30th (110.5 ft). The newly installed rubber dams are remotely operated and are also able to deflate as required to pass additional water. As noted in Section 12.2.2 - Louvre System Improvements, the changes to the louvre system will look to improve the efficiency of overall downstream passage. NS Power has committed to a post construction pit tagging study which will look to illustrate improved efficiency in the louvre system after the improvements are made. See Appendix K – Monitoring Plan for further details. NS Power is proposing post-construction monitoring of the Ruth Falls fishway for a period of two years, starting in spring 2025 to assess effectiveness of the proposed fishway improvements. NS Power is using the results of the hydraulic modeling in design and operational improvement decisions. NS Power does have the ability to make immediate modifications to dam operation, if impacts are observed.	

17.0 HABITAT CREDIT

Habitat Credits will not be used as an offset for death of fish or the harmful alteration, disruption, or destruction of fish habitat.

18.0 OFFSETTING CREDIT

NS Power is proposing, in partnership with the Mi'kmaw Conservation Group (MCG) and the Nova Scotia Salmon Association (NSSA), a restoration project that is suitable for offsetting of serious harm for the Ruth Falls Dam refurbishment as described in Table 13. MCG has provided an offsetting plan to NS Power which outlines the proposed project. The project includes improvements to fish migration and fish habitat by restoring suitable instream and streambank habitat on the West River Sheet Harbour watershed. MCG will provide oversight and guidance on the project and will also collaborate with the Millbrook First Nations Community on the project in order to potentially engage community members to implement habitat offset work. The attached offsetting plan has been adjusted to only include the offsetting for Ruth Falls (previous iterations included offsetting for another NSP project – Sloane Dam Refurbishment – which is no longer the case). The offsetting blocks are based on 1350 m^2 (structures spaced 90 m along the river and an offsetting width of 15 m). As a result, two blocks are being proposed to offset Ruth Falls for a total of 2700 m^2 which is reflected in the updated plan. Please see Appendix N - Offsetting Plan for details.

The offset project is intended to compensate for HADD and death of fish associated with the Project, as follows:

- Temporary HADD of up to approximately 1.15 km^2 (115 hectares) of littoral zone habitat that fish species use for a portion of their life cycle form drawdown activities.

- Temporary HADD of wetland fish habitat from drawdown activities.
- Death of fish due to entrainment from drawdown activities.
- Death of fish due to stranding from drawdown activities.

With respect to the potential temporary HADD, NS Power considered a direct 2:1 or even 1:1 compensation for the 1.15 km2 of temporary habitat disruption, plus any additional disruption of wetland fish habitat, to be unfeasible and not commensurate with the project (i.e to find, fund and execute an offset project of 1,000,000 m2 at minimum). It is NS Power's understanding that there are no specific guidelines on compensation for a temporary habitat disruption associated with a drawdown. NS Power's approach, in following DFO's offsetting policy, was to find a quality offset in close proximity to the Ruth Falls dam that targeted similar habitat and species that will be impacted by the drawdown. The proposed offset project is on the west river, where ongoing salmon (SAR) habitat restoration and enhancement is taking place, including liming to improve water quality. The high quality offset also comes with a high cost of $320.813.44 as indicated below. Based on other offset projects, this project is significantly more costly.

The offset is also intended to capture impacts related to death of fish from stranding and/or entrainment from the drawdown. Without knowing the results of the entrainment study (how many fish have been entrained and what this number represents in terms of actual losses), NS Power used the approach outlined above to come up with a suitable offset. It is NS Power's understanding that habitat restoration is an acceptable way to offset for death of fish. The focus of the offset was on location, target species and quality of habitat restored, knowing the impossibility of finding and executing habitat restoration projects at a size that would be needed to directly link habitat requirements for fish that may have died as a result of entrainment.

The offset project was also developed in partnership with MCG and Millbrook First Nation and restoration work on this river is of interest to the community.

The following is a summary of the offset project execution:

Year One (1): Finalize the footprint of the restoration area, conducting any pre-monitoring activities needed (incorporating any relevant and available data in the baseline), securing all permitting and permissions, and finalizing a post monitoring plan. The pre-monitoring report can be found in Appendix N. This work occurred in 2022.

Year Two (2): Complete second round of pre-monitoring. This work is proposed for 2023.

Year Three (3) Perform largescale restoration work within the middle section (between two previously restored areas by the NSSA) of the West River. This work is proposed for 2024.

Year Three (3) through seven (7): Post monitoring of sites where offsetting work was completed. Post-offset monitoring will be completed in years three (3), five (5), and seven (7). A final report will be completed at the end of year seven (7). This work is proposed for 2025, 2027, and 2029.

NS Power has obtained a letter of credit for the offset project for the value of $343.032.00. The amount of the letter of credit was originally estimated based on the cost for a previous offsetting plan developed by MCG for a project conducted at the Trenton Generating Station in 2019 at $62,000 but has since been

updated. The value put forward in the Letter of Credit exceeds the total value of the proposed offsetting work put forward in Appendix N which is equal to $320.813.44. A Letter of Credit for $$343,032.00 is presented in Appendix O reflecting an updated expiry of December 31st, 2025.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Reservoir Bathymetry
3. Ruth Falls Reservoir Location of Structures

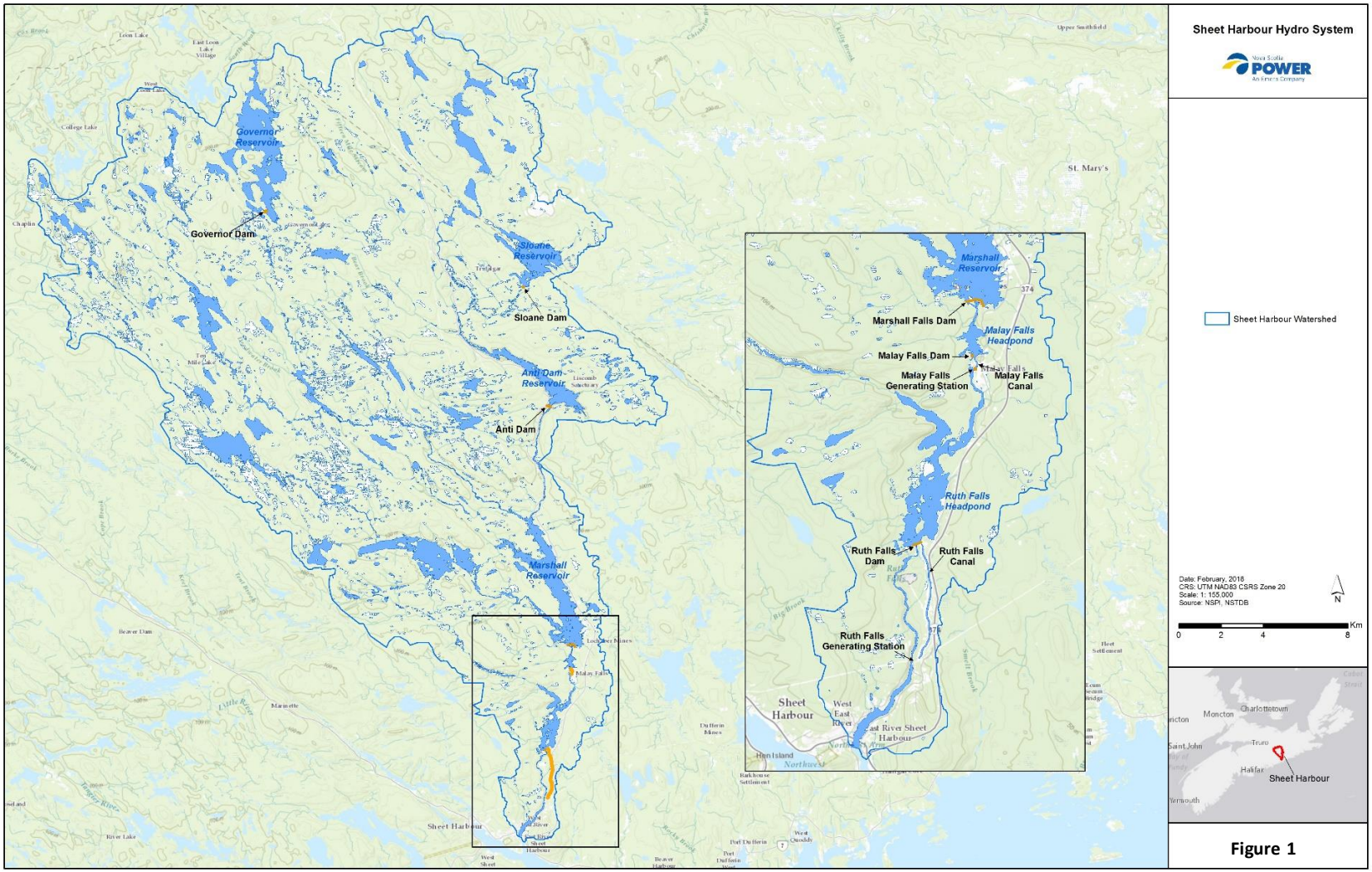

Sheet Harbour Hydro System
Nova Scotia POWER
An Emera Company
Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
Sheet Harbour Watershed
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1: 155,000
Source: NSPI, NSTDB
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Moncton
Charlottetown
Saint John
Truro
Halifax
Sheet Harbour
Yarmouth

Figure 1

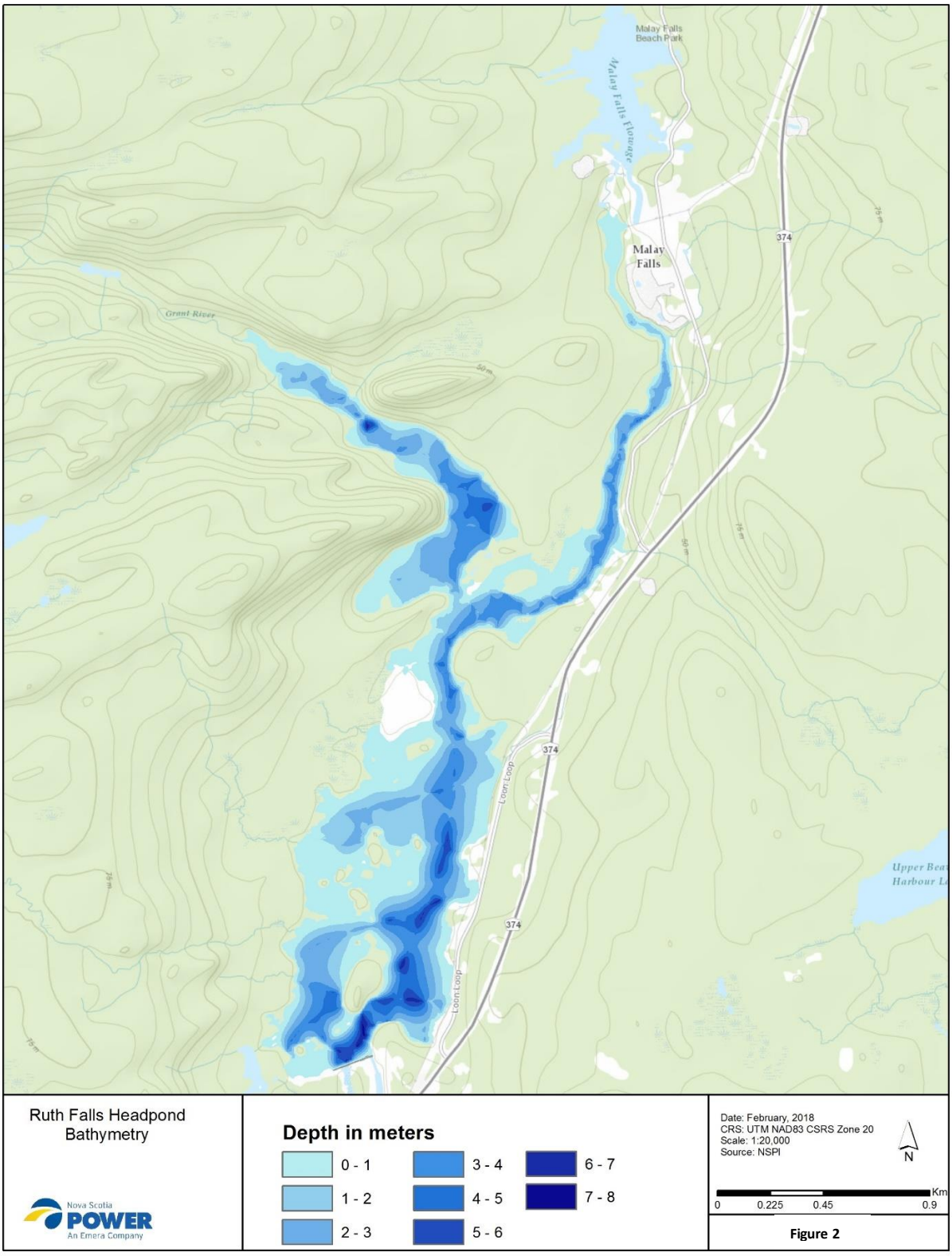

Malay Falls Beach Park
Malay Falls Tramway
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Bea
Harbour L
Ruth Falls Headpond Bathymetry
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
N
Km
0
0.225
0.45
0.9
Nova Scotia POWER
An Emera Company

Figure 2


Ruth Falls Fish Ladder
Ruth Falls Canal
Ruth Falls Dam/ Spillway
Ruth Falls Spillway Channel
November 2, 2017
GeoBase_AboriginalLands
Wetland of Special Significance
NSDNR Wetland Inventory
Existing and Pending Protected Areas
Protected Watershed
Municipal Water Supply
Parks
DNR-RLUL
1:4,514
0 0.035 0.07
0 0.0425 0.085 0.17 km
DNR, NSE, IBA
Nova Scotia Environment, courtesy of the Nova Scotia Departme

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

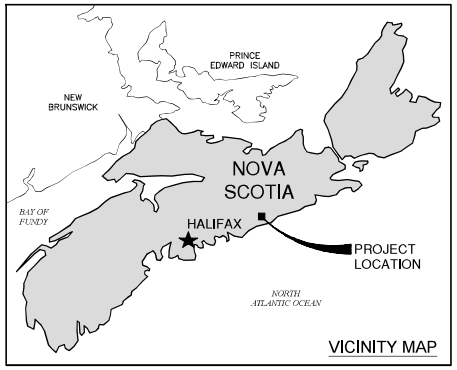
APPENDIX C – ENGINEERING DRAWINGS – DAM STRUCTURE

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NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
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SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-052
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-056
320-01	NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-057
320-02	NEW STEEL GRATED ACCESS PLATFORM	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-060

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GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON-SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21-350W.
     - III. STEEL PLATE: ASTM A-36, OR CSA G40.21-300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6-8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/- 25mm (4" +/- 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F-1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI-HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON-SHRINK GROUT: CRD-C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C-827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C-109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON-WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D-3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN-PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310-04 FOR EARTHWORK.

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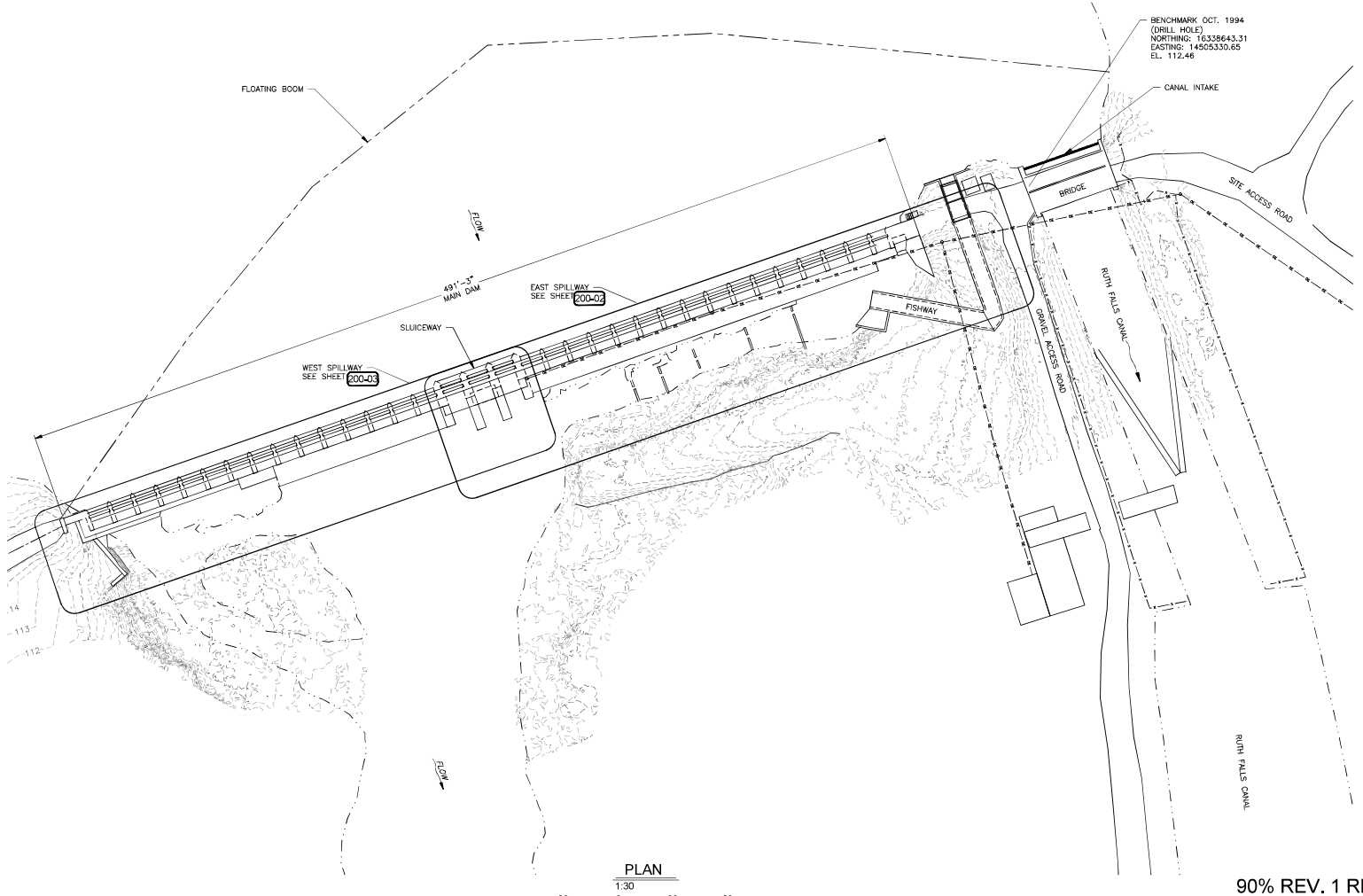
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GENERAL NOTES

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PLAN
1:30
30 0 30 60
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

200-01

Kleinschmidt

J:\1890018\Drawings\Working Drawings\1890-018 200-01.dwg
PRINTED Dec. 9, 2020 - 2:53 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	-----	E & I	-----
MECH	-----	CONST	-----

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED ---
DATE 2020-12-11
W.O. XXXX

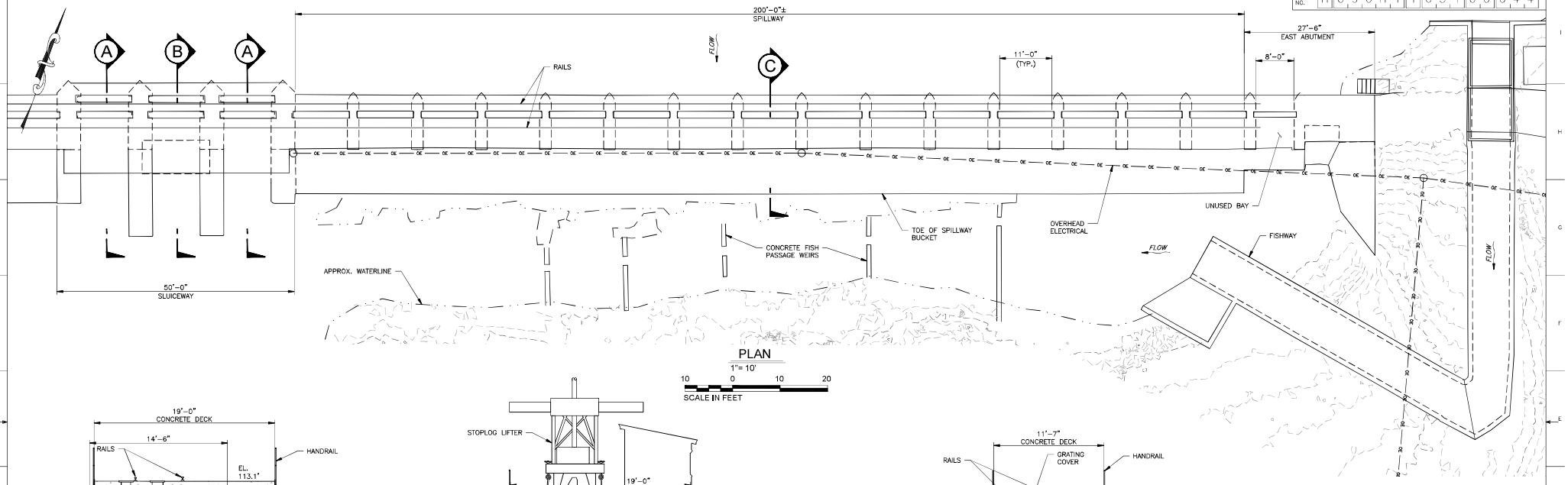
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

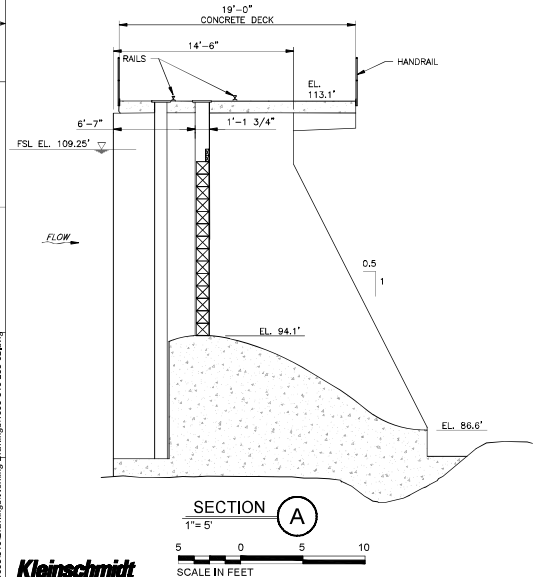
EXISTING CONDITIONS
OVERALL SITE PLAN

DWG.NO. H096H1163100043 REV. C

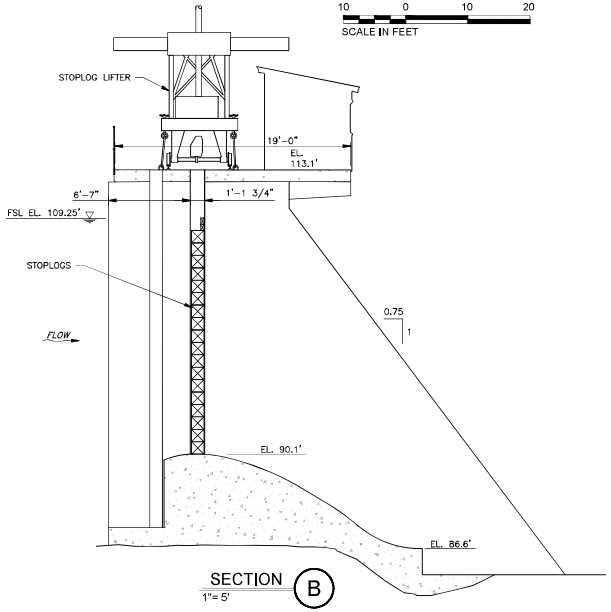
DWG. NO. H096H1163100044



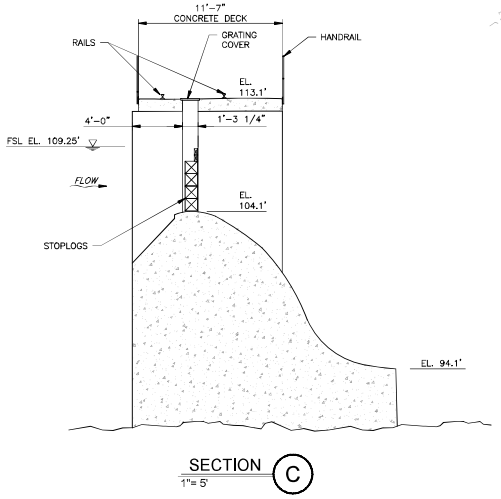
PLAN
1"= 10'
10 0 10 20
SCALE IN FEET



SECTION A
1"= 5'



SECTION B
1"= 5'



SECTION C
1"= 5'

5 0 5 10
SCALE IN FEET

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NOT FOR CONSTRUCTION

200-02

Kleinschmidt

J:\189\0018\Drawings\Working Drawings\189D-018-200-02.dwg
PRINTED Dec. 11, 2020 - 2:32 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____
MECH _____ CONST _____

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ---
CHECKED ---
DATE 2020-12-11
W.O. XXXX

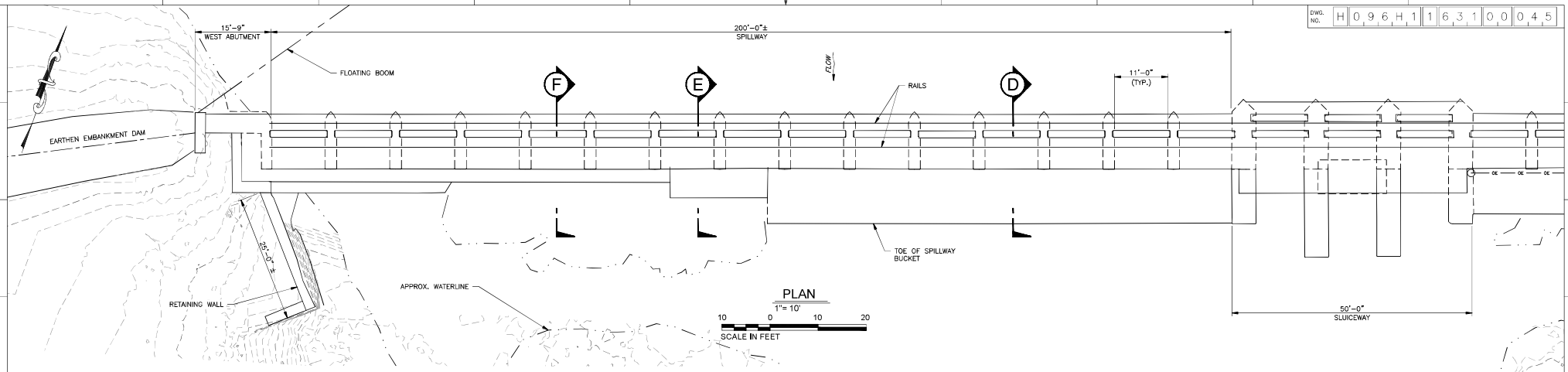
Nova Scotia POWER An Emera Company energy everywhere.

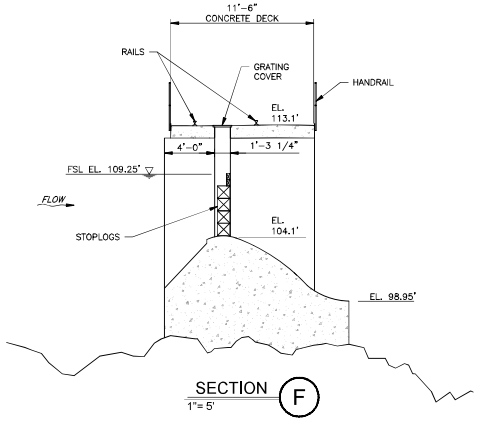
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

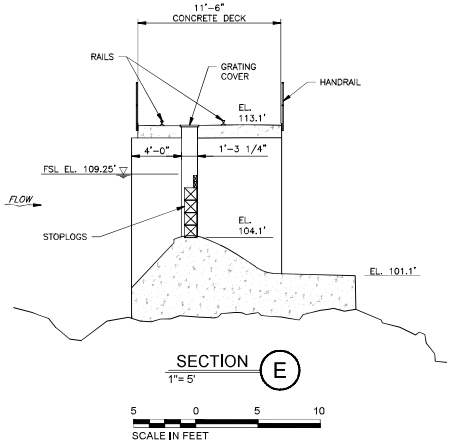
EXISTING CONDITIONS EAST SPILLWAY
PLAN AND SECTION

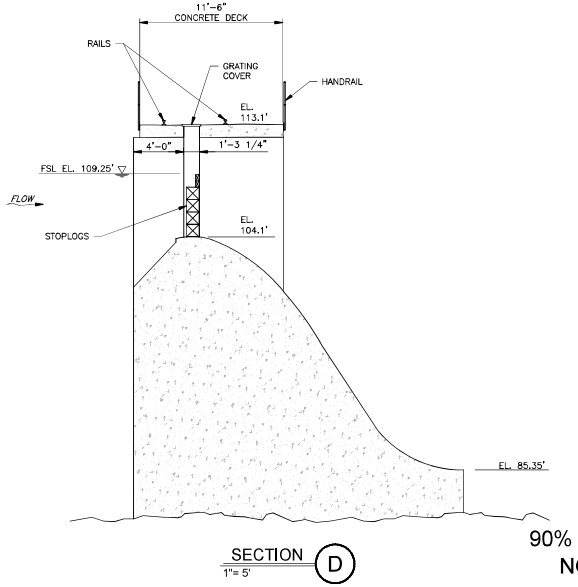
DWG.NO. H096H1163100044 REV. C

DWG. NO. H096H1163100045









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NOT FOR CONSTRUCTION

Kleinschmidt

200-03

J:\1690\018\Drawings\Working Drawings\1690-018-200-03.dwg
PRINTED: Dec. 9, 2020 - 3:36 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

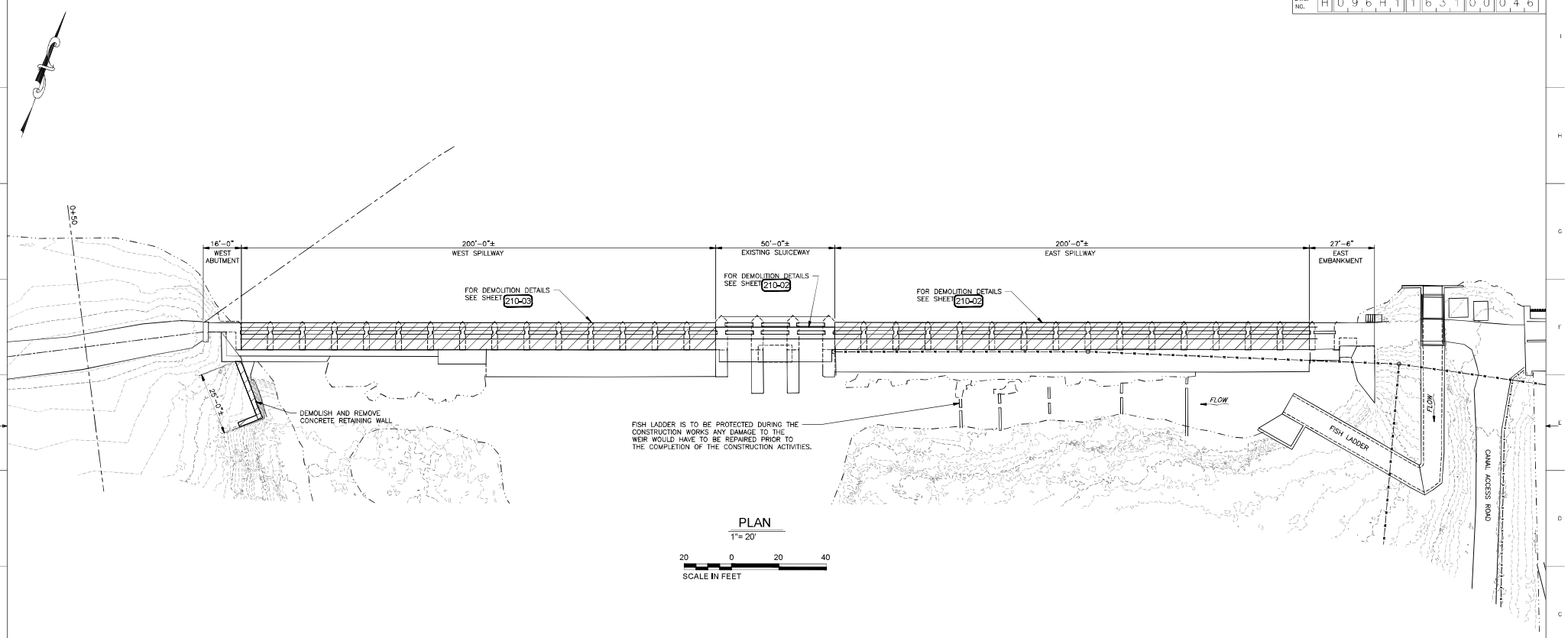
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS WEST SPILLWAY
DAM PLAN AND SECTIONS

DWG.NO. H096H1163100045 REV. C

DWG. NO. H096H1163100046



PLAN

1"= 20'

20 0 20 40

SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

210-01

J:\1690018\Drawings\Working Drawings\1690-218 210-01.dwg
PRINTED Dec. 9, 2020 - 2:55 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.											

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-11

W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

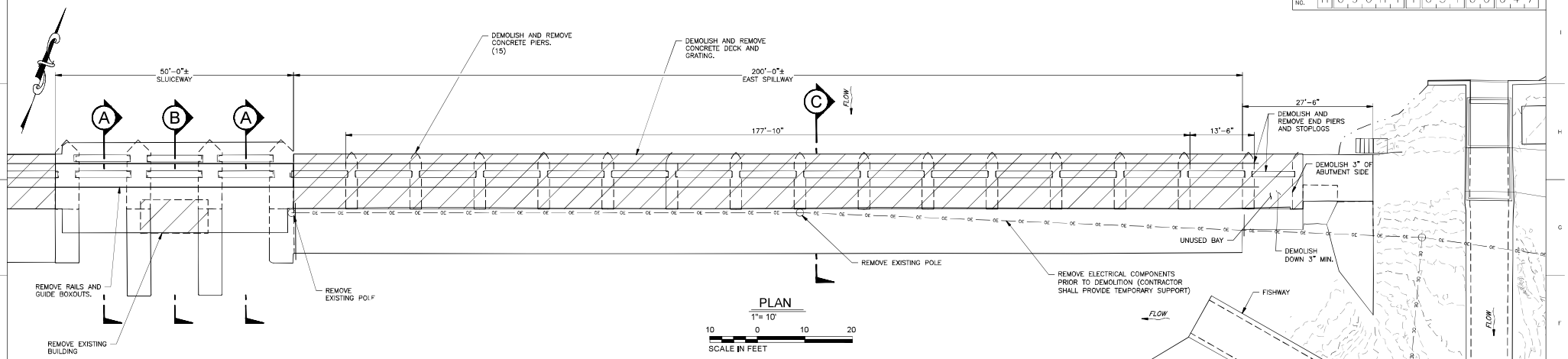
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

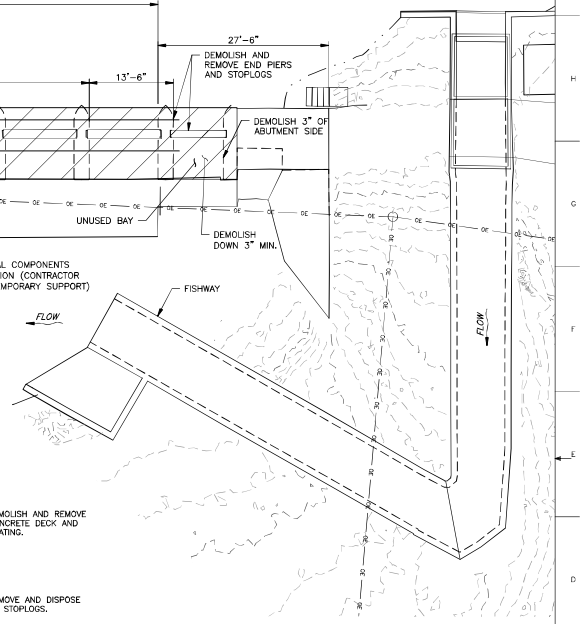
TEMPORARY CONDITIONS/DEMO PLAN

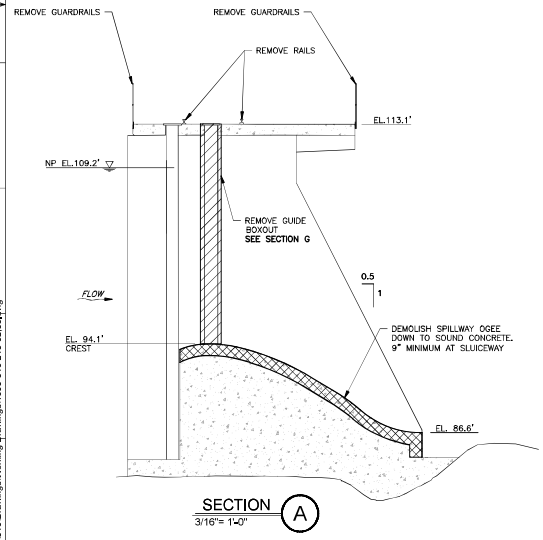
DWG.NO. H096H1163100046 REV. C

DWG. NO. H096H1163100047

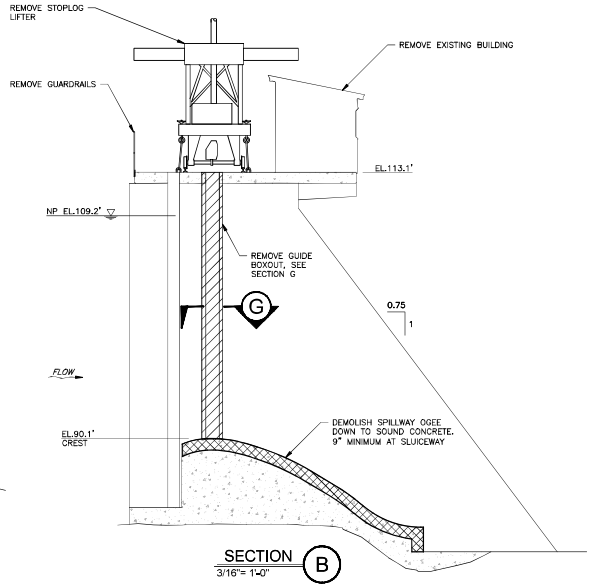


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

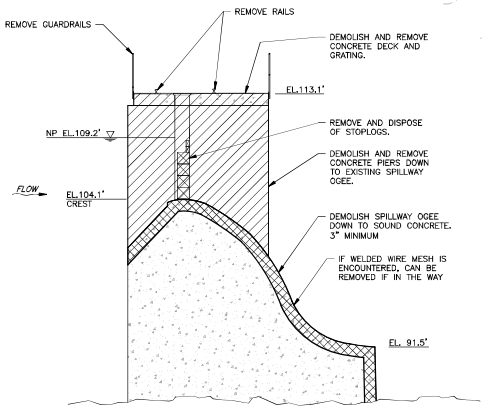




SECTION A
3/16"= 1'-0"

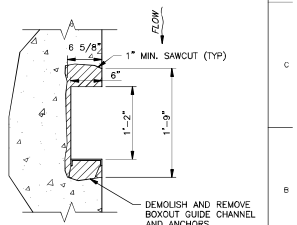


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

210-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-____-____

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	--
CHECKED	--
DATE	2020-12-11
W.O.	XXXX

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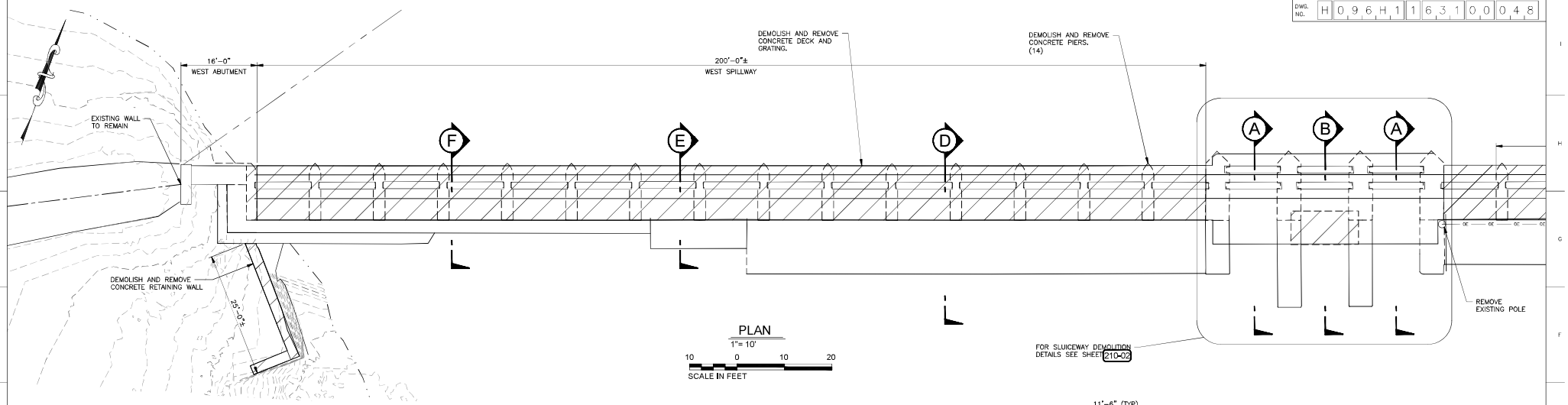
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

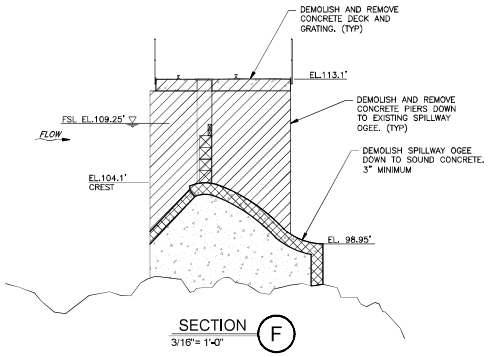
DWG.NO. H096H1163100047 REV. C

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DWG. NO. H096H1163100048

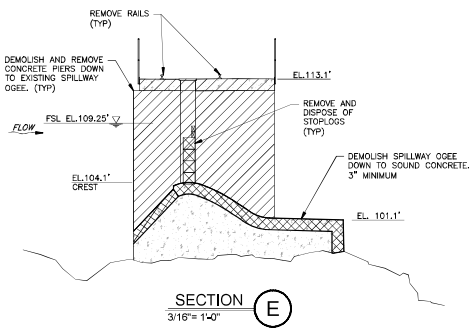


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

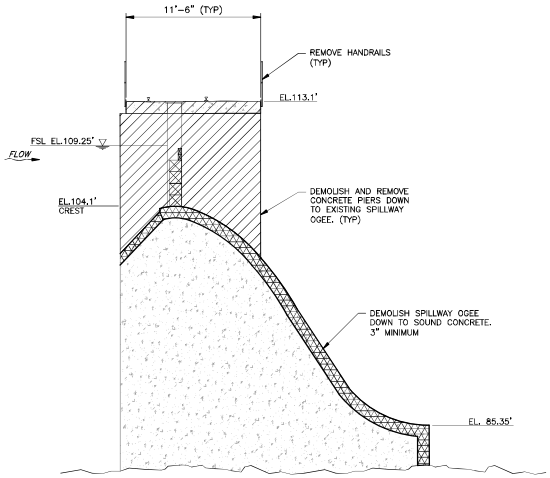


SECTION F
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION D
3/16"= 1'-0"

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Kleinschmidt

210-03

PRINTED Dec. 11, 2020 - 9:55 AM
J:\1890018\Drawings\Working Drawings\1890-018 210-02,03.dwg

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED ---
DATE 2020-12-11
W.O. XXXX

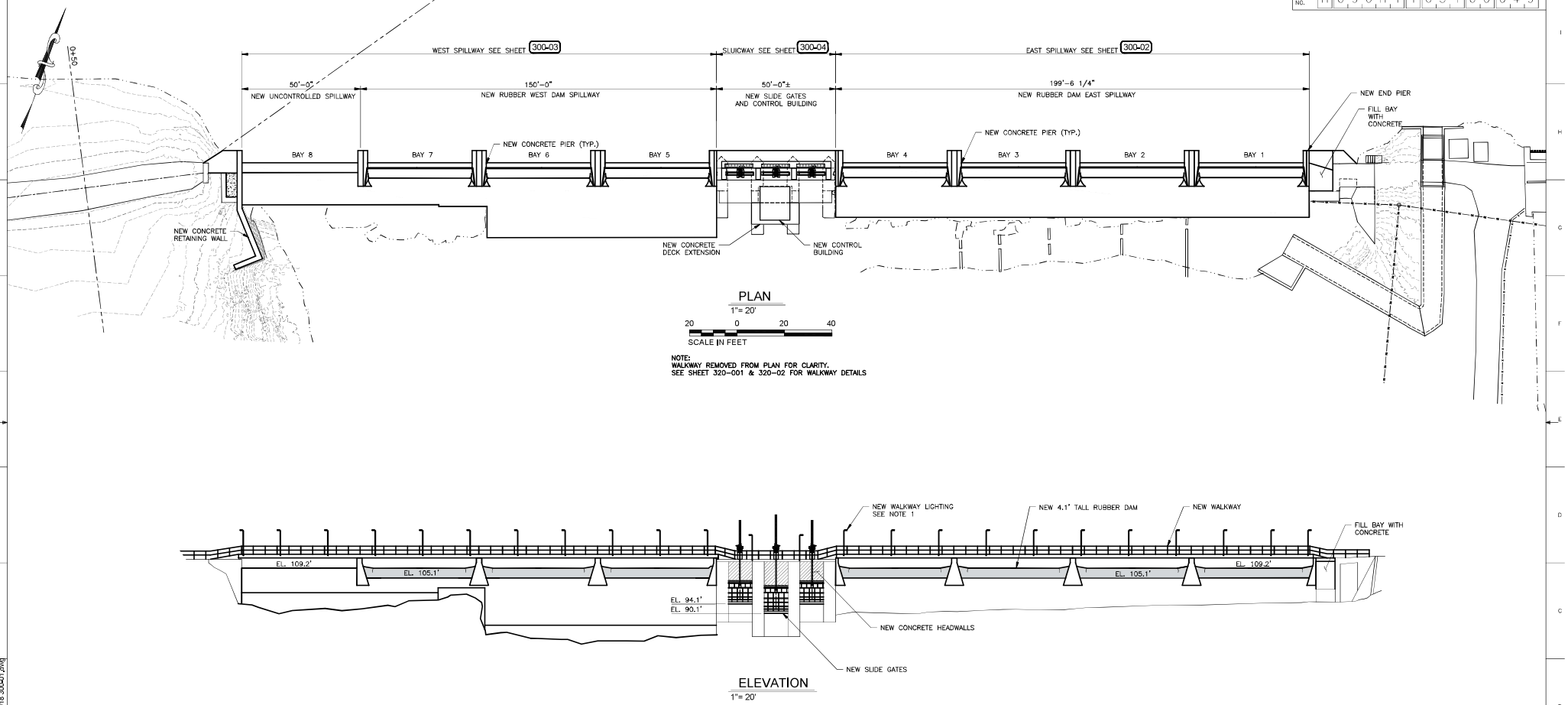
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. C

DWG. NO. H096H1163100049



NOTE:
1. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-01

J:\1890\018\Drawings\Working Drawings\189D-018 300-01.dwg
PRINTED Dec. 9, 2020 - 3:37 PM

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REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

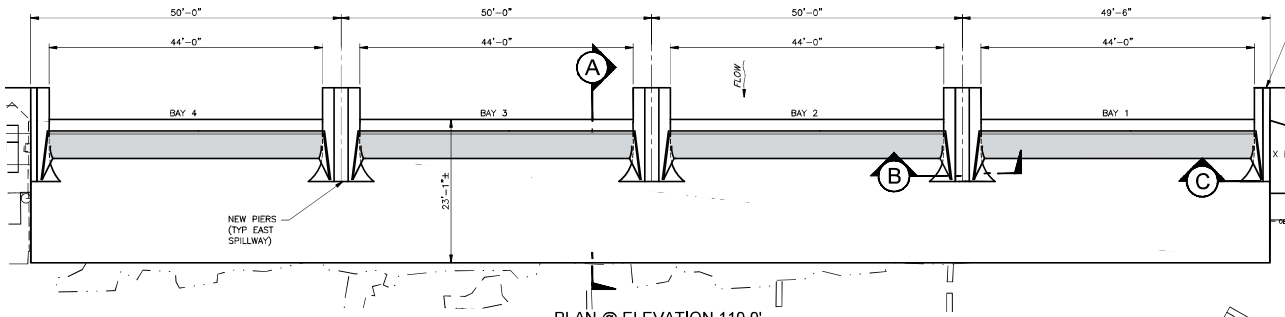
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

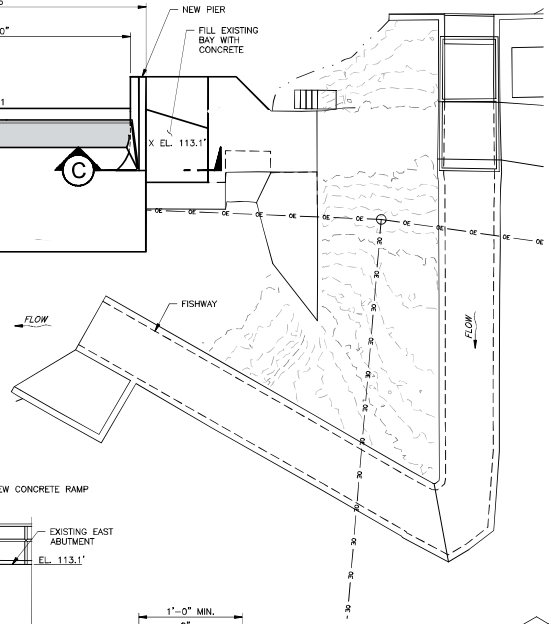
NEW CONDITIONS
DAM PLAN AND ELEVATION

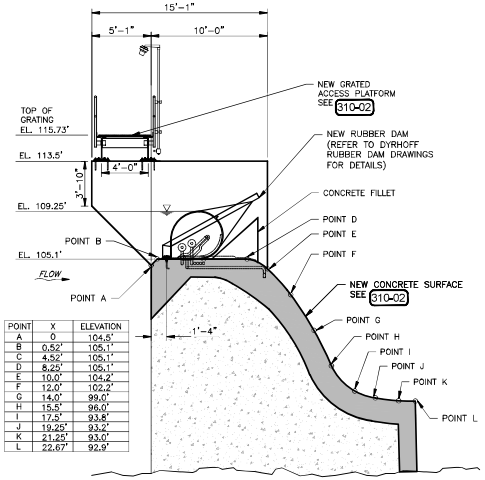
DWG.NO. H096H1163100049 REV. C

DWG. NO. H096H1163100050



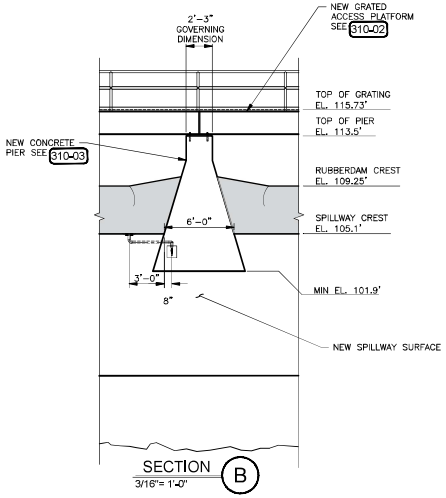
PLAN @ ELEVATION 110.0'
1"= 10'
10 0 10 20
SCALE IN FEET



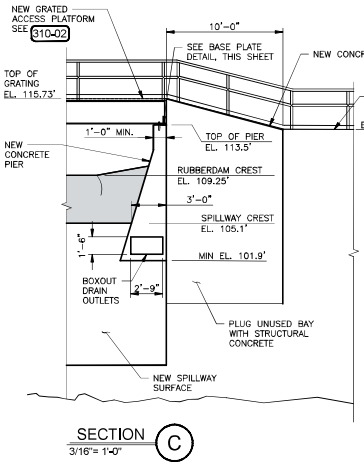


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5'	93.8'
J	19.25'	93.2'
K	21.25'	93.0'
L	22.67'	92.9'

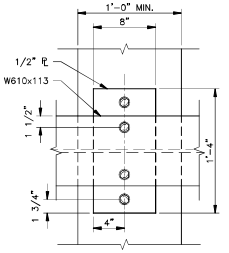
SECTION A
3/16"= 1'-0"
4 0 4 8 12
SCALE IN FEET



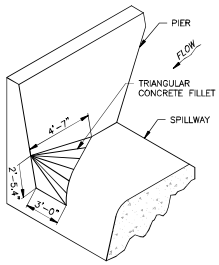
SECTION B
3/16"= 1'-0"



SECTION C
3/16"= 1'-0"



TYPICAL END PIER
BASE PLATE DETAIL
1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.

90% REV. 1 REVIEW SUBMITTAL
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300-02

J:\1690\018\Drawings\Working Drawings\1690-018-300-02.03.04.dwg
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REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

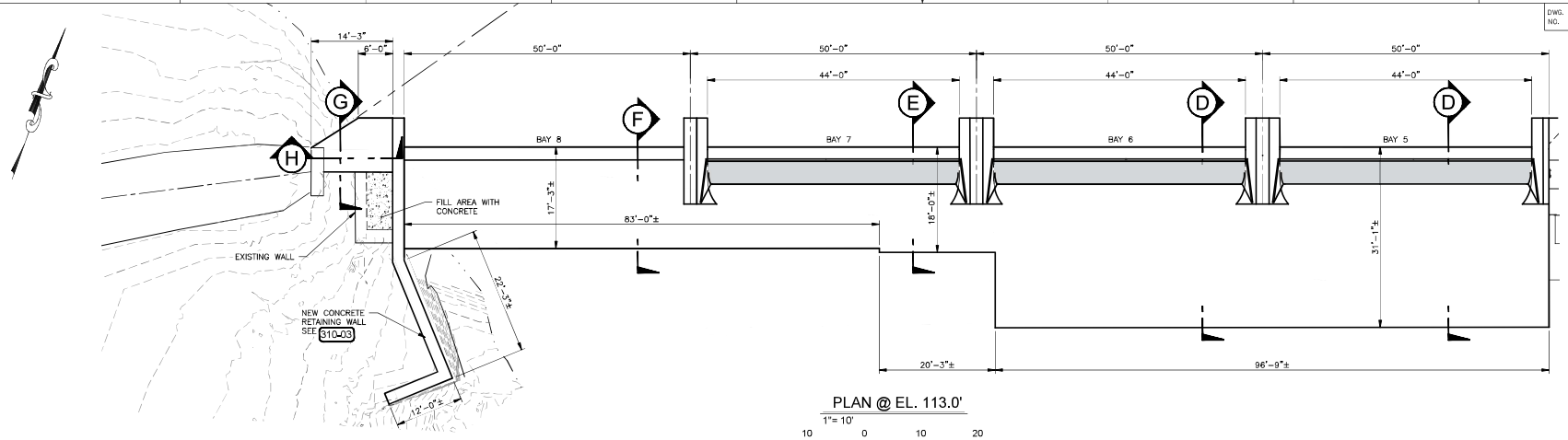
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100050 REV. C

DWG. NO. H096H1163100051



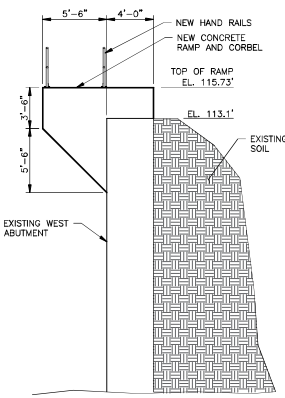
PLAN @ EL. 113.0'

1"= 10'

SCALE IN FEET

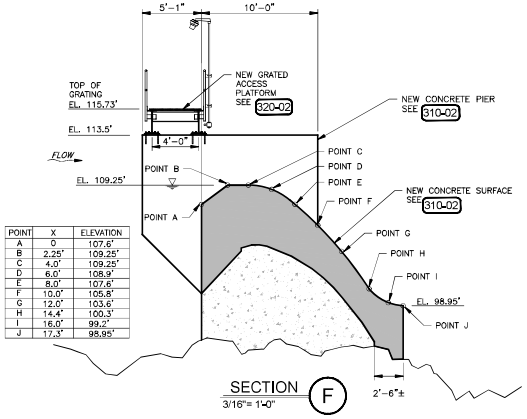
10 0 10 20

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS



SECTION G

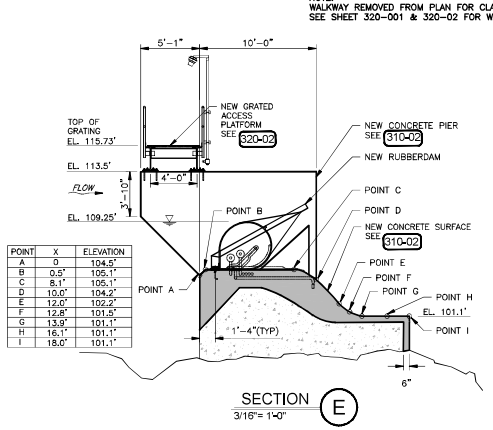
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F

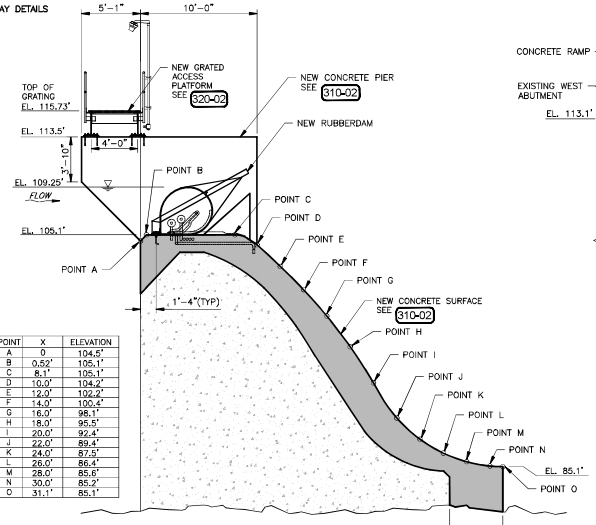
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

SECTION E

3/16"= 1'-0"



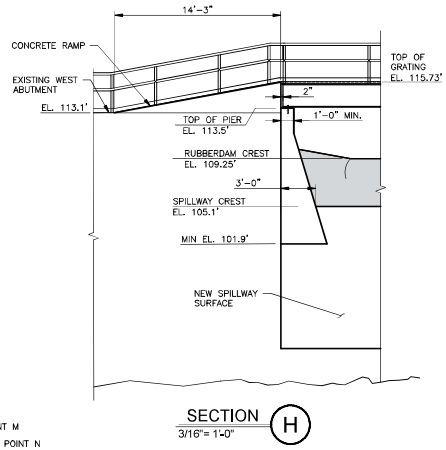
POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	16.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET



SECTION H

3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

300-03

Kleinschmidt

J:\189\0018\Drawings\Working Drawings\189-0218-300-02-03-M.dwg

PRINTED Dec. 9, 2020 - 2:14 PM

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REFERENCE DRAWINGS

DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-____-____

SEAL

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED --

CHECKED ---

DATE 2020-12-11

W.O. XXXX

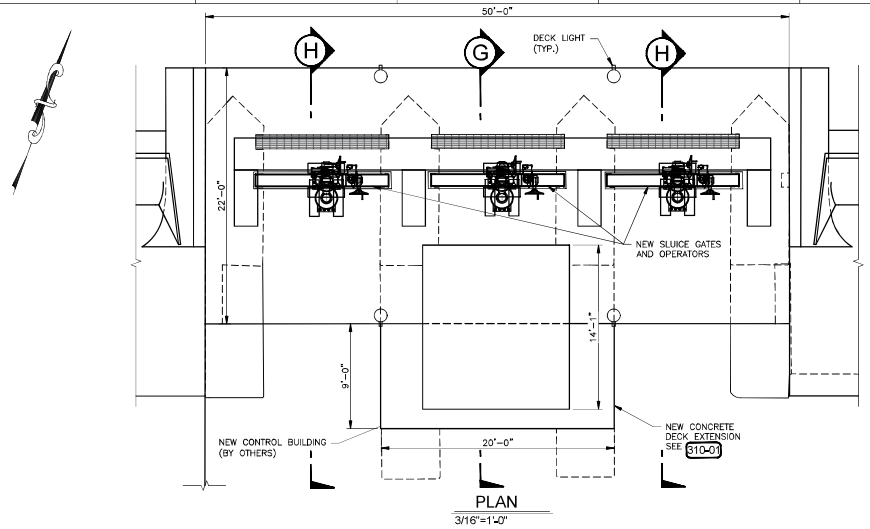
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

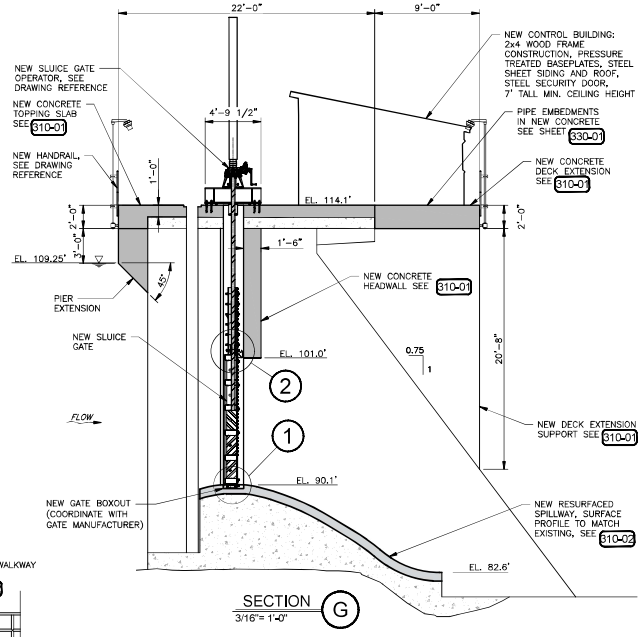
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

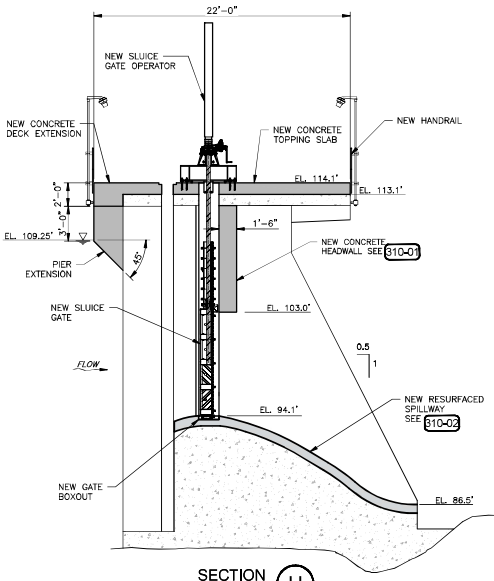
DWG.NO. H096H1163100051 REV. C



PLAN
3/16"=1'-0"

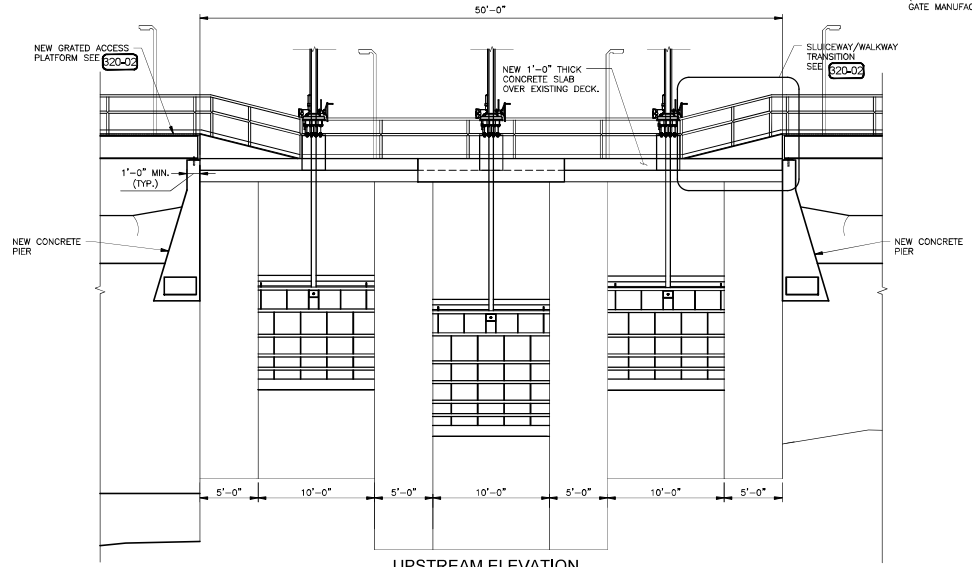


SECTION G
3/16"= 1'-0"

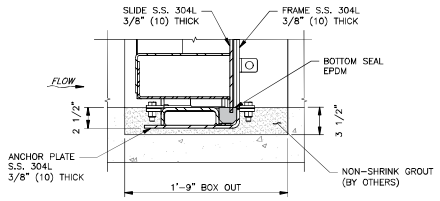


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

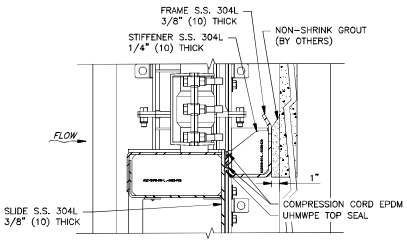


UPSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

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300-04

J:\189001618\Drawings\Working Drawings\189U-018-300402.03.04.dwg
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STANDARD GUARD SYSTEMS DETAILS	H001H016900000 1
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REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-____-____

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

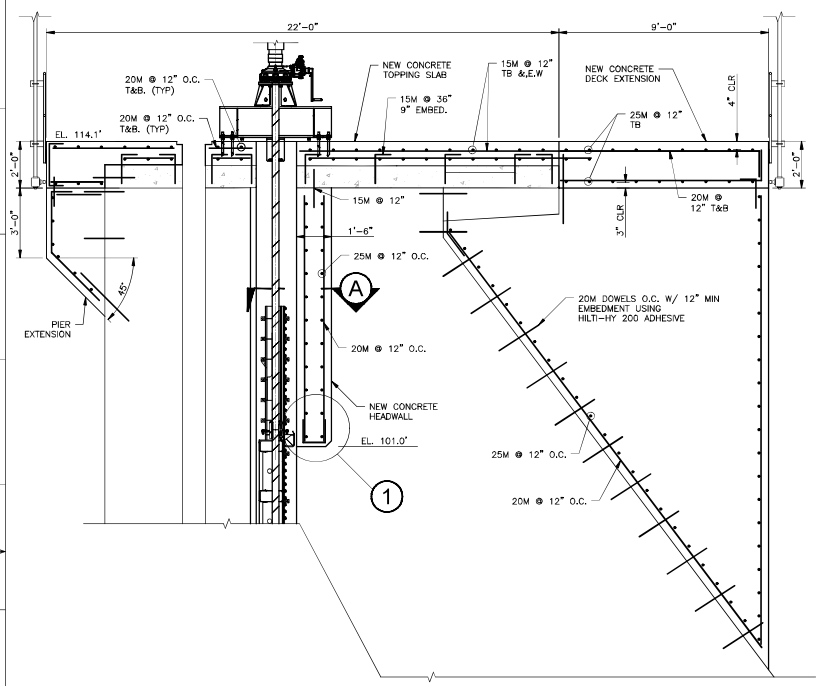
SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2020-12-11
W.O.	XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

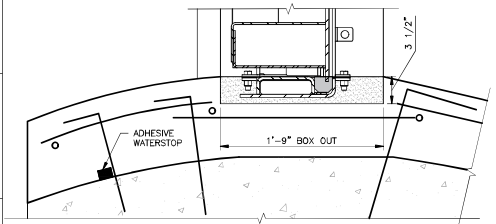
NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

DWG.NO. H096H1163100052 REV. C

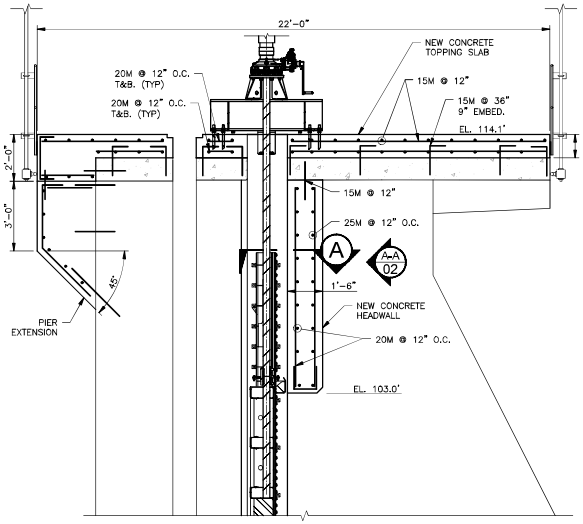


INNER SLUICEWAY DETAIL
3/8"= 1'-0"

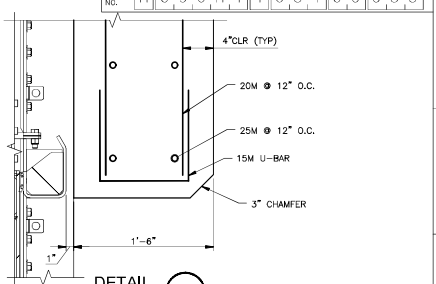
SCALE IN FEET
2 0 2 4 6



DETAIL 2
1 1/2"= 1'-0"

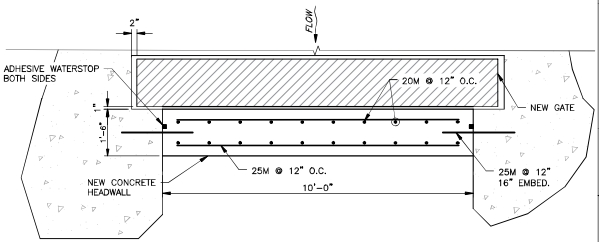


OUTER SLUICEWAY DETAIL
3/8"= 1'-0"



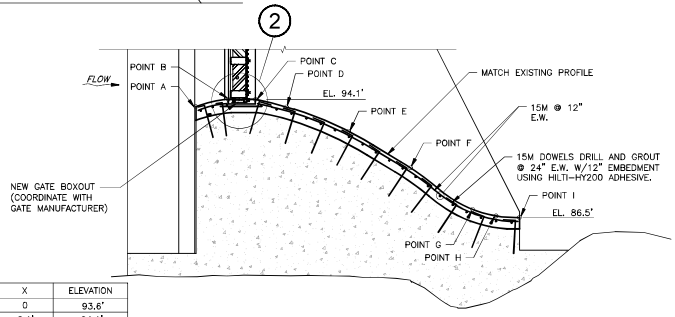
DETAIL 1
1 1/2"= 1'-0"

SCALE IN INCHES
8 0 8 16



SECTION A
1/2"= 1'-0"

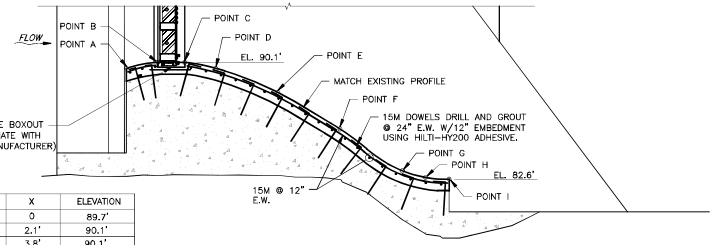
SCALE IN FEET
2 0 2 4



POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL
1/4"= 1'-0"

SCALE IN FEET
4 0 4 8



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL
1/4"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

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310-01

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-____-____

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE

UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED ---
DATE 2020-12-18
W.O. XXXX

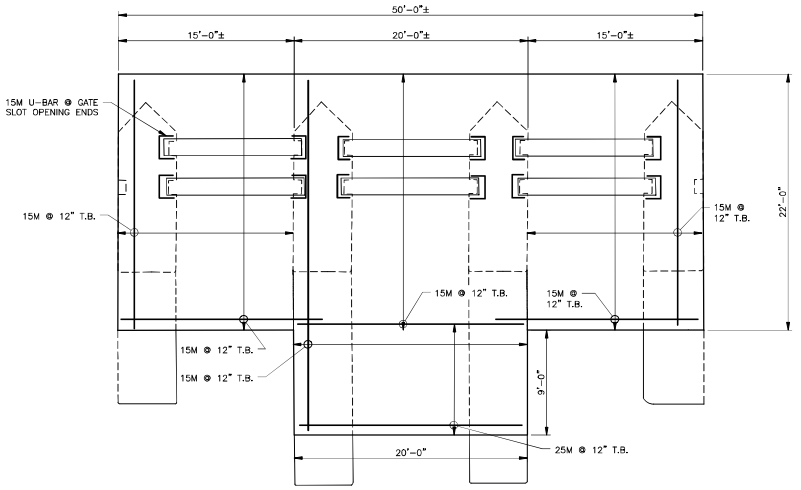
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

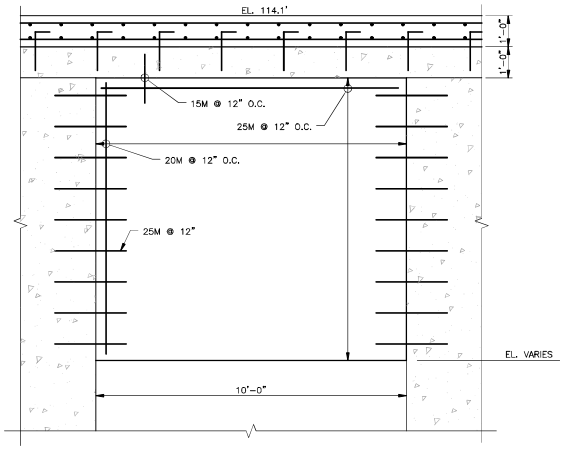
NEW CONCRETE
SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100053 REV. C

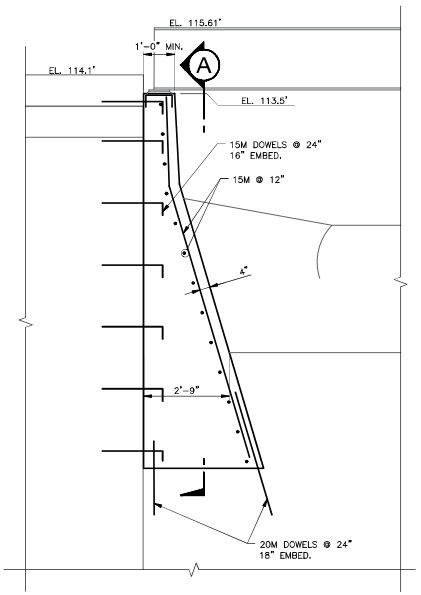
DWG. NO. H096H1163100054



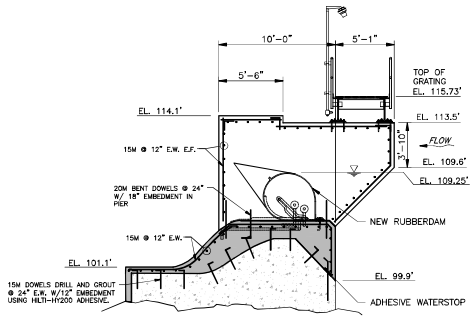
SLUICEWAY DECK REBAR PLAN
3/16"= 1'-0"
4 0 4 8 12
SCALE IN FEET



TYPICAL HEADWALL ELEVATION A-A 01
1/2"= 1'-0"
2 0 2 4
SCALE IN FEET



PIER TO SLUICEWAY REBAR DETAIL
1/2"= 1'-0"



SECTION A
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
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310-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.														

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BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
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DRAWN ZJA
CHECKED --
CHECKED ---
DATE 2020-12-18
W.O. XXXX

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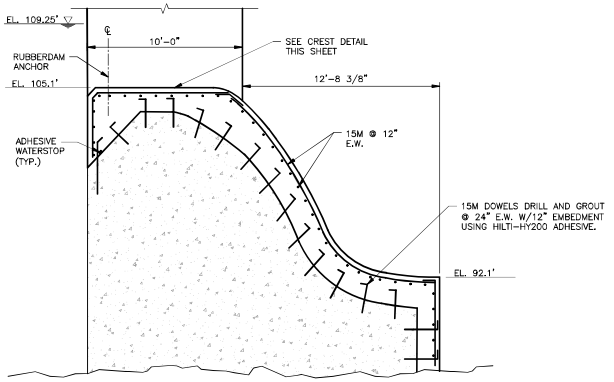
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE
SLUICEWAY HEADWALL AND DECK DETAILS

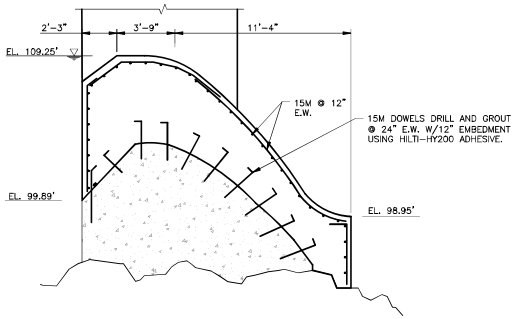
H096H1163100054 REV. C
DWG.NO.

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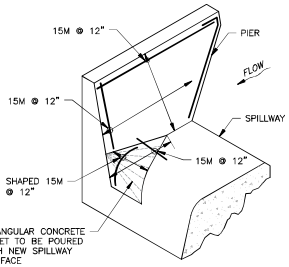
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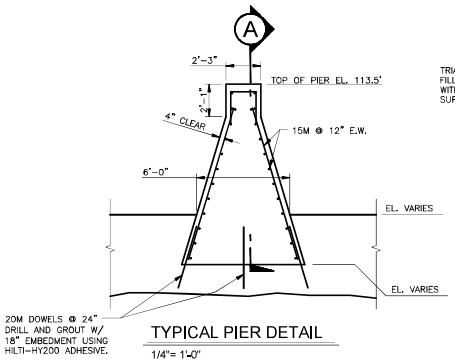
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)
1/4"= 1'-0"



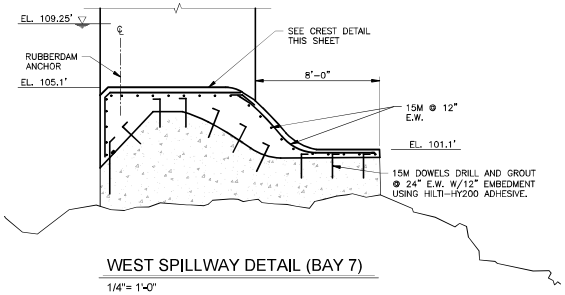
UNCONTROLLED SPILLWAY DETAIL (BAY 8)
1/4"= 1'-0"



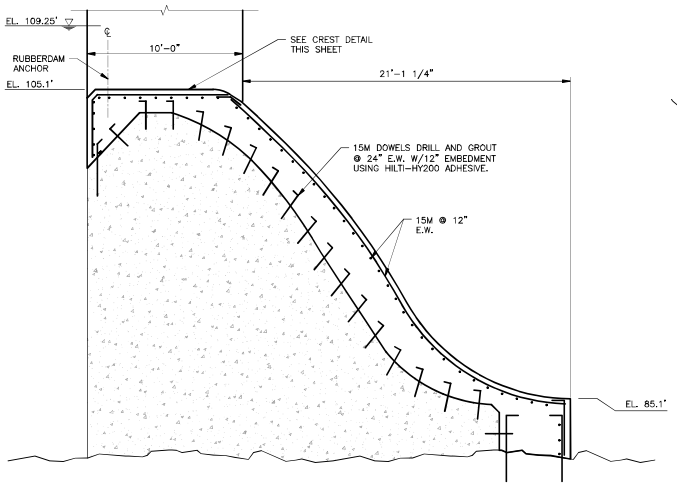
TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.



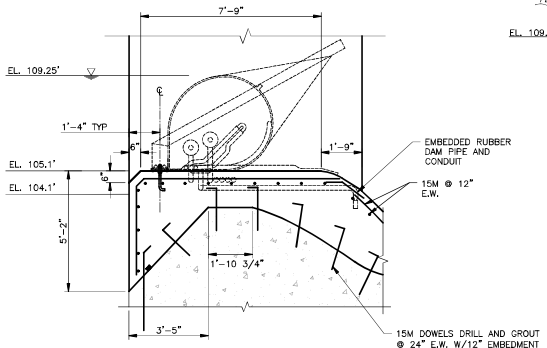
TYPICAL PIER DETAIL
1/4"= 1'-0"



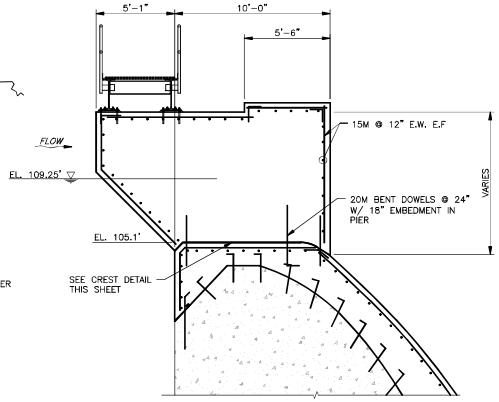
WEST SPILLWAY DETAIL (BAY 7)
1/4"= 1'-0"



WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)
1/4"= 1'-0"



RUBBERDAM CREST TYPICAL
3/8"= 1'-0"



TYPICAL PIER SECTION (A)
1/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

310-03

Kleinschmidt

J:\1890\018\Drawings\Working Drawings\189O-018-310403.dwg
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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

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DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

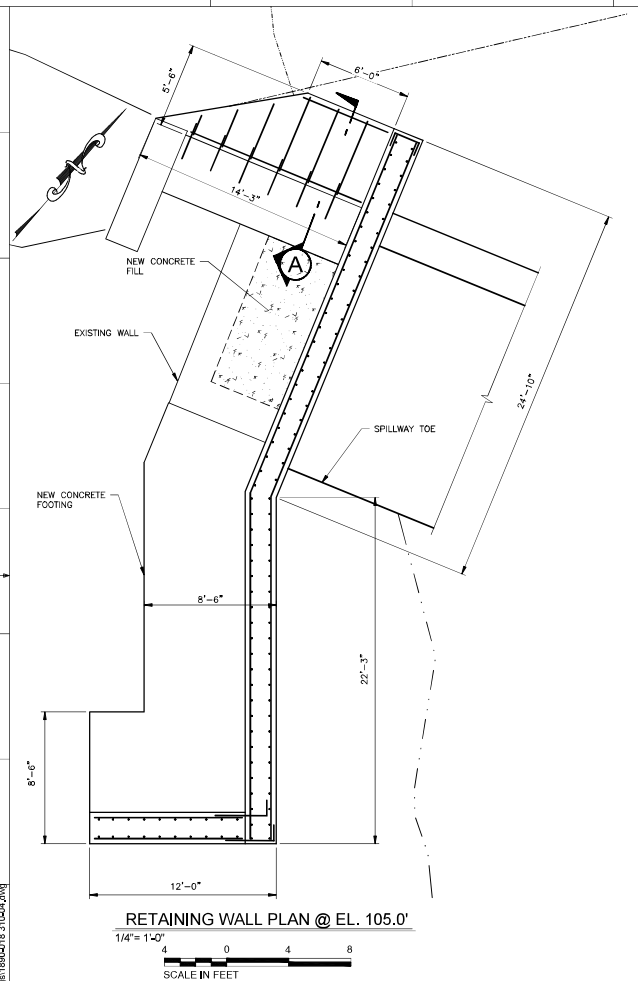
SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED ---
DATE 2020-12-18
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

DWG.NO. H096H1163100055 REV. C

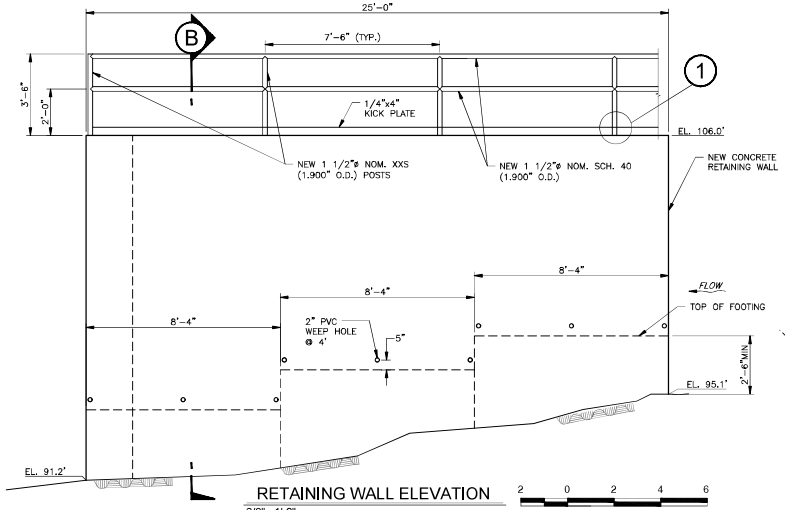


RETAINING WALL PLAN @ EL. 105.0'

1/4"= 1'-0"

4 0 4 8

SCALE IN FEET

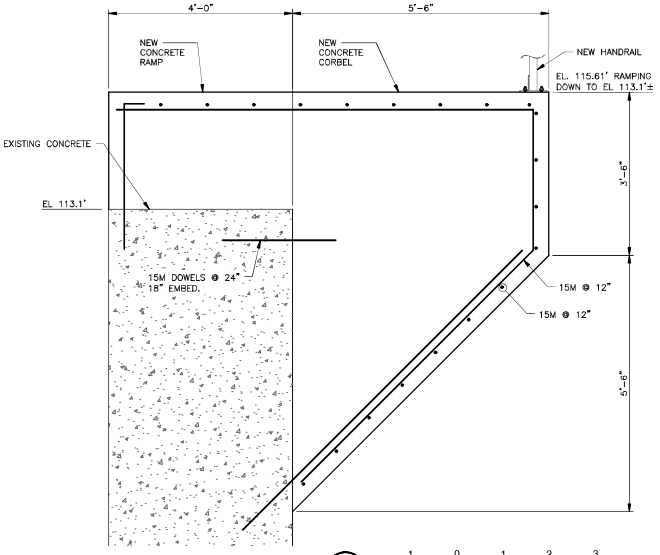


RETAINING WALL ELEVATION

3/8"= 1'-0"

2 0 2 4 6

SCALE IN FEET

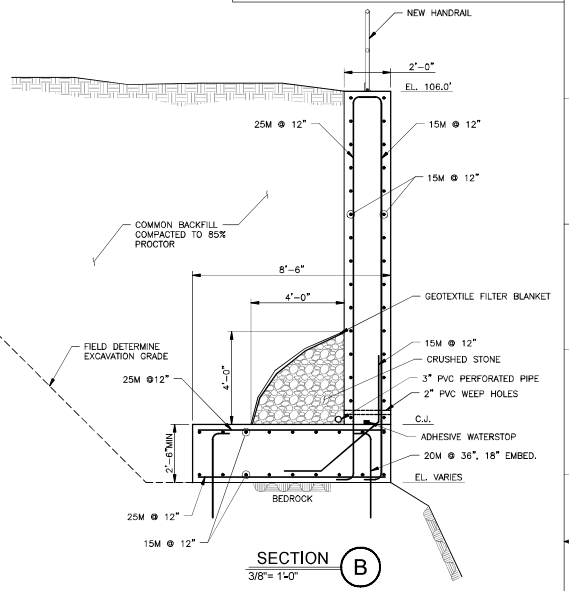


SECTION A

3/4"= 1'-0"

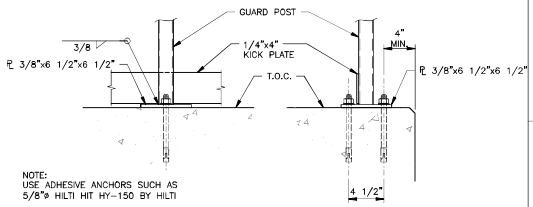
1 0 1 2 3

SCALE IN FEET



SECTION B

3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

8 0 8 16

SCALE IN INCHES

90% REV. 1 REVIEW SUBMITTAL

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310-04

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J:\189\0018\Drawings\Working Drawings\189-0018-310-04.dwg

PRINTED Dec. 18, 2020 - 8:41 AM

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REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-____-____

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED --

CHECKED ---

DATE 2020-12-18

W.O. XXXX

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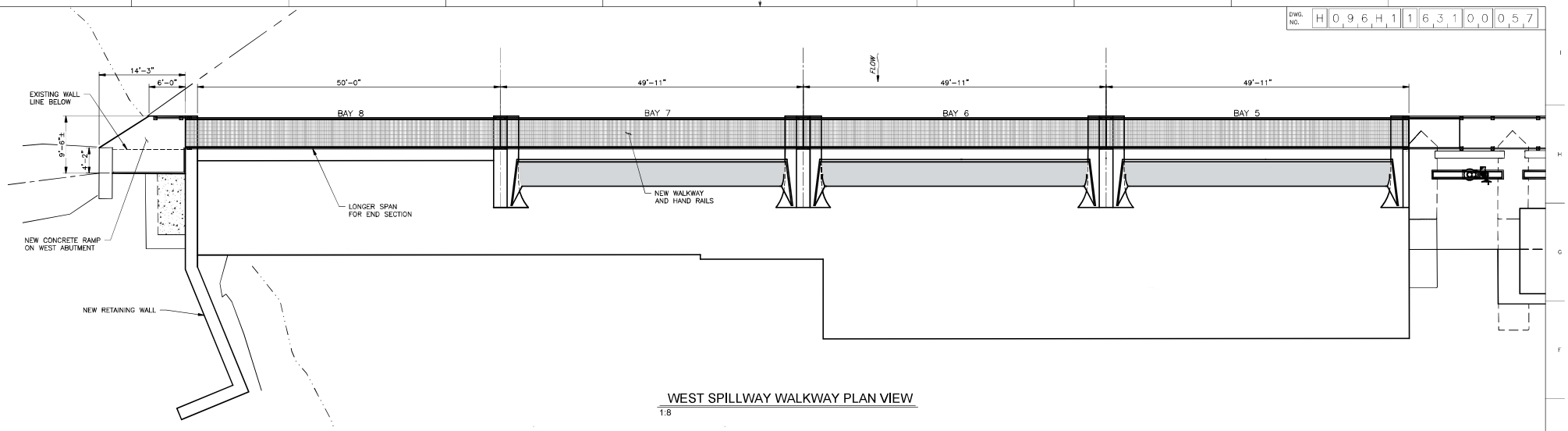
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

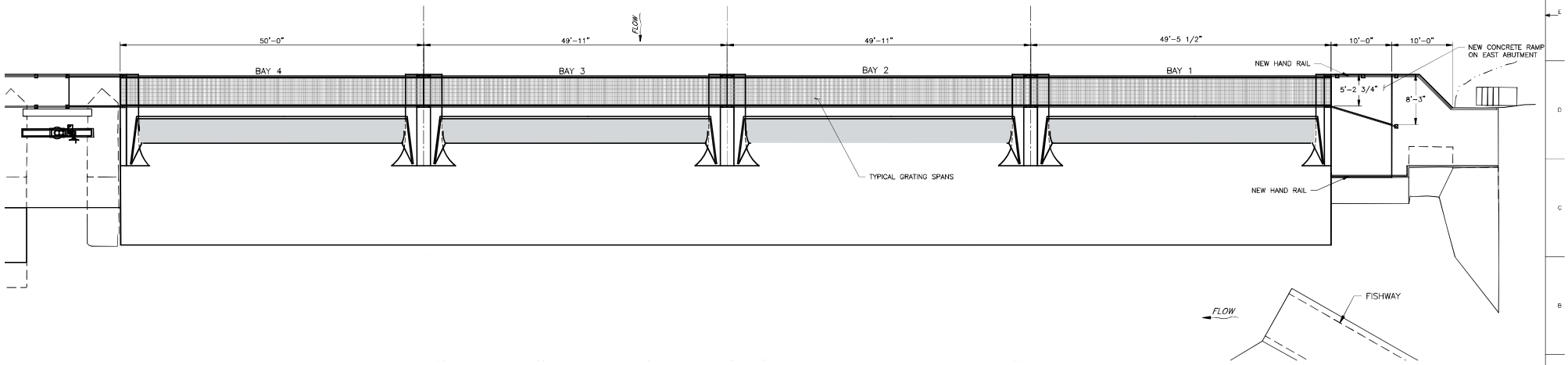
NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 5 6 REV. C

DWG. NO. H096H1163100057



WEST SPILLWAY WALKWAY PLAN VIEW
1:8



EAST SPILLWAY WALKWAY PLAN VIEW
1:8

8 0 8 16
SCALE IN FEET

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NOT FOR CONSTRUCTION

Kleinschmidt

320-01

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SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

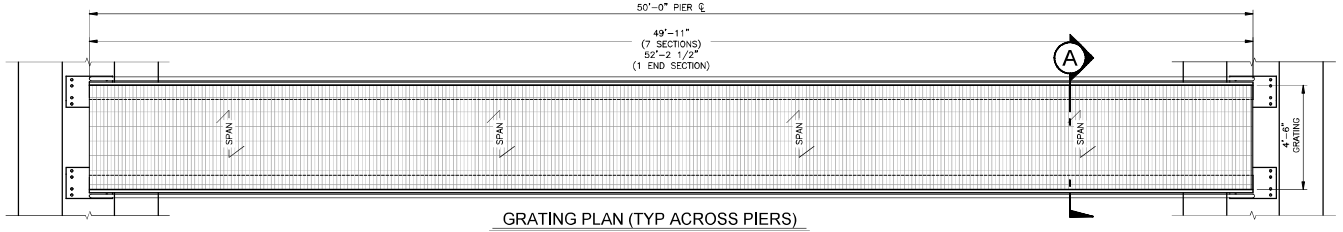
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UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
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DATE 2020-12-11
W.O. XXXX

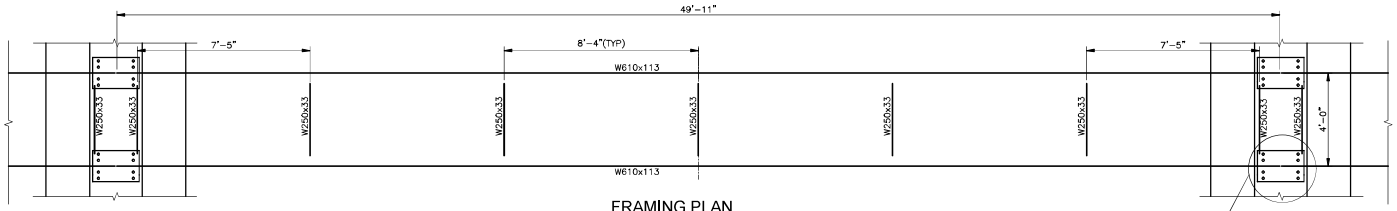
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT
NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW

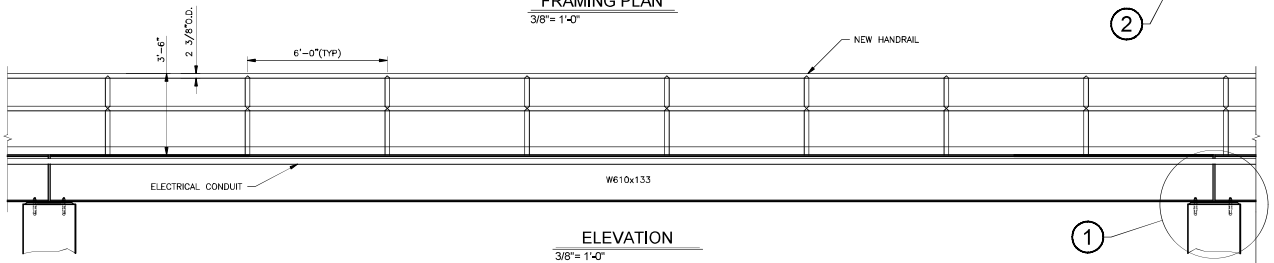
DWG.NO. H096H1163100057 REV. C



GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"

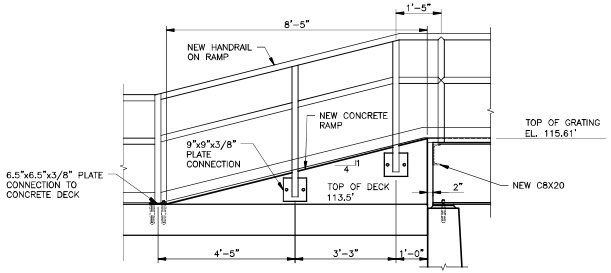


FRAMING PLAN
3/8"= 1'-0"

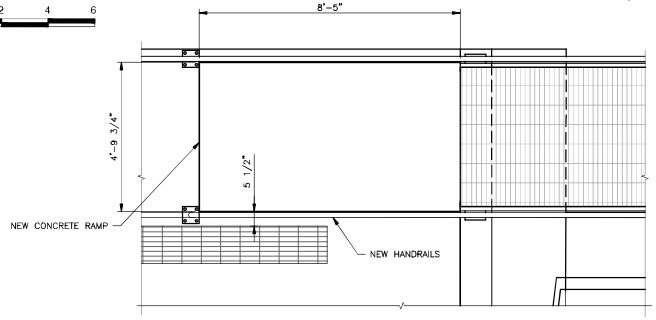


ELEVATION
3/8"= 1'-0"

2 0 2 4 6
SCALE IN FEET

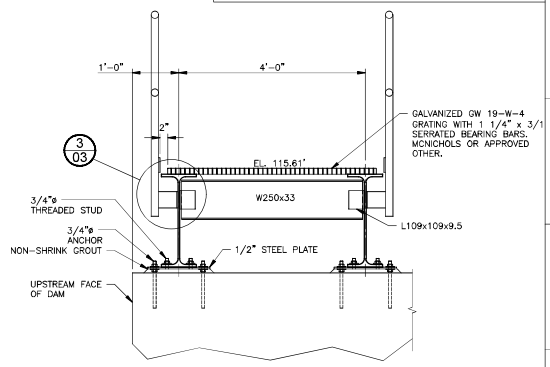


SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

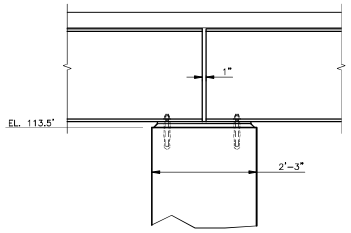


2 0 2 4
SCALE IN FEET

SLUICEWAY/WALKWAY TRANSITION PLAN
1/2"= 1'-0"

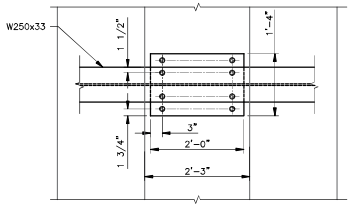


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

1 0 1 2 3
SCALE IN FEET



DETAIL 2
3/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

320-02

Kleinschmidt

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PRINTED Dec. 9, 2020 - 2:43 PM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED --
DATE 2020-12-11
W.O. XXXX

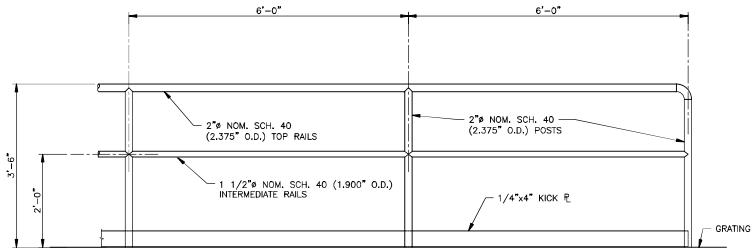
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW STEEL
GRATED ACCESS PLATFORM

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 8 REV. C

DWG. NO. H096H1163100059

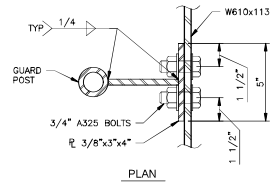


STEEL ACCESS PLATFORM TYPICAL HANDRAIL DETAIL

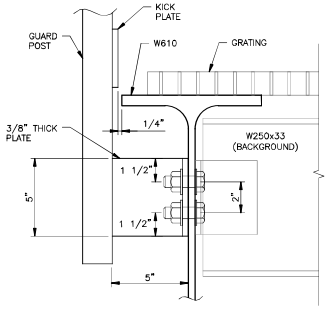
3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

Kleinschmidt

320-03

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PRINTED Dec. 9, 2020 - 3:06 PM

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REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL ----- E & I -----

MECH ----- CONST -----

APPROVED

DATE

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED --

CHECKED ---

DATE 2020-12-11

W.O. XXXX

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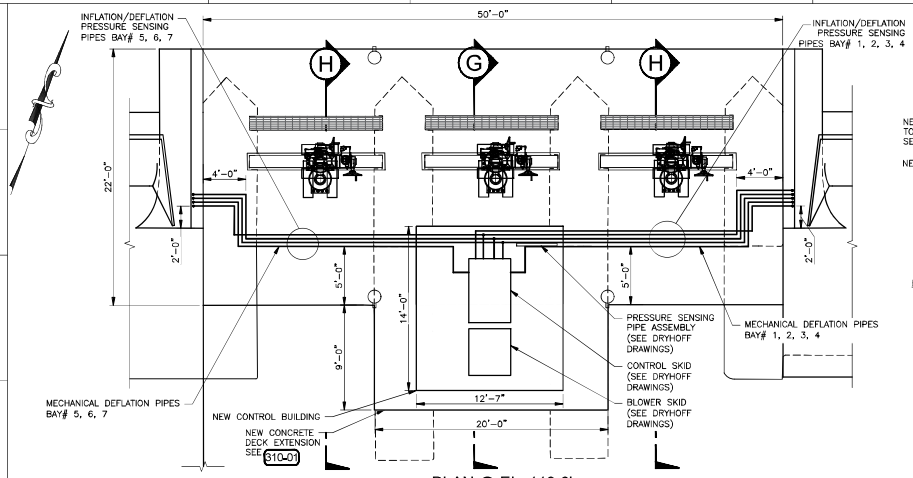
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

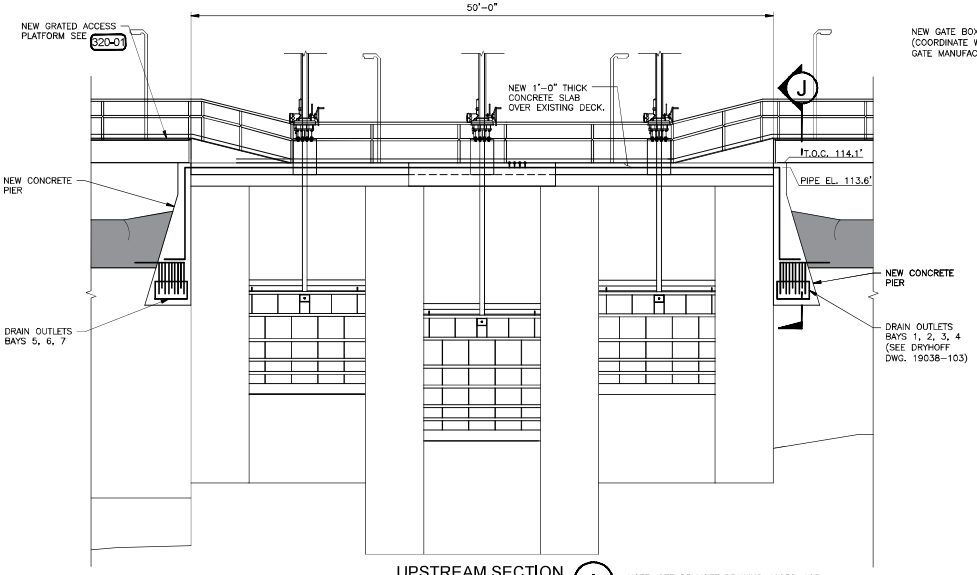
NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS

H096H1163100059 REV. C

DWG.NO.

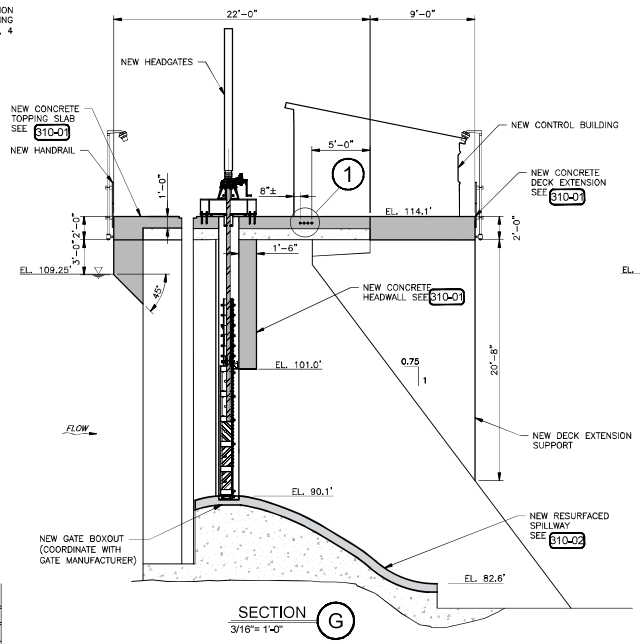


PLAN @ EL. 113.6'
3/16"=1'-0"

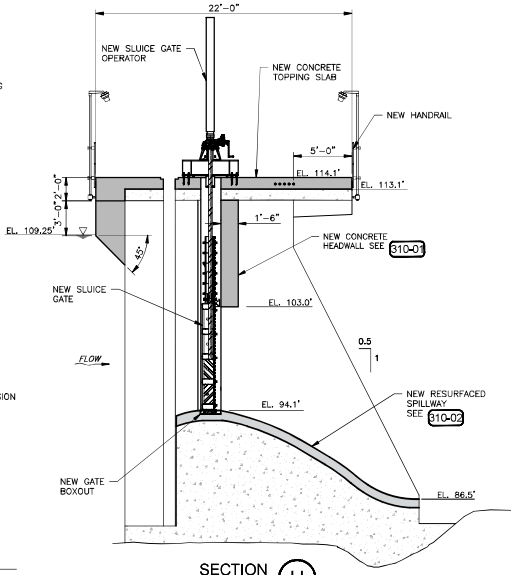


UPSTREAM SECTION I
3/16"= 1'-0"

NOTE: SEE DRYHOFF DRAWING 19038-103

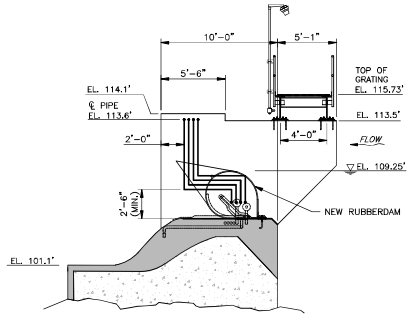


SECTION G
3/16"= 1'-0"

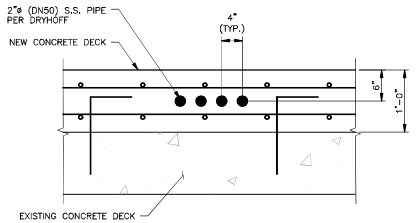


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

330-01

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 0

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
DRYHOFF DRAWINGS 19038 PACKAGE NOV. 2019														
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-____-____

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	--
CHECKED	--
DATE	2020-12-11
W.O.	XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

RUBBER DAM PIPING AT SLUICEWAY

H 0 9 6 H 1 1 6 3 1 0 0 0 6 0 REV. C

DWG.NO.

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APPENDIX D – ENGINEERING DRAWINGS – FISH PASSAGE

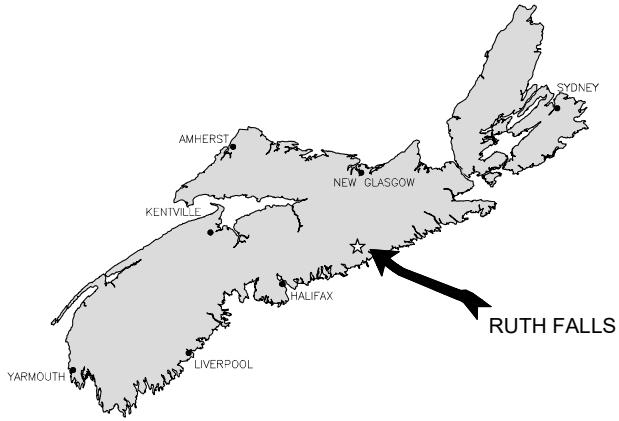
DWG. NO. H096H1-1620-00-011

RUTH FALLS

FISHWAY MODIFICATIONS

Nova Scotia POWER
An Emera Company

LIST OF DRAWINGS		
NOVA SCOTIA POWER DWG NO.	DRAWING TITLE	ISSUE / REVISION
H-096H1-1-620-00-011	FISHWAY MODIFICATIONS – COVER SHEET	A
H-096H1-1-620-00-012	FISHWAY MODIFICATIONS – GENERAL NOTES	A
H-096H1-1-620-00-013	FISHWAY MODIFICATIONS – EXISTING CONDITIONS, GENERAL ARRANGEMENT	A
H-096H1-1-620-00-014	FISHWAY MODIFICATIONS – EXISTING CONDITIONS, FISHWAY – PLAN	A
H-096H1-1-620-00-016	FISHWAY MODIFICATIONS – GENERAL ARRANGEMENT PLAN	A
H-096H1-1-620-00-017	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – PLAN AND SECTIONS	A
H-096H1-1-620-00-018	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – CROSS SECTIONS	A
H-096H1-1-620-00-019	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – SECTIONS AND DETAILS	A
H-096H1-1-620-00-020	FISHWAY MODIFICATIONS – FISH BYPASS – PLAN AND SECTIONS	A
H-096H1-1-620-00-021	FISHWAY MODIFICATIONS – FISH BYPASS – SECTIONS AND DETAILS	A
H-096H1-1-620-00-022	FISHWAY MODIFICATIONS – UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	A
H-096H1-1-620-00-023	FISHWAY MODIFICATIONS – UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS	A



PROJECT LOCATION

0 50 100
Kilometres

ISSUED FOR PERMIT

2023-05-05

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS | DWG.NO.

ISSUED FOR PERMIT DATED 2023-05-05

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS
CIVIL | E & I
MECH | CONST

APPROVED
DATE MAY 2023

REFERENCE NO.
SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

wood.
Nova Scotia POWER An Emera Company
RUTH FALLS
FISHWAY MODIFICATIONS
COVER SHEET

H096H1-1620-00-011 REV. A

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

DWG. NO. H096H1116200001 2

GENERAL NOTES

1. DRAWINGS ARE NOT TO BE SCALED. ONLY FIGURED DIMENSIONS TO BE FOLLOWED.
2. ALL DIMENSIONS ARE IN FEET AND INCHES UNLESS NOTED OTHERWISE.
3. ELEVATIONS ARE SHOWN IN FEET.
4. ELEVATIONS SHOWN ARE TO CGVD 2013. TOPOGRAPHIC SURVEY INFORMATION IS BASED ON FIELD SURVEY PERFORMED BY TALISMAN TECHNICAL SOLUTIONS IN NOVEMBER, 2022.
5. COORDINATES AND ELEVATIONS SHOWN ARE TO THE NOVA SCOTIA CONTROL COORDINATE SYSTEM, WGS72, MODIFIED TRANSVERSE MERCATOR, ZONE 5.
6. DESIGN BASED ON INFORMATION RECEIVED TO DATE. DESIGN TO BE CONFIRMED PRIOR TO CONSTRUCTION.
7. REFER TO THE PROJECT SPECIFICATIONS. IF THERE IS A CONTRADICTION BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, THE MORE STRINGENT OF THE TWO SHALL APPLY IN CONSULTATION WITH THE OWNER AND ENGINEER.
8. THE CONTRACTOR SHALL VERIFY ALL CONDITIONS AND MEASUREMENTS AT THE SITE AND REPORT TO THE ENGINEER ANY DISCREPANCIES OR UNSATISFACTORY CONDITIONS WHICH MAY ADVERSELY AFFECT THE PROPER COMPLETION OF THE PROJECT BEFORE PROCEEDING WITH WORK.
9. THE CONTRACTOR IS TO ASSUME FULL RESPONSIBILITY FOR THE INTEGRITY OF THE STRUCTURE DURING CONSTRUCTION.
10. ELEVATION OF BEARING SURFACES TO BE CONFIRMED IN THE FIELD. REPORT ANY DISCREPANCIES TO ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
11. THE CONTRACTOR TO STORE AND HANDLE ALL MATERIALS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND OWNER'S INSTRUCTIONS.
12. THE CONTRACTOR TO REINSTATE ALL AREAS AFFECTED BY NEW CONSTRUCTION TO THEIR ORIGINAL CONDITION TO THE SATISFACTION OF THE ENGINEER.
13. SHOP DRAWING(S) AND DETAILS OF CONCRETE MIX DESIGN TO BE SUBMITTED TO ENGINEER FOR REVIEW. SHOP DRAWINGS TO BE STAMPED AND SIGNED BY A PROFESSIONAL ENGINEER LICENSED IN THE PROVINCE OF NOVA SCOTIA, CANADA. SHOP DRAWINGS WILL BE REVIEWED AND RETURNED TO CONTRACTOR WITHIN 14 DAYS.
14. SUBMIT ERECTION/SHOP DRAWINGS INDICATING DETAILS AND INFORMATION NECESSARY FOR ASSEMBLY AND ERECTION PURPOSES.
15. SUBSTITUTION REQUESTS FOR ALTERNATIVE PRODUCTS OR METHODS MUST BE APPROVED IN WRITING BY THE STRUCTURAL ENGINEER PRIOR TO USE. CONTRACTOR SHALL PROVIDE, AT THEIR EXPENSE, CALCULATIONS DEMONSTRATING THAT THE SUBSTITUTED PRODUCT MEETS OR EXCEEDS THE PERFORMANCE CAPACITIES OF THE SPECIFIED PRODUCT.
16. ALL PRODUCTS TO BE INSTALLED AS PER MANUFACTURER'S INSTRUCTIONS.
17. WORK SHALL CONFORM TO THE NATIONAL BUILDING CODE OF CANADA AND ITS SUPPLEMENTS, AND THE NOVA SCOTIA BUILDING CODE.
18. MINIMUM REQUIRED BEARING CAPACITY OF 3000 PSF UNDER ALL CONCRETE STRUCTURES.
19. FOUNDATIONS BEARING SURFACE TO BE APPROVED BY ENGINEER PRIOR TO PLACING CONCRETE.
20. ENGINEERED FILL TO BE AN IMPORTED, WELL GRADED MATERIAL (GRANULAR A) FREE OF DEBRIS, ORGANIC OR DELETERIOUS MATERIAL. IT SHALL NOT CONTAIN ROCKS OR LUMPS OVER 4 INCHES IN GREATEST DIMENSION AND IT SHALL CONTAIN NOT MORE THAN 8% PASSING THE 200mm SIEVE. ENGINEERED FILL SHALL BE PLACED IN MAX 6 INCH LIFTS AND COMPACTED TO 98% SPMDD.

CONCRETE NOTES

1. UNLESS OTHERWISE SHOWN, THESE NOTES ARE TYPICAL FOR ALL CONCRETE DRAWINGS.
2. FOR CONCRETE SPECIFICATIONS, REFER TO THE RUTH FALLS FISHWAY MODIFICATIONS PROJECT TECHNICAL SPECIFICATION". IF THERE IS A CONTRADICTION BETWEEN THE DRAWINGS AND SPECIFICATIONS, THE MORE STRINGENT OF THE TWO SHALL APPLY.
3. CONCRETE MATERIALS, TESTING AND WORKMANSHIP TO CONFORM CSA STANDARDS A23.1/A23.2, LATEST EDITION.
4. CONCRETE TO MEET THE FOLLOWING PERFORMANCE CRITERIA:
   a. 28 DAY MINIMUM COMPRESSIVE STRENGTH OF 30 MPa
   b. DURABILITY AND CLASS OF EXPOSURE: F-1
   c. ONLY USE AGGREGATE THAT IS NON-REACTIVE. AGGREGATE SUSCEPTIBLE TO AAR IS NOT PERMITTED.
5. CONCRETE COVER ON REINFORCING STEEL: (UNLESS NOTED OTHERWISE)
   a. EXPOSED TO FLOWING WATER: 4 INCHES
   b. EXPOSED TO WATER: 3 INCHES
   c. CAST AGAINST FILL OR BEDROCK: 3 INCHES
   d. CAST AGAINST FORMS: 2 INCHES
6. WATERSTOPS:
   a. TYPE 1: HYDROTITE CJ 0725 HYDROPHILIC WATERSTOP. INSTALL IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. MAINTAIN A MINIMUM EDGE DISTANCE TO CONCRETE OF 4" UNLESS NOTED OTHERWISE.
   b. TYPE 2: LEAKMASTER HYDROPHILIC WATERSTOP ADHESIVE MANUFACTURED BY HYDROTITE. INSTALL IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
   c. ALL WATERSTOPS TO BE MADE CONTINUOUS
7. CONCRETE TO BE PLACED IN THE DRY.
8. USE HIGH FREQUENCY VIBRATOR TO PLACE ALL CONCRETE. VIBRATION SHALL BE IN ACCORDANCE WITH CSA A23.1 / A23.2.
9. PROVIDE ACCURATE RECORDS OF POURED CONCRETE ITEMS INDICATING DATE AND TIME, LOCATION OF POUR, QUALITY, AIR TEMPERATURE AND TEST SAMPLES.
10. MIX, DELIVER TO SITE OF WORK AND DISCHARGE CONCRETE WITHIN 120 MINUTES MAXIMUM AFTER BATCHING.
11. INSPECTION AND TESTING OF CONCRETE AND CONCRETE MATERIALS WILL BE CARRIED OUT BY TESTING LABORATORY DESIGNATED BY OWNER.
12. REINFORCING STEEL TO BE DEFORMED NEW BILLET STEEL WITH A MINIMUM YIELD STRENGTH OF 400 MPa. REINFORCING STEEL TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS INCLUDING, BUT NOT LIMITED TO:
   a. CSA G30.18 — CARBON STEEL BARS FOR CONCRETE REINFORCEMENT
   b. CSA G40.20/G40.21 — GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL/STRUCTURAL QUALITY STEEL
13. REINFORCING STEEL TO BE FREE OF LOOSE MILL SCALE, LOOSE RUST AND FOREIGN MATERIAL.
14. UNLESS NOTED OTHERWISE REINFORCING STEEL TO BE SPLICED AS FOLLOWS:
   a. ALL SPLICES TO BE TENSION LAP SPLICES, CLASS "B".
   b. NO MORE THAN 50% OF THE REINFORCING TO BE SPLICED AT ANY GIVEN LOCATION U.N.O.
15. ALL REINFORCEMENT BENDS TO BE STANDARD BENDS UNLESS NOTED OTHERWISE.
16. DO NOT FIELD BEND REINFORCEMENT EXCEPT WHERE INDICATED OR AUTHORIZED BY ENGINEER. WHEN FIELD BENDING IS AUTHORIZED, BEND WITHOUT HEAT, APPLYING SLOW AND STEADY PRESSURE. REPLACE BARS WHICH DEVELOP CRACKS OR SPLITS.
17. REINFORCING STEEL, EMBEDDED PARTS, ANCHOR RODS, DOWELS ETC. TO BE SECURED IN POSITION PRIOR TO PLACING CONCRETE.
18. SET ANCHOR RODS, SLEEVES AND OTHER MISCELLANEOUS ITEMS EMBEDDED IN CONCRETE AS SHOWN ON DRAWING. IF INSERTS CANNOT BE LOCATED AS SPECIFIED, OBTAIN APPROVAL BEFORE PLACING.
19. CAST-IN-PLACE ANCHORS SHALL BE HELD SECURELY IN POSITION WITH TEMPLATES.
20. REINFORCING STEEL TO BE INSPECTED BY THE ENGINEER PRIOR TO CLOSING THE FORMS.
21. ENSURE COVER TO REINFORCEMENT IS MAINTAINED DURING CONCRETE POUR/PLACEMENT.
22. ALL EXPOSED CORNERS SHALL HAVE A MINIMUM CHAMFER OF 1", UNLESS NOTED OTHERWISE.
23. GROUT TO BE SIKAGROUT – 212 HP, OR BASF MASTERFLOW 928, OR APPROVED EQUIVALENT.

CONCRETE FORMING NOTES

1. CONCRETE FORMWORK TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS. INCLUDING, BUT NOT LIMITED TO:
   a. CSA S269.1 — FALSEWORK AND FORMWORK
   b. CSA 086 — ENGINEERING DESIGN IN WOOD
   c. CSA A23.1/A23.2 — CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION
   d. CSA 0121 — DOUGLAS FIR PLYWOOD
   e. CSA 0153 — POPLAR PLYWOOD
   f. CSA 0151 — CANADIAN SOFTWOOD PLYWOOD
2. FORMWORK MATERIALS TO BE WOOD AND WOOD PRODUCT MATERIALS CONFORMING TO CSA 0121, CSA-086 AND CSA 0153, LATEST EDITIONS.
3. FORM LINER MATERIAL TO BE PLYWOOD CONFORMING TO CSA 0151.
4. FORM RELEASE AGENT: NON-TOXIC, BIODEGRADABLE, LOW VOC.
5. BEFORE PLACEMENT OF CONCRETE, FORMWORK SHALL BE CLEANED IN ACCORDANCE WITH CSA A23.1/A23.2, LATEST EDITION.

STEEL NOTES

1. STRUCTURAL STEEL TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS. INCLUDING, BUT NOT LIMITED TO:
   a. CSA S16 DESIGN OF STEEL STRUCTURES
   b. CSA G40.20/G40.21 GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL/STRUCTURAL QUALITY STEEL
   c. CSA G164 HOT DIP GALVANIZING OF IRREGULARLY SHAPED ARTICLES
   d. CSA W48 FILLER METALS AND ALLIED MATERIALS FOR METAL ARC WELDING
   e. CSA W59 WELDED STEEL CONSTRUCTION
2. ERECT STRUCTURAL STEEL AS INDICATED AND IN ACCORDANCE WITH CSA-S16 AND IN ACCORDANCE WITH REVIEWED ERECTION DRAWINGS.
3. FIELD CUTTING OR ALTERING STRUCTURAL MEMBERS TO THE APPROVAL OF THE ENGINEER.
4. CLEAN WITH A MECHANICAL BRUSH AND TOUCH UP SHOP PRIMER TO BOLTS, WELDS AND BURNED OR SCRATCHED SURFACES AT COMPLETION OF ERECTION.
5. FABRICATOR TO DESIGN CONNECTION DETAILS.
6. DESIGN DETAILS AND CONNECTIONS IN ACCORDANCE WITH REQUIREMENTS OF CSA-S16 TO RESIST FORCES, MOMENTS, SHEARS AND ALLOW FOR MOVEMENTS INDICATED.
7. MATERIALS:
   a. STRUCTURAL STEEL IN ACCORDANCE WITH CSA G40.20/G40.21 GRADE 350W.
   b. ANCHOR RODS IN ACCORDANCE WITH CSA G40.20/G40.21 GRADE 300W UNLESS NOTED OTHERWISE.
   c. STRUCTURAL BOLTS IN ACCORDANCE WITH ASTM F3125/F3125M, GRADE A325M, GALVANIZED.
   d. NUTS SHALL BE HEAVY HEX NUTS IN ACCORDANCE WITH ASTM A563, GALVANIZED.
   e. WASHERS SHALL BE HEAVY DUTY HARDENED WASHERS IN ACCORDANCE WITH ASTM F436/F436M, GALVANIZED.
   f. WELDING MATERIALS IN ACCORDANCE WITH CSA W48 AND CSA W59, BY A COMPANY CERTIFIED BY THE CANADIAN WELDING BUREAU UNDER THE REQUIREMENTS OF CSA W47.1 (DIVISION 1 OR DIVISION 2).
   g. SHOP PAINT PRIMER IN ACCORDANCE WITH CISC/CPMA 2-75 SOLVENT REDUCIBLE ALKYD, GREY.
   h. HOT DIP GALVANIZING IN ACCORDANCE WITH ASTM A123/A123M AND ASTM A153/A153M.
8. FABRICATE STRUCTURAL STEEL IN ACCORDANCE WITH CSA-S16 AND IN ACCORDANCE WITH REVIEWED SHOP DRAWINGS.
9. CLEAN, PREPARE SURFACES AND SHOP PRIME STRUCTURAL STEEL IN ACCORDANCE WITH CSA-S16 EXCEPT WHERE MEMBERS TO BE ENCASED IN CONCRETE.
10. APPLY PAINT AND OTHER COATINGS UNDER COVER, ON DRY SURFACES IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
11. UNLESS NOTED OTHERWISE, ALL STRUCTURAL STEEL, INCLUDING HANDRAILS AND BASE PLATES SHALL BE GALVANIZED.
12. GRATING TO BE SECURED TO SURFACE OF CONCRETE USING HOLD DOWN CLIPS.

ENVIRONMENTAL NOTES

1. ALL CONSTRUCTION SHALL BE DONE IN THE DRY CONDITION.
2. MEASURES SHALL BE TAKEN TO PREVENT MATERIALS SUCH AS FRESH CONCRETE, CEMENT AND CONSTRUCTION DEBRIS FROM ENTERING ANY WATERCOURSE. ALL CONSTRUCTION DEBRIS AND DEMOLISHED MATERIALS WILL BE DISPOSED OF IN ACCORDANCE WITH NSECC WASTE DISPOSAL SITE REGULATIONS.
3. ALL EQUIPMENT AND MACHINERY OPERATED ON OR NEAR A BODY OF WATER WILL BE MECHANICALLY SOUND WITH NO LEAKING FUEL TANKS OR HYDRAULIC CONNECTIONS. FUEL STORAGE, REFUELING AND LUBRICATION SHALL BE COMPLETED IN ACCORDANCE WITH THE SITE'S ENVIRONMENTAL PROTECTION PLAN. MACHINERY AND EQUIPMENT WILL BE STORED ABOVE FLOOD WATER LEVELS.
4. ALL WORK OPERATIONS WILL BE CONDUCTED WITH MEASURES TAKEN TO CAUSE A MINIMUM OF SILTATION AND DISRUPTION TO ADJACENT AND DOWNSTREAM AREAS.

ABBREVIATIONS

ABUT.	ABUTMENT
APPROX.	APPROXIMATE
BP	BASEPLATE
C/L, ℄	CENTERLINE
C/C	CENTER TO CENTER
C.J	CONTROL JOINT
C/W	COMPLETE WITH
COL.	COLUMN
D/S	DOWNSTREAM
DIA.	DIAMETER
DWG	DRAWING
EL.	ELEVATION
EQ	EQUAL
EW	EACH WAY
FDN	FOUNDATION
FIN.	FINISHED
HOR.	HORIZONTAL
I.W.O.	IN WAY OF
O.A.L.	OVERALL LENGTH
O.D.	OUTSIDE DIAMETER
LG	LONG
MIN	MINIMUM
MAX	MAXIMUM
PL	PLATE
HORIZ.	PROJECTION
R	RADIUS
REINF.	REINFORCEMENT
REF	REFERENCE
REQ'D	REQUIRED
STIFF.	STIFFENER
THK	THICK
T.D.	TOP OF
TOC	TOP OF CONCRETE
TOG	TOP OF GRATING
TOS	TOP OF STEEL
T&B	TOP AND BOTTOM
TYP.	TYPICAL
U/S	UPSTREAM
UNO	UNLESS NOTED OTHERWISE
VERT.	VERTICAL
WP	WORKING POINT

PRELIMINARY
NOT FOR CONSTRUCTION

EXISTING CONDITIONS – GENERAL ARRANGEMENT — H096H1116200001 3
REFERENCE DRAWINGS — DWG.NO.

REV.	BY	CHK.	MECH. E. & I.	CONST.	DRAWING
A0	ES	CHK.	MECH. E. & I.	CONST.	DRAWING
A1	ES	CHK.	MECH. E. & I.	CONST.	DRAWING

ISSUED FOR PERMIT DATED: 2023-05-05

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS: CIVIL, E & I, MECH, CONST, APPROVED, DATE MAY 2023

REFERENCE NO.

SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O. H096H1116200001 REV. A

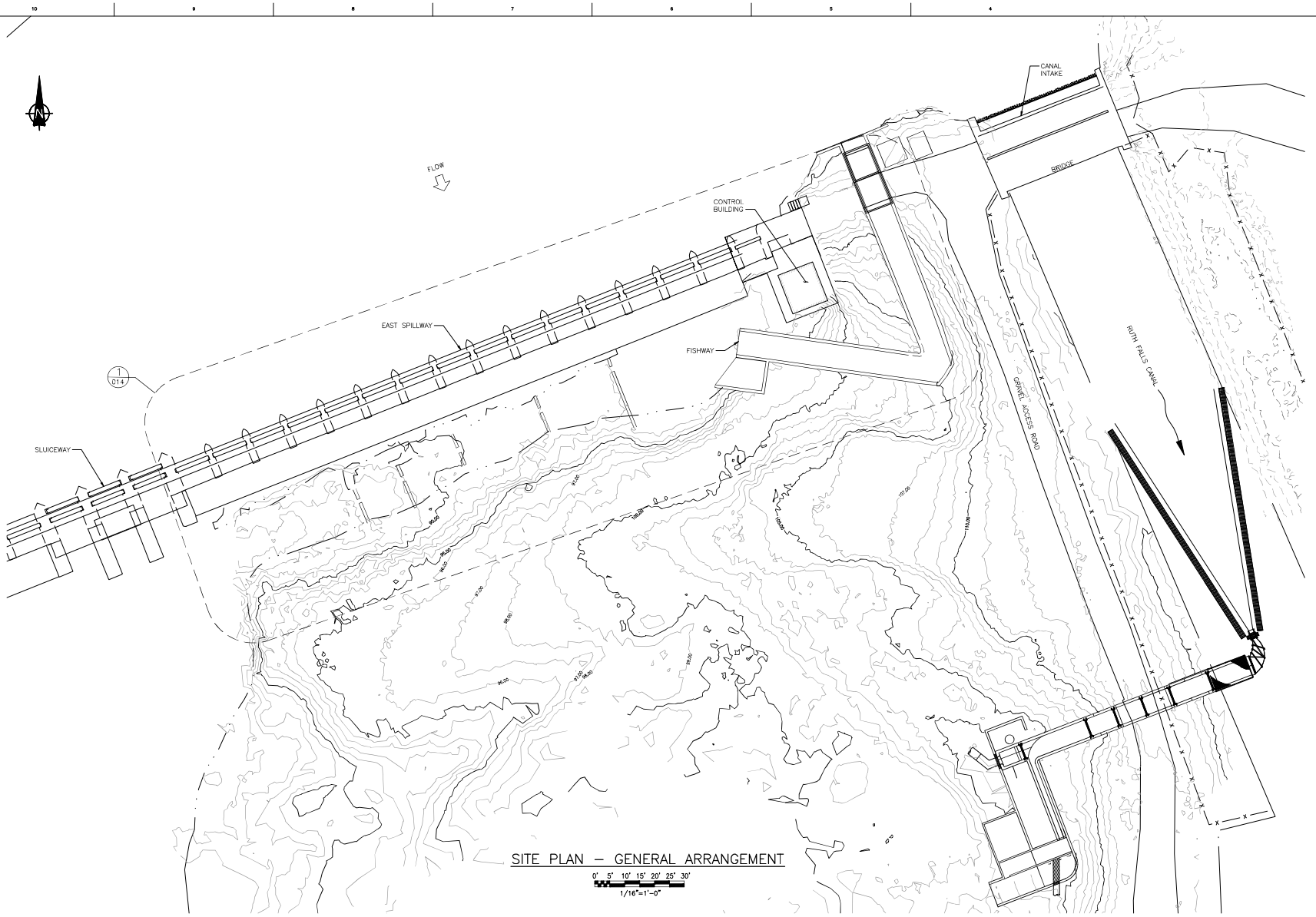
wood.
Wood Canada POWER An Entura Company

RUTH FALLS
FISHWAY MODIFICATIONS
GENERAL NOTES

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,3

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



SITE PLAN – GENERAL ARRANGEMENT

0' 5' 10' 15' 20' 25' 30'

1/16"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

JOB No. 254103

EXISTING CONDITIONS FISHWAY – PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,4
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	DWRD
B	RE-ISSUED FOR PERMIT DATE: 2023-06-19					
A	ISSUED FOR PERMIT DATE: 2023-05-05					

SEAL

DEPARTMENTAL APPROVALS

CIVIL E & I

MECH CONST

APPROVED

DATE MAY 2023

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

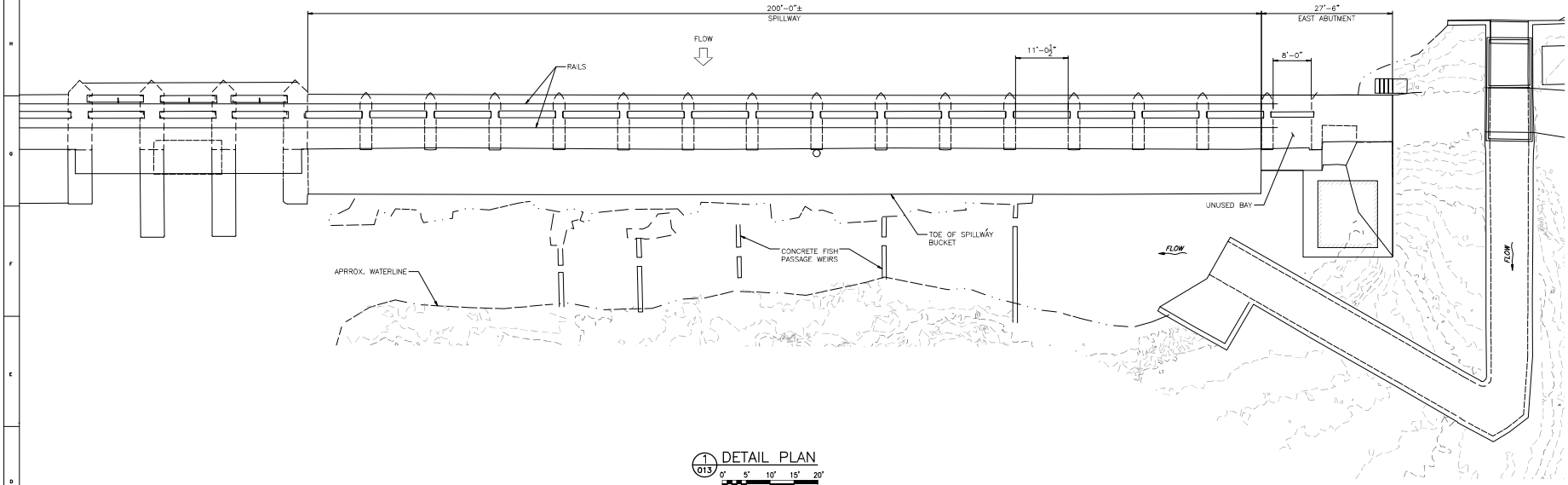
EXISTING CONDITIONS GENERAL ARRANGEMENT

H 0,9,6,H,1 1 6,2,0 0,0 0,1,3 REV. B

DWG. NO. H-096H1-1-6200-0014

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



1/013 DETAIL PLAN

0' 5' 10' 15' 20'

3/32"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EXISTING CONDITIONS – GENERAL ARRANGEMENT	H-096H1-1-6200-0013
GENERAL NOTES	H-096H1-1-6200-0012

ISSUED FOR PERMIT DATE: 2023-05-05

JOB No. 254103

DEPARTMENTAL APPROVALS

APPROVED

DATE MAY 2023

SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

REFERENCE NO.

wood.

Wood Dudley POWER An Enterra Company

RUTH FALLS
FISHWAY MODIFICATIONS

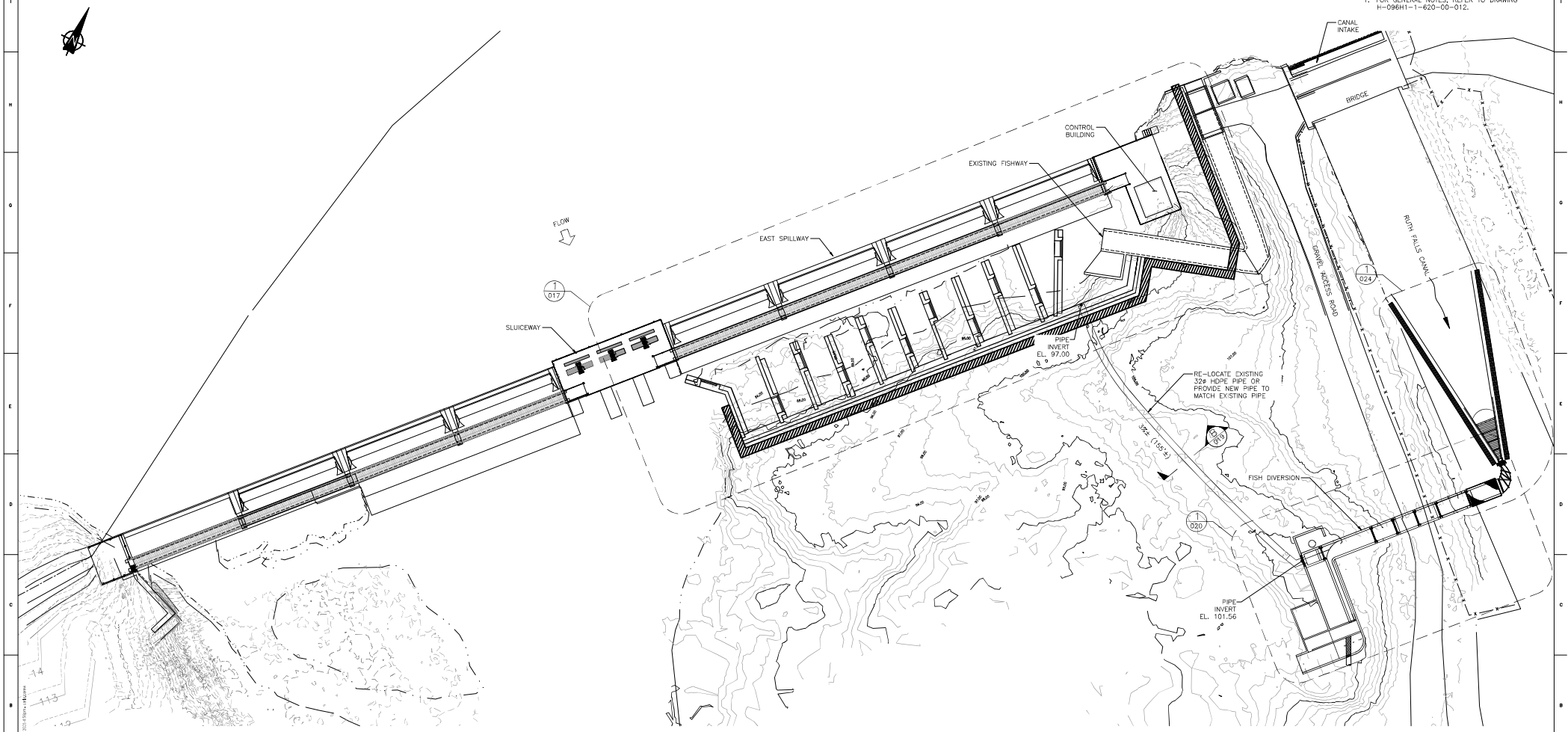
EXISTING CONDITIONS
FISHWAY – PLAN

H-096H1-1-6200-0014 REV. A

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,6

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



PLAN

0 5' 10' 20' 40'

1"=20'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

DOWNSTREAM EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,4
FISH BYPASS – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,0
CHANNEL FISHWAY – SECTIONS AND DETAILS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,9
CHANNEL FISHWAY – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,7
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CHK	MECH	E & I	CONST	DWRG
B	RE-ISSUED FOR PERMIT DATE: 2023-06-19					
A	ISSUED FOR PERMIT DATE: 2023-05-05					

SEAL

DEPARTMENTAL APPROVALS

CIVIL E & I

MECH CONST

APPROVED

DATE MAY 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

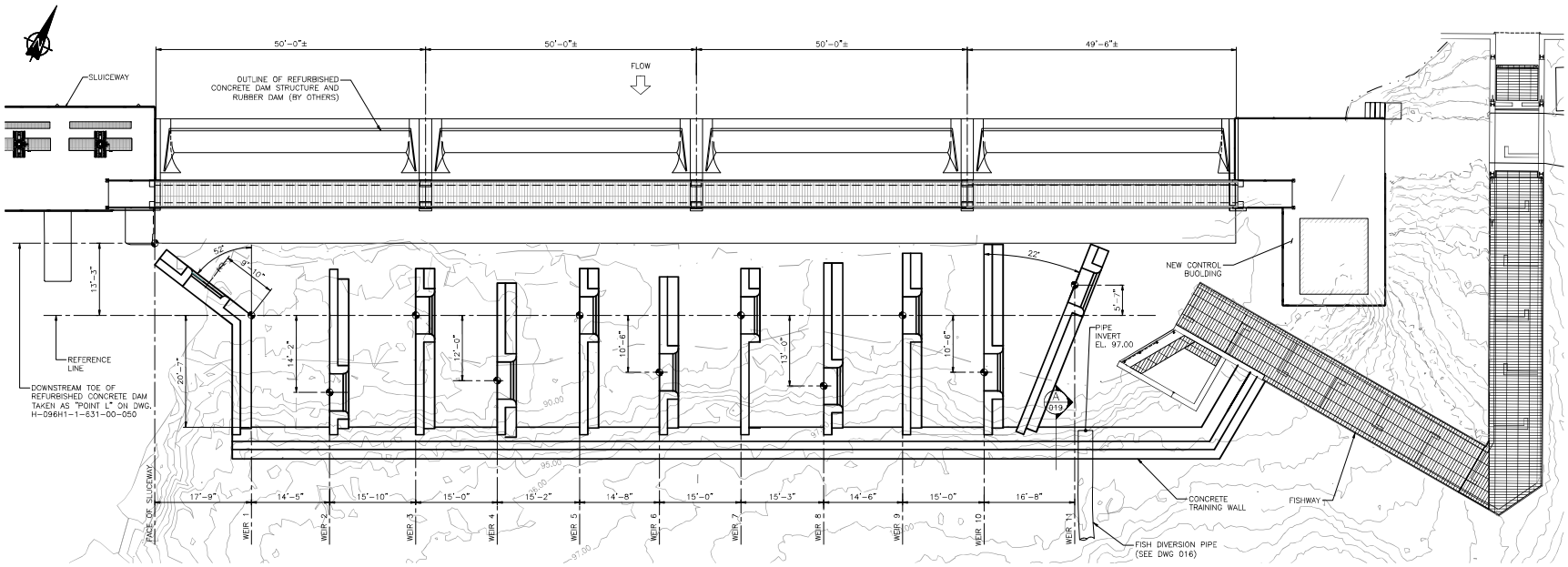
GENERAL ARRANGEMENT PLAN

H 0,9,6,H,1 1 6,2,0 0,0 0,1,6 REV. B

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,7

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. FOR DIMENSIONS OF WEIRS IN CHANNEL FISHWAY SEE DWG. 018 AND 019.

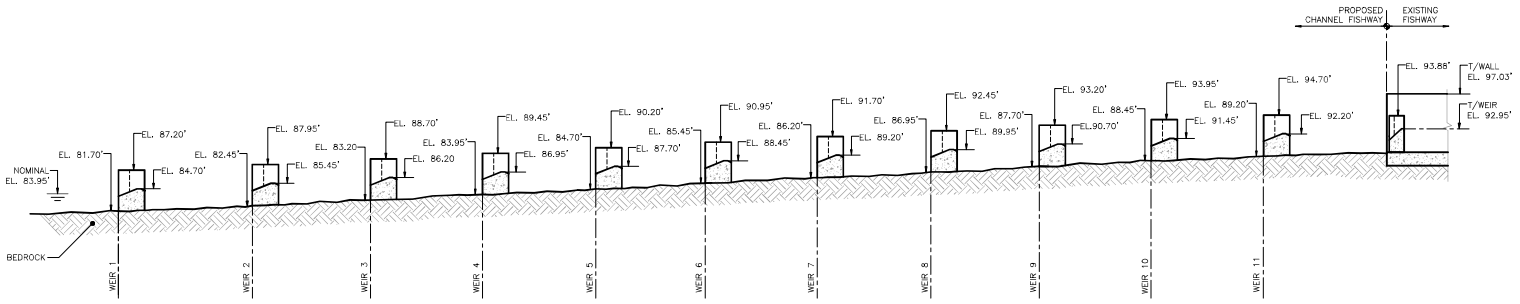


1 / 016 PLAN

0 2' 5' 10' 20'

1"=10'-0"

NOTE:
EEL PASSAGE NOT SHOWN FOR CLARITY (SEE DRAWING 022 FOR DETAILS)



DEVELOPED SECTION

0' 5' 10' 15'

1/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EAST SPILLWAY PLAN AND SECTIONS	H 0,9,6,H,1 1 6,3,1 0,0 0,5,0
UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,2
CHANNEL FISHWAY – SECTIONS AND DETAILS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,9
CHANNEL FISHWAY – CROSS SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,8
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV.	BY	CHK.	MECH'L & I	CONST.	ISSUED
A	ES	CHK.	MECH'L & I	CONST.	ISSUED FOR PERMIT DATED 2023-05-05

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	

APPROVED

DATE MAY 2023

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

Wood Dudley POWER An Enterra Company

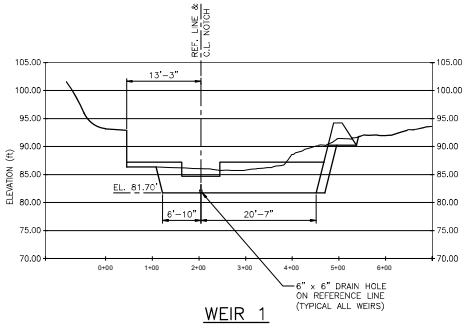
RUTH FALLS

FISHWAY MODIFICATIONS

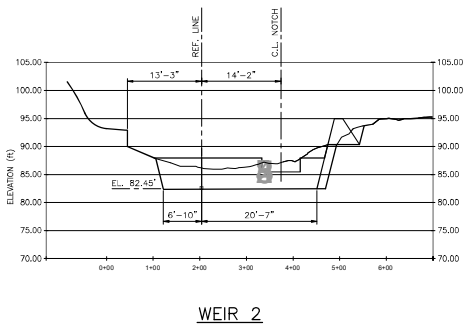
CHANNEL FISHWAY – PLAN AND SECTIONS

H 0,9,6,H,1 1 6,2,0 0,0 0,1,7 REV. A

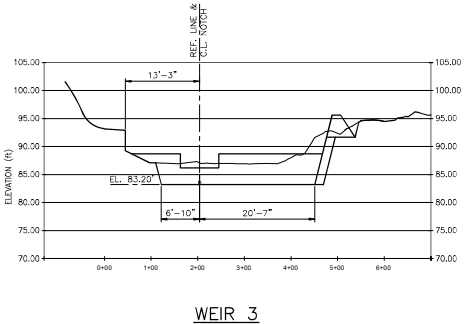
DWG. H 0,9,6,H,1 1 6,2,0 0,0 0,1,8



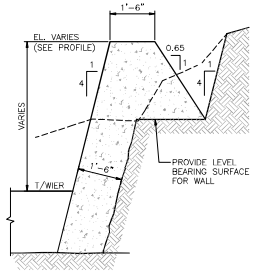
WEIR 1



WEIR 2



WEIR 3

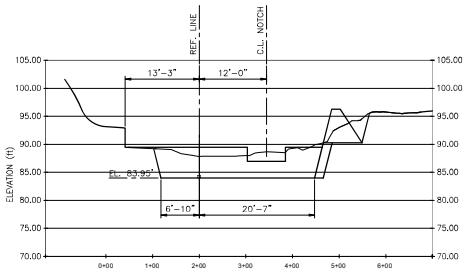


NOTES:

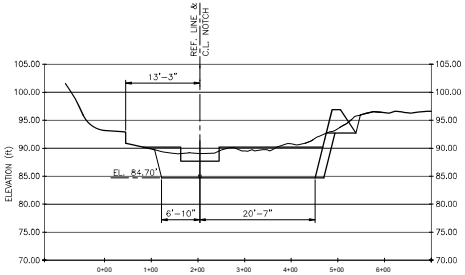
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.

TYP. CONCRETE TRAINING WALL DETAIL

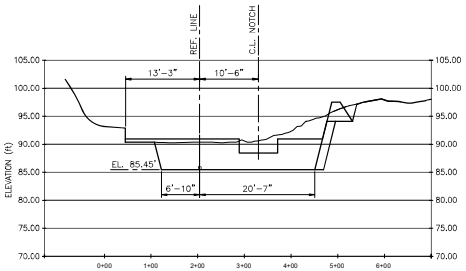
0' 1' 2' 3' 4'
1/2"=1'-0"



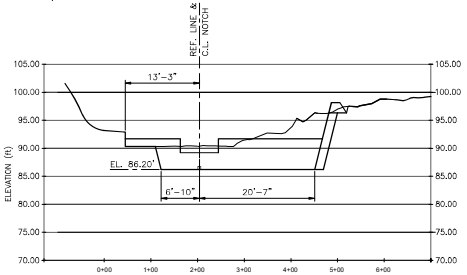
WEIR 4



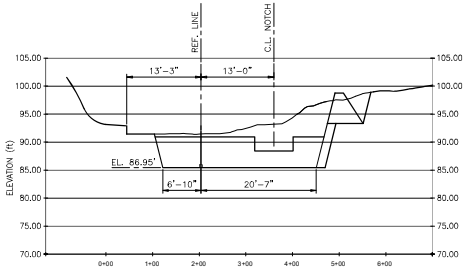
WEIR 5



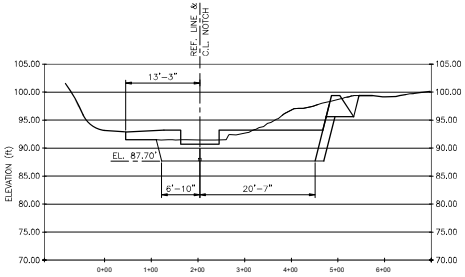
WEIR 6



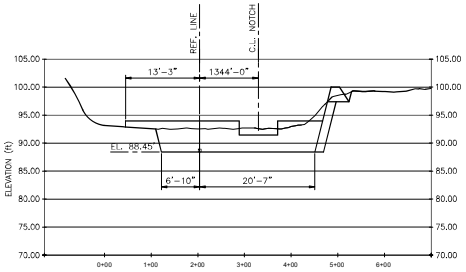
WEIR 7



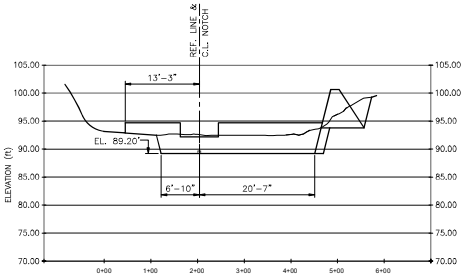
WEIR 8



WEIR 9



WEIR 10



WEIR 11

PRELIMINARY
NOT FOR CONSTRUCTION

GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2
REFERENCE DRAWINGS	DWG.NO.

REV.	BY	CHK.	MECH'L & I.	CONST.DRAWING
A	ES	CHK.	MECH'L & I.	CONST.DRAWING

ISSUED FOR PERMIT DATED: 2023-05-05

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

SCALE	3/32"=1'-0"
UNITS	Imperial
DESIGNED	EO
DRAWN	AT
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

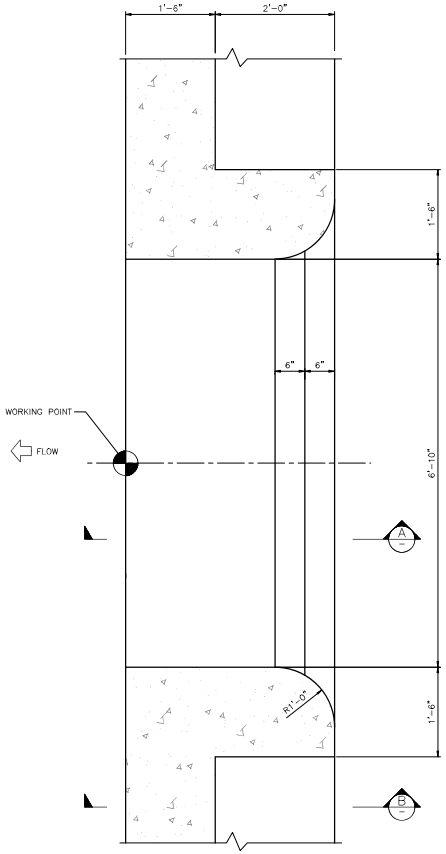
wood.
Wood PLC
POWER
An Amentum Company

RUTH FALLS
FISHWAY MODIFICATIONS
CHANNEL FISHWAY – CROSS SECTIONS

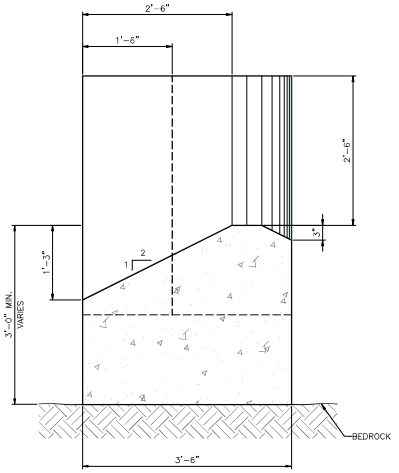
H 0,9,6,H,1 1 6,2,0 0,0 0,1,8 REV. A

DWG. NO. H096H1-1-620-00-012

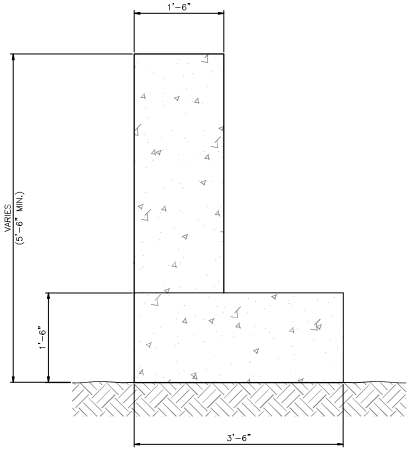
NOTES:
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



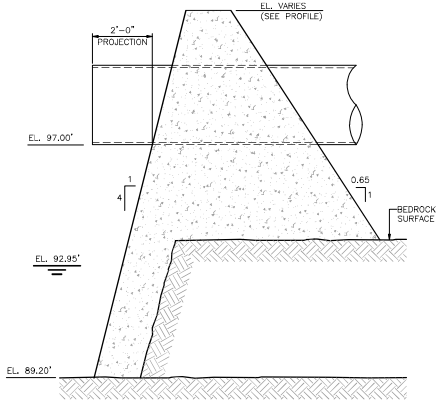
TYPICAL WEIR PLAN DETAIL
0' 1' 2' 3'
1"=1'-0"



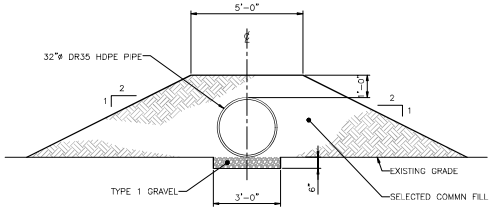
A SECTION
0' 1' 2' 3'
1"=1'-0"



B SECTION
0' 1' 2' 3'
1"=1'-0"



A 017 SECTION
0' 1' 2' 3' 4'
1/2"=1'-0"



B 016 SECTION
0' 1' 2' 3' 4' 5'
3/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
CHANNEL FISHWAY – PLAN AND SECTIONS	H096H1-1-620-00-017
GENERAL ARRANGEMENT PLAN	H096H1-1-620-00-016
GENERAL NOTES	H096H1-1-620-00-012

ISSUED FOR PERMIT DATE: 2023-05-05

JOB No. 254103

DEPARTMENTAL APPROVALS
CIVIL E & I
MECH CONST
APPROVED
DATE MAY 2023

SEAL

REFERENCE NO.
SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN AT/CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

wood.
Wood Dudley POWER An Entera Company

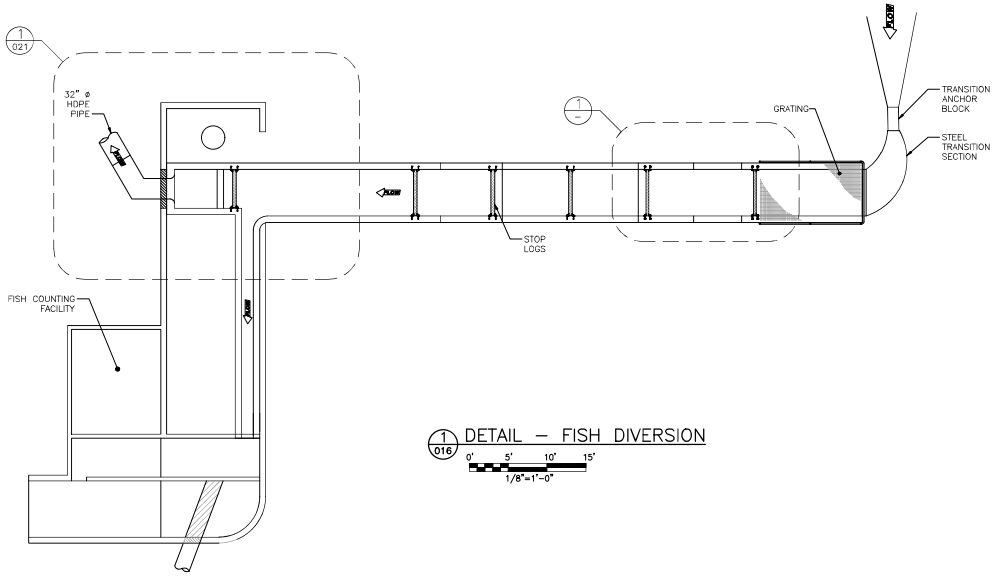
RUTH FALLS
FISHWAY MODIFICATIONS
CHANNEL FISHWAY – SECTIONS AND DETAILS

H096H1-1-620-00-019 REV. A

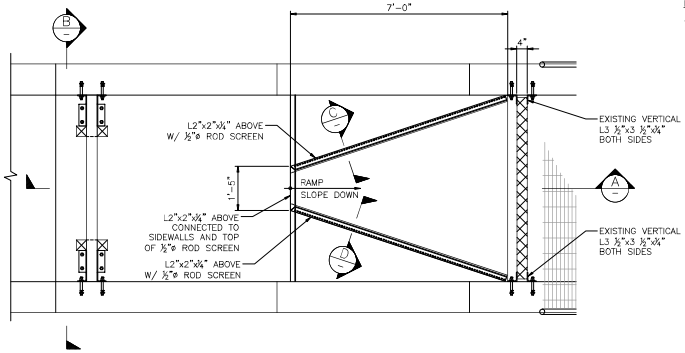
DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,2,0

NOTES:

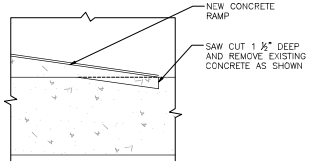
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



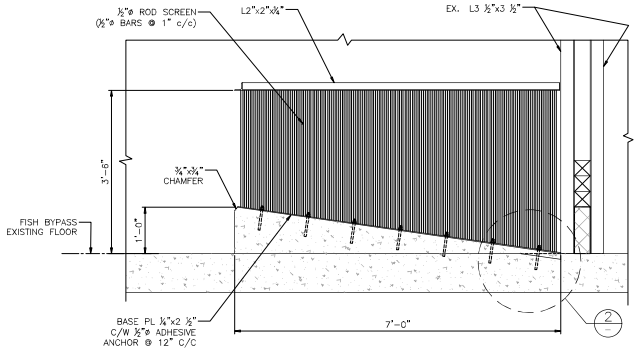
1 016 DETAIL – FISH DIVERSION
0' 5' 10' 15'
1/8"=1'-0"



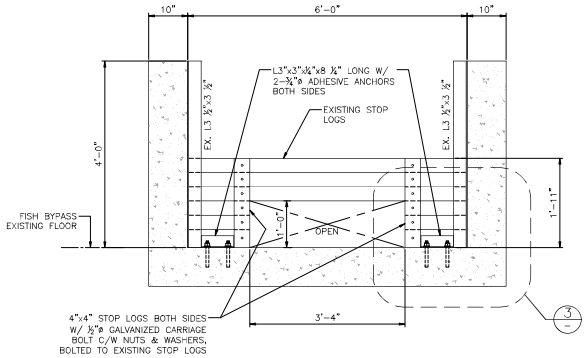
1 DETAIL PLAN
0' 1' 2' 3' 4'
1/2"=1'-0"



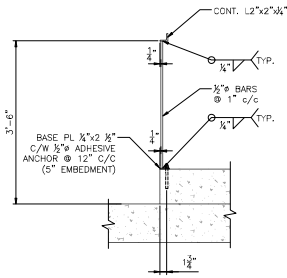
2 DETAIL
0" 6" 12" 24"
1-1/2"=1'-0"



A SECTION
0' 1' 2' 3'
3/4"=1'-0"

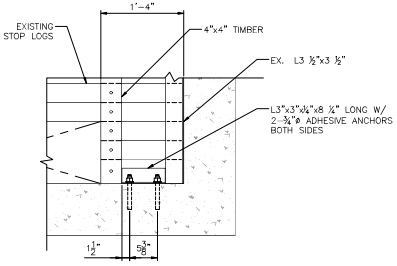


B SECTION (TYPICAL ALL 6 STOP LOG LOCATIONS)
0' 1' 2' 3'
3/4"=1'-0"



C SECTION (AS SHOWN)

D SECTION (OPP. HAND)
0' 1' 2' 3'
3/4"=1'-0"



3 DETAIL
0' 1' 2' 3'
1"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

FISH BYPASS– PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,1
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV	DS	CIVIL	MECH	E & I	CONST	OWNER	DATE	DESCRIPTION
B	DS	CIVIL	MECH	E & I	CONST	OWNER	2023-06-13	RE-ISSUED FOR PERMIT
A	DS	CIVIL	MECH	E & I	CONST	OWNER	2023-05-05	ISSUED FOR PERMIT

SEAL

DEPARTMENTAL APPROVALS: CIVIL, E & I, MECH, CONST

APPROVED

DATE MAY 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

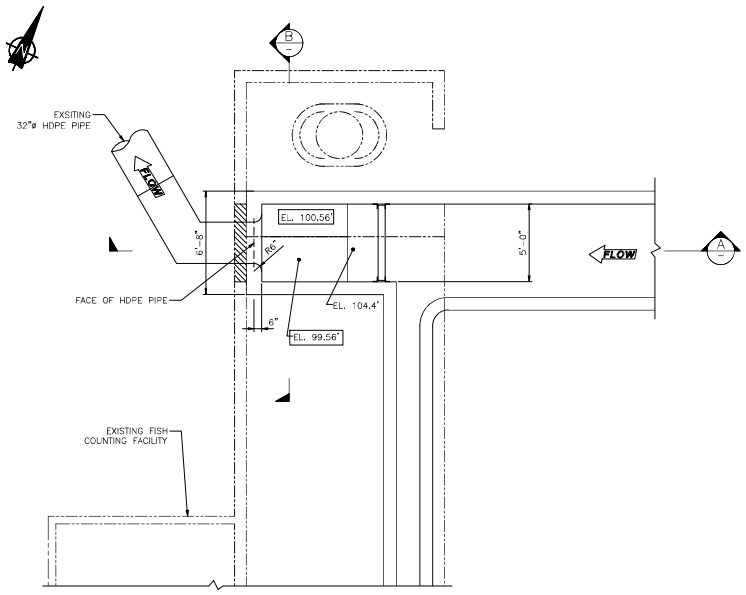
FISH BYPASS – PLAN AND SECTIONS

H 0,9,6,H,1 1 6,2,0 0,0 0,2,0 REV. B

DWG. NO. H096H1-1-6200-0021

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.

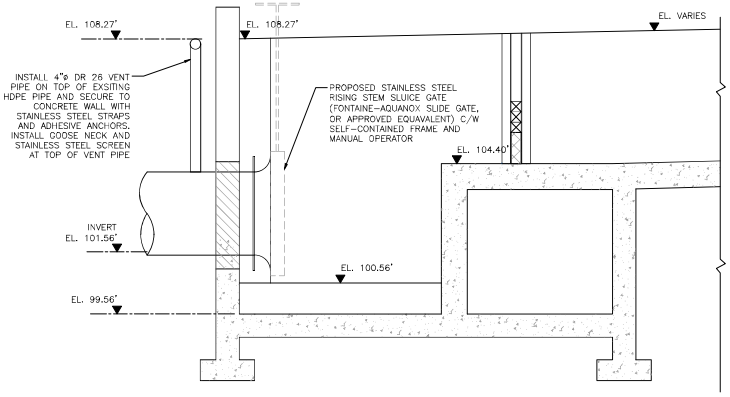


1/020 DETAIL PLAN

0' 1' 5' 10'

1/4"=1'-0"

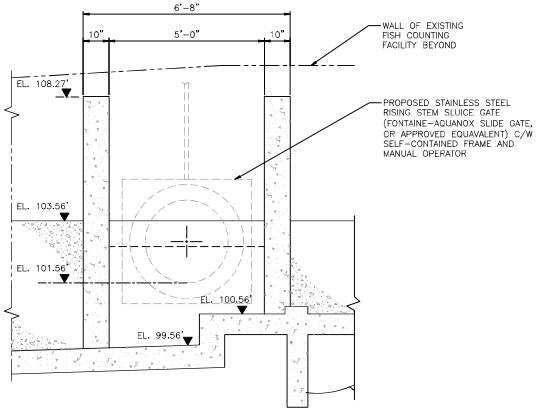
(ACCESS PLATFORM NOT SHOWN FOR CLARITY)



A SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"



B SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

FISH BYPASS – PLAN AND SECTIONS	H096H1-1-6200-0020
GENERAL NOTES	H096H1-1-6200-0012

REV	DS	CHK	MECH	E & I	CONST	DWRD	DESCRIPTION
B							RE-ISSUED FOR PERMIT DATE: 2023-05-03
A							ISSUED FOR PERMIT DATE: 2023-04-13

JOB No. 254103

SEAL

DEPARTMENTAL APPROVALS

CIVIL | E & I

MECH | CONST

APPROVED

DATE MAY 2023

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

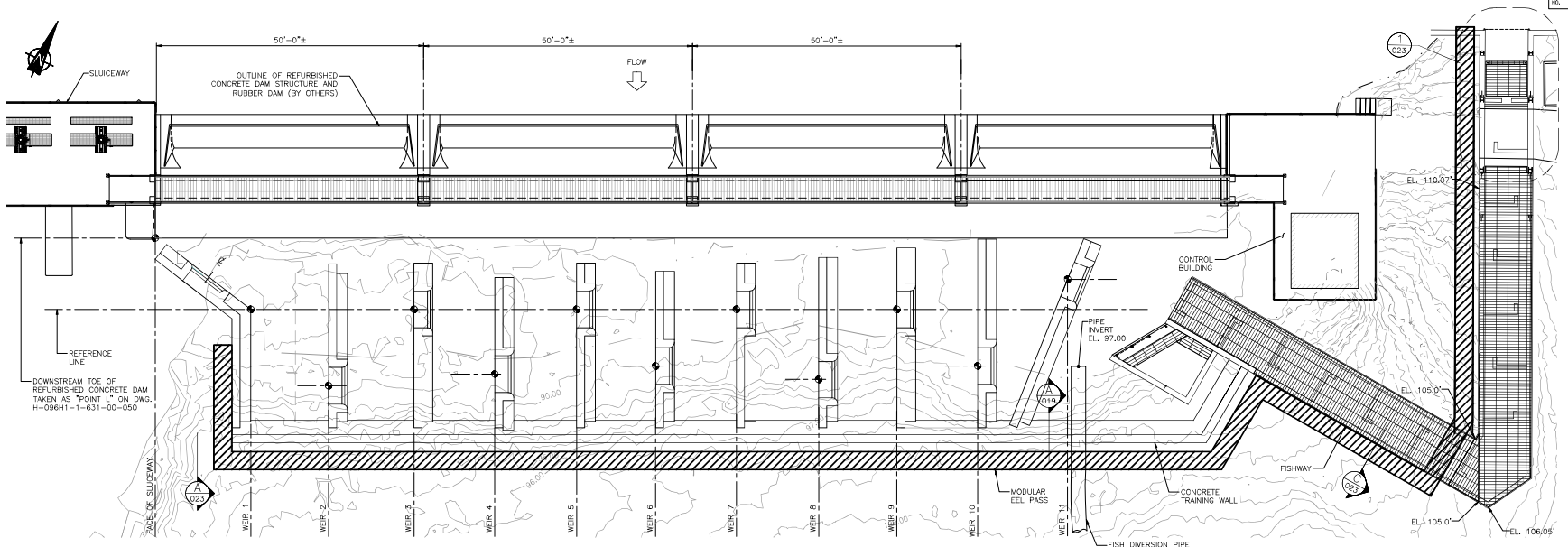
FISH BYPASS – SECTIONS AND DETAILS

H096H1-1-6200-0021 REV. B

DWG. NO. H096H1-1-16200-00-0222

NOTES:

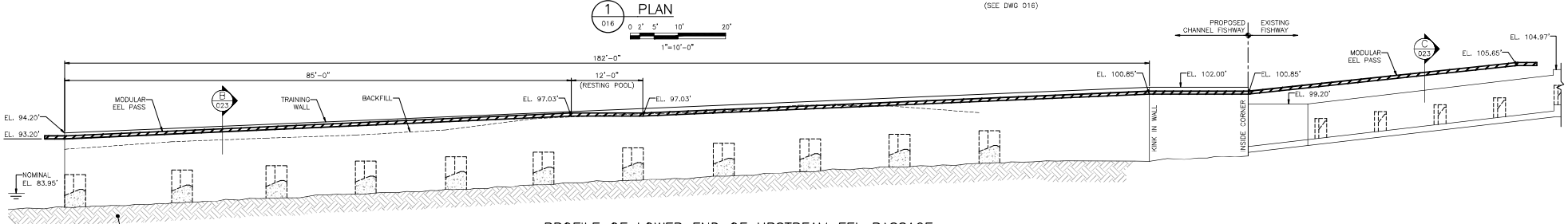
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. FOR DIMENSIONS OF CHANNEL FISHWAY, SEE DRAWING H-096H1-1-620-00-017.



1/016 PLAN

0 2' 5' 10' 20'

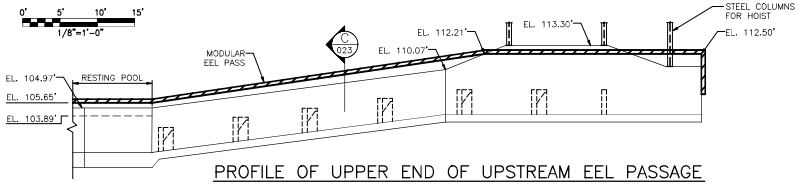
1"=10'-0"



PROFILE OF LOWER END OF UPSTREAM EEL PASSAGE

0' 5' 10' 15'

1/8"=1'-0"



PROFILE OF UPPER END OF UPSTREAM EEL PASSAGE
(FAR SIDE OF FISHWAY)

0' 5' 10' 15'

1/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EAST SPILLWAY PLAN AND SECTIONS	H096H1-1-63100-00-050
UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS	H096H1-1-62003-00-023
CHANNEL FISHWAY – PLAN AND SECTIONS	H096H1-1-62000-00-017
GENERAL ARRANGEMENT PLAN	H096H1-1-62000-00-016
GENERAL NOTES	H096H1-1-62000-00-012

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

JOB No. 254103

REFERENCE NO.

SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	AT/CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.

Wood Dublin POWER An Enturo Company

RUTH FALLS

FISHWAY MODIFICATIONS

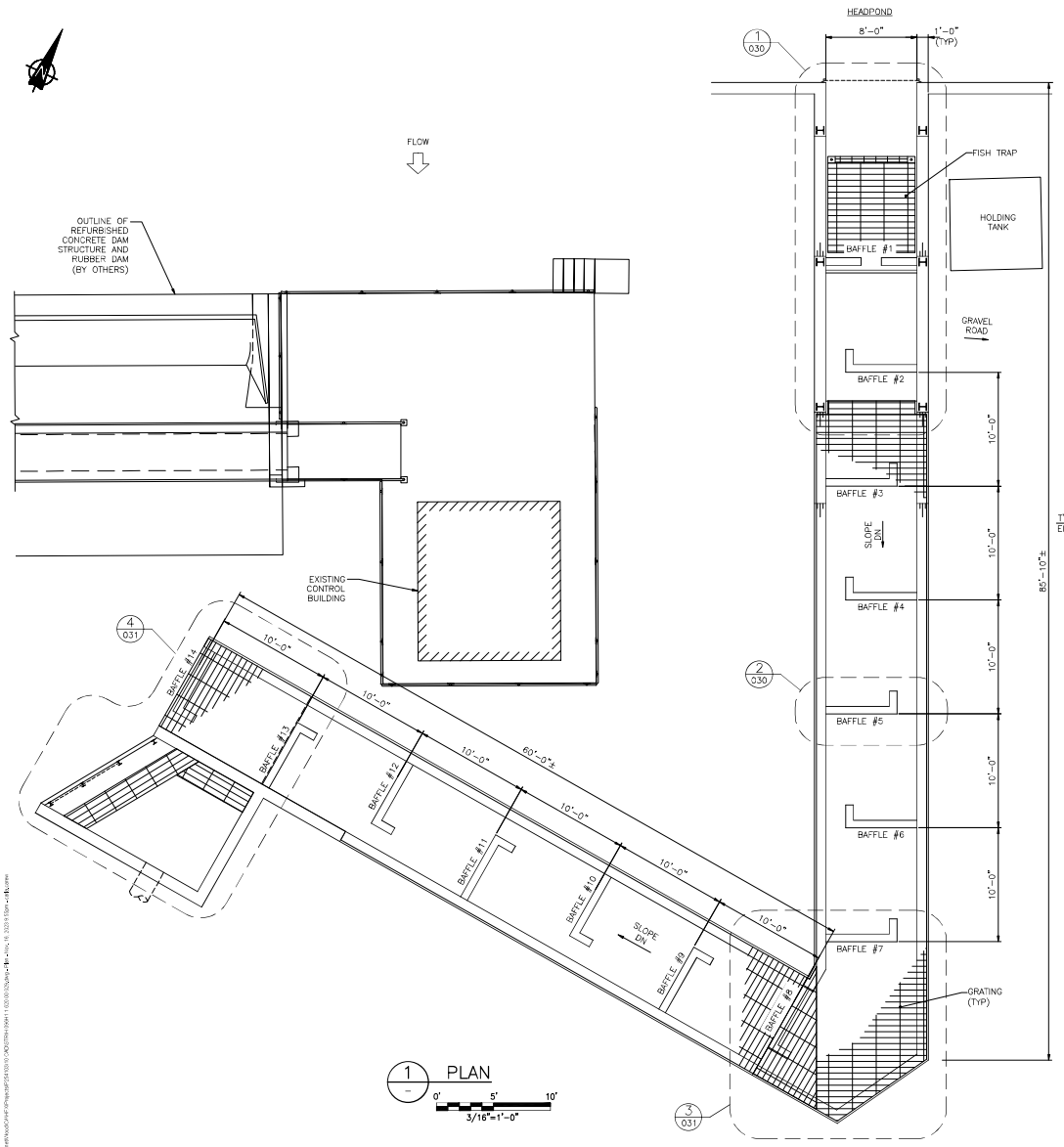
UPSTREAM EEL PASSAGE – PLAN AND SECTIONS

H096H1-1-16200-00-0222 REV. A

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,2,9

GENERAL NOTES:

1. DRAWINGS ARE NOT TO BE SCALED. ONLY FIGURED DIMENSIONS TO BE FOLLOWED.
2. ALL DIMENSIONS ARE IN FEET AND INCHES UNLESS NOTED OTHERWISE.
3. ELEVATIONS ARE SHOWN IN FEET.
4. ELEVATIONS SHOWN ARE TO CGVD 2013. TOPOGRAPHIC SURVEY INFORMATION IS BASED ON FIELD SURVEY PERFORMED BY TALISMAN TECHNICAL SOLUTIONS IN NOVEMBER, 2022.
5. COORDINATES AND ELEVATIONS SHOWN ARE TO THE NOVA SCOTIA CONTROL COORDINATE SYSTEM, WGS72, MODIFIED TRANSVERSE MERCATOR, ZONE 5.
6. STRUCTURE DIMENSIONS ARE BASED ON MEASUREMENTS TAKEN DURING FIELD VISIT ON NOVEMBER 25, 2022.
7. WEIR ELEVATIONS WERE DETERMINED BY MEASURING FROM SIDEWALLS OF FISHWAY AND ARE APPROXIMATE ONLY.

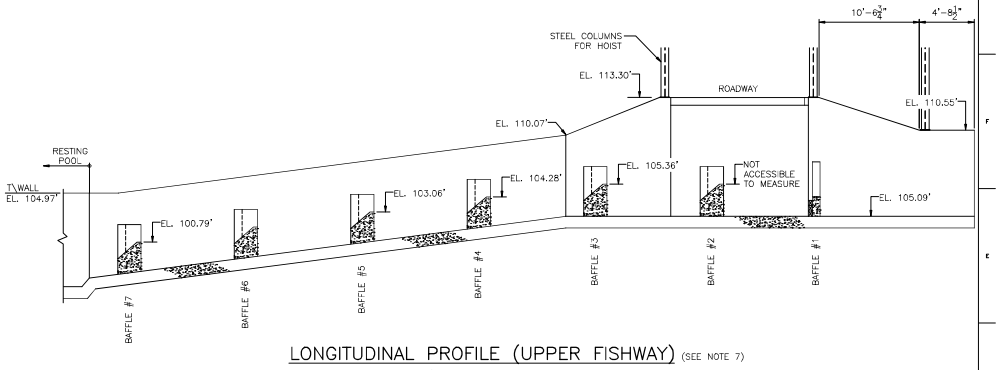


1 030 — 2 030 — 3 031 — 4 031

1 — PLAN

0' 5' 10'

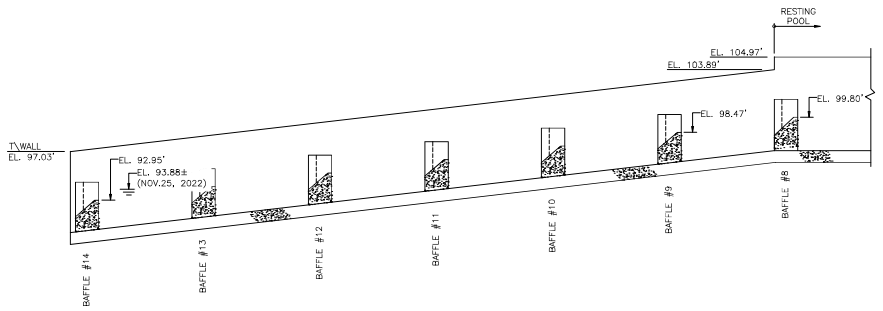
3/16"=1'-0"



LONGITUDINAL PROFILE (UPPER FISHWAY) (SEE NOTE 7)

0' 5' 10'

3/16"=1'-0"



LONGITUDINAL PROFILE (LOWER FISHWAY) (SEE NOTE 7)

0' 5' 10'

3/16"=1'-0"

REFERENCE DRAWINGS	DWG.NO.
EXISTING FISHWAY – DETAILS SHEET 2	H 0,9,6,H,1 1 6,2,0 0,0 0,3,1
EXISTING FISHWAY – DETAILS SHEET 1	H 0,9,6,H,1 1 6,2,0 0,0 0,3,0

JOB No. 254103

SEAL

DEPARTMENTAL APPROVALS

CIVIL — E. & M.

MECH — CONST.

APPROVED

DATE NOV 2023

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN CC

CHECKED AC

CHECKED EO

DATE 2023-11-16

W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

EXISTING FISHWAY PLAN AND PROFILE

H 0,9,6,H,1 1 6,2,0 0,0 0,2,9 REV. A

REV. DS CIVIL MECH E & M CONST DWRD

REV. DS CIVIL MECH E & M CONST DWRD

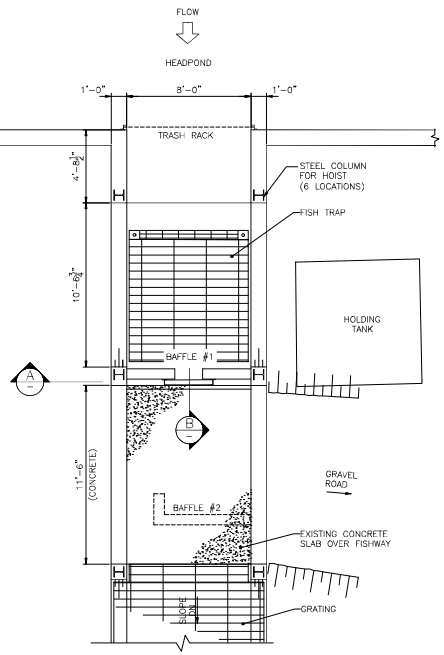
A REV. DS CIVIL MECH E & M CONST DWRD

ISSUED FOR AS-BUILT DWG 2023-11-16 M. EO AC

DWG. H096H1-1-620-00-030

NOTES:

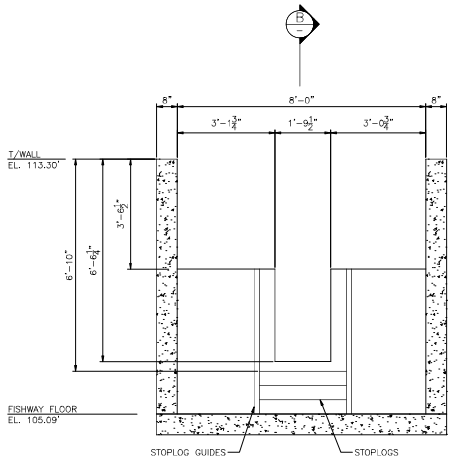
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-029.



1/029 DETAIL

0' 1' 5' 10'

1/4"=1'-0"

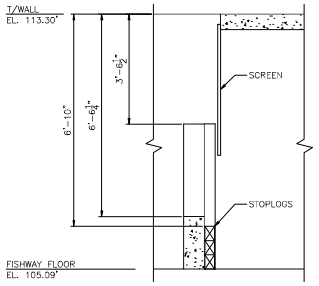


BAFFLE #1

A SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

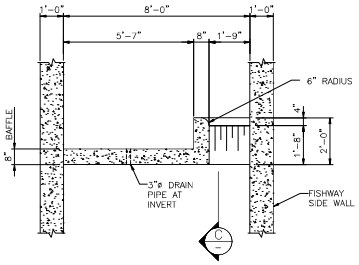


BAFFLE #1

B SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

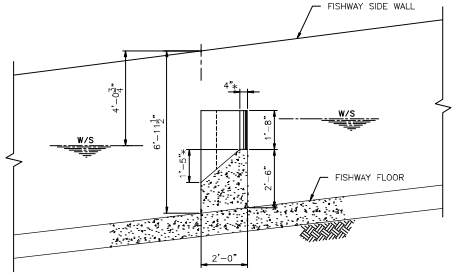


2/029 DETAIL

0' 1' 2' 3' 4' 5'

3/8"=1'-0"

TYPICAL BAFFLE



C SECTION

0' 1' 2' 3' 4' 5'

3/8"=1'-0"

* INFERRED DIMENSION COULD NOT BE MEASURED IN FIELD (TYPICAL WATER SURFACES ELEVATIONS SHOWN)

JOB No. 254103

SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-11-16
W.O.	

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

EXISTING FISHWAY DETAILS SHEET 1

DWG. H096H1-1-620-00-030 REV. A

EXISTING FISHWAY – PLAN AND PROFILE

REFERENCE DRAWINGS

DWG.NO. H096H1-1-620-00-029

SEAL

DEPARTMENTAL APPROVALS

CIVIL / E & I

MECH / CONST

APPROVED

DATE NOV 2023

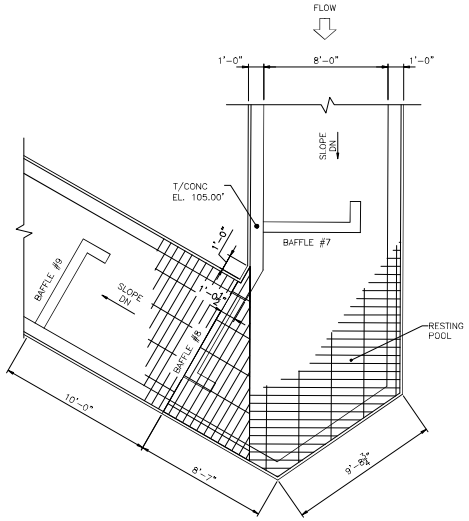
ISSUED FOR AS-BUILT DATE: 2023-11-16

M. EO AC

DWG. H 0,9,6,H,1 1 6,2,0 0,0 0,3,1

NOTES:

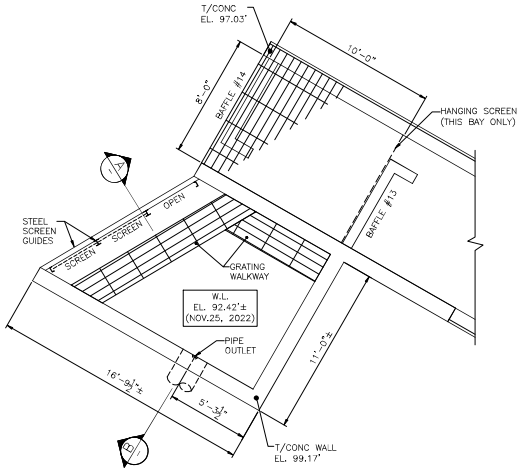
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-029.



3/029 DETAIL

0' 1' 5' 10'

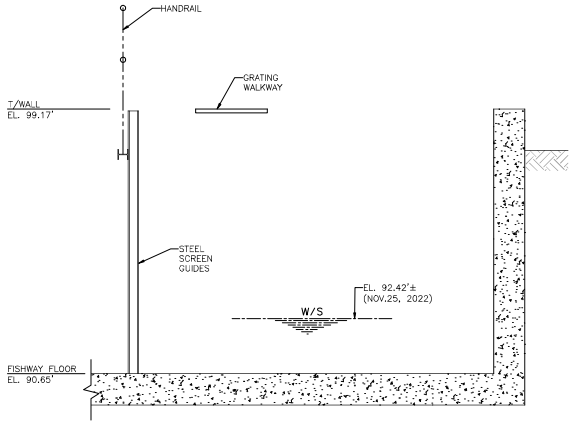
1/4"=1'-0"



4/029 DETAIL

0' 1' 5' 10'

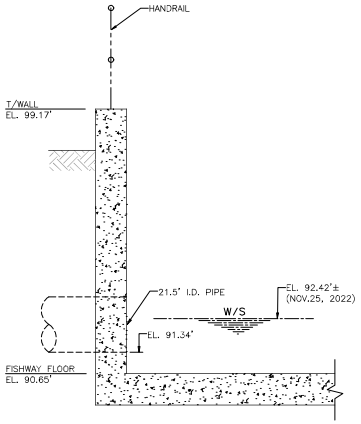
1/4"=1'-0"



A SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"



B SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

JOB No. 254103

EXISTING FISHWAY – PLAN AND PROFILE	H 0,9,6,H,1 1 6,2,0 0,0 0,2,9	DEPARTMENTAL APPROVALS	SCALE As Noted Imperial
REFERENCE DRAWINGS	DWG.NO.	CIVIL / E & I	UNITS
		MECH / CONST	DESIGNED EO
		APPROVED	DRAWN CC
		DATE NOV 2023	CHECKED AC
			CHECKED EO
			DATE 2023-11-16
			W.O.

ISSUED FOR AS-BUILT DATE: 2023-11-16

wood.

Nova Scotia POWER An Emera Company

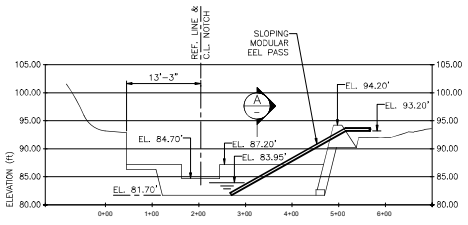
RUTH FALLS

FISHWAY MODIFICATIONS

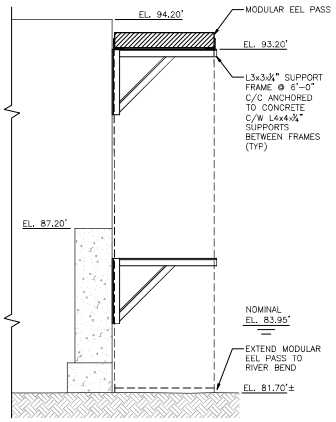
EXISTING FISHWAY DETAILS SHEET 2

H 0,9,6,H,1 1 6,2,0 0,0 0,3,1 REV. A

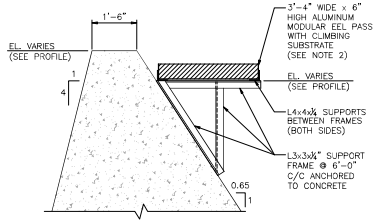
DWG. H 0,9,6,H,1 1 6,2,0 0,0 0,2,3



A 022 SECTION
0' 5' 10' 15' 20'
3/32"=1'-0"



A 022 SECTION
0' 1' 2' 3' 4'
1/2"=1'-0"



B 022 SECTION
0' 1' 2' 3' 4'
1/2"=1'-0"
(TYPICAL ALONG TRAINING WALL)

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. MODULAR EEL PASS TO CONSIST OF 6" HIGH ALUMINUM TROUGH WITH HINGED LOCKABLE COVER (SEE FIGURE 1), (EXCEPT NO COVER AT DOWNSTREAM END WHERE EEL PASS IS SUBMERGED) C/W CLIMBING SUBSTRATE. CLIMBING SUBSTRATE TO BE HIGH DENSITY CO-POLYMER MANUFACTURED BY AQUATIC CONTROL ENGINEERING OR BERRY AND ESCOTT ENGINEERING. (SEE FIGURE 2)

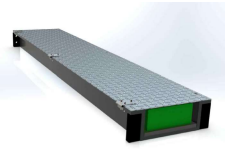


FIGURE 1

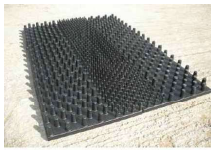
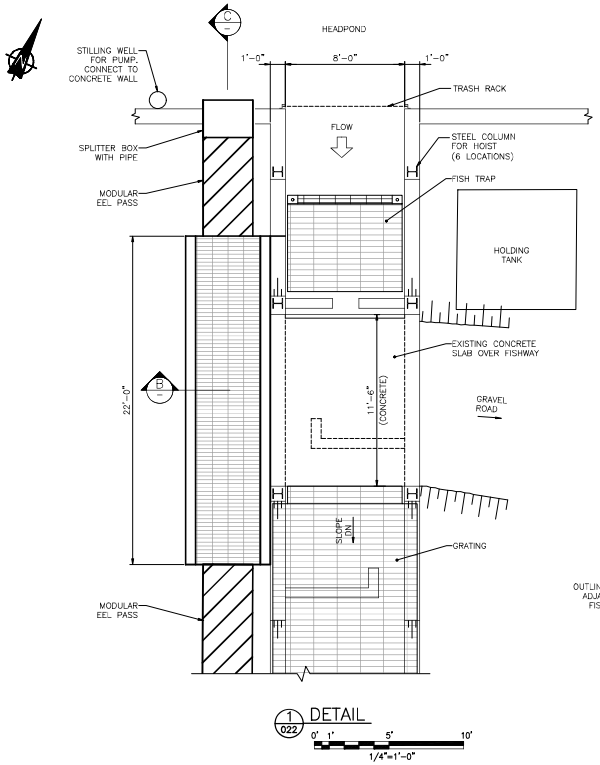
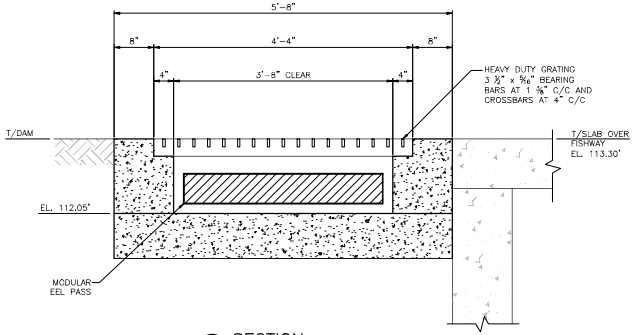


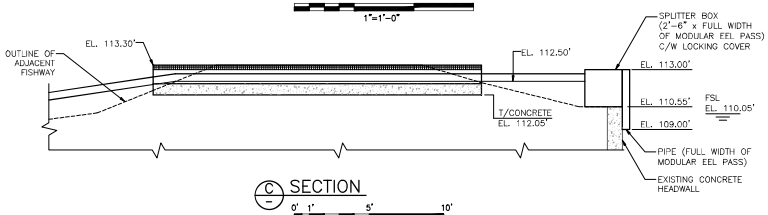
FIGURE 2



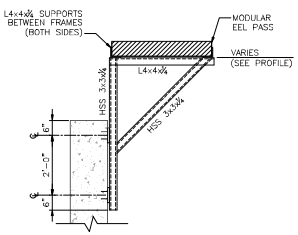
1 022 DETAIL
0' 1' 5' 10'
1/4"=1'-0"



B SECTION
0' 1' 2' 3'
1"=1'-0"



C SECTION
0' 1' 5' 10'
1/4"=1'-0"



C 022 SECTION
0' 1' 2' 3' 4'
1/2"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,2
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV.	BY	CHK.	DISC.	ISSUED
A	EO	CHK.	MECH. E. & I.	CONST. DRAWING
				ISSUED FOR PERMIT DATED 2023-05-05

SEAL

DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

JOB No. 254103

SCALE	3/32"=1'-0"
UNITS	Imperial
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.

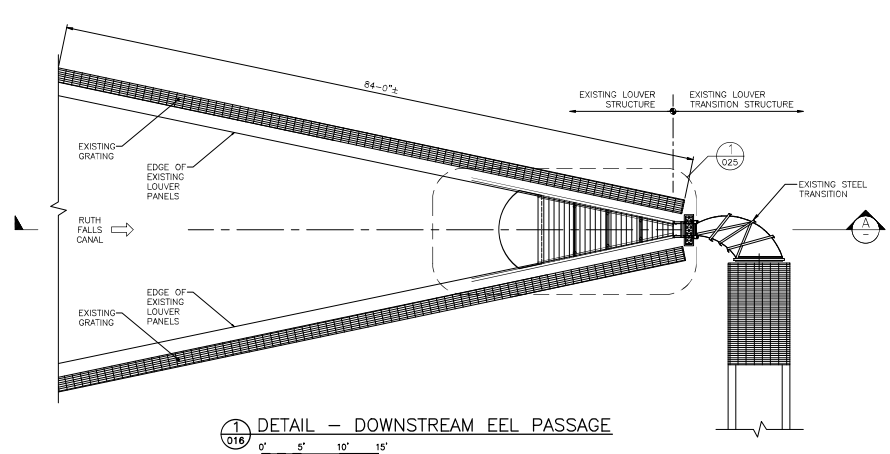
Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS

UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS

H 0,9,6,H,1 1 6,2,0 0,0 0,2,3 REV. A

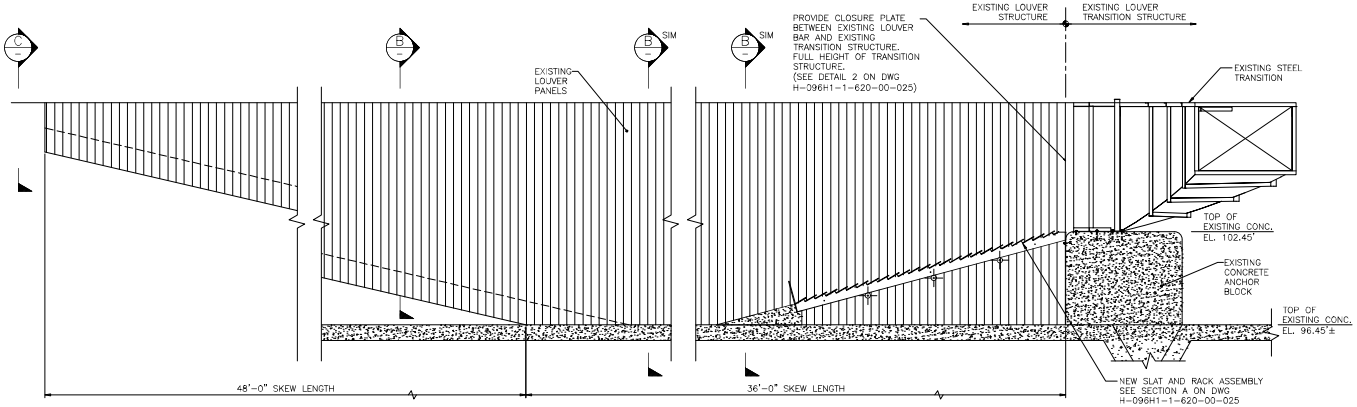
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1 016 DETAIL – DOWNSTREAM EEL PASSAGE

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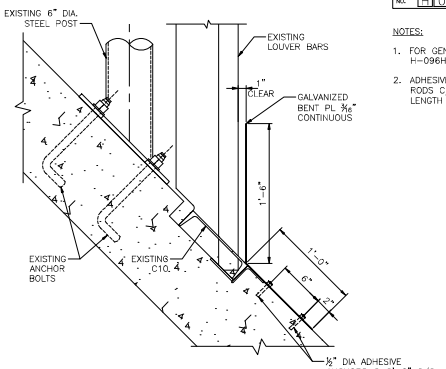
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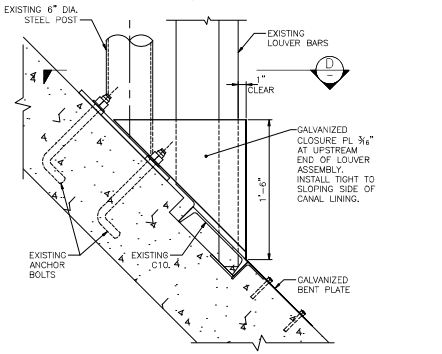
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B SECTION

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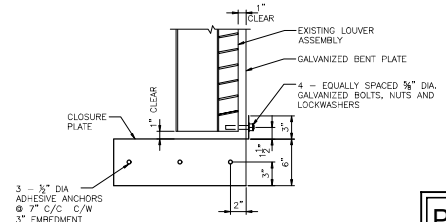
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C SECTION

0" 6" 12" 24"

1-1/2"=1'-0"



D SECTION

0" 6" 12" 24"

1-1/2"=1'-0"

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. ADHESIVE ANCHORS TO BE HAS-R 316SS ANCHOR RODS C/W HIT-RE 500 V3 EPOXY. SIZE AND LENGTH AS INDICATED.

PRELIMINARY

NOT FOR CONSTRUCTION

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GENERAL NOTES	H 0,9,6,H,1 1	6,2,0 0,0 0,1,2

REV.	BY	CHK'D	DISCIPLINE	DWG NO.
A	EO	AC	CIVIL, MECH, E & I, CONST	DWG

ISSUED FOR PERMIT
DATE: 2023-06-13
M. EO AC

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST
APPROVED	
DATE	JUNE 2023

JOB No. 254103

REFERENCE NO.

SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-06-13
W.O.	

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

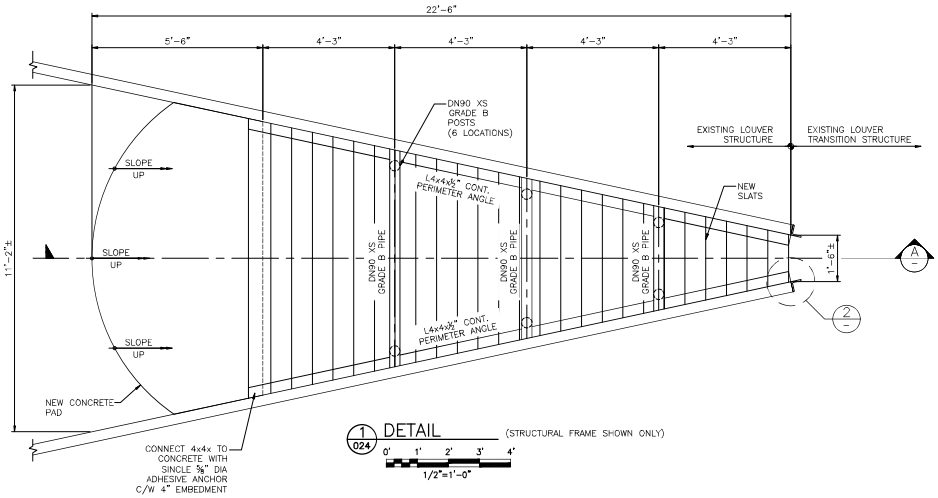
DOWNSTREAM EEL PASSAGE PLAN AND SECTIONS

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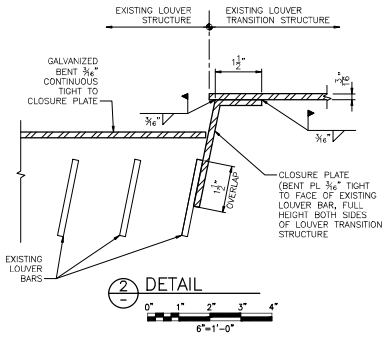
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2. ADHESIVE ANCHORS TO BE HAS-R 316SS ANCHOR RODS C/W HIT-RE 500 V3 EPOXY. SIZE AND LENGTH AS INDICATED.



1 024 DETAIL (STRUCTURAL FRAME SHOWN ONLY)

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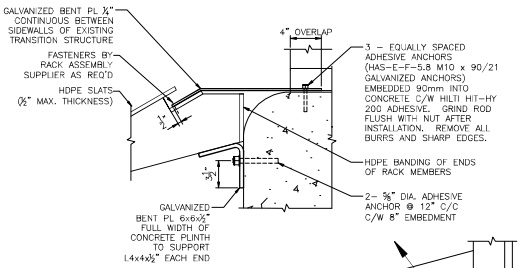
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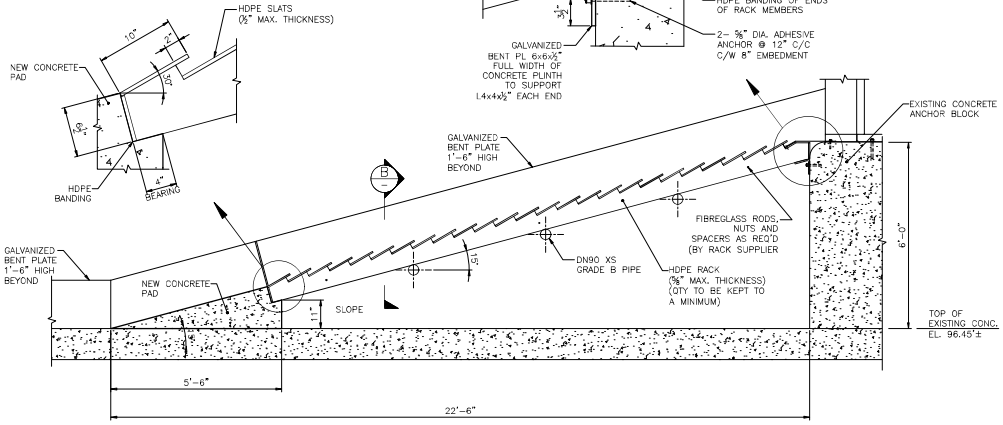


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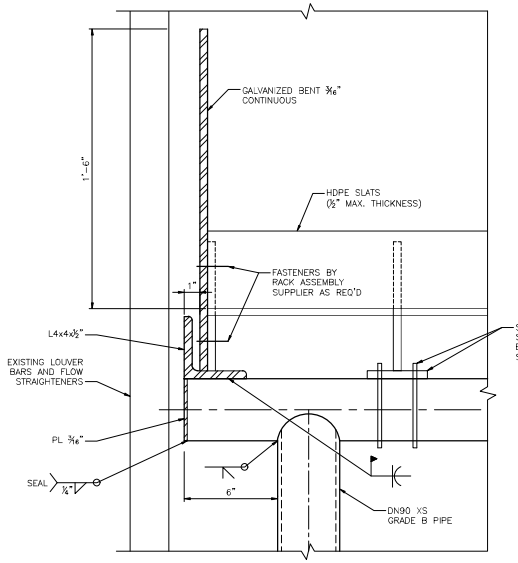




A SECTION

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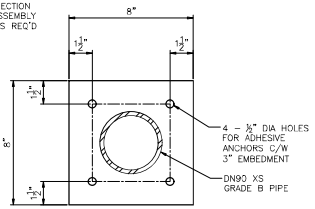
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B SECTION

0" 6" 9" 12"

3"=1'-0"



C SECTION (6 LOCATIONS)

0" 6" 9" 12"

3"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,4
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

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DATE	JUNE 2023

JOB No. 254103

REFERENCE NO.

SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-06-13
W.O.	

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

DOWNSTREAM EEL PASSAGE SECTIONS AND DETAILS

H 0,9,6,H,1 1 6,2,0 0,0 0,2,5 REV. A

APPENDIX E – PROPOSED WATER MANAGEMENT STUCTURES

SITE PLAN SHOWING UPSTREAM AND DOWNSTREAM ACCESS ROADS AND BRIDGE

FOOTPRINT OF TEMPORARY STRUCTURES

LEFT DOWNSTREAM ACCESS ROAD: 10,530 SQ FT (978 SQ M)

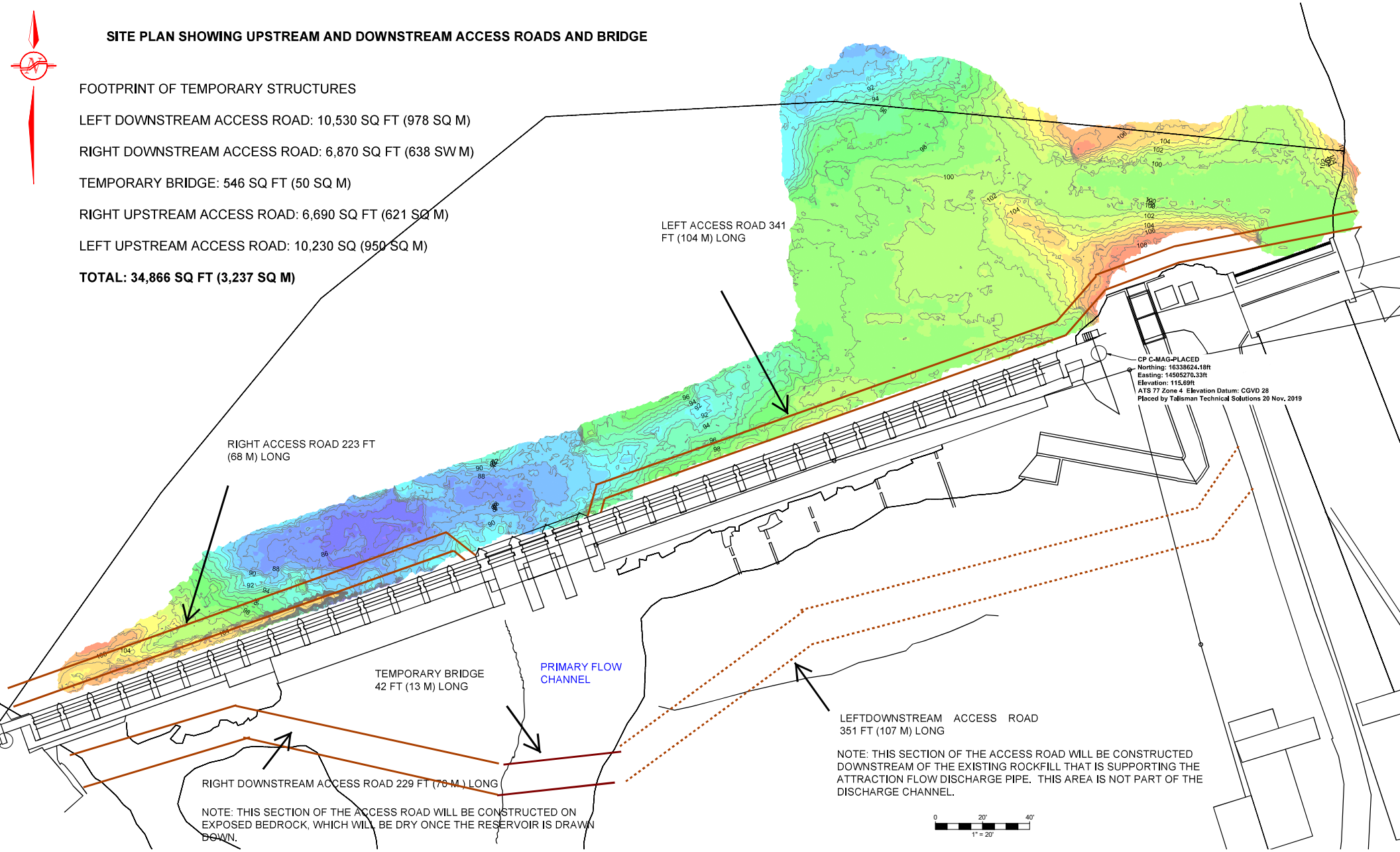
RIGHT DOWNSTREAM ACCESS ROAD: 6,870 SQ FT (638 SW M)

TEMPORARY BRIDGE: 546 SQ FT (50 SQ M)

RIGHT UPSTREAM ACCESS ROAD: 6,690 SQ FT (621 SQ M)

LEFT UPSTREAM ACCESS ROAD: 10,230 SQ (950 SQ M)

TOTAL: 34,866 SQ FT (3,237 SQ M)



APPENDIX F – EEL AND SALMON STUDY SUMMARY

Nova Scotia POWER
An Emera Company

2009 / 2010 American Eel and Salmon Smolt Study Summary Ruth Falls Downstream Louvre System

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2.0 LOUVRE SYSTEM 2
3.0 STUDY DETAILS 3
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1.0 STUDY OVERVIEW

In 2009 and 2010, NSP completed tagging studies to assess the downstream movement of two migrating species at the Ruth Falls Dam: Atlantic salmon smolts and American eels. The intended outcome of the studies was to determine the efficiency of downstream fish passage using the existing louvre diversion system which is situated at the beginning of the powerhouse canal. The louvre system is designed to divert fish toward a bypass pipe which then carries fish through the pipe, eventually releasing them downstream of the dam in the original East River.

In 2009 salmon smolts and American eels were assessed using pit tags, and based on the findings, a second year of study was conducted focusing on the survival rate of seaward migrating American eel. The 2010 study showed that of 30 acoustic tagged silver stage eels, 33% used the existing bypass or spillway (10 eels), 40% of the remainder (7 eels) were detected below the powerhouse and considered to have survived passage through the turbines for a total successful passage rate of 57%. The remainder were not accounted for in the study and assumed to have been killed.

Based on the acoustic data of the 2010 study, NSP identified that 70% of the eels were able to evade the louvres. Additionally, approximately 40% of the eels that went through the turbine reported at the gate downstream. These animals were identified as having survived but were not recaptured to assess heath status.

2.0 LOUVRE SYSTEM

The louvre system at the Ruth Falls Dam was originally installed in 1966 as a downstream bypass and counting facility for the passage of Atlantic salmon smolts. The louvre system is a series of vertical slats arranged in a V pattern across the intake canal. Each leg of the V is approximately 50 ft long and orientated 12 degrees to the approach flow with a fish bypass located downstream at the vertex. The louvre bars are approximately 2 inches apart and extend from the bottom of the canal to a top walkway deck at elevation 114.0 ft. Every sixth bar (12 inches) has a flow straightener extending from the bar in an arc that forces flow to exit the louvres parallel with the canal. The fish bypass is located at the vertex of the louvre V array.

The louvres have been modified on numerous occasions since they were installed in 1966. Major changes were undertaken during the rebuild of the louvre bypass exit and monitoring shed operations in 2005. Other changes include switching the bottom outlet pipe to a top outlet pipe as it was determined that it would be a better suit for salmon smolts and other pelagic species who typically swim in the upper part of the water column. Figure 1 shows the current design facing upstream toward the Ruth Falls Headpond.

Figure 1: Current Ruth Falls Downstream Louvre System



3.0 STUDY DETAILS

Following the completion of improvement work, the assessment of fish passage and the efficiency of the louvre diversion system was conducted over 2 years – the first taking place in 2009 and the second in 2010. In May 2009 NSP assessed efficiency for salmon smolts and in late September and October for American eels using pit tags and Pit tag antennas installed in the bypass. The study was limited to tracking the fish travelling through the bypass.

2009 Study Results

3.1 Salmon smolt study

The first study was carried out in May 2009 using hatchery grown Atlantic salmon smolts. Close to 300 fish were individually Pit tagged and released for three consecutive days at the entrance to the canal leading to the Ruth Falls generation station. A previous study had demonstrated that the most important factor contributing to the effectiveness of the bypass was the ratio between the approach velocity of the water in the main body of the canal and the nose cone velocity at the tip of the louvres, with a value of 1.5 identified as a threshold. Consequently, each release was performed under different bypass setups (Table

1). The bypass was monitored continuously for the duration of the study up to 48 hours after the last fish release.

Table 1 Fish Bypass Conditions

Bypass Setup	# of Stop Logs	Approach Velocity (ft/s)	Nose Cone Velocity (ft/s)	Bypass to Approach Velocity Ratio	Height of Water over check (in.)
Release #1	3	1.70	3.74	2.21	16.19
Release #2	5	1.67	2.20	1.32	9.19
Release #3	1	1.69	4.00	2.37	23.19

Results showed that increasing approach to nose cone velocity ratios were associated with increasing proportions of fish recovered in the bypass monitoring facility (Figure 2). The most noticeable difference in the results of the three releases was the magnitude of the recovery of fish in the first 10 hours post-release (74%, 47% and 85%, respectively).
Based on these results, approach velocity ratios of 2.21 and 2.37 represent strong attraction flows, resulting in most salmon "finding" the entrance to the bypass within the first 2 to 4 hours post-release, whereas a ratio of 1.32 would appear sufficient to attract most fish into the bypass over a period of 30 hours or more.

Figure 2: Recovery of Atlantic salmon smolts at Ruth Falls Bypass Facility

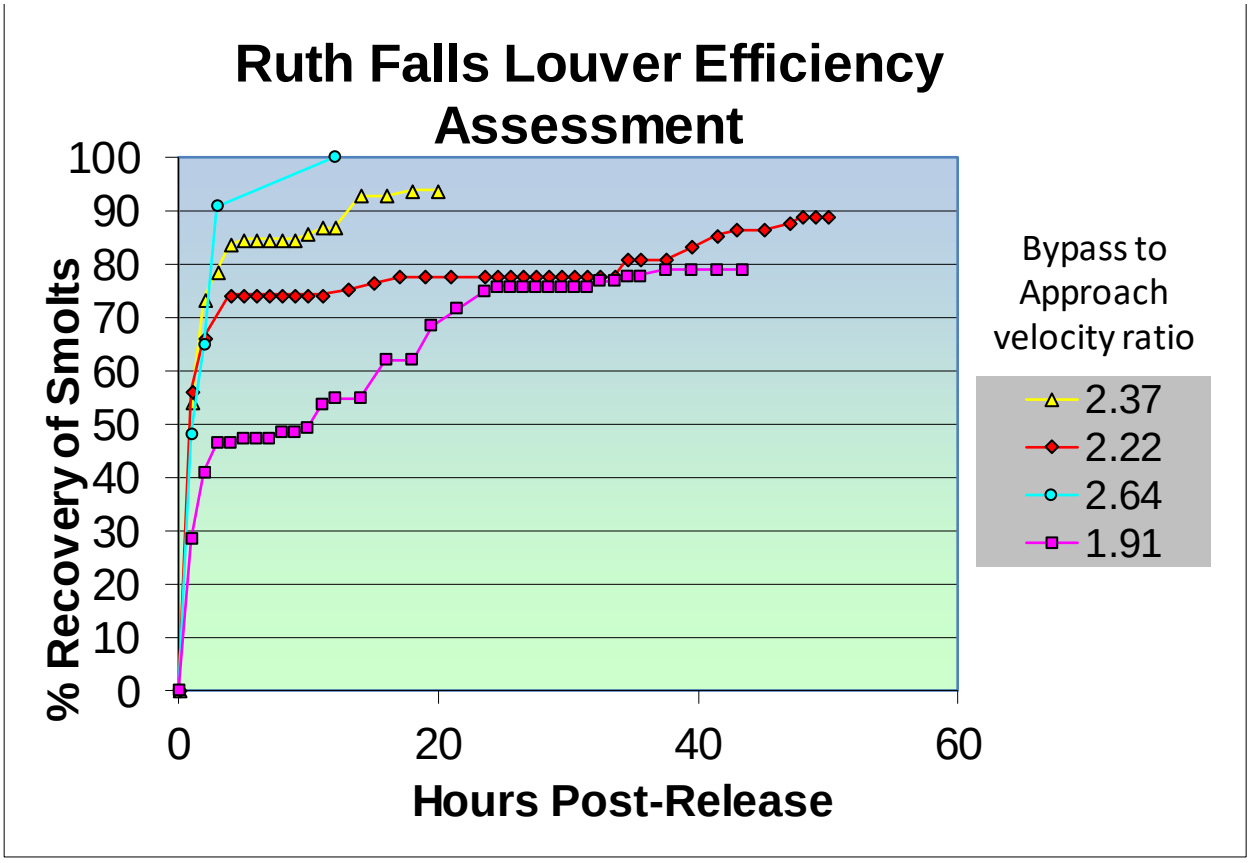
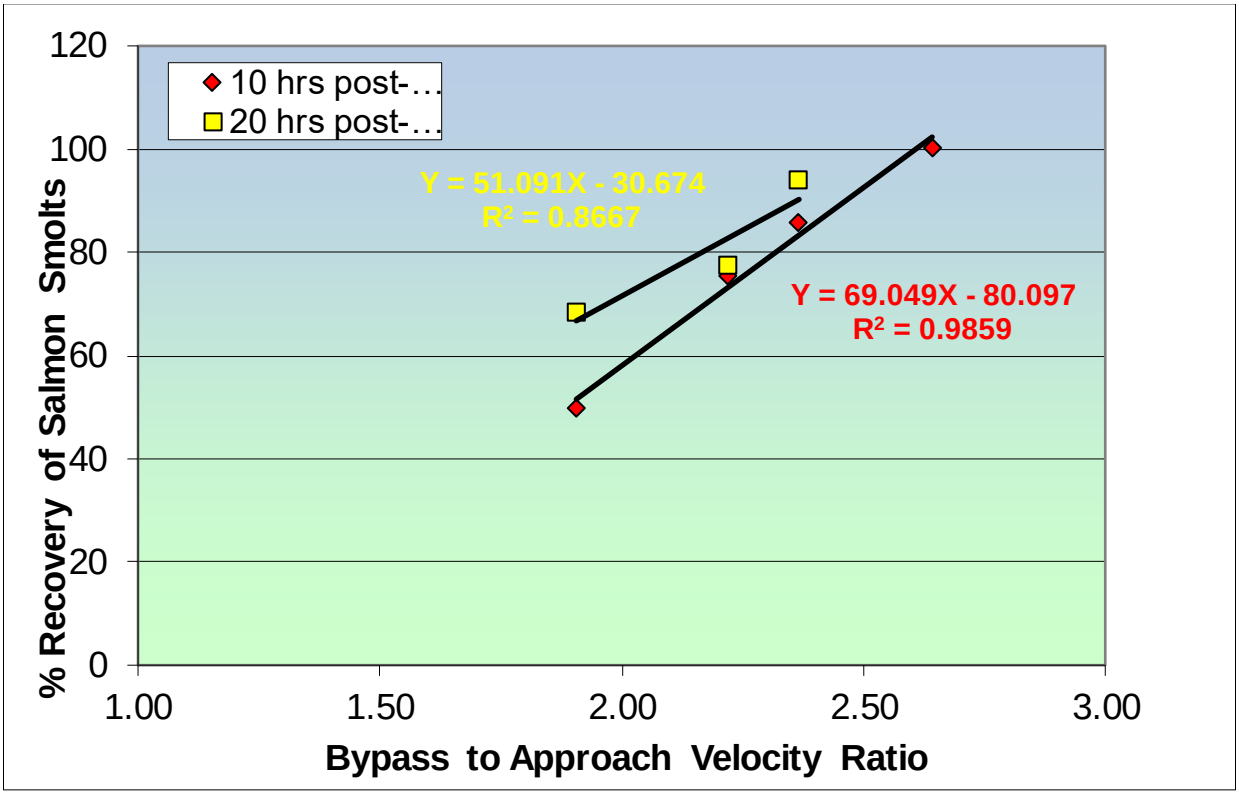


Figure 3: Correlation between bypass to approach velocity ratio and fish recovery



Furthermore, this study confirmed the importance of the bypass to approach velocity ratio as a significant factor in the effectiveness of the louvre bypass for outmigrating salmon (Figure 3). Based on the "bycatch" identified during this study, including alewife, NSP is of the opinion that the louvre bypass system is likely effective for most migratory pelagic species. However, assessing the effectiveness of the bypass for non-migratory species is not a feasible task, as these fish have no behavioural tropism to enter the power canal or use the bypass.

3.2 American eel study

A fall (2009) study of the bypass was also undertaken to assess passage of downstream migrating silver eels. Between September 28 and November 12 NSP monitored the fish bypass. More than 3300 fish were documented and catalogued as they moved through the bypass facility (see below). Alewife and American eels represented the majority of fish (3225). Furthermore, of the 1082 eels captured, 165 were identified as silver eels.

- 1082 eels were identified using the bypass.
- NSP tagged 148 eels, released them upstream the below Malay Falls dam, and detected 40 travelling through the bypass representing 30% efficiency, assuming all remaining eels entered the canal (worst case scenario). This is likely an underestimate as the pit tag passive detections are not as reliable as acoustic detections.
- NSP also identified alewife (2143), speckled trout (53), yellow perch (10), white sucker (9) and even a salmon over a period of 46 days. This data also illustrates the low number of non-migratory species using the bypass.

Based on this information NSP conducted a second study in 2010 specifically focused on eels survival using acoustic tags. This study was focused on assessing the number of eels successfully migrating to sea rather than the effectiveness of the bypass at diverting eels away from the canal. The receiver setup deployed (Figure 4) didn't allow for distinguishing between a fish that used the louvre bypass and a fish that went over the spillway, as they would both end up in the river. In 2010 the study was conducted using acoustic receivers, this allowed for a broader range of transmitting throughout the watershed. Figure 2 shows one of the acoustic receivers used.

Figure 2: Example of receiver set up used in 2010 study



3.3 Study Assumptions

The study had the following assumptions:

- An eel that did not report past a receiver was assumed to have died upstream of that receiver
- Eels that were detected in the estuary were assumed to have survived and successfully migrated to sea.
- Eels that were identified as having survived were not recaptured to assess heath status.

2010 Study Results

The October 2010 study was designed to assess successful outmigration of American eel. The details and results of the 2010 study including receiver and release locations are described below:

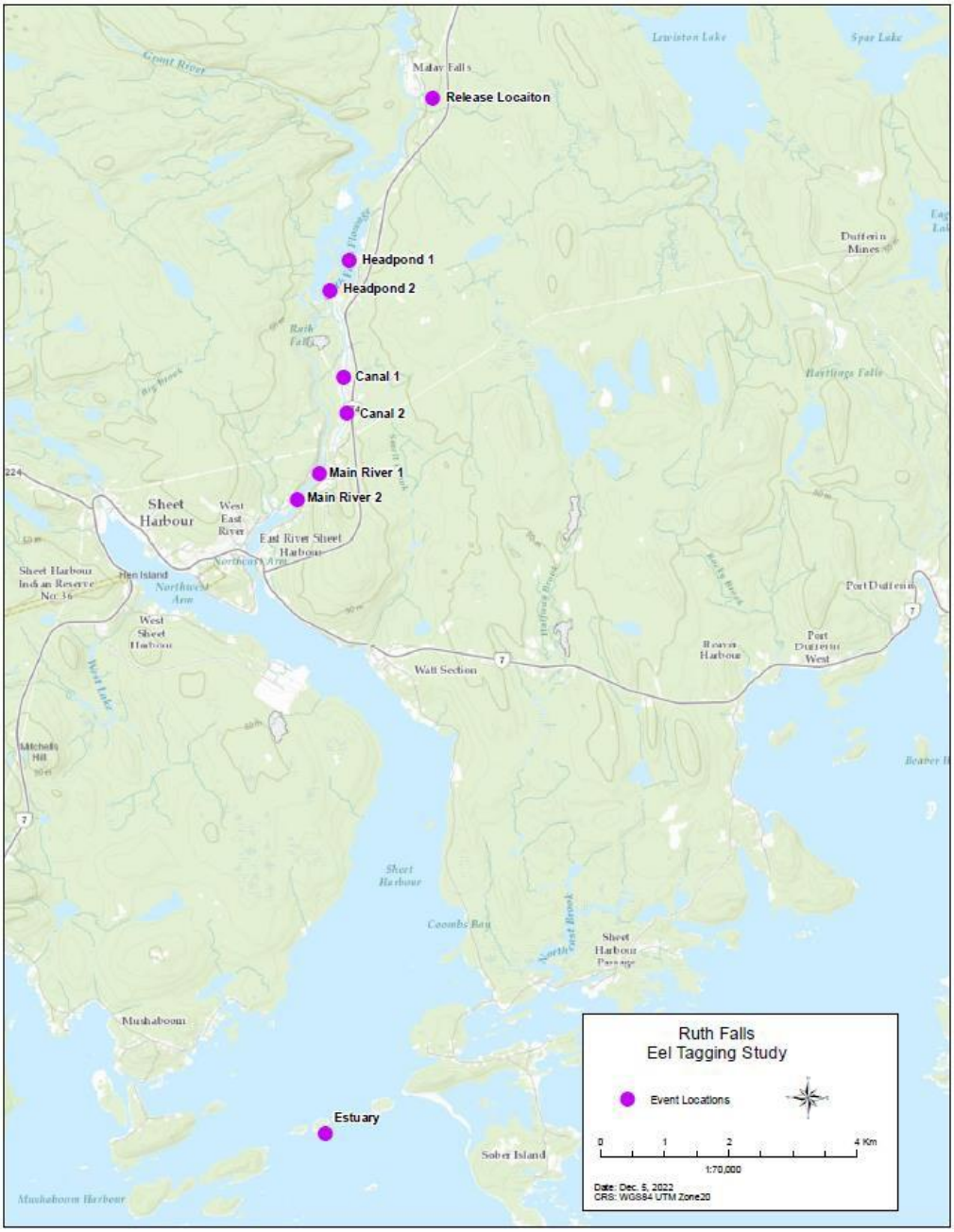
American eels were captured as they travelled through the bypass. These eels were identified as mature silver (migrating) eels. DFO science conducted the surgeries implanting the pit and acoustic tags:

- On October 7, 2010: 181 eels were measured and weighed.
- On October 12, 2010: 64 eels were measured and weighed and received a pit tag; 32 eels were also surgically implanted with an acoustic transmitter.
- On October 15, 2010: 55 eels were measured and weighed and received a pit tag.
- On October 19, 2010: 318 eels travelled through the bypass; none were tagged.
- All fish tagged on October 12, 2010 were released on October 13, 2010 at 15:23 below Malay falls (lat 44.983415; lon -62.478809) Shown on Map in Figure 4 below.
- Six receivers were deployed to track the movement of eels as they migrated back down the watershed (see table below for coordinates).
- Two receivers were placed in the headpond above the canal entry and spillway, they were installed so that they could detect fish approaching either structure.
- Two receivers were placed in the canal downstream of the louvres.
- Two receivers were placed in the main body of the river below the confluence of the river and the tailrace.
- One receiver was placed in the estuary, approximately 12 kilometers below the confluence.

Figure 3: Receiver and Release Location Chart

Receiver location	Lat	Lon
Headpond1	44.96078	-62.4955
Headpond2	44.95658	-62.4993
Canal1	44.94423	-62.4967
Canal2	44.93929	-62.4962
Main River1	44.93088	-62.5017
Main River2	44.92724	-62.5061
Estuary	44.83831	-62.5013

Figure 4: Receiver and Release Location Map



Upon completing the study, the following results were concluded:

- 30 eels were tagged; all eels successfully reported to the receivers in the headpond.
- 9 eels reported to the receivers in the river and the estuary and assumed to have survived. This means that all 9 eels travelled either over either over the spillway or used the louvre bypass. The exit to the bypass is situated directly below the dam – this is the reason there was no feasible way to distinguish between eels traveling over the spillway or using the louvres.
- 21 eels circumvented the louvre system and entered the canal.
    - 8 reported to the river and estuary receivers; assumed to have survived.
    - 13 last reported in the canal but did not report to the river or the estuary and are assumed to have died from turbine interaction.

Figure 4: Study Result Breakdown

	PASSAGE ROUTE		
30 Total Fish		**No Turbine**	**Turbine**
Number	30	9	21
%		30.0	70.0

	RIVER ROUTE MORTALITY				CANAL / TURBINE ROUTE MORTALITY			
9 Fish		**Alive**	**Mortality Observed**		**21 Fish**		**Alive**	**Mortality Observed**
Number	9	9	0		Number	21	8	13
%		100.0	0.0		%		38.1	61.9

	TOTAL MORTALITY		
30 Total Fish		**Alive**	**Mortality Observed**
Number	30	17	13
%		56.7	43.3

4.0 CONCLUSION

Upon review of both the 2009 and 2010 studies, NSP has made certain assumptions:

- Both studies with very different techniques have similar efficiency estimates for the louvres – approximately 30% when assessing American eel.
- Based on 2009 study, the louvre system and associated bypass is effective for most migratory pelagic species such as Atlantic salmon, alewife and trout.
- The bypass may work marginally for eels - there was no way to determine the difference between an eel reporting downstream of the dam who traveled through the bypass pipe or who traveled over the spillway

As a result, NSP recognizes that improvements are needed to the louvre and bypass system to make it suitable for eels and other bottom dwelling fish species. It is recognized that the system is old and may have damage including broken slats and other damage which could decrease efficiency. It is also understood that additional improvements may be required to guide eels towards the upward bypass pipe in the top of the water column.

APPENDIX G – HYDRAULIC MODELING RESULTS



Ruth Falls Dam Refurbishment

3D Modelling and Fish Passage Assessment

Nova Scotia POWER
An Emera Company

CBCL

FINAL REPORT ver.2

Project 221107.00 • 20th March 2023

2	FINAL REPORT ver.2	A Wilson / M Browne	20-Mar-2023	Y Zhang / C Jardine
1	FINAL REPORT	A Wilson / M Browne	13-Mar-2023	Y Zhang / C Jardine
0	DRAFT REPORT	A Wilson / M Browne	22-Feb-2023	Y Zhang / C Jardine
Rev.	Issue	Reviewed By:	Date	Issued By:

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REGISTERED PROFESSIONAL ENGINEER
DATE 20 MAR 2023
A. WILSON
7668
PROVINCE OF NOVA SCOTIA

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1.2 Flow Assessment 1
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1.4 Modelling Results 8
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2.6 Closure 16

Appendices

A FIGURE 1
B THAUMAS CONSULTANTS REPORT

1 HYDROTECHNICAL ASSESSMENT

1.1 Background

This report addresses the request made by Nova Scotia Power (NSP) by email on the 8th February, 2022, and following discussions. An excerpt is presented below to present the requested scope of work:

We have determined a need for 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post-refurbishment downstream conditions. The main refurbishments include the installation of vertical lift gates in the center section of the dam which will replace the existing stop log bay. Another big change includes the installation of a new rubber dam. We are looking to know how changes in flow releases from the vertical lift gates (and rubber dam) could impact the downstream area – specifically the entrance conditions to the fish ladder.

The following information was discussed with NSP and was used to support the assessment:

- *Historic operation of the gates at the former structure*
- *Proposed operation of the gates at the proposed structure*
- *Flow measurements and discharge curves available at the gates*
- *Maintenance flow schedules during the year*
- *Fishway release flow schedules during the year*
- *Geometry of the proposed structure (IFC drawings)*
- *Bathymetry of the tailrace, from several site surveys*

1.2 Flow Assessment

Spill flow data was available from 2015 to 2022. The full timeseries of the spill flow data is presented below in Figure 1:

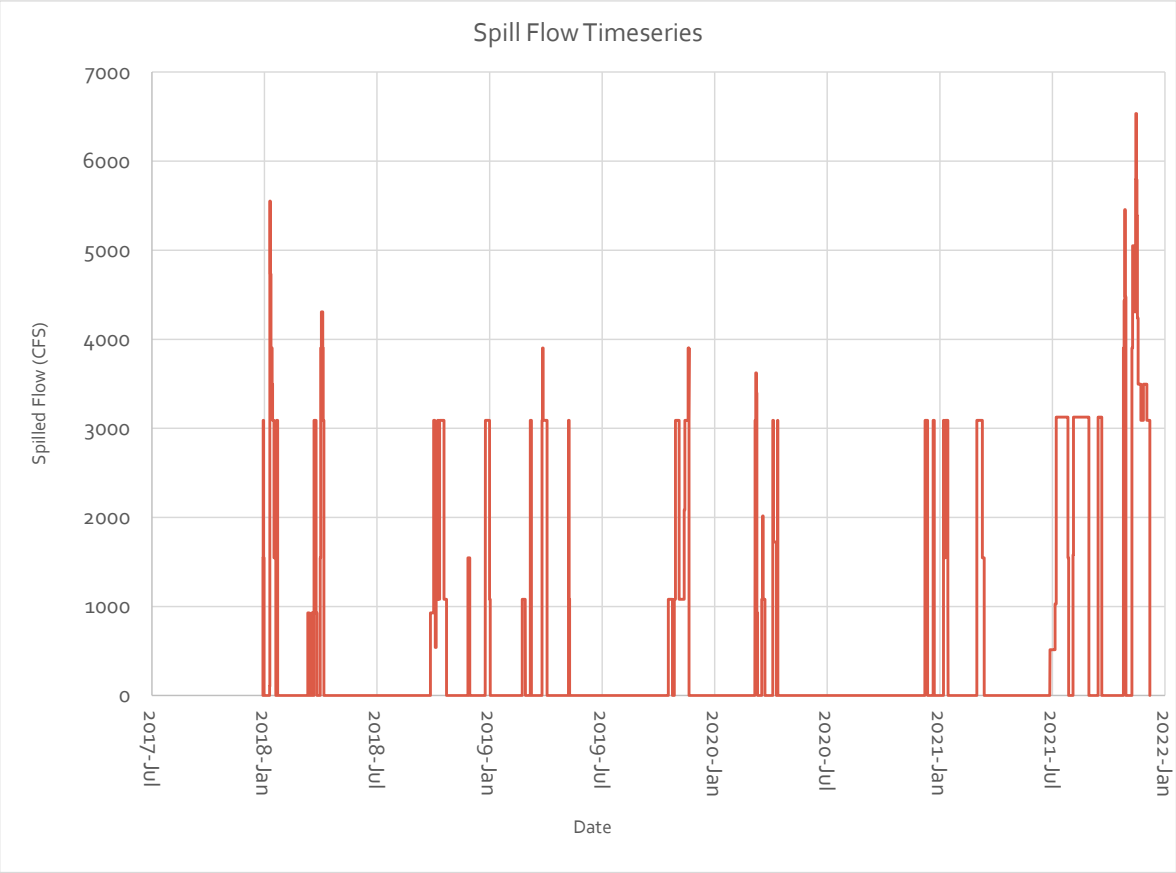


Figure 1: Spill flow Timeseries from 2015 to 2022 at the Ruth Falls Dam

As shown on the figure, spills are rather infrequent at this site. Spills increased in 2021 and 2022 due to construction activity at the dam, which has resulted in more frequent spills than would typically be seen at the site. Those years were therefore removed from the data to allow the assessment to be more representative of typical conditions. The results were also separated into seasonal time spans, to provide seasonal data that would be representative of fish migration windows. The following months were used to represent the various seasons:

Spring: May, June, July

Summer: August, September

Fall: October, November

Winter: December, January, February, March, April

Figure 2 shows the results of the flow duration curve analysis, presented as days during which the flows would be present during the various seasons.

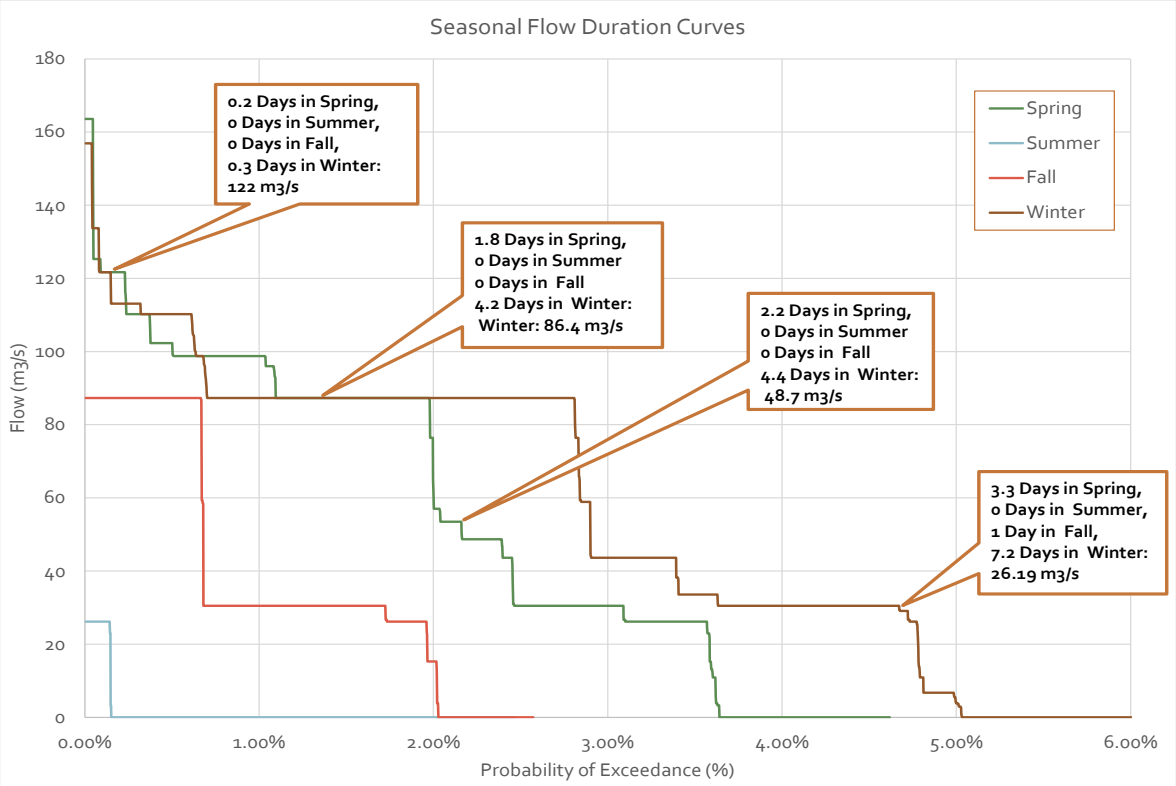


Figure 2: Seasonal Flow Duration Curves at Ruth Falls

Typically, the spills are released fairly evenly between the 3 gates, so the flow scenarios used in model include the 4 flows identified in Figure 2, all released evenly through the 3 gates.

The current structure has leakage through the stop logs, as well as through the existing gate frames. NSP measured the flows downstream of the dam, and obtained a value of 100.2 cfs. Part of this flow is from the fishway (6 cfs) and part of it is from the louvres pipe outflow (29 cfs), leaving 65 cfs as leakage through the structure. From the modelling results (see below) and the interpretation of those results for fish passage (see Thaumas Consultants report), the current flows are estimated to provide suitable conditions for fish passage in the natural river channel downstream of the dam. Higher flows produce higher velocities, especially at the rock sills, which leave no area of low velocity in the river for the passage of fish. Therefore, it was concluded that providing 65 cfs from the gates in the proposed conditions would result in the optimal conditions for fish passage.

Nevertheless, the attraction flows and existing weir configurations were not optimal for fish passage, so the weirs downstream of the fishway were re-configured in the model to improve both attraction flows and velocities for fish passage. The following steps were taken following the various model tests:

1. Existing weir configurations and louvres outflow configurations were modelled and resulted in poor attraction flows (see Figure 3)
2. The louvres outflow was moved to the last fishway to attempt to improve attraction flows towards the most downstream fish passage weir, which resulted in an improvement in attraction flows, but still no suitable passage through the weirs
3. The fish passage weirs were redesigned with the intent of providing approximately 20 cm drops, and a flow of 35 cfs, by also moving the louvres outflow beside the outlet of the fishway. The new weirs were sized to provide 23 cm drops at each pool, with a sufficient distance between the weir, and the last weir was rotated to point at 45 degrees downstream, the opening being on the south side of the weir. A rock diversion weir was also tested to evaluate its use in orienting the gate flows away from the weir attraction flows. The results of this are seen in Figure 4.
4. The same scenario was tested, but without the rock diversion just downstream of the gate (see Figure 5). It was found that with or without the rock diversion, flows from the gates would create back currents towards the last weir, disrupting the attraction flows.
5. The last weir was modified to have its notch on the north (dam) side, to join with the circulating flows from the gates. To achieve this, one weir had to be removed from the set, to maintain the alternating configuration of the notches. This is shown in Figure 6. The results show an improvement, but the strong currents circulating from the gate flows still disrupt the attraction flows.
6. The distribution of flows from the various gates was tested, to produce a more even guiding flow towards the fish passage weir, and minimize the current flowing back upstream. A range of distributions were tested, and the optimal configuration was achieved with a flow distribution of 20 cfs from the west gate, 40cfs from the centre gate, and 5 cfs from the east gate. The flow is highest from the centre gate because the centre gate ogee spillway is lower than the others. The velocity of the water is therefore much reduced, and the flow released enters the river at a lower elevation, where its energy is significantly more dissipated. It is noted that in practice, as the flows and velocity patterns at the gates and downstream may be slightly different than in the model, it is expected that some field verification and gate adjustment will be needed once the dam is completed, to obtain the desired fish passage goals. The gate settings may therefore be different than noted here, while still delivering a total of 65cfs. The results for this scenario are shown the figures S1-1 to S7-13.

For the last geometric configuration (point 5 above), results are shown below for a range of flow scenarios. These include the following:

- S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

- S2: 6 cfs from the fishway, 29 cfs from the louvres outfall, 165 cfs from the gates
- S3: 6 cfs from the fishway, 29 cfs from the louvres outfall, 925 cfs from the gates
- S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates
- S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates
- S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates
- S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

It is noted that the flow values in cfs for scenarios 3 to 7 correspond to the 4 spill flow values shown in Figure 2 above.

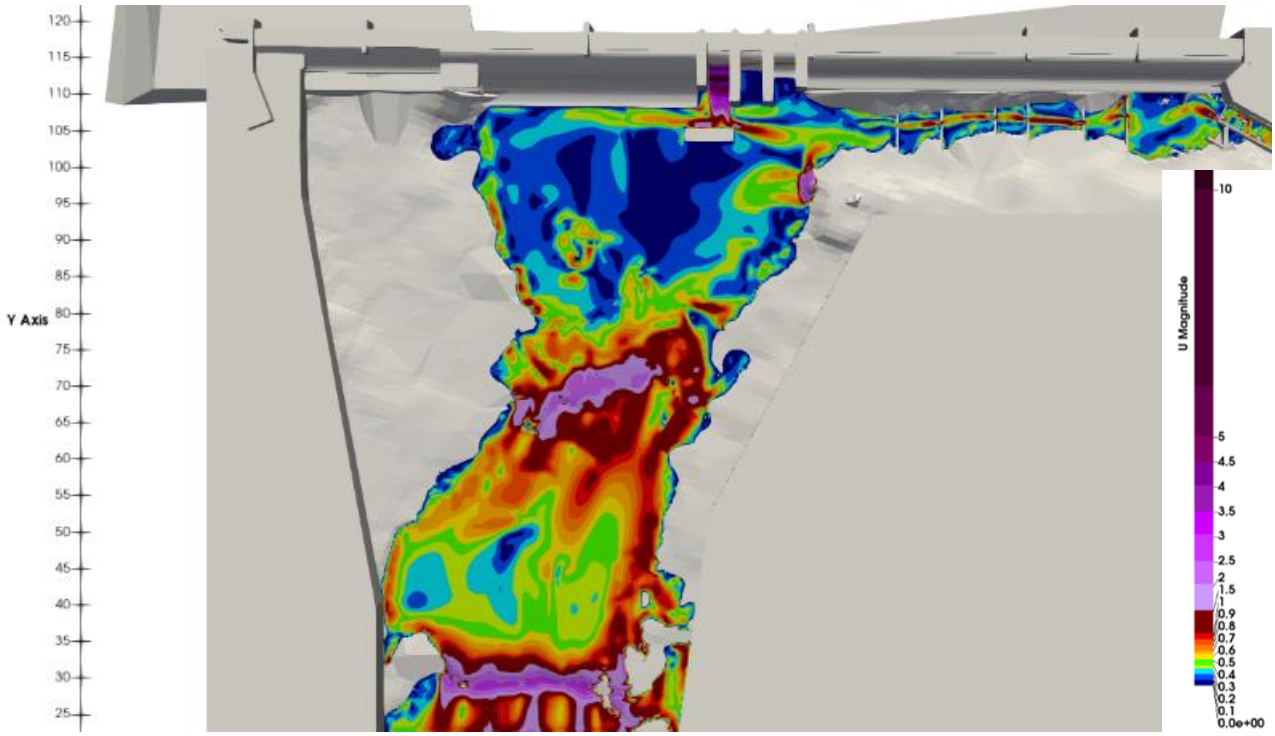


Figure 3: Existing Weir and louvres outflow configuration

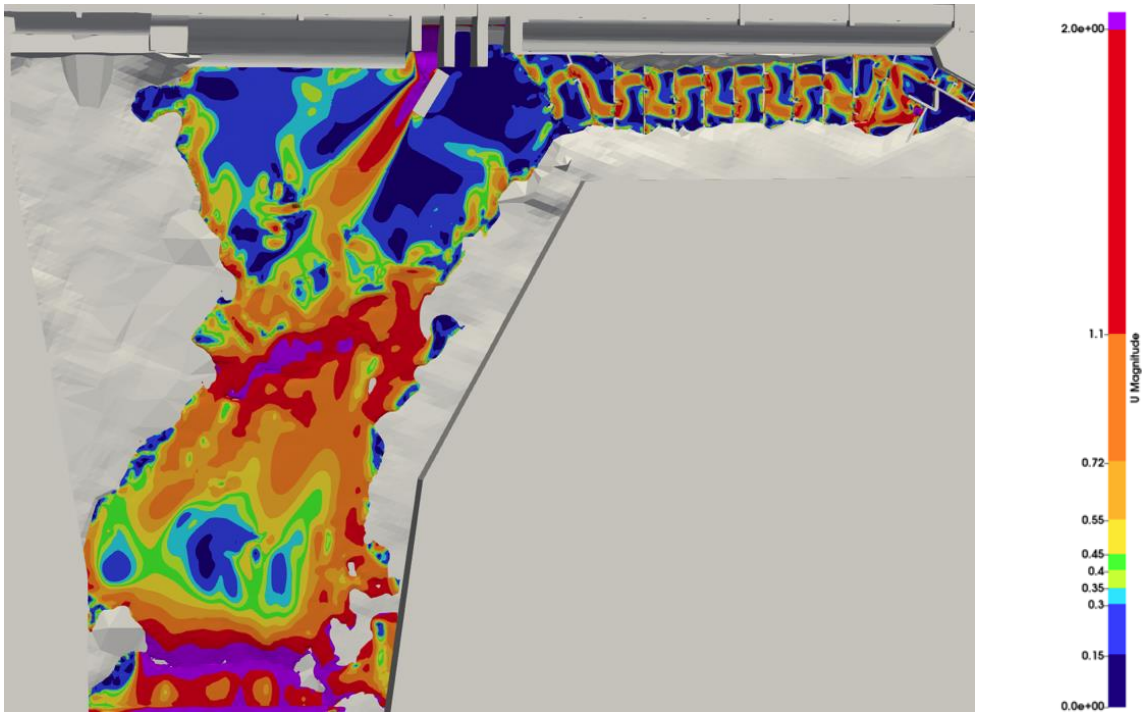


Figure 4: re-Designed Weir and louvres outflow configuration – with Rock Diversion

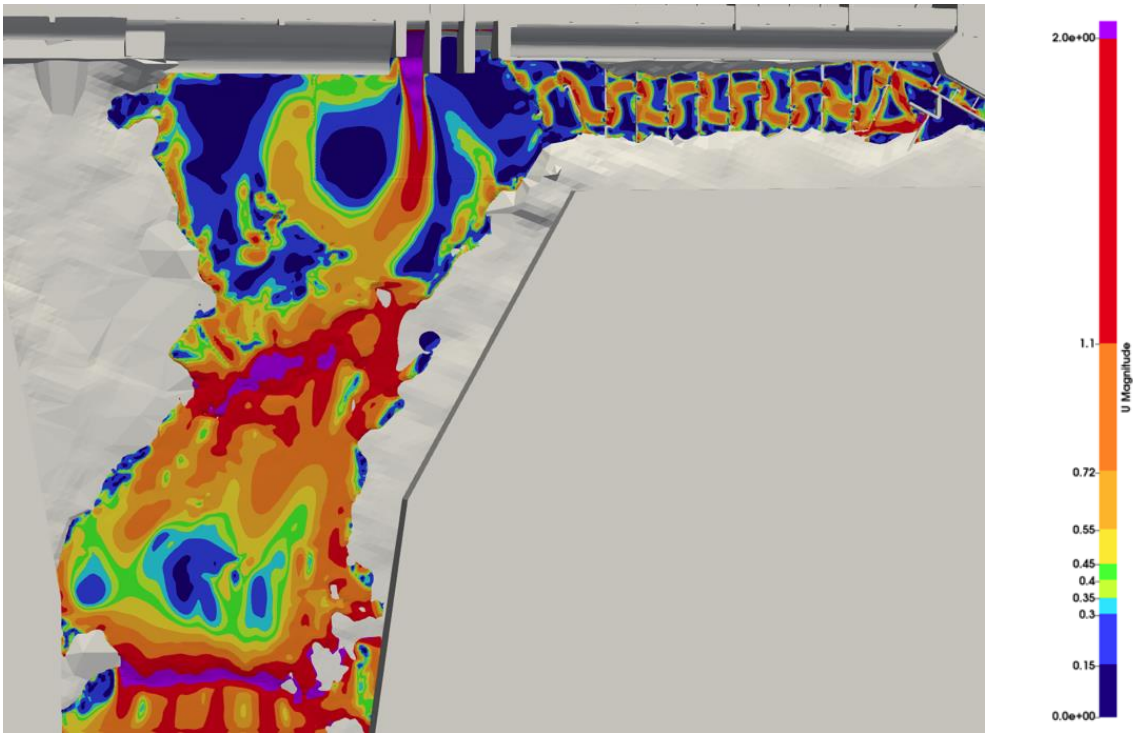


Figure 5: re-Designed Weir and louvres outflow configuration – No Rock Diversion

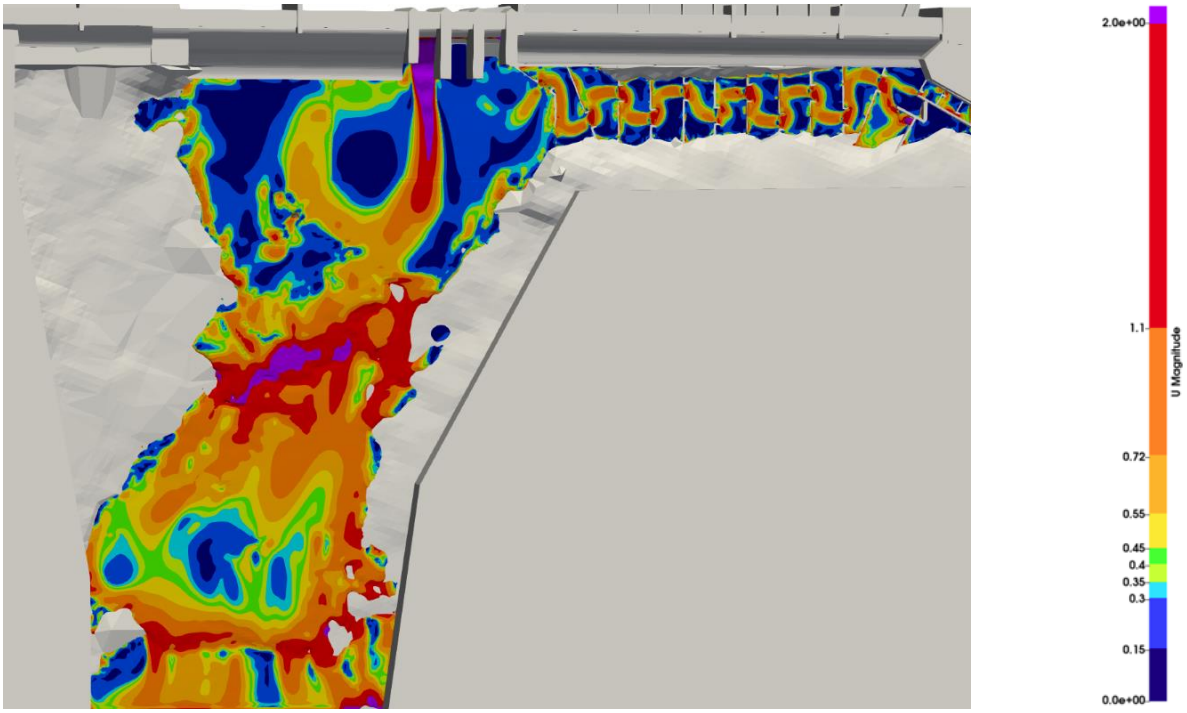


Figure 6: re-Designed Weir and louvres outflow configuration- last weir on Dam Side

1.3 3D CFD Modelling

Once the details of the geometry were fully available and completely understood, a geometric model of the proposed structure (fully constructed), together with the fishway and downstream channel was assembled in Civil3D. The extent of the modelled downstream channel was defined based on expected turbulence patterns, to make sure that the extents of the downstream influence of the fishway flows and attraction flows are included. This is important since the fish need to be able to sense the attraction flows and be guided to the fishway. Once the geometric model was completed in Civil3D, it was be exported to the 3D modelling software.

The modelling software used is OpenFoam, which has the highest recognition for Computational Fluid Dynamics (CFD) modelling in the scientific community. It was developed at Imperial College, London, is open source, and is supported by a community of users that provide technical support and additional tools to the model. CBCL has several years of experience working with this model and has developed workflows from model assembly to data extraction.

Once the geometry was set up in the model, the water levels and flows at the boundaries were set up. These were set depending on the various flow scenarios described above. The results of the modelling then allows the interpretation of fish passage quality for each species during the entire year.

1.4 Modelling Results

Each scenario (S1 to S7) contains 13 figures. Both plan views of the velocity magnitude, as well as cross-sections at regular intervals, with velocity vectors, are shown in panoramic views.

- **Figure 1 to Figure 3**: present the plan view of the water surface, mid-surface, as well as the view taken from the bottom to show the velocities along the bottom.
- **Figure 4 to Figure 8**: panoramic views of entire study domain and close-up views for the fishway area and the river channel; the vectors have a uniform length and are not scaled by velocities. Vectors are coloured by velocity magnitude.
- **Figure 9 to Figure 13**: focus on the bottom velocities (from the geometry bottom to 0.2m above it); vectors are generated only for a depth of 0.2m from the bottom and the vectors have a uniform length and are coloured by velocity magnitude.

The colour scale has been adjusted based on Bob Rutherford's request to show details from 0 to 2m/s, and only one colour for all velocities above 2m/s. The intervals between the cross sections are given in the titles for each figure.

1. Model Results of Scenario S1 with 65 cfs from the gates

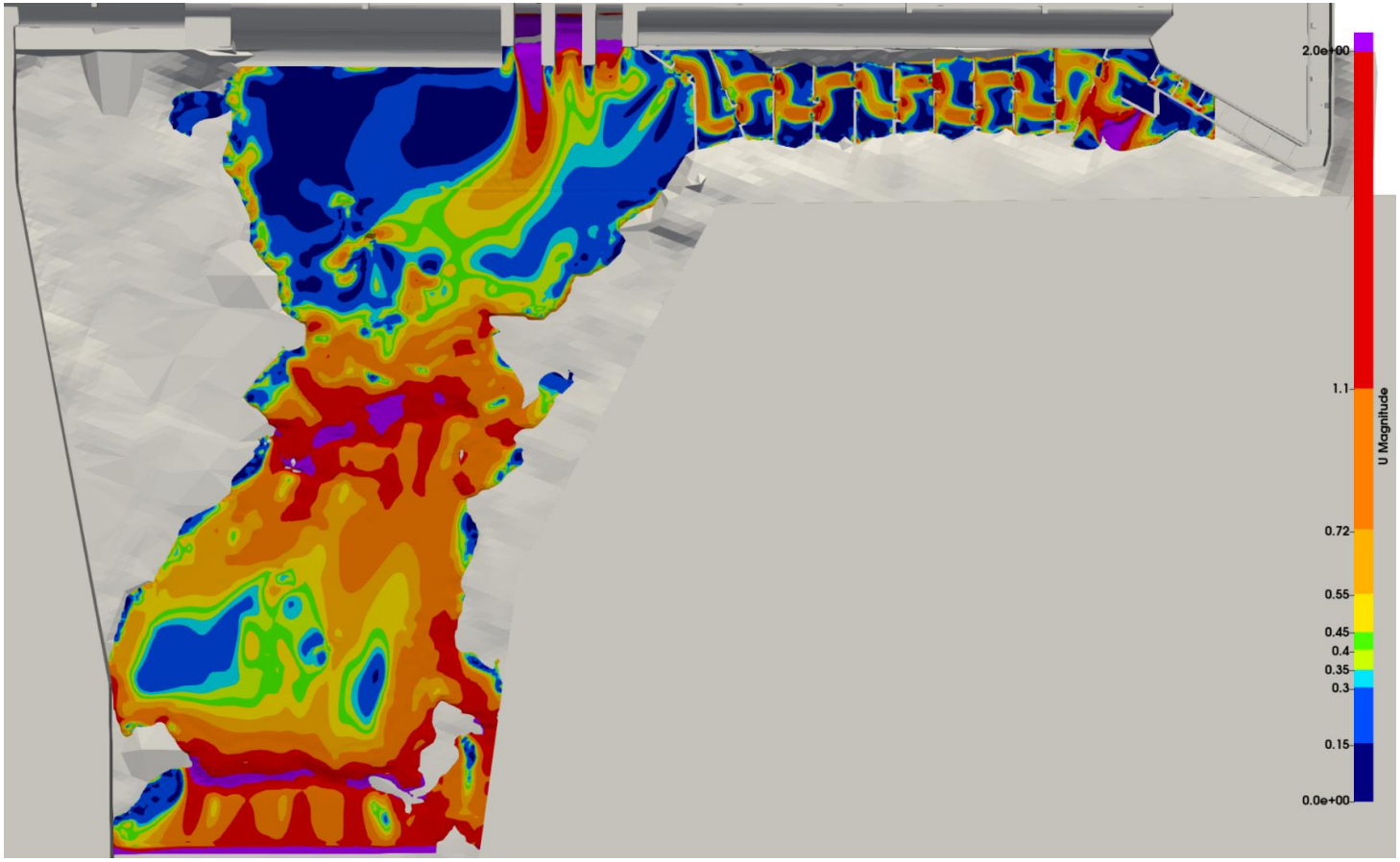


Figure S1-1: Plan view of the Water Surface Velocities

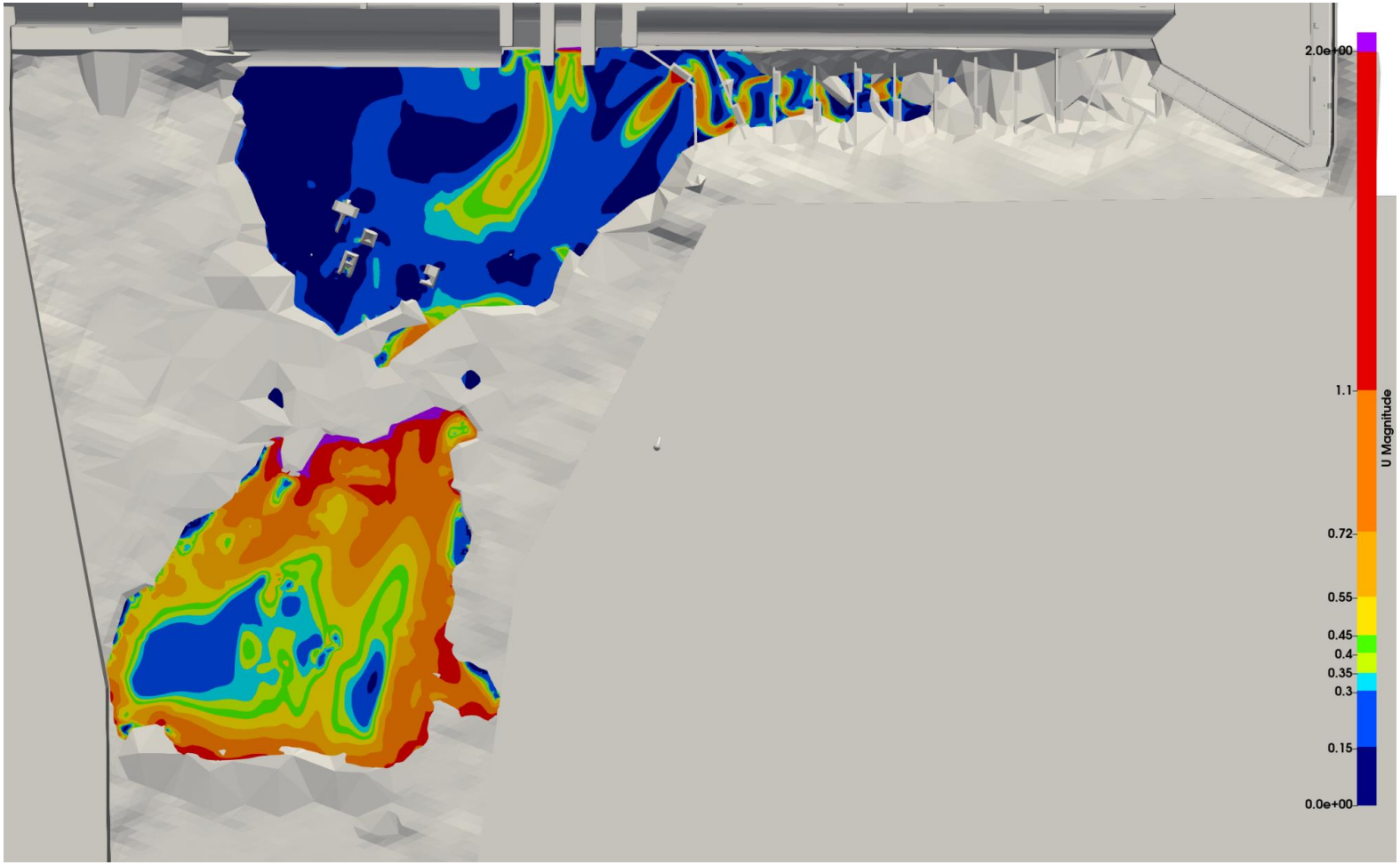


Figure S1-2: Plan view of the Mid-Surface Velocities

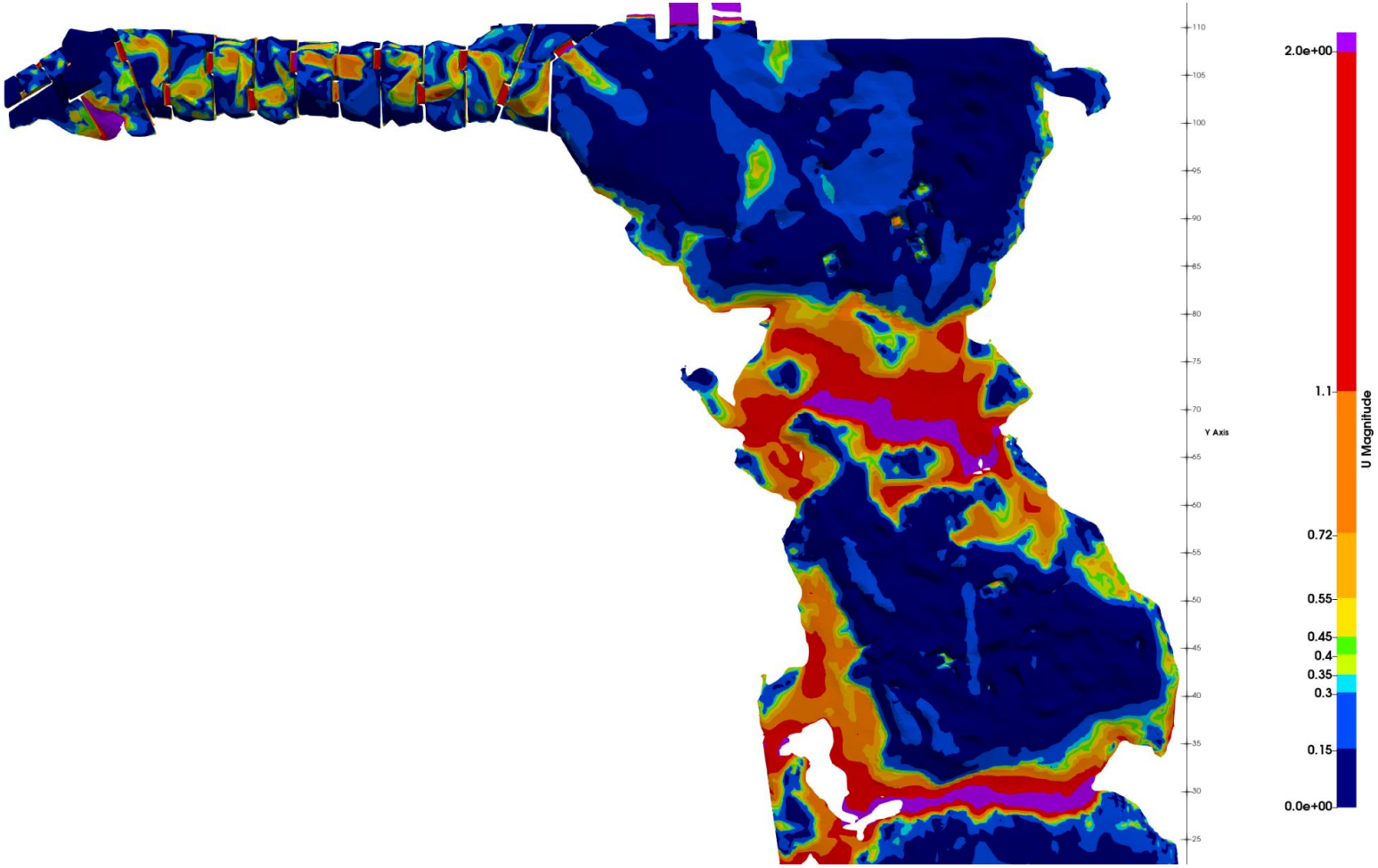


Figure S1-3: View of the Bottom Velocities

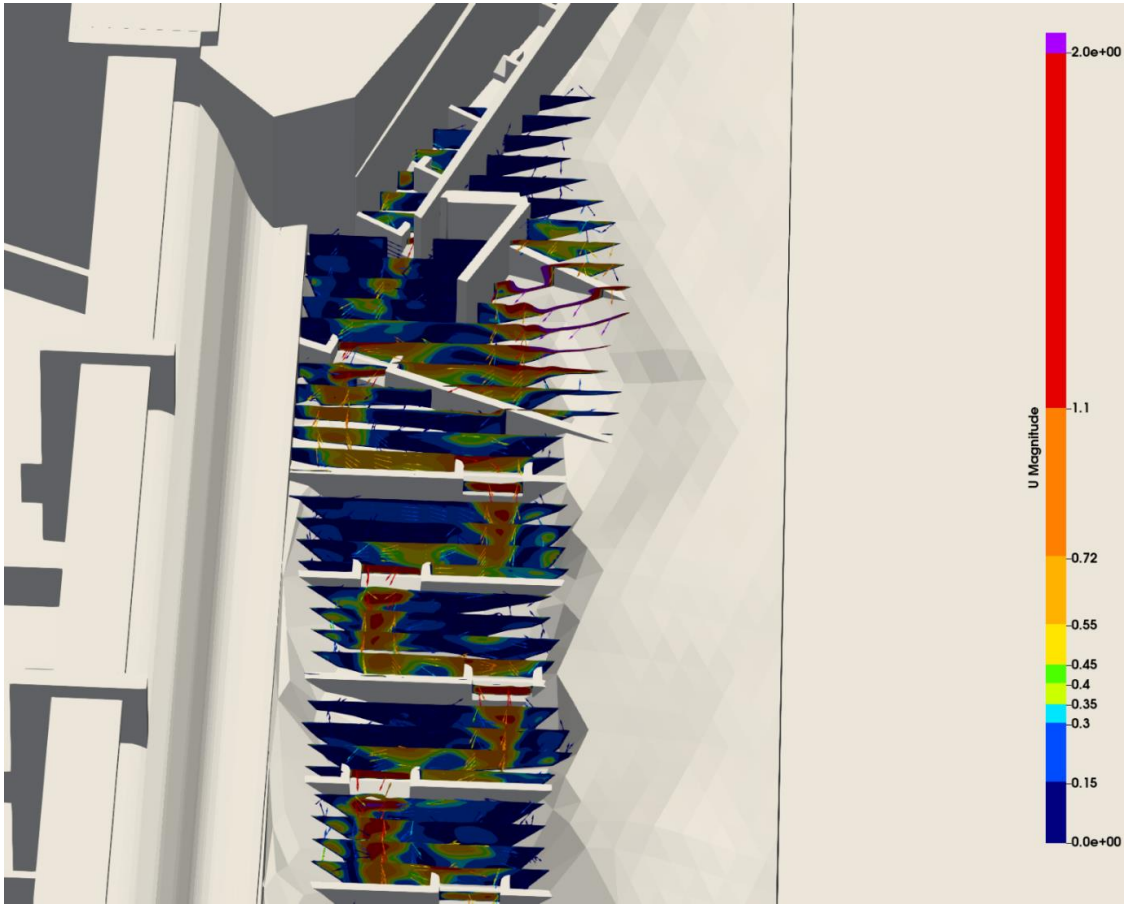


Figure S1-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

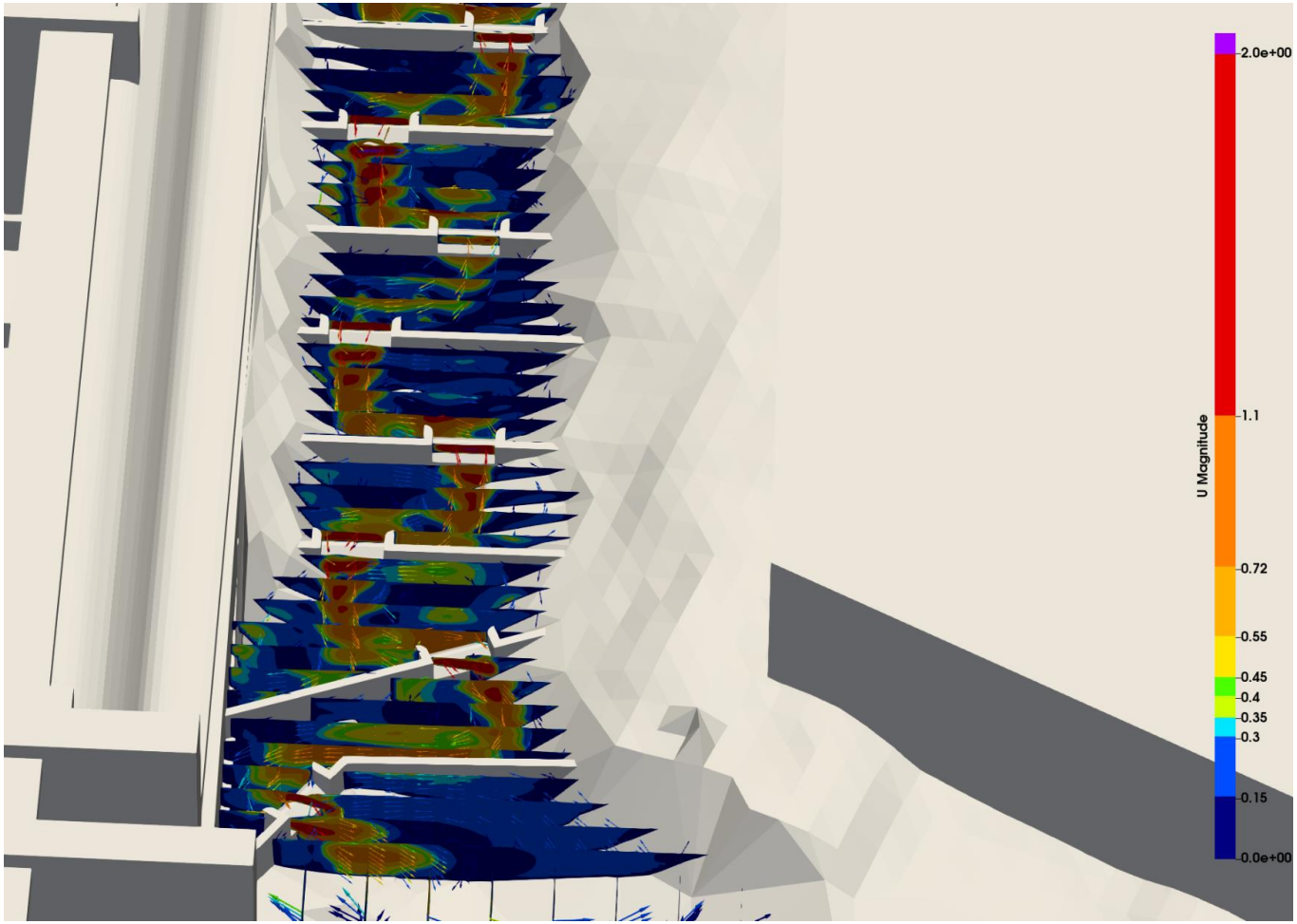


Figure S1-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

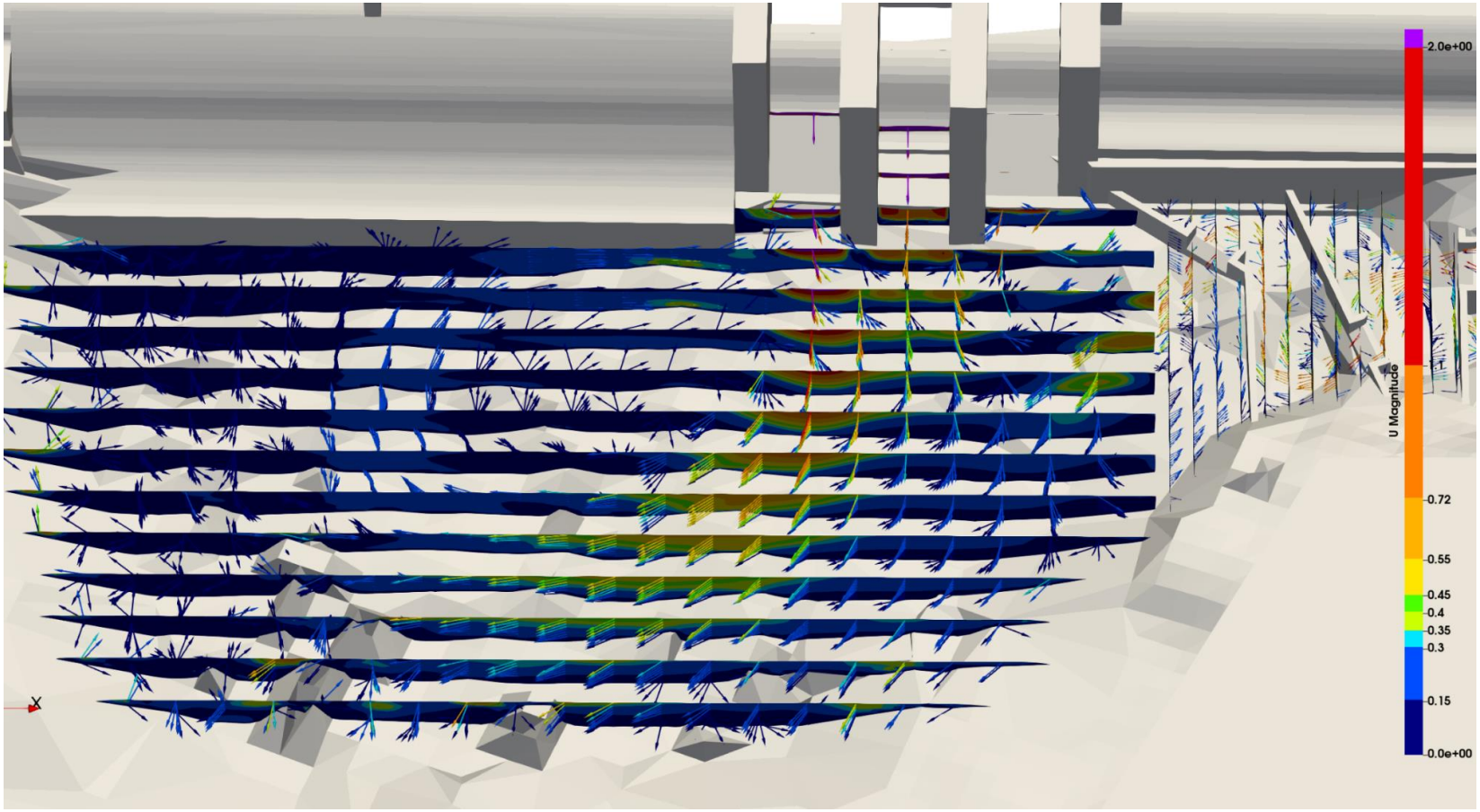


Figure S1-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

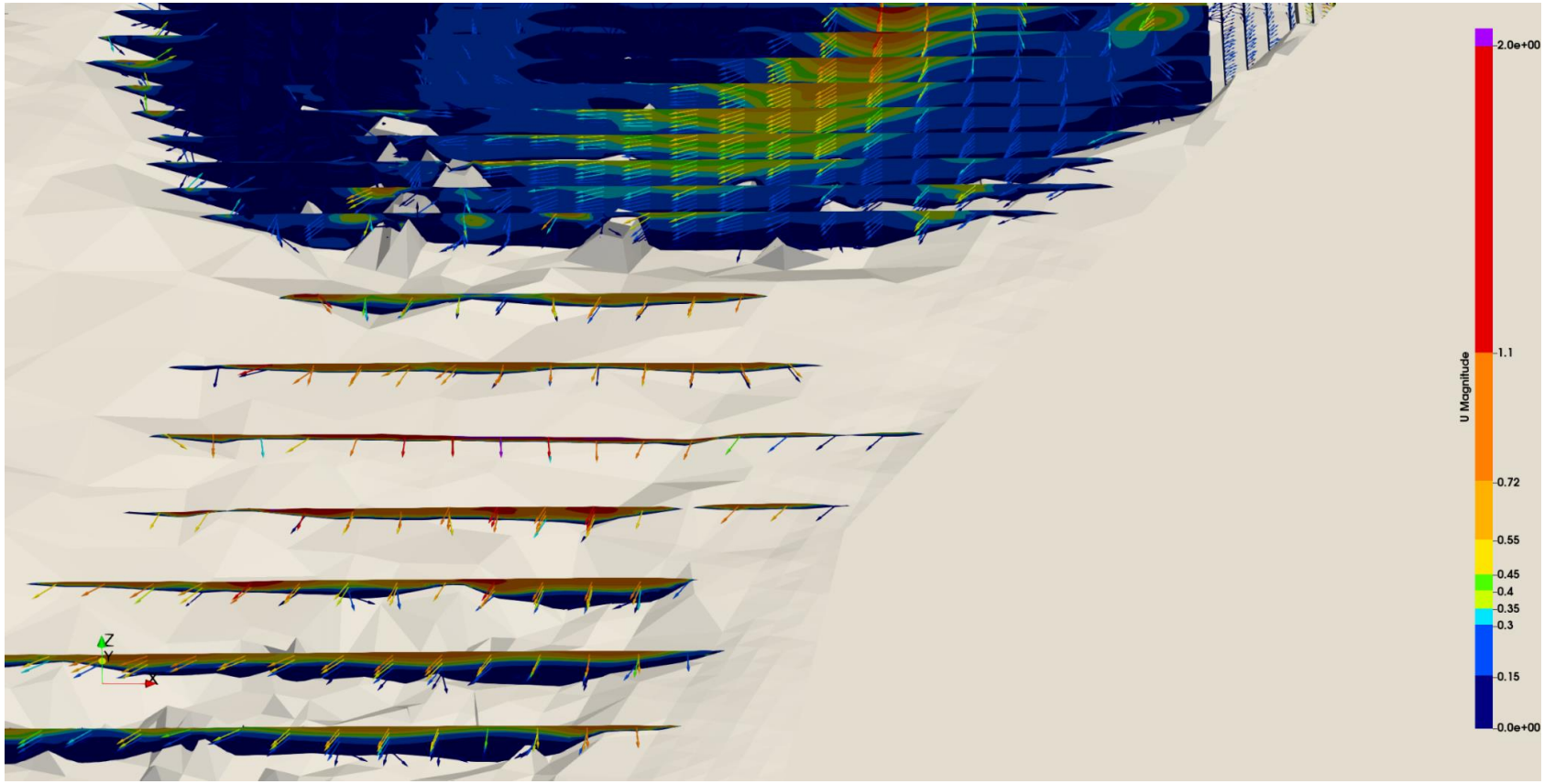


Figure S1-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction



Figure S1-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

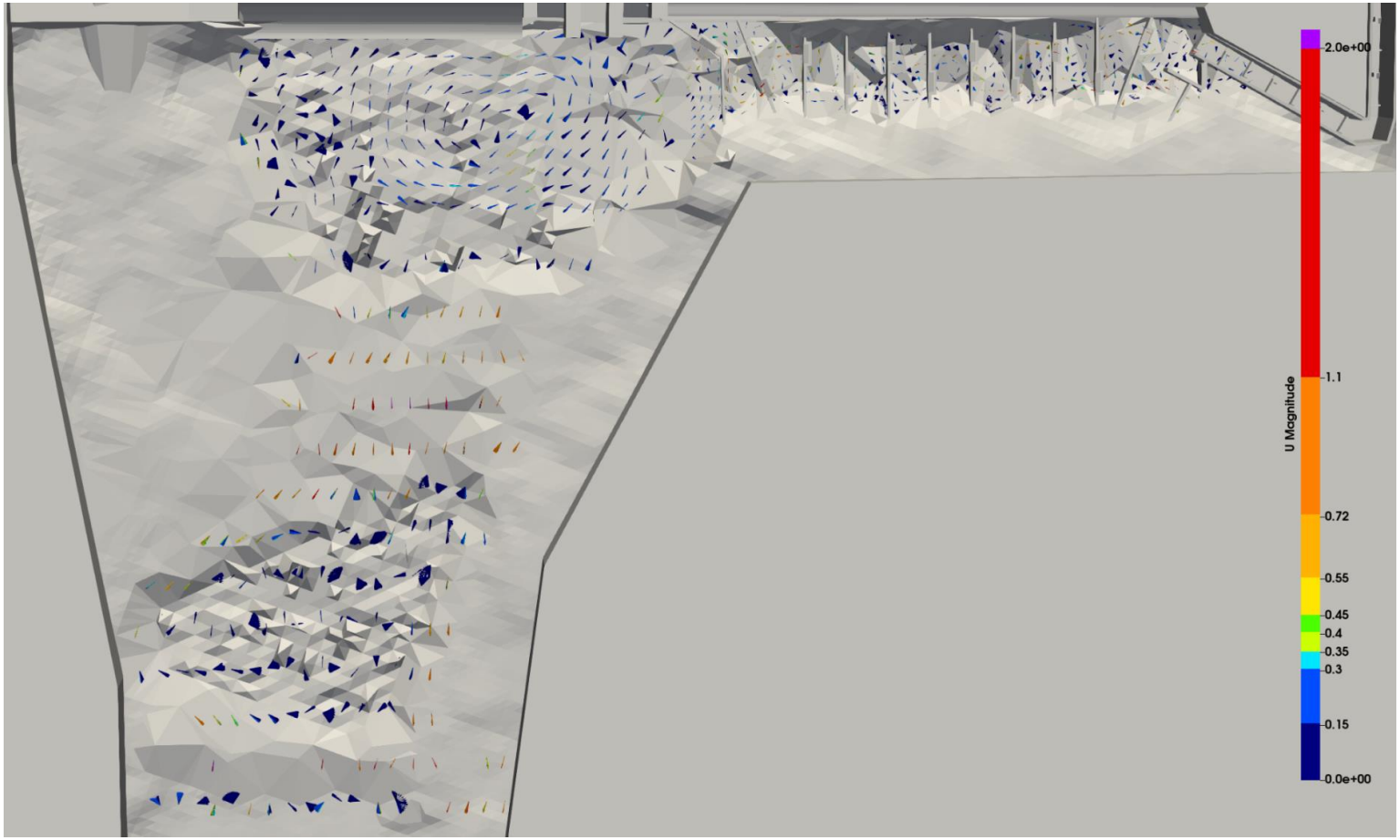


Figure S1-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

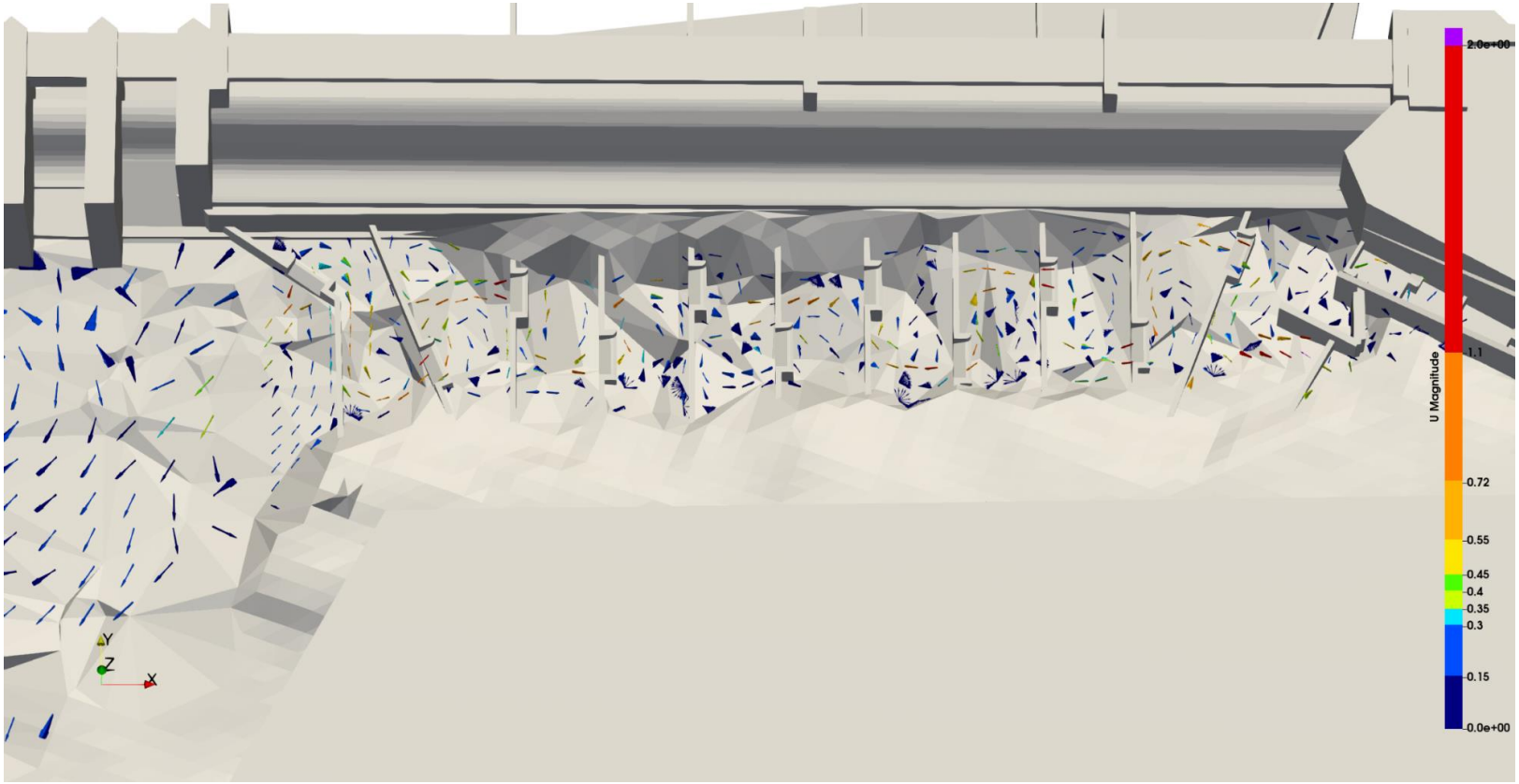


Figure S1-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

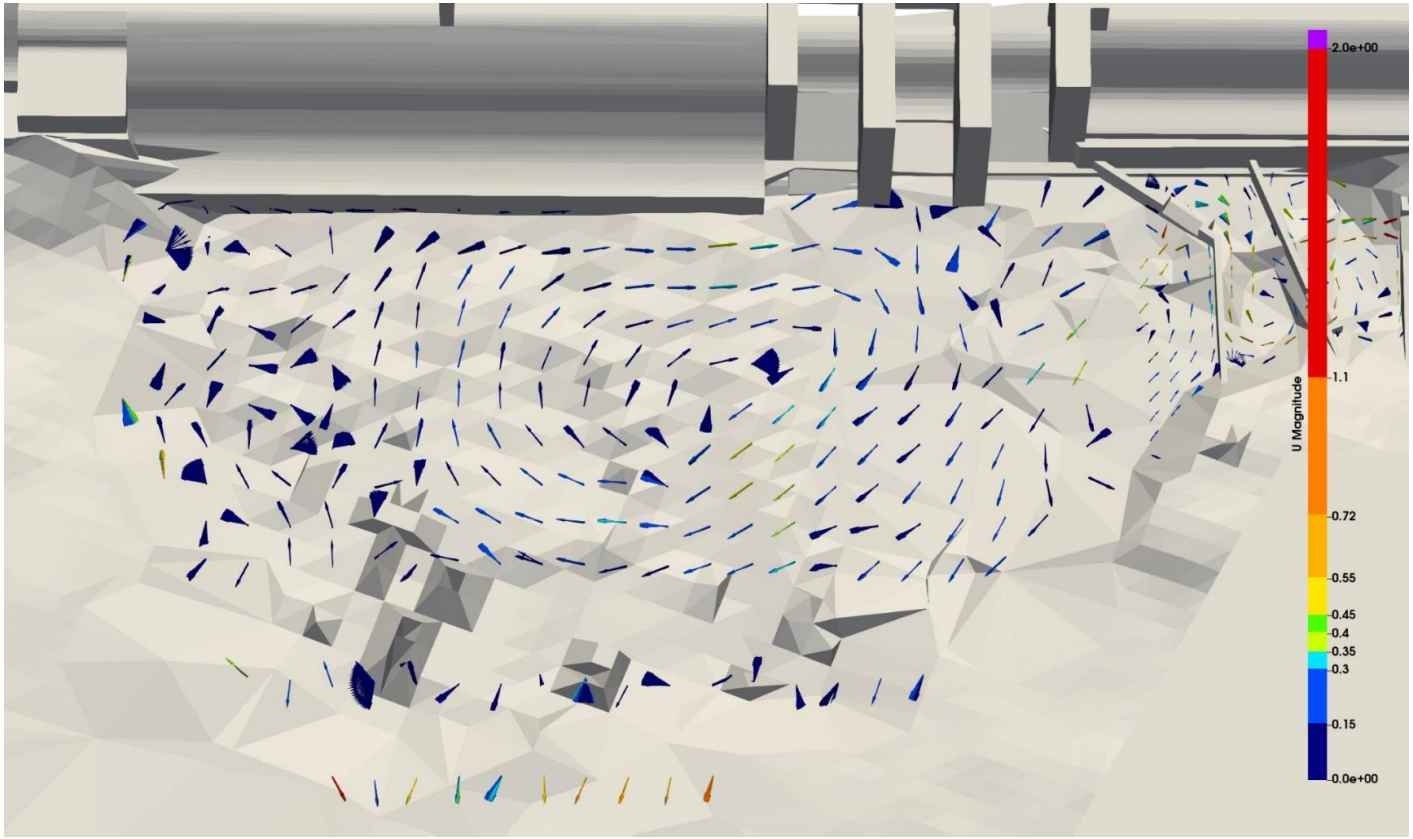


Figure S1-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

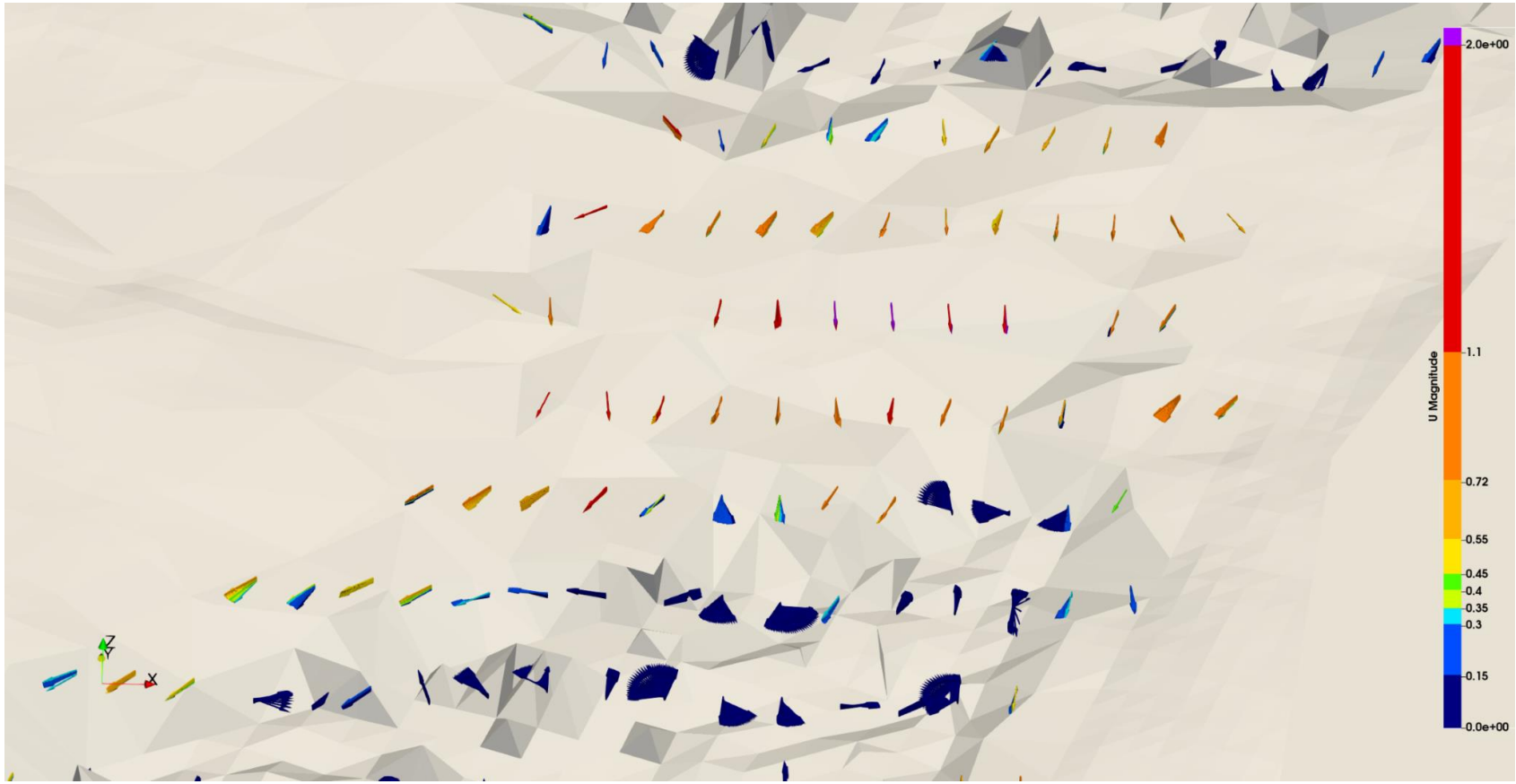


Figure S1-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

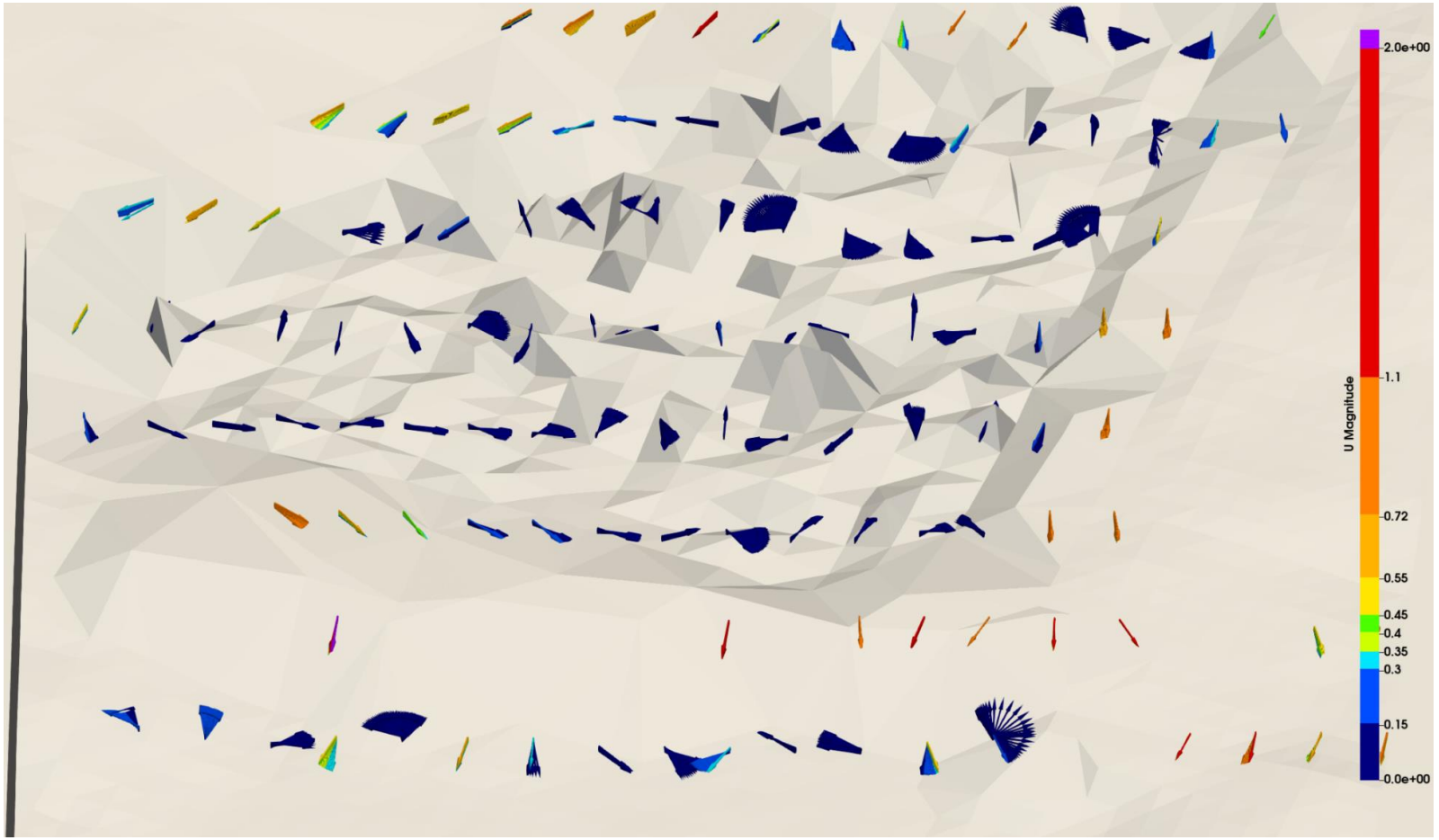


Figure S1-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2. Model Results of Scenario S2 with 165 cfs from the gates

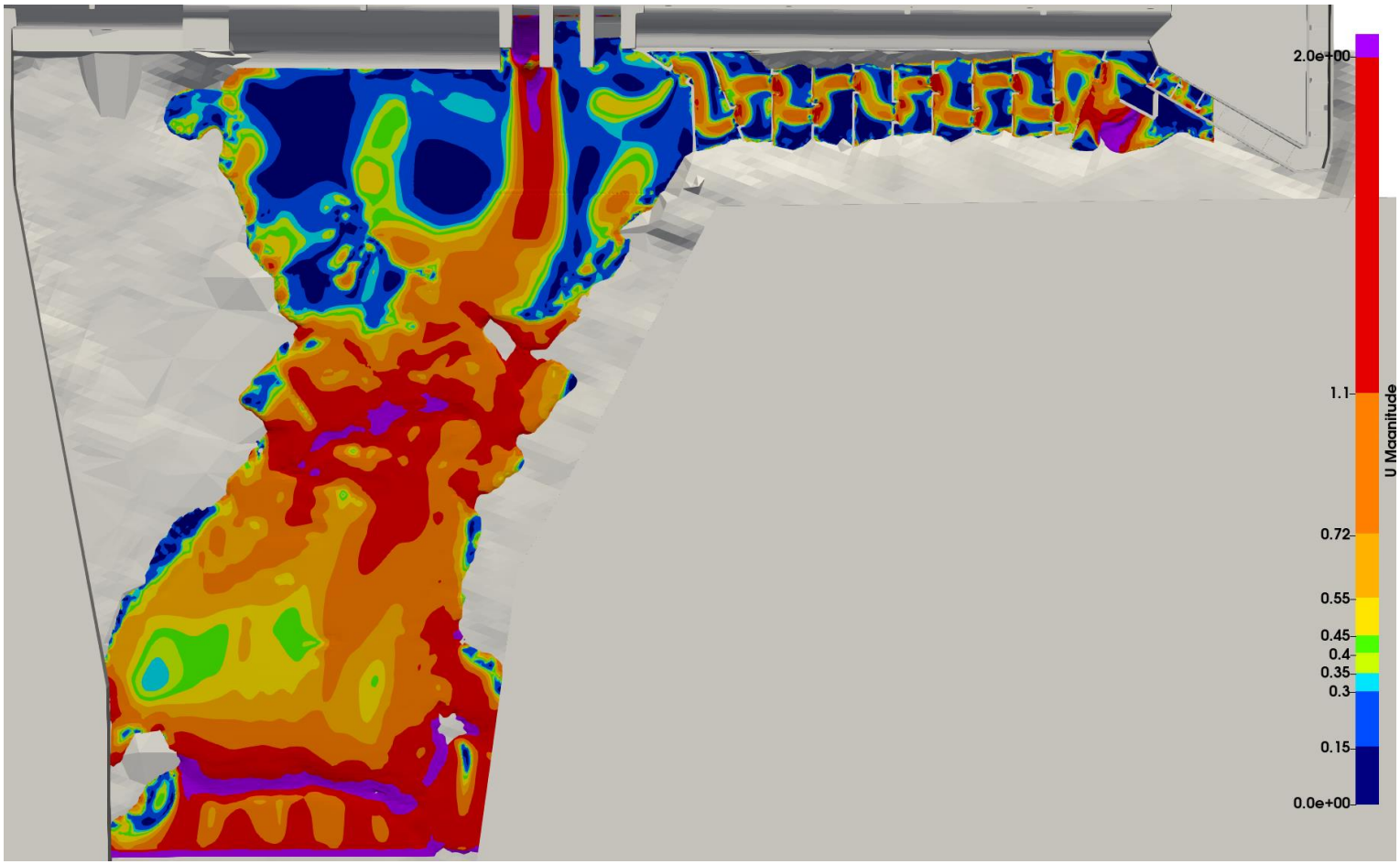


Figure S2-1: Plan view of the Water Surface Velocities

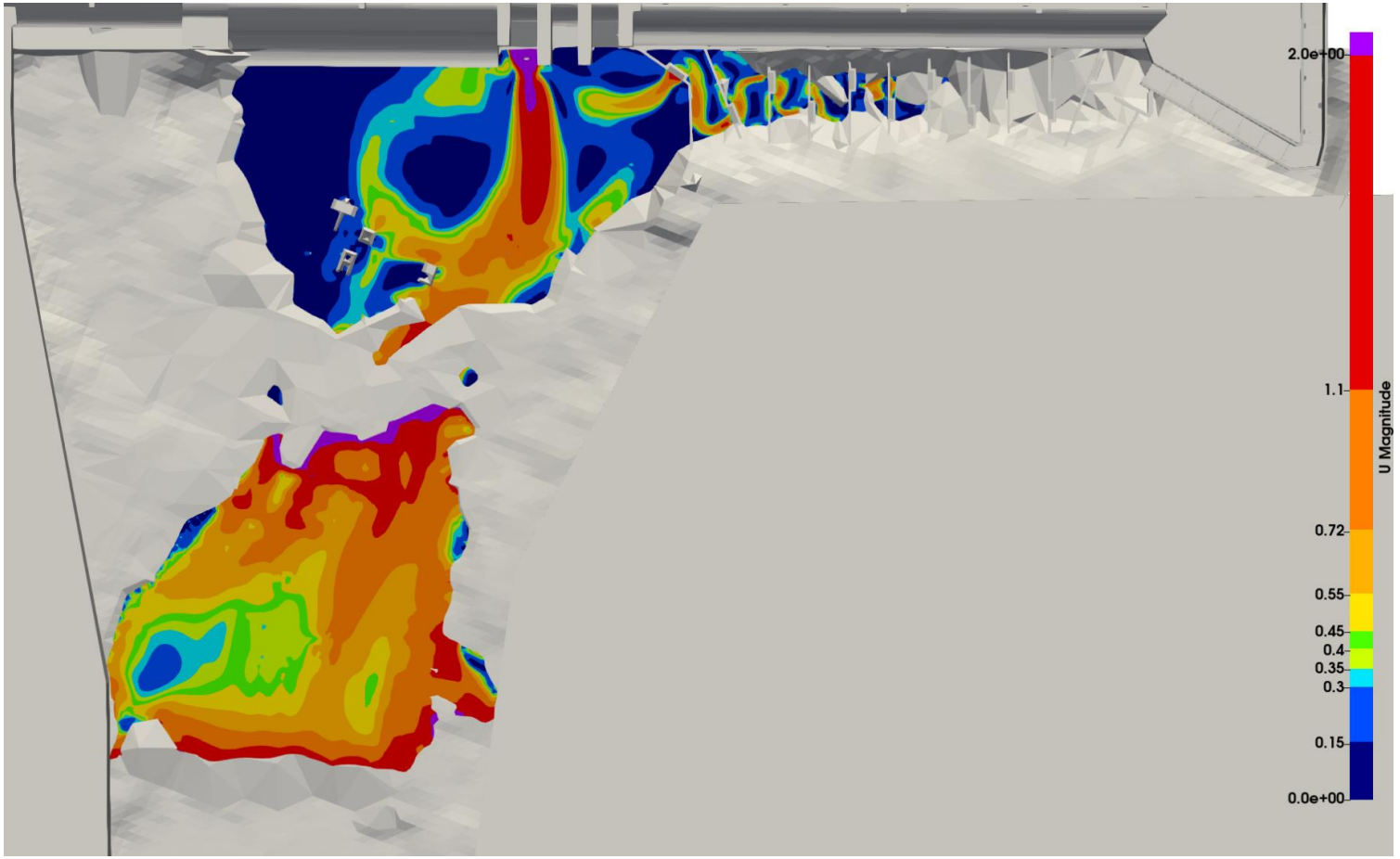


Figure S2-2: Plan view of the Mid-Surface Velocities

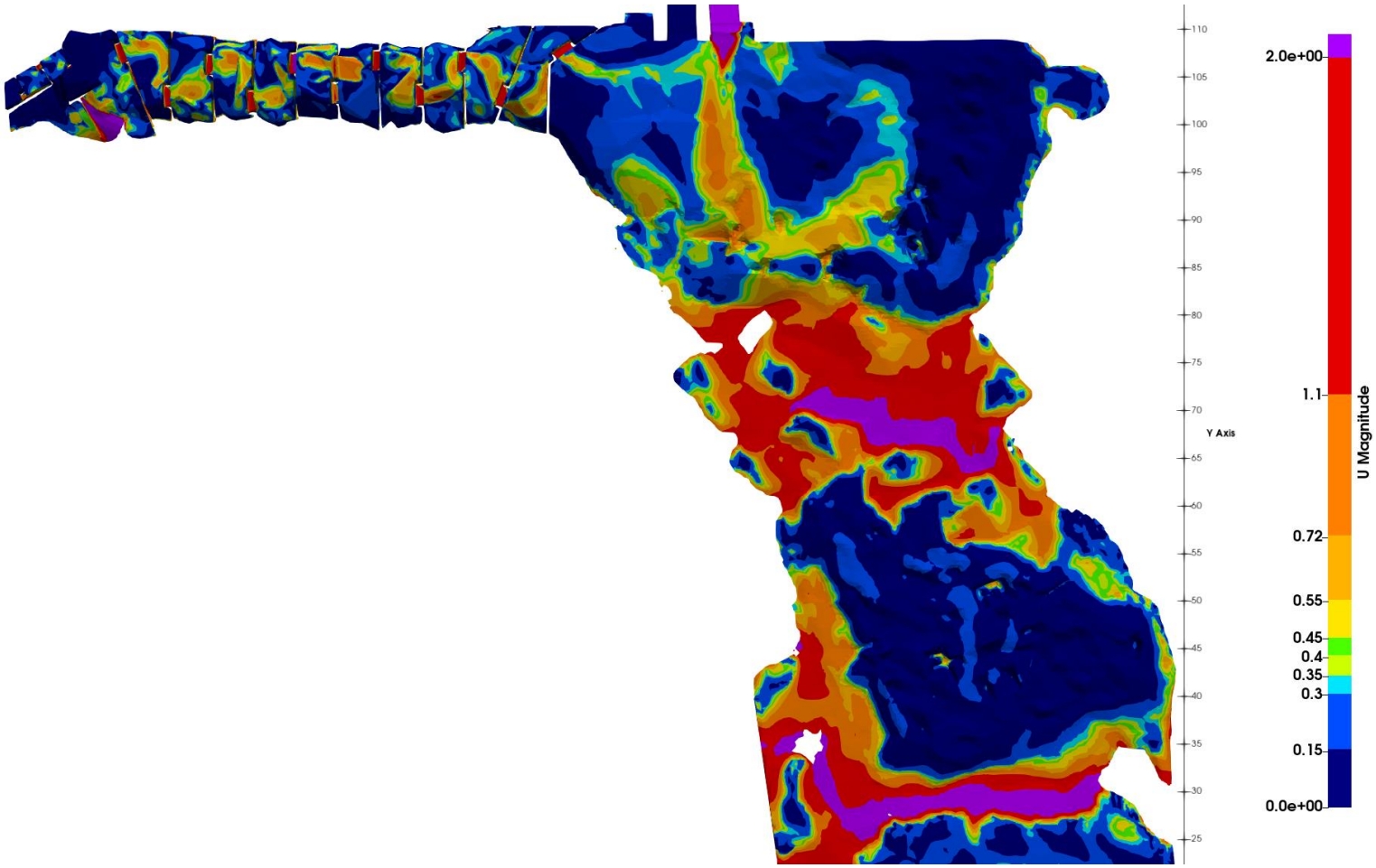


Figure S2-3: View of the Bottom Velocities

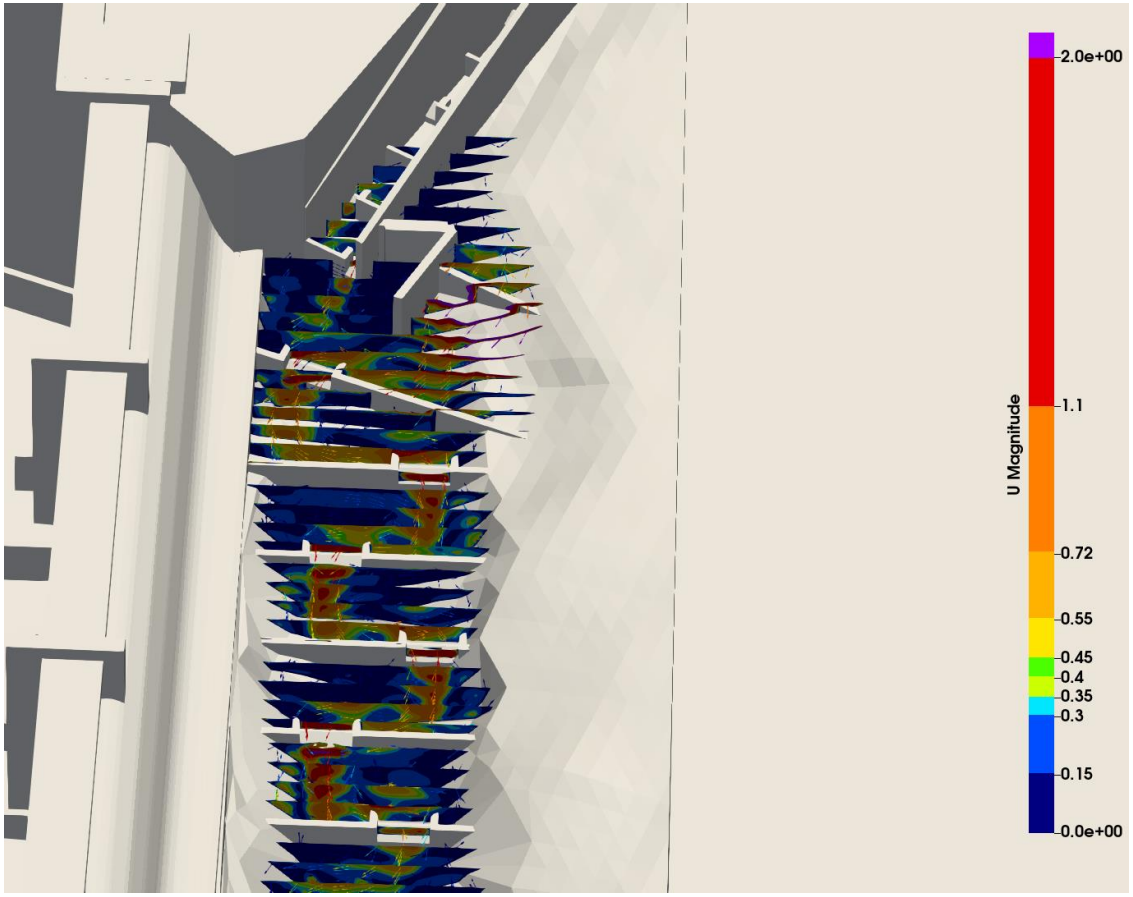


Figure S2-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

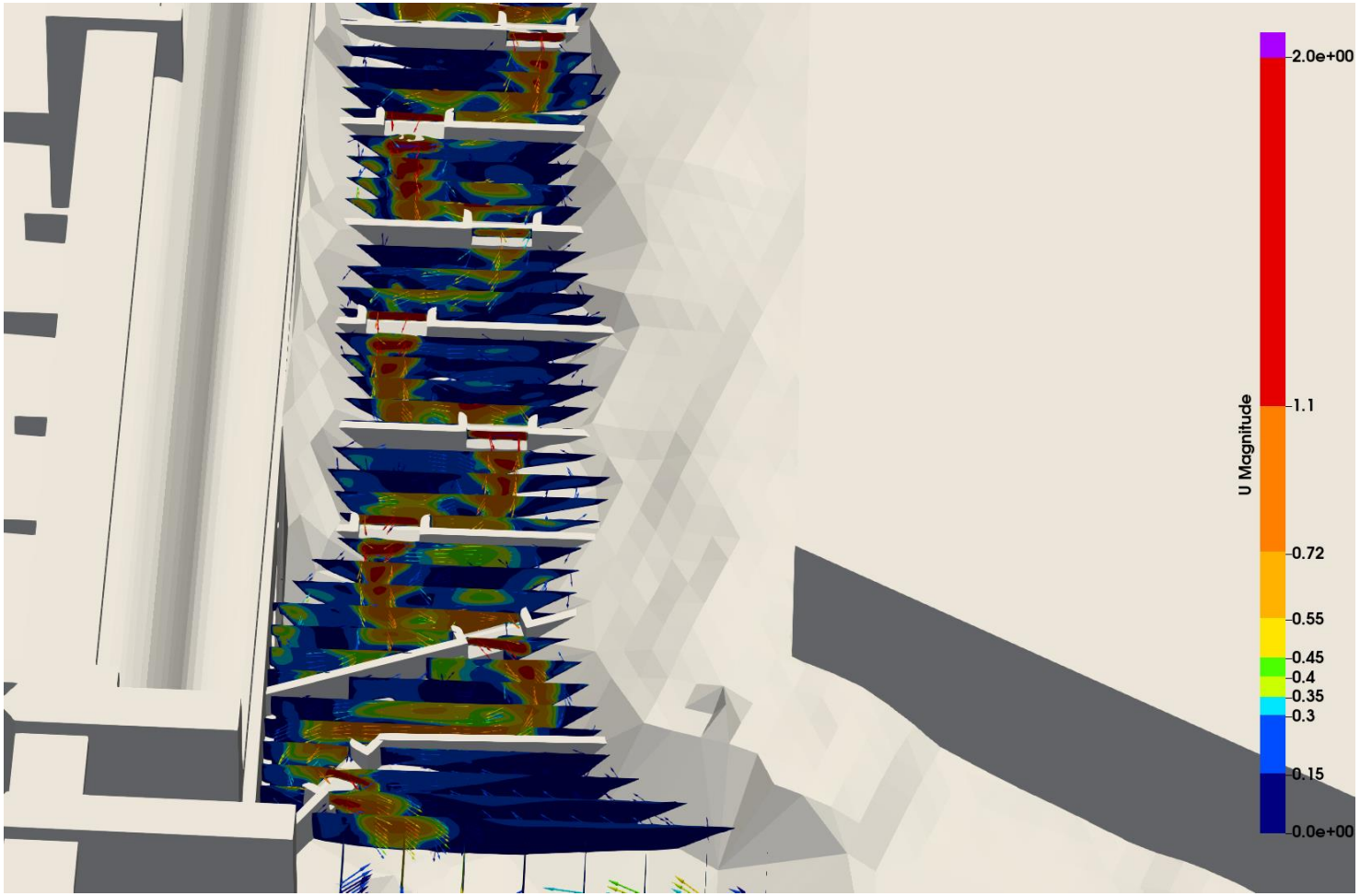


Figure S2-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

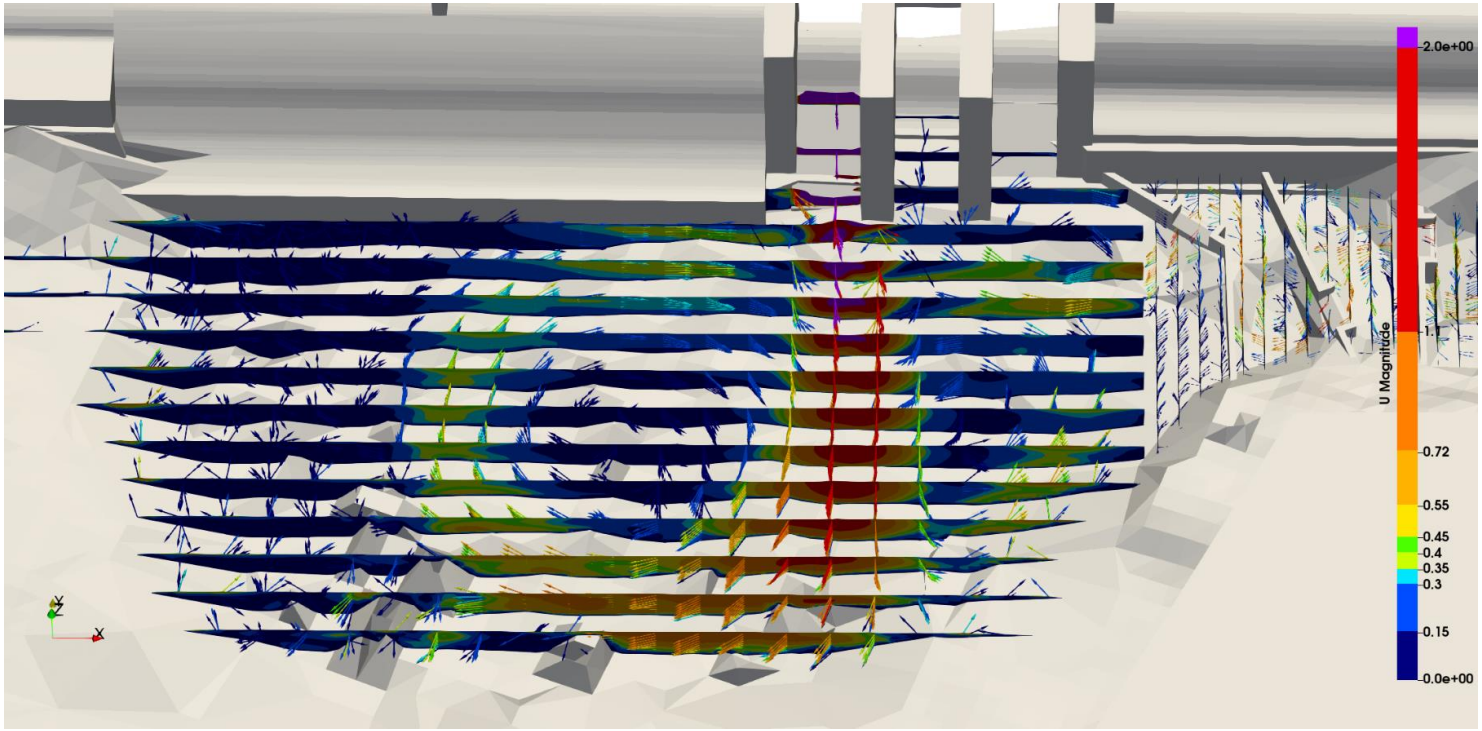


Figure S2-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

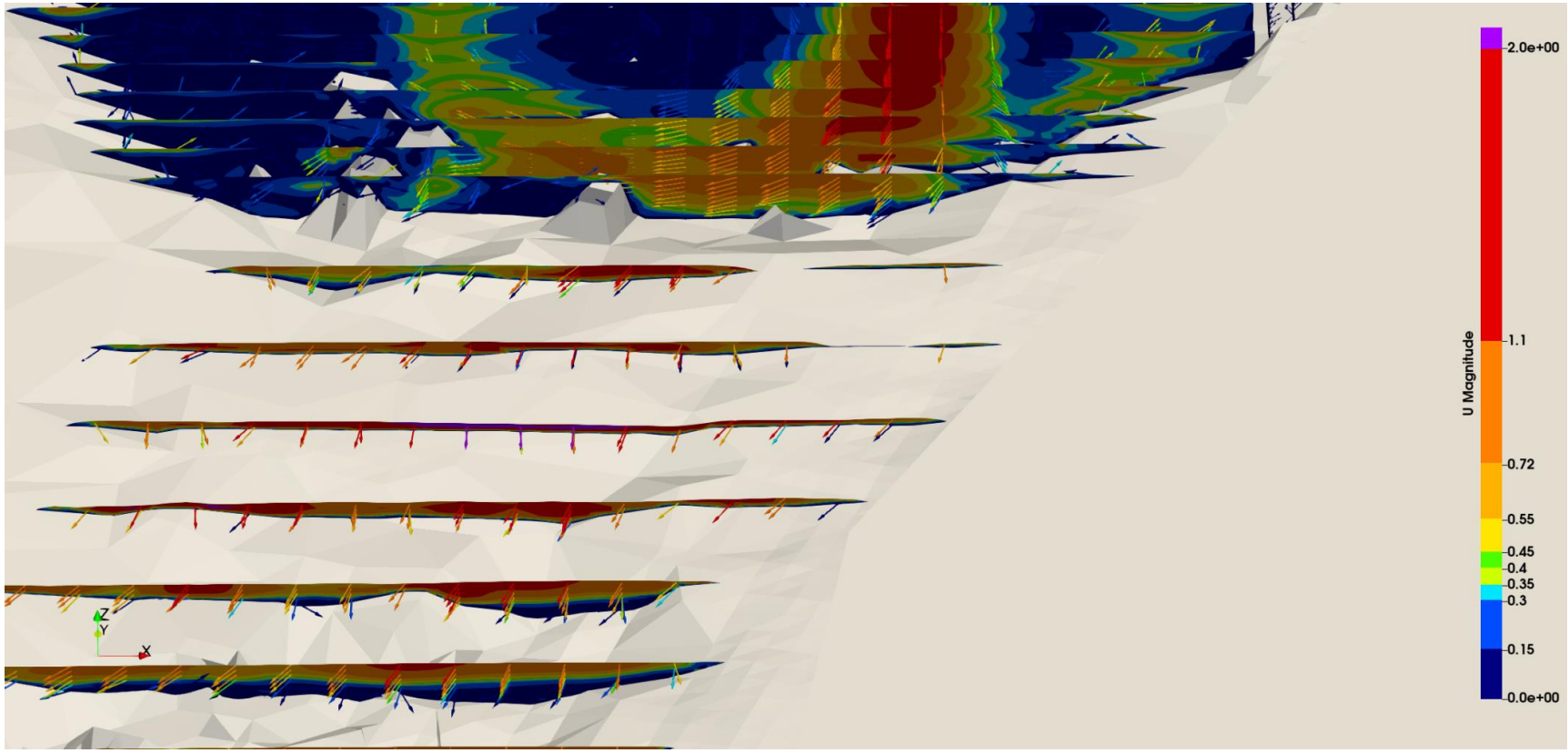


Figure S2-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

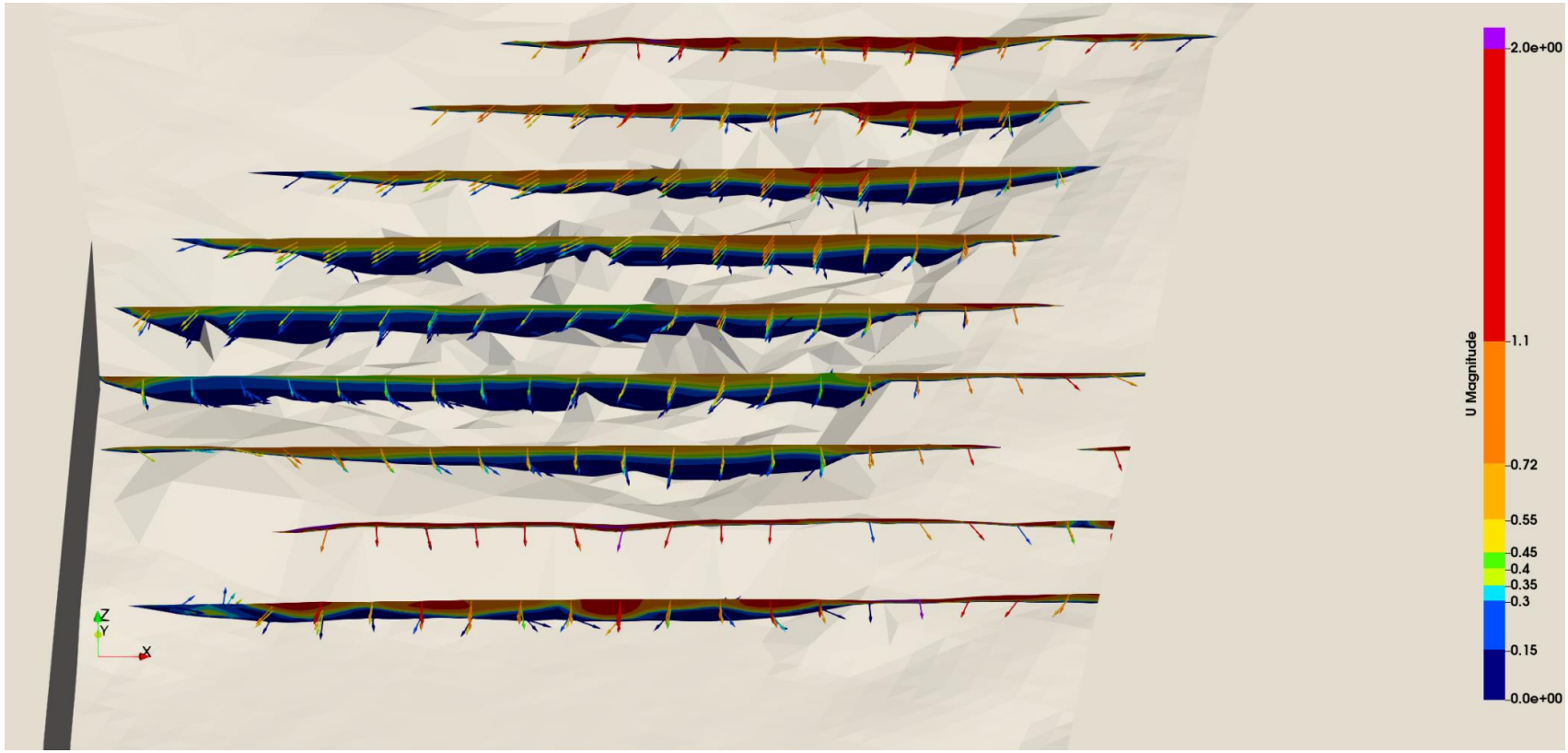


Figure S2-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

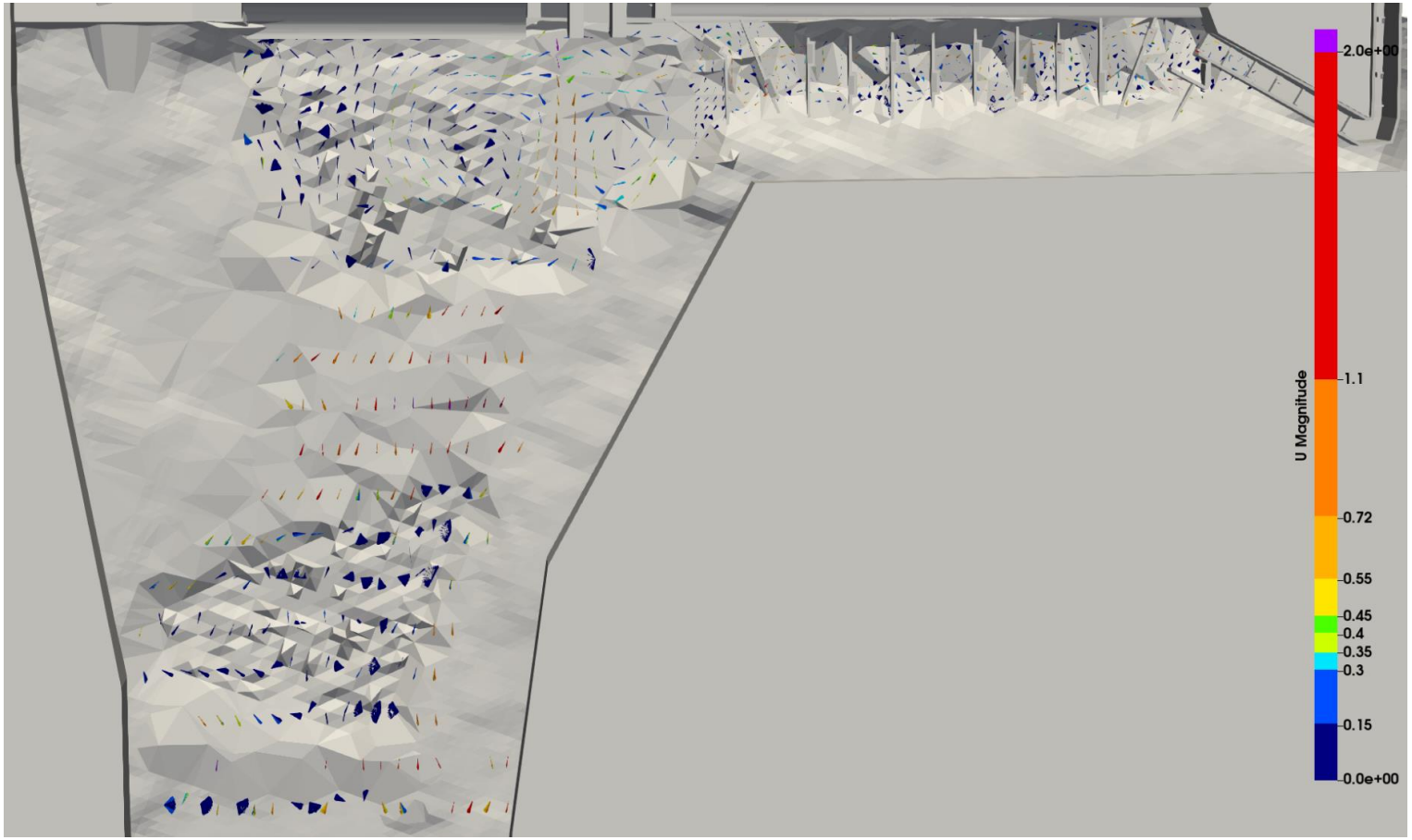


Figure S2-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

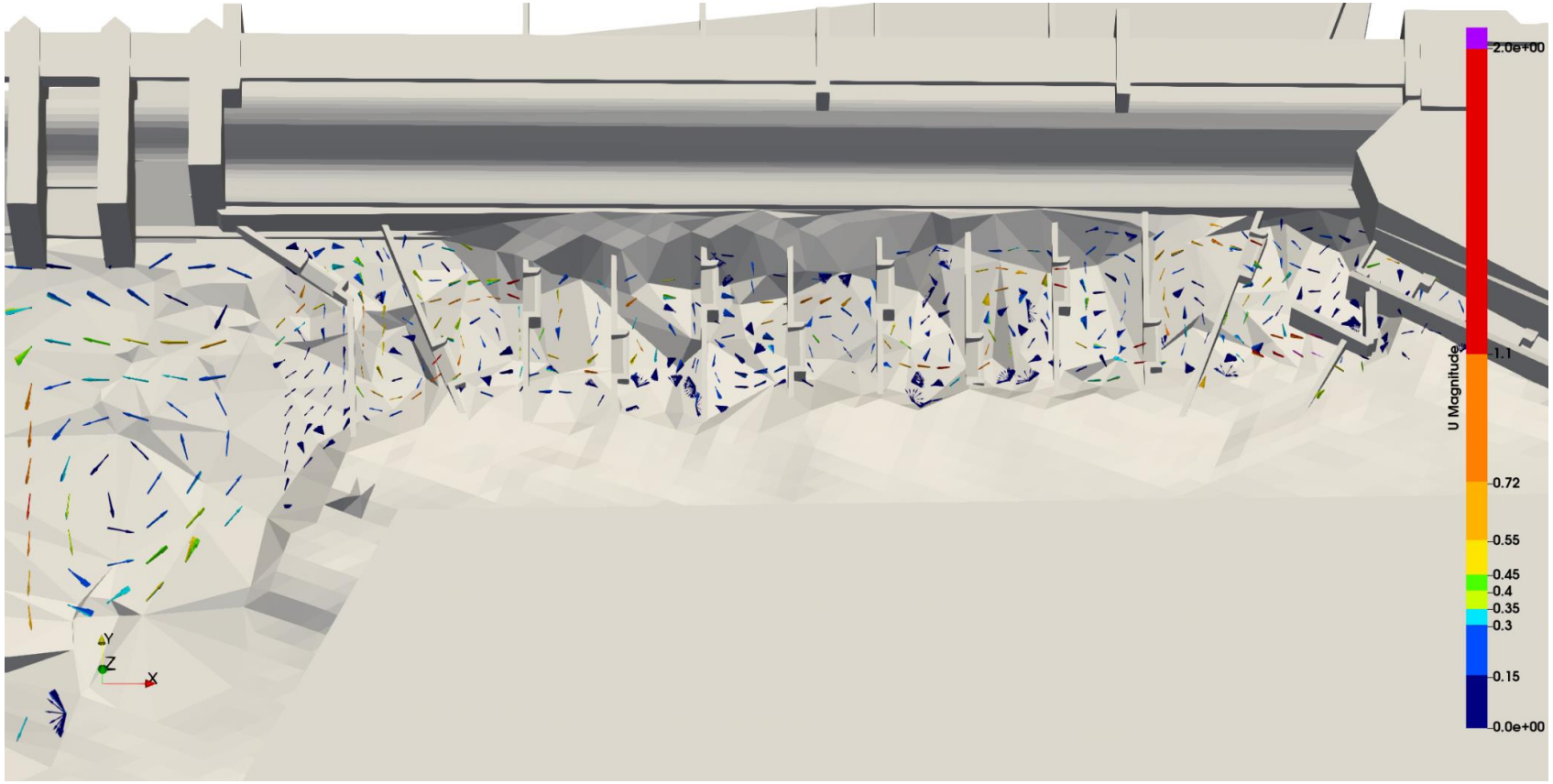


Figure S2-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

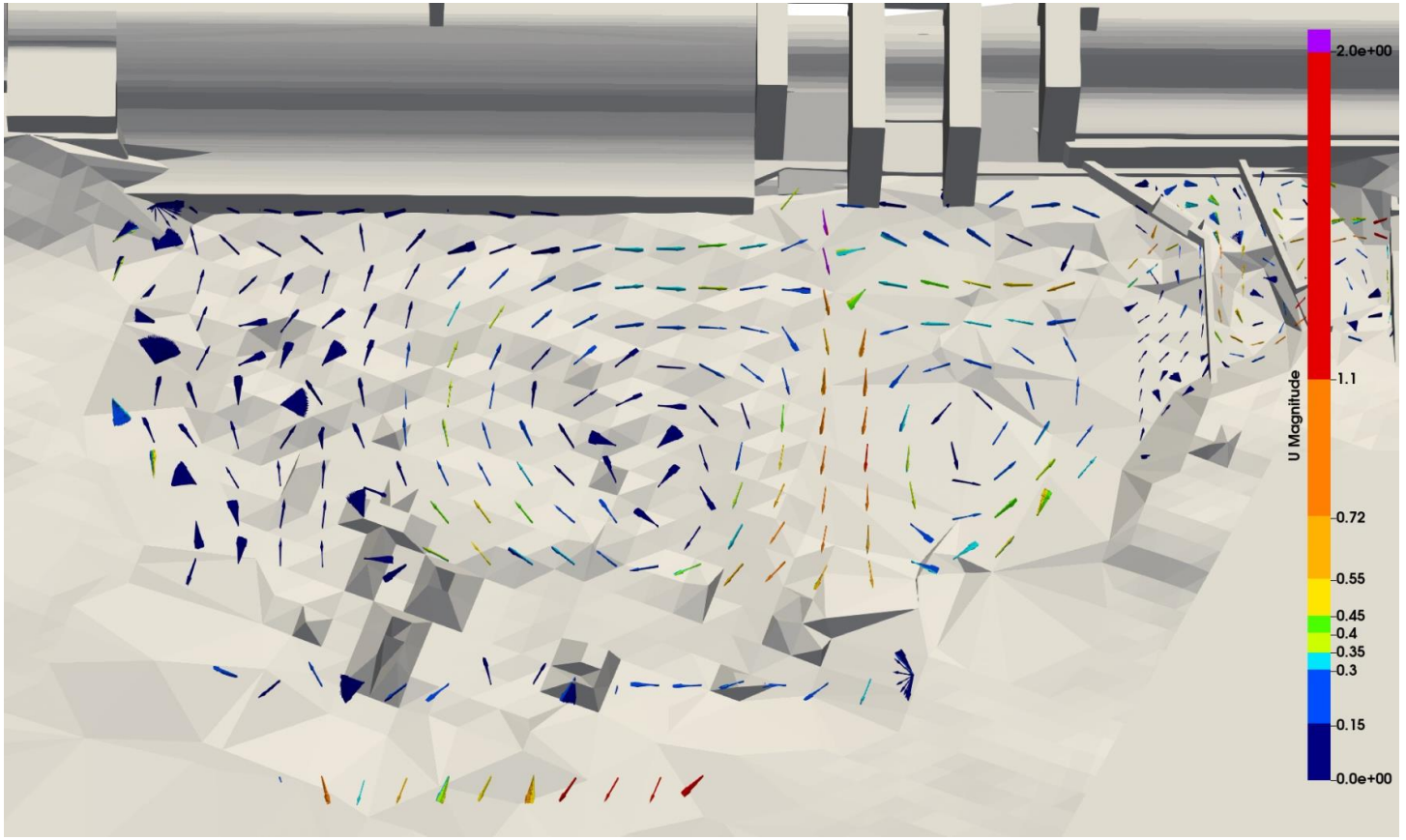


Figure S2-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

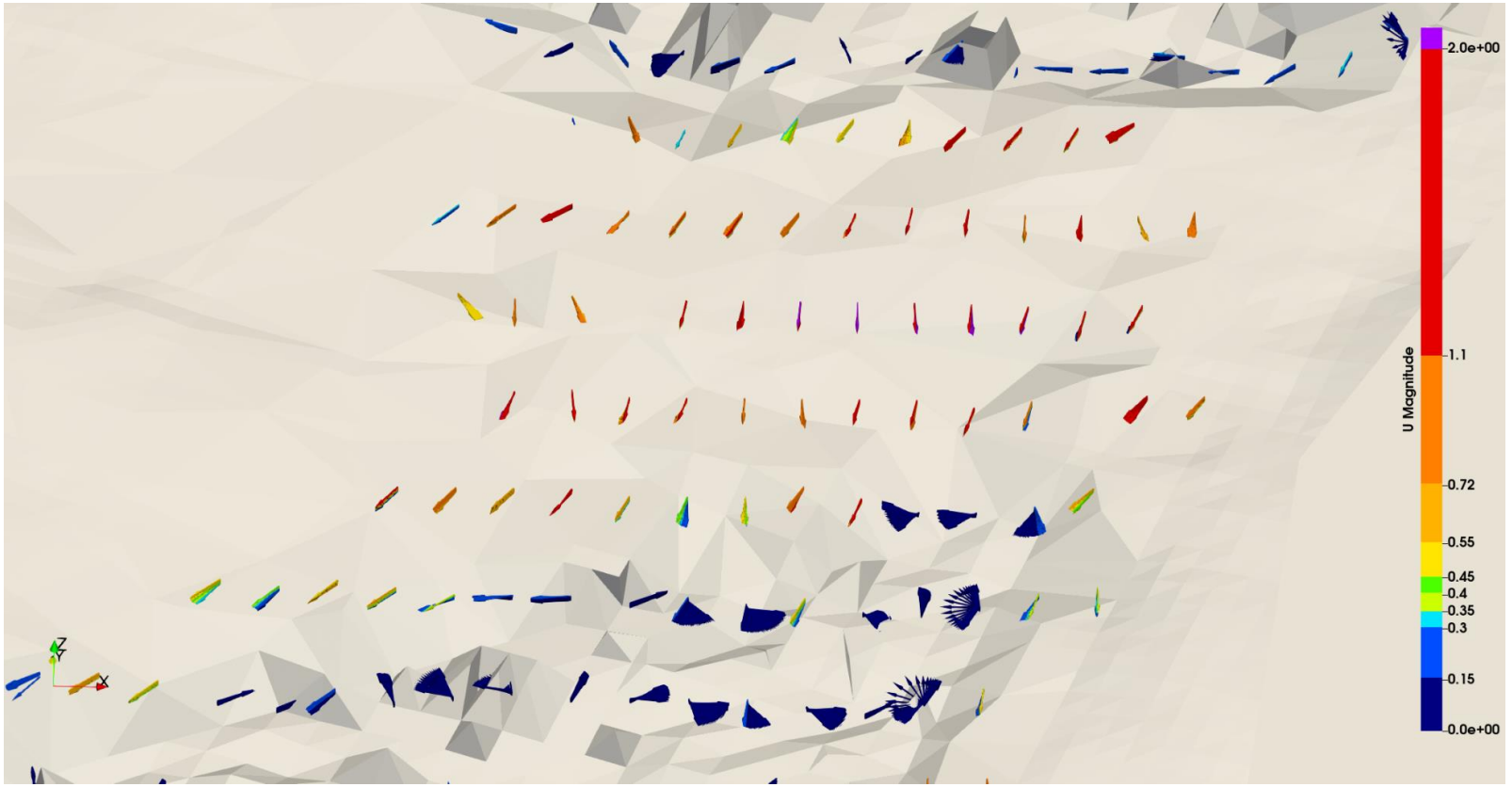


Figure S2-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

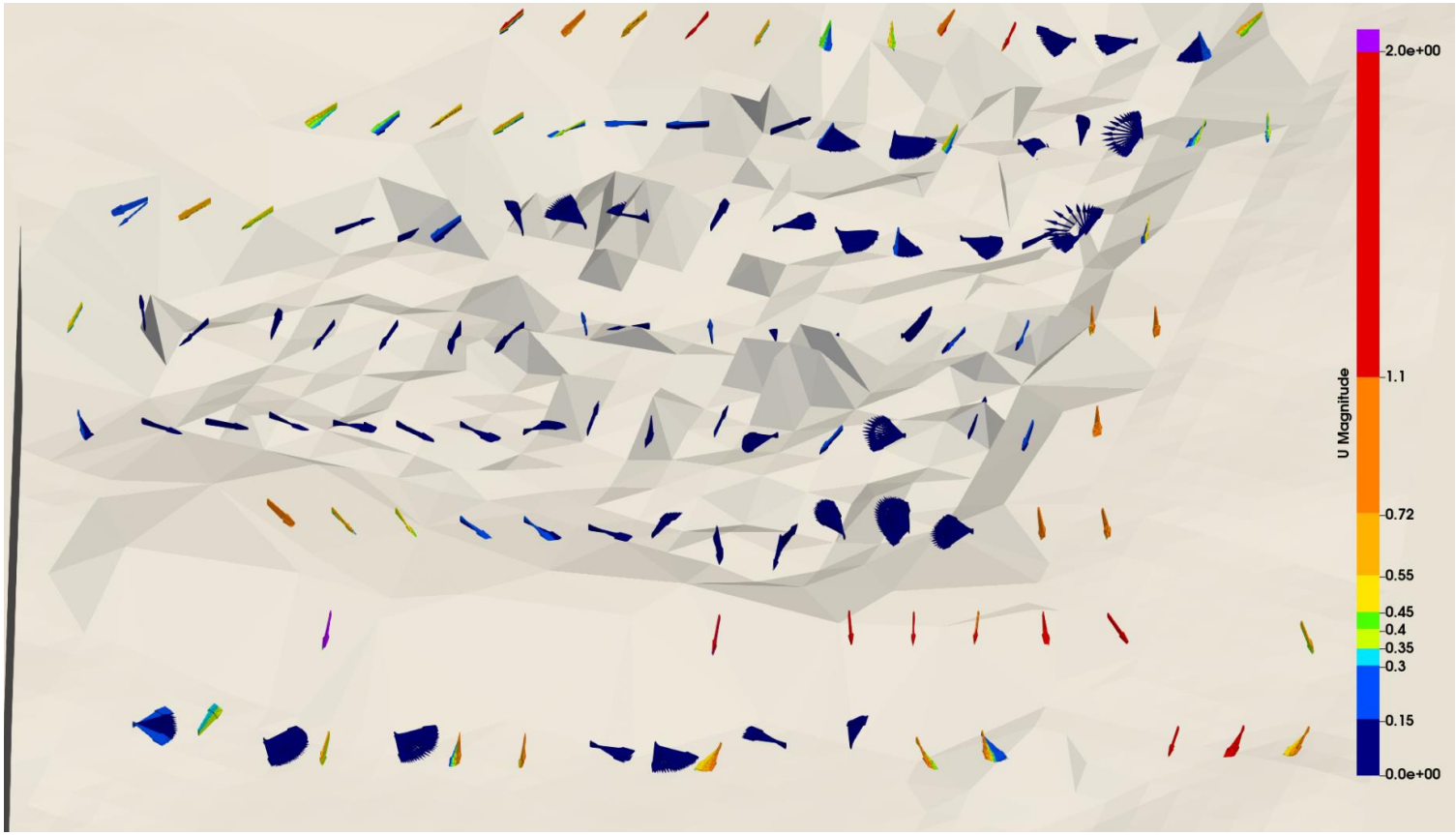


Figure S2-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

3. Model Results of Scenario S3 with 925 cfs from the gates

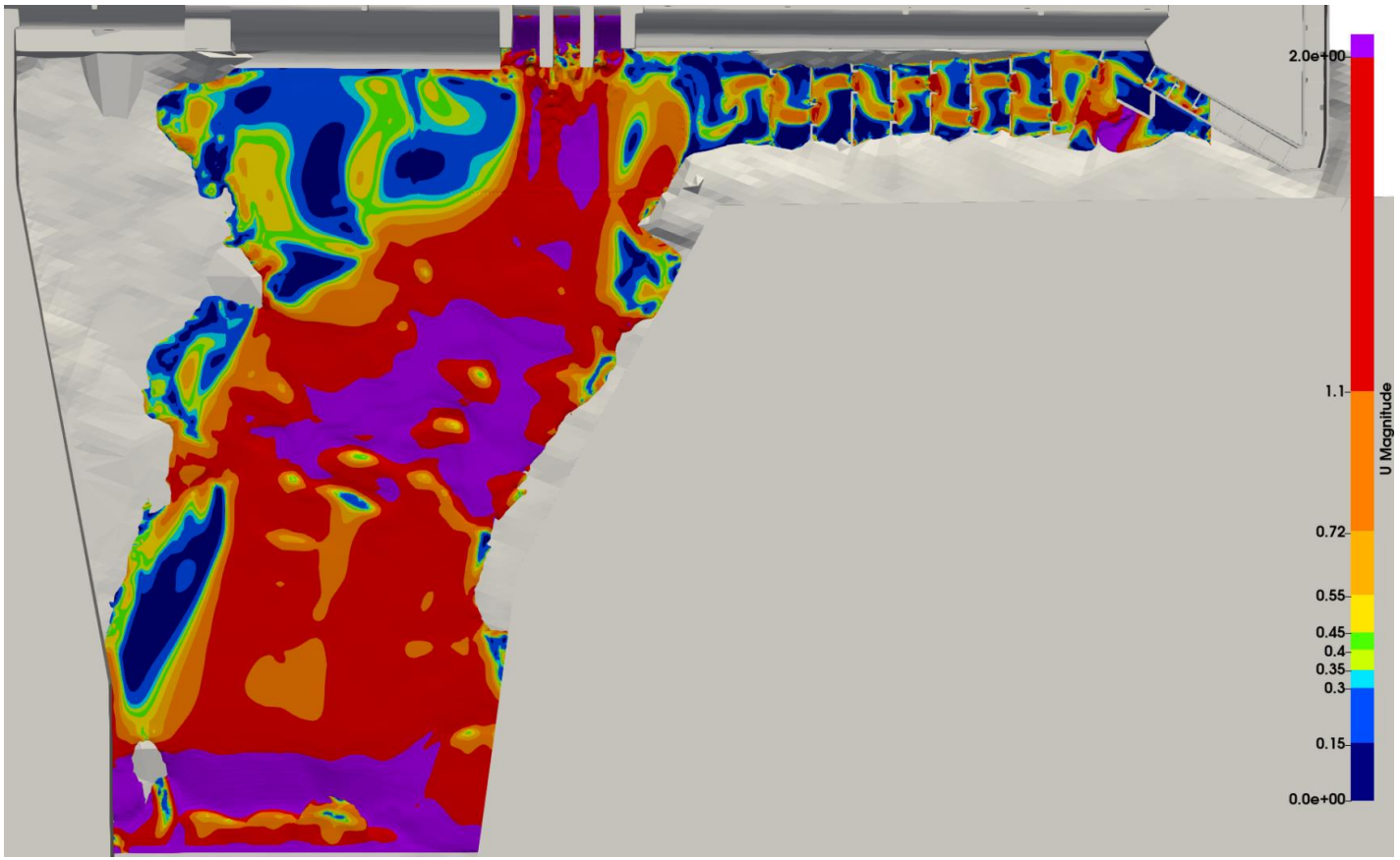


Figure S3-1: Plan view of the Water Surface Velocities

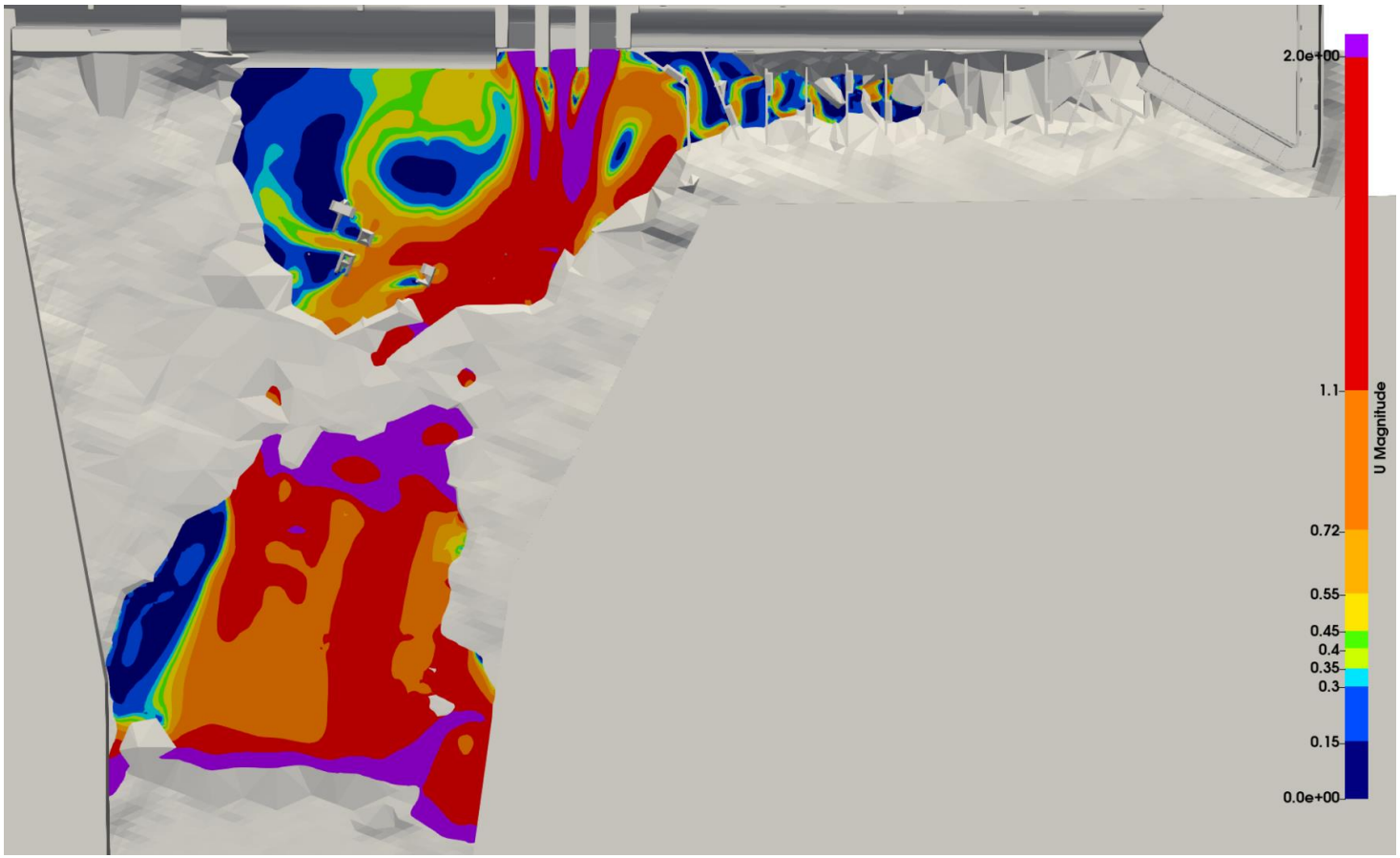


Figure S3-2: Plan view of the Mid-Surface Velocities

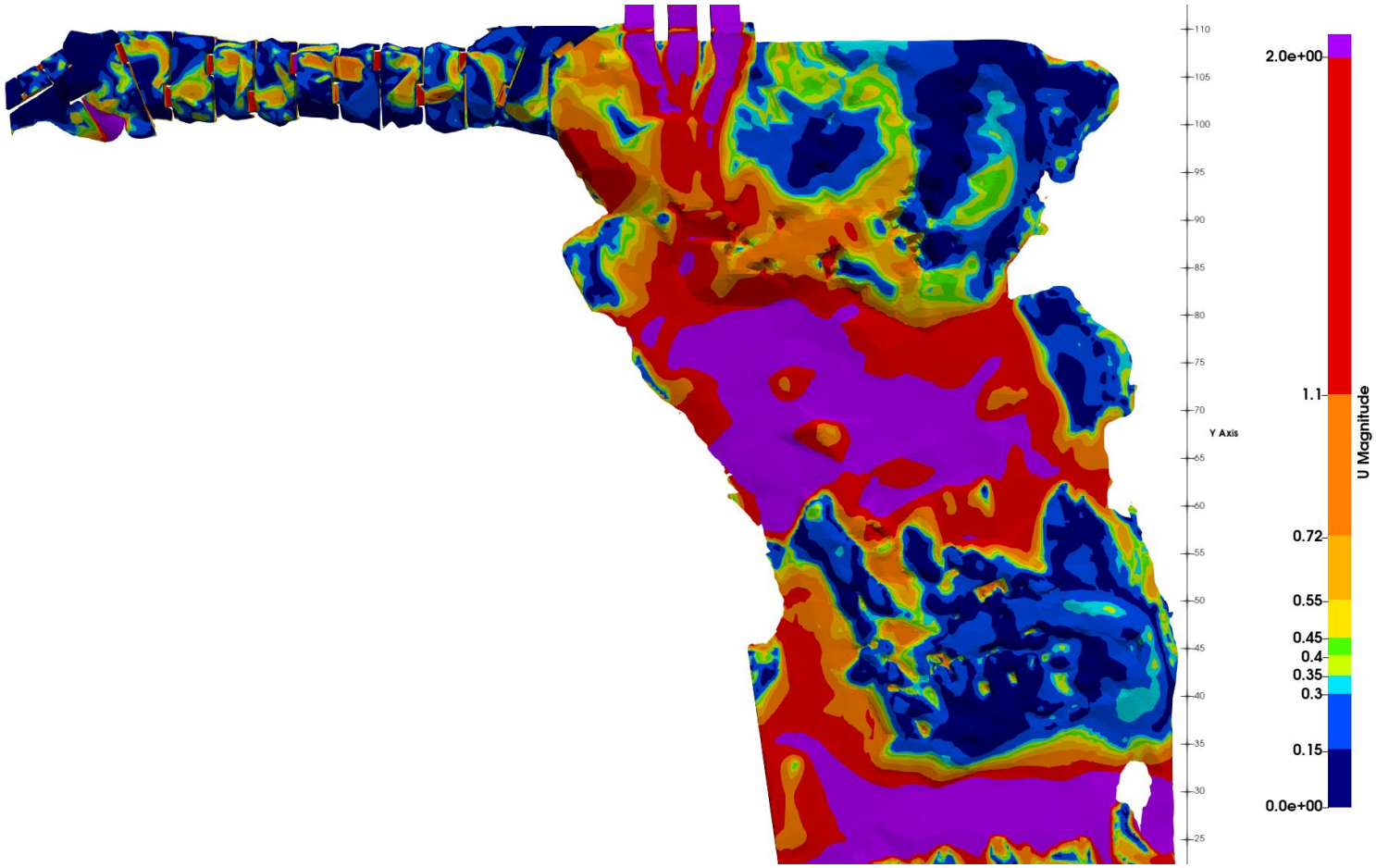


Figure S3-3: View of the Bottom Velocities

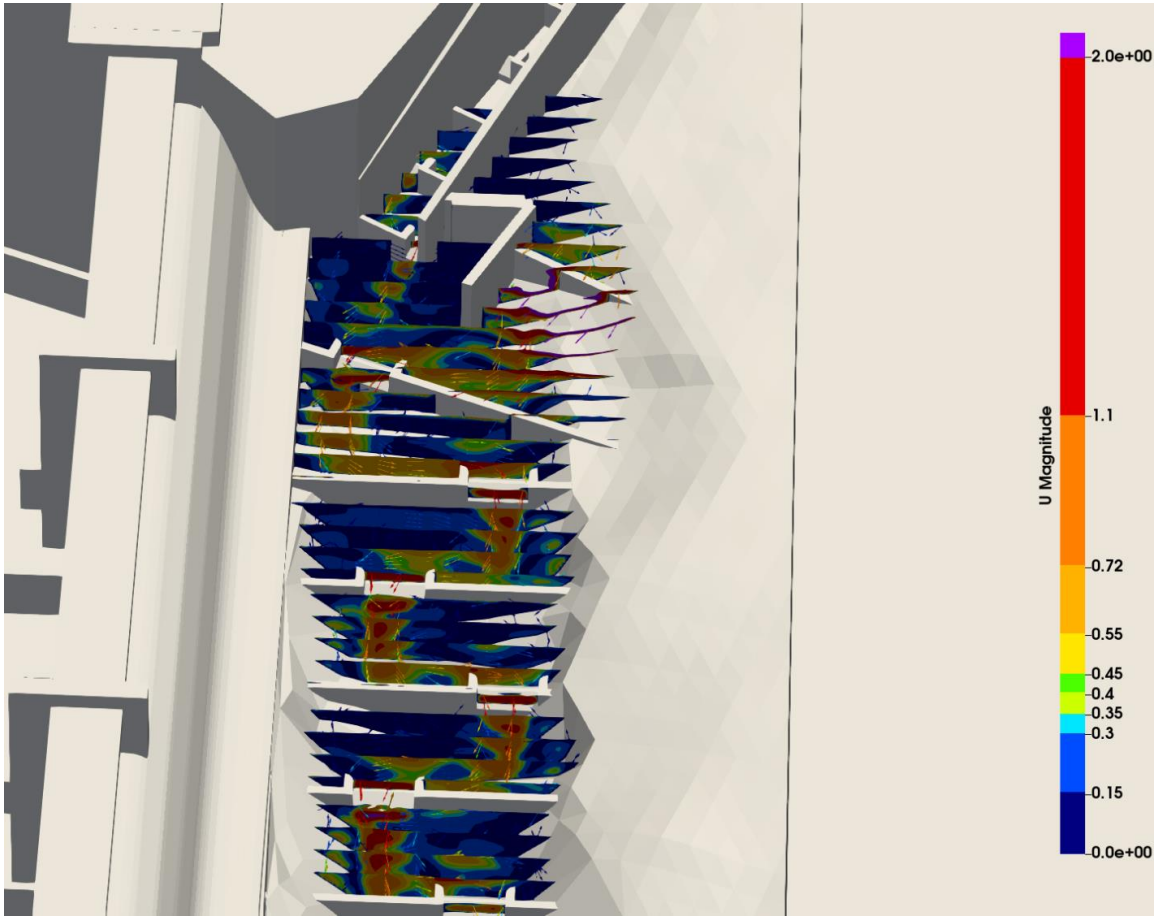


Figure S3-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

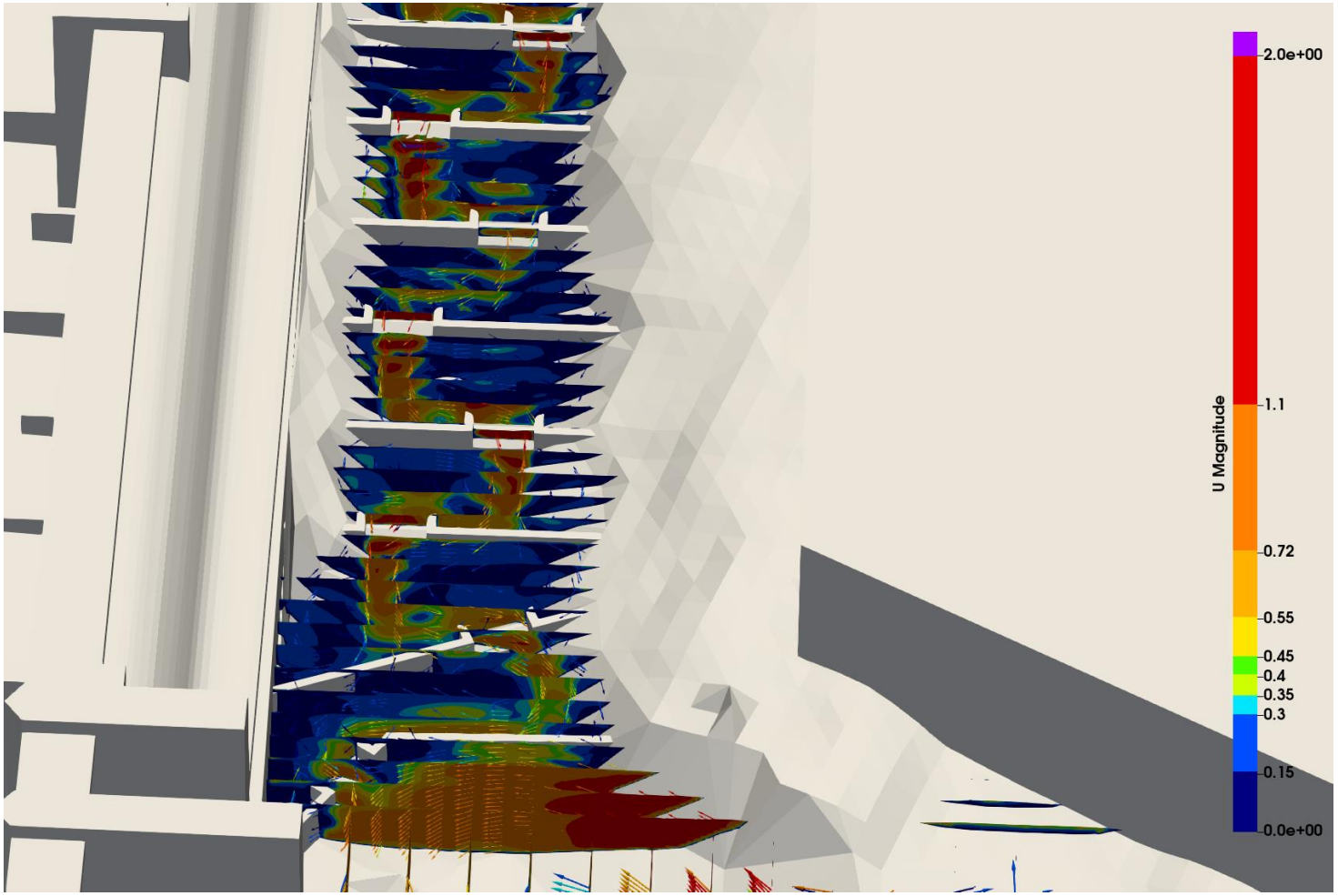


Figure S3-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

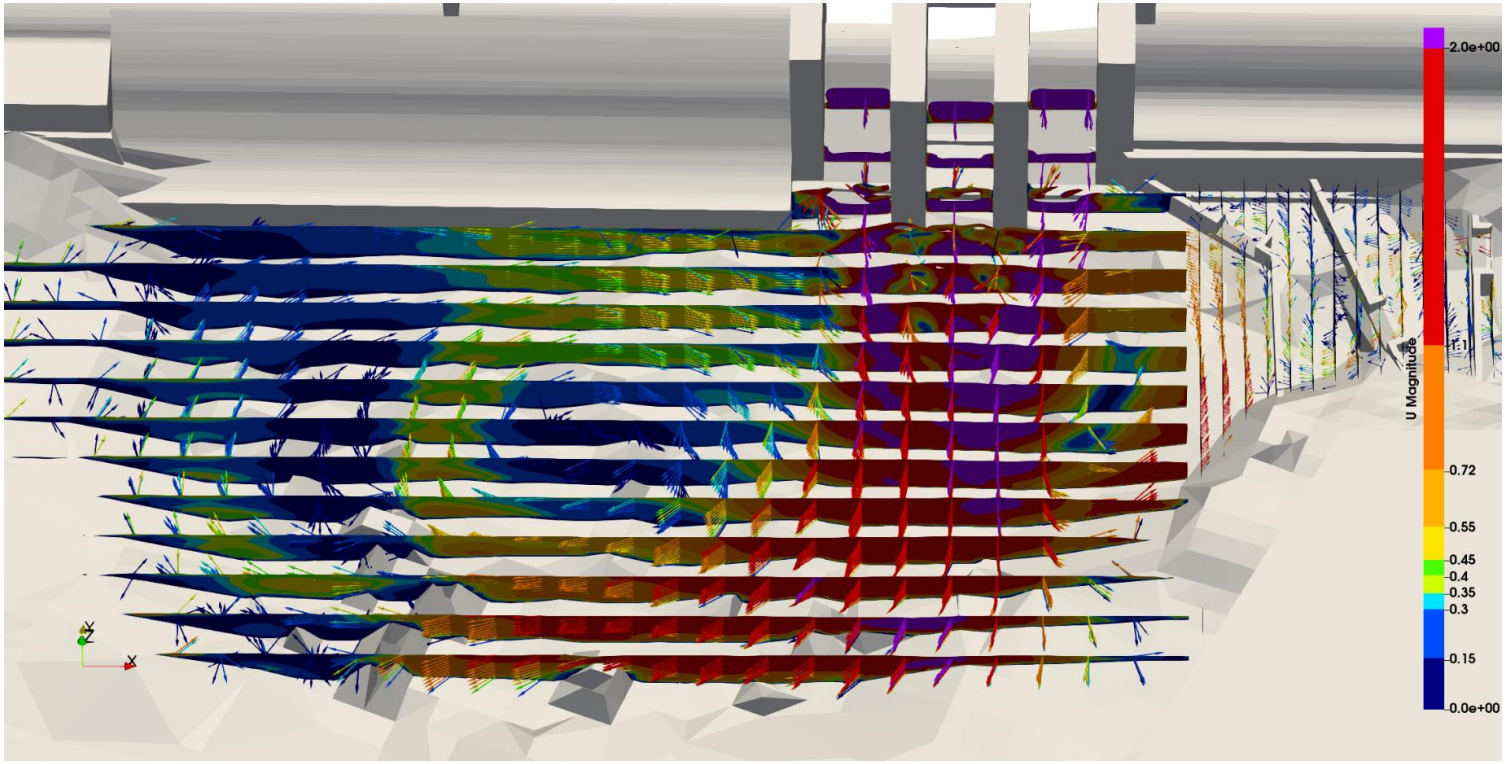


Figure S3-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

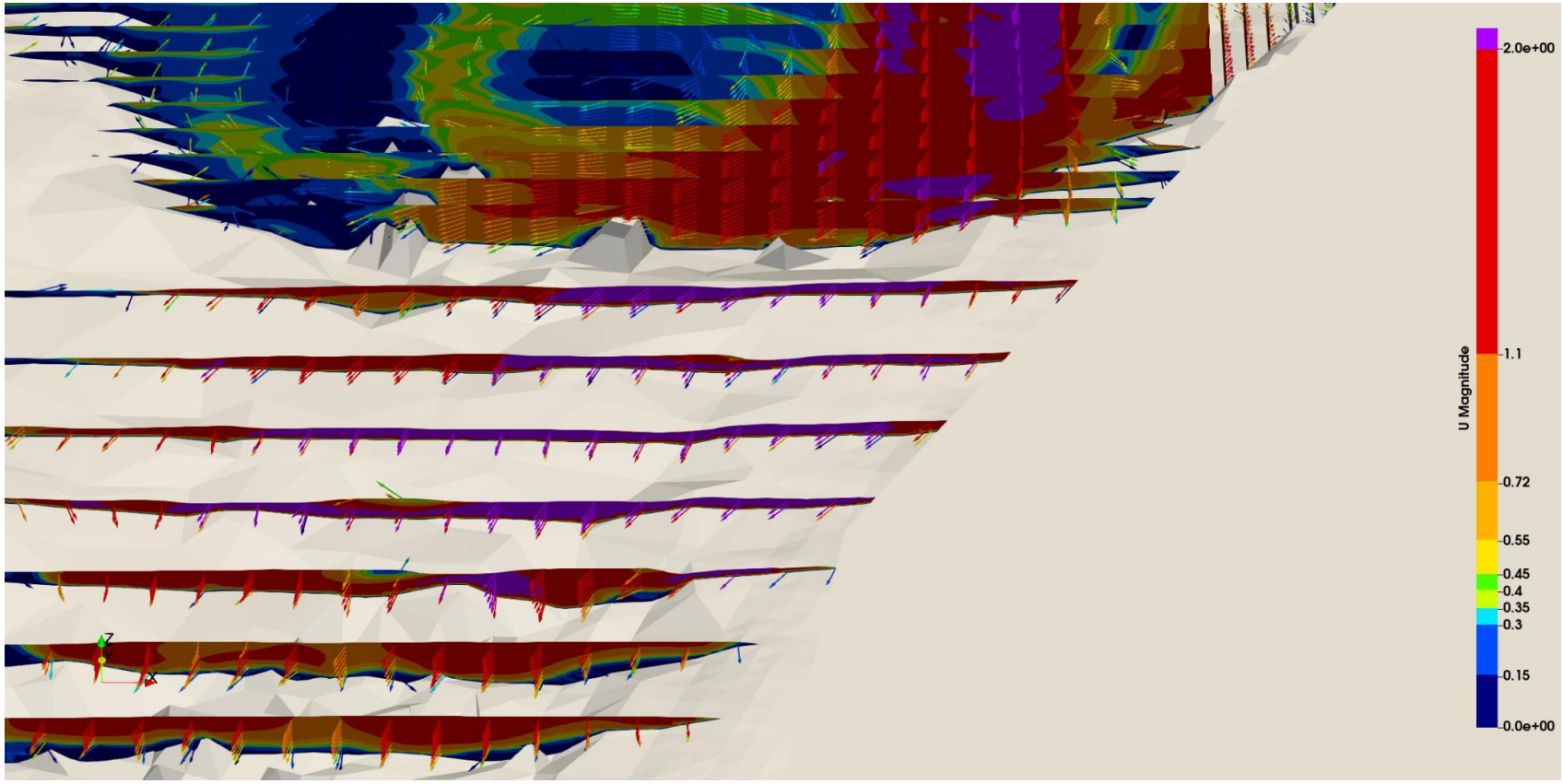


Figure S3-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

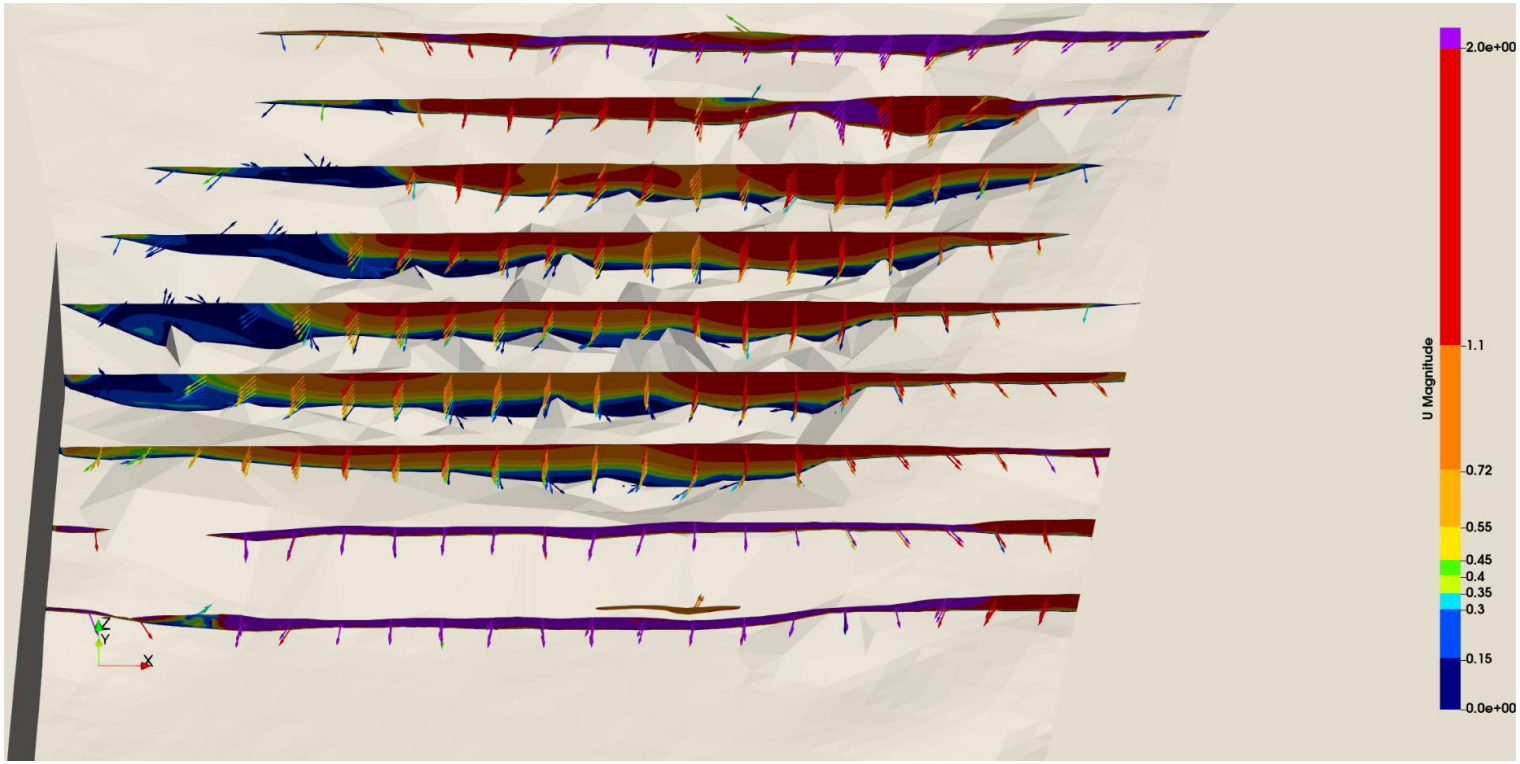


Figure S3-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

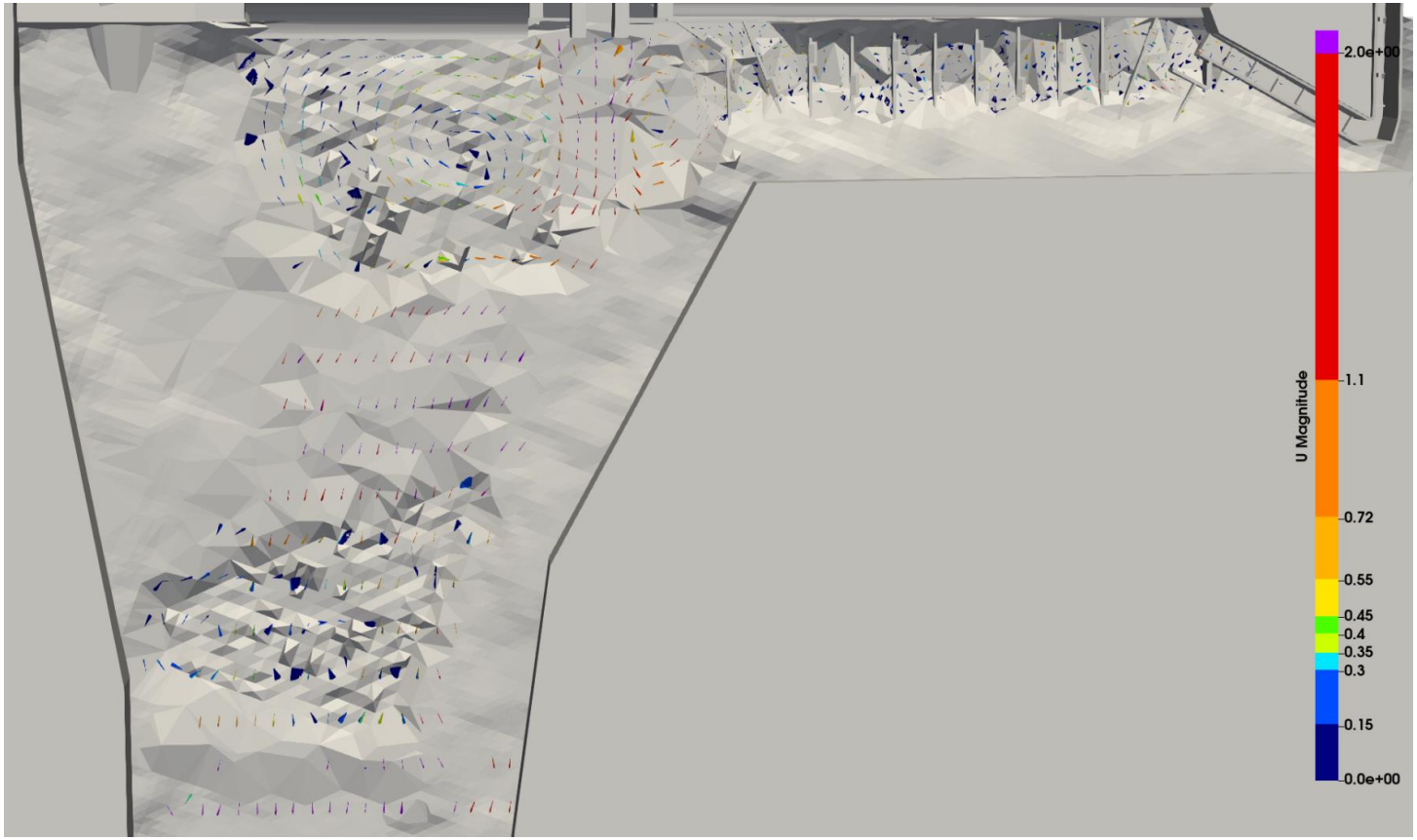


Figure S3-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

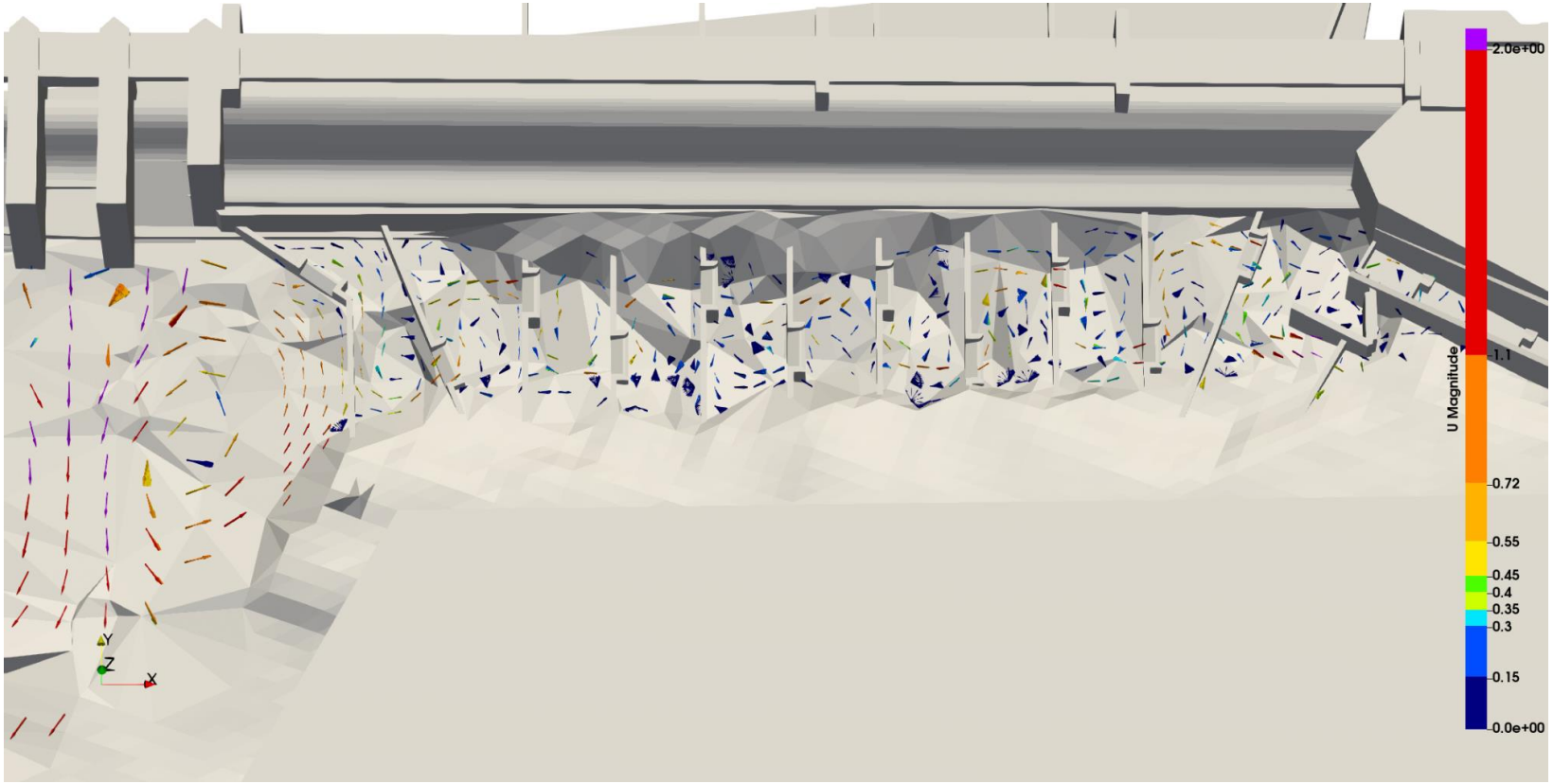


Figure S3-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

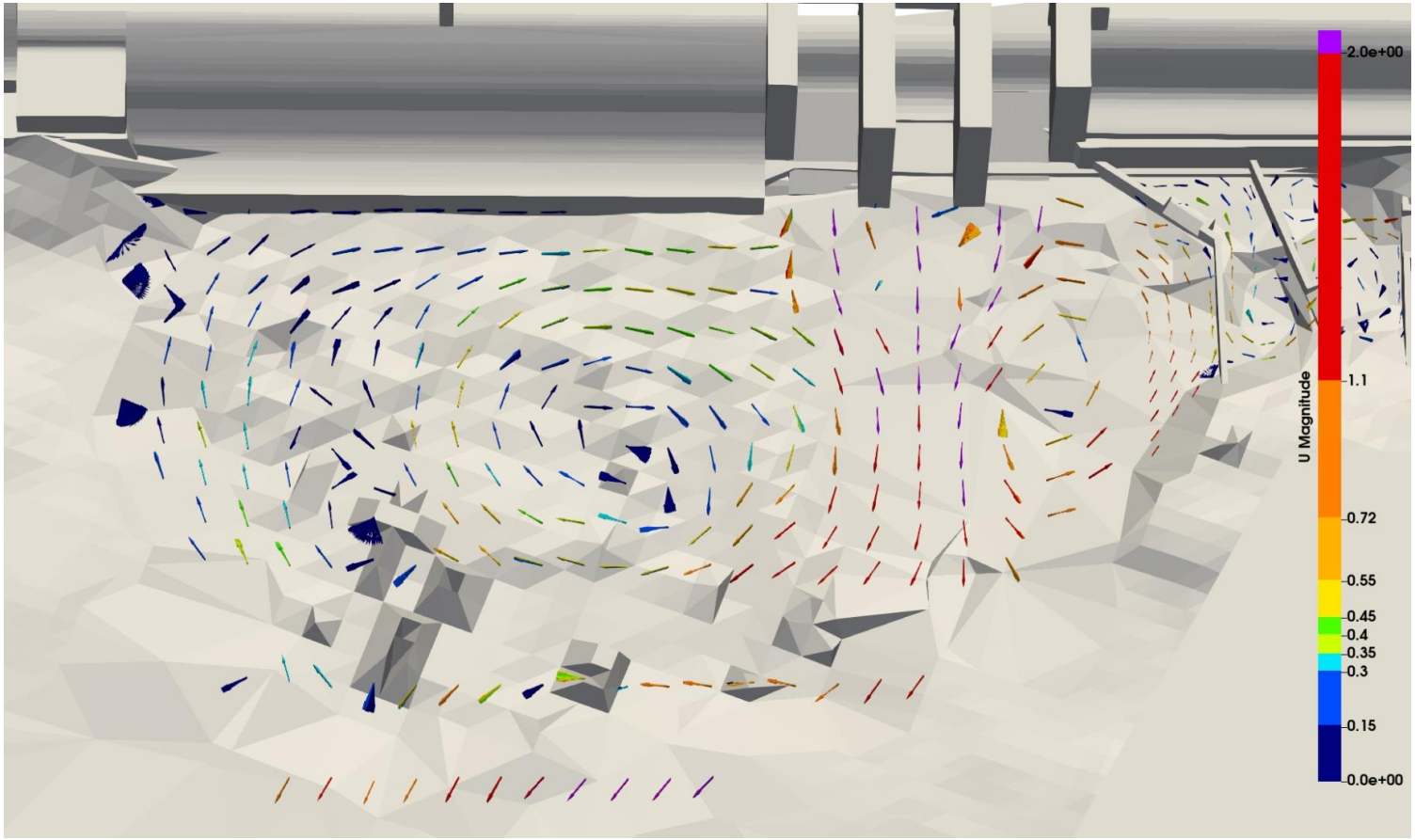


Figure S3-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

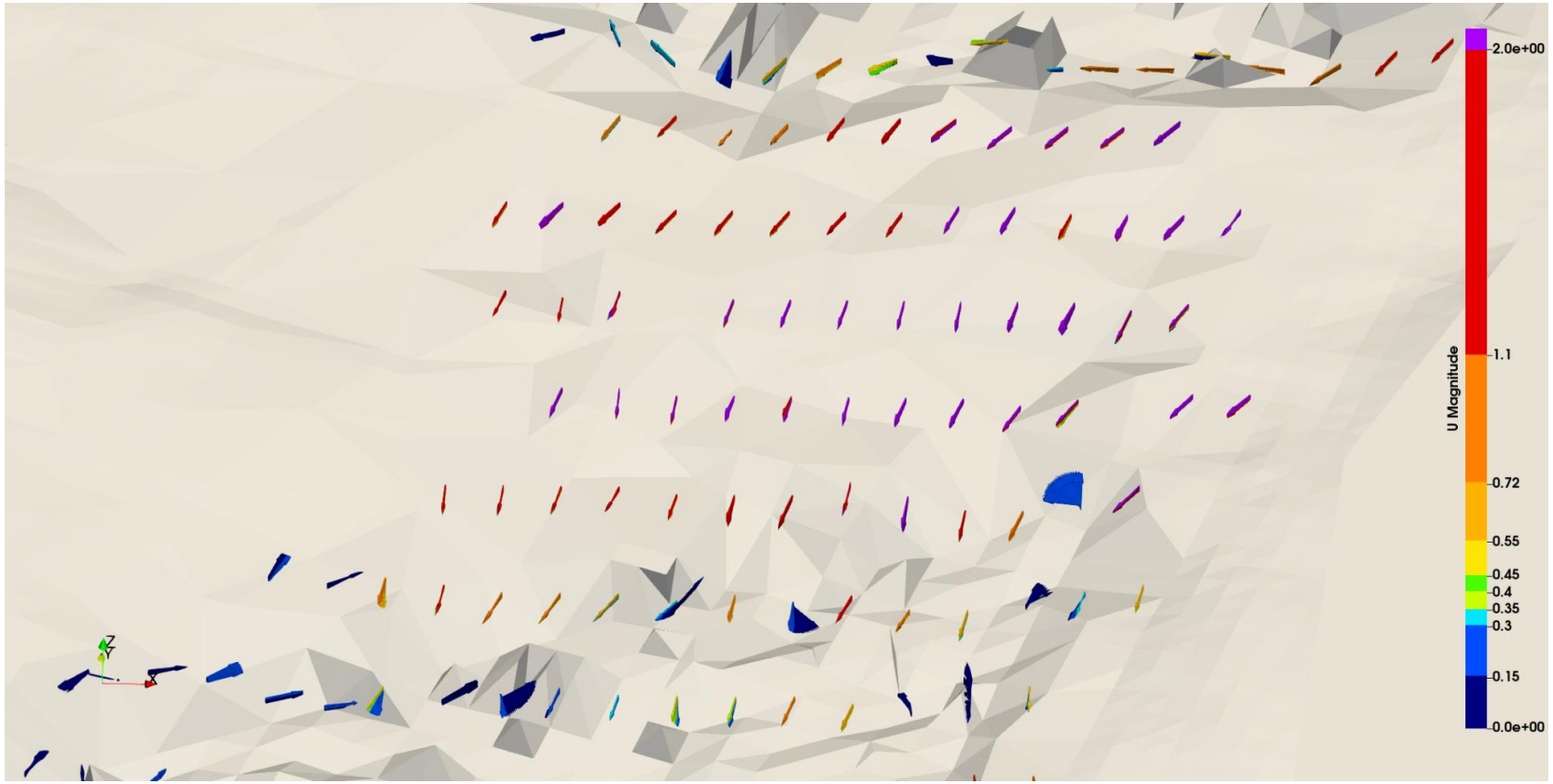


Figure S3-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

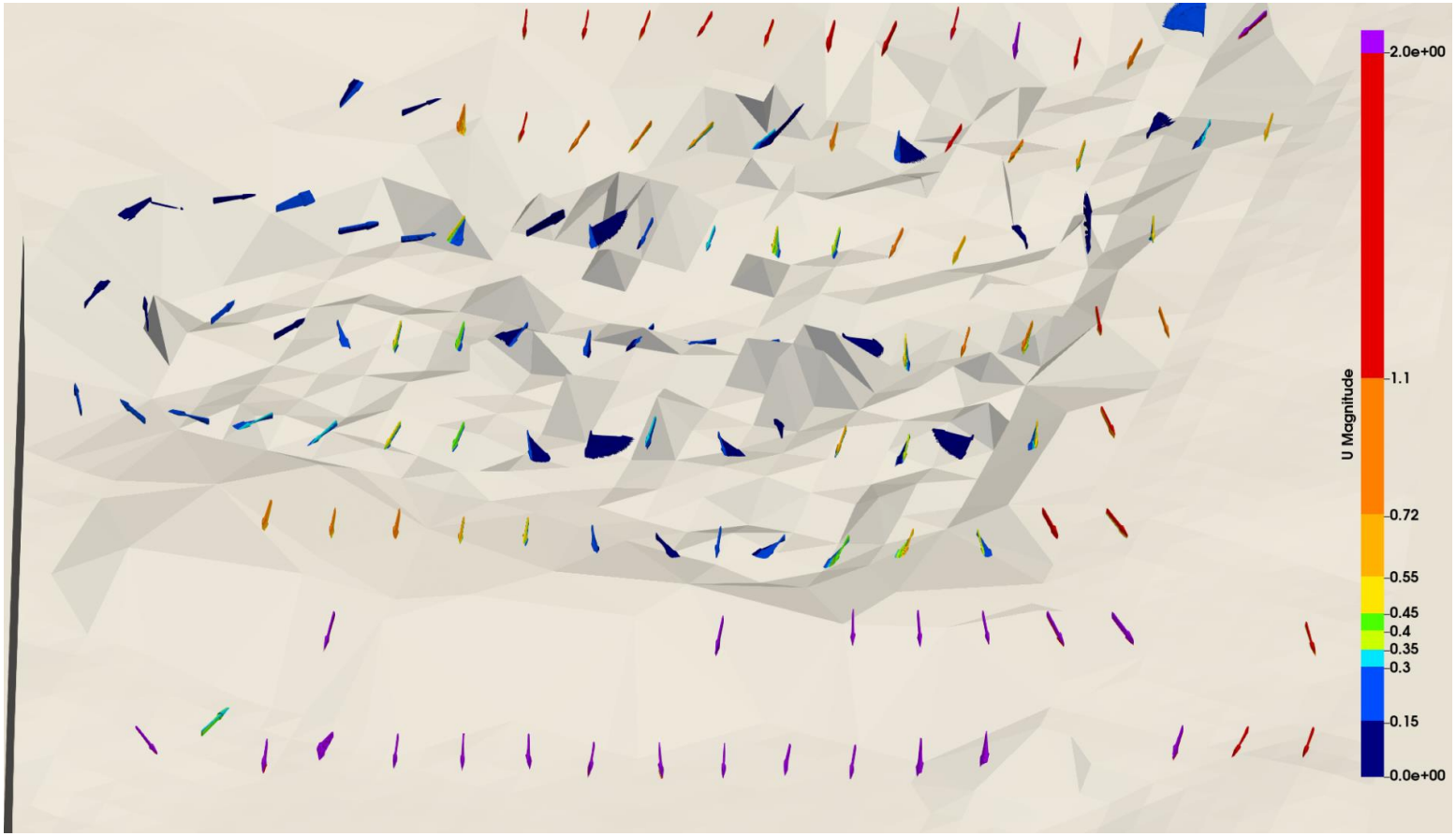


Figure S3-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

4. Model Results of Scenario S4 with 1720 cfs from the gates

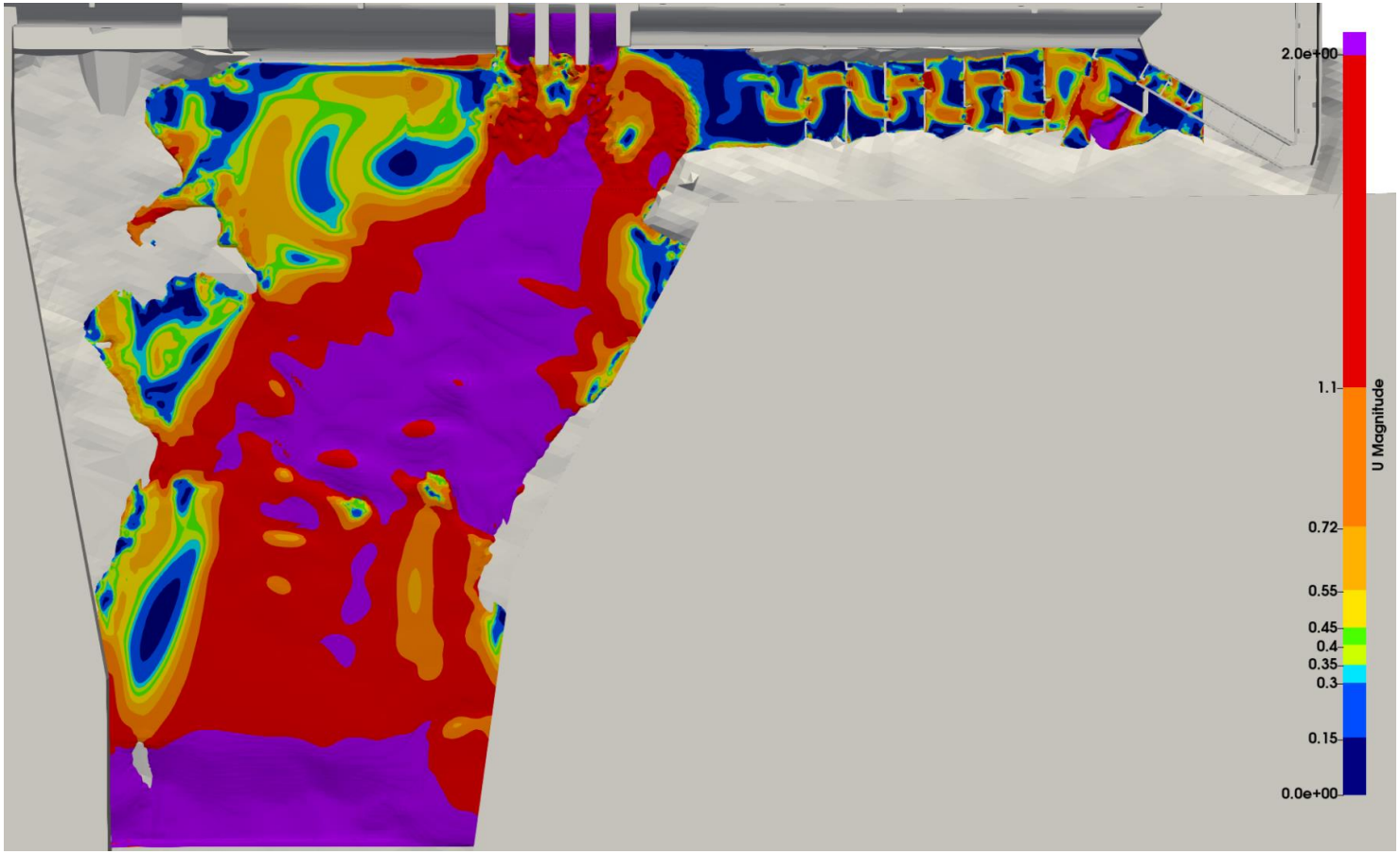


Figure S4-1: Plan view of the Water Surface Velocities

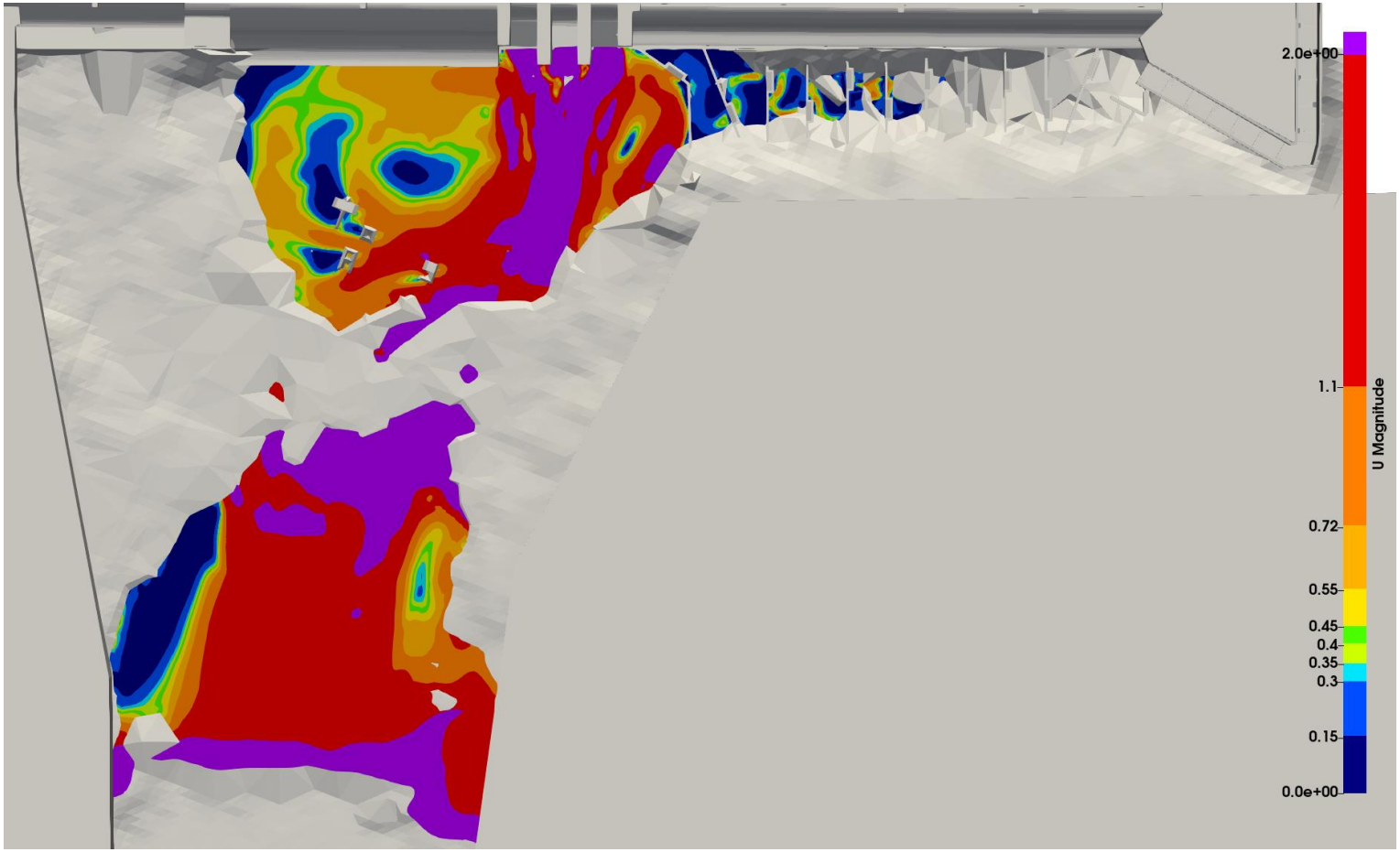


Figure S4-2: Plan view of the Mid-Surface Velocities

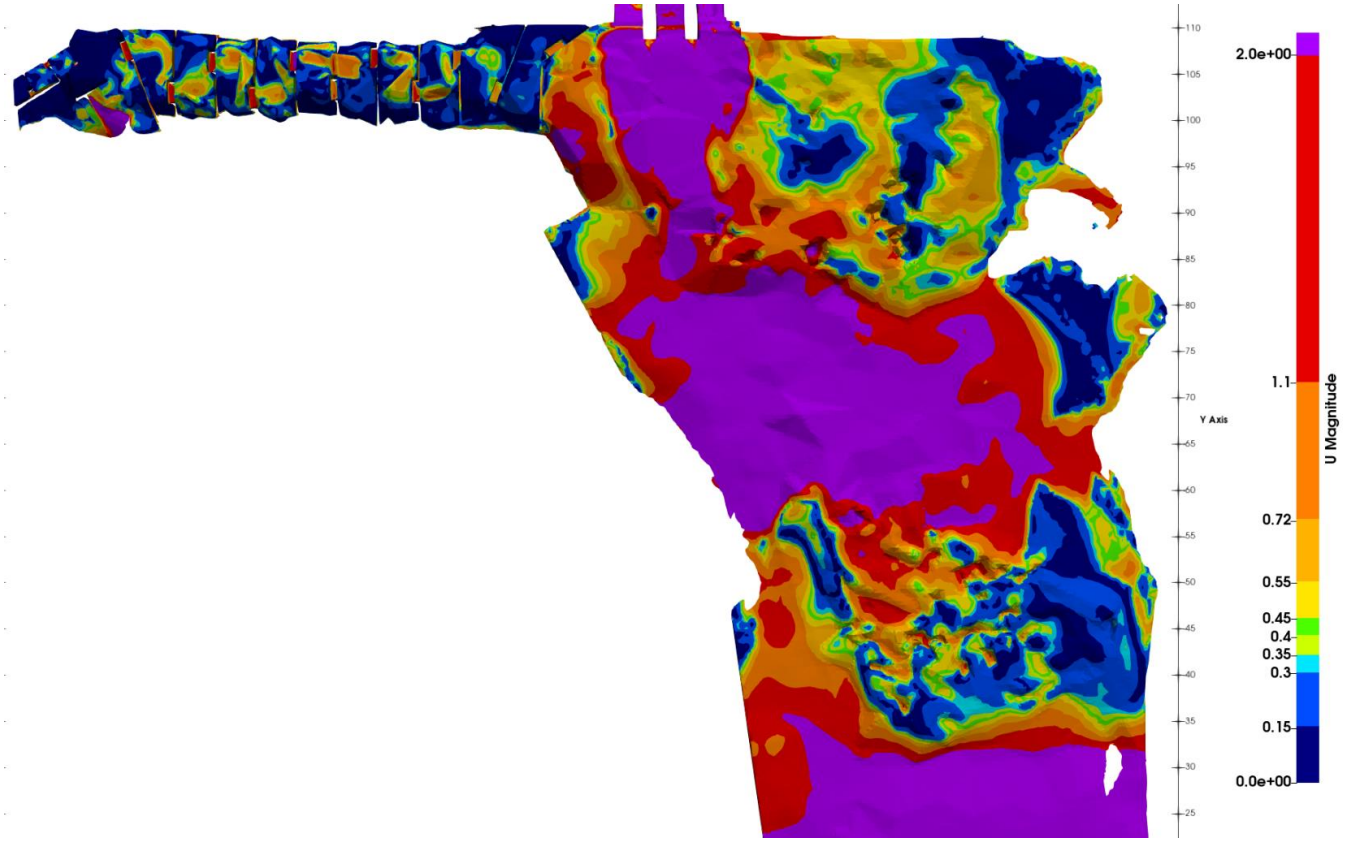


Figure S4-3: View of the Bottom Velocities

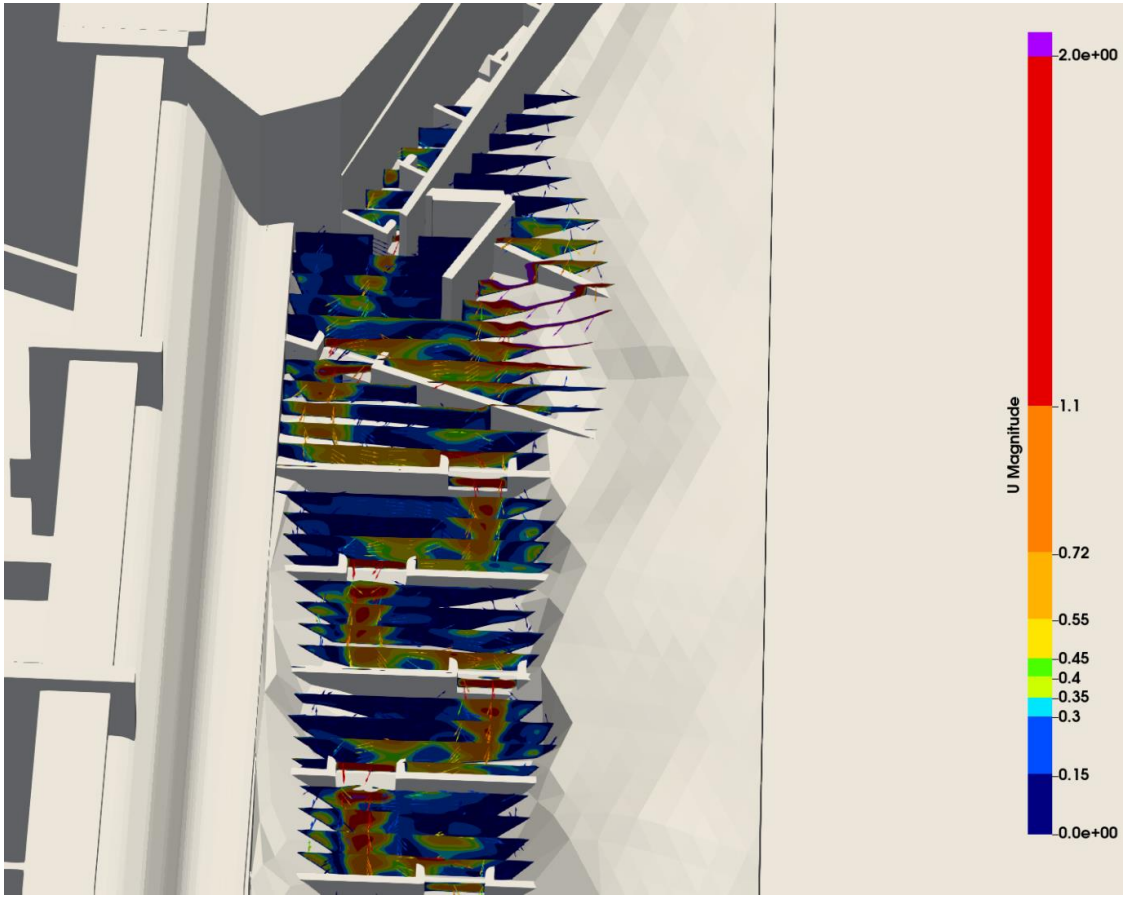


Figure S4-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

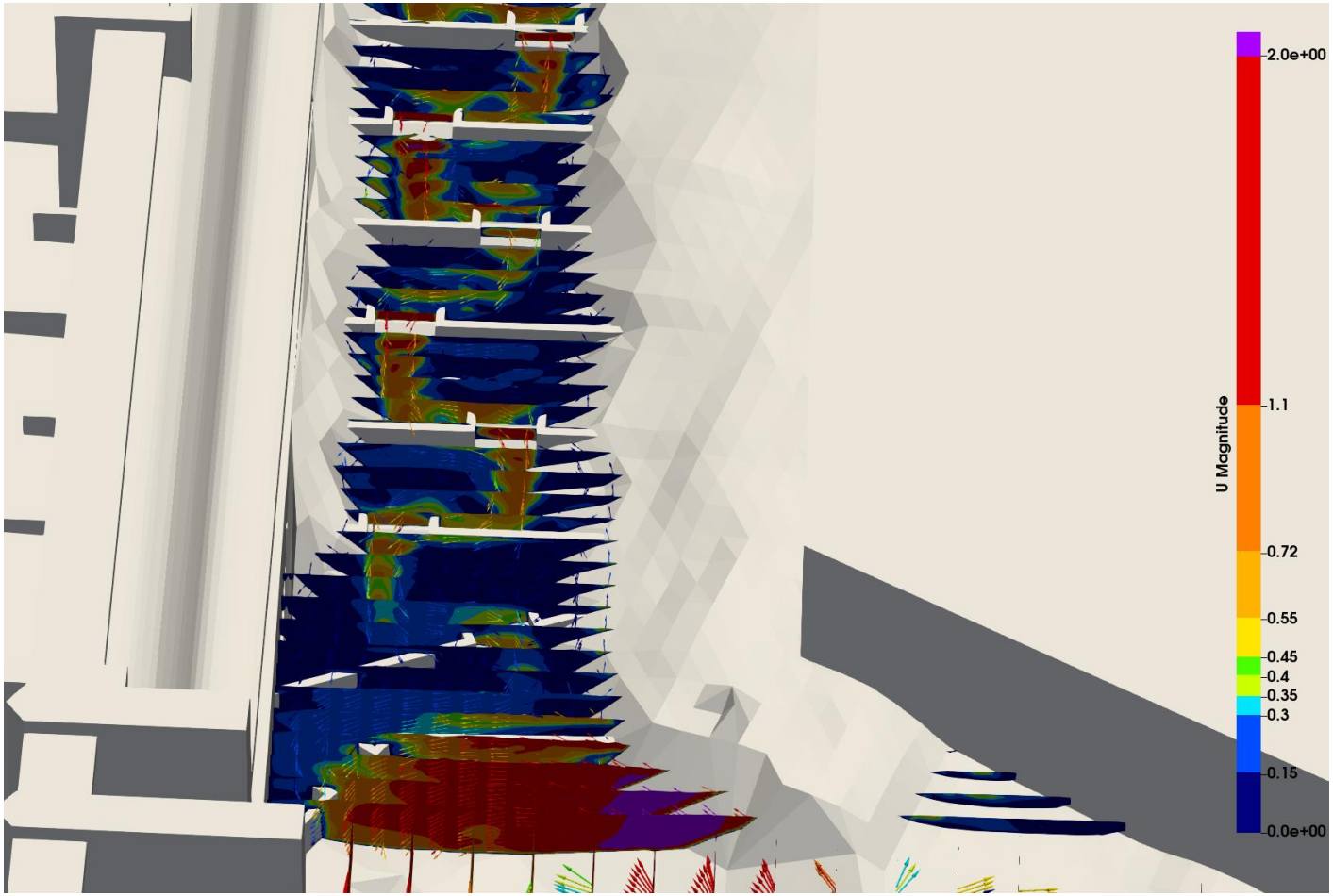


Figure S4-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

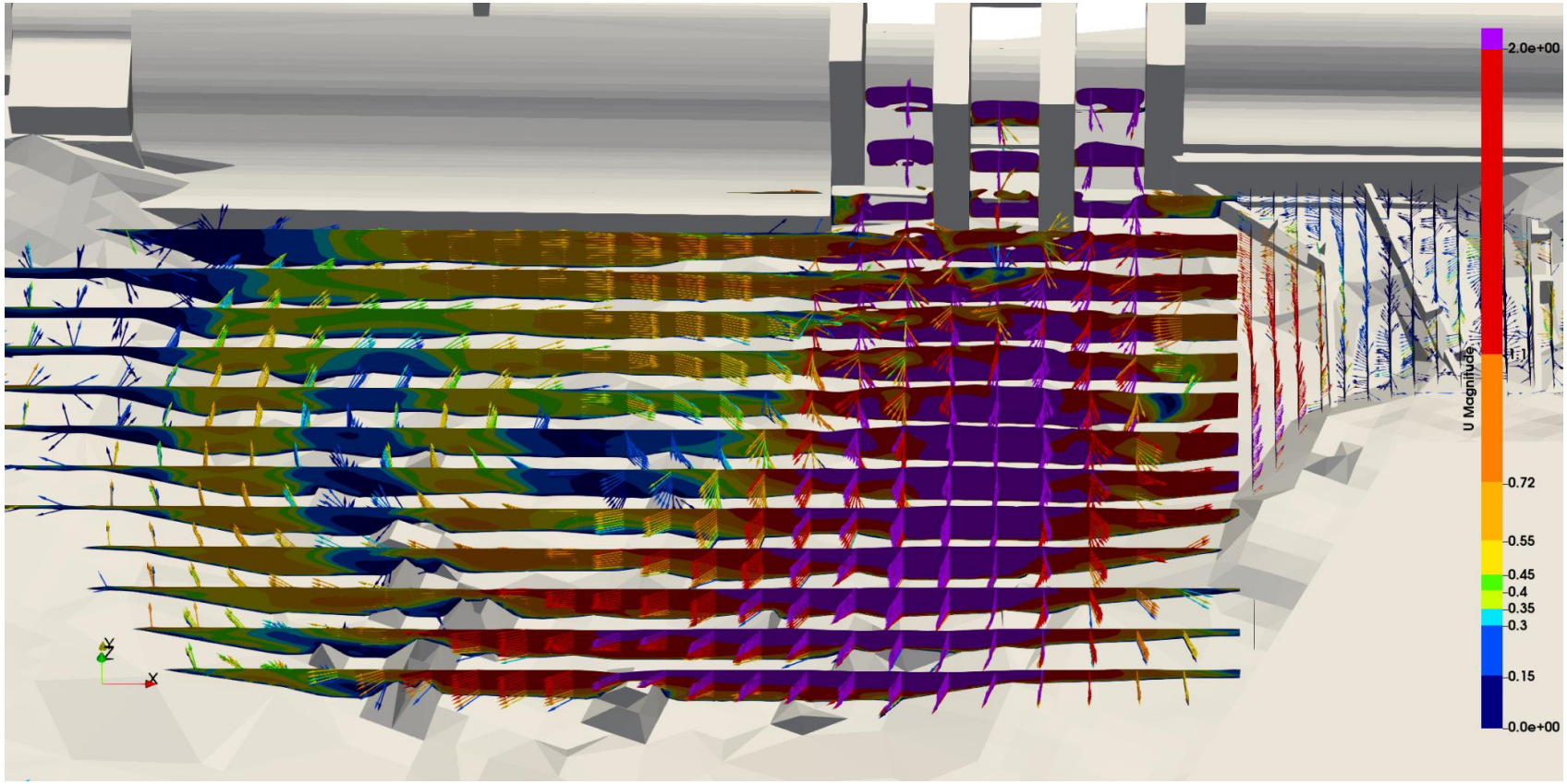


Figure S4-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

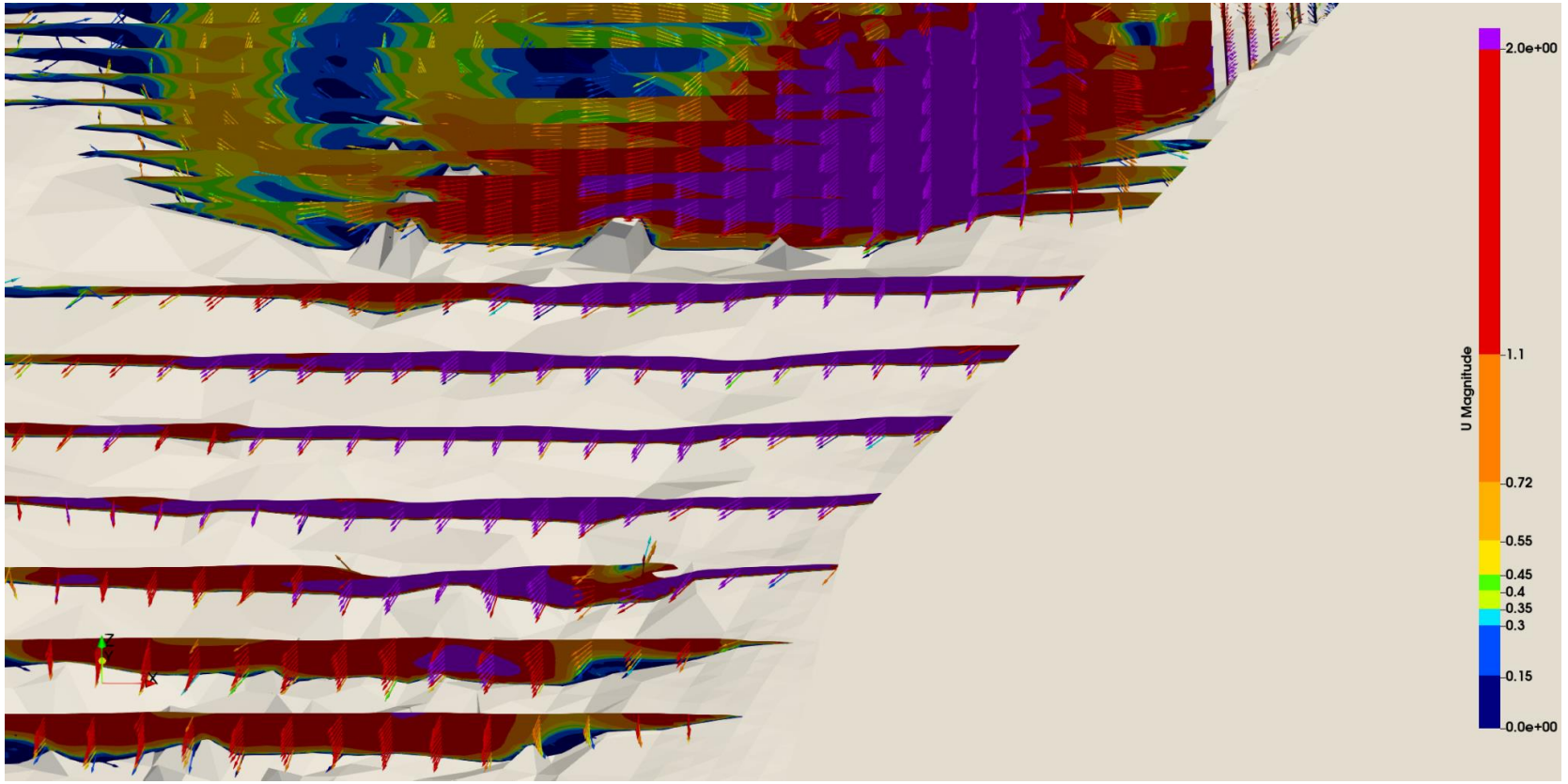


Figure S4-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

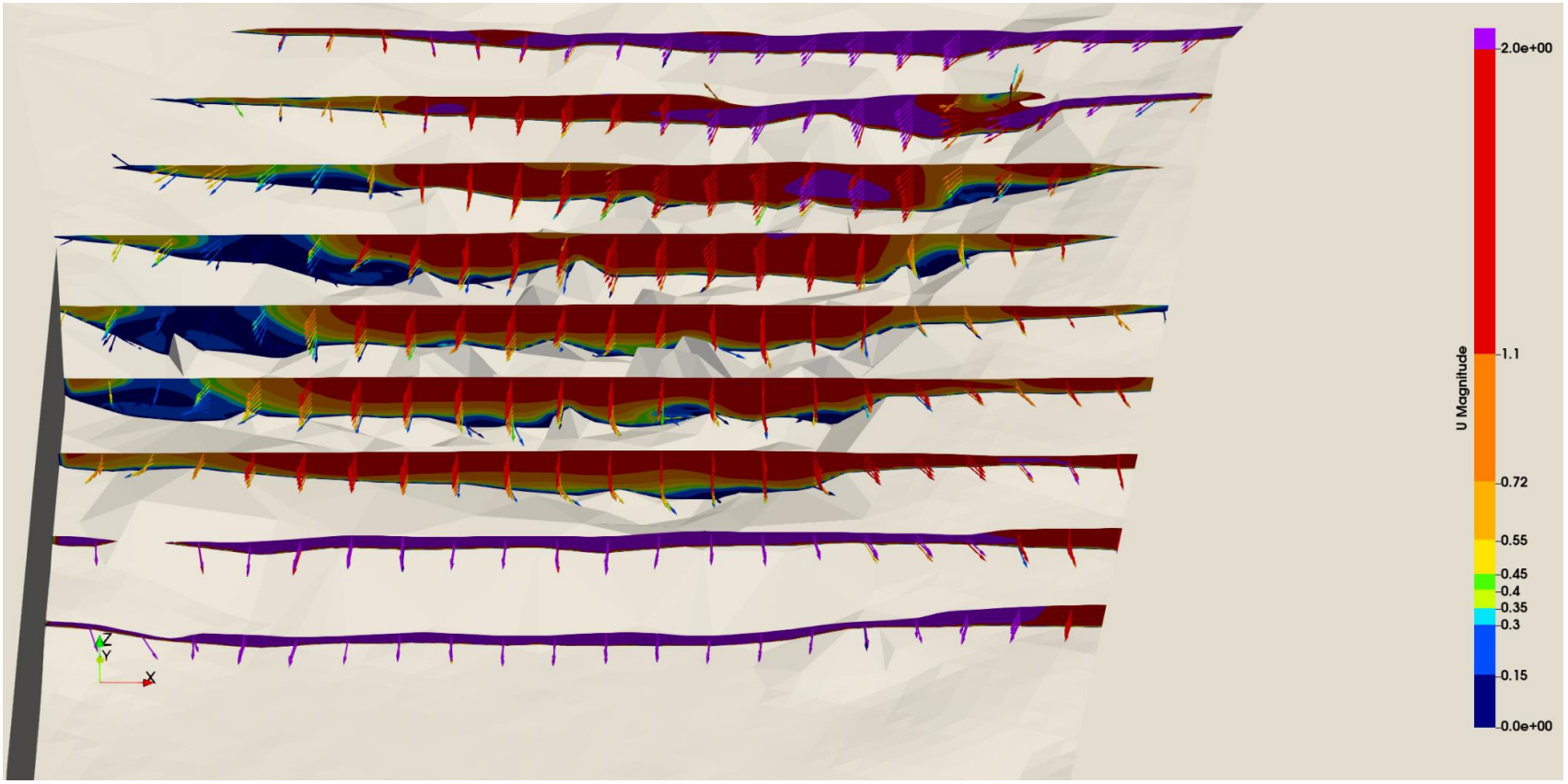


Figure S4-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

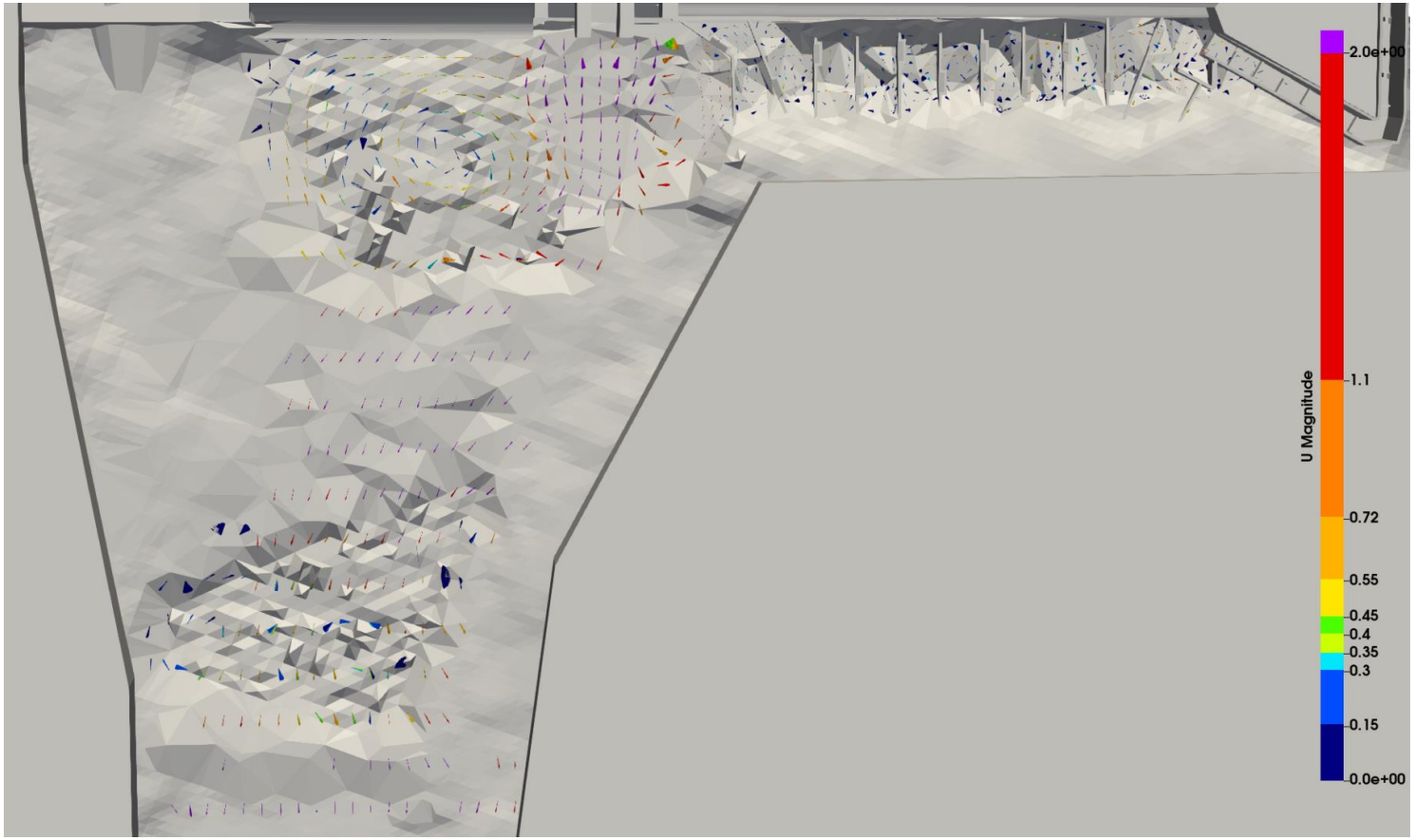


Figure S4-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

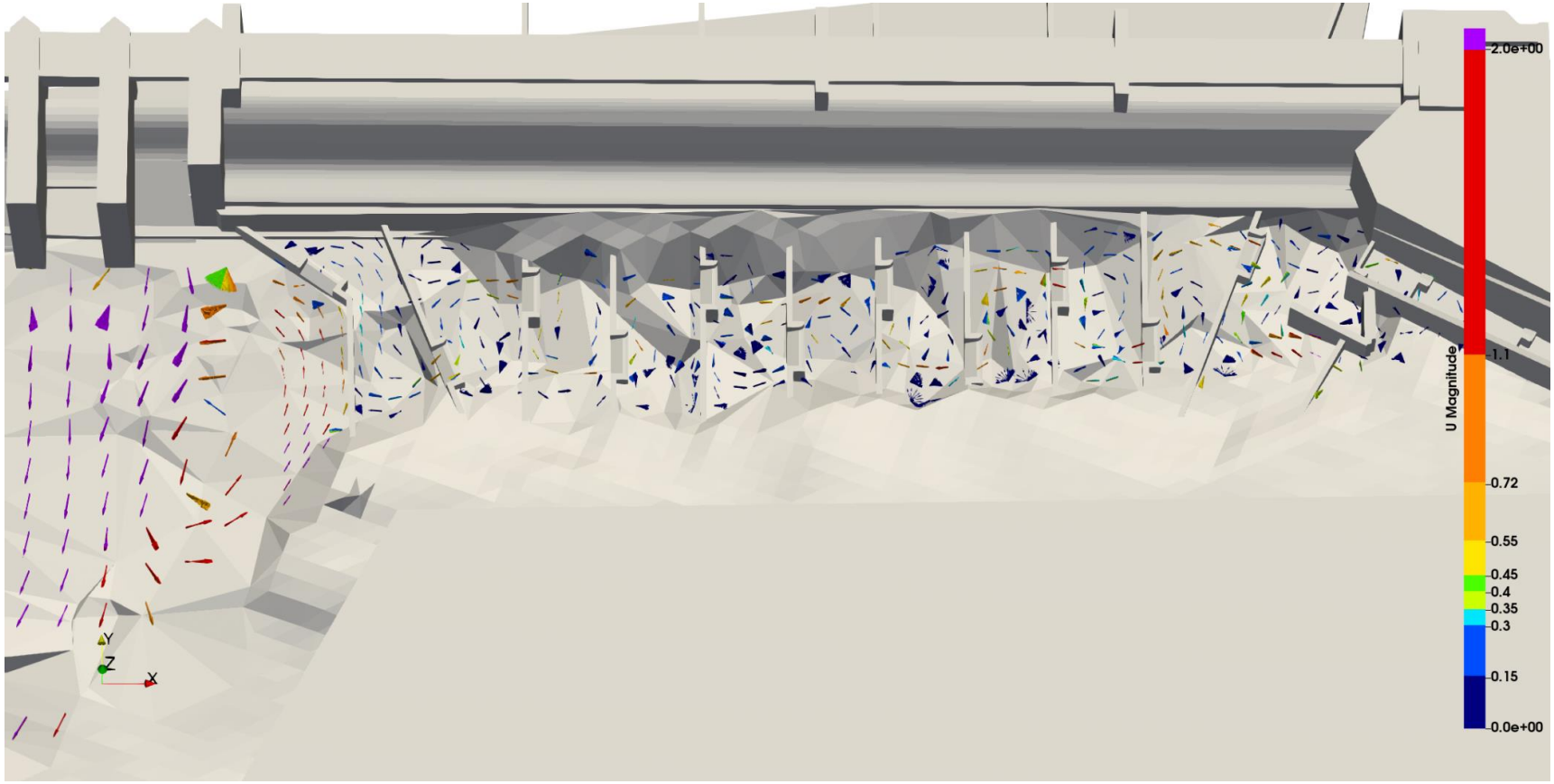


Figure S4-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

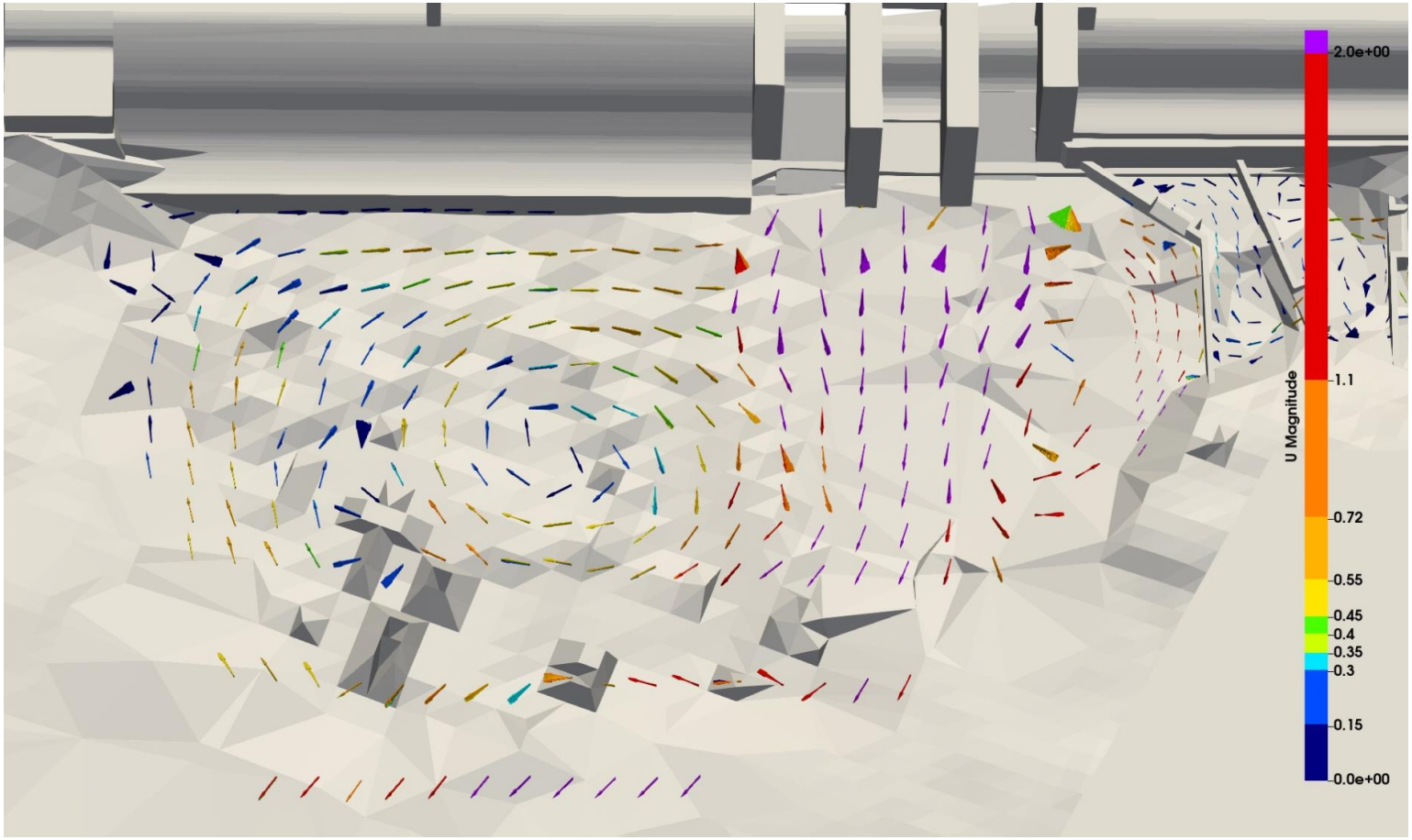


Figure S4-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

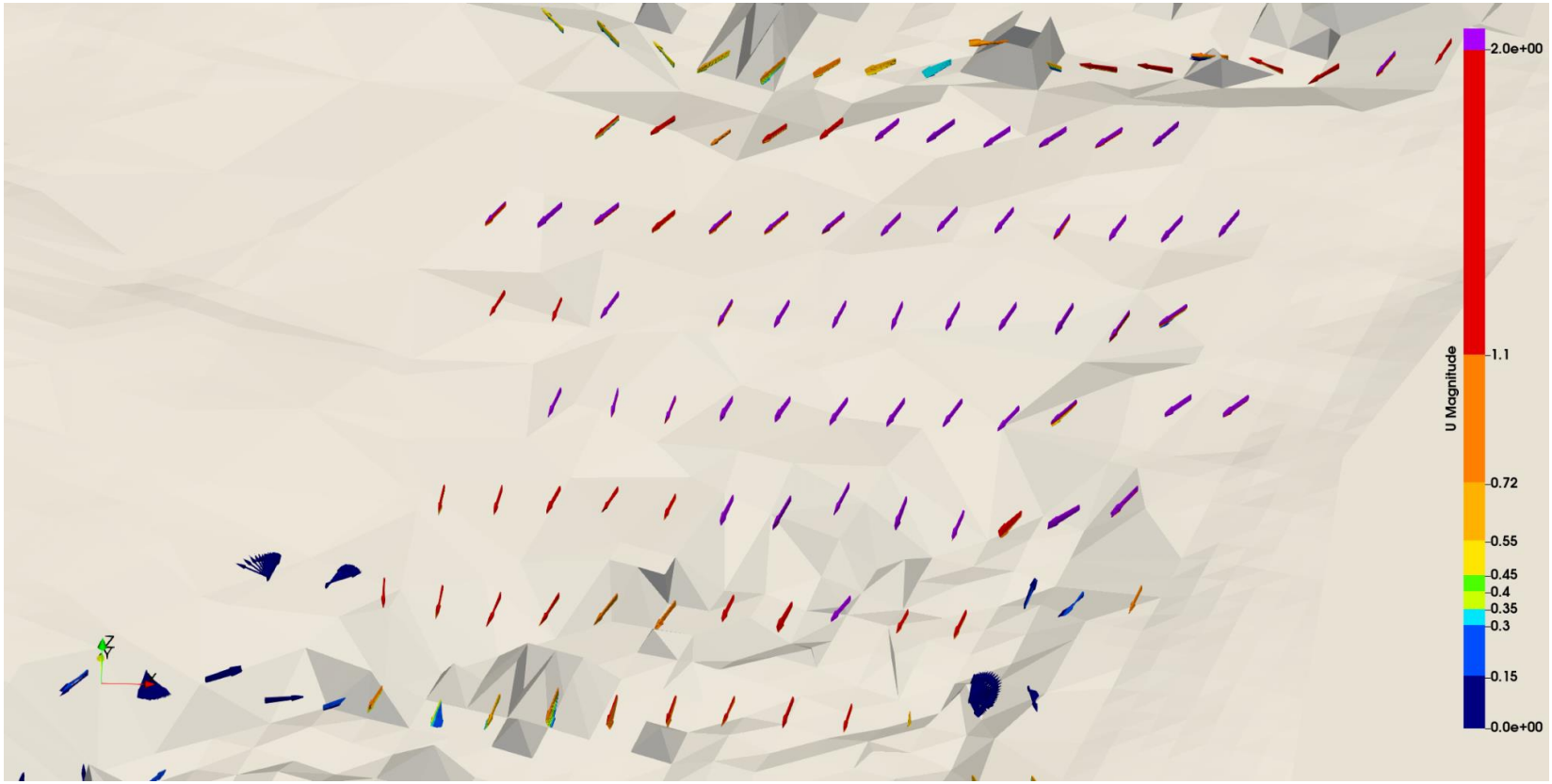


Figure S4-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

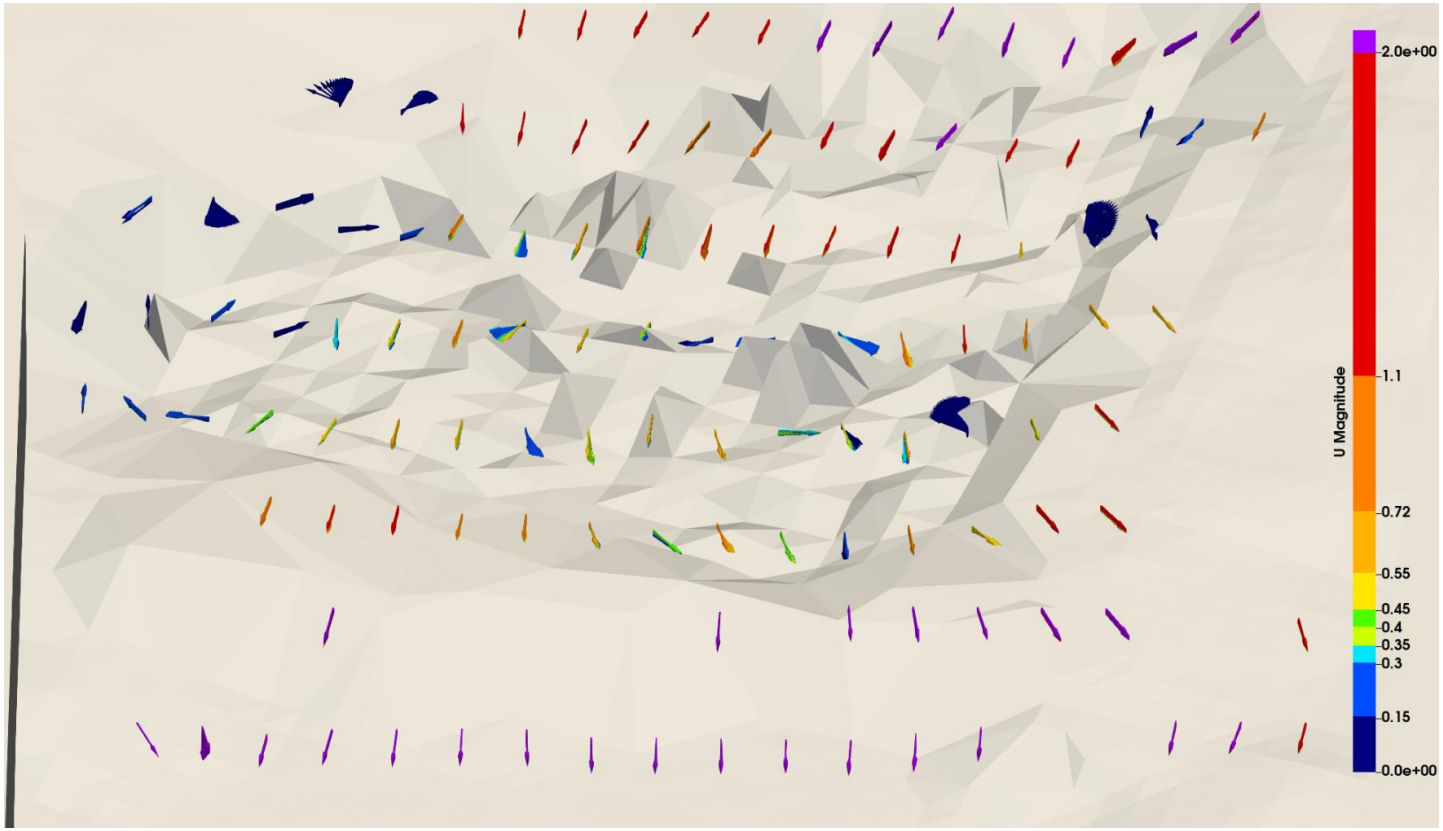


Figure S4-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

5. Model Results of Scenario S5 with 3051 cfs from the gates

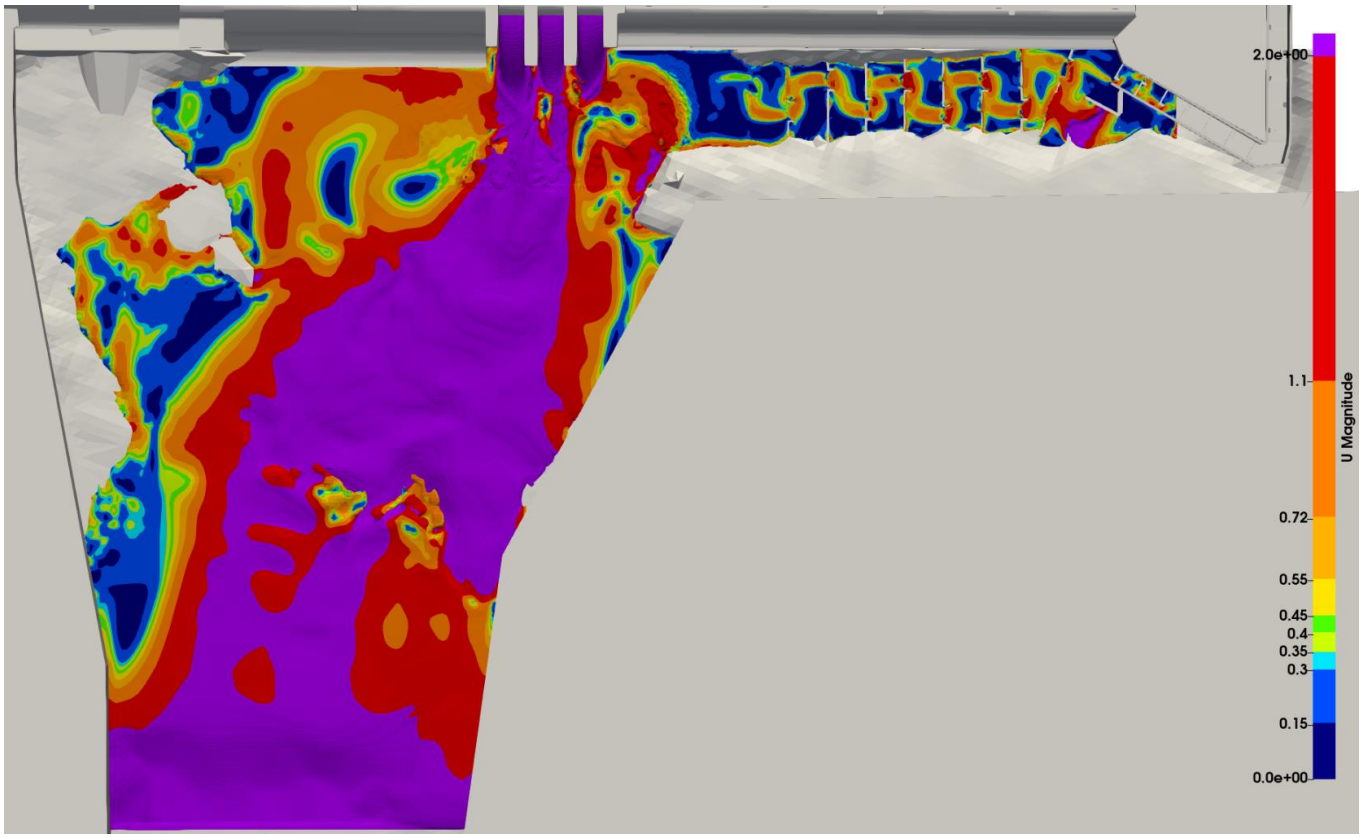


Figure S5-1: Plan view of the Water Surface Velocities

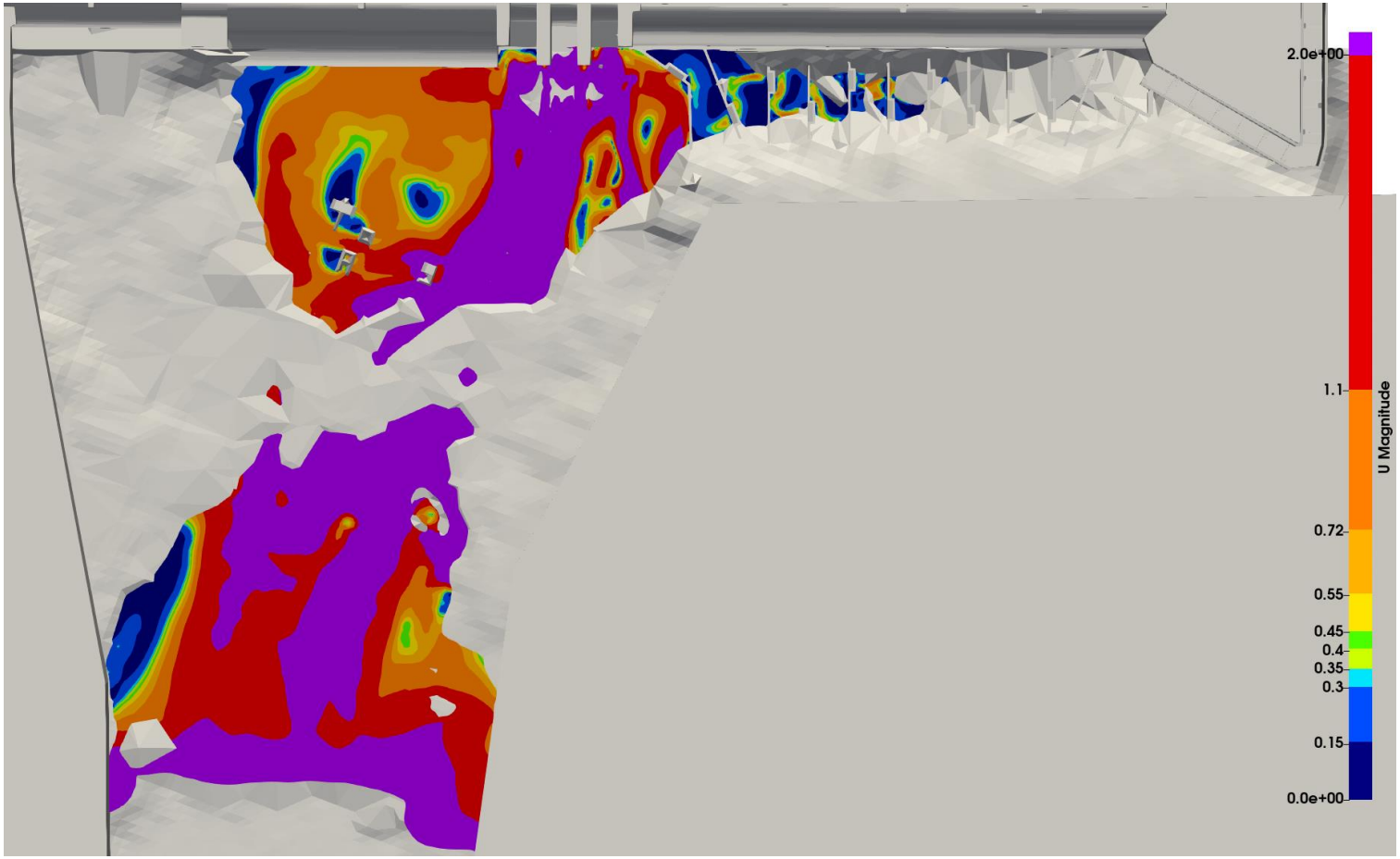


Figure S5-2: Plan view of the Mid-Surface Velocities

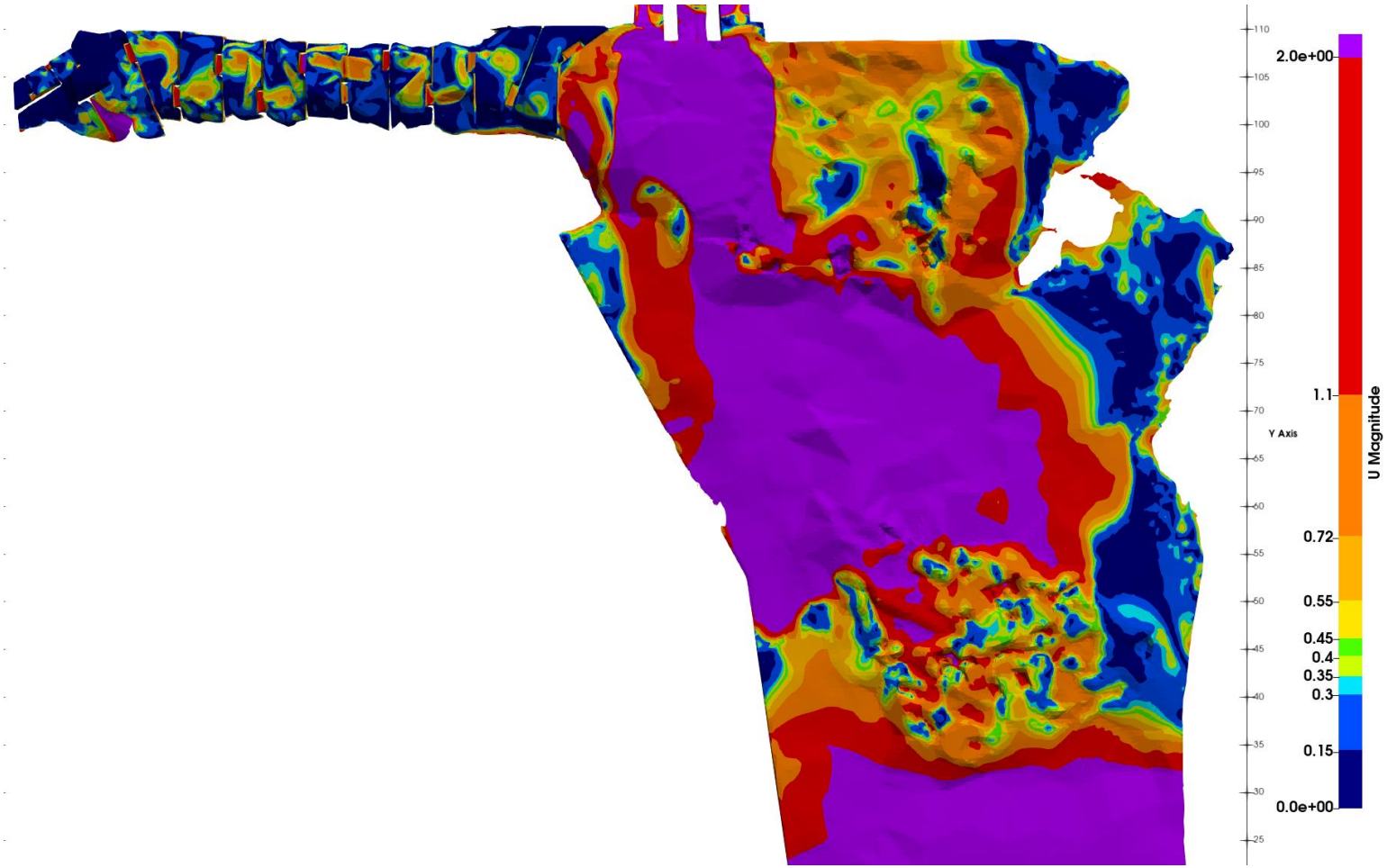


Figure S5-3: View of the Bottom Velocities

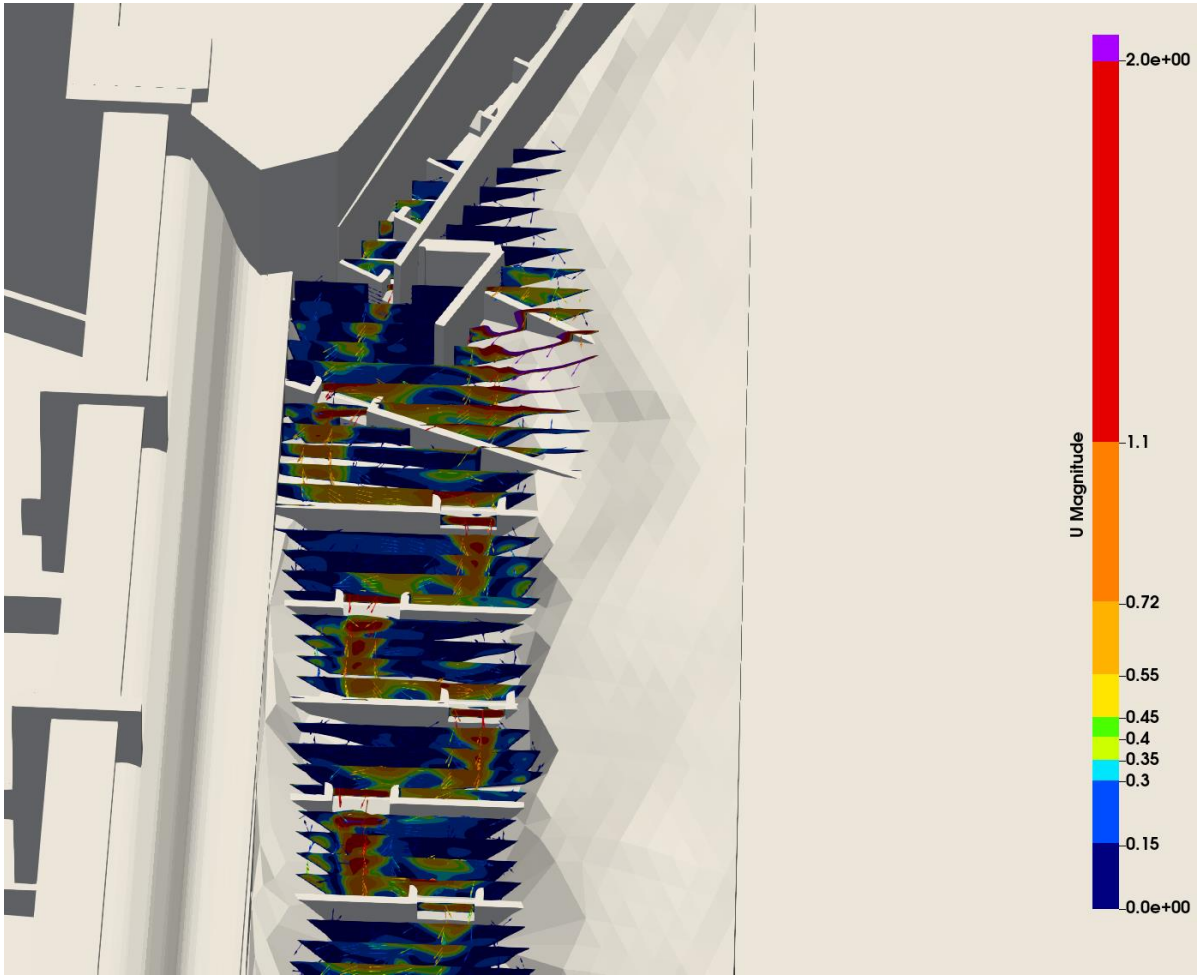


Figure S5-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

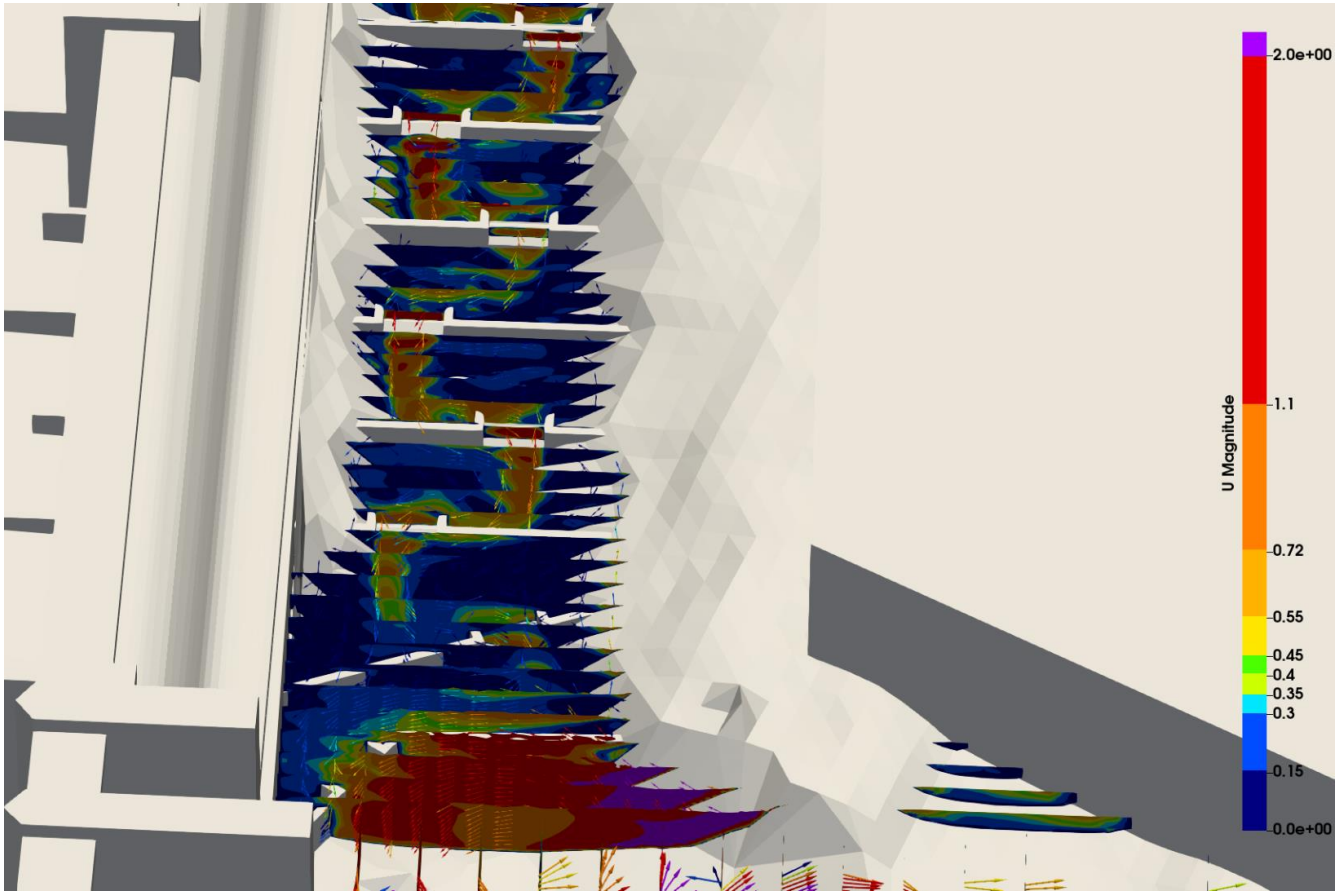


Figure S5-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

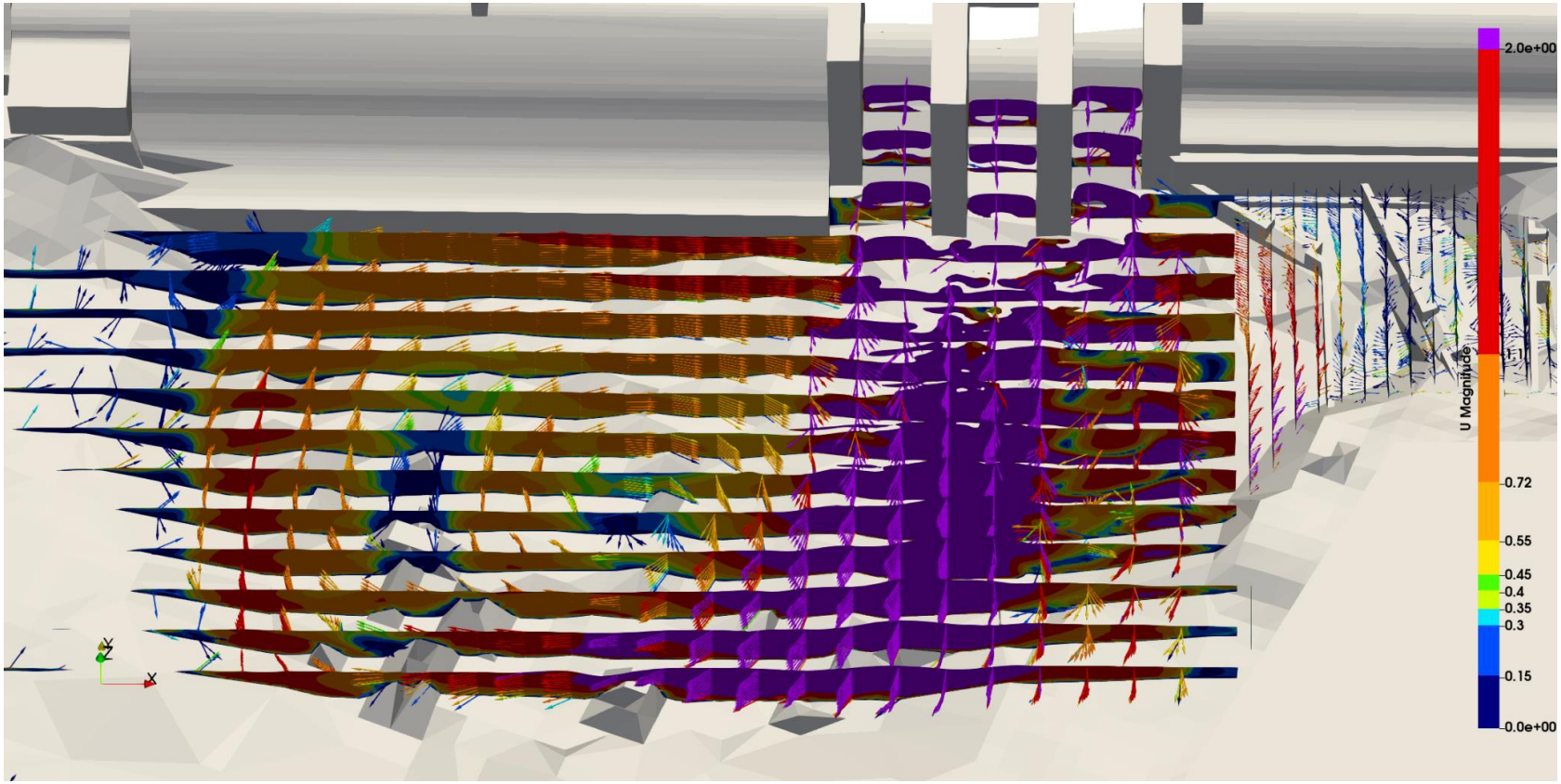


Figure S5-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

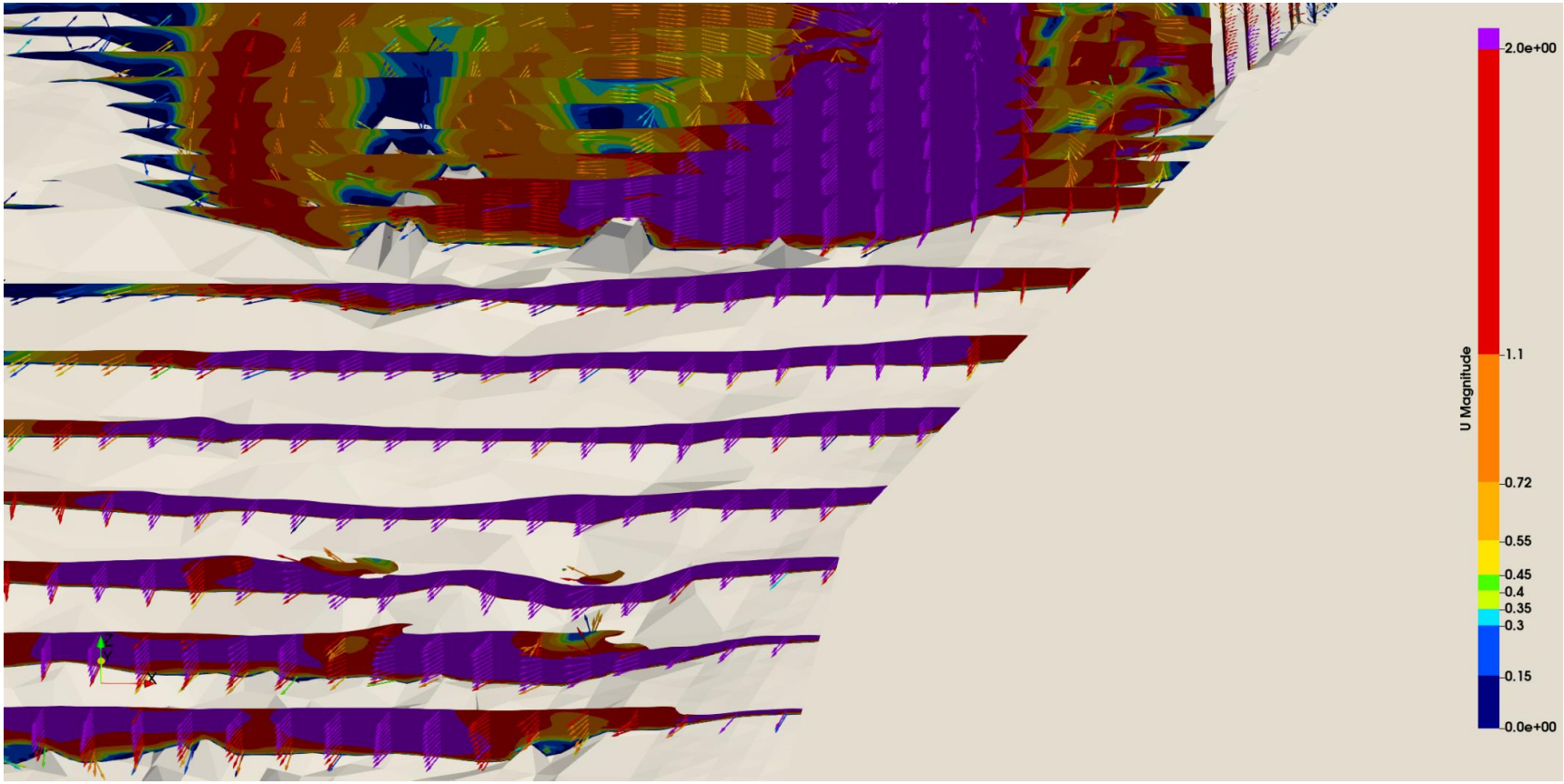


Figure S5-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

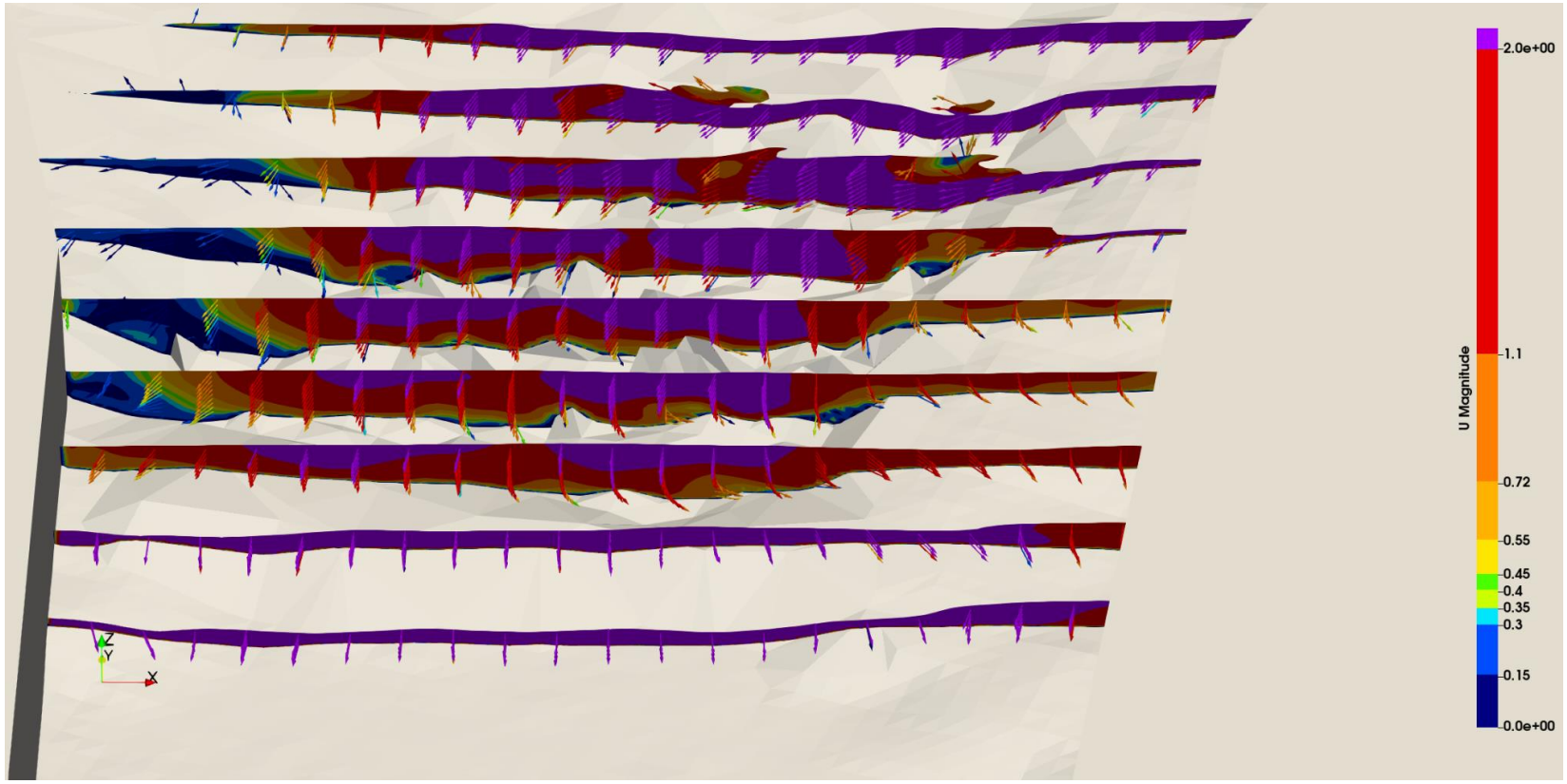


Figure S5-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

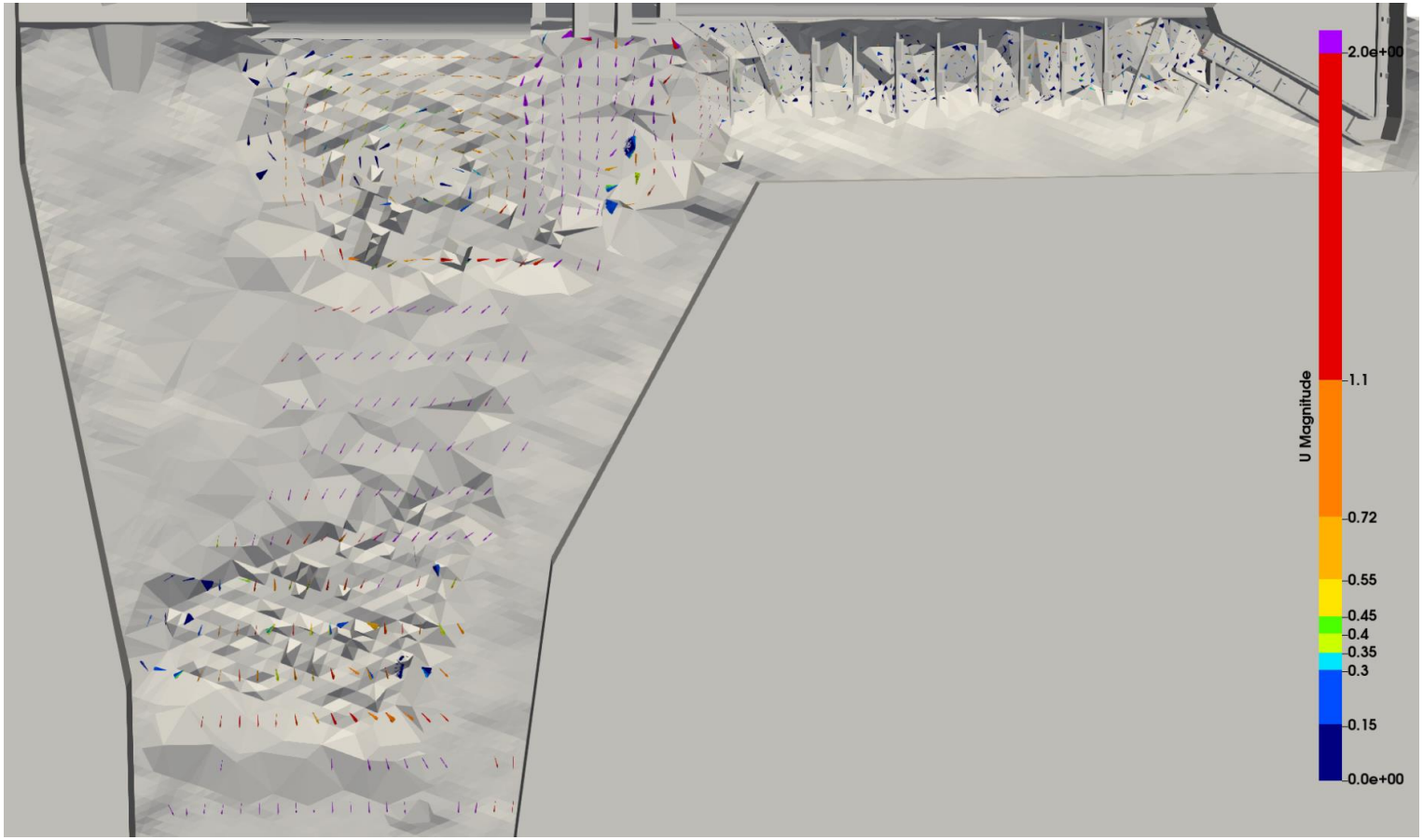


Figure S5-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

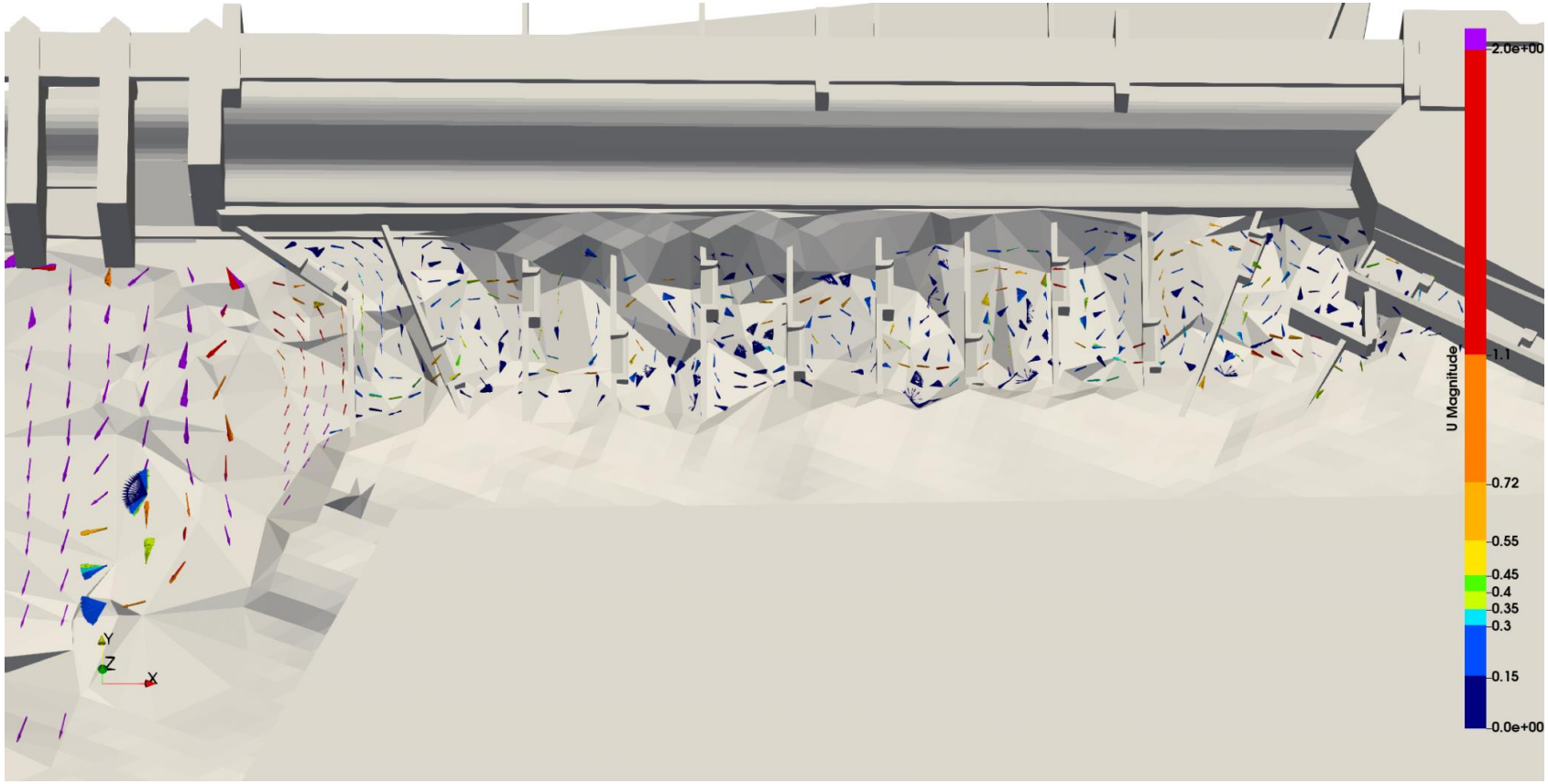


Figure S5-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

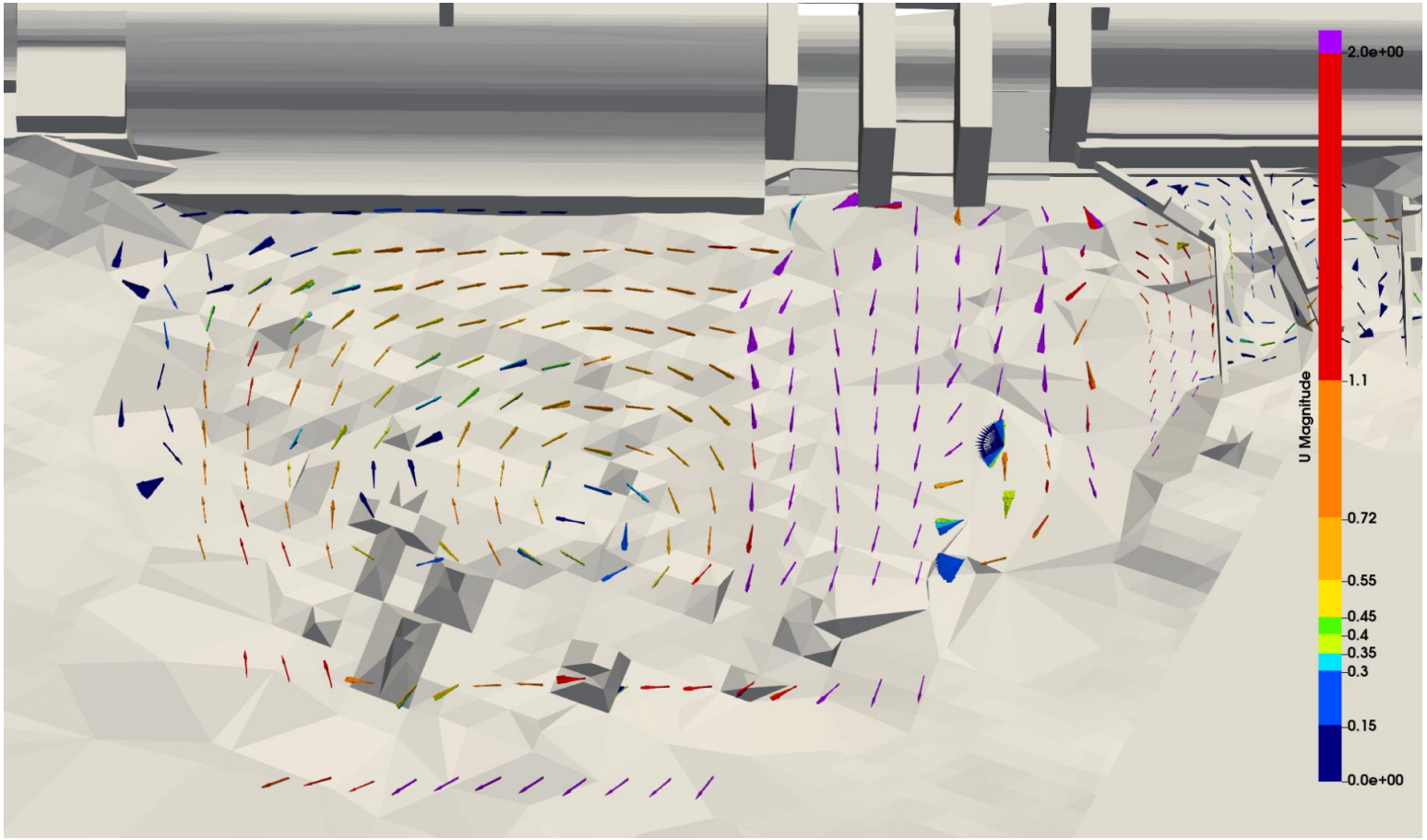


Figure S5-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

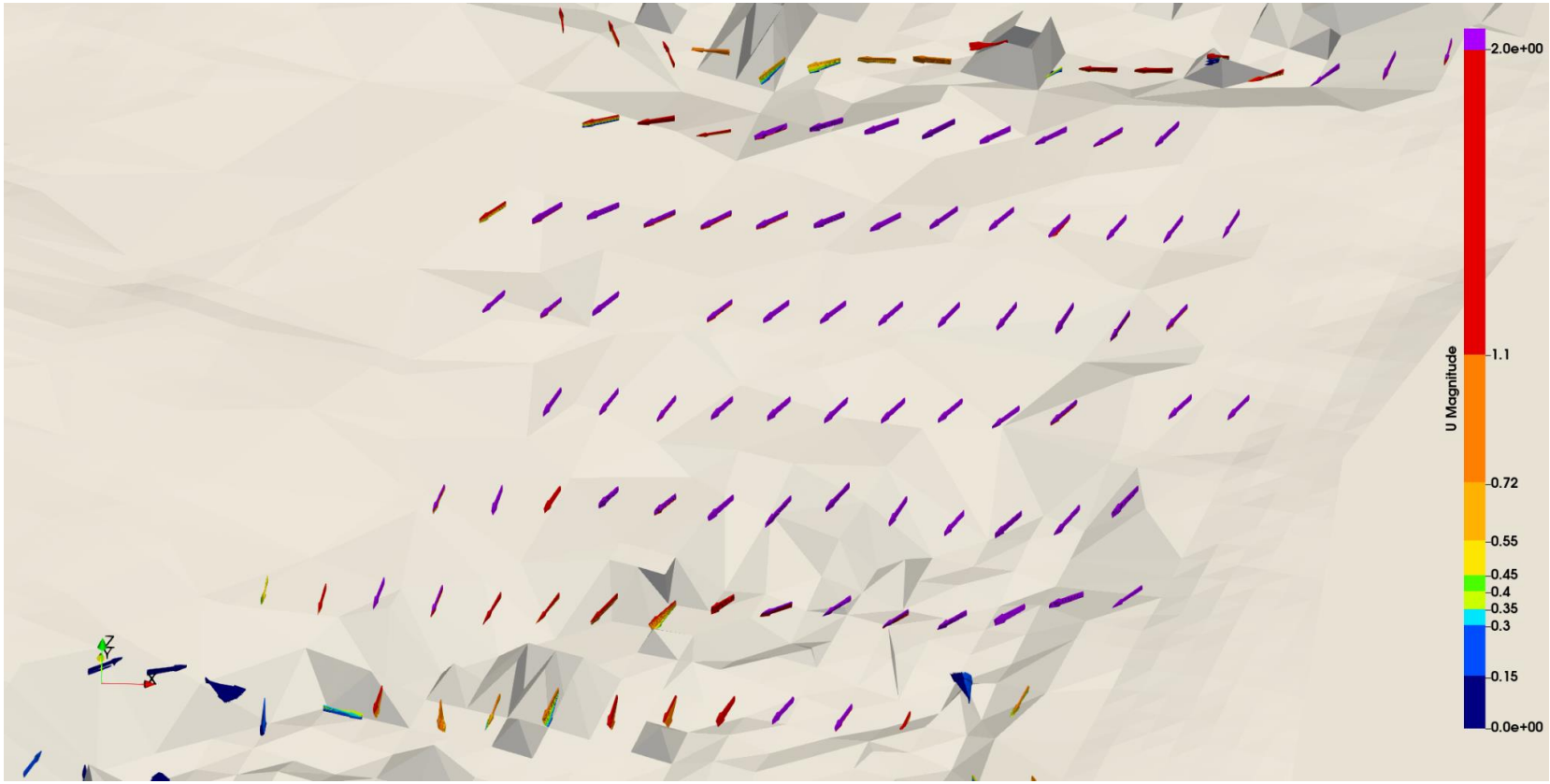


Figure S5-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

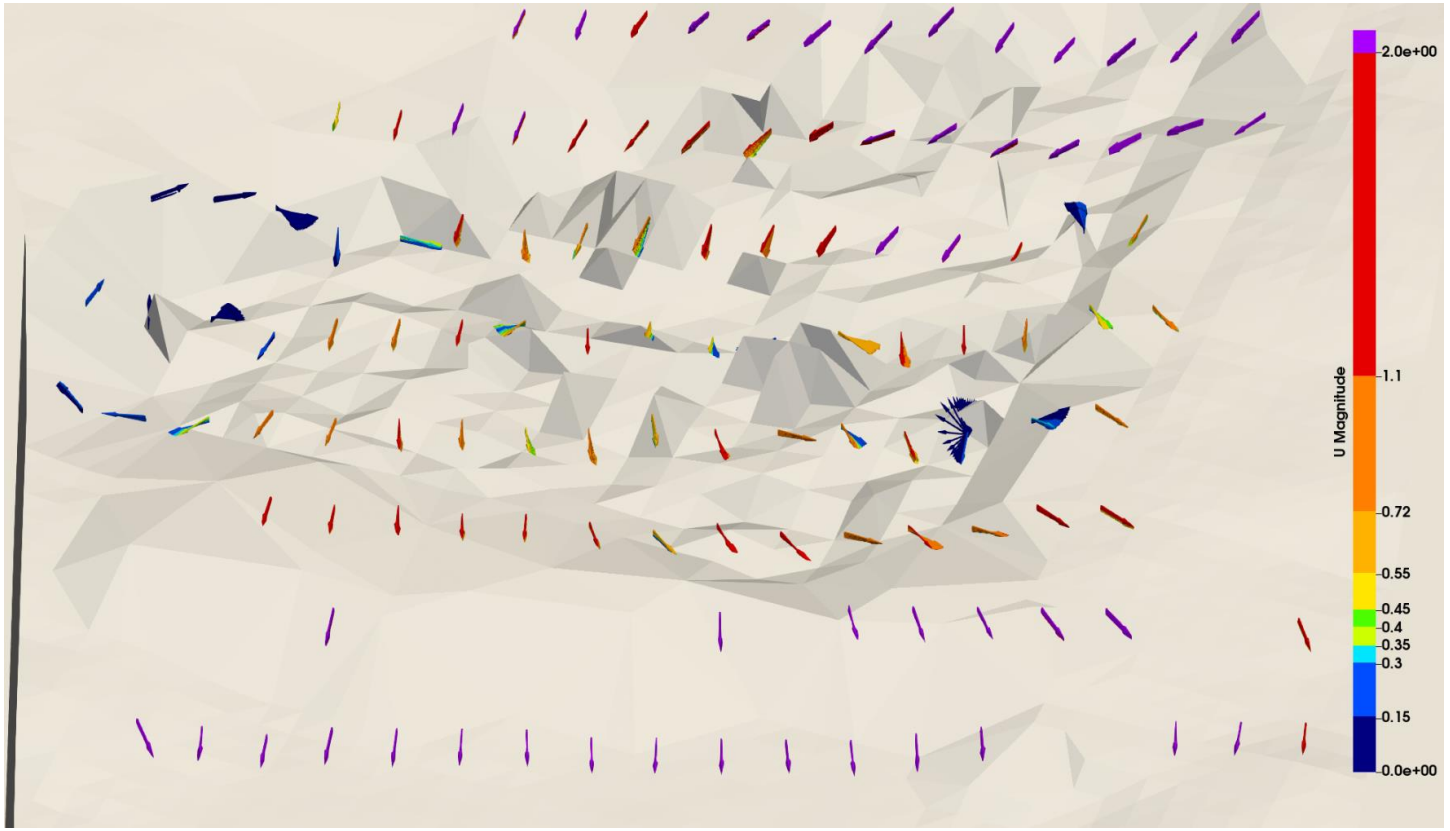


Figure S5-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

6. Model Results of Scenario S6 with 4308 cfs from the gates

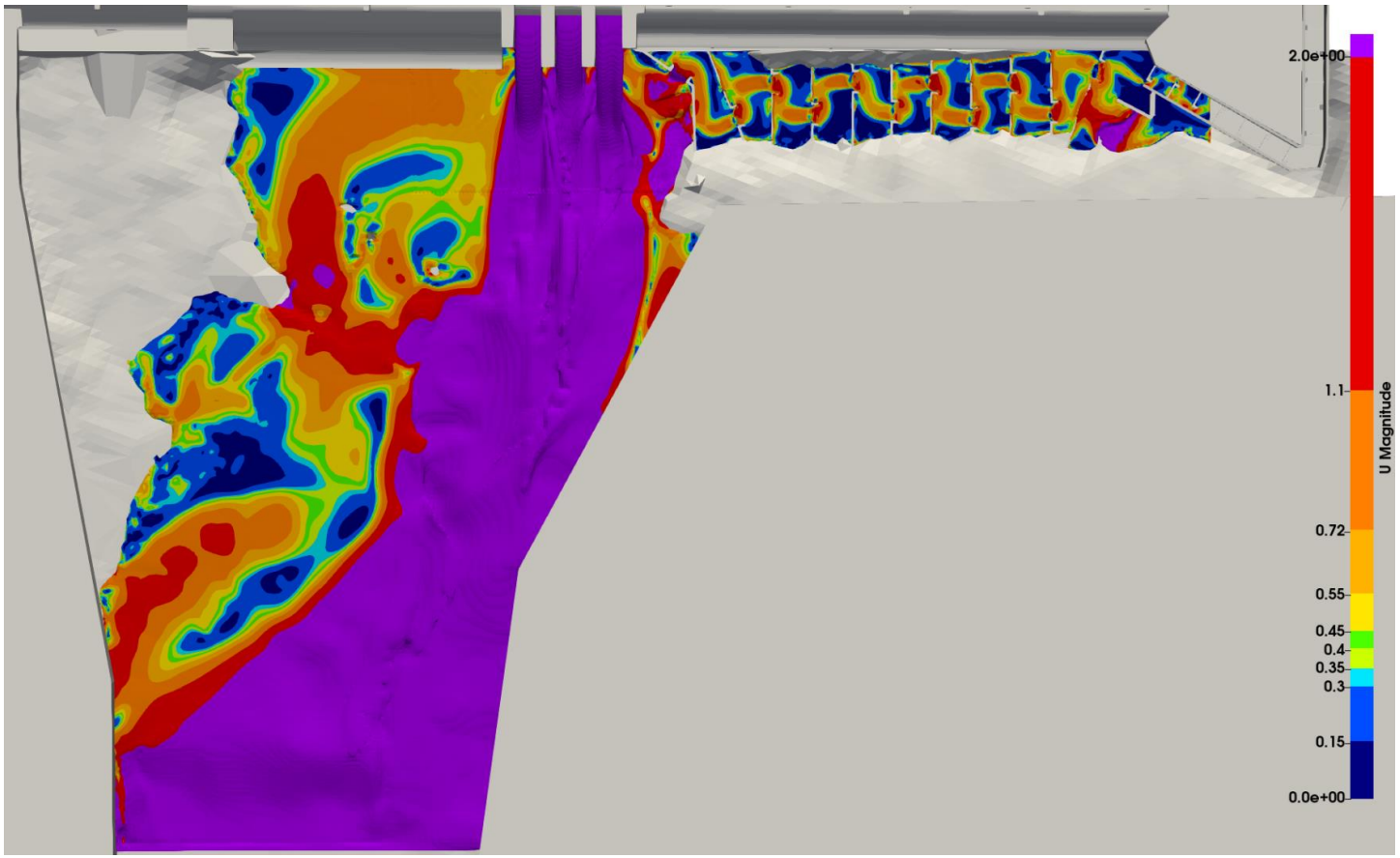


Figure S6-1: Plan view of the Water Surface Velocities

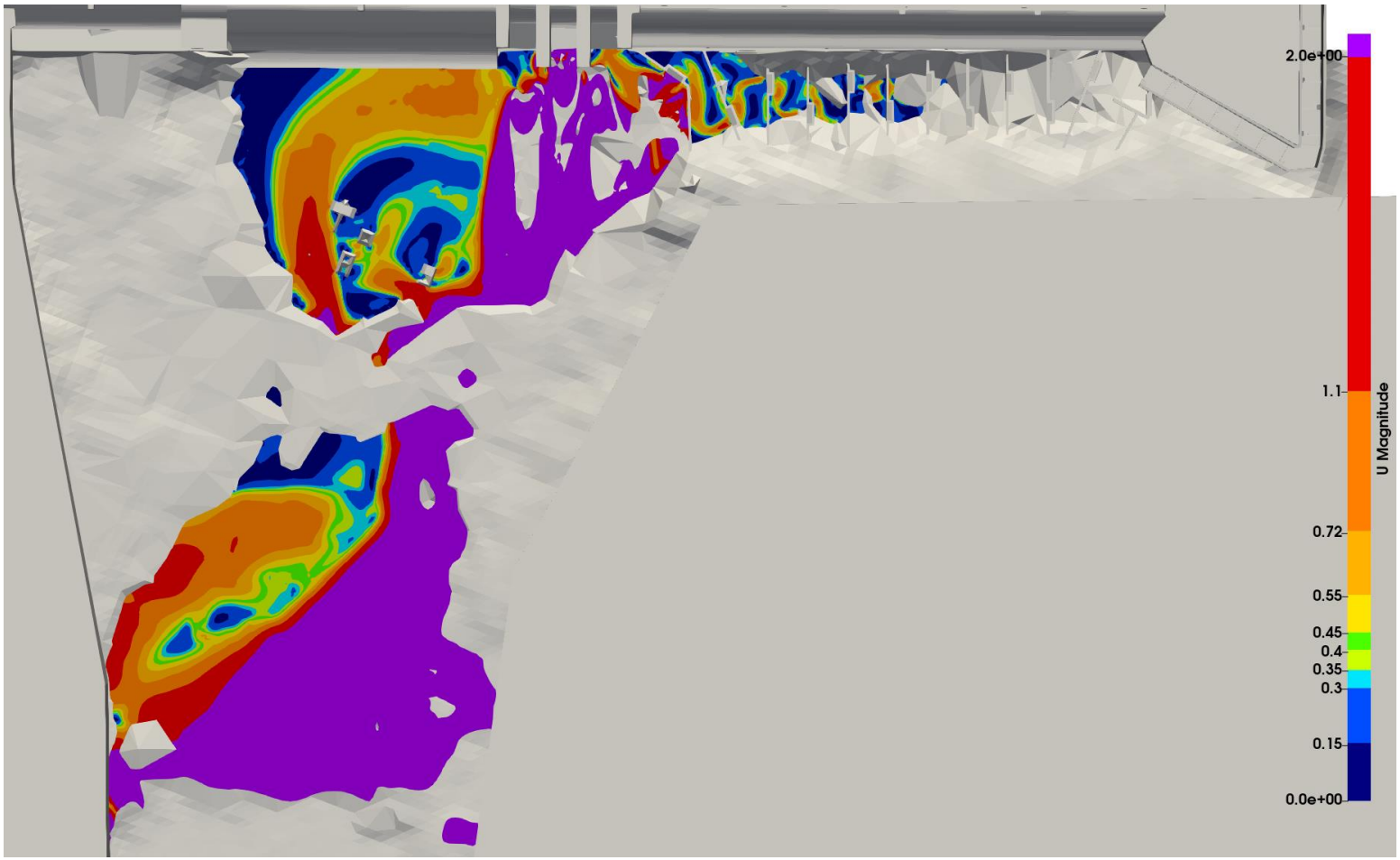


Figure S6-2: Plan view of the Mid-Surface Velocities

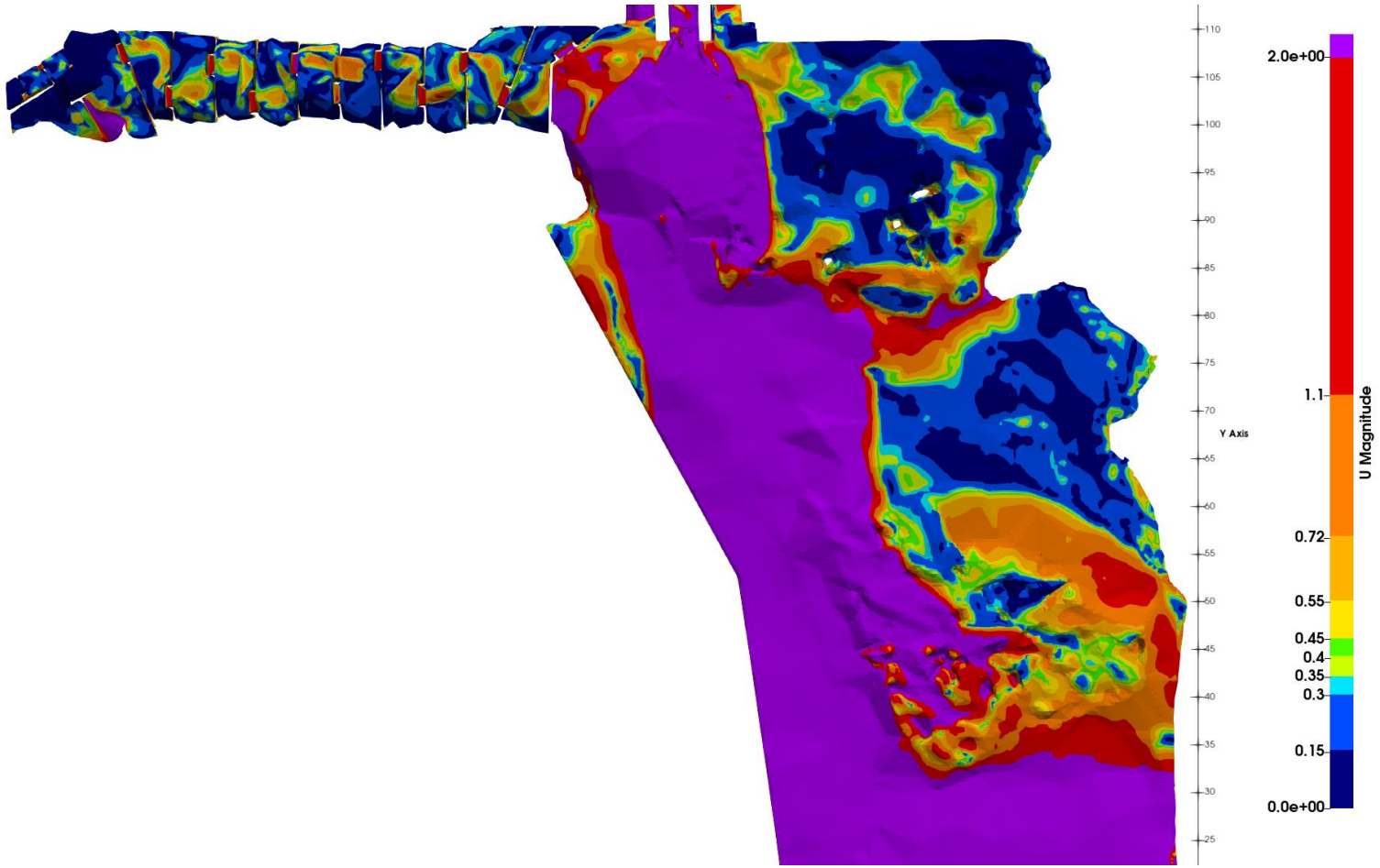


Figure S6-3: View of the Bottom Velocities

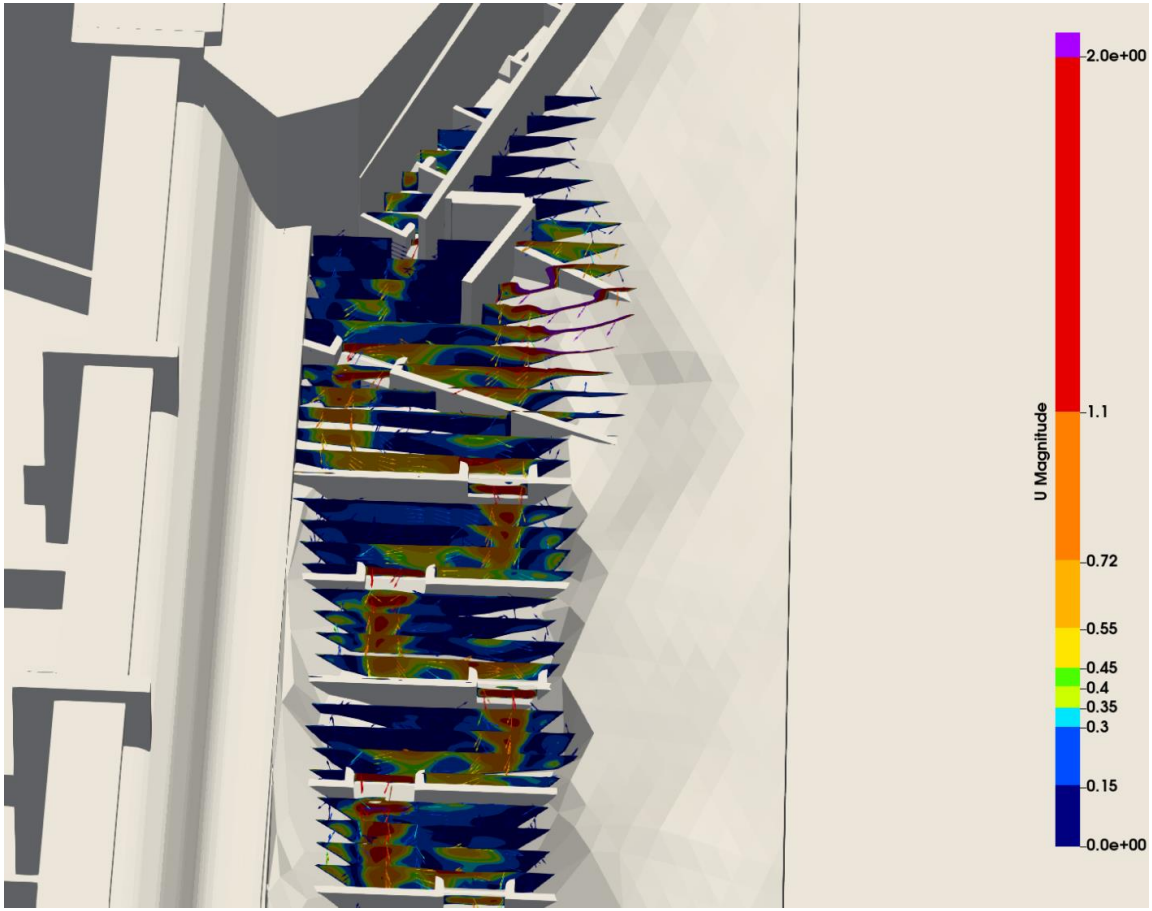


Figure S6-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

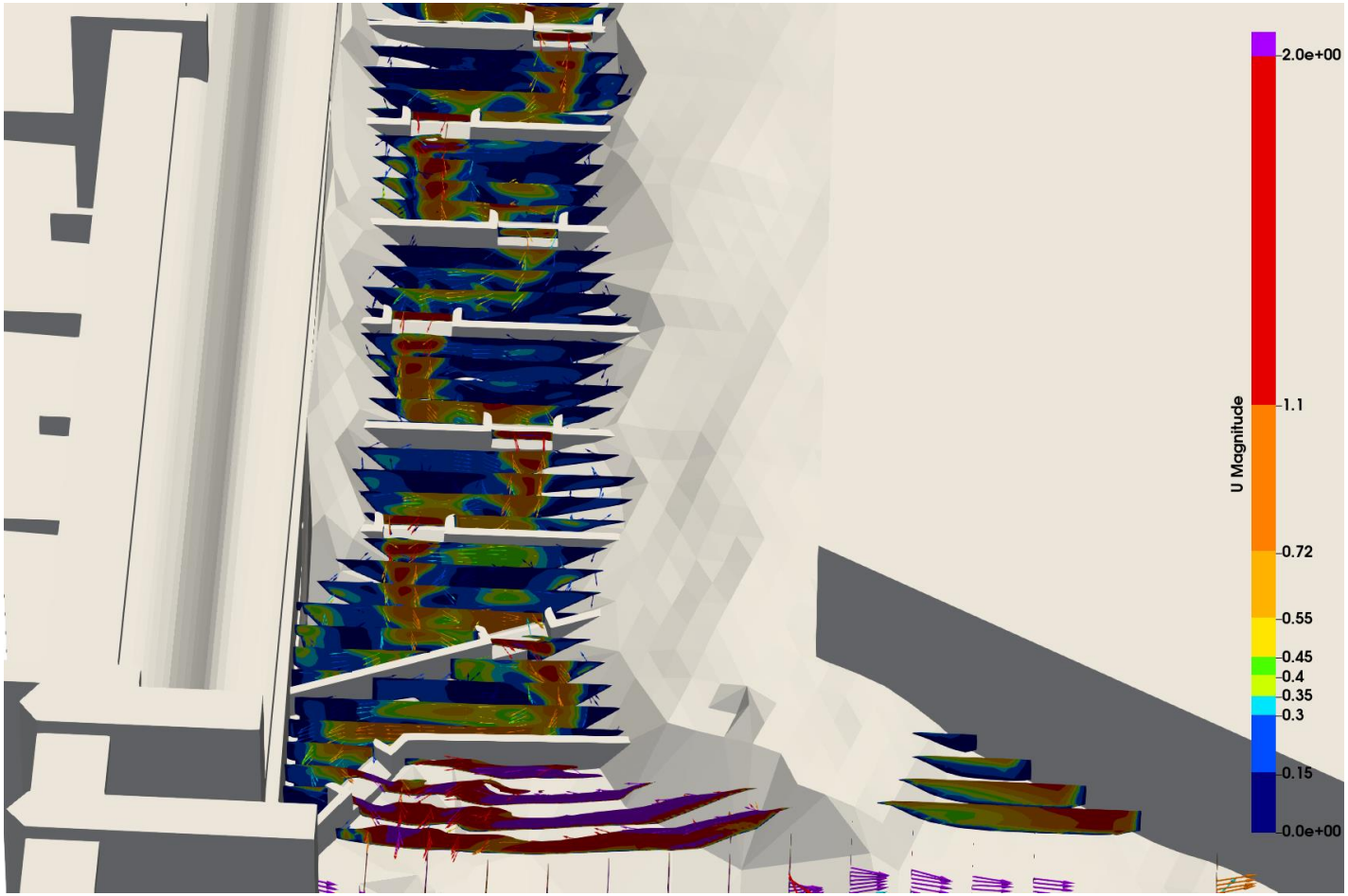


Figure S6-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

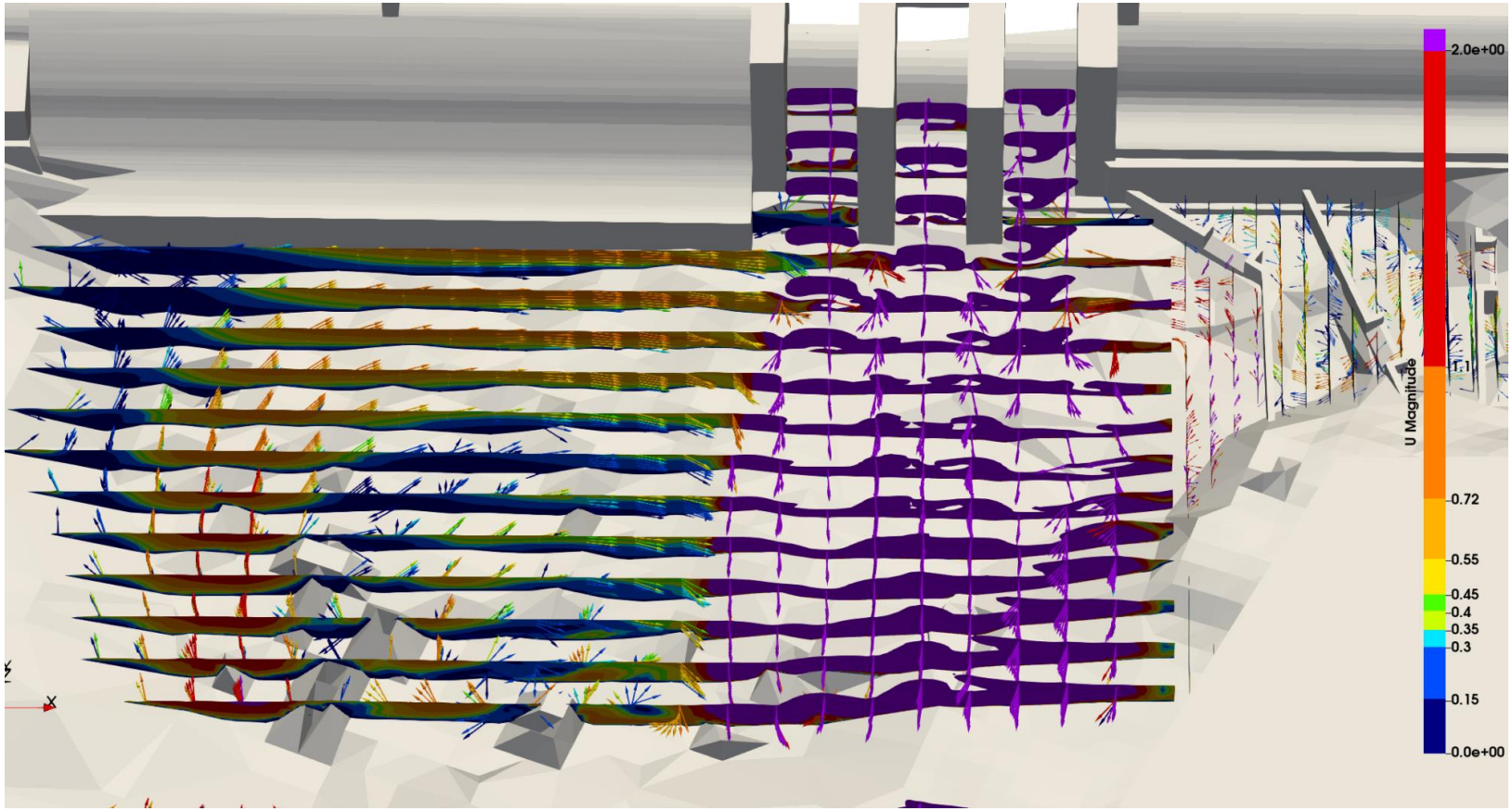


Figure S6-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

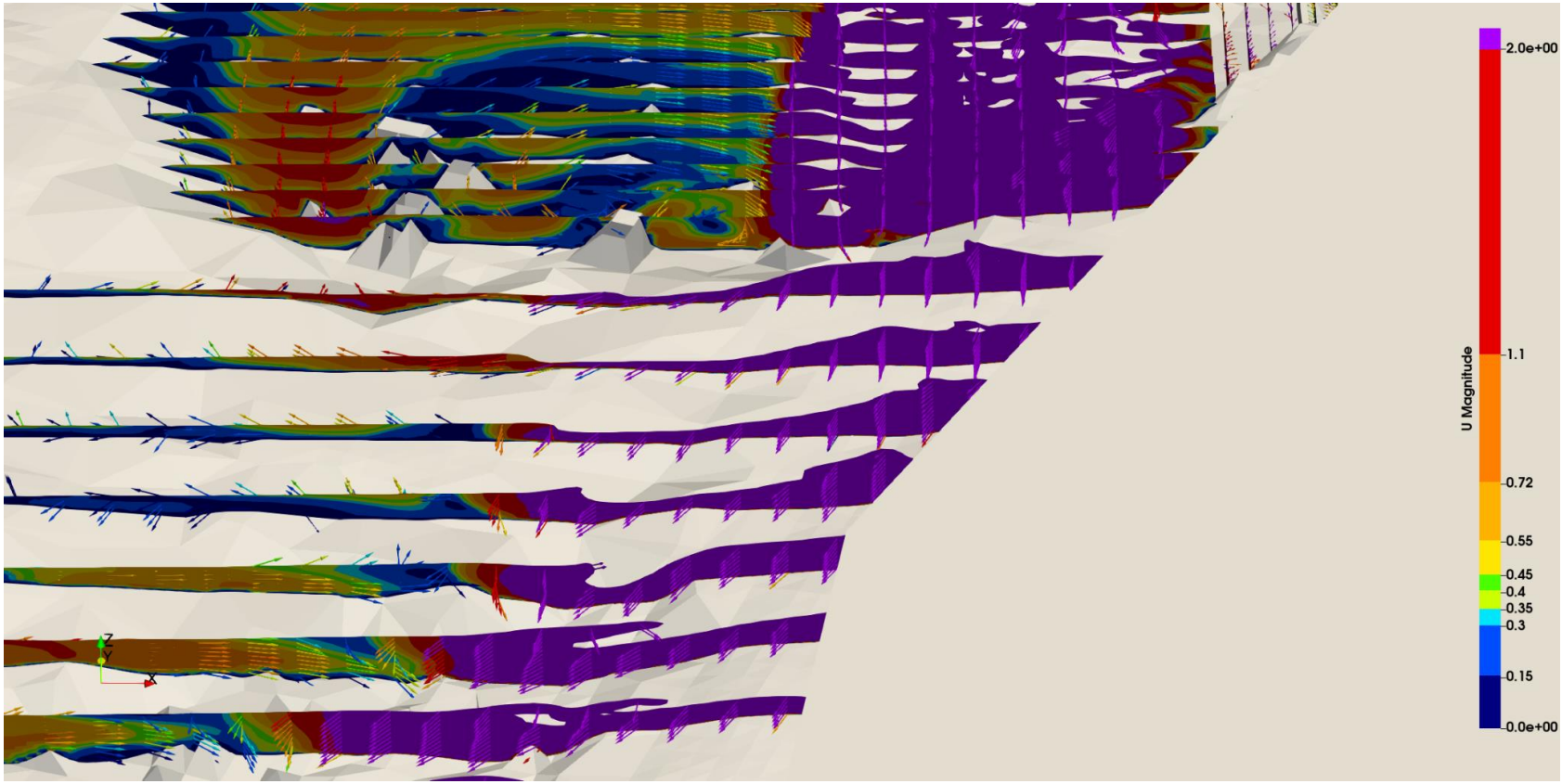


Figure S6-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

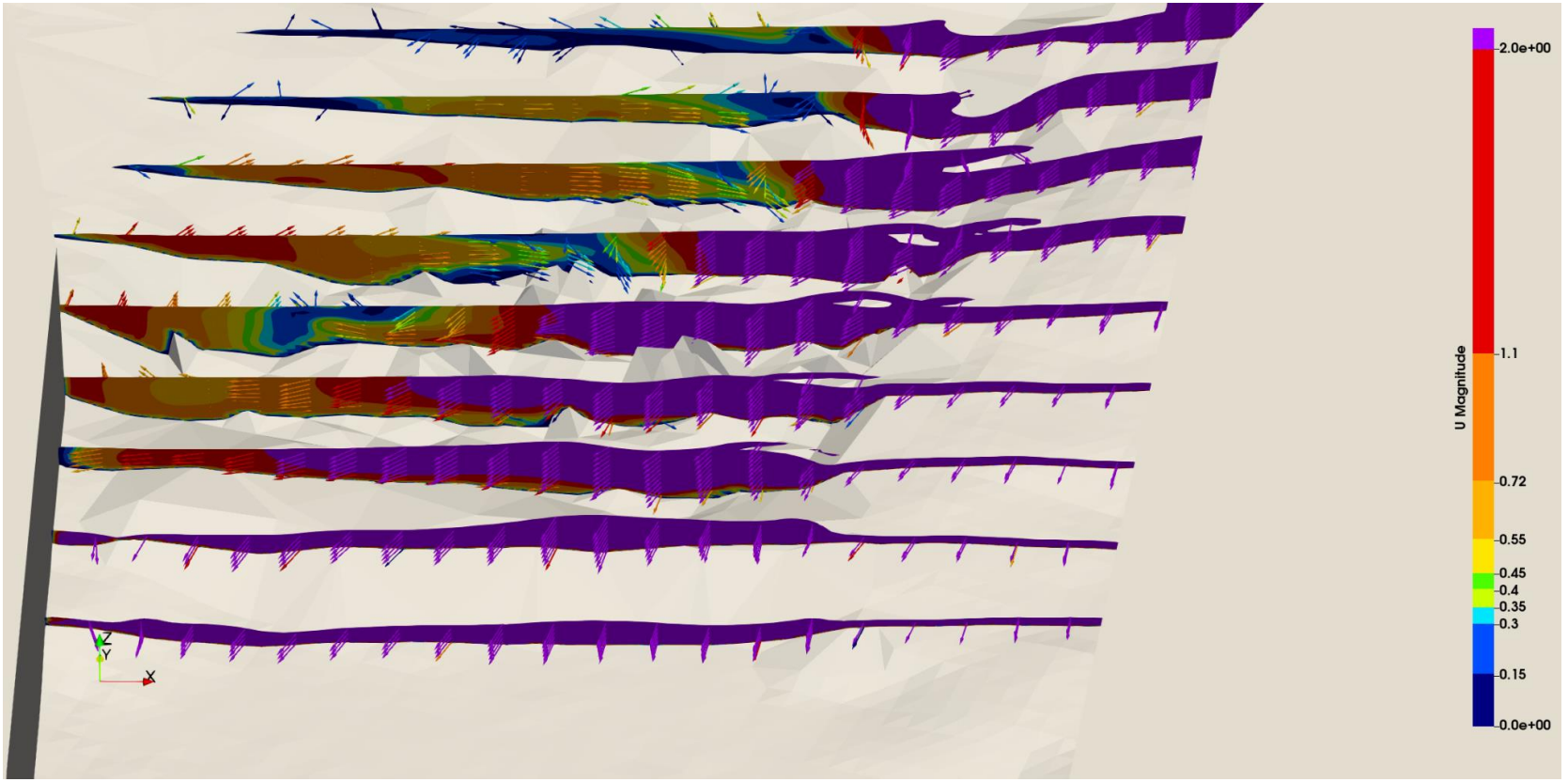


Figure S6-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

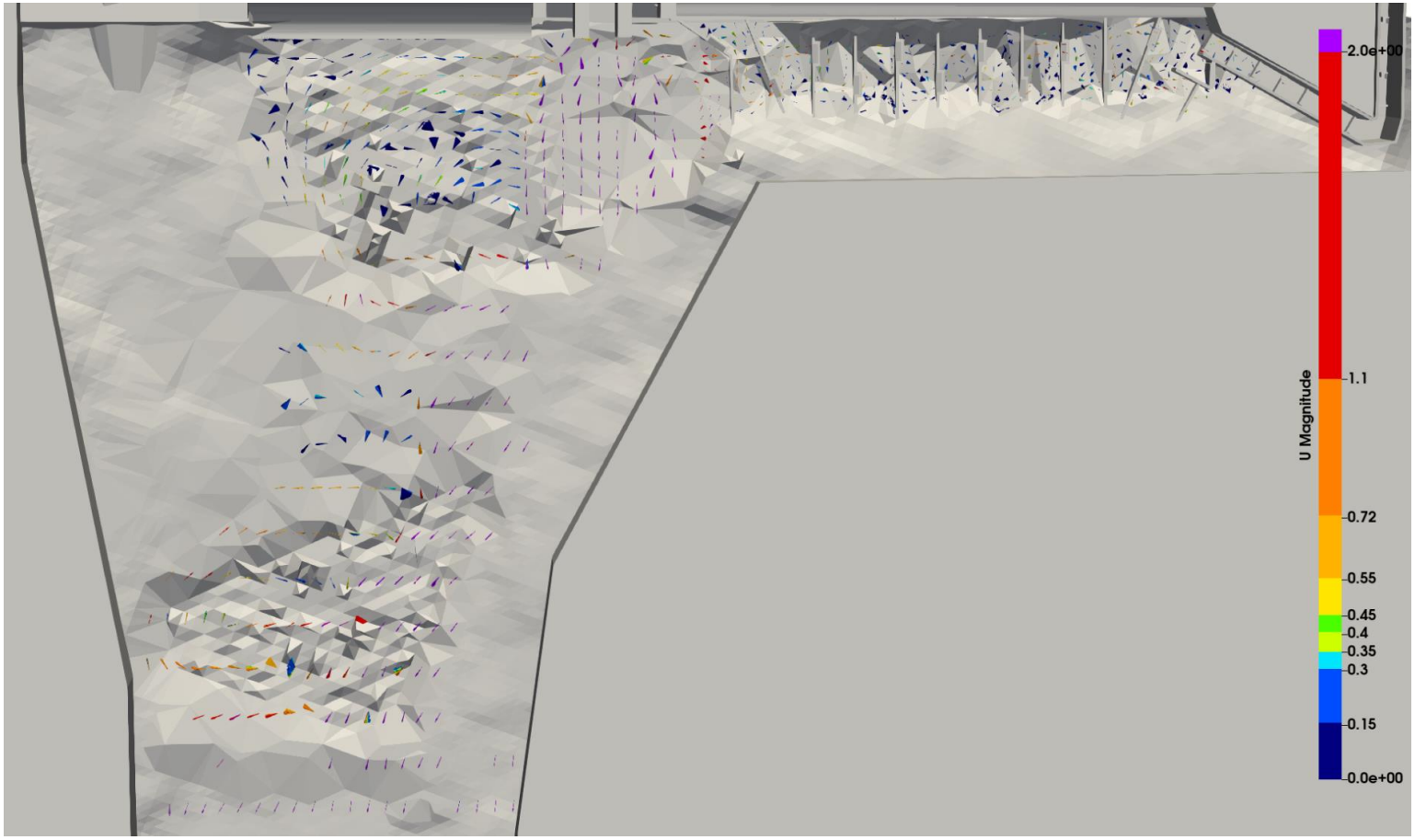


Figure S6-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

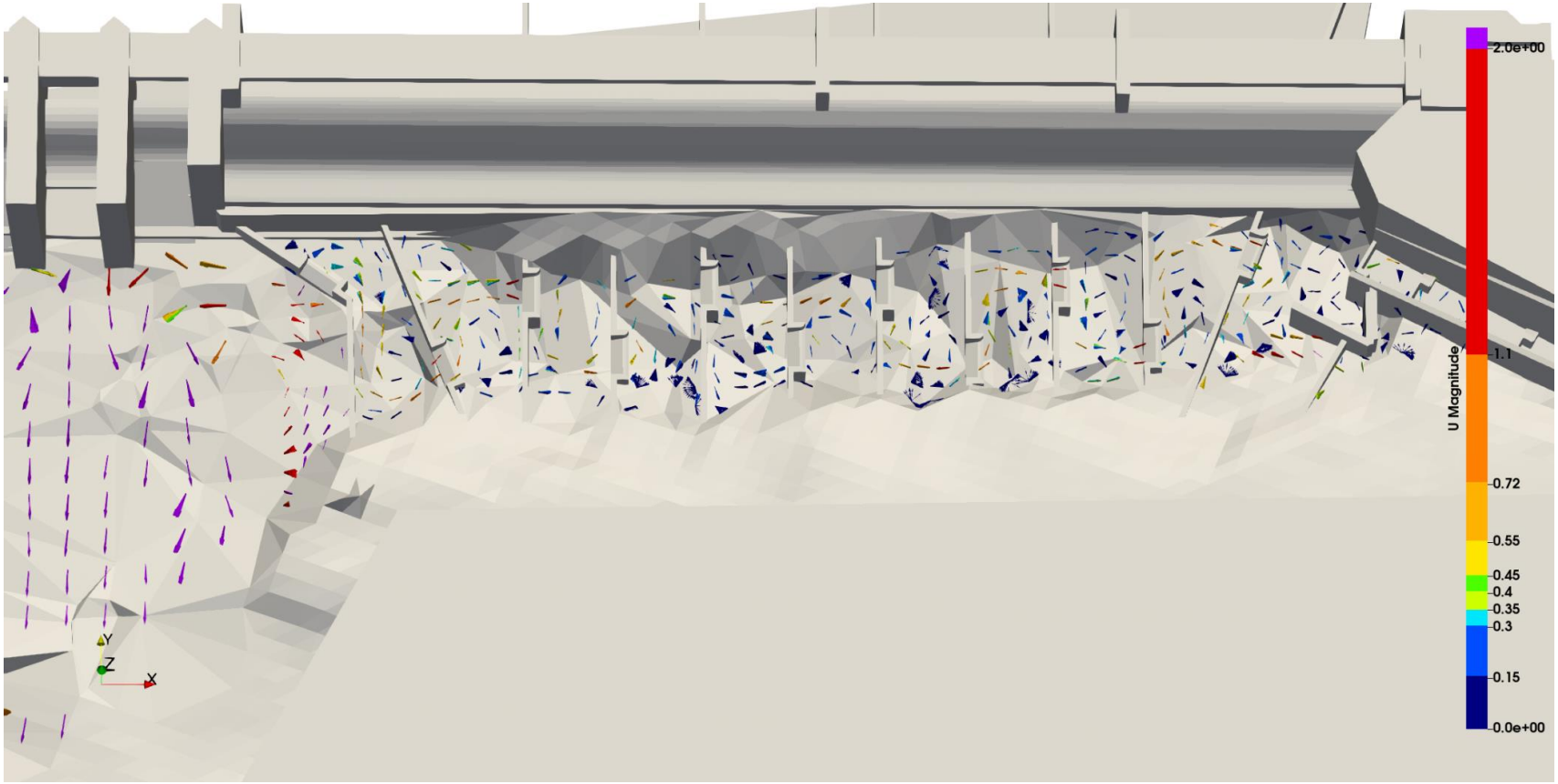


Figure S6-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

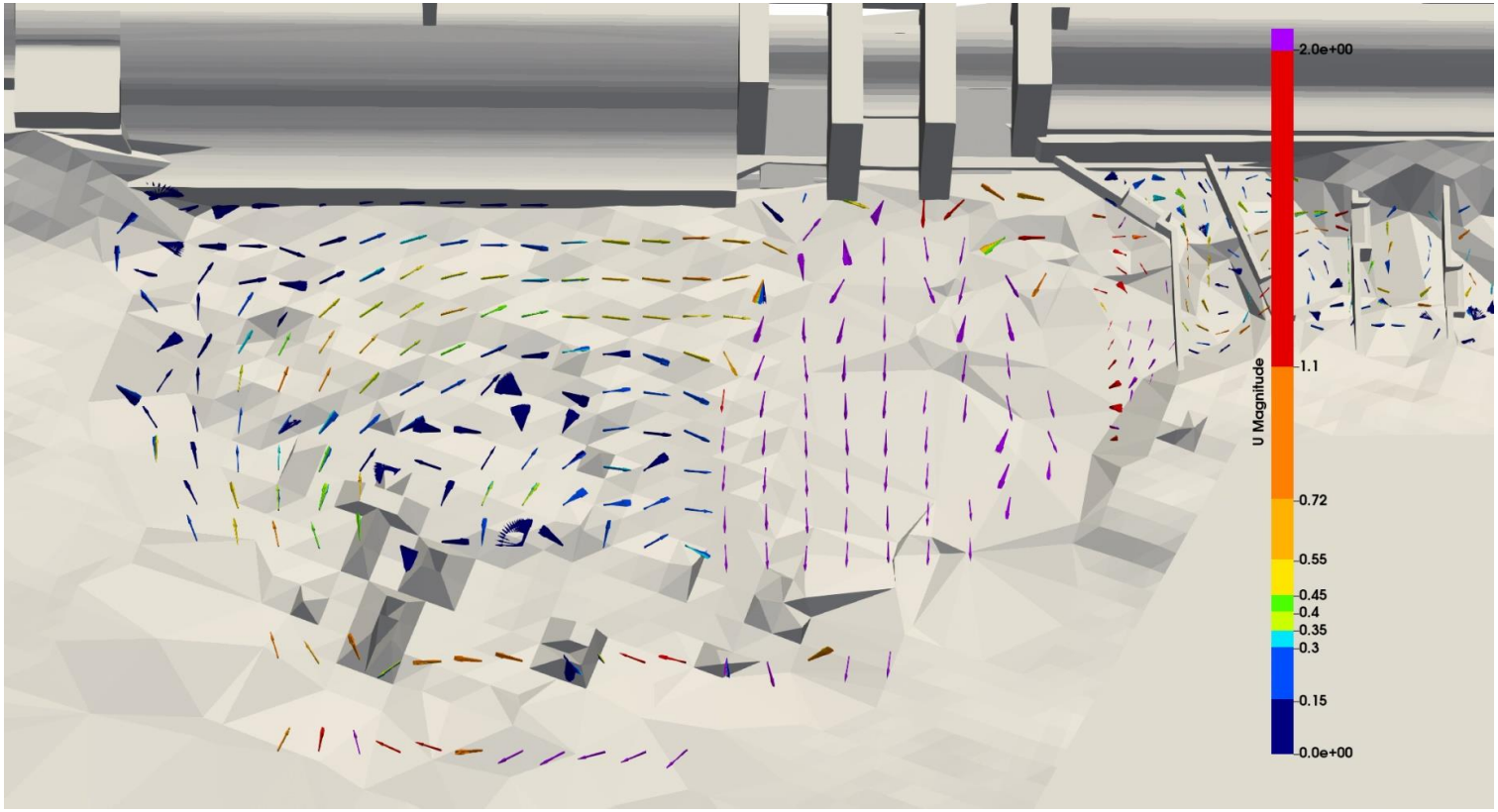


Figure S6-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

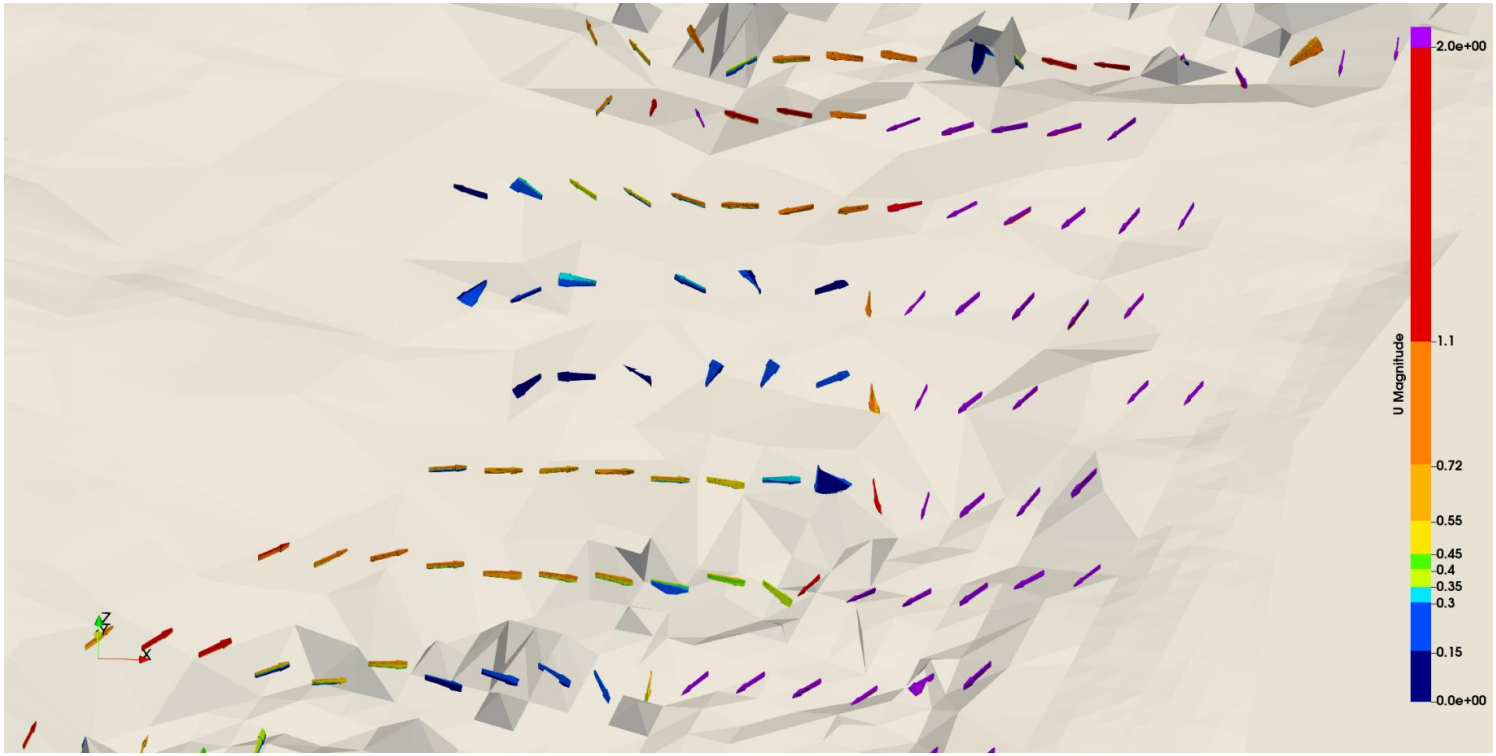


Figure S6-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

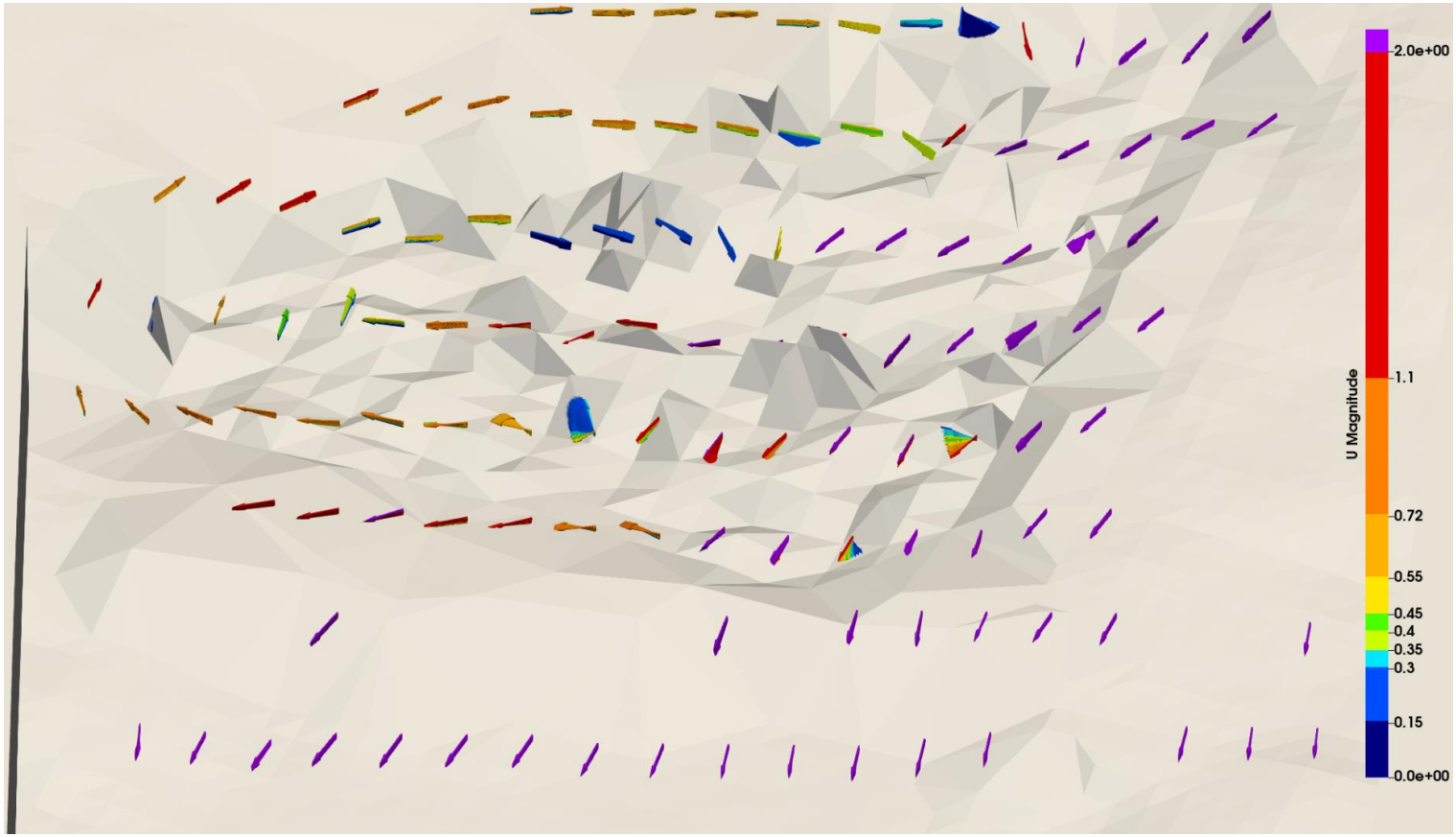


Figure S6-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

7. Model Results of Scenario S7 with 0 cfs from the gates

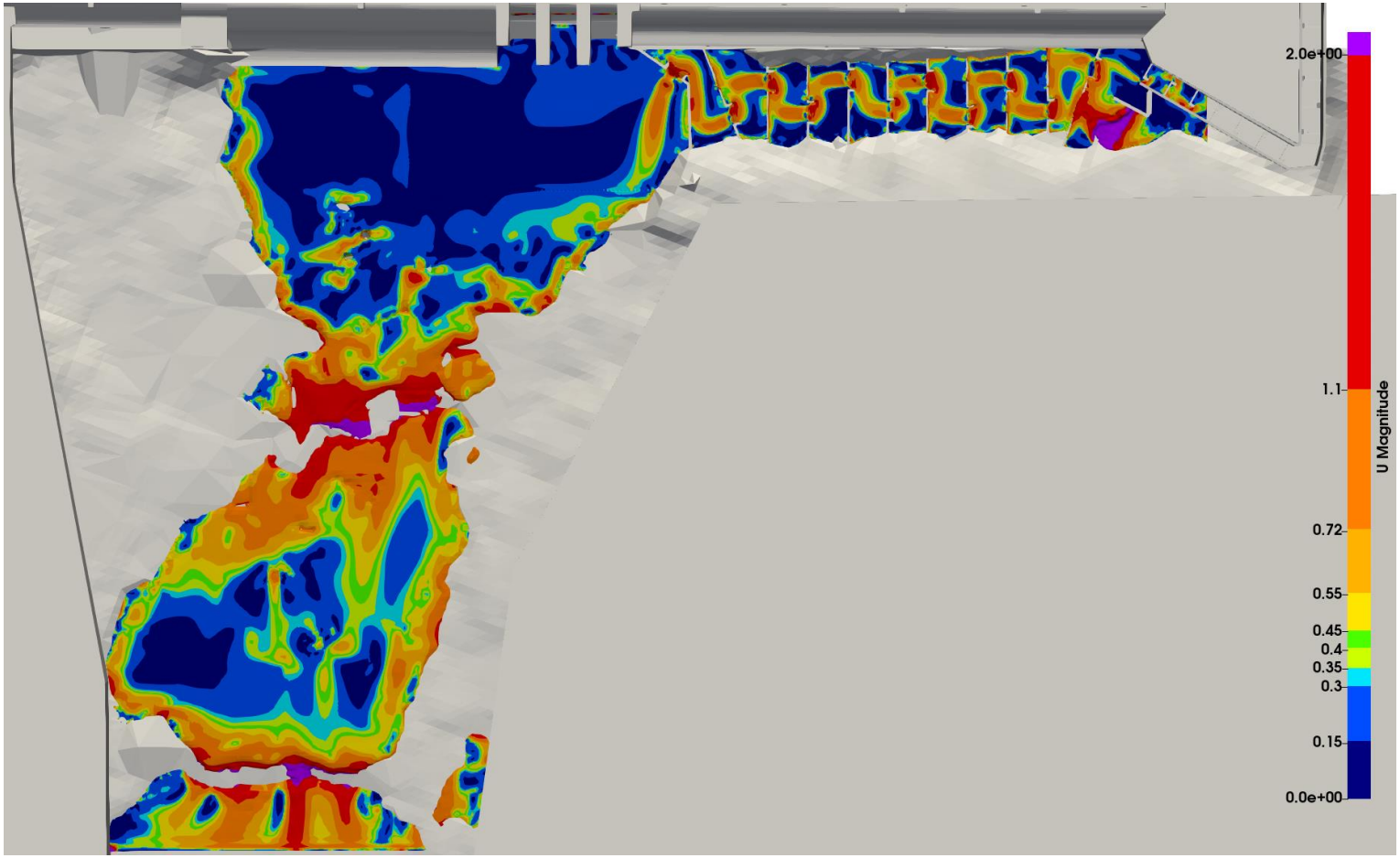


Figure S7-1: Plan view of the Water Surface Velocities

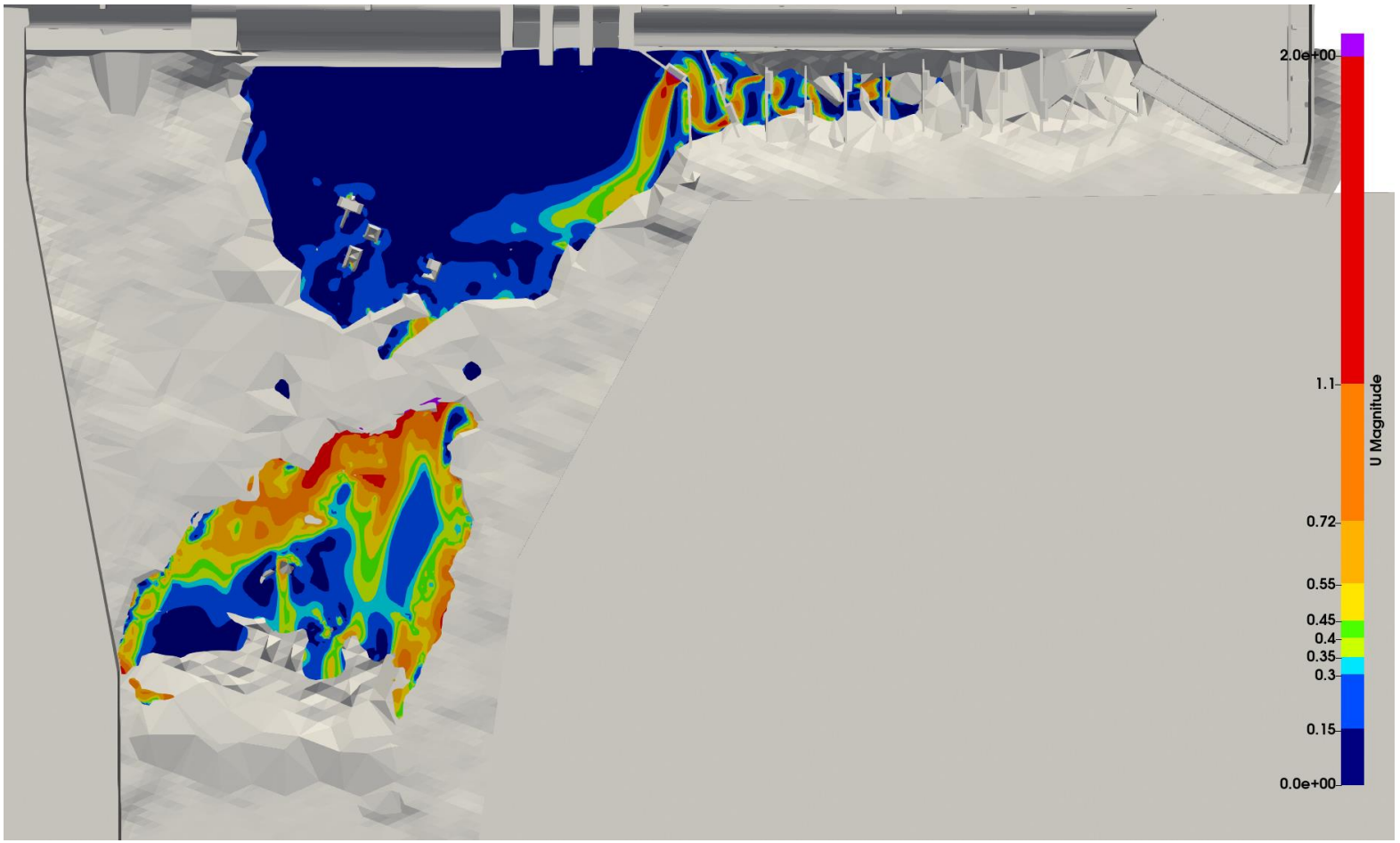


Figure S7-2: Plan view of the Mid-Surface Velocities

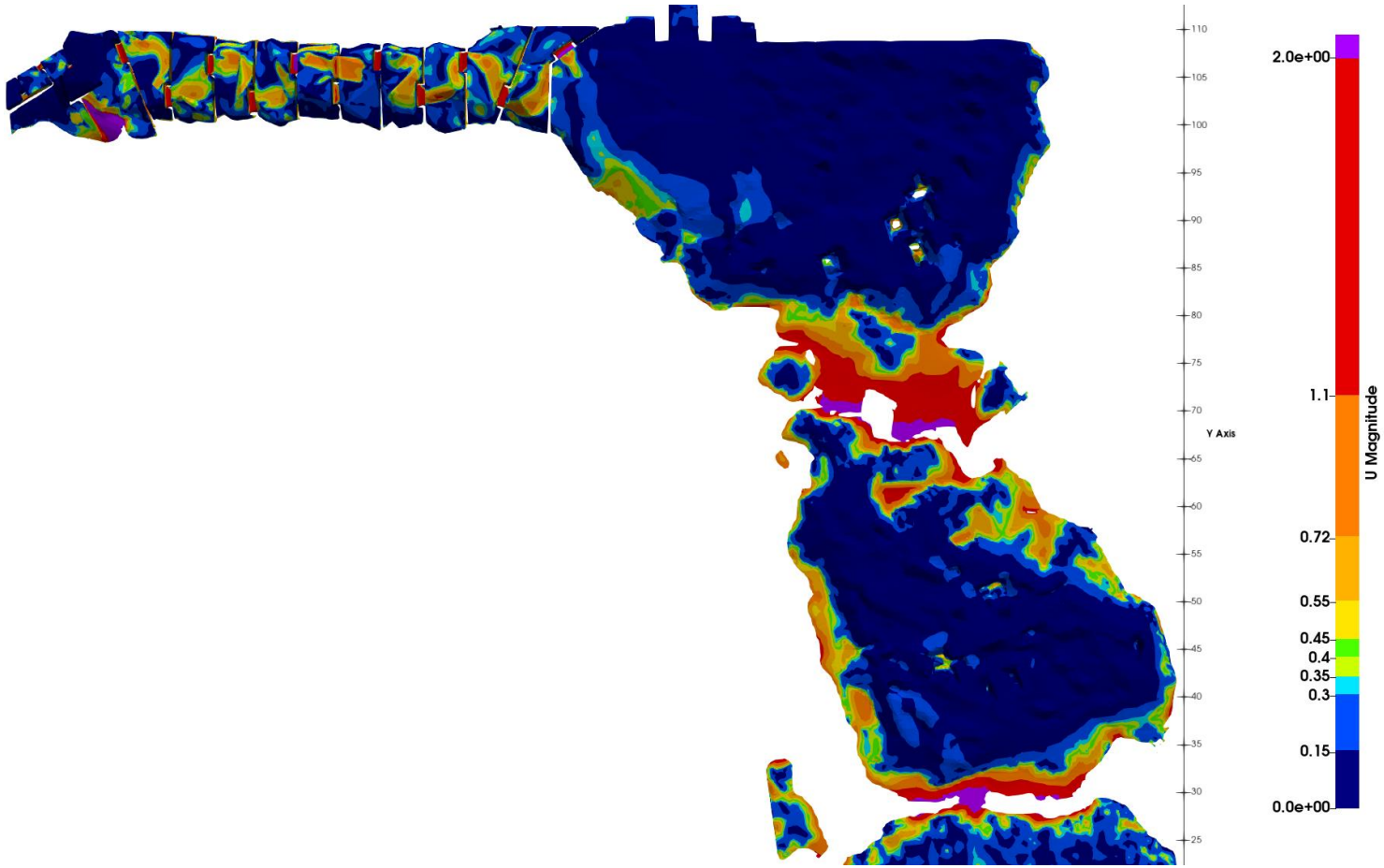


Figure S7-3: View of the Bottom Velocities

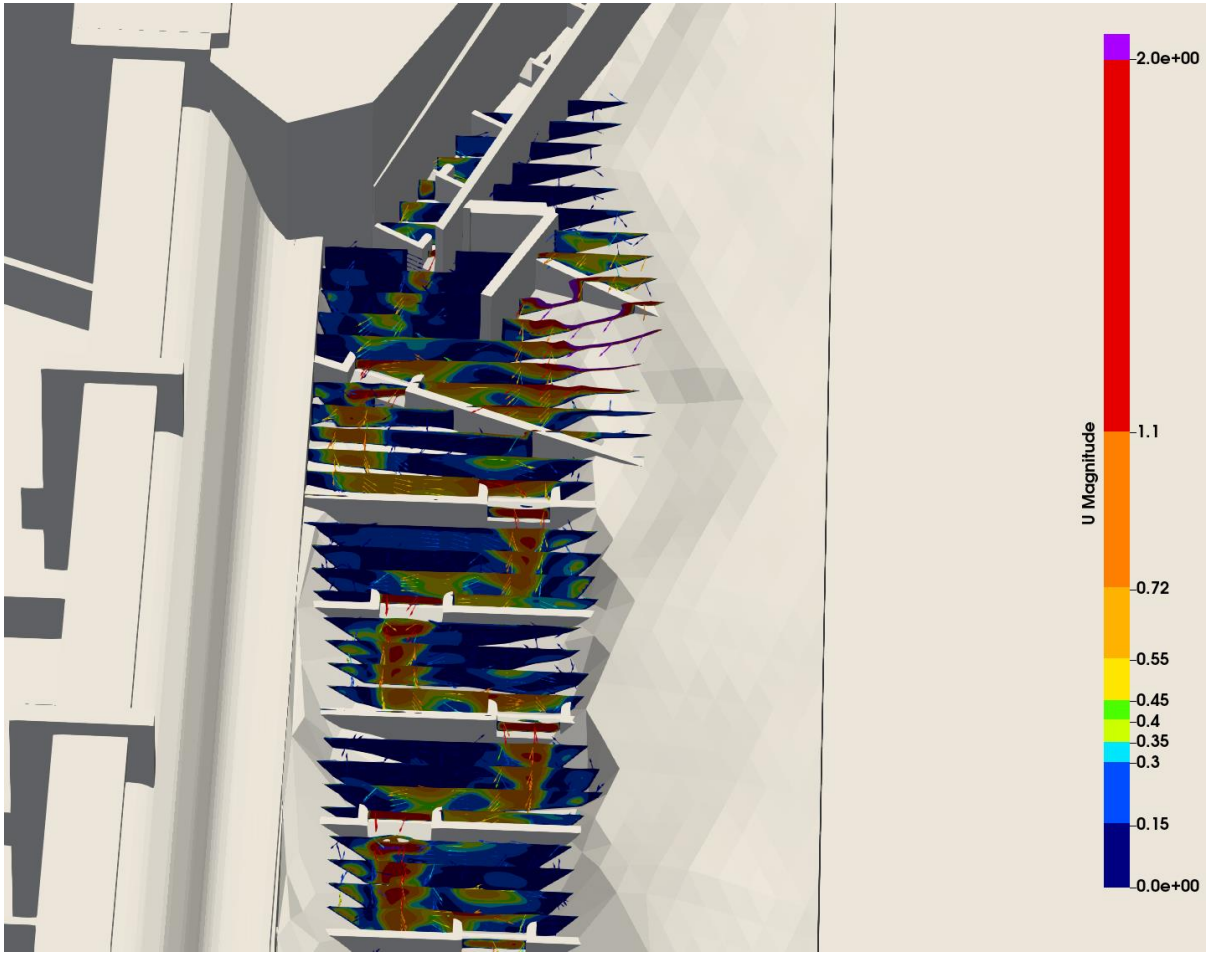


Figure S7-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

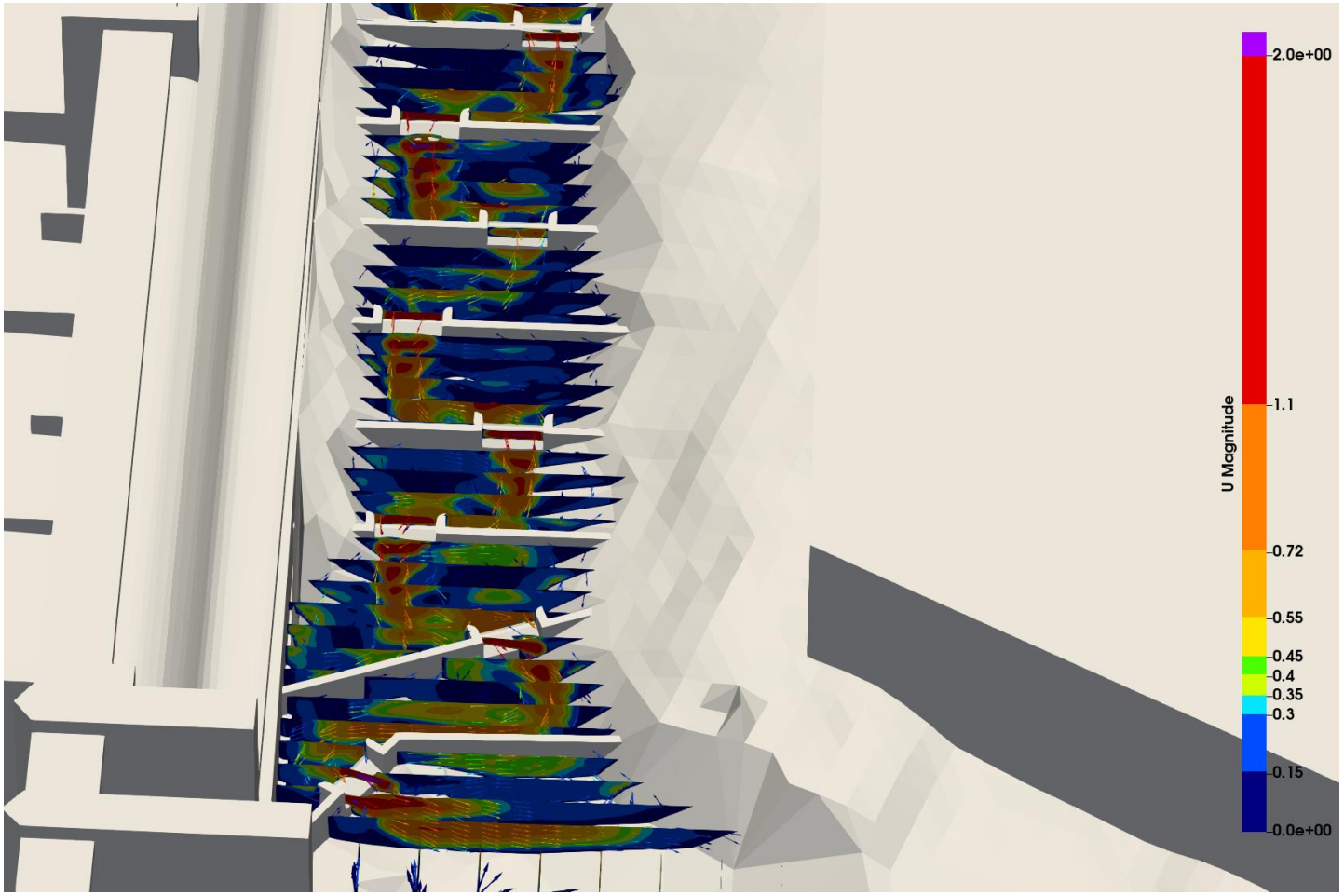


Figure S7-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

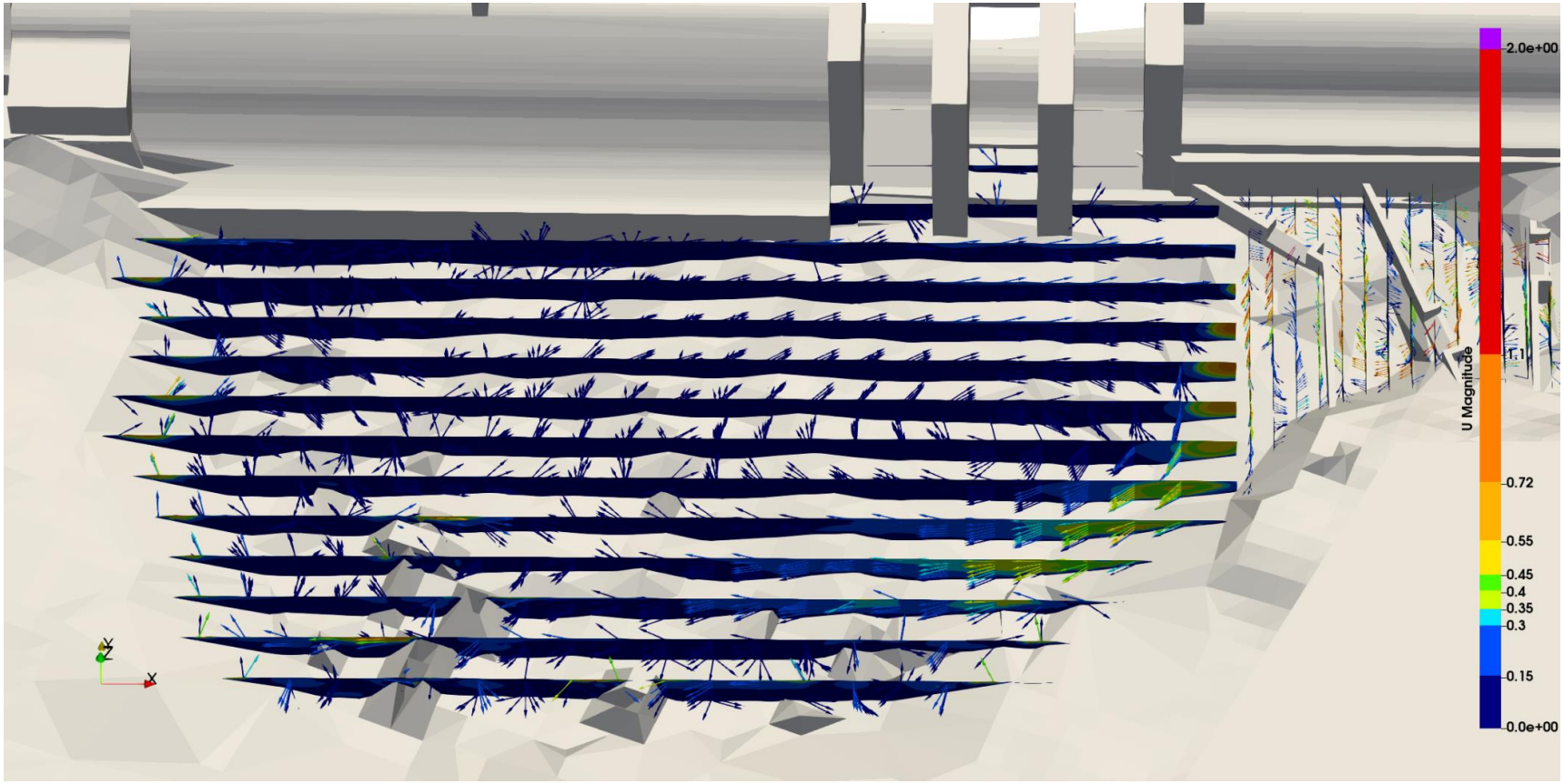


Figure S7-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

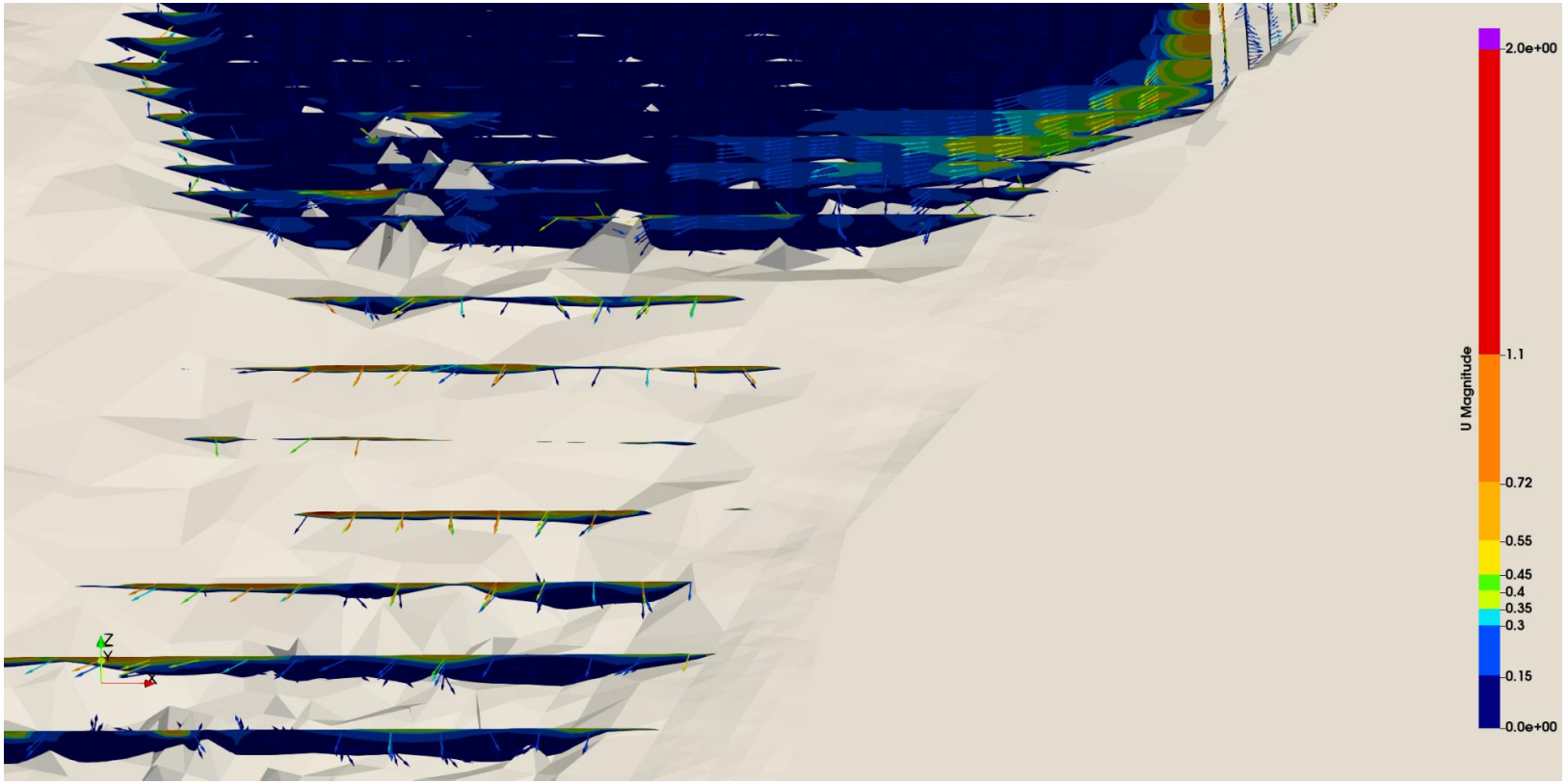


Figure S7-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

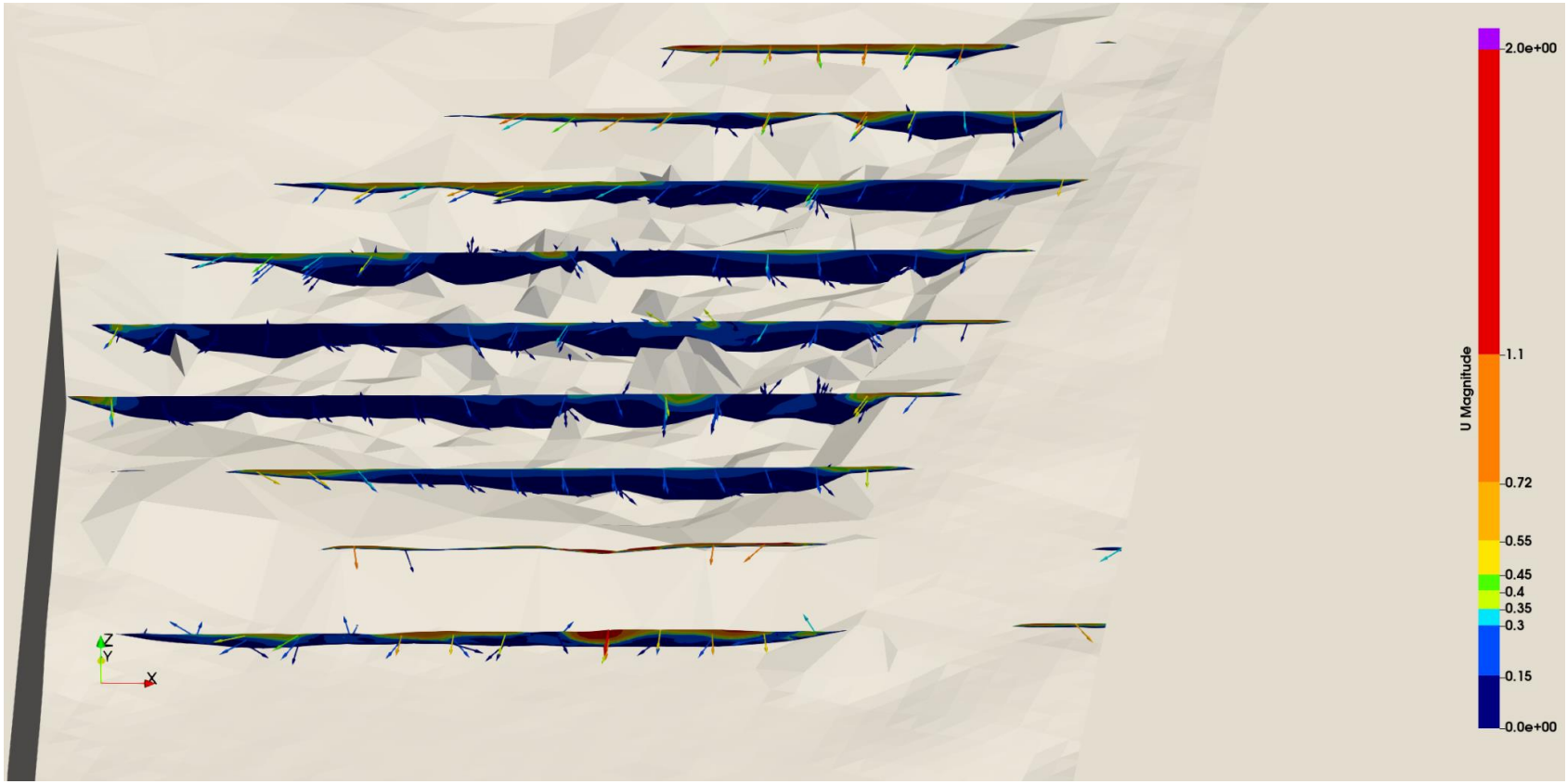


Figure S7-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

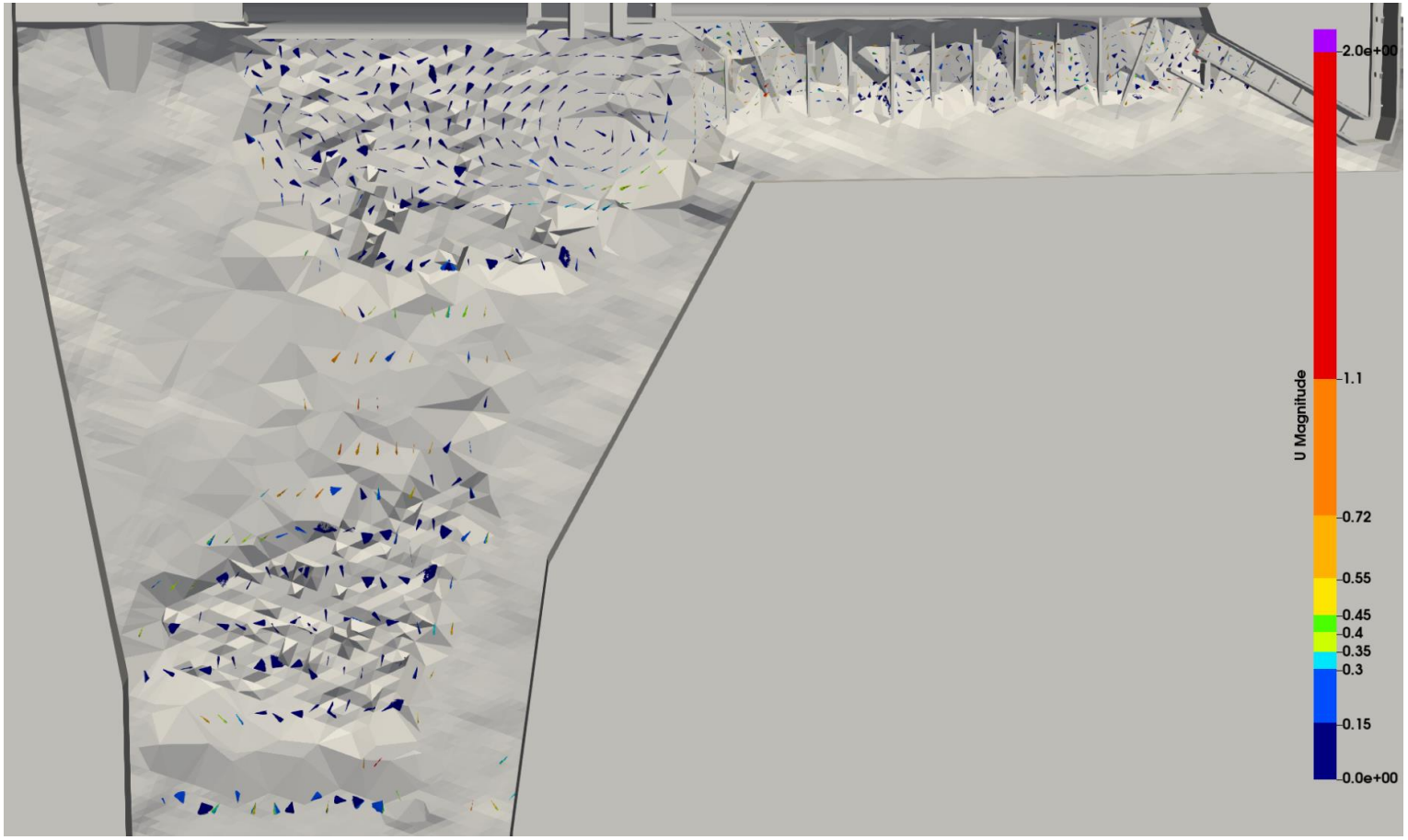


Figure S7-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

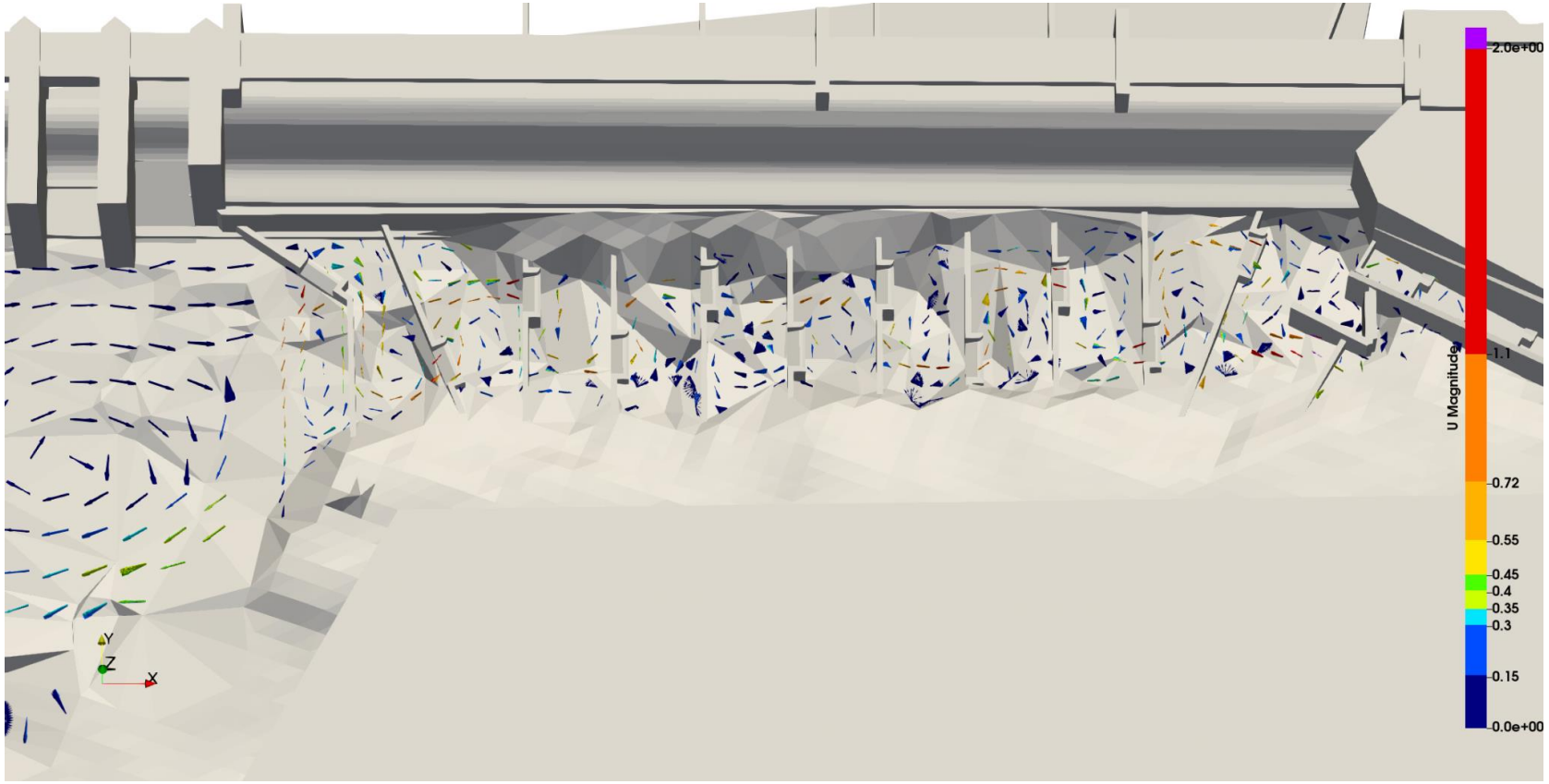


Figure S7-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

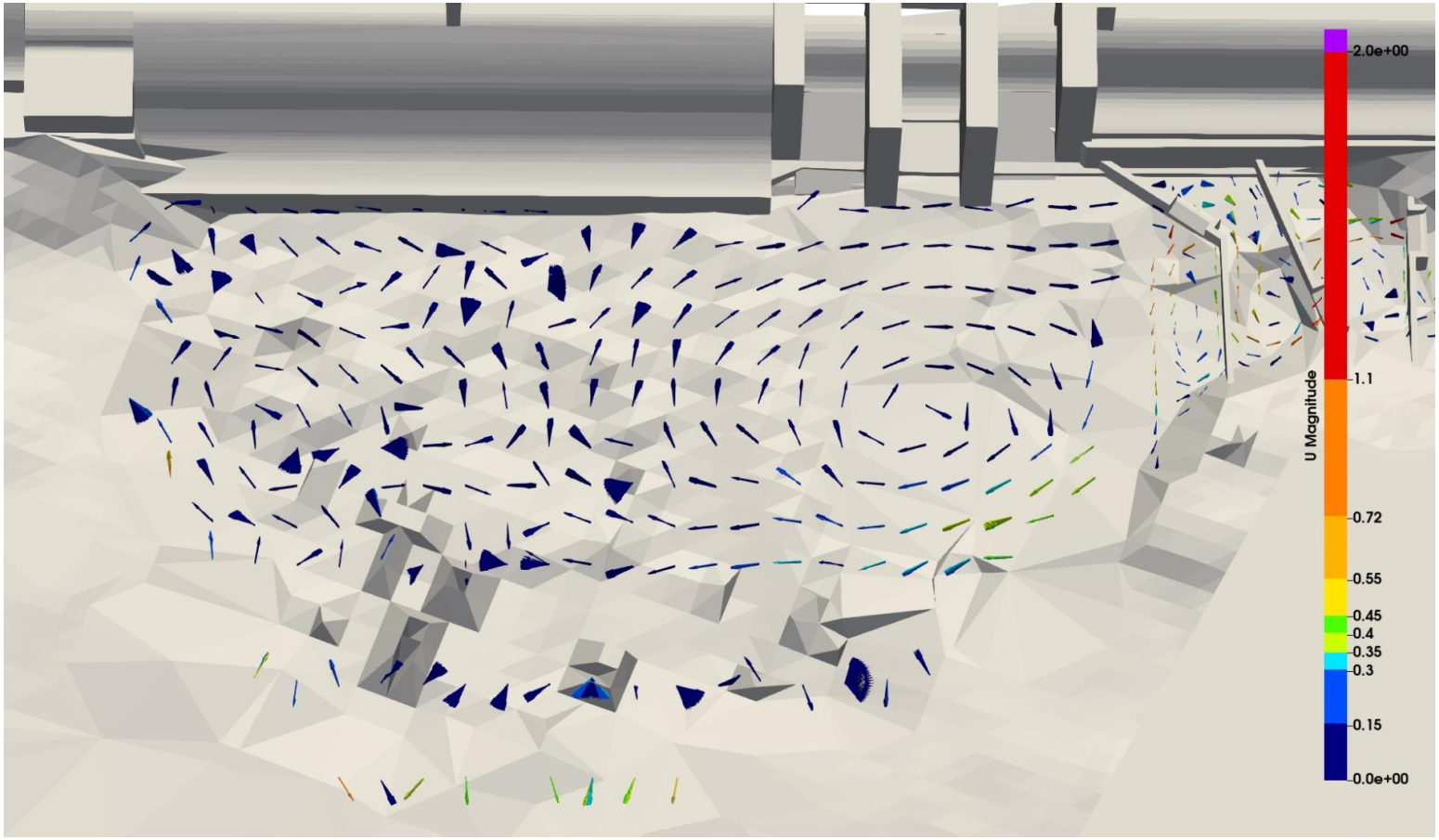


Figure S7-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

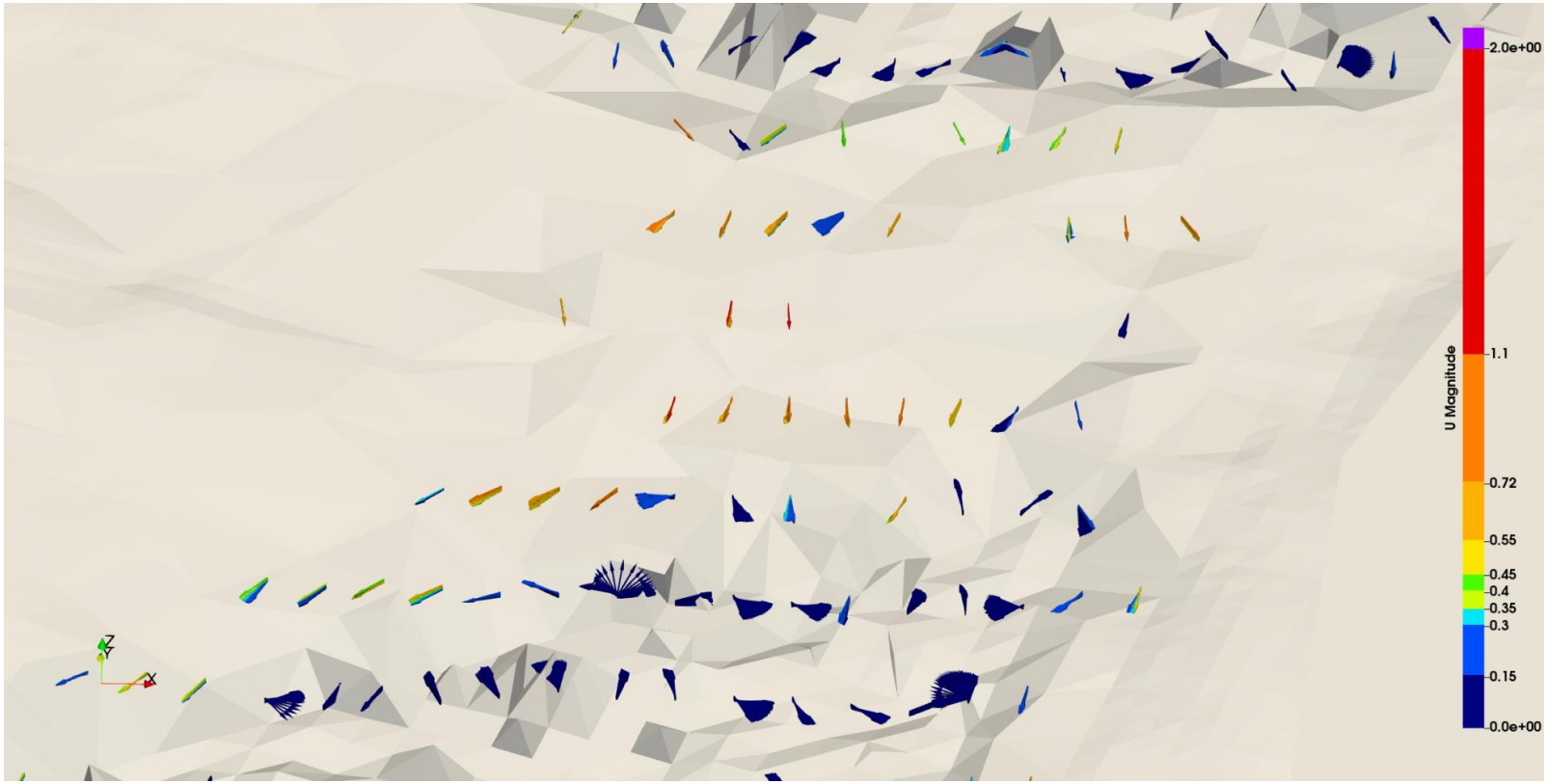


Figure S7-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

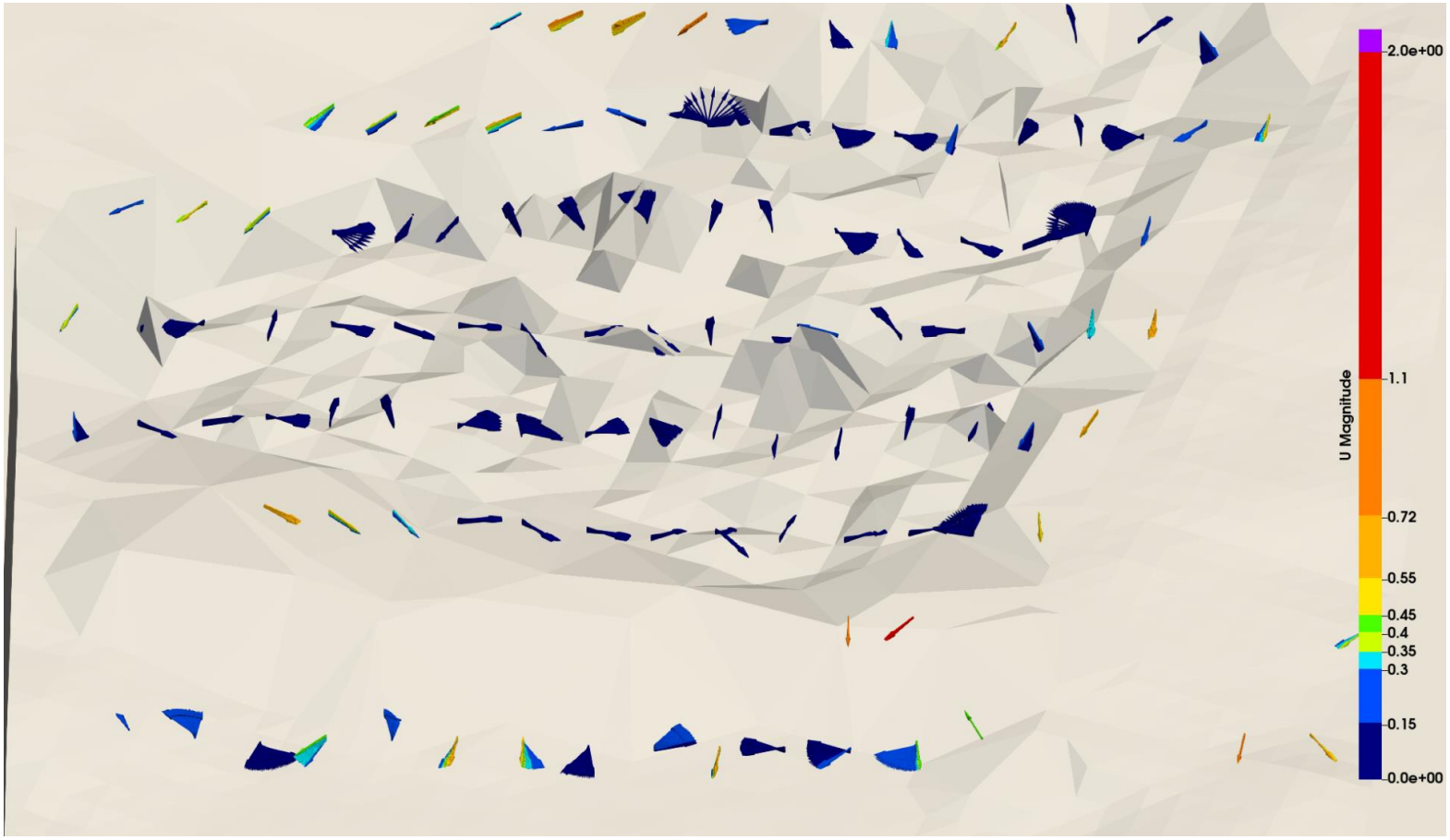


Figure S7-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2 Ruth Falls Dam – River Fish Passage Modelling: Summary of Thaumas Environmental Consultants Ltd. Report

2.1 Introduction

Nova Scotia Power (NSP) has requested that CBCL Limited (CBCL) conduct 3D Computational Fluid Dynamics (CFD) hydraulic modelling (3D modelling) for the post-refurbished downstream conditions and proposed changes at the Ruth Falls Dam in Sheet Harbour, Nova Scotia (Appendix A: Figure 1). The main refurbishments and changes that were modelled by CBCL and evaluated by Thaumas Environmental Consultants Ltd (Thaumas) are shown in Table 1 and Appendix A: Figure 1).

Table 1: Proposed Refurbishments and Changes to the Ruth Falls Dam and Explanations

#	Proposed Refurbishment / Change	Explanation
1	Replacement of the existing stop log bay with three vertical lift gates in the center of the dam and the flows distributed between the gates.	The current stop logs are leaking and are difficult to adjust to maintain the headpond within a narrow depth range.
2	Installation of a new rubber dam.	Large inflatable rubber cylinders will be replacing the existing stoplog sections, on top of the concrete spillway of the refurbished dam, to replace the existing stop logs and stop all leakage.
3	Eleven new fish passage weirs in the fishway channel section at the toe of the dam.	The existing seven fishway weir configuration has varying drops and pool sizes and does not provide adequate fish passage. The weirs will be replaced with 23 cm drops and notches sized to accommodate the louvre flow for additional fishway attraction flow.

#	Proposed Refurbishment / Change	Explanation
4	Fishway entrance	The notch in the entrance weir is located to the dam side of the fishway channel and aligned to direct its flow along the edge of the gate flows.
5	Louvres flow and bypass pipe relocated	The louvre flow will be relocated to the upper end of the fishway channel to provide additional attraction flow to the fishway.
6	Removal of rock flow diversion at gate three	A rock outcrop in front of gate three will be removed so the flow is directed down river vs. along the toe of the dam.
7	Riverbed bathymetry was flattened in the model just below the fishway and the three spill gates	To remove flow obstructions along the bottom, which disrupt favourable velocity patterns for fish passage.

The modelling was requested to determine if the proposed changes to the refurbished dam would affect fish passage in the river, at the entrance to the fishway, and in the lower channel section of the fishway. At the request of NSP, CBCL performed the CFD 3D modelling with the OpenFoam[1] modelling software. Thaumas evaluated and reviewed the computer modelling for fish passage and provided a report entitled, "Ruth Falls Dam – River Fish Passage Modelling". The following sections are a high-level summary of the Thaumas report and the full Thaumas report is provided in Appendix B.

2.2 Literature and Background Review

Thaumas conducted a background review of the current operating conditions, fish passage facilities at Ruth Falls, and fish swimming abilities and behaviour for the species present at the site. Thaumas found that the Ruth Falls concrete fishway currently passes fish well, based on the modelling and observations, and does not need any modification. Currently, the normal operating conditions of the dam provide approximately 100 cubic feet per second (cfs) of flow to the river below the dam. The licence requirements for the facility requires a minimum fishway flow of 6 cfs, and a minimum louvre flow of 29 cfs. These flows are supplemented by the stoplog leakage providing an additional flow of 65 cfs, for an approximate total flow of 100 cfs. The results of the fish passage background review indicated that these current flow requirements allow satisfactory upstream passage of most fish species; however, the depth over the river's rock sills would need additional flow to provide a water depth of at least 38 cm on the river's rock sills for multi-sea year Salmon passage.

The current operating licence also requires 10 or more supplemental flows from June 15 to July 15 and September 26 to November 30 of greater than 50 cfs overnight for a minimum of 12 hours, and nightly when Atlantic Salmon are present. The location of this release

[1] Open-source Field Operation and Manipulation is a 3D Computational Fluid Dynamics model.

must be immediately below the dam. The supplemental flow events are intended to complement significant high flow events (i.e., ≥ 24 mm of rain in 24 hours) and to attract Atlantic Salmon to migrate upstream to the fish ladder by providing migration flow depth over the river's rock sills.

As part of the literature review, Thaumas evaluated the swimming speeds, swimming endurance, orientation to flows, and behaviours of the fish species found at the site that want to migrate past the dam. The species assessed cover the full range of swimming abilities of all fish species present and include:

- Gaspereau (Alewife and Blueback Herring)
- Brook Trout (20 cm Total Length (TL))
- Atlantic Salmon (Salmon Grilse[2], multi-sea-year Salmon)
- American Eels (Elver 6 cm TL, yellow 20 cm TL, yellow 60 cm TL)

A summary of migration times and cues, size range and the assessed sizes is provided in Table 2. Lake species found in the reservoir that do not need to migrate past the dam to complete their life cycles were not specifically evaluated but their abilities fall within the range of the assessed species (i.e., Yellow Perch, Brown Bullhead, White Sucker, Golden Shiner, and Lake Chub).

Table 2: Migration Times and Cues and Size of Selected Fish Species

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
Gaspereau	March until Fall, upstream Spring Run: Mid-April to Late June; downstream till fall	- temperature - flow velocity - water depth - orientation to flows - behaviour - swimming ability & endurance	20-35	25
Brook Trout	Year Round & Fall spawning	- flow - temperature - water depth - orientation to flows - behaviour - swimming ability & endurance	20-55	20
Atlantic Salmon - Grilse	Spring, Summer, and Fall	- river migration - velocity - temperature	45-60	50

[2] Salmon that have only been to sea for one year

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
		- water depth - behaviour - swimming ability & endurance		
Atlantic Salmon – Multi-Sea-Year	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	75-105	100[3]
American Eel Elvers	Mid-March - June	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	6	6
American Eel Yellow 20 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	20	20
American Eel Yellow 60 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	60	60

[3] Larger size was assessed to ensure larger salmon can pass.

2.3 Proposed Scenarios Based on 3D Model Results

Using the OpenFOAM model results, Thaumas, evaluated the routes the fish are anticipated to select in the river below the dam based on their swimming abilities and endurance, required water depth, flow direction, and behaviour to plot routes they could use against the river flow velocities and depths before having to rest. Scenarios were evaluated to find the optimal conditions between the interaction of the fishway attraction flow and the gate flow, to attract the fish to the fishway entrance. The revised lower channel section of the fishway, with its new 11 weirs, the louvre flows of 35 cfs, and the upper concrete fishway section, was also assessed. Seven different flow scenarios from the gates (Scenarios 1-7) (Table 3) were assessed. Details of each flow scenario can be found in the detailed report (Section 3D model results; Appendix B). Under all scenarios the fishway flow and louvre flows remain consistent at the minimum required flow. Changes in flows arise from the gates or the required supplementary flows released from the gates[4]. The supplementary flow events were not modelled during the evaluation. Thaumas considered fish passage downstream of the gates to be occurring mainly within the Scenarios 1 and 2. Since the current operating licence requires supplementary flows of 50 cfs, flow events under Scenario 1 would be approximately 150 cfs in total during those events, which would fall in between Scenario 1 at 100 cfs and Scenario 2 at 200 cfs, which as stated above are the flows where fish passage occurs.

Table 3: Flows Scenarios Evaluated and Considered for Fish Passage

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Current Scenario (for comparison)	6	29	65	50	100-150**
Fishway	6	29	n/a	n/a	35
Scenario 1	6	29	65	n/a	100
Scenario 2	6	29	165	n/a	200
Scenario 3	6	29	925	n/a	960
Scenario 4	6	29	1720	n/a	1755
Scenario 5	6	29	3051	n/a	3086
Scenario 6	6	29	4308	n/a	4343

[4] Proposed Supplementary flows can be defined as 10 or more supplementary flows of 50 cfs that occur from June 15 to July 15 and September 26 to November 30.

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Scenario 7	6	29	0	n/a	35
Required Supplementary Flow (not modelled but considered)	6	29	65	50	150

Table Notes:
n/a = not applicable
* Supplementary flows can be defined as 10 or more supplementary flows of >50 cfs that occur from June 15 to July 15 and September 26 to November 30 and each night when salmon are detected.
**150 cfs would only occur during supplementary flows.

2.4 Fish Passage Routes Based on 3D Modelling

The swimming ability and water depth requirements, plus a behaviour evaluation for each of the listed species and size classes, was used to evaluate fish passage routes in the river approaches to the dam and the lower channel fishway section for all the modelled flow scenarios using the details in the 3D model.

The Fish Protection Tools for Swim Distance, Velocity, and Water Depths were used to calculate the swim distance and percentage of fish that could physically pass in each scenario through various routes in the river below the dam. The percent potential passage categories based on swimming ability included the following:

- 97.5% - Always pass fish and will sustain fish populations.
- 87.5% - Acceptable fish passage and will sustain fish populations.
- 50% - Satisfactory fish passage, may not be enough passage to sustain the population for some species.
- 12.5% - Poor fish passage, will not sustain fish populations.
- 2.5% - Unlikely passage, will not sustain fish populations.

When the swim distance, based on velocities encountered before access to a resting area, fell between categories, the lower percent category was used. The potential estimated percent passage of the selected fish species is based on the model results for the best route evaluated for fish passage (see Table 4).

Table 4: Estimated % ability of the selected fish species to pass through the river section modeled to the fishway entrance based on the best routes found in the Evaluated Model Scenarios

Scenario	Gaspereau	Brook Trout*	Grilse Salmon	Multi-Sea-Year Salmon	American Eel - Elver	American Eel – Yellow 20 cm	American Eel – Yellow 60 cm
New Lower Section of the Fishway	97.5%	97.5%	97.5%	97.5%	< 2.5%	97.5%	97.5%
Eel Pass	n/a	n/a	n/a	n/a	97%	97%	n/a
Scenario 1	97.5%	50%	87.5%	97.5%	< 2.5%	12.5%	87.5%
Scenario 2	50%	12.5%	50%	97.5%	< 2.5%	< 2.5%	12.5%
Scenario 3	None	None	12.5%	50%	None	None	None
Scenario 4	None	None	None	None	None	None	None
Scenario 5	None	None	None	None	None	None	None
Scenario 6	None	None	None	None	None	None	None
Scenario 7	None	None	None	None	None	None	None

Table Notes:
*Based on 20cm TL trout, the % passage for larger sea run trout may be higher but was not evaluated.
n/a = not applicable

2.5 Proposed Scenario

Based on the evaluation of the OpenFOAM model results, Scenario 1, with 6 cfs from the upper fishway and 29 cfs from the louvres (combining to provide 35cfs at the fishway entrance), and an additional 65cfs from the gates, provides the best conditions for upstream fish passage in the river up to the dam and the best attraction to the fishway entrance for all modelled species.

This scenario provides the best passage for Eels compared to the other proposed scenarios. Elvers are shown as having poor passage in all scenarios due to the scale of the bathymetry and flow modelling for these very small eels, that require only a very shallow flow. It is expected that the elvers and very young yellow stage eels will preform much better at moving up the river than the modelling shows, as they move between rocks on the bottom and along the shallow low velocity flows along the bank.

The pool and weir fishway will pass the larger eels but the velocities and distances in the notches exceed the passage ability of the elvers and smaller eels. For this reason, the addition of an Eel pass is proposed for American Eels to provide passage past the dam for

all upstream migrating age classes of eels. The best location for an American Eel pass is depicted on Figure 1 in Appendix A.

This scenario provides a minimum passage depth over the river's rock sills for the multi-sea-year Salmon so it is likely they will choose not to pass until the water level is deeper during the supplemental flow releases. Under Scenario 1, the 10 or more nighttime supplemental flow releases from June 15 to July 15 and September 26 to November 30, of 50 cfs, as currently provided under the licence, are required and are best released from the three gates. The number and timing of the supplemental flows provides the attraction and water depths over the river's rock sills the Salmon need, while still providing passage for the other species during the day and on the other nights.

Table 5: Proposed Scenario Based on Estimated Fish Passage of Selected Fish Species

Scenario	Fishway Flow (cfs)	Louvre Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow (cfs) (≥10 Events)	Total Flow (cfs)
Scenario 1 with Eel Pass	6	29	65	50	100-150*

Table Notes: *150 cfs would only occur during supplementary flows.

2.6 Closure

This memo has been prepared for the sole benefit of NSP based on the information provided by Thaumas Environmental Consultants Ltd. The memo may not be relied upon by any other person or entity without the express written consent of CBCL or NSP. Any use which a third party makes of this document and any reliance on decisions made based on it, are the responsibility of such third parties. CBCL accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this document. The comments and recommendations in this memo represent the best judgement of CBCL based on the information provided.

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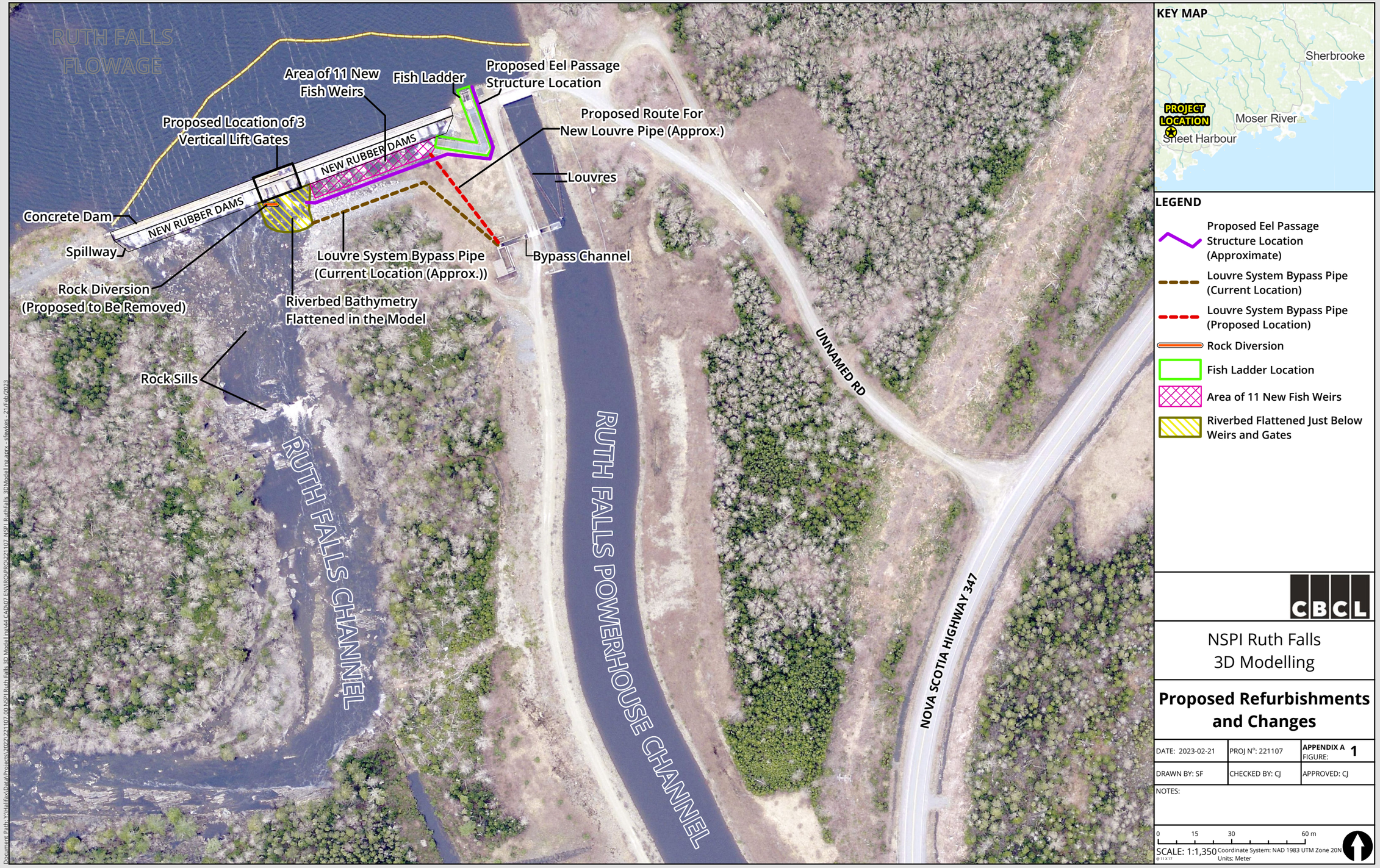
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APPENDIX A

Figure 1


RUTH FALLS FLOWAGE
Area of 11 New Fish Weirs
Fish Ladder
Proposed Eel Passage Structure Location
Proposed Location of 3 Vertical Lift Gates
Proposed Route For New Louvre Pipe (Approx.)
NEW RUBBER DAMS
NEW RUBBER DAMS
Louvres
Concrete Dam
Spillway
Louvre System Bypass Pipe (Current Location (Approx.))
Bypass Channel
Rock Diversion (Proposed to Be Removed)
Riverbed Bathymetry Flattened in the Model
Rock Sills
UNNAMED RD
RUTH FALLS CHANNEL
RUTH FALLS POWERHOUSE CHANNEL
NOVA SCOTIA HIGHWAY 347
KEY MAP
Sherbrooke
PROJECT LOCATION
Moser River
Sheet Harbour
LEGEND
Proposed Eel Passage Structure Location (Approximate)
Louvre System Bypass Pipe (Current Location)
Louvre System Bypass Pipe (Proposed Location)
Rock Diversion
Fish Ladder Location
Area of 11 New Fish Weirs
Riverbed Flattened Just Below Weirs and Gates
CBCL
NSPI Ruth Falls 3D Modelling
Proposed Refurbishments and Changes
DATE: 2023-02-21
PROJ N°: 221107
APPENDIX A FIGURE: 1
DRAWN BY: SF
CHECKED BY: CJ
APPROVED: CJ
NOTES:
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SCALE: 1:1,350 @ 11 x 17
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Units: Meter
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APPENDIX B

Thaumas Consultants Report

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Ruth Falls Dam – River Fish Passage Modeling

THAUMAS ENVIRONMENTAL CONSULTANTS FEBUARY 10, 2023

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Introduction

Nova Scotia Power Inc has requested 3D hydraulic modeling to be completed at the Ruth Falls dam East River Sheet Harbour for the purpose of assessing post-refurbishment downstream river flow conditions. The main refurbishments to the dam include the installation of vertical lift gates in the center section of the dam which will replace the existing stoplog bays. The change also includes the installation of a new rubber dam along the other stoplog spillways. The modeling is to assess how changes in flow releases from the vertical lift gates and rubber dam would impact fish passage in the river area downstream of the dam and specifically the entrance conditions to the fish ladder. The lower section of the fish ladder is changed to improve fish passage and operate effectively with the changes in the refurbished dam (Thaumas 2023 a, b, c) and these new fishway conditions have also been modeled.

The 3D modeling has been done by CBCL and the results provided in their memo dated January 27th, 2023, titled "NSPI Ruth Falls 3D Modelling Model Results with new fish passage weirs pointing south-west, louvres flow relocated, with no rock flow diversion and bathymetry flattened just below weirs and gates, and flows distributed between the 3 main gates." The model results were also provided in electronic format for further fish passage route computer analysis.

The fish route plots are drawn on plots provided in this CBCL memo.

Ruth Falls Fish Passage Background

Fishway Layout and Operation

The Ruth Falls concrete fishway passes fish well based on the modeling and observations and does not need any modifications. Measurements taken showed some pools had a slightly larger drop than others, but this is due to either plugged drain holes or materials built up in the pool, is well within the proper operating range of depth, and this will be fixed when the fishway is dewatered. The notch width is 1.75 ft, with a typical water depth of 1ft over the crest of the notches. The pool size is 8 ft wide by 10 ft long with a sloping floor, containing a water depth of 2 ft at the upstream end and 3 ft at the downstream end. There is a range of velocities in the notches with the maximum velocity of 1.2m/sec (3.9 ft/sec). The EDF in the pools is 1.8 (ft-lb/s-ft3) and the fishway flow is 6 cfs Velocities are lower at the bottom and especially in the corners of the notch as the water level in the pool below backs the water level up to the crest of the weir for a combination plunging and streaming flow which is better for fish passage. This notch design is very good for fish passage and the operating depth range at or a few inches above 1 ft must be maintained.

Current flow requirements

The current fishway and flows were modeled with the minimum depth over the concrete fishway notches of 1 ft, the minimum fishway flow of 6 cfs, the minimum louvre flow of 29 cfs, and the stoplog leakage and spill of 65 cfs. Some of the stoplog leakage increases the flow in the lower fishway channel section but the amount is not known and was included in the gate release as the new dam will not have any leakage along this part of the dam.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events when the Ruth Falls headpond elevation is at 33.3 m (109.4ft). These supplemental flow events are scheduled to complement significant inflow events, where a significant inflow event is defined as greater than or equal to 24 mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. A supplemental flow event is defined as release of water exceeding 50 cfs immediately downstream from the discharge point for a minimum of 12 hours released overnight. These flows are intended to attract salmon out of the tide and to migrate upstream. These supplementary flows are not modeled and would fall between the modeled current flows of a minimum of 6cfs from the fishway, 29 cfs from the louvre outfall, 65cfs from the gates for a total of 100cfs and the modeled flows of 200cfs.

Refurbished Dam Layout and Operation

The plans for the dam refurbishment were used to identify where there will be fish passage issues, where changes may need to be made to the flow requirements and flow patterns to provide good fish passage following the refurbishment.

Changes to the flow pattern

The current fishway flow does not provide significant attraction flows on it own. The stoplog leakage along the fishway channel at the toe of the dam does not add enough flow to significantly improve attraction, and this leakage equivalent can not be provided through the new rubber dam spills. The design of the fishway channel that runs along the toe of the dam was designed for salmon but does not meet the proper design criteria even for them with inline small size notches, pools with various lengths, widths, and depths, plus flow over the lower weirs even in low flow, and excessive pool turbulence when additional flow is added from the spillways to provide entrance attraction. This section of the fishway is poor, so a redesign is needed with additional flow.

The fishway channel weirs will be replaced by 11 new weirs that will handle the fishway flows plus the louvre flows. This provides a good flow of (35cfs) at the fishway entrance to attract fish under various gate releases (Thaumas 2023 a).

The gate flows are released at different depths with the two outside gates releasing at the river surface water level, parallel to the surface, so there are high velocities across the surface in the river but not at depth. The center gate releases deeper in the river and affects velocities right to the bottom where the salmon, trout, and eels swim and at mid water where the migrating gaspereau swim in this depth of water. This flow energy dissipates quickly in the deeper water vs the other two gates that show high velocities across the surface.

To provide a consistent downstream flow and minimize the back eddies, especially in front of the fishway, the flow has been distributed between the three gates. Various combinations were modeled, and the best was 20 cfs from the west gate, 40 cfs from the deeper center gate, and 5

cfs from the east gate closest to the fishway. The rock in front of the west gate will be removed and the bathymetry in front of the fishway has been smoothed.

This combination of flows will need to be checked when operational to get the best balance of flows from the gates as the bathymetry in the area is not very detailed so the model only gives a good indication of the flows and velocities but may not be giving the best combination of gate flows.

The fish passage migration routes are predicted based on the swimming abilities, distance against the velocity, behaviour, and required water depth for Gaspereau, Brook trout, Salmon grilse, multi-sea-year Salmon, and American eels. These species requirements span the upstream passage requirements for all the species that need to migrate up past the dam to complete their life cycle.

The fishway operation is the same under all scenarios. It is only the gate flows that change.

Fish Swimming Performance Background

Loss of habitat connectivity due to built structures is among the greatest threats to freshwater fish populations. Re-establishing river connectivity through fishways can be an effective and cost-efficient method of enhancing the watershed's productivity, but many are unsuccessful due to flow patterns in the tailrace, location of the fishway entrance, poor attraction flows without suitable velocities, and within the fishway due to excessive turbulence due to low pool volumes, high velocities and low water depths in the notches, and poor notch design, that are not suitable for migration and resting for all the species that require passage.

A good understanding of swimming performance and behavioural response to hydraulic conditions for all the species present is needed to assess fish passage and migration conditions in the following locations: the river below to determine where the fish will approach the dam, near the dam face for fish searching for the fishway, and in the immediate area around the fishway entrance for attraction and entrance conditions.

Ideally a fishway including the entrance attraction flow in the river should allow fish to continue their upstream and downstream migration with no delay, added risk of predation, or extra energy expenditure compared to the natural migratory route, and without reducing fitness due to stress, disease, or injury (Castro-Santos, 2009). Evaluation of fish pass effectiveness is largely dependent on determining attraction, for example the percent of migrating fish in the dam tailrace that are able to find the fishway entrance without delay, the proportion of fish that approach the fishway and enter, and the proportion of the fish which successfully ascend/descend and the related efficiencies and length of delay (Castro-Santos, 2009; Bunt, 2012).

It has long been recognised that the success of mitigation measures to maintain freshwater connectivity are dependent on a good understanding of fish swimming ability (Brett, 1964). Water velocities exceeding the capability of the individual species and related fish size will prevent passage, therefore this is the main ecological metric accounted for in fishway design

(Clay, 1995). Fishway length, slope, dimensions of pools, water depths, weir, the design of slots and orifices, and the frequency and size of resting pools all have to be determined based on the resultant water velocity and depth and the ability of fish to move upstream (Clay, 1995; USFWS, 2019). Perhaps most importantly, the fishway entrance and its attraction flow must be located properly with a strong enough flow to be detected by fish within the dam tailrace without excluding weak swimming species (Weaver, 1963).

Literature Background

Despite a long history of research into fish swimming abilities (Katopodis & Williams, The development of fish passage research in a historical context, 2012), fishway attraction and passage efficiencies remain highly variable (Bunt, 2012; Noonan, 2012). As swimming ability depends on fish species and life stage (Katopodis & Gervais, 2012), where there has been historically a bias towards designing fish passes for strong swimming salmonids on their spawning migration, which has been widely blamed for low efficiencies for other species and life stages (Petts, 1989; Mallen-Cooper, 2007; Katopodis and Williams, 2012; Foulds and Lucas, 2013).

The widespread swim chamber methodologies used to quantify swimming ability have also come under recent criticism. Several studies have shown that data obtained in swim chambers can underestimate swimming ability and result in conservative fishway and migration flow velocities, which can be a problem for upstream passage route determination and attraction to fishway entrances. These studies are also limited by the size of fish studied and the water temperature, so swimming ability is often extrapolated from younger life stages but seldom reflect the temperature effects both positive and negative. Oxygen levels in the water are also critical but not reported in most the swimming tests. Also, fish muscle function is related to water temperature (Brett and Glass 1973; Bernatchez 1985) which has a strong influence on both swimming ability and fish behaviour which are not fully accounted for in these studies. (Plaut, 2001; Peake, 2004a; Peake and Farrell, 2006; Tudorache *et al.*, 2011; Castro-Santos and Haro, 2006). It has also been shown that the habitat the fish is reared in, fast flowing stream vs a lake or pond, affects their swimming ability and endurance (Jones P. E. 2020).

Basing designs on swimming ability alone has resulted in a lack of consideration of a fish's behavioural response to the hydraulic conditions they experience, which may improve, prevent, limit, or delay passage (Castro- Santos and Haro, 2008; Castro-Santos, T. (2005; Enders *et al.*, 2017; Rice *et al.*, 2010; Williams *et al.*, 2012). Fish behaviour including preferred migration velocities they swim against and swimming depth; orientation to the bed and banks; and the use of currents and turbulence patterns they use to ride upstream reducing energy expenditure while for some species, maintaining a preferred ground speed, all need to be considered but not well studied if at all for the species present at this site.

The Biology of Fish Swimming Abilities

Fish swimming behaviour uses different speeds that have been classified into four modes based on the muscles activated and the relationship between speed and endurance. The four modes are sprint, burst, prolonged and sustained swimming (Beamish, 1978; Nelson *et al*., 2002).

Sustained speed (also known as continuous or cruising) can be maintained for long periods, primarily using energy derived from aerobic processes to power red muscles (Brett *et al*., 1958), and is used for holding, resting, and routine movements. Water velocities in structures and rivers below a fish's maximum sustained speed are passable regardless of the distance covered. This is often recommended for very long culverts, fishway pools, at the approach to fish screens, and for resting areas (Peake *et al.*, 1997). During laboratory tests a time limit of 200 minutes (recommended by Brett, 1967) is often used in endurance tests, after which time it is assumed, fish are swimming at sustained speeds. However, 60, 100, and 120-minute-long trials are also common (McDonald *et al*., 1998).

Prolonged swimming uses both aerobic and anaerobic processes to power red and white muscle fibres, with an increasing contribution from the white muscle at higher velocities. Prolonged speeds are those resulting in fatigue following a swimming duration between 20 seconds to 200 minutes (Brett, 1964). These intermediate speeds are regularly used during ascent of fishways and culverts (Bunt *et al.*, 1999). Swimming at prolonged speeds is also reflected in a gait change for many fish species, whereby more white muscle fibres are used, and anaerobic processes must be increased (Peake and Farrell, 2004). The prolonged speed that fish can swim at decreases rapidly as the time increases, so the velocity that fish must swim against and the time to make it through the river flows or fishway before reaching a resting area, must both be considered. Also, the condition of the fish, how fatigued they are approaching the fishway, and the availability and size of resting areas upon exiting must be considered.

Burst swimming is powered by anaerobic metabolic processes and contraction of white muscle fibres. This high-speed swimming can only be maintained for a short time before a rest period is required for glycogen resynthesis and removal of muscle lactate (Wilson and Egginton, 1994). Burst speeds are usually defined as speeds that result in fatigue within 20 seconds (Beamish, 1978). Short duration, high swimming speeds are essential for predator escape, prey capture and passage through short velocity barriers. Passage success at sluices, pool and weir, vertical slot, and orifice fishways is determined by burst swimming ability (Russon *et al.*, 2011).

Sprint swimming refers to very high speeds that are maintained for only 1 to 5 seconds (Nelson *et al*., 2002, Castro-Santos, 2005). Sprint speed can be used for very short high velocity sites but is normally just used for predator escape and is not recommended for fish migration design, even in very short sections of flow.

Prolonged, burst, and sprint swim speeds can be combined with a glide behaviour. A burst swim speed in a high velocity flow so that the fish is moving faster than its usual ground speed can be followed by a glide, where they continue upstream, but their ground speed slows until the next burst and glide movement. This is used in turbulent flows, in streams with a stepped pool structure, or in baffled fishways where the velocity is high at a baffle and lower or even moving upstream above it.

Critical swimming speed (U_{crit}) is a special category of prolonged swimming first introduced by Brett (1964). The protocol is carried out on fish enclosed in a swim tunnel respirometer, during which the fish are forced to swim against a particular water velocity for a set time interval. Water velocity (and therefore swimming speed) is then increased by a set increment until the individual fails to swim for an entire time interval. Critical swimming speed is calculated as the sum of the ultimate velocity attained and a fraction of the velocity increment proportional to the time spent swimming at the final velocity relative to the full-time interval (Hammer 1995). Although U_{crit} has often been used to estimate maximum sustained speed, it has also been defined as the highest swimming speed that a fish can maintain for a period equal in magnitude to the time interval used in the test (Peake et al. 1997c). Time intervals as low as 2 min, and as high as 60 min are used in these trials, although values greater than 20 min are most common. Critical swimming speed separates the sustained and prolonged performance swim speeds, and it is therefore considered the best available metric for establishing water velocity criteria for fish passage.

The time limits commonly applied to define swimming modes during performance studies (i.e., sprint < 5 sec, burst < 20 sec, prolonged > 20 sec and < 200 sec, sustained > 200 min;) are somewhat arbitrary values. The transitions do not occur at discrete time intervals and are variable between species. Some species move seamlessly between the different modes while others show definite changes in swim speed and gait.

As swimming speed increases the energy derived from anaerobic processes increases. The use of anaerobic energy stores leads to physiological effects, which must be reversed following exercise, through increased oxygen consumption (known as postexercise oxygen consumption). The anaerobic cost of swimming can therefore be studied by evaluating EPOC (excess post-exercise oxygen consumption) and the time needed for oxygen consumption to return to resting levels (Peake and Farrell, 2004). This recovery time after fatigue can be one or more hours (Lee *et al*., 2003; Reidy *et al*., 1995), therefore, fish swimming endurance at a test velocity can also depend on previous exercise intensity (Jain and Farrell, 2003). The migration conditions in the river below the dam needs to be considered as the fish approach the dam, the time spent searching for the fishway entrance, and where they have been able to find suitable resting areas to rest and recover from this exercise before using the fishway.

Water velocities exceeding the fish swimming capability will prevent passage, therefore it is the main ecological metric accounted for in fish pass design guidance (Clay, 1995, FAO and DVWK, 2002). Also, the attraction flow must be strong enough to be detected by fish within the barrier's tailrace flows without excluding weak swimming species (Weaver, 1963). However, other factors such as water temperature, fish condition including both how well fed they are and if they have been recently fatigued, body condition, age, behaviour with respect to the reason for migration such as spawning, feeding, or habitat selection, and physical parameters such as the orientation to velocities, shoreline, substrate, swimming depth, reaction to turbulence both positive and negative, tidal levels, current patterns, and light conditions all are important factors affecting fish swimming ability and behaviour.

Fish Swimming Behavior

Fish have five swim behaviours they use to try to maintain their ground speed while migrating upstream. The five modes can be combined so that the fish use the least effort possible.

Mode one is to swim against a preferred migration velocity that is, for example, approximately 1 to 1.5 body lengths per second for gaspereau, which would be 0.30 m/sec to 0.4 m/sec. This is a velocity range used by most species but varies a bit from species to species. It is a bit higher for the larger salmonids, and slower for most benthic species and smaller species.

Mode two is to use upstream currents along the side of faster flows, both swimming and riding up on them to maintain a preferred ground speed. If the flow is faster than their preferred ground speed, they tend to turn and face into the current instead of riding on it. This is an issue in back eddy flows and in downstream passage locations.

Mode three is to use the vortices, which are small clockwise and counter-clockwise eddies found along both sides of a faster flow moving through slower flowing water. In Karman Gate (Liao 2017) swim behaviour, fish swim along vortices of approximately 1 to 1.5 body lengths, using the side of the vortices that are headed upstream to make upstream migration easier, but they will use smaller and larger horizontal vortices as well. Fish can be seen swimming in these circulation patterns along the side of faster currents.

Mode four is maintaining their preferred ground speed and adjusting their swimming speed along the route as the currents change. To do this they will use sustained, prolonged, burst and glide, burst, and even sprint speeds if needed, but anything more than low prolonged speed, normally used for migration, shortens the distance they can swim before resting.

Mode five is to school. In this mode they create their own turbulence to aid in swimming. The lead fish keep changing but they are still orienting to the flow and physical parameters.

For mode one, when fish are swimming against a constant velocity, a maximum distance needed between resting areas can be estimated. The estimate is conservative as all the other modes save energy and allow the fish to swim further before resting. Fish can switch easily between modes and combine modes as the conditions along the route change. The swim ability modeling has been conservative.

As fish are migrating upstream or downstream, they orient to physical features, such as the banks, the bottom, the water surface, as well as light intensity and direction using sight and adjusting to currents or turbulence using the lateral line. They also orient to chemical cues such as water temperature, salinity, acidity, and the chemical ion makeup that distinguishes individual rivers due to the geology and recent land use using their olfactory and lateral line senses.

Schooling Behavior

Schools of fish adjust in numbers of fish and shape, both in width and depth, to match conditions. This often puts fish deeper and shallower than the depths noted below. The schools are a predator avoidance technique as well as for swimming assistance, so they can be very large and come in a continuous stream when the fish numbers are high. As an example, early and late in the migration run the numbers are small and the upstream movement for gaspereau occurs in the early morning and at dusk in otherwise ideal route conditions (Alcott 2021). Schools at this time can be as small as 3 or 4 fish. When they are running strong, the highest rate of passage or greatest numbers of fish are migrating in the afternoon to early evening. The fishing weirs use the gaspereau's orientation to the physical stream profile and flows to guide them to the dipping station location (Peake 2008) using a guide wall, which is a simulated diagonal riffle creating shallower and faster flow that the fish avoid and lead along to the upstream end. Individual species behaviours will be noted below.

Passage Depth

The next thing to consider is the depth the fish are swimming at, as the flow velocity and patterns change with depth and fish also need a minimum depth for safe passage, which for most fish is a minimum of 1/3 the body length, although a water depth of two body depths is often recommended. Alewife, for example, move up and down in the water column with the light level. Typically, in deep water, if they are not crowded, they swim with their dorsal fins at the secchi disc depth (the point where a white object disappears), which changes with the light level. So, they will be deeper in the sunlight and shallower in the early morning, evening, and at night. In shallow water they swim at mid water. Other species such as trout and salmon orient to the bottom in shallow water and eels always orient to the bottom no matter what the depth is, in rivers, lakes, and estuaries. This behaviour is likely due to a combination of a need for cover from predators and the light level to see for orientation. However, they will all make short term movements into other water depths.

All species, if they are crowded by a migration restriction, such as approaching an obstruction like a dam, can fill the water column. If there are not suitable holding or resting areas providing enough space for each fish, some will fall back. Also, in a crowded environment fish have trouble orienting to flows as they are blocked by other fish. This over crowding often happens in fishway pools where they are trying to rest or orient to the flows, or when there is a change in light levels, all creating a passage barrier which should be avoided.

Upstream and downstream fish passage routes are complex to plot as the fish behaviour and response to conditions is variable, but general routes and bounds can be established.

Fish Swimming Speeds and Behaviours by Species

Based on the available literature and fish swim speed models, criteria have been developed to guide the assessment of fish passage in the river and the lower fishway. The fish size selected is the mean size of the smallest spawning adults and the velocity and endurance are set for the fish's ability to successfully pass 97.5% of the time for a fish of this size. This means excellent passage potential for larger individuals and lower passage potential for the smallest individuals in a population.

Gaspereau

This group includes Alewife and Blueback Herring. Adult Alewife are usually 25-35 cm, and Blueback Herring are often 20 cm (Scott & Scott, 1988). They are present in the tide from late March until Fall. They begin running into the river mid to late April, when river water temperatures are above 9°C, and end in late June (Jessop 2003). They are expected to run at dawn and dusk in the early and late run times and peak in the late afternoon early evening during the main run, but it can be any time of the day (Alcott 2021). Timing is mainly driven by water temperature. They use visual and lateral line cues to orient upstream in water with all velocities less than 0.30 m/sec and in turbulent or back eddy flows.

For their size gaspereau are better swimmers for short distances than the salmonids but do have issues with currents hitting them from the side that the salmonids don't, something we must watch for where the currents come a right angle, or the side turbulence/circulation pattern velocity is high. The model does not show these small circulation patterns but clearly shows the flows from the fishway and gates. While they can swim a bit faster than salmonids of the same size, they have less endurance so the distance they can swim against a current is less.

Table 1: Swimming Speeds by Time for 250 mm gaspereau in m/sec (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 + seconds
97.5	3.19	1.82	0.723	0.614	0.465	0.299
87.5	3.49	2.00	0.792	0.673	0.529	0.327
50.0	3.97	2.27	0.901	0.765	0.579	0.332

Brook trout

Sea trout that overwintered in the estuary will follow eels, and gaspereau into the river on feeding runs and will go back and forth following the food supply, staying in the estuary when the river temperature is >20°C. There is a spawning run in the fall following the fall rains with spawning in mid October to mid November depending on flows and water temperatures. They can move from the estuary to freshwater several times a year and may stay in the freshwater. Adults range in size from 20cm to 55cm, with a mean length of 35 cm (MacMillan & Madden, 2007).

Table 2: Swimming Speeds by Time for 350 mm Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.64	1.20	0.672	0.608	0.511	0.388
87.5	2.22	1.57	0.883	0.789	0.671	0.510
50.0	3.27	2.31	1.300	1.18	0.988	0.751

There are also resident Brook trout that are generally smaller and may also need to pass upstream at the dam for spawning or feeding runs. The criteria for the smaller resident trout are the same as for the generally larger sea run Brook trout but this assessment focuses on the smaller trout averaging 20 cm in length.

The length assessed for swimming capabilities was 200 mm. Trout rest in velocities of < 0.2 m/sec and hold in velocities of 0.2 - 0.3 m/sec (Tudorache 2011). Their preferred migration velocity is 0.3 to 0.4 m/sec, which 20 cm long trout can swim against for 16 m (Katopodis 2016).

Table 3: Swimming Speeds by Time for 200 mm long Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Atlantic salmon

Salmon may come out of the tide at any time of the year if the water is under 20˚C and there is a good flow. There are spring, summer, and fall runs, with the latter being the spawning run. They wait in the tide until water temperatures are generally between 9°C and 20˚C and flows are high enough to provide a water depth > 2 body depths in shallow reaches of the river. Normally they will move upstream at dawn and dusk, but it can be at any time of day. Spawning runs can continue till freeze up or late December.

Salmon use freshwater cues to migrate upstream and strongly orient to the flow. Salmon will need velocities under 0.2 m/sec for resting and can hold oriented to the flow in velocities of 0.2 – 0.4 m/sec.

Salmon are strong swimmers and can go long distances between resting areas. The ability of Atlantic salmon to swim for long distances against relatively strong currents, makes it easy for them to go up the fishways. It also gives them an advantage navigating the eddies and fast flows present in the tailwater. They have a good chance of navigating the currents, finding the fishway, and swimming up it before needing to rest.

Grilse

Atlantic salmon Grilse range in size from 450 mm to 600 mm in length and 500 mm was used for assessment. They have a preferred migration velocity 0.4 to 0.5 m/sec, which they can swim against for 110 m (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016).

Table 4: Swimming Speeds by Time for 500 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	2.11	1.49	0.84	0.759	0.639	0.458
87.5	2.78	1.96	1.10	0.998	0.839	0.637
50.0	4.09	2.89	1.63	1.47	1.24	0.938

Atlantic salmon multi sea year

The larger multi sea year Atlantic salmon are 850 mm to 1050 mm long (Reid 2012). The length assessed for swimming ability was 1000 mm. They have a preferred migration velocity of 0.4 - 0.55 m/sec, which they can swim against for 340 m (Katopodis 2016).

Sufficient water depth over the bedrock sills in this river is an issue for multi-year Salmon at Ruth Falls, especially in the lower flows.

Table 5: Swimming Speeds by Time for 1000 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	3.26	2.30	1.30	1.17	0.985	0.78
87.5	4.29	3.03	1.70	1.54	1.29	0.983
50.0	6.30	4.46	2.51	2.27	1.90	1.45

American Eels

American eels live in both the estuary and the freshwater. Access to the freshwater is needed as most of the females develop in freshwater habitats. Some of the eels will move in and out of the estuary several times during their life.

The eel tiles that are proposed to be used contain two different sizes of pegs. The smaller pegs have a space of 17.5 mm between them and will pass elver and yellow stage eels up to 25 cm long. The larger pegs have a space of 29.6 mm between them and can accommodate eels up to around 44 cm long, based on a body depth to length ratio of 0.068 cm (Berry & Escott Ltd., 2020). The larger eels are capable of swimming up through the main fishway.

Yellow stage eels and silver stage eels and lamprey require downstream passage. They travel on the bottom with occasional movements up the water column.

American eel elvers 60 mm long

Elvers will begin their upstream migration in mid March. They will use the eel pass. They have a swimming ability of 0.11 m/sec for 60 sec, which results in very short distances between resting areas. They tend to use upstream currents along the edges of rivers to aid passage.

Table 6: Swimming Speeds by Time for 60 mm long American Eel Elvers in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.367	0.221	0.0948	0.0817	0.0634	0.0423
87.5	0.456	0.274	0.118	0.102	0.0787	0.0526
50.0	0.621	0.373	0.160	0.138	0.107	0.0716

Yellow stage American eel (200 mm)

Yellow stage American eels do not move around until water temperatures are above 12°C. The eel pass has a section suitable for the passage of yellow stage eels under 45 cm long. 20 cm long eels have swimming speeds of 0.35 m/sec for 60 sec and they travel very short distances at a time.

Table 7: Swimming Speeds by Time for200 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.836	0.503	0.216	0.186	0.144	0.0964
87.5	1.04	0.625	0.268	0.231	0.179	0.120
50.0	1.41	0.850	0.365	0.315	0.244	0.163

Yellow stage American eel (600 mm)

These eels will be too big for the eel pass, but they do have a strong swimming ability 0.87 m/sec for 60 sec and modeling shows they can pass though the fishway near the bottom surface or along the edge of the notches. They prefer to travel short distances at a time which would be limiting. They also use the drain hole orifices at the bottom of the baffles.

Table 8:Swimming Speeds by Time for 600 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.77	1.07	0.457	0.394	0.306	0.204
87.5	2.2	1.32	0.568	0.490	0.380	0.254
50.0	3.0	1.80	0.774	0.667	0.517	0.345

Lake Species

The following species were found in the reservoir above the dam and do not need to pass to complete their lifecycles.

Yellow Perch

Yellow perch are freshwater fish but may be found in brackish water up to 10 ppt. they use a wide range of habitats from large lakes to ponds to slow moving sections of rivers or the upper estuaries. They are most abundant in open water of lakes with moderate amount of vegetation.

They spawn in the spring in from mid April to early May along the shallow shoreline of lakes or in the tributaries. They live up to 9 years and are 200 mm to 300 mm when caught by angers (Scott & Crossman, 1973).

Brown Bullhead

The Brown bullhead is a freshwater fish that lives in lakes and ponds but may venture into brackish water. They spawn in late spring or early summer in shallow water along the shoreline of lakes and ponds. Most adults are between 250 mm to 300 mm long (Scott & Crossman, 1973).

White Sucker

White suckers generally live in warm, shallow lakes and tributary rivers of larger lakes. They are bottom feeders and have been known to live for up to 15 years, reaching sexual maturity at age 5-8. In the spring, they begin migrating to spawn when daily water temperatures stay above 10°C. They often move out of the lake to spawn in tributary streams with shallow water and gravel bottoms, but they sometimes spawn on the lake margins. They move off the spawning

grounds 10-14 days later. The young begin to migrate into the lake about a month after spawning beginning when they are around 15 mm in length (Scott & Crossman, 1973).

The sizes of White suckers are difficult to determine as they grow at different rates depending on sex and location. A 200 mm average size was used for the assessment which is typical of the spawners seen on the eastern shore.

White suckers do not need to pass by the dam to complete their lifecycle, but they are strong enough swimmers that they should be able to get up the fishway if they choose to or accidentally go down the downstream bypass.

Table 9: Swimming Speeds by Time for 200 mm long White Sucker in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Minnow Species

Minnow species do not need to pass the dam to complete their lifecycle. Both minnow species identified were found in the reservoir above the dam and will spawn on the margins of the lake.

Golden Shiner

The Golden shiner, (*Notemigonus crysoleucas)*, has an average length of 76 – 127 mm and has a golden colouration. It is a lake fish, and moves in schools in weedy, shallow areas. Spawning occurs when water temperatures reach 20°C over filamentous algae or aquatic vegetation (Scott & Crossman, 1973).

Lake Chub

Lake chub (Couesius plumbeus) are a freshwater fish found in lakes, ponds, and streams. They move from the lakes to streams in early spring to spawn usually in April. They are a large minnow that can reach 150mm in length and even larger if they have been in brackish water. Average length of an adult is 10 cm (Scott & Crossman, 1973).

Table 10: Swimming Speeds by Time for a 100 mm long minnow in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.773	0.546	0.307	0.278	0.234	0.177

87.5	1.02	0.718	0.404	0.365	0.307	0.233
50.0	1.49	1.06	0.594	0.537	0.452	0.343

Summary of Passage Metrics for all Species

Figure 1: Swim distance vs. water velocity for the species present shows how far each of the species requiring passage below the dam can swim over a range of water velocities (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020). For this graph average fish sizes were used and swim distances are those at which 97.5% of fish of that size will be able to achieve.

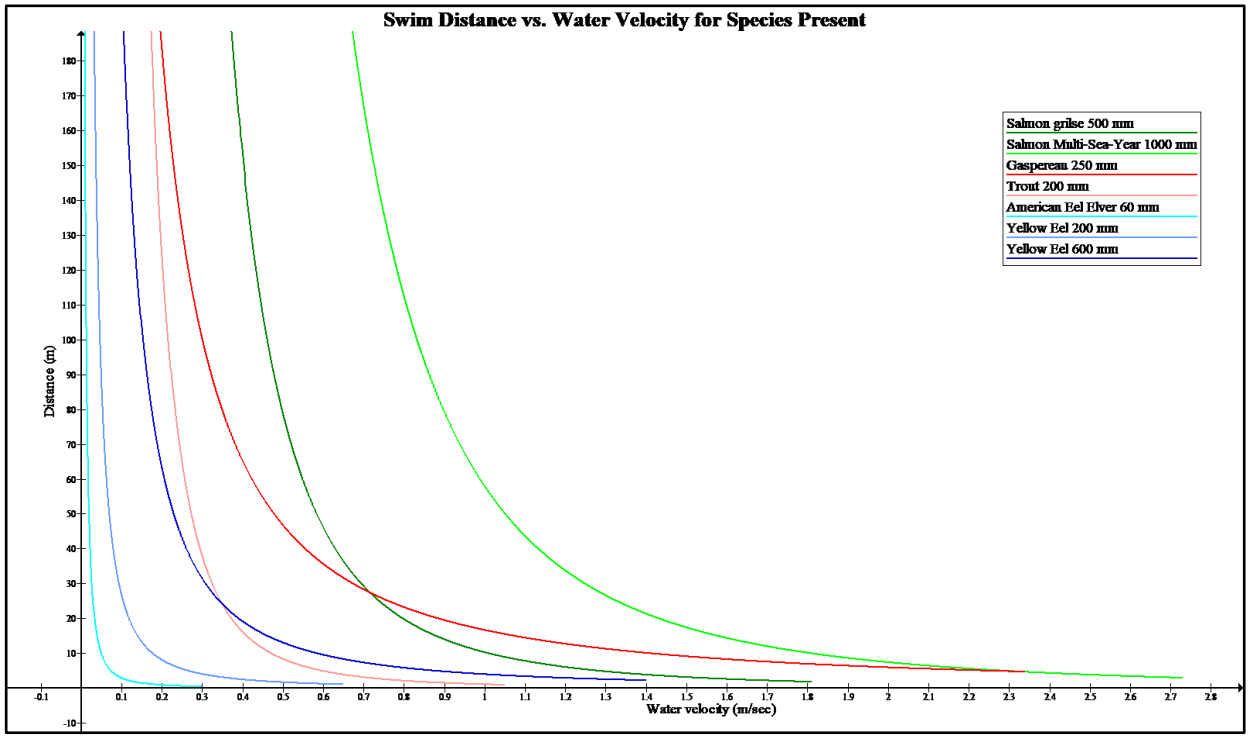


Figure 1: Swim distance vs. water velocity for the species present at 97.5% passage

Table *11* shows the same information for swim distance vs. velocity as in written form above, with categories for distances matching those from the modeling. The table also shows the body depth of the fish and the minimum depth required for passage, based on the largest of each species. The body depth is taken from US Fish Passage Engineering Design Criteria (2019), but the minimum passage depth was taken as 1/3 of the length of the largest fish size to accommodate extended dorsal and ventral fins. Eels are the exception to this, as they have a small body depth for their length. Ideally, the eels would have three times the body depth for safe, comfortable passage (US Fish and Wildlife Service, 2019).

Table 11: Distance before resting for each modeling category at 97.5% passage (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Species	Gaspereau	Trout	Salmon Grilse	Salmon Multi-Sea-Year	American Eel Elver	Yellow Stage American Eel	Yellow Stage American Eel
Average Size (cm)	25	20	50	100	6	20	60
max size (cm)	35	55	60	105	7	45	100
Max body depth (cm)	8	14	13	23	0.5	3	7
Depth required for passage (cm)	12	18	20	35	0.5	3	7
Velocity range (m/sec)	Distance before resting (m)						
0 – 0.15	Resting	Resting	Resting	Resting	1 – 3	15 – 30	Resting
0.15 – 0.3	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	< 1	5 – 15	30 – 100
0.3 – 0.35	80 – 100	25 - 40	225 – 355	>620	No passage	3 – 5	25 – 30
0.35 – 0.4	65 – 80	15 – 25	150 – 225	>620	No passage	3	20 – 25
0.4 – 0.45	55 – 65	10 – 15	110 – 150	>620	No passage	2	15 – 20
0.45 – 0.55	40 – 55	6 – 10	60 – 110	340 – 620	No passage	1	10 – 15
0.55 – 0.72	25 – 40	3 – 6	25 – 60	155 – 340	No passage	< 1	7 – 10
0.72 – 1.1	15 – 25	< 3	10 - 25	45 – 155	No passage	No passage	3 – 7
1.1 - 2	5 – 15	No passage	1.5 - 10	7 – 45	No passage	No passage	No passage
>2	Limited passage	No passage	No passage	Limited passage	No passage	No passage	No passage

3D model results

NSPI requested 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post dam refurbishment downstream flow patterns and velocities as they relate to fish passage. The main refurbishments include the installation of vertical lift gates in the center 3 gate section of the dam which will replace the existing stoplog bays and the installation of new rubber dams along the spillways adjacent to the lower section of the fishway that runs along the toe of the dam. The changes will affect the fishway operation and entrance conditions including the river routes to the fishway for migrating fish.

The diagram of velocities 20 cm from the bottom was used to display the fish migration routes below the dam, as this route best represents the velocities that fish will be traveling though. These velocities are most representative of the mid water velocities that gaspereau will be swimming through and they are the velocities that trout and salmon will be moving through along the bottom. Eels will be traveling directly on the bottom and will find areas with slower moving water as they have a small body depth so can move between cobbles and small boulders on the bottom.

All the fish swimming abilities and behaviours described above have been taken into consideration in determining the migration routes.

Fish migration routes were determined directly from the computer model using all the available models to get a detailed picture of the routes. This included point depths, velocities, and flow direction along the routes. These detailed 3D assessments were transposed on the diagrams.

There are two shallow bedrock sills that fish must pass over to get to the area below the dam. These sills have shallow fast flows that present passage problems for weaker swimming fish, especially as the flows increase below the dam. The first sill is located at around 30 m on the Y Axis of the diagrams and the second sill is located between 65 m and 75 m. Generally, the river flows are very shallow and fast over the sills and become faster as the flow increases. Depth in the dark blue areas is up to 1 m deep and the depth over the rock outcrop sills is shallow except for the one channel near the left bank (looking downstream) which is used by most fish for migration due to both a suitable depth and a passable velocity. The most downstream rock sill shown in the plots may have better passage opportunities than it appears because the velocities and depth here may not be correct since the model's bathymetry is cut off on both banks and the lower end of all models does not have the effect of the downstream bathymetry backwater effect. Further downstream in the river there are several other bedrock sills. Passage over these sills is unknown, so the percentage of fish attempting passage from the mouth of the river that reach the dam is unknown.

The Fish Protection Tools Swim Distance and Velocity tool was used to calculate distances and percentage of fish that have the ability pass along certain routes (Di Rocco, 2020; Katopodis C. a., 2016). The estimates are given in levels for 97.5%, 87.5%, 50%, 12.5%, and 2.5% passage. When swim distance was between levels, the lower passage percentage was used. Passage rates are very conservative, as fish may use other swim modes to decrease energy expenditure, or they may find small eddies behind and between boulders.

The Fishway Flows

The upper, concrete section of the fishway has been designed to operate with 1 ft of water over the crests of the notches with the water level in the pool below equal to the elevation of the notch crest. The velocity in the notches ranges from 1.0 ft/sec (0.3 m/sec) at the bottom up to 4 ft/sec (1.2 m/sec) at mid to surface depth. These velocities are passable by all the species needing to pass using burst or sprint speed over this short distance. Part of the reason for the lower velocities at the bottom is that the water level in the pool below the notch is backed up to at least the level of the notch crest above it when operating with at least 1 ft of water depth. When the notch depth is higher the velocities at the bottom decrease as the notch is further backwatered.

The flow depth in the channel portion of the fishway is now designed to carry 35 cfs at a depth of 1 ft and 9 inches in the notches, backwatered by 1 ft, for drops of 9 inches. This provides easier passage for fish, with a range of velocities in the notches from 1 ft/sec to 6 ft/sec (0.3 – 1.8 m/sec). The pools have good resting areas and a range of velocities for migration.

Fishway attraction velocities extend from the surface to the bottom in the range most fish seek for upstream migration and this is combined with a strong flow along the side of the gate flows to orient fish toward the fishway.



Figure 2: Fishway and entrance area velocities

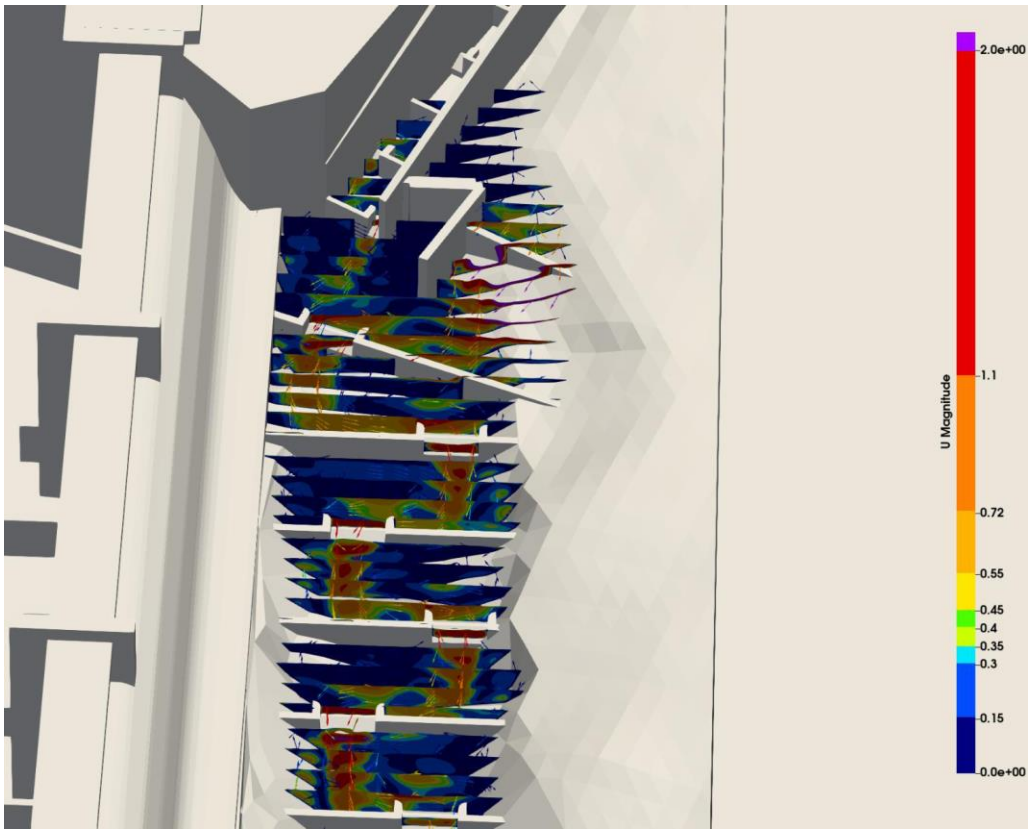


Figure 3: Cross section view of the fishway flows

The velocities in the notches of the concrete fishway are shown in Figures 4 and 5. The maximum velocity shows in the red but is just a maximum of 1.2 m/sec. In the pools, faded out in these screen shots you see the resting areas in the blue and a current through the pool for the fish to follow notch to notch. These velocities are within the swimming ability of all the migratory species with the exception of the smallest eels.

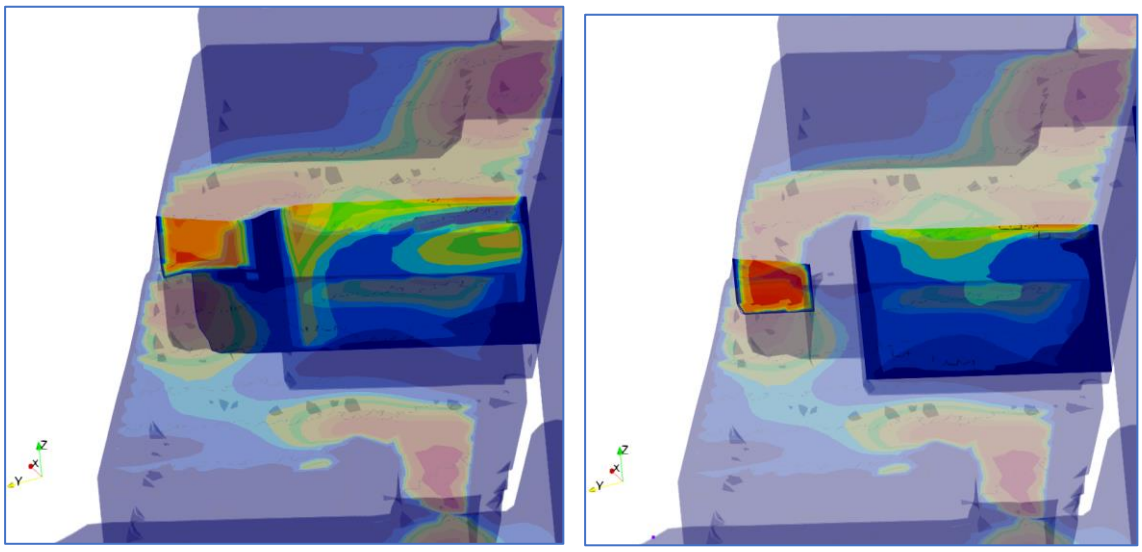


Figure 4: Velocity at top of notch (left); velocity at 23 cm down (right) showing the max notch velocity.

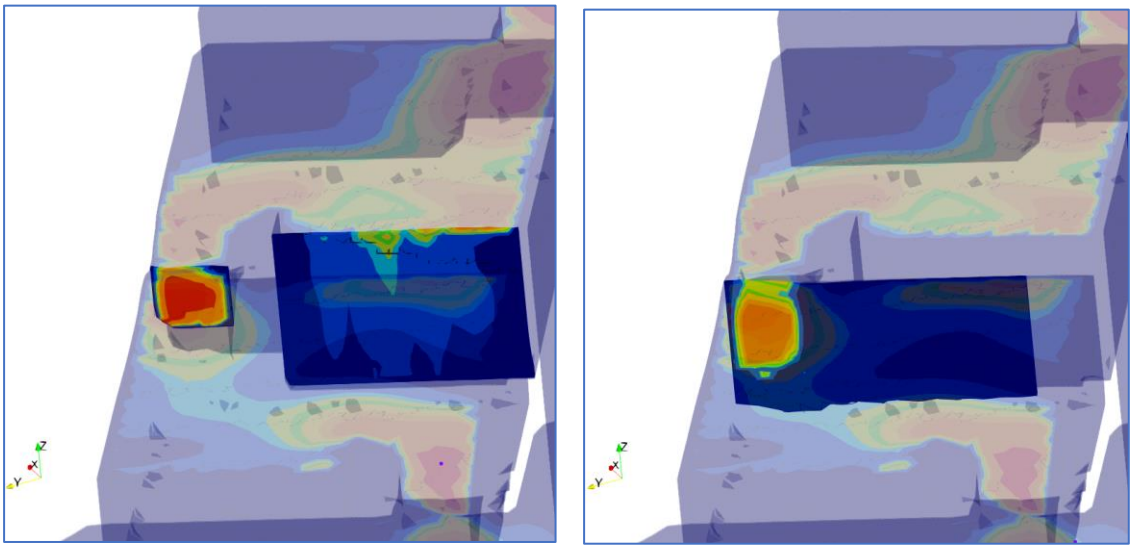


Figure 5: Velocity 46 cm down in notch (left); velocity as notch enters the pool (right)

The velocities in the notches of the channel fishway, shown in Figure 6, with a flow of 35 cfs have a similar pattern to the other fishway but with velocities in the cross sections mid way along the notch range from 1.8 m/sec in the center to 0.8 m/sec along the sides and bottom. Providing good fish passage for all the migratory species except the smallest eels. There are large resting areas and a flow pattern through the pools that has migration velocities.

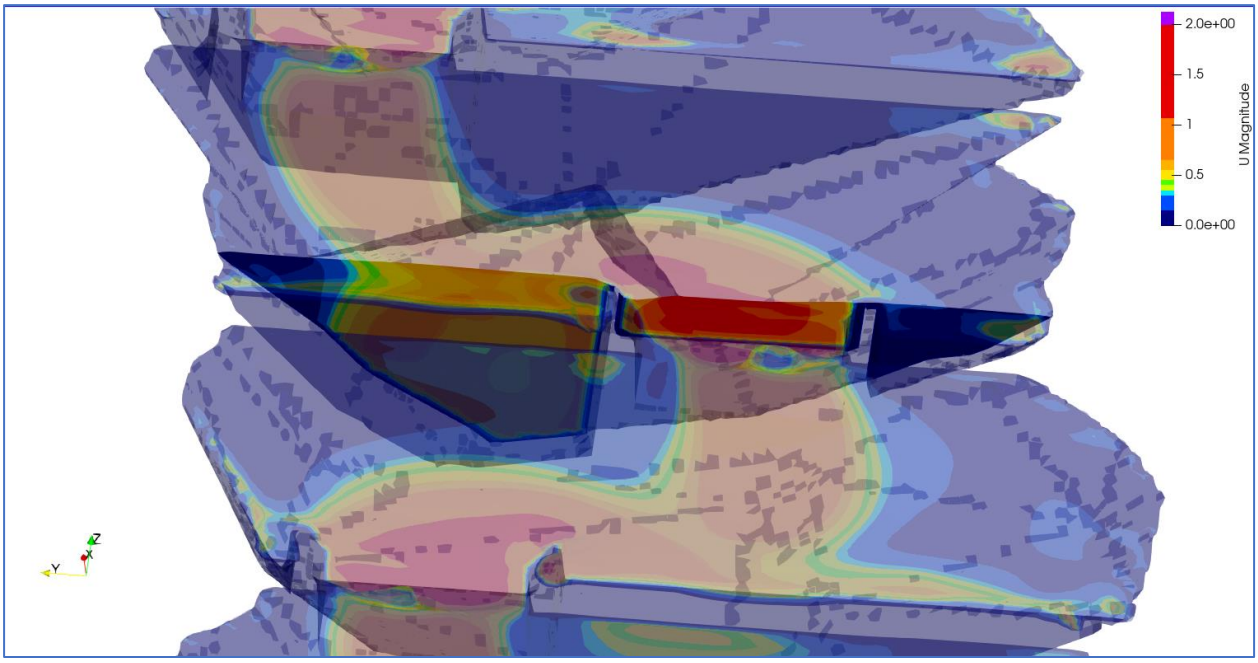


Figure 6 The velocities in the notches of the channel fishway section with 35 cfs flow.

S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

This flow scenario has the best passage for gaspereau, trout, grilse, and eels, but has barely enough water depth for the larger salmon.

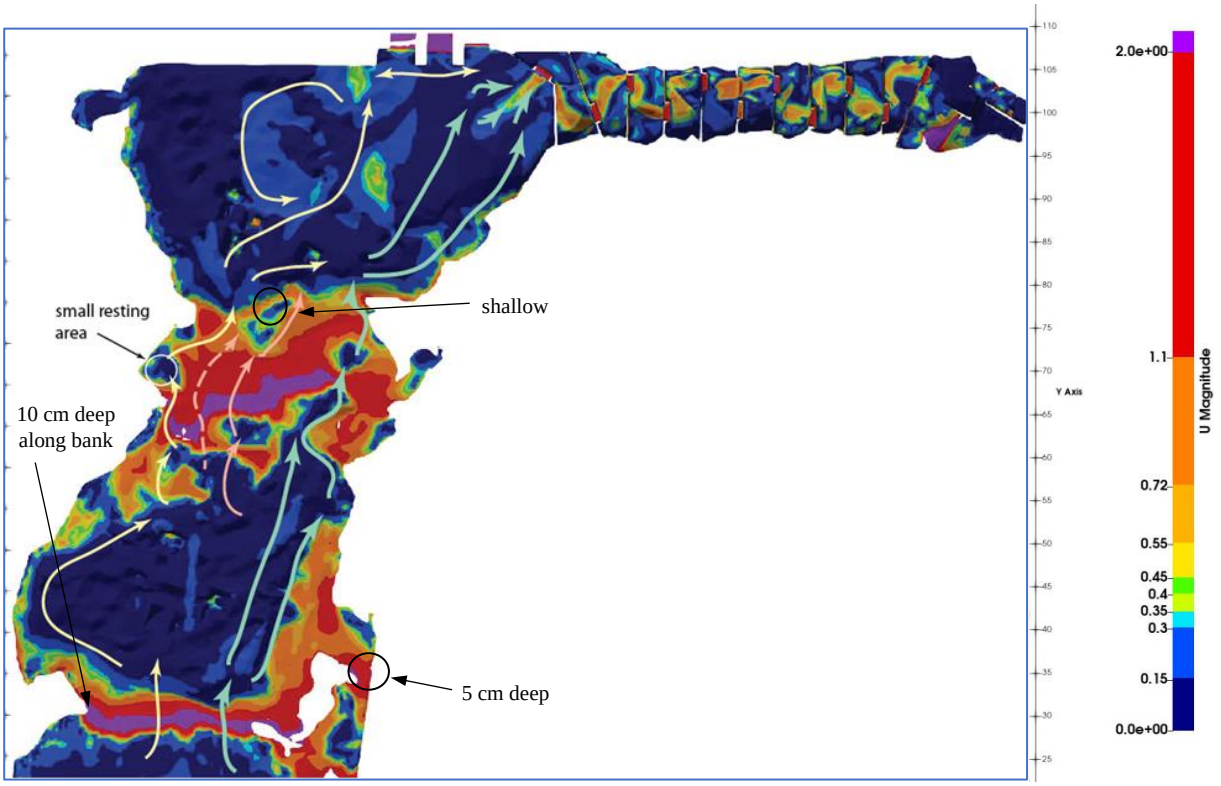


Figure 7: S1 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

The route marked with green arrows follows the main thalweg of the river and will be the most used route for gaspereau as it is the easiest. Using this route fish can avoid velocities greater than 2 m/sec over the first sill by traveling through the deepest channel, where the water is around 30 cm deep, and the velocities are the slowest at depth in this cross-section. Since the distance to get over the sill is less than 5 m 97.5% of gaspereau should make it over. Then they can rest before attempting to go over the second sill, which has lower velocities, under 1.1 m/sec, but the distance fish must swim before resting is much longer, around 20 m. This is within the swimming ability of gaspereau.

The yellow route is the next best route, but limited numbers of gaspereau will be able to use it due to the small size of the resting area on the right bank. Using this resting area, the fish won't have to go more than 10 m in dark orange and reds, which is well within the swimming abilities for the distance involved of 97.5% of gaspereau. Once the resting area fills up fish may fall back.

The route marked with orange arrows is at the edge of how far gaspereau can go without resting. There is 20 m of fast water, with velocities ranging from 0.55 m/sec – 2.0 m/s. Only the strongest fish will choose this route, passing 50% of 250 mm gaspereau. Some may fall back and choose another route.

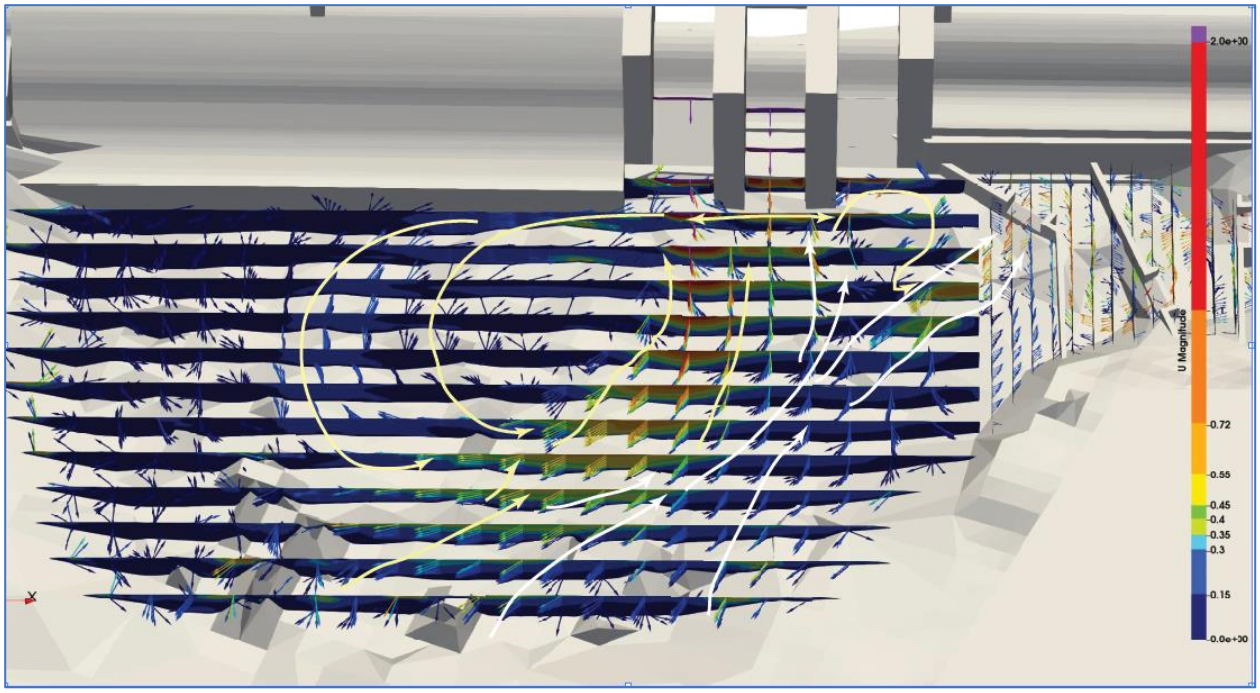


Figure 8: A close up of the routes for gaspereau below the dam with cross-sections spaced at 5 m

It is expected that the gaspereau will gather in the resting areas below the dam for some time to rest before seeking the fishway to move further upstream. The velocities just below the dam are well within swimming abilities of gaspereau and they can choose their preferred velocity to follow. Those on the left bank will easily find the fishway, as the new fishway entrance has good attraction velocities throughout the water column. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross under the main flow to find the fishway or will not have to go too far downstream to be able to cross the surface flow, as velocities near the streambed are well within swimming abilities. The main migration route is in white. The yellow areas the fish will be delayed looking for the fishway.

Trout

Trout are much smaller than the salmon so have a weaker swimming ability. They will have a hard time getting through the fast flows on the bedrock sills. About 50% of 200 mm trout will be able to pass through the green route, 12.5% through the yellow route, and 2.5% through the orange route. Larger Sea Trout will have better passage success. The main route is the white arrows in fig 9 with delays if they take the other routes as they have to search for the fishway.

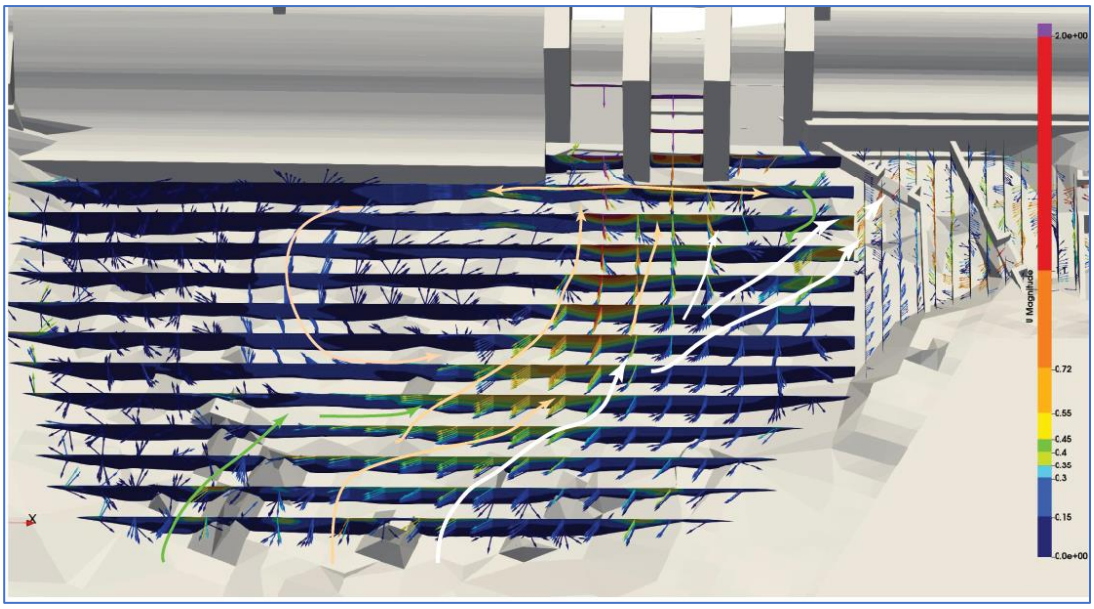


Figure 9: A close up of the routes for trout below the dam with cross-sections spaced at 5 m

Salmon Grilse

Grilse will follow the same routes as gaspereau, the green route will have 87.5% passage, the yellow route will have 50% passage, and the orange line will have 50% passage.

Multi-sea-year-salmon

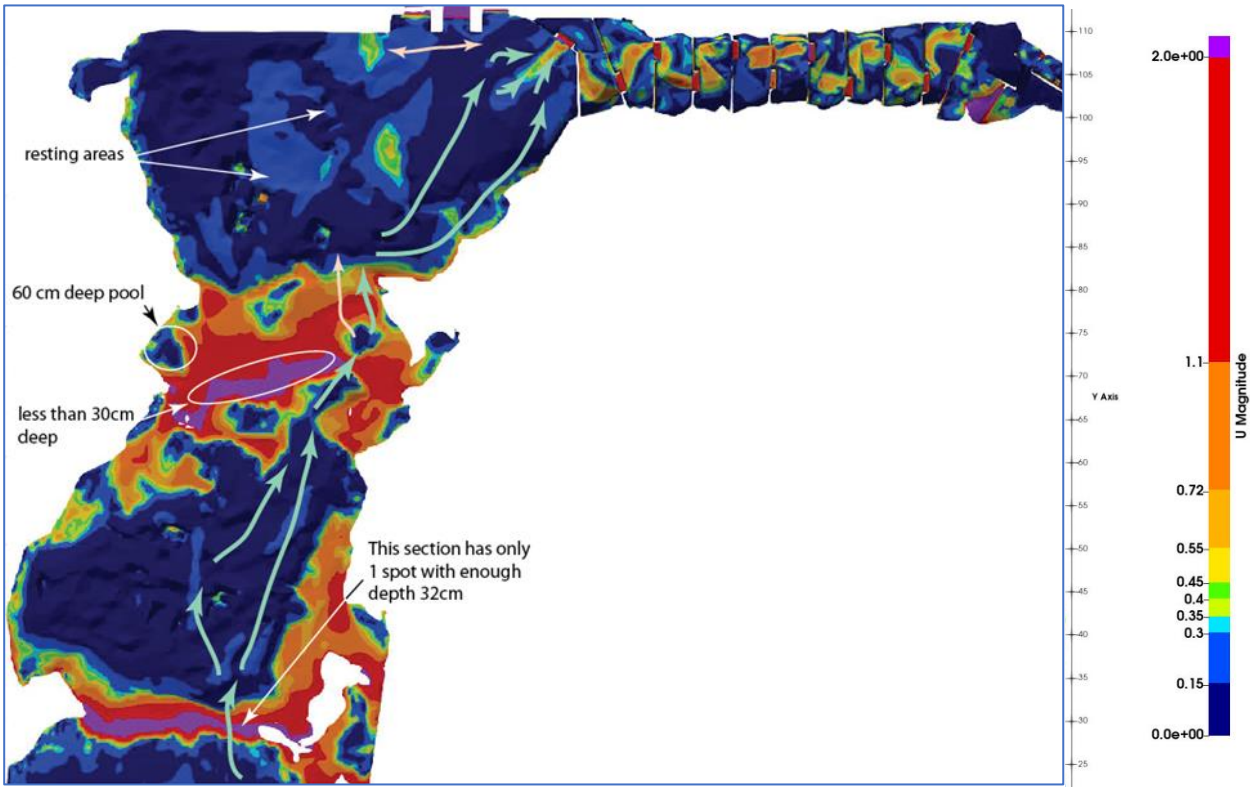


Figure 10:S1 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

The route through the deeper main channel is the only one with enough depth for multi-sea-year salmon to pass. This route has areas with a minimum depth as low as 32 cm. They are strong swimmers and will not have any issues with water velocities on this route.

In the pool below the dam, both lines here are well within swimming abilities of salmon. Those on the left bank will easily find the fishway. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross the main flow to find the fishway. At these flows Salmon will not have to go too far downstream to be able to cross the flow, as velocities near the streambed are well within their swimming abilities.

American eel

Elvers

Elvers can only navigate in the dark blue and medium blue colors (<0.3 m/sec). Velocities over the bedrock sills are too high for them to navigate.

Yellow stage eels

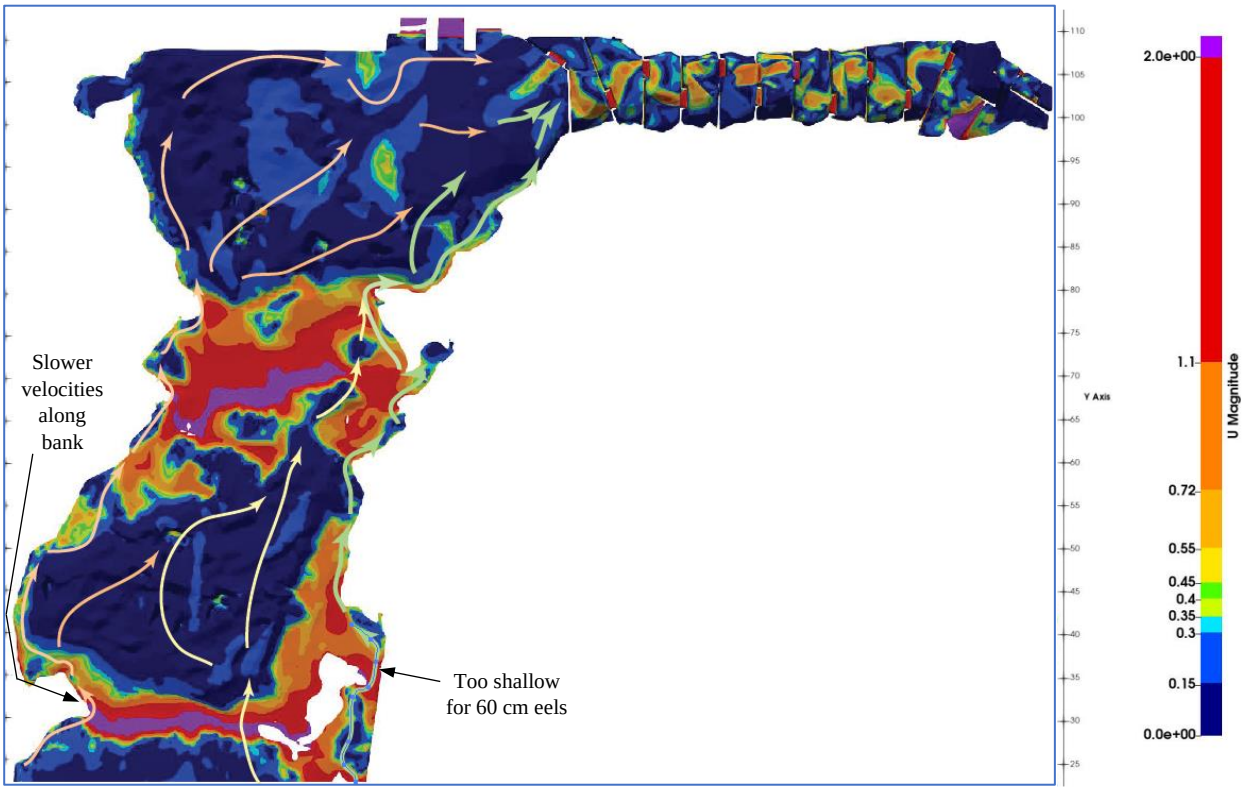


Figure 11: S1 routes for yellow stage eels shown on velocities 0.2 m from the bottom.

The yellow stage eels will be oriented to the bottom. They can navigate comfortably in the blue colors and can't go more than a few meters in higher velocities, so eels will struggle with the high velocities over the two sills but will find large resting areas in between and at the base of the dam to recover. For 97.5% passage they can't navigate in the dark orange, red, and purple colors. The passage rates derived from the model for 20 cm long eels would be very low, varying form 2.5% - 12.5% passage for the different routes, while passage for 60 cm eels would be close to 90%. Actual passage rates may be higher as eels can use small eddies between and behind boulders and large cobble for resting that are not shown within the level of detail of the model.

The orange route that goes up the right bank (looking downstream) from the dam and uses the low velocity water on the river margins, that are mostly under 0.3 m/sec. The eels will need to navigate through some faster water getting around the edge of the first bedrock sill. There is 4.5 m of fast water on the edge of the sill in the dark orange to red coloring, providing passage for the strongest 12.5% of 20 cm eels and 87.5% of 60 cm eels. This route along the right bank margin has around 10 cm of water in it at the shallowest of places, giving enough depth for both sizes of eels. There is a large resting area after the first sill where eels can spread out and rest before continuing along the right bank margins in low velocity water. At the point where the stream narrows near the large pool at the base of the dam there is another short area with higher velocities. In this area the eels can continue along the side and will need to swim through 1.5 m of water with velocities in the light to dark orange range. This short section will pass 87.5% of 20 cm eels and 97.5% of 60 cm eels.

There is a large resting area on the right side of the spill flows where eels can gather before heading towards the fishway. The velocities on the bottom are low, so eels will be able to pass under the spill flow towards the fishway. Eels over 10 cm will be able to go up the main fishway, but eels up to 50 cm long may choose to use the eel pass.

The yellow route goes through the thalweg. Using the deepest area over the first sill lowers the distance that the eels must travel through the fast moving water to 4 m. Velocities over the sill are up to 1.7 m/sec, which is too fast for most 20 cm eels. Passage over this sill will be 2.5% for 20 cm eels and 50% for 60 cm eels. Once eels are over the sill there is a large slow area for resting, where the eels will follow upstream along the bottom. There is some fast water again going over the second sill. Here, there is a deeper channel where the eels will be traveling that stays over 30 cm deep with slower velocities on the bottom. In deeper areas there is a good depth of slow moving water with a velocity under 0.15 m/sec, but in areas where the channel is shallower than 50 cm eels may experience higher velocities of up to 1.1 m/sec for up to 5 m. This section will pass 2.5% of 20 cm eels and 87.5% of 60 cm eels.

The green route follows along the margins of the left bank, looking downstream. One section, about 10 m up along the route is only 4 cm deep so 20 cm eels will fit but 60 cm eels would be partially out of water. In this route eels must swim 5 m through velocities between 0.7 m/sec and 2 m/sec, passing 12.5% of 20 cm eels and 87.5% of 60 cm eels. The route continues along the left bank margins. There are a few places larger eels may have to come further into the main flow velocity to get enough depth. They may have to enter velocities in the range of 0.45 m/sec - 0.72 m/sec for a few meters at a time. The larger yellow stage eels should be able to handle these velocities. There is a narrow area before the large pool at the base of the dam with velocities in between 0.7 m/sec and 2 m/sec along the left bank margin. This area will pass 12.5% of 20 cm eels and 87.5% of 60 cm eels.

From there eels will enter a large resting area and will be able to follow the flow to the fishway.

S2: 6 cfs from the fishway, 29 cfs from the louvre outfall, 165 cfs from the gates

This scenario has worse passage for gaspereau, trout, grilse, and eels, due to higher velocities, but better passage for multi-sea-year salmon, as the water depth increases.

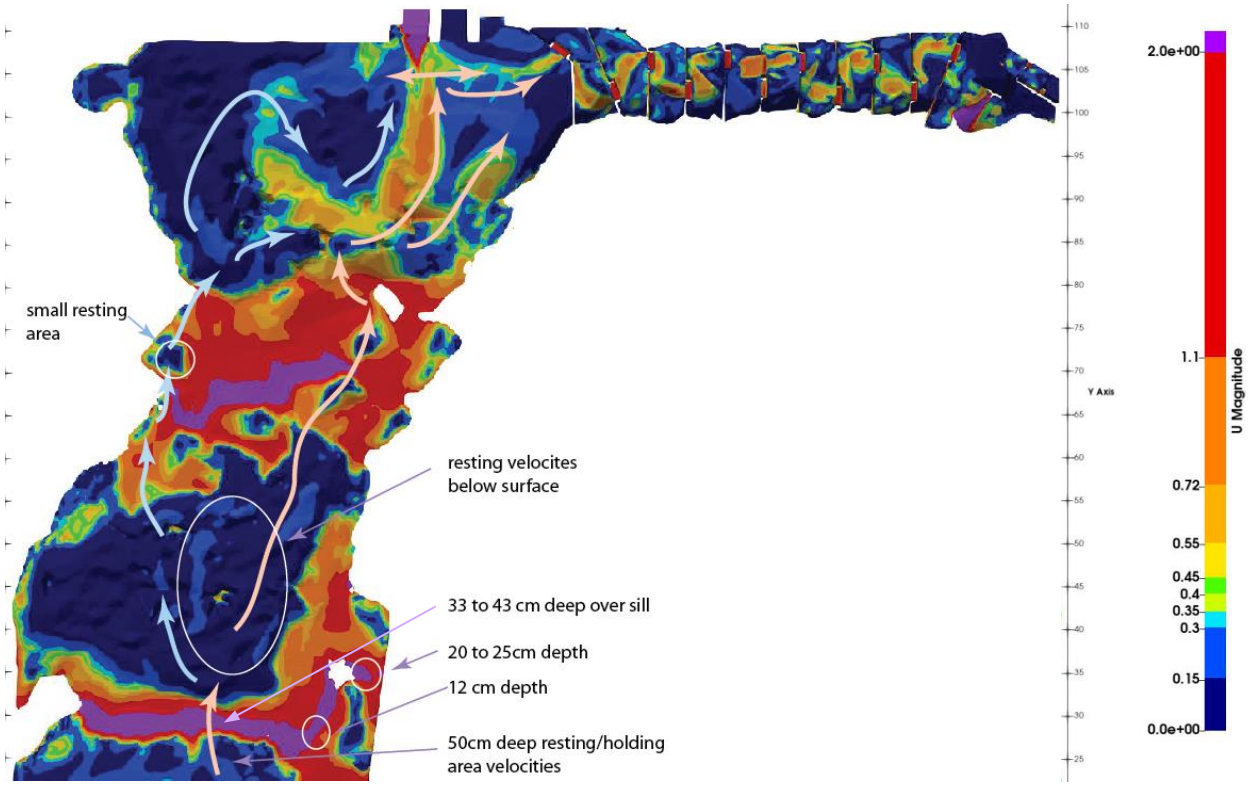


Figure 12: S2 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

Using the orange route gaspereau will have 12.5% passage overall. Over the first sill there is 5.5 m where the gaspereau must pass through velocities of up to 2.5 m/sec. 87.5% can pass over the first sill. Then they enter resting velocities present under the surface flows where they can recover. Over the second sill there are 35 m of fast velocities, mostly under 1.1 m/sec but with a short section with velocities up to 1.5 m/sec, that the gaspereau must pass through, giving 12.5% passage, due to the length of the section.

Using the blue route gaspereau will have 50% passage, but the size of the resting pool will limit the numbers that can use the route. After passing over the first sill, the gaspereau can rest and then head towards the right bank, looking downstream. They must pass through water velocities in the 0.55 m/sec – 1.1 m/sec range for 10 m, then pass through 7 m of water at velocities up to 1.5 m/sec, before reaching a small resting pool. From the resting pool it is another 10 m through velocities of up to 1.1 m/sec before the fish reach a larger resting area. This route will have 50% passage if there is room to rest in the small pool and 2.5% passage once the pool fills up.

There are other routes around the first sill, but none that offer better then 12.5% passage.

Trout

20 cm Trout will have poor overall passage in these flows. Using either route the passage will be 12.5%. On the blue route, once the resting pool is full of fish the passage will be reduced and will be 2.5%.

Salmon Grilse

Grilse will have around 50% passage using either route. They will not need to use the resting pool on the right bank.

Multi-sea-year salmon

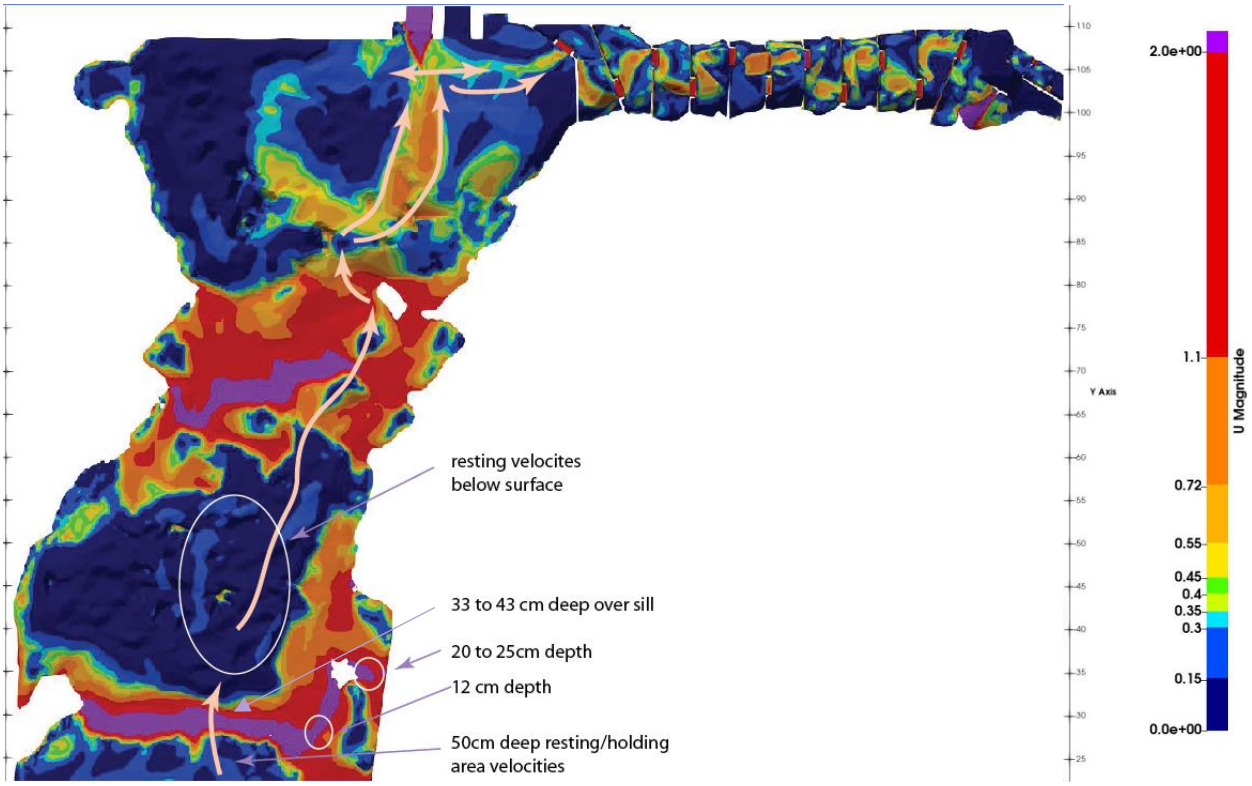


Figure 13: S2 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

There is enough depth in the main channel for multi-sea-year salmon, with 45 cm over the first sill in the thalweg. The velocities going over the first sill are less than 2.5 m/sec. Multi-sea-year salmon are strong swimmers and should be able to overcome these velocities since the distance is only 4.5 m in the high velocities. The salmon can rest after going over the high velocities at the first sill. Then they will continue 35 m through mainly dark orange with a short section of red to the resting areas below the dam. 97.5% of multi-sea-year salmon should be able to swim against these velocities.

American eel

Elvers

The water velocities over the sills are too fast for elvers. Any passage will be along the very edge in shallow areas or back eddies.

Yellow stage eels

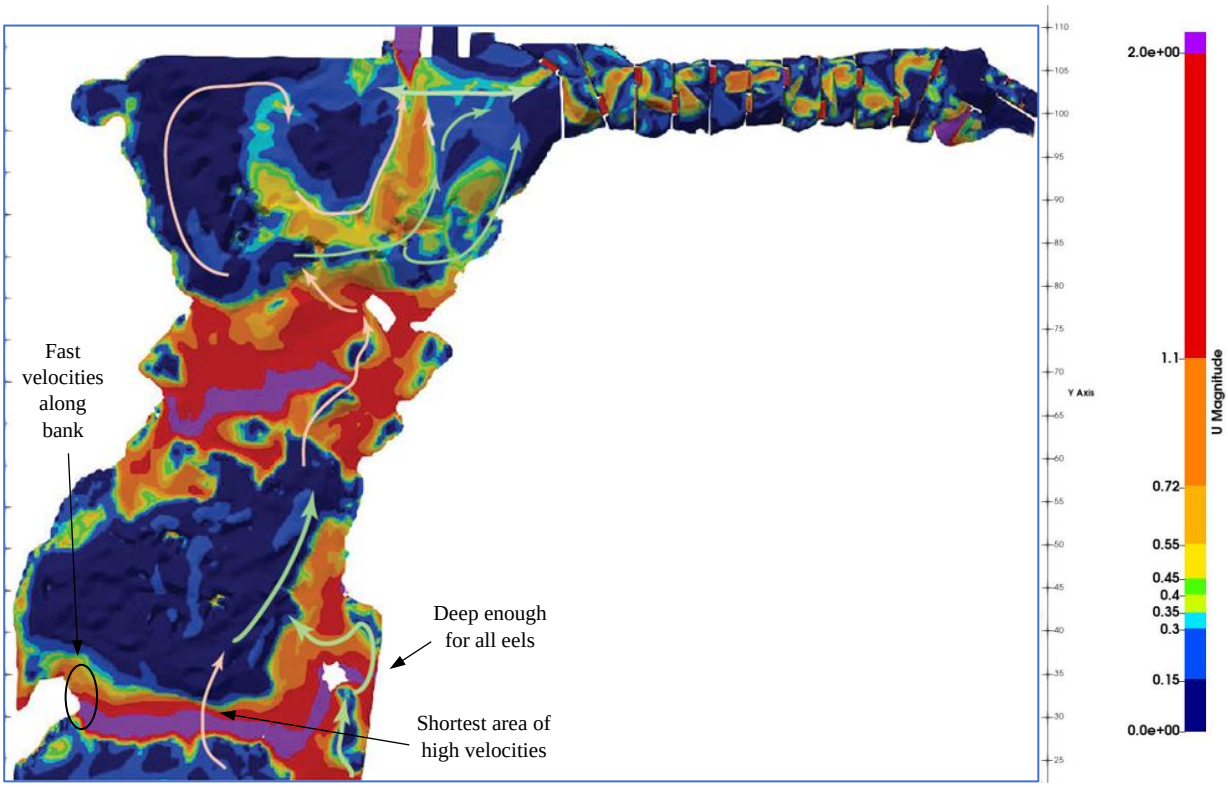


Figure 14: S2 routes for yellow stage eels on velocities 0.2 m from the bottom

Some yellow stage eels will be able to navigate up to the fishway with 165 cfs of spill, but there are areas of fast velocity that will prevent the majority from being able to get past. The velocities will prevent the smaller 20 cm long eels from getting up, but a small number of larger eels will be able to get up. Both routes will pass 12.5% of 60 cm yellow stage eels.

S3: 6 cfs from the fishway, 29 cfs from the louvre outfall, 925 cfs from the gates

At these flows the resting areas in the middle of the channel are almost gone, but there are some eddies with resting velocities that form on the right bank, looking downstream, for fish that are strong enough swimmers to make it over the first sill. Velocities over the first sill are too high for gaspereau, trout, and eels. There will be limited passage for Salmon.

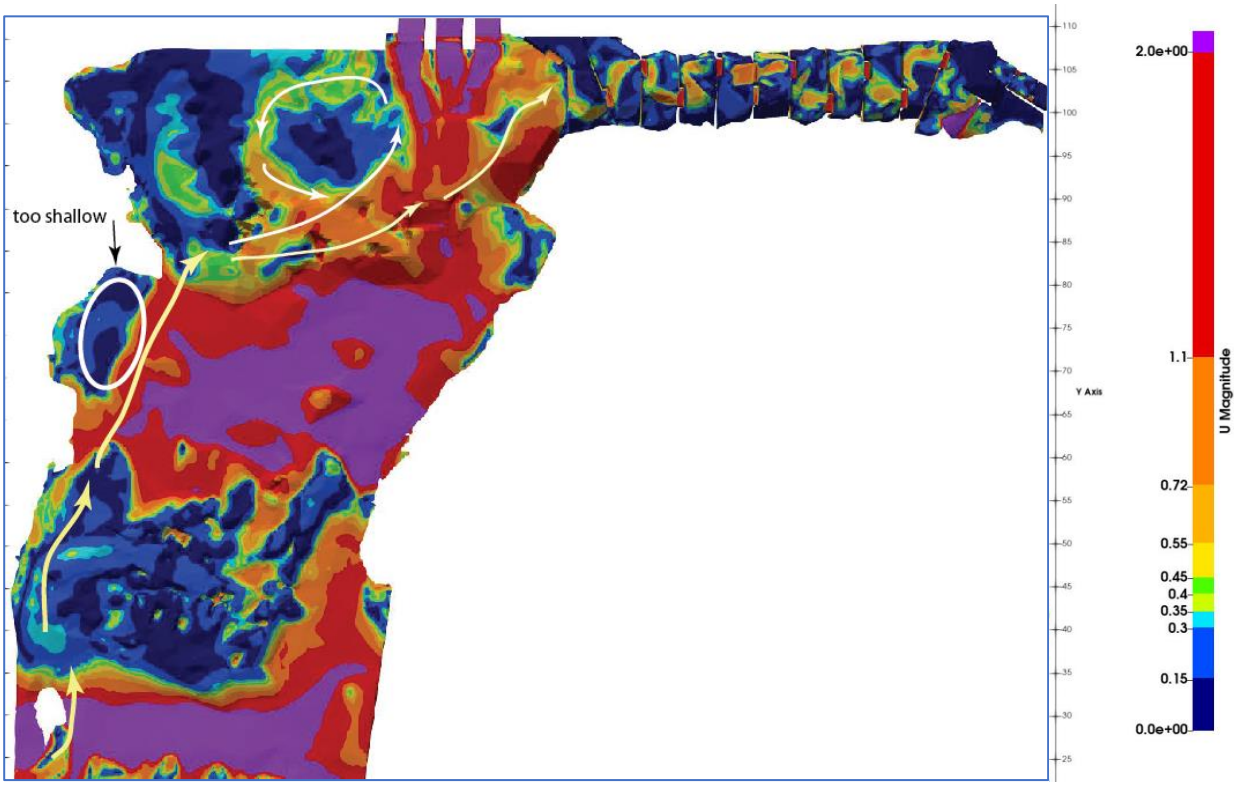


Figure 15: S3 routes for salmon on velocities 0.2 m from the bottom

Salmon Grilse

Grilse will have 12.5% passage.

multi-sea-year Salmon

Multi-Sea-Year salmon will have 50% passage to the dam. Over the first sill fish must pass through water with velocities up to 2.5 m/sec for 20 m in the model, but with unknown distance from the downstream resting areas this may be limiting. Over the second sill fish must pass 30 m of water in velocities up to 2 m/sec which should be passable if they rest between the sills.

S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates

Velocities are too high for passage.

S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates

Velocities are too high for passage.

S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates

Velocities are too high for passage.

S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

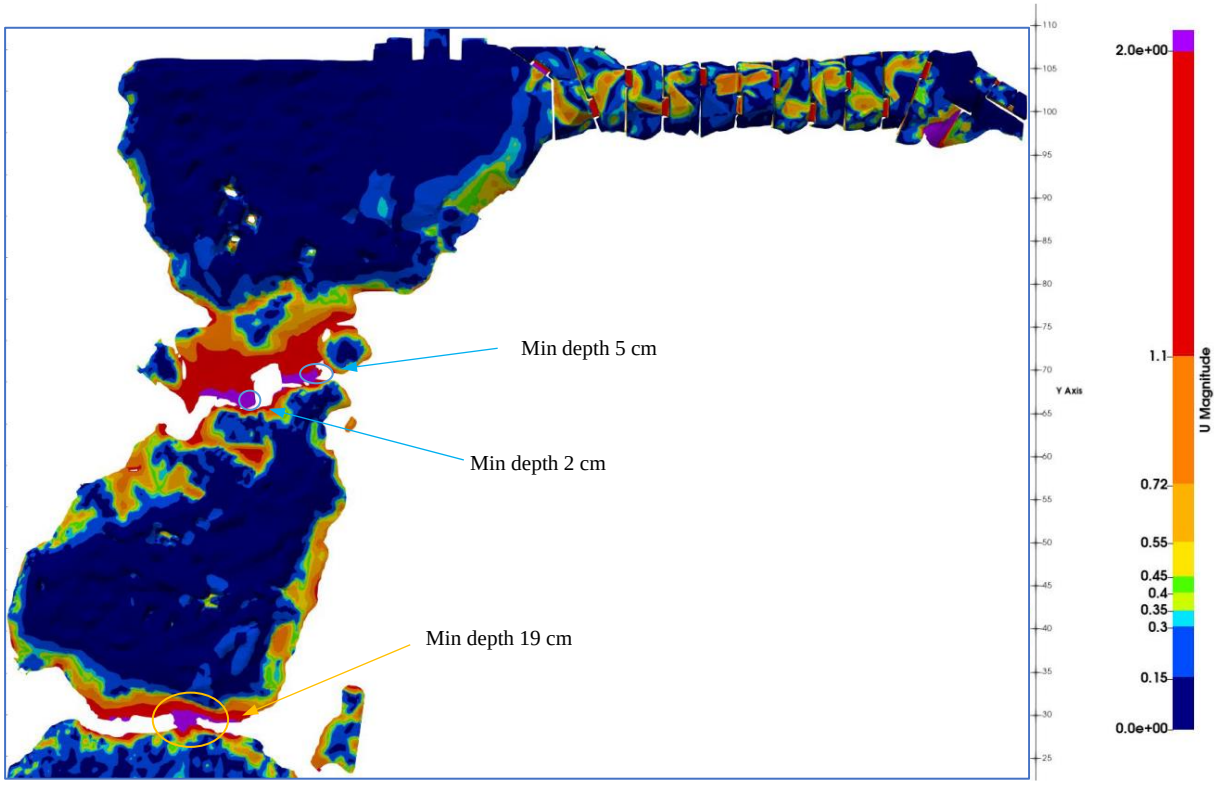


Figure 16: S7 velocities 0.2 m from the bottom

There is no passage in this scenario. The deepest area for passage over the second sill is only 5 cm deep, which is too shallow for gaspereau, trout, salmon, and larger yellow eels. Elvers and smaller yellow stage eels would have enough depth to pass, but the velocities over the sills are too high.

Conclusion

The fishways and eel pass will provide good passage for the fish that make it up the river to the dam. Attraction flow to the fishway is good with a volume of 35 cfs of attraction flow against a gate flow of 65 cfs in the first scenario, which is normal operations. The addition of 50 cfs supplementary flows as required should provide enough depth of water over the sills for all salmon as the flows are just slightly to shallow for the multi sea year salmon without these additional flows. The duration of the supplementary flows at 12 hours each is good as it allows for better passage of the other species in between. Care should be taken in using this flow all the time when salmon are present as it would limit the passage of other species.

The fishway /louvre flow of 35 cfs is not sufficient to provide fish passage in the river below the dam. This has not been an issue due to the leakage of at least 65 cfs from the stoplogs. However, the new dam will not have this leakage so the 65 cfs should be provided to the river through the gates on an ongoing basis.





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APPENDIX H – ASSESSMENT OF UPSTREAM AND DOWNSTREAM FISH PASSAGE

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January 31, 2023

Re: Ruth Falls Fish Passage Assessment

Introduction

Nova Scotia Power (NSPI) has requested an assessment of the existing downstream and upstream passage and a concept design be developed for changes needed to improve passage and to work with the proposed refurbished dam at Ruth Falls. The detailed engineering drawings will follow based on the recommendations of this concept design and review by NSPI and the regulatory government departments. This report gives an overview of the upstream fish passage and modifications and refers to the more detailed reports for the downstream passage louver upgrade, upstream fishway passage and eel pass, and the in-river fish passage routes and related issues.

Upstream passage

The fishway at Ruth Falls dam is a pool and weir fishway with two distinct sections.

The upper section is a concrete fishway with 1 ft drops between pools, the pools are 8 ft wide by 10 ft long, each pool is 2 ft deep at the top end and 3 ft deep and the downstream end with a sloping floor. There is a fish trap in the top pool then six pools down to a large corner resting pool that turns the fishway approximately 135 degrees to the right followed by 6 more pools for an overall drop of 13ft. The notches are 3 ft 3inches wide and against the outside wall in an alternating pattern. The top inside corner of the notch is curved on a 6-inch radius. The notch crest has a 4inch flat area at the upper end dropping on a 2H:1V slope over 2 ft for a drop of 1ft. Running with 1ft of water at the crest of the notches, the water level in the pools below is at the crest of the notch above. The fishway is required to be run at 12 inches of flow over the crest of the notches. Water flow is approximately 5.56cfs with this type of notch with the 1ft depth in the notch with the sloping backwatered apron verses the 6cfs that would be the flow from a sharp crested weir. So, some small variation of the flow above the 1ft depth is acceptable.

This upper section is a concrete fishway connects to a **channel fishway** section running along the toe of the dam that is cut into bedrock with concrete weirs across the channel each taking a portion of the head drop to the river. The drop through this section is 8.35ft with nominal river

level and the drop is taken up on 7 weirs. The first weir is located approximately 35 ft downstream of the concrete fishway then the weirs are spaced at 20, 25, 15, 25, 20, and 20ft apart. These fishway channel weirs currently have various drops on the weirs ranging from 1.63 ft to 1.17 ft and notches 1.75 wide and 1.67 deep. The three lower weirs have a 1V:2H sloping floor in the notch, the upper 4 weirs have level floors in their notches. Under the 5.6cfs fishway flow these notches run full. These weirs do get additional flow from the leakage through the stoplog sections in the adjacent spillway, but the amount is not known. From observations this leakage backs the water up on the lower notches so the flow is over the weirs but has no effect on the uppermost notch. The upper weir does not properly back the water up on the notch in the entrance to the concrete fishway which should be higher up to the notch crest height.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events of 50cfs are released immediately downstream from the discharge point for a minimum of 12 hours released overnight, when Ruth Falls headpond elevation is at 33.3m (109.4ft). These supplemental flow events are scheduled to complement natural significant inflow events, where a significant inflow event is defined as greater than or equal to 24mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. These flows are intended to attract salmon out of the tide and to migrate upstream. When salmon have been caught in the fishway trap these flows are to continue nightly. This flow of a total river flow of 150cfs has not been modeled.

When the new dam is built there will be no leakage or additional flow available for this channel section of the fishway.

Pool and Wier fishway design background

Pool-and-weir fishways are very sensitive to water level fluctuations at both the upstream and downstream ends.

In these fishways, low tailwater levels will result in a high drop out the entrance notch increasing velocities and reducing or eliminating the backwatering of the notch which is important for fish passage. High tailwater levels will lead to drowning of the fishway entrance and, consequently, poor fish attraction flows with low velocities. The entrances are often supplied with additional attraction flow, and this aids entrance attraction flow conditions during fluctuating water levels.

Changes in the upstream water level affects the turbulence conditions in the fishway pools. High water levels increase flows through the fishway reducing or eliminating fish resting areas due to turbulence in the pools limiting fish passage. A very low upstream water level will result in low discharges and very shallow or no water depths in the notches passable by the fish. The water surface in the pool below the notch should be equal or above the crest of the notch. With low flows, shallower depths in the notches than designed for, drops the pool water surface below the crest of the notch making fish passage more difficult. Water depth should also be at least 1/3 the

body length of the fish requiring passage. So, the 1ft depth is the minimum for multi-sea year salmon.

It is very important that the fishways operate with the flows and drops between pools they were designed for with very little water level fluctuation. Any fluctuation should be above the design water depth for the notches.

Fishways at most NSPI sites are designed as what has been termed “salmon” fishways as historically the fishways were designed only for anadromous salmon on their spawning migration as this was the focus in the Department of Fisheries and Oceans (DFO) and was the Salmon section of the Science Branch the fishway engineers were in who developed the designs and provided the federal *Fisheries Act* approval. That is the case for this fishway. What makes them “salmon “fishways is the turbulence in the pools which is created as the notch flow velocity dissipates the energy of the drop as it reaches the pool bottom, upwells on the downstream weir, turning back and across the pool upwelling on the side opposite the upstream notch then down the next notch. So, the drop between pools, the volume of flow, and pool size length, width and depth that make up the water volume in the pool are important when looking at passing species and age classes other than the upstream migration of salmon spawners. The various species deal with the turbulence in the pools differently and most require more frequent resting areas than the salmon. Salmon also arrived in relatively small numbers, moved though the fishway quickly not needing to rest in these relatively short fishways in Nova Scotia. Gaspereau are at the other extreme arriving in large numbers and requiring resting areas while passing through these fishways. Crowding in the pools is also an issue that can slow down or even stop passage so the fishway has to take the numbers of fish at a given time into the design consideration.

This basic “salmon” design was then copied with some minor modifications to dimensions for other salmonid species, gaspereau, and in a few cases smelt. This was done by designing the fishways to operate with a lower drop between pools generally 8 to 9 inches for gaspereau and 6 inches for smelt while maintaining the 8ft wide x10ft long x 2 to 3 ft deep pools. These lower drops between pools lowered the velocity some in the notches while still backwatering the notches, but mainly by reducing the flow volume so there was less energy to dissipate resulting in less turbulence in the pools and in turn more resting areas. The flow volume can be reduced by narrowing the notches where the pool turbulence is too high, which also allows for them to be backwatered more improving passage. The burst or sprint swim speeds for the short distance through the notches are greater than the velocities with the one-foot drop between pools for all migratory species but the gaspereau and smelt do not have the endurance the salmon have, so need those resting areas in the pools provided by the lower flow volume into the same pool size. The same is true for the smaller and weaker swimming fish species. It is that greater energy dissipation in the pools for the volume of water dropping into the pool that makes the distinction between fishway types. The lower drops still maintained the notch design including having the pool water surface level at least equal to the notch crest but work better for all fish species if backwatered preferably by a minimum of 2 inches or 20% of the notch depth above the crest. This design feature changes the flow in the notch from a fully plunging flow if there was no

backwater on the notch slope, to one that is a combination of plunging and streaming flow. This improves passage for all species. It also introduces the flow deeper in the pool below and that increases the energy dissipation resulting in lower turbulence and velocity in the pools and more resting area.

The Ruth Falls upper concrete fishway

At Ruth Falls the water elevation in the pool below the notch is designed to be at the level of the notch crest when there is a 1ft deep flow in the notch. This is the proper operational water depth for this fishway and is acceptable for the passage of all the major species.

This concrete fishway should be operated with a 1ft of flow depth or slightly above through the notches to meet the design criteria. If it is observed during monitoring that the pools do not provide enough resting area for the number of weaker swimming fish present then the notches can be narrowed from the wall side to reduce the fishway flow while maintaining the notch depth and pool volume there by reducing the pool turbulence providing more resting are for gaspereau, smelt, suckers etc. while keeping the notch operating within parameters. The modeling of the fishway and the operation with 1 ft water depth in the notches, and observations of the flow patterns, confirm the turbulence in the pools is good providing resting areas and needs no adjustment with the expected numbers of fish.

The lower fishway channel and entrance

The current attraction to the fishway entrance is poor with the louver flow at a minimum of 29cfs coming out at right angles to the river flow and the water from the spillway aligned with the river flow boxing in the 5.6 cfs fishway flow. This is causing the fish to collect either downstream of the louver flow or on the right side of the gate flow missing the flow from the fishway. It is not known what the current flow is out of the channel section of the fishway is as in addition to the 5.6cfs of the concrete fishway flow it collects additional flow from the stop log spillways along its right side. When the fishway is run at 1 ft deep and a flow of 5.6cfs plus the leakage and additional supplemental flow of 50cfs it is more competitive with the other flows but still boxed in. This large supplemental flow overtopping the weirs creates very turbulent pools between the weirs and is particularly bad at the narrow weirs with shorter, shallower pools. With the new dam these additional flows, both the stoplog leakage and the supplemental 50cfs flow, will be eliminated from this part of the fishway and relocated to the spill gates.

Eel passage past the dam is possible as indicated by the population upstream but they must pass through the existing fishways to get upstream. This is limited to the larger eels that can swim through the fishway velocities.

Changes to provide improved fish passage at the refurbished dam

To provide attraction flow from the fishway and eliminate the larger flow from the louvers, just downstream of the fishway entrance, the louver flow will be realigned to the top of the fishway channel as described within the downstream passage report. This will provide a combined

fishway minimum flow of 5.6cfs with a minimum louver flow of 29cfs for a total at least 34.6 as attraction flow at the fishway's river entrance. To properly accommodate this flow in the fishway channel, the 7 existing weirs are to be replaced by 11 new weirs each with a 0.75 water drop, 11ft wide by 1.75 deep notches with sloping on at 2H:1V, backwaterd over the crests of the notches by 1ft. Pools between the weirs will be at least 4ft deep with the notches are running at 1.75 depth over the crest of the notches, and a weir width of 25 ft bank to bank. The modeling of the flow pattern and velocities in the pools and notches has shown that this design will provide easy passage though this section of the fishway for the fish including resting areas in each pool.

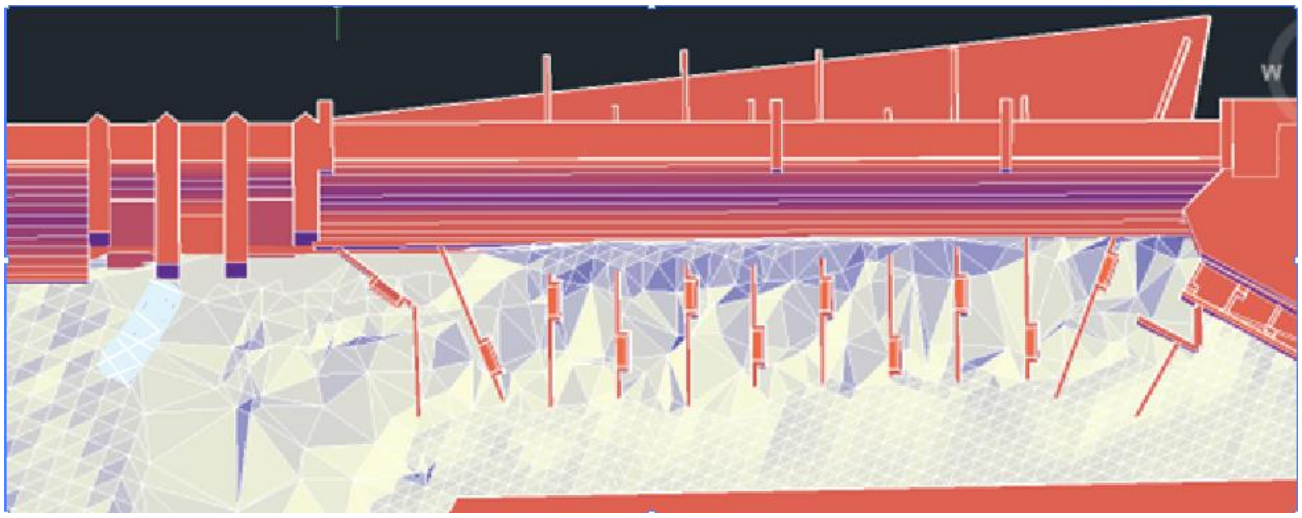


Figure 1: The layout of the 11 channel fishway weirs

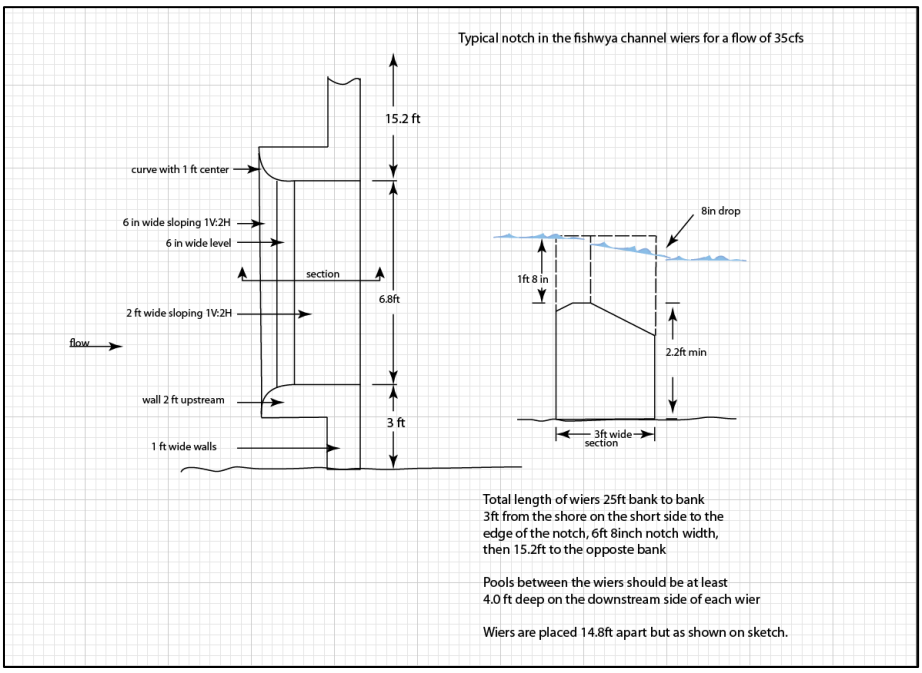


Figure 2: Design details of the notches in the channel fishway weirs

It is preferable to have the fishway entrance flow at least 10% to 15 % of the river flow, if possible, to attract the fish. The upper concrete fishway flow of 5.6cfs provides 16% of the combined fishway and louver flow in a small area where the two flows meet at the top of the fishway channel with its new baffles. At the entrance to the fishway at the river the percentage will vary depending on the flow from the gates but at the minimum flow of 65cfs from the gates the fishway flow will be up to 39% of the total flow. During higher river flows they could go as high as 390 cfs and still meet the 10% criteria.

Additional fish passage for eels

One species that cannot use the fishway effectively are the smaller American eels. Having the louver flow moved to the fishway as attraction flow, the river flow currents will lead the majority of the eels to the downstream corner of the lowest fishway notch. The upstream eel pass entrance is to be located at the downstream corner of the fishway entrance. See eel pass report for more details.

Eels tend to be smaller near the tide and Ruth Falls is close to the tide, so designs have to accommodate the 0+ year class. There are some challenging natural sections for these young eels in the river below the dam but there are likely locations along the bottom or along the shore they can use for migration over these natural sections particularly under low flows. For this reason, an eel pass is designed to provide this passage for the smaller eels. The lower channel fishway with its drowned weirs and the concrete fishway when the weirs are backwatered with 1 ft of flow allow eels larger than 15cm long to use their burst speed over the notches along the bottom and especially in the bottom corners of the notches where the velocity is lower. Passage is also available through the 3-inch diameter drain hole in each weir. Details regarding the eel pass are outlined within the upstream eel passage report.

Downstream passage

The diadromous fish need to come back down past the dam at some point in their life cycle and resident species may choose to migrate down seeking suitable habitat. Some may come back down through the fishway or exit through the gate flows, but it is expected most will follow the power cannel flow and be led through the louvers. The louvers are currently of the best designs used to date for downstream passage but there are a few improvements that can be made at this site. Eels travel along the bottom and do not guide well with currents at louvers so a solid wall fitting tight to the bottom is needed guide them to the exit. Bottom outlets are best for eels, or they need to be led up to the surface outlet. To do this a slated ramp is to be installed to lead them up. See the louver report for eel behaviour and design requirements for downstream passage.

For all fish the velocity into the louver exit is good but below their burst speeds. Then they reach a series of partial barrier stop log sections that they have to go up and over. As a partial barrier these sections will cause many of the fish to return back upstream. To prevent movement back up and out of the louvers a trap funnel will be installed, and the stop log sections will become

orifices vs the overflow weirs in the concrete transition channel. This will ensure quick passage through a barrier free transition channel to the louver outflow pipe. See the downstream passage louver report for more details.

Louve pipe outlet is designed to discharge into pool sized to dissipate the energy from the head drop through the piped section and then the vertical drop into the top pool of the channel fishway section. The pipe can come down from the end of the louver system's concrete transition channel on a 3% slope which leaves a 6.45ft drop into the 4ft deep pool. This stays within the USFW guideline for safe downstream passage.

Summary

This completes the full loop of fish passage from the upstream river passage routes, the fishway sections and the downstream louver system discharging between the two fishway sections to provide good attraction flow to the fishway at the river.

Figure 3 provides a diagram of the location of the proposed changes. To the left of the figure and running along the toe of the spillway with its rubber dams are the series of 11 new fishway weirs in the fishway channel. These weirs are designed to have velocities and water depths for passage for all species and to carry both the concrete fishway flow and the louver flow. Above that is the existing concrete fishway which meets design standards for a good fishway. Running alongside of these fishway sections, as a blue line in Figure 3, is an eel pass for the smaller life stages of eel. This eel pass is a design that is commonly used in Europe and around the world. This completes the upstream passage. Downstream passage is through the fishway and gates but primarily through the louvers in the power canal. The louvers with their solid wall along the bottom, guide ramp to the outlet, and swimming depth passage through the transition channel to the outlet pipe removes the existing partial barriers to downstream passage for all species. They then complete the journey down the lower portion of the fishway to the river.

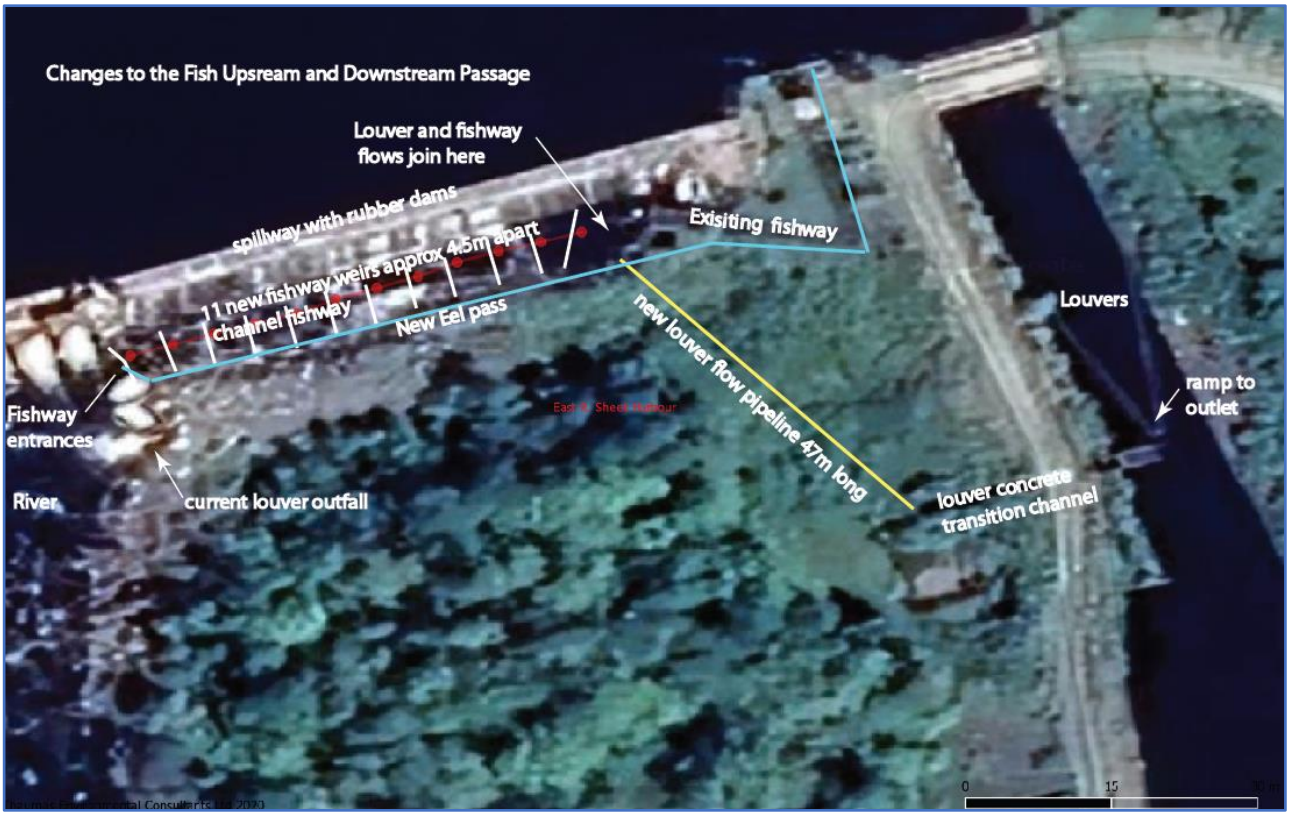


Figure 3: The overall layout of the fish passage facilities

Conclusion

Fish passage that meets or exceeds modern fish passage criteria will be provided for all species that need to migrate past the Ruth Falls dam to complete the life cycle with a few modifications to the existing fish passage facilities.

The new dam will eliminate the spill along the lower channel portion of the fishway and this required changes to be made to provide good attraction flow to the fishway entrance at the river. To provide this attraction flow the louver flow carrying the fish downstream will be diverted into the top of the channel section of the fishway. The existing 7 weirs with various head drops and notch designs will be replaced by 11 weirs with large, drowned notches to carry the additional flow without over topping. This will provide good passage for all the required fish species.

The additional eel pass will provide the latest eel pass design for upstream passage of elvers and small yellow stage eels.

The downstream passage already has a set of well-designed louvers, but the efficiency has been compromised for the benthic species, eels and suckers, by raising the outlet 5 ft above the bottom. A sloping ramp to lead the fish up to the outlet combined with walls along the bottom of

the louvers will greatly improve efficiency. The passage was further hindered by stoplog overflow weirs in the outlet transition channel combined with the slower bottom and mid water velocities the fish could swim against to return to the power canal. These have been replaced by a trap funnel to limit fish from returning upstream and orifice openings in the stop logs to remove these barriers and maintain the velocity through to the pipe. Returning the fish through the pipe diversion shortens the length and the overall drop brings this flow in halfway up the fishway. Taking the fish down the fishway will help those returning to find the fishway entrance.



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APPENDIX I – DOWNSTREAM LOUVRE ASSESSEMENT

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January 31, 2023

Re: Concept Design Report -Downstream Passage of Silver Stage Eels at Ruth Falls Dam – Draft

1. Introduction

Nova Scotia Power Inc (NSPI) requested a condition assessment of the louver system which forms a part of the fish diversion structure at the upstream end (entrance) of the power canal at Ruth Falls Dam. NSPI also requested a concept design of improvements to the louver system to increase it effectiveness in bypassing silver stage American Eels (*Anguilla rostrata*).

2. Site Visit

On May 31, 2022, Thaumas Environmental and Wood Canada Limited (Wood) visited the fish diversion louvers at the entrance to the Ruth Falls power canal in Sheet Harbour, NS. The purpose of the site visit was to determine the current configuration of the louvers and the overall fish management infrastructure at the site. It was also an opportunity to understand how the louvers are currently functioning, and to assess what opportunities there are for improving downstream American silver eel (*Anguilla rostrata*) passage at the site. A second visit to assess the condition of the louvers for damage to the louvers and attachment to the bottom was not done as the headpond was not drawn down as originally planned in 2022. It is noted we do not know what the condition of the louvers were during the 2009/ 2010 eel passage study conducted by NSPI. Another site visit was undertaken on October 20th, 2022, to check the flow volume through the louvers and to take a second look at the overall configuration.

3. History of the Fish Diversion Louvers

The louvers were originally installed in 1966 as a downstream bypass and counting facility for the passage of Atlantic salmon smolts. The louvers have been modified several times since then to improve smolt passage based on studies on smolt behaviour and passage rates from 1967 to 1971. In 2005 Nova Scotia Power contracted Alden Research Laboratory, Inc. to assess the louvers and provide an Engineering and Biological Assessment Ruth Falls Fish Deflection Facility, authored by Gregory Allen (Allen 2005).

Major changes were undertaken during the rebuild of the louver bypass exit and monitoring shed operations based on Nova Scotia Power plans dated in 2006.

Initially the louvers had a bottom outlet pipe. However, it was found that the migrating salmon smolts were concentrated in the upper 4.5 ft of the water column so the louver exit / bypass entrance was changed to provide a surface outlet that used less water and improved surface velocities and attraction for the smolt. The bottom outlet pipe was reportedly filled with concrete as part of that modification.

The powerhouse intake canal is located adjacent to the dam's east abutment. The louver facility is located about 75 ft downstream of the canal entrance. The intake canal was reconstructed and widened in 2000 downstream of the louvers to improve the conveyance capacity of the canal to the powerhouse to its original design flow rate. The original intake canal where the louvers are located is approximately 42 ft wide at the top bank, a bottom width of 14 ft, and bank slopes at 1:1 (H:V). Downstream of the louvers the canal widens to a top width of approximately 100 ft and a 25 ft bottom width. The louvers are shown in Figure1.



Figure 1: Looking downstream at the louvers May 31, 2022

4. Description of the Louvers

As shown in Figures 2 and 3, the louvers are arranged in a V pattern across the intake canal and consist of steel bars orientated perpendicular to the flow. Each leg of the V is approximately 50 ft long and orientated 12 degrees to the approach flow with a fish bypass located downstream at the vertex. As shown in Figure 4, the louver bars are 2 inches apart and extend from the bottom of the canal to a top walkway deck at elevation 114.0 ft. Every sixth bar (12 inches) has a flow straightener extending from the bar in an arc that forces flow to exit the louvers parallel to the

canal. The fish bypass is located at the vertex of the louver V array. As previously noted, the original bypass entrance design extended the full depth of the intake canal. Testing conducted in the late 1960's suggested optimizing the entrance design by blocking off the lower 5 ft creating a surface bypass and increasing the bypass velocity. The bypass entrance is 18 inches wide with an invert at El. 104.0 ft. (Allen et al 2005). The 2006 modifications built a new bypass entrance with the bottom 5ft closed off by a concrete block that supports a metal bypass with 18-inch-wide vertical opening curving 90 degrees and widening to 6 ft wide and 4 ft deep into a concrete channel. The operating water depth in the channel is 2 ft at 29 cfs minimum flow. This channel incudes the diversion to the monitoring shed and ends with the inlet to a 32-inch diameter pipe that carries the flow to the river where it drops into the river just downstream of the fishway entrance and at right angles to the spill gates.



Figure 2: Looking upstream at the louvers May 31,2022

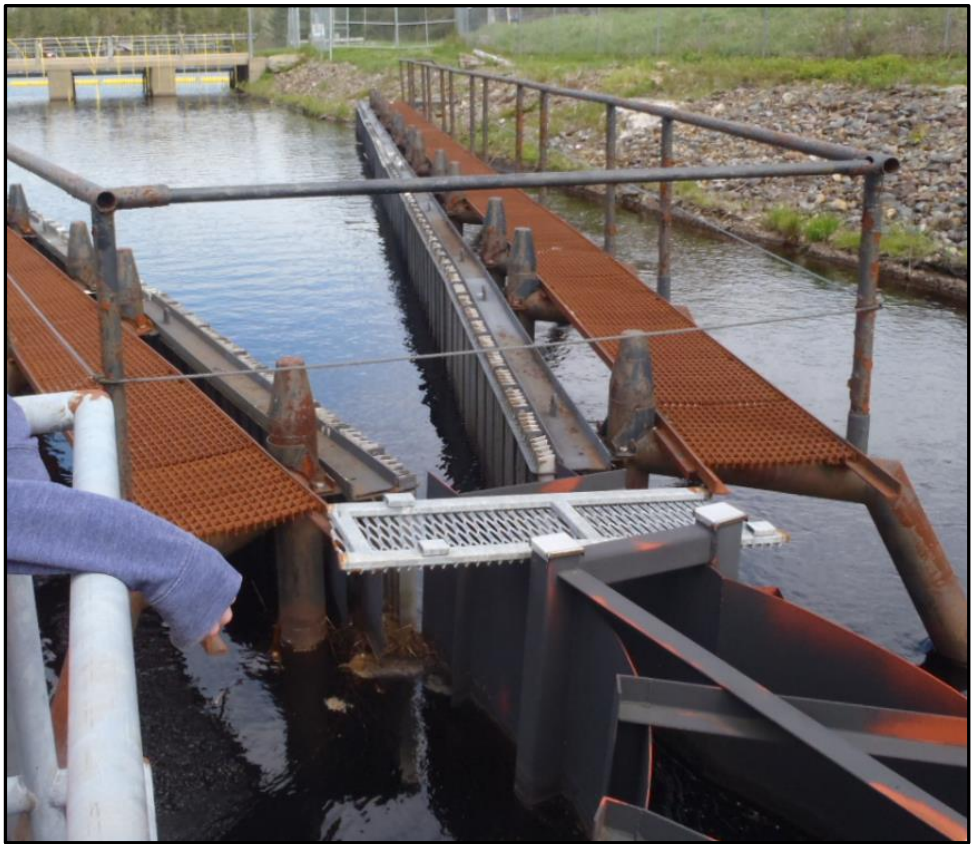


Figure 3: Looking at the louver /Bypass connection gap May 31, 2022

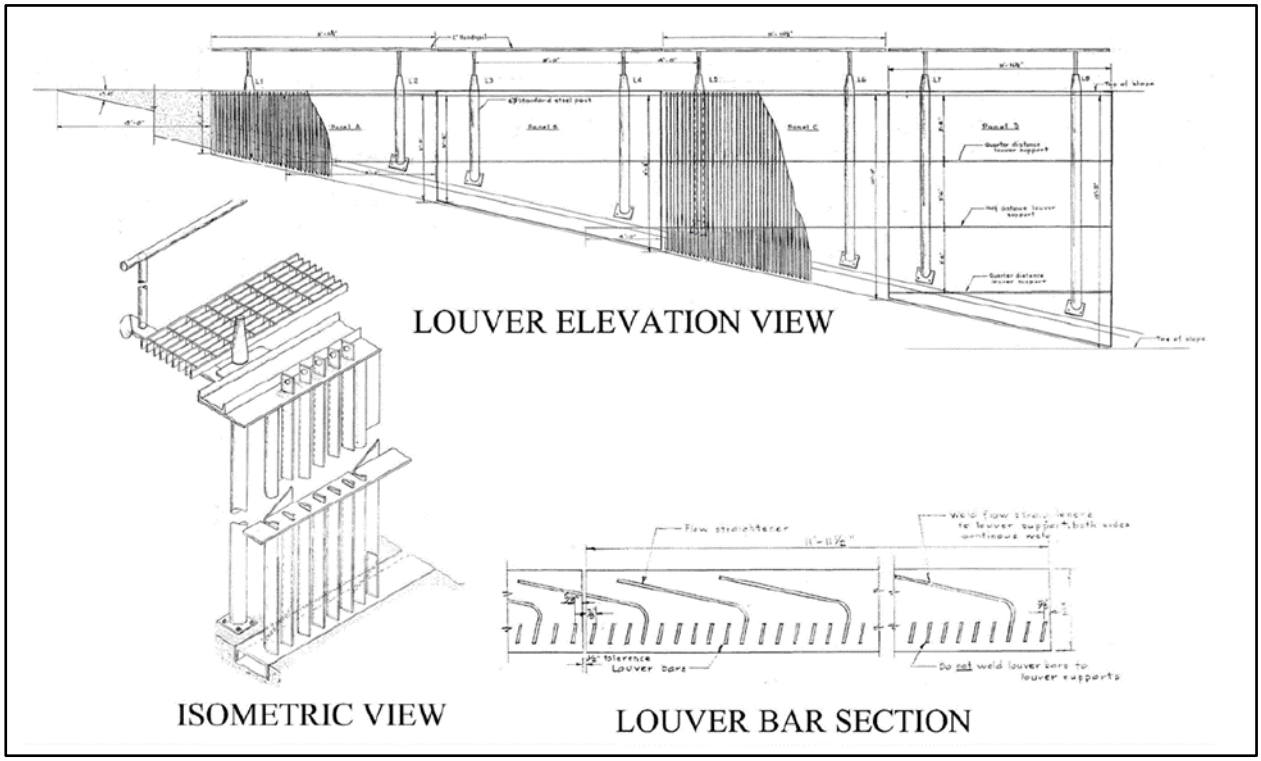


Figure 4: DFO Louver design from Ducharme 1972

Louvers can be very effective at guiding all fish including eels to a bypass if properly designed (Beck 2020) and modeling conducted at the Alden Research Laboratory (Allen 2005). Guiding angle is very important and (Amaral 2003) found a 15-degree angle to the flow was better than a 45-degree angle. In Ruth Falls the angle is even better at 12 degrees to the flow. The effectiveness for most species was very high when the flow velocities were good, and they are at Ruth Falls (Allen 2005) so eel fish guidance efficiency (FGE) should be in the 90% range.

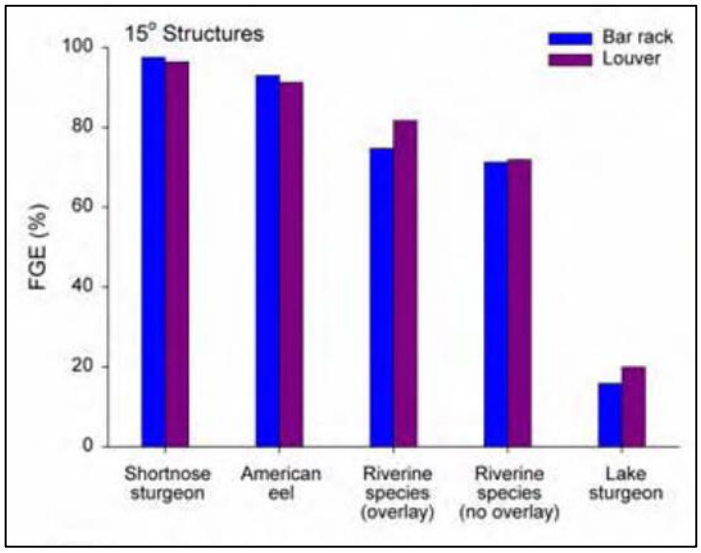


Figure 5: from Amaral 2003

The one thing that is missing at Ruth Falls that they found added efficiency for eel guidance is a barrier along the bottom (termed overlay). Figure 6 shows the difference they found with and without the barrier along the bottom.

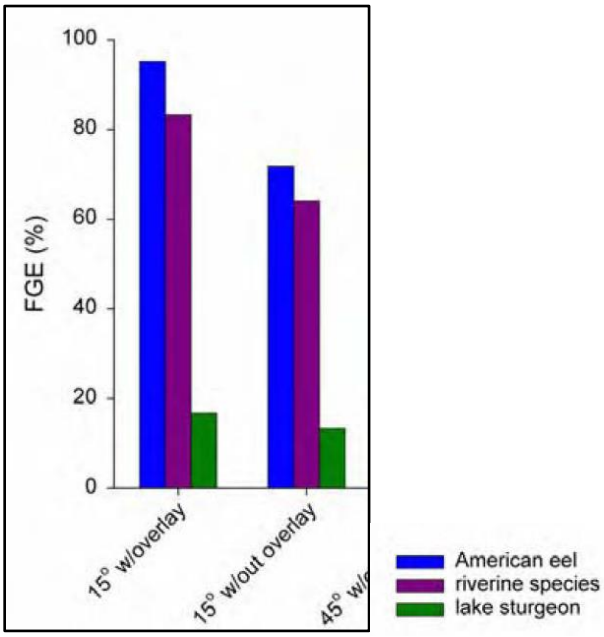


Figure 6: from Amaral 2003

So, since the basic design is good we need to look at how it is working and how it can be upgraded to work better.

5. American Eel (*Anguilla rostrata*) Silver Stage Downstream Passage

With the recent focus on the American eel, NSPI has been asked to review potential options for improving the effectiveness of the louvers to bypass downstream migrating silver stage American eels.

NSPI studies in 2010 indicated that of 30 acoustic tagged silver stage eels released above the headpond, all reached the dam, 21 (70%) were detected in the power canal downstream of the louvers, of those 8 were detected down river, and another 9 detected downstream either used the louver bypass, the fishway, or the spillway, for survival of 56.7%. There is no information on the detection efficiency of the receivers in the river below the powerhouse and this is especially important as the assumption of mortality rates is not sound if the detection rate was low as those not detected were assumed to be mortalities. This river section likely required two recorders in this channel on opposite sides to get a high detection rate. The observed results for the louvers efficiency are poor as 21 of 30 were below the louvers in the power canal at one point in their migration.

Eels are known to actively search for a downstream passage route near the bottom of the water column in forebays of structures such as hydropower stations and navigate by following the walls and bed of the headpond or power canal until the reach a barrier then they venture higher in the water column looking for a way downstream (Piper 2015) (Brown 2009) (Haro 2000). Consequently, bypass location will influence the ability of eels to find the bypass entrance. Flow is one of the main drivers for the downstream spawning migration and thus providing an attractive flow at the entrance to the bypass increases the likelihood of eels successfully locating the entrance and subsequently entering. However, they do not necessarily follow the greatest flow past a dam (Piper 2015). Understanding the swimming capabilities and behaviour of emigrating eels at a particular site is essential to ensure that they enter the bypass eventually encounter water velocities that exceed their burst swimming speed, hence preventing them from swimming upstream against bypass flow or a restriction that prevents them from moving back upstream (Baker 2019). The louvers at Ruth Falls provide the attraction flow velocities and the bypass velocities at their burst swimming ability without any sudden acceleration, and so just meets requirements for eel downstream passage based on the Alden modeling (Allen et al 2005) and supported by velocity readings taken during the October 2022 site visit and modeled for the bypass entrance. However, the bypass channel then widens, and velocities change to levels that would allow them to move back upstream. The drops over the stop logs that control the flow in the upper part of the concrete bypass channel are approximately 4 inches which allows the eels to move back upstream and out of the bypass. These 6 stop log weirs are 21 inches high with 4 inches of water over them in a 6 ft wide concrete channel leading to the pipe that carries the flow to the river. They create a series of partial barriers for eels traveling on the bottom which would lead them to use search behaviour that could result in an upstream movement back out of the bypass. Also, the flow velocity over the weirs in the channel is well within the eel swimming ability so they could move upstream back into the louvers in the power canal.

Silver eels travel on the bottom of the watercourse with occasional movements up in the water column. They tend to spend considerable time migrating near the bottom and are often insensitive to velocity changes until they encounter an obstruction, e.g., a physical guidance or exclusion device. Deep bypasses tend to be more effective than surface bypasses for downstream migrant eels (Gosset et al. 2005) (Russon et al. 2010). Movements up in the water column are common at dams and in lakes where the bottom velocities are low and do not provide an indication of downstream direction. These movements do allow some of the eels to find surface bypasses, spill over spillways, or spill under gates but can also attract them to leakage from stoplog sections.

The current design of the louvers, extending to the bottom of the power canal and with the vast majority of the flow past the dam through the canal, provides good attraction and velocities along the bottom (1 to 2 ft/sec). The physical visual behavioural barrier and the water turbulence along the louvers should be effectively leading the eels to the bypass. Full-depth guidance structures like this one can potentially guide all fish species regardless of migration depth (Linnansaari 2017). Louvers are behavioural devices, so it is critical that fish efficiently enter the bypass and do not delay or hold at any partial barrier. However, the surface outlet is 5 ft above the bottom so the eels would tend to collect at the bottom until individuals chose to move up in the water column or numbers build up so those at the top come in contact with the bypass opening and flow. With this dead-end bottom passage causing crowding, many would move back upstream or just to the sides and find their way through the louvers or seek other ways downstream through the fishway or via the spill. As previously noted, this behavior aligns with the findings of NSPI's acoustic tagging study and staff observations with 70% of the eels in the power canal below the louvers while large numbers appear in a mass at the louver vertex. Passage would have been better for the eels with the original bottom outlet, this would not be as good for the fish swimming up in the water column like the target salmon smolts.

Extensive laboratory studies were conducted by EPRI to determine if louver arrays could be employed to guide various riverine fishes and the catadromous American eel (EPRI 2001). The louvers at Ruth Falls meet or exceed the best configurations studied except they found better results if an inclined plane was used to bring eels and benthic species of fish to the surface outlet and a solid wall is placed along the sides at the bottom 1 ft of the louvers. It is also unclear what the bypass-to-louver approach velocity ratio is currently. The ratio should be 1.5 or slightly greater. The current flow through the bypass is 32cfs as set by 4inch high stoplogs so there is a slight change above and below this number as logs are removed or added with headpond fluctuation. Velocity in the bypass notch is calculated to be in the 5.0 to 6.0 ft / second range. We do not have direct measurement of the velocity along the louvers, but the Alden report (Allen et al 2005) set it at 3.1 to 3.4ft/sec depending on generation levels. This gives a ratio of 1.6 to 1.78 which is very good. The United States Bureau of Reclamation (USBR 2006) gives a general design value of 1.1−1.5 for louver bypass systems for all fish species and these louvers meet that guide without acceleration that would cause the fish to avoid passage. This velocity drops when the fish enter the concrete channel with 4 to 4.5 ft /sec with a 4 inch drop over the stoplogs and no bottom flow which acts as a barrier at each of six stoplog sections.

To ensure silver stage eel downstream passage, particular attention needs to be paid to the velocity along the face of the louvers near the bottom of the canal to get it in the right range that will lead the eels to the outlet. We have not been able to check this and are relying on

the Alden modeling (Allen et al 2005) that indicates the velocities are good for guiding the eels to the bypass both at the bottom and along the louvers. Observations made by the NSPI staff have seen large numbers of eels at the bypass entrance, so the louvers are effective at leading them to this location.

The louvers need to be checked along the bottom to see if there are any gaps in the louvers at or near the bottom that the eels may have been passing through in the earlier study. This could not be checked as the headpond was not drawn down this past summer but can be checked and repaired during dam construction.

There needs to be a design change to lead the eels to the existing surface outlet.

There are several modifications required to improve passage efficiency.

5.1 Lead the Eels to the Surface Outlet and Remove All Barriers Delaying Passage.

The surface outlet is just 5 ft above the bottom but for eels traveling on the bottom, in fact usually in close contact with the bottom, this becomes a barrier and causes the eels to begin a search behaviour to find a way past the barrier at the bottom. They would search for an opening with a current to follow. This behaviour would also include rising to find the bypass outlet, but this would involve a significant delay and the search behaviour would include movement through the louvers. Since the eels orient to the bottom, and they need to find the outlet quickly, providing a bottom structure to follow up to the bypass opening simulates the natural outlet from a lake or pond providing an easy to find the downstream route reducing the crowding.

The design shown in Figures 7 and 8 are for a proposed sloping ramp on a 15-degree slope up to the bypass with 1.5ft high sides of the ramp (Amaral 2003) to prevent the eels from moving to and through the louvers as the numbers build up in the narrowing exit area. The ramp is made of (steel or HDPE) plates 10 inches wide on an additional 15-degree slope (30-degrees to the horizontal) overlapping so that there is just a 2-inch opening between them (a 7-inch spacing along the ramp). This meets the best configuration for slope and openings tested by EPRI (EPRI 2001). Similar ramps are used at Garvin's Falls Project and Holyoke Dam louvers in New England. This ramp could be solid but using the angled plate will allow any fish that find themselves under the ramp to move up and follow the ramp to the louver outlet.

To rise the 5 ft, the ramp will extend out into the louvers by 18.66 ft with an upstream end width of 9.5ft and a width at the bypass entrance of 1.5ft. Migrating eels will follow up the ramp which will appear to them to be a solid bottom. The velocities along the ramp will be ideal for downstream passage. If fish that go through the louvers and return ending up under the ramp, they will be able to come up through the openings. There is no loss of habitat with this design and debris build up is not an issue vs fine mesh excluding screening.

A 1ft to 1.5 ft high solid barrier along the full length of the louvers, where the existing louvers meets the bottom of the canal, is needed to guide eels and benthic fish following the bottom to the vortex and the ramp.

There is currently a gap along the sides where the louvers meet the bypass as seen in Figure 3. It is not known if this extends to the bottom but needs to be closed as it is large enough to allow eel

passage as well as other species at a critical point where the water is accelerating and there is a change in the structure.

There is also a gap where the louvers meet the shoreline as can be seen in Figure 1 and these should be blocked off.

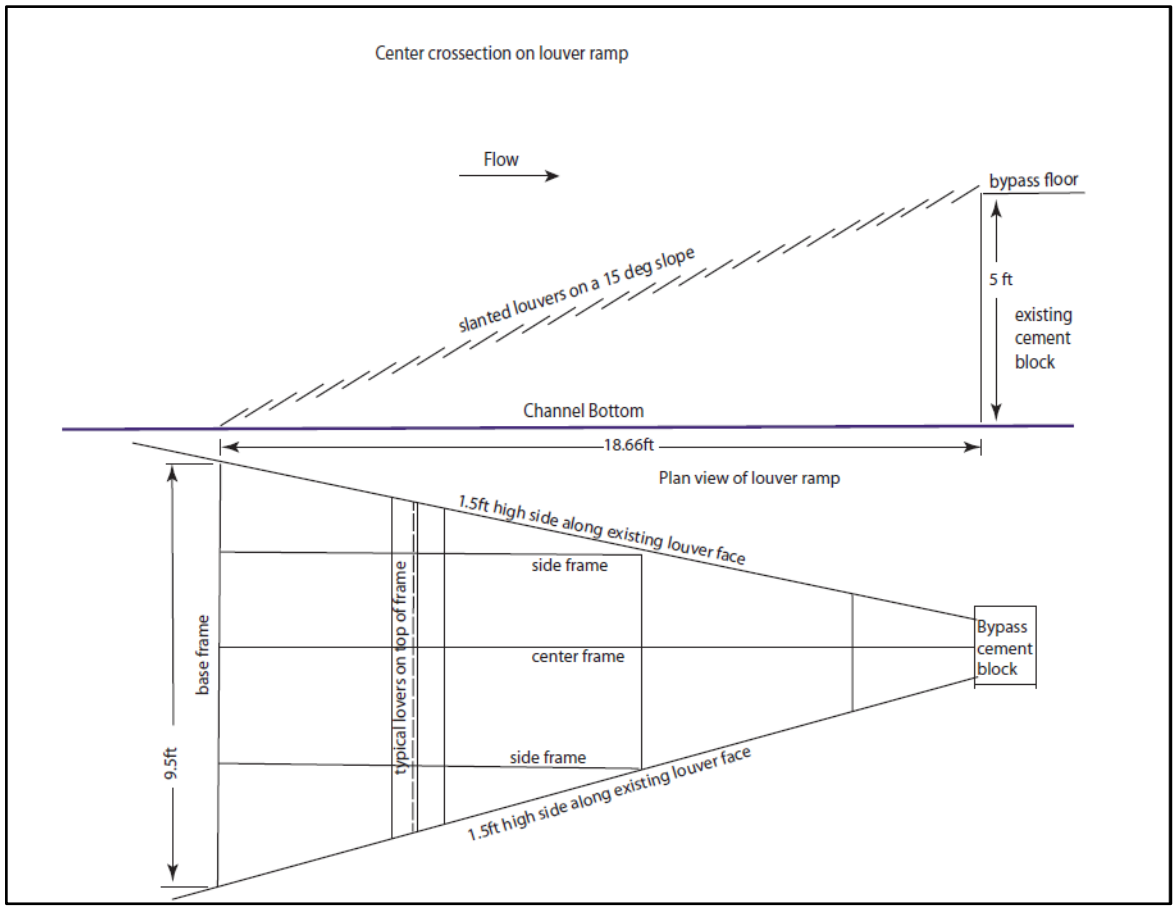


Figure 7: Longitudinal cross section (top) and plan view (bottom)

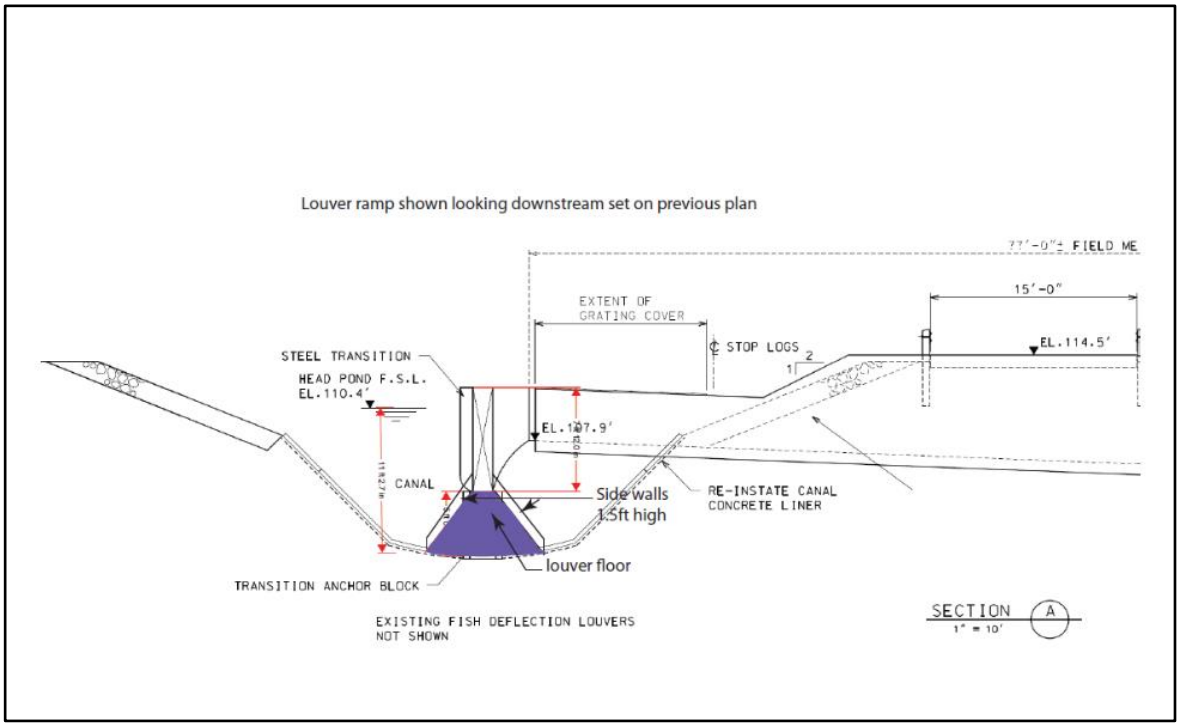


Figure 8: End View Looking Downstream

5.2 Keep the Fish in the Bypass Channel and Improve Downstream Passage

In the concrete channel, it is proposed that a trap funnel be installed at the most upstream stop log guide. This funnel would narrow the opening to 1.25ft and lead the eels and fish up 1ft to create a trap preventing them from easily returning upstream as shown in Figure 9. Then each of the 6 stop log sections that currently present partial barriers to all species will be modified to have a bottom orifice to carry the majority of the flow with an opening of 1 ft high by 3.32 ft wide as shown in Figure 10. The orifices will provide good downstream passage at the bottom for all species and eliminate the series of resting pool areas currently in place that slow eel and all other species migration and encourage them to find another way downstream.

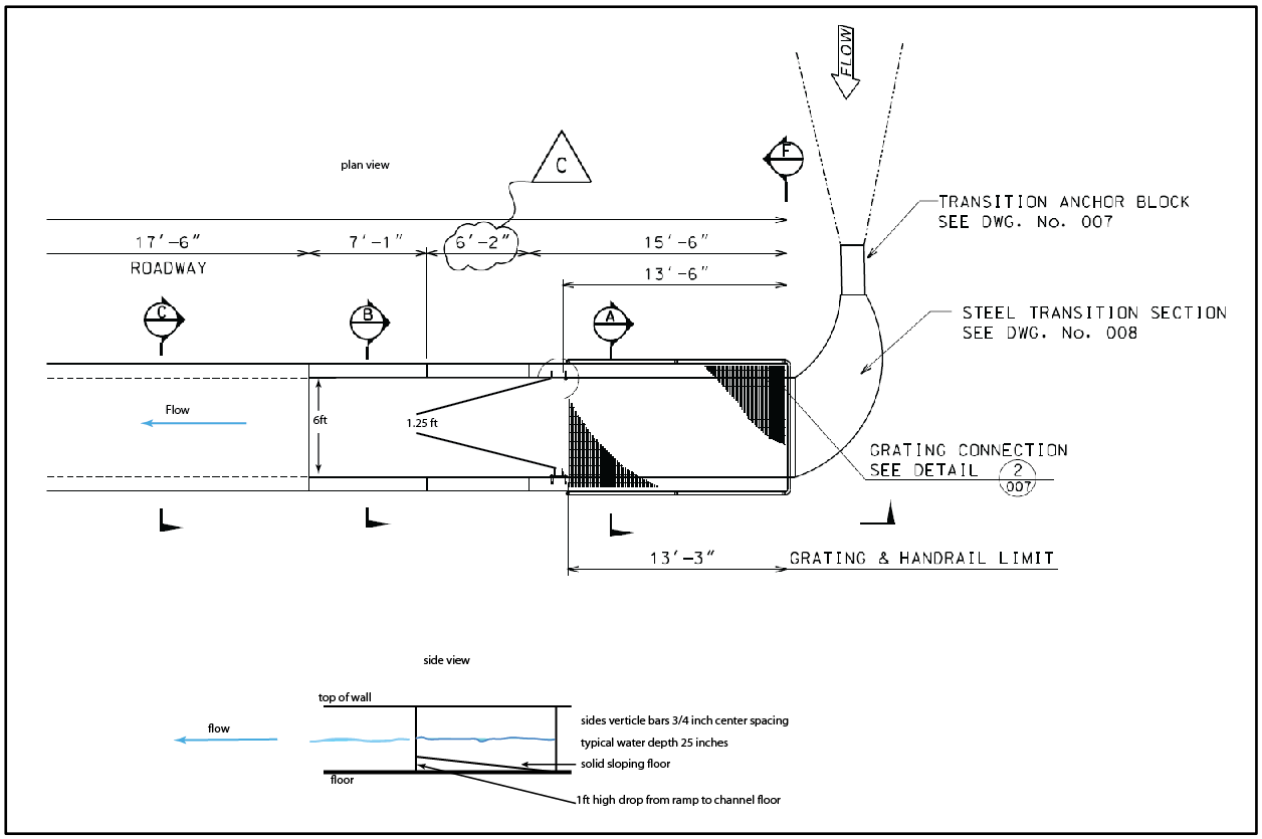


Figure 9: Trap funnel in the bypass concrete channel

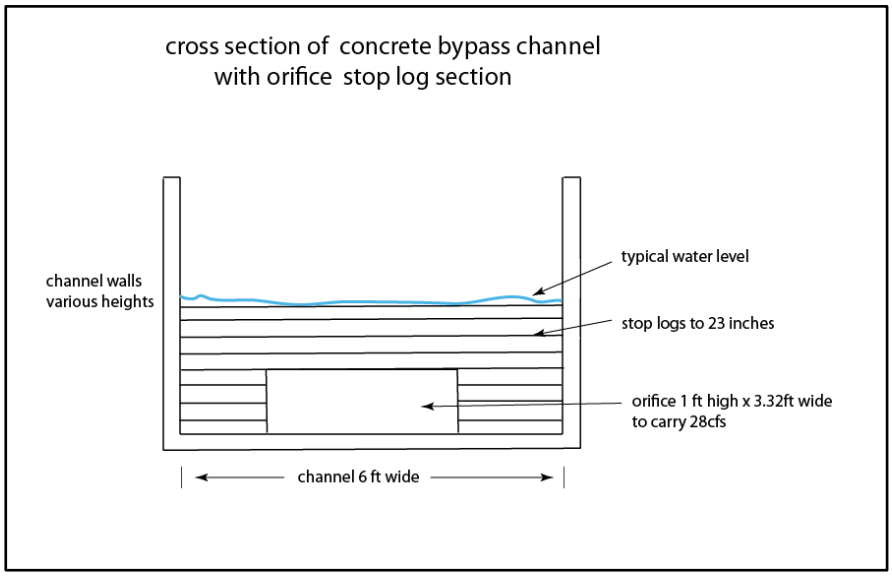


Figure 10: Typical stop log section with orifice

5.3 The Transition from the Bypass Channel to the Pipe

The next problem location is where the cement channel connects to the pipe to the river. This is a very turbulent pool as the flow drops over the stop logs down to a bottom the outlet pipe. To reduce this turbulence and possible harm to the fish, the orifice in the stoplog section entrance to

this pool will lower the drop and a surface mounted slide gate will be installed so that the flow to the pipe can be adjusted to back up water partially filling this pool and dissipating the energy in the flow. The slide gate will allow for adjustment to the water depth in the pool and allow for any future changes in louver water flow. The pipe will need an air vent to balance the pressures in the pipe.

5.4
The louver pipe is to be realigned to enter the fishway between the upper section, the concrete fishway, and the lower section, the channel fishway that enters the river. This is to provide additional attraction flow to the fishway entrance replacing the stoplog leakage currently entering the lower channel fishway section which will no longer be available with the new dam. This louver flow will discharge into the pool between the two fishway sections. The pipe will be realigned to come down from the end of the louver concrete channel on a 3% slope toward the fishway which will leave a 6.45ft drop into the 4ft deep pool just to the left of the counting bypass holding area at the downstream end of the concrete fishway. This overall drop from the 32-inch diameter pipe with the design flows stays within the USFW guideline for safe downstream passage.

6. Conclusions
    1) The installation of a ramp and bottom walls along the louver will greatly improve entrance conditions for eel and other benthic species traveling along the bottom. This option would provide passage for yellow stage eels throughout the year, silver stage eels in the fall, as well as all other species or individual fish that may be swimming deeper than the bypass inlet during downstream habitat migration or seasonal spawning movements. The Alden Research Laboratory modeled flow conditions at this site, with this addition, will provide good downstream passage for the silver stage American eels and all fish species.

    2) It is important that the louver bypass entrance is designed to keep the fish from returning upstream once they enter, so either velocities have to be above their burst/sprint swimming speeds or as proposed a trap funnel to prevent most upstream movement and bottom orifices in the stop logs to provide quick downstream migration.

        The flow in the bypass entrance is just at the sprint speed of the large eels and most species. It could be adjusted by removing stop logs at the second set of stop logs to increase the flow to ensure velocities are high enough to prevent a return upstream, but this would increase the acceleration of the flow above 1m/sec/m guideline for downstream passage at the bypass entrance and the fish would startle and go back upstream. This would also require at least 40cfs which will increase velocities in the fishway channel, where the louver flow is needed for attraction water to the upstream fishway and create velocities and turbulence at those weirs that would not be good for good passage of upstream migrating fish.

        So, stoplogs with orifices will provide the required flow at or just above the minimum of 29cfs and the orifices will provide rapid downstream movement rather than the surface overflow partial barriers.

3) The bypass pipe outfall drop to the river and plunge pool as currently operating meets the drop and depth requirements to ensure it is safe for the eels and all other species and life stages. When it is realigned to the top of the fishway channel the drop to the plunge pool and this pool's water depth exceed the USFW criteria for drops of all species and age classes at the site.

4) We were not able to conduct a condition assessment of the louver system to see if there were damaged louvers or other openings along the bottom that would allow eels to pass through rather than leading along the louvers. Such a condition assessment and repairs will be carried out when the channel is dewatered for the dam construction. A solid wall along this bottom will correct any potential issue of louvers damaged at the bottom but all bent or otherwise damage louvers must be repaired.

5) Additional eel passage monitoring studies are recommended following the modifications suggested above. When these studies are done it is suggested that some eels be released in the channel downstream of the power canal trash racks and some above to determine the effect of the trash racks on passage and calculated louver efficiency. There are suggestions in the literature (Piper 2015) that a portion of the migrating eels would be deterred by the trash racks and seek other ways downstream. Receivers should also be placed in the fishway as the bars on the trap allow for eels to pass downstream and by any gate openings to see if they are using other routes. The current dam has leakage and some spill from stop log sections high on the dam that may have provided an attraction and possible downstream passage for eels. The new dam will have minimal leakage, but it will have bottom outlets in the spill gates that will be very attractive to the eels for downstream passage being both a concentrated flow and at the bottom. This route and the fishway should monitor for downstream passage in future studies.

6) The louvers are the best downstream passage design to guide fish to a surface outlet. There are some weaknesses in the current design for benthic species like the eels and the retaining fish in the bypass channel. The modifications proposed here will correct these weaknesses. The modifications will greatly improve eel downstream passage and passage for all other species as well bringing the system up to new standards.



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APPENDIX J – UPSTREAM EEL PASSAGE ASSESSMENT

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January 31, 2023

Re: Concept Design Report - Upstream Eel Passage at the Proposed Refurbished Dam at Ruth Falls

1. Introduction

NSPI requested a concept design be developed for upstream eel passage at the proposed refurbished dam at Ruth Falls. This is an update of the November 2020 report.

2. Eel Behaviour

American eel (Anguilla rostrata) elvers migrate upstream from the ocean in the spring and can continue until fall. The older yellow eels may move repeatedly, irregularly, or seasonally, between freshwater and marine habitat and may continue to move upstream for several years after entering freshwater (Jessop, B.M., 2003). They tend to swim along the bottom but do swim up into the water column occasionally. They have average swimming ability but have strong burst or sprint swimming speeds (Langdon, S.A., 2000). Small eels can climb wet surfaces if they are rough or covered with algae or moss and do pass through some technical fishways particularly pool and weir design where there is a skim of water over algae or moss-covered weirs. They normally move at night but can be seen at any time-of-day swimming short distance of a few meters at a time through the higher velocities to resting areas and congregating in very low velocity areas. Eels start migration behaviours at temperatures above 10^0 C. Therefore, the eel pass will need to operate whenever the water temperatures are at or above 10^0 C to accommodate these movements. (Haro, A. 2013) (Shepard, S.L. 2015)

3. Modern Eel Passes

Generally, technical upstream fishways, such as fish ladders and fish lifts, are ineffective at passing juvenile eels. Therefore, specialized eel pass structures are required to provide a path for them over the dam (Vowles,2015) (Padgett 2020). Larger eels can use typical pool and weir fishways of the design currently in place at Ruth Falls and are often found living in them.

Modern eel passes consist of linear metal, plastic, or wooden channels lined with climbing substrate, and equipped with a pumped water flow and, in some cases, additional attraction water. Eels utilize the wetted substrate to propel themselves up the ramp. In this case, a metal enclosed box similar to that shown in figure 3 is used to protect the eels from predators and keep the pass dark. The entrance is uncovered to allow entrance between high and low tail water levels expected for durations of more than a couple of days at a time so neither short term extreme water levels need to be accommodated.

4. Eel Pass at Ruth Falls

4.1 General

A modern eel pass will be an effective option for upstream passage of eels at the re-constructed Ruth Falls dam. The location of the eel pass entrance at Ruth Falls is dependent on the flow patterns along the bottom below the refurbished dam under the various spill flow regimes.

4.2 Flow Conditions

Hydraulic modeling was used to identify flow patterns, velocities, and depths, downstream of the dam that support fish passage (including eels) under various flow scenarios. The results of this flow modelling have been used to determine the best location for the eel pass entrance which must be located at the most upstream point that the elvers and young yellow stage eels can reach. (Solomon, D. J. 2004) (Watz J. 2019)

The modeling shows the eels will have the ability to move along both banks and along the bottom, across the whole river where the uneven bottom creates low velocities and resting areas every few meters. These areas are coloured blue on Figure 1. There was a general bathymetry of the river bottom below the dam in the physical model, so it does not show this fine scale roughness the eels use to travel along the bottom and along the banks. However, the main travel routes will be along the banks as they move short distance using burst speed between the cobbles and boulders.

The eels will come up along both banks in the dark blue-coloured currents. Both banks will have generally equal numbers of eels as the passage is divided by the naturally high velocities across bedrock sills in the river below which they cannot cross due to the smooth bedrock surfaces. Along both banks there is cobble and boulder substrate and shallow flows the eels will use. Along the left bank they continue upstream to large blues are they can rest before following slow currents to the fishway entrance. Those coming up the right bank also come into the blue area suitable for resting and follow the bottom currents toward the gates and over to the fishway. Most of those coming up this right bank will distribute through the rearing area so that the majority are expected to be following the flow from the fishways as it joins the gate flows diagonally across this area and has an influence along the bottom.

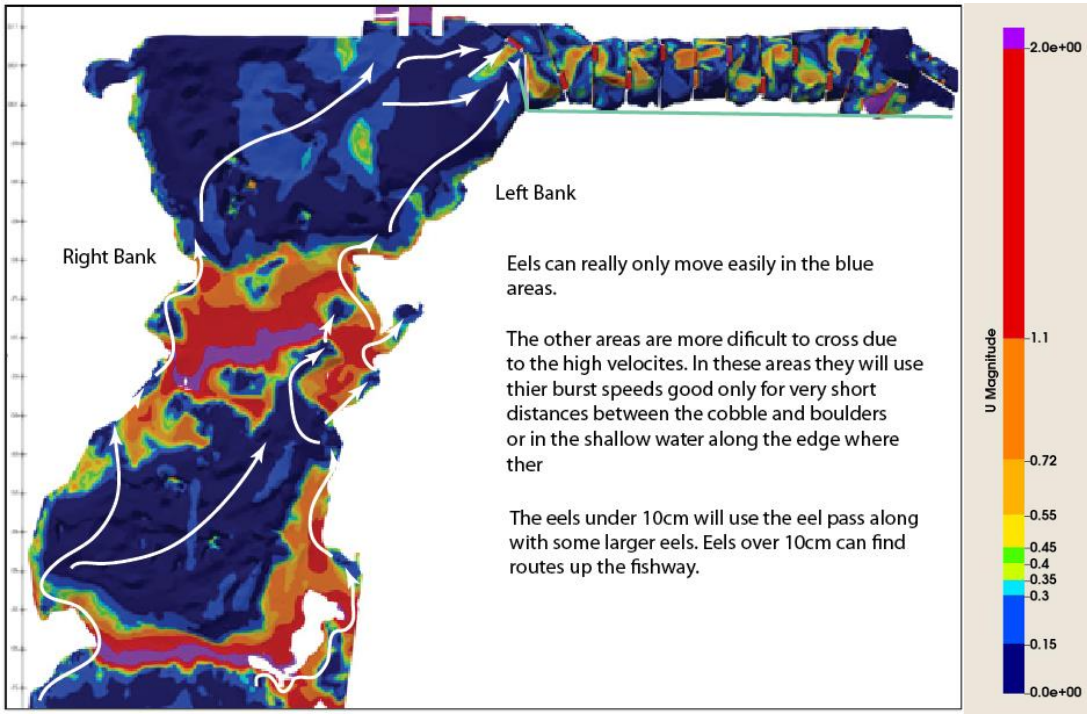


Figure 1: Bottom flow patterns (coloured by velocity) below the refurbished dam.

4.3 Concept Design

As previously noted, for upstream eel passage at the refurbished Ruth Falls dam, it is recommended to use a modern eel pass. The modern eel pass will consist of a covered linear metal, plastic or wooden channel lined with climbing substrate, and equipped with pumped water. The features / modifications of the suggested option are:

1) Louver flow going down a re-designed baffled fishway channel along the toe of the dam

2) Removal of the boulder in front of the spill gate to allow this flow to move straight downstream or be directed more to the right bank and smoothing of the bathymetry in front of the fishway entrance toward the gate flow.

3) The distribution of the gate flow between the three gates in a, 20, 40, 5cfs distribution to reduce the back eddies and provide currents that leads the eels and other fish to the fishway or as needed based on observation following the dam refurbishment.

The flow modelling shows the most appropriate location for eel pass entrance will be immediately downstream of the fishway channel lowest outlet notch on the left bank.

The eel pass, shown as a green line in Figure 2, is the most appropriate route under all scenarios that were considered. It is the only good location of the entrance segment. As shown in Figure 2, the lower segment will rise quickly to the height of the bank and then run on a very low slope to the corner of the concrete fishway. From there, it will turn to run along the left wall of the fishway to the head pond.

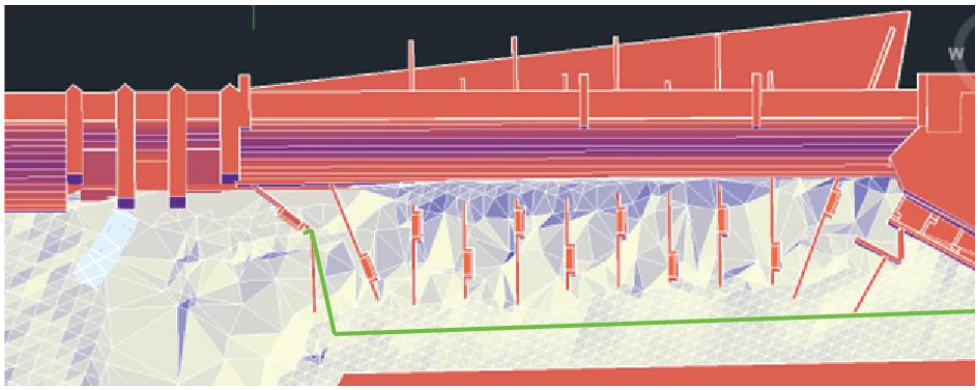


Figure 2: Eel Pass Route

The pass will be enclosed and use eel tiles by Aquatic control, https://www.aquaticcontrol.co.uk/products/eel-passes or Barry and Escott https://www.berryescott.co.uk/eel-tiles, and follow the USFW engineering guide for slope, climb heights and distances between resting areas, water supply design and drop into the head pond. Typical photos of an eel pass using the proposed design are shown as figures 3 to 6.

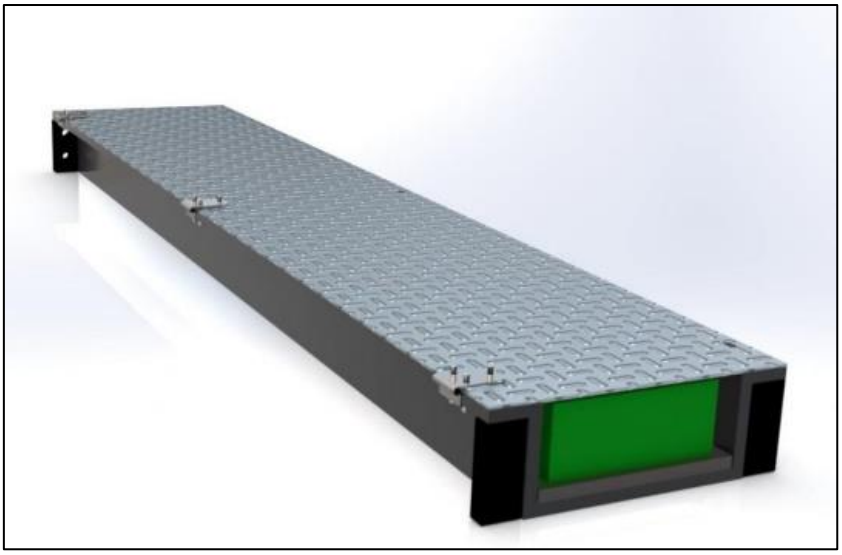


Figure 3: Aquatic enclosed eel pass box



Figure 4: Barry Escott eel boards for elvers and small yellow stage eels. good for eels 50mm to 500mm+ long



Figure 5: A typical design of an enclosed eel pass



Figure 6: An eel using the peg style substrate.

4.4 Design Criteria

To meet the USFW service recommendations, the final design will include:

- Construction Materials:
  - Ramps, pools, and supporting structural elements will be built of rust-resistant metal (typically aluminum) or UV-stable plastic for permanent facilities
- Cover:
  - To minimize predation, a fully secured, opaque cover on the entire unsubmerged length of ramp (and resting sections) the cover will remain open at the entrance below high-water level to allow entry at the water surface.
- Entrance:
  - The following specifications apply to the lower most end of the eel ramp:
    - The entrance will be matched to the surface upon which it rests; this may necessitate shaping the entrance lip to meet an irregular bedrock surface or providing a level sill upon which the entrance invert may rest and will be designed to the specific site chosen.
    - The final location of the entrance will be determined upon completion of the as built fishway and river bottom.
    - The entrance will be uncovered up to the maximum tailwater elevation so that eels may enter at any depth.
    - The entrance will be assessed for the need to be equipped with fencing, netting or other material to guard against predation by birds and carnivorous mammals.
- Climbing substrate:
  - Will run down through the entrance to the minimum tailwater elevation
- Exit: the following specifications apply to the upstream terminal end of the eel ramp:
  - Elevation: the ramp will be well above the fluctuations in headpond levels

- Location: the exit is situated at the head pond between the fishway exit and the utility shed away from turbine intakes, spill gates, and spillways and other structures that may entrain eels.

- Ramp: the following specifications apply to the sloped ramp channel:
  - Height: 6 in. high sidewalls.
  - Width: two tiles wide 3ft 4in wide
  - Length: dependent on slope; uninterrupted runs (i.e., without resting/turning pool) of sloped ramp will not exceed 10 vertical feet; total sloped length without resting pools will be less than 100 feet.
  - Slope: slopes will be 45 degrees or less on the entrance section of the ramp. The second section is very low slope then a 10% slope along the fishway.
  - Depth of Water: ramp will always remain wetted across the surface; depth is dependent on ramp width, flow, slope and influenced by substrate; 1/8 in. of water should be maintained across a flat ramp; flows can be adjusted to provide water depths up to 70mm were needed.
- Resting Section: the following specifications apply to the resting area in the ramp. Turns in the ramp layout will serve as resting pools designed to this standard:
  - Placement: a minimum of one horizontal resting section (resting pool) per 10 vertical feet of ramp.
  - Width: equal to ramp width.
  - Length: equal to the pool width, or longer.
  - Depth of Water: at least 1 inch of water should be maintained in resting pools; to accommodate uniform depth, the resting pools floors may need to be level and deeper than ramp sections to which they are connected.

5. Conclusions

1) The young eels cannot effectively use the pool and weir fishway and require an eel pass to facilitate passage.
2) A modern eel pass will be used at Ruth Falls, following the alignment shown in Figures 1 and 2.
3) The entrance will be on the downstream side, adjacent to the fishway that will provide attraction flow and on the adjacent bank below the low water level.
4) The design criteria for eel passes are set out in the USFW 2019 “Fish Passage Engineering Design Criteria” and will be followed in the detailed engineering design using tiles that have been specifically designed for eels 2 inches (5cm) and up to a size that can use the pool and weir fishway.



Bob Rutherford
President and
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APPENDIX K – MONITORING PLAN

Nova Scotia POWER
An Emera Company

Ruth Falls Dam Refurbishment Project

Fisheries Act Authorisation Application

2024 Monitoring Plan

December 2023

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1.0 Introduction

This monitoring plan outlines NS Power's proposed monitoring activities, and additional avoidance and mitigation measures for the Ruth Falls Dam Refurbishment Project (the Project) as well addresses DFO's request for additional information dated May 5th, 2022 and September 11th, 2023 to support NS Power's application for authorization for the Project (DFO file 19-HMAR-00549). The following information is included:

- Proposed monitoring activities associated with the drawdown of Ruth Falls Headpond including, entrainment monitoring, wetland monitoring, and post-construction monitoring in 2024.
- Proposed monitoring of construction activities in 2024.

The following construction activities are proposed for the Project:

- Installation of downstream access road and temporary bridge (to start prior to drawdown activities) Downstream access roads will need to be in place in order to access the right side of the dam
- Lowering of Ruth Falls Headpond approximately 18 ft.
- Dewatering of the Ruth Falls fishladder and canal and fish rescue
- Installation of temporary access for machinery on the upstream side of the dam – access from the right side and the left side. The area in front of the sluiceway bays will remain open to allow water to pass through.
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
- Removal of the existing stoplogs from stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Improvements to the upstream fishway.
- Improvements to the existing downstream louvre system.
- Installation of an upstream eel ramp.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation.
- Contractor Demobilization from site.

NS Power has considered the potential environmental and archaeological risks associated with the lowering of Ruth Falls Headpond and believes that with implementing the mitigation measures discussed in the following sections of this application, the proposed approach will prove effective. This approach will also be safest for NS Power employees and contractors. NS Power has evaluated whether the use of bulkheads, barges, work platforms or larger cofferdams would be an appropriate alternative and has determined that these scenarios present significant safety risk, potential quality issues and scheduling risks to the Project. NS Power considers the lowering of the headpond to be the safest and most efficient solution to undertake the Project.

1.1 PROJECT SCHEDULE

The Project is scheduled to take approximately nine (9) months to complete starting with the installation of the nine (downstream access roads and temporary bridge starting in late June 2024 (refer to the project schedule Gantt chart in section 5.0 Construction Schedule of the Supporting Information document) After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid July 2024. The work includes both the lowering and subsequent recharging of water in the headpond. The water level will be drawn down after July 10th, allowing time for fish eggs to hatch, and young-of-year (YoY) Gaspereau to move downstream naturally or transported during fish rescue. Lowering the reservoir will occur after July 10th, and will take approximately eight (8) days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the possibility for entrainment of fish is low.

The construction schedule is as follows:

- Installation of the downstream access roads and temporary bridge will commence in elate June 2024. This work is intended to be completed prior to the drawdown in preparation for main dam construction work to take place in mid-July after the lowering of Ruth Falls Headpond. Access to the right side of the dam will be provided by the downstream access roads connected by the temporary bridge.

- Construction activities associated with the sluiceway, main dam refurbishment, and improvements to fish passage will commence in mid-July with the lowering of Ruth falls

headpond. The lowering of the Ruth Falls Headpond will commence no earlier than July 10th 2024 and will take place over the course of 8 days.

- After the water is at an elevation of 91 ft, construction activities will then begin with the installation of the upstream access roads. Work on the main dam refurbishment, sluiceway bays, and improvements to fish passage will continue simultaneously as construction progresses, however NS Power will aim to complete the new sluice gates first in the low flow window of July-September. It is anticipated that each gate bay will take approximately 3-4 weeks to complete, and a total of 9-12 weeks to complete the entire sluice structure. This may be affected by weather should heavy inflows be required to be passed for a significant period of time.

- Remaining dam refurbishment and upgrades to existing fish passage structures will then continue with all temporary control structures and access paths removed and Ruth Falls Headpond returned to normal operation April 1st, 2025. The focus will be on completing dam refurbishments and upgrades to the louvre system (while the canal is dewatered) to ensure the dam and fish passage structures are operational by April 1st. In the event that there is not enough time to complete the improvements to the upstream fishway during the drawdown, NS Power commits to completing the work during the next construction season (avoiding upstream migration timing) in 2025. This would not require the headpond to be drawdown – cofferdams would be used to isolate the fishway while the work takes place.

2.0 Description of Effects on Fish and Fish Habitat

The following water management strategies related to the Project have the potential to result in the death of fish by means other than fishing, and/or the harmful alteration, disruption, or destruction (HADD) of fish habitat:

- The temporary drawdown of Ruth Falls Headpond, which could result in the temporary disruption of up to approximately 1.15 km^2 (115 hectares) of littoral zone habitat that fish species use for a portion of their life cycle (see Appendix A Bathymetry of the Supporting Information Document).
- Death of fish due to entrainment and/or stranding from drawdown activities.
- The installation of a temporary bridge and access roads for machinery on both the upstream and downstream sides of the dam, resulting in a temporary instream footprint. The total estimated temporary instream footprint for control measures is 3,237 m^2. The footprint associated with the temporary structures within Ruth Headpond is already accounted for within the temporary drawdown of the Ruth Falls Reservoir. When the reservoir is reduced to 91 ft, the temporary

structures will be placed upon the substrate which will be temporarily dry due to the drawdown. The footprint associated with temporary structures downstream within the spillway channel is not considered valuable fish habitat due to the periodic nature of flow releases (although NS Power acknowledges fish use this area as a migration route to access habitat upstream of the dam). NS Power does not consider the temporary footprint to be a HADD as per the above rationale and the temporary nature of the footprint.

- Temporary impact to upstream fish passage during construction. Upstream passage will not be available upon the start of the drawdown and extending until the following April 2025. NS Power does not consider this to negatively affect fish and fish habitat. The deferral of the drawdown to after July 10th avoids impact to upstream fish passage for spring migrating species (alewife, elvers) and downstream passage of any salmonid parr and smolts. The lack of upstream passage throughout the summer and fall will prevent any adult salmon from migrating upstream. However, there have been no salmon observed in the trap in the last two years, and only 1 observed since 2017. Therefore, it is not likely that this species will be negatively affected by the lack of upstream passage and should not be considered in the application of avoidance/mitigation measures for this project.
- Negative impacts to upstream and downstream passage as a result of dam refurbishment, including:
    - Some loss of surface downstream passage for surface-oriented fish species, that would typically pass over top of the existing stoplog bays;
    - Potential changes to entrance conditions of the Ruth Falls fish ladder as a result of submerged discharge through the new gates (vs. surface overflow from stoplog bays).

The Project will result in a permanent loss of fish habitat; however, based on the relatively small size (60 m^2), the Project will not be removing a critical piece of habitat from the ecosystem. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete; however, changes will be made to improve the efficiency of the fishway – these changes include the addition of weirs, and adjustments to existing weir and notch sizing – see Section 12.2.1 – (Upstream Fishway Improvements) of the Supporting Information document for details on the proposed improvements. The temporary lowering of the reservoir approximately 18 feet will cause the biggest disruption; however, the potential effects of fish and fish habitat is considered low due to the following:

1. The drawdown is temporary and will not have a long-term effect on fish populations;
2. The headpond water level will be drawn down after spawning allowing time for eggs to hatch and YoY Gaspereau to move downstream naturally or transported during fish rescue. The drawdown is scheduled to occur no earlier than July 10th, 2024;
3. Measures will be put in place to facilitate downstream migration of fish during construction. During the time the water is drawn down, NS Power intends to provide free passage of fish through the center sluice gate during construction as the canal and fish ladder will also be dewatered. The exception to this is when the center sluice gate will be under construction, which we anticipate to be 3-4 weeks during which time the water will be directed through either the west or east bay. Upstream fish passage will not be available during the 2024 construction season

after July 10th. As described above, improvements to the existing upstream fishway as proposed to take place during this timeframe; and,

4. Preliminary data collected from ongoing monitoring for the Tusket Main Dam Refurbishment project drawdown in 2021 indicates that very little change to fish habitat has been observed over an eight-month period, other than the temporary loss of available habitat as a direct result of the drawdown. No permanents impacts were reported.

Project activities with the potential to impact fish and fish habitat have been identified and are discussed in Table 1.

Table 1: Summary of potential effects on fish and/or fish habitat due to refurbishment of the Ruth Falls Dam

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect
Temporary loss of fish habitat due to lowering headpond beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.5 km^2 in Ruth Falls Headpond	High	Low
Temporary loss of fish habitat due to temporary installation of access roads	Localized: area immediately above and below the dam	High	Low
Permanent loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly below the dam	High	Low
Fish mortality due to stranding when lowering headpond.	Localized: Ruth Falls Headpond	Low	Low
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low
Potential downstream scour during drawdown of headpond.	Localized: East River of Sheet Harbour	Low	Low
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High

sluiceway and stoplog controlled to rubber dam spillway.			

There are no formal fisheries management objectives for the East River of Sheet Harbour; however, the streams and reservoirs are used for recreational fishing by the local community and traditional harvesting by the Mi'kmaw of NS.

3.0 2024 Drawdown Monitoring Activities

3.1 BACKGROUND

Based on operational experience, the drawdown of the headpond to elevation 91.0 ft is expected to take one to two days, however the drawdown has been extended to eight days to reduce potential impacts to fish and fish habitat. NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly, in a controlled manner, to ensure upstream and downstream erosion or scour is minimized.

NS Power completes fish and fish habitat surveys as part of the Hydro Relicensing Program, which takes place on a ten-year cycle as part of the renewal of Hydro System Water Storage Approvals. The relicensing fish data collection is qualitative in nature; however, NS Power has two datasets for the Sheet Harbour Hydro System collected ten years apart and some trends and observations can be drawn from that data. A list of commonly found fish species in the Sheet Harbour watershed is provided in Table 2, along with an indication of their presence during the previous relicensing.

Table 2: Fish Species present in the Sheet Harbour Watershed

Common Name	Scientific Name	NSPI 2007	NSPI 2017
Alewife	*Alosa pseudoharengus*		Confirmed
American eel	*Anguilla rostrata*	Confirmed	Confirmed
Banded killifish	*Fundulus diaphanous*	Confirmed	Confirmed
Blacknose dace	*Rhinichthys atratulus*	Confirmed	
Brown bullhead	*Ictalurus nebulosus*	Confirmed	Confirmed
Common shiner	*Luxilus cornutus*	Confirmed	Confirmed
Golden shiner	*Notemigonus crysoleucas*	Confirmed	Confirmed
Lake chub	*Couesius plumbeus*	Confirmed	Confirmed
Pearl dace	*Margariscus margarita*	Confirmed	
Speckled trout	*Salvelinus fontinalis*	Confirmed	Confirmed

Stickleback	*Pungitius*	Confirmed	Confirmed
White perch	*Morone americana*	Confirmed	Confirmed
White sucker	*Catastomus commersoni*	Confirmed	Confirmed
Yellow perch	*Perca flavescens*	Confirmed	Confirmed
Atlantic salmon*	*Salmo salar*		

* Atlantic salmon were not observed during 2007 and 2017 sampling; however, small returns of Atlantic salmon have been observed in the salmon trap operated at Ruth Falls.

3.2 FISH RESCUE

NS Power anticipates the drawdown of Ruth Falls Headpond to elevation 91.0 ft to take approximately eight days to mitigate the effects of stranding on fish present in the headpond at the time of the drawdown. Fish rescue efforts will start at the same time as the drawdown. NS Power has extensive experience completing fish rescues on various hydro systems and handling and transferring fish to support past hydro projects and initiatives. NS Power will conduct the fish rescue using a team of two, led by an experienced field biologist, during daylight hours for the duration of the drawdown. The rescue team will be equipped with a boat, backpack electrofishing units, lip seines, dip nets and beach seines. The team may need to travel on foot to certain areas that may not be accessible by boat. A fish rescue of the Ruth Falls fish ladder and power canal will also be conducted once the elevation is low enough to expose the canal invert. Given the drawdown will be occurring through the lower level stoplog bays and the louvers preventing fish from entering the canal, it is anticipated that there will be limited amounts of fish in the canal to transfer.

Capture method will be determined on a per site basis, depending on water, sediment, and weather conditions. Fish will either be immobilized using electrofishing and transferred to buckets using the dip nets, then moved as quickly as possible to the main reservoir with a minimal amount of handling as possible, or herded toward the main reservoir using seining when electrofishing is not possible. Species of conservation concern, namely Atlantic salmon, alewife, American eel and speckled trout will be given special attention, with the goal of transferring these fish as quickly as possible to the main reservoir. Fish rescue efforts will be maintained until the level of the reservoir has reached its minimum. Shoreline observations will also identify any stranded fish which will be identified and counted.

Fish rescued will be identified to the species level, counted individually for larger species or estimated for smaller species, and any instances of mortalities will be recorded. In the interest of time, no morphometric information will be recorded. The data recorded during the fish rescue will be used to estimate the fish mortality caused by the drawdown.

Based on a long experience of conducting fish rescues across all hydro systems, NS Power estimates that approximately 10% of the number of fish/life stages greater than 10 cm and 20% of the fish/life stages smaller than 10 cm, will not be successfully rescued. Acknowledging that not all stranding areas will be

identified during the fish rescue, NS Power proposes to double these values and estimate total mortality resulting from the drawdown as follows:

$$=Total\ Fish\ Mortality = Sum\ (observed\ mortality\ for\ each\ species) + 0.2 * (number\ of\ fish\ rescued > 10cm) + 0.4 * (number\ of\ fish\ rescued < 10cm)$$

NS Power is expecting there to be continuous ongoing sources of inflows into Ruth Falls Headpond therefore, the risk of ongoing fish mortality as a result of stranding is low.

3.3 TRIBUTARY MONITORING

During the fish rescue, NS Power will conduct ground truthing to confirm any tributary locations on Ruth Falls Headpond using the results of a desktop exercise identifying tributaries depicted on 1:50,000 mapping. NS Power will also document any additional tributaries observed in the field not originally identified through the desktop exercise. NS Power will walk a portion of each tributary, if safe to do so, from the exit location into the reservoir on which it's located by field personnel, after four days of the drawdown (50% complete) and again immediately after the drawdown is completed (after eight days). Connectivity of each tributary to the reservoir on which it's located will be assessed for any restrictions; other observations, such as pools within the tributary that could act as thermal refuge for fish, and bank full width and depth of the tributary, will also be documented.

3.4 WATER QUALITY

The Ruth Falls Headpond is a relatively small, shallow headpond with depths of up to 26.2 ft (8 m) in the deepest parts. Water quality of the headpond is heavily influenced by inflows from the Grant River Watershed as well as by the East River and its tributaries.

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for the headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, the headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for the headpond, approximately 1.15 km^2) of total shoreline will be exposed as a result of a drawdown to 91.0 ft from full supply level. The majority of shoreline to be exposed is very

shallow under normal FSL of 109.25 ft, with depths of less than 9.8 ft (3 m). At an elevation of 91.0 ft, the headpond will look similar to pre-inundation conditions of the East and Grant Rivers. It is unknown how the drawdown of approximately 11 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed; although, inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

As such, NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to October for temperature, dissolved oxygen, total suspended solids and turbidity.

Monitoring sites for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth
- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

NS Power will use 23 degrees Celsius in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November.

3.5 TRIBUTARY MONITORING FISH ENTRAINMENT / DOWNSTREAM MONITORING

The drawdown of the Ruth Falls Headpond will be conducted gradually to avoid creating excessive flows, which will reduce the risk of entrainment of fish and other species downstream of the dam. It should be noted that NS Power regularly generates and opens the existing stop log bays for water management and maintenance purposes. To date, these activities have not been associated with known harm to fish species.

The objective of this monitoring program is to assess the abundance of the YoY gaspereau within the Ruth Falls headpond before the drawdown, monitor the entrainment of fish from the headpond during

drawdown and characterize the aquatic habitat exposed during the drawdown. The focus of the monitoring is assumed to be early juvenile and juvenile fish (all species); however, NS Power will also monitor for egg/larvae entrainment (note: this will be difficult to achieve quantitatively) as well as entrainment of adult fish species.

The timing of the drawdown will reduce the risk of stranded larvae/eggs as the YoY gapereau will be hatched prior to the commencement of the drawdown. There is still; however, the potential for the YoY gaspereau to become entrained while the reservoir water level is being lowered. As a result, NS Power has committed to completing entrainment monitoring using a contracted a third-party consultant.

A detailed Juvenile Gaspereau and Entrainment Study Plan (Appendix L) has been included within the Supporting Information Document.

A similar study was carried out during the drawdown at the Tusket Dam. The study involved two parts; the first was to determine the presence and density of YoY gaspereau in the Vaughn reservoir using towed bongo nets, and shoreline seines. The second component of the study was to gather information on the entrainment of fish through the Tusket Dam. This was carried out before, during and after the drawdown using static bongo nets, fyke nets and shoreline seines.

Based on results of the Tusket study, some entrainment is to be expected as a result of the drawdown. However, the East River watershed Ruth provides approximately 3 km of suitable freshwater habitat below the Ruth Falls dam and accordingly, NSP considers that entrainment of juvenile and adult fish below the Ruth Falls dam does not necessarily constitute harm or loss of fish.

The study will follow the same methods as Tusket, which will include juvenile sampling to determine size classes / densities as well as entrainment to estimate abundance. The results of the Tusket study showed that all fish were found to be alive and in a healthy condition and that suitable habitat was also available to the fish downstream of the dam. Similarly, the Ruth Falls Headpond provides approximately 3 km of suitable freshwater habitat. Shoreline monitoring was also completed at Tusket, the results showing no observations of fish mortality.

3.5.1 Study Plan

The duration of the drawdown is scheduled to take eight days starting no earlier than July 10th. The planned late start date of the drawdown will provide time for juvenile fish to grow and increase their chance of survival during their downstream migration through avoiding entrainment.

The parameters of the entrainment study (Appendix L) will be as follows:

- Monitoring will begin a day in advance of the start of the drawdown;
- Monitoring will take place throughout the eight-day drawdown;
- Monitoring will take place one day after the end of the drawdown;

- Implementing an adaptive approach to sampling frequency and duration based on the time required to retrieve/sample/redeploy the equipment, and the number of fish collected during one sampling window (i.e. increase sampling duration if catches are low). Details on sampling frequency and duration for each gear type is provided within the entrainment monitoring plan found in the main application;
- A range of net/gear types will be used to capture different species and life stages, targeting egg/larvae, early juvenile and juvenile fish but also including gear types to capture adult fish such (rotary screw trap, bongo nets, fyke nets etc);
- For all other species, quantity of fish and life stage will be collected; and,
- Measuring flow rates at the mouth of the net immediately after the sampling period. This information will be combined with the measure of the opening of the net and the dimensions of the wetted area of the river to estimate the portion of river sampled at each deployment.

If the data permits, NS Power will use the information collected to estimate the total number of fish entrained and based on a review of the scientific literature, estimate the number of fish harmed or lost by the drawdown. In regards to offsetting, NS Power's approach was to find a quality offset in close proximity to the Ruth Falls dam that targeted similar habitat and species that will be impacted by the drawdown. NS Power is putting forward 2700 m2 of offsetting footprint to account for permanent impacts from the footprint of the new dam, the temporary drawdown period, as well as any entrainment of fish and impacts to wetlands.

3.6 TRIBUTARY MONITORING LAKE HABITAT CHARACTERIZATION

3.6.1 Drone Surveys

NS Power will apply the following methodology to characterize the habitat in Ruth Falls Headpond during the drawdown.

A baseline drone survey, completed within one week of the drawdown will be conducted using a drone-mounted high-resolution camera. The focus of the baseline drone survey will be to identify and delineate areas where aquatic and emergent vegetation are observed. NS Power anticipates that these areas will coincide with areas where riparian wetland habitat is present. The imagery will be used to identify and delineate shoreline habitat types and will help in identifying the best locations for the establishment of monitoring transects. Following this, a drone survey will be completed no later than one week after the desired elevation is reached and then once again in November after the growing season. This time series will provide the basis for an assessment of the evolution of the shorelines of the lake during and after the drawdown.

A geographical information system (GIS) will be used to assess the amount of suitable habitat for fish species that is located in the Ruth Falls Headpond and monitor change within this habitat over time. The focus of the habitat characterization will be in areas that are dewatered during the drawdown; suitable habitat will be assumed to be located within the littoral zone of the headpond, have little to no slope and demonstrate high diversity and/or density of emergent and aquatic vegetation. An estimate of the total area of change over time within the identified suitable habitat can be extracted from this exercise, which can be used to inform potential temporary HADD.

3.6.2 Monitoring Transects

Monitoring transects will also be completed once per month to supplement the drone surveys. Two monitoring transect will be selected on Ruth Falls Headpond. The position of the transects will not be selected randomly, and instead will be based on the analysis of the lake's shoreline drone surveys with the aim to monitor areas of greater ecological value (i.e. highest diversity). The location of the transects will be determined by analysis of the baseline drone survey.

The transects will be approximately 15 m wide and extend 15 m into the riparian zone from the bank edge, and 10 m into the littoral zone from the waterline, if safe to do so, see Figure 1 below. The shore zone, if present, lies between the littoral and riparian zones, and may include a beach and/or a bank face. Where both are present these are separated by a break in slope. The transects will be delineated with high-visibility stakes to be visible from the drone camera. Detailed GIS data will be recorded at each site.

Observations for the entire plot will be made from a boat and on foot. The dimensions of the riparian and littoral zones are based on Rowan et al. (2006) and were selected to capture the composition and diversity of features to be assessed and correspond to the field of view of the surveyor from an offshore station. The shore zone (especially beach width) will likely be of variable dimensions depending on the water level at the time of the survey.

The baseline transects will be conducted within one week of the start of the drawdown at the locations chosen through the baseline drone survey. Subsequently, each transect will be surveyed once per month starting in July 2024 and extending to November 2024 to capture peak biomass windows. The surveys will include the identification and quantification of sediment classes, vegetation types and coverage of each within a transect zone. Comparison between sequential assessments will provide the ability to quantify any changes in vegetation coverage and identify changes in habitat types over time. Changes observed within habitats where transects are located will be assumed to apply to all suitable habitat identified on the lake, based on drone surveys.

Data collected during the monitoring transects, in combination with the drone surveys will be used to determine any potential impact within the identified suitable habitat from the drawdown. NS Power

would like to note that short term changes to vegetative types and coverage or sediments as a result of the drawdown do not necessarily constitute permanent harm to the habitat.

NS Power will also complete a literature review of available scientific publications to supplement the drone survey and monitoring transects to qualify observed changes in vegetation, soils and overall habitat loss, if any, and assist in quantifying the temporal extent of impact.

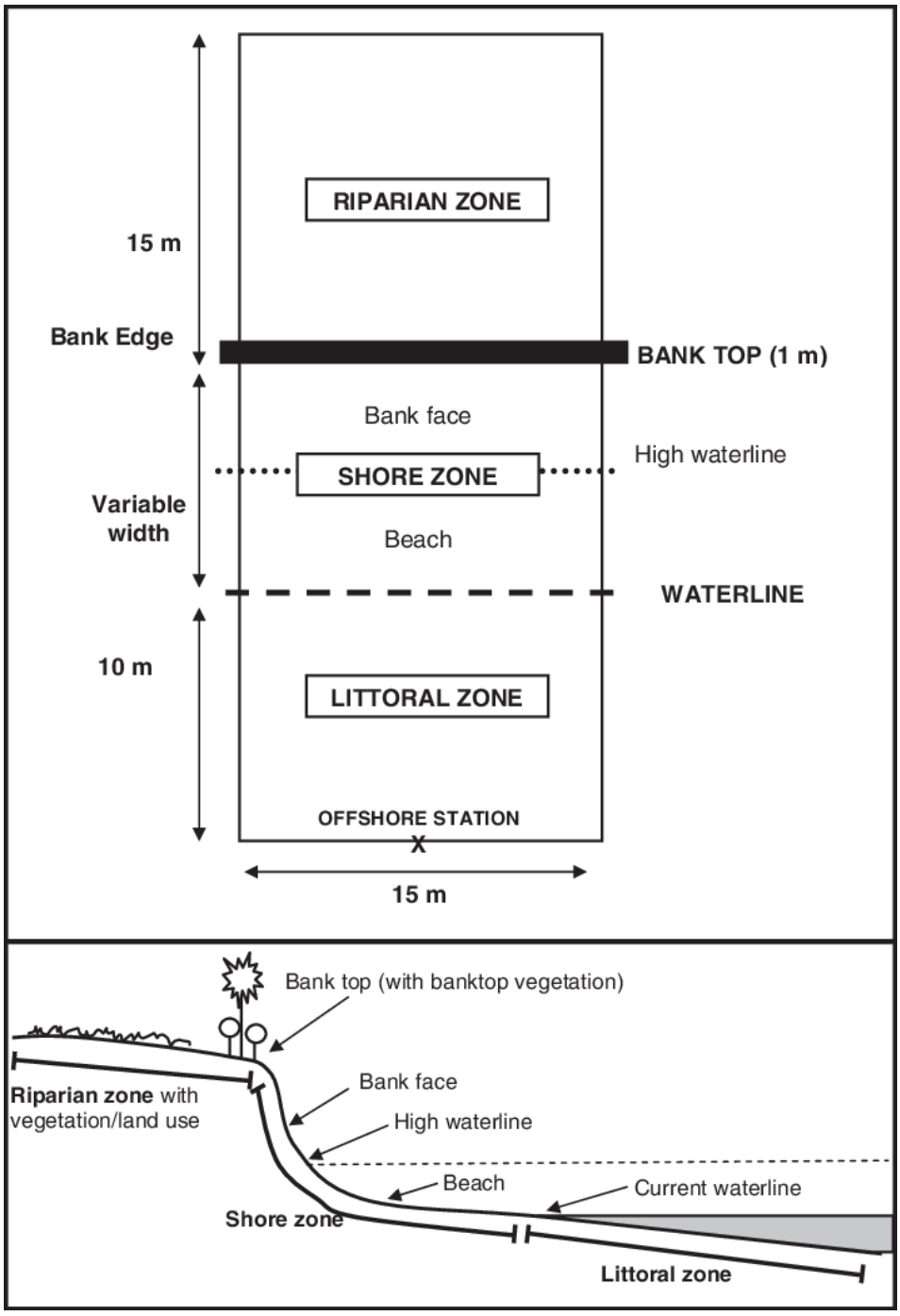


Figure 1: Plan view and schematic section of a Transect

3.6.2.1 Sediment characterization

The sediment classes used for the identification of sediment types are described in Table 3. Percent coverage of each type of substrate will be determined within each zone, delineated, and documented with digital imagery.

Table 3: Classification of substrate types

Class	Size Range (mm)
Bedrock	Continuous rock
Boulder	>250
Rubble	130-250
Cobble	30-130
Gravel	2-30
Sand	0.06-2
Mud	0.06

3.6.2.2 Vegetation Characterization

Observations for the entire plot are made from an 'offshore station', either from a boat or while standing in the water, not exceeding the maximum wading depth of 0.75 m, to ensure consistency between boat- and foot-based versions. The dimensions of the riparian and littoral zones were selected to capture the composition and diversity of features to be assessed and corresponds to the field of view of the surveyor from the offshore station. The shore zone, especially beach width, is of variable dimension depending on the water level at the time when the survey is carried out.

Vegetation characterization will be conducted in each zone of the transect. Identification of plant species/assemblage and percent coverage will be determined. Each type of vegetation will be delineated and documented with digital imagery. Identification of rare and protected species will be documented. Based on observations conducted during previous drawdowns, the current knowledge of the watershed, and the transient nature of this project, the drawdown is not expected to cause significant harm to the shoreline of the lake.

3.7 WETLANDS

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. A total of 21 wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the

2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond.

Table 4 shows the type of each wetland mapped in 2007; six of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 4: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond. Wetlands 3,5,6,15,17,19 are highlighted as they have been selected for Wetland Monitoring as described below.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an Atlantic Canada Conservation Data Centre (ACCDC) search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. An updated ACCDC search (Appendix P) was completed in 2023 for the study area, three records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond, see Figure 2. There are 14 records of Salted shell lichen (*Coccocarpia palmicola*). Salted shell lichen is listed as secure within the NS General Status Rank and has a Provincial Rarity Rank of S3S4. There is one record of Canada Warbler (*Cardellina canadensis*) which is listed as endangered within the NS General Status Rank and has a Provincial Rarity Rank of S3B. There was also one record of Boreal Chickadee *(Poecile hudsonicus*) that was noted, this species has a Provincial Rarity Rank of S3B. As per Figure 2 below, all records are not located in the immediate area of the Ruth Falls Headpond. As a result, none of the species listed above are anticipated to be impacted by the

drawdown activities. See Appendix P – ACCDC report in the Supporting Information document for full details.

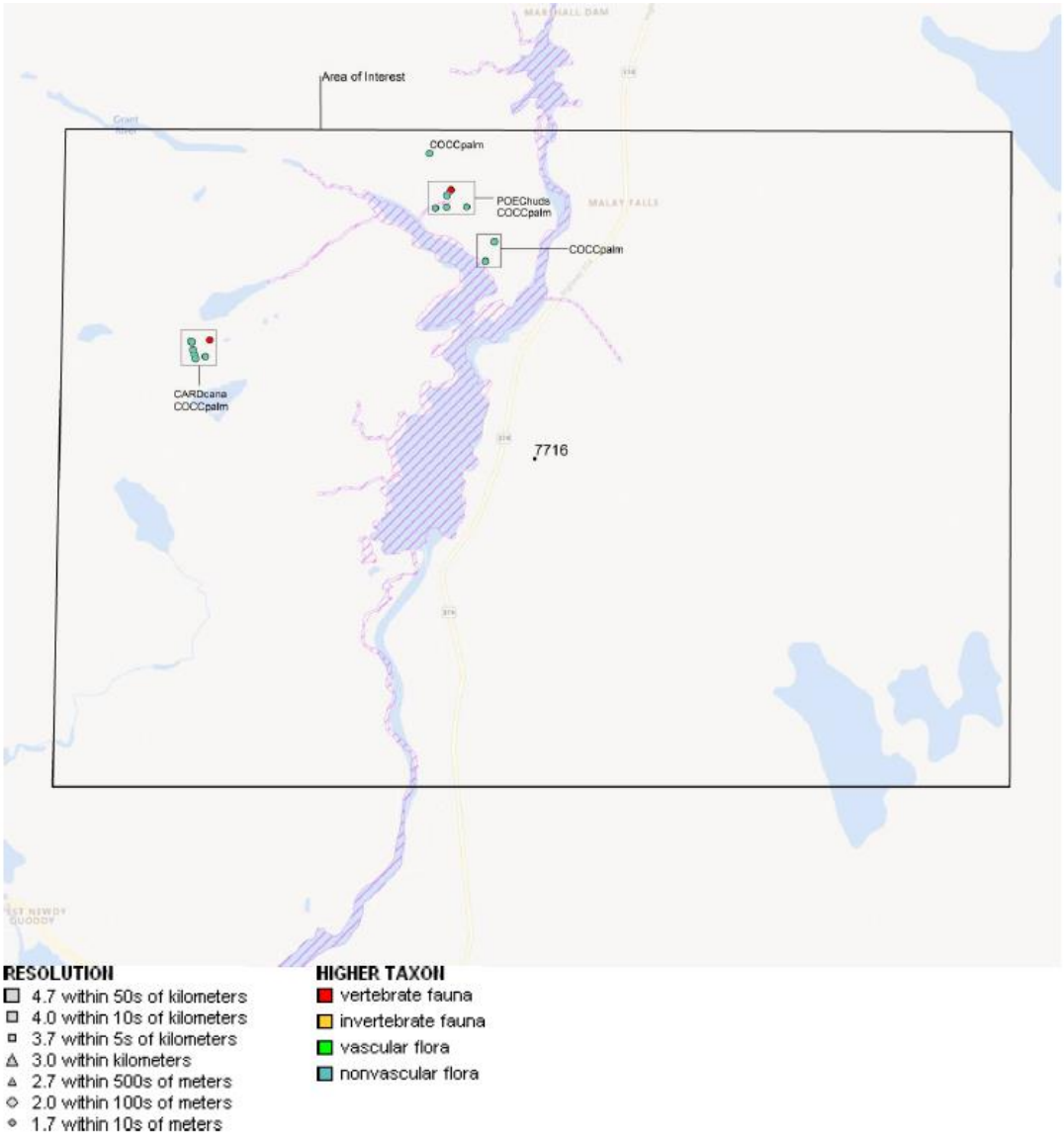


Figure 2: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points (2023)

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (nine months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a nine-month period is unknown.

Six wetlands have been selected for monitoring. Figure 3 displays the mapped wetland on the Ruth Falls Headpond, with the six wetlands to be monitored labeled. Wetland locations to be monitored include wetlands WL3, WL5, WL6, WL15, WL17 and WL19 which are described in Table 4.

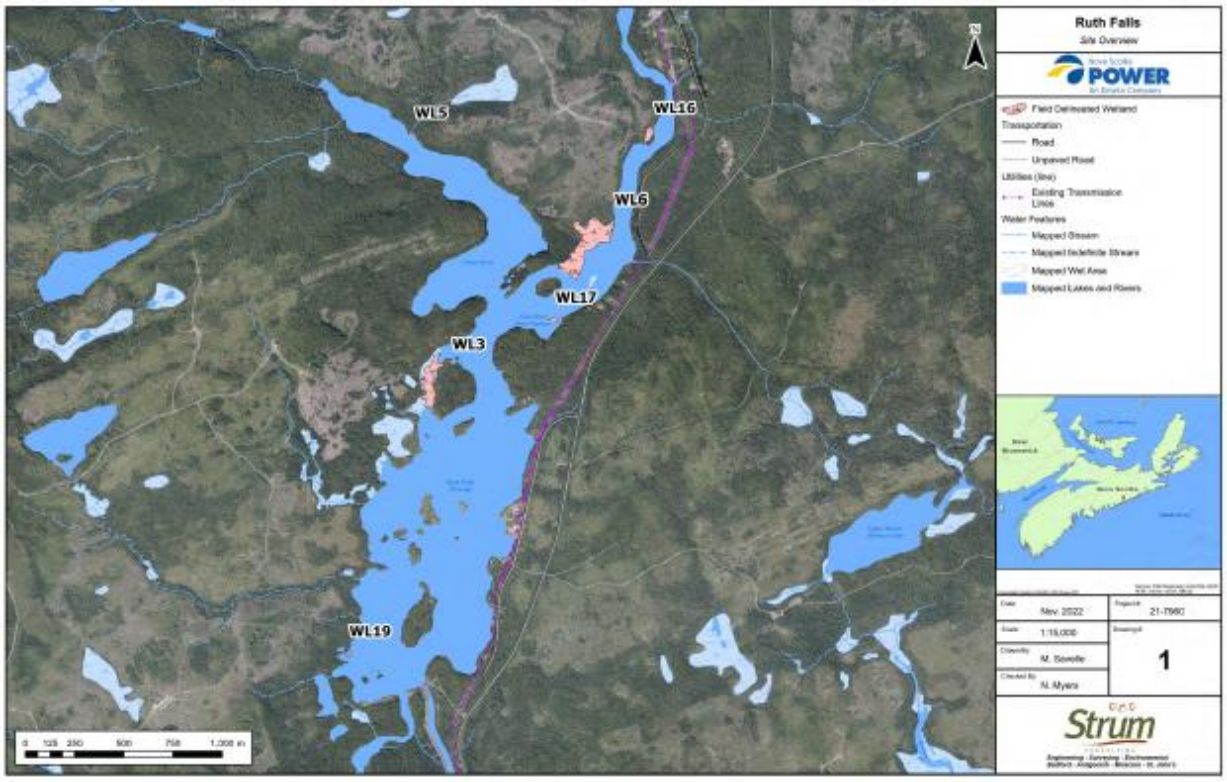


Figure 3: Mapped wetlands on Ruth Falls Headpond. Proposed Wetland Monitoring locations

3.7.1 Wetland Monitoring

While no permanent long-term alterations to the wetlands on Ruth Falls Headpond are anticipated, NS Power proposes to contract a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project.

NS Power developed a wetland monitoring plan, working with a qualified consultant, for the Tusket Main Dam Refurbishment Project, which involved a similar drawdown in 2021 of the headpond and potential impacts to a similar density of littoral zone wetlands; this plan was reviewed and approved by Nova Scotia Department of Environment and Climate Change (NSECC). Year one of post wetland monitoring is complete with the results suggesting there were temporary impacts during the drawdown period; however, there were minimal impacts to permanent wetland function / habitat. NS Power is proposing to

use this plan as a basis for monitoring at Ruth Falls. Full details can be found in Appendix M- Wetland Monitoring Plan. This plan includes:

- An updated desktop assessment, using an updated ACCDC search (2023) and available provincial data to verify potential wetland locations identified in the 2007 survey;
- Establishing monitoring stations on the select sample of wetlands. Wetland locations to be monitored include wetlands WL3, WL5, WL6, WL15, WL17 and WL19 (Table 4);
- Baseline assessment, including wetland edge mapping, vegetation data collection, baseline functional assessment and baseline hydrological monitoring prior to the drawdown. Baseline monitoring was completed in July 2022. Results of the monitoring are included in the monitoring plan;
- Construction monitoring, including vegetation and hydrological monitoring while the reservoir is drawn down;
- Post-construction monitoring, at minimum, will include monitoring immediately after refilling of Ruth Falls Headpond and again the following year. The length of post-construction monitoring will be determined in consultation with the NSECC Wetland Specialist and will include monitoring for vegetation and hydrological conditions. NS Power understands that a post-construction monitoring program is typically 5 years, with a repeated functional assessment in the last year of monitoring;
- Fish and Fish habitat suitability assessment. This assessment helps inform the selection of wetlands to be monitored and define methodology for assessing fish habitat and monitoring changes. The assessment includes a review of fish species within the reservoir, existing fish habitat, water quality conditions, wetland function to provide fish habitat, inherent wetland characteristics, including vegetative cover, accessibility, potential sources of food and nutrition, hydrology, and the potential hydrological changes within the bathymetry of reservoir as a result of drawdown;
- Fish habitat monitoring: Monitoring includes baseline monitoring of a desktop suitability assessment of wetland habitat, a review of fish sampling result and the collection of fish habitat data from the selected monitoring wetlands;
- Reporting schedule and frequency.

To evaluate the temporary impacts to wetland fish habitat, the methods within the wetland monitoring plan will be used, in combination with an evaluation of drone imagery collected throughout the drawdown. This approach was used for the Tusket Project to delineate the area of direct and indirect fish habitat for monitored wetlands, and then evaluate how much of these areas were impacted by the drawdown. Drone and other available aerial imagery will also be used to extrapolate temporary impacts to wetland fish habitat for the non-monitored wetlands. As discussed above, permanent impacts to wetland fish habitat is not expected as a result of the drawdown, but this will be evaluated through the post-construction monitoring program outlined in the monitoring plan.

3.8 REPORTING

NS Power will provide a report on 2024 drawdown monitoring activities by December 31st, 2025, detailing results of the fish rescue survey and mortality estimates, results and estimates for downstream entrainment and results of the habitat assessment. The report will also include a summary of water quality surveys conducted as mandated by NSECC.

Reporting for wetland monitoring will be in accordance with the wetland monitoring plan in Appendix M of the Supporting Information document.

4.0 Construction Monitoring

NS Power requires that the main civil contractor (or general contractor) develop a site-specific water management and erosion and sedimentation control plan that must align with NS Power's established water management and contingency plan as described in this document. The contractor plan will be reviewed by the Project Manager, Engineer and Environmental Lead to ensure the plan conforms with established design and constructability criteria and environmental standards. The contractor plan must also include details for regular inspection of control measures, water quality, as required, and machinery and processes for identifying and addressing deficiencies as well as reporting mechanisms for environmental incidents.

In addition to the contractor plan, NS Power will develop a Project Specific Environmental Protection Plan (EPP) which details NS Power's regulatory requirements, approval and authorization terms and conditions, and best practices that will be employed during construction. As part of NS Power's EPP, a regular inspection program is implemented in addition to the contractor inspection program, to evaluate contractor compliance to the contractor plan and to NS Power's EPP. Both the contractor's and NS Power's inspection program will extend throughout construction in 2024 and a summary report confirming all measures and standards as committed in this document and NS Power's Supporting Information document will be provided to DFO by December 31st, 2025.

5.0 Post-Construction Monitoring

5.1 OVERVIEW

Once construction is complete, NS Power will monitor the operation of the new dam structure as part of its regular bi-annual dam inspection and maintenance program as well as weekly inspections conducted by Hydro Operations. The new dam structure and associated fish passage improvement are expected to have positive impacts on migration. NS Power will complete post-construction monitoring to evaluate the effectiveness of the improved fish passage structures and overall operation of the new dam. The following sections outline specific monitoring measures for the various aspects of the project. The monitoring program will be in place for two years after construction is complete.

5.2 FISH LADDER

NS Power will complete monitoring activities associated with changes to the Ruth Falls Dam after construction is complete, including the improvements made to the fish ladder which includes the adjustment of weir sizing, notch depth and the additional attraction flow through the bottom non-technical fishway. These activities are as follows:

- NS Power will engage Innovasea to install and operate two artificial intelligence (AI) cameras placed at the entrance and exit of the Ruth Falls fish ladder. The cameras will be in operation between April 1st and June 15th in 2025, and 2026 to coincide with the upstream migration of Alewife. If fish are observed beyond this timeframe, the counts for that time period will also be assessed.
- NS Power will complete daily visual observations (daily inspections between April 1st and June 15th, in 2025 and 2026) of the fish ladder entrance and the downstream area to look for signs of negative impacts to upstream fish passage. Daily inspections will be completed mostly by Hydro Operations staff or supporting consultants; to properly capture any potential negative impacts to fish migration as a result of the fish ladder improvements. Specific parameters for observation in the downstream area include flow disturbances, fish milling, spawning behavior, etc. Daily spill and maintenance flows will also be recorded. In addition to daily inspections, qualified Environmental Services (ES) staff will be on site weekly to observe the downstream area and provide a more thorough observation of any negative fish passage impacts. If fish are observed beyond this timeframe, the monitoring will continue until fish numbers reduce drastically.
- Engage and retain a fish passage specialist to provide support in assessing fish passage effectiveness.

NS Power will use the camera system to record fish moving up through the ladder. The camera footage will be run through the AI counting system which will quantify the amount of fish passing under the camera. The cameras will run 24/7 between April 1 and June 15th in 2025 and 2026. The exit ladder camera will be used to quantity the number of fish successfully exiting the ladder into the Ruth Falls headpond

while the camera at the entrance will be used to quantify the amount of fish entering the ladder. Having the exit and entrance values, the efficiency of the fish ladder can be assessed by understanding how many fish that enter are successfully exiting. Due to similarities in morphology and overlapping migration periods distinguishing between species is not feasible at this time; however, this may be possible in the coming years.

Sea-run trout will also be assessed for upstream migration. NS Power will install pit tag antennas at the toe and the exit of the Ruth Falls fish ladder and will operate the trap in the fish ladder during the Atlantic salmon and trout migratory seasons to intercept and count individuals of these species. Intercepted fish would receive a pit tag and be released downstream of the fish ladder. NS Power will also work with Innovasea to train the AI fish monitoring program to recognize sea-run trout and Atlantic salmon with the aim of using camera data. However, the number of fish might be insufficient to achieve this goal.

NS Power will coordinate with the Project consulting fish passage professional to complete the following:

- On site assessment of the fish ladder once gaspereau are observed in the downstream area and migration begins, expected to be in early April.
- Assessment of the fish ladder throughout gaspereau migration – NS Power proposes to take an adaptive approach to subsequent site visits depending on assessment results and effectiveness of fish passage. The fish passage professional will remain on retainer with NS Power and is able to conduct a site visit relatively quickly.
- NS Power will provide an email summary of the assessments made by the fish passage professional to DFO, as well as any immediate flow adjustments made, or other action taken within 72 hours of the completion of an assessment.

If in collaboration with DFO and the qualified professional it is determined that contingency measures are required to improve upstream passage through the fish ladder, the following will be implemented within 72 hours of the notification of the target not being met, or observe negative impact by NS Power:

- ES qualified staff will conduct an immediate assessment of the fish ladder if negative fish passage impacts are observed during daily inspections (within 24 hours of observing the impact). NS Power will notify DFO of the observation and plan to correct, initiate a site visit by the fish passage professional, or implement contingency measures also within 24 hours.)
- If the assessment by the fish passage professional indicates the observed issue is internal to the fish ladder, NS Power will, in agreement with DFO, adjust flows in attempt to improve passage.
- If no improvements are observed, and structural issues are suspected, NS Power will work with the qualified fish passage specialist to assess which improvements could be required.

5.3 LOUVRE SYSTEM

Upon completion of the proposed improvements to the louvre system, NS Power is committed to completing a tagging study to assess how the changes impact the downward migration of eels and other migratory pelagic species such as Alewife and sea run trout. The results of this study will be used to inform successful improvements to the louvre system. A similar baseline study was conducted in 2009 / 2010 which will be used to compare the results and demonstrate improvements to the louvres being able to convert all species away from the powerhouse to the bypass pipe. Sampling for juvenile alewife will also be completed to assess the effectiveness of the louvre system at passing juvenile migratory species. The study will be conducted in 2025. Full details of the study plan for assessing downstream migration can be found in Appendix Q – Study plan of the Supporting Information document.

Should there be no improvement in efficiency for eels as a result of the study when compared to the 2009 /2010 study results, NS Power will work with the qualified Fish Passage Specialist to assess additional improvements to the louvre system which could include the adjustment of flows and other structural adjustments. As indicated by DFO, NS Power will be required to implement avoidance and mitigation measures at Ruth Falls to avoid (and possibly offset) the death of fish associated with hydroelectric operations should the results of the study and improvements to the louvres be deemed in sufficient. NS Power understands that significant fish passage improvements to avoid the death of fish must be demonstrated or further mitigation could be required by the Department, including additional offsetting, power generation shut-downs, or significant infrastructure upgrades.

5.4 UPSTREAM EEL RAMP

The eel ramp will require monitoring and maintenance to ensure it is operating as designed. Operations will complete weekly checks on the eel ramp to ensure it is free of debris by opening up the locked box surrounding the ramp substrate and cleaning out any unwanted debris while checking for damage. The checks will also ensure the ramp is in proper working order and functioning as designed. This will include checking the hose and water level output. The eel ramp will follow the same operating timeframe as the fish ladder (April 1st to November 30th) each year. The structure will include a trap which will enable NS Power to quantify the daily number of elvers ascending the ladder. This method is similar to the elver sampling conducted on the East River Chester (index river). During upstream migration season in 2025 (April 1st– June 15th) NS Power will complete a study to assess the abundance of elvers using the ladder. NS Power will place a fyke net near the entrance to the ramp and compare counts in the nets to the counts found in the trap. This will provide insight into the effectiveness of the ramp at passing elvers. If low numbers of elvers are noted in the trap compared to those found in the fyke net, NS Power will work with the fish passage specialist to adjust flows to try to facilitate movement.

It is important to note that during the first year of operation after the improvements are made to fish passage (fishway, louvre system, and the new eel ramps), it is likely that some small adjustments may be needed to ensure the structures are operating optimally.

5.5 REPORTING

A post-construction monitoring report will be provided to DFO by March 1st of 2026 and 2027.

Reporting will include:

- Results of upstream escapement monitoring;
- Results of daily and weekly inspections;
- Results of any formal assessment completed by the consulting and fish passage specialist;
- Maintenance flow records;
- Any adjustments made to the flows (fish ladder, louvre system or eel ramp);
- Any structural adjustments to fish passage (fish ladder, louvre system, or eel ramp);
- Any adjustments made to maintenance flows (65cfs through the vertical lift gates).

Given the expected duration of the louver study and elver ladder study in 2025, these reports will be provided to DFO by May 1, 2026.

6.0 Death of Fish/HADD after Avoidance and Mitigation Measures and Standards

Table 5 provides a summary of potential impacts to fish and fish habitat including proposed mitigation and potential for death of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD) as a result of water management activities associated with the Ruth Falls Dam refurbishment.

Table 5: Residual Harm from Potential Impacts Associated with the Ruth Falls Dam Refurbishment

Potential Effect	Spatial Extent of Potential Effect	Probability of Potential Effect	Magnitude of Potential Effect	Measures to Mitigate Death of Fish/HADD	Potential Residual Death of Fish/HADD
Temporary loss of fish habitat due to lowering headpond beyond the minimum operating level required from April 1 – November 30 annually.	Localized: approx. 1.5 km^2 in Ruth Falls Headpond	High	Low	Refer to Section 3	Residual HADD anticipated – temporary loss of fish habitat, to be quantified through monitoring

Temporary loss of fish habitat due to temporary installation of access roads	Localized: area immediately above and below the dam	High	Low	Refer to Section 2 and 3	No residual HADD anticipated
Permanent loss of fish habitat in the East River of Sheet Harbour.	Localized (~60 m^2) directly below the dam	High	Low	Area is extremely small (60 m2)	No residual HADD anticipated
Fish mortality due to stranding when lowering headpond.	Localized: Ruth Falls Headpond	Medium	Low	Refer to Section 3 and 4	Residual death of fish anticipated, to be quantified through monitoring
Fish mortality due to entrainment when lowering reservoir	Localized: Ruth Falls headpond	Medium	Low	Refer to Section 3	Residual death of fish anticipated, to be quantified through monitoring
Potential downstream scour during drawdown of headpond.	Localized: East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to provide safe fish passage upstream and downstream during construction.	Localized: Ruth Falls Headpond	Low	Low	Refer to Section 3	No residual HADD anticipated
Inability to monitor for salmon while trap is out of service.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated
Reduced ability for salmon to migrate upstream due to downstream supplemental flows not being released.	Localized: Ruth Falls Headpond	High	Low	Refer to Section 3	No residual HADD anticipated
Effects to fish and fish habitat due to sedimentation of the river from construction activities	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Release of hazardous materials from equipment	Localized: Ruth Falls Headpond, East River of Sheet Harbour	Low	Low	Refer to Section 3	No residual HADD anticipated
Potential effects on upstream fish passage due to change from stoplog controlled to vertical lift gate sluiceway and stoplog controlled to rubber dam spillway.	Localized: Ruth Falls Headpond, East River Sheet Harbour	Low	High	Improvements to louvre system to support improved downstream passage	No residual HADD anticipated

APPENDIX L – ENTRAINMENT STUDY PLAN

Stantec

Ruth Falls Dam Rebuild

Fish Entrainment Monitoring Program - Field Plan

November 9, 2023

Prepared for:
Nova Scotia Power Incorporated

Prepared by:

Stantec Consulting Ltd.
102-40 Highfield Park Drive
Dartmouth NS B3A 0A3

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1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by Nova Scotia Power Inc. (NS Power) to conduct fish entrainment monitoring as part of the Ruth Falls Rebuild Project (the Project). Specifically, Stantec is conducting a study of fish abundance in the reservoir upstream of the Ruth Falls dam before the drawdown, and fish entrainment monitoring downstream of the dam during the planned eight-day reservoir drawdown period. The entrainment monitoring program will focus on gaspereau[1] and other incidental species.

Additionally, NS Power has retained the services of Aerovision Canada Inc (Aerovision) to conduct aerial drone surveys of the shoreline littoral zones to assess changes in habitat before and after the reservoir drawdown.

The following document outlines the Field Plan for the Fish Entrainment Monitoring Program that has been developed for the Ruth Falls Rebuild Project.

2.0 BACKGROUND

The Ruth Falls Hydro System dam site (referred to as “the site”) is located 5 km north of the Town of Sheet Harbour, at latitude 44.95541° N and longitude -62.50016 ° W. The dam is located on the East River, downstream of Ruth Falls Flowage.

To allow maintenance and repair of the Ruth Falls Hydro System dam, NSPI plans to lower levels upstream in Ruth Falls Flowage by approximately 5.5 metres for nine months in 2024. The drawdown will occur over a period of eight days and is currently scheduled to start mid July 2024. The lowering of Ruth Falls Flowage will result in water levels returning to levels similar to historical pre-impoundment conditions for the nine months of the Project.

3.0 FIELD PROGRAM

The following section outlines the proposed Fish Entrainment Monitoring Program that will be conducted during the 2024 drawdown of Ruth Falls flowage.

The objective of the field program was to assess the abundance of Young-of-the-year (YoY) gaspereau within the reservoir before the drawdown, monitor the entrainment of fish from the reservoir during the drawdown and characterize the aquatic habitat exposed during the reservoir drawdown. Stantec has

[1] For the purpose of this report gaspereau refers to two similar and related species: the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*).

been engaged to conduct the fish entrainment monitoring tasks, while Aerovision will collect aerial imagery within the reservoir at set intervals to allow NS Power to document changes to aquatic habitat.

Specifically, the objectives addressed in this field program are:

1. Provide relative density and size distributions of YoY gaspereau and other fish incidentally caught in the Ruth Falls Flowage before the drawdown.
2. Provide an estimate of the number and species of fish entrained during the Ruth Falls Flowage drawdown.
3. Collect aerial imagery of the shoreline and nearshore at various stages of the Project to determine the change aquatic habitat within Ruth Falls Flowage.

A step-by-step work plan to accomplish these objectives is described below.

3.1 BASELINE FISH ABUNDANCE SURVEY - RUTH FALLS FLOWAGE

Prior to the drawdown a baseline fish abundance survey will be conducted in Ruth Falls Flowage. The baseline survey was developed to obtain a sample of YoY gaspereau to establish density, length and weight metrics within the reservoir.

The baseline fish abundance survey in Ruth Falls Flowage will be conducted approximately a week prior to the drawdown (i.e., early July). In July, it is anticipated that YoY gaspereau in Ruth Falls Flowage will be in the juvenile stage with fork lengths measuring less than 30 mm. Gaspereau of this size are likely to disperse based on wind induced currents or water currents. During a separate drawdown monitoring program on the Tusket River in 2021, seining and modified ichthyoplankton tows were conducted in July. Seining was shown to be successful in capturing YoY gaspereau from the reservoir environment, while the ichthyoplankton tows were only marginally successful in the reservoir, but shown to be more successful in the downstream riverine environment (Stantec 2022). As a result, the approach to collecting baseline data on YoY gaspereau will focus on the use of seines in the littoral environment.

Sampling multiple locations is thought to produce the best probability of YoY gaspereau capture and result in a more robust morphometric dataset. Therefore, up to 10 locations within the littoral zone of Ruth Falls Flowage will be sampled over one night using a 3 mm mesh (1/8 inch) beach seine. The seine sweeps will be conducted parallel to shore for 10 m using a 10 m x 1.5 m seine with 1/8-inch (3 mm) mesh, this will cover approximately 100 m^2 of habitat per seine. The seine will be closed off by bringing the offshore end towards the shoreline. Seining will be conducted by two field personnel between the hours of 18:00 and 02:00. The exact shoreline seining locations will be selected while on-site based on suitable bathymetry, substrates, shoreline vegetation and access. The target sampling area is provided in Figure 3.1.

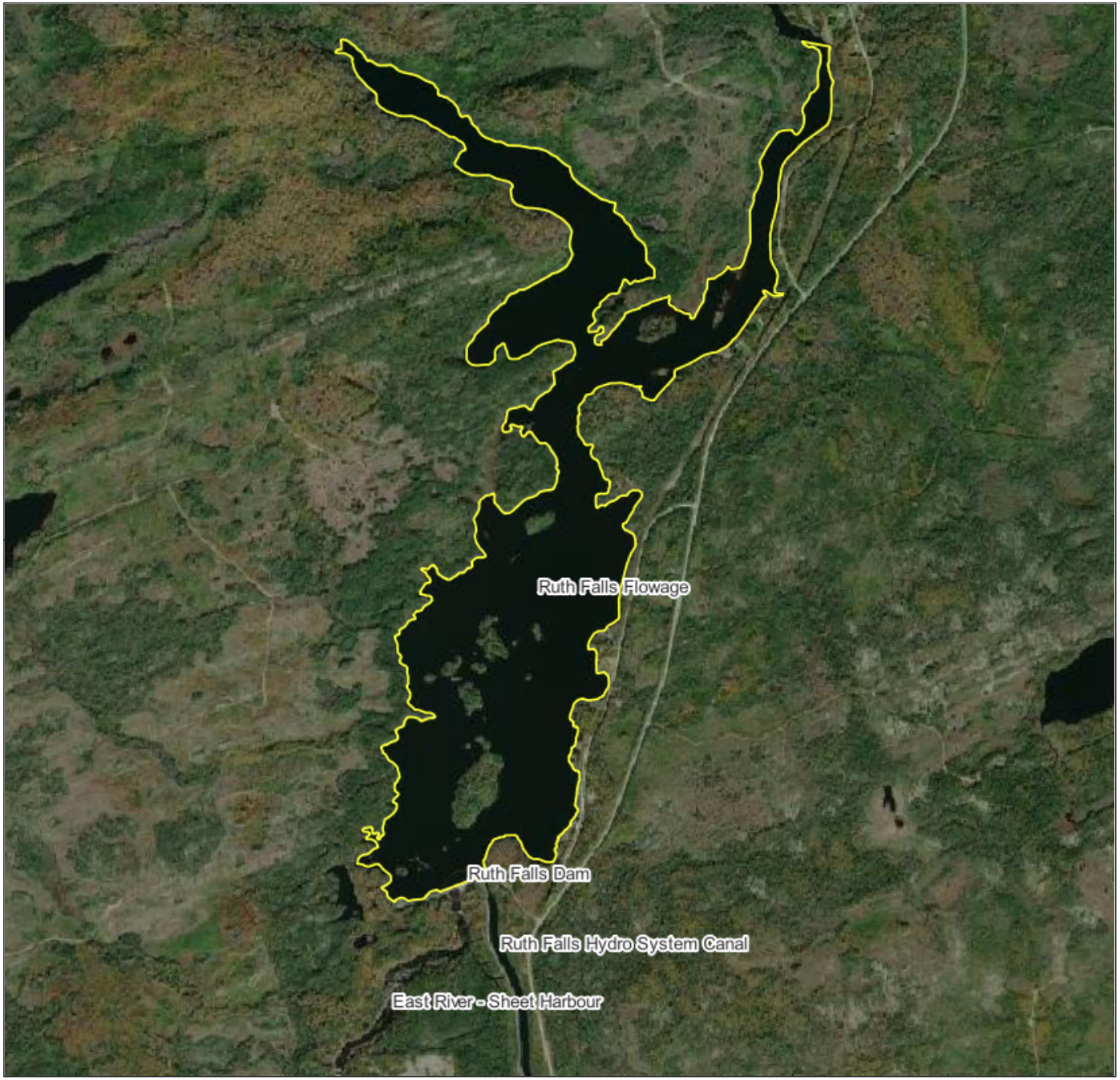
3.1.1 Fish Identification and Measurements

At each sampling location fish from the seine will be released into a cooler filled with freshwater and containing an airstone bubbler. Fish will be taken from each cooler, enumerated, and a subset of up to 50 YoY gaspereau from each net will be measured for fork length (to the nearest mm) and weighed (to the nearest 0.1 g). Where greater than 50 fish are caught in each net the subset of fish will include a random sample of juvenile gaspereau from the catch present. If large numbers of juvenile gaspereau are captured (i.e., >100) the entire sample will be weighed and released to reduce mortalities. The average weight per fish from the subsample will be used to estimate the total number of fish captured.

Other fish species collected in the sample will be identified and enumerated, with up to 25 individuals of each species weighed (to the nearest 0.1 g) and length measured (to the nearest mm) per location. Once weight and lengths of the fish have been recorded the majority of fish will be released in a similar location as their capture site.

3.1.2 Equipment

- Boat, outboard motor, and trailer
- Seine 1.5 m x 10 m
- Coolers for temporary fish storage, between collection and processing
- Fine mesh dip nets
- Scale (0.1 g resolution)
- Fish board (in mm)
- Camera
- Handheld GPS
- Data sheets or notebook
- Safety supplies (e.g., Personal Protective Equipment, boat kit, communication device, waders, personal floatation devices).



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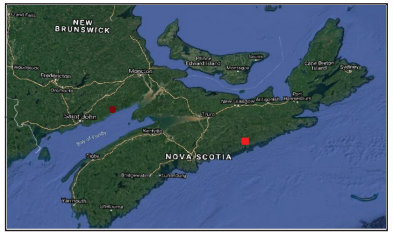
Target Baseline Sampling Area

N

0 350 700 metres

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N



Project Location
Sheet Harbour
Nova Scotia

Client/Project TBD_001
NS Power - Ruth Falls Entrainment Monitoring Program

Figure No.
3.1

Title
Target YoY Gaspereau Baseline Sampling Area

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3.2 FISH ENTRAINMENT MONITORING – EAST RIVER

Monitoring of fish entrainment during the drawdown will be conducted downstream of the Ruth Falls Flowage dam in East River. A preliminary assessment based on aerial imagery indicated the habitats in the East River downstream of the Ruth Falls Dam consists primarily of rapids and riffles. The flowing river characteristics (i.e., swift flows with large coarse or bedrock substrates) appeared to lend itself more towards the use of a rotary screw trap (e.g., Smolt wheel) over fyke traps or seine nets, particularly during the higher flows expected during the drawdown. It was noted that very few tributaries feed into the East River below the Ruth Falls Dam, decreasing the probability that species caught by the trap during the entrainment will be from other watercourses and increasing the probability that species captured will be those entrained from Ruth Falls Flowage.

In June 2022, Stantec was accompanied by NS Power representatives to evaluate the East River for suitable rotary screw trap locations. The reach of river assessed was located between the powerhouse and the Ruth Falls Dam. The suitability of habitat for the installation of a rotary screw trap was assessed based on depth, accessibility, thalweg position, presence of suitable anchor points, and distance from the Ruth Falls Dam. Based on the field assessment there were no suitable locations identified for the placement of a rotary screw trap. There were however locations identified that were suitable for the use of fyke nets (Figure 3.2). As a result, the proposed approach is similar to that used in the Tusket River, during the drawdown in 2021 and further described below.

3.2.1 YoY Gaspereau Monitoring

The location for the entrainment monitoring was selected based on the field assessment conducted in June 2022 and include two locations downstream of the Ruth Falls Dam where the flow is concentrated as shown in Figure 3.2. An alternate location has been identified upstream should this location become unsuitable due to changes in water elevations or site conditions which result in low catch rates. At each location YoY gaspereau will be caught using ichthyoplankton nets (bongo nets) with a 1/8-inch mesh (3 mm) mesh. The 3-mm mesh for the net is anticipated to be an appropriate mesh size for the size classes of juvenile gaspereau present during the drawdown. The 3-mm mesh size was successful in capturing YoY Gaspereau during the monitoring conducted on the Tusket River in 2021 (Stantec 2022).

At each location the bongo nets will be oriented facing into the flow so that fish moving downstream would be entrained in the net. The nets will be positioned in the thalweg for 10-minute periods, at least three times per day, and up to six times per day. The time samples are collected will be slightly varied each day to cover a full 24-hr period.

A mechanical flow meter attached to the bongo nets will record flow through the net to calculate the volume of water sampled. The catch in each net divided by the flow through the net during the sampling period will be used to determine the density (fish/m^3) of juvenile gaspereau. An estimate of abundance will be calculated from the average daily cross-sectional fish density (fish/m^3) and the daily discharge (m^3) through the dam as provided by NS Power.

3.2.2 Fyke-Net Monitoring

Fyke nets will be used during entrainment monitoring to assess other species and life stages of fish which may be entrained by the drawdown. Stantec proposes to set three fyke nets with ¼ inch mesh (6 mm) in suitable locations within the river downstream of the dam. The approximate locations are shown in Figure 3.2 with the exact deployment method and locations to be identified by the field staff on site based on water levels and current velocities during the drawdown. An alternate location has been identified upstream should this location become unsuitable due to changes in water elevations or site conditions which result in low catch rates. The nets will be set at the start of the drawdown and checked periodically based on catch rates.

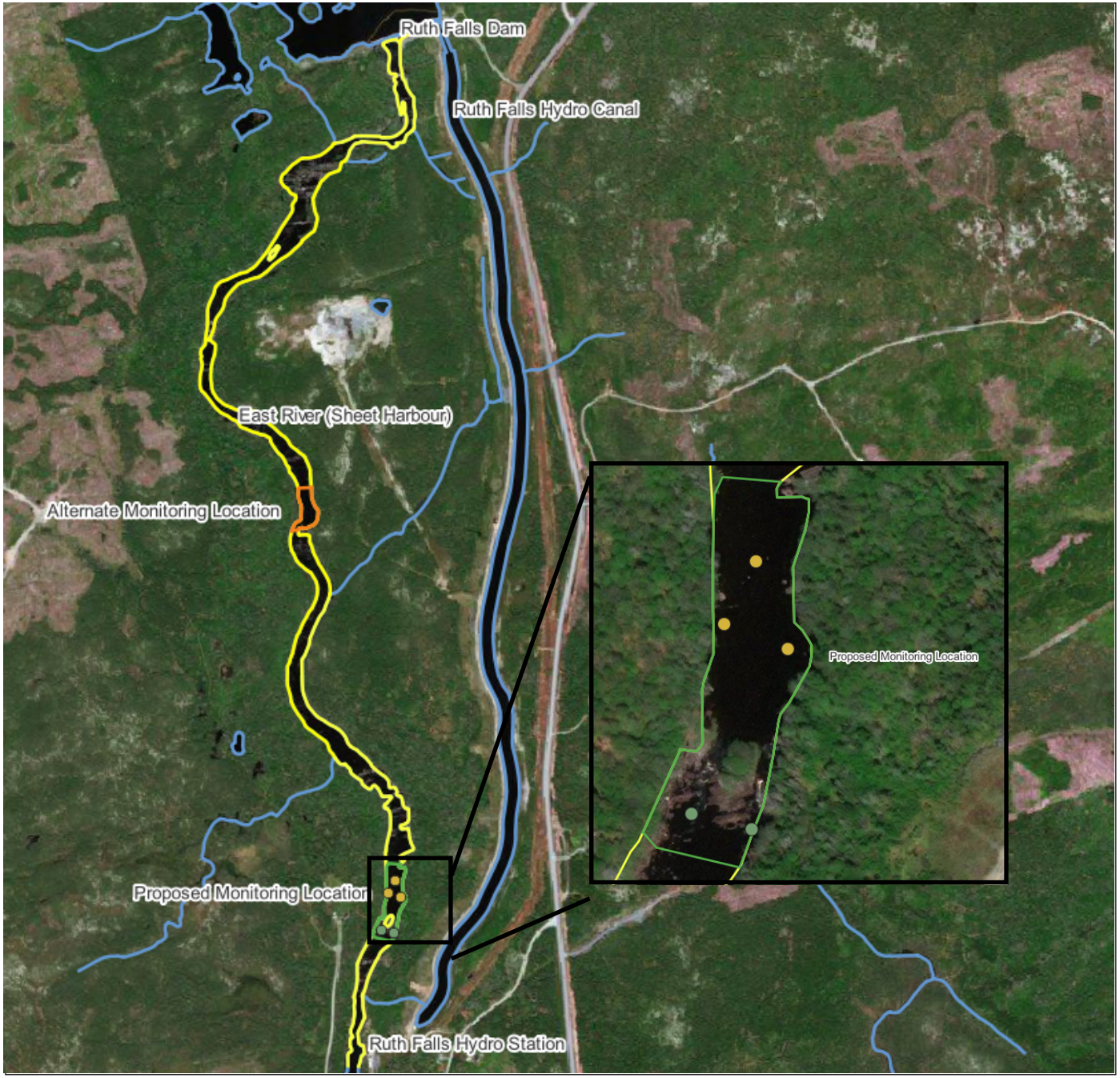
3.2.3 Fish Identification and Measurements

At each YoY gaspereau monitoring location fish from the cod-end of the bongo net will be released into a cooler filled with freshwater and containing an airstone bubbler. Fish will be taken from each cooler, enumerated, and a subset of 50 YOY gaspereau from each net will be measured for fork length (to the nearest mm) and weighed (to the nearest 0.1 g). Where greater than 50 fish are caught in each net the subset of fish will include a random sample of juvenile gaspereau from the catch present. If large numbers of juvenile gaspereau are captured (i.e. in the hundreds) the entire sample will be weighed along with a subsample of 50 fish. The average weight per fish from the subsample will be used to estimate the total number of fish captured.

Other fish species collected in the bongo or fyke nets will be identified and enumerated, with up to 25 individuals of each species weighed (to the nearest 0.1 g) and length measured (to the nearest mm) per location. Once weight and lengths of the fish have been recorded the majority of fish will be released in a similar location as their capture site. A subsample of fish from the fyke net catch will be retained for a mark-recapture experiment described below.

3.2.4 Mark-Recapture Experiment

A mark-recapture experiment will be implemented to estimate capture probability for fish caught in the fyke nets. A subsample of adult or juvenile fish will be marked via fin clip and released upstream at a suitable location. Species targeted will include those present at the time of sampling and may include large-bodied species such as: smallmouth bass, white perch, white sucker, yellow perch. Fish selected for marking will be anesthetized using clove oil, a portion of the fin will be clipped using scissors sterilized in 70% ethanol. The fish will be moved to a recovery tank prior to release upstream of the sampling area. The release location will be determined in conjunction with NS Power to determine an area that is accessible and a safe distance downstream from the Ruth Falls Dam.



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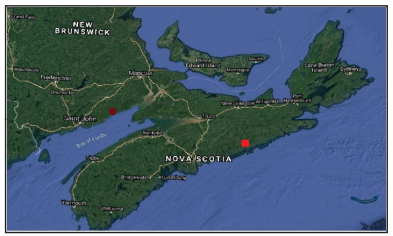
- Proposed Study Area
- Proposed Monitoring Location
- Alternate Monitoring Location
- Proposed Fyke Net Locations
- Proposed Bongo Net Locations

N

0 350 700 metres

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N



Project Location
Sheet Harbour
Nova Scotia

Client/Project TBD_001
NS Power - Ruth Falls Entrainment Monitoring Program

Figure No.
3.2

Title
Target Fish Entrainment Sampling Locations

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3.2.5 Equipment

- Boat, outboard motor and trailer
- Bongo Nets
- Fyke nets
- Coolers for temporary fish storage, anesthetization, recovery, and transport
- Air stone bubbler
- Scale (0.1 g resolution)
- Fish board (in mm)
- Clove oil
- Scissors
- 70% ethanol
- Camera
- Handheld GPS
- Data sheets or notebook
- Safety supplies (e.g., Personal Protective Equipment, boat kit, communication device, waders, personal floatation devices).

3.3 SHORELINE HABITAT CHARACTERIZATION

Aerial imagery will be collected within the reservoir at set intervals to allow NS Power to document changes to aquatic habitat. Aerial imagery collection will consist of three surveys conducted during the following periods:

- 1 survey within a period seven days prior to drawdown commencing (Early July 2024)
- 1 survey after the completion of the drawdown (August 2024)
- 1 survey conducted in November 2024.

Aerial imagery collection will be conducted by Aerovision within Ruth Falls Flowage using a fixed-wing remotely piloted aircraft system, RTK enabled with long endurance flight, and a 21MP camera. The remotely piloted aircraft system will be operated at a height at an elevation between 122 and 213 m (400 to 700 ft) along a pre-programmed flight path as shown in Figure 3.4. The imagery resulting from the flightpath will include complete coverage of a 30-m buffer on either side of the original high-water mark. Each image will be of sufficient resolution to delineate aquatic habitat types and extents, with a pixel resolution of 6.5 cm or less.

Following data capture, the imagery will be post-processed to produce a geo-referenced orthomosaic over the reservoir. The delineation of habitat types and extents will be performed by NS Power using GIS analysis.



Figure 3.3 Sample Flight Path for Ruth Falls Flowage

4.0 REPORTING

During the baseline fish abundance survey in Ruth Falls Flowage, fish capture data will be reported to DFO at the end of the baseline survey and every two days during the fish entrainment monitoring. If issues arise with the sampling methods, DFO will be informed of any variation from the methods described above.

Upon completion of the program a report summarizing the results of the fish entrainment study will be prepared for NS Power and submitted by December 31, 2024. This report will include information on the methods utilized in data collection and a summary of data from the baseline fish abundance survey and fish entrainment monitoring.

The baseline fish abundance survey data will be presented in terms of:

- the total number of fish caught by species,
- a summary of morphometric data (weight, length) by species, and
- the calculated densities by species for each seine.

The entrainment monitoring data will be presented in terms of:

- the total number of fish caught by species,
- a summary of morphometric data (weight, length) by species, and
- a daily entrainment estimate by species.

An entrainment estimate for YoY gaspereau will be calculated using the average fish densities (fish/m^3) from the bongo nets and the daily discharge (m^3) through the dam as provided by NS Power. The capture probability for large-bodied fish utilized in the mark-recapture experiment will be estimated using a suitable population size estimate method (e.g., Peterson method: N=MC/R, where N = population estimate, M = number of marked individuals, C = number of captured individuals, and R = number of recaptured individuals) with confidence intervals based on binomial confidence limits as suggested in Seber (1982). The total number of fish caught and recaptured in the fyke nets will be used to determine a capture probability to provide a daily estimate of fish entrainment.

5.0 PROJECT SCHEDULE

The proposed schedule for the 2024 Ruth Falls Entrainment Monitoring field program is outlined below.

- Preliminary Field Visit for Site Selection (Completed) - June 2022
- Baseline Aerial Shoreline Surveys – Early July 2024
- Baseline Fish Abundance Survey – Early July 2024
- Ruth Falls Flowage Drawdown – Mid July 2024
- Fish Entrainment Monitoring – Mid July 2024
- Post-drawdown Aerial Shoreline Surveys – March 2025

6.0 CLOSURE

This plan has been prepared for the sole benefit of Nova Scotia Power Incorporated (NS Power). This report may not be relied upon by any other person or entity without the express written consent of Stantec Consulting Ltd.

Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Should additional information become available, Stantec Consulting Ltd. requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

We trust that the Fish Entrainment Study Field Plan is satisfactory for your purposes at this time. If you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Matt Steeves, B.Sc.
Environmental Project Manager
Tel: (902) 620-0251
Matt.Steeves@stantec.com

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Daborn, G.R. and M.Brylinsky 2003. Fish Population Studies of the Avon Estuary, Pesaquid Lake and Lower Avon River. Acadia Centre for Estuarine Research Publication No. 76

O'Gorman, R. 1983. Distribution and abundance of larval fish in the nearshore waters of western Lake Huron. Journal of Great Lakes Research 9:14–22.

Seber, G.A.F. 1982. The Estimation of Animal Abundance and Related Parameters. 2nd edition. Griffin, London.

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APPENDIX M – WETLAND MONITORING PLAN

Ms. Kailey Osborne
Nova Scotia Power Inc.
1223 Lower Water Street
Halifax, NS B3J 3S8

Dear Ms. Osborne,

Re: Response to DFO Comments for the Ruth Falls Wetland and Wetland Fish Habitat Monitoring Plan, Ruth Falls Reservoir, Sheet Harbour, NS

The following information is delivered as responses to questions from the Department of Fisheries and Oceans (DFO). For clarity, questions/comments received have been duplicated below in **bold** with responses following.

1. **Describe how the results from the six monitored wetlands will be extrapolated to other wetlands that are not being monitored as part of this study to inform offsetting requirements for fish habitat.**

The 6 monitored wetlands were chosen from a desktop review of the inventory presented, as delineated by Jacques Whitford (2007). The wetland types assessed and identified during their surveys were accepted as true and used to inform the selection of wetlands as a component of the wetland monitoring program.

Given the constraints associated with monitoring all 21 wetlands, a selection of wetlands were chosen based on the results of the desktop review. The wetlands chosen for monitoring are distributed throughout the reservoir and selected to represent how different (spatial) areas might be affected as well as how the various types of wetlands would be affected. A table indicating the wetlands to be monitored is supplied below:

Table 1. Wetlands to be monitored at the Ruth Falls Reservoir

Wetland ID	Wetland Type	To be monitored?
1	Treed shore bog	
2	Treed shore bog	
3	**Treed shore bog**	**Yes**
4	Shore bog	
5	**Shore bog**	**Yes**
6	**Treed shore bog/ floating bog**	**Yes**

Wetland ID	Wetland Type	

7	Shore bog	
8	Shore bog	
9	Shore bog	
10	Shore bog	
11	Shore bog	
12	Shore bog	
13	Shore bog	
14	Shore bog	
15	**Treed shore bog/ treed shore swamp**	**Yes**
16	Treed shore bog	
17	**Shore bog**	**Yes**
18	Treed shore bog	
19	**Shore bog**	**Yes**
20	Shore bog	
21	Shore bog	

Information obtained from Jacques Whitford, 2007. *Report – Vegetation Surveys at the Sheet Harbour Hydroelectric System*. Project No. 1026751.

To aid in the extrapolation of data between the wetlands monitored and those that are not, standardized placement of monitoring wells and vegetation plots within wetlands will be conducted, ensuring consistency throughout the data set, as well as across the different wetland types.

- Monitoring wells will be placed halfway between (1) a point on the upland edge of the wetland furthest from open water, and (2) the nearest open water.
- Vegetation plots will be positioned between the monitoring well and the water's edge in a line, spaced 5-10 metres apart. If there isn't sufficient distance between the monitoring well and the water's edge, the plots will be positioned towards the upland edge, maintaining the linear distribution.

For many of the wetlands identified, the reservoir is assumed to be the primary source of hydrology for the wetlands. Given the consistency of the water level dropping across the entirety of the reservoir, and the standardized placement of the monitoring wells, impacts to water levels (as measured in the monitoring wells) is expected to be able to be extrapolated across similar wetland types, as well as in nearby geographical areas, throughout the reservoir.

2. **Wetlands can provide both direct and indirect benefits to fish and fish habitat. Describe how wetlands providing indirect benefits to fish habitat will be assessed to determine offsetting requirements.**

Direct benefits include food, shelter (from heat), spawning habitat, feeding habitat, etc. Depending upon the wetland type, these benefits can be significantly different.

As the different wetland types provide different benefits (both direct and indirect), a balance of wetland types have been selected for monitoring. The same approach was taken with respect to selecting

wetlands from a geographic perspective, as those wetlands that are “higher” (upstream) in the watershed provide different benefits to fish and fish habitat than those that are “lower” (downstream). Water depth in the immediate vicinity also plays a key role in how benefits are manifested.

Table 2: Direct versus Indirect Benefits

	Direct Benefits	Indirect Benefits	Notes
Open Lake	Fish feeding habitat, spawning habitat		Surveys in this zone will focus on fish habitat features and associated direct needs
Lakeshore (Foreshore)	Feeding Habitat, Food production, Spawning Habitat (emergent vegetation)	Water filtration, nutrient import to water, nutrient balancing, flow attenuation, oxygenation of water	Surveys in this zone will assess potential for fish habitat and direct benefits associated, as well as vegetation, etc. that can have positive indirect impacts to fish and their habitats.
Backshore	Tree growth for Shade (water cooling), food production	Water filtration, food-related nutrient production, flow attenuation of runoff	Surveys in this zone will assess the potential for indirect benefits to fish including vegetation cover and associated factors

3. **Baseline surveys will take place between June 1-September 30, but it is important to note that fish habitat is provided outside of these timelines, and there may be greater habitat as lake levels are expected to rise outside of this proposed timeline. Please confirm that NS Power will use the ordinary high water mark (OHWM) to delineate fish habitat.**

Ordinary High Water Mark (OHWM) will be defined as the ordinary high water level within the reservoir under normal operating conditions. Given that NSPI has some control over water levels, the OHWM is assumed to be the average of the highest operating-condition water levels. This means that water levels during flood conditions in the spring are not considered as the high water level for the purpose of this exercise. The delineation of fish habitat will occur during baseline surveys with regards to the OHWM (as defined herein), while further surveys during drawdown and post construction will assess the current conditions at those times, and be compared to the baseline conditions.

4. **For the assessments, describe the criteria that NS Power will be using to determine if a site is "direct fish habitat", "indirect fish habitat" or "not fish habitat".**

The criteria that NSPI will use to determine if a site is “direct fish habitat", "indirect fish habitat" or "not fish habitat" is provided in Table 3, below.

Table 3: Criteria to determine habitat

Habitat Type	Location(s)	Definition

Direct	Open Lake, Lakeshore (possible)	"…Water frequented by fish…on which fish depend on…to carry out their life processes including spawning grounds and nursery, rearing, food supply, and migration areas" (Federal Fisheries Act, Section 34.1)
Indirect	Lakeshore	Areas where fish might pass, but are not necessarily reliant upon for life processes, areas that may be temporarily inundated, temporarily flowing (ephemeral), or where some direct habitats draw important resources from
Not Fish Habitat*	Backshore, Lakeshore (possible)	Areas not accessible to fish, including upland areas, water that is too warm/cold (species specific). In this instance, Backshore Areas are the primary concern and will be assumed as the standard for "not fish habitat".

*Note that some nearshore environments may also qualify as "not fish habitat" dependent on factors such as vegetation and water quality. This will be further assessed as a component of the wetland and fish habitat monitoring program.

5. **The backshore definition mentions it is considered "not fish habitat". Describe if field studies will be conducted to confirm if this is accurate and whether indirect benefits to fish habitat are being considered in the backshore.**

Backshore areas are considered to not be fish habitat as they are above the annual high-water level of the lake/reservoir (not just the OHWM). These areas will be assessed during transects, as transects will be planned to continue at least 50 metres beyond the annual high water mark. Indirect Benefits to fish habitat will be assessed as part of the field studies and findings will be captured by way of notes regarding vegetation, topography, hydrology, etc.

6. **Describe how NS Power will determine the duration of impacts to wetlands deemed to be fish habitat to inform offsetting requirements for this project (e.g., describe how long will it take for wetlands impacted by the drawdown to re-establish to their full fish habitat functions). If this is to be part of the post-construction monitoring to be submitted later, state that in the plan.**

The comparison of baseline surveys, to post-drawdown (during construction) surveys, and the subsequent post-construction surveys, will inform the timetable within which monitoring will be conducted and how it will be addressed. WESP-AC assessments will be completed during baseline surveys, as well as during post-construction monitoring surveys and results will be submitted to NSECC and DFO as the program progresses. The specifics of the post-construction monitoring plan will be submitted/addressed at a later date upon completion of the baseline surveys.

Thank you,

Angus Doane, BSc., MREM
Junior Environmental Professional
adoane@strum.com

Natasha Myers, BA, BSc., EP, PMP
Senior Environmental Scientist
nmyers@strum.com

November 18, 2022

Ms. Kailey Osborne
Nova Scotia Power Inc.
1223 Lower Water St.
Halifax, NS B3J 3S8

Dear Ms. Osborne,

Re: Wetland and Wetland Fish Habitat Monitoring Plan
Ruth Falls Reservoir, Sheet Harbour, NS

INTRODUCTION

Nova Scotia Power Inc. (NSPI) is planning to temporarily lower the headpond at the Ruth Falls Reservoir (the Reservoir) within the Sheet Harbour Hydroelectric System to accommodate refurbishments (the Project). Strum Consulting was retained by NSPI to develop a Wetland and Wetland Fish Habitat Monitoring Plan (the Plan) for the Project.

The objective of the Plan is to determine whether the function of wetlands located along the shore that are contiguous with the headpond are impacted as a result of the lowered water levels. Additionally, the Plan will assess the impact on potential fish habitat provided by these wetlands.

The Plan will outline the general principles and methodology by which the wetlands and fish habitat around the Ruth Falls headpond will be monitored, before and after the water level is altered. Baseline wetland monitoring results will also be included for reference.

PROJECT DETAILS

To accommodate refurbishments at the Ruth Falls Reservoir, the water level in the headpond will be dropped from a full supply level of 109.25 ft down to 91 ft. The headpond will remain lowered for a period of approximately 9 months while work is completed on the Reservoir.

Wetlands

Initial wetland delineation was undertaken along the shores of the Reservoir during the *Vegetation Surveys at the Sheet Harbour Hydroelectric System* completed by Jacques Whitford (JW) in 2007 (JW, 2007). As a result of this delineation, 21 wetlands were identified that are contiguous with the headpond (Table 1; see Drawing 1, Attachment A).

Table 1: Wetlands identified at the Ruth Falls Reservoir (Jacques Whitford, 2007)

Wetland ID	Wetland Type
1	Treed shore bog
2	Treed shore bog
3	**Treed shore bog**
4	Shore bog
5	**Shore bog**
6	**Treed shore bog/floating bog**
7	Shore bog
8	Shore bog
9	Shore bog
10	Shore bog
11	Shore bog
12	Shore bog
13	Shore bog
14	Shore bog
15	**Treed shore bog/treed shore swamp**
16	Treed shore bog
17	**Shore bog**
18	Treed shore bog
19	**Shore bog**
20	Shore bog
21	Shore bog

Fish Sampling

Fish species data collected within the Sheet Harbour hydroelectric system was provided to Strum by NSPI; this historical data, including bathymetry information for the Ruth Falls headpond as well as fish and fish habitat assessment information from the Sheet Harbour Hydro System Relicensing Report (Nova Scotia Power, 2018), was used to establish baseline conditions and will assist in developing fish habitat post-construction monitoring assessments.

WETLAND MONITORING

The wetlands, as identified by JW (2007), provided the initial wetland assessment information; Strum has relied on this previously collected data to select and complete a monitoring assessment on six of these identified wetlands. The six wetlands **bolded** in Table 1 (Wetlands 3, 5, 6, 15, 17, and 19) are those selected for monitoring. Criteria for selection considered distribution throughout the reservoir and representation of different (spatial) areas and various wetland types. The criteria also included screening to ensure that hydrological source, landform, and location within a respective catchment area were represented throughout the Reservoir.

Wetland monitoring activities will consist of two baseline assessments (these were completed in July and September 2022), one pre-construction assessment, a minimum of one assessment during

drawdown (pending seasonality and timing of construction), and 5 years of post-construction monitoring. Pre-construction monitoring will be completed prior to the headpond being lowered to establish baseline conditions. Post-construction monitoring will begin after refurbishments are concluded and the Reservoir water level has been returned to its pre-construction full supply level. The findings of the monitoring program will allow for an evaluation of the extent of any changes in wetland characteristics and function as a result of the lowered water levels within the headpond.

Methodology

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored was delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up to date.

Vegetative monitoring will entail an assessment of vegetative composition and cover within quadrats along a transect. The linear transect will consist of a series of four 1 m x 1 m quadrats placed 5-10 m apart along the transect route. Percent cover of the herbaceous, shrub/sapling, and tree species within each quadrat will be assessed. The top right corner of each quadrat will be staked to ensure that the selected areas can be replicated for future monitoring events. Additionally, dominant plant species throughout the wetland, as identified along the transect, will be determined for each stratum based on the percentage of vegetative cover. A general assessment will be made to determine overall plant health and note any species that appear to be unhealthy or dying.

To aid in the extrapolation of data between the wetlands monitored and those that are not, standardized placement of monitoring wells and vegetation plots within wetlands has been conducted. This will ensure consistency throughout the data set, as well as across the different wetland types.

- Monitoring wells were installed halfway between (1) a point on the upland edge of the wetland furthest from open water, and (2) the nearest open water.
- Vegetation plots were positioned between the monitoring well and the water's edge in a line, spaced 5-10 m apart. Where sufficient distance between the monitoring well and the water's edge wasn't available, the plots were positioned towards the upland edge, maintaining the linear distribution.

During initial delineation, soil test pits were incorporated via manual installation (auger, shovel). Indicators of wetland hydrology were noted, including soil saturation, water table level, and standing water. Soil type(s) within each test pit were identified and will be monitored as the wetlands are re-assessed for function during the 5 years post-construction assessments. Subsequent monitoring activities will follow this same approach.

Photographs will be taken of the wetland from a fixed location (identified via GPS) for comparison with future events. All monitoring methodology will be completed during pre-construction and post-construction monitoring events. Initial monitoring events were conducted by a trained biologist and took place within the growing season (June 1 – September 30) to capture the prime growth period for plants and assess dry season conditions. Subsequent monitoring events will be timed to coincide with previous years' assessment dates to allow data comparisons to be made with previous and future monitoring events. Given the uncertainty of the timing of drawdown, subsequent monitoring events will

be timed to best reflect the changing conditions, while also considering the growing season and previously obtained baseline data.

A description of the monitoring parameters and assessment methodology for wetlands is provided in Table 2, below. All data gathering techniques will be replicated for each subsequent monitoring event.

Table 2: Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Methods of Assessment
Hydrology	Depth to groundwater will be measured in monitoring wells.
	Standing water depth measurements will be noted within the existing wetland (if applicable).
	Evidence of other positive indicators of hydrology (*e.g.*, drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.
	An assessment of the general hydrologic condition will be made.
Vegetation	Herbaceous vegetation assessments (as % cover) will be completed within plots along a vegetative transect throughout the wetland. Assessment of the potential changes in composition, species, and health will be evaluated. Photographs will be taken of each individual vegetation plot for comparison with future monitoring events. Any presence of non-native/exotic species will be noted during all surveys, and are addressed specifically in the WESP-AC assessment.
	General assessment of the above variables throughout the wetland will be completed.
	Dominant plant species throughout the wetland will be determined for each stratum based on the percentage of aerial cover.
	Photographs will be taken of the wetland from a fixed location for comparison with future monitoring events.
Soils	Soil type within test pits will be noted and recorded.
	Assessment of potential changes in soil conditions throughout the wetland habitat will be evaluated, including evidence of sedimentation and siltation.

Wetland Functional Assessments (WESP-AC)

WESP-AC was completed during baseline pre-construction surveys and will be replicated during the Year 5 post-construction monitoring event to assess whether the function and relative values of the wetlands were changed as a result of the Project.

WETLAND FISH HABITAT MONITORING

Review of Fish Sampling Results

A review of fish sampling conducted by NSPI was completed for all data available prior to the commencement of monitoring. The review involved data compilation of fish species and abundance, information related to migratory periods (including applicable date ranges and species types observed) and identified species' habitat requirements.

Desktop Fish Habitat Suitability Review

Prior to the commencement of monitoring, a desktop fish habitat suitability review was completed to assess the quality of fish habitat provided by both the Ruth Falls Reservoir and the wetlands contiguous with the Reservoir's shoreline. This review was used to help identify the wetlands that provide valuable fish habitat and inform the selection of wetlands for both wetland monitoring and wetland fish habitat monitoring, and included the following:

- Accessibility to fish
- Provision of fish cover
- Provision of water quality control features
- Potential sources of food and nutrition
- Bathymetry and water depth of the reservoir
- Review of fish sampling results

Based on this assessment, the six wetlands selected were considered most likely to provide a variety of suitable fish habitat for wetland fish habitat monitoring (in addition to meeting the requirements of the wetland monitoring selection criteria).

Assumptions for Fish Habitat Assessments

Fish habitat field surveys are to be modelled after the Ontario Ministry of Natural Resources Procedure (1991) for the Bay of Quinte. Given that the habitat assessments are taking place along the shoreline of a body of (relatively) still water, rather than along a watercourse, the application of flow assessments and fish habitat in streams is less transferable and resources such as the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt-a-stream, 2018), are not as applicable.

Given NSPI's ongoing fish monitoring at the Ruth Falls fish ladder, it is assumed that fish are present in the Reservoir, and that there are fish that use the habitats being surveyed. Therefore, minimizing damage and disruption to fish in sensitive situations, such as breeding, will take priority over the collection of any single data point. If fish breeding evidence is encountered during surveys, those effected data points may be omitted to prevent disturbance during these sensitive periods. NSPI may also want to consider structuring their work schedule around the known breeding periods of any species of conservation interest, including Atlantic salmon (*Salmo salar*).

Wetlands will be monitored for function and fish habitat during the summer months, though they are likely to provide fish habitat year-round. In this instance, the Ordinary High-Water Mark (OHWM) has been defined as the ordinary high-water level within the Reservoir under normal operating conditions. Given that NSPI has some control over water levels, the OHWM is assumed to be the average of the highest operating-condition water levels. This means that water levels during flood conditions in the spring are not considered as the high-water level for the purpose of this assessment. The delineation of fish habitat occurred during baseline surveys with consideration given to the OHWM (as defined herein), further surveys during drawdown and post construction will assess the current conditions at those times and be compared to the baseline conditions.

Methodology for Fish Habitat Field Assessments

The requirements for the baseline and subsequent fish habitat monitoring are described below in detail, including the timing of each of the field and desktop components.

The initial baseline surveys for fish habitat identification and classification were conducted by trained biologists and took place within the growing season on July 4-5, and again on September 6, 2022. The baseline surveys were conducted at the six selected wetlands surrounding the Ruth Falls Reservoir. The six wetlands were surveyed for both wetland function and characteristics as well as wetland fish habitat to incorporate the consideration of fish habitat and details associated with water quality. Given the completion of baseline studies, the monitoring schedule will proceed as outlined in the Proposed Schedule and Reporting section of this Plan.

Following the procedure outlined in the Ontario Ministry of Natural Resources (1991) document, transects will be walked from the Open Lake inland, through the Lakeshore and into the backshore for all subsequent monitoring events. This will align with the program that was completed during the baseline studies. General observations will be made, and specific parameters will be assessed for their likelihood to support fish habitat, as seen in Table 3, below.

Along the transects, the portions of each transect to be assessed will be defined as follows:

Open Lake (OL): Open Lake is the area that is completely inundated with water, and can be definitively considered direct fish habitat. There may be any combination of emergent, floating, and submerged vegetation, though the water depth should be no more than 50 cm. The Open Lake area must also be connected to the main water body of the Reservoir to allow fish passage.

Lakeshore (LS): The Lakeshore (also known as the Foreshore) is the area that is generally above the current water level of the lake (Reservoir), but below the highwater line (during flood conditions) on an annual basis. This area might be considered direct fish habitat, though indirect fish habitat should not be considered a requirement. There is wetland vegetation, with the potential for some aquatic vegetation, especially when in proximity to the Open Lake area. The point for the LS assessment should be where there is a transition from standing water to no standing water.

Backshore (BS): The Backshore is the area at least 30 m perpendicular inland to the shore's highwater line and it should not be saturated in water, though it can be wetland or upland. It is not considered fish habitat and should not be accessible to fish.

The parameters to be monitored at each portion of the transect (i.e., OL, LS and BS) are described in Table 3.

Table 3: Wetland Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Photos	OL, LS, BS	Photos will be taken of the substrate (where applicable), vegetation, surrounding habitat, and any other observations of note.
GPS	OL, LS, BS	GPS waypoints will be taken to accurately map results and track the movement of OL and LS waypoints based on de-watering activities.
Vegetation	OL, LS, BS	Relevant vegetation within a 5 m radius will be recorded, and the relative abundance within each stratum within a 30 m radius will be estimated.
Aquatic vegetation	OL, LS	Any water-bound vegetation species will be noted within a 5 m radius and the relative abundance as a percent cover within a 30 m radius will be estimated.
Water Quality	OL/LS	Standard parameters including pH, conductivity, temperature, and dissolved oxygen will be measured using a YSI Multiparameter meter where open water is present and can be accessed safely. At the Lake Shore area, this may not be possible given differing water levels and vegetation constraints but it will be captured where feasible.
Substrate	OL, LS, BS	Substrate types and relative abundance will be noted, including bedrock, boulders, rubble, cobble, gravel, sand, detritus, and fines/muck/silt.
Water Level/Depth	OL, LS	The depth or level of water compared to the substrate should be measured using a measuring device. The use of a piezometer for continuous measurement may be required in conjunction with, or as a replacement to, any monitoring wells installed within the selected wetlands to be monitored.

Given that the water level will significantly change during drawdown, the transects where the assessment points are taken will remain the same, however, new assessment points will be added at each of the monitoring sites to reflect the changing OL and LS locations. The transect lines will still inform the placement of those points of assessment, however, if safety challenges prevent access to a specific location, the point will be moved to a nearby and comparable safe location, or omitted entirely if accessible and representative habitat is not present. Upon water levels rising to pre-construction levels (or as close as can be expected in post-construction conditions), the original assessment points will be resumed for all post-construction monitoring, to the best ability of the biologist conducting surveys.

Fish habitat will be classified as it is defined in Table 4, for the purpose of determining the extent to which any given habitat might contribute to fish habitat, either directly, indirectly, or not at all.

Table 4: Criteria to determine habitat

Habitat Type	Location(s)	Definition
Direct	Open Lake, Lakeshore (possible)	"…Water frequented by fish…on which fish depend on…to carry out their life processes including spawning grounds and nursery, rearing, food supply, and migration areas" (Federal Fisheries Act, Section 34.1).
Indirect	Lakeshore	Areas where fish might pass, but are not necessarily reliant upon (the areas) for life processes, areas that may be temporarily inundated, temporarily flowing (ephemeral), or where some direct habitats draw important resources from.
Not Fish Habitat*	Backshore, Lakeshore (possible)	Areas not accessible to fish, including upland areas, water that is too warm/cold (species specific). In this instance, Backshore Areas are the primary concern and will be assumed as the standard for "not fish habitat".

*Note that some nearshore environments may also qualify as "not fish habitat" dependent on factors such as vegetation and water quality. This will be further assessed as a component of the wetland and fish habitat monitoring program.

In all cases, the assessment points and transects will be chosen to best represent the surrounding habitats.

Baseline Monitoring Results

Baseline monitoring was conducted on July 4-5, and September 6, 2022. All wetlands were accessed via boat over the Reservoir, and each wetland was accessed successfully, as locations provided by the JW (2007) were confirmed. Each wetland was assessed using WESP-AC functional assessment protocols (Attachment B – WESP-AC Forms) and delineated to establish current boundaries. Once this delineation and functional assessment was complete, the installation of monitoring wells and vegetation plots were done according to the methodologies outlined above. One wetland (WL17) was assessed as an island of wetland habitat within the reservoir, and thus had no associated upland habitat directly adjacent, nor any "Back Shore" for the purposes of fish habitat monitoring. Results from the vegetation plots and monitoring wells can be seen in Attachment C – Wetland Monitoring Data.

Detailed information obtained for each of the selected wetlands during baseline monitoring assessments can be found in Drawings 2-7, Attachment A.

Wetland delineation and characterization from baseline studies agrees overall with the JW (2007) study, though the water's edge where the wetlands are contiguous with the Reservoir has changed slightly, given the variable water levels and weather impacts. Wetland types were confirmed, and fish habitat characteristics were assessed.

Wetland Fish Habitat assessment results are included in Attachment D – Fish Habitat Assessment Data. Fish habitat assessments were conducted after delineation to ensure that boundaries could be used to inform the placement of the transect that was travelled for wetland fish habitat assessment. Given constraints surrounding accessibility, water quality measurements were only collected at LS locations for each of the wetlands surveyed.

As outlined above, each wetland (aside from WL17 – an island) had a distinctly observable upland edge where "Back Shore" measurements were collected. Significant forestry impacts exist on many of the properties that surround the reservoir, though there is generally a riparian buffer separating the water's edge from those heavily forested areas. Details on habitat for each wetland is outlined in Table 5, as a combination of both baseline surveys and general observations.

Table 5: Wetland Fish Habitat - Baseline Observations

Wetland	Open Lake	Lakeshore	Backshore
Wetland 3	Permanently flooded with abundant large woody debris and moderate floating and emergent vegetation. No fish observed, though rocky (primarily rubble) substrate suggests positive attributes to fish habitat. Quite shallow – 25 m offshore there are emergent boulders. Direct fish habitat.	Some overhanging vegetation. Shoreline is quite distinct, though there is slightly more emergent vegetation. Under normal operating conditions should be considered Indirect Fish Habitat.	Spruce dominated forest with clear signs of previous forestry management present. No evidence of watercourses or significant surface flow nearby.
Wetland 5	Permanently flooded with some rocky and woody debris. Substrate slopes away from the wetland edge quite quickly to deep water. Direct fish habitat is present in shaded areas closer to the shoreline, both adjacent to the wetland and further along the shore. Direct fish habitat.	Ephemeral brook flowing along the southeast boundary of the wetland providing cooler water inputs from the forested area upstream for Indirect Fish Habitat.	Young to moderate aged coniferous forest present in all nearby upland, except along lakeshore.
Wetland 6	Plenty of submerged and emergent woody debris and boulders, as well as moderate emergent vegetation. Fish observed. Direct fish habitat.	A poorly defined channel flows out of the wetland near the location of water quality measurements, but no flow was present during baseline monitoring events. Rocky substrate (rubble) with significant silt on top. Indirect fish habitat.	Young-mid aged softwood dominated forest. Appears to have been previously impacted by forestry operations.
Wetland 15	Appears to be permanently flooded with very little vegetation or emergent debris. Appears to drop-off to deeper water quite quickly. Direct fish habitat.	Small ephemeral outflow with boulders and overhanging vegetation present at location of water quality measurements, though the ground level of the wetland is significantly higher than water levels. Indirect fish habitat	Clearcut present approximately 25 m inshore from wetland/upland edge. No signs of waterflow over land, though some small ditches of water are present due to forestry impacts.

Wetland	Open Lake	Lakeshore	Backshore
Wetland 17	Quite shallow all around the wetland (an island), with abundant emergent and aquatic vegetation. Fairly rocky substrate, though some silt on top as well. No deep water for ~5 m in all directions surrounding the wetland. Direct fish habitat.	Shoreline habitats varied from rocky and muddy to fully vegetated. Vegetation remains consistent across the land/water boundary. Indirect fish habitat	No Backshore present. It is suspected that the entire wetland could flood during highwater conditions outside of the flood season.
Wetland 19	Permanently flooded with gravel and sand substrate present on the east side of the wetland, fish observed, and clear signs of Direct Fish Habitat. West side of wetland bordering on small cove has muck/mud substrate and is very shallow providing poor fish habitat.	No clear inflow/outflow present, with the western border of the wetland being contiguous with the open water, while the eastern border having a proper border. Indirect fish habitat on all on sides.	Backshore is young softwood with relatively few undergrowth species. No signs of waterflow overland, nor signs of flooding at any time.

All instances included passage through the Open Water by boat, where observations on habitat and substrate were made. Backshore conditions (where available) included similar species distributions throughout the Reservoir, though the impacts of forestry on those habitats is well established.

During future monitoring events, the locations of water quality measurements (Lakeshore during baseline monitoring), Open Water, and Lakeshore are likely to change, sometimes in a significant way. Pre-construction and post-construction monitoring locations are expected to remain consistent, as outlined above, although during construction there is anticipated to be differing amounts of change at each wetland, considering their positions within the Reservoir. These differences will be noted and aid in the comparison of fish habitat quality and abundance between baseline, during construction, and post-construction conditions.

With fish being observed at both WL6 and WL19, as well as the confirmed presence of fish crossing the dam and spillway at the south end of the Reservoir, it is understood that under current conditions, each of the wetlands monitored provides some level of fish habitat, as well as indirect benefits to fish habitat.

PROPOSED SCHEDULE AND REPORTING

Annual post-construction monitoring reports will be submitted to Nova Scotia Environment and Climate Change (NSECC) for the five years of post-construction monitoring. Vegetation results shall be provided in a cumulative table to allow for inter-annual comparison of data. Table 6 outlines the monitoring and reporting schedule for the Wetland Monitoring Program, while Table 7 outlines the monitoring and reporting schedule for the Wetland Fish Habitat Monitoring Program.

Table6: Monitoring and Reporting Schedule for Wetland Monitoring

Monitoring Event		Wetland and Wetland Fish Habitat Monitoring	WESP-AC	Reporting Submission to NSECC
Pre-construction	Baseline	✓	✓	
During Construction		✓		Memo
Post-construction	Year 1	✓		✓
	Year 2	✓		✓
	Year 3	✓		✓
	Year 4	✓		✓
	Year 5	✓	✓	✓

Information collected from post-construction monitoring events will be compared with the baseline data collected during the pre-construction monitoring events and previous years' monitoring events to evaluate post-construction vegetation (e.g., wetland and vegetation present, invasion of exotic species, success of any re-vegetation, etc.), hydrology, and soils. After Year 5, potential long-term impacts to the wetlands will be assessed, a follow up WESP-AC program will be completed, and required consultation with NSECC will take place.

Table 7: Monitoring and Reporting Schedule for Wetland Fish Habitat Monitoring

Monitoring Event		Fish Habitat Transect Monitoring	Desktop Review of Fish Data	Reporting Submission to NSECC & DFO
Baseline (C**ompleted**)		✓	✓	✓
Pre-construction	1 week before drawdown	✓	✓	✓
During Construction*	1 week after drawdown	✓	✓	✓
	End of growing season during drawdown/construction	✓	✓	✓
Post Construction*	1 week after water level is restored	✓	✓	✓
	Year 1	✓	✓	✓
	Year 2	✓	✓	✓
	Year 3	✓	✓	✓
	Year 4	✓	✓	✓
	Year 5	✓	✓	✓

*Monitoring may be limited depending on the time of year when construction is to be completed, ***i.e.,*** if construction is completed in January, the first post-construction survey will not be completed before the growing season begins in June.

Information during post-construction monitoring will be used to inform reports submitted to NSECC and Fisheries and Oceans Canada (DFO) on an annual basis, while further consultation with each respective governing body may be required after the post-construction monitoring is completed.

CLOSURE

Thank you for the opportunity to develop this Wetland and Wetland Fish Habitat Monitoring Plan. If you have any questions, please contact us.

Thank you,

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Natasha Myers, BSc., EP, PMP
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REFERENCES

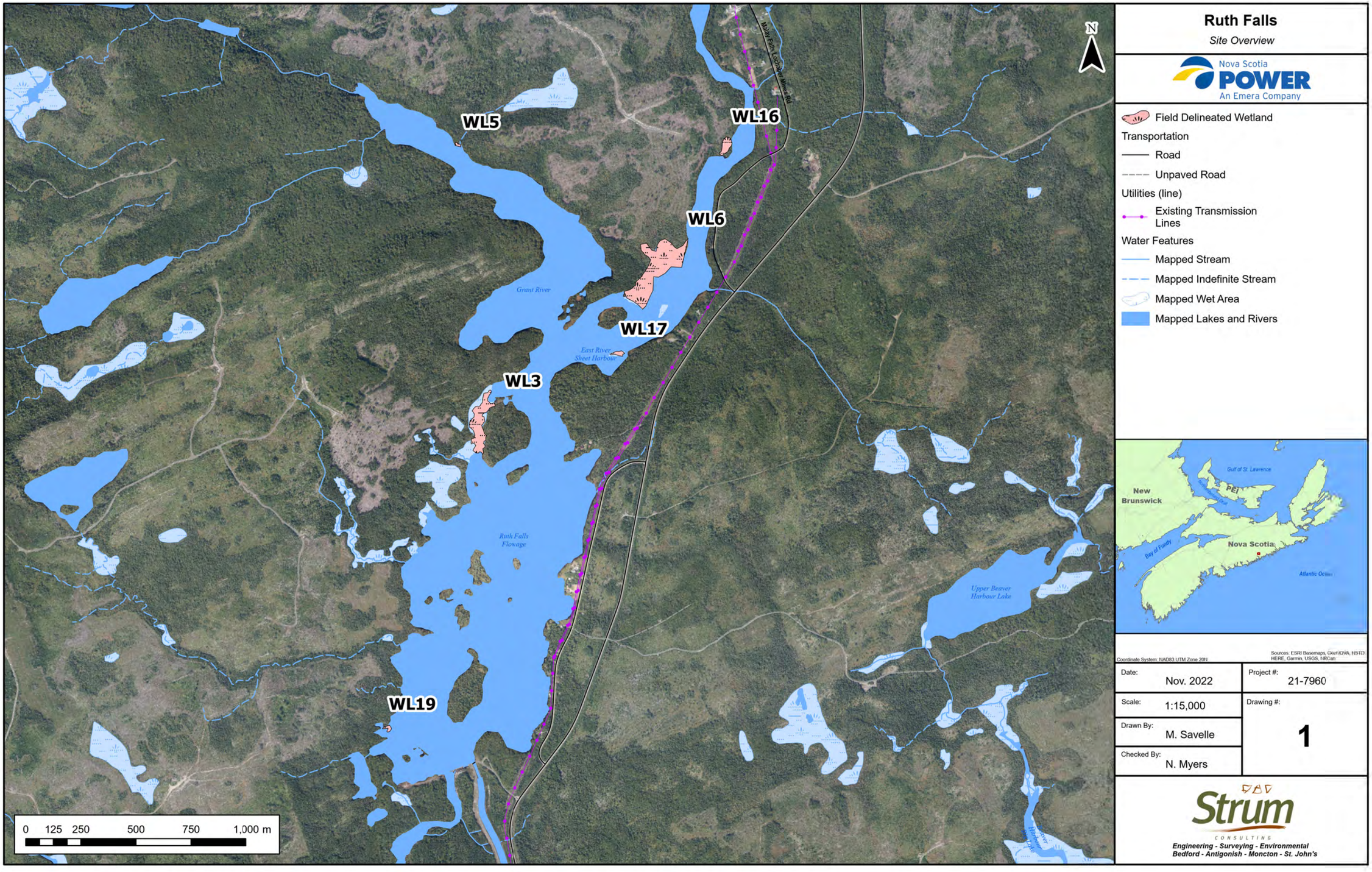
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ATTACHMENT A
DRAWINGS



Ruth Falls

Site Overview

Nova Scotia POWER
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- Field Delineated Wetland

Transportation
- Road
- Unpaved Road

Utilities (line)
- Existing Transmission Lines

Water Features
- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area
- Mapped Lakes and Rivers

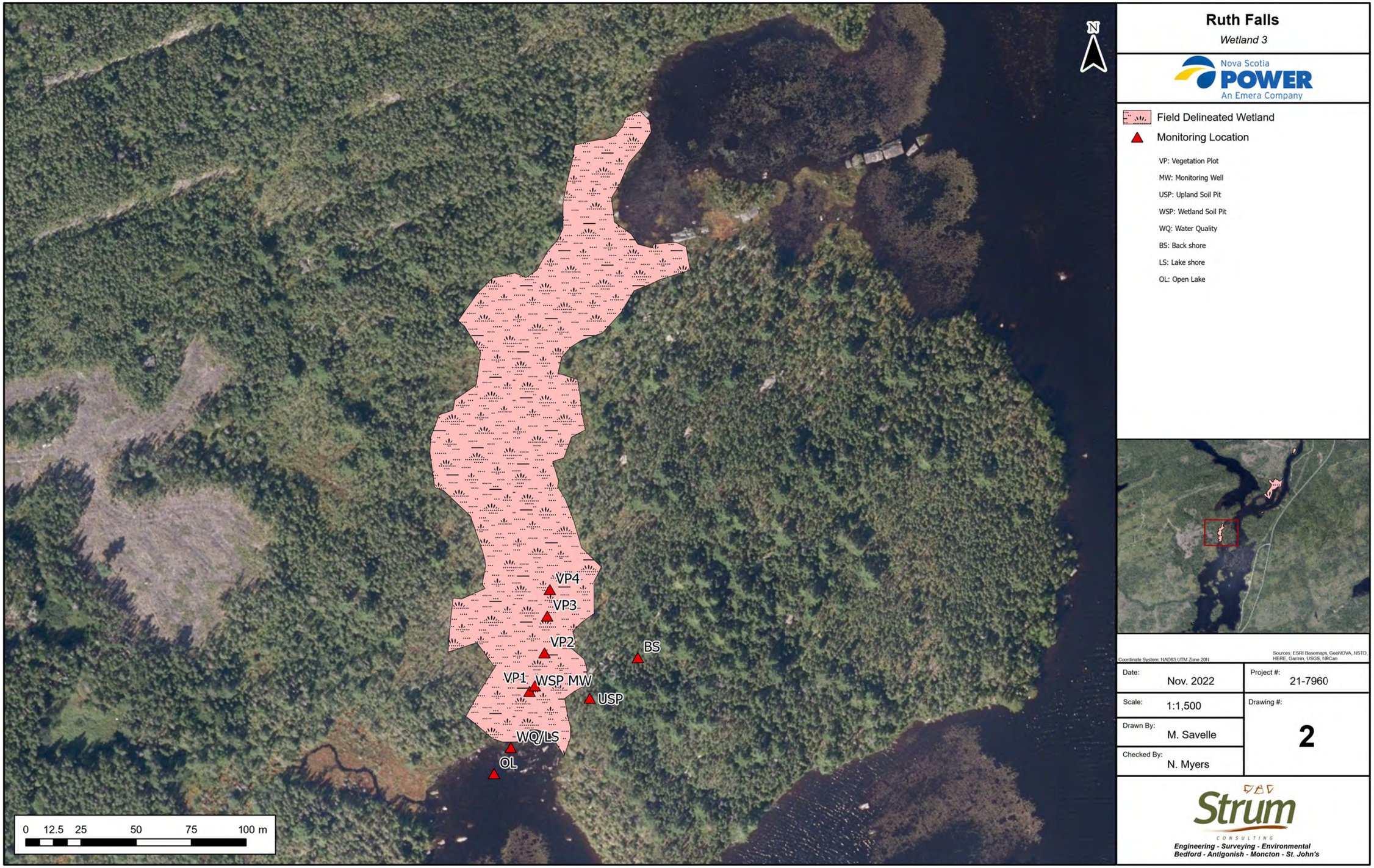
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Sources: ESRI Basemaps, GeoEYE, INSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:15,000	Drawing #: 1
Drawn By: M. Savelle	
Checked By: N. Myers	

Strum CONSULTING

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Ruth Falls

Wetland 3

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:1,500	Drawing #: 2
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 5

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

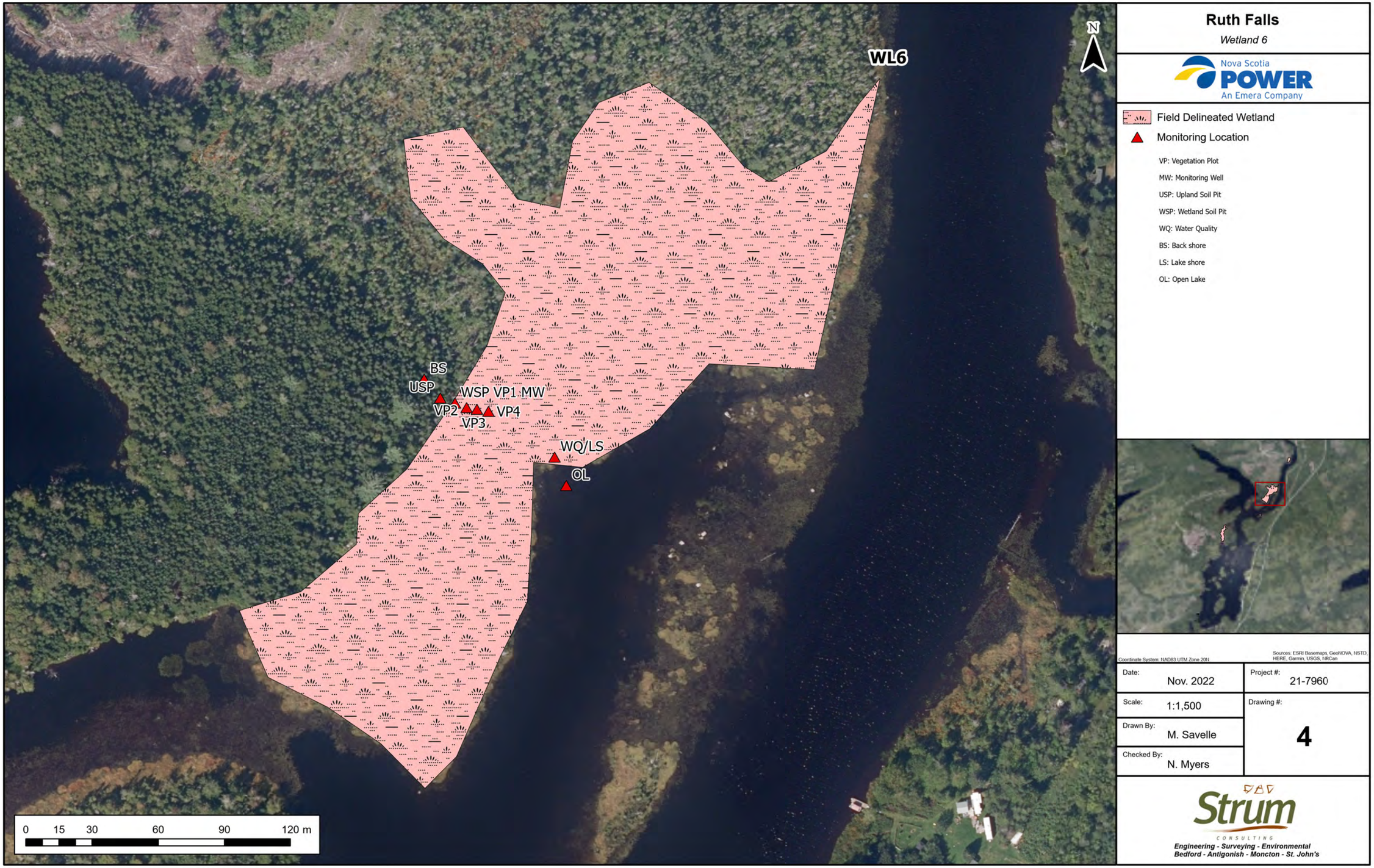


Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 3
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 6

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:1,500	Drawing #: 4
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 16

Nova Scotia POWER
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Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 5
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 17

Nova Scotia POWER
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Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 6
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 19

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 7
Drawn By: M. Savelle	
Checked By: N. Myers	

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ATTACHMENT B
WESP-AC FORMS

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 3
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.96946
Longitude (decimal degrees):	-62.49768
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	1.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	1.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100%
What percent (approx.) of the **AA** were you able to visit?	100%
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	1	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the **edge** of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) **larger than 375 hectares** (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of **paved** roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and **not** separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and **not** separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the **5-km** radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured **along** the maintained road nearest the AA, the distance to the nearest **population center** is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

	A	B	C	D	E
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	5-Jul-22		Site Identifier: Ruth Falls WL 3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11			*<u>Reminder</u> : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*		
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	0	
15			B1.	0	
16			B2.	0	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	0	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	1	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	0	
85			100-1000 sq. m.	1	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	1	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

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94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.		
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

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128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

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169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	0	
243			2-5%.	1	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	0	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL 3**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	7
			Stressor subscore=	0.58

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	0
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	2
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	3
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	3
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	8
			Stressor subscore=	0.67

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL3

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.96946 & -62.49768

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	7.98	Higher	7.86	Higher	7.90	3.48
Stream Flow Support (SFS)	1.60	Moderate	2.55	Moderate	1.29	1.70
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	4.30	Moderate	3.12	Moderate	5.56	1.53
Phosphorus Retention (PR)	2.09	Lower	2.77	Higher	5.05	2.15
Nitrate Removal & Retention (NR)	10.00	Higher	5.14	Moderate	10.00	5.14
Carbon Sequestration (CS)	4.69	Moderate			7.42	
Organic Nutrient Export (OE)	8.86	Higher			5.79	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.77	Lower	5.89	1.66
Amphibian & Turtle Habitat (AM)	2.22	Lower	4.20	Moderate	4.29	5.22
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.51	Moderate	10.00	Higher	5.67	10.00
Pollinator Habitat (POL)	7.48	Moderate	6.67	Moderate	6.20	6.67
Native Plant Habitat (PH)	5.82	Moderate	6.18	Moderate	6.22	6.18
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			8.89	Higher		4.71
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			9.42	Higher		4.70
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	7.98	Higher	7.86	Higher	7.90	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	7.64	Higher	4.41	Moderate	8.50	4.04
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	8.29	Higher	1.83	Lower	5.79	1.41
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.33	Lower	2.52	Moderate	2.57	3.13
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.04	Higher	8.81	Higher	6.13	8.81
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			9.16	Higher		4.71

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	62.68937601	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	33.64974214	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	15.16699195	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.362856423	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	62.02430846	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 5
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981186°
Longitude (decimal degrees):	-62.499067°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.031765
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	0.031765
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		"Adjacent" means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	0	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	1	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the **center** of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	

	A	B	C	D	E
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	

	A	B	C	D	E
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands. Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	1	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*				
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	1	
15			B1.	0	
16			B2.	0	
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		Deciduous shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the tree/shrubs is <95% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM

	A	B	C	D	E
18			coniferous trees (may include tamarack) taller than 3 m.	2	the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	1	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do not comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% of the woody canopy cover in the AA or >5% of the wooded areas (if any) along its upland edge (perimeter). The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation taller than 1 m nor the vegetation shorter than that comprise >70% of the vegetated part of the AA. They each comprise 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (diameter >20 cm) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces longer than 2 m and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	

	A	B	C	D	E
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of open water that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and SKIP to F41 (Floating Algae & Duckweed).	0	Open water is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is open (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	

	A	B	C	D	E
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's water edge length that is nearly flat (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage of the emergent vegetation cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		Emergent vegetation is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. SKIP to F38.	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of emergent vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and SKIP to F42.(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of dead wood and undercut banks is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore by water depths >1 m on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the least permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where surface water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by most of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into herbaceous vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into herbaceous vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into tree trunks and/or shrub stems but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly indirect path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	1	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			Evident from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			Likely based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	1	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL5**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5					
	Soil or Sediment Alteration *Within the Assessment Area*				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL5

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981186° & -62.499067°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.12	Higher	7.88	Higher	8.75	3.49
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	3.02	Moderate	7.22	1.48
Phosphorus Retention (PR)	1.85	Lower	3.04	Higher	4.91	2.36
Nitrate Removal & Retention (NR)	10.00	Higher	5.56	Moderate	10.00	5.56
Carbon Sequestration (CS)	6.58	Higher			8.31	
Organic Nutrient Export (OE)	5.34	Moderate			3.49	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.23	Lower	5.89	1.37
Amphibian & Turtle Habitat (AM)	0.44	Lower	3.88	Moderate	3.36	4.95
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	5.59	Moderate	10.00	Higher	4.86	10.00
Pollinator Habitat (POL)	6.61	Moderate	6.67	Moderate	5.48	6.67
Native Plant Habitat (PH)	3.44	Lower	5.67	Moderate	5.28	5.67
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			7.71	Higher		4.37
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.41	Higher		4.22
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.12	Higher	7.88	Higher	8.75	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.11	Higher	4.71	Moderate	8.80	4.34
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.65	Higher	0.16	Lower	5.34	0.91
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	0.27	Lower	2.33	Moderate	2.01	2.97
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	5.91	Moderate	8.72	Higher	5.34	8.72
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.06	Higher		4.29

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	71.88945608	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	38.22502401	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	1.193241535	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	0.617343402	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	51.55843686	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 6
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.975436°
Longitude (decimal degrees):	-62.487924°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	3.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	3.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.				
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	

	A	B	C	D	E
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. **This will be true for most** assessments done with WESP-AC.	0	
92	OF17	Flood Damage from **Non-tidal** Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do **not** show Flood Zone or Flood Risk areas (**or no such mapping has been done locally**) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is **no infrastructure** vulnerable to river flooding unrelated to tidal storm surges.	0	

	A	B	C	D	E
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	

	A	B	C	D	E
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]

	A	B	C	D	E
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11			*<u>Reminder</u> : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*		
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	2	
19			deciduous trees taller than 3 m.	2	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>each comprise</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	1	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	0	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	0	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	1	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter **>10 cm**, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL6**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL6

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.975436° & -62.487924°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.29	Higher	7.86	Higher	8.88	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	2.17	Moderate	7.22	1.06
Phosphorus Retention (PR)	1.59	Lower	1.88	Moderate	4.74	1.46
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.42	Higher			8.24	
Organic Nutrient Export (OE)	5.30	Moderate			3.47	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	7.88	Higher	1.03	Lower	6.71	1.80
Amphibian & Turtle Habitat (AM)	2.42	Lower	4.49	Moderate	4.39	5.46
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.34	Moderate	10.00	Higher	6.39	10.00
Pollinator Habitat (POL)	7.31	Moderate	6.67	Moderate	6.06	6.67
Native Plant Habitat (PH)	5.32	Moderate	6.37	Moderate	6.02	6.37
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			9.23	Higher		4.80
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.26	Higher		4.15
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.29	Higher	7.86	Higher	8.88	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.06	Higher	4.01	Moderate	8.77	3.75
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.59	Higher	0.68	Lower	4.63	1.20
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.45	Lower	2.69	Moderate	2.64	3.28
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.00	Higher	8.84	Higher	6.27	8.84
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.74	Higher		4.47

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	72.99984688	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	32.28886351	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	3.821786962	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.916235569	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	61.84993183	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 15
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981144
Longitude (decimal degrees):	-62.483722°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.271124 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	100
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the **edge** of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) **larger than 375 hectares** (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of **paved** roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and **not** separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and **not** separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the **5-km** radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured **along** the maintained road nearest the AA, the distance to the nearest **population center** is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]

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146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to **blank**.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to **blank** (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank** (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to **blank**.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	1	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*				
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	1	
15			B1.	0	
16			B2.	0	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	

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57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	1	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	1	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	1	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	1	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	1	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	1	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	1	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	1	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	1	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	1	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	1	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	0	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	0	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	1	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
308					

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL15**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	0
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	0
			Sum=	3
			Stressor subscore=	0.25

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	1
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	3
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	0
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	5
			Stressor subscore=	0.42

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL15

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981144 & -62.483722°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
Stream Flow Support (SFS)	1.03	Lower	0.00	Lower	0.83	0.00
Water Cooling (WC)	5.00	Moderate	0.00	Lower	3.33	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	1.80	Moderate	10.00	0.88
Phosphorus Retention (PR)	3.64	Moderate	2.14	Moderate	6.02	1.67
Nitrate Removal & Retention (NR)	10.00	Higher	10.00	Higher	10.00	10.00
Carbon Sequestration (CS)	3.60	Moderate			6.90	
Organic Nutrient Export (OE)	5.91	Moderate			3.86	
Anadromous Fish Habitat (FA)	4.13	Higher	2.71	Moderate	2.71	1.72
Resident Fish Habitat (FR)	5.10	Moderate	2.75	Moderate	2.77	1.72
Aquatic Invertebrate Habitat (INV)	7.52	Higher	7.08	Higher	6.56	5.06
Amphibian & Turtle Habitat (AM)	5.13	Moderate	7.18	Higher	5.81	7.67
Waterbird Feeding Habitat (WBF)	8.65	Higher	10.00	Higher	6.59	10.00
Waterbird Nesting Habitat (WBN)	8.33	Higher	10.00	Higher	6.04	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.39	Moderate	10.00	Higher	6.43	10.00
Pollinator Habitat (POL)	7.64	Moderate	6.67	Moderate	6.33	6.67
Native Plant Habitat (PH)	3.23	Lower	6.48	Moderate	5.19	6.48
Public Use & Recognition (PU)			1.47	Moderate		1.31
Wetland Sensitivity (Sens)			10.00	Higher		5.14
Wetland Ecological Condition (EC)			3.04	Lower		6.67
Wetland Stressors (STR) (higher score means more stress)			5.56	Moderate		2.85
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.41	Higher	7.32	Higher	9.12	7.09
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.20	Higher	4.72	Moderate	5.11	3.37
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.46	Higher	8.26	Higher	5.69	8.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.86	Higher	8.86	Higher	6.21	8.86
WETLAND CONDITION (EC)			3.04	Lower		6.67
WETLAND RISK (average of Sensitivity & Stressors)			7.78	Higher		4.00

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	48.9801358	Moderate
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	61.55144868	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	29.24667855	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	61.64799552	Moderate
HABITAT SUPERGROUP - TRANSITION HABITAT	60.79392506	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 17
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.972398°
Longitude (decimal degrees):	-62.489619°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.083111 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	1	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	0	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	1	
55			>5 km.	0	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	1	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

	A	B	C	D	E
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	0	
27			those species together do **not** comprise > 50% of such cover.	1	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each**</u> **comprise** 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	1	
75			Intermediate (1 - 10% of vegetated part of the AA).	0	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	1	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	1	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	1	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	1	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	1	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	1	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	1	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	1	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	1	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	1	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	1	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	1	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	1	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	1	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	1	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	1	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	**Input** Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	1	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.5	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	50	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	1	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	0	
276			25-50%.	0	
277			>50%.	1	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	1	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL17**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	3
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	3
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	9
			Stressor subscore=	0.75

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	1
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	1
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	1
Fertilizers applied to lawns, ag lands, or other areas in the CA.	1
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	1
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	1
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL17

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.972398° & -62.489619°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.11	Lower	7.86	Higher	3.52	3.48
Stream Flow Support (SFS)	6.28	Higher	4.77	Moderate	5.06	3.17
Water Cooling (WC)	5.29	Higher	6.88	Higher	3.53	3.73
Sediment Retention & Stabilisation (SR)	4.87	Moderate	9.79	Higher	5.99	4.79
Phosphorus Retention (PR)	3.90	Moderate	9.11	Higher	6.18	7.08
Nitrate Removal & Retention (NR)	1.77	Lower	10.00	Higher	4.05	10.00
Carbon Sequestration (CS)	4.09	Moderate			7.13	
Organic Nutrient Export (OE)	9.02	Higher			5.90	
Anadromous Fish Habitat (FA)	7.15	Higher	3.46	Moderate	4.68	2.20
Resident Fish Habitat (FR)	7.50	Higher	3.36	Moderate	4.07	2.10
Aquatic Invertebrate Habitat (INV)	6.14	Higher	6.57	Higher	6.00	4.78
Amphibian & Turtle Habitat (AM)	6.05	Moderate	4.53	Moderate	6.29	5.49
Waterbird Feeding Habitat (WBF)	8.51	Higher	10.00	Higher	6.48	10.00
Waterbird Nesting Habitat (WBN)	9.88	Higher	10.00	Higher	7.16	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	0.00	Lower	0.00	Lower	0.00	0.00
Pollinator Habitat (POL)	0.00	Lower	0.00	Lower	0.00	0.00
Native Plant Habitat (PH)	6.37	Higher	0.00	Lower	6.44	0.00
Public Use & Recognition (PU)			3.52	Moderate		2.71
Wetland Sensitivity (Sens)			3.92	Lower		3.29
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			10.00	Higher		5.46
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.11	Lower	7.86	Higher	3.52	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	4.26	Moderate	9.82	Higher	6.49	8.65
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.85	Higher	6.48	Moderate	5.56	4.34
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.85	Higher	8.14	Higher	6.45	7.98
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	4.25	Moderate	0.00	Lower	4.29	0.00
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			6.96	Higher		4.37

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	16.54837478	Low
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	41.82872928	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	50.87397482	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	71.97293334	High
HABITAT SUPERGROUP - TRANSITION HABITAT	0	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	WESP-AC version 2
Site Name:	Ruth Falls Wetland 19
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.957041°
Longitude (decimal degrees):	-62.502964°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.056483
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	1	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the **edge** of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) **larger than 375 hectares** (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of **paved** roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and **not** separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and **not** separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the **5-km** radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured **along** the maintained road nearest the AA, the distance to the nearest **population center** is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

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145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11			*<u>Reminder</u> : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*		
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	1	
61			50-95% of the vegetated part of the AA.	0	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.4	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	40	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
308					

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL19**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL19

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.957041° & -62.502964°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	8.62	Higher	7.86	Higher	8.38	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	5.73	Moderate	2.04	Moderate	6.67	1.00
Phosphorus Retention (PR)	3.04	Moderate	1.50	Moderate	5.65	1.17
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.47	Higher			8.26	
Organic Nutrient Export (OE)	7.44	Moderate			4.87	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	6.20	Higher	0.74	Lower	6.02	1.64
Amphibian & Turtle Habitat (AM)	2.27	Lower	4.15	Moderate	4.31	5.18
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.36	Moderate	10.00	Higher	5.54	10.00
Pollinator Habitat (POL)	6.27	Moderate	6.67	Moderate	5.20	6.67
Native Plant Habitat (PH)	6.07	Moderate	5.80	Moderate	6.32	5.80
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			8.38	Higher		4.56
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			7.91	Higher		3.98
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	8.62	Higher	7.86	Higher	8.38	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.15	Higher	3.92	Moderate	8.82	3.69
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.43	Moderate	0.49	Lower	4.37	1.09
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.36	Lower	2.49	Moderate	2.59	3.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.30	Moderate	8.74	Higher	6.01	8.74
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			8.14	Higher		4.27

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	67.73492558	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	31.9930733	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	2.671992164	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.390130046	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	55.07618538	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

ATTACHMENT C
WETLAND MONITORING DATA

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

Table 1A. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 3

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	35	
Soil Type			
Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Eriophorum virginicum*	Tawny Cotton-Grass		30	
	Glyceria striata	Fowl Manna Grass	20		
	Carex spp.	Carex	50		
	Rhynchospora spp.	Beaksedge		25	
	Sarracenia purpurea	Pitcher Plant	10	10	
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex stipata	Awlfruit Sedge		30	
Shrubs	*Alnus incana*	Grey Alder		5	
	Spiraea alba	Meadowsweet	10		
	Chamaedaphne calyculata	Leatherleaf	40	40	
	Ilex mucronata	Mountain Holly	5	5	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	15	25	
Osmunda cinnamomea	Cinnamon Fern	30	30	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	40		
Maianthemum canadense	False Lily of the Valley	40		
Vaccinium oxycoccus	Bog Cranberry	10	25	
Eriophorum virginicum	Tawny Cotton-Grass		30	
Solidago spp.	Goldenrod		10	
Oclemena nemoralis	Bog Aster		10	
Calamagrostis canadensis	Blue Joint		15	
Carex magellanica	Boreal Bog Sedge		10	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Chamaedaphne calyculata	Leatherleaf	30	30	
Myrica gale	Sweetgale	15	15	
Ledum groenlandicum	Labrador tea	15	15	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Osmunda cinnamomea*	Cinnamon Fern	25	25	
	Sarracenia purpurea	Pitcher Plant	10		
	Maianthemum canadense	False Lily of the Valley	40		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Carex stipata	Awlfruit Sedge		25	
	Oclemena nemoralis	Bog Aster		15	
	Drosera rotundifolia	Round-leaved Sundew		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
	Smilacina trifolia	Three-leaved false Solomon's seal	10	30	
	Carex spp.	Carex	40		
	Eriophorum virginicum	Tawny Cotton-Grass		25	
Shrubs	*Myrica gale*	Sweetgale	30		
	Chamaedaphne calyculata	Leatherleaf	35		
	Kalmia angustifolia	Lambkill	25		
	Ilex mucronata	Mountain Holly		15	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	10	20	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	20		
Maianthemum canadense	False Lily of the Valley	20		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Rhynchospora spp.	Beaksedge		15	
Vaccinium oxycoccus	Bog Cranberry	10	20	
Platanthera psycodes	Lesser Purple Fringed Orchid	5		
Ledum groenlandicum	Labrador tea	15	25	
Chamaedaphne calyculata	Leatherleaf	25	30	
Kalmia angustifolia	Lambkill	15	15	
Ilex mucronata	Mountain Holly	5	10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1B. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 5

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	N	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	4	27	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	
Preceeding 5 Day Precipitation* (mm)	2	2	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Coptis trifolia*	Goldthread	30	40	
	Cornus canadensis	Bunchberry	10	15	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Carex trisperma	Three seeded sedge	25		
	Vaccinium oxycoccus	Bog Cranberry	40	40	
	Carex spp.	Carex	30		
	Oclemena nemoralis	Bog Aster	5		
	Ajuga reptans	Bugleweed		15	
	Carex trisperma	Three seeded sedge		40	
	Linnaea borealis	Twinflower		15	
Shrubs					
Trees	*Abies balsamea*	Balsam Fir	15	25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Coptis trifolia	Goldthread	10	20	
Cornus canadensis	Bunchberry	10	20	
Sarracenia purpurea	Pitcher Plant	15	25	
Oclemena nemoralis	Bog Aster	5	20	
Iris versicolor	Norther Blue Flag	5	5	
Linnaea borealis	Twinflower	10	25	
Carex spp.	Carex	30		
Carex trisperma	Three seeded sedge		40	
Ilex mucronata	Mountain Holly	10	15	
Myrica gale	Sweetgale	30	30	
Spiraea alba	White Meadowsweet	10	15	
Acer rubrum	Red Maple	5	5	

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Calamagrostis canadensis*	Blue Joint	10	40	
	Solidago rugosa	Rough Goldenrod	5		
	Rubus pubescens	Dwarf Red Blackberry	20		
	Vaccinium oxycoccus	Bog Cranberry	15	40	
	Oclemena nemoralis	Bog Aster		15	
	Rubus hispidus	Swamp Dewberry			
Shrubs	*Viburnum nudum*	Wild Raisin		30	
	Spiraea tomentosa	Steeplebush		15	
	Chamaedaphne calyculata	Leatherleaf	20	25	
Trees	*Picea rubens*	Red Spruce	5		

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex grayi	Gray's Sedge	10		
Chamaedaphne calyculata	Leatherleaf	50		
Sarracenia purpurea	Pitcher Plant	10	10	
Solidago rugosa	Rough Goldenrod	5		
Drosera rotundifolia	Round-leaved Sundew	2	10	
Oclemena nemoralis	Bog Aster		25	
Carex trisperma	Three seeded sedge	20	35	
Myrica gale	Sweetgale	5		
Chamaedaphne calyculata	Leatherleaf		75	
Iris versicolor	Norther Blue Flag		20	
Ledum groenlandicum	Labrador tea		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1C. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 6

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	3	0	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1					
Stratum	**Scientific Name**	**Common Name**	**Baseline (July 2022) %**	**Baseline (September 2022) %**	**Notes**
Herbs	*Smilacina trifolia*	Three-leaved false Solomon's seal	30	25	
	Carex spp.	Carex	15		
	Grass spp.	Grass	20		
	Calla spp.	Calla	10	15	
	Dulichium arundinaceum	Three-way Sedge		25	
	Sarracenia purpurea	Pitcher Plant		5	
	Carex trisperma	Three seeded sedge		20	
	Carex magellanica ssp. irrigua	Boreal Bog Sedge		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	35	35	
Trees					None noted

VEGETATION PLOT 2				
Scientific Name	**Common Name**	**Baseline (July 2022) %**	**Baseline (September 2022) %**	**Notes**
Symphyotrichum puniceum	Swamp Aster	30		
Calamagrostis canadensis	Blue Joint	25	25	
Sarracenia purpurea	Pitcher Plant	10	20	
Carex spp.	Carex	15		
Grass spp.	Grass	20		
Drosera rotundifolia	Round-leaved Sundew		10	
Thelypteris palustris	Marsh Fern	25	30	
Oclemena nemoralis	Bog Aster		30	
Eriophorum virginicum	Tawny Cotton-Grass		20	
Rhynchospora spp.	Beaksedge		20	
Dulichium arundinaceum	Three-way Sedge		35	
Alnus incana	Grey Alder	25	25	
				None noted

VEGETATION PLOT 3					
Stratum	**Scientific Name**	**Common Name**	**Baseline (July 2022) %**	**Baseline (September 2022) %**	**Notes**
Herbs	*Carex spp.*	Carex	40		
	Grass spp.	Grass	10		
	Drosera rotundifolia	Round-leaved Sundew	5		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Rhynchospora spp.	Beaksedge		40	
	Dulichium arundinaceum	Three-way Sedge		15	
	Sarracenia purpurea	Pitcher Plant		15	
	Carex trisperma	Three seeded sedge		30	
	Carex sparganioides	Bur Reed Sedge		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	30	
	Ledum groenlandicum	Labrador tea	10	10	
	Ilex mucronata	Mountain Holly		10	
	Myrica gale	Sweetgale	10		
Trees					None noted

VEGETATION PLOT 4				
Scientific Name	**Common Name**	**Baseline (July 2022) %**	**Baseline (September 2022) %**	**Notes**
Osmunda cinnamomea	Cinnamon Fern	5	20	
Drosera rotundifolia	Round-leaved Sundew	5	15	
Smilacina trifolia	Three-leaved false Solomon's seal	10		
Vaccinium oxycoccus	Bog Cranberry	5		
Carex spp.	Carex	60		
Rhynchospora spp.	Beaksedge		60	
Eriophorum virginicum	Tawny Cotton-Grass		35	
Dulichium arundinaceum	Three-way Sedge		15	
Sarracenia purpurea	Pitcher Plant		15	
Calamagrostis canadensis	Blue Joint		10	
Ledum groenlandicum	Labrador tea	10	20	
Chamaedaphne calyculata	Leatherleaf	30	20	
Kalmia angustifolia	Lambkill		10	
Picea mariana	Black Spruce	5	10	None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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REDACTED (CONFIDENTIAL INFORMATION REMOVED)

Table 1D. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 15

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	6	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	20		
	Oclemena nemoralis	Bog Aster	5	10	
	Dulichium arundinaceum	Three-way Sedge		40	
	Drosera rotundifolia	Round-leaved Sundew		10	
	Vaccinium oxycoccus	Bog Cranberry		10	
	Carex trisperma	Three seeded sedge		20	
Shrubs	*Myrica gale*	Sweetgale	60	25	
	Chamaedaphne calyculata	Leatherleaf		60	
	Viburnum nudum	Wild Raisin		25	
Trees	*Viburnum nudum*	Wild Raisin		25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex trisperma	Three seeded sedge	50		
Vaccinium oxycoccus	Bog Cranberry	10		
Osmunda cinnamomea	Cinnamon Fern	15	25	
Eriophorum virginicum	Tawny Cotton-Grass		15	
Drosera rotundifolia	Round-leaved Sundew		10	
Myrica gale	Sweetgale	30	40	
Chamaedaphne calyculata	Leatherleaf	5	25	
Ledum groenlandicum	Labrador tea		20	
Ilex mucronata	Mountain Holly		5	
Picea mariana	Black Spruce	10	10	
Acer rubrum	Red Maple	20		

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Cornus canadensis*	Bunchberry	5	25	
	Carex trisperma	Three seeded sedge	10		
	Vaccinium oxycoccus	Bog Cranberry	5	15	
	Carex trisperma	Three seeded sedge		20	
	Osmunda cinnamomea	Cinnamon Fern	15	20	
	Eriophorum virginicum	Tawny Cotton-Grass		20	
Shrubs	*Ledum groenlandicum*	Labrador tea	5	20	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf		25	
	Ilex mucronata	Mountain Holly		5	
Trees	*Picea mariana*	Black Spruce	25	30	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Thelypteris palustris	Marsh Fern	15		
Carex trisperma	Three seeded sedge	15	20	
Calamagrostis canadensis	Blue Joint		15	
Oclemena nemoralis	Bog Aster	5	5	
Osmunda cinnamomea	Cinnamon Fern		20	
Cornus canadensis	Bunchberry	10	20	
Vaccinium oxycoccus	Bog Cranberry		20	
Myrica gale	Sweetgale	50	50	
Acer rubrum	Red Maple	40	20	
Picea mariana	Black Spruce		5	
Ledum groenlandicum	Labrador tea	5	10	
Chamaedaphne calyculata	Leatherleaf		20	
Ilex mucronata	Mountain Holly	5		
Ilex mucronata	Mountain Holly		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1E. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 17

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Depth to Water (cm)	5	10	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)

Monitoring Date	Baseline (July 2022)	Baseline (September 2022)	Notes
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Drosera rotundifolia	Round-leaved Sundew	15	25	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	40	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	60	75	
Zantedeschia aethiopica	Calla Lily	10		
Drosera rotundifolia	Round-leaved Sundew	10	15	
Chamaedaphne calyculata	Leatherleaf	20	30	
Alnus incana	Grey Alder	20	20	
Picea mariana	Black Spruce	30	30	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Zantedeschia aethiopica	Calla Lily	10		
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex oligosperma	Few-seeded Sedge		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	25	25	
	Picea mariana	Black Spruce	15	25	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	40	40	
Zantedeschia aethiopica	Calla Lily	5		
Drosera rotundifolia	Round-leaved Sundew	15		
Grass spp.	Grass	15		
Carex sparganioides	Bur Reed Sedge		25	
Carex oligosperma	Few-seeded Sedge		15	
Chamaedaphne calyculata	Leatherleaf	20	35	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1F. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 19

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	Y	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	9	3	September Note: Well cracked off.
Soil Type			
Histosol (A1), Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	30	15	
	Eriophorum virginicum	Tawny Cotton-Grass		25	
	Carex trisperma	Three seeded sedge			
Shrubs	*Ledum groenlandicum*	Labrador tea	40	60	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf	25	25	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Vaccinium oxycoccus	Bog Cranberry	15	25	
Carex spp.	Carex	15		
Calla spp.	Calla	15		
Drosera rotundifolia	Round-leaved Sundew	15		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Myrica gale	Sweetgale	20	60	
Chamaedaphne calyculata	Leatherleaf	40	15	
Larix laricina	Tamarack	25		
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Oclemena nemoralis*	Bog Aster	15	25	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Calla spp.	Calla	15		
	Carex spp.	Carex	25		
	Osmunda cinnamomea	Cinnamon Fern		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Ledum groenlandicum*	Labrador tea	10	10	
	Myrica gale	Sweetgale	80	60	
	Picea mariana	Black Spruce	25	20	
	Vaccinium angustifolium	Lowbush Blueberry		15	
	Ilex mucronata	Mountain Holly	10		
Trees	*Picea mariana*	Black Spruce	25	25	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex spp.	Carex	25		
Calla spp.	Calla	15		
Oclemena nemoralis	Bog Aster	10	40	
Carex diandra	Lesser Tussock-Sedge		25	
Rhododendron canadense	Rhodora	25	25	
Myrica gale	Sweetgale	30	30	
Chamaedaphne calyculata	Leatherleaf	25		
Picea mariana	Black Spruce	40	40	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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ATTACHMENT D
FISH HABITAT ASSESSMENT DATA

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 3		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	11:00	13:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	23
Water Temperature (degC)	23.5	22.0
pH	5.10	5.40
Conductivity (mS/m)	0.04	0.005
TDS (mg/L)	20	20
DO (%)	85	80.6
DO (mg/L)	7.6	7.75
Average Depth (m)	0.6	0.30
Hydroperiod (Flooded (semi) Permanently?)	Permanently flooded	Permanently flooded
Connectivity to Lake	Inflow	Inflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	Med (10-50%)	Med (10-50%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	Med	Med
Notes	Plenty of submerged logs and rocks. Lots of macrophytic veg. Mucky substrate, plenty of brownish detritus.	Macrophytes and woody debris provide decent cover for fish, though water is warm. Edge of Lake. Silt on rocks. Excess woody debris.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 5		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	13:15	12:23
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	21	15.5
pH	4.93	5.09
Conductivity (mS/m)	0.09	0.04
TDS (mg/L)	30	40
DO (%)	93.9	80.6
DO (mg/L)	9.05	7.05
Average Depth (m)	0.5	0.10
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck:25%, Gravel:50%, Rubble:25%	Gravel and Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Clear
Vegetation/Debris Cover/Shade	Trace	Abundant
Probability of Fish Presence	High	Med
Notes	Small stream/trickle inflow at southeast end of WL (appears to be spring fed). Fish seen off weltand edge. No signs of fish habitat upstream/upland. Extensive cover/shade near inflow, primarily open/unshaded elsewhere.	No flow in stream, though area is well shaded with clear water.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 6		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	15:30	11:30
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	28	21.3
pH	4.89	5.26
Conductivity (mS/m)	0.05	0.07
TDS (mg/L)	30	30
DO (%)	77	23.1
DO (mg/L)	5.7	2.19
Average Depth (m)	0.5	0.2
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Semi-permanently Flooded
Connectivity to Lake	Inflow	Outflow
Deep Open Water Present Nearby?	Shallow Open Water	No
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck and Rubble	Muck and Gravel
Turbidity (or other water characteristisc)	Slightly Cloudy	Cloudy
Vegetation/Debris Cover/Shade	None	None
Probability of Fish Presence	High	Low
Notes	Juvenile American Eels spotted durring delineation. Very little shadded water, some areas "in-land" that could be accessible to fish seasonally.	High amount of metals suspended on water surface. Area appears to be poor habitat if at all. Water is stagnant.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 15		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	12:15	11:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	22.8	20.9
pH	5.4	6.12
Conductivity (mS/m)	0.21	0.05
TDS (mg/L)	30	160
DO (%)	93	93.7
DO (mg/L)	7.51	8.43
Average Depth (m)	0.5	
Hydroperiod (Flooded (semi) Permanently?)	Semi-permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Med(10-50%)	Low(<10%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Clear	Slightly Cloudy
Vegetation/Debris Cover/Shade	None	Trace
Probability of Fish Presence	High	Med
Notes	Dead trees/snags in water.	Lake edge near outflow of watland. Some lily pads present. Woody debris.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 17		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	9:36	10:41
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	20	19
Water Temperature (degC)	21.7	20.3
pH	5.45	7.39
Conductivity (mS/m)	0.05	0.72
TDS (mg/L)	20	40
DO (%)	97.2	80.7
DO (mg/L)	9.03	7.27
Average Depth (m)	0.5	0.5
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Thoughflow	Throughflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	High(>50%)	Med(10-50%)
Substrate(s)	Muck	Gravel and Silt
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	High	Med
Notes	Entire island is wetland. Lily pads all around the perimeter. "Sheltered" coves along island edge. Seems like great fish nursery area.	Lake Edge.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 19		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	12:15	13:45
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	25.5	23.5
pH	5.36	5.67
Conductivity (mS/m)	0.04	0.04
TDS (mg/L)	20	30
DO (%)	103.0	105.8
DO (mg/L)	8.42	8.76
Average Depth (m)	0.5	0.40
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Throughflow	Lake Edge
Deep Open Water Present Nearby?	Shallow Open Water	Yes 5m
Macrophyte (% cover)	Low(<10%)	Low(<10%)
Substrate(s)	Gravel	Gravel and Rubble
Turbidity (or other water characteristisc)	Clear	Clear
Vegetation/Debris Cover/Shade	Moderate	Trace on NW side
Probability of Fish Presence	High	High
Notes	Fish observed at lake side pt. Wetland is a peninsula, open water side has excellent habitat. Cove side has mostly muck substrate with some debris/emergent veg.	

Strum CONSULTING

APPENDIX N – OFFSETTING PLAN

Offsetting Plan for Nova Scotia Power's Sheet Harbour Dam Refurbishment Projects

Prepared on:
May 14, 2021

Updated on:
October 27th. 2023

MI'KMAW CONSERVATION GROUP
THE CONFEDERACY OF MAINLAND MI'KMAQ

The Confederacy of Mainland Mi'kmaq
52 Legends Avenue
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Project Title:

Sheet Harbour Area Habitat Offsetting Initiative

Presented To:

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CMM Project Lead:

To be selected from available staff resources.

NSSA Project Lead

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Date:

October 27, 2023

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Presented To: ii
Contacts: ii
Date: ii
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1.0 The Confederacy of Mainland Mi'kmaq's (CMM's) Department of Aquatic Resource and Fisheries Management (DARFM)

Introduction

The CMM is a tribal organization that has served its members since 1986 and currently employs a staff of one hundred (100+) employees. The Mission Statement for the CMM is *"To proactively promote and assist Mi'kmaw communities' initiatives toward self determination and enhancement of community."* The CMM provides programs and services to our eight member Mi'kmaw communities: Acadia, Annapolis Valley, Bear River, Glooscap, Millbrook, Pictou Landing, Paq'tnkek and Sipekne'katik First Nations. The CMM's Board of Directors is comprised of the Chiefs of our member communities.

The Department of Aquatic Resource and Fisheries Management's (DARFM's) mission is to help promote the concept of Netukulimk within the Bay of Fundy and mainland Nova Scotia watersheds. DARFM provides the following programs to our member communities: Youth Mentorship/Capacity Building, Research, Education, Communications, Aquatic Resource Management, Ecosystem Health Assessment and, Habitat Restoration. Additionally, DARFM provides services for commercial fisheries, scientific review, and department staff also sit on several review boards and technical committees. DARFM has applied for and received a variety of both small and large funding programs and has successfully delivered projects from the federal, provincial, and municipal levels as well as from the private sector.

The department has become increasingly more involved in fish habitat offsetting projects and associated monitoring activities. We have worked with various partners to build skills within our department and our member communities. We continue to work with, and sub-contract, partner organizations to ensure our offset and industry-focused monitoring activities are done to local industry standards. It is important to note that we try to ensure our affected member communities approve of and are made aware of the work we do. The CMM and its Departments do not conduct consultation work on behalf of clients but instead provide programs and services and act as a technical resource for our member communities.

Previous Activities Undertaken by the CMM

Stewiacke River: MCG has operated/maintained a Rotary Screw Trap (RST) for the past 5 years in the Stewiacke River, NS and performed marked-recapture studies to estimate the population of Atlantic salmon smolts. MCG has also conducted fish habitat assessments and electrofishing surveys in the Stewiacke River. In autumn 2017, MCG partnered with DFO on an acoustic telemetry study to determine spawning site selection of released Live Gene Bank adult salmon within the Stewiacke river watershed.

Shubenacadie River: During the 2016-2017 funding year MCG performed baseline monitoring for fish species throughout the entire river system. Activities included: CABIN studies, beach seining, fyke nets, and other sampling methodologies.

River Philip and East River: In the fall of 2016- 2018, the MCG team performed snorkel surveys in over 20 pools to count returning adult Atlantic salmon in the River Philip and the East River. In year one major pools were surveyed, while in year two MCG expanded the swims throughs to also surveyed small river sections.

River Restoration Work: The previous four summers (2014-2018) MCG installed and repaired in-stream fish habitat structures, removed barriers to fish passage, and restored riverbanks in the following waterbodies: McLellans Brook (East River), Barneys River, Smalls Brook, Indian Brook and several tributaries to the Stewiacke River.

2.0 Project Description

Background:

In early 2020 Nova Scotia Power Incorporated (NSPI) began discussions with Millbrook chief and council regarding two dam refurbishment projects in the Sheet Harbour Area (Ruth Falls Dam and Sloane Dam). NSPI and the CMM began discussions in Spring of 2020 after Millbrook Chief and Council had recommended that the MCG/DARFM lead an offsetting project. DARFM has done limited work in the West River area so after discussions with NSPI it was decided that DARFM would reach out to the Nova Scotia Salmon Association (NSSA) as they are currently working on their West River acid rain mitigation project in the area. Once NSSA provided an offsetting plan DARFM followed up with Millbrook's consultation team regarding their initial thoughts on the project prior to submitting Draft 1 to NSPI.

Revised (2021): The Second Draft of this plan has been seen by the Millbrook Consultation team and no issues were found in the plan. NSPI met with Millbrook Chief and Council on April 20th and there was no indication of project changes required at this time.

Revised (Feb 2023): Updates to the plan include the addition of a second year of pre-monitoring and expansion of pre-monitoring activities to include thermal imagery. The offset will occur in Year 3 and three years of post-monitoring will follow.

Revised (Aug 2023): Updates to the plan include the removal of the ___ dam, shifting of activities by 1 year (delay from NSPI), and revised restoration budget costs. The offset will occur in Year 3 and three years of post-monitoring will follow.

Organization and Partners

- **CMM/DARFM:** Will be the lead proponent of the project and will assist with project activities as listed in the below proposal and will lead the administrative / project management side of the project. DARFM team members will be the principle contact for the project and will provide updates as required. The DARFM will also be responsible for engaging Millbrook First Nation with this specific offsetting project.
- **Millbrook First Nation:** Millbrook community members will have opportunities to be engaged in and potentially hired on short contracts for this project. Millbrook fishers and interested community members will be provided opportunities to provide input into the project. Millbrook's consultation team will also stay updated on this project through update meetings and will help the CMM engage with community members of Beaver Dam and Sheet Harbour.
- **NSSA:** As a regional expert in large scale restoration the NSSA will lead the physical restoration work and plan the will help build capacity within the CMM/Millbrook to do this type of large-scale restoration work in the future. NSSA will also design the monitoring plan based off their final design.

3.0 Roles and Responsibilities:

- **Project Manager: DARFM Manager (transition period)**
  - Will oversee the initial set up of the project.
  - Will oversee the project lead's management of the project.
  - Aid project lead with project delivery and reporting.
- **Project Lead: TBD**
  - Oversee day to day activities for the project.
  - Liaise with Millbrook, NSSA and NSPI
  - Provide offset project updates to Millbrook community and NSPI.
- **Millbrook: TBD (Consultation team and community members)**
  - Assist with project activities (planning, monitoring, restoration)
  - Participate in meetings.
  - Receive training (types tbd).
  - Note: this will depend on community interest throughout the project.
- **NSSA Lead: Eddie Halfyard**
  - Responsible for overseeing restoration work.
  - Oversee all contractors necessary for the project (site design, instream restoration work, and monitoring plans)
- **Additional CMM Staff:**
  - Assist with monitoring and restoration activities.
  - Provide guidance and oversight.

4.0 Goal and Objectives

Goal

As part of a contract under NSPI the DARFM, along with the NSSA, will develop and implement an offsetting project for approximately 2700m^2 (Now placing two large structures instead) on the West River Sheet Harbour watershed. The offset project relates to NSPI's dam refurbishment projects at the Ruth Falls headpond (at present Sloane Reservoir no longer requires an offset). This project will improve fish migration and fish habitat by restoring suitable instream and streambank habitat. This will be an eight-year project that will actively engage Millbrook, NSSA, and the CMM (DARFM) in improving necessary Atlantic salmon and other significant fish habitat. Performing offset work on the main branch of the river between two previously restored sections will also greatly increase migration routes for salmon and will have a long-lasting effect that other smaller scale projects often cannot achieve. In addition to these restorations, the upper West River Sheet Harbour has been the subject of a liming project since 2005 to mitigate the effects of freshwater acidification that has impacted many river systems in the southwestern and eastern parts of the province. A second lime doser was installed in the Killag River (a major tributary of the West River) in 2016[1]. This river system has an at-risk population of Atlantic salmon (*Salmo salar*) so all parties involved in the project, feel a project at this level will be very beneficial to ongoing recovery efforts.

Year 1 (2022) will focus on engagement sessions with project partners (NSSA and Millbrook First Nation) and the development of site plans. Pre-monitoring activities, recruitment, and training of Millbrook community members to assist with monitoring the installation of the restoration structures as well as assist with post-monitoring duties will also occur in year 1.

Year 2 (2023) will involve pre-monitoring activities and engagement with Millbrook First Nation and community members, continuing pre-monitoring activities and preparing for restoration work in 2024.

Year 3 (2024) will focus on performing the largescale restoration work within the middle section (between two previously restored areas by the NSSA) of the West River. This year will incur the greatest costs, which will still be approximately 75% of the initial cost due to inflation and high fixed costs.

Years 4 through 8 (2025, 2027, and 2029) will consist of the post monitoring the sites where offsetting work was completed. Post-offset monitoring will be completed in years 4, 6 and 8. A final report will be completed at the end of year 7.

[1] Nova Scotia Salmon Association. (n.d.). *Acid Rain Mitigation*. Retrieved September 29, 2022, from https://www.nssalmon.ca/acid-rain-mitigation

Overarching Objectives

Objective 1: Meaningful engagement with Millbrook First Nation
In year 1, the CMM will recruit and train interested community members to assist with project deliverables (e.g., monitoring restoration activities and being engaged in post-restoration environmental monitoring). Training opportunities will include safety and technical training (swiftwater rescue training, watercourse alteration certification, etc.) and they will also have the opportunity to job shadow CMM and NSSA staff. In years 3 through 8 the CMM will hire 1 – 3 community members from Millbrook First Nation, and/or its satellite communities in Sheet Harbour and/or Beaver Dam, to assist with monitoring the installation of restoration structures as well as any post-monitoring work. Millbrook's consultation team has stated that engaging community members in a meaningful offset project is of high importance with respect to this project.

Objective 2: Baseline monitoring and post-restoration monitoring:
Staff from the CMM will review any relevant literature to determine what baseline information is presently available, if any. Next, CMM staff will perform pre-monitoring assessments following established protocols. Based off the finalized pre-restoration monitoring work completed and results of the completed instream offsetting work the CMM in partnership with NSSA and Millbrook will complete 3 years (years 4, 6 and 8) of post-offset monitoring.

Objective 3: Aquatic habitat restoration
In Year 1, the CMM will have several meetings with the NSSA and Millbrook to develop a concrete design plan and establish timelines for the habitat offsetting work to be completed in year three of the project. The final offset area (m^2) will be based off direction from NSPI from their guidance from DFO, and the NSSA with assistance from the CMM will get revised estimates to complete offset work based off site surveys. This area is anticipated to be approximately 2700 m^2; however, there is approximately 20,000 m^2 of habitat that would benefit from a restoration in this area.

In year three the NSSA will oversee the restoration of fish habitat to be used for offsetting purposes by NSPI. More information on the current specifics of the restoration work and monitoring can be found in Appendix I.

5.0 General Workplan

Year 1 (2022):

Objective 1: Meaningful engagement with Millbrook

- The CMM's DARFM will meet with Millbrook's consultation team and community members and will involve other key individuals as directed by Millbrook's Chief and Council or consultation team

Objective 2: Pre-offset baseline monitoring:

- The pre-habitat offset monitoring work on the West River Sheet Harbour will involve performing habitat suitability assessments following established field methods[2]. While estimates of the size of the West River salmon smolt migration exist[3], there appeared to be a gap in data over the past decade. Due to the large size of the river and a lack of recent studies which determine fish abundancy, pre- and post-monitoring efforts will be focused on habitat characteristics and channel morphologies which are anticipated to be impacted most by the restorations (e.g., substrate composition, bankfull and wetted widths, thalweg depth, water temperature, etc.). Water quality monitoring (excluding temperature monitoring) is anticipated to provide little insight with respect to baseline or natural conditions due to the ongoing liming project and as such will not be a primary focus of the environmental monitoring component. It is anticipated that physical habitat monitoring will be able to show: an increase in the number of natural pools and the retention of cold water refugia, establishment of a defined natural thalweg, and establishment of a natural meander pattern.
- The freshwater biologist has indicated that, from their desktop analysis and previous work upriver and downriver of this proposed site, the design width of this section of river is approximately 15.6 m and the meander length is approximately 94 m. Currently this section of the river can be in excess of 30 m in width, is shallow, particularly during the summer months, and has degraded fish habitat. This is due to past land use, historical log driving activities and other anthropogenic effects on the river. The NSSA has restored sections down- and upriver from the proposed site, so this offset would help with fish migration, thalweg continuity, and provide a connected set of holding pools suitable for salmonids (especially Atlantic salmon). Below is an overview of the techniques and details that will be used in the pre-offset monitoring plan:

    - Visualization:
        - Map created to show monitoring sites and proposed structure placements
        - Site pictures taken at each survey site and structure site, including original orientation to allow for replication in post construction monitoring
        - Will document presence of Atlantic salmon and other fish during surveys

    - Pre-Monitoring Habitat Suitability Index (HSI) Assessments
        - Number of transects will depend on calculated bankfull width and approximate size of proposed restoration area
        - Channel measurements
        - Substrate composition assessment
        - Assessment of instream cover
        - Riparian characteristics (dominant vegetation, % stream shade, etc.)

[2] Nova Scotia Salmon Association, Adopt a Stream. (2018). *A Field Methods Manual Nova Scotia Freshwater Fish Habitat Suitability Index Assessment NSHSI Version 2.1.*
[3] Halfyard, E. A., & Ferguson, G. (2009). *Assessment of the 2009 West River, Sheet Harbour Atlantic salmon smolt migration*. Nova Scotia Salmon Association.

- Benthic macroinvertebrate surveys
- Wetted depth measurements
- Thalweg depth measurements

Year 2 (2023):

Objective 1: Meaningful engagement with Millbrook

- The CMM's DARFM will continue to meet with Millbrook's consultation team and community members to provide project updates and will involve other key individuals as directed by Millbrook's Chief and Council or consultation team.
- There will be funds allotted to hire Millbrook community members on short term contracts or reimburse at a daily rate so that they can participate in the monitoring work and/or attend applicable training opportunities.

Objective 2: Pre-offset baseline monitoring:

- Pre-offset baseline monitoring will include the repetition of Habitat Suitability Index (HSI) assessments described in Year 1 as well as the following:
  - Characterization of the thermal profile of the river pre-restoration by carrying out thermal drone surveys of the restoration site during low flow.
  - Characterization of temporal changes in water temperature during the summer by installing approximately 10 water temperature loggers throughout the study area. Effort will be made to evaluate both surface and depth temperatures.
    - Edit- Due to 2023 water conditions and plan changes summer monitoring has been altered. Previous baseline monitoring done by NSSA will be combined with survey data from fall 2023 as well as early monitoring throughout the 2024 field season.

Year 3 (2024):

Objective 1: Meaningful engagement with Millbrook:

- The CMM will continue to meet with Millbrook's consultation team and with interested community members, as well as continue to provide updates to the community when applicable or requested.
- Where possible Millbrook community member will have paid opportunities to assist with restoration activities.

Objective 2: Aquatic Habitat Restoration Planning

- All activities associated with planning and structure design will be completed for the restoration work (being used as an offset). Instream improvements will involve installing deflectors (used to assist with correcting meander pattern) and/or rock sills (used to promote pool creation) at design length intervals (approx. 94 m) but may also include other instream construction techniques. A detailed site plan will be developed for review prior to proposed construction. The plan will include maps and locations of structures, structure types, approximate dimensions, and pictures.

Objective 3: Installation of restoration structures

- The NSSA will lead the large-scale restoration work to be completed and will arrange the scheduling for their contractors (heavy machinery operators, freshwater habitat restoration consultant) to ensure the work is completed.
- The CMM will conduct site visits and have staff involved in mentorship opportunities to become more familiar with doing large-scale restoration work.
- The CMM will coordinate having Millbrook community members involved in the project (where there is interest to do so) and will coordinate any necessary or applicable training for Millbrook community members.

Years 4-8 (2025, 2027, and 2029):

Objective 1: Meaningful engagement with Millbrook:

- There will be funds allotted to hire Millbrook community members on short term contracts or reimburse at a daily rate so that they can participate in the monitoring work and/or attend applicable training.

Objective 2: Post-restoration monitoring

- The post-offset monitoring techniques will heavily mirror the techniques used in the pre-offset monitoring plan, the major difference being that in the post-offset there will be more focus on inspecting the structures and pools to ensure proper habitat creation and structural integrity. The project team (Millbrook, NSSA, and CMM) will utilize the established monitoring plan and maps to compare progress of habitat in 3 of the 5 years following completion of instream restoration (years 4, 6, and 8 of the proposed plan). Please note: these post-offset monitoring plans may change as the offset layout/plan is developed and initial monitoring is completed.

<u>Monitoring strategy and techniques:</u>

- Visualization:
  - Site pictures taken at each survey site and structure site.
    - Pictures will be taken with the same orientation and matched with the map(s) established in year 1
  - Will document presence of Atlantic salmon and other fish during surveys.

- Post-Monitoring Habitat Suitability Index (HSI) Assessments
  - Number of transects will depend on calculated bankfull width and size of proposed restoration area
  - Channel measurements
  - Substrate composition assessment
  - Assessment of instream cover
  - Riparian characteristics (dominant vegetation, % stream shade, etc.)
  - Benthic macroinvertebrate surveys
  - Wetted depth measurements
  - Thalweg depth measurements

- Water Temperature
  - Water temperature will be monitored using a handheld multimeter and water temperature loggers (approximately 10 units) will be deployed throughout the study area in a similar manner to that described in Year 2 (please note due to project and environmental changes this will shift slightly)
  - In the final year of post-monitoring, a thermal profile of the river post-restoration will be acquired using a thermal drone and will be compared to the pre-restoration profile of the same area

- Structure surveys: (based off offset layout plan)
  - Surveys to ensure structures have stayed in place and are establishing positive habitat change.
    - Note: will document any changes or damage caused by ice or other extreme weather events to the structures
    - May use drones or other methods to survey structures

- Measurements taken to determine change to pools and stream meander.
- Document presence of adult and or juvenile Atlantic salmon (and other salmonid / fish species) using habitat

6.0 Project Timeline

Table 1 Project deliverables and associated timelines

Activities	Schedule
Continued discussions between the CMM, NSSA, NSPI, and DFO regarding offsetting project requirements.	April 2022 to October 2022
Continued updates and discussions between The CMM and Millbrook regarding the lifespan of offsetting project.	Ongoing throughout project
Pre-offset monitoring	June – September 2022 & Summer-Fall 2023
Design of restoration work	Surveys: June 2022 – June 2024
Perform largescale instream restoration work. NSSA will lead this portion of the project.	June – September 2024
CMM staff and Millbrook Community members will receive mentorship from the NSSA on the restoration work and assisting with work and monitoring where applicable.	June - September 2024
Post-restoration Monitoring (3 years) Lead by NSSA in partnership with CMM and Millbrook	June- September 2025 & June- September 2027 & June – September 2029
Proposed reporting dates to NSPI.	Year 1: December 2022 Year 2: December 2023 Year 3: December 2024 Year 4: December 2025 Year 6: December 2027 Year 8: December 2029

7.0 Project Area

Site Map Via NSSA

Site Location: 45.9718, -62.6383

Nearest approximate address: 88 W River Rd, Mooseland, NS B0J 2J0

Edit- Current project location of new structures has yet to be defined as it will require further site assessments by both CMM and NSSA. It will likely reflect half of the length of the red line within the map below and will start where the green and red lines meet.

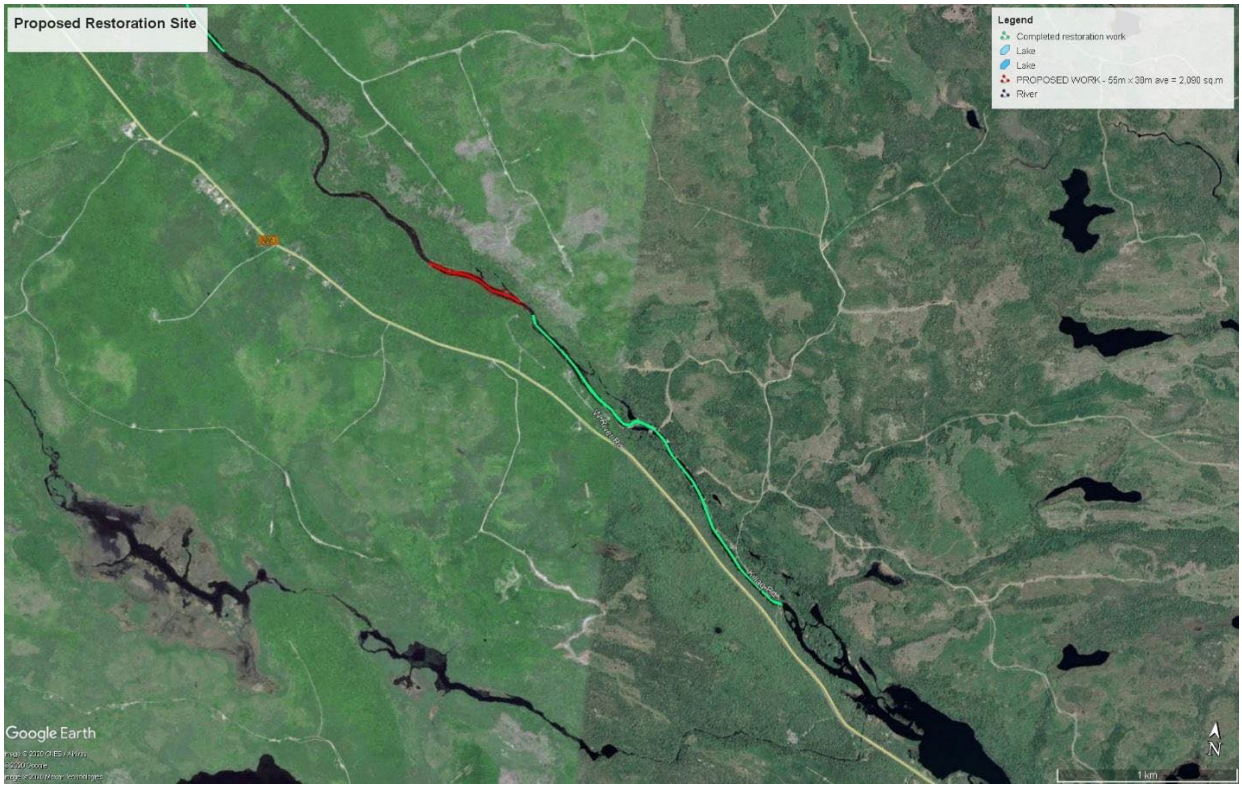


Figure 1 Map of 20,900 m^2 of stream that requires habitat restoration (red), of which the lower section (total sq meter to be determined) would be targeted by this proposed work. Green areas were previously completed. See in Appendix I. *Note: there is a discrepancy between the size of the red area reported in the legend and the caption. The legend should read: 550 m x 38 m = 20,900 m^2.*

Larger View of project area



Figure 2 Red marker indicates approximate area where restoration work will occur in comparison to the community of Sheet Harbour.

8.0 Limitations:

The total budget and timelines will be dependent on continued discussions between NSPI, DFO, NSSA and the CMM (DARFM) regarding the offset requirements, as well as ensuring proper oversight and guidance on the work by Millbrook and all other required Mi'kmaw Communities.

There may be changes to the Species-At-Risk Act that could list this population of Atlantic salmon as endangered which could cause delays, or modifications, to our plans based off DFO guidance and or regulations.

Restoration costs may change as the original estimates were based off work completed previously. Material and labour costs are highly variable. Costs will be discussed with NSPI during year 1 and 2 meetings to ensure costs are acceptable.

The estimates were also based upon an approximate 2700 m^2 area (revised from initial 5000m^2) to be offset. The current cost estimation will still be 75% of the initial estimate.(see Appendix I), the exact foot print of the structures has yet to be defined.

The CMM does not conduct consultation for proponents and will only be responsible for ensuring that Millbrook (and other parties as directed) are properly engaged in the offset project.

This project proposal plan is dated August 29, 2023, should significant changes be required this will be reflected in a revised offset plan or "change request" type document.

9.0 Budget Summary

Pre – Offset

Table 2 Year 1 (2022) Budget

Category	Description	Amount
Salaries and Wages (the CMM)	Project Manager (70 hrs @ $80/hr = $ 5,600) Field technicians (3 x technicians for 21 hrs @ $45/hr = $2,835)	$8,435.00
Training	Environmental monitoring-related training opportunities for community members engaged in monitoring activities. Examples include swiftwater rescue training, and NS watercourse alteration training	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$1,500.00
NSSA Professional Services	Project management support and thermal drone survey	$5,000.00
Administration	15% of costs*	$4,585.59
Total	All costs	$21,520.59

*Calculated based on previous budget draft of $25,985.00 + admin

Table 3 Year 2 (2023) budget

Category	Description	Amount
Salaries and Wages (the CMM)	Project Manager (70 hrs @ $80/hr = $ 5,600) Field technicians (3 x technicians for 21 hrs @ $45/hr = $2,835)	$8,435.00
NSSA Professional Services	Project management support and thermal drone survey	$5,000.00
Training	Environmental monitoring-related training for CMM and community members to implement monitoring program	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook community members	$1,500.00
Administration	15% of costs	$2,988.53
Total	All costs	$19,923.53

Offset

Table 4 Year 3 (2024) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Allotment for Millbrook (Salaries, training, and equipment)	Amount to reimburse Millbrook community member(s), money for training, and necessary equipment needed to assist with restoration and monitoring materials / supplies	$8,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$4,000.00
Salaries and Wages (NSSA)	Biologist (10 days @ $450/day) and a NSSA field technician (15 days @ $350/day)	$9,750.00
Salaries and Wages (Fresh water biologist)	Preparation of final site survey, design model, onsite structure layout and construction monitoring	$15,000.00
Professional Services (Construction contractor)	Large machinery contractor and rock materials	$123,984.38
Administration	15% of costs	$25,632.66
Total	All costs	$196,517.03

Post – Offset

Table 5 Year 4 (2025) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
NSSA Professional Services	Biologist (8 days @ $450/day) and a NSSA technician (12 days @ $350/day)	$7,800.00
Administration	15% of costs	$3,873.53
Total	All costs	$25,823.53

Table 6 Year 6 (2027) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
NSSA Professional Services	Biologist (8 days @ $450/day) and a NSSA technician (12 days @ $350/day)	$7,800.00
Administration	15% of costs	$3,873.53
Total	All costs	$25,823.53

Table 7 Year 8 (2029) Budget

Category	Description	Amount
Salaries and Wages (The CMM)	Project Manager (35 hrs @ $80/hr = $ 2,800) Project Lead (105 hrs @ $70/hr = $7,350)	$10,150.00
Salaries and Wages (Millbrook)	Amount to reimburse Millbrook community members for participating in the project	$2,000.00
Travel	Travel and lodging in Sheet Harbour for CMM and Millbrook	$2,000.00
NSSA Professional Services	Biologist (8 days @ $450/day), NSSA technician (12 days @ $350/day), and thermal drone survey ($5,000)	$12,800.00
Administration	15% of costs	$4,255.26
Total	All costs	$31,205.26

Table 8 Total Project Budget (all years)

Project Total	Amount
Year 1	$21,520.59
Year 2	$19,923.53
Year 3	$196,517.00
Year 4	$25,823.53
Year 6	$25,823.53
Year 8	$31,205.26
Grand Total	$320,813.44

10.0 Contact Information

Should there be any questions please contact:

Alyx MacDonald

Manager of Aquatic Ecosystems

Department of Aquatic Resource and Fisheries Management

The Confederacy of Mainland Mi'kmaq

amacdonald@mikmawconservation.ca

http://cmmns.com/

www.mikmawconservation.ca

Office: 1.902.895.6385 Cell: 1.902.324.3830 Toll Free: 1.877.892.2424

The Confederacy of Mainland Mi'kmaq

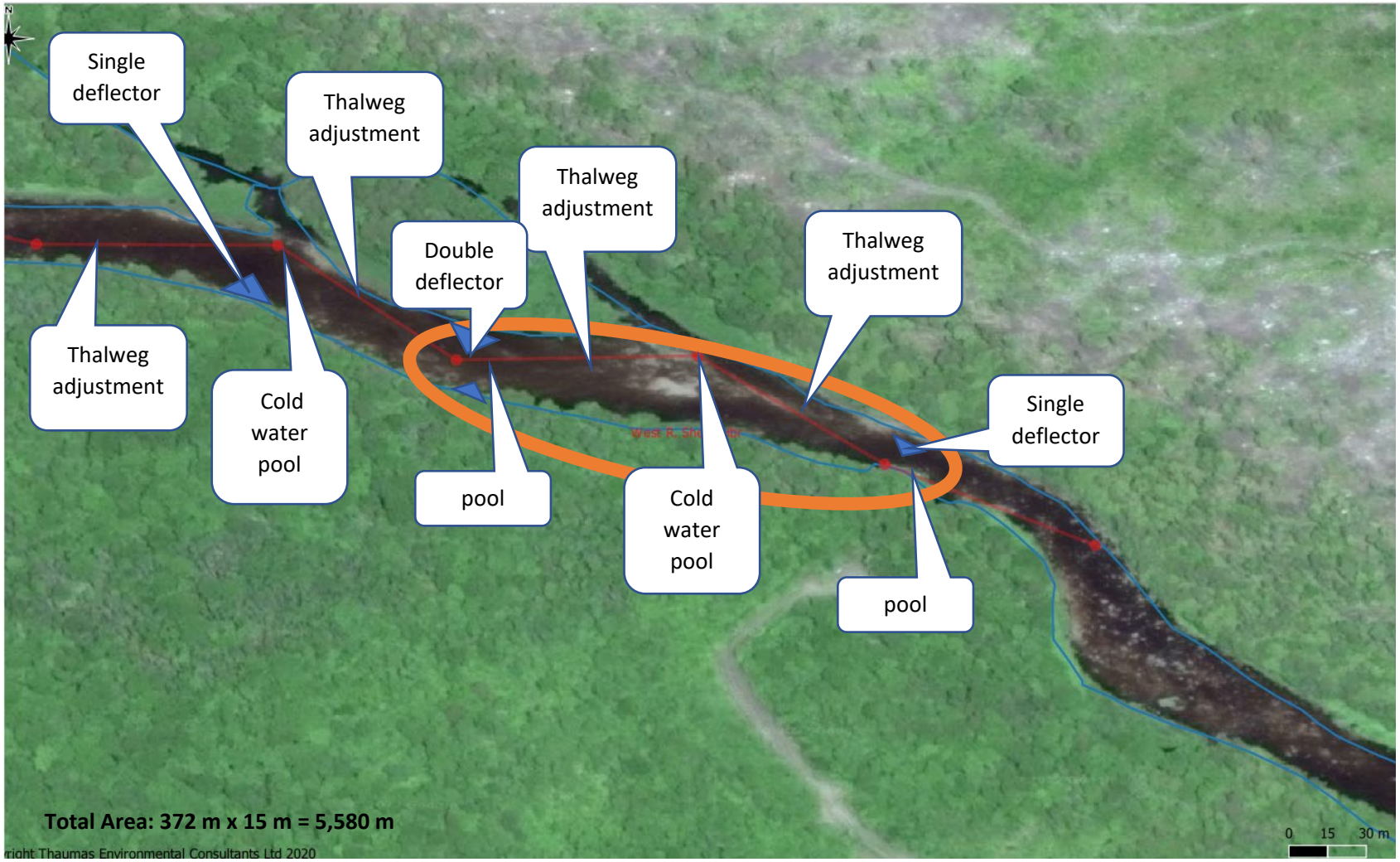
MI'KMAW CONSERVATION GROUP
THE CONFEDERACY OF MAINLAND MI'KMAQ

Appendix I NSSA - Habitat Offsetting Proposal

See attached document titled “Appendix I - NSSA West River Habitat Offsetting Considerations”.

Note: The Orange oval in this version reflects the area in which we (The CMM) anticipate the revised activities occurring. The double deflector shown may become a single deflector after site assessments are made in fall 2023 by Thaumas Environmental Consulting (or selected contactor).

Appendix II Habitat Restoration Site Design



right Thaumas Environmental Consultants Ltd 2020

APPENDIX O – COPY OF LETTER OF CREDIT



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Any carriage of your shipment by road may be subject to Federal and Provincial laws, regulations, orders or requirements which may govern and serve to limit our liability for damage, loss, delay, shortage, mis-delivery, nondelivery, misinformation or failure to provide information in connection with your shipment. LIMITATION OF LIABILITY. If not governed by Federal or Provincial laws, regulations, orders, or requirements as described above, FedEx's maximum liability for damage, loss, delay, shortage, mis-delivery, nondelivery, misinformation or failure to provide information in connection with your shipment, even if caused by our negligence or gross negligence, is limited by this Agreement to the amount of actual damages or CDN $100 per shipment, whichever is less, unless you declare in advance a higher value for carriage as described below, and pay any applicable supplementary charge. FedEx does not provide cargo liability or all-risk insurance, but you may pay an additional charge for each additional CDN $100 of declared value for carriage. If a higher value for carriage is declared and the additional charge is paid, FedEx's maximum liability will be the lesser of the declared value for carriage or your actual damages. DECLARED VALUE LIMITS. Shipments containing items of extraordinary value are limited to a maximum declared value for carriage of CDN $500. The maximum declared value we allow for carriage per air waybill for each FedEx® Letter or FedEx® Pak is CDN $100. Please check the current Worldwide Service Guide and any applicable tariff for further explanation of the declared value limits. If you send more than one package on this Air Waybill, the declared value for carriage of each package will be determined by dividing the total declared value for carriage by the number of packages in the shipment. LIABILITIES NOT ASSUMED. 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We must receive your written notice of a claim for damage or delay, including perishable and spoilage damage claims due to late or delayed delivery, within 21 days after we deliver your shipment and in the case of loss, shortage, mis-delivery, nondelivery, misinformation or failure to provide information, within 90 days after we accept the shipment for carriage. The right to claim damages against us shall be extinguished unless an action is brought within two years from the date of delivery of the shipment or from the date on which the shipment should have been delivered or from the date on which the carriage stopped. Within 90 days after you have notified us of your claim, it must be documented by sending us all relevant information regarding your claim. FedEx is not obligated to act on any claim until all transportation charges have been paid. The claim amount may not be deducted from these charges. If the recipient accepts the shipment without noting any damage on the delivery record, FedEx will assume the shipment was delivered in good condition. In order for us to consider a claim for damage, the contents, original shipping carton and packing must be made available to us for inspection at the delivery location and you must retain all such items until the claim is concluded. RESPONSIBILITY FOR PAYMENT. Even if you give us different payment instructions, you, the shipper, will always be primarily responsible for all charges, including transportation charges, and all duties, assessments, governmental penalties and fines, taxes, and FedEx's legal fees and costs related to shipments tendered under this Agreement. You also will be responsible for any costs FedEx may incur in returning your shipments to you or warehousing them pending disposition. MANDATORY LAW. Insofar as any provisions contained or referred to in this Agreement may be contrary to any applicable laws, government regulations, orders or requirements, such other provisions shall remain in effect as a part of this Agreement to the extent that they are not overridden. The invalidity or unenforceability of any provisions of this Agreement shall not affect any other part hereof. The parties expressly agree that this Agreement be drawn up in the English language. FEDERAL EXPRESS CANADA LTD., Head Office, 5985 Explorer Drive, Mississauga, ON L4W 5K6.

The Bank of Nova Scotia

Trade Services Centre
4th Floor, 1 St. Clair Avenue East
Toronto, Ontario M4T 1Z3
Tel: 1-888-722-3867
Fax: 416-866-4286
SWIFT: NOSCCATTTPG

Irrevocable Standby Letter of Credit No.: OSB62460GWS

Beneficiary:
Receiver General for Canada
on behalf of Fisheries and Oceans
Canada C/O Fisheries Protection
Program Fisheries and Oceans Canada Canada

Applicant:
Nova Scotia Power Incorporated
1223 Lower Water Street
Halifax, NS B3J 3S8 Canada

Date of Issue:
March 18, 2020

Date and Place of Expiry:
March 17, 2021 At our counter

Amount:
CAD 62,000.00 Sixty Two Thousand Canadian Dollars

Complete Beneficiary's name and address:
Receiver General for Canada on behalf of Fisheries and Oceans Canada
C/O Fisheries Protection Program
Fisheries and Oceans Canada
1 Challenger Drive,
Dartmouth, NS B2Y 4A2

Reference Number: DFO Referral File Numbers 19-W-549 and 20-HMAR-00017

We hereby authorize you to draw upon the Bank of Nova Scotia, Montreal Trade Service Centre, 1800 McGill College, 10th floor, Montreal, Quebec H3A 3K9 for the account of our Customer, Nova Scotia Power Incorporated, up to the sum total of CAD62,000.00 (Sixty Two Thousand and 00/100 Canadian Dollars) available on demand as follows:

Pursuant to the request of our Customer, we, the Bank of Nova Scotia, Montreal Trade Service Centre hereby establish and give to you an Irrevocable Standby Letter of Credit (the "Credit") in your favor in the total amount of CAD62,000.00 (Sixty Two Thousand and 00/100 Canadian Dollars). The Credit may be drawn on, by you, at any time and from time to time upon written demand by you. We will honor any such demand made by you without inquiring whether you have a right as between yourself and our Customer to make such demand and without recognizing any claim, instructions, direction or notification to the contrary from the Customer.

The Bank of Nova Scotia

Provided, however, that you are to deliver to us at such time as a written demand for payment is made upon us, a certificate purported to be signed by you, agreeing and/or confirming that monies drawn pursuant to this Credit will be retained and used by you to meet our Customer's obligations in connection with offsetting and monitoring required for completions of capital projects on the Sheet Harbour Hydro System and Sloane Lake in 2020. The original Letter of Credit must also be presented at the time for endorsement of the claim paid and will be returned to you.

It is understood and agreed that the obligation of the undersigned under this Credit is an obligation to pay money only and that in no circumstances shall the undersigned be obliged to perform or cause to perform any of our Customer's actual obligations to you.

Conditions:

- The sum total of this Credit shall be reduced from time to time as advised by written notice given to this office from time to time by you.

- The Credit will continue until March 17, 2021 and will expire at our above mentioned office address at the close of banking business on that date.

- This Credit is irrevocable until that date.

- This Credit shall be deemed to be automatically extended for one year from the present or any future expiration date hereof, unless at least thirty (30) days before any such date we give you written notice that we elect not to consider this Credit renewed for any such additional period. Upon receipt by you of such notice, you may draw upon, accompanied by written certification, the amount to be retained and used by you to meet obligations incurred or to be incurred in connection with the Authorization.

However, our Credit will not be extended beyond December 31, 2025 (the 'Final Expiry Date').

- Partial drawings on this Credit are permitted in which case the letter of Credit will be reduced by the draw amount.

- Upon successful completion of Nova Scotia Power Incorporated responsibilities under the offsetting and monitoring conditions of the Authorization, as determined by Fisheries and Oceans Canada, the original Letter of Credit shall be returned to the Bank of Nova Scotia, Montreal Trade Service Centre, 1800 McGill College, 10th floor, Montreal, Quebec H3A 3K9 for cancellation.

- This Standby Letter of Credit will be effective on March 17, 2020.

- This Standby Letter of Credit is subject to the International Chamber of Commerce (ICC) Uniform Customs and Practices for Documentary Credits, 2007 Revision, ICC Publication No. 600.

Regards,

The Bank of Nova Scotia

FERNANDO MARTINEZ

Authorised Signature(s)

ORIGINAL

The Bank of Nova Scotia

Trade Services Centre
4th Floor, 1 St. Clair Avenue East
Toronto, Ontario M4T 1Z3
Tel: 1-888-722-3867
Fax: 416-866-4286
SWIFT: NOSCCATTTPG

Irrevocable Standby Letter of Credit No. OSB62460GWS

Amendment no. 1
Dated May 19, 2021

Beneficiary:
Receiver General for Canada
on behalf of Fisheries and Oceans
Canada C/O Fisheries Protection
Program Fisheries and Oceans Canada Canada

Applicant:
Nova Scotia Power Incorporated
1223 Lower Water Street
Halifax, NS B3J 3S8 Canada

We amend our Standby Letter of Credit subject to the following terms and conditions. This amendment forms an integral part of the original instrument. All other terms and conditions remain unchanged.

Amended Terms:

The amount of the Standby Letter of Credit is increased by: CAD 281,032.00 to CAD 343,032.00

Unless otherwise instructed herein, all correspondence and enquiries regarding this transaction should be directed to our Customer Service Centre at the above address, telephone: 1-888-722-3867. Please indicate our reference number in all your correspondence or telephone enquiries.

Regards,

HALA ABDELFATTAH A1061

OMER MANZAR M1006

Authorised Signature(s)



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Any carriage of your shipment by road may be subject to Federal and Provincial laws, regulations, orders or requirements which may govern and serve to limit our liability for damage, loss, delay, shortage, mis-delivery, nondelivery, misinformation or failure to provide information in connection with your shipment. LIMITATION OF LIABILITY. If not governed by Federal or Provincial laws, regulations, orders, or requirements as described above, FedEx's maximum liability for damage, loss, delay, shortage, mis-delivery, nondelivery, misinformation or failure to provide information in connection with your shipment, even if caused by our negligence or gross negligence, is limited by this Agreement to the amount of actual damages or CDN $100 per shipment, whichever is less, unless you declare in advance a higher value for carriage as described below, and pay any applicable supplementary charge. 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FedEx won't be liable for loss, damage, delay, shortage, mis-delivery, nondelivery, misinformation or failure to provide information in connection with your shipment caused by events FedEx cannot control, including but not limited to, acts of God, perils of the air, weather conditions, acts of public enemies, war, strikes, civil commotions, or acts or omissions of public authorities (including customs and health officials) with actual or apparent authority. You should contact an insurance agent or broker if insurance coverage is desired. We do not provide insurance coverage of any kind. NO WARRANTIES. We make no warranties, express or implied. CLAIM FOR LOSS, DAMAGE OR DELAY. ALL CLAIMS MUST BE MADE IN WRITING AND WITHIN STRICT TIME LIMITS. SEE OUR CURRENT WORLDWIDE SERVICE GUIDE AND ANY APPLICABLE TARIFF FOR DETAILS. 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REDACTED (CONFIDENTIAL INFORMATION REMOVED)
CI 50518 NSUARB IR-12 Attachment 12 Page 538 of 576

APPENDIX P – ACCDC REPORT

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 7716: Ruth Falls Watershed, NS

Prepared 6 June 2023
by J. Pender, Conservation Data Analyst

CONTENTS OF REPORT

1.0 Preface
- 1.1 Data List
- 1.2 Restrictions
- 1.3 Additional Information
- Map 1: Buffered Study Area

2.0 Rare and Endangered Species
- 2.1 Flora
- 2.2 Fauna
- Map 2: Flora and Fauna

3.0 Special Areas
- 3.1 Managed Areas
- 3.2 Significant Areas
- Map 3: Special Areas

4.0 Rare Species Lists
- 4.1 Fauna
- 4.2 Flora
- 4.3 Location Sensitive Species
- 4.4 Source Bibliography

5.0 Rare Species within 100 km
- 5.1 Source Bibliography



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
RuthFallsWatNS_7716ob.xls	Rare or legally-protected Flora and Fauna in your study area
RuthFallsWatNS_7716ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
RuthFallsWatNS_7716ff_py.xls	Rare Freshwater Fish in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney
Senior Scientist / Executive Director
(506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko
Zoologist
(506) 364-2660
john.klymko@accdc.ca

Data Management, GIS
James Churchill
Conservation Data Analyst / Field Biologist
(902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Financial Manager / Executive Assistant
(506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

Western: Sarah Spencer
(902) 541-0081
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-0816
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Harrison Moore
(902) 497-4119
Harrison.Moore@novascotia.ca

Eastern: Maureen Cameron-MacMillan
(902) 295-2554
Maureen.Cameron-MacMillan@novascotia.ca

Eastern: Elizabeth Walsh
(902) 563-3370
Elizabeth.Walsh@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

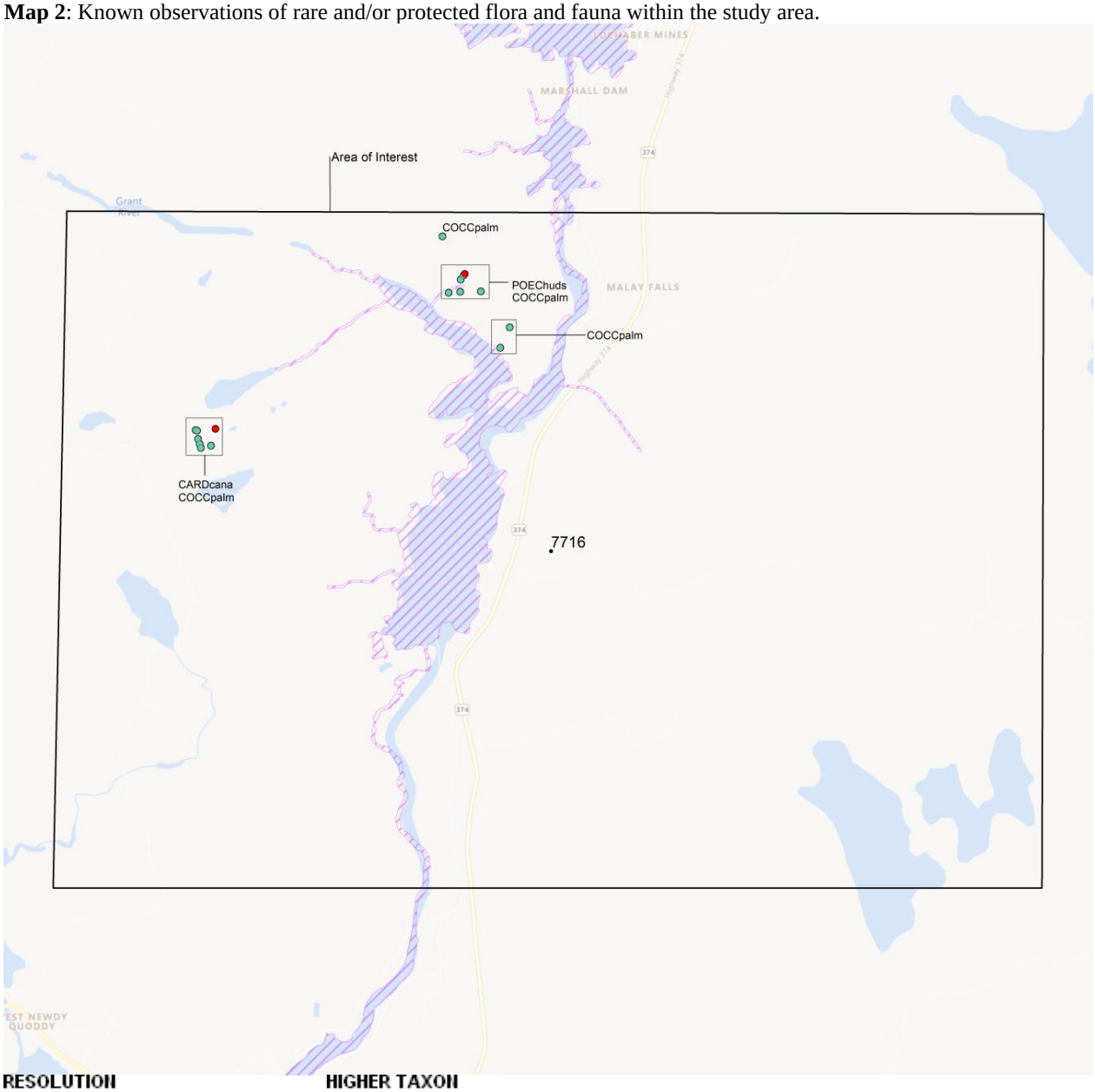
2.1 FLORA

The study area contains no records of vascular and 14 records of 1 nonvascular flora (Map 2 and attached: *ob.xls), excluding 'location-sensitive' species.

2.2 FAUNA

The study area contains 2 records of 2 vertebrate and no records of invertebrate fauna (Map 2 and attached data files - see 1.1 Data List), excluding 'location-sensitive species'. Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.

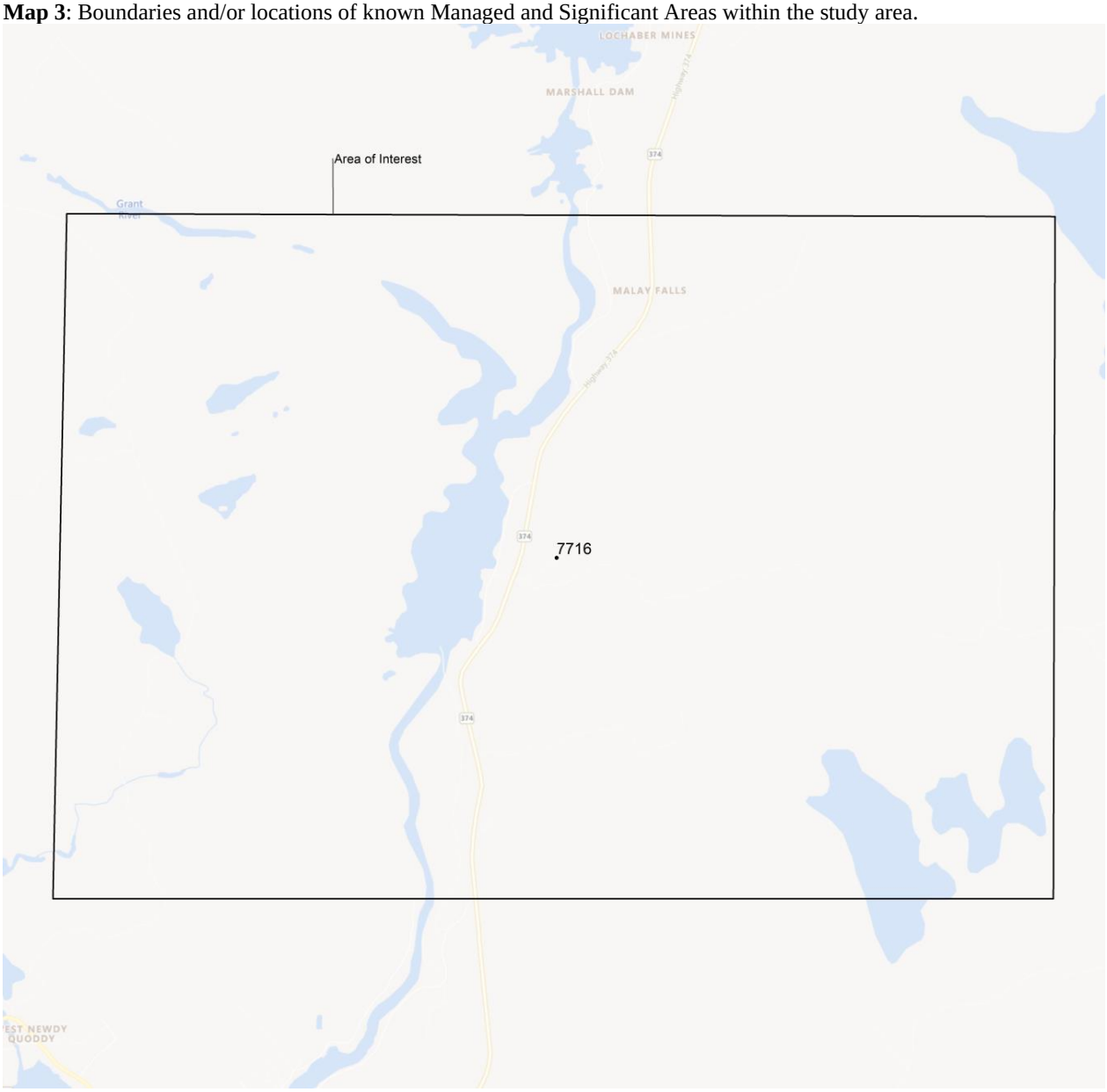


3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified no managed areas in the vicinity of the study area (Map 3).

3.2 SIGNIFICANT AREAS
The GIS scan identified no biologically significant sites in the vicinity of the study area (Map 3).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	14	1.8 ± 0.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	1	3.0 ± 0.0
A	*Poecile hudsonicus*	Boreal Chickadee				S3	1	2.5 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species "location sensitive". Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with "YES".

Nova Scotia

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Fraxinus nigra	Black Ash		Threatened	No
Emydoidea blandingii	*Blanding's Turtle - Nova Scotia pop.*	Endangered	Endangered	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.		Vulnerable	No
Bat hibernaculum or bat species occurrence		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
12	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database [as of 2018-03]. Mersey Tobeatic Research Institute.
4	Neily, T.H. 2017. Nova Scotia lichen records. Mersey Tobeatic Research Institute.
1	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 36085 records of 156 vertebrate and 1362 records of 64 invertebrate fauna; 4288 records of 234 vascular and 2565 records of 122 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including "location-sensitive" species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	51	33.9 ± 0.0	NS
A	*Myotis septentrionalis*	Northern Myotis	Endangered	Endangered	Endangered	S1	3	42.0 ± 0.0	NS
A	*Perimyotis subflavus*	Tricolored Bat	Endangered	Endangered	Endangered	S1	4	75.5 ± 0.0	NS
A	*Emydoidea blandingii*	Blanding's Turtle	Endangered	Endangered	Endangered	S1	1	96.1 ± 0.0	NS
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy population	Endangered	Endangered		S1	18	53.1 ± 0.0	NS
A	*Salmo salar pop. 6*	Atlantic Salmon - Nova Scotia Southern Upland population	Endangered			S1	43	6.2 ± 0.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus subspecies	Endangered	Endangered	Endangered	S1B	993	13.7 ± 0.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	74	11.9 ± 0.0	NS
A	*Morone saxatilis pop. 2*	Striped Bass - Bay of Fundy population	Endangered			S2S3B,S2S3N	2	74.8 ± 0.0	NS
A	*Icteria virens*	Yellow-Breasted Chat	Endangered	Endangered		SNA	21	55.8 ± 0.0	NS
A	*Lamna nasus*	Porbeagle Shark	Endangered			SNR	1	93.1 ± 1.0	NS
A	*Lasiurus cinereus*	Hoary Bat	Endangered			SUB, S1M	2	72.2 ± 0.0	NS
A	*Lasionycteris noctivagans*	Silver-haired Bat	Endangered			SUB,S1M	1	90.0 ± 0.0	NS
A	*Colinus virginianus*	Northern Bobwhite	Endangered	Endangered			2	66.2 ± 0.0	NS
A	*Asio flammeus*	Short-eared Owl	Threatened	Special Concern		S1B	9	67.9 ± 7.0	NS
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2	8514	25.7 ± 1.0	NS
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2B	966	14.4 ± 1.0	NS
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Endangered	S2S3B,S1M	733	8.2 ± 7.0	NS
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S2S3M	34	71.9 ± 0.0	NS
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened			S2S3N	2	74.1 ± 0.0	NS
A	*Hydrobates leucorhous*	Leach's Storm-Petrel	Threatened			S3B	73	14.6 ± 7.0	NS
A	*Tringa flavipes*	Lesser Yellowlegs	Threatened			S3M	575	18.2 ± 0.0	NS
A	*Anguilla rostrata*	American Eel	Threatened			S3N	71	9.5 ± 0.0	NS
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened		SHB	2	87.4 ± 0.0	NS
A	*Melanerpes lewis*	Lewis's Woodpecker	Threatened	Threatened		SNA	2	97.1 ± 0.0	NS
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened		SUB	2	93.3 ± 0.0	NS
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	36	35.8 ± 7.0	NS
A	*Salmo salar pop. 12*	Atlantic Salmon - Gaspe - Southern Gulf of St. Lawrence population	Special Concern			S1	31	61.6 ± 50.0	NS
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Special Concern	Threatened	Threatened	S1?B	11	55.9 ± 7.0	NS
A	*Passerculus sandwichensis princeps*	Ipswich Sparrow	Special Concern	Special Concern		S1B	32	19.0 ± 0.0	NS
A	*Bucephala islandica*	Barrow's Goldeneye	Special Concern	Special Concern		S1N,SUM	31	70.2 ± 0.0	NS
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	246	8.2 ± 7.0	NS
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S2S3M	7	62.8 ± 0.0	NS
A	*Morone saxatilis pop. 1*	Striped Bass - Southern Gulf of St. Lawrence population	Special Concern			S2S3N	1	86.9 ± 1.0	NS
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern population	Special Concern	Special Concern	Endangered	S2S3N,SUM	53	9.1 ± 2.0	NS
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	211	27.5 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Endangered	S3B	1048	5.9 ± 7.0	NS
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	1020	3.0 ± 0.0	NS
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Special Concern	Threatened	S3B	368	6.8 ± 7.0	NS
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Special Concern	Threatened	S3B	1001	5.9 ± 7.0	NS
A	*Dolichonyx oryzivorus*	Bobolink	Special Concern	Threatened	Vulnerable	S3B	636	36.4 ± 7.0	NS
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	630	5.9 ± 7.0	NS
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern		S3N,SUM	12	12.9 ± 0.0	NS
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	768	5.9 ± 7.0	NS
A	*Phocoena phocoena*	Harbour Porpoise	Special Concern			S4	6	15.7 ± 0.0	NS
A	*Phocoena phocoena pop. 1*	Harbour Porpoise - Northwest Atlantic Population	Special Concern			S4	1	91.9 ± 1.0	NS
A	*Chrysemys picta*	Painted Turtle	Special Concern	Special Concern		S4	26	59.8 ± 0.0	NS
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern	Special Concern		S4	117	57.8 ± 10.0	NS
A	*Calidris subruficollis*	Buff-breasted Sandpiper	Special Concern	Special Concern		SNA	5	71.9 ± 0.0	NS
A	*Zonotrichia querula*	Harris's Sparrow	Special Concern			SNA	1	90.9 ± 0.0	NS
A	*Anarhichas lupus*	Atlantic Wolffish	Special Concern	Special Concern		SNR	1	87.3 ± 0.0	NS
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1?B,SUN,SUM	18	68.7 ± 0.0	NS
A	*Fulica americana*	American Coot	Not At Risk			S1B	43	62.9 ± 0.0	NS
A	*Chlidonias niger*	Black Tern	Not At Risk			S1B	4	69.6 ± 0.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk		Vulnerable	S1B,SUM	11	53.4 ± 0.0	NS
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S2?B,SUM	12	51.5 ± 0.0	NS
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3	3	40.7 ± 100.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S3	21	31.6 ± 5.0	NS
A	*Megaptera novaeangliae*	Humpback Whale	Not At Risk			S3	1	89.3 ± 0.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	388	5.9 ± 7.0	NS
A	*Sialia sialis*	Eastern Bluebird	Not At Risk			S3B	44	45.1 ± 0.0	NS
A	*Buteo lagopus*	Rough-legged Hawk	Not At Risk			S3N	7	68.9 ± 0.0	NS
A	*Accipiter gentilis*	Northern Goshawk	Not At Risk			S3S4	108	12.2 ± 0.0	NS
A	*Glaucomys volans*	Southern Flying Squirrel	Not At Risk			S3S4	1	40.1 ± 0.0	NS
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4	3	93.7 ± 2.0	NS
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	159	15.0 ± 0.0	NS
A	*Calidris canutus rufa*	Red Knot rufa subspecies	E,SC	Endangered	Endangered	S2M	108	59.8 ± 0.0	NS
A	*Calidris canutus*	Red Knot	E,SC	E,T		S2M	7	77.3 ± 0.0	NS
A	*Morone saxatilis*	Striped Bass	E,SC			S2S3B,S2S3N	11	66.8 ± 0.0	NS
A	*Gadus morhua*	Atlantic Cod	E,SC,DD			SNR	4	59.3 ± 0.0	NS
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S1B,S1N	10	23.1 ± 0.0	NS
A	*Alces alces americana*	Moose			Endangered	S1	126	8.7 ± 0.0	NS
A	*Alces alces*	Moose				S1	7	15.3 ± 0.0	NS
A	*Picoides dorsalis*	American Three-toed Woodpecker				S1?	4	35.0 ± 7.0	NS
A	*Uria aalge*	Common Murre				S1?B	6	31.1 ± 0.0	NS
A	*Passerina cyanea*	Indigo Bunting				S1?B,SUM	22	35.0 ± 7.0	NS
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1B	1	96.9 ± 7.0	NS
A	*Oxyura jamaicensis*	Ruddy Duck				S1B	20	74.5 ± 7.0	NS
A	*Gallinula galeata*	Common Gallinule				S1B	7	68.3 ± 0.0	NS
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	9	70.9 ± 7.0	NS
A	*Mimus polyglottos*	Northern Mockingbird				S1B	30	56.8 ± 7.0	NS
A	*Toxostoma rufum*	Brown Thrasher				S1B	9	67.9 ± 7.0	NS
A	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S4M	785	17.9 ± 0.0	NS
A	*Calidris minutilla*	Least Sandpiper				S1B,S4M	484	26.5 ± 0.0	NS
A	*Anas acuta*	Northern Pintail				S1B,SUM	58	35.0 ± 7.0	NS
A	*Vireo gilvus*	Warbling Vireo				S1B,SUM	13	36.2 ± 0.0	NS
A	*Vespertilionidae sp.*	bat species				S1S2	87	3.7 ± 0.0	NS
A	*Pooecetes gramineus*	Vesper Sparrow				S1S2B,SUM	19	15.7 ± 0.0	NS
A	*Vireo philadelphicus*	Philadelphia Vireo				S2?B,SUM	37	8.2 ± 7.0	NS
A	*Alca torda*	Razorbill				S2B	7	62.8 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Fratercula arctica*	Atlantic Puffin				S2B	4	15.0 ± 7.0	NS
A	*Empidonax traillii*	Willow Flycatcher				S2B	18	35.0 ± 7.0	NS
A	*Molothrus ater*	Brown-headed Cowbird				S2B	102	5.9 ± 7.0	NS
A	*Spatula clypeata*	Northern Shoveler				S2B,SUM	25	65.7 ± 7.0	NS
A	*Mareca strepera*	Gadwall				S2B,SUM	39	42.8 ± 7.0	NS
A	*Piranga olivacea*	Scarlet Tanager				S2B,SUM	20	36.1 ± 0.0	NS
A	*Calidris alba*	Sanderling				S2N,S3M	392	17.9 ± 0.0	NS
A	*Martes americana*	American Marten			Endangered	S2S3	1	69.9 ± 0.0	NS
A	*Asio otus*	Long-eared Owl				S2S3	25	31.7 ± 0.0	NS
A	*Rallus limicola*	Virginia Rail				S2S3B	21	73.8 ± 7.0	NS
A	*Rissa tridactyla*	Black-legged Kittiwake				S2S3B	3	76.0 ± 0.0	NS
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	198	12.6 ± 0.0	NS
A	*Phalacrocorax carbo*	Great Cormorant				S2S3B,S2S3N	107	13.0 ± 0.0	NS
A	*Cathartes aura*	Turkey Vulture				S2S3B,S4S5M	60	25.4 ± 0.0	NS
A	*Setophaga pinus*	Pine Warbler				S2S3B,S4S5M	43	43.9 ± 0.0	NS
A	*Bucephala clangula*	Common Goldeneye				S2S3B,S5N,S5M	297	6.2 ± 0.0	NS
A	*Icterus galbula*	Baltimore Oriole				S2S3B,SUM	72	7.5 ± 7.0	NS
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	49	67.0 ± 0.0	NS
A	*Numenius phaeopus*	Whimbrel				S2S3M	24	29.7 ± 0.0	NS
A	*Numenius phaeopus hudsonicus*	Whimbrel				S2S3M	102	33.3 ± 0.0	NS
A	*Phalaropus fulicarius*	Red Phalarope				S2S3M	4	62.8 ± 0.0	NS
A	*Perisoreus canadensis*	Canada Jay				S3	530	5.9 ± 7.0	NS
A	*Poecile hudsonicus*	Boreal Chickadee				S3	911	2.5 ± 0.0	NS
A	*Spinus pinus*	Pine Siskin				S3	461	5.9 ± 7.0	NS
A	*Salvelinus fontinalis*	Brook Trout				S3	78	5.3 ± 0.0	NS
A	*Salvelinus namaycush*	Lake Trout				S3	2	30.0 ± 0.0	NS
A	*Pekania pennanti*	Fisher				S3	8	35.5 ± 7.0	NS
A	*Calcarius lapponicus*	Lapland Longspur				S3?N,SUM	9	15.3 ± 0.0	NS
A	*Spatula discors*	Blue-winged Teal				S3B	104	7.5 ± 7.0	NS
A	*Charadrius vociferus*	Killdeer				S3B	446	5.9 ± 7.0	NS
A	*Tringa semipalmata*	Willet				S3B	1179	5.9 ± 7.0	NS
A	*Sterna paradisaea*	Arctic Tern				S3B	76	9.0 ± 0.0	NS
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	75	6.8 ± 7.0	NS
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	175	5.9 ± 7.0	NS
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	475	5.9 ± 7.0	NS
A	*Alosa pseudoharengus*	Alewife				S3B	30	14.4 ± 0.0	NS
A	*Somateria mollissima*	Common Eider				S3B,S3M,S3N	994	5.9 ± 7.0	NS
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S4M	922	7.5 ± 7.0	NS
A	*Falco sparverius*	American Kestrel				S3B,S4S5M	318	5.9 ± 7.0	NS
A	*Gallinago delicata*	Wilson's Snipe				S3B,S5M	610	6.5 ± 0.0	NS
A	*Setophaga striata*	Blackpoll Warbler				S3B,S5M	166	5.9 ± 7.0	NS
A	*Cardellina pusilla*	Wilson's Warbler				S3B,S5M	123	5.9 ± 7.0	NS
A	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M	124	5.9 ± 7.0	NS
A	*Setophaga tigrina*	Cape May Warbler				S3B,SUM	215	3.6 ± 0.0	NS
A	*Branta bernicla*	Brant				S3M	1	87.0 ± 0.0	NS
A	*Pluvialis squatarola*	Black-bellied Plover				S3M	645	30.8 ± 0.0	NS
A	*Arenaria interpres*	Ruddy Turnstone				S3M	245	18.4 ± 0.0	NS
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	663	17.9 ± 0.0	NS
A	*Calidris melanotos*	Pectoral Sandpiper				S3M	89	53.4 ± 0.0	NS
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	441	41.8 ± 0.0	NS
A	*Chroicocephalus ridibundus*	Black-headed Gull				S3N	71	13.7 ± 0.0	NS
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	149	6.8 ± 7.0	NS
A	*Loxia curvirostra*	Red Crossbill				S3S4	163	5.9 ± 7.0	NS
A	*Botaurus lentiginosus*	American Bittern				S3S4B,S4S5M	290	6.5 ± 0.0	NS
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M	560	5.9 ± 7.0	NS
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	755	5.9 ± 7.0	NS
A	*Leiothlypis peregrina*	Tennessee Warbler				S3S4B,S5M	566	5.9 ± 7.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Passerella iliaca*	Fox Sparrow				S3S4B,S5M	115	10.5 ± 0.0	NS
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5M,S5N	336	12.5 ± 0.0	NS
A	*Calidris maritima*	Purple Sandpiper				S3S4N	60	22.3 ± 10.0	NS
A	*Lanius borealis*	Northern Shrike				S3S4N	3	45.0 ± 0.0	NS
A	*Morus bassanus*	Northern Gannet				SHB	56	15.0 ± 0.0	NS
A	*Aythya americana*	Redhead				SHB	13	53.0 ± 0.0	NS
A	*Leucophaeus atricilla*	Laughing Gull				SHB	12	26.4 ± 0.0	NS
A	*Progne subis*	Purple Martin				SHB	6	35.0 ± 7.0	NS
A	*Eremophila alpestris*	Horned Lark				SHB,S4S5N,S5M	17	15.0 ± 7.0	NS
I	*Bombus bohemicus*	Ashton Cuckoo Bumble Bee	Endangered	Endangered	Endangered	S1	24	52.9 ± 5.0	NS
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2?B,S3M	532	11.4 ± 0.0	NS
I	*Bombus suckleyi*	Suckley's Cuckoo Bumble Bee	Threatened			SH	2	76.4 ± 5.0	NS
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Threatened	S3	11	50.8 ± 0.0	NS
I	*Bombus terricola*	Yellow-banded Bumble Bee	Special Concern	Special Concern	Vulnerable	S3	84	4.2 ± 0.0	NS
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle	Special Concern		Endangered	SH	5	72.8 ± 2.0	NS
I	*Gomphurus ventricosus*	Skillet Clubtail	Special Concern	Endangered		SH	1	82.7 ± 0.0	NS
I	*Erora laeta*	Early Hairstreak				S1	1	98.0 ± 1.0	NS
I	*Pachydiplax longipennis*	Blue Dasher				S1	11	85.1 ± 0.0	NS
I	*Polygonia comma*	Eastern Comma				S1?	8	90.0 ± 0.0	NS
I	*Polygonia satyrus*	Satyr Comma				S1?	5	74.3 ± 5.0	NS
I	*Euphyes bimacula*	Two-spotted Skipper				S1S2	2	46.3 ± 0.0	NS
I	*Boloria chariclea*	Arctic Fritillary				S1S2	1	95.6 ± 2.0	NS
I	*Somatochlora brevicincta*	Quebec Emerald				S1S2	1	70.5 ± 0.0	NS
I	*Tharsalea dospassosi*	Maritime Copper				S2	12	88.3 ± 1.0	NS
I	*Satyrium acadica*	Acadian Hairstreak				S2	9	81.7 ± 2.0	NS
I	*Neurocordulia michaeli*	Broad-tailed Shadowdragon				S2	26	36.1 ± 0.0	NS
I	*Coenagrion resolutum*	Taiga Bluet				S2	2	89.8 ± 1.0	NS
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	114	22.8 ± 0.0	NS
I	*Pantala hymenaea*	Spot-Winged Glider				S2?B	7	40.1 ± 1.0	NS
I	*Nymphalis l-album*	Compton Tortoiseshell				S2S3	17	63.0 ± 0.0	NS
I	*Aglais milberti*	Milbert's Tortoiseshell				S2S3	18	68.6 ± 2.0	NS
I	*Lanthus vernalis*	Southern Pygmy Clubtail				S2S3	8	36.2 ± 0.0	NS
I	*Somatochlora kennedyi*	Kennedy's Emerald				S2S3	2	88.3 ± 1.0	NS
I	*Stylurus scudderi*	Zebra Clubtail				S2S3	4	62.5 ± 0.0	NS
I	*Alasmidonta undulata*	Triangle Floater				S2S3	24	39.5 ± 0.0	NS
I	*Strophiona nitens*	Chestnut Bark Long-horned Beetle				S3	1	98.9 ± 0.0	NS
I	*Psephenus herricki*	Herrick's Water Penny Beetle				S3	1	53.6 ± 0.0	NS
I	*Carabus serratus*	Serrated Ground Beetle				S3	1	94.1 ± 0.0	NS
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	1	89.2 ± 0.0	NS
I	*Chrysochus auratus*	Dogbane Leaf Beetle				S3	2	51.5 ± 0.0	NS
I	*Naemia seriata*	Seaside Lady Beetle				S3	4	63.8 ± 0.0	NS
I	*Elateroides lugubris*	Sapwood Ship-timber Beetle				S3	1	99.9 ± 0.0	NS
I	*Chilocorus stigma*	Twice-stabbed Lady Beetle				S3	3	79.3 ± 0.0	NS
I	*Myzia pullata*	Streaked Lady Beetle				S3	4	85.7 ± 0.0	NS
I	*Monochamus marmorator*	Balsam Fir Sawyer				S3	3	51.7 ± 0.0	NS
I	*Trachysida aspera*	Rough Flower Longhorn Beetle				S3	1	89.2 ± 0.0	NS
I	*Astylopsis sexguttata*	Six-speckled Long-horned Beetle				S3	2	91.3 ± 0.0	NS
I	*Satyrium calanus*	Banded Hairstreak				S3	29	70.5 ± 2.0	NS
I	*Callophrys lanoraieensis*	Bog Elfin				S3	4	22.1 ± 1.0	NS
I	*Strymon melinus*	Gray Hairstreak				S3	1	97.8 ± 1.0	NS
I	*Ophiogomphus mainensis*	Maine Snaketail				S3	14	36.1 ± 0.0	NS
I	*Ophiogomphus rupinsulensis*	Rusty Snaketail				S3	55	36.1 ± 0.0	NS

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I	*Epitheca princeps*	Prince Baskettail				S3	9	85.4 ± 0.0	NS
I	*Somatochlora forcipata*	Forcipate Emerald				S3	3	88.3 ± 1.0	NS
I	*Enallagma vernale*	Vernal Bluet				S3	2	66.7 ± 0.0	NS
I	*Polygonia interrogationis*	Question Mark				S3B	117	14.9 ± 0.0	NS
I	*Cecropterus pylades*	Northern Cloudywing				S3S4	26	45.2 ± 0.0	NS
I	*Amblyscirtes hegon*	Pepper and Salt Skipper				S3S4	32	37.6 ± 0.0	NS
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	3	18.6 ± 0.0	NS
I	*Argynnis aphrodite*	Aphrodite Fritillary				S3S4	23	65.3 ± 100.0	NS
I	*Polygonia faunus*	Green Comma				S3S4	19	39.0 ± 0.0	NS
I	*Oeneis jutta*	Jutta Arctic				S3S4	3	39.5 ± 0.0	NS
I	*Aeshna clepsydra*	Mottled Darner				S3S4	10	26.8 ± 1.0	NS
I	*Aeshna constricta*	Lance-Tipped Darner				S3S4	15	55.5 ± 1.0	NS
I	*Boyeria grafiana*	Ocellated Darner				S3S4	9	21.4 ± 1.0	NS
I	*Gomphaeschna furcillata*	Harlequin Darner				S3S4	10	66.7 ± 0.0	NS
I	*Erythrodiplax berenice*	Seaside Dragonlet				S3S4	6	78.8 ± 0.0	NS
I	*Nannothemis bella*	Elfin Skimmer				S3S4	6	43.5 ± 0.0	NS
I	*Sympetrum danae*	Black Meadowhawk				S3S4	4	55.9 ± 1.0	NS
I	*Amphiagrion saucium*	Eastern Red Damsel				S3S4	2	63.9 ± 0.0	NS
I	*Sphaerophoria pyrrhina*	Violaceous Globetail				SH	1	75.0 ± 5.0	NS
I	*Icaricia saepiolus*	Greenish Blue				SH	2	70.1 ± 2.0	NS
I	*Polygonia gracilis*	Hoary Comma				SH	2	68.6 ± 2.0	NS
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1	30	9.6 ± 0.0	NS
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	545	4.2 ± 0.0	NS
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened	Threatened	Threatened	S1	14	24.8 ± 0.0	NS
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	23	52.1 ± 1.0	NS
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	27	10.0 ± 0.0	NS
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S3	7	4.5 ± 0.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen	Threatened			S3	8	25.4 ± 0.0	NS
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	194	6.0 ± 0.0	NS
N	*Sclerophora peronella (Atlantic pop.)*	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S3S4	28	14.0 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	16	18.5 ± 1.0	NS
N	*Fissidens exilis*	Pygmy Pocket Moss	Not At Risk			S3	5	68.7 ± 0.0	NS
N	*Chaenotheca servitii*	Flexuous Golden Stubble	Data Deficient			S1	1	24.6 ± 1.0	NS
N	*Sematophyllum demissum*	a Moss				S1	1	90.2 ± 2.0	NS
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				S1	1	24.3 ± 0.0	NS
N	*Scytinium schraderi*	Wrinkled Jellyskin Lichen				S1	1	87.7 ± 0.0	NS
N	*Lichina confinis*	Marine Seaweed Lichen				S1	2	20.5 ± 2.0	NS
N	*Polychidium muscicola*	Eyed Mossthorns Woollybear Lichen				S1	1	38.3 ± 0.0	NS
N	*Bryoria nitidula*	Tundra Horsehair Lichen				S1	2	96.6 ± 0.0	NS
N	*Hypogymnia hultenii*	Powdered Honeycomb Lichen				S1	18	18.0 ± 0.0	NS
N	*Jubula pennsylvanica*	a liverwort				S1?	1	46.4 ± 0.0	NS
N	*Tortula obtusifolia*	a Moss				S1?	3	40.3 ± 0.0	NS
N	*Scytinium intermedium*	Forty-five Jellyskin Lichen				S1?	1	92.4 ± 4.0	NS
N	*Sematophyllum marylandicum*	a Moss				S1S2	2	87.5 ± 6.0	NS
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	1	34.9 ± 0.0	NS
N	*Haplocladium microphyllum*	Tiny-leaved Haplocladium Moss				S1S2	1	88.9 ± 5.0	NS
N	*Placidium squamulosum*	Limy Soil Stipplescale Lichen				S1S2	1	41.5 ± 6.0	NS
N	*Cladonia labradorica*	Labrador Lichen				S1S2	1	71.2 ± 0.0	NS
N	*Peltigera ponojensis*	Pale-bellied Pelt Lichen				S1S2	1	62.9 ± 0.0	NS

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N	*Parmotrema reticulatum*	Netted Ruffle Lichen				S1S2	1	88.5 ± 0.0	NS
N	*Solorina spongiosa*	Blinking Owl Lichen				S1S2	7	78.7 ± 0.0	NS
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1S2	22	11.1 ± 0.0	NS
N	*Acarospora sinopica*	a cracked lichen				S1S3	2	96.6 ± 0.0	NS
N	*Xylopsora friesii*	a Lichen				S1S3	2	93.6 ± 0.0	NS
N	*Peltigera neckeri*	Black-saddle Pelt Lichen				S1S3	2	49.9 ± 0.0	NS
N	*Stereocaulon intermedium*	Pacific Brain Foam Lichen				S1S3	1	99.1 ± 0.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2	1	95.2 ± 30.0	NS
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S2	2	86.5 ± 3.0	NS
N	*Sphagnum subnitens*	Lustrous Peat Moss				S2	1	40.2 ± 2.0	NS
N	*Nephroma arcticum*	Arctic Kidney Lichen				S2	1	96.5 ± 1.0	NS
N	*Nephroma resupinatum*	a lichen				S2	3	69.7 ± 5.0	NS
N	*Placynthium flabellosum*	Scaly Ink Lichen				S2	1	59.2 ± 17.0	NS
N	*Riccardia multifida*	Delicate Germanderwort				S2?	2	41.9 ± 0.0	NS
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S2?	2	75.7 ± 2.0	NS
N	*Drepanocladus polygamus*	Polygamous Hook Moss				S2?	2	21.4 ± 0.0	NS
N	*Kiaeria starkei*	Starke's Fork Moss				S2?	1	50.5 ± 10.0	NS
N	*Philonotis marchica*	a Moss				S2?	2	72.0 ± 0.0	NS
N	*Platydictya jungermannioides*	False Willow Moss				S2?	3	70.0 ± 0.0	NS
N	*Saelania glaucescens*	Blue Dew Moss				S2?	1	95.9 ± 0.0	NS
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2?	2	92.2 ± 5.0	NS
N	*Oxyrrhynchium hians*	Light Beaked Moss				S2S3	2	56.7 ± 25.0	NS
N	*Moelleropsis nebulosa*	Blue-gray Moss Shingle Lichen				S2S3	61	7.0 ± 0.0	NS
N	*Moelleropsis nebulosa ssp. frullaniae*	Blue-gray Moss Shingle Lichen				S2S3	3	23.2 ± 0.0	NS
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S2S3	17	20.6 ± 0.0	NS
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2S3	8	35.9 ± 0.0	NS
N	*Usnea rubicunda*	Red Beard Lichen				S2S3	4	35.0 ± 0.0	NS
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S2S3	7	10.0 ± 0.0	NS
N	*Usnocetraria oakesiana*	Yellow Band Lichen				S2S3	1	98.9 ± 0.0	NS
N	*Cetraria muricata*	Spiny Heath Lichen				S2S3	1	77.2 ± 1.0	NS
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	1	24.8 ± 0.0	NS
N	*Cladonia mateocyatha*	Mixed-up Pixie-cup				S2S3	1	99.7 ± 5.0	NS
N	*Chaenotheca gracilenta*	a lichen				S2S3	1	93.7 ± 0.0	NS
N	*Scytinium tenuissimum*	Birdnest Jellyskin Lichen				S2S3	15	40.3 ± 0.0	NS
N	*Parmelia fertilis*	Fertile Shield Lichen				S2S3	6	23.2 ± 0.0	NS
N	*Hypotrachyna minarum*	Hairless-spined Shield Lichen				S2S3	1	45.9 ± 0.0	NS
N	*Parmeliopsis ambigua*	Green Starburst Lichen				S2S3	5	50.7 ± 0.0	NS
N	*Racodium rupestre*	Rockhair Lichen				S2S3	1	100.0 ± 1.0	NS
N	*Fuscopannaria sorediata*	a Lichen				S2S3	11	19.3 ± 0.0	NS
N	*Stereocaulon condensatum*	Granular Soil Foam Lichen				S2S3	5	69.3 ± 0.0	NS
N	*Physcia subtilis*	Slender Rosette Lichen				S2S3	1	53.0 ± 0.0	NS
N	*Dimelaena oreina*	Golden Moonglow Lichen				S2S3	1	94.5 ± 0.0	NS
N	*Cladonia coccifera*	Eastern Boreal Pixie-cup Lichen				S2S3	4	25.1 ± 1.0	NS
N	*Ephemerum serratum*	a Moss				S3	2	70.9 ± 0.0	NS
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S3	3	70.9 ± 0.0	NS
N	*Anomodon tristis*	a Moss				S3	3	16.5 ± 0.0	NS
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3	3	26.3 ± 0.0	NS
N	*Rostania occultata*	Crusted Tarpaper Lichen				S3	2	43.5 ± 0.0	NS
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	10	4.2 ± 0.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S3	5	68.9 ± 2.0	NS

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N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	100	10.0 ± 0.0	NS
N	*Scytinium lichenoides*	Tattered Jellyskin Lichen				S3	29	23.2 ± 1.0	NS
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S3	1	78.0 ± 3.0	NS
N	*Nephroma bellum*	Naked Kidney Lichen				S3	5	51.1 ± 0.0	NS
N	*Placynthium nigrum*	Common Ink Lichen				S3	2	21.6 ± 10.0	NS
N	*Platismatia norvegica*	Oldgrowth Rag Lichen				S3	2	41.2 ± 0.0	NS
N	*Ephebe lanata*	Waterside Rockshag Lichen				S3	2	38.3 ± 0.0	NS
N	*Phaeophyscia adiastola*	Powder-tipped Shadow Lichen				S3	1	93.9 ± 0.0	NS
N	*Phaeophyscia pusilloides*	Pompom-tipped Shadow Lichen				S3	10	71.3 ± 0.0	NS
N	*Peltigera collina*	Tree Pelt Lichen				S3	21	12.3 ± 0.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3?	1	97.9 ± 0.0	NS
N	*Elodium blandowii*	Blandow's Bog Moss				S3?	2	83.5 ± 3.0	NS
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S3?	1	28.7 ± 0.0	NS
N	*Sphagnum riparium*	Streamside Peat Moss				S3?	2	19.0 ± 0.0	NS
N	*Cladonia stygia*	Black-footed Reindeer Lichen				S3?	5	28.1 ± 0.0	NS
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S3S4	1	93.0 ± 3.0	NS
N	*Encalypta ciliata*	Fringed Extinguisher Moss				S3S4	1	96.7 ± 2.0	NS
N	*Encalypta procera*	Slender Extinguisher Moss				S3S4	9	89.2 ± 0.0	NS
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	1	95.9 ± 0.0	NS
N	*Splachnum ampullaceum*	Cruet Dung Moss				S3S4	2	12.6 ± 0.0	NS
N	*Tomentypnum nitens*	Golden Fuzzy Fen Moss				S3S4	1	40.4 ± 2.0	NS
N	*Schistidium agassizii*	Elf Bloom Moss				S3S4	2	38.2 ± 0.0	NS
N	*Hylocomiastrum pyrenaicum*	a Feather Moss				S3S4	1	95.3 ± 0.0	NS
N	*Bryoria pseudofuscescens*	Mountain Horsehair Lichen				S3S4	1	99.3 ± 1.0	NS
N	*Enchylium tenax*	Soil Tarpaper Lichen				S3S4	7	67.8 ± 0.0	NS
N	*Sticta fuliginosa*	Peppered Moon Lichen				S3S4	51	9.5 ± 0.0	NS
N	*Arctoparmelia incurva*	Finger Ring Lichen				S3S4	69	48.3 ± 0.0	NS
N	*Scytinium teretiusculum*	Curly Jellyskin Lichen				S3S4	6	52.1 ± 0.0	NS
N	*Leptogium acadiense*	Acadian Jellyskin Lichen				S3S4	12	8.3 ± 0.0	NS
N	*Scytinium subtile*	Appressed Jellyskin Lichen				S3S4	10	11.1 ± 0.0	NS
N	*Cladonia floerkeana*	Gritty British Soldiers Lichen				S3S4	1	96.7 ± 0.0	NS
N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	1	71.1 ± 0.0	NS
N	*Heterodermia speciosa*	Powdered Fringe Lichen				S3S4	16	9.7 ± 0.0	NS
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3S4	41	10.2 ± 0.0	NS
N	*Melanohalea olivacea*	Spotted Camouflage Lichen				S3S4	2	68.5 ± 0.0	NS
N	*Parmeliopsis hyperopta*	Gray Starburst Lichen				S3S4	3	81.0 ± 1.0	NS
N	*Parmotrema perlatum*	Powdered Ruffle Lichen				S3S4	2	25.7 ± 0.0	NS
N	*Peltigera hymenina*	Cloudy Pelt Lichen				S3S4	2	12.3 ± 1.0	NS
N	*Sphaerophorus fragilis*	Fragile Coral Lichen				S3S4	5	37.6 ± 0.0	NS
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	813	1.8 ± 0.0	NS
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	6	28.4 ± 3.0	NS
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	65	10.0 ± 0.0	NS
N	*Evernia prunastri*	Valley Oakmoss Lichen				S3S4	9	65.4 ± 0.0	NS
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	59	6.0 ± 0.0	NS
P	*Clethra alnifolia*	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S2	1	91.2 ± 0.0	NS
P	*Juglans cinerea*	Butternut	Endangered	Endangered		SNA	7	67.6 ± 0.0	NS
P	*Fraxinus nigra*	Black Ash	Threatened		Threatened	S1S2	407	46.1 ± 14.0	NS
P	*Liatris spicata*	Dense Blazing Star	Threatened	Threatened		SNA	3	87.5 ± 0.0	NS
P	*Floerkea proserpinacoides*	False Mermaidweed	Not At Risk			S2S3	3	72.2 ± 7.0	NS
P	*Betula minor*	Dwarf White Birch				S1	1	55.2 ± 0.0	NS
P	*Cochlearia tridactylites*	Limestone Scurvy-grass				S1	10	23.6 ± 0.0	NS
P	*Lobelia spicata*	Pale-Spiked Lobelia				S1	1	97.2 ± 7.0	NS
P	*Hudsonia tomentosa*	Woolly Beach-heath				S1	6	76.2 ± 7.0	NS
P	*Ribes americanum*	Wild Black Currant				S1	2	77.3 ± 5.0	NS

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P	*Persicaria careyi*	Carey's Smartweed				S1	1	62.6 ± 3.0	NS
P	*Phytolacca americana*	Common Pokeweed				S1	1	92.8 ± 0.0	NS
P	*Montia fontana*	Water Blinks				S1	1	95.5 ± 1.0	NS
P	*Salix myrtillifolia*	Blueberry Willow				S1	1	55.1 ± 0.0	NS
P	*Salix serissima*	Autumn Willow				S1	2	54.8 ± 0.0	NS
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S1	1	93.2 ± 1.0	NS
P	*Carex alopecoidea*	Foxtail Sedge				S1	3	92.9 ± 0.0	NS
P	*Carex garberi*	Garber's Sedge				S1	4	67.9 ± 0.0	NS
P	*Carex plantaginea*	Plantain-Leaved Sedge				S1	4	48.0 ± 0.0	NS
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S1	1	90.6 ± 1.0	NS
P	*Carex tincta*	Tinged Sedge				S1	2	92.9 ± 0.0	NS
P	*Carex viridula var. saxilittoralis*	Greenish Sedge				S1	4	22.6 ± 0.0	NS
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	6	83.8 ± 0.0	NS
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	18	80.5 ± 0.0	NS
P	*Scirpus atrovirens*	Dark-green Bulrush				S1	1	70.2 ± 0.0	NS
P	*Iris prismatica*	Slender Blue Flag				S1	2	49.9 ± 7.0	NS
P	*Juncus vaseyi*	Vasey Rush				S1	1	69.0 ± 0.0	NS
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	1	99.6 ± 7.0	NS
P	*Elymus hystrix*	Spreading Wild Rye				S1	4	52.0 ± 1.0	NS
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	1	38.6 ± 5.0	NS
P	*Adiantum pedatum*	Northern Maidenhair Fern				S1	2	76.1 ± 0.0	NS
P	*Botrychium lunaria*	Common Moonwort				S1	10	77.1 ± 2.0	NS
P	*Solidago hispida*	Hairy Goldenrod				S1?	2	26.7 ± 7.0	NS
P	*Carex pensylvanica*	Pennsylvania Sedge				S1?	2	69.1 ± 3.0	NS
P	*Allium schoenoprasum*	Wild Chives				S1?	1	93.8 ± 0.0	NS
P	*Allium schoenoprasum var. sibiricum*	Wild Chives				S1?	1	80.1 ± 7.0	NS
P	*Sanicula odorata*	Clustered Sanicle				S1S2	4	67.5 ± 0.0	NS
P	*Ageratina altissima*	White Snakeroot				S1S2	2	88.1 ± 7.0	NS
P	*Proserpinaca intermedia*	Intermediate Mermaidweed				S1S2	1	64.1 ± 0.0	NS
P	*Anemone virginiana var. alba*	Virginia Anemone				S1S2	5	72.2 ± 5.0	NS
P	*Parnassia parviflora*	Small-flowered Grass-of-Parnassus				S1S2	1	92.2 ± 1.0	NS
P	*Carex haydenii*	Hayden's Sedge				S1S2	3	72.4 ± 0.0	NS
P	*Platanthera huronensis*	Fragrant Green Orchid				S1S2	1	70.5 ± 10.0	NS
P	*Carex vacillans*	Estuarine Sedge				S1S3	5	15.0 ± 0.0	NS
P	*Zizia aurea*	Golden Alexanders				S2	42	41.3 ± 1.0	NS
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S2	2	87.9 ± 0.0	NS
P	*Rudbeckia laciniata*	Cut-Leaved Coneflower				S2	7	50.9 ± 0.0	NS
P	*Hudsonia ericoides*	Pinebarren Golden Heather				S2	142	90.6 ± 2.0	NS
P	*Desmodium canadense*	Canada Tick-trefoil				S2	20	62.0 ± 0.0	NS
P	*Anemonastrum canadense*	Canada Anemone				S2	6	76.0 ± 0.0	NS
P	*Hepatica americana*	Round-lobed Hepatica				S2	23	52.6 ± 1.0	NS
P	*Ranunculus sceleratus*	Cursed Buttercup				S2	24	73.9 ± 0.0	NS
P	*Comandra umbellata*	Bastard's Toadflax				S2	36	91.1 ± 5.0	NS
P	*Gratiola neglecta*	Clammy Hedge-Hyssop				S2	6	58.6 ± 0.0	NS
P	*Dirca palustris*	Eastern Leatherwood				S2	5	77.1 ± 1.0	NS
P	*Carex gynocrates*	Northern Bog Sedge				S2	2	55.0 ± 0.0	NS
P	*Carex pellita*	Woolly Sedge				S2	10	39.0 ± 10.0	NS
P	*Carex livida*	Livid Sedge				S2	13	40.6 ± 0.0	NS
P	*Juncus greenei*	Greene's Rush				S2	4	87.6 ± 1.0	NS
P	*Luzula spicata*	Spiked Woodrush				S2	1	84.0 ± 0.0	NS
P	*Allium tricoccum*	Wild Leek				S2	9	72.3 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Lilium canadense*	Canada Lily				S2	98	38.5 ± 0.0	NS
P	*Cypripedium parviflorum var. pubescens*	Yellow Lady's-slipper				S2	25	84.1 ± 0.0	NS
P	*Cypripedium reginae*	Showy Lady's-Slipper				S2	29	41.3 ± 1.0	NS
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	9	72.3 ± 7.0	NS
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S2	12	58.6 ± 0.0	NS
P	*Bromus latiglumis*	Broad-Glumed Brome				S2	28	47.1 ± 0.0	NS
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S2	19	50.7 ± 0.0	NS
P	*Elymus wiegandii*	Wiegand's Wild Rye				S2	14	50.7 ± 0.0	NS
P	*Festuca subverticillata*	Nodding Fescue				S2	2	92.8 ± 1.0	NS
P	*Sparganium hyperboreum*	Northern Burreed				S2	2	71.8 ± 0.0	NS
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	9	76.3 ± 1.0	NS
P	*Crataegus submollis*	Quebec Hawthorn				S2?	3	77.5 ± 7.0	NS
P	*Carex peckii*	White-Tinged Sedge				S2?	3	70.1 ± 0.0	NS
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S2S3	1	64.6 ± 0.0	NS
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2S3	14	51.5 ± 0.0	NS
P	*Bidens hyperborea*	Estuary Beggarticks				S2S3	1	88.5 ± 1.0	NS
P	*Erigeron philadelphicus*	Philadelphia Fleabane				S2S3	3	39.8 ± 5.0	NS
P	*Lactuca hirsuta*	Hairy Lettuce				S2S3	1	69.8 ± 7.0	NS
P	*Impatiens pallida*	Pale Jewelweed				S2S3	3	64.0 ± 7.0	NS
P	*Caulophyllum thalictroides*	Blue Cohosh				S2S3	49	46.4 ± 0.0	NS
P	*Boechera stricta*	Drummond's Rockcress				S2S3	4	69.9 ± 0.0	NS
P	*Stellaria humifusa*	Saltmarsh Starwort				S2S3	5	31.3 ± 0.0	NS
P	*Oxybasis rubra*	Red Goosefoot				S2S3	5	29.5 ± 2.0	NS
P	*Hypericum majus*	Large St John's-wort				S2S3	2	92.0 ± 7.0	NS
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	3	88.6 ± 1.0	NS
P	*Empetrum atropurpureum*	Purple Crowberry				S2S3	3	91.9 ± 7.0	NS
P	*Euphorbia polygonifolia*	Seaside Spurge				S2S3	7	80.0 ± 2.0	NS
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S2S3	8	49.3 ± 0.0	NS
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	4	40.7 ± 5.0	NS
P	*Oenothera fruticosa ssp. tetragona*	Narrow-leaved Evening Primrose				S2S3	3	72.2 ± 7.0	NS
P	*Polygala polygama*	Racemed Milkwort				S2S3	1	94.2 ± 1.0	NS
P	*Polygonum aviculare ssp. buxiforme*	Box Knotweed				S2S3	2	72.5 ± 0.0	NS
P	*Polygonum oxyspermum ssp. raii*	Ray's Knotweed				S2S3	1	90.7 ± 1.0	NS
P	*Polygonum oxyspermum*	Sharp-fruit Knotweed				S2S3	1	99.1 ± 0.0	NS
P	*Rumex triangulivalvis*	Triangular-valve Dock				S2S3	1	60.6 ± 0.0	NS
P	*Primula mistassinica*	Mistassini Primrose				S2S3	17	49.3 ± 1.0	NS
P	*Anemone quinquefolia*	Wood Anemone				S2S3	21	46.0 ± 0.0	NS
P	*Caltha palustris*	Yellow Marsh Marigold				S2S3	13	76.8 ± 0.0	NS
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S2S3	1	92.9 ± 1.0	NS
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	4	83.8 ± 5.0	NS
P	*Salix pellita*	Satiny Willow				S2S3	3	58.9 ± 0.0	NS
P	*Tiarella cordifolia*	Heart-leaved Foamflower				S2S3	223	48.6 ± 7.0	NS
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S2S3	3	56.1 ± 0.0	NS
P	*Boehmeria cylindrica*	Small-spike False-nettle				S2S3	3	76.4 ± 0.0	NS
P	*Carex adusta*	Lesser Brown Sedge				S2S3	7	31.4 ± 5.0	NS
P	*Carex comosa*	Bearded Sedge				S2S3	2	88.1 ± 0.0	NS
P	*Carex houghtoniana*	Houghton's Sedge				S2S3	1	69.1 ± 1.0	NS
P	*Carex hystericina*	Porcupine Sedge				S2S3	2	93.1 ± 0.0	NS
P	*Eleocharis ovata*	Ovate Spikerush				S2S3	3	77.5 ± 0.0	NS
P	*Scirpus pedicellatus*	Stalked Bulrush				S2S3	7	53.1 ± 0.0	NS
P	*Vallisneria americana*	Wild Celery				S2S3	3	60.7 ± 1.0	NS
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S2S3	2	69.5 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Spiranthes casei*	Case's Ladies'-Tresses				S2S3	1	44.5 ± 1.0	NS
P	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses				S2S3	3	60.5 ± 0.0	NS
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2S3	22	63.4 ± 0.0	NS
P	*Potamogeton friesii*	Fries' Pondweed				S2S3	2	74.8 ± 5.0	NS
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	4	61.3 ± 5.0	NS
P	*Botrychium simplex*	Least Moonwort				S2S3	2	58.8 ± 0.0	NS
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	4	73.8 ± 7.0	NS
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S3	3	40.9 ± 2.0	NS
P	*Angelica atropurpurea*	Purple-stemmed Angelica				S3	1	54.6 ± 0.0	NS
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S3	1	71.2 ± 5.0	NS
P	*Hieracium robinsonii*	Robinson's Hawkweed				S3	3	75.1 ± 0.0	NS
P	*Senecio pseudoarnica*	Seabeach Ragwort				S3	35	5.9 ± 7.0	NS
P	*Symphyotrichum boreale*	Boreal Aster				S3	3	80.1 ± 7.0	NS
P	*Symphyotrichum undulatum*	Wavy-leaved Aster				S3	2	98.5 ± 7.0	NS
P	*Symphyotrichum ciliolatum*	Fringed Blue Aster				S3	19	47.4 ± 0.0	NS
P	*Betula michauxii*	Michaux's Dwarf Birch				S3	44	7.6 ± 7.0	NS
P	*Betula pumila*	Bog Birch				S3	3	54.8 ± 0.0	NS
P	*Cardamine parviflora*	Small-flowered Bittercress				S3	4	26.3 ± 0.0	NS
P	*Palustricodon aparinoides*	Marsh Bellflower				S3	27	49.8 ± 0.0	NS
P	*Mononeuria groenlandica*	Greenland Stitchwort				S3	51	57.3 ± 7.0	NS
P	*Sagina nodosa*	Knotted Pearlwort				S3	14	22.5 ± 0.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S3	7	20.9 ± 0.0	NS
P	*Stellaria longifolia*	Long-leaved Starwort				S3	11	50.1 ± 0.0	NS
P	*Ceratophyllum echinatum*	Prickly Hornwort				S3	3	52.2 ± 0.0	NS
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S3	112	50.6 ± 1.0	NS
P	*Viburnum edule*	Squashberry				S3	3	77.5 ± 0.0	NS
P	*Empetrum eamesii*	Pink Crowberry				S3	13	91.9 ± 7.0	NS
P	*Vaccinium uliginosum*	Alpine Bilberry				S3	3	96.7 ± 1.0	NS
P	*Halenia deflexa*	Spurred Gentian				S3	1	43.4 ± 1.0	NS
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	1	51.1 ± 0.0	NS
P	*Epilobium strictum*	Downy Willowherb				S3	3	76.6 ± 5.0	NS
P	*Polygala sanguinea*	Blood Milkwort				S3	21	7.8 ± 3.0	NS
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S3	12	40.9 ± 0.0	NS
P	*Plantago rugelii*	Rugel's Plantain				S3	7	53.0 ± 0.0	NS
P	*Samolus parviflorus*	Seaside Brookweed				S3	14	83.5 ± 1.0	NS
P	*Pyrola minor*	Lesser Pyrola				S3	1	85.1 ± 0.0	NS
P	*Anemone virginiana*	Virginia Anemone				S3	29	63.8 ± 1.0	NS
P	*Cephalanthus occidentalis*	Common Buttonbush				S3	8	93.6 ± 0.0	NS
P	*Galium labradoricum*	Labrador Bedstraw				S3	79	40.2 ± 0.0	NS
P	*Salix pedicellaris*	Bog Willow				S3	55	40.2 ± 0.0	NS
P	*Salix sericea*	Silky Willow				S3	1	85.6 ± 1.0	NS
P	*Lindernia dubia*	Yellow-seeded False Pimperel				S3	11	62.3 ± 0.0	NS
P	*Laportea canadensis*	Canada Wood Nettle				S3	37	47.1 ± 0.0	NS
P	*Pilea pumila*	Dwarf Clearweed				S3	5	67.2 ± 6.0	NS
P	*Viola nephrophylla*	Northern Bog Violet				S3	8	41.3 ± 1.0	NS
P	*Carex bebbii*	Bebb's Sedge				S3	6	71.0 ± 0.0	NS
P	*Carex castanea*	Chestnut Sedge				S3	38	48.8 ± 0.0	NS
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	6	51.3 ± 0.0	NS
P	*Carex eburnea*	Bristle-leaved Sedge				S3	34	68.4 ± 0.0	NS
P	*Carex hirtifolia*	Pubescent Sedge				S3	33	47.2 ± 0.0	NS
P	*Carex lupulina*	Hop Sedge				S3	29	50.0 ± 0.0	NS
P	*Carex rosea*	Rosy Sedge				S3	16	45.9 ± 4.0	NS
P	*Carex swanii*	Swan's Sedge				S3	3	87.0 ± 0.0	NS
P	*Carex tenera*	Tender Sedge				S3	4	71.4 ± 1.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Carex tribuloides*	Blunt Broom Sedge				S3	11	48.5 ± 5.0	NS
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	1	75.6 ± 0.0	NS
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S3	8	54.5 ± 0.0	NS
P	*Eriophorum gracile*	Slender Cottongrass				S3	4	73.8 ± 7.0	NS
P	*Schoenoplectus americanus*	Olney's Bulrush				S3	1	84.0 ± 0.0	NS
P	*Cypripedium parviflorum*	Yellow Lady's-slipper				S3	23	59.4 ± 0.0	NS
P	*Neottia bifolia*	Southern Twayblade				S3	97	13.3 ± 0.0	NS
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	142	20.6 ± 1.0	NS
P	*Platanthera hookeri*	Hooker's Orchid				S3	1	88.6 ± 0.0	NS
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S3	4	67.9 ± 7.0	NS
P	*Piptatheropsis canadensis*	Canada Ricegrass				S3	7	62.6 ± 3.0	NS
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3	11	53.4 ± 1.0	NS
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	4	47.7 ± 0.0	NS
P	*Potamogeton zosteriformis*	Flat-stemmed Pondweed				S3	13	25.8 ± 7.0	NS
P	*Dryopteris fragrans*	Fragrant Wood Fern				S3	5	44.4 ± 0.0	NS
P	*Sceptridium dissectum*	Dissected Moonwort				S3	4	54.4 ± 1.0	NS
P	*Polypodium appalachianum*	Appalachian Polypody				S3	10	45.6 ± 0.0	NS
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	2	70.4 ± 0.0	NS
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S3?	23	24.4 ± 0.0	NS
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3?	4	60.3 ± 1.0	NS
P	*Bidens vulgata*	Tall Beggarticks				S3S4	6	52.9 ± 0.0	NS
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3S4	38	72.8 ± 0.0	NS
P	*Hieracium paniculatum*	Panicled Hawkweed				S3S4	7	76.0 ± 0.0	NS
P	*Bidens beckii*	Water Beggarticks				S3S4	11	54.9 ± 0.0	NS
P	*Packera paupercula*	Balsam Groundsel				S3S4	78	62.4 ± 0.0	NS
P	*Vaccinium boreale*	Northern Blueberry				S3S4	8	30.6 ± 1.0	NS
P	*Vaccinium cespitosum*	Dwarf Bilberry				S3S4	54	36.1 ± 0.0	NS
P	*Vaccinium corymbosum*	Highbush Blueberry				S3S4	8	87.4 ± 0.0	NS
P	*Fagus grandifolia*	American Beech				S3S4	519	21.8 ± 0.0	NS
P	*Bartonia virginica*	Yellow Bartonia				S3S4	1	85.6 ± 7.0	NS
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3S4	2	37.6 ± 1.0	NS
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3S4	1	69.2 ± 2.0	NS
P	*Persicaria pensylvanica*	Pennsylvania Smartweed				S3S4	13	15.5 ± 1.0	NS
P	*Fallopia scandens*	Climbing False Buckwheat				S3S4	31	46.2 ± 0.0	NS
P	*Rumex pallidus*	Seabeach Dock				S3S4	2	56.6 ± 0.0	NS
P	*Pyrola asarifolia*	Pink Pyrola				S3S4	7	43.6 ± 0.0	NS
P	*Endotropis alnifolia*	alder-leaved buckthorn				S3S4	161	40.4 ± 1.0	NS
P	*Amelanchier spicata*	Running Serviceberry				S3S4	4	20.5 ± 0.0	NS
P	*Crataegus succulenta*	Fleshy Hawthorn				S3S4	1	93.8 ± 0.0	NS
P	*Fragaria vesca ssp. americana*	Woodland Strawberry				S3S4	63	39.3 ± 0.0	NS
P	*Fragaria vesca*	Woodland Strawberry				S3S4	11	18.4 ± 0.0	NS
P	*Galium aparine*	Common Bedstraw				S3S4	20	14.4 ± 0.0	NS
P	*Geocaulon lividum*	Northern Comandra				S3S4	17	6.0 ± 5.0	NS
P	*Limosella australis*	Southern Mudwort				S3S4	6	46.0 ± 5.0	NS
P	*Ulmus americana*	White Elm				S3S4	52	33.9 ± 0.0	NS
P	*Verbena hastata*	Blue Vervain				S3S4	114	53.2 ± 0.0	NS
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S3S4	9	58.3 ± 0.0	NS
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3S4	9	95.2 ± 0.0	NS
P	*Triglochin gaspensis*	Gasp ├⌐ Arrowgrass				S3S4	18	20.3 ± 0.0	NS
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	3	71.7 ± 0.0	NS
P	*Juncus subcaudatus*	Woods-Rush				S3S4	16	41.0 ± 1.0	NS
P	*Luzula parviflora ssp. melanocarpa*	Black-fruited Woodrush				S3S4	3	36.1 ± 0.0	NS
P	*Goodyera repens*	Lesser Rattlesnake-plantain				S3S4	1	20.6 ± 0.0	NS
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	4	58.4 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Platanthera obtusata*	Blunt-leaved Orchid				S3S4	7	15.6 ± 0.0	NS
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3S4	19	61.4 ± 0.0	NS
P	*Alopecurus aequalis*	Short-awned Foxtail				S3S4	8	71.9 ± 0.0	NS
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3S4	98	37.2 ± 0.0	NS
P	*Koeleria spicata*	Narrow False Oats				S3S4	9	62.5 ± 0.0	NS
P	*Equisetum pratense*	Meadow Horsetail				S3S4	9	68.2 ± 0.0	NS
P	*Diphasiastrum complanatum*	Northern Ground-cedar				S3S4	5	28.9 ± 0.0	NS
P	*Diphasiastrum sitchense*	Sitka Ground-cedar				S3S4	2	46.1 ± 1.0	NS
P	*Huperzia appressa*	Mountain Firmoss				S3S4	4	82.6 ± 5.0	NS
P	*Sceptridium multifidum*	Leathery Moonwort				S3S4	4	63.5 ± 0.0	NS
P	*Botrychium matricariifolium*	Daisy-leaved Moonwort				S3S4	4	78.4 ± 0.0	NS
P	*Viola canadensis*	Canada Violet				SH	1	72.2 ± 7.0	NS
P	*Greeneochloa coarctata*	Small Reedgrass				SH	1	98.2 ± 6.0	NS

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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135	Neily, T.H. & Pepper, C. 2020. Nova Scotia SMP lichen surveys 2020. Mersey Tobeatic Research Institute.
131	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
110	Blaney, C.S.; Mazerolle, D.M. 2012. Fieldwork 2012. Atlantic Canada Conservation Data Centre, 13,278 recs.
109	Toms, B. 2018. Bat Species data from www.batconservation.ca for Nova Scotia. Mersey Tobeatic Research Institute, 547 Records.
96	Klymko, J.J.D. 2012. Insect fieldwork & submissions, 2011. Atlantic Canada Conservation Data Centre. Sackville NB, 760 recs.
95	Cameron, R.P. 2009. Cyanolichen database. Nova Scotia Environment & Labour, 1724 recs.
92	Cameron, R.P. 2011. Lichen observations, 2011. Nova Scotia Environment & Labour, 731 recs.
91	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-03-18]. Mersey Tobeatic Research Institute.
87	McNeil, J.A. 2018. Wood Turtle records, 2018. Mersey Tobeatic Research Institute, 68 recs.
78	Staicer, C. & Bliss, S.; Achenbach, L. 2017. Occurrences of tracked breeding birds in forested wetlands. , 303 records.
78	Staicer, C. 2021. Additional compiled Nova Scotia Species at Risk bird records, 2005-2020. Dalhousie University.
76	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
73	Belliveau, A.G. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 10695 recs.
71	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
70	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
70	Munro, Marian K. Tracked lichen specimens, Nova Scotia Provincial Museum of Natural History Herbarium. Atlantic Canada Conservation Data Centre. 2019.
68	Nussey, Pat & NCC staff. 2019. AEI tracked species records, 2016-2019. Chapman, C.J. (ed.) Atlantic Canada Conservation Data Centre, 333.
67	Amirault, D.L. & McKnight, J. 2003. Piping Plover Database 1991-2003. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
66	Toms, Brad & Pepper, Chris; Neily, Tom. 2022. Nova Scotia lichen database [as of 2022-04]. Mersey Tobeatic Research Institute.
65	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
63	Hagerman, Christianne. 2022. Wisqoq and Eastern White Cedar field work. E.C. Smith Herbarium, Acadia University.
61	Richardson, Leif. 2018. Maritimes Bombus records from various sources. Richardson, Leif.
57	Birds Canada. 2022. Maritimes Swiftwatch project data for 2022. Pers. comm., 155 records.
57	Gallop, John. 2023. Species at Risk and Species of Conservation Interest records. McCallum Environmental.
55	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
54	MacDonald, E.C. 2018. Piping Plover nest records from 2010-2017. Canadian Wildlife Service.
54	Manthorne, A. 2014. MaritimesSwiftwatch Project database 2013-2014. Bird Studies Canada, Sackville NB, 326 recs.
53	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
53	iNaturalist. 2018. iNaturalist Data Export 2018. iNaturalist.org and iNaturalist.ca, Web site: 11700 recs.
53	Mazerolle, D.M. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 13515 recs.
50	MacDonald, E.C. 2018. CWS Piping Plover Census, 2010-2017. Canadian Wildlife Service, 672 recs.
49	Neily, T.H. & Pepper, C.; Toms, B. 2015. Nova Scotia lichen location database [as of 2015-02-15]. Mersey Tobeatic Research Institute, 1691 records.
49	Staicer, Cindy. 2022. 2021 Landbird Species at Risk observations. Dalhousie University.
49	Staicer, Cindy. 2023. 2022 SAR Bird field occurrences from the Landbirds at Risk Project, NS. Dalhousie University, 446 records.
48	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
46	Canadian Wildlife Service, Dartmouth. 2010. Piping Plover censuses 2007-09, 304 recs.
46	LaPaix, R.W.; Crowell, M.J.; MacDonald, M.; Neily, T.D.; Quinn, G. 2017. Stantec Nova Scotia rare plant records, 2012-2016. Stantec Consulting.
46	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
44	iNaturalist. 2020. iNaturalist butterfly records selected for the Maritimes Butterfly Atlas. iNaturalist.
43	Bryson, I. 2020. Nova Scotia and Newfoundland rare species observations, 2018-2020. Nova Scotia Environment.
42	Pulsifer, M.D. 2002. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 369 recs.
41	Benjamin, L.K. 2012. NSDNR fieldwork & consultant reports 2008-2012. Nova Scotia Dept Natural Resources, 196 recs.
40	Nova Scotia Nature Trust. 2013. Nova Scotia Nature Trust 2013 Species records. Nova Scotia Nature Trust, 95 recs.
38	Benjamin, L.K. (compiler). 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 15 spp, 224 recs.
36	Porter, C.J.M. 2014. Field work data 2007-2014. Nova Scotia Nature Trust, 96 recs.
35	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
33	Neily, T.H. 2010. Erioderma Pedicellatum records 2005-09. Mersey Tobiatic Research Institute, 67 recs.
31	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
31	Hubley, Nicole. 2022. Monarch (Danaus plexippus) records submitted to MTRI from the 2021 field season. Mersey Tobeatic Research Institute.
31	Mersey Tobetic Research Institute. 2021. 2020 Monarch records from the MTRI monitoring program. Mersey Tobetic Research Institute, 72 records.
29	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
28	Pepper, Chris. 2012. Observations of breeding Canada Warbler's along the Eastern Shore, NS. Pers. comm. to S. Blaney, Jan. 20, 28 recs.
27	Chapman-Lam, C.J. 2022. Atlantic Canada Conservation Data Centre 2021 botanical fieldwork. Atlantic Canada Conservation Data Centre, 15099 recs.
26	Belliveau, A.G. 2021. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2021. E.C. Smith Herbarium.
26	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
25	Ogden, J. NS DNR Butterfly Collection Dataset. Nova Scotia Department of Natural Resources. 2014.
24	Archibald, D.R. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 213 recs.
24	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.

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23	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
23	Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Part I, macrolepidoptera. Proceedings of the Nova Scotian Institute of Science, 23(3), 161-375.
23	LaPaix, Rich. 2022. Rare species observations, 2018-2022. Nova Scotia Nature Trust.
23	Popma, T.M. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 113 recs.
23	Staicer, Cindy. 2023. 2022 SAR Bird ARU occurrences. Dalhousie University, 379 records.
22	Cameron, R.P. 2018. Degelia plumbea records. Nova Scotia Environment.
20	Belliveau, A.G. 2020. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2019, 2020. E.C. Smith Herbarium.
20	Chapman, C.N. (Cody). 2020. Nova Scotia Black Ash (Fraxinus nigra) field observations by Confederacy of Mainland Mi'kmaq. Forestry Program, Confederacy of Mainland Mi'kmaq.
20	Haughian, Sean. 2021. Update to lichen data from 2017-2021. Nova Scotia Museum.
20	Wilhelm, S.I. et al. 2019. Colonial Waterbird Database. Canadian Wildlife Service.
19	Chapman, C.J. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 11171 recs.
19	Hall, R.A. 2001. S.. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 178 recs.
19	Klymko, J.J.D.; Robinson, S.L. 2012. 2012 field data. Atlantic Canada Conservation Data Centre, 447 recs.
18	Bell, G. 2018. Moose, bat and bird records from Goldboro LNG Project, NS, Environmental Assessment. Amec Foster Wheeler.
18	Feltham, Carter. 2022. Monarch (Danaus plexippus) and Milkweed MTRI records from the 2022 Field Season. Mersey Tobeatic Research Institute.
18	Neily, T.H. 2012. 2012 Erioderma pedicellatum records in Nova Scotia.
18	Powell, B.C. 1967. Female sexual cycles of Chrysemy spicta & Clemmys insculpta in Nova Scotia. Can. Field-Nat., 81:134-139. 26 recs.
17	Hall, R.A. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 189 recs.
15	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
15	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
15	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
15	Westwood, A., Staicer, C. 2016. Nova Scotia landbird Species at Risk observations. Dalhousie University.
14	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS, 88 recs.
14	Cameron, R.P. 2014. 2013-14 rare species field data. Nova Scotia Department of Environment, 35 recs.
14	Churchill, J.L. 2019. Atlantic Canada Conservation Data Centre Fieldwork 2019. Atlantic Canada Conservation Data Centre.
14	Gilhen, J. 1984. Amphibians & Reptiles of Nova Scotia, 1st Ed. Nova Scotia Museum, 164pp.
14	McNeil, Jeffie. 2023. 2022 Turtle Records. Mersey Tobeatic Research Institute.
14	Rock, J. 2020. Atlantic Canada Piping Plover field surveys: Nesting pairs by beach, 2018-2020. Environment and Climate Change Canada - Canadian Wildlife Service, 216 records.
14	Taylor, B.R., and Tam, J.C. 2012. Local distribution of the rare plant Triosteum aurantiacum in northeastern Nova Scotia, Canada. Rhodora, 114(960): 366-382.
14	Toms, Brad. 2022. Non-Lichen Observations from Lichen SMP and NCC Property Searches. Mersey Tobeatic Research Institute.
13	Cameron, R.P. 2017. 2017 rare species field data. Nova Scotia Environment, 64 recs.
13	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2014.
13	Ogden, K. Nova Scotia Museum butterfly specimen database. Nova Scotia Museum. 2017.
13	Robinson, S.L. 2015. 2014 field data.
12	Cameron-MacMillan, Maureen. 2020. Northern Goshawk Nests in Eastern Nova Scotia, as of November, 2020. Nova Scotia Department of Lands and Forestry.
12	Chapman, C.J. 2019. Atlantic Canada Conservation Data Centre 2019 botanical fieldwork. Atlantic Canada Conservation Data Centre, 11729 recs.
12	Chaput, G. 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-14. 39 recs.
12	Neily, T.H. 2019. Tom Neily NS Bryophyte records (2009-2013). T.H. Neily, Atlantic Canada Conservation Data Centre, 1029 specimen records.
12	White, S. 2018. Notable species sightings, 2016-2017. East Coast Aquatics.
11	Benjamin, L.K. 2011. NSDNR fieldwork & consultant reports 1997, 2009-10. Nova Scotia Dept Natural Resources, 85 recs.
11	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
11	NS DNR. 2017. Black Ash records from NS DNR Permanent Sample Plots (PSPs), 1965-2016. NS Dept of Natural Resources.
11	Patrick, Allison. 2021. Animal and plant records from NCC properties from 2019 and 2020. Nature Conservancy Canada.
11	Phinney, Lori; Toms, Brad; et. al. 2016. Bank Swallows (Riparia riparia) in Nova Scotia: inventory and assessment of colonies. Merset Tobeiatc Research Institute, 25 recs.
10	Cameron, R.P. 2013. 2013 rare species field data. Nova Scotia Department of Environment, 71 recs.
10	Neily, T.H. 2013. Email communication to Sean Blaney regarding Listera australis observations made from 2007 to 2011 in Nova Scotia. , 50.
10	Richardson, D., Anderson, F., Cameron, R, McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (Anzia colpodes). COSEWIC.
9	Cameron, R.P. 2005. Erioderma pedicellatum unpublished data. NS Dept of Environment, 9 recs.
9	Cameron, R.P. 2006. Erioderma pedicellatum 2006 field data. NS Dept of Environment, 9 recs.
9	McNeil, J.A. 2016. Blandings Turtle (Emydoidea blandingii), Eastern Ribbonsnake (Thamnophis sauritus), Wood Turtle (Glyptemys insculpta), and Snapping Turtle (Chelydra serpentina) sightings, 2016. Mersey Tobeatic Research Institute, 774 records.
9	Webster, R.P. Atlantic Forestry Centre Insect Collection, Maritimes butterfly records. Natural Resources Canada. 2014.
8	Manthorne, A. 2019. Incidental aerial insectivore observations. Birds Canada.
8	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
8	Patrick, A.; Horne, D.; Noseworthy, J. et. al. 2017. Field data for Nova Scotia and New Brunswick, 2015 and 2017. Nature Conservancy of Canada.
7	Cameron, B. 2006. Hepatica americana Survey at Scotia Mine Site in Gays River, and Discovery of Three Yellow-listed Species. Conestoga-Rovers and Associates, (a consulting firm), october 25. 7 recs.
7	Cameron, R.P. 2012. Rob Cameron 2012 vascular plant data. NS Department of Environment, 30 recs.
7	Hill, N.M. 1994. Status report on the Long's bulrush Scirpus longii in Canada. Committee on the Status of Endangered Wildlife in Canada, 7 recs.
7	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-05-25]. Mersey Tobeatic Research Institute, 668 recs.

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

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7	O'Neil, S. 1998. Atlantic Salmon: Northumberland Strait Nova Scotia part of SFA 18. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-08. 9 recs.
7	Robinson, S.L. 2011. 2011 ND dune survey field data. Atlantic Canada Conservation Data Centre, 2715 recs.
7	Whittam, R.M. 1999. Status Report on the Roseate Tern (update) in Canada. Committee on the Status of Endangered Wildlife in Canada, 36 recs.
6	Anderson, Frances; Neily, Tom. 2010. A Reconnaissance Level Survey of Calciphilous Lichens in Selected Karst Topography in Nova Scotia with Notes on Incidental Bryophytes. Mersey Tobeatic Research Institute.
6	Gallop, John. 2021. Sheet Harbour rare lichen observations. McCallum Environmental.
6	Hall, R. 2008. Rare plant records in old fieldbook notes from Truro area. Pers. comm. to C.S. Blaney. 6 recs, 6 recs.
6	Richardson, D., Anderson, F., Cameron, R, Pepper, C., Clayden, S. 2015. Field Work Report on the Wrinkled Shingle lichen (Pannaria lurida). COSEWIC.
5	Benjamin, L.K. 2009. Boreal Felt Lichen, Mountain Avens, Orchid and other recent records. Nova Scotia Dept Natural Resources, 105 recs.
5	Blaney, C.S. 2020. Sean Blaney 2020 field data. Atlantic Canada Conservation Data Centre, 4407 records.
5	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
5	Edsall, J. 2007. Personal Butterfly Collection: specimens collected in the Canadian Maritimes, 1961-2007. J. Edsall, unpubl. report, 137 recs.
5	Hughes, Cory. 2020. Atlantic Forestry Centre Coccinella transversoguttata collections. Canadian Forest Service, Atlantic Forestry Centre.
5	McNeil, J.A. 2020. Snapping Turtle and Eastern Painted Turtle records, 2020. Mersey Tobeatic Research Institute.
5	Plissner, J.H. & Haig, S.M. 1997. 1996 International piping plover census. US Geological Survey, Corvallis OR, 231 pp.
5	Towell, C. 2014. 2014 Northern Goshawk and Common Nighthawk email reports, NS. NS Department of Natural Resources.
5	Walker, J. 2017. Bird inventories at French River, NS, and Memramcook, NB, for Nature Conservancy of Canada. Pers. comm. to AC CDC.
5	White, S. 2019. Notable species sightings, 2018. East Coast Aquatics.
5	Whittam, R.M. 1997. Status Report on the Roseate Tern (Sterna dougallii) in Canada. Committee on the Status of Endangered Wildlife in Canada, 5 recs.
4	Bredin, K.A. 2002. NS Freshwater Mussel Fieldwork. Atlantic Canada Conservation Data Centere, 30 recs.
4	Chapman-Lam, C.J. 2021. Atlantic Canada Conservation Data Centre 2020 botanical fieldwork. Atlantic Canada Conservation Data Centre, 17309 recs.
4	Clayden, S.R. 2005. Confidential supplement to Status Report on Ghost Antler Lichen (Pseudevernia cladonia). Committee on the Status of Endangered Wildlife in Canada, 27 recs.
4	Frittaion, C. 2012. NSNT 2012 Field Observations. Nova Scotia Nature Trust, Pers comm. to S. Blaney Feb. 7, 34 recs.
4	Klymko, J. Dataset of butterfly records at the New Brunswick Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2016.
4	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database Update. Mersey Tobeatic Research Institute, 14 recs.
4	O'Neil, S. 1998. Atlantic Salmon: Eastern Shore Nova Scotia SFA 20. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-10. 4 recs.
4	Olsen, R. Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
3	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
3	Basquill, S.P. 2012. 2012 rare vascular plant field data. Nova Scotia Department of Natural Resources, 37 recs.
3	Basquill, S.P., Porter, C. 2019. Bryophyte and lichen specimens submitted to the E.C. Smith Herbarium. NS Department of Lands and Forestry.
3	Blaney, C.S. Miscellaneous specimens received by ACCDC (botany). Various persons. 2001-08.
3	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
3	Brunelle, P.-M. (compiler). 2010. ADIP/MDDS Odonata Database: NB, NS Update 1900-09. Atlantic Dragonfly Inventory Program (ADIP), 935 recs.
3	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
3	e-Butterfly. 2018. Selected Maritimes butterfly records from 2016 and 2017. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
3	Hill, N. and D. Patriquin. 2013. 2013 rare plant observations in Williams Lake Backlands area. Fern Hill Institute of Plant Conservation, Berwick, Nova Scotia, 3 records.
3	Klymko, J. Butterfly records at the Nova Scotia Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2017.
3	Mersey Tobeatic Research Institute. 2022. Nova Scotia Bobolink observations. pers. comm. to J. Churchill.
3	Neily, T.H. 2016. Email communication (May 6, 2016) to Sean Blaney regarding Fissidens exilis observations made in 2016 in Nova Scotia. Pers. Comm., 3 recs.
3	Neily, T.H. Tom Neily NS Sphagnum records (2009-2014). T.H. Neily, Atlantic Canada Conservation Data Centre. 2019.
2	Basquill, S.P. 2012. 2012 Bryophyte specimen data. Nova Scotia Department of Natural Resources, 37 recs.
2	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
2	Belliveau, A. 2013. Rare species records from Nova Scotia. Mersey Tobeatic Research Institute, 296 records. 296 recs.
2	Blaney, C.S. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 6719 recs.
2	Cameron, B. 2005. C. palmicola, E. pedicellatum records from Sixth Lake. Pers. comm. to C.S. Blaney. 3 recs, 3 recs.
2	Cameron, R.P. 2012. Additional rare plant records, 2009. , 7 recs.
2	Chapman, Cody. Unreported Species at Risk Records across Nova Scotia. Chapman, Cody, 5 records.
2	Hill, N. 2003. Floerkea proserpinacoides at Heatherdale, Antigonish Co. 2002. , Pers. comm. to C.S. Blaney. 2 recs.
2	Hill, Nick. 2021. Fraxinus nigra observations at Marshy Hope. Fern Hill Institute of Plant Conservation.
2	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
2	McAlpine, D.F. New Brunswick Museum bee specimens. New Brunswick Museum. 2013.
2	McNeil, J.A. 2019. Snapping Turtle records, 2019. Mersey Tobeatic Research Institute.
2	Nature Conservancy of Canada. 2022. NCC Field data for Nova Scotia. Nature Conservancy of Canada.
2	Neily, T.H.; Smith, C.; Whitman, E. 2011. NCC Logging Lake (Halifax Co. NS) properties baseline survey data. Nature Conservancy of Canada, 2 recs.
2	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
2	Standley, L.A. 2002. Carex haydenii in Nova Scotia. , Pers. comm. to C.S. Blaney. 4 recs.
2	Whittam, R.M. et al. 1998. Country Island Tern Restoration Project. Canadian Wildlife Service, Sackville, 2 recs.
1	Amiro, Peter G. 1998. Atlantic Salmon: Inner Bay of Fundy SFA 22 & part of SFA 23. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-12. 4 recs.
1	Bagnell, B.A. 2001. New Brunswick Bryophyte Occurrences. B&B Botanical, Sussex, 478 recs.
1	Basquill, S.P. 2011. Field observations & specimen collections, 2010. Nova Scotia Department of Natural Resources, Pers. comm. , 8 Recs.

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1	Belliveau, A.G. 2014. Plant Records from Southern and Central Nova Scotia. Atlantic Canada Conservation Data Centre, 919 recs.
1	Belliveau, A.G. E.C. Smith Herbarium Specimen Database 2019. E.C. Smith Herbarium, Acadia University. 2019.
1	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
1	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
1	Boyne, A.W. & Grecian, V.D. 1999. Tern Surveys. Canadian Wildlife Service, Sackville, unpublished data. 23 recs.
1	Brach, A.R. 2019. Correspondence to Sean Blaney regarding Calamagrostis cinnoides specimen from Halifax NS. pers. comm., Harvard University Herbaria, 1 record.
1	Bruce, J. 2014. 2014 Wood Turtle email report, Nine Mile River, NS. NS Department of Natural Resources.
1	Calhoun, J.C. Butterfly records databased at the McGuire Center for Lepidoptera and Biodiversity. Calhoun, J.C. 2020.
1	Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.
1	Clayden, S.R. 2006. Pseudevernia cladonia records. NB Museum. Pers. comm. to S. Blaney, Dec, 4 recs.
1	COSEWIC (Committee on the Status of Wildlife in Canada). 2013. COSEWIC Assessment and Status Report on the Eastern Waterfan Peltigera hydrothyria in Canada. COSEWIC, 46 pp.
1	Daury, R.W. & Bateman, M.C. 1996. The Barrow's Goldeneye (Bucephala islandica) in the Atlantic Provinces and Maine. Canadian Wildlife Service, Sackville, 47pp.
1	Docherty, Joanne. 2022. Phone call to John Klymko about Danaus plexippus observation in Nova Scotia. Personal communication.
1	Doucet, D.A. 2009. Census of Globally Rare, Endemic Butterflies of Nova Scotia Gulf of St Lawrence Salt Marshes. Nova Scotia Dept of Natural Resources, Species at Risk, 155 recs.
1	Eastman, A. 2019. Snapping Turtle observation at Brookfield, Colchester Co. NS. Halifax Field Naturalists Nova Scotia Nature Archive Facebook Page, 1 record.
1	Envirosphere Consultants Ltd., Strum. 2023. SAR records from three Environmental Assessments in Nova Scotia. Envirosphere Consultants Ltd., Strum, 48 records.
1	Golder Associates Ltd. 2021. Black Ash location from Goff's Quarry Expansion Environment Assessment, 2017. Golder Associates Ltd., 1 record.
1	Haughian, S.R. 2018. Description of Fuscopannaria leucosticta field work in 2017. New Brunswick Museum, 314 recs.
1	Heron, J. 2022. Bombus records communicated to J. Klymko over email in autumn 2022. Pers. comm.
1	Hill, N.M. 2021. Observation of Carex haydenii and black ash near Marshy Hope and Ponhook Lake. pers. comm.
1	Holder, M.L.; Kingsley, A.L. 2000. Kinglsey and Holder observations from 2000 field work.
1	Jacques Whitford Ltd. 2003. Cananda Lily location. Pers. Comm. to S. Blaney. 2pp, 1 rec, 1 rec.
1	Klymko, J. Henry Hensel's Butterfly Collection Database. Atlantic Canada Conservation Data Centre. 2016.
1	Lautenschlager, R.A. 2010. Miscellaneous observations reported to ACCDC (zoology). Pers. comm. from various persons, 2 recs.
1	MacKinnon, D.; Wright, P.; Smith, D. 2014. 2014 Common Tern email report, Eastern Passage, NS. NS Department of Environment.
1	McAlpine, D.F. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB, 241 recs.
1	McKendry, Karen. 2016. Rare species observations, 2016. Nova Scotia Nature Trust, 19 recs.
1	NatureServe Canada. 2018. iNaturalist Butterfly Data Export . iNaturalist.org and iNaturalist.ca.
1	Neily, P.D. Plant Specimens. Nova Scotia Dept Natural Resources, Truro. 2006.
1	Neily, T.H. & Pepper, C.; Toms, B. 2019. Boreal Felt Lichen Observation, April 2019. Mersey Tobeatic Research Institute.
1	Neily, T.H. & Pepper, C.; Toms, B. 2019. Boreal Felt Lichen Observation, January 2019. Mersey Tobeatic Research Institute, 1 rec.
1	Neily, T.H. 2013. Email communication to Sean Blaney regarding Agalinis paupercula observations made in 2013 in Nova Scotia. , 1 rec.
1	Payzant, P. 2018. Satyr Comma record from Bible Hill, NS. https://novascotiabutterflies.ca.
1	Pohl, G.P. Specimen data from Northern Forest Research Centre. Northern Forest Research Centre. 2022.
1	Robinson, C.B. 1907. Early intervale flora of eastern Nova Scotia. Transactions of the Nova Scotia Institute of Science, 10:502-506. 1 rec.
1	Sabine, D.L. Bombus terricola specimens in Dwayne Sabine's personal collection. pers. comm. 2022.
1	Sabine, M. 2016. NB DNR staff incidental Black Ash observations. New Brunswick Department of Natural Resources.
1	Skevington, Jeffrey H. 2020. Syrphid records used for the Field Guide to the Flower Flies of Northeastern North America. Canadian National Collection of Insects.
1	Stephen Freeman. 2022. New location for Black Ash in Queens County, NS. Personal communication, 2.
1	Whittam, R.M. 2000. Senecio pseudoarnica on Country Island. , Pers. comm. to S. Gerriets. 1 rec.
1	WIlliams, M. Cape Breton University Digital Herbarium. Cape Breton University Digital Herbarium. 2013.

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Data Dictionary

Revised: May 15, 2023

I. Biodiversity Database

The following fields of data may be included (and may or may not be populated) in occurrence records.
Text fields are 255 char max. (and may truncate text).

TAXONOMY		
Field	***Type***	***Definition***
MCODE	TXT	8 character 'Museum Code' (1 to 4 = genus, 5 to 8 = sp+ssp)
ELCODE	TXT	Unique Identifier of taxon
SCINAME	TXT	Global Scientific Name of taxon
COMNAME	TXT	English Common Name of taxon
NOMCOMMUN	TXT	French Common Name
LOCATION		
Field	***Type***	***Definition***
SURVEYSITE	TXT	General locality of occurrence
DIRECTIONS	TXT	Specific locality: e.g. bearings and distance from enduring landmark
SUBNAT	TXT	Province/State: 2 character ISO code
COCODE	TXT	County Code (2 chars for province + 4 chars for county name)
MAPCODE	TXT	Map number: NTS identifier in Canada
UTME20	INT	Easting in UTM Zone 20
UTMN20	INT	Northing in UTM Zone 20
LONDEC	DEC	Decimal Longitude
LATDEC	DEC	Decimal Latitude
LOCUNCM	INT	Horizontal precision in metres
PREC	DEC	Precision in metres by power of 10 (e.g. 3 = 10 to the 3rd = 1000 m = 1 km):

prec	***common speech***	***example***	***unit size***	***literal range***
6.0	within province	province	1000.0 km	562.3 - 1778.3 km
5.7	in part of province	'NW NB'	500.0 km	281.2 - 889.1 km
5.0	within in county	county	100.0 km	56.2 - 177.8 km
4.7	within 50s of kilometres		50.0 km	28.1 - 88.9 km
4.0	within 10s of kilometres	BBA grid	10.0 km	5.6 - 17.8 km
3.7	within 5s of kilometres		5.0 km	2.8 - 8.9 km
3.0	within kilometres	topo grid	1.0 km	0.6 - 1.8 km
2.7	within 500s of metres		500.0 m	281.2 - 889.1 m
2.0	within 100s of metres	ball field	100.0 m	56.2 - 177.8 m
1.7	within 50s of metres		50.0 m	28.1 - 88.9 m
1.0	within 10s of metres	boxcar	10.0 m	5.6 - 17.8 m
0.7	within 5s of metres		5.0 m	2.8 - 8.9 m
0.0	***NOT USED***	pace	1.0 m	0.6 - 1.8 m
-1.0	within 10s of centimetres	fingernail	0.1 m	0.1 - 0.2 m

RARITY / STATUS		
Field	***Type***	***Definition***
NRANK	TXT	National Rarity Rank of taxon (in Canada)
NPROT	TXT	National Protection Status of taxon (i.e., COSEWIC in Canada)
NPROTSAR	TXT	National Protection Status of taxon (i.e., SARA in Canada):

code	***Rank and short definition***
X	Extinct in Canada and elsewhere
XT	Extirpated in Canada but surviving elsewhere
E	Endangered in Canada
T	Threatened in Canada
V	Vulnerable in Canada
SC	Special Concern in Canada
DD	Data Deficient: data inadequate for assessment
NAR	Not At Risk in Canada

SRANK — TXT — Subnational (Provincial) Rarity Rank of taxon:

code	***Rank and short definition***
SX	Extinct or extirpated in province
SH	Historically occurring but currently undetected in province
S1	Extremely rare in province
S2	Rare in province

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		S3	Uncommon in province
		S4	Widespread, common and apparently secure in province
		S5	Widespread, abundant and demonstrably secure in province
		SE	Exotic in province
		SA	Accidental, infrequent and outside of range within province
		SNA	Ranking not applicable in province
		SNR	Not yet assessed in province
SPROT	TXT	Provincial Legal Protection Status	
		code	***Rank and short definition***
		Endangered	Facing imminent extirpation or extinction
		Threatened	Likely to become endangered if limiting factors are not reversed
		Vulnerable (NS)	Special concern because of characteristics that make it particularly sensitive to human activities or natural events
		Special Concern (NB)	May become a threatened or endangered species because of a combination of biological characteristics and identified threats
		Extirpated	No longer exists in the wild in the Province but exists in the wild outside of the Province
		Extinct	No longer exists
IUCN	TXT	International Union of Conservation Naturalists rarity rank:	
		code	***Rank and short definition***
		EX	Extinct: no individuals remaining
		EW	Extinct in the Wild: only captive or naturalised survivors
		CR	Critically Endangered: extreme risk of extinction in wild
		EN	Endangered: high risk of extinction in wild
		VU	Vulnerable: high risk of endangerment in wild
		NT	Near Threatened: likely to become endangered soon
		LC	Least Concern: lowest risk, widespread and abundant
		DD	Data Deficient: data inadequate for assessment
		NE	Not Evaluated, not yet assessed against criteria
OBSERVATION			
Field	***Type***	***Definition***	
OBSERVER	TXT	Individual(s) that observed the taxon	
OBDATE	TXT	Date of observation (YYYY MM DD)	
OBDATA	TXT	Concatenation of fields below, relating to observation	
OBEVID	TXT	Type of evidence (e.g., specimen, photo)	
OBCOUNT	TXT	Number of individuals at location	
OBABUN	TXT	Relative rarity of taxon at location, e.g. 'common', 'scattered'	
OBSIZE	TXT	Size of individual	
SIZE	TXT	Size of occurrence 'patch' (in m^2, ha or acres)	
OBDESC	TXT	Details of specimen appearance or conditions	
OBPHEN	TXT	Lifestage of individual (e.g., bud, flowering)	
OBSEX	TXT	Male/female if relevant	
OBACTIV	TXT	Activity of individual when observed (e.g., nesting, crossing road)	
OBASSP	TXT	Other taxa associated with the observation	
NOTETAX	TXT	Identifier's note on taxonomic issues	
GENDESC	TXT	Concatenation of fields below, relating to site	
HABITAT	TXT	Habitat characterization of location	
ECODIST	NUM	National Ecological Framework EcoDistrict identifier	
WSCODE	TXT	Quaternary Watershed identifier	
GENCOM	TXT	General Comments: concatenation of Notes (NOTE1, NOTE2, NOTE3)	
COLLECTION			
Field	***Type***	***Definition***	
CITATION	TXT	Primary source of data	
DATA MANAGEMENT			
Field	***Type***	***Definition***	
IDNUM	TXT	AC CDC record Unique ID	
EDITION	TXT	Last editor's initials and date (YYYY MM DD)	

II. Managed and Biologically Significant Areas (MSA) Database

The following fields of data may be included (and may or may not be populated) for Managed and Biologically Significant Areas.

IDENTITY AND DESCRIPTION		
Field	***Type***	***Definition***
msaGIS	INT	Unique GIS feature identifier
msaCode	TXT	Unique identifier for the MSA feature
msaClass	TXT	Whether the MSA feature is a Managed Area (MA) or biologically Significant Area (SA)

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msaName	TXT	MSA feature name
msaNameFr	TXT	MSA feature name (French)
description	TXT	Description of the MSA feature
notes	TXT	Additional notes about the MSA feature
JURISDICTION / OWNERSHIP		
Field	***Type***	***Definition***
localJuris	TXT	Mandated agency with jurisdiction over property
owner	TXT	Property owner
ownerCom	TXT	Details of multiparty arrangements
ownerDate	TXT	Date of property possession
CLASSIFICATION		
Field	***Type***	***Definition***
protStat	TXT	Activities permitted or restricted (when known)
legalAct	TXT	Title of enabling legislation
legalDate	TXT	Year of enabling legislation
estabDate	TXT	Year of site designation
aichit11	TXT	Whether the site counts towards the Aichi Target 11 and Canada Target 1 biodiversity targets (yes or no)
oecm	TXT	Other effective area-based conservation means (yes or no)
iucnCat	TXT	IUCN protected area category. For complete category descriptions, visit https://www.iucn.org/theme/protected-areas/about/protected-area-categories. Features categorized as "YES" are sites which meet the standard definition of a protected area, but the category of protection has not yet been determined and features categorized as "N/A" are other area-based conservation measures or sites that do not meet the protected area definition (2018 Canadian Protected and Conserved Areas Database (CPCAD) User Manual).
msaType	TXT	MSA feature type:

group	***Designation***
Conservation	Conservation Area
	Conservation Easement
	Fee-Simple Ownership by Environmental Non-Governmental Conservation Organization
	Land Trust Property
	Natural Area
	Nature Preserve
	Nature Reserve
	Nature Reserve and Conservation Easement
	Nature Trail
	Other Effective Area-Based Conservation Measure
	Privately Owned Conservation Area
	Privately Owned Natural Area
	Protected Area
	Protected Beach
	Protected Natural Area
	Provincially Owned Natural Area
	To be determined
Heritage	Heritage River
	Museum
	National Historic Event
	National Historic Site
	Provincial Heritage Site
	Provincial Historic Site
	Provincial Historic/Heritage Park
	UNESCO World Heritage Site
Parks	Municipal Park
	National Park
	Nature Park
	Park
	Privately Owned Park
	Provincial Park
	Provincial Park Beach
Wilderness	Ecological Reserve
	Environmentally Sensitive Area
	Significant Ecological Area
	Significant Ecological Area/International Biological Program
	Wilderness Area
	Wilderness Reserve
Wildlife	Eastern Habitat Joint Venture
	Important Bird Area (IBA)
	Marine Protected Area
	Migratory Bird Sanctuary
	National Wildlife Area
	Privately Owned Wildlife Management Area
	Provincial Wildlife Management Area

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			Wildlife Management Area
			Wildlife Park
			Wildlife Refuge
			Wildlife Reserve
			Wildlife Sanctuary
		Other	Education Area
			Experimental Area
			Federal Corrections Facility
			Fossil Site
			International Biological Program
			Memorial Site
			Other Managed Area
			RAMSAR Wetland Site
			Special Management Area
			Water Supply Area
			Watershed

LOCATION AND SPATIAL ATTRIBUTES		
Field	***Type***	***Definition***
subnat	TXT	Two-letter jurisdiction code (NB, NS, PE, NF, LB)
location	TXT	Directions to the MSA feature
biome	TXT	Whether an MSA feature falls within the terrestrial (T) or marine (M) environment
mapCode	TXT	The National Topographic System (NTS) map square the centre of the MSA feature falls within
coCode	TXT	Provincial county code (2 chars for province + 4 chars for county name)
latDec	DEC	Latitude of the centre of the MSA feature
lonDec	DEC	Longitude of the centre of the MSA feature
utmE20	INT	Easting of the centre of the MSA feature (NAD83 UTM Zone 20N)
utmN20	INT	Northing of the centre of the MSA feature (NAD83 UTM Zone 20N)
extentN	DEC	Northern extent of the MSA feature
extentS	DEC	Southern extent of the MSA feature
extentE	DEC	Eastern extent of the MSA feature
extentW	DEC	Western extent of the MSA feature
areaHa	DEC	Area of the polygon (ha)
SOURCE ATTRIBUTES		
Field	***Type***	***Definition***
sourceId	TXT	Unique ID of the MSA feature in the source dataset
jurisId	TXT	Unique ID of the MSA feature in the original dataset
srcFeatType	TXT	Whether the feature was a point (PT) or polygon feature (PY) in the source dataset. True boundaries of point MSA features are not known. Points have been buffered by 15m to be included in this MSA database
url	TXT	Associated website holding additional information about the source feature or database
bestSource	TXT	Unique identifier for the source database
citation	TXT	Primary source of data
edition	TXT	Initials and date (YYYY MM DD) pertaining to the last edit to the MSA feature

APPENDIX Q – STUDY PLAN

Sheet Harbour Hydro System
Ruth Falls Fish Passage Studies

Study Plan
December 2023

Prepared by Nova Scotia Power Inc.

1.0 Introduction

The Sheet Harbour Hydro System is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The hydro system has a drainage area of 573.9 km2. Presently there are six (6) controlled reservoirs in the hydro system including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond, and Ruth Falls Headpond. The Sloane Reservoir is located near the headwaters of Seventeen Mile Stream, which passes through Anti Dam Reservoir and into Marshall Reservoir, then into the Malay Falls Headpond. The Malay Falls power canal conducts water from to the Malay Falls Generating Station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. Fish passage on the Sheet Harbour Hydro System is facilitated by a total of six downstream fishways, one upstream fish ladder and a trap and truck arrangement at Ruth Falls. Fishways facilitating the downstream passage of fish species are located at Antidam Dam, Marshall Dam, Malay Falls Dam (2), Ruth Falls Dam and Ruth Falls louvers and bypass. The DFO requirements for flow releases and fish passage were designed with Atlantic salmon as the target species. Upstream fish passage for Atlantic salmon beyond Ruth Falls is provided through the trap and truck program. The trap and truck program utilizes a fish trap below Ruth Falls to capture adult salmon migrating upstream. Requirements are that the first 50 fish captured are placed into Ruth Falls Headpond where they have access to habitat on Grant River. Any fish surplus to this would be trapped and trucked to upstream locations determined by DFO. This was a DFO sponsored protocol designed to assess and support the salmon population.

Nova Scotia Power Inc. (NS Power) conducted several tagging studies in 2009 and 2010 to assess the effectiveness of the Ruth Falls louver system to divert fish away from the intake canal and return them to the main body of the river. These studies showed that the louver system in its current configuration is effective at diverting pelagic species (See Appendix F for results of the Salmon smolt study for details). The results of the American eel study (also displayed in Appendix F) were shown to be less successful at being diverted by the bypass during the 2010 study. As part of the Sheet Harbour Hydro System relicensing process, DFO requested that NS Power design and implement effective upstream and downstream fish passage at the Ruth Falls dam and conduct studies to assess their effectiveness. NS Power recruited the services of a recognized subject matter expert to assess the existing fish ladder and bypass setup and provide a cost-effective strategy to achieve effective upstream and downstream passage for migratory fish species, including American eels.

In May 2009 NS Power assessed efficiency for salmon smolts and in late September and October for American eels using pit tags and pit tag antennas installed in the bypass. The study was limited to tracking the fish travelling through the bypass.

In 2009:

- 300 salmon smolts were pit tagged and released, Results showed that increasing approach to nose cone velocity ratios were associated with increasing proportions of fish recovered. When velocities were sufficient, the bypass rate was over 90%.
- 1082 eels were identified using the bypass

- NSP tagged 148 eels, released them upstream the below Malay Falls dam, and detected 40 travelling through the bypass representing 30% efficiency, assuming all remaining eels entered the canal (worst case scenario). This is likely an underestimate as the pit tag passive detections are less reliable than acoustic detections.
- NSP also identified alewife (2143), speckled trout (53), yellow perch (10), white sucker (9) and a salmon over a period of 46 days. This data also illustrates the low number of non-migratory species using the bypass.

The October 2010 study was designed to assess successful outmigration of American eel. The details and results of the 2010 study including receiver and release locations are described below: American eels were captured as they travelled through the bypass. These eels were identified as mature silver (migrating) eels. DFO science conducted the surgeries implanting the pit and acoustic tags:

- On October 7th, 2010: 181 eels were measured and weighed;
- On October 12th, 2010: 64 eels were measured and weighed and received a pit tag; 32 eels were also surgically implanted with an acoustic transmitter;
- On October 15th, 2010: 55 eels were measured and weighed and received a pit tag;
- On October 19th, 2010: 318 eels travelled through the bypass; none were tagged;
- All fish tagged on October 12th, 2010 were released on October 13th, 2010 at 15:23 below Malay falls (lat 44.983415; lon -62.478809);
- Six receivers were deployed to track the movement of eels as they migrated back down the watershed (see table below for coordinates);
- Two receivers were placed in the headpond above the canal entry and spillway, they were installed so that they could detect fish approaching either structure;
- Two receivers were placed in the canal downstream of the louvres;
- Two receivers were placed in the main body of the river below the confluence of the river and the tailrace;
- One receiver was placed in the estuary, approximately 12 kilometers below the confluence;

Full study details can be found in Appendix F – Eel and Salmon Study Summary in the Supporting Information document.

The recommended designs consist of significant modification and upgrade of the existing louver diversion system that would prevent most eels from entering the intake canal, as well as modifications to the existing fish ladder to increase attraction flow and modify the baffles to improve passage for alewife. An elver ladder will also be installed near the existing fish ladder to take advantage of the attraction flow. NS Power is committed to monitoring passage as it relates to dam operation. Details can be found in Appendix K – Monitoring Plan of the Supporting Information document.

NS Power is committed to implementing the proposed upgrades to the fish ladder and diversion system. This document provides an overview of the proposed study and monitoring program designed to monitor the upstream migration of alewife, sea-run trout (if present) and elvers, as well as assess the effectiveness of the modified louvre system at diverting migratory species back to the main river.

No changes have been made to the fish ladder and louvre system since 2010, therefore NS Power proposes to conduct the assessment studies following the completion of the modifications and will assume that the data collected to date represent the current efficiency of the ladder and bypass. Construction of Ruth Falls is expected to commence in July 2024 with the drawdown of the Ruth Falls Headpond. Improvements to downstream and upstream fish passage and main dam refurbishments will take place over the course of nine months – with the recharging on the headpond occurring prior to March 2025. As such, NS Power intends to complete post-construction studies to assess the improvements after construction is complete.

2.0 Proposed 2024 Sheet Harbour Studies and Monitoring Programs

2.1 Species of interest

The data collected by NS Power over the past 20 years indicates that three migratory species are present in the watershed: alewife, Atlantic salmon, and American eels. However, the number of salmon present is extremely low, and would not be sufficient to conduct a reliable study. Furthermore, the fish ladder was designed to pass salmon and the assessment of the downstream passage was conducted with salmon and showed very high efficacy. This was confirmed by the results of the Hydraulic Modeling (Appendix G of the Supporting Information document). NS Power will therefore focus the proposed studies and monitoring programs on migratory species including alewife, American eels. At the request of DFO to assess other migratory species, NS Power will also include sea-run trout as part of the study design, understanding that the number of these fish might be extremely low, which could compromise the reliability of the study. NS Power will also endeavor to use resident freshwater trout to assess the efficiency of the louvres bypass for this species, understanding that resident trout likely do not have an innate migratory requirement. To illustrate this, only 53 trout were intercepted in the bypass trap between September 28th and November 12th, 2009, for an average of 1.17 fish/day. It will be assumed that the results obtained for alewife and trout can be extrapolated (with caution) to other migratory species, such as salmon and shad.

2.2 Upstream migration monitoring

It is worth noting that up to 15 sets of falls are located upstream on the East River between the Hydro generating station tailrace and the Ruth Falls dam. These natural outcroppings of bedrock represent a partial barrier to alewife upstream passage, especially in periods of high flow.

Alewife

Previous monitoring studies and observations from NS Power personnel suggest that the East River alewife run consists likely of a few thousand fish; however, this is only a qualitative statement. NS Power will work with

Innovasea to install two cameras in the fish ladder (one at the exit of the ladder and another at the entrance) and use AI technology to count the fish as they move through the ladder. Having two cameras installed will allow for efficiency rates to be established. A similar AI fish monitoring program has been used at Whiterock and Tusket with success, and with further improvements to be made in 2024. The cameras will be installed in early April to monitor the run until June 15th in 2025 and 2026. Daily checks of the cameras will be completed to ensure they are in good working order. Visual Observations of the fish ladder will also take place daily during the run timeframe to capture any negative impacts on the fish ladder as a result of dam refurbishments.

Sea-run trout and Atlantic salmon

NS Power will install pit tag antennas at the toe and the exit of the Ruth Falls fish ladder and will operate the trap in the fish ladder during the Atlantic salmon and trout migratory seasons to intercept and count individuals of these species should they be found in the trap. Intercepted fish would receive a pit tag and be released downstream of the fish ladder. NS Power will also work with Innovasea to train the AI fish monitoring program to recognize sea-run trout and Atlantic salmon with the aim of using camera data. However, the number of fish might be insufficient to achieve this goal.

Elvers

A new elver ramp will be installed as part of the fish ladder upgrades. The structure will be designed to include a trap which will enable NS Power to quantify the daily number of elvers ascending the ladder. This method is similar to the elver sampling conducted on the East River Chester (index river). Abundance of elvers will be measured by wet weight, following a calibration made on the measure of a representative number of individual fish (likely 50-100; elver size is usually similar). Daily counts will take place during upstream migration season starting April 1st to June 15th 2025.

Eels use several tropisms to guide their upstream migration. Studies have shown that elvers have the ability to recognize and will preferentially select fish passage areas that have been previously used by eels. It is therefore likely and expected that a new elver ladder will not show its optimal efficiency until a chemical signature becomes detectable to the fish. This was also the case for the East River Chester elver ladder trap. NS Power will look to assess efficiency by installing a fyke net below the eel ramp and compare number of eels found in the nets to those in the sampling box.

2.3 Downstream monitoring

Study design – Adult Alewife and American Eel

Downstream monitoring of migrating alewife and American eels will be conducted using High Resolution (HR) acoustic tags and hydrophones. Hydrophones are proposed to be deployed in the headpond (4), the entrance to the intake canal upstream of the louver (2), the intake canal downstream of the louver (2), and in the river downstream of the hydro plant tailrace (2) to monitor for the presence of tagged fish as they migrate down the watershed - see Figure 1 and Figure 2 for details. The final configuration will be discussed and optimized with the equipment manufacturer. The headpond hydrophones will have overlapping detection ranges to create a positioning array which will help determine the path of any tagged fish in the Ruth Falls headpond.



Figure 1 Proposed hydrophone deployment locations in headpond and intake canal entrance upstream of louvres



Figure 2 Proposed hydrophone deployment locations downstream of louvres and downstream of tailrace confluence

Similar to the studies conducted in 2009 and 2010, NS Power proposed to use the bypass facility to catch sample fish. The bypass flow will be redirected through the holding facility. Captured fish will be transferred to a holding cage placed in flowing water until processed. The selection of the most adequate location for the holding cage(s) will be based on the following considerations: safety, access, proximity to river, flow, sheltered location, etc. Fish will be held for the shortest practical duration. If required, fish will be anesthetized using either clove oil (80-100 mg/L) or Tricaine methane-sulfonate/MS-222 (100-200 mg/L) which are the most used anesthetics for fish. Once anesthetized, each fish will be measured and weighed. The use of internal and/or external tags is currently under review by NS Power and the tag manufacturer to determine the least invasive/most effective technique to track the fish. In the case of internal tags, a small incision will be performed approximately one inch above the anus and a HR V3 or V7 acoustic transmitter (Innovasea) will be surgically implanted in the abdominal cavity of the fish. In the case of external tags, tracking devices are attached to a short tether which is implanted under the skin in the area of the dorsal fin. The external tags are typically smaller in size and have a smaller range and life expectancy. Bycatch information will also be recorded, including fish species, number and approximate size. Depending on the type of transmitter/receiver selected for the study, tagged fish might need be released in small batches to avoid the risk of signal collisions.

NS Power will also take advantage of the dewatering of the power canal to "clean up" the entrance to the canal in order to create a smoother bottom contour. Once the dimensions of the canal entrance are finalized, a barrier net will be manufactured to match the contour and installed ahead of the rewatering. This will prevent tagged fish from moving back into the headpond, away from the louvre bypass. Although this approach will increase the likelihood that tagged fish will move towards the bypass, some resident trout might still not approach the bypass.

The Sheet Harbour hydro plant will be generating during the study to provide the flow in the intake canal. The timing of releases will be coordinated with the Sheet Harbour Hydro Superintendent to ensure normal operating conditions and generation.

Alewife

Sampling for alewife will start in August to coincide with downstream migration. Alewife should be manipulated as little as possible and held for only a short period. Up to fifty alewife will be tagged with a V3 high resolution transmitter programmed to send a transmission every two seconds. For each fish, length, weight and general status will be recorded. A similar technique was used at Whiterock with great success. To catch the required number of individuals, NS Power will combine fishing efforts in the headpond and operating the bypass trap to intercept outmigrating alewife. Preference will be given to fish caught in the lake as they will be naïve to the bypass (to avoid any bias).

The fish will then be returned to the in-flow holding cage and allowed to recover. Recovered fish will then be released at the entrance to the canal.

American eels

Sampling for mature adult eels (silver) will start in September to coincide with a period of low barometric pressure and steady rain. Eels typically travel at night, therefore the bypass trap will be operated and monitored overnight. Thirty eels will be anesthetized and tagged with a V3/V7 high resolution transmitter programmed to send a

transmission every two seconds. For each fish, length, weight, sex and general status will be recorded. Depending on the number of eels captured and the sex ratio observed, NS Power will endeavor to tag fish with a variety of sizes and a balanced sex ratio.

The fish will then be returned to the in-flow holding cage and allowed to recover. Recovered fish will then be released at the entrance to the canal.

Study Design - Sea-run Trout

Similar to alewife monitoring, NS Power will operate the bypass trap and deploy fishing nets and traps in the headpond in the hope of catching sufficient resident freshwater trout to conduct a tagging study. Given the uncertainty surrounding the success of these efforts, NS Power proposes to use Pit tags to track the movement of trout through the bypass. Fish will likely need to be anesthetized during tagging. Tagged fish will be released inside the barrier net, upstream of the bypass. Pit tag antennas will be installed in the bypass (exact locations to be determined) and at the point of discharge into the river. The area between the barrier net and the bypass will be swept for remaining fish at the end of the study. NS Power will apply a worst-case scenario whereby any non-detected fish will be assumed to have avoided the bypass and moved into the power canal. The barrier net will be removed 24 – 48 hours after the release of the tagged fish to avoid impeding downward migration of fish.

Study Design - Juvenile Alewife

Assessing juvenille alewife downward migration will be completed using a minimally invasive approach in an effort to reduce the mortality associated with handling young alewife. All methods pose a risk of harm to juvenile alewife as the fish are very sensitive to handling. The assessment will take place in early September to coincide with the expected downward migration of juvenile alewife. Because the purpose of this study is to assess the efficacy of the bypass for juvenile alewife, NS Power does not intend to monitor the entire alewife outmigration.

A bongo net will be set upstream of the louvres in the canal in an effort to capture downward migrating juvenile Alewife. An additional second bongo net will be set downstream of the louvre system while the bypass will be set to divert fish towards the counting facility where fish abundance will be also be counted and estimated. Once the fish are counted from the upstream bongo net, the fish will be released into the canal. The fish that are diverted into the bypass counting facility will be quantified (likely only order of magnitude, depending on fish abundance). An overhead camera will be installed above the tank where the fish will be held briefly to assist in counting efforts. Any fish recaptured within the downstream bongo net will also be counted and released. These data will be compared to assess the bypass efficiency for juvenile alewife. However, given past sampling experience and the schooling nature of juvenile alewife, NS Power is expecting highly variable counts which could be challenging to interpret. NS Power will endeavor to provide the most accurate assessment of the bypass based on the data available.

2.4 Data analysis and reporting

Depending on the environmental conditions, hydrophones will be recovered at least four weeks after the final fish release to ensure that all tagged fish have completed their downstream movement past the Ruth Falls dam. The exact date will depend on the timing of the American eel migration but will likely occur around the end of October. Acoustic data will be retrieved and analysed for the detections of tags.

Comparison of the data from each receiver will allow to determine for each species, the number of fish that were successfully diverted through the bypass, the number of fish that circumvented the louver system, the number of fish that returned to the headpond and the number of fish that completed their migration.

If the number of fish circumventing the louver system is high enough, a mortality rate for that species could be estimated.

NS Power will provide a report on the findings of the 2025 studies to DFO by May 1, 2026

2.5 In the case of an Innovasea positioning system array

Following the recovery of the hydrophones at the end of the downstream fish passage study, data will be downloaded and shared with Innovasea to perform the data processing. This process is proprietary and typically takes several weeks to complete. NS Power will then analyze the data and report on the findings.

The characterization of the behaviour of the fish through the Sheet Harbour reservoir and through the generating plant during their downstream migration back to sea will be based on the reconstruction of fish movements using the acoustic Innovasea Positioning System (VPS). An analysis of the reconstructed track will help inform the behaviour of the alewife and eels as they approach the Ruth Falls dam.

NS Power will provide a report on the findings of the 2025 studies to DFO by May 1, 2026.

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P.O. Box 1006, Station P500
Dartmouth, NS B2Y 4A2

January 29, 2024

Your file *Votre référence*
N/A

Our file *Notre référence*
19-HMAR-00549

Nova Scotia Power
Attention: Kailey Osborne
Environmental Scientist
PO Box 910
Halifax, NS B3J 2W5

Subject: Sheet Harbour Ruth Falls Dam Refurbishment Phase 2 – Application for a *Fisheries Act* Authorization is Complete

Dear Kailey Osborne:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada has reviewed the content of your application for an authorization under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act* and is notifying you that your application is complete as of January 29, 2024. This means that your application meets the information requirements set out in subsection 2(1) of the *Authorizations Concerning Fish and Fish Habitat Protection Regulations* (the Regulations). Please note that although your application has been identified as complete as per the regulatory requirements, there are other considerations that must be addressed which may result in modifications to your proposal. In this case, you will be informed to submit new or amended information or documentation, as per paragraph 4(6)(c) of the Regulations. Otherwise, the Program will inform you by April 27, 2024 (90th day after information complete date), as identified in the Regulations, of the decision to either issue the authorization or inform you of the refusal to do so.

If your plans have changed during the review of your application, you should contact this office to avoid any unnecessary delays in the review of your application.

If you have any questions, please contact Kelley Fraser at our Dartmouth office at 902-441-3671 or by email at Kelley.Fraser@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Canada

Yours sincerely,

Levy, Alexander

Digitally signed by Levy, Alexander
Date: 2024.01.29 16:01:27 -04'00'

Alex Levy
Section Head, Freshwater Developments
Maritimes Region

CC: Erik Van Lunen, Nova Scotia Environment and Climate Change
Betty Cougle, Manager, DFO Engagement and Partnerships

From: Levy, Alex L
To: Leblanc, Jennifer; Holland, Heather
Cc: Wambolt, Michael; Cougle, Betty; Braid, Leanna; Nurse, Stacey; Fraser, Kelley
Subject: Ruth Falls
Date: Thursday, June 6, 2024 2:06:38 PM
Attachments: RE Proponent Infomeeting follow-up.msg
NS Power Offsetting Calcs.xlsx

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Jenny, Heather,

As requested, here are the main points discussed during the June 4, 2024 meeting regarding the Ruth Falls Dam Refurbishment Project (the Project).

Overall, concerns raised by the Mi'kmaw (see attached) were discussed along with DFO concerns / requests for further information (identified in bold below). We have also included technical comments on NS Power's proposed monitoring plan for the Project.

Offsetting:

- DFO and the Mi'kmaw have communicated that the amount of offsetting proposed for the project is too low, and are requesting additional offsetting for the harmful alteration, disruption and destruction of fish habitat and the death of fish that will result from conducting the work.
- DFO previously communicated concerns with offsetting to NS Power (e.g., high administrative costs, unnecessary monitoring such as temperature monitoring, etc) and requested NS Power to explore additional offsetting.
- DFO reviewed a spreadsheet (attached) showing recent offsetting proposed by NS Power on the Tusket, Mersey and Ruth Falls systems, and inquired why the proposed offsetting was considerably less for Ruth Falls and why the cost / m^2 was considerably higher than the other offsetting projects.
- The spreadsheet also portrays an approach proposed by our National Headquarters for temporary disruptions to fish habitat (i.e., 3% / year) along with values to align with the Mi'kmaw's proposed approach of 5% of the footprint. As noted at the meeting, the 3% / year does not account for fish mortality (entrainment and stranding) associated with the drawdowns; Maritimes presented this approach and an interim approach to facilitate discussions, and assess the reasonableness of the proposed offset.
- As the methods proposed for the entrainment monitoring is unlikely to yield meaningful results that can be used to inform offsetting, DFO suggested NS Power forego the entrainment monitoring and to apply the funds toward increased offsetting.
- **NS Power to update the offsetting plan based on the discussion, and provide a revised plan to DFO. DFO will then consult on the updated offsetting plan.**

Archaeology, Site Access:

- **NS Power to provide an archaeological monitoring plan that includes proposed security measures assuming that artefacts will be present and details how that will be addressed with the Mi'kmaw during the drawdown.**
- NS Power said access will not be restricted for hunters/fishers to navigate the river during construction period. However, their experience will not be the same as the reservoir will be 18 feet lower. **NS Power to communicate this to the Mi'kmaq and update DFO on what was communicated and the response from the Mi'kmaw**.
- **NS Power to provide engagement log for Ruth Falls to DFO**.

Fish Passage:

- **NS Power to assess whether mitigation measures can be implemented to provide upstream fish passage during the drawdown**.

DFO Monitoring Plan Comments:

DFO requesting the following information and for the plans to be updated accordingly:

AI Innovasea Monitoring

- **Provide a description of how countable footage will be recorded.**
- **Provide a description of how AI results will be validated (i.e., ground truthed), including a description of human count validation methods of the AI data with information on how counts and species identification will be validated.**

Pit Tagging Monitoring

- **For the proposed tagging study of downstream migrating Alewife, it is not clear if the target life stage is post spawn adult or juveniles. Please clarify.**
- **Provide a more detailed description of the analysis to demonstrated how improved efficiencies will be determined after improvements are made to the louvres.**
- **NS Power to provide any available information for fish passage numbers through the fishway and any information on when adult and juvenile Gaspereau are out-migrating from Ruth Falls reservoir**
- **NS Power to asses a later start date for the drawdown to mitigate impacts on Gaspereau to be consistent with Tusket (e.g., after July 20th)**
- **Clarify monitoring dates – pg. 570 of PDF, Section 2.0: should this be a 2025 (or now 2026 with delay of works) study, not 2024?**

Thanks,
Alex

Alex Levy
Section Head, Freshwater Development
Regulatory Reviews – Ecosystems Management | Examens réglementaires - Gestion des écosystèmes
Telephone | Téléphone 902-240-5156
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Fisheries and Oceans Canada | Pêches et Océans Canada
PO Box 1006, Dartmouth, NS B2Y 4A2
CP 1006, Dartmouth, N-É B2Y 4A2
Government of Canada | Gouvernement du Canada

From: Cougle, Betty
To: Holland, Heather
Cc: Levy, Alex L; Nurse, Stacey; Braid, Leanna; Leblanc, Jennifer
Subject: RE: Proponent Info/meeting follow-up
Date: Friday, May 24, 2024 1:25:40 PM

Hi Heather,

We've drafted a summary of concerns raised in the May 8th letter from KMK to DFO that pertain to NSPI/Proponent. I've added them below and we can go through them in more depth at our upcoming meeting. In the meantime, please reach out if you have questions.

Thanks,
Betty

Ruth Falls Dam Refurbishment project (phase 2):

- Concern with the removal of approximately 6.35 million m3 of water over 9 months:
  - Significant exposure time and removal of habitat is sure to permanently destroy more of the habitat than anticipated in the application.
  - Lack of fish passage during the construction period prevents fish from completing their life cycles.
- Total proposed offsetting of 2700 m2 is not adequate.
  - Request an offsetting measure of 5%, or 57,500 m2, of the total surface area (1,150 000 m2).
- Concern about monitoring/security at site, to prevent looters access to potential exposed artifacts over project timeline
  - Request confirmation of what security will be in place.
- Request confirmation that hunters/fishers will be able to navigate the river during construction period.

From: Holland, Heather <Heather.Holland@nspower.ca>
Sent: Thursday, May 16, 2024 2:22 PM
To: Cougle, Betty <Betty.Cougle@dfo-mpo.gc.ca>
Cc: Levy, Alex L <Alex.Levy@dfo-mpo.gc.ca>; Nurse, Stacey <Stacey.Nurse@dfo-mpo.gc.ca>; Braid, Leanna <Leanna.Braid@dfo-mpo.gc.ca>; Leblanc, Jennifer <Jennifer.Leblanc@nspower.ca>
Subject: RE: Proponent Info/meeting follow-up

Hi Betty,

Thanks for this.

I also wanted to follow up to see if you and/or your team are able to provide a summary of the points raised in KMK's letter about Ruth Falls, as mentioned during the meeting?

Thanks again,
Heather

From: Cougle, Betty <Betty.Cougle@dfo-mpo.gc.ca>
Sent: Thursday, May 16, 2024 9:35 AM
To: Holland, Heather <Heather.Holland@nspower.ca>
Cc: Levy, Alex L <Alex.Levy@dfo-mpo.gc.ca>; Nurse, Stacey <Stacey.Nurse@dfo-mpo.gc.ca>; Braid, Leanna <Leanna.Braid@dfo-mpo.gc.ca>
Subject: Proponent Info/meeting follow-up

Exercise Caution - This is an external email from: Betty.Cougle@dfo-mpo.gc.ca. **Beware of links or attachments from external sources. If you are unsure, click "Report Email" to submit for review.**

Hi Heather,
I realized that I forgot to send you the information I highlighted at the last meeting. This link: Request a review of your project near water: Step 2. Understand the project review process (dfo-mpo.gc.ca) will give you the info that DFO has put together on Proponent's role as well as the Crown role. As always, happy to discuss further in the context of NSP projects.

Thanks,
Betty

Betty Cougle
Regional Manager, Engagement and Partnerships

Engagement and Partnerships | Aquatic Ecosystems Branch
Fisheries and Oceans Canada | Government of Canada
Betty.Cougle@dfo-mpo.gc.ca / Tel: 902-943-1574

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CI 50518 NSUARB IR-12 Attachment 14b has been removed due to confidentiality.

Request IR-13:

With regards to Exhibit N-2 filed in the current Matter:

(a) Has NS Power had any discussions with GreenQuest Power related to GreenQuest Power acquiring the Ruth Falls hydropower assets?

(i) If so, please provide a summary of these discussions.

(a) Please explain specifically why NS Power believes GreenQuest Power's offer to acquire the assets is not viable.

(b) Has NS Power had any discussions with GreenQuest Power related to GreenQuest Power acquiring any other of NS Power's existing hydropower assets?

(i) If so, please provide a summary of these discussions.

(a) If NS Power believes that such acquisitions are not viable, please explain specifically why NS Power believes this is the case.

Response IR-13:

(a-b) Prior to receipt of GreenQuest Power's Letter of Comment as submitted to the Board in this proceeding, NS Power received no communication from GreenQuest Power related to GreenQuest Power's potential interest in acquiring the Ruth Falls Hydro System or any other of NS Power's existing hydropower assets, other than as was previously discussed in M10366 (for reference please refer to Undertaking U-6 (Exhibit N-19)).

On November 27, 2024, representatives of NS Power met with Mr. Mullen of GreenQuest Power to better understand the claims put forth in the letter dated October

21, 2024. GreenQuest does not have a proposal to make. Therefore, at this time, NS Power has no basis to alter its previous views in relation to such acquisitions. With that said, NS Power intends to continue an open dialogue with Mr. Mullen and should a viable option in relation to NS Power's hydro assets present itself in the future, NS Power will consider it along with other options in assessing what is in the best interests of customers.