6.5.4.2.1 Baseline Hydrology

Flow volumes were estimated at the assessment points (AP) as the product of precipitation, catchment area, and a runoff coefficient, which is a measure of the amount of runoff generated by a precipitation event that varies depending on the land cover and antecedent moisture conditions of the surficial soils. The model used the 50-year daily records of rainfall, snowfall, average temperature, and calculated potential evapotranspiration as inputs, and included models of the snowpack and soil-water storage. As snowpack model was used to calculate yield (i.e., the sum of rainfall and snowmelt) and a soil-water storage model was used to calculate actual evapotranspiration, baseflow, surface runoff and total runoff depths for application in the water balance.

The hydrology of the system was analysed for 17 different assessment points. The assessment points are summarized in Table 6.5-5.Table .

Table 6.5-5 Water Balance Assessment Points

Assessment Point	Catchment Area at Select Mine Phases (ha)				Description
	Baseline	Phase 1	Phase 2	Closure	
AP1	136.38	120.39	88.84	97.12	Located on WC 41, a tributary of Annand Brook. Used to assess the direct impacts of mine infrastructure and the pit on mean annual flows within the tributary.
AP2	85.07	85.07	85.07	85.07	Located on WC 3, a tributary of Annand Brook. Provides an upstream control point.
AP3	351.17	335.18	258.63	266.17	Located on Annand Brook upstream of SML polishing pond and downstream of AP1 and AP2. Used to assess the direct impacts of mine infrastructure and the pit on mean annual flows within Annand Brook.
AP4	513.97	466.36	453.47	459.96	Located on Annand Brook downstream of the SML polishing pond. Used to assess the direct impacts of mine infrastructure and the pit on mean annual flows within Annand Brook.
AP5	32.98	10.89	31.11	32.84	Located along Wetland 34 before draining to Annand Brook. Used to assess the direct impacts of the pit on mean annual flows leading to the identified black ash habitat.
AP6	61.28	38.63	42.7	64.74	Located on WC22, a tributary to Annand Brook downstream of AP17. Used to assess the direct impacts of the pit on mean annual flows leading to the identified black ash habitat.
AP7	128.88	84.14	108.42	132.2	Located on Annand Brook downstream of AP4, AP5, and AP6. Used to assess the direct impacts of mine infrastructure and the open pit on mean annual flows within Annand Brook.
AP8	179.29	134.55	158.84	182.6	Located on Annand Brook downstream of AP7 and upstream of the confluence with the Gays River. Used to assess the direct impacts of mine infrastructure and the open pit on mean annual flows within Annand Brook.

Assessment Point	Catchment Area at Select Mine Phases (ha)				Description
	Baseline	Phase 1	Phase 2	Closure	
AP9	4053.81	4053.81	4053.81	4053.81	Located on the Gays River. Provides an upstream control point.
AP10	93.16	76.33	72.14	72.14	Located on an unlabelled tributary to the Gays River. Used to assess the direct impacts of Project infrastructure on mean annual flows within the tributary.
AP11	4151.15	4134.31	4130.12	4130.12	Located on the Gays River downstream of AP9 and AP10. Used to assess the direct impacts of Project infrastructure on mean annual flows within the Gays River.
AP12	61.98	26.14	26.14	34.34	Located on WC26, tributary to the Gays River. Used to assess the direct impacts of Project infrastructure on mean annual flows within the Gays River.
AP13	4435.57	4381.64	4377.44	4385.63	Located on the Gays River downstream of AP11 and AP12. Used to assess the direct impacts of Project infrastructure on mean annual flows within the Gays River.
AP14	7951.00	7896.92	7892.73	7901.10	Located on the Gays River downstream of AP13. Used to assess the direct impacts of Project infrastructure on mean annual flows within the Gays River.
AP15	8023.30	7969.22	7965.03	7973.37	Located on the Gays River downstream of AP14. Used to assess the direct impacts of Project infrastructure on mean annual flows within the Gays River.
AP16	8716.56	8570.13	8577.34	8615.93	Located on the Gays River downstream of AP8 and AP15. Used to assess the direct impacts of Project infrastructure on mean annual flows within the Gays River.
AP17	20.6	9.37	13.38	22.62	Located on WC 21, a tributary to Annand Brook upstream of AP6. Used to assess the direct impacts of mine infrastructure and the open pit on mean annual flows to the identified black ash habitat.

6.5.4.2.2 Operation and Closure Hydrology

The Project includes a variety of different land cover types, including overburden stockpiles, open pit, pit lake and the processing area and administrative area with impervious surfaces. Hydrologic processes of the uncovered stockpiles and open pit, in particular, are complex, and at this stage of the Project their specific properties are unknown; therefore, the evaporation, infiltration, and direct runoff from these areas were estimated using runoff coefficients from similar project locations in proximity to the PA.

The open water of the pit lake and settling ponds were assumed to have a runoff coefficient of 1.00, meaning all precipitation is expected to translate to runoff. The open pit and settling ponds were modelled as storage elements where lake evaporation is included as an output. The processing and administrative areas were assumed to be comprised of an impervious land cover. Impervious areas were also assigned a runoff coefficient of 1.00.

In the closure phase, the overburden stockpiles will be covered and seeded to aid in erosion and sediment control and a portion of the water will be directed to the pit to form the pit lake.

Groundwater inflow volumes were obtained from the groundwater model as described in Section 6.4 (Groundwater Resources). Predicted groundwater inflow rates range from 1,237 m^3/day in Phase 1 of operation to 2,718 m^3/day in Phase 2 of operation to 63 m^3/day in closure once the pit lake is fully formed. Baseflow volume variation to the natural watercourses within the PA were determined using the groundwater model of the Project. The baseflow impacts were incorporated into the water balance analysis as percent changes from baseline conditions at each AP.

6.5.4.2.3 Water Management

During development of the Project, surface water runoff and groundwater inflows will be directed to specified receiving storage areas and locations prior to discharging to the receiving environment. Over the life of the Project, water will be directed to two settling ponds as well as the open pit. The summary of water management and discharge locations during each phase of mine development is listed below:

Operations

- During early stages of operation (Phase 1) all water from the PA will be directed north to the north settling pond (including pit dewatering, surface water runoff from the stockpiles and processing area).
- Surface water from the north settling pond will be pumped to supplemental flow discharge locations located on Annand Brook (upstream of the SML polishing pond), wetland (WL) 34, watercourse (WC) 22 and WC21 (upstream of the identified sensitive habitat associated with the black ash). Any remaining water in the north settling pond will discharge via WC26 to the Gays River.
- During the later stages of the operation (Phase 2), water from the PA will be directed either to the north settling pond or to the south settling pond.
- Water from the north settling pond will be pumped to supplemental flow discharge locations located on WL34, WC22 and WC21 (upstream of the identified sensitive habitat associated with the black ash). Any remaining water in the north settling pond will discharge via WC26 to the Gays River.
- Water from the south settling pond will be pumped to Annand Brook (upstream of the SML polishing pond).

Closure

- During early stages of closure (Pit Filling), surface water will continue to be managed as per water management during Phase 2 of operation with the exception of the south settling pond will overflow into the pit lake to aid in pit filling. Water will still be pumped from the south settling pond to Annand Brook to maintain flow through that system.
- Once the pit has filled entirely all supplemental flow pumping system will be removed and the settling pond will be decommissioned.
- The surface water ditches will remain in place until the stockpiles have vegetated and stabilized to a point where there is no longer a concern for erosion of the cover material. Once the stockpiles have stabilized the presence of the surface water ditches will be re-evaluated.

The open pit has a maximum capacity of 23 Mm^3 (million cubic metres) with a corresponding overflow elevation of 25.1 m. The open pit will be backfilled with a total of 16 Mm^3 of process rejects, overburden and waste rock towards the end of Phase 1. The backfill will be placed in the northern end of the open pit to reduce impacts to the sensitive habitat associated with the black ash while mining continues to the south and will be placed to match existing grade. Approximately 11.5 Mm^3 of material will be placed below the overflow elevation of 25.1 m. It is assumed that the material will have a void space ratio of 0.3, which was estimated based on the backfill properties of similar mining projects. As such, the volume of water required to fill the open pit will be approximately 15.6 Mm^3. The pit lake is projected to take 14 years to fill under average precipitation conditions.

Additional details on the conceptual water management plan for the Project are presented in Appendix F.3.

6.5.4.3 Water Quality Assessment

The main water quality concern associated with mining gypsum is TSS as gypsum dust is very fine and can lead to high TSS concentrations in surface water runoff. To prevent TSS exceedances in the surface water runoff discharged from the PA, all contact water will be conveyed to a settling pond prior to discharge. Throughout the PA, best management practices for erosion and sediment control will be implemented including placement of riprap, check dams, straw waddle and erosion control blanket, as needed. Regular inspections of the ditches and settling ponds will be conducted and maintenance of the erosion and sediment control infrastructure will be completed on an as-needed basis.

The north settling pond outlet structure will be designed such that stormwater entering the pond sees a minimum of 24 hr detention time prior to discharge to aid in settling of suspended solids. The south settling pond will only discharge through a pump. As such, the intake for the pump will be placed in a clear stone well to aid in the filtering of suspended solids prior to pumping of water from the settling pond.

In addition, there are several pumps and pipeline structures through the PA to mitigate flow impacts to sensitive habitats. The pipelines will pump water from the discharge of the settling ponds to the sensitive areas (discharge point) where the water will enter the natural water system. The design of the outlet structures for these pipelines will be completed during future design phases, however, the design of the outlet structure will be completed in a way to prevent erosion downstream of the outlet.

During operation, the water quality within each settling pond will be monitored on a regular basis. The results of this monitoring will be compared to baseline conditions to ensure there are no water quality concerns regarding the effluent discharge from the PA.

6.5.4.4 Thresholds for Determination of Significance

6.5.4.4.1 Surface Water Quantity

The characterization criteria applied in the surface water quantity effects assessment are defined in Table 6.5-6 below.

Table 6.5-6 Characterization Criteria for Residual Effects on Surface Water Quantity

Characterization	Quantitative Measure or Definition of Qualitative Categories
Magnitude	**N** – Change in predicted average annual discharge is within 1% of baseline conditions **L** – Change in predicted average annual discharge is greater than 1% but less than 5% of baseline conditions **M** – Change in predicted average monthly discharge is greater than 5% but less than 10% of baseline conditions **H** – Change in predicted average monthly discharge is greater than 10% of baseline conditions
Geographic Extent	**PA** – direct and indirect effects from Project activities are restricted to the PA **LAA** – direct and indirect effects from Project activities are restricted to the LAA
Timing	**N/A** — seasonal aspects are unlikely to affect VCs **A** — seasonal aspects may affect VCs
Duration	**ST** – effects are limited to the construction phase or operations phase **MT** – effects occur in the construction phase and operations phase **LT** – effects occur in the construction phase and operations phase and persist in closure **P** – valued component unlikely to recover to baseline conditions
Frequency	**O** – effects occur once **S** – effects occur at irregular intervals throughout the Project **R** – effects occur at regular intervals throughout the Project **C** – effects occur continuously throughout the Project
Reversibility	**RE** – Surface water quantity will recover to baseline conditions before or after Project activities have been completed. **PR** - mitigation cannot guarantee a return to baseline conditions **IR** – effects to VCs are permanent and will not recover to baseline conditions

A significant adverse effect to surface water quantity from the Project is defined as:

– An unmitigated or uncompensated, Project-related effect with high magnitude, extending to the LAA and of medium to long term duration, occurring continuously throughout the Project and is irreversible.

6.5.4.4.2 Surface Water Quality

The characterization criteria applied in the surface water quality effects assessment are defined in Table 6.5-7 below.

Table 6.5-7 Characterization Criteria for Residual Effects on Surface Water Quality

Characterization	Quantitative Measure or Definition of Qualitative Categories
Magnitude	**N** – TSS concentrations remain within 2% of background concentrations when averaged over a 24-hour period **L** – TSS concentrations remain within 5% or see a maximum increase of less than 5 mg/L from background levels over a 24-hour period **M** – TSS concentrations increase by greater than 5% but less than 10% from background levels over an extended period of time (24 hours to 30 days) **H** – TSS concentrations exceed background levels by 25 mg/L when background levels are between 25 and 250 mg/L. If TSS concentrations exceed 250 mg/L, TSS concentrations increase in excess of 10% of background TSS concentrations
Geographic Extent	**PA** – direct and indirect effects from Project activities are restricted to the PA **LAA** – direct and indirect effects from Project activities are restricted to the LAA
Timing	**N/A** — seasonal aspects are unlikely to affect VCs **A** — seasonal aspects may affect VCs
Duration	**ST** – effects are limited to the construction phase or operations phase **MT** – effects occur in the construction phase and operations phase **LT** – effects occur in the construction phase and operations phase and persist in closure **P** – valued component unlikely to recover to baseline conditions
Frequency	**O** – effects occur once **S** – effects occur at irregular intervals throughout the Project **R** – effects occur at regular intervals throughout the Project **C** – effects occur continuously throughout the Project
Reversibility	**RE** – VCs will recover to baseline conditions before or after Project activities have been completed. **PR** - mitigation cannot guarantee a return to baseline conditions **IR** – effects to VCs are permanent and will not recover to baseline conditions

A significant adverse effect to surface water quality from the Project is defined as:

– A Project-related effect with a high magnitude, extending to the LAA, of medium to long term duration, occurring at regular frequency and is only partially reversible to irreversible.

6.5.5 Project Interactions and Potential Effects

Potential Project interactions with surface water are presented in Table 6.5-8 below.

Table 6.5-8 Surface Water Project Interaction

Project Phase	Relevant Project Activity
Construction	Clearing, grubbing, and grading Topsoil, overburden, and waste rock management Surface infrastructure installation and construction Haul road construction Collection ditch and settling pond construction General waste management
Operation	Gypsum management (extraction, loading, hauling, screening) Topsoil, overburden, and waste rock management Water management Haul road construction and maintenance Petroleum products management Maintenance and repairs General waste management
Closure	Earthworks Water management General waste management

6.5.5.1 Surface Water Quantity

The average annual flow volumes and percent changes for baseline, Phase 1 of operation, Phase 2 of operation, pit filling and closure conditions at each of the 17 AP are presented in Table 6.5-9 below.

Table 6.5-9 Assessment point summary results for mean annual conditions

Assessment Point	Baseline Flow Volume (m3)	Baseline Flow Rate (L/s)	Percent Change from Baseline			
			Phase 1	Phase 2	Pit Filling	Closure
1	1,241,581	39.4	-16%	-37%	-31%	-31%
2	847,327	26.9	1%	-3%	-3%	-1%
3	3,397,509	107.7	0%	15%	-2%	-6%
4	5,778,887	183.2	3%	11%	2%	1%
5	257,870	8.2	0%	0%	0%	0%
6	592,872	18.8	0%	0%	0%	0%
7	6,859,151	217.5	1%	7%	-1%	1%
8	7,343,483	232.9	1%	7%	-1%	1%
9	37,484,739	1,188.6	0%	0%	0%	0%
10	874,711	27.7	-22%	-25%	-25%	-25%
11	38,384,011	1,217.1	0%	-1%	-1%	-1%
12	626,188	19.9	47%	56%	3%	14%
13	41,014,330	1,300.6	0%	0%	-1%	0%
14	72,387,000	2,295.4	0%	0%	0%	0%
15	73,038,000	2,316.0	0%	0%	0%	0%
16	80,384,000	2,549.0	0%	1%	0%	0%
17	187,538	5.9	0%	0%	0%	0%

The predicted impacts to each AP are summarized below. Due to the presence of the black ash within the PA, annual flows were assessed for this water balance analysis. As discussed in Section 6.8, impacts to the hydrology of the watersheds draining to the black ash locations are to be minimized as the hydrology of these watercourses must match baseline conditions to prevent impacts to the black ash communities. Due to this, supplemental flow pumping system is required to mitigate any potential flow losses to AP5, AP6 and AP17. The purpose of this assessment was to determine if there was sufficient water on the PA to direct towards these catchments to mitigate potential flow loss. The annual assessment has successfully indicated that there is sufficient surface water within the PA to maintain flow to these catchments.

The operations of the supplemental flow pumping system including and the outlet structures will be designed during the detailed design phase to support subsequent permit/approval applications. The outlet structures will be designed in such a way as to mimic the baseline hydrology on a month-to-month basis. This can be accomplished using a multitude of methods including but not limited to; a small pond at the outlet of the pump to control flow, scheduled pumping times, outlet wetlands to sow the release of water or level spreaders to mimic overland flow. These potential outlet structures will be assessed in conjunction with mine operating procedures and water balance requirements to ensure the month-to-month hydrology of black ash communities is unaffected.

Further detail on the water balance analysis conducted for this assessment is provided in Appendix F.2.

AP1

The greatest change in annual flows predicted for AP1 occur during Phase 2 with a decrease of 37% (i.e., high magnitude). The AP1 contributing drainage area is reduced due to development and construction of the overburden stockpile during Phase 1 and Phase 2. The overburden stockpile will remain during closure resulting in irreversible reductions in the flow at AP1.

AP2

The greatest change in annual flows predicted for AP2 occur during Phase 2 and during pit filling with a decrease of 3% (i.e., low magnitude). The AP2 flows decrease due to reduction in baseflow from the development of the open pit and eventually the formation of the pit lake. The reduction in flow at AP2 is negligible despite the pit lake remaining in perpetuity at an elevation lower than the baseline water table.

AP3

The greatest change in annual flows predicted for AP3 occur during Phase 2 with an increase in flow of 15% (i.e., high magnitude). The AP3 flow increases due to expansion of the contributing drainage area from development of the open pit and overburden stockpile. In addition, all water from the open pit will eventually be discharged to AP3, accounting for the increase over baseline conditions. The filling of the pit lake will result in additional lake evaporation from within the catchment resulting in a decrease in flow at AP3 of 6% (i.e., medium magnitude) in closure.

AP4

The greatest change in annual flows predicted for AP4 occur during Phase 2 with an increase in flow of 11% (i.e., high magnitude). AP4 is downstream of AP3 and increases in flow due to the expansion of the contributing drainage area from development of the open pit and overburden stockpile. In addition, all water from the open pit will eventually be discharged to AP3, eventually leading to AP4, accounting for the increase over baseline conditions. During pit filling conditions and closure conditions the flow changes are a 2% and 1% increase respectively indicating there are low to negligible impacts on a long-term basis.

AP5

There are no predicted changes to annual flow rates for AP5 during any phases of Project development (i.e., negligible magnitude). AP5 is located in a catchment where black ash is present. As such, supplemental flows will be directed to this catchment during Phase 1, Phase 2 and pit filling to match existing hydrology and mitigate impacts to the black ash community. This water balance assessment has demonstrated there is sufficient water to ensure there are no potential losses in flow to the black ash community on an annual basis. The design of the outlet structure for pumped water flowing into the AP5 catchment will be refined during later design phases to ensure there are no changes to hydrology within the AP5 catchment on a month-to-month basis.

AP6

There are no predicted changes to annual flow rates for AP6 during any phases of Project development (i.e., negligible magnitude). AP6 is located in a catchment where black ash are present. As such, supplemental flows will be directed to this catchment during Phase 1, Phase 2 and pit filling to match existing hydrology and mitigate impacts to the black ash community. This water balance assessment has demonstrated there is sufficient water to ensure there are no potential losses in flow to the black ash community on an annual basis. The design of the outlet structure for pumped water flowing into the AP6 catchment will be refined during later design phases to ensure there are no changes to hydrology within the AP6 catchment on a month-to-month basis.

AP7

The greatest change in annual flows predicted for AP7 occur during Phase 2 of operation with an increase in flow of 7% (i.e., medium magnitude). AP7 is downstream of AP4 and increase in flow due to the expansion of the contributing drainage area from development of the open pit and overburden stockpile. In addition, all water from the open pit will eventually be discharged to AP3, eventually leading to AP7, accounting for the increase over baseline conditions. During Phase 1, pit filling and closure conditions the annual flow changes are 1%, -1% and 1% respectively, indicating there are negligible impacts on a long-term basis.

AP8

The greatest change in annual flows predicted for AP8 occur during Phase 2 of operation with an increase in annual flow of 7% (i.e., medium magnitude). AP8 is downstream of AP7, AP4 and AP3 and increase in flow due to the expansion of the contributing drainage area from development of the open pit and overburden stockpile. In addition, all water from the open pit will eventually be discharged to AP3, eventually leading to AP8, accounting for the increase over baseline conditions. During Phase 1, pit filling and closure conditions the annual flow changes are 1%, -1% and 1% respectively, indicating there are negligible impacts on a long-term basis.

AP9

AP9 is located upstream of the Project, on the Gays River. There are negligible predicted impacts during all phases of Project development.

AP10

The greatest change in annual flows predicted for AP10 occur during Phase 2, pit filling and closure conditions with a decrease in flow of 25% (i.e., high magnitude). AP10 occurs on a tributary of the Gays River and a portion of the AP10 catchment will be diverted away from AP10 due to the development of the overburden stockpile and other mine infrastructure. The predicted impacts to flow at AP10 will be continuous until a point in time when the stockpiles have revegetated and there is no longer a need for erosion protection works for stockpile runoff. At this point CertainTeed will re-evaluate the closure conditions and decommission any unnecessary ditches. Decommissioning of unnecessary ditches would re-establish flow to AP10 similar to baseline conditions.

AP11

The greatest change in annual flows predicted for AP11 occur during Phase 2, pit filling and closure conditions with a decrease in flow of 1% (i.e., negligible magnitude).

AP12

The greatest change in annual flows predicted for AP12 occur during Phase 2 of operations with an increase in flow of 56% (i.e., high magnitude). AP12 is located on a tributary to the Gays River where the north settling pond will discharge into. The increase in flow to AP12 is due to directing additional surface water runoff from the PA towards the north settling pond for treatment before ultimate discharge to AP12. Impacts during Phase 1, pit filling and closure conditions range from high magnitude impact (47% increase in Phase 1, 14% increase in closure) to low magnitude (3% increase during pit filling). The predicted impacts to flow at AP12 will be continuous until a point in time when the stockpiles have revegetated and there is no longer a need for erosion protection works for stockpile runoff. At this point CertainTeed will re-evaluate the closure conditions and decommission any unnecessary ditches. Decommissioning of unnecessary ditches would direct a portion of flow away from AP12, reducing the impacts on a long-term basis.

AP13

The greatest change in annual flows predicted for AP13 occur during pit filling conditions with a decrease in flow of 1% (i.e., negligible magnitude).

AP14

AP14 is located on the Gays River. There are negligible predicted impacts during all phases of Project development.

AP15

AP15 is located on the Gays River. There are negligible predicted impacts during all phases of Project development.

AP16

The greatest change in annual flows predicted for AP16 occur during phase 2 of operation with an increase in flow of 1% (i.e., negligible magnitude).

AP17

There are no predicted changes to annual flow rates for AP17 during any phases of Project development (i.e., negligible magnitude). AP17 is located in a catchment where black ash are present. As such, supplemental flows will be directed to this catchment during Phase 1, Phase 2 and pit filling to match existing hydrology and mitigate impacts to the black ash community. This water balance assessment has demonstrated there is sufficient water to ensure there are no potential losses in flow to the black ash community on an annual basis. The design of the outlet structure for pumped water flowing into the AP17 catchment will be refined during later design phases to ensure there are no changes to hydrology within the AP17 catchment on a month-to-month basis.

In summary, Annand Brook will experience increased flow during all phases of the Project. Annand Brook flows north converging with the Gays River. Based on the water balance completed for the Project, the flow is balanced at the convergence location. Flow changes within the Gays River are negligible.

Section 6.6 and 6.7, provide additional detail on how these changes to flow effect Wetlands and Fish and Fish Habitat.

6.5.6 Mitigation

Project mitigation measures protective of surface water resources is detailed in Table 6.5-10 below.

Table 6.5-10 Surface Water Mitigation Measures

Project Activity	Mitigation Measure
Construction	Road and site grading will be directed away from wetlands and watercourses, where possible.
	Ditching around stockpiles will collect all run-off for treatment of TSS prior to discharge.
	Sediment control fences will be installed in areas (e.g., slopes and embankments) where organic materials and till are exposed to potential erosion and siltation. Sediment control fences will be inspected and maintained until the disturbed areas have stabilized and revegetation has occurred.
	All ditching will be designed to reduce erosion and sedimentation through use of rock check dams, silt fences, plunge pools, and grading as appropriate. All contact water ditching will be lined to mitigate contaminant leaching into the receiving environment.
	Perimeter grading will divert non-contact water from entering the open pits to reduce the amount of dewatering required.
	Design of stockpiles will include perimeter ditches to direct water to settling ponds prior to discharge.

Table 6.5-10 Surface Water Mitigation Measures

Project Activity	Mitigation Measure
	Existing drainage patterns will be maintained to the extent feasible with the use of culverts and bridges.
	Disturbed areas will be graded and/or scarified, covered with organic material and till, where required, and seeded with native seed mix to promote natural plant colonization and succession.
	The overburden stockpile will be covered with till and organic material immediately following completion.
Construction and Operations	Disturbed areas will be limited to the extent practical.
	Clearing associated with road construction will be limited, where possible, to the width required for the road embankment and drainage areas.
	Blasting, if required will be conducted by a certified contractor who will develop a Blast Management Plan and Blast Designs for review and approval prior to carrying out the work.
	Surfaces of organic material and till stockpiles will be stabilized during extended periods between usage by means of vegetating or covering exposed surfaces.
Construction, Operations, and Closure	Erosion and sediment control measures will be established around all disturbed areas.
	Disturbed areas will be monitored to ensure erosion and sediment control measures are maintained/effective and to identify if additional mitigation is required.
	Seepage and surface runoff from the stockpiles and open pit will be collected in two settling ponds located throughout the PA and will be discharged to Annand Brook and the Gays River.
	All surface water discharges from settling ponds to the natural environment will be sampled as per requirements listed in IA to ensure water quality conforms to applicable regulations and guidelines.
	Progressive water management will be implemented over the life of Project. This includes construction of water management infrastructure as areas are developed.
	Erosion and sediment controls will be implemented throughout the PA and in all Project phases as per the Conceptual Water Management Plan located in Appendix F.3.
	An Environmental Emergency Response and Spill Contingency Plan will include information on incident prevention, response procedures, and response training in the case of accidental spills.
	A maintenance schedule will be developed and implemented to provide for regular maintenance and inspection of Project mine water management infrastructure.
	Spill kits will be available in the vehicles and machinery circulating in the PA and at various places throughout the PA to facilitate the management of accidental spills. Spill kits will include a quantity of sufficient absorbent materials as well as watertight containers intended to collect petroleum products and other hazardous residual materials.
	Petroleum products (hydrocarbons) will be handled in such a way as to prevent and control leaks and spills. Hydrocarbon absorbents will be kept at all times on the premises of storage or use of oil products.
	Disposal and handling of waste oils and hazardous waste will be as recommended by the suppliers and/or manufacturers in compliance with federal and provincial regulations.
	Fuel will be obtained from a licensed contractor who will be required to comply with federal and provincial regulations.
Operations	Runoff from mine pit walls and groundwater seepage will be collected, with water pumped to the north settling pond during Phase 1 and south settling pond in Phase 2 prior to discharge to the receiving environment.
	Water pumped to dewater the open pits will be discharged to the Gays River during Phase 1 and Annand Brook during Phase 2 to mitigate surface water flows.
Operations and Closure	The settling ponds will be decommissioned during reclamation of the PA. Upon establishment of vegetation on the PA CertainTeed will reevaluate the need for surface water ditches and will decommissions any unnecessary surface water ditches.

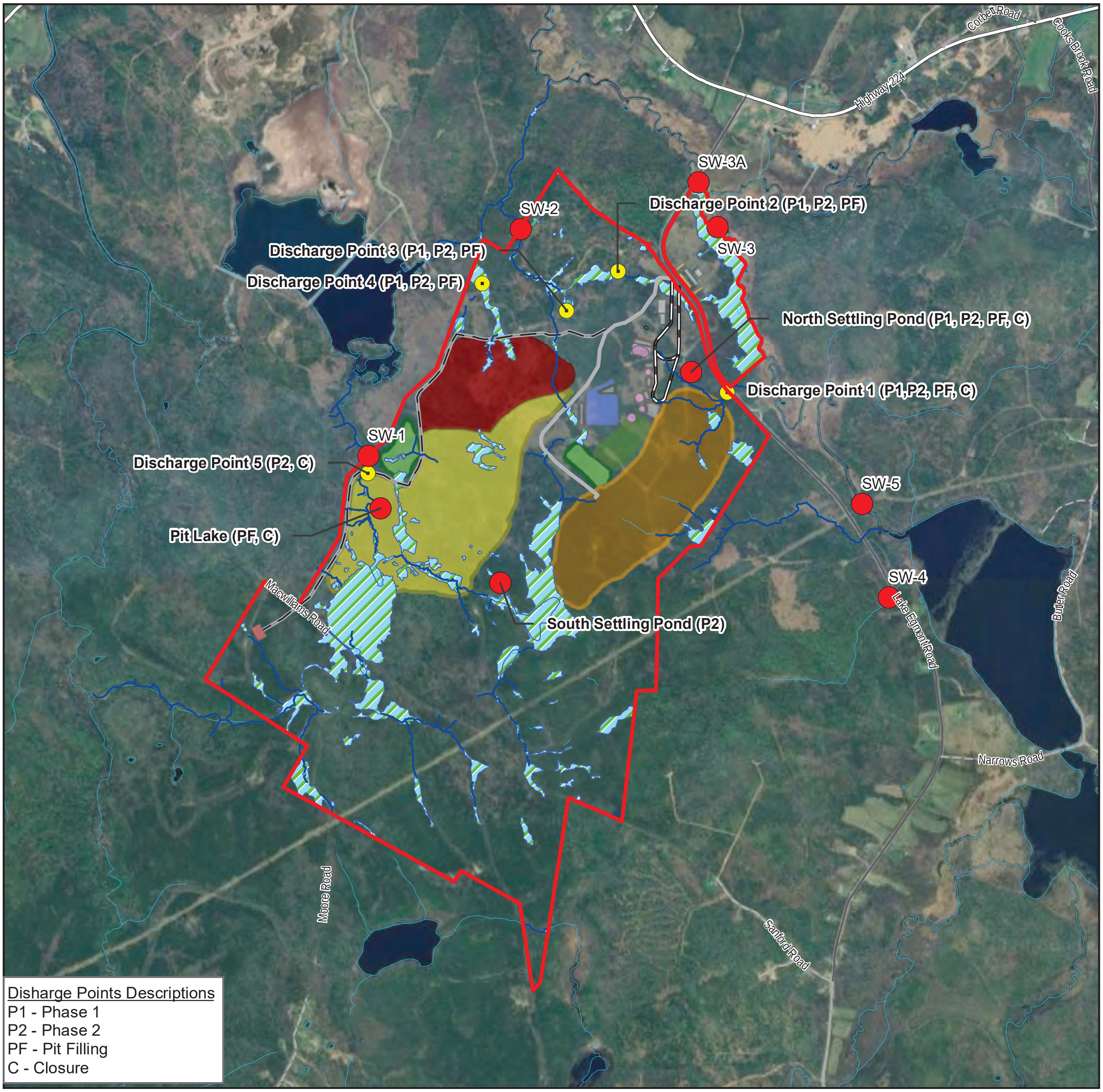
6.5.7 Monitoring and Follow-up

Monitoring will be completed over the life of the Project to validate the predicted impacts to surface water quantity and quality and the efficacy of planned mitigation measures. Discharge points and associated monitoring locations are indicated on Figure 6.5-4.

During the construction phase, five water quality surveillance locations are proposed to be sampled weekly for the first three months of construction, and then monthly from thereon until the end of closure. Continuous water levels will continue at five surface water stations through to the end of closure. A detailed Surface Water Monitoring Plan will be developed for all phases of the Project and will support future permitting/approval requirements. The plan will outline the discharge monitoring requirements. It’s anticipated that monthly monitoring will be required for TSS and metals and will occur at each settling pond prior to pumping or discharge of water to the receiving environment.

Surface water quality and quantity monitoring will continue following the completion of the operation phase throughout the pit filling period and will be terminated once water quality and quantity stabilize and following consultation with applicable regulators.

Discharge to the receiving waterbody from the open pit is anticipated to begin in 14 years following completion of operating conditions. SW-1 will remain in place to confirm CCME/EQS compliance and will be monitored for three years.



Legend

- Discharge Point
- Surface Water Monitoring Locations
- Project Area
- Watercourse (Field Delineated)
- Stream
- Wetland (Field Delineated)
- Collector Road
- Local Road
- Local Road - Unpaved
- Haul Road
- Access Road
- Truck Loading Road

Mine Infrastructure

- Building
- Explosive Storage
- Fuel Pad
- Overburden Stockpile
- Parking Lot
- Pit Excavation
- Process Rejects Stockpile
- ROM Pad
- Weigh Scale
- Various Product Piles
- Staging Area
- Topsoil Stockpile
- Pit Backfill

Paper Size ANSI A

0 300 600 900

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 20N

N

GHD

CERTAINTEED CANADA, INC
LAKE EGMONT, HALIFAX CO, NOVA SCOTIA
ANTRIM GYPSUM PROJECT

CONTACT WATER DISCHARGE LOCATIONS

Project No. 12601021
Revision No. -
Date Aug 14, 2024

FIGURE 6.5-4

N:\CA\Halifax\Projects\661\12601021\GIS\Maps\Deliverables\RPT006\12601021-RPT006-HX021-Fig 6.5-4 Contact Water Discharge Locations.mxd
Print date: 14 Aug 2024 - 10:57

Data source: Google Satellite Imagery Accessed 2024-08-14.

6.5.8 Residual Effects and Significance

The predicted residual environmental effects of the Project on surface water resources are assessed to be adverse, but not significant. The overall residual effect of the Project on surface water is assessed as not likely to have significant adverse effects after appropriate mitigation measures have been implemented as summarized in Table 6.5-11.

A significant adverse effect to the Surface Water Resources (quantity and quality) VC was defined in Section 6.5.4.4 as:

- An unmitigated or uncompensated, Project-related effect for surface water quantity with high magnitude, extend to the LAA and of medium to long term duration, occur at continuously throughout the Project and are irreversible.
- A Project-related effect for surface water quality with a high magnitude, extends to the LAA and of medium to long term duration, occur at regular frequency and are only partially reversible to irreversible.

Residual effects to surface water resources are summarized in Table 6.5-11, and are further addressed in Sections 6.6 (Wetlands) and 6.7 (Fish and Fish Habitat).

Table 6.5-11 Residual Effects on Surface Water

Component	Project Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Effects Characteristics						Residual Effect	Significance
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Surface Water Quality	Construction – Clearing, grubbing, and grading; infrastructure construction	Erosion and sediment controls	A	L Erosion and sediment controls are expected to minimize impacts to receiving waterbodies	PA	A	MT	C	PR	Change in water quality	Not significant
	Operations – Effluent discharge into the receiving environment.	Contact water collection and treatment	A	L Erosion and sediment controls are expected to minimize impacts to receiving waterbodies	LAA	A	LT Contact water will be collected and treated for TSS for construction and operation.	C	IR	Change in water quality	Not significant
	Closure – Effluent discharge during reclamation activities.	Erosion and sediment controls	A	L Erosion and sediment controls are expected to minimize impacts to receiving waterbodies	PA	A	MT	C	IR	Change in water quality	Not significant
Surface Water Quantity	Operation, pit filling and closure – reduction in flow to Annand Brook headwaters (AP1, 2), AP10	Micro-siting Project infrastructure away from watercourses where possible. Fish Habitat Offsetting Plan Supplemental flow pumping Long term decommissioning of mine infrastructure	A	H Flow reductions from baseline conditions greater than 10% Note: magnitude of impacts will vary temporally. Refer to Section 6.5.5.1 for additional details	LAA	A	P	C	IR	Watercourse alteration - High magnitude flow changes will be mitigated by Fisheries Habitat Offsetting Plan.	Not significant
	Operations, pit filling and closure – Increase in flow to Annand Brook (AP3, 4), AP12	Detailed design of the outlet structure of the north settling pond to reduce scouring. Fish Habitat Offset Long term decommissioning of mine infrastructure	A	H Flow increase from baseline conditions greater than 10% Note: magnitude of impacts will vary temporally. Refer to Section 6.5.5.1 for additional details	LAA	A	MT	C	IR	Watercourse alteration - High magnitude flow changes will be mitigated by Fisheries Habitat Offsetting Plan.	Not significant

Legend (refer to Tables 6.5-6 and 6.5-7 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A – Adverse P – Positive	N – Negligible L – Low M – Moderate H – High	PA – Project Area LAA – Local Assessment Area RAA – Regional Assessment Area	N/A – Not Applicable A – Applicable	ST – Short-Term MT – Medium-Term LT – Long-Term P – Permanent	O – Once S – Sporadic R – Regular C – Continuous	R – Reversible IR – Irreversible PR – Partially Reversible

6.6 Wetlands

6.6.1 Rationale for Valued Component Selection

Wetlands provide important ecological value and functions, such as habitat for aquatic and terrestrial flora and fauna (including priority species), managing water storage and flow, and improving water quality.

In NS, wetlands are protected under the *Activities Designation Regulation* of the *Environment Act* and the Wetland Conservation Policy (NSECC, 2019). The NS *Environment Act* defines a wetland as "land referred to as a marsh, swamp, fen, or bog that either periodically or permanently has water table at, near, or above the land surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions".

The NS Wetland Conservation Policy applies to all freshwater and certain tidal wetlands with the objectives to prevent loss a net loss of wetland area or function, particularly Wetlands of Special Significance (WSS), promote wetland protection, enhance impact mitigation efforts (NSECC, 2019). Under this policy and the *Environment Act,* approvals are required to alter wetlands, with certain exceptions (e.g., area <100 m^2, specific linear developments, etc.).

6.6.2 Baseline Program Methodology

Detailed wetland assessment methodologies, results, and limitations are presented in the Antrim Gypsum Project Biophysical Baseline Report: Wetlands (Appendix G.1). Baseline wetland surveys were completed with the key objectives of facilitating avoidance of wetlands where possible, assessing wetland function (including habitat provisions for SAR), understanding the potential Project interactions with wetlands and evaluating appropriate mitigations, and to support wetland regulatory applications and permitting.

A review of background desktop resources was completed to aid in the determination of in-field assessment of wetland habitat. These resources included topographic maps, provincial databases, and aerial photography. Wetland field surveys were completed by Strum within the PA in 2022 and 2023 in accordance with the Corps of Engineers Wetland Delineation Manual (United States Army Corps of Engineers, 2009) and the Regional Supplement to the United States Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (United States Army Corps of Engineers, 2012).

The entirety of the PA was surveyed in-field for wetlands. When identified, wetland boundaries were delineated, and vegetation, hydrology, and soils data were recorded. Wetland functional assessments were completed for each wetland using the Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC) evaluation tool. All wetlands were assessed in-season (June-September) to yield accurate data collection and improve detection of priority species. Where appropriate and using species-specific methods, dedicated field surveys were conducted to assess the suitability of wetland habitat for wetland-specific species, especially those considered to be SAR or SOCI. Species-specific methodologies are presented in the respective Antrim Gypsum Project Biophysical Baseline Report: Fish and Fish Habitat, Avifauna, and Flora, Fauna, and Habitat Appendices (Appendix H.1, I.1, and I.2).

6.6.3 Baseline Conditions

A total of 79 freshwater wetlands are present within the PA, totalling 64.16 ha and representing a land cover of 11% of the total PA. Delineated wetlands range in size from 0.01 ha to 15.66 ha and are predominantly swamps. Details on each delineated wetland are provided in the Antrim Gypsum Project Biophysical Baseline Report: Wetlands (Appendix G.1).

While only 5% of the field delineated wetlands are complexes, comprising of swamp and fen components, complexes equate to 56% of the total wetland area within the PA. The largest wetland complex is Wetland WL6, which is 15.66 ha, consisting of tree swamp and fen.

Swamps (non-complex) represent the most abundant wetland class in the PA, accounting for 92% of all wetlands, and 40% of wetland area. Identified swamps are predominantly mixedwood or coniferous, with few deciduous dominant swamps. The majority of the swamps had a prominent shrub layer, which consisted of black spruce

(*Picea mariana*), balsam fir (*Abies balsamea*), red maple (*Acer rubrum*) and tamarack (*Larix laricina*). Seventy-seven percent of delineated swamps, by area, are under 1 ha in size (n=64). Fifty-four percent are hydrologically isolated (no defined inflow or outflow), 24% have throughflow, 16% are in a headwater (outflow) position, and 3% receive surface water inflow but lack a defined outflow.

One fen (non-complex, WL23) is present within the PA, accounting for 1% of all wetlands. Four wetland complexes (WL6, WL9, WL41, and WL51) contained fen components. All fens either have continuous or discontinuous throughflow watercourses and are dominated by graminoid species such as three-seeded sedge (*Carex trisperma*) and wool grass (*Scirpus cyperinus*).

One marsh (WL40) is located within the PA, and there are no wetland complexes containing marsh characteristics. The single marsh is in a headwater position and has a dominant herbaceous cover of swamp candles (*Lysimachia terrestris*), white meadowsweet (*Spirea alba*), and blue flag iris (*Iris versicolor*).

No bogs were observed within the PA.

Wetland function assessments were completed for each wetland within the PA using the WESP-AC wetland evaluation technique detailed in the Antrim Gypsum Project Biophysical Baseline Report: Wetlands (Appendix G.1). The WESP-AC evaluation results and functional scores for all wetlands in the PA show that the grouped function and benefit scores ranged from lower to higher. Wetlands within the PA generally showed higher function scores for the water quality, aquatic support, and transitional habitat groups. While higher benefit scores were generally provided for aquatic habitat and transitional habitat groups. No functional WSS were identified through the WESP-AC assessments.

Thirteen wetlands within the PA had field observations of threatened or endangered SAR (listed under SARA and/or NSESA), within their boundaries. Of those, 10 wetlands are proposed as potential WSS, as they were found to support habitat for critical life functions of the observed SAR. It is anticipated that these 10 wetlands will be classified as WSS and are presented as such herein. All 12 wetlands with confirmed SAR will be reviewed with NSECC, and final WSS designation will be made by NSECC.

In general, wetland hydrology within the PA is driven by lateral water movement in the form of linear wetlands, drainage flow paths, and watercourses. Generally, water on the landscape is flowing, either on the surface or subsurface, resulting in the lack of ombrotrophic wetlands (i.e., bogs). All water within the PA's catchment eventually flows into the Gays River. The southwestern corner of the PA flows into Far Brook, eventually flowing into the South Branch of the Gays River. The western portion of the PA flows into Annand Brook and the eastern portion flows directly into the Gays River.

6.6.4 Effects Assessment Methodology

6.6.4.1 Boundaries

The scope of the Project's wetland effects assessment is defined by spatial (i.e., geographical extent of Project effects), temporal (i.e., the timing of potential effects), administrative, and technical boundaries. Spatial boundaries were defined based on the expected maximum extent of direct and indirect impacts to wetlands. Temporal boundaries are based on the anticipated duration and timing of Project activities. The assessment boundaries are described below.

Spatial Boundaries

The spatial boundaries used for the assessment of effects on wetlands are defined below:

- PA – The PA encompasses the immediate area in which Project activities may occur and are likely to cause direct and indirect effects to VCs.
- LAA – The LAA encompasses adjacent areas beyond the PA and the maximum extent of potential Project impacts. The LAA has been defined as the tertiary watershed in which the Project falls, the 1DG-1-WW Shubenacadie River tertiary watershed (Figure 6.6-1)
- An RAA has not been defined for this VC, as the maximum extent of indirect impacts is expected to be within the LAA.

Temporal Boundaries

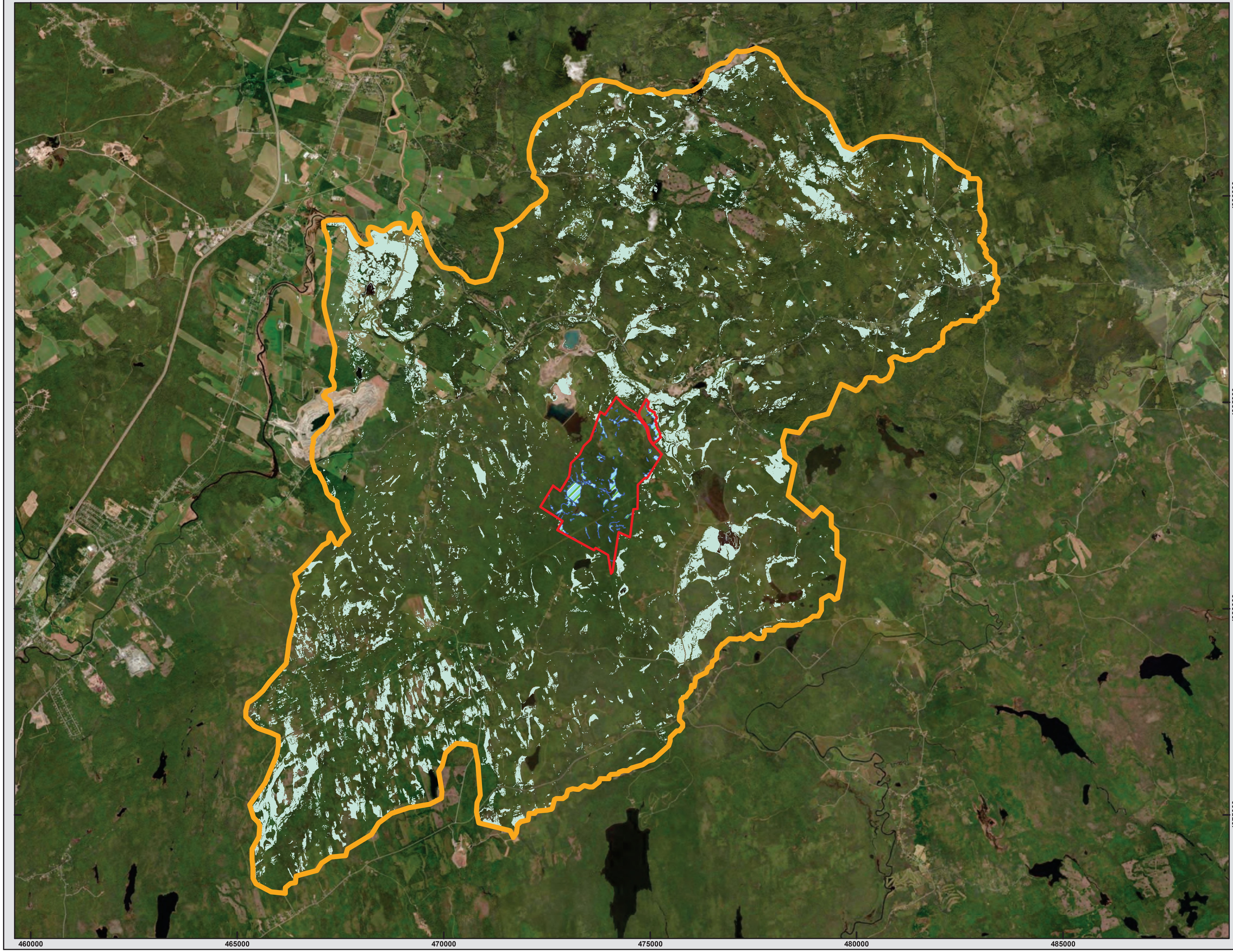
The temporal boundaries for the wetland effects assessment are defined by the construction, operation, and closure phase of the Project.

Technical Boundaries

Prediction of wetland habitat within the LAA was constrained by the limitations of the wetland model developed for the effects assessment. Wetlands modelled at the LAA scale were provided by NSECC and have not been field verified nor assessed. Due to available GIS inputs and model variables, wetlands within the LAA may be conservatively over or under predicted.

Administration Boundaries

Administrative boundaries for the protection and conservation of wetland habitat in NS include the NS Wetland Conservation Policy (NSECC, 2019), the NS Environment Act, and the NS Activities Designation Regulations.



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GHD

FIGURE 6.6-1
Wetland Local Assessment Area
Antrim Gypsum Project
Cooks Brook, Nova Scotia

NSECC Modeled Predictive Wetlands
Field Delineated Wetlands
Wetland LAA (Tertiary Watershed 1DG-1-WW)
Project Area

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 1,250 2,500 5,000 m

1:85,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By: SS

Project Number: 24-9991
Date: 7/11/2024

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CONSULTING

Document Name: Antrim Wetland LAA

6.6.4.2 Thresholds for Determination of Significance

Significance of Project related impacts to wetlands were determined as presented in Table 6.6-1 below.

Table 6.6-1 Characterization Criteria for Environmental Effects to Wetlands

Characterization	Quantitative Measure or Definition of Qualitative Categories
Magnitude	**N** – a loss of <1% of wetland habitat of modeled or field delineated wetlands in the LAA, and no direct or indirect impact to identified potential WSS **L** – a loss of up to 5% of wetland habitat of modeled or field delineated wetlands in the LAA, and no direct or indirect impacts to identified potential WSS. **M** – a loss of up to 10% of wetland habitat of modeled or field delineated wetlands in the LAA, including direct or indirect impacts to identified potential WSS. **H** – a loss of >10% of wetland habitat of modeled or field delineated wetlands in the LAA, including direct or indirect impacts to identified potential WSS.
Geographic Extent	**PA** – direct and indirect effects from Project activities are restricted to the PA. **LAA** – Residual effects extend into the LAA. **RAA** – not defined for this assessment.
Timing	**NA** – seasonal aspects are unlikely to affect VC. **A** — seasonal aspects may affect VC.
Duration	**ST** – effects are limited to occur from as little as 1 day to 12 months. **MT** – effects can occur beyond 12 months and up to 3 years. **LT** – effects extend beyond 3 years. **P** – valued component unlikely to recover to baseline conditions.
Frequency	**O**– effects occur once. **S** – effects occur at irregular intervals throughout the Project. **R** – effects occur at regular intervals throughout the Project. **C** – effects occur continuously throughout the Project.
Reversibility	**RE** – wetlands will recover to baseline conditions before or after Project activities have been completed. **PR –** mitigation cannot guarantee a return to baseline conditions. **IR**– effects to VCs are permanent and will not recover to baseline conditions.

A significant adverse effect from the Project on wetlands is defined as:

– An effect that results in an unmitigated or uncompensated net loss of wetland habitat, including WSS, as defined under the NSECC Wetland Conservation Policy (NSECC, 2019), and its associated no-net loss policy. An adverse effect that does not cause a permanent loss of wetland habitat, in consideration of wetland functions, WSS and proposed mitigation/compensation, is not considered a significant adverse effect.

6.6.4.3 Wetland Modelling

Predictive wetland modelling provided by NSECC was used to predicted wetland mapping for areas within the LAA, beyond the PA, that have not been field delineated or assessed. The impacts within the PA were compared to the modelled wetlands at the LAA (watershed) scale to assess magnitude of predicted impacts outlined by the significance characterization criteria in Table 6.6-1. This assessment recognizes that modelled wetland habitat is an estimate of wetland area using desktop methods and may underrepresent wetland area (e.g., known difficulties in predicting isolated tree dominated wetlands).

6.6.5 Project Interactions and Potential Effects

Potential Project interactions with wetlands are presented in Table 6.6-2 below. Wetland alteration permitting will be required where avoidance is not possible.

Table 6.6-2 Wetland Project Interactions

Project Phase	Relevant Project Activity
Construction	Clearing, grubbing, and grading Topsoil, overburden, and waste rock management Surface infrastructure installation and construction Haul road construction Collection ditch and settling pond construction
Operation	Gypsum management (extraction, loading, hauling, screening) Topsoil, overburden, and waste rock management Water management Haul road construction and maintenance Petroleum products management
Closure	Earthworks Water management

The placement of infrastructure related to the Project attempted to avoid and mitigate impacts to wetlands whenever possible. Project infrastructure has undergone multiple design iterations to reduce impacts to the environment, including wetlands, while also considering other VCs as well as engineering and design constraints.

Project activities will result in direct and potential indirect effects to wetlands, despite careful consideration of design options. These will be primarily through the construction phase (direct impacts) and potentially during the operations phase (indirect impacts). The following sections describe the expected Project interactions and potential effects pathways for wetlands. An overview of Project infrastructure interactions with wetlands is provided in Figure 6.6-2. Where practical, Project infrastructure was micro-sited, with the aim in reducing impacts to wetland habitat, specifically potential WSS.

These interactions have the potential to change wetlands from baseline conditions as outlined below.

– Changes in wetland habitat (quantity) due to direct disturbance to wetland area through construction of Project infrastructure resulting in direct impact to wetlands.
– Changes in wetland habitat (quality) due to clearing of wetland vegetation, introduction of invasive flora species through vehicles and/or people and dust and/or sediment accumulation from construction and operations resulting in indirect impacts to the health and integrity of wetlands.
– Changes to wetland hydrology due to change in contributing catchment area by Project infrastructure and resultant changes in flow and hydrological inputs as well as groundwater drawdown due to the open pit resulting in indirect impacts to wetland hydrology.

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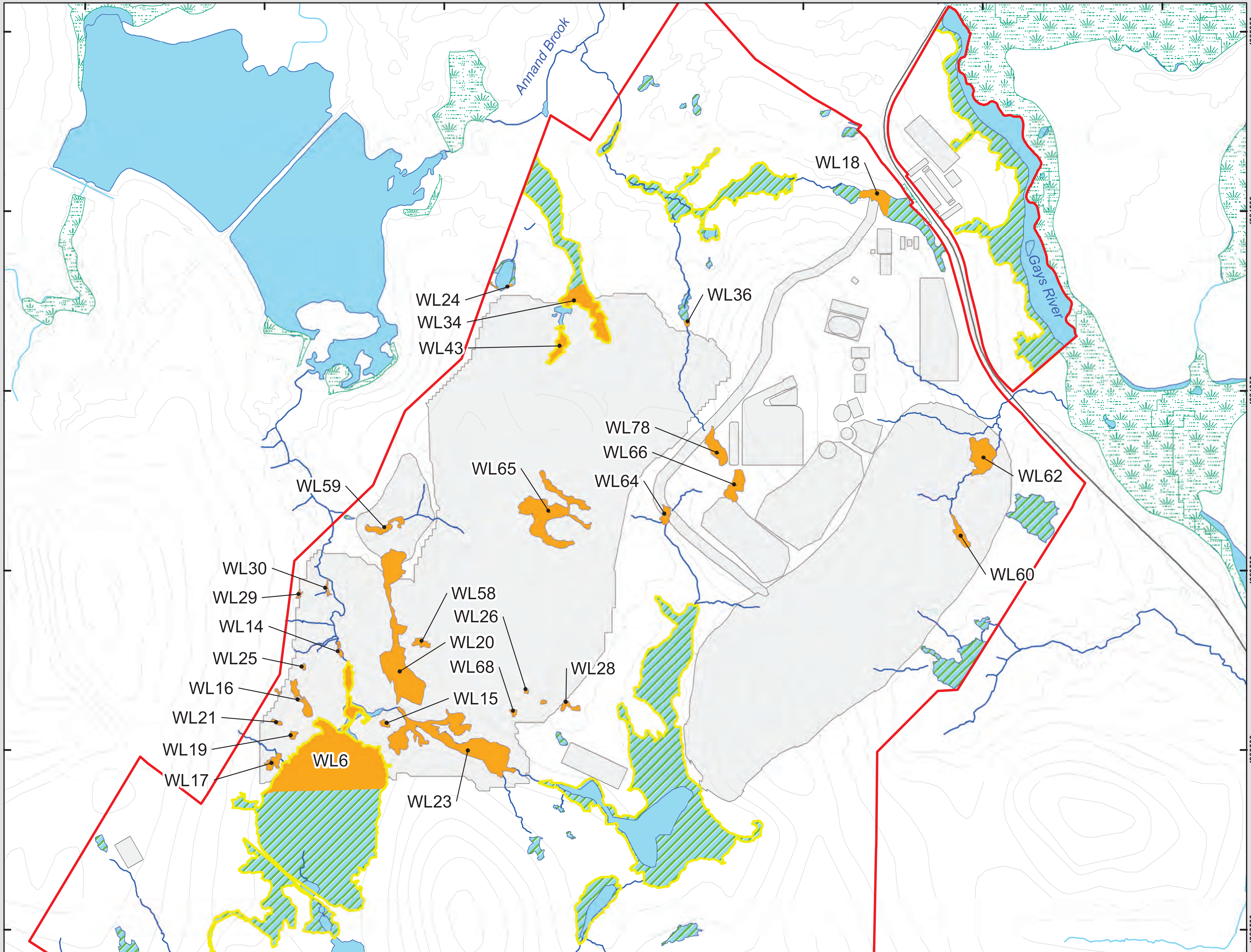
FIGURE 6.6-2
Wetland Impacts

Antrim Gypsum Project
Cooks Brook, Nova Scotia



Field Delineated Watercourse
NSTDB Watercourse
Predicted Direct Impacts to Wetlands
Proposed Wetlands of Special Significance (WSS)
Field Delineated Wetlands
NSECC Wetland Inventory
Open Water
Project Infrastructure
Project Area

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 150 300 600 m

1:10,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By: SS

Project Number: 24-9991
Date: 7/12/2024

CONSULTING

Document Name: Antrim Wetland Impacts

6.6.5.1 Direct Impacts

The direct impact to wetlands as a result of the Project are presented in Table 6.6-3 and Figure 6.6-2. Direct impacts are considered the direct loss of wetland habitat due to the physical loss as the result of infrastructure construction. Direct impacts are categorized as either partial or complete. In some cases, where a partial alteration is proposed (based on the location of infrastructure), the remaining portions of a wetland may not maintain a natural condition or function and is considered a complete alteration. Therefore, a wetland is considered completely altered when 100% of the wetland is directly impacted by the Project development or the remaining wetland area will not be self-sustaining. Additionally, to complete a more accurate assessment of predicted direct impacts, a 30 m buffer was conservatively applied on all Project infrastructure, except for the water management infrastructure and the overburden stockpile. For the effects assessment, this buffer aims to conservatively account for the Project's on the ground footprint at the time of construction (e.g., ditching, cut/fill extents, etc.), which will be refined through detailed design and permitting. As a result, the direct impact area of some wetlands has been expanded to include buffered areas and wetland fragments that lie outside of the proposed infrastructure (e.g., wetland areas isolated between infrastructure).

Each wetland proposed for alteration was assessed on a case-by-case basis by the EA Study Team of wetland biologists. When determining the extent of direct impacts, the following was considered:

- The hydrologic regime
- Wetland type and morphology
- Alteration type
- Indirect effects (e.g., edge effects)
- The relative size of the wetland compared to alteration area

The predicted extent of wetland alterations will be refined at the permitting stage and through further detailed design and engineering. Detailed designs of roads, ditching and other infrastructure will be considered during the permitting stage and will be utilized to inform the wetland monitoring program.

Table 6.6-3 Direct Wetland Impacts

Wetland ID	Wetland Type	Wetland Area (m^2)[1]	Estimated Direct Impact Area	% Direct Impact Area	Infrastructure	Alteration Type[2]
WL6 (WSS)	Complex	156602	45211	28.9	Open pit	P
WL14	Treed Swamp	352	352	100	Open pit	C
WL15	Treed Swamp	338	338	100	Open pit	C
WL16	Treed Swamp	1850	1850	100	Open pit	C
WL17	Treed Swamp	1146	1146	100	Open pit	C
WL18	Meadow Swamp	13857	3039	21.9	Open pit	P
WL19	Treed Swamp	368	368	100	Open pit	C
WL20	Treed Swamp	18501	18501	100	Open pit, topsoil stockpile	C
WL21	Treed Swamp	248	248	100	Open pit	C
WL22	Treed Swamp	124	124	100	Open pit	C
WL23	Complex	19988	19988	100	Open pit	C
WL24	Shrub Swamp	1274	236	18.5	Open pit	P
WL25	Treed Swamp	161	161	100	Open pit	C
WL26	Treed Swamp	109	109	100	Open pit	C
WL27	Treed Swamp	172	172	100	Open pit	C
WL28	Treed Swamp	675	675	100	Open pit	C
WL29	Treed Swamp	148	148	100	Open pit	C

Wetland ID	Wetland Type	Wetland Area (m²)[1]	Estimated Direct Impact Area	% Direct Impact Area	Infrastructure	Alteration Type[2]
WL30	Treed Swamp	254	254	100	Open pit	C
WL34 (WSS)	Treed Swamp	25220	7770	30.8	Open pit	P
WL36	Treed Swamp	1766	207	11.7	Open pit	P
WL43 (WSS)	Treed Swamp	2335	2335	100	Open pit	C
WL58	Treed Swamp	764	764	100	Open pit	C
WL59	Treed Swamp	1696	1696	100	Topsoil stockpile	C
WL60	Treed Swamp	1621	1621	100	Overburden stockpile	C
WL62	Treed Swamp	5458	5458	100	Overburden Stockpile	C
WL64	Shrub Swamp	1026	1026	100	Haul road	C
WL65	Shrub Swamp	12821	12821	100	Open pit	C
WL66	Shrub Swamp	2762	2762	100	Topsoil stockpile	C
WL68	Treed Swamp	263	263	100	Open pit	C
WL78	Shrub Swamp	2851	2851	100	Haul road, Staging Area	C
Totals		274,750 m²	132,494 m²		Total Complete	25
		27.4750 ha	13.2494 ha		Total Partial	5

Notes:
[1] Area of wetland within the PA. Areas beyond the PA are not field delineated.
[2] P – Partial wetland alteration, C – Complete wetland alteration

A total of 79 wetlands were identified within the PA. The Project will directly impact 30 wetlands of which 25 are expected to be completely altered, and 5 will be partially altered. Table 6.6-2 indicates the Project infrastructure that interacts with each wetland. The Project's total wetland direct impact area is expected to be 13.25 ha (partial and complete), which represents 21% of the total wetland area within the PA (64.18 ha). The remaining 49 wetlands, which account for79% of wetland area within the PA, will not be directly impacted as a result of the Project.

Infrastructure has been planned to avoid wetland impacts wherever possible, in consideration of other environmental and engineering constraints. Further infrastructure micro-siting will be conducted, and infrastructure-specific buffers will be applied as required during the wetland permitting and detailed Project design processes to further avoid and mitigate impacts to wetlands. Wetland avoidance efforts and mitigation measures are further discussed in Section 6.6.6. The impacts of the Project on fish and fish habitat within wetlands is discussed in Section 6.7. Impacts to wetland areas that are confirmed potential fish habitat are included in the drafted Conceptual Fisheries Offsetting Plan provided in Appendix H.2.

Direct Impacts to Wetlands of Special Significance

As presented in the Wetlands Baseline Report (Appendix G.1), a total of 10 wetlands were assessed as potential WSS within the PA based on SAR lichen, avian and black ash observations. All wetlands with confirmed SAR (mobile or sessile) will be reviewed with NSECC, and final WSS designations will be determined by NSECC.

Of the 10 potential WSS, seven were successfully avoided through project micro-siting6.6.6.1 . Only three are proposed to be directly impacted by Project activities and infrastructure (Table 6.6-2, Figure 6.6-2). One WSS (WL43) is proposed for complete alteration by the open pit whereas two WSS (WL6 and WL34) will be partially impacted by the infrastructure identified in Table 6.6-2 above. In total 5.53 ha of WSS, 12.09% of the total WSS area within the PA, are proposed for direct alteration. These impacts to potential WSS are specifically considered in the Project's significance thresholds and residual effects.6.6.7 The remaining seven WSS (WL1, WL35, WL41, WL44, WL51, WL67, and WL72) will be completely avoided by Project infrastructure. Potential indirect impacts to WSS are discussed in the following section.

6.6.5.2 Indirect Impacts

Indirect impacts are described as changes to wetland condition where wetland habitat is not directly lost but may be indirectly altered as the result of Project activities. Project-related indirect impacts to wetlands may occur as a result of:

- Changes to local hydrology resulting in wetting or drying of wetland habitat, such as inadvertent drainage or impoundment, groundwater drawdown associated with the open pit, loss of surface water flow within local catchment areas (LCA) or impacts to headwater contributing areas.
- The spread of introduction of invasive species into wetlands through construction equipment, machinery, vehicles or runoff from adjacent. Increased traffic during the construction and operation phases can elevate this risk.
- Potential sedimentation within wetlands as a result of up-gradient activities (e.g., earth works, excavation, removal of vegetation, overburden and topsoil stockpiles). Depending on the degree, a sedimentation event may suffocate wetland vegetation and increase nutrient levels.
- Dust deposition, which can, similarly to sediment, also introduce minerals and nutrients into wetlands and stress wetland vegetation (particularly non-vascular species).
- Changes to wetland microclimate and habitat functions as a result of proximity to Project infrastructure and edge effects.

Potential indirect impacts to wetland flora and fauna (e.g., edge effects, dust, invasive species) are further discussed in Section 6.8. Changes to water quality are not expected to indirectly impact wetland habitat integrity. Surface water, including groundwater baseflow contributions, will be tested and treated to meet regulatory water quality discharge criteria for the aquatic environment prior to release. Settling is required for TSS only during operation and for the first two years of the closure phase. Project effects to water quality and sampling locations are further discussed in Sections 6.4 (Groundwater Resources) and 6.5 (Surface Water Resources). Mitigation measures and monitoring to address potential indirect pathways which may impact wetlands from other VC, such as dust, sedimentation, invasive species, habitat quality, etc. are presented in respective VCs mitigation discussions. The potential effect of these pathways on wetlands is anticipated to be mitigated through VC specific measures, however, wetland monitoring Section 6.6.6.3 will capture impacts from these sources should they occur.

Changes to wetland hydrology are a common driver of indirect alterations to wetland function and habitat integrity. Potential indirect impacts to wetland hydrology through changes in contributing LCAs, surface water flow reductions, and groundwater drawdown can be assessed through modelled impacts to surface water and groundwater. These hydrological effects are evaluated and discussed in the following sections. As a result of the models used, the indirect wetland impact estimates provided herein represent a “worst-case”, conservative impact extent and are primarily used to inform recommendations for wetland monitoring throughout the permitting phase, and will be refined through the Project’s detained design. Actual indirect impacts of the Project will be determined at the permitting stage and through monitoring programs. Through this exercise the monitoring program will be informed with consideration of potential indirect impacts related to flow effects on the LCA, in addition to groundwater drawdown modelling during the operations and closure phases of the Project.

6.6.5.2.1 Indirect Hydrological Impacts

Hydrological indirect impacts were assessed on a case-by-case basis in consideration of wetland type, functional characteristics, direct Project impacts and infrastructure type, and associated hydrological function (e.g., recharge vs discharge, watercourse association, landscape position, associated surface water features). Detailed surface water and groundwater modelling as well as effects to fish and fish habitat, as described in their respective VCs, was used to guide wetland effects assessments. To identify potential effects of the Project on local wetland hydrology, the below indirect impact pathways were assessed for each wetland in the PA.

- Modelled flow reductions within each LCA in which infrastructure is proposed (detailed in Section 6.5 (Surface Water Resources) and 6.7(Fish and Fish Habitat))
- Modelled open pit groundwater radius of influence (ROI; detailed in Section 6.4 (Groundwater Resources))

– Changes in headwater contributing area and water management within each LCA

Potential for down-gradient, indirect wetland impacts can be expected as a result of up-gradient hydrological alteration and reduction of contributing LCA. Indirect impacts can also be a result of Project infrastructure and associated water management and runoff from infrastructure to settling pond locations through the water management infrastructure (Section 6.5 (Surface Water Resources)). The water management infrastructure in some cases, diverts water away from local surface water features within each relevant catchment and divert water from one LCA to another.

As a result, it is expected that the alteration of hydrological flow paths may result in indirect impacts to wetlands through catchment surface water flow reduction. The effects of these hydrological changes to wetlands were evaluated at the LCA scale with support of modelled flow reductions at a series of down-gradient assessment points (described in Section 6.5 (Surface Water Resources)) and a qualitative assessment of headwater infrastructure impacts and water management within each LCA. Where applicable, the average annual percent changes flows were reviewed at each assessment point (see Figure 6.5-3 for assessment points locations). Wetlands within LCAs with a >10% modelled change in flow and/or notable headwater impacts were evaluated on a case-by-case basis. Changes in flow will affect each wetland differently, depending on wetland type, water source, watercourse/waterbody association, magnitude of predicted flow change, and position both in the LCA and relative position to proposed infrastructure. As an example, The LCA of WL54 is proposed to experience a high level of alteration, and the WC56 system is expected to be directly and indirectly impacted resulting in annual flow reductions of >10%. As such, WL54 may experience a notable reduction in its hydrological inputs, possibly resulting in an indirect alteration over the life of the Project, and may be scoped into the wetland monitoring program as a result.

Indirect impacts to wetlands through groundwater drawdown adjacent to the open pit is another pathway for indirect effects. Groundwater (baseflow) reductions are included in surface water modelling and LCA assessments described above. Additionally modelled ROI is evaluated to further assess potential impacts of groundwater drawdown. When assessing the ROI drawdown, the most conservative, EOM scenario (largest) ROI extent, at the Project's maximum footprint, was used to guide the evaluation of potential indirect effects through proposed monitoring. Intact or partially intact wetlands within the ROI are expected to experience drawdown (conservative estimate) on the order of, at minimum, 0.5 m, increasing with proximity to the open pit. The PC stage predicted groundwater ROI is also assessed to determine if water levels are expected to recover to baseline conditions within these wetland areas. As an example, indirect impacts to WL6, a WSS, are expected as a result of groundwater drawdown impacts. The LCA of WL6 is largely unimpacted and is not expected to experience flow impacts. Within the wetland monitoring program, portions of WL6 that lie within the operational worse-case 0.5 m ROI will be monitored for potential indirect impacts to help support the delineation of potential indirect alteration boundaries.

Wetlands regularly undergo seasonal relative groundwater depth (RGWD) fluctuations in response to annual precipitation and seasonal variability. Geographically isolated wetlands were reported to have seasonal fluctuations ranging as high as ± 20 cm, whereas wetlands associated with lakes and watercourses were found to have seasonal variability as high as ± 1.5 m (Keddy, 2010). The stability, size and function of wetlands is primarily controlled by hydrological processes (Carter, 1996; Price et al., 2005, Tiner, 2005). Large wetland systems, with varying wetland types and surface water associations and inputs are more naturally resilient to hydrological change and less likely to be indirectly impacted. Additionally, many wetland plants can survive periodic dry conditions and reproduce under altered hydrologic conditions.

Indirect hydrological effects to Project wetlands will continue to be assessed during detailed design and permitting to inform monitoring and, as needed, scoped into the wetland alterations should unmitigable changes be observed.

6.6.5.3 Direct and Potential Indirect Impacts Summary

To support the effects assessment, conservative impact scenarios were employed in determining total direct and potential indirect impacts to wetlands, as described in the previous sections. Direct and potentially indirect impacts to wetlands will occur as a result of the Project. Project infrastructure footprints will result in the direct alteration of wetland area (13.25 ha). The extent of indirect impacts will be further assessed through the detailed monitoring program prepared at the permitting stage.

Generally, changes in hydrology (i.e., reduced flow and LCA, groundwater drawdown) due to the placement of Project infrastructure have the greatest potential to indirectly affect wetland function. On-going detailed infrastructure design and additional micro-siting will be completed to minimize these impacts where possible. Targeted monitoring in wetlands will also be conducted where hydrological impacts are evaluated to potentially result in indirect effect.

The protection and viability of connected unaltered wetland area is considered a part of the provincial wetland alteration process. Design of suitable hydrological connectivity structures (e.g., culvert), implementation of an Environmental Management Plan (EMP) and planned mitigation measures, will be employed to protect upstream or downstream wetland areas against avoidable indirect impacts as a result of Project activities. In addition, post-construction wetland monitoring, including invasives species monitoring, will be completed as discussed in Section 6.6.7.

Table 6.6-3 provides a summary of potential watershed area impacts based on the Project infrastructure footprint. Wetlands within the portion of the LAA beyond the PA that may face potential impacts have not been delineated as part of the Project. Total modelled wetland areas outside of the PA within the LAA is 2,240 ha. Indirect impacts to wetlands beyond the PA as a result of groundwater drawdown are possible based on current groundwater modelling and will be verified through onsite monitoring. As the groundwater model extends into areas without field delineated features (e.g., wetlands, watercourses), there are limitations with its accuracy beyond the PA. As a result, effects to wetlands beyond the PA are expected to be unlikely but are conservatively discussed herein. If possible offsite effects are observed, additional monitoring will be considered in consultation with NSECC through annual monitoring reporting. Table 6.6-4 identifies the low percent of LAA which will be directly impacted by the Project.

Table 6.6-4 LAA Impacts

Watershed (LAA)	Watershed Area (LAA) (ha)	Wetland Area in LAA (ha)	Project Footprint (ha)	Project Direct Impact to Wetlands (ha)	% of LAA Impacted	% of LAA Wetland Impacted
1DG-1	20,533	2,240	283	13.23	1.4%	0.6%

No protected areas are located within or downstream of the PA. No project effects are expected within protected areas. The nearest protected area is the Lake Egmont Nature Reserve, approximately 3 km to the east of the PA. Dollar Lake provincial park is located approximately3.8 km south of the PA at its closest point. Clattenburgh Brook wilderness area is locatedapprxoimately10.9 km southwest of the PA and Lake Egmont Significant Ecological Area (SEA) is located 750 m east of the PA; this area is not legally protected.

All altered wetlands require compensation under the NS Wetland Conservation Policy, which is outlined in the Project's preliminary Wetland Compensation Plan (Appendix G.2).

6.6.6 Mitigation

The following sections detail the avoidance, mitigation, and monitoring measures taken or proposed to limit Project effects to wetlands.

6.6.6.1 Wetland Avoidance

Throughout the process of the Project design wetland avoidance has been prioritized to the highest degree possible. CertainTeed has worked to avoid wetlands where possible, placing a higher priority on avoiding WSS to minimize impacts to SAR and habitat.

The PA was defined to be larger than infrastructure would require, especially to the south on the Crown land portion, allowing for micro-sighting of infrastructure to avoid sensitive features, including wetlands, wherever possible. The two largest components of Project infrastructure, the open pit and overburden stockpile, were sited in areas of lower overall wetland presence, reducing the overall direct impacts on wetlands, and specifically avoiding WSS and their catchments as is possible. In earlier iterations of the Project design, the open pit impacted the north-western portion of the PA and multiple WSS triggered by avian SAR observations notably a significant amount of black ash observations. Relocating the open pit further to the south, three WSS (WL35, WL67, WL72) and the majority of their contributing catchments, were completely avoided. Infrastructure has been designed to stay compact to avoid the southern portion of the Crown land parcels where significant wetland habitat was delineated.

Throughout the design of the Project, priority was placed on avoiding WL41 after initial designs included proposed direct alteration. WL41 contains multiple SAR observations and habitat including Canada warbler, olive-sided flycatcher, eastern wood-peewee, frosted glass whiskers, and blue felt lichen. WL41 has been entirely avoided by direct impacts through Project micro-siting.

6.6.6.2 Wetland Mitigation

Table 6.6-5 provides the proposed wetland mitigation measures and common best practices that will be implemented where direct and potential indirect impacts to wetlands are expected. Mitigation measures are detailed for all phases of Project development, including construction, operations, and closure.

A Preliminary Wetland Compensation Plan is provided in Appendix G.2 and will be refined through the permitting process. CertainTeed will target local compensation opportunities whenever practical. The Plan outlines the compensation and project design process as well as preliminary identification of primary and secondary compensation opportunities. Further detail will be provided through the permitting process as impacts and compensation needs are refined, with the goal of identifying viable opportunities prior to Project construction.

Table 6.6-5 Wetland Mitigation Measures

Project Phase	Mitigations
Construction	Ensure all wetlands in the PA are visually delineated with flagging tape prior to construction.
	Complete pre-construction site meetings for all relevant staff/contractors related to working around wetlands and watercourses to minimize unauthorized disturbance.
	Acquire and adhere to wetland alteration permit approvals prior to alteration of any wetland habitat.
	Complete detailed design of road alignments and infrastructure micro-siting to avoid or minimize impacts to wetlands wherever practical. Wherever practical, design wetland crossings to occur at the narrowest parts of wetlands or wetland edges.
	Complete detailed culvert design to maintain current hydrology and necessary fish passage, including culvert upgrades.
	Implement construction methods that reduce the potential to drain or flood surrounding wetlands. For example, appropriately size/space culverts, no unpermitted pilling of soil/grubbings, no unnecessary ditching/artificial channelization.
Construction, Operations	Implementation of an ESC Plan to ensure site runoff is not directed towards wetlands to maintain habitat integrity and existing drainage patterns.
	Minimize erosion of wetland soils by limiting flow velocities using hydraulic dissipation techniques and directing any runoff through natural upland vegetation, wherever practical.
	Minimize wetland rutting by limiting machinery use in wetlands. Use swamp mats and corduroy bridges wherever practical.
	Follow all NSECC watercourse crossing guidelines for temporary and permanent crossings.
	Maintain pre-construction hydrological flows through wetland habitat wherever practical, particularly through wetlands bisected by roads.
	Salvage and store organic topsoil for use in site reclamation, where practical.
	Re-vegetate slopes adjacent to wetlands, using native seed mixes, to limit erosion and sediment release.
	Conduct vegetation management such as cutting and clearing in or near wetlands and watercourses in accordance with applicable guidelines and in consideration of breeding bird windows and wetland associated SAR. Maintain wetland vegetation wherever practical.
	Employ measures to reduce the spread of invasive species (especially by vehicles) into wetlands and retain habitat integrity. Do this by inspecting vehicles regularly, particularly vehicles arriving from outside the PA. If necessary, cleaning will be undertaken at a designated cleaning station that is away from wetlands and watercourses.

Project Phase	Mitigations
	Prepare and implement a site-specific Wetland Monitoring Plan through the wetland permitting process and in consultation with NSECC. Plan to include baseline and post-construction monitoring.
	Implement an Emergency Response and Contingency Plan and appropriately store/manage hazardous and non-hazardous materials/waste to protect wetland habitat from accidental spills.
Closure	Review and consider alternatives to traditional hydroseeding methods to advance vegetation reestablishment and reclamation methods. Consideration will be given to native species with Indigenous significance.
	Compensate for permanent loss of wetland through implementation of the Wetland Compensation Plan (Appendix G.2).
	Follow wetland monitoring requirements laid out in any wetland alteration permit approval conditions.

6.6.7 Monitoring and Follow-up

Wetlands are protected under the provincial *Environment Act* and Wetland Conservation Policy (NSECC, 2019) to mitigate net loss of habitat and function. Wetland alteration applications will be submitted and permitting will be obtained prior to any Project alterations to wetlands. Wetlands altered by the Project will be compensated at the ratio determined through consultation with NSECC and the Wetland Compensation Plan, in keeping with the prevention of no net less of wetland habitat and function. CertainTeed will continue to work with NSECC to develop the required mitigation measures, including wetland compensation, to mitigate loss of habitat based on function and relative value.

Wetland monitoring will be completed to verify the predicted environmental effects, the effectiveness of the mitigation measures and signal a need to implement environmental control measures if monitoring indicates adverse environmental effects are or may be occurring due to activities of the Project. A detailed Wetland Monitoring Plan will be established through the life cycle of the permitting process, in consultation with NSECC, and will commit to monitoring baseline conditions in all relevant wetlands to establish pre-construction condition, and throughout the construction and operational phases. The focus of the Plan will be to ensure the long-term protection of remaining wetland habitat post-development. Wetland monitoring may be completed at the closure phase if determined to be required by NSECC.

Wetland monitoring will be completed for the Project on all wetlands that have been predicted to have direct or potential indirect effects from Project development. Based on predictions in the above wetlands effects assessments, wetlands meeting the conditions below are recommended for monitoring. Additional wetlands may be added (or removed) through the development of the detailed Wetland Monitoring Plan, informed by on-going Project design, detailed permitting, and regulatory consultation.

- All partially altered wetlands.
- Wetlands with predicted or potential indirect hydrological impacts due to changes in groundwater and surface water contributions (e.g., LCA flow reduction, groundwater drawdown, reduction in headwater contributing area).
- Additional avoided wetlands may be monitored if up or down gradient impacts to contiguous hydrological features may result in indirect impacts (e.g., potential drying through up-gradient impacts to a connected watercourse/wetland).
- All WSS with direct or potential indirect impacts (using a worst-case scenario) will be monitored. With respect to those with sessile species, additional respective programs (e.g., black ash and lichen monitoring) will be implemented in addition to the wetland monitoring programs. All WSS will have detailed monitoring completed including general observations, detailed vegetation and hydrological monitoring to assess for indirect impacts as a result of the Project.

The Wetland Monitoring Plan will outline the methods used to evaluate partially altered or potentially impacted wetlands, as listed above. The typical methods employed to evaluate wetland health include hydrological and vegetative monitoring programs to determine potential shifts in wetland characteristics and function over time. Visual observations of wetland conditions are also used to supplement this information. A hierarchy of monitoring approaches will be applied in consideration of the magnitude and type of individual wetland impacts. Monitoring level of effort will be dictated by degree of impact, WSS status, and wetland type.

Baseline monitoring (pre-construction) will take place before construction commences. Post-construction monitoring of these variables will also be completed during operations at the established locations. Conditions recorded during baseline monitoring will be compared to post-construction monitoring to determine whether areas of unaltered wetland habitat remain viable, and healthy wetland characteristics are present. Comparison methods and indicators of change will be detailed in the Wetland Monitoring Plan and subsequent reporting. Generally, the wetland monitoring program will include the following assessments:

– **Wetland hydrology**: Hydrological conditions, and possible shifts in hydrology, will be evaluated in each monitored wetland. Techniques will range from standardized visual qualitative observations of hydrological conditions to the installation of shallow monitoring wells equipped with automated water level loggers. Water level loggers will be used to record the detailed hydroperiod within the wetland or wetland system. Additionally, small soil test pits will be hand dug to a depth of ~30 cm to determine if positive indicators of wetland hydrology are present (i.e. saturation within 20 cm, groundwater within 30cm, hydrogen sulfide odour, etc.). Presence of hydric soil indicators will also be recorded.
– **Wetland vegetation**: Vegetative conditions, health, and possible shifts, will be evaluated in each monitored wetland. Techniques will range from standardized visual qualitative observations of vegetation conditions to the completion of specified, repeatable vegetation plots to monitor the quantitative presence of vegetative species over time. Data collected will include general vegetive health, presence of invasive species and relative species abundance.
– **Observations of direct and indirect impacts**: Standardized general observations will be completed at all monitored wetlands to determine whether the wetland was subject to additional direct or indirect impacts, beyond permitted extents. Impacts could include ground disturbances (e.g., rutting, excavation), sedimentation and erosion issues, and unplanned changes in hydrological inflow and outflow (e.g., damming, de-watering, disturbance to natural swales and drainage corridors).

Implementation of the strategies discussed above will support the mitigation process associated with wetland protection. The final Wetland Monitoring Plan will be refined to meet the specific activities and timing of activities within the Project. Annual monitoring results, as well as any changes to the program, will be provided to NSECC, as per wetland alteration permit conditions.

Should post construction wetland monitoring and/or ongoing construction monitoring indicate a potential issue above natural variation, CertainTeed will consult with NSECC to identify whether corrective actions or compensation will be required. Operations staff will be notified, and an investigation of the possible contributing factors will take place to identify and attempt to rectify the cause. Specific action levels and response procedures will be based on the Project related activity responsible for the variation in wetland conditions being observed. NSECC will be contacted and consulted in the instance of direct and/or indirect wetland response as a result of such activities, and a determination to what degree further action is required will be determined by all parties.

Wetland impacts and monitoring programs were reviewed with local communities, organizations, and the Mi’kmaq of Nova Scotia during engagement efforts, including open houses and meetings. On-going engagement with the Mi’kmaq of Nova Scotia will continue through the EARD process and associated permitting relating to follow-up programs and monitoring.

6.6.8 Residual Effects and Significance

The predicted residual environmental effects of Project on wetlands are assessed to be adverse, but not significant. Following implementation of the proposed mitigation measures and wetland compensation requirements, the Project is not likely to result in a significant adverse effects to wetlands, as defined (i.e., an unmitigated or uncompensated net loss of wetland habitat).

A significant adverse effect on the Wetlands VC was defined as:

– A Project-related effect that results in an unmitigated or uncompensated net loss of wetland habitat, including WSS, as defined under the NSECC Wetland Conservation Policy (NSECC, 2019), and its associated no-net loss policy. An adverse effect that does not cause a permanent loss of wetland habitat, in consideration of wetland functions, WSS and proposed mitigation/compensation, is not considered a significant adverse effect.

A significant adverse environmental effect for wetlands has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

During construction:

– Direct impacts to wetlands will occur. However, these losses are <3% of the total available wetland habitat within the LAA. The majority of wetlands proposed for alteration are locally abundant and relatively isolated systems.
– With the proposed impacts to WSS, the direct effects results in a moderate magnitude.

During operations:

– Indirect hydrological impacts may potentially occur in wetlands as a result of the Project. Wetland monitoring will be implemented to evaluate additional potential indirect impacts as dictated through the permitting process.

During closure:

– Limited additional impacts to wetlands are predicted based on the implementation of mitigation measures (e.g., sediment and erosion control) during closure. The reclamation process will endeavor to maintain hydrological pathways and flows.
– Off-site wetland compensation will be completed to off-set Project-related wetland alterations (Appendix G.2 – Wetland Compensation Plan). Local compensation projects will be prioritized wherever practical.
– On-site wetland reclamation opportunities within the PA will be considered where practical.

Residual effects to wetlands are summarized in Table 6.6-6.

Table 6.6-6 Wetland Residual Effects

Project Phase	Mitigation and Compensation Measures	Nature of Effect	Residual Effects Characteristics						Residual Effect	Significance
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction – Direct wetland alteration, clearing/grubbing	Limit impacts through detailed Project design, on-site wetland training, wetland permitting process	A	M Project results in up to 10% loss of a specific wetland habitat in the LAA. Direct impacts to potential WSS.	PA Potential adverse effects to wetlands within the PA	A Seasonal aspects may affect VC	P VC unlikely to recover to baseline conditions	O Effects occur once during construction	IR VC will be permanently altered from baseline conditions	Habitat loss, disturbance	Not significant
Construction and Operations – Indirect impacts to wetlands: hydrological, dust, sediment and erosion, invasive species, accidents/malfunctions)	Sediment and erosion control, maintain hydrological flow paths, water management, wetland heath and invasive species monitoring, spill preparedness	A	M Project results in up to 10% loss of a specific wetland habitat in the LAA. Predicted indirect impacts to potential WSS.	LAA Potential adverse effects to wetlands within the PA and small portion of ROI groundwater drawdown that extends outside of the PA into the LAA	A Seasonal aspects may affect VC	LT Effects extend beyond 3 years	R Effects occur at regular intervals throughout the Project	PR Mitigations can not guarantee a return to baseline conditions	Disturbance	Not significant
Closure – Reclamation activities	Sediment and erosion control, best practices, spill preparedness, wetland compensation	P	L On-site wetland reclamation opportunities	PA Potential effects to wetlands within the PA	A Seasonal aspects may affect VC	LT Effects extend beyond 3 years	O Effects occur once during reclamation	PR Mitigations and reclamation can not guarantee a return to baseline conditions	Habitat reclamation	Not significant

Legend (refer to Table 6.6-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A – Adverse	N – Negligible	PA – Project Area	N/A – Not Applicable	ST – Short-Term	O – Once	RE – Reversible
P – Positive	L – Low	LAA – Local Assessment Area	A – Applicable	MT – Medium-Term	S – Sporadic	IR – Irreversible
	M – Moderate	RAA – Regional Assessment Area		LT – Long-Term	R – Regular	PR – Partially Reversible
	H – High			P – Permanent	C – Continuous	

6.7 Fish and Fish Habitat

6.7.1 Rationale for Valued Component Selection

Fish and fish habitat and aquatic SAR are protected under federal legislation by the *Fisheries Act* and *Species at Risk Act*. Fish and fish habitat were chosen as a VC as habitat that supports fish may be directly or indirectly altered, disturbed, or destroyed by the Project. Moreover, Project activities may result in the incidental death of fish.

The *Fisheries Ac*t prohibits the carrying out of any work, undertaking or activity, other than fishing, that results in the death of fish and/or harmful alteration, disruption, or destruction (HADD) of fish habitat. If a project cannot avoid, or is likely to cause, death of fish and/or HADD of fish habitat, then a *Fisheries Act* Authorization (FAA) is required.

The Fish and Fish Habitat VC is linked to:

– Groundwater and Surface Water Resources (Sections 6.4 and 6.5): the predicted effect of the Project on Fish and Fish Habitat ties directly to predicted Project interactions on groundwater and surface water modelling, and specifically on the linkages between the groundwater and surface water resources VCs. Predicted indirect effects to fish and fish habitat are based on model results provided in Sections 6.5).
– Wetlands (Section 6.6): Wetlands that support fish habitat (as presented in the Fish and Fish Habitat Biophysical Baseline Report (Appendix H.1) are further evaluated under effects to fish and fish habitat.
– Socioeconomic Conditions and Mi'kmaq of Nova Scotia (Section 6.9 and 6.10): impacts to fish and fish habitat could affect usage of the PA by Mi'kmaq of Nova Scotia and local community members, for both traditional and recreational fishing.

6.7.2 Baseline Program Methodology

Fish and fish habitat surveys were completed with the key objectives of facilitating avoidance of fish habitat where practicable, understanding the potential Project interactions with fish and fish habitat (including brook floater, a freshwater mussel), and to support fish and fish habitat regulatory applications. These objectives were achieved by completing a review of available desktop resources in combination with field studies to identify potential environmental constraints and sensitivities. Field studies were performed within the ASA – a spatial boundary designed in anticipation of potential Project-related effects to fish and fish habitat beyond (i.e., downstream of) the boundary of the PA (Figure 6.7-1). The ASA includes the PA.

Field studies within the ASA included:

– Identification and initial characterization of aquatic habitats throughout the PA (wetland and watercourse delineation)
– In-situ water quality measurements
– Fish collection (i.e., electrofishing and trapping) within selected watercourses and waterbodies
– Environmental DNA (eDNA) outside the ASA
– Detailed fish habitat characterization of watercourses predicted to be directly and indirectly affected by Project development
– Brook floater surveys and habitat suitability assessments.

6.7.2.1 Wetland and Watercourse Delineation

Watercourse identification and description, as well as wetland delineation and evaluation were completed across the PA in accordance with NS standards for identification of watercourses and wetlands. A detailed account of wetland delineation methods and results is provided in the Wetlands Baseline Report (Appendix G.1), and further details related to initial baseline fish habitat characterisation are outlined in the Fish and Fish Habitat Baseline Report

(Appendix H.1). Each of these aquatic habitat types were evaluated for the presence of fish habitat and potential ability to support fish species during initial assessment and identification.

Fish habitat is described as any aquatic feature that is contiguous with a fish bearing stream, whether it is located within a watercourse, wetland, waterbody, or other (i.e., mosaic). Fish habitat is described in the context of watercourses, however the terms ‘open water,’ ‘wetland mosaic’, ‘upland mosaic’, and ‘watercourse mosaic’ are used, as defined below (and fully in described in Appendix H.1). Where fish habitat is present in a watercourse that flows through a wetland in an entrenched channel, that habitat is described in the context of the watercourse. Where fish habitat is present in a wetland or upland, but outside of an entrenched channel, it is described as a wetland or upland mosaic (accessible to fish). Where watercourses were confined to the entrenched channels but braiding was too complicated to map with a GPS that has +/- 5 m accuracy, the term ‘watercourse mosaic’ was used. In addition, watercourses were assumed to provide fish habitat, regardless of whether they are directly connected to fish bearing streams or proven to be occupied by fish. In an effort to make conservatively inclusive decisions in this effects assessment, even those watercourses lacking connectivity to known fish bearing streams are assumed fish habitat. This will be further assessed in the future, if required to support permitting/approvals.

Open water features were identified as either off-line ponds or components of linear watercourses. From a regulatory perspective, open water features are defined as watercourses by the *NS Environment Act*. Habitats were considered open water habitats if less than 2 m depth, <8 ha in size, and less than 50% vegetative cover, following guidance from the Army Corps of Engineer wetland delineation manual (United States Army Corps of Engineers, 2009). Wetland mosaics are unlike open water as they have greater than 50% vegetation and less than 2 m of standing water. These habitats provide ephemeral or perennial fish access, depending on the contribution of flow from the associated watercourse.

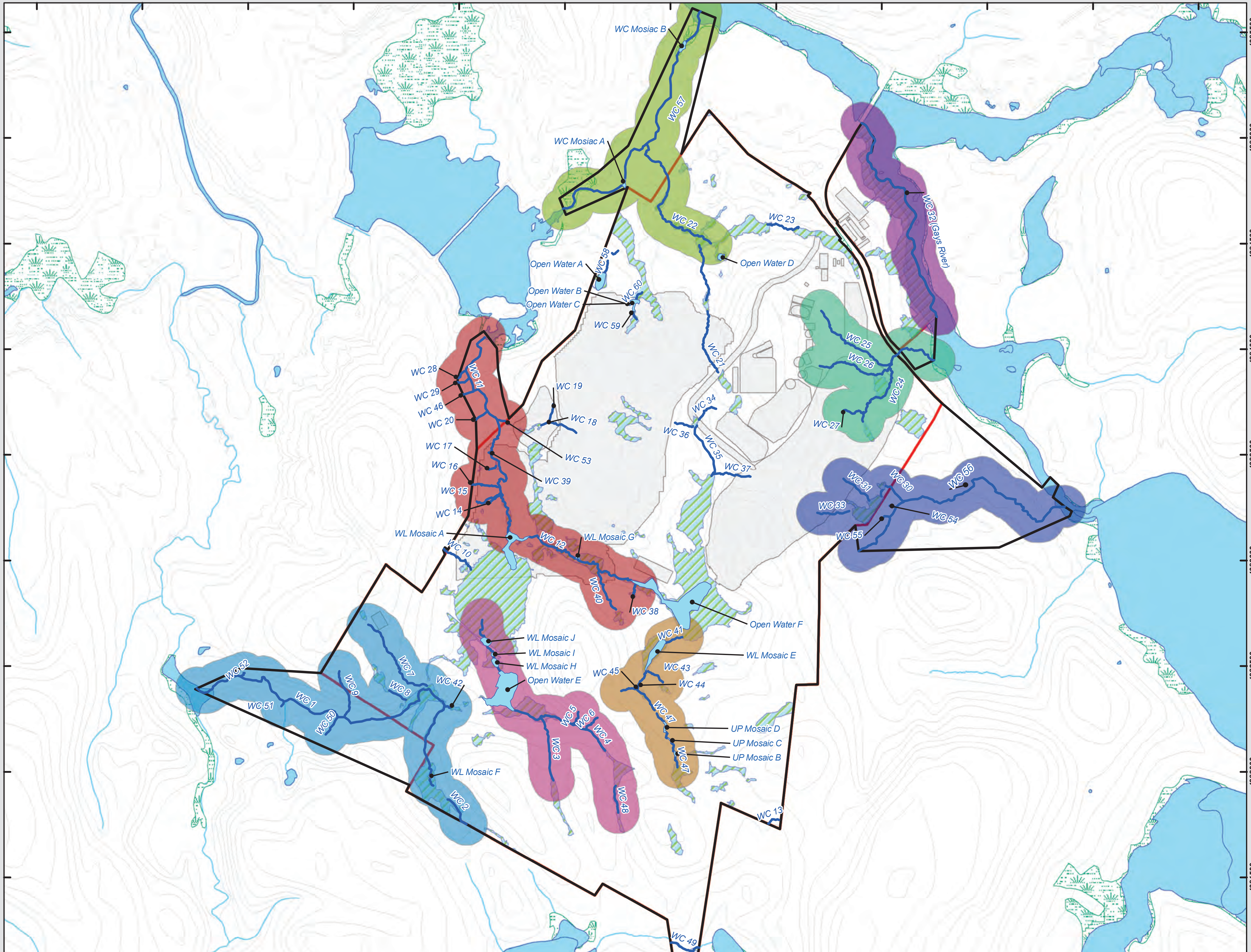
The results of baseline wetland and watercourse assessments delineation were used to inform all additional field programs, particularly detailed fish habitat evaluations and fish collection. Detailed wetlands, watercourses and waterbodies are shown on Figure 6.7-1.

Prepared For:

GHD

FIGURE 6.7-1
Fish & Fish Habitat

Antrim Gypsum Project
Cooks Brook, Nova Scotia



Systems

- Anaand Brook
- Gays River
- Watercourse 1 System
- Watercourse 11 System
- Watercourse 26 System
- Watercourse 44 System
- Watercourse 56 System
- Watrecourse 4 System
- Field Delineated Watercourse
- NSTDB Watercourse
- Field Delineated Wetlands
- NSECC Wetland Inventory
- Open Water
- Project Infrastructure
- Project Area
- Aquatic Study

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 250 500 1,000 m

1:17,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By: KF

Project Number: 24-9991
Date: 7/24/2024

strum CONSULTING

Document Name: Antrim Fish Baseline

6.7.2.2 In-situ Water Quality

In-situ water quality measurements were recorded at all electrofishing and trapping sites prior to each sampling event. In addition, water quality measurements were recorded for each watercourse delineated through detailed habitat assessments. These water quality measurements were collected using a calibrated YSI Multi-Probe water quality instrument (or equivalent) or a combination of a Myron Ultrapen DO Pen Probe and Hannah Combo pH/Conductivity/TDS Probe at the time of the sampling event/survey. The pen probes used collectively measure dissolved oxygen, temperature, pH, conductivity and total dissolved solids.

6.7.2.3 Fish collection

Quantitative fish collection involves a closed site setup (reach is isolated with barrier nets) and triple passes of electrofishing. This setup allows for population estimates, and is the preferred methods for fish sampling, unless the physical characteristics of the stream do not allow for reach isolation, or if fish abundance is expected the be low. Qualitative electrofishing involves an open site setup with a single pass of electrofishing. This method is suitable to determine species richness and relative (not absolute) abundance by calculation of Catch Per Unit Effort (CPUE).

Quantitative electrofishing was undertaken using barrier nets (1 8" mesh) that were secured to the stream bed at either end of the reach to isolate an area of habitat within each watercourse. Within each isolated reach, a minimum of three passes with the electrofisher were completed. Additional passes were completed if depletion in catch was not obtained after the first three passes. If no fish were captured after two passes, the third pass was deemed unnecessary. The number and characteristics of fish collected during each pass were recorded so that quantitative fish population estimates could be calculated. The total seconds of electrofishing effort were also recorded.

Qualitative electrofishing surveys were performed using an "open" site methodology with no barrier nets. One pass with a backpack electrofisher was performed unless crew members noted a high number of fish that evaded capture. In that case, a second or third pass was performed to obtain greater species representation. In the Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations (Johnson et al, 2007) the authors describe the use of single-pass electrofishing without barrier nets and provide a summary of academic reports supporting this method (Johnson et al., 2007). Though the technique does not support estimates of absolute abundance or population estimates, research has found that single-pass electrofishing works well to determine species richness (Simonson and Lyons, 1995), and relative abundance (Kruse et al., 1998). Qualitative species abundance estimates were calculated using electrofishing CPUE indices, standardized to 300 seconds of effort (Scruton and Gibson, 1995).

Supplementary trapping was used at locations where electrofishing was not deemed to be efficient, effective or safe (e.g., deeper water, high conductivity). At these sampling locations, biologists deployed either baited minnow traps or eel pots. CPUE was determined for each trap type and fish species based on trapping effort, which was calculated as total catch or total catch per species per wetted hour.

6.7.2.4 eDNA

Environmental DNA (eDNA) is a well-established technique which identifies environmental or exogenous DNA molecules from aquatic or semi-aquatic organisms. The premise of eDNA is that all organisms shed genetic material into the environment: water samples are collected, filtered and analyzed using a qPCR (quantitative polymerase chain reaction) technique to extract eDNA and identify organisms present within the aquatic environment. When genetic material found in the collected water sample matches with a known genetic primer for the target species or taxa, a positive result is provided by the production of fluorescence in the qPCR process. Genetic primers can be species-specific (i.e., based on matching 20 base pairs of a genetic sequence), or generic (i.e., identifying presence of particular taxa such as fish, amphibians, etc., based on a shorter genetic sequence of ten base pairs).

Based on the review of fish species expected within the Shubenacadie/Stewiacke River primary (1DG), Atlantic salmon are expected to be present. The Shubenacadie River has been identified as an important river for long-term population self-sustainability for the inner Bay of Fundy (iBoF) population of Atlantic salmon (DFO, 2021). The ASA does not fall within critical habitat for the iBoF population of Atlantic salmon as identified in the Recovery Strategy

(DFO, 2010); however, remnant individual Atlantic salmon may be potentially found within the major tributaries to the Shubenacadie River. This survey was completed to provide evidence on the presence or absence of Atlantic salmon (iBoF population) within watercourses surrounding the ASA. Through consultation with DFO, it has been identified that seasonal sampling of eDNA can demonstrate absence of IBoF Atlantic salmon in habitat surrounding the ASA.

eDNA samples for Atlantic salmon were collected within 16 sites, 14 sites within watercourses adjacent to the ASA and along with two reference sites that are known DFO stocking locations. eDNA sampling sites were initially scoped to support fish and fish habitat work for SML, data agreement the client allowed for data sharing to support this Project, Sample locations are shown on Figure 6.7-5 within Section 6.7.3.11.

– Sites 1-3 and 5- 8 were collected within the Gays River downstream of the ASA.
– Site 4 was collected at the confluence of Gays River and South Branch Gays River, downstream of the ASA.
– Sites 9, 15 and 16 were collected within the Gays River adjacent (north) to the ASA.
– Sites 10-12 were collected within South Branch Gays River (northwest of the ASA).
– Site 13 (reference site) was collected within Stewiacke River at a DFO Atlantic salmon stocking location (stocked May 31, 2023).
– Site 14 (reference site) was collected within Pembroke River at a DFO Atlantic salmon stocking location (stocked May 6, 2020).

Sample collection was completed on between September 5-6, 2023, November 2-3, 2023, March 25-27, 2024 and May 13-14, 2024.

Standard protocols outlined by the British Columbia Ministry of Environment (MOE) were strictly adhered to for sample collection, labelling, filtration and sanitization between samples at every stage of the process (BC Ministry of Environment (MOE), 2017). Each sample was collected in triplicate. Sample filtration occurred each evening after samples were collected. As described in the BC MOE protocol, one field blank sample per day was completed. Sample collection and filtration details are provided in Appendix H.1.

Samples collected for identification of salmon were submitted to Dr. Paul Bentzen's laboratory at Dalhousie University. Following extraction of eDNA from filters, hydrolysis probe assays were performed in 10 µl volumes in a Roche LightCycler 480 II qPCR machine. Each eDNA extraction was run in three replicates. Cycling conditions were 95°C 3 min, 50x (95 °C 15 s, 60 °C 1 min) with fluorescence acquisition following each extension step. Negative (water) and positive (genomic Atlantic Salmon DNA) controls were run in triplicate with each assay.

The hydrolysis probe assay is used to determine presence of Atlantic Salmon in the eDNA sample. When DNA is amplified during PCR, the fluorescence of the reaction increases. The PCR cycle at which fluorescence exceeds background is reported as the crossing threshold (Ct). Any assay with a positive Ct value is defined as positive for Atlantic Salmon presence. Assays which measured no change in fluorescence (have no Ct value) are considered negative for Atlantic Salmon.

6.7.2.5 Detailed Habitat Assessments

Detailed fish habitat surveys within selected watercourses were conducted using standard methodologies to gather key measurements such as reach length (m), reach wetted and bankfull width (m), reach slope (%), stream substrate composition (% composition), water depths (m), water velocities (m/s), cover (%), and riparian habitat per habitat unit. The data was used to determine the overall habitat area within each reach as well as the habitat suitability based on measured stream substrate, water depths, and water velocities (habitat parameters) for each fish species identified within the ASA.

Traditional lentic fish habitat characterizations for open water, wetland mosaics, upland mosaics, and watercourse mosaics could not be completed due the limited sizes and largely unsafe boating and wading conditions brought on by shallow water, numerous snags, and deep muck substrates. For these features, a revised method was employed to describe habitat that more closely reflects the methodology for lentic habitats. Each general habitat type was described and measurements of depth, substrate, velocity (where possible), vegetative cover and width were recorded, and validated with aerial image interpretation. When possible, these features were waded, and measurements were recorded on foot. If features were unsafe to wade, characteristics of fish habitat were described more generally from the safety of the riparian edges.

Detailed fish habitat surveys were performed on all watercourses, open water features, upland mosaics, wetland and watercourse mosaics throughout the ASA with the exception of WC13 and WC49, which lie in the southeastern corners of the ASA and are geographically distant from potential Project impacts (Figure 6.7-1).

6.7.2.6 Brook Floater Habitat Suitability Assessment

Brook floater is a freshwater mussel listed under SARA/COSEWIC as Special Concern, under the NSESA as Threatened, and critically imperiled/imperiled by the Atlantic Canada Conservation Data Centre (ACCDC) (S1S2). They have a kidney-shaped shell that is 50-65 mm long (COSEWIC, 2009), and shell color varies from yellowish, greenish, or brownish to black.

Brook floater were reported in eleven disjunct rivers and lakes in Nova Scotia, including the Gays River (Marshall and Pulsifer, 2010). Preferred habitat consists of shallow watercourses with moderate to high flows and sand or fine gravel substrates (COSEWIC, 2009). In NS, brook floater has been identified in sandy bottom lakes with no water flow and in watercourses with cobble substrate (COSEWIC, 2009).

Two watercourses (WC11 and WC12) were identified to possibly contain suitable brook floater habitat based on their perennial flow, substrate type, and minimal turbidity. Habitat surveys were conducted along the entirety of these watercourses, working from upstream to downstream, to confirm the presence and/or habitat suitability of brook floater within these watercourses (Figure 6.7-6, Section 6.7.3.12). Where possible, field biologist walked on both banks of the watercourse searching for suitable freshwater mussels, brook floater habitat and/or middens (piles of dead shells left by predators, such as muskrats). If middens were observed, crew members searched the middens for empty brook floater shells and identified any other freshwater mussels.

6.7.3 Baseline Conditions

A summary of baseline conditions is presented in the following sections. Full details related to baseline conditions outlined in Appendix H.1.

6.7.3.1 Watersheds

The ASA is situated entirely within the largest secondary watershed within NS – the Shubenacadie River secondary watershed (1DG-1). This secondary watershed is contained within the second largest primary watershed– the Shubenacadie/Stewiacke primary watershed (1DG; Figure 6.7-2). The secondary watershed comprises two major drainage features: the Shubenacadie Canal Waterway and associated lakes from the southwest and the Stewiacke River from the east. Both feed the Shubenacadie River which empties into the Bay of Fundy at Cobequid Bay.

The ASA lies entirely within the 1DG-1-WW tertiary watershed (Figure 6.7-2). The primary drainage feature of this sub-watershed is the Gays River, which flows in a general northwest direction and empties into the Shubenacadie River, just south of the village of Shubenacadie. The Gays River is fed by numerous named tributaries, including but not limited to the South Branch Gays River, Far Brook, Ervin Brook, and McLean Brook. Lake Egmont and Lower Lake Egmont form the largest waterbody within the sub-watershed. Smaller headwater lakes include Buckley Lake, Ruggs Lake, Scott Lake, and Cranberry Lake.

The multiple topographical highs located throughout the ASA generate multiple divisions of flow through low-order streams. The north and western edges of the ASA drain in a general northwest direction into Annand Bog, which serves as the adjacent Scotia Mine polishing pond (Figure 6.7-2). The most southwestern portion of the ASA flows into Far Brook, a tributary to South Branch Gays River. Near Lake Egmont Road, on the eastern side of the ASA, watercourses flow directly into Gays River or act as a headwater tributary to Lake Egmont.

A review of aerial imagery and NSTDB mapping identified two waterbodies within and two waterbodies adjacent to the ASA. There is a small, unnamed waterbody of approximately 0.28 ha situated within the northern extent of the ASA, herein referred to as Open Water A. Open Water A is not associated with any NS Topographic Database (NSTDB) mapped watercourse but was field verified to have a small ephemeral outflow that was frozen at the time of assessment. Another small, unnamed waterbody was identified in the north and is approximately 0.04 ha in size. This waterbody is herein referred to as Open Water D, which was confirmed to be isolated from watercourses in the field, contrary to NSTDB mapping. Two named waterbodies were identified adjacent to the ASA - Annand Bog (47.2 ha) located to the northwest and Lake Egmont located to the east (98.5 ha; Figure 6-7.2).

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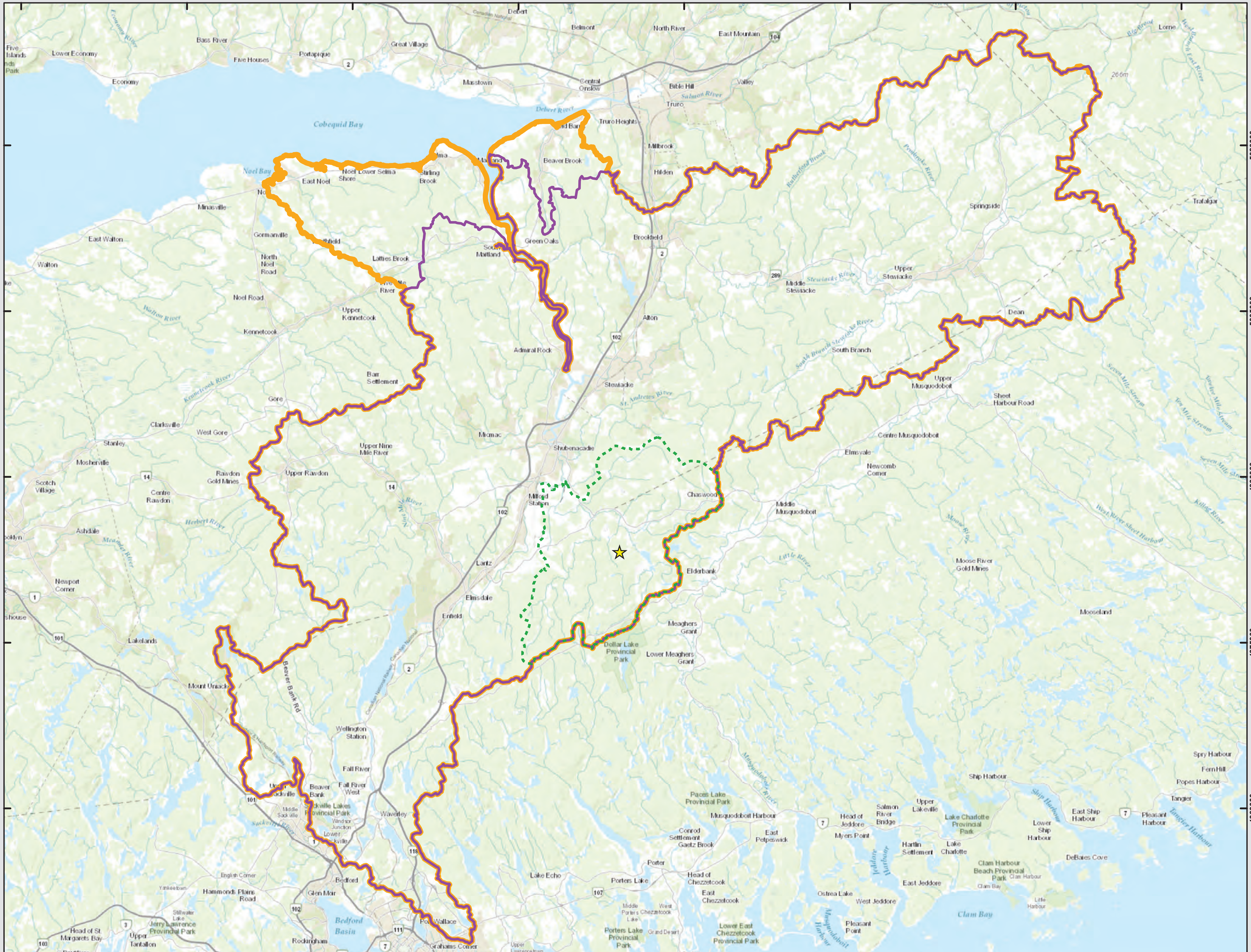
FIGURE 6.7-2 Watersheds

Antrim Gypsum Project
Cooks Brook, Nova Scotia



☆ Project Location

Tertiary Watershed (1DG-1-WW)

Shubenacadie River Secondary Watershed (1DG-1)

Shubenacadie/Stewiacke Primary Watershed (1DG)

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 3.75 7.5 15 km

1:325,000 Scale when printed @ 11" x 17"

Drawn By: AS
Reviewed By: MJ

Project #: 24-9991
Date: 2024-07-24

strum CONSULTING

Document Name: 240212_Antrim_Watersheds

6.7.3.2 Wetlands and Watercourses

Throughout the PA, 48 watercourses were mapped during baseline delineation. Within the broader ASA an additional 12 watercourses were delineated. A total of 79 wetlands were identified and delineated throughout the PA, which are further described in the Wetland Baseline Report (Appendix G.1). Wherever fish habitat extends into wetlands, it is described herein under the context of contiguous watercourses, open water bodies and/or mosaics.

Seven WL mosaics, three upland (UP) mosaics, and two watercourse (WC) mosaics were identified: WL Mosaics A, E, F, G, H, I, and J; UP Mosaics B, C, and D; and WC Mosaics A and B. In addition, six open water features (Open Water A through Open Water F) were identified within the ASA. These features are shown on Figures 6.7-1.

These features are defined and further described in the Fish and Fish Habitat Biophysical Baseline Report (Appendix H.1).

6.7.3.3 In-situ Water Quality

Throughout the ASA, recorded summer temperatures ranged from 18℃ to 24.8 ℃. Temperatures within smaller, first and second order streams largely remained within the suitable temperature range for cold-water species, but some first and second order streams and the larger Gays River (WC12, 27, 30, 32, 34 and 36) exceeded this range (>20°C). These watercourses were described during detailed habitat surveys as slow-moving watercourses (flat and runs). The average pH throughout the ASA was 5.66, with the fish community documented within the ASA considered generally acid tolerant. Water quality across the ASA is generally not considered limiting to fish habitat provisioning for the broader fish community.

6.7.3.4 Fish Collection

During the field program, a total of 10 species and 754 individual fish were captured though electrofishing and trapping efforts. Table 6.7-1 present a summary of fish species captured, in order of abundance with priority species **bolded.** Full details on sample methods, locations and results are provided in Appendix H.1.

Table 6.7-1 Fish Species Captured within the ASA.

Species	Species Code	Srank	SARA/ NSESA/ COSEWIC Listing	Total Catch	
				#	%
Northern redbelly dace (*Chrosomus eos*)	NRD	S5	-	567	75.2
Golden shiner (*Notemigonus crysoleucas*)	GSH	S4	-	97	12.9
American eel (*Anguilla rostrata*)	**EEL**	**S3N**	**COSEWIC: threatened**	**52**	**6.9**
Threespine stickleback (*Gasterosteus aculeatus*)	3SB	S5	-	11	1.5
Brook trout (*Salvelinus fontinalis*)	**BKT**	**S3**	**-**	**9**	**1.2**
Brown bullhead (*Ameiurus nebulosus*)	BBH	S5	-	5	<1
Ninespine stickleback (*Pungitius pungitius*)	9SB	S5	-	5	<1
Chain pickerel (*Esox niger*)	CHP	SNA	-	3	<1
White sucker (*Casosomus commersonii*)	WHS	S5	-	3	<1
Blacknose dace (*Rhinichtys atratulus*)	BND	S4	-	2	<1
Total Individuals				**754**	

Of these documented fishes, American eel (COSEWIC Threatened; S3N) and brook trout (S3) are considered priority species. Although this species diversity is considered relatively high within the context of NS, the highest species diversity recorded within a single aquatic feature was four (WC1 and WC11). Most aquatic features with confirmed fish presence only had one or two species observed. Fish captured are predominantly cool-warm water species, with the exception of northern redbelly dace and brook trout as cold-water species. Chain pickerel, an aquatic invasive species and known predator of salmonids, was confirmed in WC11. Confirmed brook trout presence was limited to WC11 and WC1, and overall abundance was low at only nine individuals. Northern redbelly dace accounted for the vast majority of individuals captured as a direct result of hundreds (567) of the dace found within two isolated ponds. With the exception of northern redbelly dace, overall fish abundance throughout the ASA was low with the majority of features fished resulting in no capture (Figure 6.7-3 and 6.7-4).

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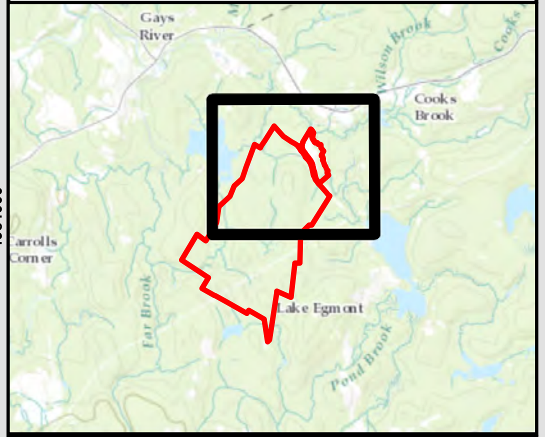
FIGURE 6.7-3
Fish Collection and Detailed Habitat Methods (North)

Antrim Gypsum Project

Cooks Brook, Nova Scotia

Trapping Location
Closed Electrofishing
Open Electrofishing
Field Delineated Watercourses
NSTDB Mapped Watercourse
Open Water
WC Mosaic
WL Mosaic
Field Delineated Wetland
NSECC Wetland Inventory
Aquatic Study Area
Project Area



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Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

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1:10,000 Scale when printed @ 11" x 17"

Drawn By: AS
Reviewed By: MJ

Project #: 24-9991
Date: 2024-07-24

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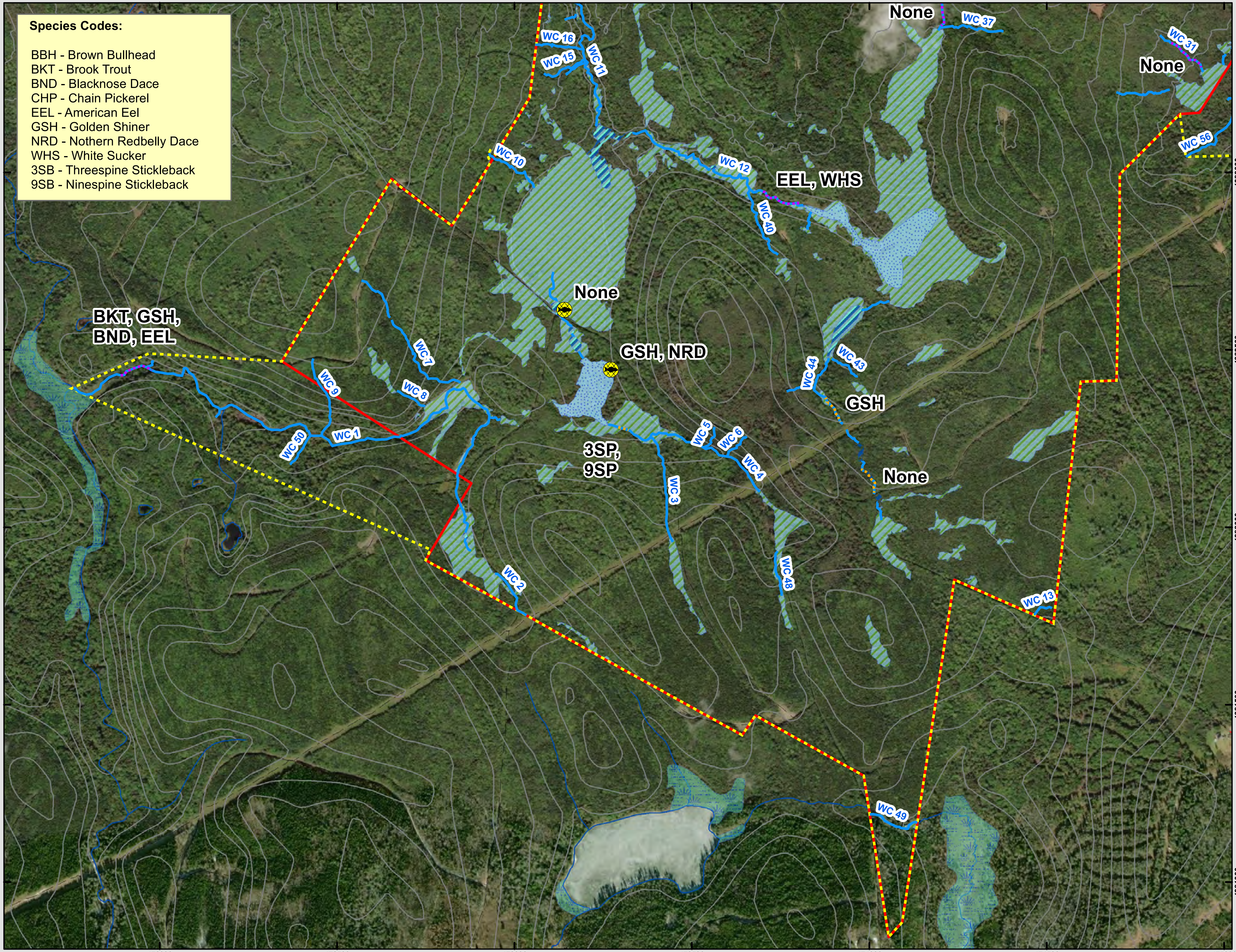
Document Name: 240212_Fish_Results



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GHD

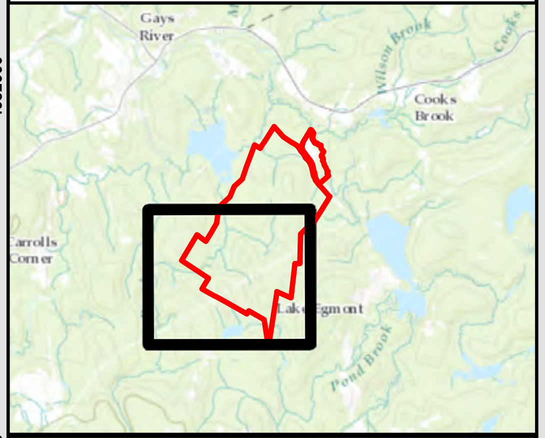
FIGURE 6.7-4

Fish Collection and Detailed Habitat Methods (South)

Antrim Gypsum Project

Cooks Brook, Nova Scotia

- Trapping Location
- Closed Electrofishing
- Open Electrofishing
- Field Delineated Watercourses
- NSTDB Mapped Watercourse
- Open Water
- UP Mosaic
- WL Mosaic
- Field Delineated Wetland
- NSECC Wetland Inventory
- Aquatic Study Area
- Project Area



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Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

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1:10,000 Scale when printed @ 11" x 17"

Drawn By: AS
Reviewed By: MJ

Project #: 24-9991
Date: 2024-07-24

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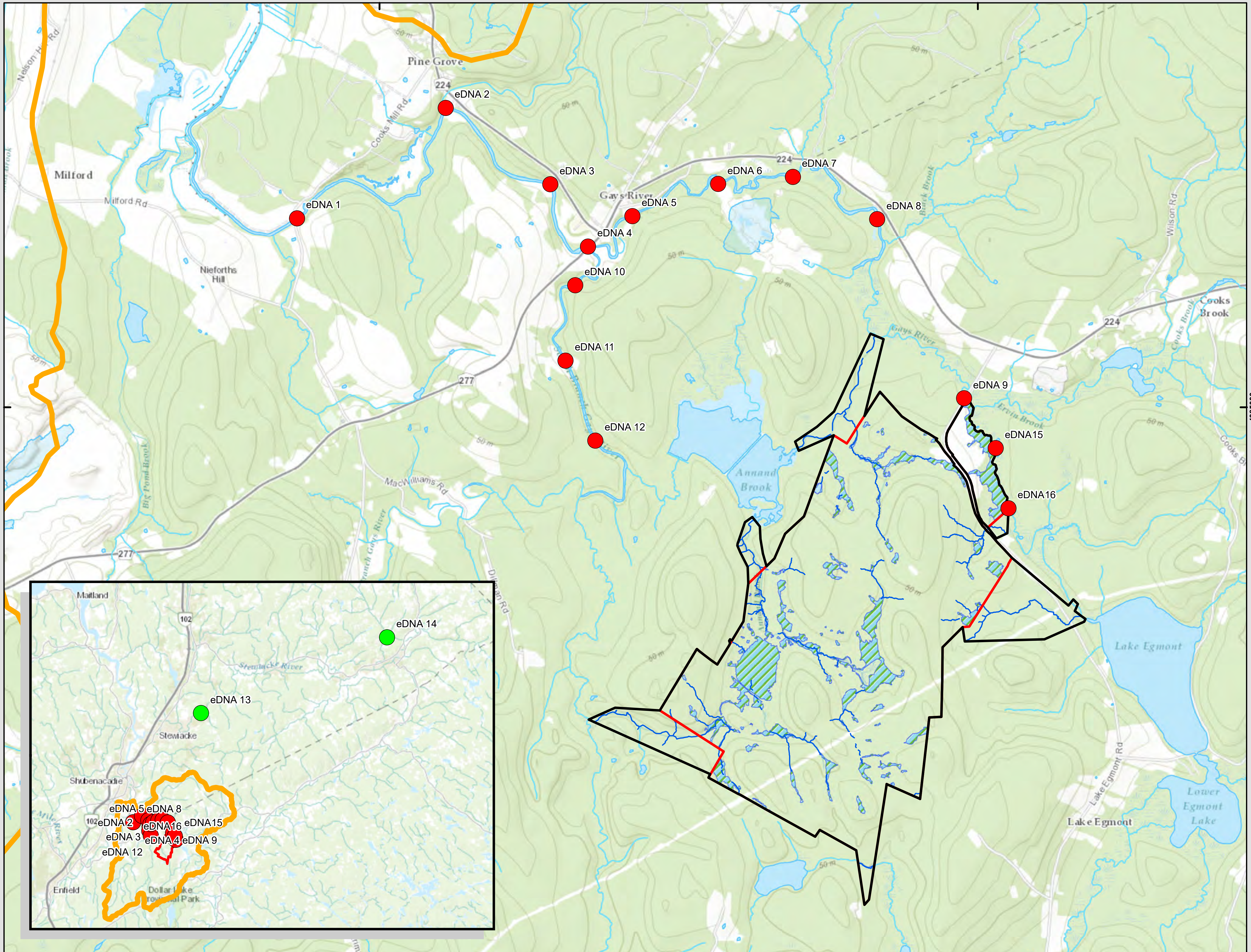
Document Name: 240212_Fish_Results

6.7.3.5 eDNA

The results of eDNA samples collected outside and adjacent to the are provided in Table 6.7-2. Note that Sites 15 and 16 were added prior to the third round of eDNA sampling (March 2024) to further try to detect for Atlantic salmon adjacent of the ASA. The laboratory results report is presented in Appendix H.1. To reduce the probability of false-negatives, samples were diluted ten-fold and re-analyzed, to reduce any PCR inhibiting compounds. Sample location and results shown on Figure 6.7-5.



Prepared For:

GHD

FIGURE 6.7-5
eDNA Results

Antrim Gypsum Project
Cooks Brook, Nova Scotia

Site Type, Results for Salmon DNA

- Control, Positive
- Survey, Negative
- Field Delineated Watercourse
- NSTDB Watercourse
- Field Delineated Wetlands
- Open Water
- Aquatic Local Assessment Area (LAA)
- Project Area
- Aquatic Study Area (ASA)

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 400 800 1,600 m

1:30,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By: KP

Project Number: 24-9991
Date: 7/20/2024

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Document Name: Antrim Fish LAA

Table 6.7-2 Summary of eDNA Sample Results (2023 and 2024).

Site ID	WC Number	Sample	September 5-6, 2023		November 2-3, 2024		March 25-27		May 13-14	
			Result	Interpretation	Result	Interpretation	Result	Interpretation	Result	Interpretation
1	Gays River (downstream of confluence with South Branch Gays River)	1A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		1B	0/3		0/3		0/3		0/3	
		1C	0/3		0/3		0/3		0/3	
2	Gays River (downstream of confluence with South Branch Gays River)	2A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		2B	0/3		0/3		0/3		0/3	
		2C	0/3		0/3		0/3		0/3	
3	Gays River (downstream of confluence with South Branch Gays River)	3A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		3B	0/3		0/3		0/3		0/3	
		3C	0/3		0/3		0/3		0/3	
4	Gays River (confluence with South Branch Gays River)	4A	0/3	Negative	0/3	Negative	0/3	Inconclusive*	0/3	Negative
		4B	0/3		0/3		0/3		0/3	
		4C	0/3		0/3		1/3		0/3	
5	Gays River (downstream of ASA)	5A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		5B	0/3		0/3		0/3		0/3	
		5C	0/3		0/3		0/3		0/3	
6	Gays River (downstream of ASA)	6A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		6B	0/3		0/3		0/3		0/3	
		6C	0/3		0/3		0/3		0/3	
7	Gays River (downstream of ASA)	7A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		7B	0/3		0/3		0/3		0/3	
		7C	0/3		0/3		0/3		0/3	
8	Gays River (downstream of ASA)	8A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		8B	0/3		0/3		0/3		0/3	
		8C	0/3		0/3		0/3		0/3	
9	Gays River (along the northeastern edge of the ASA)	9A	0/3	Inconclusive*	0/3	Negative	0/3	Negative	0/3	Negative
		9B	1/3		0/3		0/3		0/3	
		9C	0/3		0/3		0/3		0/3	
10	South Branch Gays River (northwest of the ASA)	10A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		10B	0/3		0/3		0/3		0/3	
		10C	0/3		0/3		0/3		0/3	
11	South Branch Gays River (northwest of the ASA)	11A	0/3	Inconclusive*	0/3	Negative	0/3	Negative	0/3	Negative
		11B	0/3		0/3		0/3		0/3	
		11C	1/3		0/3		0/3		0/3	
12	South Branch Gays River (northwest of the ASA)	12A	0/3	Negative	0/3	Negative	0/3	Negative	0/3	Negative
		12B	0/3		0/3		0/3		0/3	

Site ID	WC Number	Sample	September 5-6, 2023		November 2-3, 2024		March 25-27		May 13-14	
			Result	Interpretation	Result	Interpretation	Result	Interpretation	Result	Interpretation
		12C	0/3		0/3		0/3		0/3	
13**	Stewiacke River	13A	0/3	Inconclusive*	3/3	Positive	2/3	Positive	3/3	Positive
		13B	1/3		3/3		1/3		3/3	
		13C	0/3		3/3		1/3		3/3	
14**	Pembroke River	14A	3/3	Positive	3/3	Positive	3/3	Positive	3/3	Positive
		14B	3/3		3/3		2/3		3/3	
		14C	2/3		3/3		3/3		3/3	
15	Gays River (along the northeastern edge of the ASA)	15A	N/A		N/A		3/3	Negative	0/3	Negative
		15B					0/3		0/3	
		15C					0/3		0/3	
16	Gays River (along the northeastern edge of the ASA)	16A	N/A		N/A		0/3	Negative	0/3	Negative
		16B					0/3		0/3	
		16C					0/3		0/3	

*Sites 4, 9, 11, and 13 were inconclusive during one round of eDNA sampling due to the single PCR replicate amplification of Atlantic Salmon in one of the nine replicates, these may be false negatives. Sites 4, 9 and 11 are considered negative based on the previous and subsequent rounds of sampling resulting in a negative detection of Atlantic Salmon. Site 13 is considered positive for Atlantic due to subsequent rounds of eDNA sampling resulting in positive detection, this discrepancy may be a result of human error during sampling or filtration.

**Positive control sites where Atlantic salmon are expected to be present. Analysis for Atlantic Salmon was completed by Dr. Paul Bentzen's laboratory at Dalhousie University. Full details on sample analysis and interpretation for these samples are provided in the Dalhousie Report, Appendix H.1.

Sample results for Atlantic Salmon are consistent with expectations based on knowledge of the PA and fish collection efforts to date. Detection for Atlantic Salmon within the Gays River and South Branch Gays River both resulted in negative detection and/or inconclusive (possible false positives). While conventional fish collection was not completed by Strum within the Stewiacke River or Pembroke River, Atlantic Salmon was expected based on confirmation of DFO stocking programs within the eDNA sampling areas.

Based on the negative detection across the 15 sites adjacent to the ASA, Atlantic salmon are not expected within the Gays River, South Branch Gays River or up gradient water features within the ASA (Figure 6.7-5).

6.7.3.6 Brook Floater Habitat Suitability

The results of the brook floater and habitat suitability survey are described in detail in the Fish and Fish Habitat Biophysical Report (Appendix H.1). WC11 and WC12 were observed to have reaches that were described as poor to high quality habitat. Delineated reaches can be seen on Figure 6.7-6. Though moderate-high and high quality habitat is available within WC11 and WC12, the habitat is sparse (only accounting for 252 m out of the entire 1674 m surveyed) and fragmented by long sections of lower quality habitat. During the brook floater surveys, no evidence of brook floaters or any other freshwater mussels were found within or adjacent to the watercourses. Brook floater are not expected to be within the ASA.

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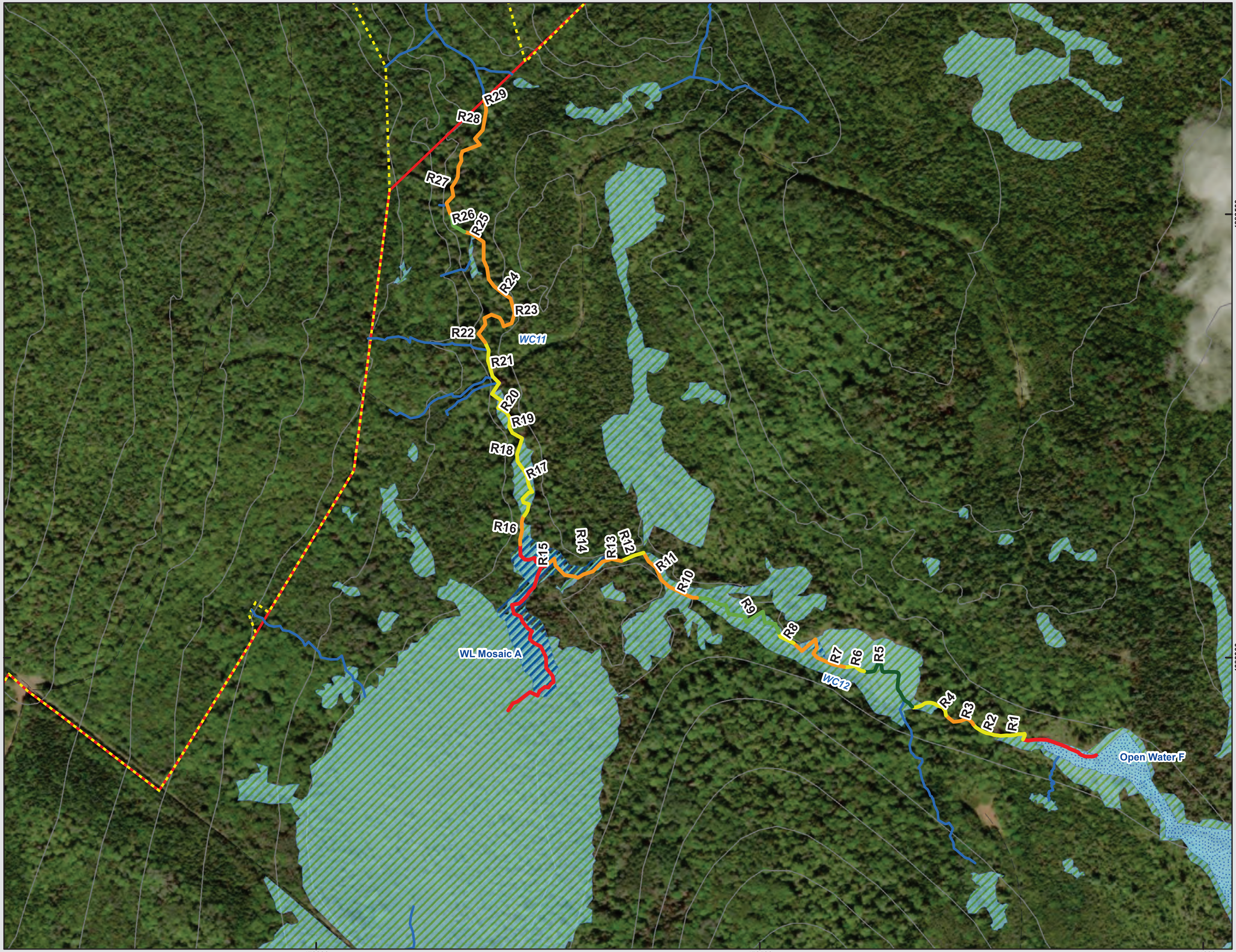
FIGURE 6.7-6

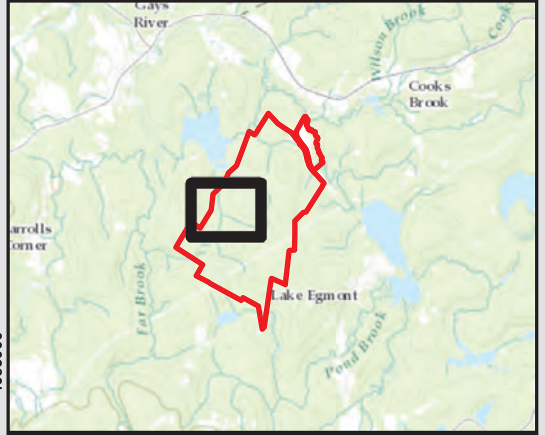
Brook Floater: Habitat Assessment Results

Antrim Gypsum Project Cooks Brook, Nova Scotia



Habitat Suitability

- High
- Moderate-High
- Moderate
- Low
- Very Low
- Field Delineated Watercourse
- Trail
- Open Water
- WL Mosaic
- Field Delineated Wetland
- Aquatic Study Area
- Project Area



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Projection: Transverse Mercator
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Units: Meter

0 50 100 200 m

1:4,000 Scale when printed @ 11" x 17"

Drawn By: AS
Reviewed By: MJ

Project #: 24-9991
Date: 2024-07-24

strum CONSULTING

Document Name: 240213_BF_Results

6.7.3.7 Summary of Baseline Conditions

The ASA is largely comprised of smaller, first and second order intermittent streams as a result of multiple topographical highs generating several divisions of flow. Larger, named systems located within the ASA include Annand Brook (in the northwest) and Gay River (in the northeast).

In total, 60 watercourses were mapped within the ASA during baseline delineation. A total of 79 wetlands were identified and delineated throughout the PA. Wherever fish habitat extends into wetlands, it is described in the context of contiguous watercourses, open water bodies and/or mosaics. Seven wetland mosaics, three upland mosaics, and two watercourse mosaics identified throughout the ASA: WL Mosaics A, E, F, G, H, I, and J; UP Mosaics B, C, and D; and WC Mosaics A and B. In addition, six open water features (Open Water A through Open Water F) were identified within the ASA.

Two watercourses (WC11 and WC12) were identified to possibly contain suitable brook floater habitat based on their perennial flow, substrate type, and minimal turbidity. Twenty-nine brook floater reaches delineated between these two watercourses, of which only three were characterized as providing moderate-high or high habitat suitability. These habitats are sparse (only accounting for 252 m out of the entire 1674 m surveyed) and fragmented by long sections of lower quality habitat. No evidence of brook floaters or any other freshwater mussels were found within or adjacent to the watercourses.

Detailed fish habitat assessments revealed that overall fish habitat viability and accessibility within select aquatic systems are limited due to naturally poor connectivity. Thirty-three percent of all watercourses delineated within the ASA are isolated, first order ephemeral or intermittent watercourses with no observed surface water connections to any downgradient, fish-bearing features. Although these watercourses indirectly support fish habitat through hydrological contributions, they are not considered to directly support one or more life stages of fish. Some isolated systems (e.g., WC3) support resident fish, but habitat availability is restricted to the local system. WC11, WC12 (and those watercourses with direct connectivity to these systems), as well as Annand Brook are considered to provide the most diverse habitat for the local fish community within the ASA.

For detailed descriptions of methodologies and results, refer to the Fish and Fish Biophysical Baseline Report (Appendix H.1).

6.7.4 Effects Assessment Methodology

6.7.4.1 Boundaries

The scope of the environmental effects assessment is defined by spatial (i.e., geographic extent of Project effects), temporal (i.e., the timing of potential effects), administrative, and technical boundaries. Spatial boundaries were defined based on the expected maximum extent of impacts to fish and fish habitat. Temporal boundaries are based on the anticipated duration and timing of Project activities. The assessment boundaries are described below.

Spatial Boundaries

The following spatial boundaries were used to evaluate Project effects and interactions, including residual effects to fish and fish habitat.

– The PA encompasses the immediate area in which Project activities may occur and are likely to cause effects to fish and fish habitat.
– An ASA was defined which incorporates the entirety of the PA, an extension along the entirety of Annand Brook, two extensions to the east of the PA, and one extension to the south). The extent of the ASA was determined based on anticipated Project-related effects to fish and fish habitat beyond (i.e., downstream of WC11, WC56 and Annand Brook) the boundary of the PA, and supported by modelled extents used in the groundwater and surface water chapters. Baseline field work was completed through the ASA.

- The LAA encompasses adjacent areas outside of the PA where Project related effects to fish and fish habitat may occur. For fish and fish habitat, the LAA consists of the PA, ASA, and encompasses the tertiary watershed in which the PA lies (1DG-1-WW), herein referred to as the Gays River tertiary watershed.
- No RAA is defined for this VC, as the effects are expected to occur entirely within the LAA.
- The spatial boundaries are shown in Figure 6.7-7

The Project infrastructure lies entirety within the Gays River tertiary watershed. It is not expected that impacts to the aquatic environment, including fish habitat will extend beyond the ASA. Based on the type and location of the infrastructure and considering the planned water management systems, these activities are not expected to impact downgradient of the ASA (i.e., Gays River or the broader extent of the tertiary watershed) beyond natural variability. As the Project has potential to cause effects to fish and fish habitat outside of the ASA, the LAA is the appropriate boundary for evaluation of this VC.

Temporal Boundaries

The temporal boundaries for the fish and fish habitat effects assessment are defined by the construction, operation, and closure phase of the Project.

The assessment of effects to fish and fish habitat is further evaluated based on modelling scenarios during operations (Phase 1 and Phase 2), and two scenarios during closure (pit filling and PC).

Technical Boundaries

The assessment of potential effects to fish and fish habitat as a result of changes in surface and groundwater contributions is limited by the accuracy of the models developed. For limitations relating to the Water Balance Assessment refer to Section 6.5 and Appendix F.2.

Administrative Boundaries

Effects of the Project on fish and fish habitat were evaluated within the framework offered by the *Fisheries Act* and supporting policy statements and management objectives from DFO, including those referenced herein. DFO interpretation of death of fish and HADD of fish habitat supports the evaluation of this VC. Administrative boundaries also include the SARA and NSESA.

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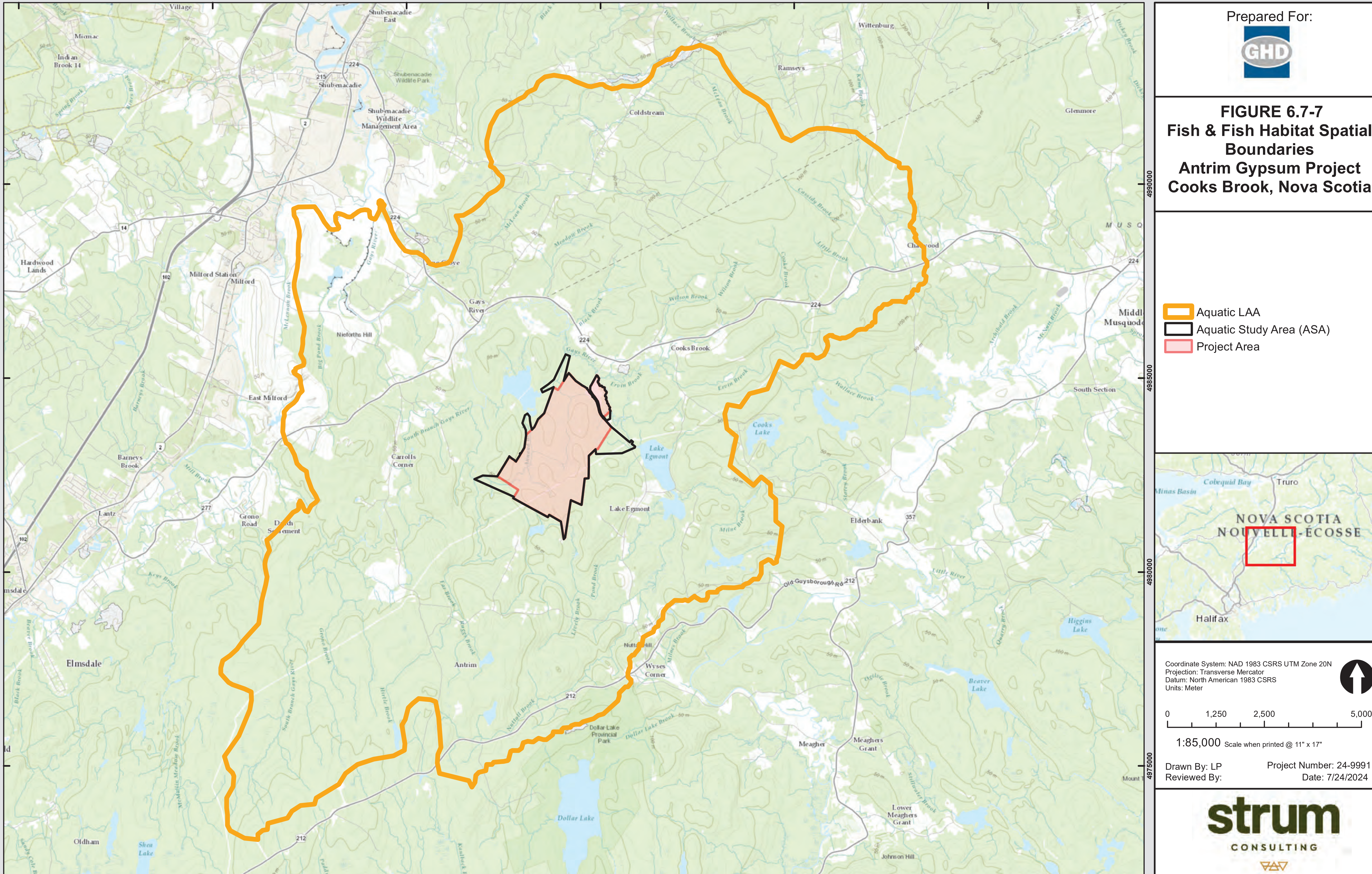
FIGURE 6.7-7
Fish & Fish Habitat Spatial Boundaries
Antrim Gypsum Project
Cooks Brook, Nova Scotia



Aquatic LAA
Aquatic Study Area (ASA)
Project Area

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 1,250 2,500 5,000 m

1:85,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By:

Project Number: 24-9991
Date: 7/24/2024

strum CONSULTING

Document Name: Antrim Fish Spatial

6.7.4.2 Thresholds for the Determination of Significance

Table 6.7-3 summarizes the characterization criteria for environmental effects to fish and fish habitat.

Table 6.7-3 Characterization Criteria for Environmental Effects

Characterization	Quantitative Measure or Definition of Qualitative Categories
Magnitude	**N** – no measurable change in fish habitat quantity or quality: Less than 1% change in surface flow No direct loss of fish habitat **L** – a measurable change in fish habitat quantity or quality, but within natural variation with consideration of the following variables: Less than 10% change in surface flow not affecting the ability of fish to use the habitat to carry out one or more life processes No direct loss of fish habitat **M** – a measurable change in fish habitat quantity or quality which partially limits the ability of fish to use the habitat to carry out one or more life processes (i.e., an effect which occurs only seasonally) with consideration of the following variables: Less than 25% change in surface flow not affecting the ability of fish to use the habitat to carry out one or more life processes Partial loss of fish habitat quantity **H** – a measurable change in fish habitat quantity or quality to an extent which limits the ability of fish to use the habitat to carry out one or more life processes with consideration of the following variables: More than 25% change in surface flow not affecting the ability of fish to use the habitat to carry out one or more life processes Complete direct loss of fish habitat
Geographic Extent	**PA** – direct and indirect effects from Project activities are restricted to the PA. **LAA** – Residual effects extend into the LAA. **RAA** – not defined for this assessment.
Timing	**N/A –** seasonal aspects are unlikely to affects VCs. **A** — seasonal aspects may affect VCs.
Duration	**ST** – effects are limited to occur from as little as 1 day to 12 months. **MT** – effects can occur beyond 12 months and up to 3 years. **LT** – effects extend beyond 3 years. **P** – valued component unlikely to recover to baseline conditions.
Frequency	**O** – effects occur once. **S** – effects occur at irregular intervals throughout the Project. **R** – effects occur at regular intervals throughout the Project. **C** – effects occur continuously throughout the Project.
Reversibility	**RE** – Fish and fish habitat will recover to baseline conditions before or after Project activities have been completed. **PR –** mitigation cannot guarantee a return to baseline conditions. **IR** – effects to VCs are permanent and will not recover to baseline conditions.

A significant adverse effect on fish and fish habitat from the Project is defined as:

– A Project-related effect that is likely to cause a temporary or permanent change to fish habitat that impairs the habitat's capacity to support one or more life processes of fish, that cannot be avoided, mitigated, or offset; and/or,

– A Project-related effect that is predicted to cause a measurable change in local fish populations beyond the range of natural variability (for example, through changes in abundance, health, growth, or survival).

6.7.4.3 Water Balance Assessment

Based on the methods and results discussed in Section 6.5 and in the Water Balance Assessment Report (Appendix F.2), subsequent sections herein outline and evaluate the predicted changed in water quantity within each aquatic receiving feature within the ASA.

6.7.4.4 Interpretation of Regulatory Guidelines

Effects to fish and fish habitat through flow reductions were assessed using guidance outlined in the Framework for Assessing the Ecological Flow Requirements to support Fisheries in Canada (DFO, 2013). According to DFO (2013), "The scientific literature supports natural flow regimes as essential to sustaining the health of riverine ecosystems and the fisheries dependant on them. Riverine ecosystems and the fisheries they sustain are placed at increasing risk with increasing alteration of natural flow regimes".

Riverine systems are naturally dynamic, with seasonal and annual variability; as a result, determination of the occurrence and extent of an effect to fish and fish habitat can be difficult to determine. To support this determination, DFO (2013) provides the following guidance:

– "Cumulative flow alterations <10% in amplitude of the actual (instantaneous) flow in the river relative to a "natural flow regime" have a low probability of detectable effects to ecosystems that support commercial, recreational or Aboriginal fisheries. Such projects can be assessed with "desktop" methodologies.
– Cumulative flow alterations that result in instantaneous flows < 30% of the mean annual discharge (MAD) have a heightened risk of impacts to fisheries.

For cumulative water use >10% of the instantaneous discharge or that results in flows < 30% of the MAD, a more rigorous level of assessment is recommended to evaluate potential impacts on ecosystem functions which support fisheries". It is worth noting that further guidance on more rigorous assessment methods and interpretation of results is not provided by DFO (2013).

A key limitation of the Ecological Flow Requirement guidance identified by DFO (2013) is that the determination of effects to fish and fish habitat are not well understood in intermittent, seasonal, or ephemeral watercourses. The in-stream flow needs for watercourses that naturally lack flow at certain times of the year are not well understood, and guidance is lacking to determine effects to fish habitat in these systems. As a result, if these systems are encountered in the effects assessment, a determination will be made based on known physical parameters of the watercourse, known or expected fish usage, and predicted alterations in the natural flow regime. Of the watercourses with expected flow disruption impacts, the majority are second order perennial streams.

The Projects predicted effects to watercourses were modelled at 17 assessment points (Figure 6.7-8), under four scenarios:

– Phase 1: The first phase of excavation and processing of gypsum. The northern portion of the open pit has been excavated and the northern portion of the proposed overburden stockpile has been developed.
– Phase 2: Full build-out conditions for the PA including excavation of the open pit, backfilling of the northern portion of the pit and development of all stockpiles
– Pit filling: Active mining has finished, and reclamation activities have commenced. Stockpiles have been covered and seeded and any administrative areas have been restored. The open pit is filling with direct precipitation, groundwater inflows, overflow from the south settling pond, and surface flows from upstream catchments
– Closure: All mine infrastructure has been removed. The open pit is filled to an elevation of 25.1 masl. No further closure activities to be conducted.

Based on this initial assessment, a determination of effects could be made at a particular assessment point; meaning that the impacts were substantial enough to form a preliminary conclusion related to HADD of fish habitat. For the purpose of this EARD, a conservative assumption was made that any flow reduction or increase over 10% is considered a HADD but will require additional assessment to support any future FAA submission. The impact area to fish and fish habitat is quantified conservatively based on the total area of each watercourse, water body, watercourse mosaic, upland mosaic or wetland mosaic. Habitat measurements were recorded using methods outlined in detail in the Fish and Fish Habitat Baseline Report (Appendix H.1). The HADD has been calculated based on the total area of each watercourse, waterbody or wetland mosaic. This approach is highly conservative, as these streams are expected to still provide fish habitat, albeit changed fish habitat. Refinement of the HADD calculations will be completed during the permitting stage of the Project.

6.7.5 Project Interactions and Potential Effects

Potential Project interactions with fish and fish habitat are presented in Table 6.7-4 below.

Table 6.7-4 Fish and Fish Habitat Interactions

Project Phase	Relevant Project Activity
Construction	Clearing, grubbing, and grading Topsoil, overburden, and waste rock management Surface infrastructure installation and construction Haul road construction Collection ditch and settling pond construction
Operation	Gypsum management (extraction, loading, hauling, screening) Topsoil, overburden, and waste rock management Water management Haul road construction and maintenance Petroleum products management
Closure	Earthworks Water management

The Project can impact fish and fish habitat through multiple direct and indirect pathways. The identification of potential Project interactions with fish and fish habitat were guided by DFO's Pathways of Effects (2018a). These interactions have the potential to change fish and fish habitat from baseline conditions as outlined below.

- Change in fish habitat quantity due to the direct removal of fish habitat through dewatering, rerouting, infilling, excavation or road crossings.
- Change in fish habitat quality due to changes in surface flow and temperature though water management, groundwater drawdown, and changes to contributing drainage areas resulting in flow increases or reductions in streams within the ASA.
- Change in fish health and survival due to the use of equipment in or near water, the release of deleterious substances, changes to water quality, blasting in or near fish habitat and impingement or entrainment of fish through water management.

The effects assessment to fish and fish habitat was completed with the understanding that an authorization under the *Fisheries Act* will be required due to unavoidable and unmitigable impacts. Table 6.7-5 provides a summary of all fish habitat which was identified within the PA (Figure 6.7-1). It outlines the determination of which habitats were carried through the effects assessments, based on expected change in fish quantity or flow disruption effects. Fish habitat with predicted effects are carried through the effects assessment and carried forward into Table 6.7-6 which provides detailed related to the type of potential project interaction, effect pathway, commencement of proposed impact and duration of proposed impact.

Table 6.7-5 Summary of Fish Habitat Evaluated in the Effects Assessment

Fish Habitat	Stream Order	Proposed Effect	Carried through Effects Assessment
WC1	1-2	None	No
WC2	1	None	No
WC3	1-2	None	No
WC4	1-2	None	No
WC5	1	None	No
WC6	1	None	No
WC7	1	None	No
WC8	1	None	No
WC9	1	None	No
WC10	1	Change in fish habitat quantity	Yes
WC11	1-2	Change in fish habitat quantity and flow	Yes
WC12	1-2	Change in fish habitat quantity	Yes
WC13	1	None	No
WC14	1	Change in fish habitat quantity	Yes
WC15	1	Change in fish habitat quantity	Yes
WC16	1	Change in fish habitat quantity	Yes
WC17	1	Change in fish habitat quantity	Yes
WC18	1	Change in fish habitat quantity	Yes
WC19	1	Change in fish habitat quantity	Yes
WC20	1	None	No
WC21	1	Change in fish habitat quantity	Yes
WC22	1	None	Yes
WC23	1	None	No
WC24	1-2	Change in fish habitat quantity	Yes
WC25	1	Change in fish habitat quantity	Yes
WC26	1-2	Change in fish habitat quantity and flow	Yes
WC27	1	Change in fish habitat quantity	Yes
WC28	1	None	No
WC29	1	None	No
WC30	1	Change in flow	Yes
WC31	1	Change in fish habitat quantity	Yes
WC32 (Gays River)	4	None	No
WC33	1	Change in fish habitat quantity	Yes
WC34	1	Change in fish habitat quantity	Yes
WC35	1	Change in fish habitat quantity	Yes
WC36	1	Change in fish habitat quantity	Yes

Fish Habitat	Stream Order	Proposed Effect	Carried through Effects Assessment
WC37	1	Change in fish habitat quantity	Yes
WC38	1	None	No
WC39	1	Change in fish habitat quantity	Yes
WC40	1	Change in fish habitat quantity	Yes
WC41	1	None	No
WC42	1	None	No
WC43	1	None	No
WC44	1-2	None	No
WC45	1	None	No
WC46	1	None	No
WC47	1	None	No
WC48	1	None	No
WC49	1	None	No
WC50	1	None	No
WC51	1	None	No
WC52	1	None	No
WC53	1	Change in fish habitat quantity	Yes
WC54	1	Change in flow	Yes
WC55	1	Change in flow	Yes
WC56	1-2	Change in flow	Yes
WC57 (Annand Brook)	2	Change in flow	Yes
WC58	1	Change in fish habitat quantity	Yes
WC59	1	Change in fish habitat quantity	Yes
WC60	1	Change in fish habitat quantity	Yes
Wetland Mosaic A	2	Change in fish habitat quantity	Yes
Wetland Mosaic E	2	None	No
Wetland Mosaic F	2	None	No
Wetland Mosaic G	2	Change in fish habitat quantity	Yes
Wetland Mosaic H	2	None	No
Wetland Mosaic I	2	None	No
Wetland Mosaic J	2	None	No
Upland Mosaic B	1	None	No
Upland Mosaic C	1	None	No
Upland Mosaic D	1	None	No
Watercourse Mosaic A	2	Change in flow	Yes
Watercourse Mosaic B	2	None	No
Open Water A	1	Change in fish habitat quantity	Yes

Fish Habitat	Stream Order	Proposed Effect	Carried through Effects Assessment
Open Water B	1	Change in fish habitat quantity	Yes
Open Water C	1	Change in fish habitat quantity	Yes
Open Water D	1	None	No
Open Water E	2	None	No
Open Water F	1	None	No

Table 6.7-6 Overview of Potential Project Interaction Types and Duration

Fish Habitat	Potential Interaction Description	Potential Interaction Type	Duration of Interaction
WC10	Open pit	Change in fish habitat quantity	Permanent
WC11	Open pit	Change in fish habitat quantity	Permanent
WC11	Flow disruption	Change in flow	Temporary
WC12	Open pit	Change in fish habitat quantity	Permanent
WC14	Open pit	Change in fish habitat quantity	Permanent
WC15	Open pit	Change in fish habitat quantity	Permanent
WC16	Open pit	Change in fish habitat quantity	Permanent
WC17	Open pit	Change in fish habitat quantity	Permanent
WC18	The open pit and topsoil stockpile	Change in fish habitat quantity	Permanent
WC19	Topsoil stockpile	Change in fish habitat quantity	Permanent
WC21	Haul road and the open pit	Change in fish habitat quantity	Permanent
WC24	Overburden stockpile	Change in fish habitat quantity	Permanent
WC25	Settling pond and loss of catchment to overburden stockpile	Change in fish habitat quantity	Permanent
WC26	Overburden stockpile	Change in fish habitat quantity	Permanent
WC26	Flow disruption	Change in flow	Permanent
WC27	Overburden stockpile	Change in fish habitat quantity	Permanent
WC30	Flow disruption	Change in flow	Permanent
WC31	Overburden stockpile	Change in fish habitat quantity	Permanent
WC33	Overburden stockpile	Change in fish habitat quantity	Permanent
WC34	The haul road, and loss of catchment from topsoil and process reject stockpile	Change in fish habitat quantity	Permanent
WC35	The haul road, and loss of catchment from open pit and overburden stockpile	Change in fish habitat quantity	Permanent
WC36	Loss of catchment to the open pit	Change in fish habitat quantity	Permanent
WC37	Overburden stockpile	Change in fish habitat quantity	Permanent
WC39	Open pit	Change in fish habitat quantity	Permanent
WC40	The open pit and interruption of flow	Change in fish habitat quantity	Permanent
WC53	Open pit	Change in fish habitat quantity	Permanent

Fish Habitat	Potential Interaction Description	Potential Interaction Type	Duration of Interaction
WC54	Flow disruption	Change in flow	Permanent
WC55	Flow disruption	Change in flow	Permanent
WC56	Flow disruption	Change in flow	Permanent
WC57 (Annand Brook)	Flow disruption	Change in flow	Temporary
WC58	Open pit	Change in fish habitat quantity	Permanent
WC59	Open pit	Change in fish habitat quantity	Permanent
WC60	Open pit	Change in fish habitat quantity	Permanent
Wetland Mosaic A	Open pit	Change in fish habitat quantity	Permanent
Wetland Mosaic G	Open pit	Change in fish habitat quantity	Permanent
Watercourse Mosaic A	Flow disruption	Change in flow	Temporary
Open Water A	Open pit	Change in fish habitat quantity	Permanent
Open Water B	Open pit	Change in fish habitat quantity	Permanent
Open Water C	Open pit	Change in fish habitat quantity	Permanent

6.7.5.1 Change in Habitat Quantity

The Project will result in a permanent loss of aquatic habitat due to Project infrastructure. This impact is defined as:

- Any fish habitat feature that is directly overlayed by infrastructure.
- In some cases, direct impacts include sections of downstream habitats, if significant direct impacts to headwater habitat habitats are proposed which will result in a complete loss of habitat in a downstream section of stream.
- Similarly, if direct impact prevents fish passage to an upstream portion of a watercourse and fish passage structures are not practical or viable, the upstream portion may be considered as a direct impact.

Permanent losses of aquatic habitat are those Project interactions which are expected to result in a change in fish habitat quantity, measured in m^2 of lost habitat. As described in the Fish and Fish Biophysical Baseline Report (Appendix H.1), detailed habitat assessments were completed on all fish habitat where impacts were expected. Detailed transect measurements were recorded at a 25-m frequency within each individual watercourse reach. The bankfull width of each transect survey point was used along with reach length to calculate the impact area (in m^2). Where impacts are proposed to an open water feature or mosaic, the delineated polygon was used to calculate the impact area.

Throughout the construction phase, permanent losses of aquatic habitat to fish and fish habitat are expected to occur through construction of access and haul roads, water management structures such as ditching systems, open pit development, associated topsoil and overburden stockpiles. Construction of the process rejects stockpile, topsoil stockpile west of the overburden stockpile, process plant, explosives area (if required), various product piles and administrative buildings will all occur during the construction phase, though none will result in permanent losses to fish habitat due to micro-siting efforts to avoid impacts. No additional destruction of fish habitat is expected to occur during operation or closure phases.

Permanent losses are described by the calculated habitat area (in m^2) and the fish species and life stages the habitats are expected to support (i.e., spawning, young of year (YOY), juvenile, adult). All permanent losses to fish habitat are considered a HADD of fish habitat. Impact areas were quantified in m^2 in Table 6.7-7 and shown on Figure 6.7-8.

Table 6.7-7 Summary of Permanent Losses of Fish Habitat

Fish Habitat	Stream Order	Flow	Fish Species and Life Stages Supported	Infrastructure Associated	Impact Extent (partial or full)	Habitat Type(s)	Length (m)	Wetted Width (m)	Bankfull width (m)	Number of Transects	Area of Impact (m^2)
WC10	1	I	None	Open pit	Full	Riffle-run	188.6	0.2-0.6	0.8-1.9	7	222
WC11	1-2	P	EEL – J/A BKT – S/Y/J/A CHP - S/Y/J/A WHS – S/Y/J/A	Open pit	Partial	Riffle-run	560.7	1.8-7.5	3.3-10.4	17	3,583
WC12	1-2	P	EEL – J/A BKT – S/Y/J/A CHP – S/Y/J/A WHS – S/Y/J/A	Open pit	Full	Flat, riffle-run	623.1	0.8-5.9	0.5-12.1	24	3078
WC14	1	E	EEL – J/A BKT – Y/A CHP – S/Y/J/A	Open pit	Full	Pool	74.1	0-0.65	1.2-2.8	3	156
WC15	1	I	EEL – J/A BKT – S/Y/J/A WHS – S/Y/J/A	Open pit	Full	Cascade	140.6	0-0.65	0.5-0.85	6	92
WC16	1	P	EEL – J/A BKT – S/Y/J/A WHS – S/Y/J/A	Open pit	Full	Riffle-run	148.8	0.45-1.1	0.9-2.2	5	177
WC17	1	I	None	Open pit	Full	Cascade	40	0.3-0.45	0.45-0.55	1	20
WC18	1-2	E	None	Open pit, topsoil stockpile	Full	Riffle-run	189.1	0.32-0.72	0.9-4.0	7	455
WC19	1	E	None	Topsoil stockpile	Full	Riffle-run	89.7	0.5-0.58	1.9-3.5	2	219
WC21	1	I	None	Haul road, open pit	Full	Riffle-run	339	0.3-1.0	1.0-2.8	11	515
WC24	1-2	I-P	EEL – J/A BBH – S/Y/J/A	Overburden stockpile	Full	Riffle-run	364.2	0.4-2.6	1.4-3.9	11	726
WC25	1	E	EEL – J/A BBH – S/Y/J/A	Settling pond, overburden stockpile	Full	Riffle	476.3	0.3-1.7	0.9-4.1	13	1,061
WC26	1	E-I	EEL – J/A BBH – S/Y/J/A	Overburden stockpile	Partial	Riffle-run, pool	522.1	0.4-1.9	1.0-3.7	16	1,003
WC27	1	I	EEL – J/A BBH – S/Y/J/A	Overburden stockpile	Full	Riffle	116.2	0.4-1.0	1.1-2.1	4	174
WC31	1	P	None	Overburden stockpile	Full	Flat	171	0.4-0.85	0.9-1.5	4	192
WC33	1	E	None	Overburden stockpile	Full	Riffle-run	163.3	0.3-1.0	0.6-1.7	5	186
WC34	1	E	None	Haul road, topsoil and process reject stockpile	Full	Riffle-run, flat	119.6	0.4-1.0	0.9-1.5	5	147
WC35	1-2	E	None	Haul road, open pit, overburden stockpile	Full	Run	282	0.5-2.0	1.0-2.5	10	485
WC36	1	E	None	Open pit	Full	Run	96.5	0.3-1.4	0.9-1.7	3	112
WC37	1	I	None	Overburden stockpile	Full	Flat	194.8	0.4-0.9	1.5-2.6	5	341
WC39	1	I	BKT - J WHS - A	Open pit	Full	Cascade	9.2	0.4	0.6	1	6

Fish Habitat	Stream Order	Flow	Fish Species and Life Stages Supported	Infrastructure Associated	Impact Extent (partial or full)	Habitat Type(s)	Length (m)	Wetted Width (m)	Bankfull width (m)	Number of Transects	Area of Impact (m^2)
WC40	1	P	EEL – J/A WHS – S/Y/A	Open pit	Full	Flat	231.5	0.5-2.0	2.0-6.7	8	859
WC53	1	I	EEL – J/A BKT – Y/A CHP - S/Y/J/A	Open pit	Full	Flat	42.6	0.9	3	1	128
WC58	1	E	NRD – S/Y/J/A	Open pit	Full	Run	100.4	0.5	2.5	2	251
WC59	1	I	NRD – S/Y/J/A	Open pit	Full	Flat	46.8	0.8	4	1	187
WC60	1	I	NRD – S/Y/J/A	Open pit	Full	Run	51.3	0.3-0.4	1.5-4.0	3	94
WL Mosaic A	N/A	N/A	EEL – J/A BKT - A CHP – S/Y/J/A WHS - none	Open pit	Full	Open Water	N/A				1,117
WL Mosaic G	N/A	N/A	EEL – J/A BKT - A CHP – S/Y/J/A WHS - None	Open pit	Full	Open Water	N/A				86
Open Water A	N/A	N/A	NRD – S/Y/J/A	Open pit	Full	Open Water	N/A				2787
Open Water B	N/A	N/A	NRD – S/Y/J/A	Open pit	Full	Wetland Mosaic	N/A				6,899
Open Water C	N/A	N/A	NRD – S/Y/J/A	Open pit	Full	Wetland Mosaic	N/A				215
Total Loss of Fish Habitat (m^2)											25,573
Total Habitat Units											255.7

S = Spawning, y = Young-of-Year, J = Juvenile, A = Adult

Considerable micro-sitting of the Project infrastructure has occurred to reduce overall impacts to fish habitat. As outlined in Table 6.6-7, direct impacts to fish habitat are expected for 26 watercourses, 3 open water features, and 2 wetland mosaics to support Project development. Except for Open Water A, B and C, all fish habitat proposed for direct impacts are first and second watercourses. In total 25,573 m^2 will require authorization under the *Fisheries Act*.

Impacts related to the development of the open pit, overburden stockpile, topsoil stockpile and haul road are expected to be permanent. The entirety of 22 small first order and second streams (i.e., WC10, WC12, WC14, WC15, WC16, WC17, WC18, WC19, WC24, WC25, WC27, WC31, WC33, WC34, WC35, WC37, WC40, WC58, WC59 and WC60) were identified to be completely lost due to both the direct overlay of the Project footprint and loss of a large component of the catchment area (Figure 6.7-8).

WC34, WC35, WC36 and WC53 were identified as direct losses due to the loss of a large portion of the catchment area from infrastructure (i.e., overburden and topsoil stockpile). While these watercourses do not involve direct infrastructure placement on fish habitat, they were conservatively counted as a direct loss based on professional judgement and familiarity with the baseline conditions, and proposed Project interactions in the headwaters. Those systems expected to experience more moderate or small flow reductions will be evaluated in further detail in the Flow Disruption Section (6.7.5.2), supported by hydrological modelling data. WC11, WC21, and WC26 all are predicted to be partially impacted by the Project infrastructure.

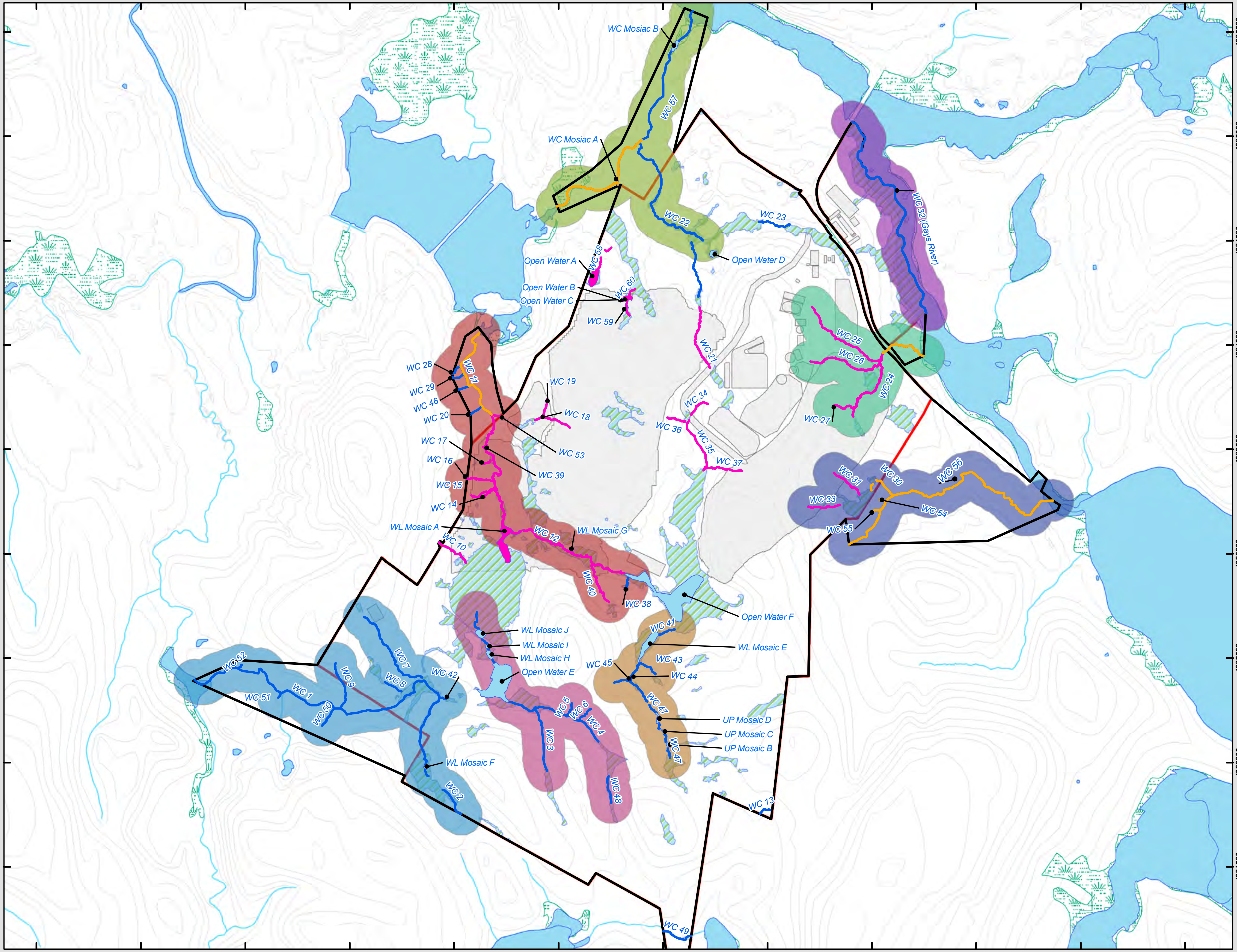
Fish habitat proposed for direct impact to support the Project is primarily used by American eel and brook trout; and to a lesser extent, white sucker, brown bullhead, northern redbelly dace (found within open water features) and one invasive species – chain pickerel. Three more species are 'known or expected to be present' in various watercourses throughout the ASA. Direct loss of fish habitat impacts is therefore expected to primarily effect brook trout and American eel within linear watercourses and northern redbelly dace, a forage fish, within open water features (Open Water A, B and C). Golden shiner are not expected to be impacted even though they are the second most abundant fish throughout the ASA.

Fish habitat upstream of infrastructure may also be considered a HADD of fish habitat if the downstream impact prevents fish passage upstream and fish passage structures are not practical or viable. There are two headwater systems that, while not overlayed by infrastructure, drain towards the pit, Watercourse 3 System and WC44 System (see Figure 6.7-8).

Watercourse 3 System consists of WC3, WC4, WC5, WC6, Open Water E, and three wetland mosaics [H, I and J], while Watercourse 44 System consists of WC41, WC43, WC44, WC45, and WL Mosaic E. No connectivity between WC3 and any downgradient aquatic resource (i.e., WC11) has been identified through multi-year (2022 and 2023) and multi-season (spring, summer) assessments. Two stickleback species (threespine and ninespine) as well as golden shiner and northern redbelly dace were confirmed within this system through electrofishing and trapping efforts. No migratory (e.g., American eel) or otherwise highly mobile species (e.g., brook trout) were confirmed or otherwise observed. Similarly, no surficial connection was observed between WC41 and downgradient aquatic systems (Open Water F). Only one species (one individual golden shiner) was confirmed in this system through electrofishing efforts. As such, both systems have confirmed resident fish presence, but no species captured are considered migratory or mobile through a watershed. Fish habitat and the resident fish these habitats support is expected to be maintained though Project development. Therefore, these systems are not subject to HADD authorization under the *Fisheries Act*. Further data collection will be conducted within Open Water F to support permitting and the FAA to refine potential impacts within the aquatic feature.

The primary mitigation measure to avoid death of fish is fish rescues, which will be conducted for all fish habitat directly overlayed by Project infrastructure. Death of fish will be minimized, but not completely avoided due to the inherent inefficiencies of fish rescue practices. As such, it is expected that incidental death of fish may occur as a result of permanent losses to aquatic habitats. Fish rescue methods are further described in Section 6.7.6.

Full descriptions of fish habitats proposed for direct impact are outlined in Fish and Fish Habitat Biophysical Baseline Report (Appendix H.1).



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GHD

FIGURE 6.7-8
Fish & Fish Habitat Impacts

Antrim Gypsum Project
Cooks Brook, Nova Scotia

Impact
- Direct Impact
- Indirect Impact

Systems
- Anaand Brook
- Gays River
- Watercourse 1 System
- Watercourse 11 System
- Watercourse 26 System
- Watercourse 44 System
- Watercourse 56 System
- Watercourse 4 System

- Field Delineated Watercourse
- NSTDB Watercourse
- Field Delineated Wetlands
- NSECC Wetland Inventory
- Open Water
- Project Infrastructure
- Project Area
- Aquatic Study

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 250 500 1,000 m

1:17,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By: KF

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CONSULTING

Document Name: Antrim Fish Impacts

6.7.5.2 Flow Disruption

Changes in fish habitat quality can occur through any mechanism that alters or disrupts the habitat's ability to support fish. Throughout this section, effects to fish and fish habitat will be explored through the following pathways of effects:

– Changes to surface flow (i.e., flow regime) from a combination of surface water management, groundwater drawdown, and changes to contributing drainage areas.
– Changes to water temperature from a combination of surface water management, groundwater drawdown, and changes to contributing drainage areas.
– Changes in water quality through water management or release of deleterious substances

6.7.5.2.1 Flow Regime

The construction and operation of the Project is expected to result in changes to surface flow from a combination of water management, groundwater drawdown, and changes to contributing drainage areas. Changes in the natural flow regime of riverine ecosystems can be detrimental to the fish and fish habitat these aquatic features support.

A summary of the predicted baseline flow volumes and average annual change for all 17 AP through each phase of the Project and closure is presented in Table 6.7-8 and shown on Figure 6.7-3. For further information from the Water Balance Assessment refer to Appendix F.2.

Table 6.7-8 Summary of Water Balance Assessment

Assessment Point	Baseline Flow Volume (m3)	Percent Change from Baseline			
		Phase 1	Phase 2	Pit Filling	Closure
1	1,241,581	-16%	-37%	-31%	-31%
2	847,327	1%	-3%	-3%	-1%
3	3,397,509	0%	15%	-2%	-6%
4	5,778,887	3%	11%	2%	1%
5	257,870	0%	0%	0%	0%
6	592,872	0%	0%	0%	0%
7	6,859,151	1%	7%	-1%	1%
8	7,343,483	1%	7%	-1%	1%
9	37,484,739	0%	0%	0%	0%
10	874,711	-22%	-25%	-25%	-25%
11	38,384,011	0%	-1%	-1%	-1%
12	626,188	47%	56%	3%	14%
13	41,014,330	0%	0%	-1%	0%
14	72,387,000	0%	0%	0%	0%
15	73,038,000	0%	0%	0%	0%
16	80,384,000	0%	1%	0%	0%
17	187,538	0%	0%	0%	0%

*AP 9 no flow disruption of any magnitude during any phase of the Project

As demonstrated within the water balance assessment (Appendix F.2), AP 2, 5, 6, 8, 9, 11, 13, 14, 15, 16 and 17 never exceed the >10% flow disruption (increase or decrease) during any month over all the phases of the Project. These AP included the Watercourse 3 System, and 6 separate locations along the Gays River to provide evidence that Gays River will not be impacted by flow disruptions from the Project. This mainly is because the large catchment for Gays River will remain relatively unchanged throughout all phases of the Project. Therefore, as per DFO (2013), no detectable changes to flow from existing conditions within these systems are anticipated, and these systems are not discussed further in the effects assessment of water quantity or quality on fish and fish habitat with the exception of AP17 which is discussed in further detail in the following sections.

AP1 has been identified as a HADD based on the DFO's Framework for Assessing Ecological Flow Requirements to Support Fisheries in Canada (>10% reduction in flow [2013]). Due to the location of the Project footprint the water features associated with this flow reduction will be overlain with Project infrastructure which will result in a change in habitat quantity. and are discussed in Section 6.7.5.1.

Watercourse 11

The Watercourse 11 System is the largest system within the ASA, and it incorporates a variety of aquatic features. Watercourses 11, 12, 14, 15, 16, 20, 28, 29, 38, 39, 40, 46 and 53 together form the northwestern tributary system towards the SML polishing pond (Annand Bog) (outside the ASA). WC11 and its tributaries (WC 14, 15, 16, 39 53, 20, 46, 29, and 28), flow from WL6 northwest into Annand Brook. WC12 and its tributaries (WC40 and 38) originate from Open Water F in WL41, flowing west to Wetland Mosaic A and joining with WC11.

Within this system, watercourses 12, 14, 15, 16, 17, 40, 53 and a portion of WC11 are proposed to be directly overlain by the Project infrastructure or will loss a majority of their catchment and are described in Section 6.7.5.1.

Downstream of the direct overlay of the open pit, WC11 will experience flow disruptions. This portion of WC11 was described as a perennial second order stream which ranges between 2.8-10.4 m wide and between 6-72 cm deep. It is comprised of a variety of habitats, riffle, runs, flats and pools with smaller rock (cobble and gravel) observed as the predominant substrate within most transects. American eel (all freshwater life stages), brook trout (YOY and adult, but only two individuals), chain pickerel (juvenile and adult), and white sucker (juvenile and adult) were all confirmed within this system.

Throughout Phase 1, pit filling and closure, WC11 will experience no detectable impacts (<10%). During Phase 2, WC11 will experience an increase in flow of 15% which will negatively impact fish habitat. As the open pit expands during Phase 2 (encroaching on WC11's catchment), surface water will be collected and relocated to the south settling pond. Water from within the south settling pond will be pumped around the open pit back into WC11. This increases the flow into WC11 during Phase 2, which concurrently increases the flow of the outlet of the SML polishing pond (WC57 - Annand Brook) which is discussed in the following section. The outlet structure will be designed to prevent scour at the discharge location and monitoring of the WC11 will be required if scouring occurs.

Increase in flow within WC11 is expected to occur throughout the year, even in months of high flow (spring). During these months it is expected that increased streamflow will have negative impacts on fish and fish habitat within the watercourse. The increase in stream flow is expected to change channel morphology and deposit eroded material, this is expected to reduce the availability of suitable habitat for known species within the watercourse as the gravel in the upper reach will be washed out. However, erosion or changes to channel morphology would not be expected during summer low flow conditions. Any percent increase in flow during summer low-flow conditions would likely be significantly lower than flows currently experienced during wetter seasons (spring).

The flow increase through this section of WC11 is predicted to result in an increased flow rate above the 10% as described in the DFO ecological Flow Framework (DFO, 2013). This prediction will be refined through the permitting stage and additional operational mitigation measures will continue to be explored during detailed design to reduce increased flow through this system. At this stage in in the permitting process, a conservative calculation of 2,481 m^2 were included for a potential FAA. In practice, this system, as shown on Figure 6.7-8, will maintain some function to support fish, especially during lower flow periods throughout the year.

Watercourse 21 and 22

In the northern portion of the ASA, WC22 flows northwesterly through a series of wetlands, eventually discharging into Annand Brook (WC57) (Figure 6.7-8). No additional direct tributaries were mapped along this system; however, both WC21 and WC23 are located upgradient of this watercourse and likely provide indirect hydrological inputs.

WC21 forms within an upland forest as an intermittent watercourse that disperses within WL36 for 50 m before rechannelizing and draining into WL67(a WSS). The watercourse was delineated into four reaches, dominated by low gradient habitats such as runs, flats and poos. The 300 m upgradient of WL36 is overlain by the haul road and pit and thus described and quantified within Section 6.7.5.1. The remaining 275 m was described as between

1.2 m and 3.1 m wide, with a depth range between 2 to 36 cm. Substrate was dominated by muck with smaller rocks (gravel and cobble) present in lesser amounts.

WC22 forms from drainage collected by a forest service road which bisects WL35 and WL67 (two WSS). WC22 was delineated into two reaches. The first reach (1) was a 665 m run underlain by a variety of substrates: sand, gravel, cobble, muck/detritus, boulder, rubble, and clay. As the watercourse increases in gradient it becomes wider and shallower, during which the habitat transitions into a series of riffles and runs (Reach 2). The substrate becomes more homogeneous and is dominated by cobble, gravel, and sand. Instream cover, aquatic vegetation and overhanging vegetation were observed throughout the reach, providing ample habitat for fish. No fish collection was conducted within these watercourses but the fish community documented within WC11 is assumed through Annand Brook (WC57) and its tributaries (WC22/WC21).

– During all phases of the Project, AP 17 and its catchment (including WC21 and 22) will experience no increase or decrease in annual runoff (0%).
– A supplemental flow pumping system will be installed in advance of Phase 1 mining activities to minimize the hydrological impacts to the northwestern portion of the PA including WC22. The system will pump water from the north settling pond. Details of the proposed pumping system are provided in the Conceptual Water Management Plan in Appendix F.3.
– Maintaining flow through this catchment negates the impacts to WC21, WC22 and the two WSS within the catchment. For further information on the two WSS, see Sections 6.6.

The supplemental flow pumping system will maintain a natural hydrological flow regime (<10% flow disruption), the Project is not expected to cause HADD of fish habitat within WC21 or WC22.

Watercourse 26

Near the northeastern side of the ASA, there is a system of five watercourses that converge before flowing under Lake Egmont Road and into Gays River (Figure 6.7-8). The main watercourse (WC26) begins as an ephemeral upland channel, transitioning into intermittent and finally perennial flow as it picks up contributions from additional first order streams (WC24, WC25, and WC27). The watercourse passes through two corrugated metal pipes on Lake Egmont Road, both of which are perched approximately 30 cm and blocking upstream fish passage. WC26 ends by dispersing into the large wetland complex which surrounds the Gays River (WL51 serving as the delineated portion of this complex within the ASA). There is no channelized connection between this system and the Gays River; however, there may be temporal passage provided during high flow events when the wetland floods and when upstream passage across Lake Egmont Road is possible.

No fish were captured through electrofishing efforts on WC24/WC26 upstream of Lake Egmont Road, but as a conservative measure, fish species captured within the Gays River are considered “probably occurring” within this system (American eel, brown bullhead).

Upstream of Lake Egmont Rd, this system will be overlain by the overburden stockpile and north settling pond resulting in the loss of fish habitat quantity. This will result in a HADD and is further described in Section 6.7.5.1. Flow disruptions within the downstream portion of WC26 from Lake Egmont Road to the Gays River (Figure 6.7-3) are summarized in the following paragraphs.

On an annual average, throughout all Project phases, WC26 will experience the greatest increase in flow during Phase 2 (56% flow increase). As operations begin, all surface water from infrastructure will be collected and distributed to the north settling pond. Once settled, water from the north settling pond will be pumped into WC26 upstream of Lake Egmont Road (along the southwestern side). Additionally, Phase 1 and closure will also result in increases in flow (47% and 14%, respectively).

Increase in flow (Phase 1, 2 and closure) to the downstream extent of WC26 (from Lake Egmont Rd to the riparian wetland of Gays River) is expected to occur throughout the year, even in months of high flow (spring). During these months it is expected that increased streamflow may have negative impacts on fish and fish habitat within the watercourse. The increase in stream flow is expected to change channel morphology and deposit eroded material, this is expected to reduce the availability of suitable habitat for known species within the watercourse as the gravel in the upper reach will be washed out. However, erosion or changes to channel morphology would not be expected during summer low flow conditions. Any percent increase in flow during summer low-flow conditions would likely be significantly lower than flows currently experienced during wetter seasons (spring).

Based on DFO's guidance, the increase in flow predicted in WC26 is expected to affect approximately 750 m^2 of fish habitat (from the upstream western extent of WC26 at Lake Egmont Rd to where WC26 disperses into the riparian wetland surrounding Gays River). Based on the natural channel morphology, the predicted flow increase through this watercourse is expected to result in a preliminary identification of a HADD and require a FAA. The predicted flow increase are conservative estimates of potential change in stream flow. In practice, this system, as shown on Figure 6.7-8, is expected to maintain some function to support fish. During detailed design, the infrastructure around the WC26 System will be micro-sited to reduce impacts.

Watercourse 56 System

Within the most eastern side of the ASA, four watercourses form a system with WC56 acting as the primary channel (Figure 6.7-8). WC56 begins within an unnamed wetland outside of the PA and flows east under Lake Egmont Road, before draining into the Gays River (WC32). WC56 receives water from three small, first-order tributaries (WC30, WC54, and WC55). These tributaries flow in from the north all starting within what is assumed to be WL54 (outside of the ASA) before draining into WC56. No fish collection was conducted within this system. Fish collection will follow to support the submission of the FAA.

WC56 flows east as one reach. This perennial flat is approximately 2,230 m in length, with sporadic microhabitats (<5 m in length) including riffles, runs and pools. This watercourse was dominated by various substrates such as sand, gravel, cobble and muck/detritus. Two beaver dams were observed along the watercourse, likely acting as obstacles to fish passage but not full barriers. The culvert on Lake Egmont Road is a corrugated metal pipe with a rusted out bottom and perch of approximately 15 cm, which is considered a barrier to upstream fish passage. Still, based on the habitat present and direct connectivity to Gays River (WC32), the watercourse is considered to support all life stages of brown bullhead and juvenile to adult American eel.

WC30 is the most downstream tributary to WC56 and comprises two reaches. The most upstream and longer reach is considered an ephemeral flat, which transitions into a 30 m long riffle (Reach 2). Substrate throughout the watercourse is dominated by mud and muck. Direct connectivity to Gays River and the current habitat types provides suitable habitat for all life stages of brown bullhead and juvenile to adult American eel. Habitats are suitable for all life stages of brown bullhead and American, though restricted by seasonal dryness.

WC54 and 55 are both small intermittent first order watercourses that flow into WC56. These watercourses were described as flat and are approximately 3 m wide and 30 m long. No detectable velocity was recorded for either watercourse and both are underlain with muck/detritus substrates. These watercourses may support all life stages of brown bullhead and juvenile and adult American eel during seasonally higher flow.

It is expected that the entirety of the Watercourse 56 system will be impacted by a flow reduction to the confluence with the Gays River. Downstream of the confluence with WC56, the Gays River is predicted to have no neglectable impact in flow change during all phases (AP11), this is due to the large catchment relatively staying unaltered. Flow disruptions within the Watercourse 56 system (AP10) are summarized in the following paragraphs.

Throughout every phase of the Project, Watercourse 56 System is expected to experience reductions in flow (annual average range between -22% to -25%). These flow reductions are not expected to impact the watercourse during high flow months (spring) as the reduction in flow during high flow will likely be significantly higher than the streamflow naturally occurring in low flow months. However, this permanent decrease in flow will be exaggerated during months of low flow (summer). This flow reduction is expected to result in HADD of fish habitat.

In closure, the overburden stockpile will be covered to mimic the natural ground cover. CertainTeed will continue to refine the closure approach for the overburden stockpile. Revegetation, grading and removal of the ditching around the stockpile will re-establish flow conditions to be similar to baseline.

The predicted flow decrease through this system is expected to result in the preliminary identification of a HADD and require a FAA. Based on DFO's guidance, the reduction in flow predicted that the Watercourse 56 System is expected to affect a maximum of 6,551 m^2 (from loss of a portion of the catchment to the overburden stockpile). The predicted flow decrease are conservative estimates of potential change in stream flow. In practice, this system, as shown on Figure 6.7-8 is expected to maintain some function to support fish. Additional micro siting and regrading opportunities during the detailed design phase will help reduce the level of impact to fish and fish habitat within this system.

Annand Brook (WC57)

Annand Brook (WC57) is the named and topographically mapped watercourse which serves as the outlet of the SML polishing pond (Annand Bog) (Figure 6.7-8). The brook was evaluated in its entirety from the outlet of the polishing pond to its confluence with the Gays River. To date no fish collection was performed on this system. Fish collection will follow to support the submission of the FAA.

The watercourse begins at the outlet of the of the SML polishing pond (northeastern point). The watercourse is fed by the pond drainage outlet consisting of a grated pipe with water level control drop. At the time of the assessment, this drop could not be measured due to frozen pond conditions but is estimated to be greater than 50 cm. No pipe outlet could be seen on the downstream side of the polishing pond, but flows could be seen coming in under the berm. There are two other adjacent, large concrete box culverts which are partially barricaded at the inlets. These were completely dry at the time of the assessment. It is presumed that when water levels rise during periods of high flow, these culverts would also drain the pond. As such, there is currently no direct fish passage provisioning between Annand Brook (WC57) and the pond. However, given the presence of catadromous elver (90 mm American eel recorded) within WC11, it is presumed that passage into the polishing pond is available at least during higher flow periods, for example, during elver migration (late March – June). As a conservative measure, all fish species captured within WC11 are presumed as probably occurring with Annand Brook (this includes American eel, brook trou, ninespine stickleback, and white sucker).

During Phase 1, pit filling and closure, Annand Brook is expected to experience no significant increase or decrease in flow from the Project (<10%). However, during Phase 2 when the inflow to WC3 is at its highest, the upstream assessment point (AP4) along Annand Brook has an estimated 11% increase in streamflow (Figure 6.7-8). Further downstream during Phase 2, AP7 the impacts of the Project begin to balance out and the increase in stream flow to Annand Brook is reduced to 7%. Before converging with Gays River the increase in stream flow is at 7% (AP8). Just downstream of the confluence during Phase 2, Gays Rivers is calculated to be balance to the Annand Brook system.

This increase in flow through Annand Brook (WC57) will occur year-round, including during high flow months (spring). It is expected that during the high flow months an increase in flow through Annand Brook (WC57) will result in detectable negative effects on fish and fish habitat. For example, an increase in flow may change the channel morphology through erosion and deposition of eroded material. Annand Brook (WC57) is susceptible to erosion based on the bed and banks primarily being made of softer substrates such as muck and sands, with smaller rocks observed in lesser amounts. Additionally, Annand Brook (WC57) is a relatively straight and homogeneous watercourse, an increase in flow will increase velocity throughout the entirety of the watercourse washing away microhabitats for forage fish to seek refuge in.

The flow increase within the upper 575 m of Annand Brook (WC57) is predicted to result in an increased flow rate above the 10% threshold as described by DFO (2013). This prediction will be refined through the permitting stage and additional operational mitigation measures will continue to be explored during detailed design to reduce increased flow through this system. A conservative calculation of 9,228 m^2 has been included for a potential FAA. This impact is expected from the SML polishing pond to the confluence with WC22 where Annand Brook no longer experiences flow disruptions above the 10% threshold. It is expected that upper 575 m of Annand Brook will maintain some function, Figure 6.7-8.

6.7.5.2.2 Temperature

Water temperature affects the metabolic rates and biological activity of aquatic organisms, thus influencing the use of habitat by aquatic biota. There are no CCME guidelines related to temperature and aquatic biota. Temperature preferences of fish vary between species, as well as with size, age and season. Salmonids are cold-water fish species, meaning they require cold water to life and reproduce (Bowlby et al., 2014; Kanno and Beazley, 2004). The optimal temperature range for growth of juvenile brook trout is 10-20°C (The Stream Steward, nd). American eel, however, have a broader temperature range preference, and can tolerate temperatures up to 25°C (Fuller et al., 2019; Kanno and Beazley, 2004).

Baseline temperatures measured in situ during fish collection and late summer habitat assessments range between 10.6-25.0°C. It is important to note, however, that in situ temperature measurements were typically recorded close to surface, rather than in the deepest parts of a watercourse, where thermal refuge may be provided.

Flow reduction throughout the Watercourse 56 System is expected to result in an increase in water temperature. Water temperature throughout WC56 was recorded only in fall conditions (October), an accurate representation of summer temperatures is not readily available. However, one of the main tributaries into WC56 (WC30), was recorded at 20.0°C in early summer (July). It is expected that this system may experience water temperatures above the optimal temperature range for juvenile brook trout (10-20°C) but may be within the range of fish species expected throughout the system (brown bullhead and American eel). WC56 System is expected to trigger an FAA based on the predicted flow reductions.

Flow increase throughout the Annand Bog System (WC11 and Anand Brook WC57) is not expected to increase water temperature. The increase in flow throughout the system may help provide additional thermal refuge for fish during months of elevated water temperatures (summer). This is not expected to be harmful to fish.

CertainTeed will monitor temperatures at various locations that are predicted to not be impact by the Project as part of the Aquatic Effects Monitoring Plan (AEMP) and implement additional mitigative measures if necessary, as described in Section 6.7.7.

6.7.5.2.3 Water Quality

Another pathway for effects to fish and fish habitat related to water quality is through release of deleterious substances. All deleterious substances will be stored in appropriate secondary containment. Fuel storage, refueling, and equipment servicing will not occur within 30 m of a watercourse or waterbody, to prevent accidental release of fuel into surface water. Standard spill prevention and response procedures will be in place and communicated to all relevant personnel.

Erosion and release of sediment could occur as a result of the Project. Proactive and diligent adherence to erosion and sediment control is the best defence against sediment release. Construction related activities such as clearing and grubbing, and regular mining activities such as extraction, processing, and water management can mobilize sediment into neighbouring aquatic features. All surface water will be collected on site and managed through two settling ponds (north and south settling ponds). These ponds were sized appropriately to ensure that sediment will have time to settle prior to discharge. An ESC Plan will be developed for the Project.

Buffers will be maintained on watercourses wherever possible, and removal of vegetation will be minimized. Cleared areas will be regraded and revegetated as soon as possible to reduce the likelihood of sediment releases.

Settling pond releases may result in release of sediment laden water to the receiving waterbodies. Mitigation and monitoring, as described below, will ensure discharge is within permitted parameters. No residual impact to fish and fish habitat is expected from changes in water quality with appropriate mitigation measures applies and the implementation of a water quality monitoring program.

6.7.5.3 Change in Fish Health and Survival

Water management activities can lead to direct fish mortality through the use of industrial equipment in water or water intake features. Impacts to fish through the use of industrial equipment in or near water, or impingement or entrainment of fish through water management activities can be mitigated through widely accepted best management practices and standards for working in and near water, including but not limited timing in-water works with appropriate fish timing windows, isolating in-water work areas and performing fish rescues prior to equipment mobilization, and employing properly sized screens on intakes. Mitigation measures are further discussed in Section 6.7.6. Changes in water quality through water management practices and release of deleterious substances are discussed in Section 6.5.

6.7.5.3.1 Blasting

The operation phase will include extraction (surface miner, loading, and hauling), processing, and waste management. Blasting may be used if required to safely access or excavate the material.

Blasting can impact fish and fish behaviour, habitats, and migration patterns. The detonation of explosives near watercourses can produce post-detonation shock waves which involves a rise to a high peak pressure and then a subsequent fall to below ambient hydrostatic pressure. This pressure deficit can cause impacts in fish (Wright and Hopky, 1998). In addition, blasting can alter the physical and/or chemical structure of fish habitat from, for example, the sedimentation or deleterious by-products of explosive materials (Wright and Hopky, 1998).

An overpressure in excess of 100 kPa can result in effects in fish including damage to the swim bladder in finfish, and potential rupture and hemorrhage to the kidney, liver, spleen and sinus venous. It is also possible that fish eggs and larvae can be damaged (Wright and Hopky, 1998). The degree of damage is related to the type of explosive, size and pattern of the charges and the distance to the watercourse, depth of water within the watercourse, and species, size and life stage of the fish. Sub lethal effects have also been observed including changes in fish behavior on several occasions as a result of noise produced during blasting (Wright and Hopky, 1998).

Should blasting be required for extraction, CertainTeed will adhere to setback recommendations and other mitigation strategies to minimize impact to fish and fish habitat from blasting activities outlined in Wright and Hopky (1998) and by DFO in the Measures to Avoid Causing Harm to Fish and Fish Habitat Including Aquatic Species at Risk Pertaining to Blasting (DFO, 2018b).

6.7.5.4 Summary of Impacts to Fish and Fish Habitat

A summary of Project-related impacts is provided in Table 6.7-9.

Table 6.7-9 Summary of Impacts to Fish and Fish Habitat

Impact	Area
Change in Habitat Quantity	25,573
Flow Disruption	19,010
Total (m^2)	**44,583**
Total (Hectares)	**4.46**

As a result of Project-related impacts, CertainTeed will be seeking authorization under both Paragraphs 34.4(2)(b) (death of fish) and 35(2)(b) (HADD) of the *Fisheries Act*. Though Project activities may result in death of fish, this loss is expected to be largely non-quantifiable and incidental. The death of fish as a result of Project activities will be minimized through fish rescues, isolating in-water work areas, implementation of sediment and erosion control measures, water treatment (TSS), and in-water work timing windows.

Indirect effects related to surface and ground water quantity are, however, based on predictive modelling. While predictive modelling has been completed with layers of explicitly stated contingencies and conservatism, models do inherently involve a level of uncertainty, given their predictive nature. To support future permitting under the *Fisheries Act*, model outputs will be further refined, calibrated, and validated against site specific data, which will be used to update and adjust model predictions and mitigative measures as necessary.

6.7.6 Mitigation

The following sections detail the avoidance, mitigation, and monitoring measures taken or proposed to limit Project effects to fish habitat.

6.7.6.1 Measures to Avoid

Measures to avoid impacts to fish and fish habitat are the highest priority in the mitigation sequence. Throughout the iterative process of developing the current Project infrastructure layout, avoidance of effects to fish habitat was attained through several key design considerations.

Initial delineation of wetlands and watercourses within the ASA was completed to allow for detailed fish and fish habitat to help inform an optimized site layout and reduce potential impacts to fish habitats. Additionally, the PA was defined to be larger than infrastructure would require, especially to the south on the Crown land portion, allowing for micro-siting of infrastructure to avoid sensitive features, including watercourses and wetlands, wherever possible. This delineation of wetlands and watercourses and increased PA, facilitated infrastructure planning; and as a result, the following Project components were planned to avoid direct impacts to fish and fish habitat:

– Topsoil stockpile west of the overburden stockpile
– ROM pad

- Process reject stockpile
- Parking lot
- Settling ponds
- Multiple staging areas
- Multiple unassigned buildings

Construction of the haul road, overburden stockpile, topsoil stockpile west of the open pit, and open pit will result in unavoidable impacts to fish and fish habitat. The open pit and overburden stockpile were actively sited in areas of lower overall wetland and watercourse presence, reducing the overall direct impacts and specifically avoiding WSS and their catchments as is possible. In earlier iterations of the Project design, the open pit would have impacted the north-western portion of the Project Area and multiple WSS triggered by avian SAR observations and notably a significant amount of black ash observations. By relocating the pit further to the south, three WSS (WL35, WL67, WL72) and the majority of their contributing catchments, have been completely avoided. Infrastructure has been designed to stay compact to avoid the southern portion of the crown land parcels where significant wetland habitat was delineated.

Throughout the design of the Project, priority was placed on avoiding WL41 after initial designs included proposed direct alteration. WL41 contains multiple SAR observations and habitat including Canada warbler, olive-sided flycatcher, eastern wood-peewee, frosted glass whiskers, and blue felt lichen. WL41 has been entirely avoided by direct impacts through Project micro-siting.

Early in the design process, Annand Brook and Gays River were identified as two aquatic features to avoid indirect impacts to. It was identified that a decrease (>10%) in flow to the Annand Brook could result in significant effects to the downgradient habitats (Gays River). The new Project infrastructure increases streamflow into the Annand Brook to allow for continued fish passage from Annand Brook to upstream habitat such as WC11.

Gays River was additionally identified as an aquatic feature to avoid adverse effects based on the ecological role the river plays for many SAR species such as brook floater, wood turtle, snapping turtle and the historical presence of Atlantic salmon.

6.7.6.2 Measures to Mitigate

Where avoidance of impacts to fish and fish habitat are not possible, mitigation measures must be employed to further reduce impacts to fish and fish habitat. Standards and best practices for working in and near water are well understood and will be followed (DFO,2024). Standard mitigation measures will include, but are not limited to, fish rescues, site water management, adherence to timing windows to protect sensitive life cycle periods, and maintenance of riparian and wetland habitats (where possible). Key Project mitigation strategies are described in the subsequent sections. A list of proposed measures to mitigate the death of fish and/or HADD of fish habitat is provided in Table 6.7-10.

Table 6.7-10 Proposed Mitigation Measures for Fish and Fish Habitat

Project Phase	Mitigation
Construction	Complete permitting processes under the *Fisheries Act* and wetland/watercourse alterations.
	Adhere to all Approval conditions outlined in regulatory approvals, specifically related to timing of works outside of sensitive time windows for fish (June 1- September 30)
	Complete site kick-off meetings with relevant staff/contractors to educate and confirm policies related to working around fish habitats. Ensure fish habitat is adequately signed or flagged in the field, and clearly communicated to staff/contractors.
	Limit vegetation clearing, revegetate slopes as soon as possible, and maintain a 30 m buffer on fish habitat wherever practical. Use vegetated buffers to provide shade to onsite ponds wherever practical. Minimize removal of upgradient vegetation and stabilize shorelines disturbed by Project activities
	Minimize temporal extent of in-stream works as much as practical. Ensure machinery on site is clean and maintained and free of fluid leaks, and that all Approval conditions for in-stream works are communicated and adhered to.

Project Phase	Mitigation
	Complete fish rescue within all fish bearing streams to be impacted by the Project, as described in the Fish Rescue Plan
	Develop and implement the Final Offsetting Plan, including monitoring for effectiveness of the Offsetting Plan
Construction, operation and closure	Implement and adhere to the site-specific ESC Plan. Use clean, non-ore bearing, non-watercourse derived, non-toxic materials for erosion and control measures. Incorporate drainage structures, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material.
	Follow spill preparedness protocols and ensure fueling areas are a minimum of 30 m from wetlands and watercourses.
	Use and maintain properly sized screens on any water intakes or outlet pipes to prevent entrainment or impingement of fish (DFO, 2020).
	Follow DFO-advised measures to avoid causing harm to fish and fish habitat pertaining to blasting (DFO, 2019b). Develop and implement a detailed Blast Management Plan, if blasting is planned.
	Develop and implement a water management plan. This will include collection and treatment of water, as necessary, and contingency measures.
	Develop and implement an AEMP

6.7.6.2.1 Fish Rescue

Fish rescues are the key method to avoid death of fish where direct impact to fish habitat is unavoidable. The specific plan for each individual fish rescue must be developed on a site-specific basis; however, the general approach to completion of fish rescues is provided herein. During the permitting phase of the Project, a detailed Fish Rescue Plan will be prepared and submitted to DFO.

The primary goal of fish rescue work is to capture and relocate as many fish as is reasonably practical, with habitat area and complexity, water temperature and turbidity, access, and safety considerations as the key constraints. As the extent of those constraints is somewhat unknown, a quantitative estimate of fish mortality is not provided herein. It is expected that a small proportion of fish present may not be successfully rescued. CertainTeed commits to a reasonable level of effort to rescue as many fish as practical, and that the details surrounding reasonable depletion targets will be completed at the permitting phase in consultation with DFO.

Guidance for the approach to fish rescue was obtained from DFO (2015; Appendix F, Fish Rescue Guidelines). While the specific capture methods will be finalized during permitting, the general approach will involve a combination of passive trapping, seine netting, dip netting, and electrofishing in habitats and for species where each is effective. Timing of fish rescue activities will be closely coordinated with habitat dewatering or other water diversion/infilling activities during construction.

The fish rescue will be completed by a team of aquatic ecologists, experienced in the collection, handling and transfer of fish. The team will obtain a scientific research license which allows for collection of fish, including collection for fish rescue purposes. The transfer of fish from one watershed to another is not being considered. Release locations within the same watercourse, or those watercourses where natural connectivity exists will be used. The team will adhere to all specific terms and conditions of the Scientific Licence. For linear and open water features which are safely wadeable and easily isolated, the following approach to fish rescue will be taken:

– The license holder will identify the area to be isolated and barrier nets (or similar, such as berms) will be installed on the upstream and downstream ends of the habitat.
– The specific fish rescue methodology will vary based on factors such as depth, substrate, wadeability, water temperature and turbidity of the water. The following techniques will be used either alone or in combination, until an appropriate depletion target is reached:
    - Passive trapping (minnow traps, eel pots, fyke nets)
    - Seining
    - Electrofishing
    - Dip-netting

– Standard Operating Procedures (SOP) for each method as well as an overall plan that will describe methods of holding, transporting, and monitoring fish during rescue will be provided as part of the permitting process.
– All fish collection methods selected are based on inherent low mortality (i.e., gill nets and other lethal fish collection methods will not be used).
– The rescue will be completed to minimize handling and stress to fish, particularly if completed during warmer months. Measures such as oxygen supplementation and water cooling will be used as needed. To reduce handling and stress to fishes, measurements of length, weight and age class, will not be recorded, unless requested by DFO. Fish will be released into the natural environment as soon as possible, and the rescue team will closely monitor fish for signs of stress throughout all stages of the fish rescue. The rescue team may be supported by 'porters' as necessary, to facilitate efficient movement and release of fish back into the natural environment.

For open water features where safe wading is not possible due to water depth and soft substrate, CertainTeed will consider the use of a barge electrofisher or rely on passive trapping. In this habitat, the fish rescue will likely occur through successive isolation of sections where possible, using repeated days of extensive trapping efforts and seine netting. This work will be conducted immediately prior to, and during dewatering efforts, to facilitate isolation of fish in smaller, shallower portions, where fishing efforts can be concentrated. During the completion of each rescue reach, personnel will remain on site during all de-watering to dip-net any fish remaining in the reach, wherever safely practical.

6.7.6.2.2 Water Quality and Quantity

CertainTeed will develop and implement a detailed ESC plan which is proactive and protective of fish and fish habitat. Contact water will be collected and treated prior to release. Release of contact water from the settling ponds will only be permitted if monitoring indicates compliance with all regulatory guidelines specified in Section 6.5.

In-stream works will only be completed where approved, adhering to all approval conditions. In-stream works will be completed with minimal disturbance to riparian habitat, which provide shade and erosion protection that is protective of fish habitat. CertainTeed will avoid refueling, fuel storage, and servicing of equipment within 30 m of a watercourse or water body, to prevent accidental release of deleterious substances to fish habitat. If this is not possible (e.g., non-mobile equipment like cranes), additional mitigation measures will be implemented. Diligent spill prevention, preparedness and response measures will be key components of construction, operations and reclamation works completed within the ASA.

For more information on water quality and quantity mitigation refer to Section 6.5 in the Surface Water chapter.

6.7.6.2.3 Blasting

To minimize effects of blasting on fish (should it be required for extraction), a Blast Management Plan will be developed and strictly adhered to. Appropriate blast designs will be developed to limit blasting impacts (vibration, fly-rock and overpressure). All required information for each blast will be documented including hole-depth and the quantity of explosive used, blast timing, and monitoring data. All blasting will adhere to guidelines outlined by Wright and Hopky (1998) and will adhere to NS Blasting Regulations.

6.7.6.3 Measures to Offset

Offsetting investigations for the Project are ongoing. A multi-step review process has been undertaken to identify potential offsetting concept including:

– Desktop review within the Shubenacadie River secondary watershed (1DG-1) and adjacent watersheds if necessary.
– Desktop review of watersheds containing aquatic SAR, with emphasis on those containing IBoF Atlantic salmon.
– Desktop review of watersheds that are known to have been historically degraded and where fish habitat restoration project could potentially exist.
– Preliminary field assessments of potential offsetting locations by restoration specialists to determine overall feasibility.

- Engagement with the Mi'kmaq of Nova Scotia to discusses fish habitat restoration priorities
- Engagement with community-based watershed groups to discuss fish habitat restoration priorities
- Engagement with landowners
- Field assessments of locations identified in the desktop review process to determine their feasibility

Conceptual offsetting projects presented within the Conceptual Fish Habitat Offsetting Plan (Appendix H.2) were developed using DFO guidance and include locations where offsets may be both technically and logistically feasible while being primarily beneficial for fish species impacted by the Project – American eel and brook trout. Preliminary offsetting identification and selection were guided by the principles from DFO's Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat (2019).

DFO's guiding principles clarify a preference for offsetting measures located within the vicinity of a Project, as measures to benefit local fish populations and fish habitat are most likely to balance the residual effects of a project (DFO, 2019b). The ASA is entirely found within the Shubenacadie River Secondary Watershed (1DG-1); in keeping with DFO's guiding principles, preliminary offset identification was first initiated within the Shubenacadie River secondary watershed.

The desktop review for potential offset concepts was then performed within adjacent secondary watersheds with anticipated ecological similarities to that of the ASA (i.e., Inner Bay of Fundy draining watersheds). This included the Salmon River (1DH-6), Cornwallis River (1DD-2), and Kennetcook River (1DF-10) secondary watersheds. Proven techniques in these geographic settings that could support similar fish species through in-kind habitat restoration were prioritized to offset lost habitat, as they were considered lower-risk and biologically relevant. Three additional drivers guided selection of priority watersheds for offset identification: watersheds that support Atlantic salmon, watersheds with proportionally higher rates of anthropogenic disturbance, and watersheds where landowner relationships have been established.

The Conceptual Offset Plan presents options where working relationships with landowners were established, as well as high priority sites identified through desktop review for further evaluation. Conceptual offsetting options were ranked and include the rehabilitation of degraded aquatic habitats caused by channelization of streams and draining of former wetland areas by agricultural activities. Restoration methods are well-known and can be successful if used in the proper location. Proven techniques in geographic settings that could support similar fish species through "in-kind" habitat creation were prioritized to offset lost habitat, as they are considered lower-risk and biologically relevant. Offsetting opportunities closer to the ASA will be investigated as offset planning continues and will serve as a focus for engagement.

CertainTeed has commenced through the provincial One Window process and will continue engagement with DFO and will follow their guidance documents to identify requirements for Authorization under the *Fisheries Act*, and to identify the scope of the offsetting requirements. Engagement with the Mi'kmaq of Nova Scotia have commenced and will continue through the selection and implementation processes for offsetting projects. The proposed offsetting concepts require further engagement with the Mi'kmaq of Nova Scotia, DFO, and relevant stakeholders on acceptability and ranking of the preliminary options. Preferred offsetting options will be further refined based on these discussions as CertainTeed begins the detailed offset planning process. It is also possible that alternative approaches not listed in the Conceptual Fish Habitat Offset Plan could be integrated into any final authorization application if required.

6.7.7 Monitoring and Follow-Up

CertainTeed will be implementing a series of management and monitoring plans to guide the development and operation of the Project, including an AEMP to be implemented during construction, operation, and closure phases of the proposed Project. The AEMP will be established as a requirement of the permits and licenses under which the proposed Project will operate (e.g., Fisheries Act Authorization, IA, and NSECC wetland and watercourse approvals). The focus of the AEMP will be to ensure regulatory compliance, monitor the effectiveness of mitigation measures, and to verify the predictions of the Project effects assessment.

The goal of the AEMP will be to eliminate or minimize potential adverse effects on the aquatic receiving environment, while systematically seeking to enhance positive effects. Spatially, the AEMP will focus on the mine site area and the identified receiving environment for the Project including Gays River, as well as reference sites.

Data collected during monitoring programs will document trends in monitoring results and enable a comparison to the predicted project effects. Data and analysis will be provided in annual reports, as well as in any regulatory reporting.

6.7.8 Residual effects and Significance

The predicted residual environmental effects of the Project on fish and fish habitat are assessed to be adverse, but not significant. The overall residual effect of the Project on fish and fish habitat is assessed as not likely to have significant adverse effects after appropriate mitigation measures have been implemented as summarized in Section 6.7-6.

A significant adverse effect on the Fish and Fish Habitat VC was defined in Section 6.7.4.2 as:

– A Project-related effect that is likely to cause a temporary or permanent change to fish habitat that impairs the habitat's capacity to support one or more life processes of fish, that cannot be avoided, mitigated, or offset; and/or,
– A Project-related effect that is predicted to cause a measurable change in local fish populations beyond the range of natural variability (for example, through changes in abundance, health, growth, or survival).

This effects assessment was developed to be consistent with Fish and Fish Habitat Protection Policy (DFO, 2019b), which states "the Department interprets "harmful alteration, disruption or destruction" as any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish." However, it is recognized that the total impacts determined within this assessment will be further reviewed and determination of the amount of HADD will be made by DFO during the authorization application process. The determination of significance of effects has been made in consideration of multiple linkages between other VCs, specifically surface water and ground water interactions.

The effects assessment includes:

– Direct and indirect effects were quantified through detailed habitat evaluations and modelling exercises to identify indirect effects to water quantity. Of particular importance is the interpretation of effects related to flow reductions, which is based on a predictive modelling exercise, with explicit conservatism, assumptions, and limitations. Indirect effects to water quality were discussed but not quantified.
– All fish habitat with proposed impacts were accounted for in the Conceptual Offset Plan, which will be further refined prior to the Fisheries Act permitting process for harmful alterations to fish habitat.
– Project specific mitigation measures were proposed to minimize, avoid and minimize the extent and duration of effects to fish and fish habitat, including both change in fish habitat quantity and flow disruptions.

Residual HADD of fish habitat is outlined in Table 6.7-11 . Conceptual offsetting plans were estimated and described in the Conceptual Offset Plan (Appendix H.2).

A significant adverse effect to fish and fish habitat as not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the PA:

Construction

– Direct impact to fish and fish habitat will occur, primarily to support development of the open pits, stockpiles, haul roads, and water management features. The impacts associated with the open pit is considered unavoidable to support Project development. Impacts associated with haul roads and water management features have been and will continue to be optimized to further reduce impacts to fish habitat prior to permitting.
– The water management infrastructure will be constructed, and collection of contact water will commence near the end of the construction phase of the Project.
– Strict adherence to the ESC Plan to limit the potential water quality effects to fish and fish habitat commencing in the construction phase and continuing throughout the operational life of the Project.
– The death of fish by means other than fishing will be limited by the completion of fish rescue wherever change in fish habitat quantity is required.

- All habitats proposed for effects through construction, operation, and closure will be accounted for and included in the Conceptual Offset Plan to support the Fisheries Act Authorization for harmful alteration to fish habitat. The Conceptual Offset Plan will be executed as close as possible to the timing of the impacts to reduce time lag.

Operation

- Impacts to flow disruption through WC11 will occur, primarily to support the expansion of the open pit.
- Water collection, treatment and release will occur, resulting in water quality impacts to fish and fish habitat, primarily due to flow disruptions. Water quality will be maintained through collection and treatment of effluent discharge for TSS.
- Prediction of potential HADD associated with flow disruptions is presented in this EARD conservatively, and potential offsetting projects were identified such that it has been demonstrated that losses can be mitigated through appropriate offsetting project implementation.

Closure

- Predicted flows throughout WC56 are expected to remain reduced (-25%) post closure. Potential opportunity for regrading of the stockpile may result in a decrease in flow reduction.

Predicted flows throughout WC11 and Annand Brook at closure are consistent with pre-development conditions. Residual effects to fish and fish habitat are summarized in Table 6.7-11.

Table 6.7-11 Fish and Fish Habitat Residual Effects

Project Phase	Mitigation and Compensation Measures	Nature of Effect	Residual Effects Characteristics						Residual Effect	Significance
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction – Habitat Loss from watercourse alteration	Erosion and sediment control. Code of practice and best management practices for working in water Spill preparedness Wetland and Watercourse permitting Fish rescue Final Offset Plan	A	H	ASA Adverse effect to fish habitat is limited to the ASA	A Watercourse alterations to occur between June 1 and September 30 to avoid sensitive fish window	P Direct effects are expected to be permanent	O Effects occur once during construction	IR VC will be permanently altered from baseline conditions	Harmful Alteration, Disruption and Destruction of Fish Habitat	Not significant
Construction, Operations and Closure – Altered hydrology due to surface and groundwater interactions	Watercourse and Fisheries Act Permitting Final Offset plan	A	M	ASA Adverse effect to fish habitat is limited to the ASA	A Seasonal habitat provisions may affect the VC	P Flow disruptions are expected to be long term to permanent	C Effects occur at continuously throughout the Project	PR Mitigations can not guarantee a return to baseline conditions	Harmful Alteration, Disruption and Destruction of Fish Habitat	Not significant
Operations – Water quality	Water collection and treatment as required to adhere to all applicable guidelines Erosion and sediment control Spill preparedness	A	L	ASA Adverse effect to fish habitat is limited to the ASA	A Seasonal habitat provisions may affect the VC	LT Water quality effects are expected to be long term	R Effects occur regularly during Project	PR Mitigations and reclamation can not guarantee a return to baseline conditions	Alteration of Fish Habitat	Not significant
Construction, Operation - Blasting	Follow Blast Management Plan, if required	A	L	ASA Adverse effect to fish habitat is limited to the ASA	A Blasting to occur between June 1 and September 30 to avoid sensitive fish window	ST Effects are expected to be short term	S Effects are expected to be sporadic	RE VC is expected to recover to baseline	Disruption of Fish Habitat	Not significant

Legend (refer to Table 6.7-3 for definitions)						
Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A – Adverse	N – Negligible	PA – Project Area	N/A – Not Applicable	ST – Short-Term	O – Once	RE – Reversible
P – Positive	L – Low	LAA – Local Assessment Area	A – Applicable	MT – Medium-Term	S – Sporadic	IR – Irreversible
	M – Moderate	RAA – Regional Assessment Area		LT – Long-Term	R – Regular	PR – Partially Reversible
	H – High			P – Permanent	C – Continuous	

6.8 Terrestrial Environment

6.8.1 Rationale for Valued Component (VC) Selection

Terrestrial environment encompasses upland and wetland habitats, associated vegetation communities, and wildlife species that depend on these habitats, including terrestrial SAR and SOCI. The terrestrial environment was chosen as a VC because ecosystems, habitat, vegetation communities, and fauna species reliant on these habitats may be altered directly or indirectly by proposed Project activities.

Provincial and federal legislation that protect wildlife and their habitat include the Canada *Species at Risk Act*, and *Migratory Birds Convention Act,* along with NS *Endangered Species Act, Wildlife Act*, and *Environment Act.* Associated policies include but not limited to, the NS *Wetland Conservation Policy* (NSECC, 2019). NS species at risk recovery plans and special management practices for SAR were also reviewed. This broad VC includes the following major groups based on taxonomic and ecological similarities:

- Terrestrial habitat and vegetation
- Lichens
- Terrestrial fauna
- Avifauna

6.8.2 Baseline Program Methodology

The terrestrial environment is a broad VC and includes a diverse group of species, habitat, and taxa. Field methods varied depending on the targeted species, group of species, or habitat being surveyed. For detailed information on the baseline programs, refer to the Flora, Fauna, and Habitat Biophysical Baseline Report and Avifauna Biophysical Baseline Report (Appendices I.1 and I.2).

6.8.2.1 Priority Species List

A desktop priority species list was created to guide all surveys described in this VC. Species rankings used in the biophysical report appendices and terrestrial effects assessment are based on rankings retrieved from the ACCDC on March 23, 2022. A priority species list functions as an over-arching tool to guide survey design and effort. Priority species include SOCI and SAR. The definition of a priority species and detailed methods in developing this list is described in Appendix I.1.

6.8.2.2 Habitat Types and Vegetation Communities

Prior to completing field assessments, several public geospatial datasets and a predictive habitat model were reviewed to inform the surveyors of the landscape, to aid in field survey design. Avian survey points were laid out strategically to record the full diversity of vegetation communities present with the PA. Habitat surveys took place from May 2022 to October 2023 and were completed concurrently with wetland and watercourse delineation and during fall avian migration surveys.

6.8.2.3 Vascular Plants and Lichens

The objectives of the vascular plant and lichen baseline surveys were to complete a species inventory, document any rare flora species and to facilitate avoidance where possible, and support understanding of the potential Project interactions with rare species within the PA. Prior to undertaking the vascular plant and lichen field surveys, a detailed desktop review of known vascular plant and lichen observations and potential habitat within the PA was completed. Several databases were reviewed including the ACCDC database, provincial and federal databases, the Atlantic Coastal Plain Flora (ACPF) database and available Mersey Tobeatic Research Institute (MTRI) databases. Prior to completing field assessments, several geospatial datasets were reviewed to inform the surveyors of the landscape within the PA and a predictive habitat model was made based on the forest inventory GIS database (NSDNRR, 2021), a Canopy Height Model from GeoNOVAs Elevation Explorer (GeoNOVA, 2019), and the Wet Areas Mapping database (NSE, 2022). First, three proxy layers were created: the NS Forest Inventory layer was re-classified into ten categories based on the "FORNON" attribute, four height classes from the Canopy Height Model were defined as proxies for tree age (0-1 m, 1-6 m, 6-11 m, and >11 m), and the Depth to Water model was used to predict wet areas with <0.5 m considered wet, and >0.5m considered dry. The layers were rasterized and combined, then turned into polygons using the "Majority Filter" tool on QGIS. Results were adjusted based on aerial imagery to best reflect current conditions.

Dedicated botanical surveys were completed early and late in the growing season to capture plant species with different flowering periods. Early botany surveys took place in July 2022 and June 2023; late botany surveys took place in September 2023. Meandering transects were completed on foot, and all major habitat types were assessed, targeting habitats with elevated potential to support priority species.

During early biophysical surveys within the PA, several black ash were identified. Since this species is listed as Threatened in NS and is of cultural significance to Mi'kmaq people, a site-wide black ash survey and health assessment was conducted. The purpose of the survey was to locate any black ash individuals that may have been missed during botanical surveys or incidentally, and to record more detailed information on the trees using a standardized assessment methodology. These surveys, which took place August 2-4, 2023, included the collection of basic metrics, health assessment, reproductive indicators and habitat characteristics.

Lichen surveys were completed throughout the PA in April 2023 and incidentally during other biophysical surveys. Meandering transects were completed on foot and targeted mature trees or other habitats appropriate for hosting priority lichen species. Full methods are presented in Appendix I.1.

6.8.2.4 Fauna

Wildlife surveys were completed opportunistically throughout all biophysical surveys in 2022 and 2023. All observations were identified and recorded by Strum biologists experienced in identification of wildlife tracks, scat and browse, resulting in an overall species list. Where a SAR or SOCI was identified during surveys, additional effort was made in the field to understand the habitat at the sighting location and evaluate whether it was essential to the species' survival or life cycle requirements. Detailed terrestrial fauna methods are described in Appendix I.1.

Targeted wood turtle surveys were conducted in May 2022 and May-June 2023. The goal of these surveys was to better understand if wood turtle are using the PA and to identify any potential suitable habitat for this species within the PA. Surveys occurred along seven transects within the PA. Surveyors searched for physical evidence of turtles (including wood turtle (*Glyptemys insculpta*), snapping turtle (*Chelydra serpentina*) and eastern painted turtle (*Chrysemys picta*)), as well as suitable habitat. Transects were completed when air temperatures were above 9˚ C and repeated three times.

Standalone mainland moose surveys were not considered necessary as the closest mainland moose core habitat polygon is located 7 km south of the PA and the nearest ACCDC record is approximately 13 km away (Appendix I.1). No evidence of moose was observed during all biophysical surveys.

Standalone bat surveys were not considered to be necessary, as no abandoned mine openings (AMOs) or other hibernacula were located within the PA or nearby. However, all surveyors were instructed to record any bat observations or evidence of bat hibernacula or roosting habitat during all biophysical surveys.

6.8.2.5 Avifauna

Avian field surveys were initiated in May 2022 and continued through October 2023; a total of 66.32 hours (3979 minutes) of surveys were completed by Strum biologists. The objective of the baseline avifauna field surveys was to identify species and habitat usage with a focus on SAR and SOCI within and surrounding the PA, and also to determine trends in species composition and bird group usage throughout different seasons where possible.

The field studies were completed as follows:

- Spring migration surveys (May 2022/2023)
- Nocturnal owl surveys (May 2022; nocturnal owl focused surveys were conducted due to their nocturnal nature and owls not being reliably detected during the morning migration and breeding surveys)
- Breeding bird surveys (June to July 2022/2023)
- Nightjar surveys (June to July 2022; nightjar focused surveys were conducted due to the likelihood of their presence within the PA based on desktop analyses and, due to their crepuscular nature, nightjars not being reliably detected during the morning migration and breeding surveys)
- Fall migration surveys (August to October 2023)

Incidental avifauna observations were recorded opportunistically throughout the suite of biophysical surveys in 2022 and 2023. Detailed avifauna methods are described in Appendix I.2.

6.8.3 Baseline Conditions

The baseline conditions of the terrestrial environment, including terrestrial habitat, plants, lichens, fauna, and avifauna are summarized below. Full descriptions including results from both desktop review and in-field assessments can be found in the Antrim Gypsum Project Biophysical Reports: Flora, Fauna, and Habitat and Avifauna (Appendices I.1 and I.2).

6.8.3.1 Habitat Types and Vegetation Communities

The PA consists of a range of habitat types including regenerating and mature softwood and hardwood forested communities, treed wetlands, disturbed areas, and swaths of flooded lowlands. These diverse habitat types provide conditions for a diverse array of vascular and nonvascular plants, including rare species such as black ash. The disturbed habitats (e.g., gravel roads and historic timber harvesting) consisted primarily of herbaceous pioneer species, with the majority of the exotic species being confined to the edges of the gravel roads.

Eight natural vegetation community groups and 17 vegetation types were observed within the PA, including upland and wetland vegetation groups (Figure 6.8-1). The observed vegetation communities are typical of this ecoregion. Vegetation community results are provided in Appendix I.1.

No Old Growth Forest polygons were identified through the Old Growth Policy GIS layer (NSDNRR, 2024) or the Old Growth Forest Policy Dashboard as of July 2024.

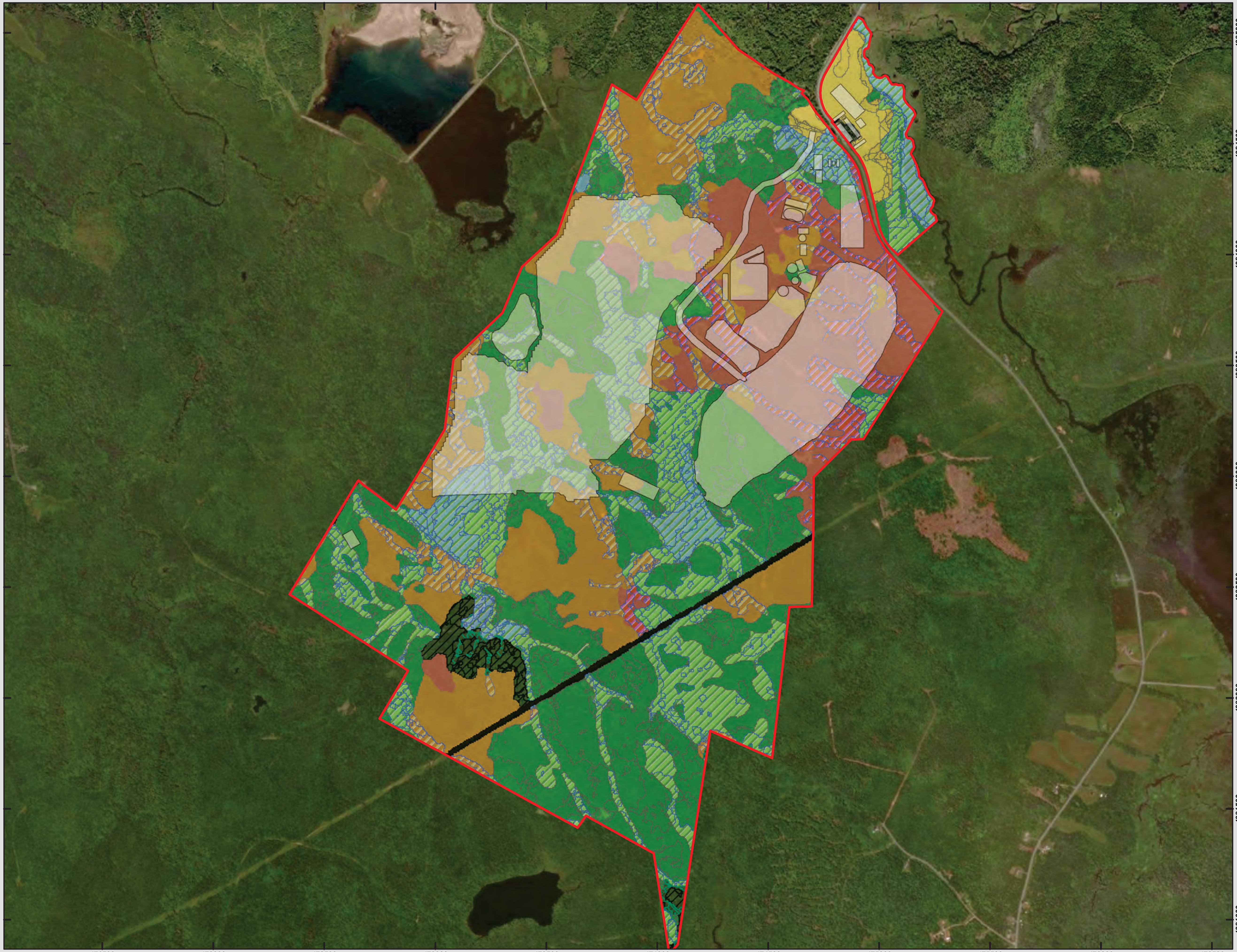

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FIGURE 6.8-1
Terrestrial Habitat

Antrim Gypsum Project
Cooks Brook, Nova Scotia

- Agriculture
- Cutover
- Cutover Swamp
- Hardwood Forested Swamp
- Hardwood Forests
- Mixedwood Forested Swamp
- Mixedwood Forests
- Open Wetlands
- Softwood Forested Swamp
- Softwood Forests
- Urban/developed
- Waterbodies
- Project Infrastructure
- Project Area

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 225 450 900 m

1:16,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By:

Project Number: 24-9991
Date: 7/25/2024

strum CONSULTING

Document Name: Antrim Terr HabPA

6.8.3.2 Vascular Plants and Lichens

A total of 202 vascular plant species, and 10 bryophyte species were identified across the PA. Only 4 species (2%) were priority species with only one SAR plant species. Seven species (3%) are considered to be invasive in NS, and two species (1%) are part of the ACPF.

The four priority vascular plants observed within the PA are: northern maidenhair fern (*Adinatum pedatum*), alder-leaved buckthorn (*Endotropos alnifolia*), black ash, and small yellow pond-lily (*Nuphar microphylla*). Black ash was the only observed vascular or nonvascular plant listed as SAR. Out of the four priority vascular plants observed within the PA, black ash was the most abundant.

During field surveys, 51 lichen species were observed with10 priority lichen species observed within the PA during the field surveys and 2 of these are SAR: frosted glass whiskers (*Sclerophora peronella*) and blue felt lichen (*Pectenia plumbea*). 8 SOCI lichens were observed: eastern candlewax lichen (*Ahtiana aurescens*), shaggy fringed lichen (*Anaptychia palmulata*), crumpled bat's wing lichen (*Leptogium leptaleum*), Acadian jellyskin lichen (*Leptogium acadiense*), *Fuscopannaria sorediata*, blistered tarpaper lichen (*Collema nigrescens*), blistered jellyskin lichen (*Leptogium corticola*), and stretched jellyskin lichen (*Leptogium milligranum*).

6.8.3.2.1 Species at Risk

One SAR vascular plant (black ash) and two SAR lichens (blue felt and frosted glass whiskers lichen) were observed during the dedicated survey periods as well as incidentally. Black ash is listed as Threatened under SARA, COSEWIC, and NSESA. Blue felt lichen is listed as SARA, COSEWIC Special Concern, NSESA Vulnerable and frosted glass-whiskers is listed as SARA, COSEWIC Special Concern.

Black ash

Black ash is a slow-growing tree characteristic of wooded and poorly drained swamps, often in low-lying areas (Zinck, 1998). It grows across eastern North America from Manitoba to Newfoundland and south in North Dakota (Native Plant Trust, 2020). Black ash is dioecious, meaning that male and female reproductive structures are found on separate trees (Native Plant Trust, 2020). The tree is used to make baskets as it is fibrous and easy to split, it is culturally significant for the Mi'kmaq people.

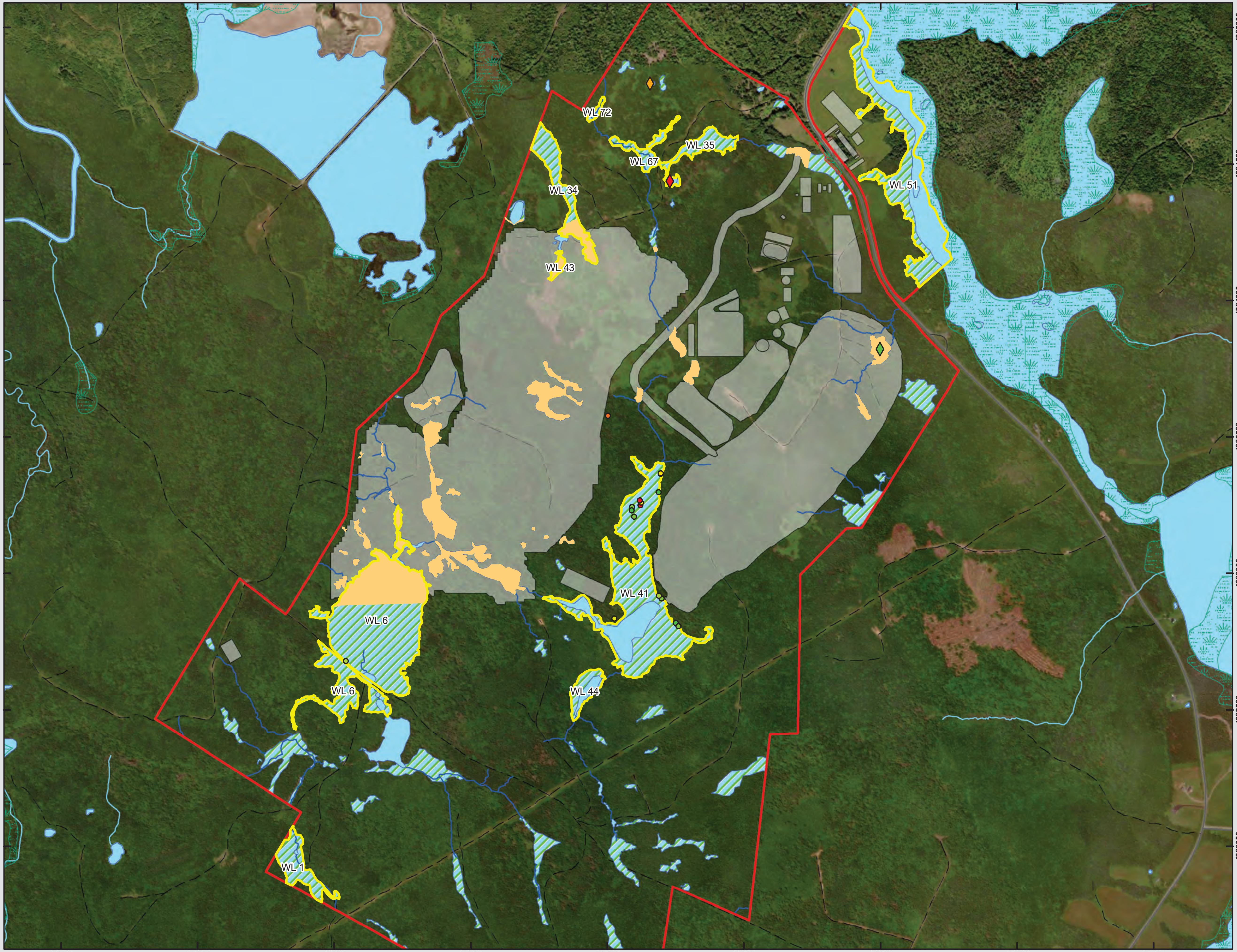
In total there were 100 black ash trees observed and recorded, concentrated within WL35 (n=7), WL67 (n=46), and WL72 (n=16). In total, 98 of the 100 black ash trees were located in the northern portion of the PA and a single observation was recorded on the far southern boundary (Figure 6.8-2). A subsequent field visit with KMKNO occurred on May 23rd to tour the black ash stands clustered in the northern wetlands and the isolated individual located within the proposal Project infrastructure footprint. During this field visit it was observed that several trees (>5) were in fruit including the isolated tree to the south within the proposed infrastructure footprint.

Blue felt lichen

Blue felt lichen is a very large foliose lichen that can appear thick and rigid due to its prominent blue-black hypothallus. The thallus can appear scalloped as a result of its crescent shaped curves near the margins. Its convex apothecia are numerous, ranging in colour from reddish-brown to blackish. One observation of blue felt lichen was made within WL41(Figure 6.8-2).

Frosted glass whiskers

Frosted glass whiskers belong to a group known as calicioids or "stubble" lichen, due to their tiny, stalked structures, which are imbedded in substrates. They generally occur on hardwoods, usually on the exposed heartwood or living trunks, particularly red maple and yellow birch. It is mostly often found in mature and old-growth coniferous and deciduous forests (ECCC, 2011). There were four observations of frosted glass-whiskers in the PA (Figure 6.8-2). One observation of abundant stalks was made on the western side of WL41. Two observations were made in WL44, one occurring on yellow birch on the WL edge. The fourth was an incidental observation during wetland delineation surveys. This occurrence was found on a red maple snag in mature hardwood upland northwest of WL41 (Figure 6.8-2).



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GHD

FIGURE 6.8-2
Terrestrial SAR SOCI Impacts

REDACTED as requested by NSNRR

Antrim Gypsum Project
Cooks Brook, Nova Scotia

Note:SAR Species noted in legend have been removed for public version as per NSNRR

Note: SOCI avifauna have not been included on this map - please refer to baseline report

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 175 350 700 m

1:13,000 Scale when printed @ 11" x 17"

Drawn By: LP
Reviewed By: MM

Project Number: 24-9991
Date: 7/25/2024

strum CONSULTING

Document Name: Antrim Terr SARREDACT

6.8.3.3 Fauna

The PA is within a Critical Habitat 10 x 10 km standardized UTM grid square for bats (COSEWIC, 2018), however, neither bats nor their hibernacula were observed within the PA to date. While the PA is within a general geographic area containing critical habitat for one or more of Little brown myotis (*Myotis lucifugus*), Northern myotis (*Myotis septentrionalis*), and Tri-coloured bat (*Perimyotis subflavus*), the closest known hibernaculum is approximately 2.5 km to the north of the PA, and there are several bat occurrences between 1.5 and 3 km to the north (ECCC, 2018; Spencer, 2023). During all biophysical surveys within the PA, biologists were instructed to record any evidence of caves, open wells, cavities in mature trees, rock outcrops, or other potential hibernacula or maternity roosting habitats, or any incidental observations of bats. No bat evidence, maternity roost, or hibernacula were identified within the PA. There were nine mammal species identified within the PA. Fauna observed within the PA include American beaver (*Castor canadensis*), porcupine (*Erethizon dorsata),* snowshoe hare (*Lepus americanus*), white-trailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), American red squirrel (*Tamiasciurus hudsonicus*), Eastern chipmunk (*Tamias striatus*), American black bear (*Ursus americanus),* and an unknown mouse species. Other species with the potential to use the PA, as per the baseline report, include the red fox (*Vulpes vulpes*), deer mouse (*Peromyscus maniculatus*), Eastern coyote (*Canis latrans*), red-backed vole (*Myodes gapperi*), as well as various bat species.

There were 10 herpetofauna species identified within the PA including the Eastern American toad (*Anaxyrus americanus americanus)*, snapping turtle (*Chelydra serpentina)*, wood turtle (*Glyptemys insculpta)*, bullfrog (*Lithobates catedbeianus)*, green frog (*Lithobates clamitans)*, Northern leopard frog *Lithobates pipiens)*, wood frog (*Lithobates sylvatica)*, maritime garter snake (*Thamnophis sirtalis pallidulus)*, Eastern red-back salamander *(Piethodon cinereus)*, and spring peeper (*Pseudacris crucifer)*. Two are considered to be priority species: wood turtle and snapping turtle. No wood turtles were observed during the wood turtle surveys, however a wood turtle was observed incidentally during late botany surveys basking in the open water of WL24. Snapping turtle were observed in three locations: WL6 within a flooded area near WC3; WL9 within a ponded area adjacent to WC1; and, WC11 within WL14.

Methodology and field results can be referred to in full in the Flora, Fauna, and Habitat Biophysical Baseline Report (Appendix I.1), as well as further information regarding desktop review, regulatory context, and more information regarding priority (SAR and SOCI) species.

6.8.3.3.1 Species at Risk

Two SAR herpetofauna were observed incidentally during wetland delineation and botanical surveys. Wood turtle are listed as Threatened under SARA, COSEWIC, and NSESA. Snapping turtle are listed as Special Concern under SARA, COSEWIC, and Vulnerable under NSESA.

Within the PA, habitat for herpetofauna is present within wetlands, open water, and watercourses. There were 10 herpetofauna species identified within the PA, two of which are considered to be priority species: wood turtle and snapping turtle. Analysis of suitable turtle habitat as it relates to these two species is provided in Table 6.8-1 below Descriptions of habitat observed along the seven surveyed wood turtle transects are presented in Figure 6.8-3, along with commentary on their potential for turtle habitat. Habitat potential is based on review of known preferred overwintering (O), nesting (N), and general (G) for each species.

Three transects contained potentially suitable habitat for at least one of the priority herpetofauna species observed within the PA. Transect 2 along WC11 and WC12 contained short stretches (<3m in length) of sand-gravel-cobble riparian edge, with full sun exposure. Several of these observations were made along a 50 m reach. Transect 4 along WC24 also contained one location of sand-gravel along a riparian edge with sun exposure, however, it was located at a road crossing, which may be an ecological trap for turtles (ECCC, 2020a). Transect 4 may also provide habitat for turtle movement, however, it had a mucky substrate makeup, which may inhibit its use by wood turtle. Transect 6 along WC1 was identified as having marginally suitable general habitat for snapping turtle due to its mucky substrate and slow-moving flow. Lastly, WC32 (the Gays River) may provide suitable habitat for overwintering of all 2 species due to its depth and water flow during the winter. The watercourse may also provide suitable general habitat for all two species, however, nesting habitat was not observed due to the prevalence of mucky riparian edges. Further detail on transects discussed above are provided in the Flora, Fauna, and Habitat Biophysical Baseline Report (Appendix I.1).

Table 6.8-1 Habitat descriptions along seven surveyed transects

Transect	Associated Watercourse Number(s)	Dominant Substrate	Water Velocity Range (m/s)	Watercourse Width and Depth (m) Ranges	Riparian and Instream Habitat Descriptions	Potential Wood Turtle Habitat	Potential Snapping Turtle Habitat
T1	WC 21, WC 22, WC 23	Sand, gravel, cobble, muck, boulder, rubble, clay	Low (0.05-0.14 m/s)	0.1-4.2 m wide, 0.05-0.43 m deep	Mixedwood stand transitioning to wetland. The watercourse eventually splits, with the south branch (WC21) transitioning to forest. This section has been heavily disturbed by forestry and an access road. The eastern branch also has evidence of logging activity (WC23). The riparian vegetation transitions from alders to softwood.	O: not suitable N: not suitable G: not suitable	O: not suitable N: not suitable G: not suitable
T2	WC 11 and WC 12	Gravel, sand, boulder, cobble, rubble, sand, muck	Moderate (0.03-0.75 m/s)	0.47-12.1 m wide, 0.03-0.75 m deep	Riparian zone mainly consists of mixedwood forest. The watercourse flows through wetlands. Woody debris may provide cover. Short reaches (<3m in length) of sand-gravel riparian areas in full sun. Snapping turtle observed May 12, 2022 submerged in main watercourse channel	O: not suitable N: marginal G: not suitable	O: not suitable N: marginal G: suitable - observed
T3	WC 3 and WC 4	Sand, cobble, rubble, muck	Low (0.05-0.25 m/s)	0.16-3.5 m wide, 0.01-0.55 m deep	The riparian zone consists of alders, mixedwood forest, and wetland. Beaver activity has caused flooding and a dam that is approximately 10m wide. Floodplain conditions are present. Woody debris.	O: not suitable N: not suitable G: not suitable	O: not suitable N: not suitable G: not suitable
T4	WC 24	Muck, sand, gravel, rubble	Low (~0.05 m/s)	0.6-2.6 m wide, 0.03-0.18 m deep	Portions of the watercourse are intermittent. Woody debris and blowdown are present. Riparian zone consists of mixedwood forest. Short reaches (<3m in length) of sand-gravel	O: not suitable N: marginal G: marginal	O: not suitable N: marginal G: marginal

Transect	Associated Watercourse Number(s)	Dominant Substrate	Water Velocity Range (m/s)	Watercourse Width and Depth (m) Ranges	Riparian and Instream Habitat Descriptions	Potential Wood Turtle Habitat	Potential Snapping Turtle Habitat
					riparian areas in full sun		
T5	WC 1 (downstream)	Muck, mud, boulder, gravel, cobble, sand, boulder, rubble	Low (~0.05 m/s)	0.5-20 m wide, 0.05-1.0 m deep	Watercourse begins in a mixed wood forest, then transitions to wetland. Snapping turtle observed, submerged in small ponded area adjacent to the watercourse	O: not suitable N: not suitable G: not suitable	O: not suitable N: not suitable G: suitable - observed
T6	WC1 (upstream)	Muck, mud	Low (0/05 – 0.54 m/s)	1.5-2.6 m wide, 0.07-0.38 m deep	Watercourse begins in a wetland. Mucky, mud substrates dominate. Riparian area is mostly alders and graminoids.	O: not suitable N: not suitable G: not suitable	O: not suitable N: not suitable G: marginal
T7	WC 32 (Gays River)	Muck	Low (~0.05 m/s)	7-14 m wide, 0.4-1.6 m deep	The watercourse has a fen riparian edge and mixed wood forest beyond the riparian area. Predominantly grass and sedge riparian area. The entire watercourse is sun exposed. Emergent grasses are present. Deep pools with submergent vegetation and woody debris cover observed. Bank is mostly steep, with limited muddy banks. An unidentified turtle was observed slipping into the water on May 9, 2023. The turtle stay submerged in deep water and observers were not able to identify the species.	O: suitable N: not suitable G: suitable	O: suitable N: not suitable G: suitable

Wood turtle

This turtle species is the most terrestrial of all freshwater turtles in Canada (ECCC, 2020a). Wood turtle use wetlands and moderate to slow-moving clear-water streams, in-stream deep pools, and sand/gravel bars for thermoregulation, foraging, mating, movement and nesting (ECCC, 2020a). Wood turtle general habitat includes areas that provide thermoregulation, foraging, mating and movement opportunities. Wood turtle nesting habitat is in sand/gravel banks along a river where there is sun exposure. Preferred wood turtle overwintering habitat includes sites with a mean water depth of 91 cm in a variety of microhabitats including submerged logs, overhanging banks or resting on the bottom of a pool. Most individuals overwinter within deeper areas of their main inhabited stream or side channel of a watercourse with well oxygenated water flowing at a rate to prevent freezing to the substrate (ECCC 2020a).

No wood turtles were observed during the wood turtle surveys; however, a wood turtle was observed incidentally during late botany surveys. It was seen basking on a log within an open water area within WL24 in the northwest corner of the PA on September 8, 2023 (Figure 6.8-2). The pond has no gravel or sandy beaches, banks, or flowing water; therefore, which may provide suitable habitat for snapping turtles (ECCC, 2016a, COSEWIC 2008) but does not provide suitable nesting or overwintering habitat for wood turtles. The pond is approximately 1.3 km from the provincial core habitat layer (i.e., Gays River). The open pit lies within approximately 13 m of this open water pond within WL24 and within approximately 80 m of where the wood turtle was observed. The surrounding habitat is a shrub swamp with overhanging vegetation.

Snapping turtle

Snapping turtles were observed on 3 of the wood turtle survey transects (transects 2, 5, and within 24 m of transect 3). 3 observations of snapping turtles were recorded incidentally within open water or ponded sections of wetlands during wetland and watercourse delineation (associated with WL6, WL9, and WL14, as well as WC1 and WC11; see Figure 6.8-2). The snapping turtles were basking below the water's surface during the observations. No nesting activity was observed. Preferred habitat for snapping turtles includes ponds, lakes, slow-moving streams with soft mud bottoms and abundant aquatic vegetation (ECCC, 2016a). Hibernation occurs in freshwater systems deep enough to prevent freezing during the winter, with a mucky or muddy substrate. Snapping turtles travel through upland habitat and use gravelly areas to nest but they require wetland habitat as part of their life cycle activities (ECCC 2016a, COSEWIC 2008).

Preferred habitat for snapping turtles includes ponds, lakes, slow-moving streams with soft mud bottoms and abundant aquatic vegetation (ECCC, 2020b). Hibernation occurs in freshwater systems deep enough to prevent freezing during the winter, with a mucky or muddy substrate. Snapping turtles travel through upland habitat and use gravelly areas to nest but they require wetland habitat as part of their life cycle activities (ECCC, 2020b; COSEWIC 2008). These turtles nest in areas of soft sand, soil or gravel where there is high sun exposure. This may include meadows, shorelines, rocky outcrops and roadsides (ECCC, 2020b).