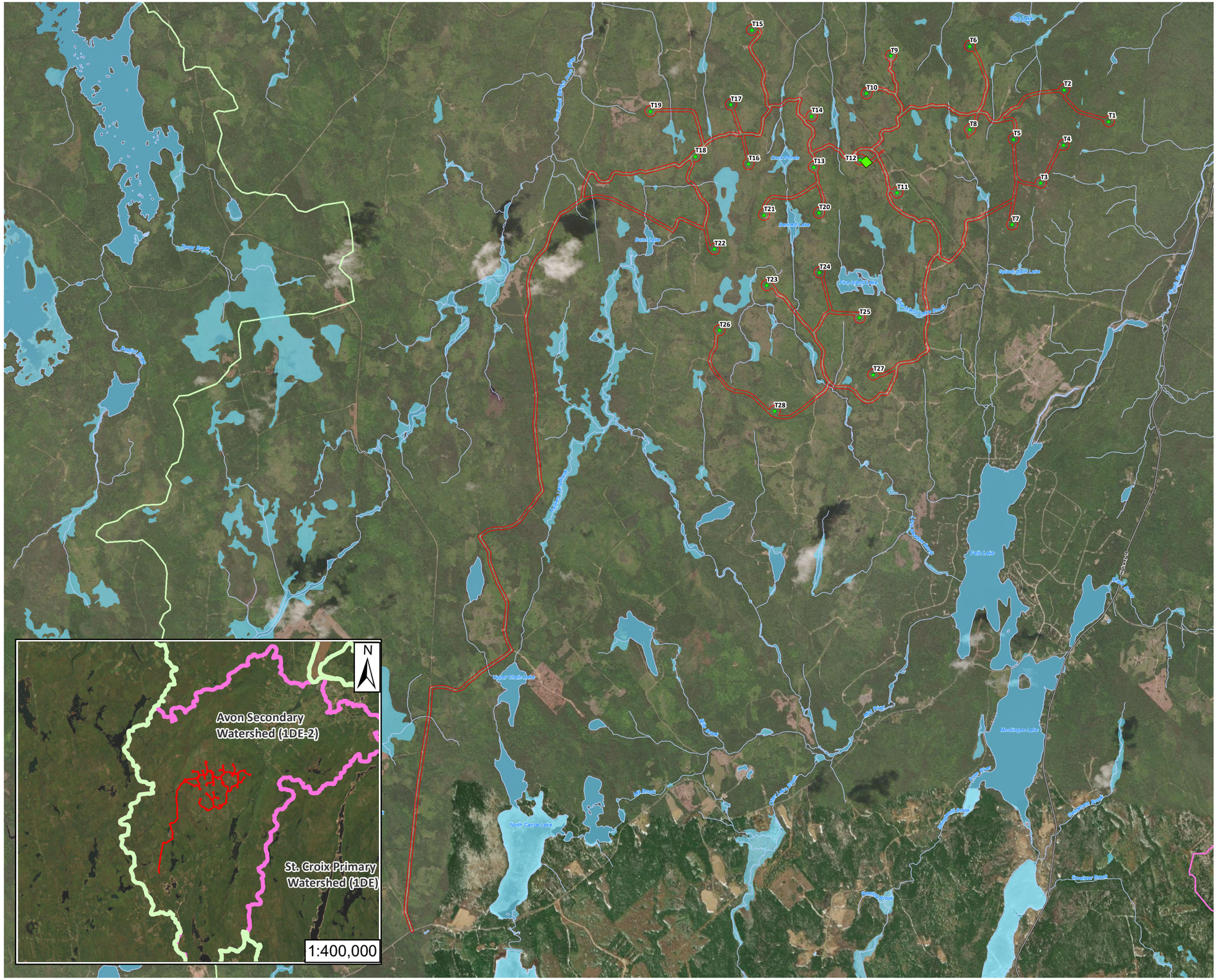

BENJAMINS MILL WIND PROJECT

LOCAL ASSESSMENT AREA, SECONDARY WATERSHEDS AND WATERCOURSES

FIGURE 9

- Proposed Turbine Location
- Proposed Substation Location
- Potential Development Area (PDA)
- Highway
- Watercourse
- Waterbodies
- Avon Secondary Watershed (1DE-2)
- St. Croix Primary Watershed (1DE)

0 0.25 0.5 1 km

SCALE 1:50,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING, GEONB, NATURAL FORCES

MAP CREATED BY: DU
MAP CHECKED BY: KB
MAP PROJECTION: NAD 1983 UTM ZONE 20N

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PROJECT: 21-1329
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DATE: 2022-12-14

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3.1.4.1 Desktop Watercourse Assessment

Approach and Methodology

A desktop assessment of watercourses and potential aquatic habitat was carried out prior to the onset of the field surveys. While reviewing the resources for the wetland and watercourse surveys, the information was also reviewed to evaluate the potential for aquatic SAR and SoCC within the general area of the proposed Project and to assist in scoping the field programs. The following sources were reviewed:

- Site-specific Atlantic Canada Conservation Data Centre reports (AC CDC 2021; AC CDC 2022);
- Reports from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC);
- Department of Fisheries and Oceans (DFO) Species at Risk Mapping;
- Nova Scotia Natural Resources and Renewables Provincial Landscape Viewer (NSDNRR 2022); and
- Google Earth satellite imagery.

Results

Surface water flow across the PDA is expected to be guided by topography. The PDA is situated on ridges that are broken up by steep valleys and surface water flow is directed towards watercourses which are contained within their watersheds by the surrounding topography. Based on topographical mapping, the highest elevations within the PDA are approximately 270 m above mean sea level (m amsl) near the proposed location of Turbine 7 (T7) on the eastern side of the PDA and approximately 190 m amsl at several locations in valleys within the southern area of the PDA.

The PDA is located within the Avon River secondary watershed (1DE-2) which is part of the St. Croix (1DE) primary watershed. The Avon River secondary watershed encompasses a drainage area of 460 km^2 and includes three main branches of the Avon River (i.e., South, West, and Southwest) (Isaacman 2005). The watercourses that fall within the general vicinity of the proposed Project include the Mint River, Levy Meadow Brook, and Five Island Brook, although several unmapped watercourses are also present. Lakes in the general vicinity of the Project include Five Island Lake, Bennett Lake, Duck Ponds, Pine Lake, and Splash Dam Lake.

The watercourses and waterbodies with crossings within the LAA eventually flow towards the Avon River either directly or via several large river systems. The main tributaries from the PDA to the Avon River are shown on **Figure 9** discussed below:

- The Avon River forms at the outlet of Falls Lake and receives inputs from some of the tributaries that cross the PDA;
- Levy Mountain Brook, Five Island Brook, and Mint River flow through the PDA and/or receive flow from tributaries within the PDA before flowing to Falls Lake;
- Mint River, which is the main outlet for Burnt Lake, receives water further downstream from Aalders Lang Brook and Mill Brook;

- Mill Brook is an outlet of Little Island Lake which is fed from North Canoe Lake, Chain Lake, Upper Chain Lake and their associated tributaries that have crossings with the PDA;
- Southwest Branch Avon River receives water from several direct tributaries from crossings of the PDA and flows towards the West Branch Avon River; and,
- Roaches Brook crosses the PDA and flows to the Southwest Branch Avon River via Muddy Lake and Mud Lake.

Freshwater species that have been documented within the Avon River watershed (Daborn and Brylinsky 2004) are summarized in **Table 15** below. Based on the aquatic habitat identified during the 2021 preliminary watercourse assessments and initial measurements of watercourse acidity throughout the Study Area, the dominant fish species expected within the watercourses are likely to be acid-tolerant species, such as white sucker (Lacroix 2011).

TABLE 14: SUMMARY OF FRESHWATER FISH SPECIES DOCUMENTED IN THE AVON RIVER WATERSHED

Scientific Name	Common Name
Gasterosteus aculeatus	Three Spine Stickleback*
Apeltes quadracus	Four Spine Stickleback
Pungitius pungitius	Nine Spine Stickleback
Fundulus diaphanus	Banded Killifish
Perca flavescens	Yellow Perch*
Micropterus dolomieu	Smallmouth Bass*
Catostomus commersonii	White Sucker*
Chrosomus eos	Northern Redbelly Dace
Couesius plumbeus	Lake Chub*

*Indicates an acid-tolerant species

3.1.4.2 Field Assessments

Approach and Methodology

Fish habitat suitability assessments were conducted for watercourses that have crossings within 30 m of the PDA to evaluate the potential for each watercourse to support fish and provide fish habitat. A preliminary assessment was completed in October 2021 and further detailed assessments were completed from October 4 to 21, 2022 and November 1, 2022. Fish habitat suitability assessments included the collection of physical characteristics of each watercourse. Where it was practical to do so, data were collected from watercourses within 30 m of the PDA at a minimum of four locations (e.g., 50 m upstream of the PDA crossing location, within the PDA, and 50 and 100 m downstream from the PDA crossing location). The following assessment criteria were recorded at each assessed location:

- **Dominant substrate type**: Dominant substrate types (e.g., gravel or silt) were described and documented. Substrate type is especially important for fish spawning habitat;

- **Stream channel characteristics**: Stream channel characteristics including average wet width, approximate bankfull width, average wetted depth and maximum wetted depth were measured in the field;
- ***In-situ* water quality parameters**: Water quality parameters (i.e., temperature, pH, dissolved oxygen [DO], specific conductivity) were measured in the field with a calibrated YSI professional plus multi meter; and
- In-stream and bank vegetation.

Representative photos and global positioning system (GPS) points (using a handheld GPS unit and Arc Geographic Information Systems [ArcGIS] applications) were collected for each watercourse during the field assessments (see **Appendix E**).

The presence and/or the potential presence of fish in each aquatic feature was evaluated based on visual confirmation of fish during field surveys, watercourse characterizations conducted during low and mid-stage flow conditions, and the desktop evaluation for fish species potentially present within the Study Area. The biophysical characteristics of each watercourse were evaluated for fish habitat potential based on the habitat requirements for brook trout and other acid-tolerant fish species with the potential to occur within the watercourses that enter the PDA.

Suitable habitat characteristics, along with water quality to support aquatic species and direct observations of fish, were the basis of considerations on the likelihood of watercourses to support fish habitat. Watercourses were classed with the following descriptors:

- Unlikely to provide suitable fish habitat;
- May provide seasonally accessible fish habitat;
- Likely provides fish habitat; or,
- Confirmed (i.e., fish observed).

An explanation was provided where fish habitat is possible but unconfirmed. Ephemeral streams and watercourses with barriers to fish passage were typically given a low rating, whereas permanent watercourses with direct observations of fish were given a higher rating for presence of fish habitat. Permanent or intermittent watercourses where fish were not observed that were considered likely to provide fish habitat, and/or contained seasonally-accessible fish habitat are also identified as such.

Water quality parameters (dissolved oxygen (DO), pH, conductivity, pH, temperature) were measured *in-situ* using a handheld YSI Professional Plus water quality meter. The Canadian Council of Ministers of the Environment (CCME) has published guidelines for DO and pH, which were used as indicators of suitability for aquatic life. Watercourses with pH and DO within the recommended range from the CCME for the protection of aquatic wildlife were considered to have a higher likelihood to provide suitable fish habitat. The CCME freshwater aquatic life (FWAL) range for pH is 5-9 and a minimum DO concentration of 6.5 mg/L is recommended for a watercourse to support cold water biota life stages (excluding early life stages) (CCME 1999).

Results

Throughout the field assessments in 2021 and 2022, 24 watercourses were confirmed or identified and then assessed within the Study Area. A total of 28 watercourse crossings were assessed with potential crossings with linear features of the PDA, noting that four of the 24 watercourses have more than one crossing location with the PDA. The Study Area and the locations of assessed watercourse crossings are shown on **Figure 10** and discussed on **Table 15**. Data collected at watercourse assessment locations are summarized in **Appendix E** and discussed in the sections below.

An assessment of fish habitat suitability for the watercourse locations in the Study Area is presented in **Table 15** below and presented on **Figure 10,** which include colour coded rankings of fish habitat suitability for the assessed locations of watercourses. The following assessment took into consideration information obtained through the desktop screening assessment as well as *in-situ* water quality measurements (presented in **Appendix E**) and the physical habitat characteristics recorded during assessment of watercourse crossing locations throughout 2021 and 2022.

The assessed locations of the watercourses within the Study Area had pH levels below the Canadian Council of Ministers of the Environment (CCME) recommended range for the protection of aquatic life (i.e., 6.5-9.0). Watercourses with a pH of 5.0, as was the case with 14 of the assessed watercourses, are expected to have low fish densities and little to no acid-sensitive species (including juvenile salmon and cyprinids) (Lacroix 2011). Based on the aquatic habitat present and watercourse acidity throughout the Study Area, the dominant fish species expected within the watercourses are likely to be acid-tolerant species, such as white sucker (Lacroix 2011).

TABLE 15 POTENTIAL WATERCOURSE CROSSINGS WITHIN THE PDA AND PROPOSED ALTERATIONS

Watercourse ID	Description	pH and DO (mg/L)[2]	Suitability as Fish habitat	Potential Barriers	Proposed Alterations
WC-1-US (Upstream)	Levy Mountain Brook: A permanent defined channel with gravel/boulder substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.84-3.98 DO: 9.55-10.22	Likely provides direct fish habitat	None observed	An existing road crosses this tributary in two locations, both have existing bridges which may require upgrades. The upstream crossing location is not aligned with the existing bridge.
WC-1-DS (Downstream)	Levy Mountain Brook: A permanent defined channel with gravel/boulder substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.84-3.98 DO: 9.55-10.22	Likely provides direct fish habitat	None observed	An existing road crosses this tributary in two locations, both have existing bridges which may require upgrades.
WC-2	Tributary to Levy Mountain Brook: Intermittent, less defined channel with fine substrate and variable banks. The channel flows through shrubs and grasses and feeds into WC-1.	pH: 4.43 DO: 4.49	Unlikely to provide fish habitat	Insufficient water in the upstream reaches	Potential – An existing road to be upgraded is supported by a bridge.
WC-3	Tributary to Levy Mountain Brook: Permanent, defined channel with boulder/gravel substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.64-3.83 DO: 7.39-8.35	May provide seasonally accessible fish habitat	Insufficient water in the upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.
WC-4	Tributary to Five Island Lake Brook: Permanent, defined channel with gravel substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.31-3.94 DO: 7.22-10.64	Likely provides direct fish habitat	None observed	Potential – An existing road to be upgraded is supported by a bridge.
WC-5-US (Upstream)	Upstream Tributary to Five Islands Lake Brook: Intermittent, less defined channel with fine substrate and stable banks. The channel flows through shrubs and grasses. Culvert is too high for fish access.	pH: 4.55-4.86 DO: 6.05-9.81	Unlikely to provide fish habitat	Raised culvert on downstream side of road crossing	Potential – An existing road to be upgraded is supported by a raised culvert at crossing.
WC-5-DS	Tributary to Five Islands Lake Brook:	pH: 3.63-4.07	Confirmed fish	None	A proposed new access road would

Watercourse ID	Description	pH and DO (mg/L)[2]	Suitability as Fish habitat	Potential Barriers	Proposed Alterations
(Downstream)	Permanent, defined channel with boulder/cobble substrate and stable banks. The channel flows through mature mixed forest.	DO: 6.62-8.79	habitat	observed	cross this watercourse.
WC-6	Tributary to Avon River: Permanent, defined channel with boulder/cobble substrate and stable banks. The channel flows through mature mixed forest.	pH: 4.34-4.5 DO: 3.76-5.56	May provide seasonally accessible fish habitat	Insufficient water in the upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.
WC-8	Tributary to West Branch Avon River via WC-9. Intermittent, defined channel with cobble/gravel substrate and stable banks. The channel flows through mature mixed forest and low marsh area.	pH: 3.94-4.5 DO: 3.55-9.04 mg/L	May provide seasonally accessible fish habitat	Insufficient water in upstream reaches, beaver dam	Potential – An existing road to be upgraded is supported by a culvert.
WC-9	Tributary to West Branch Avon River: Permanent, defined channel with gravel substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.37-3.67 DO: 8.84-11.8	Confirmed fish habitat	Insufficient water in upstream reaches, downed tree dam	Potential – An existing road to be upgraded is supported by a culvert.
WC-10-US (Upstream and back channel)	Tributary to Burnt Lake: Permanent, defined channel with gravel substrate and stable banks. The channel flows through mature mixed forest. A backchannel of this watercourse is located to the north of the main channel.	pH: 3.14-3.53 DO: 5.31-11.55	Upstream reach and backchannel may only be seasonally accessible	Insufficient water in upstream reaches	Potential – The PDA crosses this tributary in two locations. An existing road to be upgraded is supported by a culvert at the upstream location.
WC-10-DS (Downstream)	Tributary to Burnt Lake: Permanent, defined channel with gravel substrate and stable banks. The channel flows through mature	pH: 3.14-3.53 DO: 5.31-11.55	Downstream reach likely provides direct	None Observed	The PDA crosses this tributary in two locations. A proposed new access road will would cross the downstream

Watercourse ID	Description	pH and DO (mg/L)[2]	Suitability as Fish habitat	Potential Barriers	Proposed Alterations
	mixed forest.		fish habitat.		crossing, which may require a structure installed when the road is constructed.
WC-11	Tributary to Burnt Lake: Permanent, defined channel with fine substrate and stable banks. The channel flows through mature mixed forest and is embedded by an existing access road, forming ponding in the north side ditch.	pH: 3.07-3.62 DO: 10.44-11.64	Confirmed fish habitat	Insufficient water in upstream reaches	Potential – Watercourse is embedded by an existing road to be upgraded.
WC-12	Wetland drainage to WC-11: Intermittent, defined channel with fine substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.8-3.95 DO: 6.89-8.32	May provide seasonally accessible fish habitat	Insufficient water in upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.
WC-13-US (Upstream)	Tributary to Southwest Branch Avon River: Permanent, defined channel with cobble substrate and stable banks. The channel flows through mature mixed forest.	pH: 4.39-4.77 DO: 9.76-11.37	Fish are unlikely to access to the upstream reaches due to insufficient water and a dam caused by downed trees.	Downed tree dam	The PDA crosses this tributary in two locations. A proposed new access road would cross the upstream crossing, which may require a structure installed when the road is constructed.
WC-13-DS (Downstream)	Tributary to Southwest Branch Avon River: Permanent, defined channel with cobble substrate and stable banks. The channel flows through mature mixed forest.	pH: 4.39-4.77 DO: 9.76-11.37	Likely provides direct fish habitat	None Observed	The PDA crosses this tributary in two locations. An existing road to be upgraded is supported by a culvert at the downstream location.
WC-14	Tributary to Southwest Branch Avon River: Intermittent, less defined channel with gravel substrate and stable banks. The channel flows through mature mixed forest. High gradient	pH: 4.21-5.06 DO: 8.47-11.37	Likely provides direct fish habitat	Insufficient water in upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.

Watercourse ID	Description	pH and DO (mg/L)[2]	Suitability as Fish habitat	Potential Barriers	Proposed Alterations
	cascades may act as an impediment to upstream fish passage.				
WC-15	Ephemeral, less defined channel with cobble/fines substrate. This channel flows through mature mixed forest.	pH: 4.43-4.47 DO: 2.3-3.17	Unlikely to provide fish habitat	Insufficient water in upstream reaches, lacks stable channel	Potential – An existing road to be upgraded is supported by a culvert.
WC-16	Tributary to Aalders Lang Brook: Intermittent less defined channel with gravel substrate and eroding banks. The channel flows through mature mixed forest.	pH: 4.85-4.96 DO: 7.11-10.6	Unlikely to provide fish habitat	Insufficient water in upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.
WC-17	Tributary to Aalders Lang Brook: Intermittent, defined channel with cobble/silt substrate and eroding banks. The channel flows through mature mixed forest.	pH: 4.33-4.52 DO: 1.89-5.23	May provide seasonally accessible fish habitat	Insufficient water in upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.
WC-18	Tributary to Chain Lake: Permanent, defined channel with gravel/sand substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.64-3.99 DO: 3.74-8.84	Likely provides direct fish habitat	None observed	Potential – An existing road to be upgraded is supported by a culvert.
WC-19	Roachs Brook: Permanent, defined channel with gravel/sand substrate and stable banks. The channel flows through mature mixed forest.	pH: 4.12-4.28 DO: 4-8.7	May provide seasonally accessible fish habitat	Insufficient water in upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.
WC-20	Tributary to Roachs Brook: Intermittent, defined channel with fine substrate and stable banks. The channel flows through mature mixed forest.	pH: 4.43-4.65 DO: 4.97-7.3	May provide seasonally accessible fish habitat	Insufficient water in upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.

Watercourse ID	Description	pH and DO (mg/L)[2]	Suitability as Fish habitat	Potential Barriers	Proposed Alterations
WC-21	Tributary to Roachs Brook via WC-22: Intermittent, defined channel with fine substrate and stable banks. The channel flows through mature mixed forest. Drains into WC-22.	pH: 5.6-5.9 DO: 1.67-1.71	Unlikely to provide fish habitat	Insufficient water in upstream reaches	Potential – An existing road to be upgraded is supported by a culvert.
WC-22	Tributary to Roachs Brook: Intermittent, defined channel with gravel/sand substrate and stable banks. The channel flows through mature mixed forest.	pH: 4.58-5.22 DO: 1.82-3.5	May provide seasonally accessible fish habitat	Insufficient water in upstream reaches	Potential - An existing road to be upgraded is supported by a culvert.
WC-23	Tributary to Roachs Brook: Intermittent, defined channel with gravel/cobble substrate and stable banks. The channel flows through mature mixed forest.	pH: 4.01-6.86 DO: 1.13-5.71	May provide seasonally accessible fish habitat	Insufficient water in upstream reaches	Potential - An existing road to be upgraded is supported by a culvert.
WC-24	Tributary to Avon River: via WC-6: Permanent, defined channel with gravel substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.35-3.65 DO: 4.79-10.37	Likely provides direct fish habitat	None observed	A proposed new access road would cross this watercourse to support the interconnection to the transmission line.
WC-25	Tributary to Avon River: via WC-6: Permanent, defined channel with boulder substrate and stable banks. The channel flows through mature mixed forest.	pH: 3.44-3.52 DO: 5.32-10.31	Likely provides direct fish habitat	Insufficient water in upstream reaches	A proposed new access road would cross this watercourse to support the interconnection to the transmission line.

Notes:

1. As previously described, the PDA encompasses all of the proposed 28 turbine locations and their associated infrastructure. The Project would consist of up to 28 of those locations and their associated infrastructure. As such, this list encompasses all watercourse in this secondary watershed within 30 m of the PDA.
2. Range report for pH and DO is based on readings taken in 2022 using a YSI Professional Plus meter, additional parameters are included in **Appendix E.**
3. This list encompasses all potential watercourse crossings in this secondary watershed within 30 m of the PDA.

Table 15 provides a judgment of the suitability of each assessed watercourse to provide suitable fish habitat as well as the range of water quality parameters for DO and pH and potential barriers for fish passage observed during the assessments in 2022.

Of the watercourses surveyed within the assessment area, five watercourses are considered unlikely to provide seasonal or permanent direct fish habitat because they either are ephemeral or to contain significant barriers to fish passage.

The remaining assessed watercourses may provide suitable habitat for some freshwater and anadromous species based on the physical watercourse characteristics assessed (see **Appendix E** for assessed data). Watercourses identified as likely providing fish habitat show dynamic features, including hard substrate, habitat cover and were free of potential barriers for fish passage. Watercourses with pH levels lower than 4.7 could make it difficult for a fish like Atlantic salmon to successfully spawn (DFO 2010); however, acid-tolerant fish could make use of the otherwise suitable habitat conditions.

Natural Forces

BENJAMINS MILL WIND PROJECT

WATERCOURSE AND FISH HABITAT SUITABILITY ASSESSMENT

FIGURE 10 A

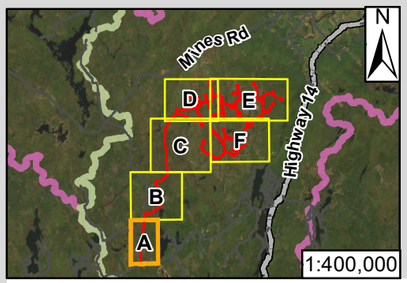
- Proposed Turbine Location
- Proposed Substation Location
- Study Area
- Potential Development Area (PDA)

Watershed

- Avon Secondary Watershed (1DE-2)
- St. Croix Primary Watershed (1DE)

Assessed Watercourse/Fish Suitability

- Confirmed
- Likely
- Seasonal
- Unlikely



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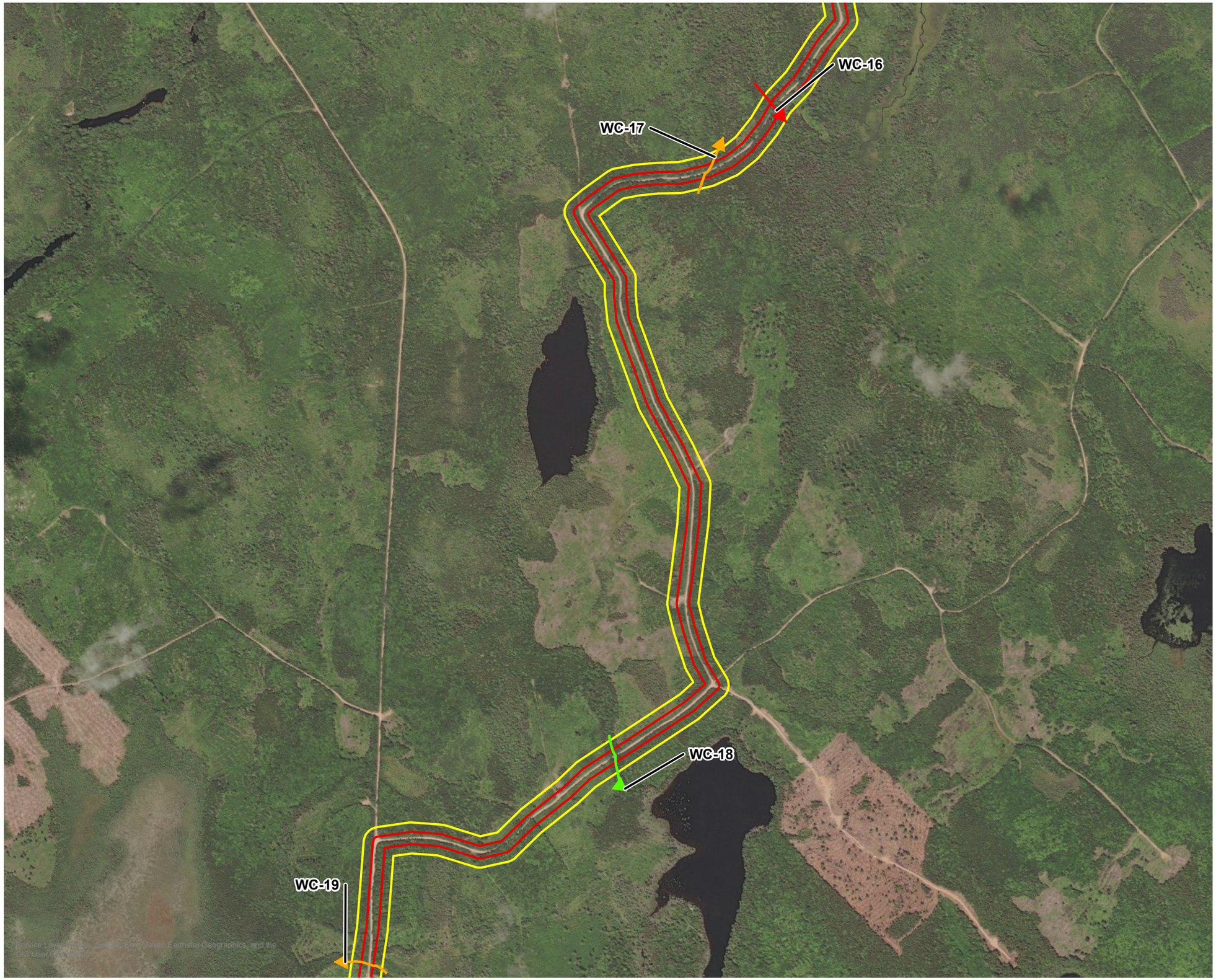

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BENJAMINS MILL WIND PROJECT

WATERCOURSE AND FISH HABITAT SUITABILITY ASSESSMENT

FIGURE 10 B

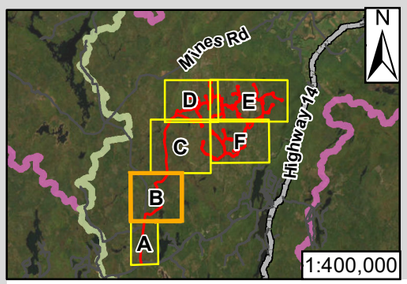
- Proposed Turbine Location
- Proposed Substation Location
- Study Area
- Potential Development Area (PDA)

Watershed

- Avon Secondary Watershed (1DE-2)
- St. Croix Primary Watershed (1DE)

Assessed Watercourse/Fish Suitability

- Confirmed
- Likely
- Seasonal
- Unlikely



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