A SUBSIDIARY OF
CHAMPION IRON

Kami Mining Project

Champion Kami Partner Inc.

Wabush, NL

TSD IX: Fish and Fish Habitat Offsetting Plan

Environmental Impact Statement

Document Number: CA00387135261-R-Rev0-TSD_IX_Fish and Fish Offsetting Plan

July 2025

1155 René-Lévesque Blvd. West, 33rd Floor
Montréal, Québec H3B 3X7 CANADA
T +1 514 316-4858
championiron.com

REPORT

Fisheries Authorization Habitat Offsetting Plan

Kami Mining Project

Submitted to:

Champion Kami Partner Inc.

Submitted by:

WSP Canada Inc.

36 Pippy Place, St. John’s, NL, A1B 4A5, Canada

Document Number: CA00387135261-R-Rev0-TSD-IX_Fish and Fish Offsetting Plan

July 2025

Contributors

Champion Kami Partner Inc.

Project Manager	Michel Groleau

WSP

Senior Biologist /HADD and Offsets	Jim McCarthy, MSc.
Senior Scientist /MAA and Schedule 2	Daniel Russell
Senior Biologist /Review	Dale Klodnicki, MESc.
Intermediate Biologist	Matthew Gosse, BSc.
Senior Technician	Dermot Kenny, Nat. Tech.
GIS (Geographic Information System) Analysis	Juanita Abbott
Project Manager	Jean-Marc Crew

Study Limitations

WSP Canada Inc. (WSP) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, has been prepared by WSP for the sole benefit of Champion Kami Partner Inc. (Champion). It represents WSP's professional judgement based on the knowledge and information available at the time of completion. WSP is not responsible for any unauthorized use or modification of this document. All third parties relying on this document do so at their own risk.

The factual data, interpretations, suggestions, recommendations and opinions expressed in this document pertain to the specific project, site conditions, design objective, development and purpose described to WSP by Champion and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations and opinions expressed in this document, reference must be made to the entire document.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, as well as all electronic media prepared by WSP are considered its professional work product and shall remain the copyright property of WSP. Champion may make copies of the document in such quantities as are reasonably necessary for those parties conducting business specifically related to the subject of this document or in support of or in response to regulatory inquiries and proceedings. Electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore no party can rely solely on the electronic media versions of this document.

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

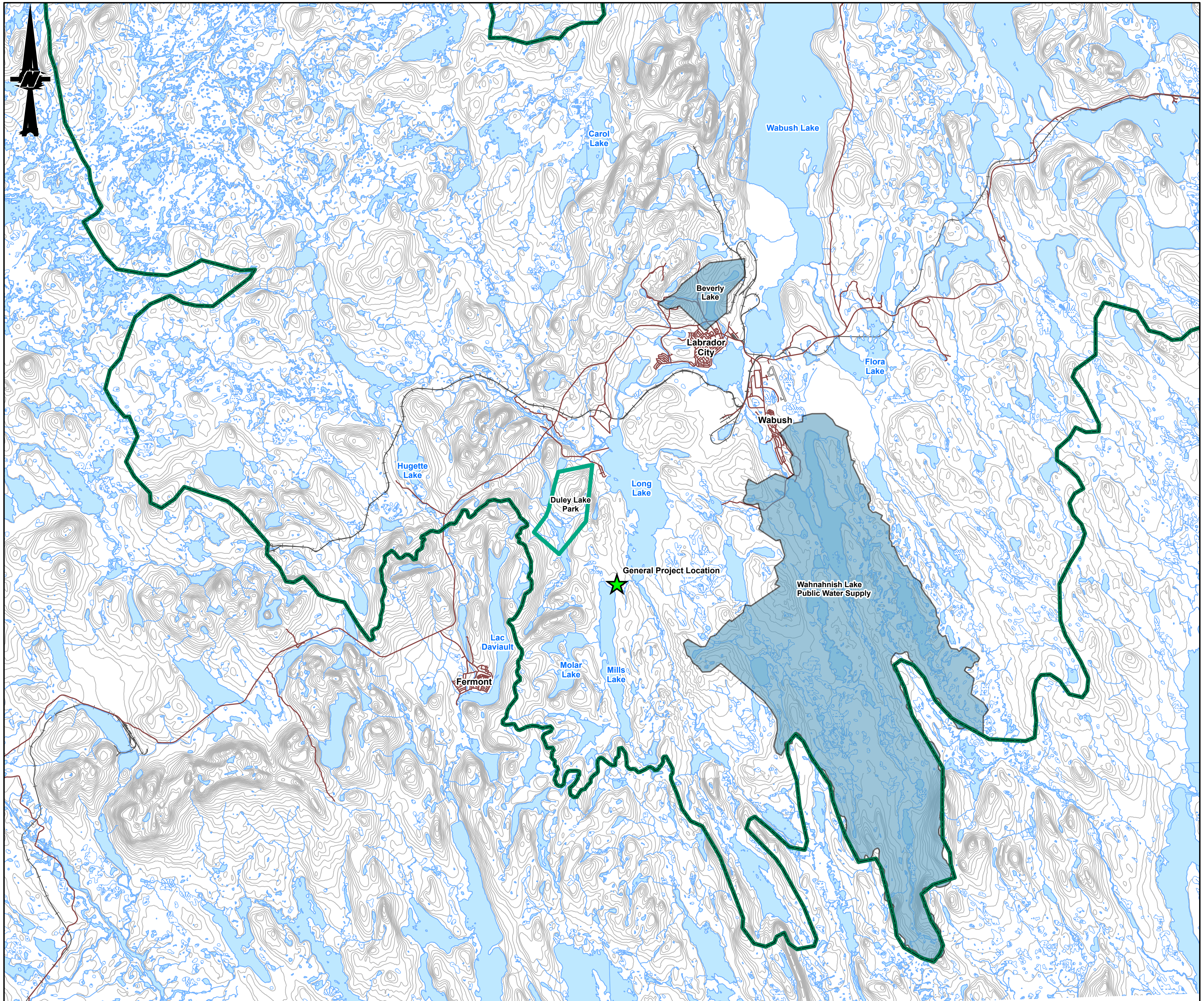
The Kamistiatusset (Kami) Iron Ore Mine Project (the Project) is a proposed iron ore mine in Newfoundland and Labrador. The Project site is located approximately 7 km southwest of the Town of Wabush, 10 km south of the Town of Labrador City, and 5 km northeast of the Town of Fermont, Québec (Figure 1-1).

The Project was originally proposed by the Alderon Iron Ore Corporation (Alderon) and underwent a provincial and federal environmental impact assessment from 2011 to 2013, including a comprehensive baseline program that was completed in 2011 and 2012. The Project was released from the provincial and federal Environmental Assessment (EA) process in 2014. In 2021, Champion Kami Partner Inc. (Champion), completed the acquisition of the Project from Alderon.

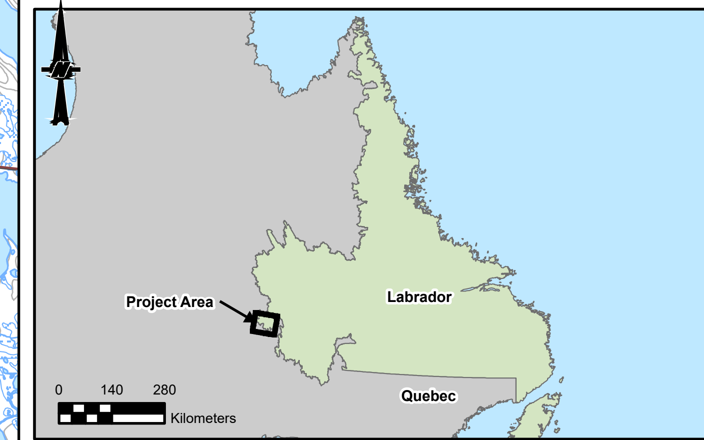
Champion is proposing several changes to the Project design proposed by Alderon in the previous Environmental Impact Statement (EIS) (Alderon 2012). These proposed changes include optimizations to the Project's water management strategy and modernization of the proposed ore handling, conveyance, and processing. Champion's objective for the Kami Project is to produce high purity (>67.5%) iron concentrate, which can be used as direct reduction pellet feed for electric arc furnaces in the green steel supply chain.

The Project will consist of an open pit iron ore mine and associated infrastructure in western Labrador. The mine Property is located south of the towns of Wabush and Labrador City in Newfoundland and Labrador and east of Fermont, Québec. The Kami Iron Ore Mine and Rail infrastructure is located entirely within Labrador, and includes construction, operation, rehabilitation and closure of an open pit, overburden stockpile, mine rock stockpile, processing infrastructure, a tailings management facility (TMF), ancillary infrastructure to support the mine and process plant, and a rail transportation component. The mine will have a nominal capacity of approximately 8.6 million metric tonnes of iron ore concentrate per year. Concentrate will be transported by existing rail to the Pointe-Noire Terminal at the Port of Sept-Îles, where Project-related components will be located on land within the jurisdiction of the Port Authority of Sept-Îles.

The federal assessment process has changed substantially since the 2014 decision statement was issued for the Project. The previous EA for this Project was begun under the previous *Canadian Environmental Assessment Act* (CEAA) before the 2012 CEAA (Government of Canada 2012) and the more recent *Impact Assessment Act* (Government of Canada 2019) came into force, replacing the CEAA. The EA for the Project was completed under very different legislative requirements than would be applied today. On June 19, 2024, the Impact Assessment Agency of Canada confirmed that the *Impact Assessment Act* does not apply to the Project because it had previously undergone a federal comprehensive study and received a determination under the CEAA; therefore, it is included in the transition provision in subsection 185.1(1) of the *Impact Assessment Act*, which indicates that the Act does not apply. To this end, the Project will follow the provincial EA process only. Champion submitted a Project Registration document to the Newfoundland and Labrador (NL) Department of Environment and Climate Change (the Department) in April 2024 to restart the EA process for the Project. On June 13, 2024, the Minister issued a Decision Letter to Champion concluding that an EIS would be required for the Project.



KEY MAP



SCALE 1:20,000,000

LEGEND

- General Project Location
- Duley Lake Park
- Road
- Railway
- Watercourse
- Contour
- Waterbody
- Bog/Wetland
- Public Water Supply
- Labrador/Quebec Boundary

0 1,500 3,000 6,000

1:190,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

PROJECT LOCATION

CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	1-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1.1 Project Contact Information

Table 1-1 provides the details regarding the Proponent, the Project Title, location, and Proponent contact details.

Table 1-1: Project Contact Information

Proponent or Project Information	Description
Proponent:	Champion Kami Partner Inc.
Project Title:	Kami Mining Project
Location:	Labrador West, Newfoundland and Labrador, Canada
Contact:	Michel Groleau Principal Director, Sustainable Development Champion Kami Partner Inc.
Telephone:	418-670-6590
Email:	mgroleau@championiron.com
Mailing Address:	1155 Boul. René-Lévesque O suite #3300, Montréal, QC H3B 3X7

1.2 Regulatory Context and Document Purpose

The Kami Mine Project was previously assessed and released under applicable provincial and federal processes and permits and related plans were finalized (e.g., environmental monitoring, communication, sediment and erosion control). The Project also received a harmful alteration, disruption, or destruction (HADD) of fish and fish habitat determination by Fisheries and Oceans Canada (DFO), and an offset plan was submitted and approved as part of its previous permitting and *Fisheries Act* authorization; however, the authorization was never finalized by the previous proponent. Additionally, the updated Project has now incorporated many mine development mitigations related to mine water management that were not identified in the previous mine plan and these mitigations require greater aquatic interactions but allow for greater certainty in terms of potential interactions with aquatic resources. The new mine layout will also require listing under Schedule 2 of the *Metal Diamond Mining Effluent Regulations* and hence this offset plan outlines avoidances, mitigations, and offsets related to both requirements.

The *Fisheries Act* contains a prohibition with respect to the HADD of fish habitat. DFO must consider if there are alternatives that avoid adverse effects on fish and fish habitat and if the adverse effects on fish and fish habitat are unavoidable, DFO must consider if there are measures to mitigate that would reduce or minimize those adverse effects. If there are any residual effects, DFO must consider offsetting measures to counterbalance the death of fish and the HADD of fish habitat (DFO 2025) as per subsections 34.4(2) and 35(2) of the *Fisheries Act* for the proposed work, undertaking, or activity to proceed without contravening the *Fisheries Act*. The Act permits the Minister to issue an authorization, under Section 35 (2) of the *Fisheries Act*, which will permit death of fish or a “HADD” to occur. Additionally, the Project will require gazetting under Schedule 2 of the *Metal and Diamond Mining Effluent Regulations* (MDMER) for any fish and fish habitat where the deposit of a deleterious substance would occur.

The Project includes the construction of an open pit mine for the extraction of iron ore material. Mine operating infrastructure will include the mine pit, overburden stockpile, mine rock stockpile, TMF, wastewater treatment facilities with a single discharge location, and road/rail access. A portion of these features have been determined to directly and indirectly affect fish and fish habitat and therefore this document contains the amended quantification and offsetting plan for this Project in support of a request for a *Fisheries Act* authorization.

This document provides an updated Project description, summary of affected habitat, a plan of the options selected to provide offsetting replacement habitat, planned and ongoing public consultations, and a proposed monitoring program. Where appropriate, this offsetting plan has incorporated agreed upon habitat mitigations and offsetting under the previously submitted offset plan for the Project proposed by the previous owner.

1.3 Document Overview

This Project-specific offsetting plan has been developed in consideration of the predicted residual effects resulting from the works, undertakings, or activities. The key components of the offsetting plan are based on DFO (2019). Corresponding sections in this document are listed in Table 1-2 as a reference guide.

Table 1-2: Key Components within the Proposed Offsetting Plan

Step	Description	Considerations	Applicable Section of this Report
1	Characterize the residual death of fish and harmful alteration, disruption, or destruction of fish habitat.	Quantify the residual harmful effects on fish and fish habitat resulting from the works, undertakings, and activities. This was updated based on an updated mine footprint.	▪ 3.0 Existing Fish and Fish Habitat ▪ 4.1 Measures to Avoid ▪ 4.2 Measures to Mitigate ▪ 4.3 Summary of Effects
2	Select measures to offset	Follow guiding principles for measures to offset	5.0 Measures to Offset
3	Determine the required quantity of measures to offset the effects on fish and fish habitat.	▪ Quantify measures to offset. ▪ Balance measures to offset with the residual effects on fish and fish habitat. ▪ Account for uncertainty. ▪ Consider implementation time lags.	6.0 Quantity of Required Measures to Offset
4	Establish the monitoring and reporting plan.	▪ Describe methods to assess the effectiveness of the measures to offset. ▪ Describe contingency measures.	7.0 Monitoring and Reporting
5	Submit offsetting plan to Fisheries and Oceans Canada for review.	▪ Estimate offsetting plan implementation cost. ▪ Provide financial guarantee. ▪ Secure access to lands and water bodies (DFO 2019).	Letter of Credit (pending)

Source: DFO 2019.

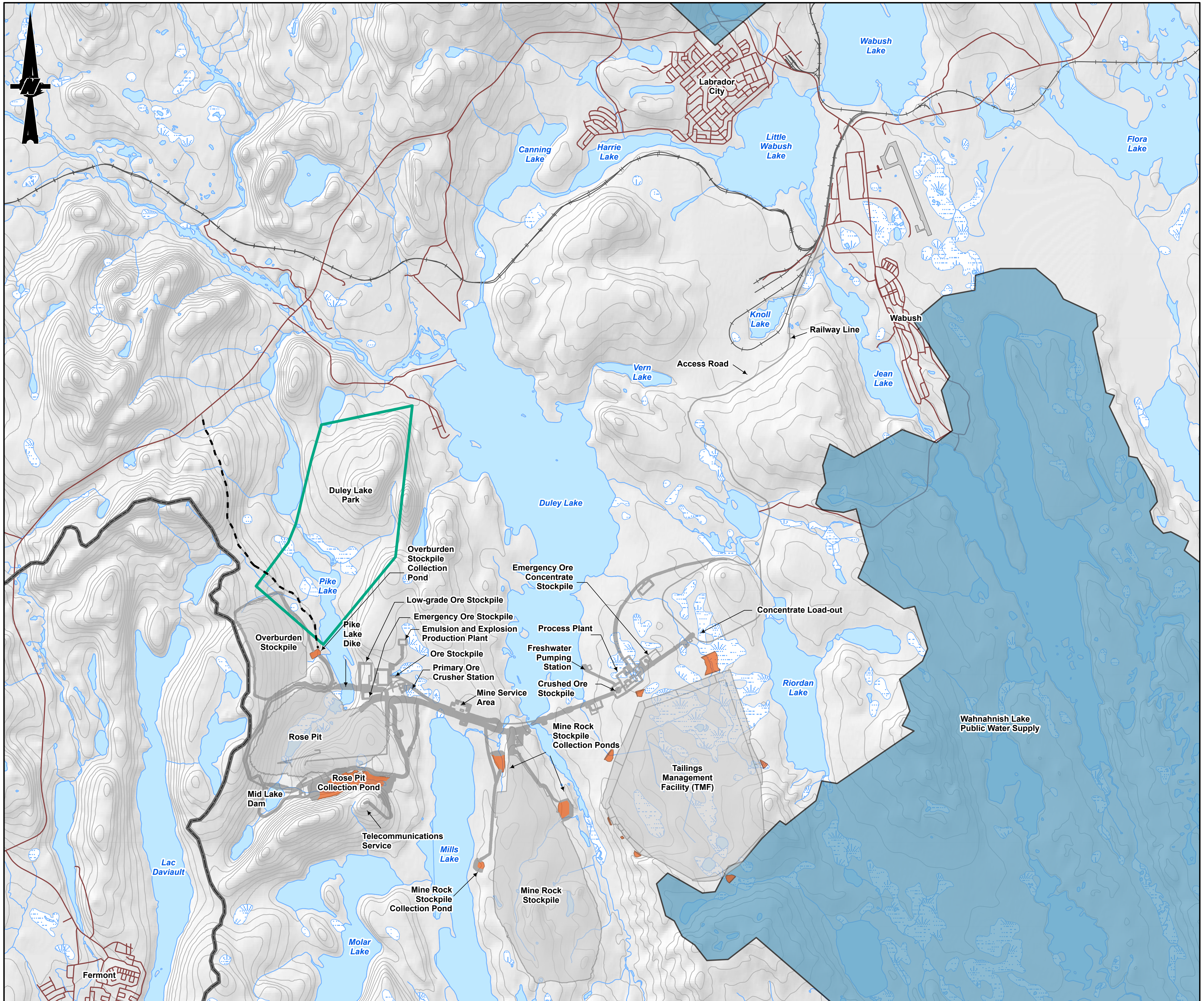
2.0 PROPOSED WORK, UNDERTAKING, AND ACTIVITIES

2.1 Project Overview and Layout

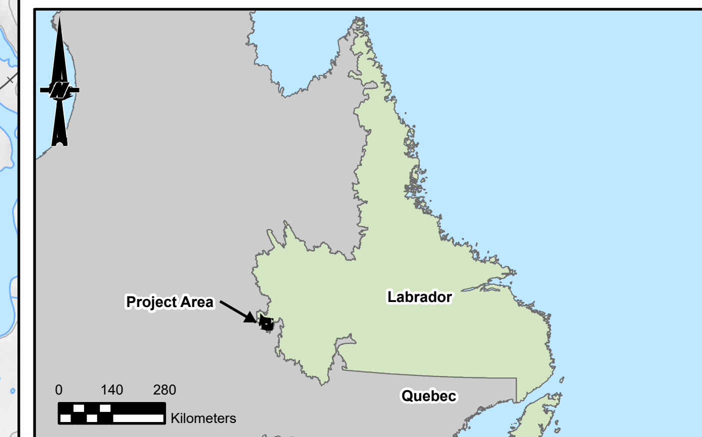
The proposed Project will include an open pit mine and surface infrastructure to support the extraction of iron ore from the Kami deposit and the production of high purity iron ore concentrate. The Project includes construction, operation, and closure of the following components:

- an open pit (referred to as the Rose Pit)
- ore processing infrastructure, including conveyors and transfer stations, stockpiles, the process plant, and load-out facilities
- waste management infrastructure, including an overburden stockpile, mine rock stockpile, and TMF
- water management infrastructure that will collect, convey, store, treat, and discharge contact and non-contact water, including dams, dikes, and collection ponds
- supporting infrastructure, including site roads, workforce accommodations, a mine service area, freshwater pumping stations, fuel storage, an emulsion and explosion production plant and explosive storage, a crushing plant, transmission lines for local site distribution, and telecommunication services
- transportation corridors, including access roads and a railway corridor that includes a spur line to connect the mine site to the Québec North Shore & Labrador Railway

A presentation of the site layout is provided in Figure 2-1. All mining and processing operations will take place within the Newfoundland and Labrador provincial boundary. All Project components will be constructed, operated and closed in accordance with governing federal, provincial and municipal regulations, as well as industry regulations and standards.



KEY MAP



SCALE 1:20,000,000

Legend

PROJECT DATA
- Proposed Project Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION
- Duley Lake Park
- Railway
- Watercourse
- Contour
- Bog/Wetland
- Waterbody
- Labrador/Quebec Boundary
- Public Water Supply

0 1,000 2,000 4,000
1:71,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
PROJECT LOCATION AND SITE LAYOUT

CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	2-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

2.2 Project Schedule

Champion has developed a schedule outlining the duration and timing of the Project stages, phases, and periods, including the following:

- permitting and approvals stage
- Construction, Operations, and Decommissioning and Reclamation (Closure) phases
- Post-closure period

The proposed schedule is presented in Table 2-1.

The duration of the permitting and approvals stage is a tentative estimate based upon Champion's current understanding of the federal and provincial approvals and permitting processes for the Project.

In November 2024, NL Hydro announced the plans to initiate the Labrador West Transmission Study (NL Hydro 2024), which explores the feasibility of an expansion of the transmission system into Labrador West from Churchill Falls and the potential economic impact of future development. The principal consideration in this transmission study is the development of a 735 kilovolt (kV) transmission line from Churchill Falls to the Flora Lake substation east of Wabush. The Kami Project is dependent on the construction of this 735 kV transmission line as well as the subsequent 315 kV transmission line from the Flora Lake substation to the Project site to enable the operation of the Kami Project. Delay to the construction and operation of the 735 kV transmission line from Churchill Falls to Flora Lake and/or the 315 kV transmission line from Flora Lake to the Project site would result in a delay to the construction start date. Therefore, the start date for the Construction phase for the Kami Iron Ore Mining Project has not been determined.

The Kami Iron Ore Mining Project Construction, Operations, and Closure phases are anticipated to span approximately 40 years (Table 2-1). The Construction phase is anticipated to last 4 years. The Operations phase is 26 years and includes 1 year of ramp-up, referred to as pre-development mining. Closure is from the end of active mining operations to the start of the Post-closure period. The Post-closure period was defined based on Section 17.7 of the *Rehabilitation and Closure Plan Guidance Document* from the Government of NL's Mineral Development Division, which states that "the post closure monitoring period will begin when the flooding of the mined-out pits is complete, and the site has reached equilibrium." Equilibrium in this context refers to the state in which monitored physical or chemical constituents have no further tendency to change with time. It is currently assumed that pit flooding and equilibrium will take 10 years to complete from the initiation of the Closure phase. Monitoring of dams, specifically the TMF dam, is required for 50 years (Rehabilitation and Closure Plan Guidance Document Section 17.7 h) following the completion of the Operations phase. Therefore, the Post-closure period is currently estimated to extend for another 40 years following the Closure phase. At this time, the lengths of Project phases and the Post-closure period are an estimate based on Pre-Feasibility Study design detail, which will be refined as the design process progresses.

Table 2-1: Project Schedule

Schedule Stage, Phase, or Period	Description	Duration
Permitting and approvals stage	The permitting and approvals stage includes release from the provincial EA process from the Government of NL and receipt of permits from applicable provincial and federal regulatory agencies.	3 years
Construction phase (referred to as Construction)	Includes site preparation, mine, process plant and site infrastructure development, and commissioning the structures, systems, and components.	4 years
Operations and Maintenance phase (referred to as Operations)	Includes the mining and milling of iron ore, production and shipment of iron ore concentrate, tailings management, management of mine rock, waste management, water management, release of treated effluent, site maintenance and transportation of staff and materials to and from the site. Operations includes one year of pre-development mining (i.e., ramp-up).	26 years
Decommissioning and Rehabilitation phase (referred to as Closure)	Include accelerated flooding of the Rose Pit, re-establishment of passive surface water drainage following the pit-flooding period, recontouring and revegetating disturbed areas. Physical infrastructure that is not required during post-closure monitoring and for other activities required to achieve the Project's decommissioning criteria and to return the Project site to a safe and stable condition will be removed.	10 years
Post-closure period	The transition from closure to post-closure involves ongoing dam safety monitoring, water treatment and environmental monitoring to verify that water quality is achievable for passive discharge and decommissioning criteria have been met. The length of the post-closure period could be further refined through the completion of additional analysis as part of the Feasibility Study.	40 years

EA = Environmental Assessment; NL = Newfoundland and Labrador.

2.3 Indigenous Group and Stakeholder Consultations

Consultation activities on the Project with Indigenous groups, the public, local community stakeholders and regulatory agencies have been ongoing since 2011. The previous owner completed consultation activities from 2011 to 2014 as part of the previous EA process and to support post-EA approval planning. Champion has continued discussions with stakeholders, including local stakeholders and Indigenous groups, since the acquisition of the Project in 2021; most of whom were involved in the Environmental Assessment of the Project, which was initially released from EA in 2014.

Indigenous Peoples in Canada have Aboriginal and treaty rights recognized and affirmed under Section 35 of the *Constitution Act*. The *Fisheries Act* requires the Minister of DFO to consider any adverse effects on the rights of Indigenous Peoples when making decisions under the *Fisheries Act*. This includes the decision to authorize any work, undertaking or activity and the offsetting plan associated with it (DFO 2019). During the previous EA, five Indigenous groups were identified by the former CEA Agency as being potentially affected (i.e., having potential Indigenous and/or treaty rights that could be adversely affected by the Project). Champion has confirmed with the NL Office of Indigenous Affairs and Reconciliation that the Indigenous groups previously identified for engagement in 2011 for the previous EA remain the same. These include:

- Innu Nation
- Innu Takuaikan Uashat mak Mani-Utenam
- Nation Innu Matimekush-Lac John
- Naskapi Nation of Kawawachikamach
- NunatuKavut Community Council (NCC)

The Labrador Friendship Centre is identified as a stakeholder in the region. The Centre's membership may be made up of Indigenous Persons, although the Centre itself is not identified as a rightsholder.

Local stakeholders for this Project have been identified based on previous experience and Champion's experience in Labrador West, and by using the following criteria:

- proximity of persons or groups that reside, have property, or have an interest within or near the proposed Project area, or could be potentially affected due to proximity from the proposed Project area
- past or current interest of persons or groups in the Project, or similar projects or developments in the vicinity of the Project
- persons or groups not located near the Project area, but who could be potentially affected from the outcomes of the Project

As documented in the 2012 EIS, previous consultation with the following stakeholders took place:

- Local stakeholders included residents of the communities of Labrador City, Wabush and Fermont.
- Other potentially affected or interested stakeholders beyond these boundaries included provincial and federal government agencies and departments, NGOs, economic development organizations, and outdoor recreation users and outfitters.

Table 2-2 summarizes the identified local stakeholders for the Project. Additional stakeholders may be identified through future stakeholder consultation activities.

Table 2-2: Identified Stakeholders

Category	Stakeholder
Municipal governments	Town of Wabush
	Town of Labrador City
	Town of Fermont
	Port Hope Simpson, NL
	Mary's Harbour, NL
	St. Lewis, NL
Local economic development	Centre local de développement de Caniaspicau
	Conseil de développement économique d'Uashat mak Mani-Utenam
	Labrador West Chamber of Commerce
	Labrador West Employment Corporation
	Labrador West Tourism Corporation
	Newfoundland and Labrador Organization of Women Entrepreneurs
	Town of Labrador City Economic Development Department
	Women in Resource Development Corporation
Local environment interest groups	Conseil régional de l'environnement de la Côte-Nord
	Organisme de Bassin Versant

Table 2-2: Identified Stakeholders

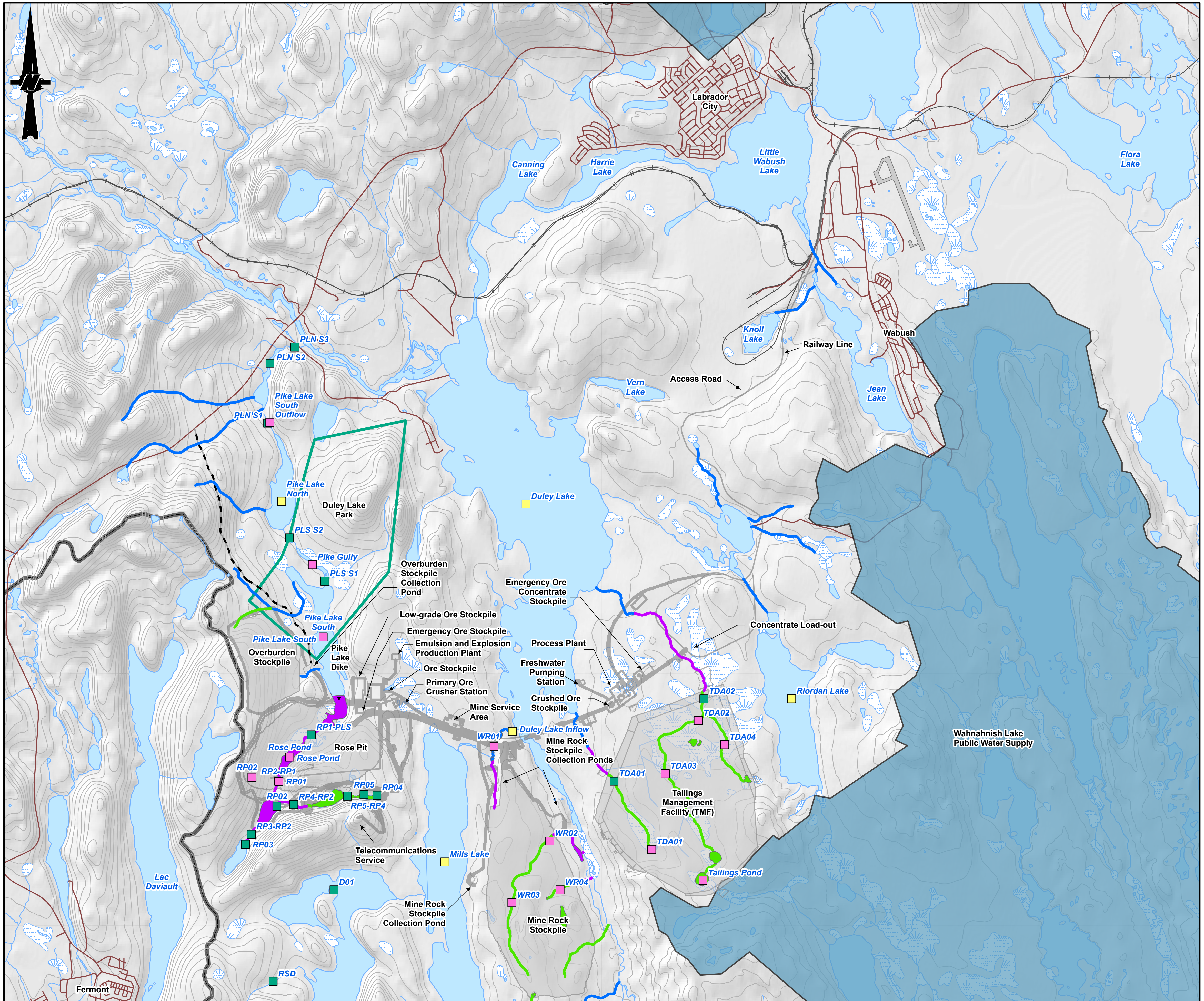
Category	Stakeholder
Local education, social services, and health services	College of the North Atlantic
	Centre de santé et service sociaux de L'Hematite
	Labrador Grenfell Health
	Labrador Institute of Memorial University, Labrador Campus
	Labrador West Status of Women
	Labrador Friendship Centre
	Newfoundland and Labrador English School District
	Conseil Scolaire Francophone
	Newfoundland and Labrador Housing Corporation
	Provincial Advisory Council on the Status of Women
	Royal Newfoundland Constabulary
Outfitters and recreation	Cabin Owners
	Duley Lake Family Park
	Newfoundland and Labrador Outfitters Association
	White Wolf Snowmobile Club
Non-profit organization	Heritage Foundation of Newfoundland and Labrador

Champion is committed to continued engagement with stakeholders during the planning and execution of all work scopes. Meetings will continue as required, whereby minutes of meetings will be kept, capturing issues and concerns raised.

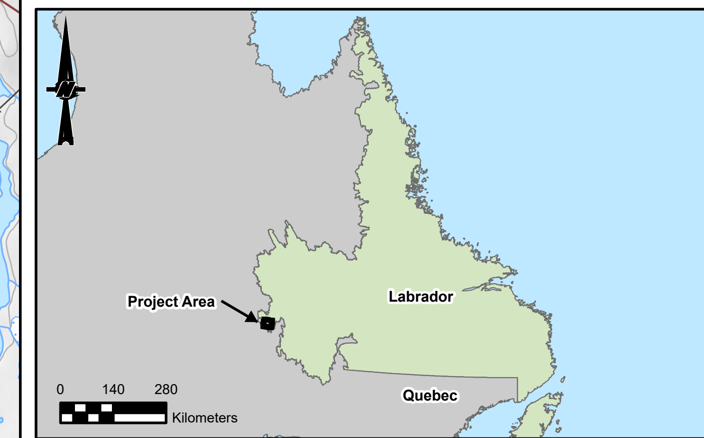
3.0 EXISTING FISH AND FISH HABITAT

Fish and fish habitat surveys were completed within the Project area for both iterations and assessments of the Project (Figure 3-1). The latest included surveys through 2023 and 2024, and previously between 2010-2013. Surveys have included fish habitat characterization of lacustrine and fluvial habitats within and near the Project area, as well as fish species presence, abundance, and population estimates within these habitats. Habitat characterization included lacustrine bathymetric and habitat mapping (depths, water quality, substrate quantities and distributions) and standardized fluvial stream surveys. Fish species presence and abundance surveys were also completed using various techniques applicable to each habitat type.

The surveys have been extensive and have occurred over two separate time periods. This allows some measure of habitat and fish population stability in the Project area. A summary of the existing fish and fish habitat as described by the data collected is presented below, which includes all available baseline data since 2010. Further details are available within the fish and fish habitat baseline study report (WSP 2025).).



KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA

Sample Location (by year)

- 2011
- 2012
- 2023

FISH HABITAT AUTHORIZATION

- Fish Habitat
- Schedule 2 MDMER HADD
- Section 35 HADD

PROJECT INFRASTRUCTURE

- Proposed Infrastructure Footprint
- Potential Access Road

BASEMAP INFORMATION

- Duley Lake Park
- Railway
- Watercourse
- Contour
- Duley Lake Park
- Bog/Wetland
- Waterbody
- Labrador/Quebec Boundary
- Public Water Supply

0 1,000 2,000 4,000

1:71,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

FISH AND FISH HABITAT SURVEY LOCATIONS, 2010-2013 AND 2023-2024

CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

3.1 Methods

Provided below is a summary of the methodologies that were employed during the 2010–2013 and 2023–2024 field surveys. Methodologies used in the previous baseline surveys are still valid to characterize the aquatic habitat and the fish species/abundances present. Therefore, the same methods were used throughout this program to provide consistent data and characterization. Many habitats were previously sampled in the last successful assessment (i.e., the previous owner) and *Fisheries Act* authorization and were re-sampled in the recent baseline program. The direction of the baseline data collection since the reactivation of the proposed Project has been on collecting additional information from waterbodies that may be affected by the proposed Project.

It is recognized that all sampling methods have limitations and restrictions in terms of where they can be deployed and their effectiveness to sample all fish species. Additionally, sampling licence requirements must be adhered to, and this can have an impact on the duration or effectiveness of methods. While these limitations are typical of most sampling programs, they are not limiting to the validity of the data. For example, when a population estimate is generated from the collected data, the Project and regulators can use that estimate (with confidence limits) to determine effects and establish a portion of the DFO *Fisheries Act* HADD determination. It is understood that greater efforts can reduce population estimate confidence limits around the mean and therefore greater accuracy; however, regulators are very aware of the limitations put on data collection permits and the potential challenges in getting tight confidence limits. The assessment and determinations take this into consideration in the habitat types being affected or lost as well as the populations utilizing them. Given the habitat-based approach used by DFO in HADD determination, along with input on the fish species and possible abundance of each in the habitat potentially affected, these standard methods remain valid to describe and assess the habitat and fish species present (and an estimate of abundance) in each waterbody affected by the proposed Project and provide the information needed for DFO to determine the HADD and required offsets to compensate for any of the determined adverse effects.

3.1.1 Fisheries Literature Review and Interviews

In addition to Project-specific fish and fish habitat surveys, literature reviews of available, published information on regional limnology, regional hydrology, fish and fisheries have been completed and relevant data consolidated. In addition, interviews were carried out in 2012 with residents of the Labrador City, Wabush and Fermont areas to determine target sport fish species and the areas in which locals fished.

3.1.2 Riverine Habitat Surveys

In addition to literature reviews for available information, stream surveys were conducted throughout several watercourses within the Project area by WSP biologists who also completed the previous surveys as AMEC Earth & Environmental (AMEC). The methods used to classify and quantify the aquatic habitat were based on standardized DFO methodologies such as DFO (2012), Scruton and Gibson (1995), and Sooley et al. (1998). Survey data collection consisted of a series of measurements for each habitat reach including:

- channel dimensions (channel width, wetted width, ice scour height)
- substrate composition (percentage of each class of substrate found within the stream bed—for example, cobble, gravel, aquatic vegetation)
- instream features (discharge, water depths and velocity)
- riparian vegetation (dominant species, percent cover, instream woody debris)
- upstream and downstream photos at each transect

A general habitat description was also used to classify each section of stream with similar habitat features (e.g., pool, riffle, run) and the quantity of each in the surveyed section of the stream.

Additional habitat information was collected in 2024 for the potential west access road and rail line crossings prior to final route selection; however, field surveys followed the same procedure as previous riverine habitat surveys. Air photo analysis was also completed, which allowed for estimates of slope, wetted width, dominant substrate, flow morphology and riparian habitat, for any crossings which were inaccessible to the field crew. When assessing dominant substrate using air photo, it is classified as Fine or Coarse, as this is the resolution that is typically available. Should final routes be changed, additional air photo analysis will be completed and the ground-truthed sites used to characterize crossings.

3.1.3 Riverine Fish Population Surveys

Riverine fish populations were assessed with electrofishing, through a combination of quantitative and index (qualitative) stations. Numerous quantitative electrofishing stations were completed in 2012 (Section 4.3.1), while index was completed in 2011, 2023 and 2024 (Section 4.3.2). Each method collects information on species presence and biometrics (i.e., lengths and weights).

3.1.3.1 Quantitative Electrofishing Surveys

Fish populations in selected watercourse were assessed with quantitative electrofishing. Each electrofishing station was isolated using barrier nets at the upstream and downstream boundaries. The isolated area was then electrofished with a minimum of four sweeps, or until the last sweep had a total catch of less than half of the previous sweep.

Abundance and biomass estimates were calculated using the Zippen removal method using the Fisheries Stock Assessment package (Ogle 2016) for R (R Core Team 2020). This approach was applied to the abundance and biomass of all species combined and then estimates were calculated based on the proportion of the total catch for each species. This approach helps to overcome any issues associated with low catch rates of some species.

3.1.3.2 Index Electrofishing Surveys

Index electrofishing stations were completed in 2012, 2023, and 2024 at selected sites. Electrofishing in 2023 and 2024 was completed using a Smith-Root LR24 backpack electrofisher. A single electrofishing site was completed in Duley Lake (also known as Long Lake, but referred to here as Duley Lake) inflow on August 5, 2023. Electrofishing in 2024 was completed between July 30 and August 5. Rather than blocking an area of habitat with barrier nets and completing multiple passes, a single pass of at least 400 seconds was completed. All fish collected were identified to species, numerated, measured, weighed, and live release downstream of further electrofishing. Abundance and biomass catch-per-unit effort (CPUE) was then calculated and standardized to 300 seconds of electrofishing effort. This allows for comparison across years and locations, where applicable.

3.1.3.3 Fish Biometrics

Each fish captured during electrofishing was processed following the completion of each sweep. Processing included:

- identification to species
- measuring to nearest millimetre (fork length or total length for burbot and sculpin)
- weighing to nearest 0.1 gram

Length (L) and weight (W) data were then used to calculated Fulton's Condition Factor (K; Peterson and Harmon 2005), which is length-weight relationship:

$$K = ((W \times 10^5)) / L^3$$

Smaller fish often have errors associated with the calculation of condition factors. Likewise, instrument error can also affect the data. To account for this, two conditions were considered:

- Fish smaller than 80 mm in length were removed from estimates of fish condition as slight errors in the weights of these individuals could skew the estimates.
- Ranges were calculated using two standard deviations of the mean for each species and values outside of the calculated range were removed from further analysis as they most likely included errors in length and/or weight measures. This was completed separately for each species to account for varying body types.

3.1.4 Lacustrine Habitat Surveys

In addition to stream surveys, bathymetric surveys were completed in numerous waterbodies by Stantec in 2012, AMEC in 2012, and WSP in 2023. All surveys were completed in 2012 and 2023 utilized a differential GPS sonar unit attached to a Zodiac style inflatable boat. The unit links GPS and sonar technology in a digital environment so that depths and location are digitally mapped. The Lowrance sonar/GPS unit was set up in the field to collect combined positional and depth data once every second. The boat was generally moving at a rate of less than 2 m/s for optimal coverage. The unit has been tested using known survey pin locations for positional accuracy and has been recorded at being less than 1 m. The error associated with sonar depth detection has been given as 1 cm; however, weather conditions such as wave height and variable water temperatures can also affect this slightly.

Shoreline surveys were also completed in select waterbodies to quantify substrate coverage within the littoral zone. This information, while summarized to present a classification of habitat, will be utilized for habitat quantifications, as part of the offsetting process.

3.1.5 Lacustrine Fish Community Surveys

Lacustrine fish populations were assessed in several waterbodies between 2011 and 2023, using a combination of fyke nets and gillnets. For both surveys, fyke nets were installed for a minimum of 16 hours, to cover the dawn and dusk periods when fish are most active. Gillnets were primarily utilized to determine deep water species presence (i.e., lake trout or lake whitefish), with live release being desired. Therefore, gillnets were checked at regular intervals to avoid mortalities as much as possible. Regardless of capture technique, all fish were identified to species, weighed and measured, as discussed in Section 4.3.3.

Additionally, during 2012, population estimates were calculated using a mark-recapture study in Pike Lake South and Pike Gully. In each of these waterbodies, all brook trout and northern pike captured were marked with a small clip at the top of the caudal fin to identify recaptures. All fish, regardless of being marked, were then live released near the capture area, and during subsequent net checks, any recaptures were weighed, measured and noted as a recapture (Section 4.3.3). Population estimates and confidence intervals were calculated using the Schnabel multiple mark-recapture method (Ricker 1977; Ogle 2016).

3.2 Regional Fisheries

There are recreational fishing areas within the vicinity of the general Project area. Recreational fisheries are pursued throughout the region, with activity tending to be centred in accessible streams, ponds, and lakes near the towns of Labrador City and Wabush, as well as cabins in the area, along access roads, highways, and rail lines. Specifically, the main areas that are fished include Duley Lake, Shabogamo Lake, Waldorf River, Mills Lake, Ossokmanuan Reservoir, Panchia Lake, Lobstick Lake, Ashuanipi Lake, unnamed lakes, ponds and rivers south of Wabush. Fermont fishers reported use of Lac Daviault and Lac Carheil, which are two small lakes west of the open pit mine, where people gather for ice fishing in the winter. In 2012, the Town of Labrador City identified a water system south of Riordan Lake that locals used for fishing, and the town of Wabush identified some fishing areas near the proposed mine rock stockpile, as reported by local cabin owners. Additionally, during field surveys for the Project, local anglers were noted fishing within Pike Lake North as well as in Duley Lake.

Based on interviews with residents of Labrador West and Fermont, recreational species caught include brook trout, burbot and northern pike. There are no known commercial or Indigenous fisheries in the area. Informal interviews with local anglers in 2023 indicate that lake trout and *ouananiche* (landlocked Atlantic salmon) are also recreational species in the area, particularly in Duley Lake.

3.3 Fish Species Presence

Various waterbodies and watercourses have been sampled throughout the study area since 2010, with several differing gear types. Table 3-1 presents a summary of the species which have been confirmed as present within the Project area, as well as those anecdotally observed, and likely present based on the literature review.

Table 3-1: Summary of Species Present Throughout the 2011 to 2024 Studies

Common Name	Scientific Name	Present in Riverine Habitats	Present in Lacustrine Habitats
Brook trout	*Salvelinus fontinalis*	•	•
Burbot	*Lota lota*	•	•
Lake chub	*Couesius plumbeus*	•	•
Lake trout	*Salvelinus namaycush*	-	•
Lake whitefish	*Coregonus clupeaformis*	-	•
Longnose dace	*Rhinichthys cataractae*	•	•
Longnose sucker	*Catostomus catostomus*	•	•
Ouananiche[(a)]	*Salmo salar*	-	-
Northern pike	*Esox lucius*	•	•
Pearl dace	*Margariscus nachtriebi*	•	•
Round whitefish	*Prosopium cylindraceum*	-	•
Sculpin[(b)]	*Cottis bairdii/C.ognatus*	•	•
White sucker	*Catostomus commersonii*	•	•

(a) Species not observed throughout field surveys, but were indicated as present in the area by local anglers and are likely present based on the literature review.

(b) Two species of sculpin are likely present. Field identification is difficult; therefore, mottled and slimy sculpin are recorded as sculpin (*Cottis* sp.).

• = present; - = not present

Provided below is a brief description of each key fish species captured through baseline sampling surveys within the area of the Project. Much of the life history information is provided from DFO documents, which summarize existing information on each species within the province (e.g., Bradbury et al. 1999; Grant and Lee 2004). While land-locked Atlantic salmon were not captured through baseline surveys, it may be located in areas of offsetting measures and is a recreational fish species; therefore, a species description is provided at the end of this section.

3.3.1 Brook Trout (*Salvelinus fontinalis*)

The brook trout is widely distributed throughout Newfoundland and Labrador, at least as far north as the Hebron Fiord, where they have been reported to make extensive use of clear, cool (less than 20°C) lake habitats.

Within Newfoundland and Labrador, lakes and ponds are utilized for spawning, overwintering and feeding. Optimal brook trout riverine habitat has been characterized as clear, cold spring-fed streams with a silt-free rocky substrate in riffle to run areas; an approximate 1:1 pool to riffle ratio with areas of slow, deep water, well vegetated stream banks, abundant instream cover, and relatively stable water flow, temperature regimes and stream banks. Brook trout spawning has been observed in a variety of habitats and substrates, including lake shorelines, sandy and heavily silted substrates and over aggregations of waterlogged sticks, woodchips and debris. This generalist spawning behaviour appears to be less dependent on substrate and more strongly correlated to the presence of groundwater upwelling, particularly for mainland populations. Groundwater upwelling is beneficial in that it protects eggs from freezing and carries dissolved oxygen to and metabolic wastes away from developing embryos.

Young-of-year (YOY) and small juveniles (less than 15 cm in length) are generally associated more with instream cover (mostly rubble substrate) than overhead stream bank cover, and that an area of cover at least 15% of the total stream width is required. Aquatic vegetation is an important form of cover for young salmonids. In two Avalon Peninsula streams, YOY and juveniles showed a strong preference for cover (where available), but that the presence of competing species and/or lack of available cover can result in shifts of habitat utilization. In Newfoundland, juvenile brook trout typically move into lakes at one to three years of age and move to deeper, cooler, waters during the warmer summer months.

In an Avalon Peninsula stream, brook trout biomass had a negative relationship to maximum flood height, indicating that habitats with more stable flows had higher production. Adults are often found in association with cover, which is sometimes considered a factor limiting to production. Cover can be provided by overhanging vegetation, submerged vegetation, undercut banks, instream objects (woody debris, roots, and large boulders), rocky substrates, depth, and water surface turbidity. In two Michigan streams, trout biomass and number of adults were significantly correlated with bank cover. In two Avalon Peninsula streams, as brook trout increase in size, they tend to move from shallow stream margins to deeper water (pools) with undercut banks and other forms of cover.

3.3.2 Burbot (*Lota lota*)

Burbot is the only member of the Gadidae family that resides in freshwater. They occur in continental Eurasia and North America, southward to about 40°N, where they frequent cool waters of large rivers, lower reaches of tributaries, and large lakes. Burbot have been reported within the Churchill River, including Labrador West, and within the Atikonak Lake watershed of southern Labrador.

Burbot spawn in both lakes and rivers. Spawning usually takes place in mid-winter (January to March) under the ice in lakes or rivers. Eggs typically hatch from late February to June. Those that spawn in rivers reside in lakes but migrate into rivers to spawn. They tend to utilize areas with little accumulation of silt or detritus, usually at depths of 0.3 to 3.0 m, but have been reported at depths of 18 to 20 m. The semi-buoyant eggs are broadcast into the water column well above the substrate, then become demersal and settle into interstices in the substrate.

Typically, by early summer, larval burbot attain a length of approximately 30 mm at which point they undergo a habitat shift from pelagic to a mainly benthic existence. YOY are typically found in the littoral regions of lakes over gravel, cobble or rubble bottoms where they have been observed in shallow water (0.5 to 3.0 m) during the day, sheltering under rocks and debris and are mainly active at night. Juveniles have been shown to occupy essentially the same habitat as YOY and feed mainly on benthic invertebrates. In streams, young fish typically use undercut banks, submerged logs, and vegetation for cover in sandy areas, especially when rocky habitats are limited. Throughout its geographical range in Canada, burbot generally reach sexual maturity between two to eight years of age.

Adults tend to congregate over gravel, rock, or cobble substrates and often utilize undercut banks, roots of trees and dense vegetation as cover. They have been observed inhabiting deep sections of rivers and deep eddies in large northern rivers, mostly at depths greater than 1.5 m. Adult burbot tend to move offshore to deeper waters (i.e., hypolimnion zone) and return to littoral regions during the autumnal decline in water temperatures. In shallow water, especially where the bottom is brightly illuminated, burbot may seek overhead cover during the day and are sometimes found amongst aquatic plants. The loft habitat provided by the tops of boulders is also a preferred resting area for adults. Burbot feed on benthic invertebrates initially, moving to an exclusively fish diet once they reach a size greater than 500 mm (AGRA 1999).

3.3.3 Lake Chub (*Couesius plumbeus*)

In northwestern Canada and Alaska, the lake chub has been found in both clear and turbid waters of lakes and streams, while in Labrador, they have been reported to occur mostly in streams and lake-like expansions of rivers. In central Canada, lake chub appear to be common in tributary streams only during spring spawning migrations, returning to the lake once water temperatures exceed 16°C. They have been known to tolerate a wide variety of conditions, ranging from clear to turbid waters and from cool northern lakes to the outlets of hot springs.

Lake chub usually undergo spawning migrations from lakes to tributary streams in May or June, shortly after ice-out. In rivers and small streams, spawning has been observed in shallow water over rocky or gravelly bottoms, as well as among large rocks. In lakes, spawning typically takes place along shallow rocky shores and may be observed over a variety of substrates, including silt, leaves, gravel, cobble, and rubble. Fry have been observed utilizing submergent vegetation for cover, while YOY and juveniles are generally found over silty, sandy or gravel/cobble substrates.

Adults are commonly found in lakes in the southern portion of their range, with more northern populations preferring large lake-like expanses of rivers. Within the Churchill River system, adults are more prevalent in the upper stretches of rivers with shallow gradients and more pools, lakes and ponds (AGRA 1999). Along shores, lake chub have been observed over a mainly sand bottom interspersed with large boulders. Although it is essentially a shallow-water species, lake chub have been reported to move into deeper and cooler regions of lakes during thermal summer stratification. In Labrador, lake chub were found to feed mainly on benthic invertebrates.

3.3.4 Lake Trout (*Salvelinus namaycush*)

Lake trout, the largest of the char, are widely distributed in northern North America. They are found throughout southern Labrador, except for the southeastern corner, but do not occur in insular Newfoundland. In the south, lake trout prefer cool (less than 10°C), deep lakes, but in the north, where temperatures are lower, they may inhabit shallow lakes and large rivers. In Labrador, lake trout occur throughout the Churchill River watershed but are more prevalent in the upper reaches.

Lake trout usually spawn in shallow inshore areas of lakes, rarely in streams. In most areas of Canada, spawning occurs in late summer to early fall, mainly in September or October in Labrador. Lake trout have been reported to spawn over a great variety of depths, ranging from 0.1 to 5 m in shallower lakes, to 5 to 10 m in larger lakes. There are also reports of spawning occurring at depths up to 100 m. The spawning substrate is usually composed of large gravel (greater than 2 cm in diameter), cobble and rubble, interspersed with boulders and is generally free of sand, mud, detritus and vegetation.

Newly hatched larvae typically undergo early development within the protection of rocky substrate on the spawning grounds. Within a month of emergence, fry begin moving from the spawning area towards their nursery lake. In lake spawning populations, they may remain in shallow areas for several weeks to three months before moving to deeper water when temperatures exceed 15°C. Juveniles and adults generally have similar habitat, generally preferring boulders in shallower waters until temperatures exceed 10°C, when they retreat to depth. Diet consists primarily of fish, supplemented by insects and small mammals. Sexual maturity is thought to occur at a relatively old age. When Parsons (1975) sampled the Ossokmanuan Reservoir in western Labrador, they found no sexually mature lake trout less than nine years of age.

3.3.5 Lake Whitefish (*Coregonus clupeaformis*)

Lake whitefish are widely distributed throughout North America from the Atlantic coast, across Canada and the northern United States, to British Columbia, the Yukon Territory, and Alaska. They are distributed throughout southern Labrador. Although they are primarily found in lakes, they are relatively abundant in the main stem of the Churchill River, as well as the adjoining lakes and ponds within its watershed.

Lake whitefish undertake migrations to spawning grounds, ascending rivers or moving into the shallows of lakes when water temperatures cool to 4.5°C to 10°C. Optimal growth and development occurs at 0.6°C, with 99% mortality at temperatures of 10°C and greater. There is some evidence that lake whitefish return to the same spawning grounds year after year. In Labrador, spawning migrations are reported from early September to mid-October. River spawners generally utilize shallow (0.1 to 1.0 m) riffles or rapids with a gravel/cobble substrate, while lake spawners tend to utilize sandy substrates. Spawning occurs in schools, with eggs being randomly deposited and remaining in the spawning area until hatching in mid May to mid June. More northerly populations tend to produce fewer eggs. In the extreme northern limits of the range, individuals may only spawn once every two or three years. Egg counts can vary greatly depending on a fish's size, with specimens from the Ossokmanuan Reservoir in western Labrador yielding anywhere from 967 to 20,963 eggs per fish.

Upon hatching, whitefish larvae tend to aggregate along steep shorelines, although they have been observed at depths of 0.3 to 1 m near aquatic vegetation. Whitefish growth is relatively rapid, with the young feeding mainly on cladocerans and copepods. By early summer, young fish leave the shallow inshore waters and enter deeper lake waters. The diet of adult whitefish consists of aquatic insects and larvae, supplemented by other fish and even their own eggs. Outside of spawning, adult whitefish appear to have no preference for substrate type. In Labrador, the Churchill River watershed lake whitefish reach maturity over a range of three to nine years old and, as a species, tend to be long lived, with individuals reaching ages of 28 years.

3.3.6 Longnose Dace (*Rhinichthys cataractae*)

The longnose dace is widely distributed throughout north-central North America; however, in the Canadian Atlantic provinces, it has only been reported along the Churchill, Pinus, and Naskaupi river systems in southwestern Labrador. Although the longnose dace is typically a stream inhabitant in Labrador, it has also been reported in lakes throughout its geographical range.

Spawning normally occurs in riffles over a gravel substrate in spring but may also occur in lakes. In lakes, spawning occurs along wave-swept inshore areas over a cobble/rubble/boulder substrate. Nests are not built; however, territories are often established with one parent guarding the demersal and adhesive eggs, which are deposited in groups among the substrates. Young are pelagic upon hatching and occupy still, shallow waters close to shore with overhanging vegetation for approximately their first four months of life. They feed primarily on algae, diatoms, zooplankton and fish scales. YOY move to deeper areas of rivers predominated by swift currents upon attaining a size of 30 mm (total length).

In streams, adults seem to prefer areas with aquatic vegetation and overhead cover and may exhibit similar preferences in lake habitats. However, field surveys by AGRA (1999) in the Churchill River found that they generally inhabited clear, fast-flowing streams with limited cover. Adults have been found in turbulent, inshore regions of lakes over boulder or gravel bottoms throughout the summer, but generally move into deeper, cooler waters as water temperatures increase. Adult longnose dace feed primarily on terrestrial insects that are presumably washed into the surge zone of the lake by wind and turbulent wave action, as well as benthic organisms and fish eggs.

3.3.7 Longnose Sucker (*Catostomus catostomus*)

The longnose sucker can be found throughout northern North America from Alaska to western Labrador, and from the northern United States to the southern portion of the Northwest Territories. Longnose suckers are primarily bottom dwellers and inhabit lakes, rivers and reservoirs. They have also been reported in brackish waters near the vicinity of river mouths. They are abundant in Labrador in the Churchill River system and can be found in the main stem and throughout the adjoining lakes and tributaries.

Longnose suckers which inhabit lacustrine habitats migrate into rivers to spawn. Spawning generally occurs in the spring (mid-April or May); however, spawning has been observed in June in the Labrador region. During spawning, the female moves into the faster riffle or midstream waters of rivers and inlet streams, but they may also use the outlet streams of lakes or shallow lake margins. Longnose suckers are broadcast spawners, which repeatedly broadcast their adhesive eggs over a clean substrate composed of cobble, or rubble in riffle areas where velocities range from 0.3 to 1.0 m/s and depth are between 15 and 60 cm. The young spend one to two weeks in the spawning area and then move to lentic habitat.

YOY in Alaska were most abundant over silt and sand substrate in shallow (less than 0.2 m) backwaters having velocities less than 0.1 m/s. However, the same study found them to occur over gravel, cobble, and rubble substrates at varying densities depending on depth and velocity. Juveniles (23 to 89 mm in length) live in lentic waters and are frequently found in shallow reedy areas (Edwards 1983). Juveniles prefer sand/gravel substrate but have also been found over silt, sand, gravel, cobble and rubble. Juveniles have been observed seeking areas with some current and may enter the lower reaches of streams. Adults were captured in tributaries of Atikonak Lake, southwestern Labrador, at temperatures ranging from 13.9°C to 19.6°C and depths between 17 and 75 cm over a gravel, cobble, or boulder substrate. Adults are well adapted to high current velocities (Walton 1980) and are often found in swift rivers with stony bottoms.

The diet of the longnose sucker consists entirely of invertebrates and algae. Longnose suckers grow at a rate of approximately 15 to 20 mm per year and reach an average size of 305 to 356 mm in length, living for up to 19 years. In the Churchill River, longnose suckers exhibit linear growth at a rate near the lower limits exhibited by the species. Sexual maturity of the Churchill River system occurs at six to seven years of age.

3.3.8 Northern Pike (*Esox lucius*)

The northern pike has a circumpolar distribution in the northern hemisphere above 40° N latitude. Its native North American range includes Alaska, most of Canada south of the Arctic Circle, the drainages of the Missouri and Ohio Rivers, and the Great Lakes. In Labrador, northern pike occur throughout the Churchill River watershed, including western Labrador.

Northern pike are not adapted to strong currents and occur most frequently in lakes where they inhabit backwaters and pools. In Canada, pike generally inhabit clear, cool to moderately warm, slow, meandering, heavily vegetated rivers or warm, weedy bays of lakes. Pike inhabit areas containing aquatic vegetation throughout all stages of their life cycle and have been found within a wide range of turbid waters, although they are much more common in clear and only slightly turbid water.

Northern pike are early spring spawners, with males and females moving into flooded vegetated areas immediately after spring thawing. They generally spawn during daylight hours in shallow, heavily vegetated floodplains of rivers, marshes, and lakes. Spawning occurs over a variety of substrates, but rubble beds covered with a layer of silt and decaying vegetation are commonly utilized. The preferred spawning substrates are well-oxygenated detritus and elaborate root systems of emergent vegetation, but spawning has also been reported to occur over sand and mud substrates. Adhesive eggs are attached to vegetation where they incubate for only twelve to fourteen days. The newly hatched young (6 to 8 mm in length) remain attached to the vegetation and feed on the yolk sac. After 6 to 10 days, the yolk is absorbed, and the free-swimming young feed heavily on zooplankton and immature aquatic insects.

Within seven to ten days, the juveniles begin to feed on small fish, and by the time pike reach 50 mm in length, fish have become the primary diet. Juveniles are typically found over a mud or silt bottom at depths less than 2.0 m with abundant submerged vegetation. Adult pike require cover to enable their ‘ambush’ style of foraging, usually in the form of aquatic vegetation, tree stumps or fallen logs. However, complete vegetative cover is sub-optimal for adult pike foraging efficiency, with most adults preferring areas containing open water interspersed with moderately abundant vegetation. Typically, large pike inhabit deeper, unvegetated waters more often than smaller ones. Outside of vegetation, the preferred habitat of large pike is a ‘broken bottom’. Both juvenile and adult pike have been shown to avoid habitat predominated by sand.

3.3.9 Pearl Dace (*Margariscus margarita*)

In northern Canada, the pearl dace can be found inhabiting cool, clear headwater streams, as well as ponds, small lakes, bog drainage streams, and low-visibility, acidic waters of beaver ponds. Despite their abundance in most streams and lakes in northwestern Ontario, they have been rarely found in lakes containing northern pike, which suggests that they are an important forage species in lakes.

In many northern lakes, pearl dace spawn in tributary streams or vegetation on the periphery of lakes in early spring, about the time spring melt and ice-off occur. Spawning in beaver ponds and small lakes is typically over soft organic substrates, while stream spawning occurs at depths of about 60 cm over a sand or gravel bottom in wide-ranging currents. Males do not build nests but appear to defend territories. Investigations on diet composition suggest that pearl dace are omnivorous, consuming invertebrates, plant material and detritus.

3.3.10 Round Whitefish (*Prosopium cylindraceum*)

Round whitefish are widely distributed in lakes and ponds throughout their southern range, rivers in their northern range, as well as brackish waters, from northern North America to eastern Asia. Its range encompasses northern New Brunswick, Labrador, and Ungava west through Québec, Ontario, and north westward from northern Manitoba through the Northwest Territories and northern British Columbia. Round whitefish have been reported in Labrador in the Churchill River system, residing in cool ponds, streams and rivers. However, they are considered rare in the Churchill River system.

Round whitefish are fall spawners (October to December). Spawning can take place in the inshore areas of lakes, at river mouths, or occasionally in rivers. In a Yukon Territory stream, spawning occurred over a variety of substrates ranging from mud to gravel and boulders, with a preference for gravel substrates. In contrast to the lake whitefish, spawning is conducted in pairs, not in schools. Normandeau (1969) indicated that females of the species can produce up to 20,000 eggs. The eggs remain in the spawning substrate until hatching occurs the following April.

Upon hatching, the young remain on the bottom and disperse from the spawning area within two to three weeks. In Alaska, young seek cobble or boulders, debris and overhanging vegetation at water depths ranging from 5 to 30 cm (optimal 5 to 15 cm) in relatively calm areas. Gillnet catches of mature specimens in the Churchill River system in Labrador were higher in fast-flowing sections than in steadies or backwaters. These distributions possibly indicate that juveniles prefer slow steadies and backwater habitat until they reach maturity, after which they prefer faster flowing sections of the main channel. Round whitefish tend to move into deeper and faster water as they grow. The optimal water velocity for adults was 0.6 to 0.9 m/s, with them utilizing the following cover types in order of preference, from most to least preferred: cobble and boulder, undercut banks, overhanging vegetation, debris/deadfall, submergent and emergent vegetation, and rubble and large boulders.

Round whitefish are benthic, and their diet consists mainly of benthic invertebrate larvae, insects and molluscs. The species has been noted to live up to 14 years. The growth rates for round whitefish in the Churchill River are at an intermediate level when compared to results from other regions of North America.

3.3.11 Mottled Sculpin (*Cottus bairdii*)

In eastern Canada, the mottled sculpin is confined to northern areas, occurring throughout the Churchill and Atikonak river systems of Labrador, north through Ungava Bay, Québec. DFO surveys have identified sculpin from the stomach contents of several species of fish (burbot, brook trout, lake whitefish, northern pike, lake trout) taken in the Churchill River main stem.

Mottled sculpin occur in cool, headwaters and, although typically a stream-dwelling species, they also inhabit large lakes. Mottled sculpin are intolerant of high water temperatures and tend to occur in the coldest streams during the summer, usually with water temperatures between 11°C and 16°C. Spawning typically takes place in the spring, around April or mid-May, in the littoral zone (less than 1 m) of lakes under rocks and logs. Nesting is peculiar, with females depositing adhesive eggs on the ceilings of rocks, ledges or burrowed nesting sites (usually consisting of small gravel) while in an inverted position, with the male subsequently guarding and aerating the eggs.

Substrate preference tends to vary from study to study, possibly illustrating a generalistic or place-dependent habitat utilization strategy. A study in the Mad River, Ontario, documents the occurrence of YOY on a mud bottom at depths of 5 to 25 cm. Studies in eastern Ontario and Wisconsin suggest that mottled sculpin prefer sandy substrates in both lakes and streams. Mottled sculpin have also been observed foraging at night in open, sandy areas. They may also utilize substrates composed of a mixture of cobble, rubble and sand. Additional studies found that small sculpin were largely associated with cover, being located under rocks and logs.

*3.3.11.1 Slimy Sculpin (*Cottus cognatus*)*

In eastern Canada, the slimy sculpin occurs in the Churchill and Fraser River systems of Labrador through most of Québec and Ungava Bay. The species typically inhabits deep, oligotrophic lakes, swift, rocky-bottomed streams, areas of groundwater upwelling, and headwater pools and riffles. In eastern Canada, the slimy sculpin frequents rocky or gravel streams and lake bottoms, and have been captured at depths ranging from 0.5 to 150 m. However, the habitat utilized varies greatly depending on substrate and temperature. The slimy sculpin has been shown to have a very small home range, and they do not migrate great distances.

Spawning occurs in May, shortly after ice-out, over sand and gravel substrate in shallow sections of streams and lakes. The male selects the spawning site, which can be found under rocks, submerged logs, tree roots, or among large gravel or other foreign debris, and is most common at depths of less than 30 cm. In rivers, juveniles and adults are generally found in areas with cobble/rubble bottoms at velocities of less than 0.3 m/s. In shallow lakes (0.5 to 1.5 m) they have been found over gravel and sand bottoms interspersed with rocks and boulders. Generally, as young slimy sculpin grow and mature, they shift from a shallow water habitat and nocturnal feeding to continuous activity in deeper water. Diet mainly consists of benthic organisms.

*3.3.11.2 White Sucker (*Catostomus commersonii*)*

White suckers are restricted to North America, occurring from central Ungava, Labrador, southwestern Georgia in the United States and west to Alberta, British Columbia and the Mackenzie River delta. They can be found in Nova Scotia and New Brunswick in the south, through to northern Labrador and northern Québec, but are not found on the Island of Newfoundland. White suckers occur throughout the Churchill River system, including western Labrador.

Spawning, similar to the longnose sucker, takes place in the spring as stream temperatures rise, with females moving from the lakes into streams. Spawning generally takes place in pond/lake inlets and outlets, small creeks, and rivers with relatively swift, shallow waters running over gravel or coarse sand bottoms, but has been reported over boulder substrates as well. Demersal, adhesive eggs are scattered over a period of 10 to 14 days and adhere to the immediate, or downstream, substrate. Adults that move into tributary streams to spawn generally return to the lake after spawning is complete. The incubation period required is variable and has been linked with temperature and geographical location.

YOY have been found over a range of substrates, including sand/gravel substrate in areas with moderate currents, shallow-pool areas having velocities less than 0.3 m/s, depths less than 0.6 m, and along channel margins where boulders, vegetation, woody debris, and undercut banks were the primary cover types. YOY school during the first year, either remaining in their natal streams or migrating from them, approximately one month after spawning. Juveniles (less than 150 mm in length) were reported in shallow backwaters and riffles with moderate water velocities (approximately 0.50 m/s) and a predominantly sand/rubble substrate. Adults occur mainly over gravel, sand, silt, and rubble substrates, and tend to be closely associated with riparian (e.g., overhanging trees, grass, shrubs) and instream cover, such as submerged logs, roots, macrophytes, undercut banks, and large boulders. Adults are known to increasingly seek cover as water velocities increase.

The diet of the white sucker consists mainly of aquatic insect larvae. While growth rates can vary widely, the growth rate for the Churchill River lies near the middle of the range described for the species as a whole. Growth may cease when sexual maturity is reached, which requires five to six years in the Churchill River system, with white suckers able to live up to 17 years.

*3.3.11.3 Threespine Stickleback (*Gasterosteus aculeatus*)*

Threespine stickleback are almost circumpolar in distribution (it is absent from the cold Arctic but have been observed in northern seas of Siberia and North America) and are widely distributed in the northern hemisphere. It is an euryhaline species and exists as both a freshwater resident and an anadromous marine-dwelling form in Newfoundland and Labrador. Its presence has been noted in Labrador in the Churchill River system.

Spawning generally occurs in the summer months, but timing can vary from April to September, depending on local conditions. Freshwater resident populations spawn in both lakes and rivers, with anadromous populations spawning in brackish or freshwater. River spawning populations undergo a spring migration from lakes or larger rivers into smaller, slower tributaries and backwaters. The males build nests over sandy/muddy substrates in areas of low flow and are usually found in the vicinity of submergent vegetation. Lake spawning populations utilize two distinct habitat types, either open water or in association with aquatic vegetation. Anadromous populations spawning in marine or brackish water build nests in rock crevices, eelgrass beds, algal mats and sometimes over sand near vegetative cover. Nesting in the vicinity of aquatic vegetation or rock/boulder cover, whether in rivers, lakes or brackish water, is thought to increase the structural complexity of the habitat and reduce the risk of predation.

Males construct the nest from small twigs, algae, or plant debris, typically over a sandy or muddy bottom. However, nests have been found on a wide variety of substrates, including silt, algal tufts and rock. Females deposit adhesive eggs in clusters in the nest. The males subsequently guard and fan the nests, protecting the young for up to two weeks after hatching or until they are able to fend for themselves.

Outside the breeding season, threespine sticklebacks return to the sea (anadromous) or into deeper waters or large rivers (freshwater resident) in the fall. Threespine sticklebacks typically inhabit vegetated areas, usually over mud or sand. Threespine sticklebacks have been observed at a variety of depths (less than 1 m up to 17 m) in lakes along the Avalon Peninsula, Newfoundland and have been shown to feed mainly on pelagic zooplankton and benthic organisms. Newfoundland populations normally mature in their second or third year and generally have a life expectancy of 2.5 years or less.

3.3.12 Ouananiche/Atlantic Salmon (*Salmo salar*)

Throughout Newfoundland and Labrador, Atlantic salmon occur in both anadromous and landlocked populations. Anadromous salmon have been captured at sea up to the northern tip of Labrador. Landlocked salmon, commonly called ouananiche, are the dominant species in some provincial lakes where they may exist as either normal or dwarf forms. Ouananiche are the predominant form of the species which occupies the Churchill River watershed, including those waterbodies in the Labrador West area.

Ouananiche spawning typically occurs between late September and early November, depending on water temperature, with females ascending tributaries to prepare redds (nests). In Newfoundland, lake spawning has been reported to occur over a gravel substrate at water depths of 0.5 to 1.3 m. Lake spawning has also been observed along shorelines as well as near areas of moving water, usually above outlet streams and near the mouths of inlet streams. Milt and eggs (1,500 eggs per kg of female) are deposited in the redd, and the female then covers the eggs, which range in size from 5 to 7 mm, with a layer of gravel. When spawning is complete, the adults return to the lake. Incubation lasts for about 110 days (depending on temperature), with hatching generally occurring in April. The larvae, or sac fry, remain in the redds until the yolk sac is absorbed, after which they emerge in May or June.

For the next two or three years, the parr remain in stream habitat, preferring rapid water. They then move to a lacustrine habitat and continue to grow rapidly. Researchers have found that juveniles utilized the littoral zone throughout the entire ice-free season, with smaller individuals occupying areas closer to the bottom than larger ones. Ouananiche mature at two to three years of age and may live for up to ten years in Newfoundland. Adults are generally pelagic and feed heavily on pelagic and surface organisms during June and July, but as water temperatures increase during the summer, they move to deeper, cooler water and appear to feed more on benthic organisms. It has been shown that ouananiche will overwinter in deep warmer waters of reservoir systems as well as fast to flowing ice free waters of inlets, outlets and canals.

3.4 Regional Hydrology

Available flow records for the Labrador West area were obtained from Water Survey Canada (a division of Environment and Climate Change Canada). All flow data are adjusted under quality management controls by Environment and Climate Change Canada. The regional hydrology of each offsetting location where physical habitat construction will occur is important. Similar to enhancements completed for other unregulated rivers, any enhancement has to consider the local flows which could be encountered. Inherent in this approach within a natural watercourse is the knowledge that the material placed will remain and that the channel is to remain accessible to fish year-round. The maximum flows have been considered with respect to habitat and substrate stability.

Typical and high fall flows have also been incorporated into the design, as they will determine the appropriate slope and substrate depths in each reach to achieve the preferred range of water depth and velocity for spawning.

As indicated, no watershed will be modified as part of the offset design (i.e., the natural hydrologic cycle will be experienced by all physically enhanced habitat). The underlying characteristics of any modified/created habitat will depend highly on local flow characteristics. That is, the general width, depth and slope of modified habitat will be such that high flows naturally experienced in the system will be transported without excess erosion or damage. While habitat enhancements have been designed to maximize suitability by the species present, minimal disturbance of the existing riparian habitat is also desirable. For example, any machinery that may be needed within the drainage will be as small as possible and have a relatively small “footprint” for riparian disturbance. Any riparian disturbance will attempt to take place at locations that have been identified for habitat expansion or in areas of lowest velocity.

There are currently no active hydrometric stations at any drainage outlet of interest; therefore, these areas are referred to as ungauged basins. The available flows from gauging stations as well as the drainages upstream of each enhancement area are all located in the drainage division 030A, as delineated by Water Survey Canada. In total, four hydrometric stations with data available to the public are within this drainage division.

A review of the data available from the gauging stations was conducted. A summary of the four public hydrometric stations is provided in Table 3-2, information provided by Water Survey Canada. Of the four gauging stations, three were located either on streams where flow is regulated, or the flow is only measured seasonally. The remaining gauge station, Wabush Lake, provides the most complete and applicable flows, but the available flow data are only available for two years. It should also be noted that the drainage area of Wabush Lake (030A005) is quite large compared to the drainage basins of interest. This station was chosen as the representative gauge because of its similar watershed characteristics and its proximity to the Project catchments.

Existing data from the Wabush Lake gauge station were used to generate prorated flows for the ungauged stations. Typical prorating of ungauged stations is more reliable when the gauged and ungauged stations are similar in size and function (e.g., neither has flows that are regulated). As shown in Table 3-2 and Figure 3-2, the size differences between the gauged and ungauged are considerable and therefore prorated flows must be used conservatively.

It is suggested that these prorated flows be updated when more information is recorded and becomes available and that discharges and stream profiles at each site be measured to estimate bank full flows. These estimated bank full flows are also used to determine material and structure stability.

In all cases, the flows generated by the prorating were used conservatively (i.e., the maximum mean flows generated were used in the design rather than the mean so that material movement and structure stability is increased). Figure 3-2 provides the watershed areas and points within each drainage where prorated hydrographs were generated. It should also be noted that where multiple offsetting measures are within one drainage, the hydrology of the most downstream was used for all sites (a more conservative approach as higher flows that predicted are used in the design).

Flow duration curves and hydrographs were derived for each ungauged drainage basin.

Table 3-3 tabulates various flow estimates for each catchment; maximum daily flow estimates, mean annual flow estimates, and the upper limit flow in which 90% of the time the flow within the stream is below. Individual flow duration Curves and hydrographs are presented in the appropriate sections below. The hydrographs depict the monthly flow variations for mean, maximum, and minimum flow rates. For Labrador West, the lowest flows are observed in winter from January to April and the highest flows are observed in the late spring months May and June. These high flows are presumably high from spring snowmelt runoff and large amounts of rainfall.

Table 3-2: Summary of Hydrometric Stations Within Drainage Division 030A

Station Name	Station ID	Drainage Area (km^2)	Flow Records
Wabush Lake at Lake Outlet	030A005 (active)	1,597	2007–2008 (two years)
Ashuanipi River below Wightman Lake	030A004 (active)	8,310	1972–1983 Seasonal/Continuous (zero complete years)
McPhadyen River near the mouth	030A003 (discontinued)	3,610	1972–1985 Seasonal/Continual (three full years)
Ashuanipi River at Menihek Rapids	030A001 (active)	19,000	1952–2003 (52 years; regulated flow)

Table 3-3: Flow Estimates for Delineated Catchments in Labrador West, Newfoundland and Labrador

Catchment	Max. Mean Daily Flow (m^3/s)	Mean Daily Flow (m^3/s)	Median Daily Flow (m^3/s)
Pike Lake Outflow	1.63	0.43	0.38
Walsh River	57.19	15.17	13.20
Tamarack Brook	0.68	0.18	0.16

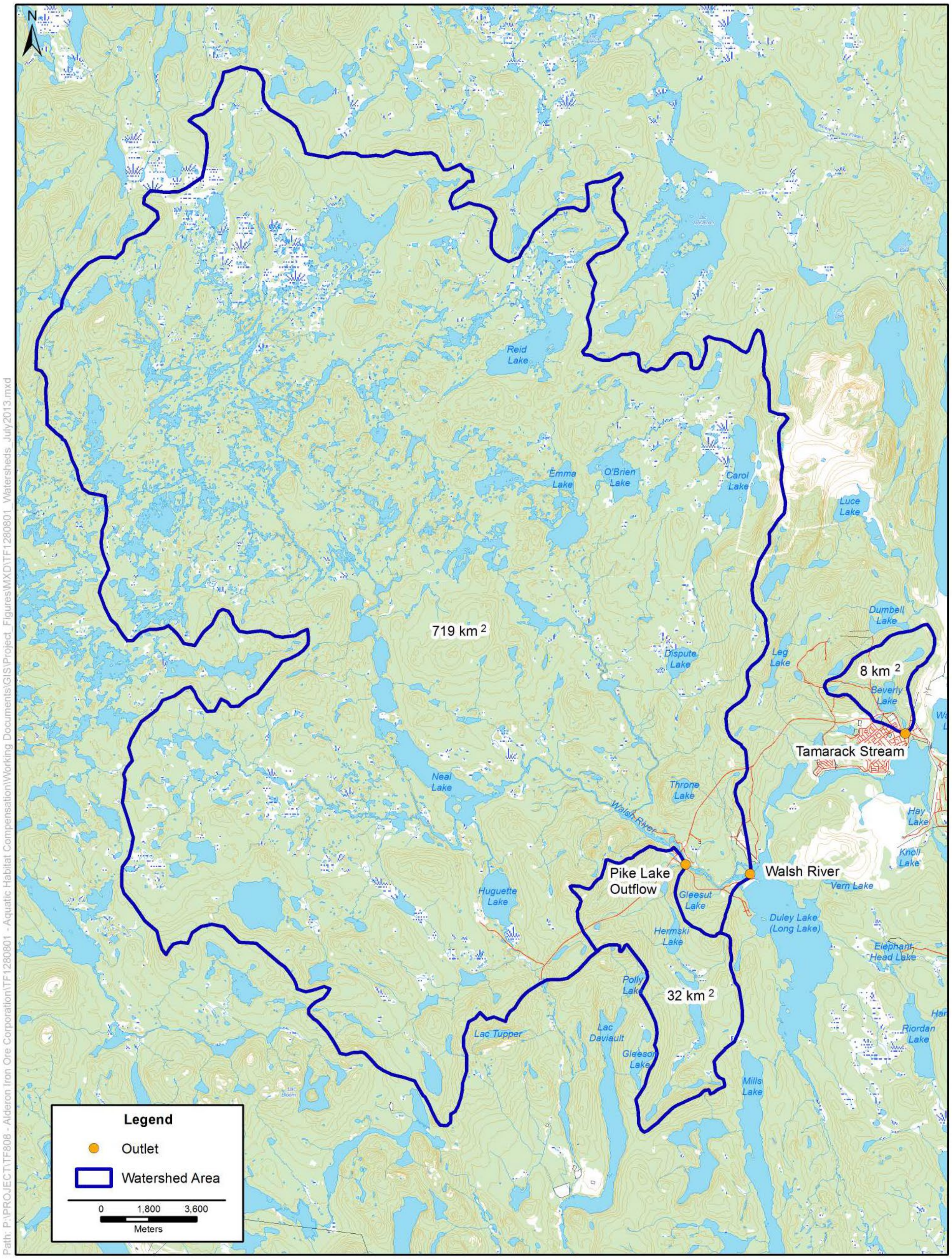


Figure 3-2: Watersheds (based on 1:50,000 topographic mapping and Geographic Information System)

3.5 Water Quality and Quantity

3.5.1 Water Column Profile Measurements

Lake column profiling was conducted at the various stations in 2023 (June, August, and October) and 2024 (March, June, and August), presented in Figure 3-3 to characterize the lake chemistry and physiology with depth at Daviault Lake, Duley Lake, Mills Lake, Molar Lake, Pike Lake, and Riordan Lake. The selection of locations within the lake for profiling included the deepest sections of the lake basins and/or sub-basins.

At each sample location, in situ water quality measurements (water temperature, electrical conductivity, pH, and dissolved oxygen) were taken at 1m intervals throughout the water column, using a Horiba Water Quality meter and a YSI Multiparameter Water Quality Sonde. Water quality samples were taken at the same time as the water column profile measurements.

Temperature affects physical mixing within the lake column (due to density differences of water at different temperatures). Physical mixing of a water column can occur when temperatures throughout the profile are isothermal. In comparison, thermal stratification (i.e., marked differences in near-surface and near-bed temperatures) resists lake turnover.

Electrical conductivity (EC) measures the presence of ions within the water column. However, the readings are non-specific (i.e., it cannot determine which ions are responsible for any observed increase). EC can affect physical mixing within the lake column since the ionic composition of water affects its density. In this assessment, the EC values are used to determine potential limitations on mixing processes within the water column, whereby chemical stratification (i.e., notable differences in near-surface and near-bed ion concentrations) provides resistance to lake turnover. EC is measured in microsiemens per centimetre (µS/cm).

Dissolved oxygen (DO) is used as an indicator of lake turnover. Oxygen levels in the bottom waters of a lake are reduced during thermal stratification and replenished during turnover events (when oxygenated surface waters are mixed throughout the water column). Therefore, an increase in bottom water DO concentrations is an indication that turnover has occurred. DO is also used to identify potential changes in redox conditions within the lake column that accompany associated fluctuations between oxic and anoxic conditions, and, in turn, can affect metal mobility from lakebed sediments (i.e., the release of metals bound to more labile sediment fractions). DO was measured in milligrams per litre (mg/L).

Table 3-4: Lake Column Profile Stations

Lake Basin	Station ID	UTM Coordinates[a] Northing/Easting	Description	Approx. Water Depth (m)	Water Column Profile Events
Reference Lake	DL-02	5853048/629986	Daviault Lake – deepest location near the centre	22	August 2023, October 2023, June 2024, and August 2024
Duley Lake	LL-02	5859719/637173	Duley Lake – deepest location near the centre	28	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
	LL-03	5861616/635757	Duley Lake – second deepest location in the north	15	August 2023, October 2023, March 2024, June 2024, and August 2024

Table 3-4: Lake Column Profile Stations

Lake Basin	Station ID	UTM Coordinates[a] Northing/Easting	Description	Approx. Water Depth (m)	Water Column Profile Events
Mills Lake	MIL-02	5854958/ 635121	Mills Lake – deepest location near the north side	20	June 2023, August 2023, October 2023, June 2024, and August 2024
	MIL-03	5850640/ 635773	Mills Lake – second deepest location near the centre	25	August 2023, October 2023, June 2024, and August 2024
Molar Lake	MOL-02	5850987 /632847	Molar Lake – near deepest location in the southwest	27	August 2023, October 2023, June 2024, and August 2024
Pike Lake	PL-02	5857541/ 632953	Pike Lake – deepest location near the centre	9	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
Riordan Lake	RL-02	5855616/ 641565	Riordan Lake – deepest location in the south	15	August 2023, October 2023, June 2024, and August 2024

UTM = Universal Transverse Mercator.

Temperature

Water column profile measurements at each of the lake basin stations demonstrated steady and gradual development of thermally stratified conditions from June 2023 to August 2023, followed by the decay of thermally stratified conditions from August 2023 to October 2023. The progression of thermal stratification at each of the lake profile stations was relatively consistent with observed air temperature trends (i.e., steady increase in air temperatures from mid-May 2023 to mid-June 2023 followed by mostly stable and warm conditions through the early to mid-August 2023, and subsequent decrease in air temperatures from mid-August 2023 through October 2023. The results of temperature profiles are as follows:

- **June 2023**—Temperature profiles at each station in the spring were weakly stratified and characterized by slight warming in the upper 3 to 9 m of the water column followed by mostly isostatic conditions or a steady decreasing pattern through the intermediate layers of the water column, noting the following:
  - Near-surface temperatures ranged from 20°C to 21°C at Duley Lake (LL-02) and Mills Lake (MIL-02); however, at Pike Lake (PL-02) it was observed elevated to 25°C.
  - Near-bed temperatures ranged from 14°C to 16°C at Duley Lake (LL-02) and Mills Lake (MIL-02); however at Pike Lake (PL-02) it was observed elevated to 19°C.
- **August 2023**—Thermal conditions at each lake basin station in August 2023 were well stratified and included a marked thermocline through the intermediate layers of the water column (in general between 4 and 10 m below the surface), noting the following:
  - Near-surface temperatures in the upper 3 to 4 m of the profile were relatively uniform and ranged approximately from 16°C to 17°C at Daviault Lake (DL-02), Duley Lake (LL-02 and LL-03), Mills Lake (MIL-02 and MIL-03), Molar Lake (MOL-02), and Riordan Lake (RL-02), while at Pike Lake (PL-02) temperatures ranged from 21°C to 24°C. This temperature difference is explained by the smaller size and shallower depth of Pike Lake compared to the rest of the lakes.

  - Near-bed temperatures at depths of generally 7 m or more, where applicable and in most cases, followed a gradual decline from approximately between 16°C and 10°C to roughly 6°C with relatively warmer near-bed water temperatures of between 8°C and 9°C at Duley Lake (i.e., LL-02 and LL-03), Mills Lake (i.e., MIL-02 and MIL-03), and Pike Lake (i.e., PL-02).

- **October 2023**—Observed lake column conditions at each of the sampling locations in October 2023 were indicative of physical mixing via partial or complete turnover and included near-vertical trends in each of the measured parameters for a large portion of the respective profiles, noting the following:
  - Near-bed and near-surface temperatures at lake stations ranged from 7°C to 9°C.
  - The extent of physical mixing at the various lake basin stations in October 2023 was as follows:
  - Complete turnover in the upper layers of Daviault Lake at the time of the sampling round (TSD III, Mine Waste Multiple Accounts Analysis Report, Figure D-1), noting a shallower location was profiled due to unsafe conditions.
  - Complete turnover in each lake basin station of Duley Lake (LL-02 and LL-03), Mills Lake (MIL-02 and MIL-03), Molar Lake (MOL-02), Pike Lake (PL-02), and Riordan Lake (RL-02) at the time of sampling in late October 2023 (TSD III,, Figures D-2 through D-8).
- **March 2024**—Temperature profiles at each station in March 2024 were weakly stratified and characterized by slight warming in the upper 2 to 3 m of the water column followed by mostly isostatic conditions or a steadily increasing pattern through the intermediate layers of the water column towards the bed, noting the following:
  - Near-surface temperatures ranged from 0.6°C to 1.3°C at Duley Lake (LL-02), 0.3°C to 1.4°C at Duley Lake (LL-03), and -0.1°C to 2.1°C at Pike Lake (PL-02).
  - Near-bed temperatures ranged from 3°C to 4°C at Duley Lake (LL-02), 2°C at Duley Lake (LL-03), and 3°C at Pike Lake (PL-02).
- **June 2024**—Temperature profiles at each station in June 2024 showed initiation of stratification. Overall, the profiles were found weakly stratified and characterized by slight warming in the upper 1 to 2 m of the water column followed by mostly isostatic conditions or a steady decreasing pattern through the upper and intermediate layers of the water column, noting the following:
  - Near-surface temperatures ranged from 18°C to 12°C at Duley Lake (LL-02, LL-03) and Molar Lake (MOL-02), 17°C to 14°C at Riordan Lake (RL-02), 19°C to 18°C at Mills Lake (MIL-02), 15°C to 10°C at Mills Lake (MIL-03), 14°C to 8°C at Daviault Lake (DL-02), and 20°C to 19°C at Pike Lake (PL-02).
  - Near-bed temperatures ranged from 4°C to 5.5°C at Duley Lake (LL-02, LL-03), Mills Lake (MIL-02, MIL-03), Molar Lake (MOL-02), Daviault Lake (DL-02), and Riordan Lake (RL-02); however at Pike Lake (PL-02) it was observed elevated to 6°C.
- **August 2024**—Thermal conditions at each lake basin station in August 2024 were well stratified and included a marked thermocline through the intermediate layers of the water column (in general between 4 and 10 m below the surface), noting the following:
  - Near-surface temperatures in the upper 3-4 m of the profile were relatively uniform and ranged approximately from 16°C to 18°C at Daviault Lake (DL-02), Duley Lake (LL-02 and LL-03), Molar Lake (MOL-02), and Pike Lake (PL-02), while at Mills Lake (MIL-02 and MIL-03) and Riordan Lake (RL-02)

temperatures ranged approximately from 18°C to 20°C. This temperature difference is explained by the smaller size of Mills Lake and Riordan Lake compared to the rest of the lakes.

- Near-bed temperatures at depths of generally 7 m or more, where applicable and in most cases, followed a gradual decline from approximately between 17°C and 12°C to roughly 7°C with relatively warmer near-bed water temperatures of between 8°C and 10°C at Mills Lake (MIL-02), Pike Lake (PL-02), Duley Lake (LL-03), and Riordan Lake (RL-02). Relative colder near-bed water temperatures of 5°C were recorded at Molar Lake (MOL-02).

Electrical Conductivity

Water column profiles at lake basin stations showed an increase in EC from June 2023 to August 2023 followed by a decrease in EC from August 2023 to October 2023. The results of EC profiles are as follows:

- **June 2023**—EC profiles at Duley Lake (LL-02), and Mills Lake (MIL-02) were relatively consistent over depth and generally ranged from 52-58 µS/cm, except one near-bed EC value at Pike Lake (PL-02) that spiked to 95 µS/cm.
- **August 2023**—Like June 2023, EC profiles at all stations were relatively consistent over depth and generally ranged from 50-86 µS/cm, noting that a few near-bed EC values higher than the observed range were found at Pike Lake (PL-02) and Riordan Lake (RL-02). At Pike Lake (PL-02), a few near-bed EC values were elevated and increased from 83 µS/cm at 6 m to 119 µS/cm at 9 m. Similarly, at Riordan Lake (RL-02), a few near-bed EC values were also elevated and increased from 86 µS/cm at 12 m to 146 µS/cm at 15 m. Furthermore, at Molar Lake (MOL-02), the near-bed EC value increased from 62 µS/cm at 26 m to 70 µS/cm at 27 m (i.e., a modest increase of 8 µS/cm over a depth of 1 m).
- **October 2023**—EC profiles at all stations were consistent over depth and generally ranged from 50-84 µS/cm, noting that a few relatively higher near-bed EC values were observed at Mills Lake (MIL-03) and Molar Lake (MOL-02). At Mills Lake (MIL-03) and Molar Lake (MOL-02), near-bed EC values increased from 71 µS/cm at 24 m to 76 µS/cm at 25 m, and 59 µS/cm at 26 m to 72 µS/cm at 27m, respectively.
- **March 2024**—The EC profile at Duley Lake (LL-03) was relatively consistent over depth and generally ranged from 73-77 µS/cm. EC profiles at Duley Lake (LL-02) and Pike Lake (PL-02) showed strong to moderate stratification. At Duley Lake (LL-02), EC ranged from 77-91 µS/cm near-surface (10 m below surface) and 94-132 µS/cm near-bed (10 m above bed). Similarly, at Pike Lake (PL-02), EC ranged from 107 µS/cm near-surface to 141 µS/cm near-bed.
- **June 2024**—The EC profile at Daviault Lake (DL-02) was relatively consistent over depth and generally ranged from 46-47 µS/cm. EC profiles at Duley Lake (LL-02, LL-03) and Mills Lake (MIL-02, MIL-03) were consistent and generally ranged from 70-63 µS/cm. The EC profile at Molar Lake (MOL-02) ranged from 58 to 56 µS/cm. Similarly, at Riordan Lake (RL-02), the EC profile was consistent over depth and ranged from 77-79 µS/cm. Further, at Pike Lake (PL-02), near-surface EC decreased from 53 µS/cm at 1 m to 50 µS/cm at 3 m, and at near-bed, EC increased from 52 µS/cm at 6 m to 59 µS/cm at 9 m.
- **August 2024**—Like June 2024, EC profiles at all stations were relatively consistent over depth and generally ranged from 50 to 76 µS/cm, noting that EC values ranged from 83 to 84 µS/cm at Riordan Lake (RL-02). At Pike Lake (PL-02), a few near-bed EC values were elevated and increased from 72 µS/cm at 6 m to 90 µS/cm at 9 m.

Dissolved Oxygen

Water column profiles at lake basin stations showed a general increase in DO values towards October 2023. DO profiles in June 2023 and October 2023 were relatively consistent across the depth, noting that a few low near-bed DO values were observed in some lakes. In August 2023, DO profiles demonstrated vertical variations and showed marked differences between the near-surface and near-bed DO values. The results of DO profiles are as follows:

- **June 2023**—DO profiles at Duley Lake (LL-02), Mills Lake (MIL-02) and Pike Lake (PL-02) were generally consistent across depth, noting a few near-bed DO values at Pike Lake showed a decline towards the bed of the lake. DO values generally range from 6 to 9.8 mg/L, except for two near-bed DO values at Mills Lake (MIL-02) and Pike Lake (PL-02) which were lower than the observed range. At Mills Lake (MIL-02), near-bed DO at a depth of 20 m was 4.67 mg/L. At Pike Lake (PL-02), near-bed DO values showed a decreasing trend and reduced from 8.26 mg/L at 5 m to 0.22 mg/L at 9 m.
- **August 2023**—DO profiles at all stations showed a gradual decrease in DO values towards the bed of the lakes. DO values generally ranged from 5.8-10 mg/L, noting that a few near-bed DO values lower than the observed range and below 5.5 mg/L were found at Duley Lake (LL-03), Molar Lake (MOL-02), Pike Lake (PL-02), and Riordan Lake (RL-02). At Duley Lake (LL-03), the near-bed DO value at a depth of 15 m was 4.39 mg/L. At Molar Lake (MOL-02), the near-bed DO value at a depth of 27 m was 1.09 mg/L. At Pike Lake (PL-02), near-bed DO values decreased from 7.92 mg/L at 5 m to 0.21 mg/L at 9 m. At Riordan Lake (RL-02), near-bed DO values decreased from 6.37 mg/L at 11 m to 0.83 mg/L at 15 m.
- **October 2023**—DO profiles at all stations were consistent over depth. DO values generally ranged from 7.14 to 13.25 mg/L, noting that two near-bed DO values at Mills Lake (MIL-02: 4.8 mg/L at 19 m and MIL-03: 1.74 mg/L at 25 m) were found lower than the observed range and were below 5.5 mg/L.
- **March 2024**—DO profiles at all stations showed a gradual decrease in DO values towards the bed of the lakes. At Duley Lake (LL-02, LL-03), DO was 13.6 mg/L near-surface and 0.5 mg/L, and 8.4 mg/L near-bed, respectively. At Pike Lake (PL-02), DO was 5.4 mg/L near-surface and 1.9 mg/L near-bed.
- **June 2024**—DO profiles at Duley Lake (LL-02, LL-03), Daviault Lake (DL-02), Mills Lake (MIL-03), and Riordan Lake (RL-02) were generally consistent across depth, noting a few increased DO values from near-surface to mid-column of each lake. DO values ranged from 10.1-11.7 mg/L, except near-bed to mid-column DO values at each lake (LL-02, LL-03, DL-02, MIL-03, and RL-02) that were found higher than the observed range and the DO values at Pike Lake (PL-02) that were found lower than the observed range. At Duley Lake (LL-02, LL-03), near-surface DO at 3 m and 4 m were 12.1 mg/L and 12.2 mg/L, respectively. At Daviault Lake (DL-02), near-surface DO at a depth of 2 m was 11.9 mg/L. At Mills Lake (MIL-03) and Riordan Lake (RL-02), near mid-column, DO was 12.4 mg/L and 12.2 mg/L, respectively. Further, at Mills Lake (MIL-02) DO range from 9.3 mg/L near-surface to 11.3 mg/L near-bed, with an increased DO of 12.3 mg/L mid-column at a depth of 7 to 8 m. Lastly, Pike Lake (PL-02) showed the lowest DO range, 8.6 mg/L near-surface and 5.7 mg/L near-bed, with an increased DO of 10.8 mg/L at a depth of 3 m.
- **August 2024**—DO profiles at all stations showed a gradual decrease in DO values towards the bed of the lakes, except at Mills Lake (MIL-03) and Molar Lake (MOL-02). DO values generally ranged from 4.6 mg/L to 9.1 mg/L, noting that at Pike Lake (PL-02), near-bed DO values showed a decreasing trend and reduced from 4.9 mg/L at 6 m to 0.5 mg/L at 9 m. Further, DO values slightly increased at the middle of the lake column profile at Mills Lake (MIL-03) and Molar Lake (MOL-02), with values ranging from 9.0 to 9.2 mg/L and 9.1 to 9.9 mg/L, respectively.

pH

The pH conditions at all lake basin stations in 2023 (June, August, and October) and 2024 (March and June) were generally near neutral throughout the water column with minor variations over depth and season, noting that in August 2024, pH values were higher and lower than the range observed in previous field campaigns. At Molar Lake (MOL-02), pH values ranged from 8.4-9.9 with higher values observed at the middle of the lake column profile. Further, like in August 2023, a general decreasing trend of pH values was observed in all lakes, noting that the lowest near-bed pH values of 5.5 and 5.9 were measured at Daviault Lake (DL-02) and Mills Lake (MIL-02). As such, water column measurements of pH are not discussed in detail herein.

Overall, the water column profile results from the 2023 and 2024 investigations (mid-June 2023 through August 2024), demonstrated that the reference and study lakes begin to be thermally stratified in mid-June with the upper thermal layer increasing in temperature and depth through August. Water temperatures in August 2024 were slightly higher near-surface to middle column at two lakes (Mills Lake and Riordan Lake) compared to August 2023. In addition, the lake column profile results at these same locations demonstrated a complete turnover in late October 2023, and due to similarity in stratification trends, a complete turnover in the lakes is also expected in October 2024. The bottom waters at each of the lake column stations (reference and study lakes) were characterized by low DO under stratified conditions.

The thermal and chemical behaviour at all reference and study lakes were relatively similar throughout the study period (as reflected by the observed patterns in temperature, EC, and DO). The lake column profiles at each location included evidence of complete physical mixing in late October 2023 and are also expected to demonstrate the same in October 2024.

The pH values remained consistent at all reference and study lakes throughout the study period, except August 2024 where slightly elevated and low pH values were observed at three lakes (Molar Lake, Daviault Lake, and Mills Lake).

3.5.2 Water Quality Sampling

Water quality sampling was conducted at various watercourses and waterbodies within the Project site in 2023 (June, August, October) and 2024 (March, June, August), as presented in Figure 3-3. Samples were taken using a standard grab technique via a Van Dorn discrete water sampler; at approximately 1m below the surface, and, where possible, at approximately 1m above the bottom of the water feature.

The samples were then submitted to Bureau Veritas, under chain of custody documentation, and analyzed for the following parameters:

- General parameters—pH, acidity, alkalinity, colour, electrical conductivity, hardness, dissolved organic carbon (DOC), total organic carbon, total dissolved solids (TDS), and total suspended solids
- Anions and nutrients—ammonia, bromide, chloride, fluoride, nitrite, nitrate, nitrate plus nitrite, orthophosphate, phosphorus, reactive silica, and sulphate
- Major cations, trace metals, and metalloids—aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, cesium, calcium, cerium, chromium, cobalt, copper, dysprosium, erbium, europium, gadolinium, gold, holmium, iridium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, mercury, molybdenum, neodymium, nickel, palladium, phosphorus, platinum, potassium, praseodymium, rubidium, ruthenium, samarium, scandium, selenium, silicon, silver, sodium, strontium, sulphur, tellurium, terbium, thallium, thorium, thulium, tin, titanium, tungsten, uranium, vanadium, ytterbium, yttrium, zinc, and zirconium

- Radionuclides—lead-210, polonium-210, radium-226, and thorium-230 for select locations
- Surrogate recovery parameters—D10-Anthracene, D-14-Terphenyl, D8-Acenaphthylene, and D8-Naphthalene for select locations
- Polyaromatic hydrocarbons (PAHs)—Acenaphthene, Acenaphthylene, Acridine, Anthracene, Benzo(a)anthracene, Benzo(b/j)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Benzo(c)phenanthrene, Benzo(a)pyrene, Benzo(e)pyrene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indenolol (1,2,3-cd)pyrene, 1-Methylnaphthalene, 2-Methylnaphthalene, Naphthalene, Phenanthrene, Perylene, Pyrene, and Quinoline for select locations
- Biological parameters—fecal and total coliforms for Duley Lake

Water quality sampling was conducted at watercourses and lake stations in 2011 and through 2012 in support of a previous EA process for the Kami Mines Project. The historical results were reviewed and used for comparison purposes, where appropriate.

Table 3-5: Water Quality Sampling Stations

Station ID	Description	Water Sampling Event
WC-01	Unnamed stream – reporting to Pike Lake from the southwest	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-02	Unnamed stream – immediately downstream of Pike Lake Outlet	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-03	Unnamed stream – reporting to Mills Lake from the west	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-04	Unnamed stream – reporting to Duley Lake from the southwest	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-05	Waldorf River – reporting to Duley Lake from the south	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-06	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-07	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-08	Unnamed stream – reporting to Duley Lake from the east	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-09	Duley Lake Outlet	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-10	Walsh River - reporting to Duley Lake from the northwest	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-11	Unnamed stream – immediately downstream of Riordan Lake	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-12	Unnamed stream – immediately downstream of Daviault Lake	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-13	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the east[(a)]	October 2023 and August 2024
WC-14	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake northwest[(a)]	October 2023 and August 2024
WC-15	Proposed railway crossing – unnamed stream reporting Little Wabush Lake from the southeast[(a)]	October 2023 August 2024

Table 3-5: Water Quality Sampling Stations

Station ID	Description	Water Sampling Event
WC-16	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the southeast[(a)]	October 2023 and August 2024
DL-01	Daviault Lake – at staff gauge location	June 2024 and August 2024
DL-02	Daviault Lake – deepest location near the centre	August 2023, October 2023 and June 2024, and August 2024
LL-02	Duley Lake – deepest location near the centre	June 2023, August 2023 (2), October 2023, March 2024, June 2024, and August 2024
LL-03	Duley Lake – second deepest location in the north	August 2023, October 2023, March 2024, June 2024, and August 2024
MIL-02	Mills Lake – deepest location near the north side	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
MIL-03	Mills Lake – second deepest location near the centre	August 2023, October 2023, June 2024, and August 2024
MOL-02	Molar Lake – near deepest location in the southwest	August 2023, October 2023, June 2024, and August 2024
PL-02	Pike Lake – deepest location near the centre	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
RL-02	Riordan Lake – deepest location in the south	August 2023, October 2023, June 2024, and August 2024

(a) Sampling was completed at this location based on an earlier design iteration of the proposed railway; therefore, the sampling location does not align with the proposed railway alignment.

Water quality sampling was conducted to characterize the existing water chemistry of the surface waters near the Kami Project site. Note that the fecal and total coliform sampling at Duley Lake was not carried out due to the challenges of sample hold time and logistics. As described, water quality samples at waterbodies (lakes) were collected during the 2023 and 2024 field campaigns (Table 3-5). The water quality results were compared to the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life – Freshwater (CCME 2011).

Daviault Lake

Near-surface (NS) and near-bed (NB) water samples were mainly collected at DL-02 for laboratory testing, noting that during June and August 2024, NS water samples were also collected at DL-01.

At DL-02, NS pH values ranged from 7.18 to 7.48 with an average of 7.35, while at NB, the pH values ranged from 6.98 to 7.48 with an average of 7.22. At NS, total alkalinity ($CaCO_3$) ranged from 17 to 21 mg/L with an average of 18 mg/L, while at NB it ranged from 17-21 mg/L with an average of 18.8 mg/L. In all samples, the acidity concentrations were below the reporting detection limit (RDL) (<5 mg/L).

The NS and NB electrical conductivity values did not vary significantly and averaged 51.6 µS/cm. The NS turbidity values ranged from 0-4.33 Nephelometric Turbidity Units (NTU)and averaged 1.45 NTU, while NB turbidity values ranged from 0-2 NTU and averaged 0.5 NTU. Note that the turbidity was recorded higher in August 2023 than other sampling events. The NS and NB TDS ranged from 35 to 55 mg/L with an average of 46.7 mg/L and 35 to 60 mg/L with an average of 43.3 mg/L, respectively, noting that TDS was observed higher in the summer (August) 2023. Both hardness ($CaCO_3$) and dissolved organic carbon (DOC) did not vary significantly. The NS and

NB hardness ($CaCO_3$) averaged 19 to 19.7 mg/L, respectively, while the NS and NB DOC averaged 3.5 mg/L and 3.4 mg/L, respectively.

At DL-01 (lake water level station located close to the shore of Daviault Lake), the water quality was observed like DL-02. The pH values ranged from 7.32 to 7.44 with an average of 7.38. Total alkalinity ($CaCO_3$) ranged from 16 to 22 mg/L and averaged 19 mg/L. In all samples, acidity concentrations were below the RDL (<5 mg/L). Electrical conductivity did not vary significantly and averaged 51 µS/cm. Turbidity averaged 1.82 NTU. TDS ranged from 20 to 40 mg/L with an average of 30 mg/L, noting that TDS was observed higher in August 2024. Both hardness and DOC did not vary significantly and averaged 18 mg/L and 3.7 mg/L, respectively.

In general, except for phosphorous, the concentrations of all water quality parameters (including anions, nutrients, and metals) were below CCME guidelines. Specific details are as follows:

- **June 2024**—At DL-02, NB and NS total phosphorous concentrations (ranging from 4.2 to 6.5 µg/L) exceeded CCME long-term limit for ultra-oligotrophic (<4 µg/L) conditions. At DL-01, the total phosphorous concentration exceeded the CCME long-term limit for ultra-oligotrophic conditions. Note that the concentrations of phosphorous (total and dissolved) in June 2024 samples were measured with a lower detection threshold (2 µg/L) compared to all previous samples.

Duley Lake

NS and NB water samples were collected at LL-02 and LL-03 for laboratory testing.

At NS, the pH values ranged from 7.44 to 7.81 with an average of 7.62, while at NB, the pH values ranged from 7.19 to 7.78 with an average of 7.5. At NS, total alkalinity ($CaCO_3$) ranged from 32 to 39 mg/L with an average of 35.5 mg/L, while at NB, it ranged from 32 to 49 mg/L with an average of 36.5 mg/L. Acidity concentrations were below the RDL (<5 mg/L) in all samples, except at LL-02 NB with an acidity value of 7.0 mg/L in March 2024.

The NS and NB electrical conductivity averaged 74-75.8 µS/cm. Electrical conductivity did not vary significantly, except for one electrical conductivity measurement of 103 µS/cm at LL-02 NB in March 2024. The NS and NB turbidity values ranged and averaged below 1 NTU. The NS and NB TDS values ranged from 41-95 mg/L with an average of 55.6 mg/L and 20-75 mg/L with an average of 47.6 mg/L, respectively. The NS and NB hardness ($CaCO_3$) averaged 35.7 mg/L and 37.1 mg/L, respectively, while the NS and NB DOC averaged 3.5 mg/L and 3.2 mg/L., respectively. March 2024 results at LL-02 NB for hardness (CaCO3) were above the observed range (51 mg/L), while DOC results were below the observed range (2.8 mg/L). Samples collected in August 2023 at LL-02 NS and NB were also tested for radionuclides, surrogate recovery parameters and PAHs. The values of parameters were observed to be below the RDL.

In general, the concentrations of all water quality parameters (including general chemistry, anions and nutrients, metals, radionuclides, and PAHs) were below CCME guidelines, noting that the concentrations of some parameters (phosphorous, aluminum, iron, and manganese) were elevated. Specific details are as follows:

- **June 2023**—Total phosphorus concentration (9 µg/L) at LL-02 NS exceeded the CCME long-term limit for ultra-oligotrophic (<4 µg/L) and total phosphorus concentration (25 µg/L) at LL-02 NB exceeded the CCME long-term limit for mesotrophic conditions (i.e., 10 to 20 µg/L). Metals including total aluminum, iron, and manganese at LL-02 NB exceeded the respective CCME long-term limits with 313 µg/L, 1,480 µg/L, and 1,110 µg/L, respectively. The field notes suggested that the sample at LL-02 NB appeared to be influenced by inadvertent disturbance of bed sediment; thus, the reported total metal concentrations should be reviewed with discretion.

- **June 2024**—Total phosphorous concentrations exceeded the CCME long-term limit for ultra-oligotrophic (<4 µg/L) conditions at LL-02 and LL-03. At LL-02, NS and NB total phosphorous concentrations were 4.6 µg/L and 5.5 µg/L, respectively. At LL-03, the NS total phosphorous concentration was 4.5 µg/L. Total lead was in exceedance at LL-03 NS with a concentration of 1.13 µg/L.

Mills Lake

NS and NB water samples were collected at MIL-02 and MIL-03 for laboratory testing.

At NS the pH values ranged from 7.43-7.71 with an average of 7.59, while at NB, the pH values ranged from 7.35 to 7.76 with an average of 7.56. At NS & NB total alkalinity ($CaCO_3$) did not vary significantly and averaged 35.1 mg/L and 35.8 mg/L, respectively. In all samples, the acidity concentrations were below the RDL (<5 mg/L).

The NS and NB electrical conductivity values did not vary significantly and averaged 71.7 and 73.2 µS/cm, respectively. The NS and NB turbidity values ranged and averaged below 1 NTU. The NS TDS ranged from 40 to 75 mg/L with an average of 50.1 mg/L and NB TDS ranged from 40 to 75 mg/L with an average of 49.7 mg/L, noting the values in June 2023 were measured higher. Both hardness ($CaCO_3$) and DOC did not vary significantly. The NS and NB hardness ($CaCO_3$) averaged 35.5 and 35.3 mg/L, respectively, while the NS and NB DOC averaged 3.1 and 3.0 mg/L, respectively.

In general, the concentrations of anions, nutrients, and metals were below CCME guidelines, noting that the concentrations of some parameters (dissolved copper and phosphorous) were elevated. Specific details are as follows:

- **August 2023**—The concentration of dissolved copper at MIL-02 NB was found equal to the CCME long-term limit (2 µg/L).
- **June 2024**—Total phosphorous concentrations (ranging from 4.1 to 6.7 µg/L) exceeded CCME long-term limit for ultra-oligotrophic (<4 µg/L) conditions at MIL-02 and MIL-03.

Molar Lake

NS and NB water samples were collected at MOL-02 for laboratory testing.

At NS the pH values ranged from 7.37 to 7.68 with an average of 7.53, while the pH values ranged from 7.20 to 7.71 with an average of 7.47 NB. Total alkalinity ($CaCO_3$) did not vary significantly at NS and NB, averaging 30 and 29.5 mg/L, respectively. In all samples, the acidity concentrations were below the RDL (<5 mg/L).

The NS and NB electrical conductivity values also did not vary significantly and averaged 61.2 and 61.7 µS/cm, respectively. The NS and NB turbidity values ranged and averaged below 1 NTU. The NS TDS ranged from 35 to 70 mg/L with an average of 35 mg/L, while the NB TDS ranged from 40 to 55 mg/L with an average of 46.7 mg/L, noting that the NS and NB values of TDS in August 2024 were observed higher (70 mg/L and 55 mg/L, respectively). Both hardness ($CaCO_3$) and DOC did not vary significantly. The NS and NB hardness ($CaCO_3$) averaged 28.3 mg/L while the NS and NB DOC averaged 3.3 and 3.2 mg/L, respectively.

In general, the concentrations of anions, nutrients, and metals were below CCME guidelines, noting that the concentrations of some parameters (total aluminum and total phosphorous) were elevated. Specific details are as follows:

- **August 2023**—Total aluminum concentration of 11 µg/L at MOL-02 NB exceeded the CCME long-term limit.
- **June 2024**—Total phosphorus concentrations of 4.6 and 4.4 mg/L at MOL-02 NS and MOL-02 NB, respectively, exceeded the CCME long-term limit for ultra-oligotrophic (<4 µg/L).

Pike Lake

NS and NB water samples were collected at PL-02 for laboratory testing.

At NS, the pH values ranged from 7.25-7.58 with an average of 7.47, while the pH values ranged from 7.29 to 7.53 with an average of 7.38 NB. At NS total alkalinity ($CaCO_3$) ranged from 26-51 mg/L with an average of 36.6 mg/L, while at NB it ranged from 27-62 mg/L with an average of 39.6 mg/L. Acidity concentrations were below the RDL (<5 mg/L), except in March 2024 with NS and NB values of 7.4 ($CaCO_3$) and 8.2 mg/L ($CaCO_3$), respectively.

Electrical conductivity ranged from 56 to 112 µS/cm with an average of 78 µS/cm and from 56 to 132 µS/cm with an average of 83.5 µS/cm for NS and NB, respectively. The NS and NB turbidity values averaged below 1 NTU. The NS TDS values ranged from 20 to 105 mg/L with an average of 60.8 mg/L, while the NB TDS values ranged from 20 to 80 mg/L with an average of 57.5 mg/L. The NS hardness ($CaCO_3$) ranged from 26 to 53 mg/L with an average of 36.9 mg/L, and NB hardness ($CaCO_3$) ranged from 26 to 62 mg/L with an average of 38.5 mg/L. The NS DOC ranged from 3.4 to 6.2 mg/L with an average of 4.8 mg/L, and the NB DOC ranged from 2.8 to 5.8 mg/L with an average of 4.4 mg/L. Note that in March 2024, the values of general parameters were generally measured higher than the range observed in other samples.

The concentrations of all water quality parameters (including general chemistry, anions, nutrients, and metals) were below CCME guidelines, noting that some parameters (dissolved copper, total lead, total phosphorous, and total and dissolved manganese) were elevated. Specific details are as follows:

- **August 2023**—Total phosphorus concentrations of 32 mg/L at PL-02 NS exceeded the CCME long-term limit for ultra-oligotrophic (<4 µg/L) conditions. Dissolved copper and total lead concentrations were 2.2 µg/L and 3.9 µg/L, respectively, at PL-02 NB – which were above the CCME long-term limit. Total and dissolved manganese exceeded the CCME guidelines, with values of 1,400 µg/L and 1,300 µg/L, respectively.
- **June 2024**—Total phosphorus concentrations of 8.8 mg/L at PL-02 NS exceeded the CCME long-term limit for ultra-oligotrophic (<4 µg/L) conditions. At PL-02, the NB total phosphorous concentration of 15.7 µg/L exceeded the CCME long-term limit for oligotrophic (4 to 10 µg/L) conditions.
- **August 2024**—Total and dissolved manganese exceeded the CCME guidelines, with values of 1050 and 854 µg/L, respectively.

Riordan Lake

NS and NB water samples were collected at RL-02 for laboratory testing.

At NS, the pH values ranged from 7.61 to 7.86 with an average of 7.78, while at NB, the pH values ranged from 7.35 to 7.87 with an average of 7.60. At NS, total alkalinity ($CaCO_3$) ranged from 41-51 mg/L with an average of 45.5 mg/L, while at NB, it ranged from 40 to 44 mg/L with an average of 42.3 mg/L. In all samples, the acidity concentrations were below the RDL (<5 mg/L).

The NS and NB electrical conductivity values did not vary significantly and averaged 86 and 85.6 µS/cm, respectively. The NS and NB turbidity values ranged and averaged below 1 NTU. The NS TDS values ranged from 40 to 55 mg/L with an average of 45 mg/L, while the NB TDS values ranged from 45 to 65 mg/L with an average of 55 mg/L. Both hardness ($CaCO_3$) and DOC did not vary significantly. The NS and NB hardness ($CaCO_3$) averaged 42.3 and 42 mg/L, respectively, while the NS and NB DOC averaged 2.9 and 2.7 mg/L, respectively.

The concentrations of all water quality parameters (including anions, nutrients, and metals) were below CCME limits except for one exceedance of total phosphorus. Specific details are as follows:

- **June 2024**—Total phosphorous concentrations at RL-02 NB exceeded the CCME long-term limit for ultra-oligotrophic (<4 µg/L) conditions with a value of 5.8 mg/L.

Field Results

Field measurements were taken at 12 watercourse stations (WC-01 through WC-12) during 2023 and 2024, noting that in March 2024 field measurements were limited to three stations (WC-01, WC-02, and WC-09) only.

In general, the water temperature of the watercourses showed seasonal variations. In 2023, water temperatures were recorded higher during June (ranging from 9.8°C to 24.3°C) sampling event as opposed to lower average temperatures in August (ranging from 11.9°C to 19.5°C) and October (ranging from 5°C to 9.5˚C) sampling events. In 2024, water temperatures were recorded higher during August (ranging from 9.1°C to 22.6°C) as opposed to lower average temperatures in June (ranging from 10°C to 21°C) and March (ranging from -0.3°C to 1˚C). The average water temperatures of all watercourses during June and August of 2023 and 2024 did not vary significantly and ranged from 16.3°C to 18.8˚C.

Electrical conductivity generally increased from June 2023 (ranging from 22.6 to 105.2 µS/cm with an average of 65.3 µS/cm) to August 2023 (ranging from 26.6 to 117.2 µS/cm with an average of 75.4 µS/cm), and then to October 2023 (ranging from 47.7 to 134 µS/cm with an average of 85.2 µS/cm). Like 2023, electrical conductivity generally increased from June 2024 (ranging from 25.7 to 107.7 µS/cm with an average of 67.3 µS/cm) to August 2024 (ranging from 44.7 to 185.6 µS/cm with an average of 92.8 µS/cm). Note that the electrical conductivity recorded at selected stations in March 2024 ranged from 64.3 to 70.6 µS/cm with an average of 68.1 µS/cm.

Dissolved oxygen ranged from 7.83 to 11.2 mg/L in June 2023, 8.62 to 9.83 mg/L in August 2023, and 10.3 to 14.5 mg/L in October 2023. In 2024, dissolved oxygen ranged from 7.21 to 12.21 mg/L in June and 8.2 to 11.2 mg/L in August. Dissolved oxygen at selected stations in March 2024 ranged from 5.25 to 13.84 mg/L and recorded one dissolved oxygen value below the threshold of 5.5 mg/L at WC-02.

The pH values at each watercourse were consistently within the CCME limits. Average turbidity was 0.56 NTU, noting that the maximum (6.56 NTU) was recorded at WC-12 in June 2023, while the minimum (0 NTU) was recorded at most watercourses in October 2023 and August 2024.

Laboratory Results

Water quality samples were also sent for laboratory analysis at the 12 watercourse stations (WC-01 through WC-12).

At the watercourse stations, pH values ranged from 6.96 to 8.03 and averaged 7.58. Total alkalinity ($CaCO_3$) ranged from 9.9 to 90.0 mg/L and averaged 41.2 mg/L. Acidity was below the RDL (<5 mg/L) for all samples, except one value of 8.0 mg/L at WC-02 in March 2024.

Electrical conductivity ranged from 26 to 191 µS/cm and averaged 85.2 µS/cm. TDS ranged from 20 to 115 mg/L and averaged 62.3 mg/L. Hardness ranged from 11 to 97 mg/L and averaged 40.7 mg/L. DOC ranged from 2.2 to 9.4 mg/L and averaged 4.2 mg/L. Turbidity ranged from 0 to 6.56 NTU with an average of 0.58 NTU, noting that turbidity at most stations was observed below 1 NTU.

Samples collected in August 2023 at WC-02, WC-03, WC-09 and WC-10 were also tested for radionuclides, and PAHs. The values of most parameters were observed below the RDL except at WC-02 where benzo(a)pyrene, benzo(b/j) fluoranthene, benzo(g,h,i)perylene, and pyrene were observed above the RDL.

The concentrations of all water quality parameters (including general chemistry, anions, nutrients, metals, radionuclides, and PAHs) were below CCME guidelines. Any exceedances of the CCME guidelines are summarized below.

- **August 2023**—An exceedance of total iron was observed in WC-07. The value observed was 390 µg/L with a CCME threshold of 300 µg/L. Total lead was observed to be in exceedance at WC-09. The concentration observed was 2.4 µg/L, exceeding the CCME guideline of 1 µg/L.
- **June 2024**—Total phosphorus concentrations (ranged 4.4 to 13.8 µg/L) at WC-01, WC-02, WC-03, WC-04, WC-06, WC-07, WC-09, WC-10 and WC-12 exceeded the CCME long-term limit for ultra-oligotrophic (<4 µg/L), noting that total phosphorous concentrations at WC-01, WC-02, WC-10 and WC-12 also exceeded oligotrophic (4 to 10 µg/L) conditions. Note that the phosphorous concentrations in June 2024 samples were measured with a lower detection threshold than all previous samples. Total aluminum was observed to be in exceedance at WC-10. The concentration observed was 196 µg/L with the CCME threshold being 100 µg/L.

Field Results

Field measurements were taken at four rail crossing watercourse stations (WC-13 through WC-16). The results are presented in the Surface Water Baseline Report (WSP 2025) in Table E-1, noting that measurements are available only for the October 2023 and August 2024 field campaigns.

The water temperature at the watercourses ranged from 8.4°C to 19.4°C with an average of 12.6°C. The field pH measurements ranged from 6.87 to 8.21 with an average of 7.5, within CCME limits. Electrical conductivity ranged from 29 to 140 with an average of 90.3 µS/cm, noting that the values of 29 µS/cm and 140 µS/cm were observed in August 2024 at WC-14 and WC-13, respectively. Dissolved oxygen ranged from 5.3 to 13.3 mg/L with an average of 10.2 mg/L, noting that dissolved oxygen below the threshold of 5.5 mg/L was measured at WC-14 in August 2024. Average turbidity was 0.92 NTU, with the values being between 0 and 2.28 NTU.

Field Results – Rail Crossings

Field measurements were taken at four rail crossing watercourse stations (WC-13 through WC-16). The results are presented in Surface Water Baseline Report (WSP 2025) in Table E-1, noting that measurements are available only for the 2023 October and 2024 August field campaigns.

The water temperature at the watercourses ranged from 8.4-19.4°C with an average of 12.6°C. The field pH measurements ranged from 6.87-8.21 with an average of 7.5, within CCME limits. Electrical conductivity ranged from 29-140 with an average of 90.3 µS/cm, noting that 29 µS/cm and 140 µS/cm were observed in August 2024 at WC-14 and WC-13, respectively. Dissolved oxygen ranged from 5.3-13.3 mg/L with an average of 10.2 mg/L, noting that dissolved oxygen below the threshold of 5.5 mg/L was measured at WC-14 in August 2024. Average turbidity was 0.92 NTU, with values between 0 NTU and 2.28 NTU.

Laboratory Results – Rail Crossings

Water samples were also sent for laboratory analysis at four rail-crossing watercourse stations (WC-13 through WC-16). The results are presented in Surface Water Baseline Report (WSP 2025)) in Tables E-4 and E-5, noting that the results are only available for the October 2023 and August 2024 field campaigns.

The lab pH results ranged from 6.52-7.91 with an average of 7.63, within CCME limits. Alkalinity ($CaCO_3$) ranged from 13-70 mg/L and averaged 42.4 mg/L, noting that 13 µS/cm and 70 µS/cm were observed in August 2024 at WC-14 and WC-13, respectively. Acidity was below the RDL (<5 mg/L) except for one acidity of 12 mg/L at WC-14 in August 2024. The TDS ranged from 55-100 mg/L with an average of 66.3 mg/L, noting that 100 mg/L was observed at WC-13 in August 2024. The hardness ($CaCO_3$) ranged from 13-67 mg/L with an average of 40.3 mg/L, noting that 13 µS/cm and 67 µS/cm were observed in August 2024 at WC-14 and WC-13, respectively. DOC ranged from 2.9-8.1 mg/L with an average of 4.6 mg/L.

The concentrations of all water quality parameters were below CCME guidelines. Any exceedances of the CCME guidelines are summarized below.

- **August 2024**—Total and dissolved iron exceeded the CCME guidelines at WC-14, with values of 1980 µg/L and 1020 µg/L, respectively.

3.5.3 Sediment Quality Sampling

Sediment quality sampling was performed to indicate the long-term water quality conditions, potential historical contaminant releases, aquatic/benthic community potential and health and the sensitivity of aquatic sediment to environmental changes (Table 3-6). Sediment samples were submitted to Bureau Veritas, under chain of custody, and analyzed for the following parameters:

- General parameters: moisture, particle size analysis (i.e., clay, sand, and silt)
- Anions and nutrients: total Kjeldahl nitrogen, nitrite, nitrate, nitrate plus nitrite, nitrogen, and total organic carbon (TOC)
- Metals: aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, selenium, silver, sodium, strontium, tin, titanium, uranium, vanadium, and zinc

Table 3-6: Sediment Quality Sampling Stations

Station ID	Description	Sediment Sampling Event
WC-01	Unnamed stream – reporting to Pike Lake from the southwest	June 2023, August 2023, and October 2023
WC-02	Unnamed stream – immediately downstream of Pike Lake outlet	June 2023, August 2023, and October 2023
WC-03	Unnamed stream – reporting to Mills Lake from the west	June 2023, August 2023, and October 2023
WC-04	Unnamed stream – reporting to Duley Lake from the southwest	June 2023, August 2023, and October 2023
WC-05	Waldorf River – reporting to Duley Lake from the south	June 2023, August 2023, and October 2023
WC-06	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, and October 2023
WC-07	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, and October 2023
WC-08	Unnamed stream – reporting to Duley Lake from the east	June 2023, August 2023, and October 2023
WC-09	Duley Lake outlet	June 2023, August 2023, and October 2023

Table 3-6: Sediment Quality Sampling Stations

Station ID	Description	Sediment Sampling Event
WC-10	Walsh River – reporting to Duley Lake from the northwest	June 2023, August 2023, and October 2023
WC-11	Unnamed stream – immediately downstream of Riordan Lake	October 2023
WC-12	Unnamed stream – immediately downstream of Daviault Lake	August 2023 and October 2023
WC-13	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the east	October 2023
WC-14	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake northwest[(a)]	October 2023
WC-15	Proposed railway crossing – unnamed stream reporting Little Wabush Lake from the southeast[(a)]	October 2023
DL-02	Daviault Lake – deepest location	August 2023 and October 2023
LL-02	Duley Lake – deepest location	June 2023, August 2023, and October 2023
LL-03	Duley Lake – second deepest location	August 2023 and October 2023
MIL-02	Mills Lake – deepest location	June 2023, August 2023, and October 2023
MIL-03	Mills Lake – second deepest location	August 2023 and October 2023
MOL-02	Molar Lake – near deepest location	August 2023 and October 2023
PL-02	Pike Lake – deepest location	June 2023, August 2023, and October 2023
RL-02	Riordan Lake – deepest location	August 2023 and October 2023

The sediment quality results were compared to the *Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life Freshwater and Marine ISQG/PEL* (CCME 1999).

Daviault Lake

Sediment samples were collected from the deepest basin (DL-02) at Daviault Lake. The sediment sample collected at DL-02 in August 2023 was silt-dominated and the sediment texture was described as clay loam having grain sizes of 29% clay, 23% sand, and 49% silt.

TOC ranged from 50,000 to 69,000 mg/kg with an average of 59,500 mg/kg. Nitrogen ranged from 0.41% to 0.72% with an average value of 0.56%. Calculated total Kjeldahl nitrogen ranged from 4,110 to 7,160 µg/g, with an average of 5,635 µg/g. Both nitrate and nitrite were observed below the detection limit.

Most metals were noted to be below CCME guidelines, noting that the observed concentrations of cadmium, chromium, copper, lead, and zinc were elevated. Specific details of elevated metals are as follows:

- **August 2023**—Concentrations of cadmium and chromium at DL-02 exceeded the CCME Interim Sediment Quality Guidelines (ISQG) limit.
- **October 2023**—Concentrations of cadmium, chromium, copper, lead, and zinc at DL-02 exceeded CCME-ISQG limits.

Duley Lake

Sediment samples were collected from two stations located at the two deepest basins at Duley Lake (LL-02 and LL-03). Samples were found to be dominated by sand. Due to variations in sand and silt contents, the sediment texture varied from loamy sand in June 2023 having grain sizes of 2.6% clay, 74% sand, and 24% silt to loam in August 2023, with average grain sizes of 11% clay, 48% sand, and 40% silt.

TOC ranged from 39,000 to 68,000 mg/kg with an average of 56,800 mg/kg. Nitrogen ranged from 0.21% to 0.76% with an average of 0.56%. Calculated total Kjeldahl nitrogen ranged from 2,090 to 7,620 µg/g with an average of 5,578 µg/g. Nitrate was observed below the detection limit, while nitrite was observed above the detection limit only once in October 2023 at LL-02 resulting in 0.9 µg/g.

Most metals were noted to be below the CCME guidelines, noting that the observed concentrations of arsenic, cadmium, chromium, lead, and zinc were elevated. Specific details of elevated metals are as follows:

- **June 2023**—Concentrations of cadmium, chromium and zinc were observed above the CCME-ISQG limit at LL-02.
- **August 2023**—Concentrations of cadmium, chromium, and zinc were above CCME-ISQG limits at LL-02 and LL-03, in addition to concentration of lead that also exceeded the CCME-ISQG limit at LL-02.
- **October 2023**—Concentrations of arsenic, cadmium, chromium, and zinc were observed above the CCME-ISQG limit at LL-02 and LL-03.

Mills Lake

Sediment samples were collected from two stations at the two deepest basins at Mills Lake (MIL-02 and MIL-03). The sediment samples collected in August 2023 were sand and silt-dominated, while the soil texture was described as loam having average grain sizes of 16% clay, 46% sand, and 39% silt.

TOC ranged from 81,000-93,000 mg/kg with an average of 85,600 mg/kg. Nitrogen ranged from 0.67% to 0.92% with an average of 0.79%. Calculated total Kjeldahl nitrogen ranged from 6,740-9,210 µg/g with an average of 7,874 µg/g. Both nitrate and nitrite were observed below the detection limit.

Metals were noted to be below CCME guidelines, noting that the observed concentrations of cadmium, chromium and zinc were elevated. Specific details of elevated metals are as follows:

- **June 2023**—Concentrations of cadmium and chromium were observed above CCME ISQG limits at MIL-02.
- **August 2023**—Concentrations of cadmium and chromium were observed above CCME-ISQG limits at MIL-02 and MIL-03, in addition to the concentration of lead that also exceeded the CCME-ISQG limit at MIL-03.
- **October 2023**—Concentrations of cadmium and chromium were observed above CCME-ISQG limits at MIL-02 and MIL-03, in addition to the concentration of zinc that also exceeded the CCME-ISQG limit at MIL-03.

Molar Lake

Sediment samples were collected from a station near the deepest basin at Molar Lake (MOL-02). The sediment sample collected in August 2023 was silt-dominated and the texture was described as silt loam with grain sizes of 19% clay, 30% sand, and 51% silt.

TOC ranged from 86,000-110,000 mg/kg with an average of 98,000 mg/kg. Nitrogen ranged from 0.73% to 1% with an average of 0.87%. Calculated total Kjeldahl nitrogen ranged from 7,300 to 10,300 µg/g, with an average of 8,800 µg/g. Nitrate was below the detection limit, while nitrite was observed above the detection limit only once in October 2023 at 0.7 µg/g.

Most metals were noted to be below CCME guidelines, noting that the observed concentrations of chromium were found above the CCME-ISQG limit in August and October of 2023 at MOL-02.

Pike Lake

Sediment samples were collected from a station located at the deepest basin at Pike Lake (PL-02). The sample collected in August 2023 was sand-dominated, and the texture was described as sandy loam with grain sizes of 17% clay, 69% sand, and 15% silt.

TOC ranged from 130,000 to 150,000 mg/kg, averaging 143,333 mg/kg. Nitrogen ranged from 0.25% to 1.6% with an average of 1.05%. Calculated total Kjeldahl nitrogen ranged from 2,510 to 16,000 µg/g with an average of 10,503 µg/g. Both nitrate and nitrite were observed below the detection limit.

Most metals were below the CCME guidelines, noting that the observed chromium concentrations were elevated. Specific details of elevated metals are as follows:

- **October 2023**—The chromium concentration was above the CCME-ISQG limit at PL-02. 10-10027-101

Riordan Lake

Sediment samples were collected from the deepest lake basin at Riordan Lake (RL-02). The sediment sample collected in August 2023 was sand-dominated and the texture was described as loamy sand with grain sizes of 5.7% clay, 87% sand, and 7.2% silt.

TOC ranged from 110,000 to 150,000 mg/kg with an average of 130,000 mg/kg. Nitrogen was 1.4% in both samples, while calculated total Kjeldahl nitrogen averaged 143,000 µg/g. Both nitrate and nitrite were below the detection limit.

Most metals were below CCME guidelines, noting that the observed cadmium concentration was above the CCME-ISQG limit in August 2023.

Sediment Quality at Watercourses

Sediment samples were collected at twelve watercourse stations (WC-01 through WC-12). Sediment samples in June and August 2023 consisted primarily of sand. During habitat surveys, the sediment at each station was described as sand, with variation in texture observed at WC-01, WC-05, and WC-09, ranging from sand to loamy sand. The grain size distribution showed that clay, sand, and silt contents ranged from <2% to 7.4%, 50% to 98%, and <2% to 42%, respectively.

TOC ranged from 2,100 to 80,000 mg/kg, averaging 14,558 mg/kg. Nitrogen ranged from <0.01% to 0.5%, while calculated total Kjeldahl nitrogen ranged from <100 to 5,020 µg/g. Both nitrate and nitrite were below the CCME detection limit.

Most metals were noted to be below CCME guidelines in all watercourse stations, and the observed concentrations of arsenic and chromium were elevated. While arsenic exceeded the CCME-ISQG limit only once at WC-06, chromium exceeded the CCME-ISQG limit once at WC-09 and three times at WC-05 and WC-10. Note that all these watercourses receive flows from or discharge to Duley Lake. Specific details of elevated metals are as follows:

- **June 2023**—Arsenic exceeded the CCME-ISQG limit at WC-06 (watercourse discharging to Duley Lake from the southeast side), and chromium exceeded the CCME-ISQG limit at WC-05 (Waldorf River discharging to Duley Lake from the south) and WC-10 (Walsh River discharging to Duley Lake from the northwest).
- **August 2023**—Chromium exceeded the CCME-ISQG limit at WC-05 and WC-10.
- **October 2023**—Chromium exceeded the CCME-ISQG limit at WC-04 (watercourse discharging to Duley Lake from the southwest), WC-05, WC-09 (watercourse immediately downstream of Duley Lake outlet), and WC-10.

Sediment Quality at Rail Crossings

Sediment samples were collected at three watercourse stations near rail crossings (WC13 through WC-15).

TOC ranged from 500 to 52,000 mg/kg, averaging 23,500 mg/kg. Nitrogen ranged from <0.01% to 0.34%, while calculated total Kjeldahl nitrogen ranged from <100 to 3,360 µg/g. Both nitrate and nitrite were below the CCME detection limit at all sites. Metal concentrations were below the CCME guidelines at all stations.

3.5.4 Flow Measurements

Manual flow measurements were taken at the WC series stations (Figure 3-3) during the 2023 and 2024 surface water monitoring campaigns to better understand the seasonal variation in water flows within the Project Site and the local, and regional watersheds (Table 3-7).

Flow measurements were estimated via the velocity-area method, where representative channel cross-sections were generally established and marked with wooden stakes at each surface water station. During each measurement, a tape measure was extended across the length of each cross-section. Stream flow velocities and corresponding depth measurements were taken at various intervals along the tape: 0.1 to 3 m apart depending on the width of the channel. At most flow stations, velocity and depth measurements were taken by wading channels or atop crossing features. Velocities were recorded using a Hach Flow Meter Model 950.1 at 60% of the total water depth in water depths less than 0.75 m and at 20% and 80% in water depths greater than 0.75 m.

Table 3-7: Manual Flow Measurement Stations

Station ID	UTM Coordinates Northing/Easting	Description	Flow Measurement Event
WC-01	5856192/ 632810	Unnamed stream – reporting to Pike Lake from the southwest	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-02	5858897/ 632920	Unnamed stream – immediately downstream of Pike Lake Outlet	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-03	5853179/ 634709	Unnamed stream – reporting to Mills Lake from the west	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-04	5855857/ 635378	Unnamed stream – reporting to Duley Lake from the southwest	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-05	5854636/ 637507	Waldorf River – reporting to Duley Lake from the south	August 2023, June 2024, and August 2024

Table 3-7: Manual Flow Measurement Stations

Station ID	UTM Coordinates Northing/Easting	Description	Flow Measurement Event
WC-06	5856351/ 637511	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-07	5858758/ 637921	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-08	5860478/ 637962	Unnamed stream – reporting to Duley Lake from the east	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-09	5863790/ 635635	Unnamed stream – immediately downstream of Duley Lake Outlet	June 2023, August 2023, and August 2024
WC-10	5863449/ 632468	Walsh River - reporting to Duley Lake from the northwest	June 2023 and August 2024
WC-11	5858315/ 641017	Unnamed stream – immediately downstream of Riordan Lake	October 2023, June 2024, and August 2024
WC-12	5848673/ 628202	Unnamed stream – immediately downstream of Daviault Lake	October 2023, June 2024, and August 2024
WC-13	5859809/ 640950	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the east	August 2024
WC-14	5860604/ 640077	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake northwest	August 2024
WC-15	5865198/ 641766	Proposed railway crossing – unnamed stream reporting Little Wabush Lake from the southeast	August 2024
WC-16	5858663/ 640772	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the southeast	August 2024

UTM = Universal Transverse Mercator.

Manual flow measurements were also taken in October 2011 (Stantec 2012) at five stream stations. The historical sites were located close to the 2023–2024 sites except for one station, which was located at a small headwater watershed draining into Molar Lake.

Where applicable, manual flows were used to develop stage-discharge rating curves. The stage-discharge rating curves were obtained using the power-law rating curve equation:

$$Q = a(y)^b$$

Where:

Q = stream flow rate (m^3/s)

y = water depth (m) calculated as $Y-Y_o$ (Y = measured water level and Y_o = water level in metres when no flow will occur)

a and b = rating curve parameters (dimensionless)

The flow measurement results are presented in Table 3-8.

Table 3-8: Manual Flow Measurements (litres per second)

Station ID	2023			2024		
	June (spring)	August (summer)	October (fall)	March (spring)	June (spring)	August (summer)
WC-01	57	150	110	44	93	44
WC-02	135	532	237	79	206	40
WC-03	110	209	164	-	391	163
WC-04	629	1,013	947	-	1,610	593
WC-05	(a)	189	(d)	-	570	138
WC-06	41	299	71	-	39	14
WC-07	244	780	302	-	101	31
WC-08	313	621	540	-	835	146
WC-09	13,802 (b)	19,551 (b)	(a)	-	(a)	7,076
WC-10	13,430 (b)	(a)	(a)	-	(a)	6,068
WC-11	(c)	(c)	230	-	532	170
WC-12	(c)	(c)	1,191	-	4,415	653
WC-13	-	-	-	-	-	8.6
WC-14	-	-	-	-	-	0.84
WC-15	-	-	-	-	-	1,953
WC-16	-	-	-	-	-	37

(a) Data not available due to unsafe stream conditions.
(b) Flow measurements estimated with fewer than normal velocity readings.
(c) Data not available due to limited access during the monitoring event.
(d) Stagnant conditions.

– = Surveys not performed.

These flow readings are based on a specific point in time, and it is therefore difficult to account for hydrological lag times between stations because of storage and/or time of concentration effects. While these readings provide a comprehensive evaluation of the flow regime, the flow rates are referenced to support observations and inferences related to water quality trends.

3.5.5 Continuous Flow Monitoring

Continuous flow measurements were also taken at WC-01 to WC-12 (Table 3-9) using Van Essan DIVER water level dataloggers. Loggers were generally installed with steel T-posts, set into the channel bed in an upstream pool of a riffle, or channel control. In most cases, the dataloggers were installed during the first field campaign in June 2023, except for WC-10, which was installed in August 2023 due to limited access to the site. Due to the reliable outlet controls at WC-11 and WC-12, lake discharge was estimated by developing stage-discharge rating curves using lake water levels and manual flow surveys downstream of the lake outlet. The gauge at WC-09 was damaged by ice and could not be reinstalled during the June 2024 campaign; thus, water level data at this station range only from June 8, 2023, to June 12, 2024.

Table 3-9: Continuous Flow and/or Water Level Stations

Station ID	UTM Coordinates[a] Northing/Easting	Description	Period of Record
WC-01[b]	5856192/632810	Unnamed stream – reporting to Pike Lake from the southwest	June 2023–August 2024
WC-02[b]	5858897/632920	Unnamed stream – immediately downstream of Pike Lake Outlet	June 2023–August 2024
WC-03[b]	5853179/634709	Unnamed stream – reporting to Mills Lake from the west	June 2023–August 2024
WC-04	5855857/635378	Unnamed stream – reporting to Duley Lake from the southwest	June 2023–August 2024
WC-05[c]	5854636/637507	Waldorf River – reporting to Duley Lake from the south	June 2023–August 2024
WC-06[b]	5856351/637511	Unnamed stream – reporting to Duley Lake from the southeast	June 2023–August 2024
WC-07	5858758/637921	Unnamed stream – reporting to Duley Lake from the southeast	June 2023–August 2024
WC-08	5860478/637962	Unnamed stream – reporting to Duley Lake from the east	June 2023–August 2024
WC-09	5863790/635635	Unnamed stream – immediately downstream of Duley Lake Outlet	June 2023–June 2024
WC-10	5863449/632468	Walsh River – reporting to Duley Lake from the northwest	June 2023–August 2024
WC-11[d]	5858315/641017	Unnamed stream – immediately downstream of Riordan Lake	August 2023– August 2024
WC-12[e]	5848673/628202	Unnamed stream – immediately downstream of Daviault Lake	June 2023–August 2024

(a) UTM coordinates based on NAD83 Zone 19.

(b) Continuous water levels and flows were also measured from October 2011 to May 2012 at a nearby historical station (Stantec 2012). Note that the locations of 2011–2012 and 2023–2024 continuous water level and flow stations were not the same. Location coordinates of 2011–2012 monitoring stations are provided in Appendix F.

(c) GPS survey could not be completed due to lack of signal reception. The water levels at this station are tied to local benchmark.

(d) Continuous water levels were not recorded. Water level records from a nearby station RL-01 were used to develop flow hydrographs for WC-11.

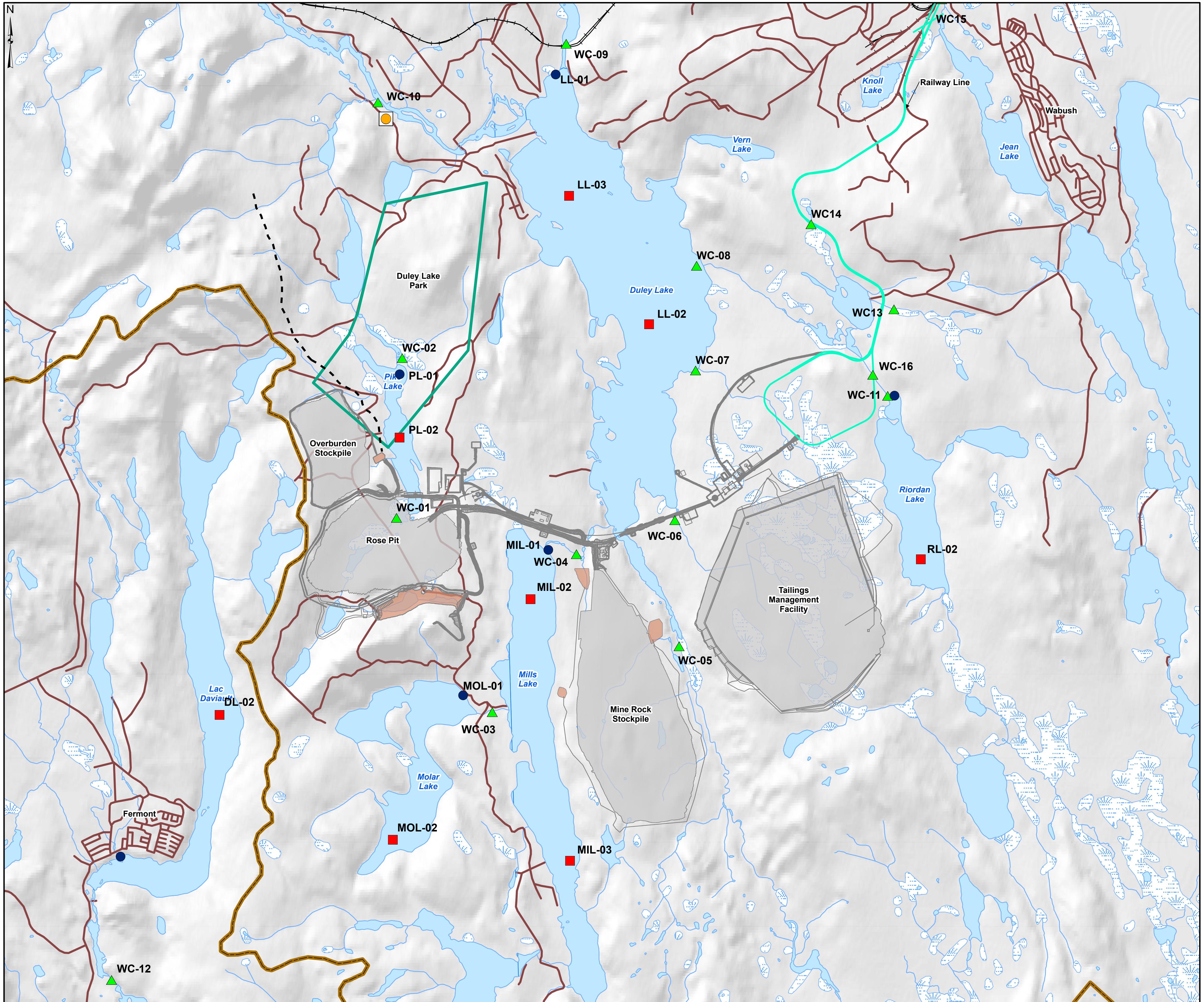
(e) Continuous water levels were not recorded. Water level records from a nearby station DL-01 were used to develop flow hydrographs WC-12.

UTM = Universal Transverse Mercator.

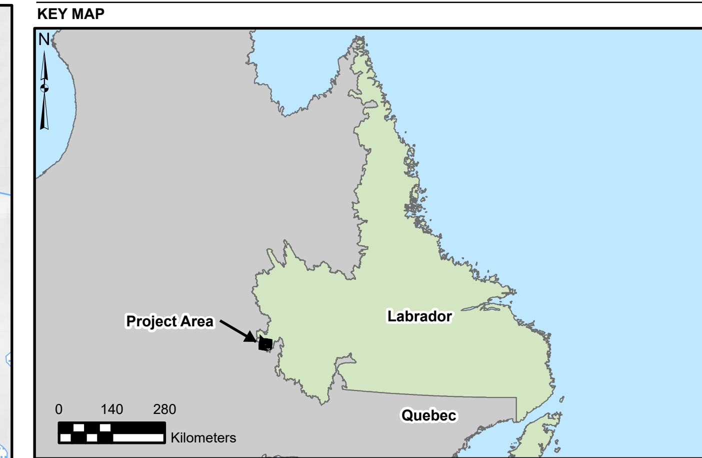
The results of water level and flow monitoring are as follows:

- Water level fluctuations at watercourse and lake outlet stations ranged from 0.29 to 1.569 m. The lowest and the highest water level fluctuations were recorded at WC-04 and WC-09, respectively.
- Similar to the lake outlet water levels, stream water levels were generally observed to gradually decrease from June 2023 to August 2023 and then, gradually increase from August 2023 to early fall 2023 followed by gradual decrease in the winter months of 2023 and 2024 (November to March).
- In 2024, the water levels were observed to generally increase from April that peaked in May. In May, a sudden increase in water levels were observed that persist throughout the month and started to decline relatively sharply from end-May to mid-June.
- In 2023, flows and/or water level hydrographs at the watercourse and lake outlet stations were in correlation with rain events generating moderate to high flows.
- In 2024, an increase in water levels/flows in May could be attributed to spring freshest and/or beaver activity. After July, water level hydrographs at the lake outlet stations showed a correlation with major rain events generating higher water levels like the trends in 2023, noting that 2024 rainfall data at Wabush Airport station did not show significant rainfall events before July 2024.

- Additional stage-discharge rating curves, to be used during spring 2024, were developed for WC-01, WC-02, WC-06, WC-07 and WC-08. To generate a hydrograph for stations with two stage-discharge rating curves, the transition from the normal stage-discharge rating curve to the spring 2024 stage-discharge rating curve was based on field observation and professional judgment.
- Most watercourse water levels exhibited a marked, but gradual response to major rain events. Only three watercourse stations WC-01 (stream discharging to Pike Lake from the southwest), WC-06 and WC-07 (both located on streams discharging to Duley Lake from the southeast) exhibited rapid and flashy hydrologic response to precipitation events characterized by higher peaks with steep rising and falling limbs.
- As discussed above, major water level changes were observed in May 2024. The increase in water levels in May could be attributed to spring freshest and/or beaver activity. Other than May 2024, no major water level changes were observed downstream of watercourse stations (i.e., due to beaver and/or debris accumulation), except WC-03 which showed a minor drop in observed water level in the mid to late June 2023 and July 2024, and WC-02 that showed a minor drop in observed water level in the late July 2024.
- Flow hydrographs generated using stage-discharge rating curves showed that the peak flows could range from 556 L/s (estimated at WC-01) to 87,870 L/s (estimated at WC-09), noting that the peak flows were influenced by spring freshet.
- Comparison of 2011 to 2012 historical water levels and flows (Stantec 2012) with the 2023 to 2024 water levels and flows, at stream stations located in the proximity of historical stations, showed similarity in range and/or season water level trends, noting that some deviations due to meteorological factors are generally expected in comparisons with historical results. Like 2023 to 2024 water levels, historical water levels also indicated an increase in water levels at stream stations due to spring freshet from mid-April to May. A station-wise comparison of water levels and flows is presented in Appendix F.
- Results of the surface water sampling at each site are available in TSD III.



KEY MAP



Scale: 1:20,000,000

Legend

- Watercourse Station
- Lake Level Station
- Lake Basin Station
- Rain Gauge Station
- Existing Railway
- Existing Road
- Proposed Project Infrastructure (Linear)
- Potential Access Road
- Proposed Access Road and Railway Corridor
- River/Stream
- Labrador/Quebec Boundary
- Proposed Project Infrastructure
- Proposed Sedimentation Pond
- Bog/Wetland
- Waterbody

0 500 1,000 2,000

1:64,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
2023 SURFACE WATER SAMPLING LOCATIONS

CONSULTANT

wsp

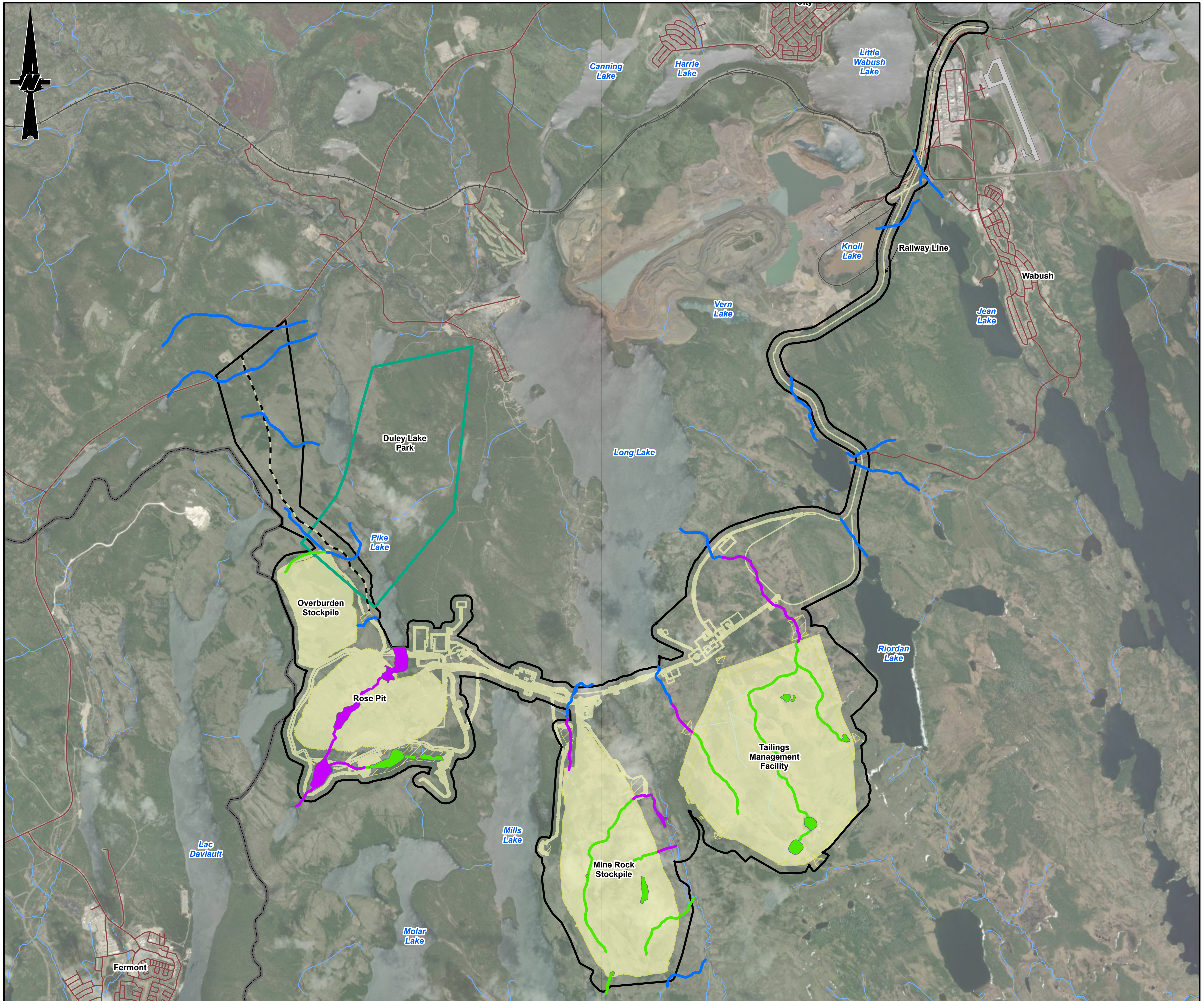
YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	KM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-3

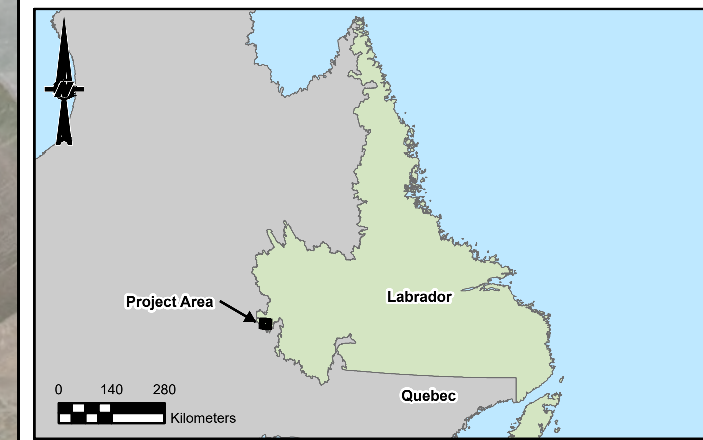
3.6 Fish Habitat

The summary of fish and fish habitat information is provided relative to Project infrastructure and potential interactions with the Project (see Figure 3-4). Project features that have identified fish and fish habitat within and near them include:

- **Rose Pit**—The Rose Pit includes the area that contains the ore body and pit water management facilities (i.e., Rose Pit collection pond, Mid Lake Dam, and Pike Lake Dike). The pit itself will be mined and all waterbodies and streams in the area will either be dewatered/lost, diverted, or used as part of the water treatment and containment system. Any fish-bearing water within the direct footprint of any water treatment facility will be included in the MDMER accounting and any habitat negatively affected outside the direct footprint of the water treatment facility (e.g., those portions of steam that may be dewatered or removed as part of pit development) will be included in Section 35 HADD accounting.
- **Overburden stockpile**—General storage area of overburden materials that will be removed during both Construction and Operations to assist in construction of infrastructure or to allow for greater access to the ore deposit. This material will generally consist of organic material such as soils and peat that may be stockpiled for both water management from runoff and to be used in any remediation or reclamation activities during ongoing operations and closure. Any fish-bearing water within the direct footprint of this facility and its water management infrastructure (i.e., ditches and collection ponds) will be included in any MDMER accounting and any habitat adversely affected outside the direct footprint will be included in Section 35 HADD accounting.
- **Mine rock stockpile**—Similar to the overburden stockpile, all run-off and seepage from the mine rock stockpile will be captured and / or diverted to its collection ponds before it is pumped to the process plant for treatment and either reused for processing or treated and discharged to Duley Lake. There is some potentially acid generating material in the mine rock stockpile, but with sufficient blending there is enough neutralization potential to minimize acid rock drainage and metal leaching. The mine rock stockpile therefore limits any untreated water from re-entering the surrounding aquatic environment prior to treatment to regulatory release requirements. Non-contact water (i.e., water that has not interacted with the mine rock stockpile and supporting water management facilities) will be directed around the stockpile area to limit the quantity of water requiring treatment and to maintain natural water quality and flows to nearby aquatic habitat to the extend possible. Any fish-bearing water within the direct footprint of the mine rock stockpile or its water management facilities will be included in the MDMER accounting and any habitat adversely affected outside the direct footprint of the water treatment facility (e.g., those portions of downstream habitat that may have reduced flows due to the structure) will be included in Section 35 HADD accounting.
- **Tailings management facility**—The TMF will be constructed and bound to contain all tailings during the mining process. It will also be used during mine closure to permanently contain any residual tailings. Similar to the mine rock stockpile, it will be bound to contain any water prior to treatment to regulatory standards and release. Non-contact water will also be redirected around the facility. Any fish-bearing water within the direct footprint of the TMF or its water management facilities will be included in the MDMER accounting and any habitat adversely affected outside the direct footprint of the TMF (e.g., those portions of downstream habitat that may have reduced flows due to the structure) will be included in Section 35 HADD accounting.



KEY MAP



SCALE 1:20,000,000

LEGEND

FISH HABITAT AUTHORIZATION
- Fish Habitat
- Schedule 2 MDMER HADD
- Section 35 HADD

PROJECT INFRASTRUCTURE
- Proposed Infrastructure Footprint
- Potential Access Road

BASEMAP INFORMATION
- Road
- Railway
- Watercourse
- Duley Lake Park
- Labrador/Quebec Boundary
- Site Assement Area

0 1,000 2,000 4,000

1:65,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: EARTHSTAR GEOGRAPHICS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
OVERVIEW OF FISH HABITAT WITHIN/NEAR EACH PROJECT FEATURE, RELATIVE TO POSSIBLE MDMER AND SECTION 35

CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

3.6.1 Rose Pit

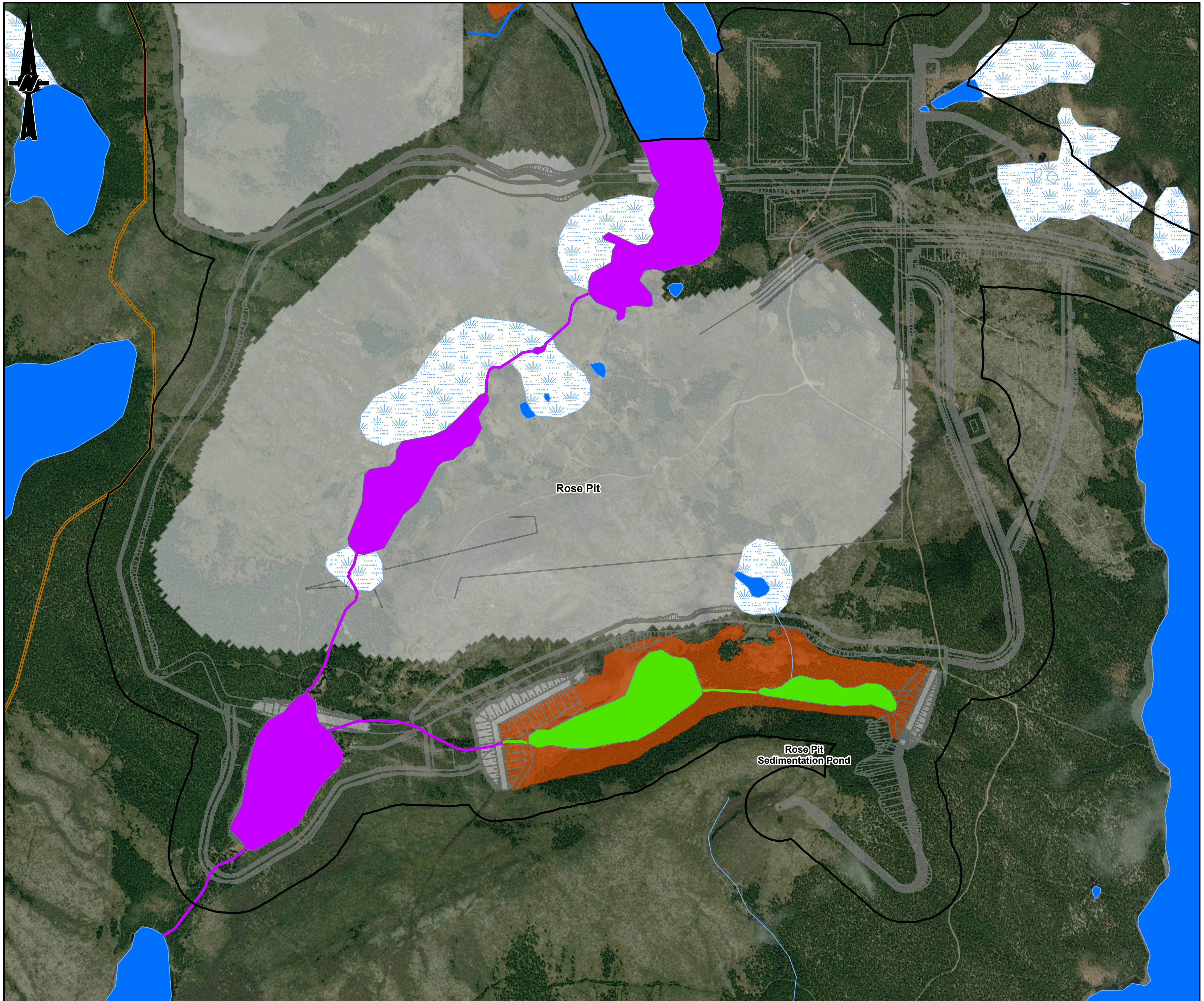
The Rose Pit area is contained within the Pike Lake watershed. The Pike Lake watershed is estimated at 32 km^2 in size and flows from a series of small headwater ponds around the Rose Pit area to its confluence with Walsh River to the north. The hydrology of the Pike Lake system is described in Section 3.5.4.

The fish and fish habitat within the Pike Lake watershed includes a total of approximately 3,000 m of linear stream habitat and eight ponds, including Pike Lake North and Pike Lake South, the larger waterbodies within the watershed. Provided below is the habitat characteristics of the Pike Lake watershed, including the habitat within and near the footprint of the Rose Pit infrastructure. The Rose Pit footprint includes a total of five ponds and several interconnecting streams (Figure 3-5). The Rose Pit footprint falls across five watersheds: the Elfie and End Lakes (4 ha), Mid and Upper Mid Lakes (17.5 ha), Mills Lake (12.2 ha), Pike Lake South (178.8 ha), and Rose Lake (137.8 ha). The total catchment area that the Rose Pit will affect is 346 ha. The Rose Pit collection pond footprint spans four of the same five watersheds as the Rose Pit: Elfie and End Lakes (77.6 ha), Mid and Upper Mid Lakes (5.3 ha), Mills Lake (0.2 ha), and Pike Lake South (1.6 ha). The total catchment area that the Rose Pit collection pond will affect is 78.6 ha.

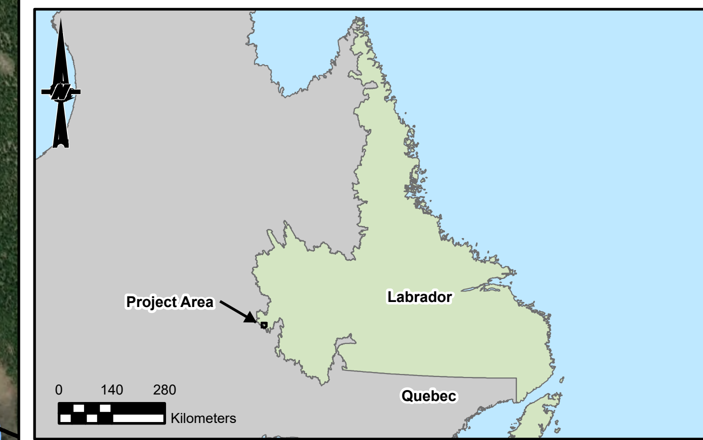
Two additional effects on catchment areas associated with Rose Pit is the Pike Lake Dike, which is expected to span 14 ha of Pike Lake South watershed, and the Mid Lake dam, which is expected to affect 267 ha of the Mid and Upper Mid Lakes watershed.

3.6.1.1 Main Stem Riverine Habitat, Pike Lake Watershed

The riverine habitat consists of approximately 2,350 linear metres of stream that interconnects the ponds within the Pike Lake Stream watershed. The data provided below are presented from the downstream confluence with Walsh River and extending upstream to the headwaters at the Rose Pit area. Each stream section between ponds is presented separately within Table 3-10 for greater clarity.



KEY MAP



SCALE 1:20,000,000

LEGEND

FISH HABITAT AUTHORIZATION
- Fish Habitat
- Schedule 2 MDMER HADD
- Section 35 HADD

PROPOSED PROJECT INFRASTRUCTURE
- Site Study Area (SSA)
- Proposed Project Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION
- Labrador/Quebec Boundary
- Duley Lake Park
- Wetland/Bog
- River/Stream

0 137.5 275 550

1:13,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: MAXAR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
FISH HABITAT WITHIN THE ROSE PIT AREA POTENTIALLY AFFECTED BY THE PROJECT

CONSULTANT

wsp

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-5

PATH: S:\Clients\Champion_Iron_Ore_Mines\Kami Iron Ore\99_PROJ\CA0038713.5261_EIS\40_PROD\0026_FisOffsetting\CA0038713-5261-0026-RB-0001.aprx PRINTED ON: AT: 9:32:36 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

Table 3-10: Summary of Main Stem Habitat Characterization, Pike Lake Watershed.

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)[a]	Substrate (% coverage)								Habitat Type[b]
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
PLN-S3														
1	-	4.1	-	0.32	-	0	10	5	40	30	15	0	0	Run
2	50	5.4	2.70	0.31	-	0	10	5	40	30	15	0	0	Run
3	50	5.5	2.75	0.21	-	0	20	25	30	20	5	0	0	Riffle
4	25	6.9	1.73	0.23	-	0	15	25	25	25	10	0	0	Riffle
5	100	4.3	4.30	0.35	-	-	-	-	-	-	-	-	0	Run
6	50	7.1	3.55	0.25	-	0	60	20	0	15	5	0	0	Rapids
7	75	6.2	4.65	0.35	-	-	-	-	-	-	-	-	0	Steady
8	15	14.2	2.13	0.34	-	0	25	30	20	15	10	0	0	Pool
Small Unnamed Steady														
PLN-S2														
1	-	6.4	-	0.24	-	0	50	40	0	5	5	0	0	Run
2	50	14.0	7.00	0.15	-	0	50	40	0	5	5	0	0	Run
Small Unnamed Pond														
PLN-S1														
1	-	4.9	-	0.25	-	0	60	30	0	5	5	0	0	Run
2	50	3.1	1.55	0.18	-	0	40	30	0	20	10	0	0	Run
3	50	0.4	0.20	0.47	-	0	40	30	10	10	10	0	0	Run
4	50	11.8	5.90	0.23	-	0	30	20	0	10	15	25	0	Riffle
5	50	7.0	3.50	0.25	-	0	50	30	15	5	0	0	0	Run
6	50	6.1	3.05	0.27	-	0	70	30	0	0	0	0	0	Run
7	50	3.5	1.75	0.23	-	0	65	20	0	10	5	0	0	Run
8	50	6.9	3.45	0.19	-	0	60	30	0	5	5	0	0	Run
9	50	4.1	2.05	0.27		0	60	25	0	5	10	0	0	Run
10	25	4.5	1.13	0.23	-	0	60	25	0	5	10	0	0	Run
Pike Lake North														
PLS-S2														
1	-	4.1	-	0.20	-	0	40	30	30	0	0	0	0	Run
2	50	3.5	1.75	0.31	-	0	40	30	30	0	0	0	0	Run
3	50	4.6	2.30	0.23	-	0	60	40	0	0	0	0	0	Rapids
4	50	5.0	2.50	0.28	-	0	45	45	0	5	5	0	0	Rapids
5	50	6.7	3.35	0.33	-	0	50	25	25	0	0	0	0	Run
6	90	3.2	2.88	0.27	-	-	-	-	-	-	-	-	0	Pool
7	50	4.0	2.00	0.51	-	0	80	20	0	0	0	0	0	Run
8	50	2.7	1.35	0.18	-	0	80	20	0	0	0	0	0	Run
9	30	4.8	1.44	0.45	-	0	50	20	0	0	0	30	0	Run

Table 3-10: Summary of Main Stem Habitat Characterization, Pike Lake Watershed.

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)[(a)]	Substrate (% coverage)								Habitat Type[(b)]
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
Pike Gully														
PLS-S1														
1	-	7.4	-	0.13	-	0	10	40	40	0	10	0	0	Run
2	50	3.1	1.55	0.19	-	0	10	40	40	0	10	0	0	Run
3	50	11.8	5.90	0.63	-	0	20	30	0	0	0	50	0	Pool
Pike Lake South														
RP1-PLS														
1	-	-	-	-	-	0	30	15	10	0	0	45	0	Pool
2	25	-	-	-	-	0	30	15	10	0	0	45	0	Pool
3	25	2.4	0.34	0.29	-	0	30	15	10	0	0	45	0	Pool
4	25	4.1	0.18	0.26	-	0	30	50	20	0	0	0	0	Rapids
5	25	2.5	0.25	0.28	-	0	30	50	20	0	0	0	0	Rapids
6	25	-	-	-	-	0	0	15	15	10	0	60	0	Pool
7	25	-	0.80	0.00	-	0	0	15	15	10	0	60	0	Pool
8	25	-	-	-	-	0	0	0	0	0	0	100	0	Pool
9	25	-	0.90	0.01	-	0	0	0	0	0	0	100	0	Pool
10	25	-	-	-	-	0	0	0	0	0	0	100	0	Pool
11	25	-	0.95	0.00	-	0	0	0	0	0	0	100	0	Pool
12	25	-	-	-	-	0	0	0	0	0	0	100	0	Pool
13	25	-	0.85	0.09	-	0	0	0	0	0	0	100	0	Pool
14	25	-	-	-	-	0	30	10	0	0	0	60	0	Pool
15	25	-	0.80	0.03	-	0	30	10	0	0	0	60	0	Pool
16	25	-	-	-	-	0	30	10	0	0	0	60	0	Pool
17	25	-	0.65	0.03	-	0	30	10	0	0	0	60	0	Pool
18	25	-	-	-	-	0	30	10	0	0	0	60	0	Pool
19	25	4.2	0.77	0.05	-	0	30	10	0	0	0	60	0	Pool
Pose Pond														
RP2-RP1														
1	-	4.9	-	0.44	-	0	0	0	0	0	0	100	0	Pool
2	25	3.2	0.80	0.67	-	0	0	0	0	0	0	100	0	Pool
3	25	3.6	0.90	0.74	-	0	0	0	0	0	0	100	0	Pool
4	25	2.7	0.68	0.49	-	0	0	15	15	0	0	70	0	Pool
5	25	2.0	0.50	0.19	-	0	0	15	15	0	0	70	0	Steady
6	25	1.4	0.35	0.25	-	0	15	15	0	0	0	70	0	Pool
7	25	1.9	0.48	0.53	-	0	15	15	0	0	0	70	0	Pool
8	25	3.7	0.93	0.27	-	0	0	5	20	0	0	75	0	Pool
9	25	2.1	0.53	0.27	-	0	0	5	20	0	0	75	0	Pool
10	25	2.0	0.50	0.27	-	0	0	30	20	0	0	50	0	Pool
11	25	1.0	0.25	0.02	-	0	0	30	20	0	0	50	0	Steady
12	25	0.8	0.20	0.02	-	0	5	5	0	0	0	90	0	Steady
13	25	1.5	0.38	0.02	-	0	5	5	0	0	0	90	0	Steady

Table 3-10: Summary of Main Stem Habitat Characterization, Pike Lake Watershed.

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)[(a)]	Substrate (% coverage)								Habitat Type[(b)]
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
Rose Pond 2														
RP3-RP2														
1	-	-	-	-	-	0	0	0	0	0	0	100	0	Steady
2	25	3.9	0.98	0.46	-	0	0	0	0	0	0	100	0	Pool
3	25	1.1	0.28	0.23	-	0	0	0	0	0	0	100	0	Pool
4	25	0.9	0.23	0.10	-	0	0	20	30	40	0	10	0	Riffle
5	25	2.6	0.65	0.18	-	0	0	20	30	40	0	10	0	Riffle
6	25	1.1	0.28	0.07	-	0	0	10	50	20	0	20	0	Riffle
7	25	1.8	0.45	0.10	-	0	0	10	50	20	0	20	0	Riffle
8	25	0.9	0.23	0.17	-	0	40	30	0	10	20	0	0	Run
9	25	0.8	0.20	0.07	-	0	40	30	0	10	20	0	0	Run
10	25	1.9	0.48	0.19	-	0	10	10	0	0	0	80	0	Steady
11	25	2.0	0.50	0.13	-	0	10	10	0	0	0	80	0	Steady
12	25	-	-	-	-	0	10	10	0	0	0	80	0	Steady
13	25	3.4	0.85	0.44	-	0	10	10	0	0	0	80	0	Pool

Source: Stantec 2012.

(a) Slope was not measured in the field in 2011.

(b) Habitat type determined in the field.

Aq. = aquatic; – = data are not available.

Stream PLN-S3

Stream section PLN-S3 is the main outflow of the Pike Lake watershed that flows north from a small unnamed steady to the confluence of the Walsh River. It is approximately 385 m in length and has 24.65 units of riverine habitat. Channel widths ranged from 4.1 to 14.2 m and mean depths along transects ranged from 0.21 to 0.35 m. Mean water velocities ranged from 0.02 to 0.64 m/s (Table 3-10). Stream Reaches Are Presented Starting at the Confluence with Walsh River and Ending at Headwaters

Stream Section PLN-S2

Stream section PLN-S2 flows in a northerly direction and flows from a small unnamed waterbody to the downstream unnamed steady. It is approximately 50 m in length and has 5.10 units of riverine habitat. Channel widths ranged from 6.4 to 14 m and mean depths ranged from 0.15 to 0.24 m. Mean water velocities ranged from 0.08 to 0.27 m/s (Table 3-10).

Stream PLN-S1

Stream section PLN-S1 is the outflow of Pike Lake North which flows north into a small unnamed waterbody just downstream. It is approximately 425 m in length and has 22.68 units of riverine habitat. Channel widths ranged from 3.1 to 11.8 m and mean depths ranged from 0.18 to 0.47 m. Mean water velocities ranged from 0.07 to 0.68 m/s (Table 3-10).

Stream Section PLS-S2

Stream section PLS-S2 runs northerly and is the stream section between Pike Lake South and Pike Gully. It is approximately 420 m in length and has 17.57 units of riverine habitat. Channel widths ranged from 2.7 to 6.7 m and mean depths measured at transects ranged from 0.18 to 0.45 m. Mean water velocities ranged from 0.0 to 0.32 m/s (Table 3-10).

Stream Section PLS-S1

Stream section PLS-S1 runs northerly out of Pike Lake South into Pike Gully. It is approximately 100 m in length and has 7.45 units of riverine habitat. Channel widths ranged from 3.1 to 11.8 m and mean depths at measured transects ranged from 0.13 to 0.63 m. Mean water velocities ranged from 0.12 to 0.32 m/s (Table 3-10).

Stream RP1-PLS

The outflow of the series of small ponds that flows from Rose Pond (RP1) into Pike Lake South (PLS) is approximately 450 m in length and contains 53.65 units of riverine fish habitat. Channel widths range from 2 m to 35 m and water depths between 0.18 m to 0.95 m. Water velocities during surveys ranged between 0 m/s to 0.29 m/s (Table 3-10).

Stream RP2-RP1

Stream RP02-RP01 is located and flows in a general northeast direction between Rose Pond 2 (RP2) and RP1 and is approximately 300 m in length and contains 7.33 units of fish habitat. Channel widths ranged from 0.8m to 4.9 m and depths ranged from 0.02m to 0.74 m. Mean water velocities were low and ranged from 0.00 m/s to 0.14 m/s (Table 3-10).

Stream RP3-RP2

Stream section RP3-RP2 is located and flows in a general northeast direction between Rose Pond 3 (RP3) and RP2 and is approximately 300 m in length and contains 5.60 units of fish habitat. Pond RP3 is the headwater pond for the southern portion of the Pike Lake watershed and contains no inflows. Channel widths ranged from 0.8 m to 3.9 m and depths ranged from 0.04 m to 0.58 m. Mean water velocities were low and ranged from 0.00 m/s to 0.24 m/s (Table 3-10).

3.6.1.2 Tributary Riverine Habitat, Pike Lake Watershed

The tributary stream habitat within Pike Lake consists of approximately 650 linear metres of stream that interconnects Rose Pond 4 (RP4) and Rose Pond 5 (RP5) to Rose Pond 2 (RP2). The data provided below are presented from the downstream confluence with RP2 and extending upstream to the headwater pond of RP5. Each stream section between ponds is presented separately within Table 3-11 for greater clarity.

Table 3-11: Summary of 2011 Habitat Surveys Completed in Stream RP04-RP02

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)[(a)]	Substrate (% coverage)								Habitat Type[(b)]
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
Rose Pond 2														
RP4-RP2														
1	-	1.1	-	0.13	-	0	0	0	0	15	50	35	0	Pool
2	25	0.9	0.23	0.20	-	0	0	0	0	15	50	35	0	Steady
3	25	0.7	0.18	0.28	-	0	0	0	0	15	50	35	0	Steady
4	25	1.1	0.28	0.13	-	0	0	10	10	0	80	0	0	Pool
5	25	0.5	0.13	0.09	-	0	0	10	10	0	80	0	0	Steady
6	25	1.4	0.35	0.19	-	0	0	40	45	15	0	0	0	Run
7	25	0.8	0.20	0.08	-	0	0	40	45	15	0	0	0	Run
8	25	0.9	0.23	0.31	-	0	0	20	40	20	20	0	0	Riffle
9	25	0.5	0.13	0.17	-	0	0	20	40	20	20	0	0	Riffle
10	25	1.4	0.35	0.21	-	0	0	40	30	20	0	10	0	Riffle
11	25	0.8	0.20	0.25	-	0	0	40	30	20	0	10	0	Riffle
12	25	1.1	0.28	0.23	-	0	0	30	35	20	15	0	0	Riffle
13	25	2.0	0.50	0.22	-	0	0	30	35	20	15	0	0	Riffle
14	25	1.1	0.28	0.15	-	0	0	25	55	10	10	0	0	Riffle
15	25	1.3	0.33	0.09	-	0	0	25	55	10	10	0	0	Riffle
16	25	0.4	0.10	0.14	-	0	0	40	60	0	0	0	0	Riffle
17	25	1.4	0.35	0.20	-	0	0	40	60	0	0	0	0	Steady
18	25	0.9	0.23	0.19	-	-	-	-	-	-	-	-	0	Steady
19	25	-	-	-	-	-	-	-	-	-	-	-	0	-
20	25	4.9	1.23	0.42	-	0	0	0	0	0	0	100	0	Pool
21	25	2.0	0.49	0.12	-	0	0	0	0	0	0	100	0	Steady
22	25	4.2	1.05	0.39	-	0	0	0	0	0	0	100	0	Pool
23	25	2.5	0.63	0.42	-	0	0	0	0	0	0	100	0	Pool
Rose Pond 4														
RP5-RP4														
1	-	2.6	-	0.52	-	0	0	0	0	0	0	100	0	Pool
2	25	1.4	0.35	0.25	-	0	0	0	0	0	0	100	0	Steady
3	25	2.1	0.53	0.09	-	0	0	0	0	0	0	100	0	Pool
4	25	1.9	0.48	0.11	-	0	20	25	50	0	0	5	0	Run
5	25	1.9	0.48	0.13	-	0	20	25	50	0	0	5	0	Run

Source: Stantec 2012.

(a) Slope was not measured in the field in 2011.

(b) Habitat type determined in the field.

Aq. = aquatic; – = no data available.

Stream RP4-RP2

Stream section RP4-RP2 is located between Pond RP4 and RP2 and is approximately 550 m in length and contains 8.44 units of fish habitat. Stream RP4-RP2 drains from Pond RP4 in a westerly direction into Pond RP2. There is a single stream section (RP5-RP4) and a single headwater pond (RP5) located upstream of Pond RP4. Channel widths ranged from 0.4 to 4.9 m and depths ranged from 0.09 to 0.42 m. Mean water velocities were low and ranged from 0.00 to 0.35 m/s (Table 3-11).

Stream RP5-RP4

Stream section RP5-RP4 is located and flows in a westerly direction between RP5 and RP4 and is approximately 100 m in length and contains 1.83 units of fish habitat. Pond RP5 is the headwater pond for the eastern portion of the Pike Lake watershed within the Rose Pit area and based upon mapping contains a small inflow from the north (TRIB1). Field surveys indicated that TRIB 1 is composed only of wetland pockets of standing water with no interconnecting flow or channel. Channel widths in stream RP5-RP4 ranged from 1.4 to 2.6 m and mean depths ranged from 0.09 to 0.52 m. Mean water velocities were low and ranged from 0.01 to 0.08 m/s (Table 3-11).

3.6.1.3 Riverine Fish Presence and Abundance

In addition to the consolidated fish species list outlined in Section 3.3 based on all sampling, angler interviews, and literature review, specific species presence and abundance estimates within each habitat type (riverine and lacustrine) are provided within each watershed.

Within the Pike Lake watershed, electrofishing was completed along several stream reaches. Initial electrofishing surveys only recorded fish species numbers captured (Stantec 2012) with no information on effort (time) or sweep-catch pattern; therefore, only fish species presence numbers captured is provided (Table 3-12).

Quantitative electrofishing was also completed on stream reaches within the Rose Pit as well as near the outflow of the Pike Lake watershed (Table 3-13).

Table 3-12: Summary of Total Catches for Each Species, Pike Lake Watershed. Sample Locations Are Presented from Most Downstream to Headwaters and Are Linked to Stream Reach Identifications and Shown in Figure 3-4

Sample Location	Brook Trout	Burbot	Lake Chub	Longnose Dace	Longnose Sucker	Pearl Dace	Sculpin	White Sucker
PLN S1	1	4	36	4	-	-	3	4
PLN S2	3	1	1	3	-	-	-	-
PLN S3	13	-	-	22	-	-	3	-
PLS S1	5	6	7	7	-	1	-	1
PLS S2	9	2	1	18	-	26	14	5
RP1-PLS	-	1	12	-	-	-	1	2
RP2-RP1	3	-	7	-	-	-	4	-
RP3-RP2	7	2	5	-	-	1	1	-
RP4-RP2	10	-	-	-	-	-	-	1
RP5-RP4	2		1		-	1	-	-
Total	52	16	70	44	0	29	26	13

Source: Stantec 2012.

– = Species not observed.

Table 3-13: Population and Biomass Estimates for Quantitative Electrofishing Stations Completed in Pike Lake Watershed

Site	Species	Abundance			Biomass (g)		
		Total Catch	Estimate[a]	Confidence Interval[b]	Total Biomass	Estimate[c]	Confidence Interval[b]
RP2-RP1 Stn1	Brook trout	3	2.5	0.8–4.2	126.2	126.2	84.3–105.2
	Lake chub	7	5.8	1.9–9.7	15.2	15.2	10.1–12.7
	Northern pike	2	0.8	0.3–1.4	169.1	169.1	112.9–140.9
RP2-RP1 Stn2	Lake chub	1	1.3	0.7–1.9	9.4	12.1	12.0–12.1
	White sucker	2	2.6	1.4–3.7	65.7	84.2	83.8–84.7
PLN-S3 Stn 1	Brook trout	39	29.5	15.4–51.4	682.2	516.0	269.4–899.1
	Longnose sucker	29	21.9	11.5–38.2	120.8	91.2	47.9–159.1
	Sculpin	13	9.8	5.1–17.1	36.2	27.3	14.2–47.6
PLN-S3 Stn 2	Brook trout	58	44.6	41.4–48.3	1379.5	1060.8	984.7–1148.8
	Ouananiche	4	3.1	2.8–3.3	111.7	86.6	78.2–92.2
	Lake chub	2	1.5	1.4–1.7	16.3	12.1	11.3–13.7
	Longnose sucker	53	40.8	37.6–44.2	361.4	278.2	256.4–301.4
	Sculpin	6	4.6	4.3–5.0	21.1	16.2	15.1–17.6

Source: AMEC 2012, 2014.

(a) Fish/habitat unit (100 m^2).

(b) 95% Confidence Interval.

(c) Grams/habitat unit (100 m^2).

3.6.1.4 Lacustrine Habitat, Pike Lake Watershed

All waterbodies within the Pike Lake watershed that are within the Rose Pit project footprint area were characterized and quantified, as well as the larger downstream waterbodies of Pike Lake North, Pike Lake South and Pike Gully. Results below are provided from most downstream—that is, closest to the Walsh River—to most upstream within the Rose Pit area. A summary table of general habitat characteristics is provided in Table 3-14.

Table 3-14: General Lacustrine Habitat Characteristics, Pike Lake Watershed

Waterbody	Surficial Area (m^2)	Secchi Depth (m)	Maximum Depth (m)	Mean Depth (m)	Substrate						
					Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Muck
Pike Lake North	530,102	6.6	10	8.2	5	25	35	15	10	5	5
Pike Gully	40,846	-	-	-	0	30	12	0	0	5	53
Pike Lake South	897,755	4.5	10.6	2.2	0	15	16	21	1	8	39
Rose Pond (RP1)	87,387	1.4	-	0.7	0	1	1	0	0	0	98
Rose Pond 2 (RP2)	106,825	2.5	-	4.3	0	9	5	4	0	14	68
Rose Pond 3 (RP3)	117,145	2.1	-	2.2	0	10	1	0	0	1	89
Rose Pond 4 (RP4)	92,221	4.8	-	9.0	0	13	9	0	0	56	23
Rose Pond 5 (RP5)	25,296	2.6	-	2.4	0	3	5	6	3	34	50

Sources: Stantec 2012; AMEC 2012; WSP 2024.

Note: Characteristics are those primarily used in habitat quantification.

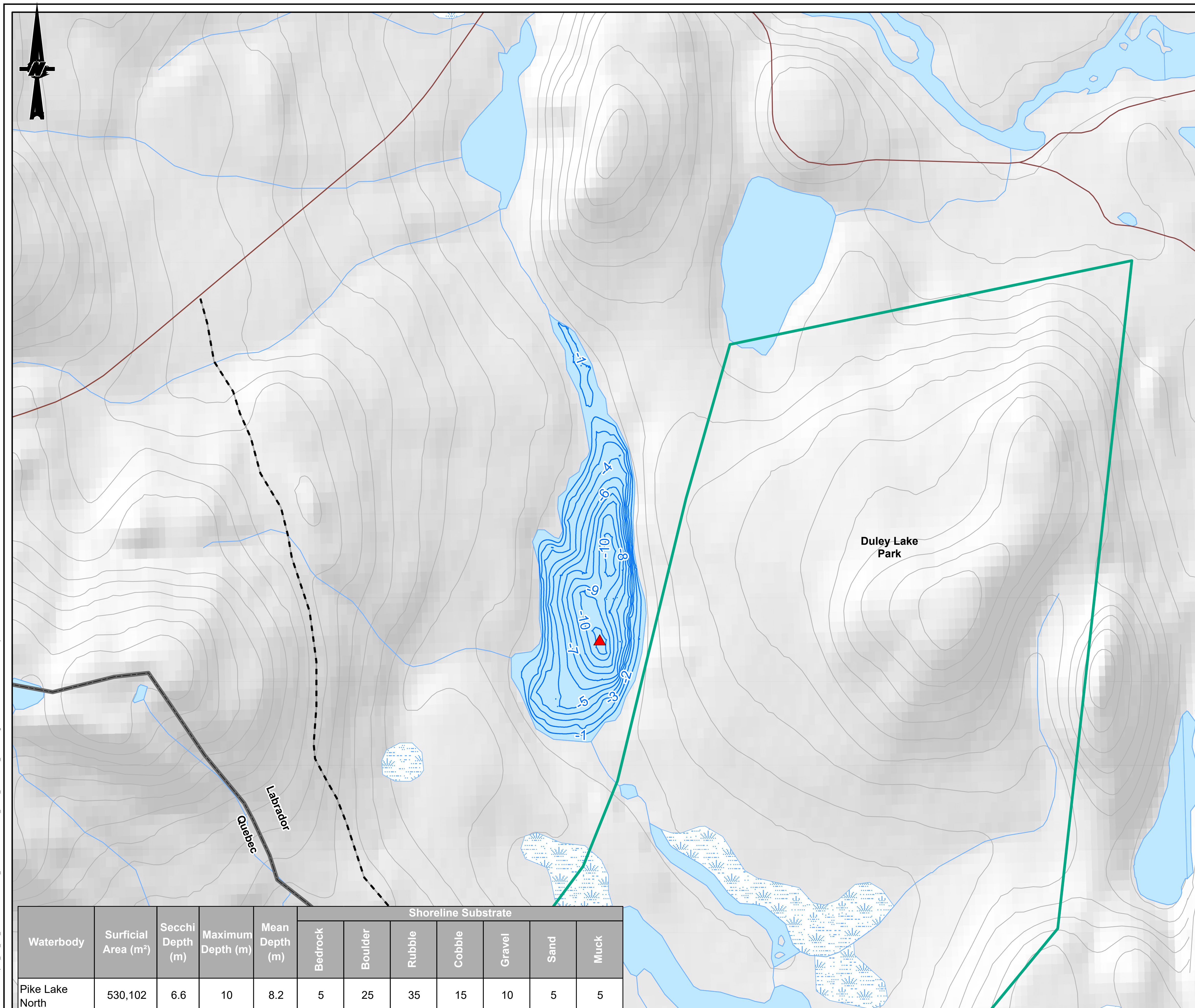
– = Data not available .

Pike Lake North has a surface area of just over 0.5 km^2 and is located downstream of the Project. Shoreline substrate was predominantly rubble and boulder with aquatic vegetation near its inflow and outflow. Pike Lake North had a maximum measured water depth of 10 m, with a mean of 8.2 m and a Secchi depth of 6.6 m (Figure 3-6).

Pike Lake South is the largest waterbody in the system (~0.9 km^2) but is relatively shallower than Pike Lake North with the dominant substrate type being muck. Pike Lake South had a maximum measured water depth of 10.6 m, with a mean of 2.2 m and a Secchi depth of 4.5 m (Figure 3-7).

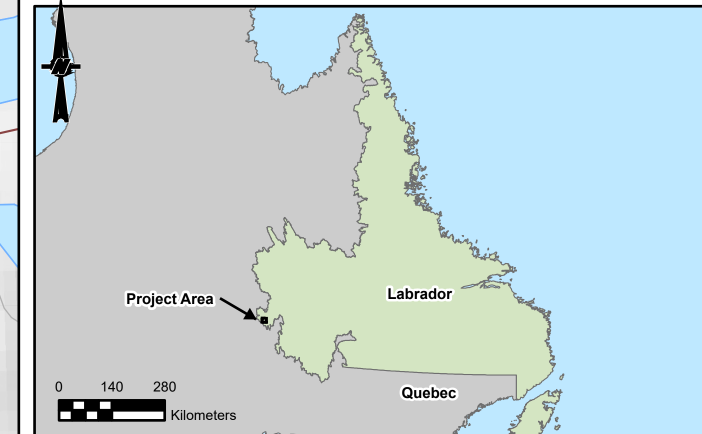
Pike Gully was too shallow to complete bathymetry surveys (<1 m throughout). It was much smaller in size than both Pike Lake North and South at approximately 0.04 km^2 but lies between both. It was dominated by muck substrate type with interspersed boulders.

The five small waterbodies within the Rose Pit project area were surveyed extensively. Muck made up the majority of the substrate coverage in all of the waterbodies, with the exception of Rose Pond 4 (RP4), where sand was the most dominant (Table 3-14). Mean depths within the ponds ranged from 0.7 m in Rose Pond (RP1) to 9.0 m in RP4. Figure 3-6 through Figure 3-12 presents the bathymetric survey data and substrate distribution within each waterbody.



Waterbody	Surficial Area (m²)	Secchi Depth (m)	Maximum Depth (m)	Mean Depth (m)	Shoreline Substrate						
					Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Muck
Pike Lake North	530,102	6.6	10	8.2	5	25	35	15	10	5	5

KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA
- Deepest Point in Lake
- Depth Location

PROPOSED PROJECT INFRASTRUCTURE
- Proposed Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION
- Road
- Contour
- Waterbody
- Bog/Wetland
- Watercourse
- Railway

0 170 340 680

1:16,020 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE PROJECT
WABUSH, NL

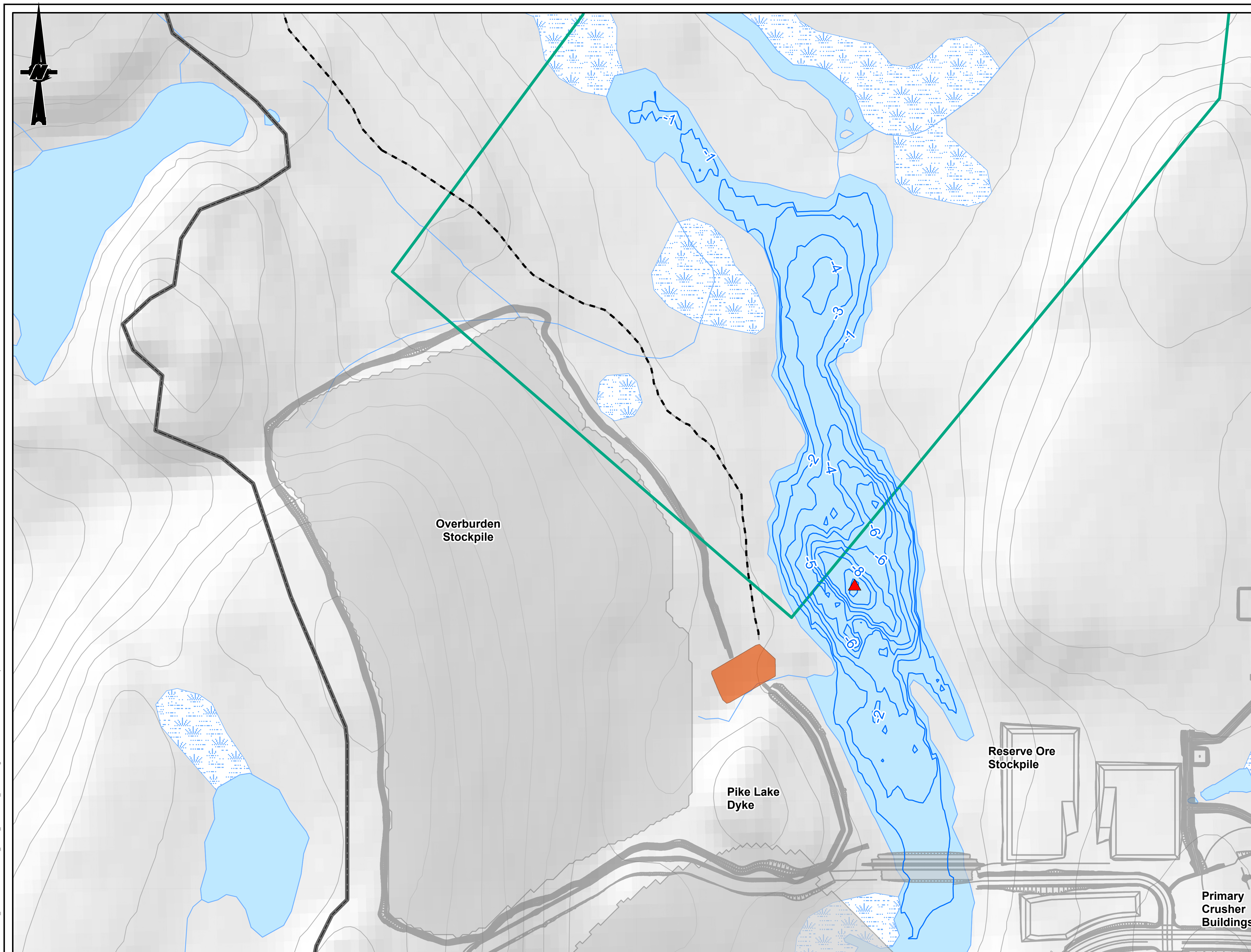
TITLE
PIKE LAKE NORTH BATHYMETRY

CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

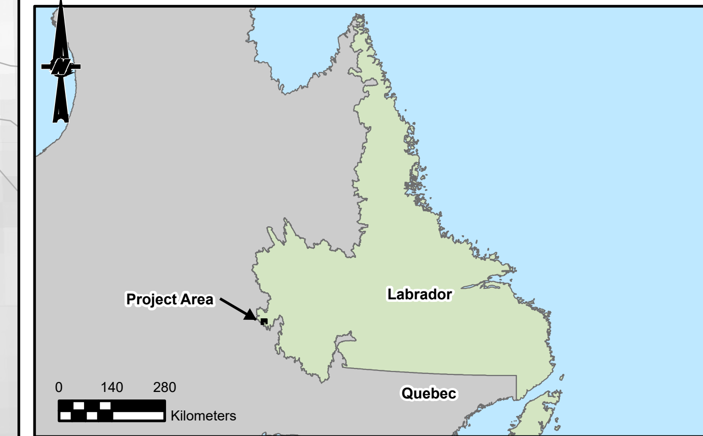
PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



Waterbody	Surficial Area (m^2)	Secchi Depth (m)	Maximum Depth (m)	Mean Depth (m)	Substrate						
					Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Muck
Pike Lake South	897,755	4.5	2.2	10.6	0	15	16	21	1	8	39

KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA

- Deepest Point in Lake
- Depth Location

PROPOSED PROJECT INFRASTRUCTURE

- Proposed Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION

- Road
- Contour
- Waterbody
- Bog/Wetland
- Watercourse
- Railway

0 135 270 540

1:12,500 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE PROJECT
WABUSH, NL

TITLE

2023 PIKE LAKE SOUTH BATHYMETRY

CONSULTANT

wsp

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: S:\Clients\Champion_Iron_Ore_Mines\Kami Iron Ore\99_PROJ\CA0038713.5261_EIS\40_PROD\0026_FishOffsetting\CA0038713-5261-0026-RB-0001.aprx PRINTED ON: AT: 10:18:16 AM

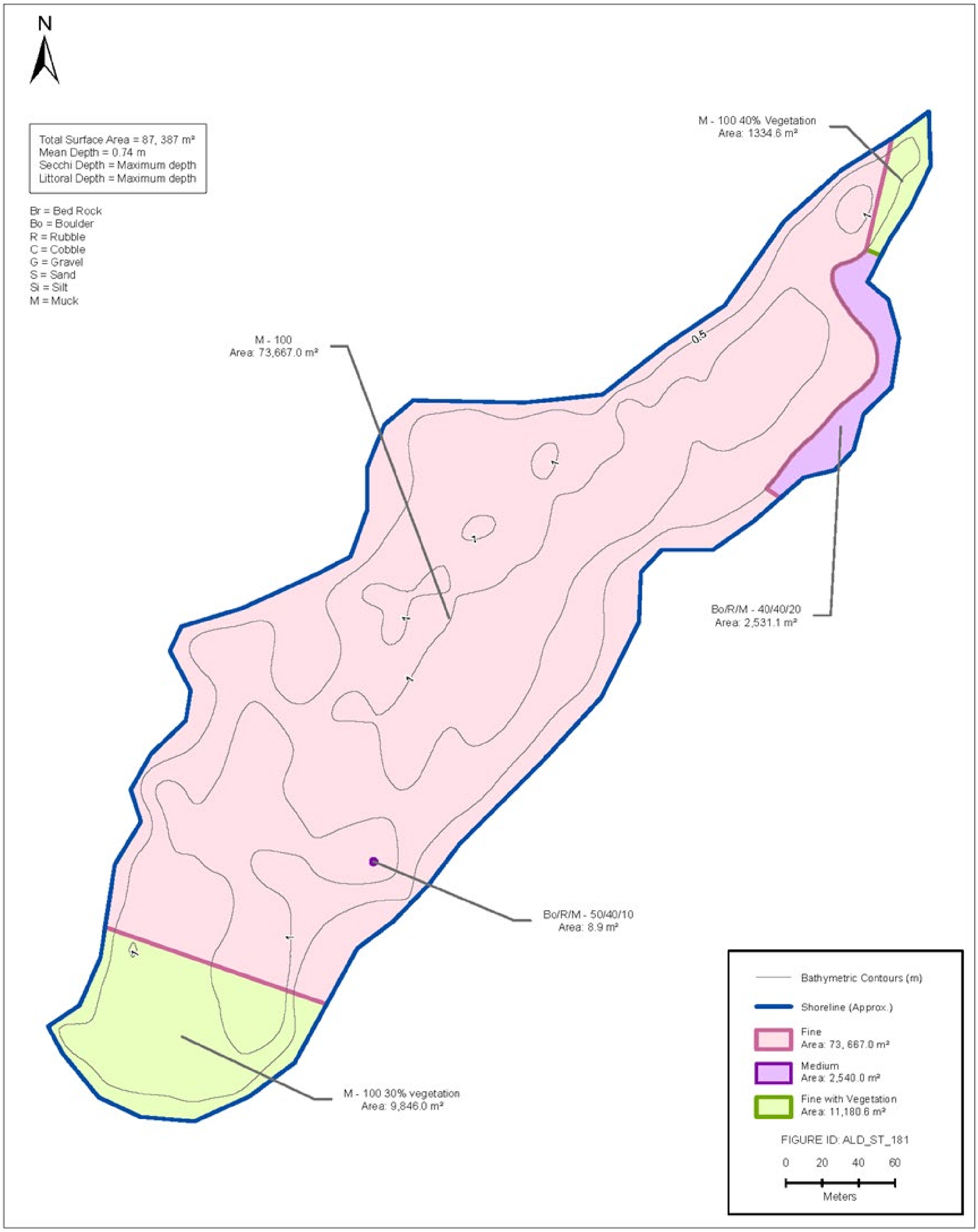


Figure 3-8: Bathymetry and Substrate Distribution, Rose Pond (RP1)

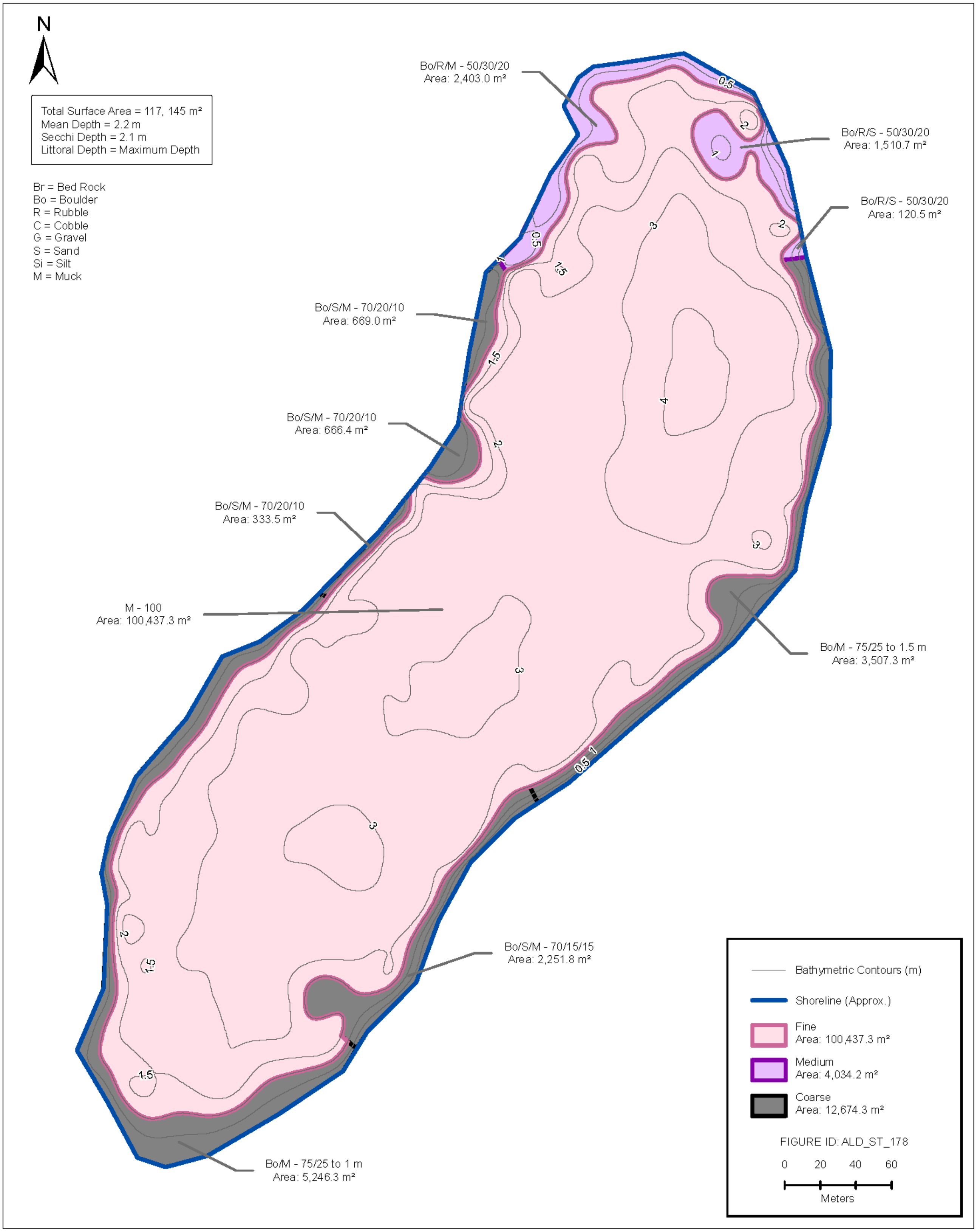


Figure 3-9: Bathymetry and Substrate Distribution, Rose Pond 2 (RP2)

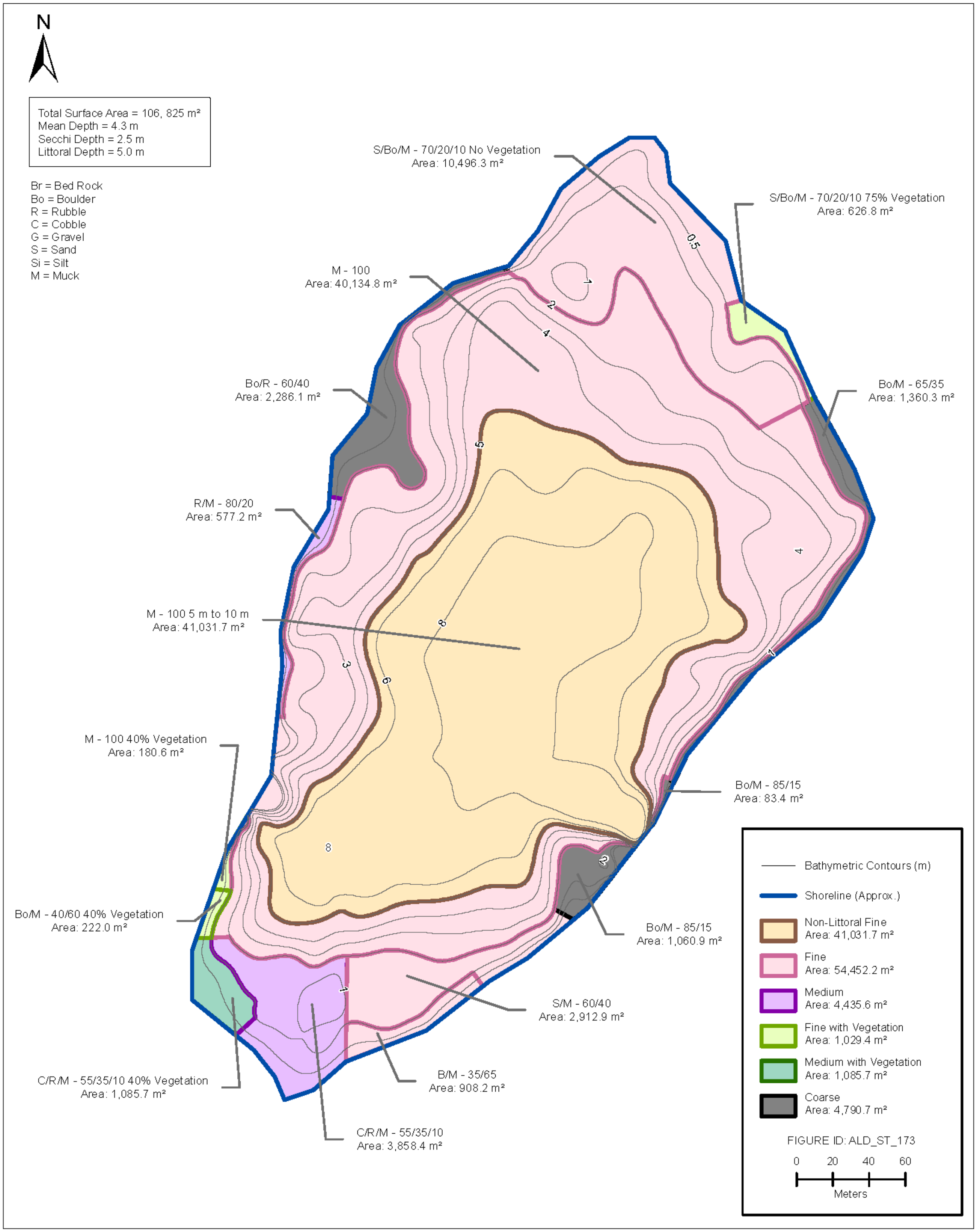


Figure 3-10: Bathymetry and Substrate Distribution, Rose Pond 3 (RP3)

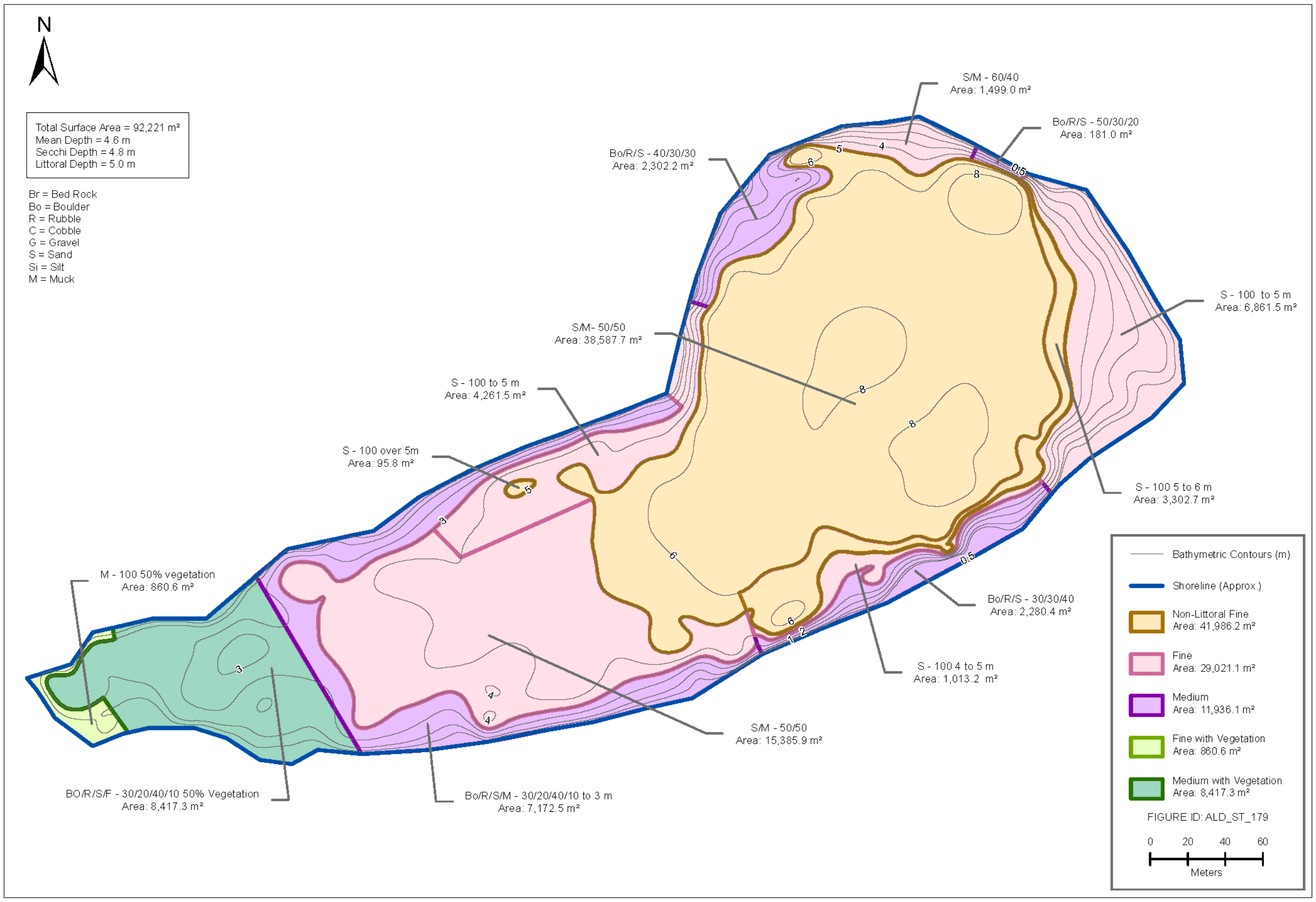


Figure 3-11: Bathymetry and Substrate Distribution, Rose Pond 4 (RP4)

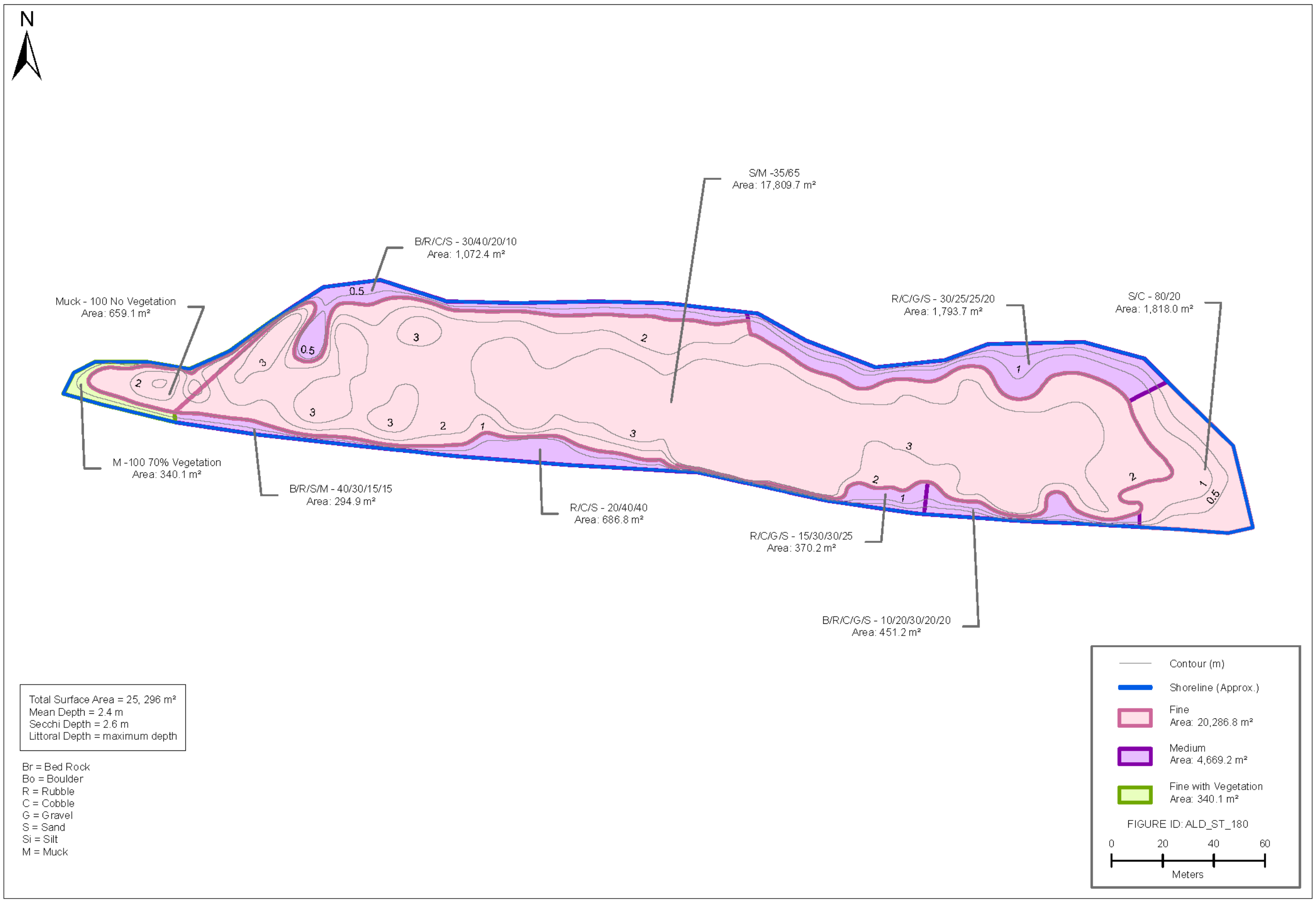


Figure 3-12: Bathymetry and Substrate Distribution, Rose Pond 5 (RP5)

3.6.1.5 Lacustrine Fish Presence and Abundance

Fish communities within the Pike Lake watershed have been sampled in several waterbodies since 2011, utilizing a combination of fyke nets, tended gill nets and minnow traps. Similar to electrofishing surveys, the intended outcome of lacustrine fish surveys has varied throughout the years of baseline assessment, with species presence and relative abundance (catch-per-unit effort; CPUE) being the focus in 2011 and 2023, with select population estimates being undertaken during 2012.

Within the Pike Lake watershed, fish presence/CPUE sampling surveys recorded various fish species at various CPUE values throughout the watershed using fyke nets (Table 3-15) and tended gill nets (Table 3-16).

Multiple mark-recapture surveys provide population estimates for various waterbodies within the watershed, with the focus being on those within and nearest to the Project footprint (Table 3-17).

Table 3-15: Summary of Fyke Net Abundance Catch-per-Unit Effort and Biomass from Various Locations Throughout the Project Area

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/net-night)	Total Catch (g)	CPUE (grams/net-night)
2023 Pike Lake North (PLN)	Burbot	3	0.30	30.8	3.08
	Lake chub	1	0.10	8.3	0.83
	Northern pike	11	1.10	67.9	6.79
	Sculpin	8	0.80	10.8	1.08
	White sucker	31	3.10	10,240.7	1,024.07
	Total	54	5.40	10,358.5	1,035.85
2011 Pike Lake South (PLS)	Burbot	2	1.00	1.2	0.60
	Lake chub	7	3.50	18.6	9.30
	Northern pike	3	1.50	2,405.5	1,202.75
	Sculpin	10	5.00	11.6	5.80
	Total	22	11.00	2,436.9	1,218.45
2012 Pike Lake South (PLS)	Burbot	31	1.29	68.3	2.85
	Lake chub	1	0.04	4.6	0.19
	Northern pike	14	0.58	7,090.4	295.43
	Sculpin	3	0.13	12.5	0.52
	Total	49	2.04	7,175.8	298.99
2012 Pike Gully	Burbot	2	0.33	16.5	2.75
	Northern pike	3	0.50	202.0	33.67
	White sucker	63	10.50	13,529.5	2,254.92
	Total	68	11.33	13,748.0	2,291.34
2011 Rose Pond 1 (RP1)	Burbot	1	0.50	38.0	19.00
	Lake chub	639	319.50	1,919.7	959.85
	Northern pike	1	0.50	126.5	63.25
	White sucker	11	5.50	808.1	404.05
	Total	652	326.00	2,892.3	1,446.15
2012 Rose Pond 1 (RP1)	Brook trout	6	0.24	1794.4	71.78
	Burbot	3	0.12	32.9	1.32
	Lake chub	2	0.08	11.2	0.45
	Northern pike	42	1.68	7,677.6	307.11
	Sculpin	3	0.12	8.0	0.32
	White sucker	7	0.28	1,509.1	60.36
	Total	63	2.52	11,033.2	441.34

Table 3-15: Summary of Fyke Net Abundance Catch-per-Unit Effort and Biomass from Various Locations Throughout the Project Area

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/net-night)	Total Catch (g)	CPUE (grams/net-night)
Rose Pond 2 (RP2)	Lake chub	6	3.00	24.4	12.20
	Northern pike	2	1.00	1,195.0	597.50
	Sculpin	13	6.50	23.0	11.50
	Total	21	10.50	1,242.4	621.20
Rose Pond 3 (RP3)	Northern pike	2	1.00	2,594.1	1,297.07
	Total	2	1.00	2,594.1	1,297.07
Rose Pond 4 (RP4)	Brook trout	2	1.00	198.7	99.35
	Burbot	9	4.50	606.0	303.00
	Lake chub	40	20.00	386.8	193.38
	Pearl dace	29	14.50	198.3	99.15
	Sculpin	1	0.50	0.5	0.25
	White sucker	41	20.50	1,089.0	544.49
	Total	122	61.00	2,479.2	1,239.62
Rose Pond 5 (RP5)	Burbot	2	1.00	50.3	25.15
	Lake chub	95	47.50	856.7	428.35
	Pearl dace	33	16.50	168.6	84.30
	Sculpin	1	0.50	1.5	0.75
	White sucker	9	4.50	110.4	55.20
	Total	140	70.00	1,187.5	593.75

Sources: Stantec 2012; AMEC 2012; WSP 2024.

CPUE = catch-per-unit effort.

Table 3-16: Summary of Gill Net Abundance Catch-per-Unit Effort and Biomass from Various Locations Throughout the Project Area

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/hour)	Total Catch (g)	CPUE (grams/hour)
Pike Lake South (PLS)	Northern pike	1	0.25	2,980.7	745.18
	White sucker	1	0.25	17.6	4.40
	Total	2	0.50	2,998.3	749.58
Rose Pond 1 (RP1)	Total	0	0.00	0.0	0.00
Rose Pond 2 (RP2)	Northern pike	1	0.25	1,338.4	334.6
	Total	1	0.25	1,338.4	334.6
Rose Pond 3 (RP3)	Northern pike	2	0.50	3,123.0	780.75
	Total	2	0.50	3,123.0	780.75

Table 3-16: Summary of Gill Net Abundance Catch-per-Unit Effort and Biomass from Various Locations Throughout the Project Area

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/hour)	Total Catch (g)	CPUE (grams/hour)
Rose Pond 4 (RP4)	White sucker	3	0.75	2,394.7	598.68
	Total	3	0.75	2,394.7	598.68
Rose Pond 5 (RP5)	Brook trout	7	1.75	1,790.2	447.55
	White sucker	11	2.75	3,988.8	997.20
	Total	18	4.50	5,779.0	1,444.75

Sources: Stantec 2012.
CPUE = catch-per-unit effort.

Table 3-17: Summary of Number of Fish Caught and Population Estimates from Waterbodies Within the Pike Lake Watershed

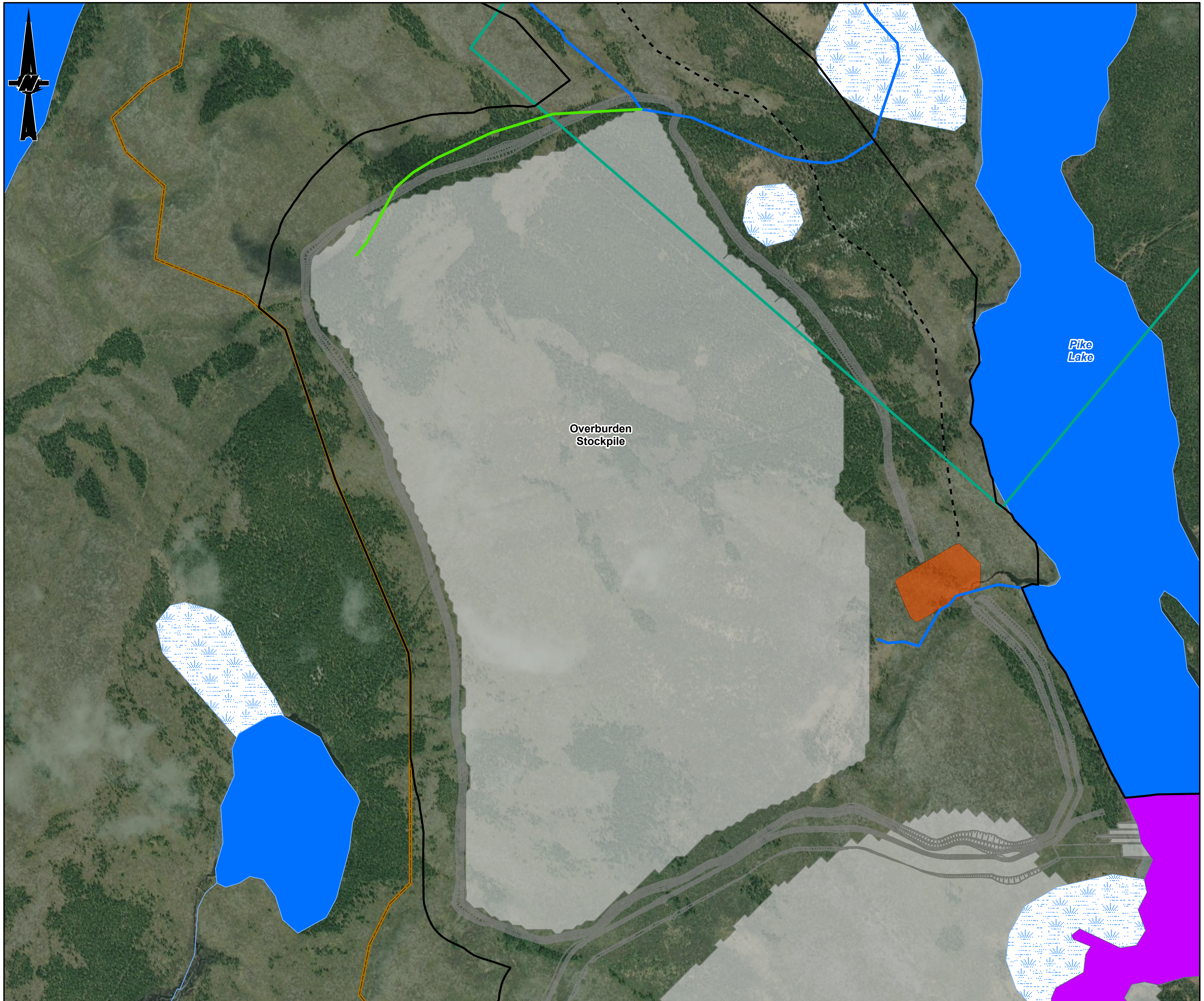
Waterbody	Species	Total Catch	Total Recaptures	Population Estimate[(a)]	95% Confidence Interval
Pike Lake South (PLS)	Brook trout	0	0	-	-
	Northern pike	14	1	38	11-73
Pike Gully	Brook trout	0	0	-	-
	Northern pike	3	3[(b)]	3[(c)]	-[(c)]
Rose Pond 1 (RP1)	Brook trout	6	0[(b)]	6	2-12
	Northern pike	42	4	128	57-306

Source: AMEC 2012.
(a) Estimates based on Schnabel method in Fisheries Stock Assessment Package (Ogle 2016) for R (R Core Team 2020).
(b) No recaptures observed. One recaptured assumed on last day to complete calculations.
(c) Low catch rates resulted in poor estimates. Total catch is presented as estimate and confidence intervals are not presented.
– = Not applicable.

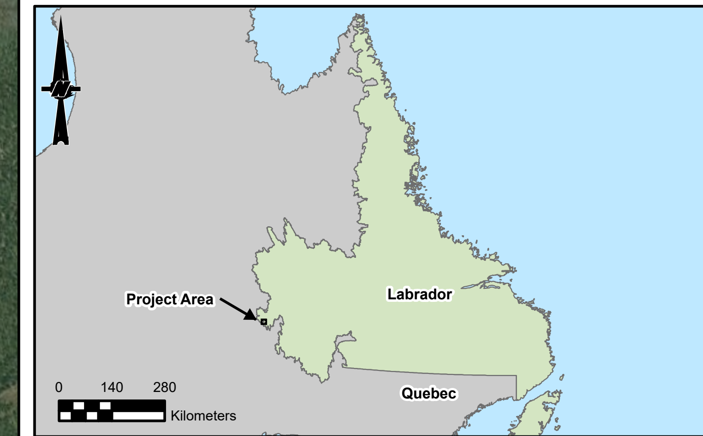
3.6.2 Overburden Stockpile

The overburden stockpile area is located to the northwest of the Rose Pit area and is approximately 205 ha in size. It has a small sub-tributary stream along its northern boundary that drains into a tributary of the Pike Lake watershed main stem with its confluence in Pike Lake South (PLS). This sub-tributary has no waterbody or source associated with it, except possible groundwater (Figure 3-13).

The stream is 795 m in length and consists of intermittent habitat with an overall drainage area upstream of its confluence with Pike South estimated at 205 ha. It flows into another small stream that empties into Pike Lake South. Based on previous work completed in Labrador West, the drainage area is sufficiently small that the stream is likely intermittent in nature and only contains flow during high spring or heavy rainfall flow events. Investigations in Labrador West, for the former Wabush Mine, and Voisey's Bay on small streams, at the request of DFO, indicated that drainages less than 2.5 km^2 were frozen completely in winter and dry during the low-flow period in summer and therefore not viable fish habitat. The overburden stockpile spans two watersheds: Pike Lake South (203 ha), and Rose Lake (2.3 ha). The total catchment area that the overburden stockpile will affect is 205.3 ha.



KEY MAP



SCALE 1:20,000,000

LEGEND

FISH HABITAT AUTHORIZATION

- Fish Habitat
- Schedule 2 MDMER HADD
- Section 35 HADD

PROPOSED PROJECT INFRASTRUCTURE

- Site Study Area (SSA)
- Proposed Project Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION

- Labrador/Quebec Boundary
- Duley Lake Park
- Wetland/Bog
- River/Stream

0 95 190 380

1:9,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: MAXAR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

SMALL STREAM ALONG THE NORTH BOUNDARY OF THE OVERBURDEN STOCKPILE

CONSULTANT

wsp

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-13

3.6.3 Mine Rock Stockpile

The mine rock stockpile area is contained within the Duley Lake watershed and is approximately 680 ha in size and flows from a series of large headwater ponds along the Labrador–Québec border approximately 12 km south of the mine rock stockpile via the Waldorf River. Duley Lake is at the confluence of the watershed where it empties into the Walsh River.

The mine rock stockpile is located at the southern end of Duley Lake between the Waldorf River on its east side and Mills Lake to the west. Mills Lake empties into Duley Lake to the north of the mine rock stockpile. The hydrology of the Duley Lake system is described in Section 3.5.4.

The fish and fish habitat within the Duley Lake watershed is extensive and includes a total of approximately 40,000 m of linear stream habitat along the main stem and at least 10 larger lakes and numerous smaller ponds, including Duley Lake, Swanson Lake, Strawberry Lake, and two large unnamed lakes near the southern border with Québec. The watershed also includes a large tributary from the west that drains Mills Lake and Beardon Lake into Duley Lake and a large tributary from the east that drains Riordan Lake and Elephant Head Lake from the west. Much of the watershed main stem is south of the Project area and beyond any Project influence. Additionally, much of the western Mills Lake and eastern Riordan Lake tributaries are beyond Project influence; however, provided below are the habitat characteristics of the Duley Lake watershed, including the habitat within and near the footprint of the mine rock stockpile infrastructure. The mine rock stockpile footprint spans three basins: the east, west, and north basins.

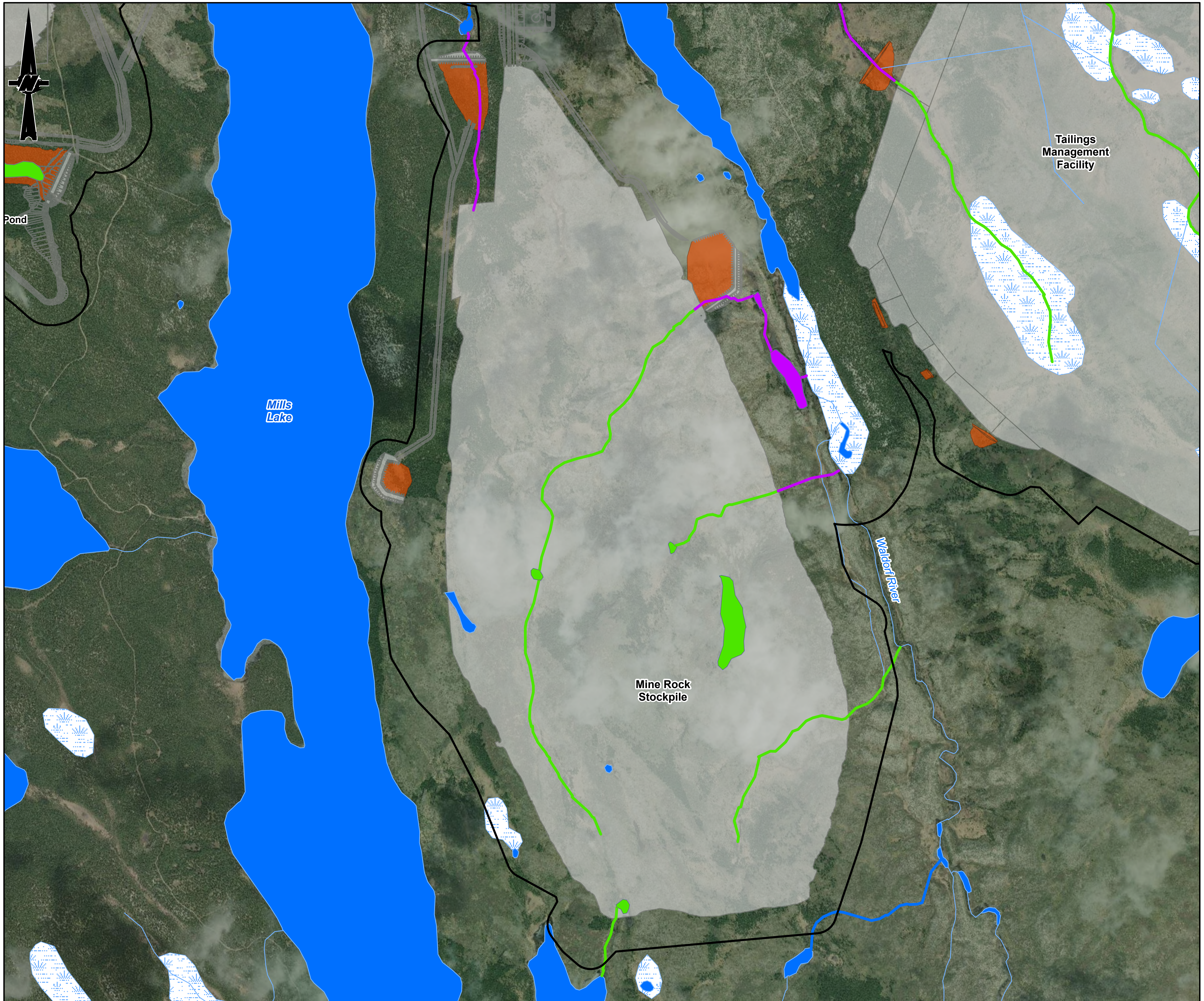
The east mine rock stockpile basin spans two watersheds: Duley Lake (1 ha), and Waldorf River (178.2 ha), with a total catchment effect of 356.9 ha.

The west mine rock stockpile basin spans two watersheds: Mills Lake (40.6 ha), and Waldorf River (178.2 ha), with a total catchment effect of 218.8 ha.

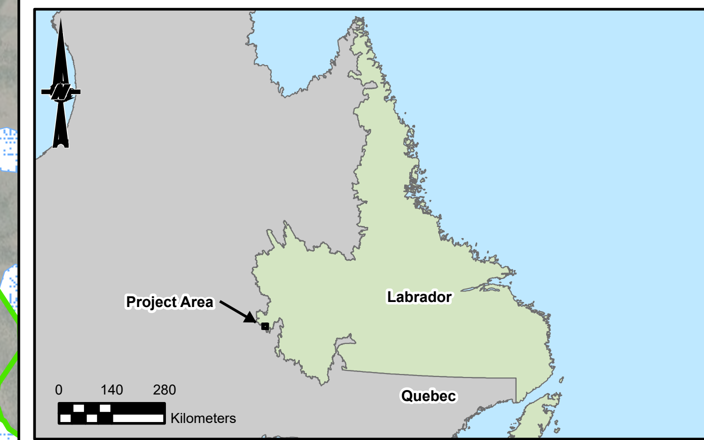
The north mine rock stockpile basin spans three watersheds: Duley Lake (77.6 ha), Mills Lake (2.8 ha), and Waldorf River (23.8 ha) with a total catchment effect of 104.2 ha. The total catchment area that the mine rock stockpile will affect is 679.9 ha.

3.6.3.1 Riverine Habitat Within the Mine Rock Stockpile, Duley Lake Watershed

The mine rock stockpile was relocated during the previous EIS based on public consultation, engineering optimization, and environmental considerations. There are a total of five streams identified within the mine rock stockpile (AD01, AD02, AD03, AD04, AD05). Of the four streams present, only one has a mean width near 1 m. AD01 drains from the northern most portion of the stockpile and empties into the outflow of Mills Lake which then empties into Duley Lake. AD02, AD03, AD04, and AD05 drain the remainder of the waste rock area to the east, into Waldorf River (Figure 3-14) (AMEC 2012). The majority of the habitat is characterized as shallow, boggy drainage (13 reaches as pools), dominated by sand, fine material and aquatic vegetation. Steady (six reaches) and run (five reaches) habitat were the only other habitat types surveyed, and were only found in AD02 and AD05 (Table 3-18 through Table 3-22).



KEY MAP



SCALE 1:20,000,000

LEGEND

FISH HABITAT AUTHORIZATION

- Fish Habitat
- Schedule 2 MDMER HADD
- Section 35 HADD

PROPOSED PROJECT INFRASTRUCTURE

- Site Study Area (SSA)
- Proposed Project Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION

- Labrador/Quebec Boundary
- Duley Lake Park
- Wetland/Bog
- River/Stream

0 200 400 800

1:19,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: EARTHSTAR GEOGRAPHICS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
GENERAL LOCATION OF FISH HABITAT, MINE ROCK STOCKPILE

CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-14

Table 3-18: Summary of Habitat Surveys Completed in Stream AD01, Mine Rock Stockpile

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)	Substrate (% coverage)								Habitat Type
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
1	100	0.8	0.21	0.33	0.08	0	0	0	0	0	0	20	80	Pool
2	100	0.7	0.38	0.11	0.80	0	0	0	0	0	0	20	80	Pool
3	100	1.2	0.25	0.09	0.55	0	0	0	0	0	0	20	80	Pool
4	100	0.3	0.33	0.00	1.60	0	0	0	0	0	0	20	80	Pool
5	100	0.5	0.21	0.00	0.85	0	0	0	0	0	0	5	95	Pool

Source: AMEC 2012.

Aq. = aquatic.

Table 3-19: Summary of Habitat Surveys Completed in Stream AD02, Mine Rock Stockpile

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)	Substrate (% coverage)								Habitat Type
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
1	100	0.3	0.04	0.27	0.00	0	0	0	10	40	30	20	0	Pool
2	100	0.4	0.04	0.03	1.21	0	0	0	10	30	50	10	0	Steady
3	100	0.4	0.04	0.00	6.34	0	0	0	5	20	35	40	0	Run
4	100	0.2	0.06	0.00	4.79	0	0	0	0	0	60	40	0	Run
5	100	0.4	0.03	-	7.66	0	0	0	5	10	60	25	0	Run
6	100	0.6	0.08	0.00	1.17	0	0	0	0	5	25	70	0	Steady
7	100	0.8	0.03	0.04	2.22	0	0	0	10	10	40	40	0	Steady
8	100	0.9	0.04	0.00	1.33	0	0	0	10	25	30	35	0	Steady
9	44	0.4	0.10	0.00	3.17	0	0	0	0	5	30	65	0	Steady

Source: AMEC 2012.

Aq. = aquatic; – = data not available.

Table 3-20: Summary of Habitat Surveys Completed in Stream AD03, Mine Rock Stockpile

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)	Substrate (% coverage)								Habitat Type
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
1	100	0.5	0.11	0.19	0.0	0	0	0	0	2	20	75	0	Pool
2	100	0.4	0.14	0.04	0.0	0	0	0	0	0	40	60	0	Pool
3	120	0.7	0.09	0.05	0.0	0	0	0	0	0	50	50	0	Pool

Source: AMEC 2012.

Aq. = aquatic.

Table 3-21: Summary of Habitat Surveys Completed in Stream AD04, Mine Rock Stockpile

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)	Substrate (% coverage)								Habitat Type
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
1	100	0.2	0.10	0.01	0.30	0	0	0	0	0	30	70	0	Pool
2	100	0.9	0.02	0.15	2.42	0	0	0	0	0	60		0	Steady
3	43	0.9	0.09	0.08	16.76	0	0	0	0	0	60		0	Run
4	100	0.7	0.05	0.08	0.00	0	0	0	0	0	60	40	0	Pool
5	100	0.7	0.05	0.00	0.26	0	0	0	0	0	60	30	0	Pool
6	100	0.6	0.03	0.43	1.38	0	0	0	0	0	40	25	0	Pool
7	100	0.4	0.05	0.00	6.13	0	0	0	0	0	40	15	0	Run
8	120	0.2	0.04	0.00	1.40	0	0	0	0	0	40	60	0	Pool

Source: AMEC 2012.

Aq. = aquatic.

Table 3-22: Summary of Habitat Surveys Completed in Stream AD05, Mine Rock Stockpile

Reach #	Section Length (m)	Wetted Width (m)	Area (units)	Average Depth (m)	Average Velocity (m/s)	Slope (%)	Substrate (%)												Classification
							B	LgB	SmB	R	C	G	S	St	Cl	D	M	AqV	New
1	60	1.3	0.78	0.05	0.10	21.02	0	10	60	20	10	0	0	0	0	0	0	0	Rapids
2	100	1.1	1.10	0.06	0.20	2.62	0	0	40	20	0	0	0	0	0	0	30	10	Riffle
3	100	0.7	0.67	0.05	0.00	1.22	0	0	0	0	0	0	0	0	0	5	30	65	Riffle
4	100	1.0	1.00	0.09	0.08	2.83	0	0	0	0	0	0	0	0	0	0	30	70	Riffle
5	45	1.2	0.52	0.11	0.05	0.31	0	0	0	0	0	0	0	0	0	0	20	80	Pool
6	100	1.2	1.20	0.06	0.30	14.68	0	0	5	15	10	0	10	0	0	0	20	40	Riffle
7	100	0.6	0.64	0.05	0.19	0.56	0	0	15	10	0	0	0	0	0	0	25	50	Pool
8	100	1.6	1.60	0.10	0.17	2.67	0	0	0	30	0	0	0	0	0	0	30	40	Riffle
9	46	0.8	0.35	0.10	0.24	0.20	0	0	0	0	0	0	0	0	0	5	20	75	Riffle
10	100	1.0	1.00	0.08	0.27	0.00	0	0	0	0	0	0	0	0	0	0	20	80	Riffle
11	100	1.1	1.05	0.11	0.20	0.24	0	0	0	0	0	0	0	0	0	0	20	80	Pool
12	100	0.8	0.84	0.08	0.26	0.24	0	0	5	5	0	0	0	0	0	0	20	70	Riffle
13	100	0.8	0.84	0.28	0.01	0.00	0	0	0	0	0	0	0	0	0	0	20	80	Pool
14	100	0.6	0.64	0.11	0.09	0.67	0	0	0	0	0	0	0	0	0	0	20	80	Pool
15	100	0.9	0.90	0.13	0.03	0.00	0	0	0	0	0	0	0	0	0	0	20	80	Pool
16	100	0.7	0.74	0.20	0.00	0.00	0	0	0	0	0	0	0	0	0	0	20	80	Pool
17	100	1.0	1.00	0.28	0.00	0.00	0	0	0	0	0	0	0	0	0	0	20	80	Pool
18	100	1.0	1.00	0.13	0.15	0.91	0	0	0	5	0	0	0	0	0	0	20	75	Pool
19	100	1.0	1.00	0.07	0.17	0.75	0	0	0	10	0	0	0	0	0	0	10	80	Pool
20	100	1.7	1.70	0.07	0.21	1.82	0	0	0	10	0	0	0	0	0	0	20	70	Riffle
21	100	1.6	1.60	0.24	0.01	0.00	0	0	0	0	0	0	0	0	0	0	20	80	Pool
22	100	1.5	1.50	0.23	0.00	0.00	0	0	0	0	0	0	0	0	0	0	10	90	Pool
23	100	1.0	1.00	0.24	0.00	0.00	0	0	0	0	0	0	0	0	0	0	10	90	Pool
24	60	0.9	0.52	0.08	0.13	0.00	0	0	0	0	0	0	0	0	0	0	10	90	Pool
25	100	0.9	0.90	0.09	0.07	3.33	0	0	0	0	0	0	0	0	0	0	20	80	Riffle
26	100	0.9	0.86	0.11	0.11	1.94	0	0	0	25	20	20	10	0	0	0	25	0	Run
27	100	0.9	0.94	0.04	0.14	0.37	0	0	5	15	20	35	20	0	0	0	5	0	Pool
28	100	0.7	0.70	0.08	0.11	0.17	0	0	0	15	25	30	25	0	0	0	5	0	Pool
29	100	1.2	1.20	0.03	0.18	0.91	0	0	10	20	10	20	20	10	0	0	10	0	Pool
30	100	0.6	0.60	0.07	0.11	0.00	0	0	0	5	0	0	5	0	0	0	90	0	Pool
31	100	0.4	0.42	0.07	0.00	2.17	0	0	10	20	30	0	10	0	0	0	30	0	Run
32	100	0.5	0.50	0.08	0.00	0.00	0	0	0	10	0	0	0	0	0	0	90	0	Pool
33	60	0.4	0.26	0.02	-	0.45	0	0	0	15	0	10	10	15	0	0	50	0	Pool

B = bedrock; LgB = large boulder; SmB = small boulder; R = Rubble; C = cobble; G = gravel; S = sand; St = silt; Cl = clay; D = detritus; M = muck; AqV = aquatic vegetation; – = no data.

3.6.3.2 Riverine Fish Presence and Abundance

In addition to the consolidated fish species list outlined in Section 3.3 based on all sampling, angler interviews, and literature review, specific species presence and abundance estimates within each habitat type (riverine and lacustrine) are provided within each watershed.

Within the mine rock stockpile area of the Duley Lake watershed, electrofishing was completed along the two larger streams: AD01 and AD05. At the time of quantitative electrofishing surveys, these were the only streams that contained any flow (Table 3-23). AD02 and the upper reaches of AD05 were electrofished in isolated pockets of water.

Two index electrofishing stations were completed in Duley Lake Outflow on August 4, 2023. White sucker and sculpin were the most abundant species observed within Duley Lake inflow, while brook trout and white sucker yielded the most biomass (Table 3-24).

3.6.3.3 Lacustrine Habitat within Mine Rock Stockpile, Duley Lake Watershed

While there are many larger waterbodies within the Duley Lake watershed, none will be affected by the mine rock stockpile area water management. However, Mills Lake and Duley Lakewere surveyed in 2023 (Figure 3-15 and , respectively). The mitigations related to water management and quality are provided in Section 4.2.

Table 3-23: Population and Biomass Estimates for Quantitative Electrofishing Stations Completed in Waste Rock Stockpile, Duley Lake Watershed

Site	Species	Abundance			Biomass (g)		
		Total Catch	Estimate[(a)]	Confidence Interval[(b)]	Total Biomass	Estimate[(c)]	Confidence Interval[(b)]
AD01 Stn1	Brook trout	4	3.2	1.7–4.7	13.9	11.1	11.0–11.3
AD02 Stn 1	No fish captured						
AD05 Stn2	Brook trout	35	23.6	19.7–27.5	195.3	125.0	121.0–129.0
AD04 Stn 1	No fish captured						

Source: AMEC 2012.

(a) Fish/habitat unit (100 m^2).

(b) 95% Confidence Interval.

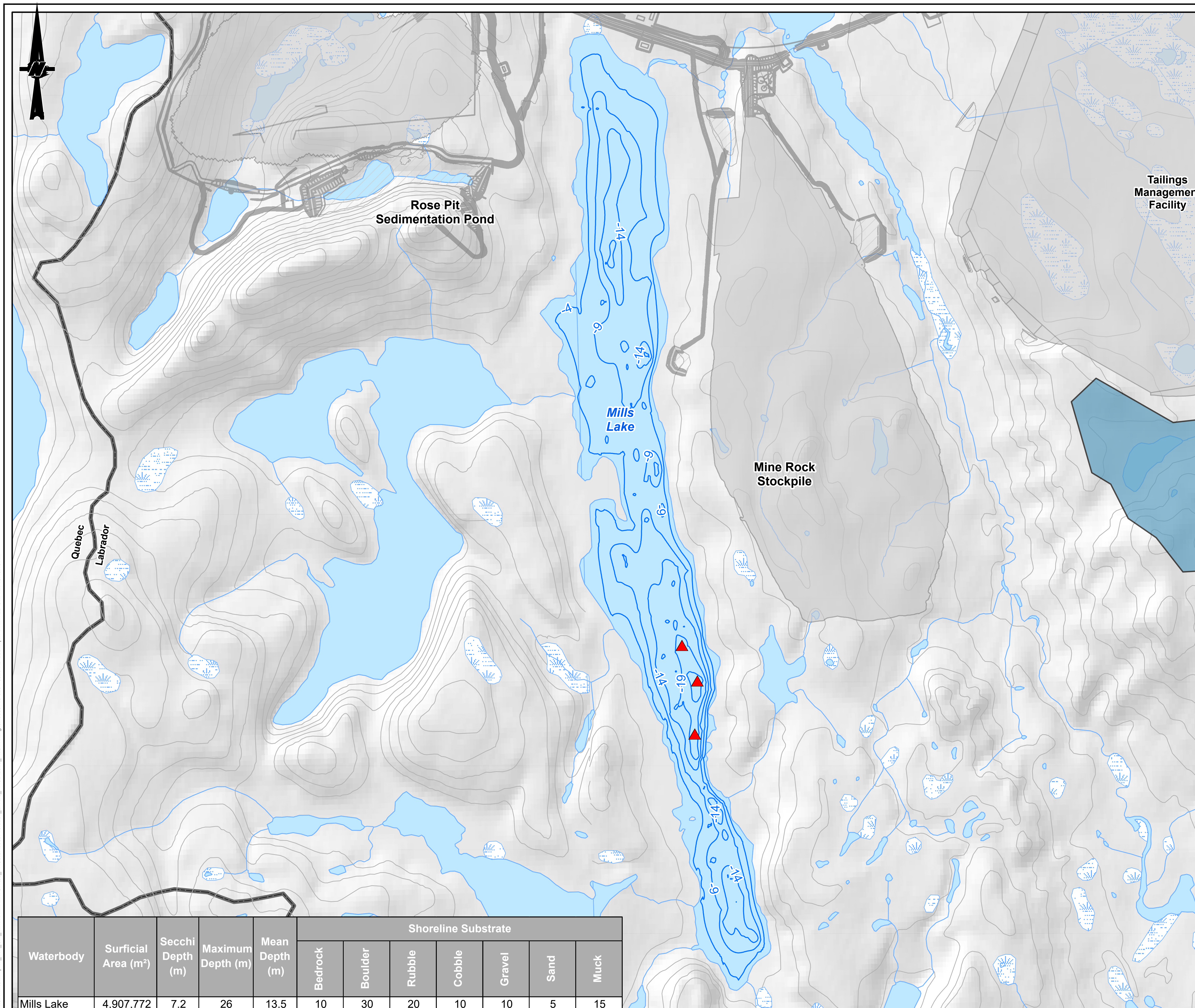
(c) Grams/habitat unit (100 m^2).

Table 3-24: Index Electrofishing Catch-per-Unit Effort in Duley Lake Inflow (Mills Lake outflow)

Station Number	Species	Abundance		Biomass (g)	
		Total Catch	CPUE (fish/300 seconds)	Total Catch	CPUE (grams/300 seconds)
LL-01	Brook trout	3	2.24	136.1	101.57
	Lake chub	4	2.99	30.5	22.76
	Longnose dace	2	1.49	8.7	6.49
	Sculpin	10	7.46	25.6	19.10
	White sucker	4	2.99	80.9	60.37
LL-02	Brook trout	3	2.12	111.1	78.61
	Burbot	3	2.12	70.8	50.09
	Lake chub	6	4.25	32.5	23.00
	Longnose dace	10	7.08	36	25.47
	Longnose sucker	7	4.95	40.4	28.58
	Sculpin	10	7.08	26.3	18.61
	White sucker	19	13.44	89.4	63.25

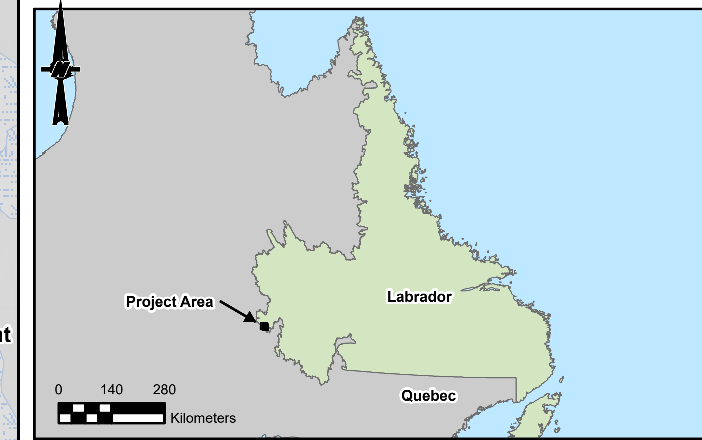
CPUE = catch-per-unit effort.

There is one small waterbody within the mine rock stockpile area. It has no inflow nor outflow and the estimated drainage area is <2.5 km^2. Based on previous surveys, and the lack of a defined inflow or outflow, this waterbody is not considered suitable fish habitat. This is also supported by the results of ice observations completed on the Kami site in 2012 when Pond SW1 within the tailings management area (TMA) was shown to be frozen completely. This pond is only 41,550 m^2 (4.15 ha) in size and similar to the small pond in the waste rock stockpile area (ice observation data are provided in Appendix A.



Waterbody	Surficial Area (m²)	Secchi Depth (m)	Maximum Depth (m)	Mean Depth (m)	Shoreline Substrate						
					Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Muck
Mills Lake	4,907,772	7.2	26	13.5	10	30	20	10	10	5	15

KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA
- Deepest Point in Lake
- Bathymetry (m)

PROJECT INFRASTRUCTURE
- Proposed Project Infrastructure
- Potential Access Road

BASEMAP INFORMATION
- Road
- Railway
- Watercourse
- Contour
- Bog/Wetland
- Waterbody
- Labrador/Quebec Boundary
- Duley Lake Park

0 500 1,000 2,000
1:32,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

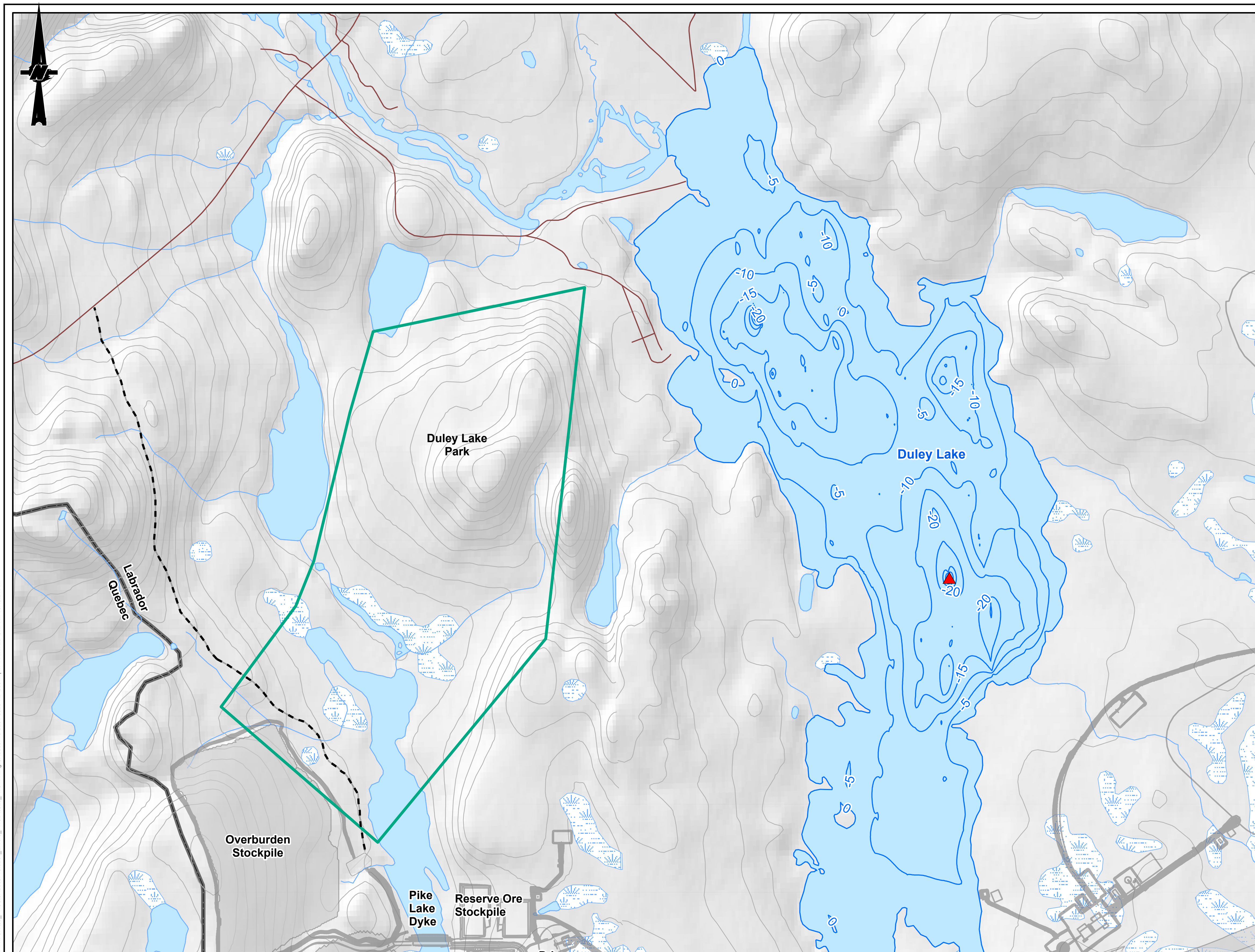
PROJECT
KAMI IRON ORE PROJECT
WABUSH, NL

TITLE
2023 MILLS LAKE BATHYMETRY

CONSULTANT

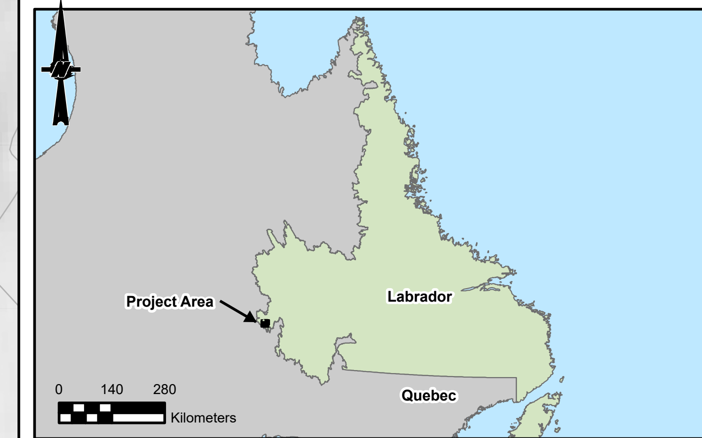
YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-15



Waterbody	Surficial Area (m^2)	Secchi Depth (m)	Maximum Depth (m)	Mean Depth (m)	Shoreline Substrate						
					Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Muck
Duley Lake	11,112,572	5	55	17.6	35	25	15	15	5	10	0

KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA

- Deepest Point in Lake
- Bathymetry (m)

PROJECT INFRASTRUCTURE

- Proposed Project Infrastructure
- Potential Access Road

BASEMAP INFORMATION

- Road
- Railway
- Watercourse
- Contour
- Bog/Wetland
- Waterbody
- Labrador/Quebec Boundary
- Duley Lake Park

0 500 1,000 2,000

1:32,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE PROJECT
WABUSH, NL

TITLE

2023 DULEY LAKE BATHYMETRY

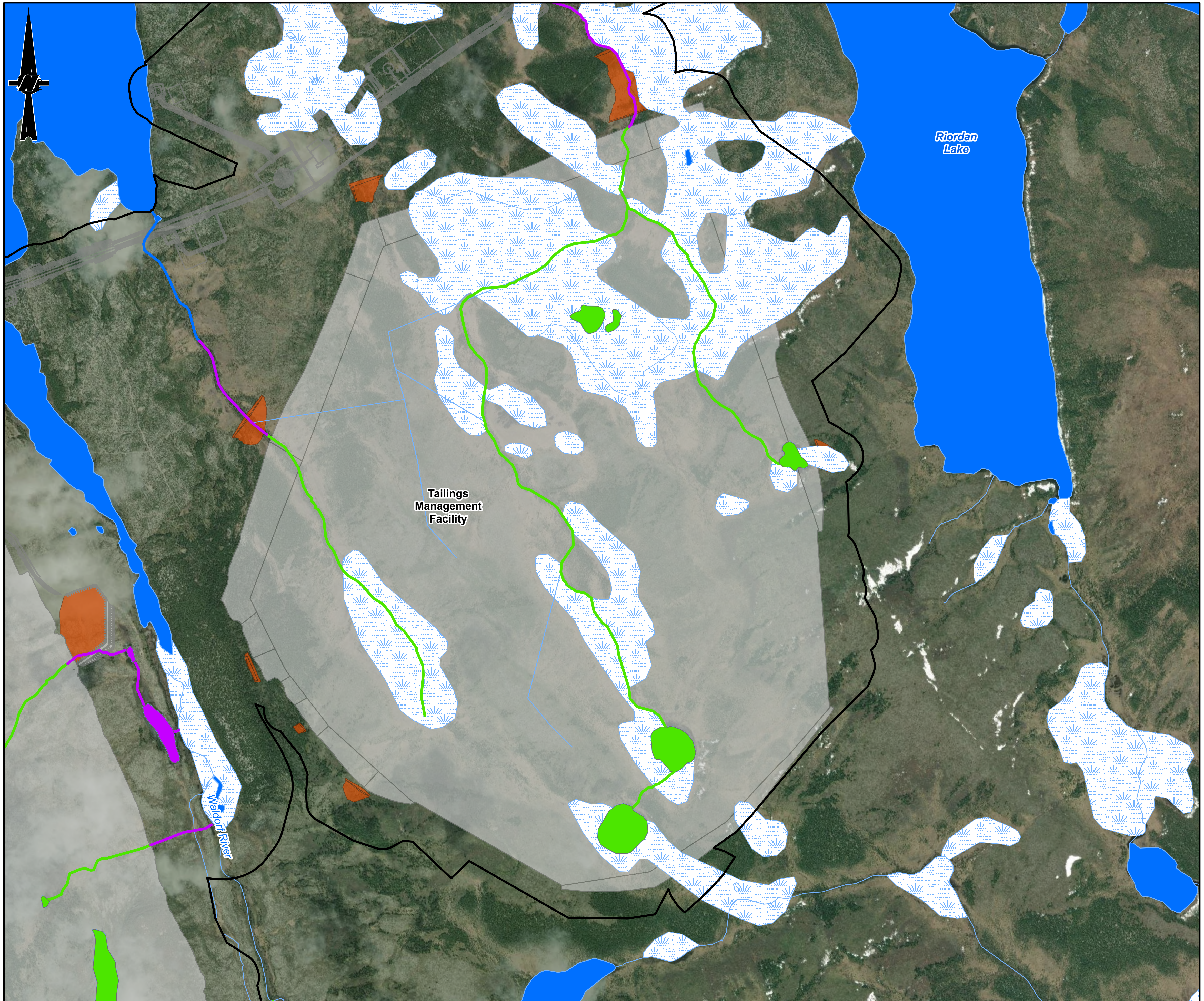
CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

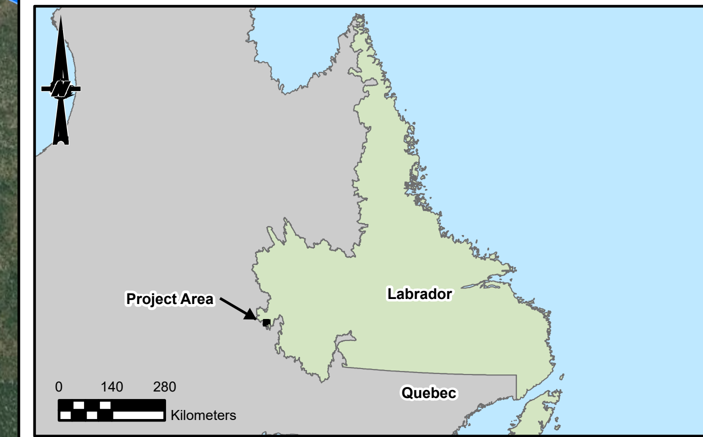
PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-16

3.6.4 Tailings Management Facility

The drainages within the TMF all drain into Duley Lake (Figure 3-17). Figure 3-18 presents the sub-divided drainages within TDA01, TDA02, and TDA02 East. The TMF spans four watersheds: Duley Lake (994 ha), Riordan Lake (3.8 ha), Waldorf River (13.6 ha), and Rectangle Lake (2.8 ha). The total catchment area effect that the TMF will have is 1,014.2 ha.



KEY MAP



SCALE 1:20,000,000

LEGEND

FISH HABITAT AUTHORIZATION

- Fish Habitat
- Schedule 2 MDMER HADD
- Section 35 HADD

PROPOSED PROJECT INFRASTRUCTURE

- Site Study Area (SSA)
- Proposed Project Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION

- Labrador/Quebec Boundary
- Duley Lake Park
- Wetland/Bog
- River/Stream

0 200 400 800

1:19,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: MAXAR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

FISH HABITAT WITHIN AND NEAR THE TAILINGS MANAGEMENT FACILITY

CONSULTANT

wsp

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	3-17

PATH: S:\Clients\Champion_Iron_Ore_Mines\Kami Iron Ore\99_PROJ\CA0038713.5261_EIS\40_PROD\0026_FishOffsetting\CA0038713-5261-0026-RB-0001.aprx PRINTED ON: AT: 10:19:51 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

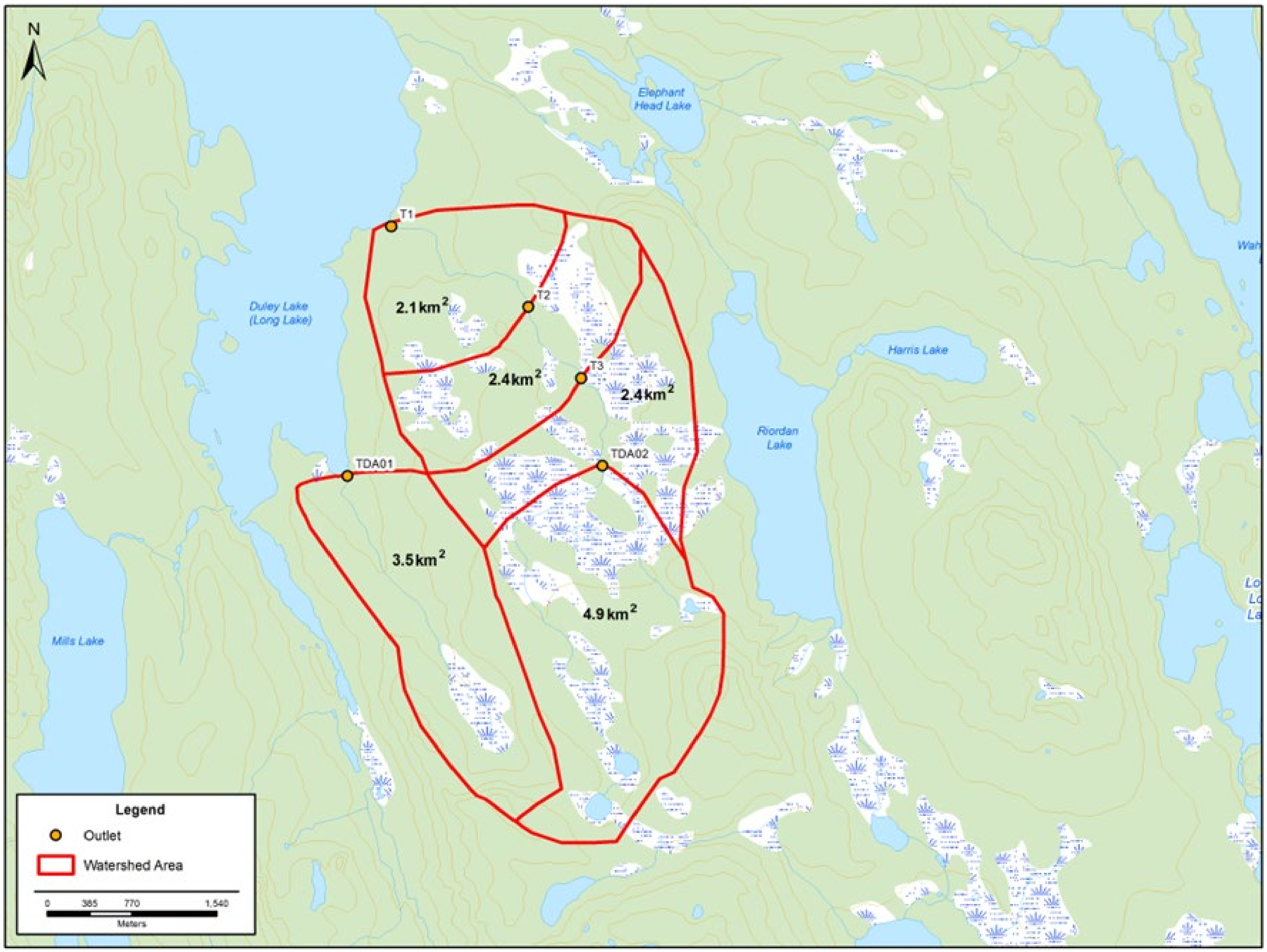


Figure 3-18: Subdivision of TDA01 and TDA02 Watersheds Used to Determine Overall Habitat/Production Loss Downstream of the Tailings Management Facility (transects T1, T2, and T3 are located downstream of the TMF footprint)

3.6.4.1 Riverine Habitat within the Tailings Management Area, Duley Lake Watershed

There are a total of two small streams located within the TMF: TDA01 and TDA02. TDA02 was divided into a main stem (TDA02) and a tributary that drains a small bog pond from the east side of the TMF (TDA02 East).

3.6.4.1.1 Stream TDA01

Stream TDA01 is the most westerly of the stream sections within the TMF. It flows in a north-northwest direction into Duley Lake. Stream TDA01 does not have a headwater pond, nor are there any ponds located along its length. It is approximately 2,800 m in length and contains 28.25 units of riverine fish habitat. Channel widths ranged from 0.5 to 2.2 m and depths ranged from 0.10 to 0.96 m. Water velocities ranged from 0.0 to 0.78 m/s. Table 3-25 presents a summary of the habitat present in Stream TDA01.

Table 3-25: Summary of Habitat Surveyed in Stream TDA01

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)[a]	Substrate (% coverage)								Habitat Type[b]
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
1	-	-	-	0.00	-	0	20	30	0	10	10	0	0	Steady
2	150	0.6	0.90	0.66	-	0	20	30	0	10	10	0	0	Riffle
3	50	1.8	0.90	0.23	-	10	30	30	0	5	10	10	0	Rapids
4	100	1.4	1.40	0.17	-	10	35	10	0	20	25	10	0	Riffle
5	100	0.9	0.90	0.18	-	0	25	30	0	30	15	0	0	Rapids
6	150	0.5	0.75	-	-	0	0	0	0	0	0	0	0	Steady
7	150	0.8	1.20	0.16	-	0	0	10	15	40	30	0	0	Riffle
8	150	0.6	0.90	0.43	-	0	15	15	0	30	30	0	0	Pool
9	150	1.4	2.10	0.47	-	0	10	0	0	40	30	0	0	Pool
10	150	0.5	0.75	0.51	-	0	15	0	0	20	20	0	0	Pool
11	150	1.2	1.80	0.40	-	0	10	0	0	20	20	0	0	Pool
12	150	0.7	1.05	0.95	-	0	5	0	0	15	15	0	0	Pool
13	150	0.7	1.05	0.28	-	0	10	0	0	10	10	0	0	Pool
14	150	1.3	1.95	0.61	-	0	0	0	0	10	10	0	0	Pool
15	150	1.0	1.50	0.17	-	0	5	0	0	10	10	0	0	Steady
16	150	2.2	3.30	0.75	-	0	5	0	0	5	5	0	0	Pool
17	150	1.5	2.25	0.34	-	0	0	0	0	10	10	0	0	Pool
18	150	1.3	1.95	0.22	-	0	0	10	0	20	20	0	0	Pool
19	150	0.6	0.90	0.32	-	0	20	0	0	20	15	0	0	Pool
20	150	0.7	1.05	0.16	-	0	10	0	0	10	20	0	0	Steady
21	150	1.1	1.65	0.11	-	10	10	0	0	30	10	10	0	Steady

(a) Slope was not measured in the field.
(b) Habitat type determined in the field.
Aq. = aquatic; – = data not recorded.

3.6.4.1.2 Stream TDA02

Stream TDA02 is located to the east of TDA01 and is the longest stream section within the TMF; it flows in a general northwest direction into Duley Lake. Stream TDA02 has a headwater pond (SW1) and has an additional pond (SW2) located a short distance downstream of SW1. It is approximately 6,800 m in length and contains 172.15 units of riverine fish habitat. Channel widths ranged from 0.7 to 5.5 m and mean depths measured at transects ranged from 0.01 to 0.67 m. Mean water velocities ranged from 0.0 to 0.51 m/s. Table 3-26 presents a summary of the habitat present in Stream TDA02.

Table 3-26: Summary of Habitat Surveyed in Stream TDA02

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)[a]	Substrate (% coverage)								Habitat Type[b]
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
1	-	3.4	-	0.41	-	0	50	30	20	0	0	0	0	Run
2	150	3.5	5.25	0.23	-	0	60	35	5	0	0	0	0	Run
3	100	4.7	4.70	0.32	-	0	30	20	20	10	20	0	0	Riffle
4	100	3.1	3.10	0.38	-	0	25	25	20	12	18	0	0	Riffle
5	100	3.3	3.30	0.33	-	0	18	25	22	15	20	0	0	Riffle
6	100	4.1	4.10	0.45	-	0	10	30	20	20	20	0	0	Riffle
7	100	3.1	3.10	0.48	-	5	15	25	25	15	15	0	0	Riffle
8	150	3.7	5.55	0.24	-	0	25	25	20	20	10	0	0	Run
9	150	3.9	5.85	0.40	-	10	50	35	0	0	5	0	0	Run
10	150	4.7	7.05	0.17	-	0	30	30	20	10	10	0	0	Riffle
11	150	3.2	4.80	0.27	-	0	40	30	0	15	15	0	0	Riffle
12	150	4.2	6.30	0.67	-	0	30	30	20	15	5	0	0	Run
13	150	1.6	2.40	0.65	-	0	60	20	0	0	15	5	0	Run
14	150	3.5	5.25	0.36	-	0	60	20	0	10	10	0	0	Run
15	150	3.2	4.80	0.24	-	0	30	20	25	20	5	0	0	Rapids
16	150	5.5	8.25	0.14	-	0	40	30	10	20	0	0	0	Rapids
17	150	3.8	5.70	0.38	-	0	20	20	35	15	10	0	0	Riffle
18	150	4.7	7.05	0.46	-	0	0	0	5	60	35	0	0	Riffle
19	150	3.4	5.10	0.43	-	0	10	0	0	50	40	0	0	Riffle
20	150	3.2	4.80	0.44	-	0	20	30	0	10	10	30	0	Riffle
21	150	3.4	5.10	0.41	-	0	0	0	0	50	50	0	0	Pool
22	100	2.9	2.90	0.25	-	0	30	23	22	25	0	0	0	Run
23	100	2.7	2.70	0.16	-	0	30	30	22	18	0	0	0	Run
24	100	-	-	-	-	0	15	15	25	40	5	0	0	Run
25	150	2.0	3.00	0.07	-	0	0	0	30	60	10	0	0	Riffle
26	150	2.1	3.15	0.29	-	0	20	20	20	20	20	0	0	Riffle
27	150	1.5	2.25	0.09	-	0	10	30	20	20	20	0	0	Riffle
28	150	1.7	2.55	0.21	-	0	0	0	20	30	40	10	0	Steady
29	150	1.4	2.10	0.28	-	0	0	0	0	0	40	60	0	Steady
30	150	1.2	1.80	0.19	-	0	5	0	0	0	50	45	0	Pool
31	150	0.7	1.05	0.42	-	0	0	20	20	20	30	10	0	Steady
32	150	1.6	2.40	0.19	-	0	20	15	15	20	30	0	0	Riffle
33	150	2.4	3.60	0.01	-	0	5	0	0	15	40	40	0	Steady
34	150	0.9	1.35	0.20	-	0	0	0	0	30	40	30	0	Steady
35	150	2.2	3.30	0.55	-	0	0	0	0	30	40	30	0	Pool
36	150	1.9	2.85	0.15	-	0	0	0	0	30	40	30	0	Steady
37	150	1.2	1.80	0.07	-	0	30	0	0	30	40	0	0	Riffle

Table 3-26: Summary of Habitat Surveyed in Stream TDA02

Reach	Length (m)	Wetted Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Slope (%)(a)	Substrate (% coverage)								Habitat Type(b)
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Vegetation	
38	150	1.6	2.40	0.17	-	0	30	20	30	20	0	0	0	Run
39	150	2.1	3.15	0.16	-	0	30	30	30	10	0	0	0	Run
40	150	1.5	2.25	0.09	-	0	20	20	10	10	20	20	0	Riffle
41	150	1.7	2.55	0.17	-	0	20	30	30	20	0	0	0	Steady
42	150	1.5	2.25	0.15	-	0	5	30	0	15	50	0	0	Steady
43	150	1.1	1.65	0.16	-	0	20	20	0	40	0	20	0	Steady
44	150	1.8	2.70	0.08	-	0	0	20	20	40	20	0	0	Riffle
45	150	1.7	2.55	0.17	-	0	0	50	30	20	0	0	0	Run
46	150	1.5	2.25	0.18	-	0	0	30	30	40	0	0	0	Run
47	150	1.3	1.95	0.20	-	0	50	30	10	5	5	0	0	Run
48	150	1.5	2.25	0.18	-	0	0	0	0	0	0	100	0	Pool

Source: Stantec 2012.

(a) Slope was not measured in the field in 2011.

(b) Habitat type determined in the field.

Aq. = aquatic; – = data are not available.

3.6.4.1.3 Stream TDA02 East

Stream TDA02 East is located within the TMF. It flows in a north-northwest direction into TDA02 which flows into Duley Lake (Figure 3-4; Figure 3-18). TDA02 East has a small headwater pond (SW3) and there are no other ponds located along its length. It is approximately 1,650 m in length and contains 12.15 units of riverine fish habitat. Channel widths ranged from 0.4 to 1.3 m and mean depths measured at transects ranged from 0.09 to 0.48 m. Mean water velocities ranged from 0.01 to 0.26 m/s. Table 3-27 presents a summary of habitat characteristics.

Table 3-27: Summary of Habitat Surveyed in Stream TDA02 East

Reach #	Distance	Section Length	Wetted Width (m)	Area (units)	Average Depth (m)	Average Velocity	Substrate (%)							Classification
							Be	B	R	C	G	S	F	New
0	0	150	0.6	0.90	0.21	0.01	0	0	0	0	0	0	100	Steady
1	150	150	0.8	1.20	0.17	0.01	0	0	0	0	0	0	100	Steady
2	300	150	0.4	0.60	0.09	0.12	0	20	0	0	0	0	80	Steady
3	450	150	0.4	0.60	–	–	–	–	–	–	–	–	–	–
4	600	150	0.5	0.75	0.10	0.07	0	0	0	0	0	100	0	Steady
5	750	150	0.7	1.05	0.26	0.15	0	0	0	0	0	90	10	Steady
6	900	150	0.7	1.05	0.28	0.20	0	0	0	0	50	50	0	Riffle
7	1050	150	1.3	1.95	0.17	0.22	0	0	0	0	50	50	0	Riffle
8	1200	150	1.0	1.50	0.48	0.12	0	0	0	0	50	50	0	Riffle
9	1350	150	1.0	1.50	0.21	0.26	0	0	0	0	30	70	0	Riffle
10	1500	150	1.3	1.95	0.20	0.19	0	30	0	20	0	50	0	Steady

Note: Orange cells were estimated based on field observations and photos.

– = data not available

3.6.4.1.4 Riverine Fish Presence and Abundance

In addition to the consolidated fish species list outlined in Section 3.2 based on all sampling, angler interviews, and literature review, specific species presence and abundance estimates within each habitat type (riverine and lacustrine) are provided within each watershed.

Two index electrofishing stations were also completed in TDA01 and TDA02 (Table 3-28). Brook trout were the only fish species captured in TDA01. They were the most abundant fish captured in TDA02, with pearl dace and sculpin caught in lesser numbers.

Within the TMA of the Duley Lake watershed, four quantitative electrofishing stations were completed along both TDA02 and TDA02 East (Table 3-29). Throughout all the stations, brook trout were the most abundant species and were found in all areas.

Table 3-28: Summary of Total Index Electrofishing Catches for Each Fish Species, Tailings Management Facility, Duley Lake Watershed

Sample Location	Brook Trout	Burbot	Lake Chub	Longnose Dace	Longnose Sucker	Pearl Dace	Sculpin	White Sucker
TDA01	23	0	0	0	0	0	0	0
TDA02	127	0	0	0	0	2	12	0
Total	150	0	0	0	0	2	12	0

Source: Stantec 2012.

Table 3-29: Population and Biomass Estimates for Quantitative Electrofishing Stations, Tailings Management Facility, Duley Lake Watershed

Site	Species	Abundance			Biomass (g)		
		Total Catch	Estimate(a)	Confidence Interval(b)	Total Biomass	Estimate(c)	Confidence Interval(b)
TI01 (downstream of TDA02)	Brook trout	17	9.4	8.9-10.0	371	206.6	205.7-207.5
	Sculpin	7	3.9	3.7-4.1	19	10.6	10.5-10.6
TI02 (TDA02 East)	Brook trout	14	10.0	9.6-10.4	300.8	214.9	214.2-215.6
TI03 (TDA02)	Brook trout	10	7.3	4.6-9.9	370.6	279.1	261.3-296.9
TI04 (TDA01)	Brook trout	7	4.7	3.9-5.5	45.6	30.8	30.7-30.9

Source: AMEC 2012.

(a) Fish/habitat unit (100 m^2).

(b) 95% Confidence Interval.

(c) Grams/habitat unit (100 m^2).

3.6.4.2 Lacustrine Habitat Characterization, Tailings Management Area within Duley Lake Watershed

Within the TMF, there are four small ponds: SW1, SW2, SW3, and SW4.

3.6.4.2.1 Pond SW1

Pond SW1 is located within the TMF and is the headwater of stream TDA02 (Figure 3-18). It is small and shallow (less than 1 m in depth) with visibility to the bottom. The bottom substrate is composed entirely of fines and organics (muck). The surface area is 41,550 m^2 and is all classified as littoral habitat.

3.6.4.2.2 Pond SW2

Pond SW2 is located within the TMF, just downstream from Pond SW1 and is also within stream TDA02 (Figure 3-18). It is small and shallow (less than 1 m in depth) with visibility to the bottom. The bottom substrate is composed of fines and organics (muck). The surface area is 34,940 m^2 and is classified entirely as littoral habitat.

3.6.4.2.3 Pond SW3

Pond SW3 is located within the TMF (Figure 3-18) and is the headwater of stream TDA02 East. It is small and shallow (less than 1 m in depth) with visibility to the bottom. The bottom substrate is composed of fines and organics (muck). The surface area of the pond is 11,585 m^2 and all of it is classified as littoral habitat.

3.6.4.2.4 Pond SW4

Pond SW4 is located within the TMF and is not connected directly to any stream in the area (Figure 3-18). The pond is small and shallow (less than 1 m in depth). It has a surface area of 15,000 m^2 and a substrate composed of fines and organics. Based on the absence of connectivity to any identified fish habitat, SW4 was not considered productive or sustained fish habitat in the previous HADD and offset plan and is not considered further.

3.6.4.3 Lacustrine Fish Presence and Abundance

Pond SW1 was selected as a representative waterbody for population estimates within the TMF as it is the largest pond within the TMF footprint. Fish species presence and abundance using fyke net catch-per-unit effort (CPUE) from SW1 shows only brook trout and lake chub captured (Table 3-30). Population estimates were possible for Brook Trout (Table 3-31).

Table 3-30: Summary of Fyke Net Abundance and Biomass Catch-per-Unit Effort from the Tailings Management Facility, Duley Lake Watershed

Waterbody	Species	Abundance		Biomass	
		Total Catch[(a)]	CPUE (fish/net-night)	Total Catch (g)[(b)]	CPUE (grams/net-night)
SW1 (tailings pond)	Brook trout	7	1.40	253.2	50.64
	Lake chub	49	9.80	314.5	62.89
	Total	56	11.20	567.7	113.53

Source: AMEC 2012.

(a) Total catch and CPUEs include all fish captured, including recaptures.

CPUE = catch-per-unit effort.

Table 3-31: Summary of Number of Fish Caught and Population Estimates from the Tailings Management Facility, Duley Lake Watershed

Waterbody	Species	Total Catch	Total Recaptures	Population Estimate[(a)]	95% Confidence Interval
SW1 (tailings pond)	Brook trout	7	0[(b)]	8	2-16
	Northern pike	0	0	-	-

Source: AMEC 2012.

(a) Estimates based on Schnabel method in Fisheries Stock Assessment Package (Ogle 2016) for R (R Core Team 2020).

(b) No recaptures observed. One recaptured assumed on last day to complete calculations.

– = not applicable.

4.0 AQUATIC HABITAT AFFECTED BY THE PROJECT

4.1 Measures to Avoid

Since the previous HADD determination and offset plan from the previous owner, EA, and regulatory approvals, the Project design has been undergoing advanced engineering design updates, primarily related to uncertainties surrounding water management and groundwater seepage into the mine site from Pike Lake South. This has meant that several waterbodies and streams not identified as being affected within the previous HADD determination and offset plan, may now be included. While these additional waterbodies seem to suggest a greater effect on fish and fish habitat than previously assessed, had the engineering uncertainties around mine site water management continued as part of the previous proposed development, it is likely that these waterbodies would have eventually been included and required offsetting.

While there may be a larger number of waterbodies potentially affected than previously, Measures to Avoid for the conservation and protection of fish habitat is the first and most important step in the hierarchy of measures and therefore have been the major focus of this Project to date. There have been several measures put in place to avoid and minimize the effects on fish and fish-bearing water.

4.1.1 Site Plan Alternatives

As part of Project planning and site assessment efforts, multiple site layouts were considered for both Project efficiencies and the avoidance of effects on fish frequented waters. Although components such as the open pit are fixed due to the orebody, other Project footprints such as the mine rock stockpile, overburden stockpile, TMF, and road networks have some flexibility in their location. To this end, the Project team reviewed multiple locations and site plans for these features, before selecting the proposed arrangement. The assessment of multiple locations for any infrastructure that may be used as storage and/or treatment of mine effluents or waste rock is required under the MDMER to allow any deposit of a deleterious substance. Further details regarding this process and the outcomes are provided in the Kami Mine Waste Alternatives Assessment (TSD III).

4.1.1.1 Water Management Plan – Pike Lake Watershed Flow Augmentation

The loss of the Rose Pit area headwater ponds within the Pike Lake watershed, including the loss of a portion of Pike Lake South, is predicted to reduce flows downstream throughout the Pike Lake system. The final water infiltration values from Pike Lake South into the Pit that would require collection and disposal via the water treatment system to Duley Lake is pending; however, it is conservatively estimated that the losses would reduce much of the stream habitat downstream of Pike Lake South to unsuitable, particularly during winter months when reduced flows could cause complete freezing. It would also likely isolate the lakes and therefore also reduce connectivity and habitat use.

As a result, the water management plan includes a water transfer system from Duley Lake to Pike Lake South so that typical annual flows are maintained and mitigate any potential habitat alteration, disruption, or destruction. Lorax Environmental modelled the discharge rates in 2025. Three different scenarios were modelled, and under the scenario where the current mean annual precipitation is maintained, the Pike Lake discharge is expected to remain above the seasonal minimum discharge threshold rates (0.03 m^3/s for December to April and 0.25 m^3/s for May to November) established by MacCarthy (2024). Under the scenario which modelled the 25th percentile, corresponding to the climate year closest to the 25th percentile of the precipitation recorded at 780 mm (1994), the discharge rates are projected to fall below the minimum threshold during the winter months in the early years of the Closure phase coincident with pit filling. Total transfer rates from Duley Lake to Pike Lake and the pit are limited by pump capacity assumptions and water availability in Duley Lake. While increasing the transfer rate from Duley Lake to Pike Lake could help prevent discharge from dropping below threshold levels, it may prolong pit filling (Lorax 2025). Further details are provided in the Surface Water Baseline Report (WSP 2025).

4.1.1.2 Overburden Stockpile

The overburden stockpile area has been strategically located to the northwest of the ore body in an area that is close to the mine site but where no fish habitat is overprinted. Based on previous surveys throughout Labrador, including Labrador West, drainages with total areas <2.6 km^2 typically freeze in winter and are devoid of flow during mid-summer and are not considered suitable fish habitat.

4.1.1.3 Mine Rock Stockpile

The mine rock stockpile was relocated to its currently proposed location to the east of the ore body to avoid as much known fish frequented water as possible, particularly larger waterbodies such as Mills Lake and Riordan Lake. It is located between two larger waterbodies; Mills Lake to the west and Waldorf River to the east; however, it does not encroach either. While the streams within the mine rock stockpile are small, a portion of it has been shown to be fish bearing and is addressed within the offsets below.

4.1.1.4 Preferred Haul Road and Railway

The alignment of the haul road and railway line have been undergoing continued constraints analysis, which are not fully complete. However, ongoing iterations are removing as much interaction with fish-bearing waters as possible. This has included a recent relocation of the potential access road from the eastern portion of the Project, following the proposed railway line, to the western portion of the property. This western route avoids any major waterways and waterbodies and reduces the length of road construction required.

The preferred railway alignment has not yet been finalized but will avoid any larger waterbodies as recommended by DFO during consultation and discussions. For example, re-assessment of alternative rail and road route options has eliminated several challenging crossings that may have had an effect on fish habitat; most notably the crossing at SC11 (Loon Lake) and the rerouting away from the town of Wabush's water supply area. The relocation of the haul road outside the railway right-of-way also reduces the overall footprint of the railway line to further reduce interaction with fish-bearing water in that area.

4.2 Measures to Mitigate

Measures to mitigate adverse effects on fish and fish habitat through all phases of the Project (i.e., Construction, Operations, Closure) include a combination of site-specific mitigation measures as defined in permits, approvals, or environmental assessment commitments and best management practices. Measures and standards would include, but not be limited to, construction water management; erosion and sedimentation controls; and timing windows to protect sensitive fish life cycle periods. Site-specific mitigation designs include redesign of the water management plan to better simulate a natural surface water flow within the habitat downstream of the Pike Lake South containment dike, design of treated water dispersion into the natural receiving waters, and fish relocation activities.

4.2.1 Standard Measures and Best Practices

To mitigate and reduce overall loss of function of fish and fish habitat, the actions provided in Table 4-1 will be implemented by Champion within watercourses where direct effects and potential indirect effects on fish and fish habitat are expected. Mitigation measures will be confirmed and adaptively managed through ongoing monitoring requirements, as described at the permitting stage. Considering the extensive planning, ongoing engagement with local Indigenous groups, stakeholders, and regulatory agencies, and the use of proven mitigation measures/best management practices, Champion is confident that the Project can be constructed, operated, rehabilitated and closed, in an environmentally responsible and safe manner that minimizes and mitigates effects on fish and fish-bearing water.

Where possible, offset and compensation measures will be constructed in advance of major Project effects. This approach will allow for the initial development and stabilization of the offsetting works to be achieved, and significant colonization of the new replacement habitats by adjacent fish communities prior to any predicted losses. Any changes to the approximate time periods specified in the final plan would require notification and approval by DFO in advance of a revised schedule within an authorization.

4.2.2 Fish Relocation

Prior to any watercourse being lost, fish relocation will be required to avoid death of fish by means other than fishing, as outlined in the *Fisheries Act*. These habitats would include those fish-bearing waterbodies and watercourses within the Rose Pit area, the waste rock stockpile, and the TMA. The following outlines the general tasks required to complete the capture and relocation of fish.

4.2.2.1 Permitting

Upon issuance of an authorization under Section 35 of the *Fisheries Act*, general permits required for fish relocation include an experimental license from DFO to handle fish, and a relocation permit to move fish from one waterbody to another (particularly if transfers are required outside the fish’s resident watershed). A detailed fish rescue plan will be provided to DFO at the permitting phase of the Project, prior to completion of this task. Within the Project area, all fish can be relocated to other portions of their resident watershed (e.g., Pike Lake and Duley Lake watersheds); therefore, no intra-watershed transfers will be required. Given the numbers of fish captured during baseline habitat characterization, numbers for relocation are anticipated to be low; and as such it is expected that the adjacent waterbodies will have capacity to accommodate any transferred fish.

4.2.2.2 Tributary Isolation and Relocation

Guidance for the approach to fish rescue was obtained from the DFO Fish Rescue Guidelines (DFO 2015). The general approach outlined therein will involve a combination of passive trapping, seine netting, fish collection via electrofishing where possible, and dip-netting isolated pools during de-watering. The approach to the fish rescues typically involves adaptive management based on fish collection results and site conditions.

The fish rescue will be overseen by an aquatic ecologist, experienced in the collection, handling, and transfer of fish. For linear features and open water features which are safely wadable and easily isolated, the following approach to fish rescue will be taken. The license holder will identify the area to be isolated by installing barrier nets (or similar) on the upstream and downstream ends of the reach. The specific fish rescue methodology will vary based on factors such as depth, substrate, wade-ability, water temperature, and turbidity of the water.

Table 4-1: List of Mitigation Measures for Fish and Fish Habitat

Project Phase	Mitigation Measure
C, O, CL	Complete site meetings with relevant staff/contractors to educate and confirm policies related to working around fish bearing surface water systems including schedule of construction activities to minimize unauthorized disturbance and limit vegetation clearing
C	Provide signage on fish habitat streams
C	Complete micro siting of mine infrastructure to avoid or minimize fish habitat effect as necessary
C	Complete fish rescue within all fish bearing streams to be affected by the Project, prior to commencement of mine development, with DFO approval if required
C	Implement construction methods that reduce potential interaction with fish habitat and limit vegetation clearing around watercourses
C	Complete culvert installations and upgrades in accordance with the NLWRMD Chapter 5: Environmental Guidelines of Culverts (2018) and NL Construction Standards for Resource Access Roads in Newfoundland and Labrador (NLDFLR 2018) or as updated at time of construction. Limit vegetation clearing where possible.
C, O	A 20 m treed buffer zone shall be established around all waterbodies that are identified on the latest 1:50,000 topographic maps around waterbodies greater than 1.0 m in width that do not appear on the maps. Where the slope is greater than 30% there shall be a no-harvest buffer of 20 m +(1.5x% slope).
C, O	Use vegetated buffers and aquatic vegetation wherever practicable to provide shade to on-site ponds.
C	Minimize the removal of vegetation upgradient of watercourses and stabilize shorelines or banks disturbed by any activity associated with Project activities.
C	Minimize the temporal extent of permitted in-stream works as much as practicable.
C, O	Follow DFO-advised *Measures to avoid causing harm to fish and fish habitat* pertaining to blasting (DFO 2025).
C, O	Implement Explosive Management Plan.
C, O	Use an emulsion-type explosive that will minimize nitrogen release to surface water and groundwater.
C, O	Use clean, non-ore-bearing, non-watercourse derived and non-toxic materials for erosion control methods.
C, O	Incorporate drainage structures, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material.
C, O	Limit clearing within confirmed fish habitat outside of approved alteration areas to within approved areas.
C, O	Acquire and follow provincial permit conditions related to work near water.
C, O	Adhere to applicable timing windows, as directed by DFO, for construction where infilling has been approved in wetlands and watercourses where fish habitat is present.
C, O	Ensure fuelling areas are a minimum of 30 m from waterbodies. All gasoline or lubricant depots must be placed 100 m from the nearest waterbody.
C, O	Use and maintain properly sized screens on any water intakes or outlet pipes to prevent entrainment or impingement of fish (DFO 2020).
C, O	Ensure that machinery arrives on site in a clean condition and is maintained and free of fluid leaks.
C, O	Develop and implement Mine Water Management Plan.
C, O, CL	Collect and treat all contact water, as required.
C, O, CL	Implement Erosion and Sediment Management Plan.
C, O, CL	Maintain pre-construction hydrological flows into and out of down-stream surface water habitats, to the extent practicable, to limit indirect effects on fish habitat.
C, O, CL	Complete offsetting for HADD and Section 36 (MDMER), including for permanent loss of fish habitat through fish habitat restoration activities, subject to DFO approval, as required under the *Fisheries Act.*
C, O, CL	Develop and implement the Aquatic Effects Monitoring Program to identify and further mitigate any additional adverse effects on fish and fish habitat.

C = Construction; O = Operations; DFO = Fisheries and Oceans Canada; HADD = harmful alteration, disruption, or destruction; NLWRMD = Newfoundland and Labrador Water Resources Management Division; NLDFLR = Newfoundland and Labrador Department of Forestry and Land Resources; EEM = environmental effects monitoring; MDMER = *Metal and Diamond Mining Effluent Regulations*.

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

The rescue will be completed to minimize handling of fish, particularly if completed during warmer months, to reduce stress to fish. Measures such as oxygen supplementation, aeration, and water cooling can be used as needed. A sub-sample of individuals per species will be sampled (physical measurements recorded), with the remaining to be identified and enumerated only. To reduce handling and stress on fish, 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. For each individual reach requiring fish rescue, a release point will be clearly identified as close to the rescue site as possible in directly contiguous waters.

For open water features where safe wading is not possible, consideration will be given to the use of a barge or boat-based electrofisher or rely on passive trapping.

Fish will be released primarily into Pike Lake or Duley Lake watersheds, as they are the nearest contiguous watercourses. During each rescue event, personnel will remain on site during de-watering to capture any fish remaining in the dewatered reach, wherever safely practicable. This will allow an estimate of mortalities to be provided to DFO in a summary report outlining the results of the fish rescue.

4.2.3 Mitigation Monitoring

Monitoring of standard mitigations described above and their effectiveness during Construction are typically required as part of a *Fisheries Act* authorization. Monitoring will clearly be defined in the DFO authorization and reported to DFO in an “as constructed” report following the works being completed. The “as constructed” monitoring report will document the construction of the offset and works as per the approved plans, and a summary of the mitigation measures and any contingency measures implemented to prevent further effects on fish habitat. A detailed photographic record will be taken during implementation of the plan using consistent vantage points prior to, during, and post-construction. To ensure that the measures and standards described are implemented as proposed, Champion on-site monitors (or designates) will monitor construction and implement mitigations.

4.3 Habitat Characterization and Predicted Effects/Alterations

Standard mitigations as well as Project-specific avoidances and redesigns have minimized the potential aquatic habitat effects/alterations. It is understood that the final HADD determination will be provided by DFO; however, this description of habitat effects and the extent of possible alterations are provided to show that all interactions with the aquatic environment have been considered and that offset concepts described in Section 5 and 6 can be designed to meet HADD and Schedule 2 MDMER quantity expectations, including any offset ratios. The quantification of fish habitat for the purposes of determining HADD to fish habitat waterbodies requires a process that removes as much subjectivity as possible so that final determinations are defensible in approach and rationale.

The description and quantity of the habitat was not adjusted/corrected for existing species utilization and therefore represent very high quantities of habitat potentially affected/altered by the Project. Further quantification as to the relative loss of habitat in terms of productivity and species utilization will be confirmed during the Request for Project Review and ongoing HADD determination with DFO.

4.3.1 Pathways of Effects

DFO has outlined a pathway of effects for “placement of material or structures in water,” “water diversion,” and “dewatering.” The mine infrastructure footprint and operations have been assessed in terms of key effects; namely sedimentation of fish habitat, changes to or losses of habitat structure and cover, fish passage, and wetted area (DFO 2024). For each potential effect, the DFO’s general effect category is presented as well as how it applies to this Project (Project-specific assessment) and the location of relative material in this report. The pathways are generally listed in order of the potential effect of the Project. A descriptor for each pathway is listed in Table 4-2. This assessment has been completed for all infrastructure that is within and near fish-bearing water where these effects are likely to occur.

4.3.2 Effects Assessment

To assess the effects of the Project location, the following components were considered:

- Baseline information at the site (Table 4-3)
- Projected changes from the Project (Table 4-4)
- Pathway of Effects (Table 4-5)

Table 4-2: Fisheries and Oceans Canada Descriptors for Possible Changes Related to Each Pathway of Effect

Change	General Descriptor of Pathway
Change or loss of habitat structure or wetted area	Loss of aquatic habitat area can be caused by activities such as infilling, dewatering, or diversions that can physically remove available wetted habitat from fish species. This can reduce the overall habitat carrying capacity for fish species. Wetted area losses can include important habitat types for life stages such as spawning, migration, or incubation.
Change in fish passage	Loss or reduction of fish passage for fish between habitats can be caused by disruptions or alterations in stream flow beyond that considered naturally occurring. This can be caused by water diversions or reductions that create reaches in streams that become impassible due to high water velocity or low water depth barriers that a fish species/size can pass. Fish passage between habitats can be important for some fish species life stages such as migrating to spawning, overwintering, or feeding areas.
Sedimentation of fish habitat	Increased sedimentation and deposition may result in an excess of organic and inorganic material which is transported by water, wind, ice, and gravity. These sediments, which contain nutrifying elements and can capture or absorb contaminants, are suspended, resuspended, or else settle and collect in depositional areas affecting physical processes, structural attributes, and ecological conditions such as water clarity (by increasing turbidity), damaging fish gills, and reducing the availability and quality of courser habitats (through smothering).

Source: DFO 2019.

Table 4-3: Baseline Habitat Characterization for the Kami Mine General Project Area

Baseline Parameter	Details
Habitat	The characterization of the aquatic habitat within and near the Project footprint consists of many small streams and ponds. The majority of the streams are less than 1 m in width. Stream and lacustrine habitat distributions as well as quantification of the various components is provided in Section 3.6.
Connectivity	The small streams and ponds within and near the Project footprint are generally connected such that fish passage is not naturally obstructed during open water conditions. However, winter measurements of water/flow conditions indicated that most of the small streams within the Project infrastructure footprint showed signs of ice constrictions/blockages, except the lower reaches of TDA02 downstream of the TMF where moving water was identified. The outflow of Pond SW1 (within the TMF) and the confluence of streams TDA02 and TDA02 East were frozen completely, with the other sample sites showing water present but no flow indicating a constriction/blockage downstream (Appendix A).
Fish species	There are a total of 14 different fish species identified within the Project Area that represent various trophic levels, life histories, and habitat preferences; brook trout (*Salvelinus fontinalis*), burbot (*Lota lota*), lake chub (*Couesius plumbeus*), lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), longnose dace (*Rhinichthys cataractae*), longnose sucker (*Catostomus Catostomus*), ouananiche (*Salmo salar*), northern pike (*Esox lucius*), pearl dace (*Margariscus nachtriebi*), round whitefish (*Prosopium cylindraceum*), sculpin (*Cottis bairdii / C.cognatus*), white sucker (*Catostomus commersonii*).

TMF = tailings management facility.

Table 4-4: Predicted Changes to Fish and Fish Habitat for the Kami Mine Footprint

Changes	Details of Change
Change or loss of habitat structure or wetted area	The habitat directly under the main components of the Project footprint will be lost. The habitat immediately downstream of the Project footprint in several streams is predicted to experience reduced flows such that the remaining wetted width is predicted to be unsuitable habitat and/or a restriction to fish passage.
Fish species	The fish species within and just downstream of the Project footprint will be displaced and/or smothered.
Mitigations	The main mitigations are to place all Project infrastructure to minimize interactions with fish-bearing waters. In areas where habitat loss will occur, complete a fish relocation program prior to any habitat dewatering within the direct footprint and to augment downstream flows wherever possible to minimize indirect habitat losses and restrictions to fish passage beyond natural conditions. Habitat offsets to replace any lost habitat and fish production will also be completed using options identified in Section 5.

Table 4-5: Pathway of Effect Related to the Kami Mine Footprint

Pathway of Effect	Predicted Effect
Change or loss of habitat structure, wetted area, or fish passage	The majority of the fish-bearing water beneath the Project footprint will be lost and a portion of several small streams immediately downstream of the Project footprint will also be reduced in wetted area; however, the augmentation of flows into Pike Lake South will limit any downstream effects on the remaining watershed and will provide habitat areas that will have available and consistent flows for fish passage as well as habitat enhancement/offsets.
	The water management plan for the Project will reduce the downstream effects of the Project as will proper placement of infrastructure to minimize interactions with fish-bearing water. However, it is predicted that a portion of fish-bearing water within the head waters of the Pike Lake watershed will be lost under the Rose Pit, a portion of small streams will be lost under the mine rock stockpile area (and some stream reaches immediately downstream), and several small streams and ponds will be lost under the tailings management area (and some small stream sections immediately downstream).
Sedimentation of fish habitat	The construction and operation of the Project will adhere to a site-specific erosion and sediment control plan to minimize any sedimentation of downstream fish-bearing water. Any offsets will be constructed using clean material (i.e., without fines) prior to placement to avoid sedimentation.
	It is predicted that the Project will not affect the overall long-term erosion and sedimentation of the area.

4.3.3 Direct Project Effects

Direct Project effects include all watercourses and waterbodies that would be lost because of direct interaction with Project infrastructure. These habitats include watercourses within the Project footprint, waterbodies that will be dewatered because they are near the ore body (pit), and those used in the water treatment process. Details of each watercourse is provided in Section 3.6. Each Project feature where fish-bearing water (fish habitat) is predicted to be directly affected is summarized below. Because authorizations will be required under both Section 35 (HADD) and Section 36 (Deleterious Substance) of the *Fisheries Act*, the fish-bearing water associated with each have been described and quantified separately.

4.3.3.1 Rose Pit

The fish-bearing waters within the Rose Pit area include a total of five small ponds, the interconnecting streams, and a portion of Pike Lake South. The ponds and stream reaches directly affected by Project construction and operation include those within the mine and water management/treatment footprints. A total of 337,417.1 m^2 of fish-bearing water of varying quality will be lost within the Project footprint; 1,249.44 m^2 (12.49 units) of stream and 336,167.64 m^2 (33.62 ha) of lacustrine habitat (Table 4-6). Of this, 219,900.1 m^2 would be required for Section 35 offsetting and 117,517 m^2 would be required for Section 36 compensation.

Table 4-6: Summary of Fish-Bearing Waters Directly Lost Within the Proposed Rose Pit Footprint

Waterbody/Watercourse	Habitat Type	*Fisheries Act* Offset Requirement	Habitat Area (m^2)	Habitat Units (100 m^2)	Habitat Units (ha)
Pike Lake South (PLS)	Lacustrine	Section 35	131,263.64	1,312.64	13.13
Rose Pond 1 (RP1)	Lacustrine	Section 35	87,387	873.9	8.74
RP1-PLS	Stream	Section 35	1,249.44	12.49	0.13
Rose Pond 4 (RP3)	Lacustrine	Section 36	92,221	922.21	9.22
Rose Pond 5 (RP4)	Lacustrine	Section 36	25,296	252.96	2.53
Total		**Section 35**	**219,900.1**	**12.49**	**21.87**
		Section 36	**117,517**	**1,175.17**	**11.57**

4.3.3.2 Mine Rock Stockpile

The fish-bearing waters within the mine rock stockpile area include a total of four small streams near the stockpile footprint. Three of the four have fish-bearing water directly within the footprint for a total of 2,324.3 m^2 and therefore would require Section 36 compensation (Table 4-7).

Table 4-7: Summary of Fish-Bearing Waters Directly Lost Within the Proposed Mine Rock Stockpile Footprint

Waterbody / Watercourse	Habitat Type	*Fisheries Act* Offset Requirement	Habitat Area (m^2)	Habitat Units (100 m^2)	Habitat Units (ha)
AD02	Stream	Section 36	301.44	3.01	0.03
AD04	Stream	Section 36	325.26	3.26	0.03
AD05	Stream	Section 36	1,697.60	16.98	0.17
Total		**Section 36**	**2,324.30**	**23.24**	**0.23**

4.3.3.3 Tailings Management Area

The fish-bearing waters within the TMA footprint includes a portion of two small streams and three small waterbodies. A total of 95,965.0 m^2 of fish-bearing water of varying quality will be lost within the Project footprint; 7,890.00 m^2 (78.90 units) of stream and 88,075.00 m^2 (8.81 ha) of lacustrine habitat (Table 4-8). All of which would be required for Section 36 compensation.

Table 4-8: Summary of Fish-Bearing Waters Directly Lost within the Proposed Tailings Management Area Footprint

Waterbody/Watercourse	Habitat Type	*Fisheries Act* Offset Requirement	Habitat Area (m^2)	Habitat Units (100 m^2)	Habitat Units (ha)
TDA01	Stream	Section 36	1,665.00	16.65	0.17
TDA02	Stream	Section 36	1,305.00	13.05	0.13
TDA02 East	Stream	Section 36	4,920.00	49.20	0.50
SW1	Lacustrine	Section 36	41,550.0	415.5	4.16
SW2	Lacustrine	Section 36	34,940.0	349.4	3.49
SW3	Lacustrine	Section 36	11,585.0	115.85	1.16
	Total	**Section 36**	**95,965.0**	**78.90**	**8.81**

4.3.4 Indirect Project Effects

Indirect Project effects include all fish-bearing water that is predicted to be affected as a result of the Project construction and operation but are not within the direct footprint. They include fish-bearing water that may have reduced flows due to direct habitat loss upstream or waters that require diversion/dewatering within the water management plan to avoid further negative effects on water quality or quantity.

4.3.4.1 Rose Pit

Within the Rose Pit area, most waterbodies and streams are considered directly affected by Project construction and operation. However, even though Rose Pond 2 (RP2) and Rose Pond 3 (RP3) are located upstream of any Project infrastructure, it has been assumed that they will require dewatering / diversion within the mine water management plan to avoid pit inflows and therefore have been added to the habitat indirectly affected. This also includes the interconnecting streams between RP3 and RP2 (RP3-RP2), between RP2 and RP1 (RP2-RP1), and the inflow stream from Rose Pond 4 (RP4-RP2) (Figure 3-4). A total of 226,562.0 m^2 of fish-bearing water of varying quality will be lost within the Project footprint; 2,592.0 m^2 (25.93 units) of stream and 223,970.0 m^2 (22.39 ha) of lacustrine habitat (Table 4-9). All would be required for Section 35 offsetting.

Table 4-9: Summary of Fish-Bearing Waters Indirectly Lost within the Proposed Rose Pit Footprint

Waterbody/Watercourse	Habitat Type	*Fisheries Act* Offset Requirement	Habitat Area (m^2)	Habitat Units (100 m^2)	Habitat Units (ha)
RP2-RP1	Stream	Section 35	647.50	6.48	0.07
Rose Pond 2 (RP2)	Lacustrine	Section 35	106,825	1,068.3	10.68
RP3-RP2	Stream	Section 35	562.00	5.62	0.06
Rose Pond 3 (RP3)	Lacustrine	Section 35	117,145	1,171.5	11.71
RP4-RP2	Stream	Section 35	1,382.50	13.83	0.14
	Total	**Section 35**	**226,562.0**	**2,265.73**	**22.66**

4.3.4.2 Mine Rock Stockpile

The fish-bearing waters within the mine rock stockpile area include a total of four small streams near the stockpile footprint. A portion of each would remain downstream of the direct footprint; however, the loss of the upstream portion of each stream is estimated to reduce the flow within at least a portion of the remaining downstream habitat, rendering it unsuitable. Within the four small streams, a total of 1,819.3 m^2 would be required for Section 35 offsetting (Table 4-10).

Table 4-10: Summary of Fish-Bearing Waters Indirectly Lost within the Proposed Mine Rock Stockpile Footprint

Waterbody/Watercourse	Habitat Type	*Fisheries Act* Offset Requirement	Habitat Area (m^2)	Habitat Units (100 m^2)
AD01	Stream	Section 35	350.00	3.50
AD02	Stream	Section 35	113.03	1.13
AD03	Stream	Section 35	160.00	1.60
AD04	Stream	Section 35	87.44	8.74
AD05	Stream	Section 35	1,108.80	11.09
Total		**Section 35**	**1,819.27**	**18.19**
		Section 36	**-**	**-**

– = not applicable.

4.3.4.3 Tailings Management Facility

The ponds and stream reaches indirectly affected by the TMA construction and operation are located just downstream of the TMF footprint, where the loss of upstream flow input is predicted to render a portion of these reaches as unsuitable habitat. A total of 7,515.0 m^2 of fish-bearing water of varying quality will be indirectly affected by the Project footprint; all of which is classified as stream habitat and would be required for Section 35 offsetting (Table 4-11).

Table 4-11: Summary of Fish-Bearing Waters Indirectly Lost within the Proposed Tailings Management Area Footprint

Waterbody/Watercourse	Habitat Type	*Fisheries Act* Offset Requirement	Habitat Area (m^2)	Habitat Units (100 m^2)
TDA01	Stream	Section 35	675.00	6.75
TDA02	Stream	Section 35	6840.00	68.40
Total		**Section 35**	**7,515.00**	**75.15**
		Section 36	**-**	**-**

– = not applicable.

4.3.5 Project Footprint Summary

The Kami Mine Project as designed will have a negative effect on fish-bearing waters, both directly and indirectly. Direct Project effects will include the loss of habitat due to dewatering, diversions, and use of several small waterbodies for water storage and treatment. Indirect effects are primarily related to reduced flows within fish-bearing waters just downstream of direct habitat and/or drainage losses because the total reduction is predicted to render a portion of this habitat as unsuitable. To avoid Harmful Alteration Disruption or Destruction of fish habitat such that the Project will cause serious harm, authorization of these effects will be required under the *Fisheries Act*. As such, offsets (Section 35 of the *Fisheries Act*) and compensation (Section 36 of the *Fisheries Act*) will be required.

A summary of the direct and indirect habitat losses is provided in Table 4-12. The overall total of fish-bearing waters affected by the Project is 671,602.7 m² which includes 455,796.4 m² requiring authorization under Section 35 of the *Fisheries Act* (139.63 units of stream habitat and 44.26 ha of lacustrine habitat) and 215,806.3 m² requiring authorization under Section 36 of the *Fisheries Act* (102.15 units of stream habitat and 20.56 ha of lacustrine habitat). Further details on direct and indirect effects are provided in Table 4-12.

Table 4-12: Summary of Fish-Bearing Waters Directly and Indirectly Lost Within the Proposed Project Footprint

Waterbody/Watercourse	Project Footprint	Direct/Indirect	Habitat Type	*Fisheries Act* Offset Requirement	Habitat Area (m²)	Stream Habitat Units (100 m²)	Lacustrine Habitat Units (ha)
Pike Lake South (PLS)	Rose Pit	Direct	Lacustrine	Section 35	131,263.64	1,312.6	13.13
Rose Pond 1 (RP1)	Rose Pit	Direct	Lacustrine	Section 35	87,387	873.87	8.74
RP1-PLS	Rose Pit	Direct	Stream	Section 35	1,249.44	12.49	0.13
Rose Pond 4 (RP3)	Rose Pit	Direct	Lacustrine	Section 36	92,221	922.21	9.22
Rose Pond 5 (RP4)	Rose Pit	Direct	Lacustrine	Section 36	25,296	252.96	2.53
AD02	Mine rock	Direct	Stream	Section 36	301.44	3.01	0.03
AD04	Mine rock	Direct	Stream	Section 36	325.26	3.26	0.033
AD05	Mine rock	Direct	Stream	Section 36	1,697.60	16.98	0.17
TDA01	Tailings	Direct	Stream	Section 36	1,665.00	16.65	0.17
TDA02	Tailings	Direct	Stream	Section 36	1,305.00	13.05	0.13
TDA02 East	Tailings	Direct	Stream	Section 36	4,920.00	49.20	0.49
SW1	Tailings	Direct	Lacustrine	Section 36	41,550.0	415.5	4.16
SW2	Tailings	Direct	Lacustrine	Section 36	34,940.0	349.4	3.49
SW3	Tailings	Direct	Lacustrine	Section 36	11,585.0	115.85	1.16
RP2-RP1	Rose Pit	Indirect	Stream	Section 35	647.50	6.48	0.06
Rose Pond 2 (RP2)	Rose Pit	Indirect	Lacustrine	Section 35	106,825	1,068.25	10.68
RP3-RP2	Rose Pit	Indirect	Stream	Section 35	562.00	5.62	0.06
Rose Pond 3 (RP3)	Rose Pit	Indirect	Lacustrine	Section 35	117,145	1,171.45	11.71
RP4-RP2	Rose Pit	Indirect	Stream	Section 35	1,382.50	13.83	0.14
AD01	Mine rock	Indirect	Stream	Section 35	350.00	3.50	0.04
AD02	Mine rock	Indirect	Stream	Section 35	113.03	1.13	0.01
AD03	Mine rock	Indirect	Stream	Section 35	160.00	1.60	0.02
AD04	Mine rock	Indirect	Stream	Section 35	87.44	8.74	0.01
AD05	Mine rock	Indirect	Stream	Section 35	1,108.80	11.09	0.11
TDA01	Tailings	Indirect	Stream	Section 35	675.00	6.75	0.07
TDA02	Tailings	Indirect	Stream	Section 35	6840.00	68.40	0.68
Direct Total Losses				Section 35	219,900.1	2,198.96	22
				Section 36	215,806.3	2,158.07	21.58
Indirect Total Losses				Section 35	235,896.3	2,366.84	23.59
				Section 36	–	–	–
Overall Total				**Section 35**	**455,796.4**	**4,565.8**	**45.59**
				Section 36	**215,806.3**	**2,158.07**	**21.58**

– = No value.

5.0 MEASURES TO OFFSET

DFO objectives for offsetting are based on measures to support the conservation and protection of fish and fish habitat by counterbalancing the residual death of fish and/or harmful alteration, disruption or destruction of fish habitat resulting from carrying on works, undertakings or activities authorized under the *Fisheries Act*. This would satisfy the guiding principles under DFO's *Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat under the* Fisheries Act (DFO 2019).

The measures to offset for the protection of fish and fish habitat has four guiding principles (DFO 2019):

- **Principle 1**—Measures to offset should support fisheries management objectives and give priority to the restoration of degraded fish habitat.
- **Principle 2**—Benefits from measures to offset should balance the adverse effects resulting from the works, undertakings, or activities.
- **Principle 3**—Measures to offset should provide additional benefits to the ecosystem.
- **Principle 4**—Measures to offset should generate self-sustaining benefits over the long term.

This would be achieved through habitat restoration (i.e., actions taken to return fish habitat to an improved or unimpaired condition) and enhancement (i.e., actions taken to improve fish habitat quality) and this includes physical manipulation of existing fish habitat to improve its capacity and sustain fish (DFO 2019).

Based upon the habitat characterization of the Project area, DFO's offsetting determination, and the guiding principles listed above, Champion proposes the following potential Measures to Offset in relation to the Kami Iron Ore Mining Project footprint:

- **Labrador-specific measures**—Habitat connectivity enhancement within a prominent Atlantic Salmon River in Labrador.

The general construction plan and approach is detailed below with the understanding that consultations with DFO will be ongoing, and some revisions may be required.

5.1 Offsetting

Champion has selected habitat connectivity enhancement within a prominent Atlantic salmon River in Labrador (St. Lewis River) for the offsetting measure tied to the Project. This habitat connectivity enhancement project was previously proposed by Atlantic Rivers Outfitting and was reviewed by DFO. DFO recommended mitigative measures to avoid and lessen any potential for serious harm to fish, which were incorporated into the proposed Project mitigation measures and would be incorporated into a construction Environmental Protection Plan for this offsetting project.

Other options were also considered for offsetting projects associated with the Project. These other options have been included in the offsetting report to demonstrate that other projects have been considered but are not included in the final offsetting total.

5.2 Habitat Connectivity Enhancement

The St. Lewis River is located on the eastern coast of Labrador at latitude 51°20′0.2″ (51.3334°) north, longitude 55°36′52.8" west. It flows into St. Lewis Inlet, a 30 km long estuary on the coast of Labrador (Figure 5-1). The falls lie approximately 28 km upstream on the main stem of the river and approximately 25 km from the Trans Labrador Highway, Route 510.

Figure 5-1: St. Lewis River Atlantic Salmon Enhancement General Location

The closest communities are Port Hope Simpson, located approximately 26 km to the north, and St. Lewis (formerly Fox Harbour), Battle Harbour and Mary's Harbour, all located outside of the inlet in St. Lewis Sound to the east of the Project site.

Champion is proposing to utilize a run-around flow pathway on a falls forming a partial obstruction to Atlantic salmon passage on the St. Lewis River, Labrador, to create a pool and weir-type fishway which will provide greater accessibility for Atlantic salmon to a 32 km section of this river. The falls forming the partial obstruction is located approximately 28 km upstream on the main stem of the river.

The DFO assessment of Atlantic salmon habitat and productivity potential in the rivers of Labrador describes the St. Lewis River as having a drainage area of 2,590 km², consisting of the 145 km long main stem and 45 tributaries (Anderson 1985). The lower main stem is characterized by narrow gorges and canyons surrounded by steep hills. A falls located approximately 28 km upstream on the main stem was identified as a complete obstruction to Atlantic salmon migration. However, it cannot be confirmed that field surveys were completed in making this assessment (e.g., species presence above the falls or measurements at the falls). The DFO, in conjunction with Atlantic Rivers Outfitting, has conducted recent research on salmon movements and habitat use on the St. Lewis River that confirmed, through electrofishing and observations, that Atlantic salmon adults and juveniles are located upriver of the falls, although in low numbers (Robertson, personal communication).

The St. Lewis River is approximately 145 km long and occurs within the southern portion of the Paradise River ecoregion and Paradise River ecodistrict of Labrador (Riley et al. 2013). This ecodistrict occupies 17,176 km^2, approximately 5.8% of Labrador.

The climate of the Paradise River ecodistrict is characterized by cool summers and short, cold winters. Although close to the coast, the ecodistrict is not as strongly affected by maritime climate and weather as strictly coastal districts. The growing season is 144 days, and the average annual temperature is 0.2^{o}C. Mean annual precipitation averages 836 mm.

Bedrock in the ecodistrict is dominated by massive Archean granite, metamorphic gneiss, amphibolite, gabbro, and other acidic intrusions. The ecodistrict is rough and undulating, with deeply dissected lower elevation slopes. The surface rises rapidly from the east to elevations of 719 m above sea level and is covered with thin sandy morainal deposits of variable thickness.

Forests in the ecodistrict are dominated by closed stands of black spruce and balsam fir, typically with understories of feathermoss on moist upland slopes. Middle seepage slopes are dominated by spruce-fir-birch forests, with rich herb understoreys. Dry sites are characterized by open lichen-spruce woodlands, and a dwarf, open or sometimes closed cover of black spruce and tamarack with ericaceous shrubs found on raised dome bogs. The forests of the region provide habitat for caribou, moose, black bear, red fox, lynx, American marten, porcupine, snowshoe hare, small mammals, waterfowl, and other birds.

Fish species that typically inhabit rivers of southern Labrador and are expected to be present in the St. Lewis River include Atlantic salmon, brook trout, Arctic char (*Salvelinus alpinus*), American eel (*Anguilla rostrata*), rainbow smelt (*Osmerus mordax*), threespine stickleback and longnose sucker. Each of these (with the exception of stickleback and sucker) hold recreational and/or commercial value. A brief summary of the overall life history and uses of these species is presented in Table 5-1.

Table 5-1: Fish Species Known to Occur in the Rivers of Southern Labrador

Common Name	Scientific Name	Biological/Habitat Details
Atlantic salmon	*Salmo salar*	**Typical Habitat** Preferred temperature: 8°C to 16°C Preferred depth: Variable Preferred substrate: gravel, cobble, boulder **Biology and Ecology** Distributed throughout Newfoundland and Labrador Occurs as landlocked (ouananiche) and anadromous life histories Spawn in clean, well aerated, gravel bottom riffle sections of stream Diet depends on the size and habitat of fish, as well as season Juvenile anadromous salmon remain in natal watersheds for three to six years in Labrador Adult salmon generally remain at sea for one to three years before returning to their natal stream to spawn **Recreational/Commercial Value** Recreational fishery There has not been a commercial salmon fishery in Newfoundland and Labrador since 1997
Brook trout	*Salvelinus fontinaliss*	**Typical Habitat** Preferred temperature: 11°C to 16°C Preferred depth: 0.06 to 0.90 m Preferred substrate: gravel, cobble, boulder **Biology and Ecology** Inhabits lakes and rivers throughout Newfoundland and Labrador Can be landlocked or anadromous Feed mainly on aquatic and terrestrial insects and fish Can hybridize with other salmonid species **Recreational/Commercial Value** Recreational fishery No commercial fishery in Newfoundland and Labrador
American eel	*Anguilla rostrata*	**Typical Habitat** Preferred temperature: variable; below freezing to over 19°C Preferred depth: $\leq$1m Preferred substrate: boulder, rubble, silt, muck, clay **Biology and Ecology** The only catadromous (spawn at sea) species in Newfoundland and Labrador All American eels spawn in the Sargasso Sea. Can survive in very shallow water, and can move across wet grass or rocks during migrations Eels hibernate over the winter in soft substrates **Recreational/Commercial Value** Recreational/Commercial fishery Few commercial licences in Newfoundland and Labrador

Table 5-1: Fish Species Known to Occur in the Rivers of Southern Labrador

Common Name	Scientific Name	Biological/Habitat Details
Arctic char	*Salvelinus alpinus*	**Typical Habitat** Preferred temperature: 3°C to 16°C Preferred depth: >1m Preferred substrate: boulder, rubble, gravel Biology and Ecology Populations in Labrador are mostly anadromous but may also be landlocked Slower growing than other salmonids due to their northern distribution **Recreational/Commercial Value** Recreational fishery Several commercial fisheries throughout Arctic Canada
Rainbow smelt	*Osmerus mordax*	**Typical Habitat** Preferred temperature: approximately 15°C Preferred depth: >2m Preferred substrate: cobble, gravel, sand, clay **Biology and Ecology** Schooling pelagic species found in lakes and nearshore marine habitats. Anadromous populations spawn in rivers in April to June Landlocked populations are known to exist in both normal and dwarf form. **Recreational/Commercial Value** Recreational fishery Food source for other recreational/commercial fish species
Threespine stickleback	*Gasterosteus aculeatus*	**Typical Habitat** Preferred temperature: 9°C to 12°C Preferred depth: variable, generally <1m Preferred substrate: within or near vegetation **Biology and Ecology** Common throughout Newfoundland and Labrador, in fresh, brackish and marine environments Maximum lifespan is typically two to two and a half years **Recreational/Commercial Value** Limited; may be a food source for larger recreational/commercial species
Longnose sucker	*Catostomus catostomus*	**Typical Habitat** Preferred temperature: 10°C to 15°C Preferred depth: <1m Preferred substrate: boulder, rubble, cobble, and gravel **Biology and Ecology** Primarily bottom-dwelling in clear, cold waters Often found in swift rivers with stony bottoms **Recreational/Commercial Value** Limited

Source: Grant and Lee 2004.

Of these species, only the American eel is designated as a species of special conservation status, being listed as vulnerable under provincial legislation—Newfoundland and Labrador's *Endangered Species Act*—and assessed as threatened by COSEWIC (2012).

5.2.1.1 General Layout

Field observations conducted at the falls in 2017 by Wood Environment and Infrastructure Solutions personnel identified a small "run-around" channel along the left side (southern side) of the falls, which would likely allow intermittent upriver access during ideal flows (Figure 5-2 and Figure 5-3). As a result, the falls are considered a partial obstruction to Atlantic salmon passage. It is not clear if passage would be possible every year, or only during years when suitable flows occur during salmon presence below the falls.

DFO research on Atlantic salmon movement and spawning in the St. Lewis River during the summer of 2014 indicated that six of eight salmon that were fitted with tracking tags at locations on the lower main stem of the river moved upriver to areas below the falls at kilometre 28 during the summer. These tagged salmon migrated back to the lower reaches of the river nearer the estuary to spawn, indicating a lower availability of spawning habitat in the accessible areas of the river near the falls at kilometre 28 (Robertson, personal communication). Incidental observations by DFO researchers identified significant areas of suitable spawning and rearing habitat upstream of the falls at kilometre 28, compared to those below. As well, Anderson (1985) indicated that there were 5,613 units of accessible spawning habitat (one unit = 100 m^2) and 13,603 units of rearing habitat on the main stem of the river below the falls at kilometre 28 and an additional 6,333 units of spawning habitat and 28,076 units of rearing habitat that is less accessible because of the migration obstruction posed by the falls. Additional spawning and rearing habitat were also identified in tributary streams above the falls.

Figure 5-2: St. Lewis River Falls at Kilometre 28: View from the North Side Showing the Rock Fracture Run-Around Along the South Side (on the left)

The presence of the run-around flow pathway at the falls presents an opportunity to utilize this natural channel to create a pool and weir type fishway and regulate the water flow into the fishway at the top of the falls that will allow salmon and trout to migrate upstream of the falls at kilometre 28 during greater flow ranges than presently possible. Upon completion of the fishway, it is expected that the falls will be passable during 50% - 60% of the natural flow levels anticipated during the migration period. This will enable the enhancement of Atlantic salmon productivity in the St. Lewis River.

The fishway concept is shown in Figure 5-3. The proposed concept is a pool and weir-type fishway that will have eight baffles creating jumps for migrating salmon. Based on field surveys completed in 2017, the falls are estimated to be 4 m high from the bottom to the top of the run-around. Each fishway pool is estimated to be approximately 2 to 6 m long, 1.5 to 2 m wide and 0.6 to 1 m deep, with a jump of 0.6 m at each baffle. The uppermost baffle will have a narrow vertical slot, which will regulate water levels during high flows while allowing flow into the fishway during lower flow conditions.

Figure 5-3: St. Lewis River Falls at Kilometre 28: View from Above the Falls Showing the Rock Fracture Run-Around Along the South Side (on the right)

Figure 5-4: Fish Passage Concept with Concrete Baffles Creating Pools in the Run-Around Flow Pathway Occurring at the Falls Located at Kilometre 28

5.2.1.2 Construction

Plan and profile drawings of the proposed fishway baffle and pool arrangement are provided in Figure 5-5 and Figure 5-6. The physical infrastructure to be constructed comprises the installation of eight concrete baffles in the natural channel between the steep rock face forming the south side riverbank and a rock outcrop that splits the river flow in this area.

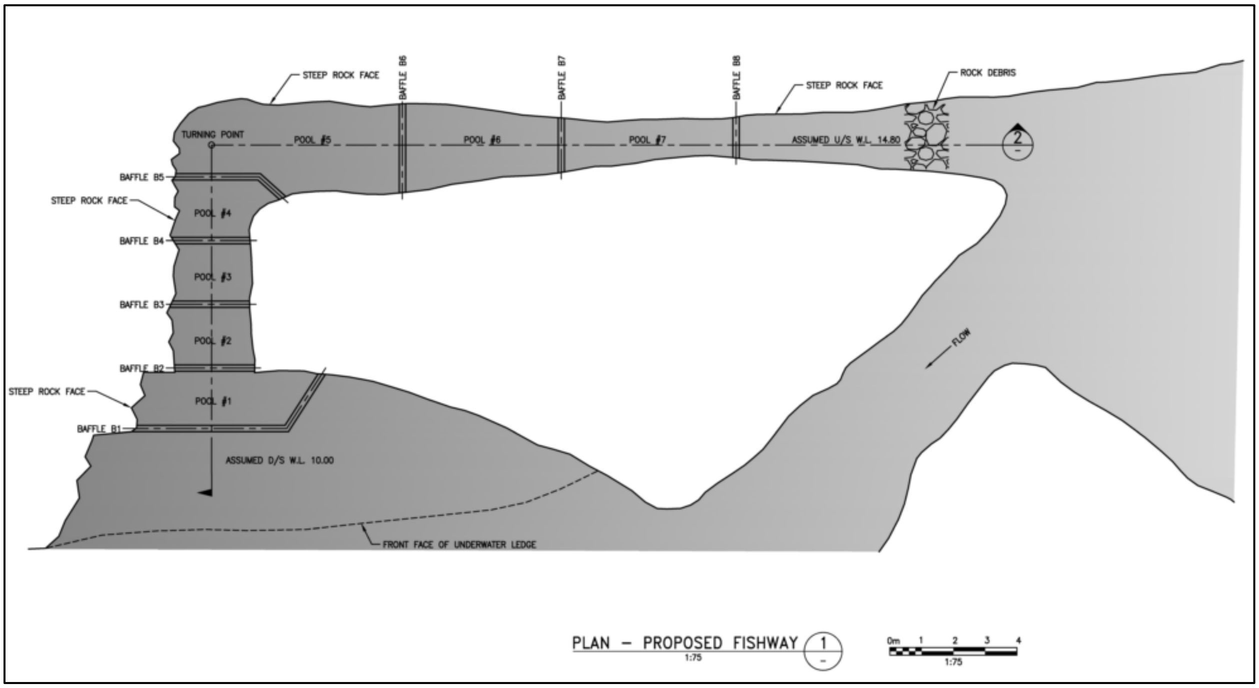


Figure 5-5: Plan View of Proposed St. Lewis River Fishway

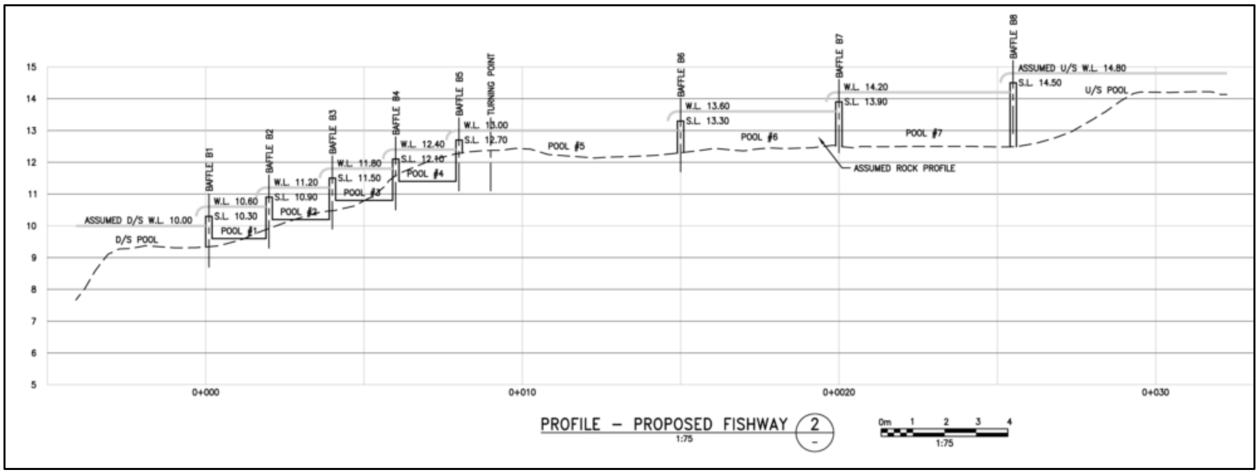


Figure 5-6: Profile View of Proposed St. Lewis River Fishway

A combination of rock removal and the installation of reinforced concrete baffles will complete construction of the fishway pools. The exact location of the fishway baffles will be determined in the field before construction.

It is proposed that the concrete baffles will be constructed of reinforced concrete to withstand the water and ice forces exhibited by the river at this location. Ready-mix concrete will be used in the construction of baffles.

Most, if not all, rock removal will be carried out using drill and wedge methodology to remove sufficient rock to create pool depths. Using this method, small holes will be drilled in the rock in a closely spaced pattern. Steel wedges will then be hammered into the holes to split the rock as required to form the pools. Explosives may be utilized to facilitate rock removal, but only on a limited “if required” basis using small amounts of dynamite. Rock removed to form the fishway pools will be deposited on the side of the river away from the fishway structure. The methodology and equipment are similar to those used by other remote construction operations.

The upstream section of the fishway is adjacent to a 7 to 10 m vertical cliff face consisting of fractured rock. This rock face will be secured using steel mesh or another protective system to ensure safe working conditions during the construction of the fishway, particularly if explosives are anticipated to be used for small portions of the rock removal. The area adjacent to the site consists of steep rock faces and a set of access stairs will be required to provide safe access to the work areas. Materials and equipment to be used in construction will be temporarily stored on the rocky plateau above the south side of the riverbank.

The construction area would be isolated from the flow of the river by constructing a cofferdam at the extreme upstream section of the run-around channel, allowing construction to be carried out in relatively dry conditions. Additionally, a cofferdam will be required at the lower section, or fishway entrance, to allow the construction of the first baffle. These temporary cofferdams will control water flow around the construction area and reduce the difficulty in constructing the remainder of the lower fishway structure. Some pumping is expected to be required during construction. Any construction water pumped from the site will be discharged into vegetation along the side of the river.

Access to the site during construction will be provided by helicopter. All materials required for construction will be delivered to the site by helicopter, and the work crew will be transported to and from the site daily.

5.2.1.3 Operations and Maintenance

Once constructed, the proposed fishway is intended to provide a pathway for Atlantic salmon migration around the falls at kilometre 28 without further need for human intervention or operational requirements. The concrete baffles and pools will be visually inspected annually to identify any physical changes or deterioration of these components, and the results of these inspections will be provided to DFO officials.

5.2.1.4 Human Environment

The nearest communities to the proposed Project site are Port Hope Simpson, located approximately 26 km to the northeast, Mary's Harbour, about 49 km to the east, and St. Lewis, roughly 58 km to the east. These communities are situated along the coast and are accessible via Route 510, the Trans Labrador Highway. The proposed Project location is not directly reachable by road. While Route 510 is the closest road, it is about 26 km from the site at its nearest point.

Port Hope Simpson has a population of approximately 575 residents and is located on the south side of the Alexis River, a scheduled salmon river. The community has commercial operations, including a hotel, a restaurant, a gas station, a grocery store, a hardware store, an airstrip, and a helicopter landing pad.

Mary's Harbour has a population of approximately 475 residents and is located at the mouth of the St. Mary's River, a scheduled salmon river. The community has commercial operations including hotel, restaurant, gas station, grocery store, and an airstrip.

Figure 5-7: View of Falls at Kilometre 28 Showing Rocky Plateau Above the South Bank of the St. Lewis River

St. Lewis, formerly known as Fox Harbour, has a population of approximately 210 residents and is located on the north side of St. Lewis inlet. It has a recorded history dating to the early 18th century, when its sheltered location, proximity to good fishing grounds, and seal migratory routes made it a desired location for the English-based migratory fishery.

The previous proponent of this offsetting project, Atlantic Rivers Outfitting, actively engaged with stakeholders to identify and address any issues relevant to the Project. Atlantic Rivers Outfitting reviewed the proposed Project with the DFO and Provincial Water Resources Management Division, the lead agencies with responsibilities for approving works that have potential to interact with fish habitat and water quality associated with Project construction and operation. Atlantic Rivers Outfitting also discussed the proposed project with representatives of the NCC.

Previous discussions regarding this habitat enhancement on the St. Lewis River with local communities and NCC have been completed in the past, and both positive feedback and concerns were identified. The overall increase in Atlantic salmon spawning and rearing habitat was previously noted by local communities as a net benefit to the salmon runs and viability of the St. Lewis population; however, other known comments suggested concern over increased access by salmon to the upper portion of the St. Lewis River and that increased fish passage success and juvenile rearing densities upriver may negatively affect the other species using the habitat. Champion has recently engaged with NCC and Innu Nation regarding this habitat connectivity enhancement project on the St. Lewis River and recognizes the concerns raised and will incorporate appropriate baseline and habitat utilization investigations upriver of the falls as part of the *Fisheries Act* authorization process so that any adverse effects are minimized.

Designated land use areas identified in the provincial land use atlas in the proposed Project area are shown on Figure 5-8. There are no known conflicts identified in the immediate Project area. The outfitter buffer identified on Figure 5-8 is for Atlantic Rivers Outfitting’s St. Lewis River Lodge, located approximately 18 km downstream from the proposed Project site. There is no other outfitter camp identified on the river.

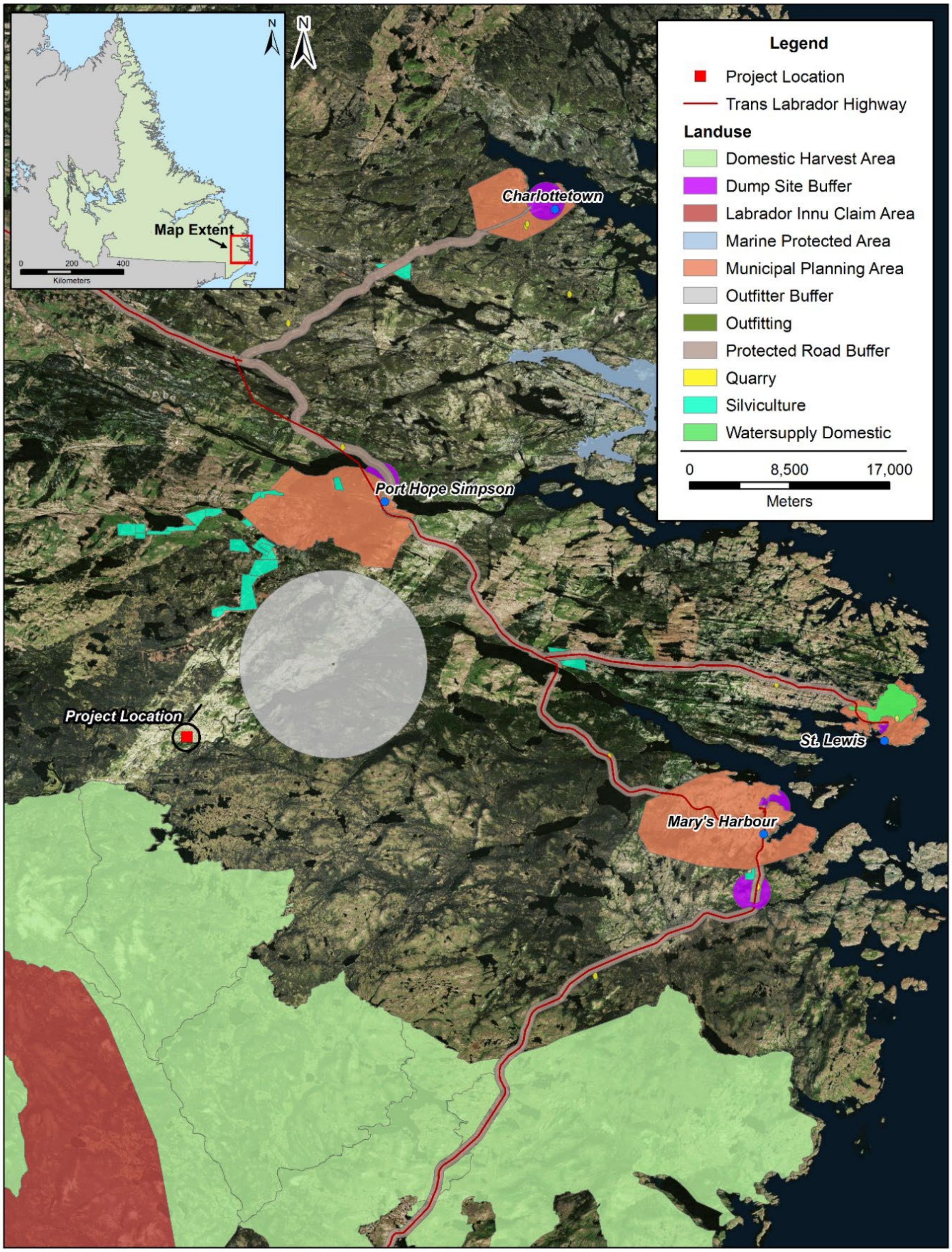


Figure 5-8: Designated Land Use Areas Identified in the Provincial Land Use Atlas in the Project Area

5.3 Stream Spawning and Rearing Enhancements

The first additional option considered was the enhancement of stream spawning and rearing habitat in Tamarack Brook and Pike Lake North Outlet. This option was designed to increase fish production related to ultimate increases in local recreational fisheries (e.g., brook trout, ouananiche, northern pike). The overall offset was based on physically manipulating existing fish habitat to improve its capacity and sustain fish as per DFO guiding principles.

A portion of this option was to be provided through increased riverine spawning, young-of-year (YOY), and rearing production in Tamarack Brook and Pike Lake North Outflow. All offsetting measures were to be directed toward habitat for species that support a recreational fishery; however, it should be noted that the habitat criteria outlined for recreational species also included most fish species in the area. Based on experience with in-stream enhancements for existing fish populations, the results were to be expected the following season after construction. For example, young-of-year salmonids would be expected to be within the location of an improved spawning habitat the year after the first spawning season, when the habitat was accessible and available. It was anticipated that juveniles and adults would begin to occupy suitable habitat within a month of construction completion.

Below are the details of the measures designed to offset capacity losses associated with the Project. The streams that will be lost due to the Project are relatively low in terms of productivity. In addition, most of the streams flow through low-lying boggy areas or large boulders; hence, the quantity of spawning substrate (gravels) within them is low. For example, the percentage of spawning gravels in each of the Project footprint areas destroying stream habitat is 0.24 units (0.4% of total habitat area) within the Rose Pit area, 1.03 units (3% of total habitat area) within the waste rock stockpile areas, and 41.54 units (19.5% of total habitat area) within the TMA. The number of brook trout using these areas is also low, suggesting that these streams are not critical in terms of spawning, for providing habitat and/or production support for downstream (i.e., Duley Lake) fish populations.

Based on surveys completed between 2011 and 2013 within the Pike Lake watershed, the interconnected streams between the larger lakes contain substrates of primarily larger materials such as bedrock, boulder, and rubble. While some reaches have spawning gravels in limited quantities, additional riverine spawning habitat would enable greater spawning of salmonids such as brook trout and ouananiche. By increasing spawning habitat across a large reach of stream, with associated water depth and velocities preferable to salmonids, concentrated predation by large ambush predators such as pike would also likely be reduced, as velocities will be too high and ambush cover limited. However, increased habitat for spawning and rearing of salmonids and smaller prey species would provide additional pike production as potential prey migrate into nearby larger waterbodies.

A review of stream reaches within the Pike Lake South watershed was completed based on the potential for increased fish production (spawning and YOY rearing) that would contribute to the populations within the watershed's larger waterbodies. Streams were reviewed for potential biological production, access, constructability, nearby infrastructure, and material. Upon review of available information, mapping, and air photos, locations near the outflow of the Pike Lake watershed, Walsh River, and Tamarack Brook (within the city limits of Labrador City) were identified.

Three areas had been identified with limited spawning habitat and/or enhancement potential (Figure 5-9). By providing greater spawning and rearing habitat, these areas would enhance salmonid capacity within the Pike Lake and Tamarack Brook watercourses.

To offset the loss of small stream habitat, larger material such as boulders and rubble (which have no spawning suitability for brook trout, as shown in Grant and Lee [2004]) would be replaced with spawning gravels. This would increase the spawning habitat within the area and increase overall fish production within the watershed. Habitat features such as low head barriers would also be installed to maintain gravels and increase spawning suitability. The total spawning/rearing habitat enhancement area will be at least 17 to 30 units along several outflow stream reaches. Champion would have had to adhere to all mitigations stipulated in the offsetting plan and the Project Environmental Protection Plan during all construction activities.

In general, habitat parameters within stream enhancements would have been designed based on salmonid preferences (e.g., brook trout). Below are the design details for each selected riverine location and a determination of the net increase in production anticipated.

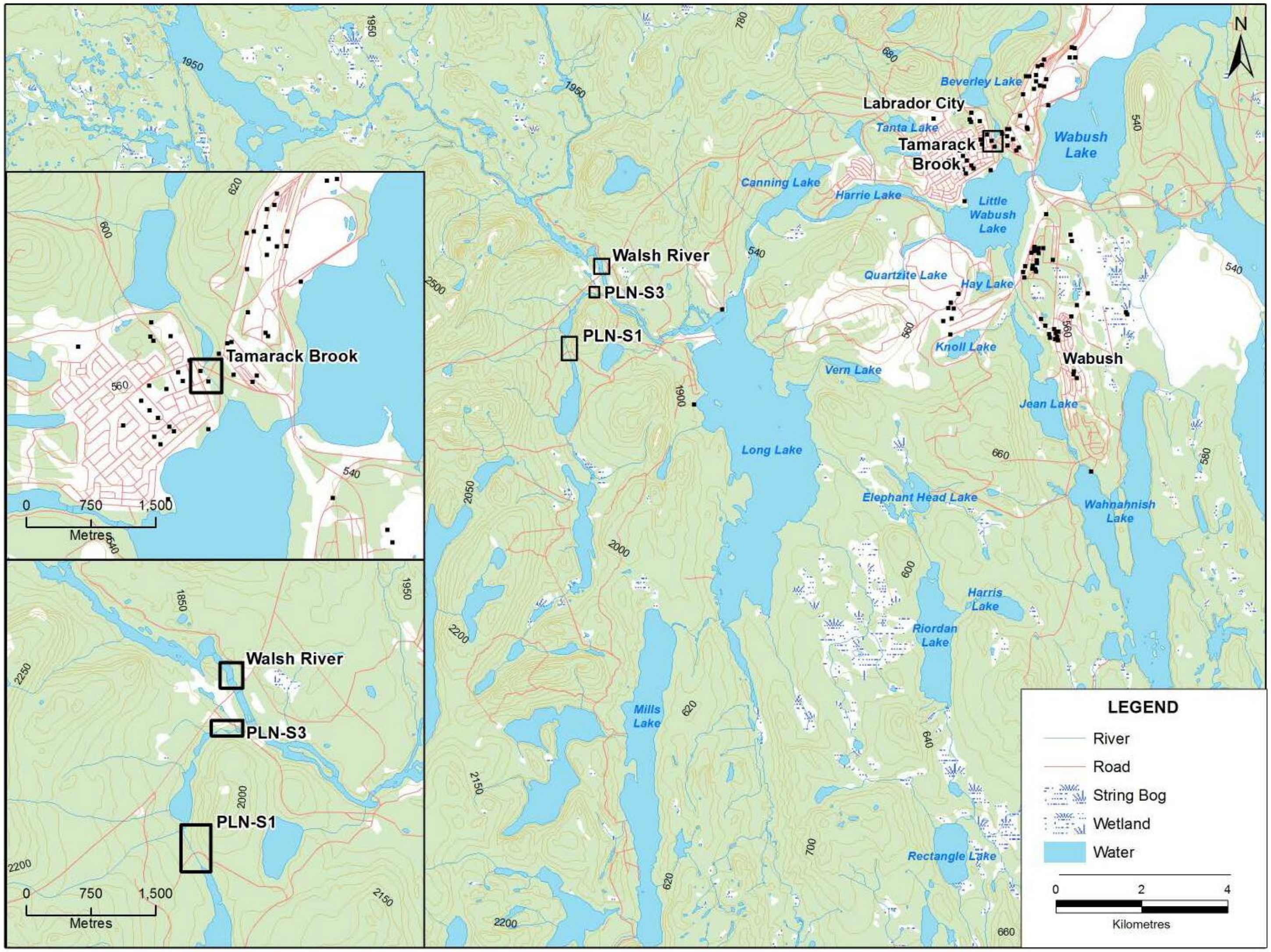


Figure 5-9: Locations of Nearby Riverine Enhancement Offset Options

5.3.1 Pike Lake North Outflow

The Pike Lake watershed flows from the general area of the Rose Pit northward to its confluence with the Walsh River (Figure 5-9). The watershed is approximately 32 km^2 in size with an overall main stem stream length of 3.5 km and 16.3 km of tributary. The stream was surveyed as part of the fish, fish habitat and fisheries baseline study and is described in detail in AMEC (2012). Two locations within Pike Lake Outflow have been designed for spawning production increases: sections PLN-S3 and PLN-S1.

Figure 5-10 and Figure 5-11 provide the typical hydrograph and flow duration curve for Pike Lake Outflow based on pro-rating from the available hydrology in Labrador West. The hydrographs depict the monthly flow variations for mean, maximum, and minimum flow rates.

5.3.1.1 Stream Section PLN-S3

The first offsetting option within Pike Lake Outflow was located in the stream's lower reaches as it enters Walsh River (Figure 5-9). The stream, between Walsh River and the first small unnamed waterbody, is approximately 385 m in length and has a total of 24.65 units of riverine habitat. During surveys in 2013 within areas considered for enhancement, wetted widths ranged from 7.1 to 10.1 m, mean depths ranged from 0.18 to 0.35 m, and mean water velocities ranged from 0.25 to 0.62 m/s. Table 5-2 summarizes habitat characteristics and the habitat classification for each stream reach within the areas where offsetting measures were considered. Figure 5-12 and Figure 5-13 provide images of the typical habitat within that stream section.

Surveys of the area in June 2013 indicate that several reaches of PLN-S3 have suitable habitat conditions for spawning enhancement. The lower reach of the tributary, immediately upstream from Walsh River (approximately 40 m in length), contains large quantities of gravel and would, therefore, not be conducive to additional enhancement; however, the 160 m of stream upriver of this reach would be suitable. The existing substrate is primarily rubble; therefore, the area has relatively low spawning productivity. Population estimates and YoY presence support this.

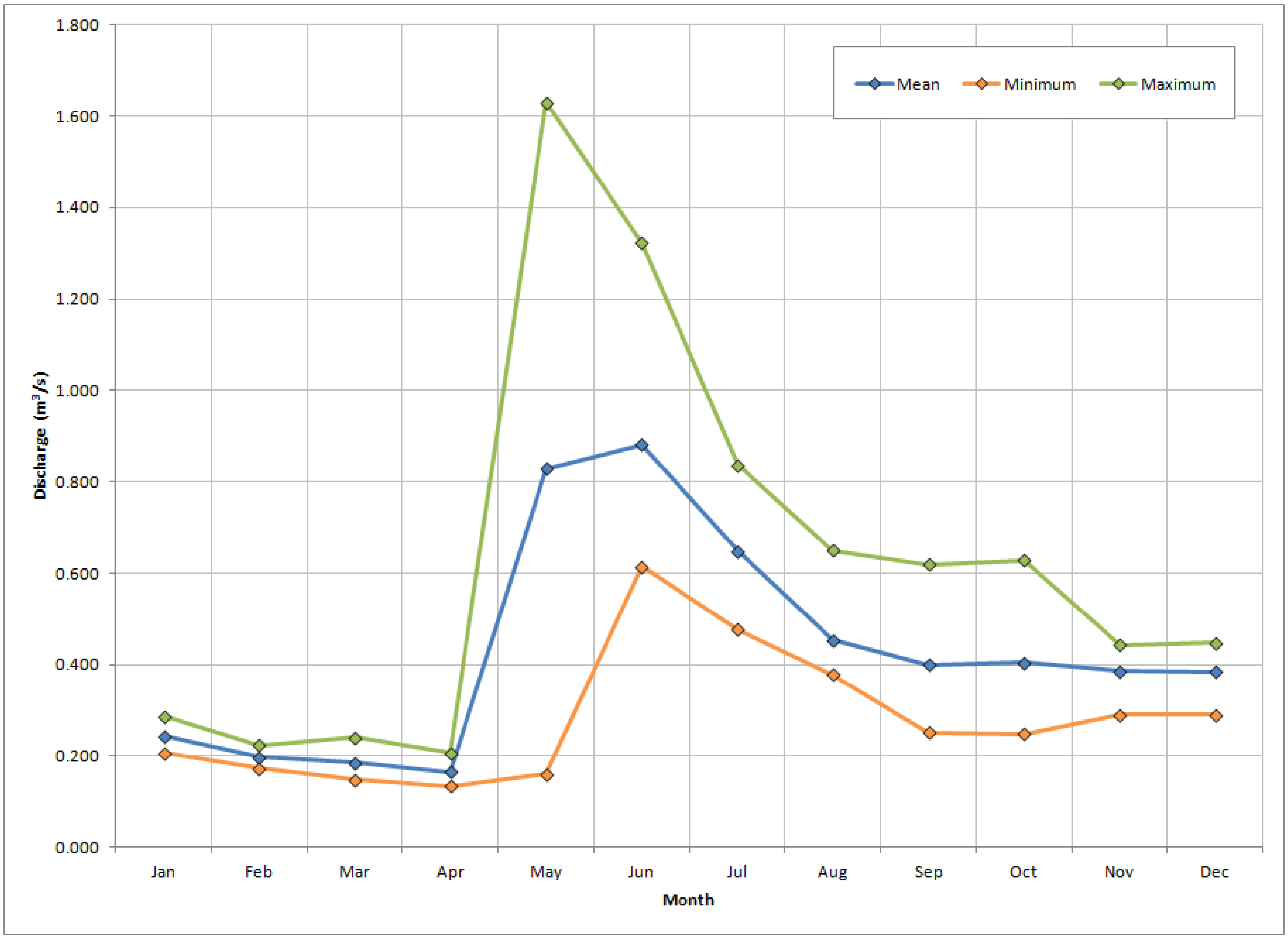


Figure 5-10: Pike Lake Outflow Mean Monthly Hydrograph

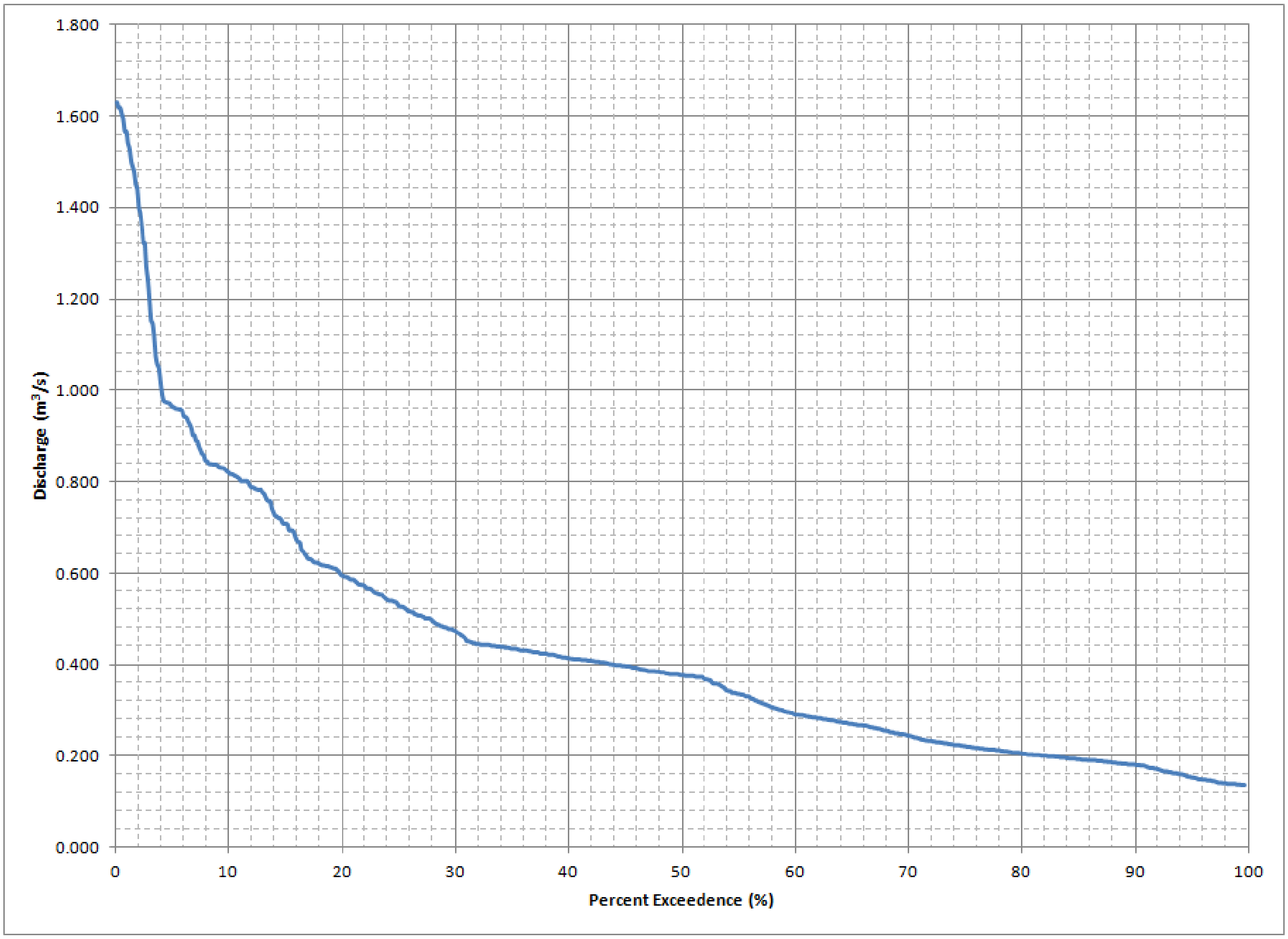


Figure 5-11: Pike Lake Outflow Flow Duration Curve

Table 5-2: Summary of Habitat Measurements and Classifications for PLN-S3 Offset Locations, June 2013

Reach #	Reach Length (m)	Wetted Width (m)	Area (units)	Average Depth (m)	Average Velocity (m/s)	Substrate (%)								Classification	
						B	Bo	R	C	G	S	F	D	Beak	New
1	42	7.7	3.23	0.35	0.27	0	5	0	20	65	10	0	0	I	Riffle
2	44	7.1	3.12	0.18	0.62	0	25	40	20	15	0	0	0	II	Rapids
3	26	7.1	1.85	0.26	0.47	0	15	60	20	5	0	0	0	II	Run
4	26	9.9	2.57	0.27	0.25	5	40	40	5	10	0	0	0	I	Run
5	64	10.1	6.46	0.32	0.30	0	15	60	20	5	0	0	0	I	Run

Figure 5-12: Habitat Within PLN-S3 (transect 3) at Midpoint Extent of Survey (about 110 m upstream of Walsh River, looking upstream)

Figure 5-13: Habitat Within PLN-S3 (transect 5) at Upper Extent of Survey (about 200 m upstream of Walsh River, looking upstream)

Quantitative electrofishing of the PLN-S3 was completed in June 2013 (Figure 5-14). Index stations provide species presence, life stages utilizing the area and standardized catch-per-unit effort (CPUE), while quantitative stations provide more accurate data on species composition and population/density. Table 5-3 summarizes the quantitative and index population estimates for salmonid life stages (YoY and total population). Population estimates can indicate the density and proportion of species YoY in the stream section and hence provide a means of estimating the potential for increasing spawning production. These values would have also been used as baseline levels for post-enhancement monitoring. As shown in Table 5-3, YoY estimates for brook trout and ouananiche are very low, both in total number and relative to their overall species population within the area. Brook trout show good population numbers overall, but very low YoY. There are low numbers of ouananiche in the area, but no spawning. Table 5-4 summarizes the population estimates for non-salmonids completed within PLN-S3 quantitative stations in 2013.

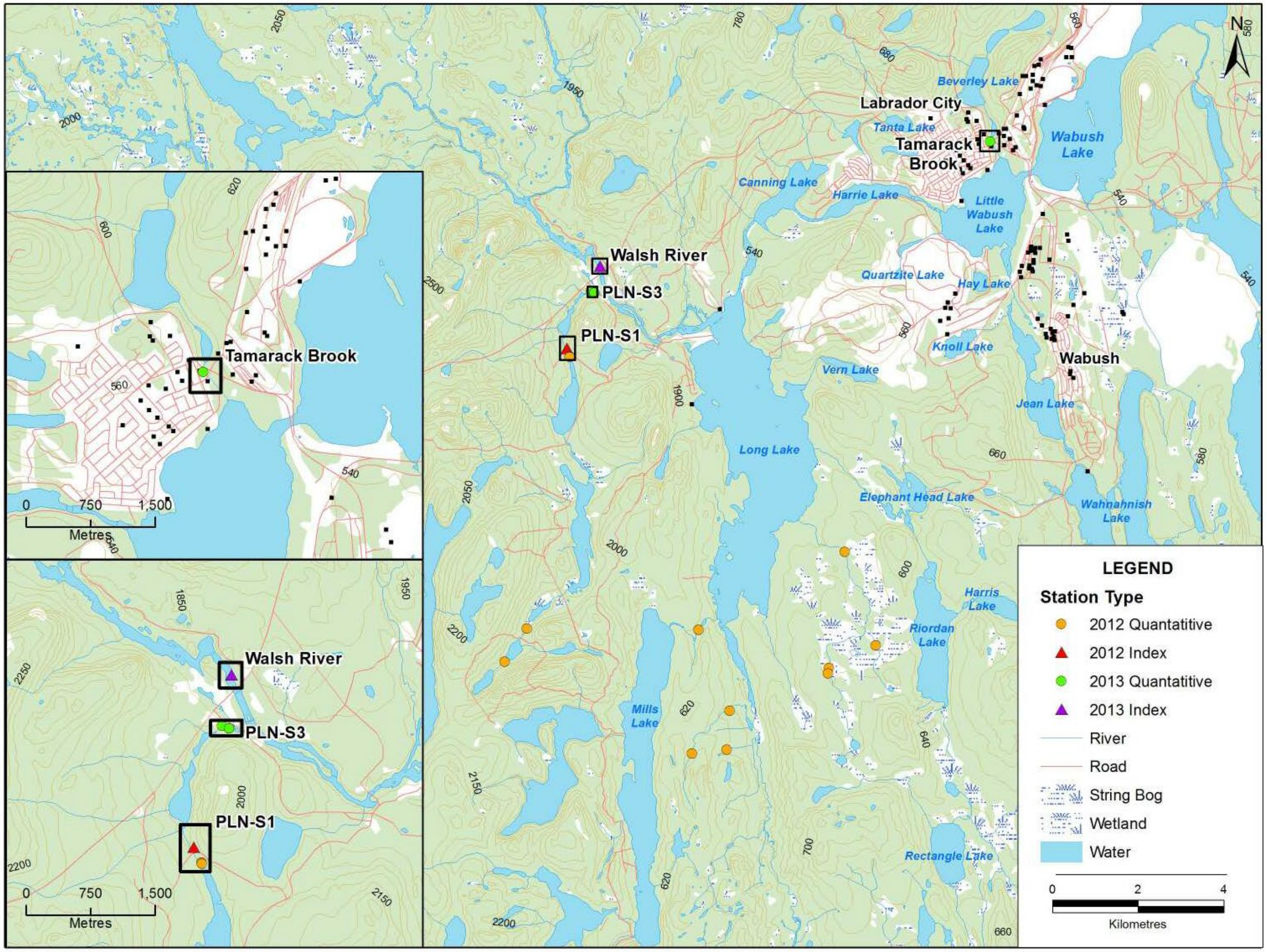


Figure 5-14: Electrofishing Locations Within Habitat Enhancement Areas and the Project Area

Table 5-3: Summary of Population Estimates for Salmonid Fish Species Caught in PLN-S3 during 2013 Baseline Electrofishing

Species	Life Cycle Stage	Electro-fishing Station	Total Area (m^2)	Total Catch	Pop. Est./Unit (N/unit)	95% Confidence Limits (N/unit)		Biomass/Area Estimate (g/unit)
						Lower[(a)]	Upper	
Brook trout	Total	1	253	39	29.5	15.4	51.4	516.0
		2	141	58	44.6	41.1	48.3	1060.8
	YOY	1	253	2	1.5	0.79	2.6	1.6
		2	141	0	0	0	0	0
Ouananiche	Total	1	253	0	0	0	0	0
		2	141	4	3.1	2.8	3.3	86.6
	YOY	1	253	0	0	0	0	0
		2	141	0	0	0	0	0

Note: One unit equals 100 m^2.

(a) Actual catch standardized to one unit (100 m^2) was used to represent the lower confidence interval.

Table 5-4: Summary of Population Estimates for Non-salmonid Fish Species Caught in PLN-S3 during 2013 Baseline Electrofishing

Species	Location (electrofishing station)	Total Area (m^2)	Total Catch	Pop. Est./Unit (N/unit)	95% Confidence Limits (N/unit)		Biomass/Area Estimate (g/unit)
					Lower[(a)]	Upper	
Lake chub	**1**	**253**	**0**	**0**	**0**	**0**	**0**
	2	**141**	**2**	**1.5**	**1.4**	**1.7**	**12.1**
Longnose sucker	**1**	**253**	**29**	**21.9**	**11.5**	**38.2**	**91.2**
	2	**141**	**53**	**40.8**	**37.6**	**44.2**	**278.2**
Slimy sculpin	**1**	**253**	**13**	**9.8**	**5.1**	**17.1**	**27.3**
	2	**141**	**6**	**4.6**	**4.3**	**5.0**	**16.2**

Note: One unit equals 100 m^2.

(a) Actual catch standardized to one unit (100 m^2) was used to represent the lower confidence interval.

5.3.1.2 PLN-S1

The location of the second offsetting option within Pike Lake outflow was within the stream's upper reaches at the main outflow of Pike Lake North (Figure 5-14). The stream is located between Pike Lake North and Pike Lake South. Its total length is approximately 425 m and contains 22.68 units of riverine habitat. Wetted widths ranged from 7.1 to 34.4 m, mean depths ranged from 0.14 to 0.20 m, and mean water velocities ranged from 0.00 to 0.40 m/s. Table 5-5 summarizes habitat characteristics and the habitat classification for each stream reach within the habitat enhancement area of PLN-S1 based on surveys in June 2013. Figure 5-15 and Figure 5-16 provide images of the typical habitat within that stream section.

Table 5-5: Summary of Habitat Measurements and Classifications for Habitat Enhancement Area within PLN-S1, June 2013

Transect #	Section Length (m)	Wetted Width (m)	Area (units)	Average Depth (m)	Average Velocity (m/s)	Substrate (%)								Classification	
						B	Bo	R	C	G	S	F	D	Beak	New
1	-	34.4	-	0.18	0.00	0	50	40	0	0	0	0	10	I	Pool
2	46	13.1	6.03	0.17	0.11	0	90	0	0	0	0	0	10	I	Rapids
3	57	12.1	6.90	0.14	0.06	0	90	0	0	0	0	0	10	IV	Rapids
4	64	7.1	4.54	0.20	0.26	0	90	0	0	0	0	0	10	I	Riffle
5	66	19.6	12.94	0.18	0.03	0	90	0	0	0	0	0	10	IV	Rapids
6	9	7.8	0.70	0.14	0.40	0	90	0	0	0	0	0	10	II	Rapids

Figure 5-15: Habitat Within PLN-S1 at Midpoint (about 120 m downstream of Pike Lake North, looking downstream)

Figure 5-16: Outlet of Pike Lake North at Upper End of PLN-S1 (looking downstream)

Surveys of the area in June 2013 indicate that approximately 240 m of stream below the mouth of Pike Lake North have suitable habitat conditions for salmonid spawning enhancement. The existing substrate is primarily boulder; therefore, the area has relatively low spawning productivity.

Quantitative electrofishing of the stream section was completed in June 2013, while index stations were established and completed in 2012 (Figure 5-14). Table 5-6 summarizes the quantitative and index population estimates and densities for all species in the 2013 surveys. As shown, no salmonids were captured in the survey area. This suggests that the habitat is unsuitable for spawning and favours chub, sucker and dace.

Table 5-6: Summary of Population Estimates for Salmonid Fish Species Caught in PLN-S1 during 2013 Baseline Electrofishing

Species	Location (Electrofishing Station)	Total Area (m^2)	Total Catch	Pop. Est./Unit (N/unit)	95% Confidence Limits (N/unit)		Biomass/Area Estimate (g/unit)
					Lower[(a)]	Upper	
Burbot	1	226.5	24	11.5	10.6	12.7	382.5
	2	280	9	3.8	3.2	4.3	134.6
Lake chub	1	226.5	17	8.2	7.5	7.0	44.0
	2	280	117	49.9	41.8	55.3	298.4
Long nose sucker	1	226.5	1	0.5	0.4	0.5	6.8
	2	280	0	0	0	0	0
Pearl dace	1	226.5	42	20.2	18.5	22.2	122.9
	2	280	18	7.7	6.4	8.5	38.7
Slimy sculpin	1	226.5	3	1.4	1.3	1.6	18.7
	2	280	7	3.0	2.5	3.3	22.2
White sucker	1	226.5	4	1.9	1.8	2.1	32.7
	2	280	92	39.2	32.9	43.4	738.0
Index station		Time[(a)]	0	CPUE[(b)]	-	-	-
Brook trout (total)	1	709	1	0.42	-	-	-
Brook trout (YOY)			0	0.00	-	-	-

Note: One unit equals 100 m^2.

(a) Index effort (time) is in seconds.

(b) Catch-per-unit effort (CPUE) is the number of fish per standardized 300 seconds of electrofishing.

YOY = young-of-year; – = Not applicable.

5.3.1.3 Salmonid Spawning/Rearing Production Enhancement

PLN-S3 and PLN-S1 are two stream sections within Pike Lake North Outflow identified for enhancement (Figure 5-14). Previous surveys indicate that stream reaches within PLN-S3 are used for salmonid spawning and rearing (brook trout), but population estimates of YoY indicate very low capacity. Reaches in salmonids do not currently use PLN-S1, although salmonids are in the system (see Table 5-6). The selected reaches for enhancement currently contain bottom substrates dominated by larger materials, including boulder, rubble, and cobble. These habitat conditions and easy access to the riverbank made these two streams good enhancement options. Existing large substrates would have been augmented with spawning materials (i.e., gravels) in each reach; total coverage is estimated at 1,396 m^2 within PLN-S3 and 3,111 m^2 within PLN-S1. As noted in the general construction outline in Section 5.2.1.2, the increase in spawning capacity would also increase the need for additional rearing habitat as the young mature and compete for space.

Improvements to the substrate composition would enhance the area for salmonid species spawning. Brook trout anticipates the maximum increase; however, other species/life-cycle stages will also benefit. The habitat features that would be created would have consisted of a combination of run and riffle sub-habitats, as these provide maximum spawning suitability.

The general layout and cross sections of each enhanced habitat type were designed using the habitat descriptions and the species preference criteria. Figures A1 through A6 in Appendix B contain the layout of the proposed habitats to be enhanced. Also shown for each figure are the estimated spawning discharge and the calculated mean water depth, mean water velocity and slope based on Manning's equation (Newbury and Gaboury 1994). Based on the primary species in the area, brook trout, and the results of transect models of water depth when substrates have been added, the minimum substrate depth of 250 mm was revised to 200 mm at these locations. It was anticipated that 250 mm of placed substrate would cause the water depths to be too shallow during spawning and summer-low flows. Low-head barriers would have also been installed downstream and at select locations within the reaches to assist in gravel stabilization and maintenance of channel features. Spawning substrates would be applied in enhanced areas over an existing base layer of larger material.

Construction access would be via the existing access roads that approach the sections from the east side of the river, off the Duley Park access road (see Figure 5-14). It is anticipated that no other access will be needed or constructed. A series of cofferdams would be placed around the work area to dry all material placement. Pumps or diversions will be used to redirect flow around the work area to keep the area dry and to maintain downstream flows during Construction. All water within the work area would be removed and pumped to an area to ensure that suspended sediment is removed. In addition, turbidity barriers would be installed downstream of the work area to manage suspended sediment. Once the reach was accessible and de-watered, an experienced biologist would have placed the spawning material as directed. Once suitable spawning material and supporting structures are placed throughout the work area, river water will slowly be reintroduced and allowed to stabilize using the natural flow regime.

A dump truck would bring suitable substrate material to the site. Trucks would dump material as close to the river as possible or directly into the de-watered reach. Appropriately sized machinery would redistribute material as directed within each de-watered section. Crew members may manually assist with the final distribution. Once completed, the cofferdams would be removed, and decommissioning/contouring of the access location would be completed as required.

Surveys and construction would mostly take place during the summer months. All construction of low-head barriers and spawning material placement would be conducted in accordance with regulations. Once access to each habitat reach was completed, bank stabilization would also have been undertaken if required. Monitoring of riparian vegetation success is outlined in Section 7.0.

The habitat was designed to maximize suitability for the fish species present with minimal disturbance of the existing riparian habitat. For example, any machinery needed within the drainage would be as small as possible and have a relatively small "footprint" for riparian disturbance. All attempts would be made to ensure that any disturbance required will occur at locations identified for habitat expansion or in areas of lowest velocity.

Stream de-watering and pumping would not have begun until all material required was on site and ready, so minimal disturbance was required. It is estimated that the spawning enhancement work would take approximately five days of in-stream construction effort to complete. It should be noted that each section may have required multiple de-watered sections completed in succession, which may have prolonged the overall instream construction. Before dewatering, fish would have been removed using standard electrofishing. While any portion of the stream was dewatered, surveys would be completed within the dewatered sections to ensure any stranded fish were relocated as quickly as possible.

5.3.1.4 Substrate Stability Estimate

Any stream enhancement must consider the local flows which could be encountered. Inherent in this approach within a natural watercourse is the knowledge that the material placed will remain. The maximum flows were considered in terms of habitat and substrate stability. Typical and high fall flows were also incorporated into the design, as they determine the appropriate slope and substrate depths in each reach to achieve the preferred range of water depth and velocity for spawning.

The Pike Lake North watershed would not have been modified as a part of the offset design (i.e., the natural hydrologic cycle would be experienced by all enhanced habitat, particularly with the augmented flows to mitigate flow losses – see Section 4.2). The underlying characteristics of any modified/created habitat would depend highly on local flow characteristics. The modified habitat's general width, depth and slope would be such that high flows naturally experienced in the system would be transported without excess erosion or damage.

Spawning material would be added to the streambed; the hydrology and water depths within PLN-S3 and PLN-S1 dictate that approximately 200 mm be added. The mean water velocities and depth values were calculated between the existing and future conditions (i.e., after suitable substrate additions), particularly for the flows associated with spawning and high spring flows (i.e., September-October and April). This was completed using Manning's equation and simulated water elevations in AutoCAD to ensure the addition of spawning/rearing substrates within each reach would not make other physical parameters unsuitable. It was also completed to ensure that the substrates would not be flushed out of the system during high-flow events. Table 5-7 presents a summary of the results. The habitat characteristics associated with the augmented habitat would remain suitable for spawning/rearing brook trout and other species. Typical flow velocities in the enhanced habitat types will be relatively low compared to scour velocities. presents typical bedload movement velocities for stream substrates (Sooley et al. 1998). Estimated high fall spawning discharges of 0.60 m^3/s and a high freshet discharge of 1.60 m^3/s were used to estimate velocities in the designed habitat. At the high discharges indicated above, velocities ranged from 0.18 to 0.43 m/s for fall and spring discharges, respectively. The largest particle size capable of movement, based on

Table 5-8, would therefore be 2.5 mm at 0.43 m/s.

Table 5-7: Summary Habitat Parameters for Enhanced Spawning Habitat, Pike Lake North Outflow

Reach	Habitat Parameters							
	Existing Conditions				Modelled Future Conditions			
	Mean Velocity (m/s)	Mean Depth (m)	Slope (%)	Manning's n	Mean Velocity (m/s)	Mean Depth (m)	Slope (%)	Manning's n
Typical Summer Low-Flow Discharge (0.40 m^3/s)								
PLN-S3	0.28	0.18	0.05	0.077	0.37	0.14	0.05	**0.051**
PLN-S1	0.16	0.24	0.05	0.174	0.30	0.10	0.05	**0.051**
High Spring Discharge (1.60 m^3/s)								
PLN-S3	0.43	0.37	0.05	0.077	0.57	0.27	0.05	**0.051**
PLN-S1	0.24	0.49	0.05	0.174	0.53	0.25	0.05	**0.051**
High Spawning Discharge (0.60 m^3/s)								
PLN-S3	0.32	0.21	0.05	0.077	0.42	0.17	0.05	**0.051**
PLN-S1	0.18	0.29	0.05	0.174	0.37	0.14	0.05	**0.051**
Mean Spawning Discharge (0.45 m^3/s)								
PLN-S3	0.30	0.19	0.05	0.077	0.39	0.15	0.05	**0.051**
PLN-S1	**0.14**	**0.10**	**0.05**	**0.174**	**0.32**	**0.11**	**0.05**	**0.051**

Table 5-8: Transport Velocities of Different Streambed Materials

Material	Diameter (mm)	Transport Velocity (m/s)
Silt	0.005–0.05	0.15–0.20
Sand	0.25–2.5	0.30–0.65
Gravel	5.0–15	0.80–1.20
Fine to coarse stone	25–75	1.40–2.40
Cobble	100–200	2.70–3.90

Similar to channel calculations above for potential streambed movement, the estimated potential incipient particle diameters for both typical fall/spring (i.e., 0.60 m^3/s) and extreme flows (i.e., 1.60 m^3/s) have also been estimated (Table 5-9). These calculations estimate that a substrate size up to 2.85 cm could be moved. As a result, it is anticipated that smaller-sized gravel material placed in this area may shift and stabilize because of extreme flows. It is not expected that all substrates less than the indicated diameter would be transported, as they will lie within a matrix of larger substrates. The potential for a portion of substrates under this size to be shifted/re-distributed is not expected to be problematic. While it can be expected that some material stabilization will occur during extreme freshets, it is anticipated that the placed material would not be removed from the reach. Calculations above are used to indicate substrate stability and movement potential and are assumed under uniform flow conditions (Newbury and Gaboury 1994). The potential incipient particle diameters are based on a mean surface water slope for each reach, a conservative oversimplification in most streams. It should also be noted that installing low-head barriers would provide a physical barrier to substrate movement and effectively reduce bottom slope and water velocities and therefore assist in reducing the potential for movement of gravels out of the reach. Low-head barriers would also provide upwelling for spawning.

Table 5-9: Potential Incipient Particle Diameters for Each Habitat Design

<table>
<tr><th>Habitat Design</th><th>Mean Water Depth (m)</th><th>Slope (%)</th><th>Flow (m^3/s)</th><th>Incipient Particle Diameter (cm)</th></tr>
<tr><td rowspan="3">PLN-S3</td><td>0.57</td><td rowspan="3">0.05</td><td>1.60</td><td>2.85</td></tr>
<tr><td>0.42</td><td>0.60</td><td>2.10</td></tr>
<tr><td>0.39</td><td>0.45</td><td>1.95</td></tr>
<tr><td rowspan="3">PLN-S1</td><td>0.25</td><td rowspan="3">0.05</td><td>1.60</td><td>1.25</td></tr>
<tr><td>0.14</td><td>0.60</td><td>0.70</td></tr>
<tr><td>0.11</td><td>0.45</td><td>0.55</td></tr>
</table>

5.3.1.5 Calculated Increases in Salmonid Spawning Production

The overall habitat area enhancement in PLN-S3 and PLN-S1 would be 13.96 units and 31.11 units, respectively. The baseline quantitative electrofishing data estimate the existing spawning productivity (as determined by population estimates of YoY). These can be used with anticipated future population estimates of YoY to calculate a net increase in spawning capacity. Existing baseline values and predicted increases would have also been used during monitoring to determine the success of the enhancements.

A conservative approach has been used to estimate the net spawning capacity increase at each enhancement area within Pike Lake North Outflow. As only one year of baseline is available at each enhancement area, the upper confidence limit of the highest YoY population estimate from each area has been used to represent the existing YoY production. Table 5-10 provides the existing spawning YoY capacity estimates. The highest existing YoY capacity estimates are 2.6 and 0.0 YoY/unit in PLN-S3 and PLN-S1, respectively.

Electrofishing results throughout the Project area were used to estimate future spawning production (AMEC 2013). The YoY captures were separated from total captures, and population estimates were generated. Each electrofishing station was also reviewed for substrate composition to determine whether any spawning material had larger quantities (i.e., gravels or coarse sands) and could represent future enhancement conditions within PLN-S3 and PLN-S1. Upon review of the data, no electrofishing station had a gravel composition greater than 35%, and many contained very high quantities of silt. Therefore, YoY population estimates from these stations would most likely under-represent the spawning potential within enhanced areas with 70% - 95% spawning material. However, within those stations electrofished within the area, Station WR-03, located in stream AD05 (i.e., within the Mine Rock Disposal Area) had the highest YoY population estimate at 12.1 YoY/unit (AMEC 2013). Post-habitat enhancement monitoring at other riverine habitat offsetting sites for salmonid spawning indicates that YoY densities can be 100/unit; however, these sites are on the Island portion of the province with lower competition with other species and lower predation by species such as northern pike and burbot.

Table 5-10: Summary of Young-of-Year Population Estimates for Salmonid Fish Species Caught in PLN-S3 and PLN-S1 during 2013 Baseline Electrofishing

Species[a]	Enhancement Area	Existing		Anticipated		Net Increase in Spawning Production (N/unit)
		Pop. Est./Unit (N/unit)	Upper 95% Conf. Limit (N/unit)	Pop. Est./Unit (N/unit)	Upper 95% Confidence Limit (N/unit)	
Salmonids	PLN-S3	1.5	2.6	48.8	56.8	40.4–54.2
	PLN-S1	0.0	0.0	48.8	56.8	40.8–56.8

Note: One unit equals 100 m^2.

(a) Brook trout and ouananiche.

Both estimate methods outlined above, using an existing local natural YoY population estimate in a non-enhanced area and/or an estimate from other post-enhancement sites on the Island portion of the province, have limitations and uncertainties regarding their use. However, if the local natural YoY population estimate was adjusted based on the substrate composition (i.e., the substrate composition at WR-03 was composed of 10% Cobble, 5% Gravel, 75% sand/silt/clay, and 10% detritus) and the YoY population estimates from post-enhancement sites were used as an upper limit, an estimated post-enhancement YoY production could be approximately four times that recorded at AD05 (i.e., the enhanced areas would have much higher spawning gravels and cobble). Using these estimates, a net increase in spawning production for PLN-S3 and PLN-S1 would range from 40.4 to 54.2 YoY/unit and 40.8 to 56.8 YoY/unit, respectively.

Using the net increase in spawning production estimated above, and the overall habitat area to be enhanced in each section (13.96 units in PLN-S3 and 31.11 units in PLN-S1), the total net increase in YoY capacity from both sites is conservatively estimated between 1,860 YoY and 2,524 YoY.

5.3.2 Tamarack Brook

The Tamarack Brook watershed flows southward from the general area of Beverly Lake into Little Wabush Lake near Labrador City (Figure 5-2). From its upper reaches, Tamarack Brook initially flows under Route 500 and through a small open field behind the Carroll Inn. Below Avalon Drive, it flows through a heavily vegetated valley between the Two Seasons Inn and the McDonald's restaurant. The lower reach of this section is a small pond. The pond empties into culverts under Tamarack Drive and into Little Wabush Lake. The stream sections have been delineated based on these descriptions and their relative locations to the roads/culverts that cross it; Large Pool is located just upstream of the Tamarack Drive culverts, Tamarack-S1 is located upstream of the Small Pond and below the Avalon Drive culverts, and Tamarack-S2 is located upstream of the Avalon Drive culverts and the Highway 500 culverts.

The watershed is approximately 8 km^2 in size, with an overall mainstem stream length of 2.4 km and 1.3 km of tributary. The stream was surveyed as part of the baseline sampling associated with this Plan. The watershed was also identified as an area of potential clean-up and enhancement associated with avifauna and community improvements (Stassinu Stantec 2012). These stream locations would, therefore, support other enhancement objectives.

Figure 5-17 and Figure 5-18 provide the typical hydrograph and FDC for the outflow of Tamarack Brook based on prorating from the available hydrology in Labrador West. The hydrographs depict the monthly flow variations for mean, maximum, and minimum flow rates.

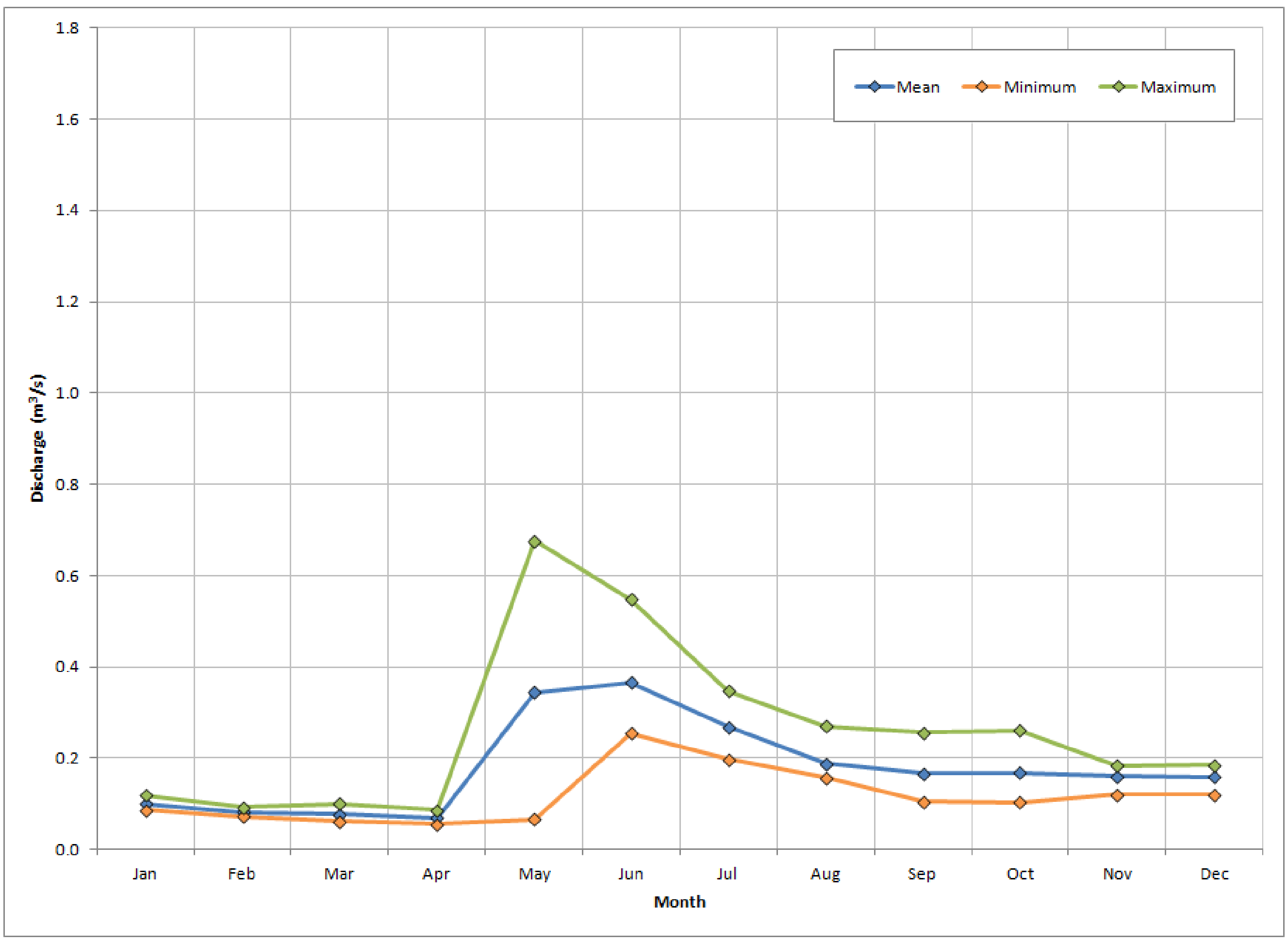


Figure 5-17: Tamarack Brook Mean Monthly Hydrograph

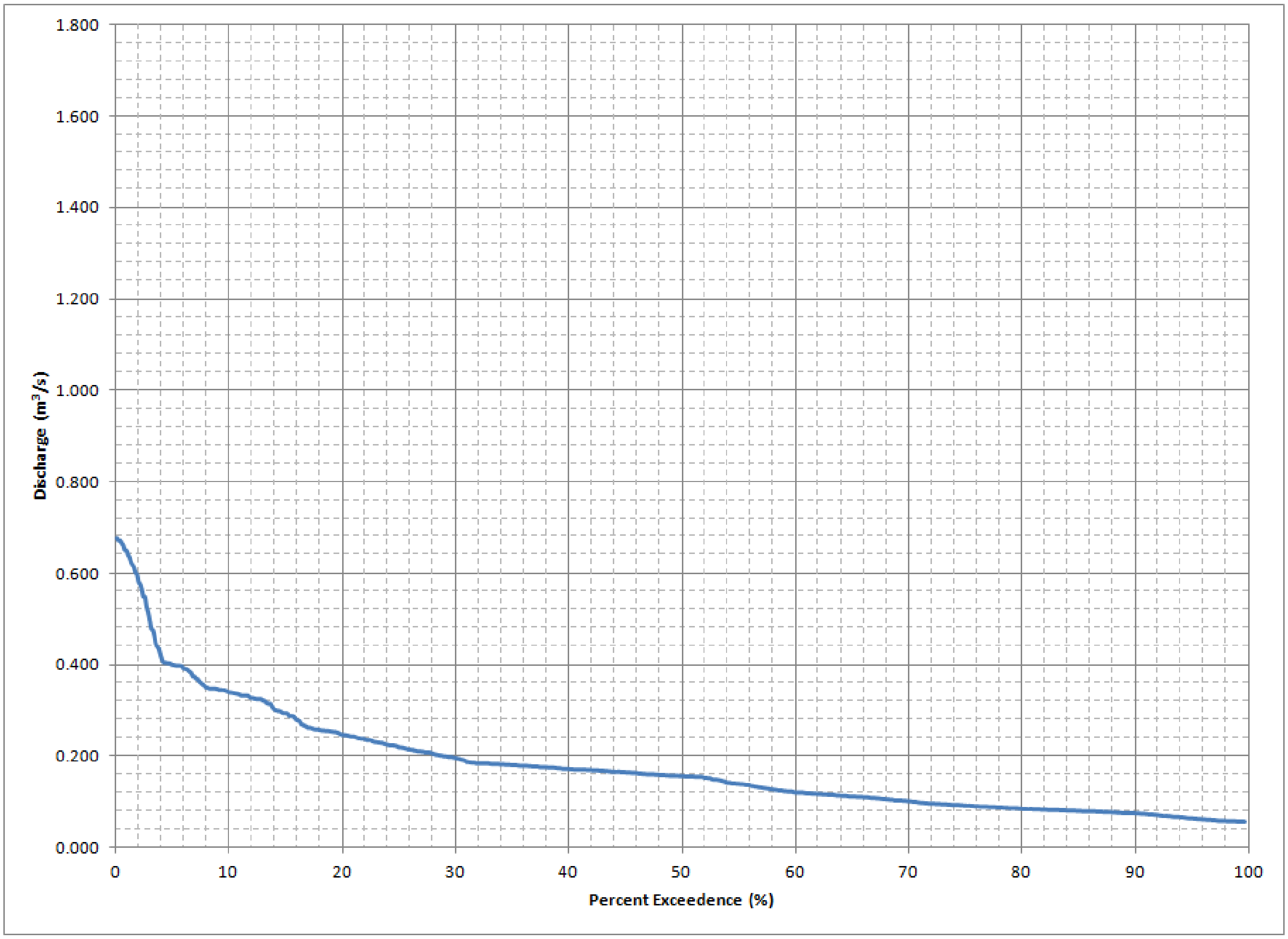


Figure 5-18: Tamarack Brook Flow Duration Curve.

5.3.2.1 Large Pool

Immediately upstream of the Tamarack Drive culverts is a large pool. It is approximately 725 m² (7.25 units) in area (approximately 59 m long and 17 m wide). It lies in a small depression between Tamarack Brook and a subdivision to the west (Figure 5-12). The entire 178 m of shoreline consists of grasses and shrubs. The substrate within the pool is sand and silt, primarily from construction runoff and poor flushing. The inflow and outflow are within 2 m of each other, flow around the pond, and flow directly from the lower reaches of the brook into the culverts under Tamarack Drive. The pool is approximately 0.5-1.0 m in water depth, but it also has an estimated 0.5-1.0 m of sand and silt.

5.3.2.2 Tamarack–S1

Tamarack-S1 flows between the small pond and Avalon Drive. Tamarack-S1 is approximately 210 m long and has 4.77 units of riverine habitat. During surveys in 2013, wetted widths ranged from 1.3 to 2.6 m, mean depths ranged from 0.14 to 0.39 m, and mean water velocities ranged from 0.12 to 0.41 m/s. Table 5-11 summarizes habitat characteristics and the habitat classification for each stream reach within Tamarack-S1 (reaches 2 to 5). Substrates are dominated by larger material in the lower reaches but quickly become dominated by sand closer to Avalon Drive. Gravels are present throughout most of the section, but in low quantities. Figure 5-19 to Figure 5-21 provide images of typical habitats within Tamarack-S1. The lower portion of this stream section has well-vegetated banks with various grasses and low-lying shrubs (willow). The upper portion is heavily vegetated with thick alder and large willow. The vegetation is so thick that light penetration is minimal. The shoreline in this heavily vegetated area is also filled with garbage and debris from the two nearby parking lots.

Table 5-11: Summary of Habitat Measurements and Classifications for Habitat Enhancement Area within Tamarack Brook, June 2013

Reach #	Reach Length (m)	Wetted Width (m)	Area (units)	Average Depth (m)	Average Velocity (m/s)	Substrate (%)										Classification	
						B	Bo	R	C	G	S	C	D	M	AqV	Beak	New
1	6	6.6	0.40	0.10	0.08	0	1	0	1	0	98	0	0	0	0	IV	Pool
Culverts at Tamarack Drive																	
2	-	2.3	-	0.22	0.22	0	20	30	10	20	10	0	10	0	0	I	Rapids
3	50	1.3	0.63	0.39	0.34	0	0	20	20	10	50	0	0	0	0	II	Eddy
4	50	2.6	1.28	0.14	0.41	0	0	0	0	0	95	0	5	0	0	IV	Riffle
5	110	2.6	2.86	0.31	0.12	5	25	15	0	10	20	0	25	0	0	I	Run
Culverts at Avalon Drive																	
6	-	2.7	-	0.23	0.22	0	10	25	0	0	65	0	0	0	0	IV	Steady
7	50	5.3	2.65	0.16	0.11	0	10	0	0	0	90	0	0	0	0	IV	Pool
8	52	2.0	1.04	0.18	0.41	0	2	3	0	75	20	0	0	0	0	II	Riffle
Culverts at Route 500																	
9	-	1.8	-	0.12	0.62	0	20	40	10	20	10	0	0	0	0	II	Rapids

– = data not available.

Figure 5-19: Small Pond at Lower End of Tamarack Brook, June 5, 2013 (note that flow is directly in and out of the pond [see arrows])

Figure 5-20: The Lower Reach of Tamarack-S1 Just Below Heavy Vegetation Overgrowth, June 27, 2013

Figure 5-21: The Upper Reach of Tamarack-S1 at the Outflow of the Avalon Drive Culverts, June 5, 2013 (note the heavy sand and gravel from winter road ice control)

5.3.2.3 Tamarack-S2

Tamarack-S2 flowsin a small valley between Avalon Drive and Highway 500. Tamarack-S2 is approximately 100 m in length and has 3.69 units of riverine habitat. During surveys in 2013, wetted widths ranged from 2.0 to 5.3 m and mean depths along transects ranged from 0.16 to 0.23 m. Mean water velocities ranged from 0.11 to 0.41 m/s. Table 5-11 summarizes habitat characteristics and the habitat classification for each stream reach within Tamarack-S1 (Reaches 6 - 8) as surveyed in June 2013. This section is dominated by sandy substrate with a large proportion of gravel immediately below Highway 500. This material has presumably been washed off the highway from winter ice control. Figure 5-22 to Figure 5-24 provide images of the typical habitat within Tamarack-S2. Vegetation in this section is primarily commercial grass species with no overhanging vegetation, which transitions to a cover of native grasses and larger overhanging shrubs when approaching Highway 500. A small foot bridge over the stream is approximately 25 m upstream of the Avalon Drive culverts. In this area, the riparian vegetation is suppressed by grooming and mowing. The riparian vegetation in the section is filled with garbage and debris. The upper portion of the stream near Highway 500 is relatively shallow and braided (Figure 5-24) with a “border” riparian zone.

Figure 5-22: The Lower Reach of Tamarack-S2 at the Inflow of the Avalon Drive Culverts, June 5, 2013

Figure 5-23: Tamarack-S2 Near the Foot Bridge, June 5, 2013 (note the debris and removal of riparian vegetation0

Figure 5-24: Upper Portion of Tamarack-S2 Below the Highway 500 Culvert, June 5, 2013 (note braiding and existing riparian vegetation)

5.3.2.4 Salmonid Rearing Production Enhancement

Surveys of the area in June 2013 indicate that several reaches of Tamarack Brook have suitable existing habitat conditions for spawning, as evidenced by the substrate composition (gravels present) and YoY population estimates; however, the brook does have potential for juvenile/adult rearing productivity enhancement. The heavy overgrowth of riparian vegetation in Tamarack-S1, damaged riparian vegetation in Tamarack-S2, the lack of flushing in the Large Pool, and limited holding/refugia habitats restrict the quality of the overall rearing habitat. Population estimates and juvenile/adult presence support this.

Quantitative electrofishing of Tamarack Brook was completed in June 2013 (Figure 5-7). Table 5-12 summarizes the population estimates for salmonid life stages (YoY and total population). These population estimates indicate the density and proportion of the population in the stream section that are YoY and juvenile/adult, and hence provide a means of estimating the potential for increasing rearing production. These values would also be used as baseline levels in post-enhancement monitoring. As shown in Table 5-12 YoY compose most of the brook trout population, with very few juvenile/adults. Relative to the overall species populations within the area, the salmonid juvenile/adult life stage is very low. Table 5-13 summarizes the population estimates for non-salmonids completed within Tamarack Brook quantitative stations in 2013.

Table 5-12: Summary of Population Estimates for Salmonid Fish Species Caught in Tamarack Brook during 2013 Baseline Electrofishing

Species	Life Cycle Stage	Electro-fishing Station	Total Area (m^2)	Total Catch	Pop. Est./Unit (N/unit)	95% Confidence Limits (N/unit)		Biomass/Area Estimate (g/unit)
						Lower[a]	Upper	
Brook trout	Total	1	96.8	30	33.1	31.0	34.6	213.5
	YOY			27	29.8	27.9	31.1	20.4
Ouananiche	Total	1	96.8	0	0	0	0	0
	YOY			0	0	0	0	0

Note: One unit equals 100 m^2.

(a) Actual catch standardized to 1 unit (100 m^2) was used to represent the lower confidence interval.

YOY = young-of-year.

Table 5-13: Summary of Population Estimates for Non-salmonid Fish Species Caught in Tamarack Brook during 2013 Baseline Electrofishing

Species	Location (Electrofishing Station)	Total Area (m^2)	Total Catch	Pop. Est./Unit (N/unit)	95% Confidence Limits (N/unit)		Biomass/Area Estimate (g/unit)
					Lower[a]	Upper	
Lake chub	1	96.8	77	84.9	78.0	88.8	954.3
Longnose sucker			5	5.5	5.2	5.8	24.6
Slimy sculpin			21	23.1	21.7	24.2	123.4
White sucker			123	135.6	127.1	141.9	436.1

Note: One unit equals 100 m^2.

(a) Actual catch standardized to 1 unit (100 m^2) was used to represent the lower confidence interval.

Many reaches within Tamarack Brook have been identified as having access to the riverbank suitable for brook trout juvenile/adult rearing enhancements. Surveys in 2013 indicate that Tamarack Brook is used for spawning by brook trout, but that juvenile/adult production within the brook itself is very low. The selected reaches for enhancement were found to contain relatively good spawning substrates but lack larger substrates and/or cover for larger brook trout. In one instance, the extremely heavy riparian cover limits light penetration to the extent that invertebrate production is most likely reduced. Existing reaches would have been augmented to allow greater instream capacity for juvenile/adult productivity. Generally, two reaches would have pools created, one reach would have a diversion to enhance existing pool habitat, and several reaches would have had larger material and low-head barriers installed to provide more cover and variable water depths during low flows. These habitat alterations would create rearing habitat for many of the YoY currently produced within Tamarack Brook.

Improvements to the rearing habitat would enhance the area for older brook trout. This increase in older trout within an easily accessible stream (within the town limits) would also enhance community initiatives by Champion. The maximum increase is anticipated by brook trout; however, it should be noted that other species/life-cycle stages would also benefit. The habitat features to be created will consist of pool and steady sub-habitats, as these provide maximum rearing suitability.

The general layout and cross sections of each enhanced habitat type were designed using the habitat descriptions and the species preference criteria. Figures A7 through A9 in Appendix B contain the layout of the proposed habitats, which would be enhanced within Tamarack Brook. Also shown for each figure are the estimated low-flow and spawning discharges and the calculated mean water depth, mean water velocity and slope based on Manning's equation. Overall habitat enhancements include several physical works: excavation of pools, selective placement of spawning material, installation of low-head barriers, and a small stream diversion.

There would have been a total of two small pools/steadies created within Tamarack Brook: one at the outflow of culverts at Avalon Drive (i.e., upper reach of Tamarack-S1) and one at the outflow of culverts at Highway 500 (i.e., the upper reach of Tamarack-S2). The dimensions of each are provided in Figure A7 and Figure A8 (Appendix B). Both have been designed using the existing terrain and slope to delineate the shoreline. For example, Figure 5-24 above shows the general area of the Tamarack-S2 pool, which would be created to the extent of the existing riparian zone. Each pool would expand the stream's wetted width and water depth to provide a greater refugia habitat for larger fish during the low-flow periods of summer and winter. Each would be excavated to a depth of 1 m. Excess material taken from each pool excavation would be trucked and disposed of at an approved location. The bottom of each pool would contain existing natural material, and the shorelines would be stabilized with rip rap. At the inflow of each pool and the outflow of the pool in Tamarack-S2, gravels would have been maintained or added, as it is assumed that some spawning capacity of the existing habitat would be reduced by pool creation, which would offset any losses. Spawning substrates would have been applied over an existing base layer of larger material. At the outflow of each pool, a low-head barrier would be installed to act as a hydraulic control to maintain water levels within the pool. The final elevation of the hydraulic control would be established before construction. Based on brook trout as the spawning target, and the results of transect models of water depth at the selected locations where substrates would have been added near the pools, the minimum substrate depth of 250 mm was revised to 200 mm at these locations. It was anticipated that 250 mm of substrate would cause the water depths to be too shallow during spawning and summer-low flows.

Low-head barriers would also have been installed at several other locations within each section of Tamarack Brook. These would maintain slightly deeper water depths within the stream and provide additional cover and refugia while maintaining any gravels within the system by reducing the stream slope in these areas. It should also be noted that the slope of all culverts was surveyed to determine whether they would be considered an obstruction to fish passage. All culverts have slopes less than 1.5% and are not considered obstructions.

The outflow of Tamarack Brook into the Large Pool near Tamarack Drive would have been diverted slightly to allow greater flushing of the pool and greater water circulation (Figure A7 in Appendix B). This would allow the pool to naturally flush a portion of the finer material that has accumulated and allow more suitable water quality in a greater portion of the pool (e.g., assist in aerating the pool). The lower 55 m of Tamarack-S1 would have been moved to the northwest so that flows enter the pool and are not “short-circuited” directly into the culverts because of their proximity. The excavated habitat diversion would have been created in existing natural material and would have been of similar dimensions to the existing stream. The diversion would be excavated in the dry with a plug left in the upstream and downstream ends until completed. Once completed, the plugs would be removed. Other smaller instream works (e.g., additional low-head barriers not associated with pools) would have been completed without dewatering.

Construction access would have been via the existing nearby roads (Tamarack Drive, Avalon Drive, Highway 500). It was anticipated that no other access would be needed or constructed. A series of one-ton sandbags would be used to stop water flow at the upper end of the Highway 500 culvert to dewater the brook at the start of instream physical works. In addition, a fish relocation program would have also been completed in Tamarack Brook so that fish would not be stranded. Pumps would redirect any leakage or groundwater seepage into the construction area to keep it dry. All water within the work area would have been removed and pumped to an area to ensure that suspended sediment is removed. In addition, turbidity barriers would be installed downstream of the work (i.e., within the Large Pool) to manage suspended sediment. Once the reach is accessible and de-watered, pools and associated spawning material would be placed, and the diversion would be completed as directed by an experienced biologist. Once the physical works are completed, stream water would slowly be reintroduced and allowed to stabilize using the natural flow regime.

Suitable substrate material would have been brought to the site by a dump truck. Trucks would have dumped material as close to the stream as possible or directly into the de-watered reach. Appropriately sized machinery would redistribute material as directed within each de-watered section (anticipated to be rubber-tired back hoes). Crew members may have manually assisted with the final distribution. Once completed, the sandbags would have been removed, and decommissioning/contouring of any disturbed access location would be completed as required. It should be noted that all excavations would have been completed with the town's approval to ensure that the stability of the surrounding infrastructure is maintained.

Surveys and construction would have occurred during the summer months, particularly during the low-flow period. All construction of low-head barriers and spawning material placement would be conducted following regulations. If required, bank stabilization would also be undertaken once access to each habitat reach is completed. Monitoring of enhanced productivity success is outlined in Section 7.0.

While habitat was designed to maximize suitability for the species present, minimal disturbance of the existing riparian habitat would occur. For example, any machinery needed within the drainage would be appropriately sized to have a relatively small “footprint” for riparian disturbance. Any riparian disturbance would attempt to take place at locations that have been identified for habitat expansion or in areas of lowest velocity.

Stream dewatering and pumping would not have begun until all the required material was on site and ready, so minimal disturbance is required. It was estimated that the stream enhancement work would take approximately five days of in-stream construction effort to complete. Like other habitat enhancement works, fish would be removed from the site using standard electrofishing before dewatering.

5.3.2.5 Substrate Stability Estimate

Tamarack Brook watershed would not have been modified as part of the offsetting design (i.e., the natural hydrologic cycle will be experienced by all enhanced habitats). The underlying characteristics of any modified/created habitat would depend highly on local flow characteristics. That is, the modified habitat's general width, depth, and slope will be such that high flows naturally experienced in the system would be transported without excess erosion or damage.

Spawning material would be added near the created pools; the hydrology and water depths within Tamarack Brook dictate that approximately 200 mm be added. Similar to other river rehabilitation projects completed by WSP personnel, the values for mean water velocities and depths were calculated between the existing and future conditions (i.e., after suitable substrate additions), particularly for the flows associated with spawning and high spring flows (i.e., September-October and April). This was completed using Manning’s equation and simulated water elevations in AutoCAD to ensure the addition of spawning/rearing substrates within each reach would not make other physical parameters unsuitable. It was also completed to ensure that the substrates would not be flushed out of the system during high-flow events. Table 5-14 presents a summary of the results. The habitat characteristics associated with the augmented habitat would remain suitable for spawning/rearing brook trout and other species.

Typical flow velocities in the enhanced habitat types would be relatively low compared to scour velocities. Table 5-15 presents typical bedload movement velocities for stream substrates (DFO 1998). Estimated high fall spawning discharges of 0.26 m^3/s and a high freshet discharge of 0.65 m^3/s were used to estimate velocities in the designed habitat. At the high discharges indicated above, velocities ranging from 0.14 to 0.37 m/s for fall and spring discharges were estimated, respectively. The largest particle size capable of movement, based on Table 5-15, would be 2.5 mm at velocities of 0.37 m/s.

Table 5-14: Summary Habitat Parameters for Enhanced Spawning Habitat, Tamarack Brook

Reach	Habitat Parameters							
	Existing Conditions				Modelled Future Conditions			
	Mean Velocity (m/s)	Mean Depth (m)	Slope (%)	Manning’s n	Mean Velocity (m/s)	Mean Depth (m)	Slope (%)	Manning’s n
Typical Summer Low-flow Discharge (0.18 m^3/s)								
Tamarack-S1	0.12	0.31	0.20	0.168	0.37	0.20	0.20	0.041
Tamarack-S2	0.25	0.29	0.40	0.102	0.39	0.14	0.40	0.041
High Spring Discharge (0.65 m^3/s)								
Tamarack-S1	0.19	0.61	0.20	0.168	0.51	0.30	0.20	0.041
Tamarack-S2	0.37	0.58	0.40	0.102	0.65	0.32	0.40	0.041
High Spawning Discharge (0.26 m^3/s)								
Tamarack-S1	0.14	0.39	0.20	0.168	0.41	0.22	0.20	0.041
Tamarack-S2	0.26	0.33	0.40	0.102	0.48	0.18	0.40	0.041

Table 5-14: Summary Habitat Parameters for Enhanced Spawning Habitat, Tamarack Brook

Reach	Habitat Parameters							
	Existing Conditions				Modelled Future Conditions			
	Mean Velocity (m/s)	Mean Depth (m)	Slope (%)	Manning's n	Mean Velocity (m/s)	Mean Depth (m)	Slope (%)	Manning's n
Mean Spawning Discharge (0.17 m^3/s)								
Tamarack-S1	0.12	0.31	0.20	0.168	0.35	0.18	0.20	0.041
Tamarack-S2	0.22	0.24	0.40	0.102	0.39	0.14	0.40	0.041

Like channel calculations above for potential streambed movement, the estimated potential incipient particle diameters for both typical fall/spring (i.e., 0.26 m^3/s) and extreme flows (i.e., 0.65 m^3/s) have also been estimated (Table 5-15). These calculations estimate that a substrate size up to 1.3 cm could be moved. As a result, it is anticipated that smaller-sized gravel/sand material placed in this area may shift and stabilize as a result of extreme flows; however, it is not expected that all substrate less than the indicated diameter would be transported, as it will lie within a matrix of larger substrate. The potential for a portion of substrates under this size to be shifted/re-distributed is not expected to be problematic. While it can be expected that some material stabilization will occur during extreme freshets, it is anticipated that the placed material would not be removed from the reach. Calculations above indicate substrate stability and movement potential and are assumed under uniform flow conditions (Newbury and Gaboury 1994). The potential incipient particle diameters are based on a mean surface water slope for each reach, a conservative oversimplification in most streams. It should also be noted that installing low-head barriers would provide a physical barrier to substrate movement and effectively reduce bottom slope and water velocities, and therefore assist in reducing the potential for movement of gravels out of the reach. Low-head barriers would also provide upwelling for spawning.

Table 5-15: Potential Incipient Particle Diameters for Each Habitat design

Habitat Design	Mean Water Depth (m)	Slope (%)	Flow (m^3/s)	Incipient Particle Diameter (cm)
Tamarack-S1	0.20	0.20	0.18	0.40
	0.22		0.26	0.44
	0.30		0.65	0.60
Tamarack-S2	0.14	0.20	0.18	0.56
	0.18		0.26	0.72
	0.32		0.65	1.28

5.3.2.6 Calculated Increases in Salmonid Rearing Production

The overall predicted habitat area enhancement in Large Pool, Tamarack-S1 and Tamarack-S2 would be 7.25, 4.77, and 3.69 units, respectively. The baseline quantitative electrofishing data estimate the existing rearing capacity (as determined by population estimates of non-YoY). These can be used in conjunction with anticipated future population estimates to calculate the net increase in rearing capacity. Existing baseline values and predicted increases would also be used during monitoring to determine the success of the enhancements.

A conservative approach was used to estimate the net rearing capacity increase within Tamarack Brook. Because only one year of baseline is available at each enhancement area, the upper confidence limit of the highest non-YoY population estimate was used to represent the existing YoY capacity. Table 5-16 provides the existing rearing capacity estimates. As shown, the existing estimate is 3.3/unit.

Electrofishing results from throughout the Project area were used to estimate future rearing capacity (AMEC 2013). The non-YoY captures were separated from total captures, and population estimates were generated. Each electrofishing station was also reviewed for substrate composition and habitat type (e.g., pool, riffle, run) to determine whether they would be considered suitable for rearing and could represent future enhancement conditions within Tamarack Brook. Upon review of the data, no electrofishing station had a pool/steady composition greater than 10%. Therefore, any non-YoY population estimates from these stations would most likely under-represent the rearing potential within enhanced areas. However, within those stations electrofished within the area, Station WR-03, located in stream AD05 (i.e., within the mine rock storage area) had the highest non-YoY population estimate at 11.5/unit.

Using an existing local natural non-YoY population estimate in a non-enhanced area has limitations and uncertainties regarding its use as a representative post-enhancement rearing utilization value; however, if this local natural population estimate is used, an estimated post-enhancement rearing capacity would be approximately 11.5/unit. Using these estimates, a net increase in rearing capacity for Tamarack Brook is 6.3 to 10.1/unit.

Using the net increase in rearing capacity estimated above and the overall habitat area previously considered to be enhanced in Tamarack Brook (7.25 units in Large Pool, 4.77 units in Tamarack-S1 and 3.69 units in Tamarack-S2), the total net increase in rearing production was conservatively estimated between **99.0** and **158.7** fish.

Table 5-16: Summary of Non-YOY Population Estimates for Salmonid Fish Species Caught in Tamarack Brook during 2013 Baseline Electrofishing

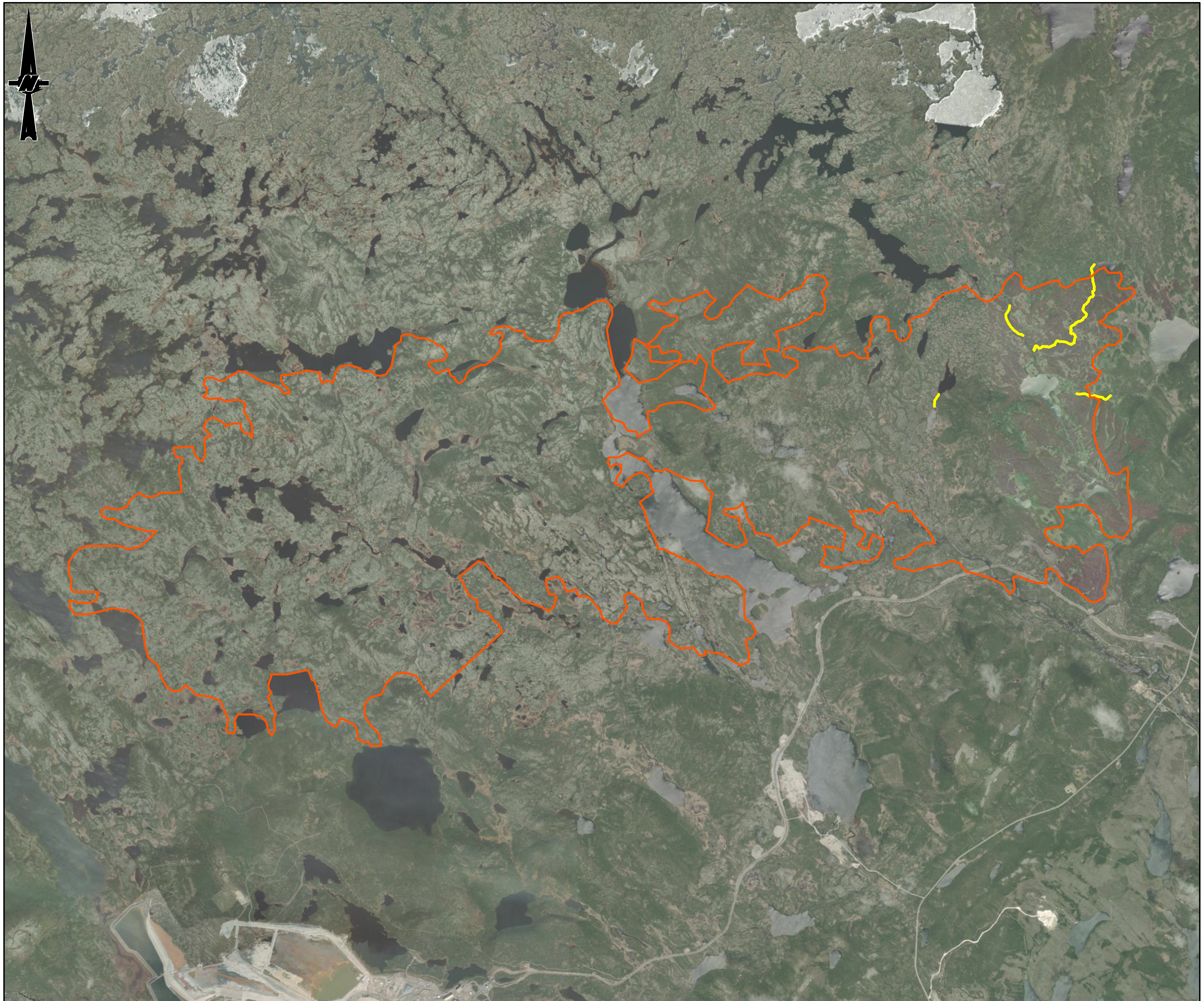
Species	Enhancement Area	Existing		Anticipated		Net Increase in Rearing Production (N/unit)
		Pop. Est./Unit (N/unit)	Upper 95% Conf Limit (N/unit)	Pop. Est./Unit (N/unit)	Upper 95% Conf Limit (N/unit)	
Brook trout	Large Pool	3.3	3.3	11.5	13.4	6.3–10.1
	Tamarack-S1					
	Tamarack-S2					

Note: One unit equals 100 m^2.

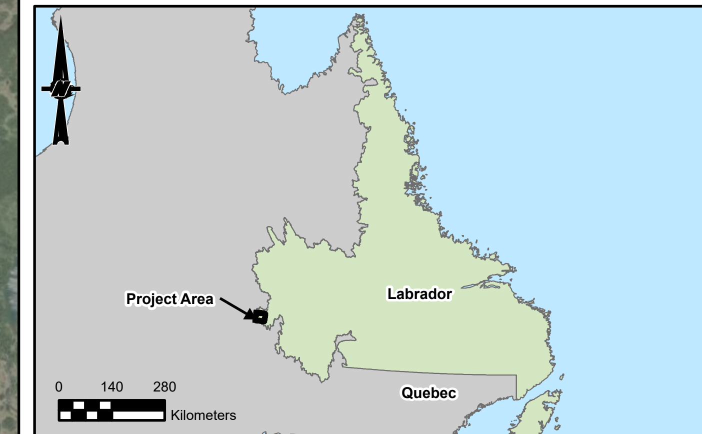
5.4 Stream Enhancements - Riparian Rehabilitation

The riparian zone is the nearshore terrestrial habitat parallel to the aquatic habitat. Aquatic and riparian vegetation is linked to the fact that it is an integral component of healthy fish habitat and serves a multifunctional role, including soil and streambank stabilization, erosion protection, nutrients, thermal regulation, and cover. Intervention through planting riparian vegetation within recently burned riparian zones is considered a viable option for restoring and maintaining aquatic habitat suitability within areas affected by riparian forest fires. Throughout North America, many fish habitat restoration projects have been focused on restoring riparian habitats affected by wildfire (e.g., Beschta 1994; Goodwin et al. 1997; Kauffman et al. 1997; Opperman and Merenlender 2004; Mouton et al. 2012, Loughlin and Clarke 2013).

Revegetation of riparian habitat lost due to forest fires has been used as an offset measure in Labrador West for other mining operations (e.g., Wabush 3 Mine Expansion) in the past. It has been implemented at locations like Cowboy Creek and Blueberry Hill, just east of Wabush. Supporting data for this offset option was collected from these previous offsets. Similar background information can be collected to support another recent forest burn location in Labrador West. Several larger tributaries of the Walsh River were extensively burned in 2024 (Figure 5-25).



KEY MAP



SCALE 1:20,000,000

LEGEND

- Surveyed Stream
- Burn Area

0 1,000 2,000 4,000

1:80,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: EARTHSTAR GEOGRAPHICS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

OUTLINE OF 2024 WALSH RIVER BURN AREA AND TRIBUTARIES WHERE RIPARIAN DAMAGE HAS BEEN IDENTIFIED

CONSULTANT

wsp

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	GM
REVIEWED	BK
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0001	0	5-25

In total, 4,600 m of tributary habitat was identified as having its riparian habitat burned. Based on preliminary investigations of the area, the estimated mean tributary width is 6.5 m; therefore, the estimated habitat area was 30,885.7 m^2 (308.86 units).

Previous surveys of historical burns in Labrador West indicate that natural riparian habitat regeneration can occur. Still, it may take many years, particularly in northern locations with restricted growth seasons. For example, there are indications from a forest fire near Pike Lake North that it occurred in 1977 (almost 48 years ago), and full regrowth has not yet occurred. Observations during baseline studies in 2015 determined that areas reforested in this burn area had recovered considerably, with excellent growth of large trees and good canopy cover. Areas not reforested had minimal to no regeneration of large trees. The major reason for the slow natural regeneration is the lack of a seed source for trees, as the fire destroyed all existing material. A seed source would need to be introduced into the burned areas through transportation by wind, fluvial transport from unburned upstream reaches and possible avian transport of seed materials – all of which would be a very slow process.

To demonstrate the overall benefit of re-vegetation to an existing but affected fish population, it is important to establish the effects of the forest fire on important fish habitat attributes (e.g., thermal habitat quality) and the corresponding effects on habitat capacity using appropriate metrics (e.g., fish populations, age/size class distribution). This is important to demonstrate the potential net increase in fish population/capacity related to offsetting initiatives.

Population estimates indicated that brook trout numbers were slightly lower in Cowboy Creek than in Blueberry Hill Stream. No YoY brook trout were captured in the index stations in August or September.

The previous riparian rehabilitation program had a field program completed by AMEC in August and September 2014, to determine the effect of the fire on candidate stream sections within Blueberry Hill Stream. Discussions with local cabin owners and anglers were also completed to identify locations within the burn previously used for fishing, including information on access and logistics. Surveys consisted of delineating the stream length within the burn areas that were most affected, determining fish population estimates using electrofishing, and water temperature monitoring through deployment of thermographs.

The baseline program also surveyed a control stream to establish differences between burned and unburned reaches (AMEC 2015). This area was used to estimate the population/capacity increase that could be expected because of the re-vegetation of the riparian zone and restoring thermal habitat quality. The program also installed thermographs in both the burn and control areas to document the change in aquatic thermal regime within the burn area. Thermographs were programmed to record water temperature hourly so that diel (24-hour) variation could also be examined. Thermographs were reinstalled at both locations to capture additional data and to confirm the effect within the burn area.

A similar baseline program would be established to determine the effects of the recent fire and the anticipated increase in capacity.

6.0 QUANTITY OF REQUIRED MEASURES TO OFFSET

The overall conservative offset requirements (i.e., no habitat equivalency applied, all habitat is quantified at full aerial extent), along with a summary of all offset options, are provided in Table 6-1 to estimate the overall residual habitat loss and the offsetting required.

Table 6-1: Quantification of Project Footprint, Residual Habitat Losses, and Offsetting Measures

Project	Residual Habitat Loss (from Table 5-12)		Offset/Mitigation Measures	
	Stream (m^2)	Lacustrine (m^2)	Stream (m^2)	Lacustrine (m^2)
Rose Pit Area – Direct Losses	1,249.4	336,167.6	-	
Rose Pit Area – Indirect Losses	2,592.0	223,970.0	-	
Mine Rock Storage Area – Direct Losses	2,324.3	–	-	
Mine Rock Storage Area – Indirect Losses	1,819.3	–	-	
Tailings Management Area – Direct Losses	7,890.0	88,075.0	-	
Tailings Management Area – Indirect Losses	7,515.0	–	-	
Totals	**23,390.0**	**648,212.6**	-	
Offsetting Component				
St. Lewis River			3,440,900	–
Net Gain[a]			3,440,900 – 671,602.6 = 2,769,297.4	
Net Gain (%)			512.3%	

(a) Gains are taken at full value and may need to be adjusted based on existing use (e.g., St. Lewis).
– = Not applicable

6.1 Accounting for Uncertainty

DFO (2019) recommends that proponents recognize certain aspects of uncertainty that should be accounted for in all offsetting plans. Table 6-2 highlights DFO recommendations regarding uncertainty as well as how they can be mitigated within offsetting plans. Based on previous discussions with DFO, concerns are typically that offsets are not as productive as initially predicted. This uncertainty can be incorporated within the offset plan with the following measures.

Optimizing the site selection—A review of existing projects, and use of experienced personnel, in the province has been conducted to understand the common variables of the most successful habitat enhancements. While site-specific conditions can play a major role in habitat enhancement success, it has been determined that habitat enhancements for spawning and rearing habitat are successful. Challenges arise when natural flows are not considered in the design, and if enhancements are incorporated into mine or facility features, such as diversion streams. In some instances, these are less successful as they must serve two functions: fish habitat and an industrial purpose (e.g., diversion around a facility). In some of these cases, the habitat is more challenging to maintain.

Contingency habitat—If some portion of the offsetting habitat is not productive after several years of monitoring (see Section 7.2.2 on definition of productive habitat), then adaptive management measures can be enacted to include additional habitat enhancement, modifying existing habitat, or some other method that may increase use of enhanced habitat. Any modifications would be completed in coordination with DFO.

All components will contribute to reducing uncertainty and increasing the success of this offsetting plan. It is important to note that some uncertainty will always remain when manipulating habitats. Therefore, some adaptations may be necessary during the plan's implementation regarding final structure placements, gravel quantities, and monitoring. Any changes and updates to this plan, however, will not occur without prior discussion and approval from DFO.

6.2 Time Lags

As noted in DFO (2019), time lags between the adverse effects on fish and fish habitat resulting from the Project and the benefits from the offsetting have a time lag that may contribute to the loss of fish or fish habitat and should be avoided where possible. The time lag for this Project can be reduced by installing the enhanced habitat prior to any instream works and loss of habitat capacity. Existing fish populations within each offset option location will also allow timely colonization of all habitat structures.

Table 6-2: Summary of Uncertainty and Measures Used to Address to the Extent Possible

<table>
<tr><th>DFO Recommendation</th><th>Kami Offsetting Plan</th></tr>
<tr><td>Habitat restoration projects may improve fish habitat, but these projects may also experience structural or ecological failure due to changing environmental conditions;</td><td rowspan="3">The options identified within this plan have incorporated natural flows, including high spring flows, so that proper placement and material selection will avoid material washouts and erosion.
It is acknowledged that enhanced habitat may not function as fully intended; however, the designs are robust and team experience has been applied to maximize success. Similar designs have been shown to be successful in the past by this team. DFO NL philosophy has been "to create/enhance habitat with a high degree of success rather than increasing the offset ratios to account for lower quality." WSP has used this philosophy to design all habitat offsets. DFO still has the option to increase the offset ratio to account for uncertainty.
All options identified within this offset plan are tested and have been applied in Newfoundland and Labrador with many previously utilized in Labrador West.</td></tr>
<tr><td>Habitat creation projects result in new fish habitat with capacity to produce and sustain fish; however, this fish habitat may not function as effectively as intended;</td></tr>
<tr><td>Untested techniques or methods may increase risks of failure of the measures to offset</td></tr>
<tr><td>Fish stocking may increase fish abundance with ongoing investment; however, it may also result in adverse effects on the reproductive success or fitness of natural populations</td><td>No fish stocking is part of this Project but rather enhancement/development of fish habitat</td></tr>
<tr><td>Chemical alteration may improve the capability to produce and sustain fish of a system but often requires continued maintenance</td><td>No chemical alterations are part of this Project. Note that all material used in these projects are well established and non-toxic (Section 4)</td></tr>
</table>

7.0 MONITORING AND REPORTING

Monitoring and reporting commitments include the schedule, methodologies, performance criteria, and reporting components. The monitoring program will document the efficacy of the constructed habitat. This will include a comprehensive monitoring of the physical and biological aspects of the created habitat. The effectiveness monitoring program will start one year following completion of construction (year 2) and will be conducted for a minimum of five additional monitoring years (i.e., years 3, 4, 5, 7, 9), or until DFO deems success criteria have been met and no further monitoring is warranted. The monitoring of the habitat will determine the success of the offsetting plan.

Champion is committed to monitoring all aspects of its completed offsetting components. Components will be monitored to assess the structural stability, utilization, and production of the newly created/enhanced habitat. The monitoring program will serve two objectives:

- evaluate the completeness and effectiveness of offsetting measures undertaken
- provide information on fish species/life cycle stage utilization of the created/enhanced habitat

This section of the offsetting plan outlines the schedule, methodologies, performance criteria, and reporting components of the monitoring program.

7.1 Duration

Champion will commit to monitoring annually for a period of four years immediately following Construction (e.g., years 2027 to 2031) and then bi-annually for the next three years (e.g., years 2033 and 2035). Structural monitoring will also be conducted on the same schedule. The results of monitoring will be submitted to DFO in December after each survey year. Monitoring programs are adaptive by nature, and as such, any necessary modifications to the program will occur following the review of each monitoring report by DFO and Champion.

7.2 Performance Criteria

Performance criteria to determine successful implementation of the offsetting plan will be based upon:

- Retention of any designed habitat features as determined by surveying and mapping created features, and
- Evidence of predicted increases in fish capacity and utilization within enhanced and created habitats.

7.2.1 Habitat Stability

Habitat stability will be assessed using as-built drawings and specifications at the prescribed schedule. All as-built habitat boundaries will be georeferenced and incorporated into a Geographic Information System to detect and correct any instability or re-vegetation as necessary.

Inspections will include an assessment of fishway stability, flows, and bank stability, utilizing as-built survey data and photo and drone documentation. General observations will also be recorded within the shoreline and riparian areas.

7.2.2 Hydrology

Discharge and velocity measurements will be conducted during high, medium, and low flow conditions at the fishway upriver entrance and at the inflow and outflow of at least three fishway cells to ensure suitable conditions are maintained. Velocity and discharge measurements will be conducted using a suitable flow probe capable of measuring water velocity to 0.01 m/s accuracy. Discharge will be calculated using the width, depth and velocity measured from selected cross sections as described in Sooley et al. (1998).

7.2.3 Fish Habitat Utilization / Capacity

Increased capacity and continued utilization of enhanced connectivity riverine spawning and rearing habitat will be conducted using population estimates, redd surveys and associated parameter/species measurements. These values will be used as an annual comparison of utilization and fish production. Surveys will be conducted between June 15 and September 15 of each monitoring year. Additionally, monitoring of fishway use will be completed with the use of remote monitoring station established at the upriver entrance to the fishway. Any remote station will be maintained for at least the months of July – September to coincide with the salmon migration period.

7.2.3.1 Population Estimates

Population estimates for riverine habitat will be completed using quantitative electrofishing data as per Scruton and Gibson (1995), using stations as close to two units in size as possible. Each captured fish will be identified by species and measured for length and weight. Catches will be separated by species and life-cycle stage to generate population estimates by life stage, age structures of fish utilization as well as biomass, length-at-age and condition values.

Two quantitative electrofishing survey locations will be established within at least three tributaries and at least one location in the main stem of the St. Lewis River. Baseline population estimates will be completed as baseline prior to final fishway operation (i.e., 2025 to 2026) and will be used to compare monitoring results. Another quantitative site (with two stations) outside any Project and enhancement areas will also be completed downriver of the fishway as a control to allow natural fluctuations in fish populations to be considered with respect to enhanced habitats. The location will be determined in consultation with DFO.

7.2.3.2 Redd Surveys

Redd surveys will be conducted in October of each monitoring year to document potential redd numbers and distribution around the enhanced spawning habitat. Visual observations of fish presence and behaviour will also be recorded during the sampling program time frame.

7.3 Reporting

There will be three types of reports submitted in relation to the offsetting:

- The “As Constructed” Report will be completed and submitted to DFO. The report will verify that the Project and associated works were completed according to and within the schedule of the offsetting plan. It will detail the offsetting measures completed within that year and will provide “as built” information that will be used as baseline for monitoring of habitat stability and features. It will also include a description of conditions at all control locations.
- An annual “mitigation report” will be completed after each year of Construction. This includes an annual report of all construction activities, a catalogue of all utilized mitigations, and an assessment of effectiveness.

- The Effectiveness Monitoring Report will be submitted to DFO Habitat Protection within six months of survey completion, either on or before December 31 (whichever is later), for each applicable year. The annual report for each prescribed monitoring year will be based on the results of the monitoring program. It will include an evaluation regarding performance criteria (where applicable), along with a comparison of the current monitoring results to those of previous monitoring. The report will be submitted to DFO for information and review. It is proposed that the submission schedule for annual reports be set for May 30 of the following year, allowing time for ice observations and data analysis to be completed and presented for review, including any necessary revisions or adaptive measures for subsequent sampling or analysis.

Each monitoring report will include the following information:

- concise explanations of all data collected
- detailed summations/conclusions describing any tables and graphs
- detailed photographs, drawings, videos
- a comparison of information from previous years, if applicable
- other relevant information

All raw biological, chemical, and physical data stated in each monitoring report will be:

- geo-referenced with latitude and longitude in degrees, minutes, seconds or decimal degrees format
- submitted in tabular form so that data can be displayed spatially in a Geographic Information System database (e.g., Excel spreadsheets)

8.0 COMPLEMENTARY MEASURES

No complementary measures are currently proposed as part of this offset plan.

9.0 SUMMARY AND COSTING

The schedule has been provided based on the anticipated construction schedule and the corresponding habitat losses. In general, habitat creation/enhancement will occur within 2026 to offset losses associated with the Project. It should be noted that all instream work to be conducted as part of this Plan is required to be completed between June 1 and September 30 in each year of Construction. If construction of habitat features continues into 2027, the monitoring of these areas will be adjusted so that it is still compliant with the monitoring duration outlined in Section 7.1 (i.e., first four years after Construction and then bi-annually for the final two monitoring years).

9.1 Operations

Once Construction is complete, the operation of the mine and facility will not have a direct effect on any offsetting measures. The hydraulic regime will be governed by the natural runoff patterns of their respective watersheds. During Operations, regular inspections and monitoring of the modifications will be required as part of the monitoring plan.

This offsetting project will meet the four principles for offsetting criteria (DFO 2019) as summarized in Table 9-1.

The construction costs associated with all aspects of the offsetting measures in this plan are provided by Champion under a separate cover. DFO will use these costs to determine the Letter of Credit to be carried by Champion associated with this offsetting plan.

Table 9-1: Guiding Principles under Fisheries and Oceans Canada's Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat under the *Fisheries Act*

Principle	Kami Offsetting Plan
Measures to offset should support fisheries management objectives and give priority to the restoration of degraded fish habitat	■ The offset options outlined in the plan will enhance existing streams near Labrador City and Wabush by increasing the spawning capacity for resident fish species. The rehabilitation of the burned tributary riparian habitat will reduce the regeneration time and provide needed seed sources for faster natural revegetation, thermal regulation, and food sources. The fish passage improvement on St. Lewis River will double the spawning habitat available to Atlantic salmon and increase the overall capacity of the river.
Benefits from measures to offset should balance the adverse effects resulting from the works, undertakings, or activities	■ The lost fish habitat is being offset by the offset options described to balance the adverse effects resulting from the works, undertakings, or activities. ■ The enhanced habitat will increase fish and fish habitat capacity thereby potentially increasing recreational activities in the region for species such as brook trout, Atlantic salmon/ouananiche, and northern pike.
Measures to offset should provide additional benefits to the ecosystem	■ The enhanced habitat options will promote greater invertebrate production, especially riparian revegetation, and create habitat complexity for many marine species that could not be achieved within the natural material complex (e.g., gravels suitable for spawning are lacking in the overall materials available to the streams).
Measures to offset should generate self- sustaining benefits over the long term	■ The habitat options have been shown in past designs to provide spawning/rearing habitat, thermal regulation, food, cover, and greater fish passage once constructed with minimal post-construction intervention. For example, once spawning and rearing material is present in the system it will be available to fish species in perpetuity.

Source: DFO 2019.

10.0 REFERENCES

AGRA (AGRA Earth and Environmental Ltd.). 1999. Fish and fish habitat, Churchill River Power Project (LHP98-07). Prepared for Labrador Hydro Project, St. John's NL.

Alderon (Alderon Iron Ore Corporation). 2012. Environmental impact statement: Kami Iron Ore Mine and Rail Infrastructure, Labrador.

AMEC (AMEC Earth & Environmental). 2012. Fish, fish habitat and fisheries baseline study, Kami Iron Ore Mine and Infrastructure Labrador West, NL. Prepared for Alderon Iron Ore Corporation, St. John's NL.

AMEC. 2013. Addendum to: fish, fish habitat and fisheries baseline study, Kami Iron Ore Mine and Infrastructure Labrador West, NL. Prepared for Alderon Iron Ore Corporation, St. John's NL.

Anderson TC. 1985. The rivers of Labrador. Fisheries and Oceans Canada, St. John's NL. 389 p.

Beschta, R. L., Rhodes, J. J., Kauffman, J. B., Gresswell, R. E., Minshall, G. W., Karr, J. R., & Frissell, C. A. (1994). Wildfire and salvage logging: Recommendations for ecologically sound post-fire salvage management. Save America's Forests. Accessed on: 05 2025. Available at http://www.saveamericasforests.org/congress/Fire/Beschta-report.htm

Bradbury C, Roberge MM, Kimms CK. 1999. Life history characteristics of freshwater fishes occurring in Newfoundland and Labrador, with major emphasis on lake habitat requirements. Can. MS Rep. Fish. Aquat. Sci. 2485:vii + 150 p.

CCME (Canadian Council of Ministers of the Environment). 2011. Canadian Water Quality Guidelines for the Protection of Aquatic Life. https://ccme.ca/en/resources/water-aquatic-life.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012. Assessment and Status Report on the American Eel *Anguilla rostrata* in Canada. Ottawa. xii + 109 pp. Accessed on 05 2025. Available at: https://publications.gc.ca/collections/collection_2013/ec/CW69-14-458-2012-eng.pdf

DFO. 2021. Science advice on revisiting pathways of effects (PoE) diagrams in support of FFHPP [Fish and Fish Habitat Protection Program] risk assessment. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/053.

Edwards, E.A. 1983. Habitat suitability index models: Longnose sucker. United States Department of the Interior, Fish and Wildlife Service. FWS/OBS82/10.35. 21p.

Fisheries and Oceans Canada (DFO). 2015. Guidelines for the design of fish passage for culverts in Nova Scotia. Accessed on: 04 2025. Available at: https://novascotia.ca/tran/publications/asphalt/DFO%20Guidelines%20for%20the%20Design%20of%20Fish%20Passage%20for%20Culverts%20in%20Nova%20Scotia.pdf

Fisheries and Oceans Canada (DFO). 2020. Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater. Accessed on: 05 2025. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html

Fisheries and Oceans Canada (DFO). 2024. Pathways of Effects. Fish and Fish Habitat Protection Program. Accessed on 05 2025. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html

Fisheries and Oceans Canada (DFO). 2025. Measures to protect fish and fish habitat. Accessed on: 04 2025. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html

Goodwin, C. N., Hawkins, C. P., & Kershner, J. L. (1997). Riparian restoration in the western United States: Overview and perspective. Restoration Ecology, 5(4S), 4–14. Accessed on: 05 2025. Available at: https://people.wou.edu/~taylors/g407/restoration/Goodwin_etal_1997_RiparianOverviewPerspective.pdf

Government of Canada. 2012. Canadian Environmental Assessment Act, 2012. SC 2012, c 19, s 52. Last amended August 28, 2019; current to June 9, 2025. Ottawa ON: Minister of Justice https://laws-lois.justice.gc.ca/eng/acts/c-15.21.

Government of Canada. 2019. Impact Assessment Act. SC 2019, c 28, s 1. Last amended June 2, 2025; current to June 9, 2025. Ottawa ON: Minister of Justice **https://laws.justice.gc.ca/eng/acts/i-2.75/index.html**.

Government of Newfoundland and Labrador Department of Fisheries and Land Resources (NLDFLR). 2018. Construction Standards for Resource Access Roads in Newfoundland and Labrador. Forest Engineering and Industry Services. Accessed on: 04 2025. Available at: https://www.gov.nl.ca/ffa/files/forestry-permits-pdf-construction-standards-for-resource-access-roads.pdf

Government of Newfoundland and Labrador Department of Municipal Affairs and Environment (NLDMAE). 2018. Environmental Guidelines for Culverts. Water Resource Management Division Water Rights, Investigations, and Modelling Section. Accessed on 04 2025. Available at: https://www.gov.nl.ca/ecc/files/waterres-regulations-appforms-chapter5.pdf

Grant CGJ, Lee EM. 2004. Life history characteristics of freshwater fishes occurring in Newfoundland and Labrador, with major emphasis on riverine habitat requirements. Can. Manuscr. Rep. Fish. Aquat. Sci. 2672:xii + 262 p.

Kauffman, J. B., Beschta, R. L., Otting, N., & Lytjen, D. 1997. An ecological perspective of riparian and stream restoration in the western United States. Fisheries, 22(5), 12–24. Accessed on: 05 2025. Available at: http://www.elkhornsloughctp.org/uploads/files/1116284956Kauffman%20et%20al.%201997.pdf

Lorax (Lorax Environmental Service Ltd.). 2025. Kamistiatusset Iron Ore Project environmental assessment water balance and water quality model technical data report, 2025.

Loughlin, K. G., & Clarke, K. D. 2013. A review of methods used to offset residual impacts of development projects on fisheries productivity. Canadian Manuscript Report of Fisheries and Aquatic Sciences, 3021, 1–38. Accessed on: 05 2025. Available at: https://www.researchgate.net/publication/272086285

MacCarthy J. 2024. Personal communication, August 13, 2024.

Mouton, A., De Baets, B., Goethals, P. L. M., & Meire, P. 2012. Riparian habitat connectivity restoration in an anthropized landscape. Ecological Engineering, 44, 1–10. Accessed on: 05 2025. Available at: https://hal.science/hal-04599263/document

Newbury, R.W., Gaboury, M.N. 1994. Stream Analysis and Fish Habitat Design *A Field Manual*. Accessed on: 05 2025. Available at: https://static1.squarespace.com/static/5c4f36c48ab722f1b25a301b/t/5c7d5337b208fcd407323a33/1551717189101/Newbury_Manual.pdf

Newfoundland and Labrador Hydro. 2024. Hydro and partners studying Labrador West transmission system. Accessed on: 05 2025. Retrieved from https://nlhydro.com/media-advisory-hydro-and-partners-studying-labrador-west-transmission-system/

Newfoundland and Labrador. 2022. St. Lewis River Atlantic Salmon Habitat Enhancement Project. Environment and Climate Change. 2022 Nov 18. https://www.gov.nl.ca/ecc/projects/project-2032/ Normandeau, D.A. 1969. Life history and ecology of the round whitefish, *Proso cylindraceum* (Pallas), of Newfound Lake, Bristol, New Hampshire. Transactions of the American Fisheries Society 98: 7-13.

Ogle, D. 2016. Introductory Fisheries Analysis with R. CRC Press.

Opperman, J. J., & Merenlender, A. M. 2004. The effectiveness of riparian restoration for improving instream fish habitat in four hardwood-dominated California streams. North American Journal of Fisheries Management, 24(3), 822–834. https://escholarship.org/uc/item/9kk5w5v9

Parsons, R.F. 1975. The limnology and fish biology of Ten Mile Lake, Labrador. Fisheries and Marine Service, Resource Development Branch, St. John’s, Newfoundland. Technical Report Series. Number NEW/T753, 75p.

Peterson, R. H., and P. R. Harmon. 2005. Changes in condition factor and gonadosomatic index in maturing and non-maturing Atlantic salmon (Salmo salar) in Bay of Fundy sea cages, and the effectiveness of photoperiod manipulation in reducing early maturation. Aquaculture Research 36:882–889

R Core Team. 2020. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.

Ricker, W. E. 1977. Computation and Interpretation of Biological Statistics of Fish Populations. The Journal of Wildlife Management 41:154.

Riley, J.L., Notzl, L., Greene, R. 2013. Labrador Nature Atlas: Vol. II, Ecozones, Ecoregions and Ecodistricts. Nature Conservancy of Canada, Toronto, Ontario. 128 p.

Scruton DA, Gibson RJ. 1995. Quantitative electrofishing in Newfoundland: results of workshops to review current methods and recommend standardization of techniques. Can. Manuscr. Rep. Fish. Aquat. Sci. v11 + 148 p., 4 appendices.

Sooley DR, Luiker EA, Barnes MA. 1998. Standard methods guide for freshwater fish and fish habitat surveys in Newfoundland and Labrador: rivers & streams. Fisheries and Oceans, St. John’s NL. Iii + 50 p.

Stantec (Stantec Consulting Ltd.). 2012. Water resources baseline study: Kami Iron Ore Mine and Rail Infrastructure Project.

Stassinu Stantec (Stassinu Stantec Limited Partnership). 2012. Community conservation initiatives for consideration (draft). Prepared for Alderon Iron Ore Corporation, St. John’s NL.

Walton, B.D. 1980. The reproductive biology, early life history, and growth of white suckers, *Catostomus commersoni*, and longnose suckers, *C. Catostomus*, in the Willow Creek – Chain Lake System, Alberta. Fish and Wildlife Division, Fisheries Research Report Number 23, Edmonton, Alberta, 180p.

Signature Page

WSP Canada Inc.

Matthew Gosse, B.Sc.
Biologist

James McCarthy, PhD
Senior Biologist

MG/JM/rd

https://wsponlinecan.sharepoint.com/sites/ca-kamieaca00030925894/shared documents/04_issued to client/02_eis/02_tsds/tsd ix_fish and fish habitat offsetting plan/ca0038712.5261_kami_offset_v4.docx

APPENDIX A

Ice Observations

Photo 1: Site 1

Photo 2: Site 2

Photo 3: Site 3

Photo 4: Site 4

Photo 5: Site 5

Photo 6: Site 5

Photo 7: Site 6

Photo 8: Site 6

Photo 9: Site 7

Photo 10: Site 8

Photo 11: Site 9

Photo 12: Site 10

Photo 13: Site 11

Photo 14: Site 12

Photo 15: Site 13

Photo 16: Site 15

Photo 17: Site 16

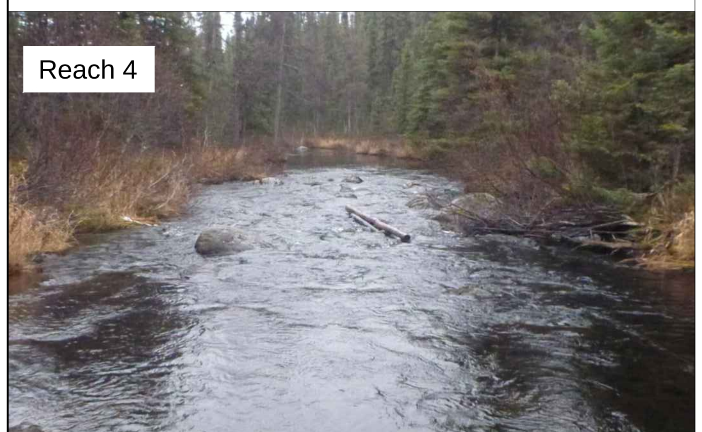
Photo 18: Site 17

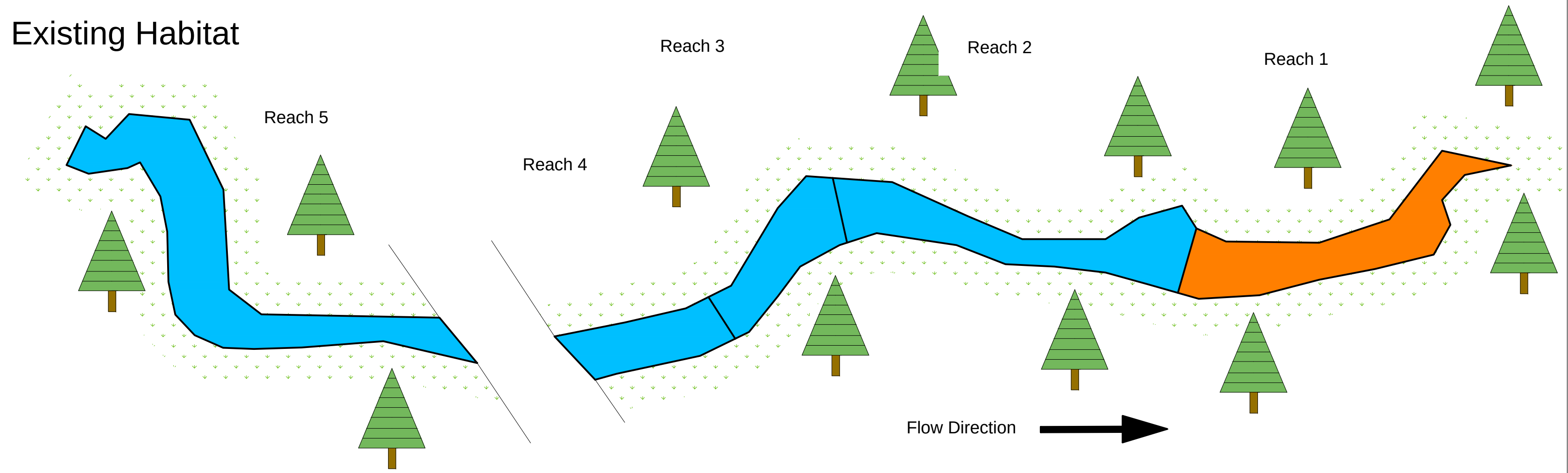
Photo 19: Site 18

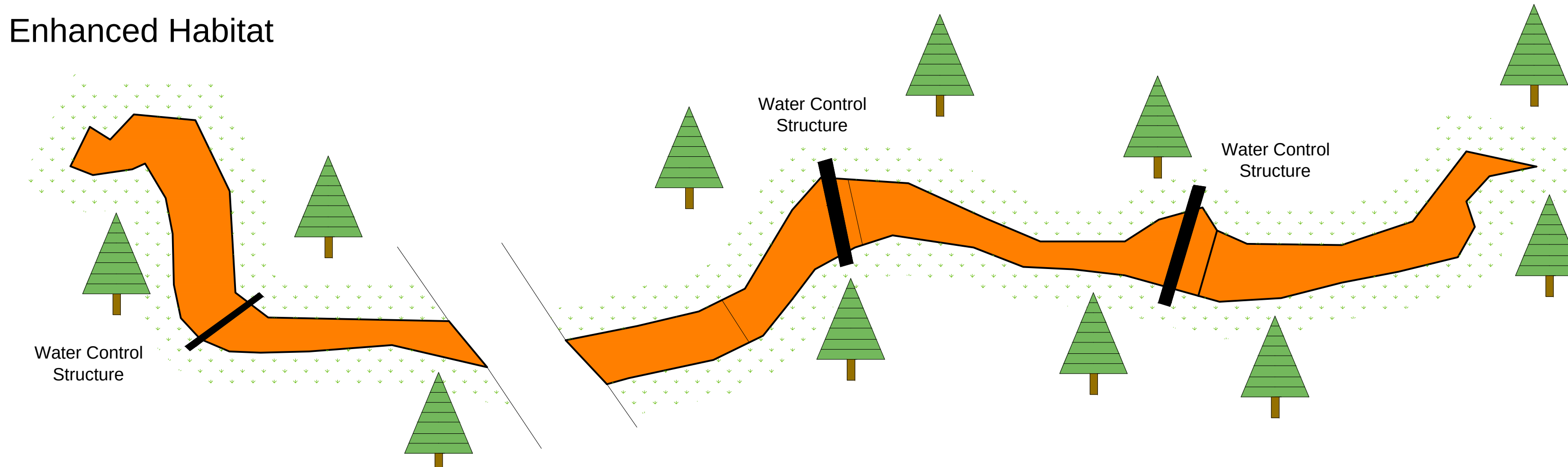
Photo 20: Site 19

APPENDIX B

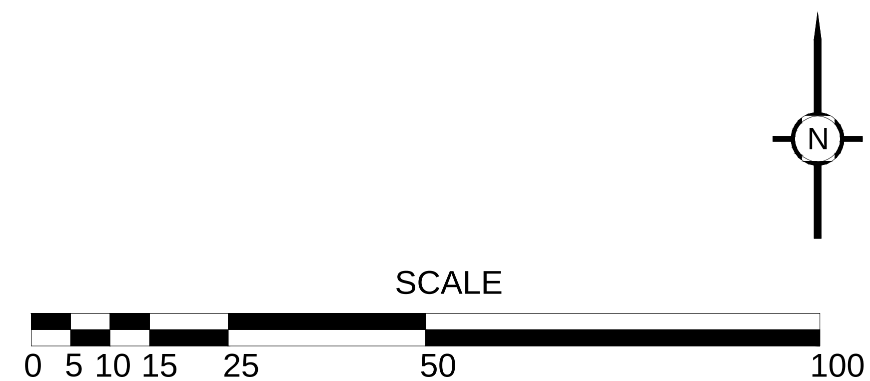
Offset Design Drawings

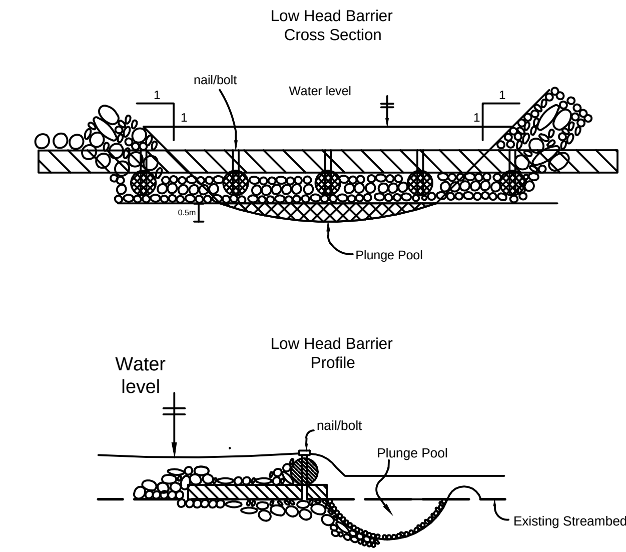


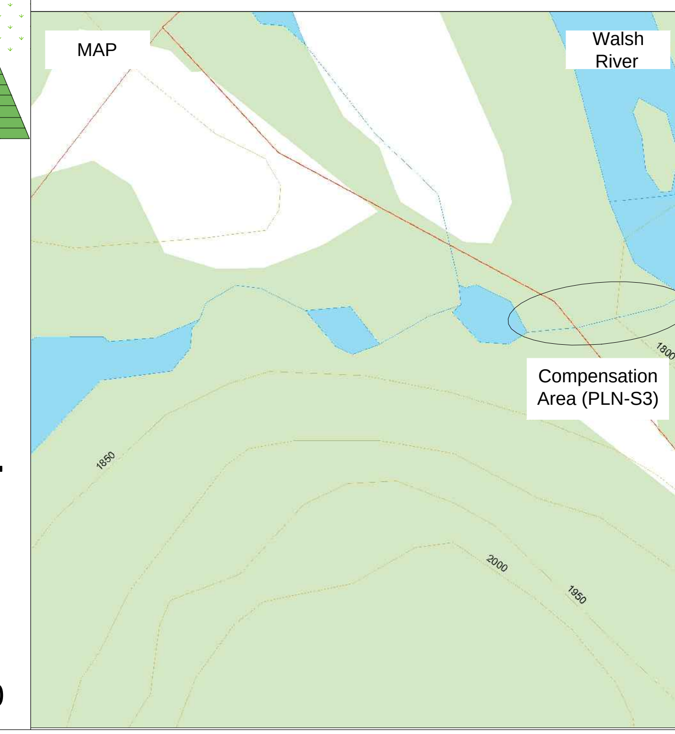




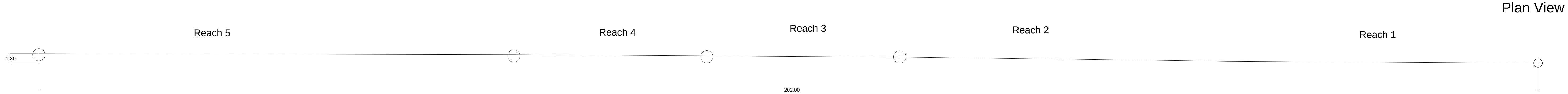
LEGEND	
(yellow)	Boulder Dominant
(light blue)	Rubble Dominant
(green)	Cobble Dominant
(orange)	Gravel Dominant
(blue)	Sand Dominant







Plan View



NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

ALDERON RESOURCE CORP.

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

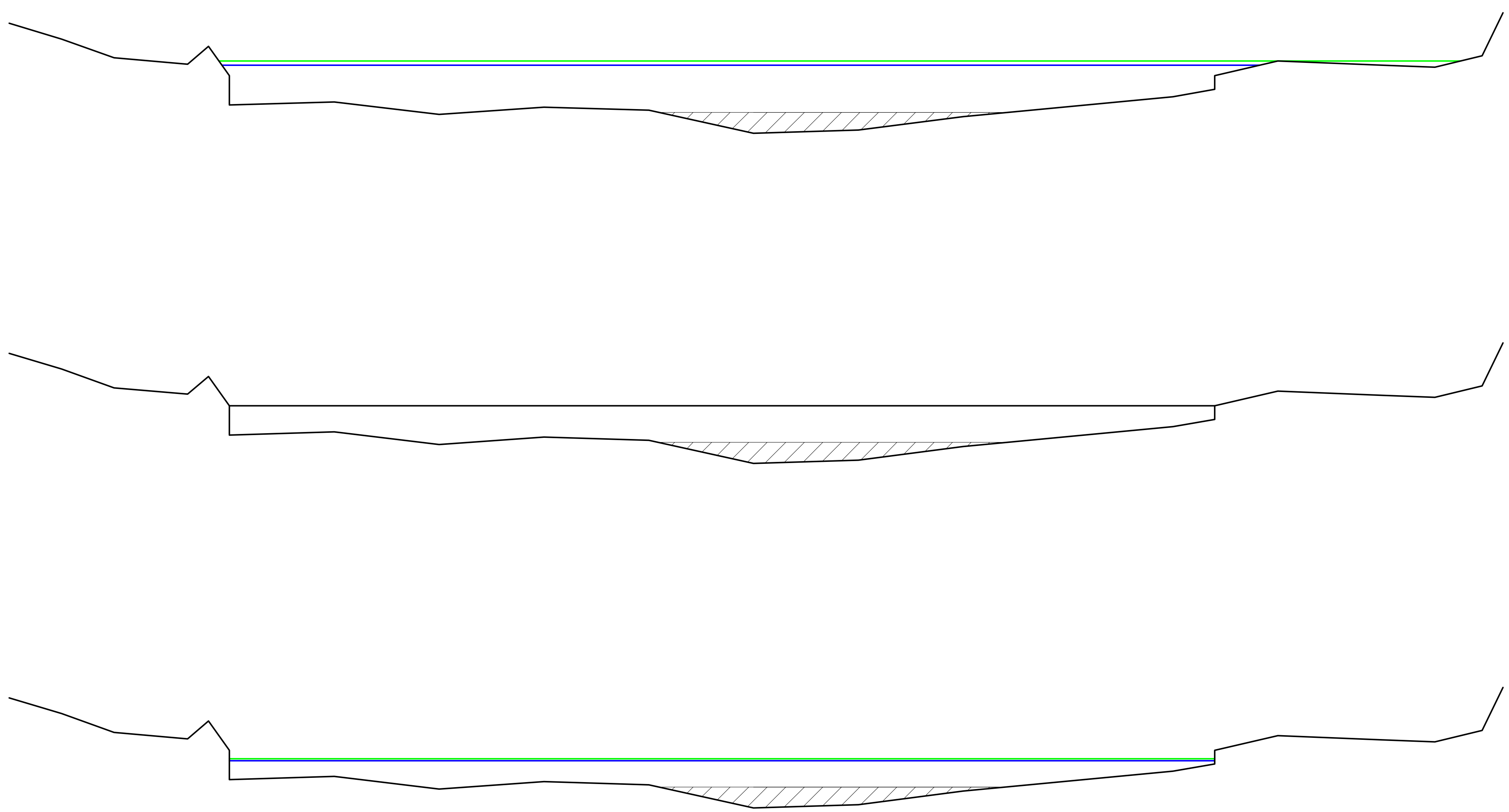
DWN BY:	M.Gosse
CHK'D BY:	J. McCarthy
SCALE:	As Shown
PROJECT	Freshwater Offsetting Plan Kami Iron Ore Mine
TITLE	A1 - Pike Lake North Outflow (PLN-S3) Offsetting Areas Preliminary Design and Site Layout
DATE	July 2013
PROJECT No.	TF1280801
FIGURE. No.	A1
DRAWING No.	TF1280801-001

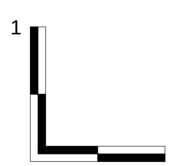
Cross sections indicate the varying water levels, for similar discharges,
under existing conditions and with enhancements (gravel placement).

Probable Maximum Flood ($1.55m^3/s$)		
	Existing	Enhanced
Mean Velocity (m/s)	0.24	0.57
Mean Depth (m)	0.53	0.27
Max Depth (m)	0.83	0.45

Mean High Flow ($0.85m^3/s$)		
	Existing	Enhanced
Mean Velocity (m/s)	0.19	0.46
Mean Depth (m)	0.35	0.2
Max Depth (m)	0.55	0.35

Mean Spawning Flow ($0.42m^3/s$)		
	Existing	Enhanced
Mean Velocity (m/s)	0.52	0.37
Mean Depth (m)	0.32	0.14
Max Depth (m)	0.52	0.25





LEGEND

Existing (Modeled) Water Level	Assumed Bank
Enhanced (Modeled) Water Level	Placed Gravels

NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. NOTED DISCHARGES OBTAINED FROM PRORATED HYDROGRAPHS DEVELOPED FOR EACH TRIBUTARY.
6. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

ALDERON RESOURCE CORP.

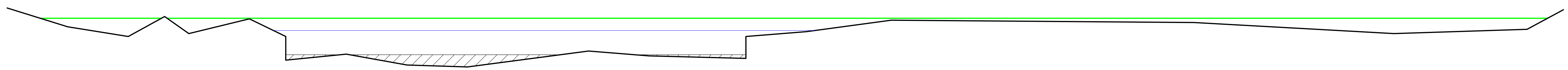
AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

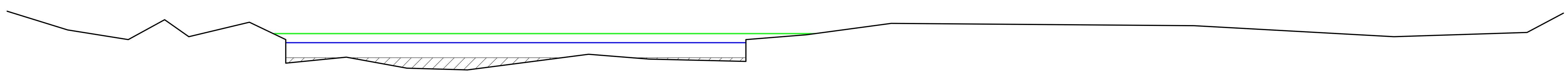
DWN BY:	M.Gosse
CHK'D BY:	J. McCarthy
SCALE:	As Shown
PROJECT	Freshwater Offsetting Plan Kami Iron Ore Mine
TITLE	A2 - Pike Lake North Outflow (PLN-S3) Reach 4, Transect 2 Cross Sections and Post Enhancement Model
DATE	July 2013
PROJECT No.	TF1280801
FIGURE No.	A2
DRAWING No.	TF1280801-002

Cross sections indicate the varying water levels, for similar discharges, under existing conditions and with enhancements (gravel placement).

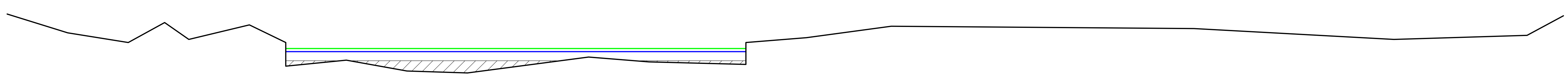
Probable Maximum Flood (1.55m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.25	0.5
Mean Depth (m)	0.81	0.36
Max Depth (m)	0.87	0.43

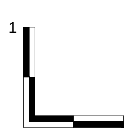


Mean High Flow (0.85m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.24	0.45
Mean Depth (m)	0.31	0.24
Max Depth (m)	0.45	0.25



Mean Spawning Flow (0.42m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.22	0.32
Mean Depth (m)	0.31	0.14
Max Depth (m)	0.36	0.15





LEGEND

Existing (Modeled) Water Level	Assumed Bank
Enhanced (Modeled) Water Level	Placed Gravels

NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. NOTED DISCHARGES OBTAINED FROM PRORATED HYDROGRAPHS DEVELOPED FOR EACH TRIBUTARY.
6. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

ALDERON RESOURCE CORP.

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

DWN BY: M.Gosse

CHK'D BY: J. McCarthy

SCALE: As Shown

PROJECT: Freshwater Offsetting Plan
Kami Iron Ore Mine

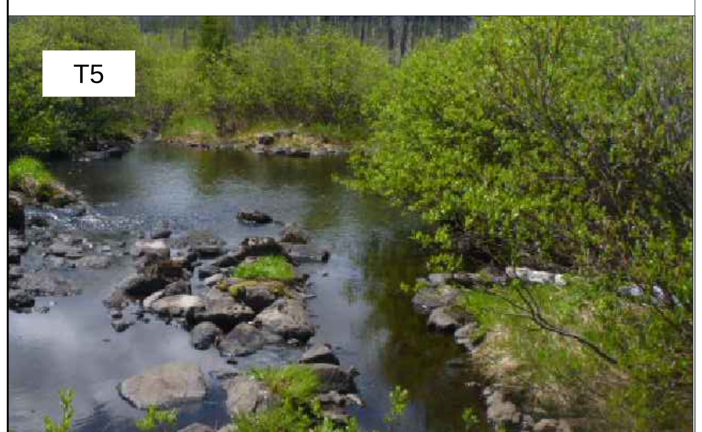
TITLE: A3 - Pike Lake North Outflow (PLN-S3)
Reach 5, Transect 1 Cross Sections and Post Enhancement Model

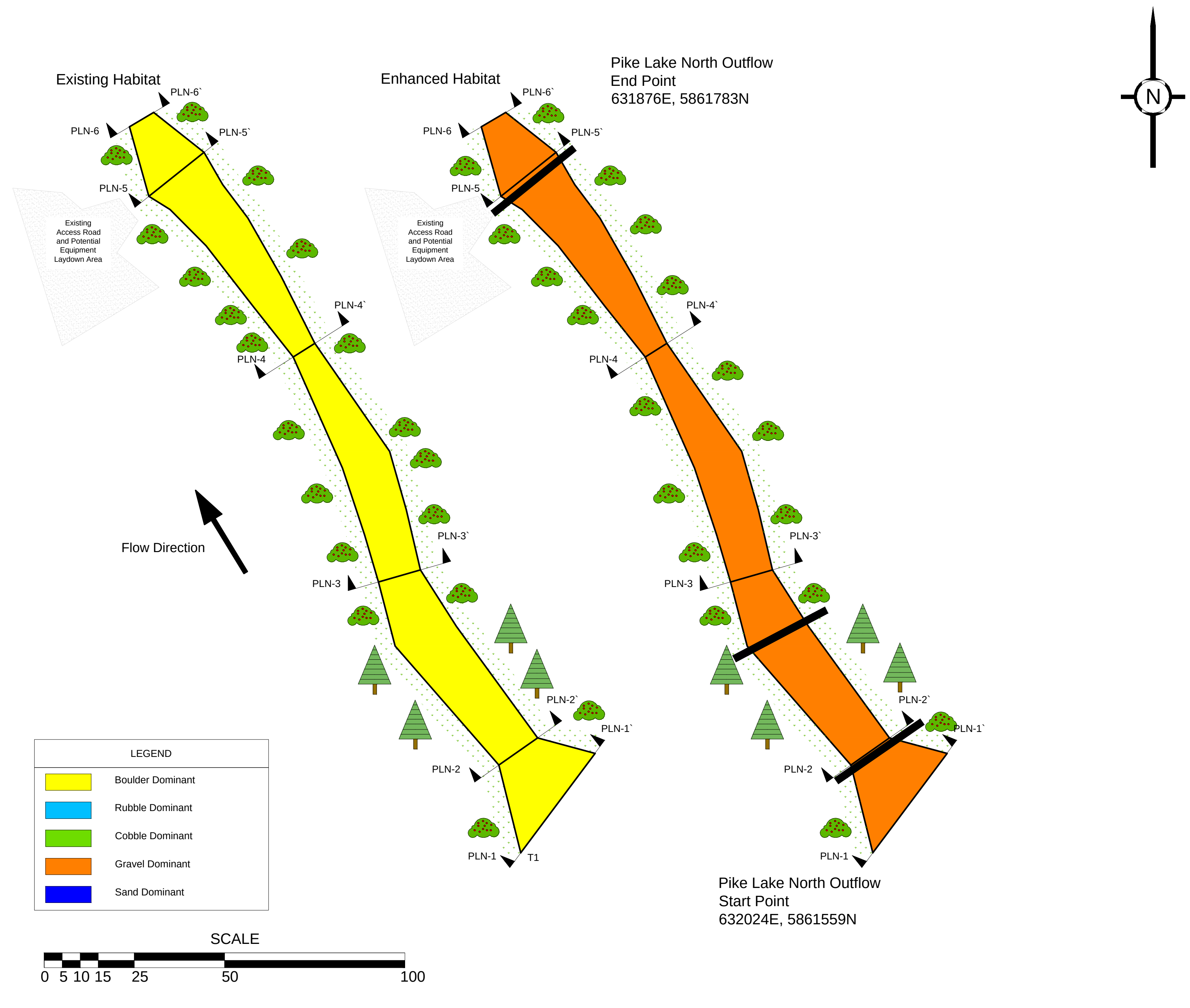
DATE: July 2013

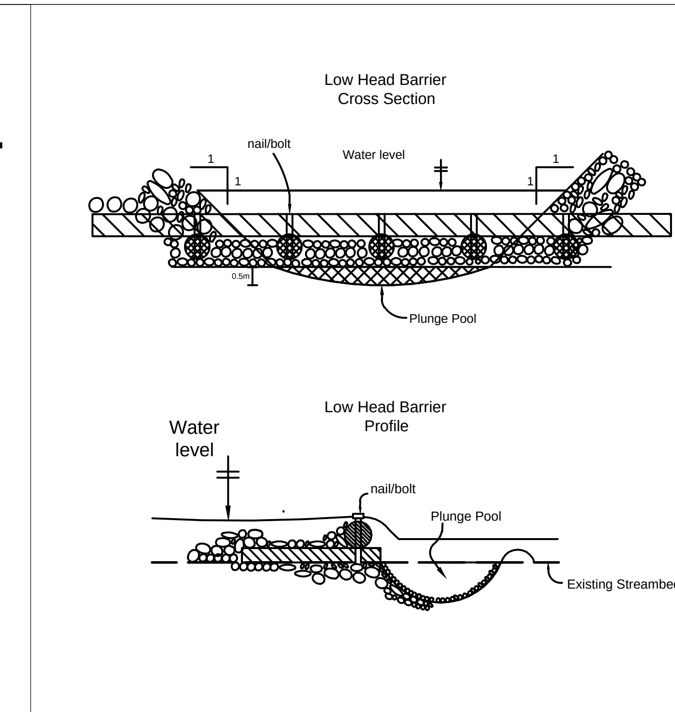
PROJECT No. TF1280801

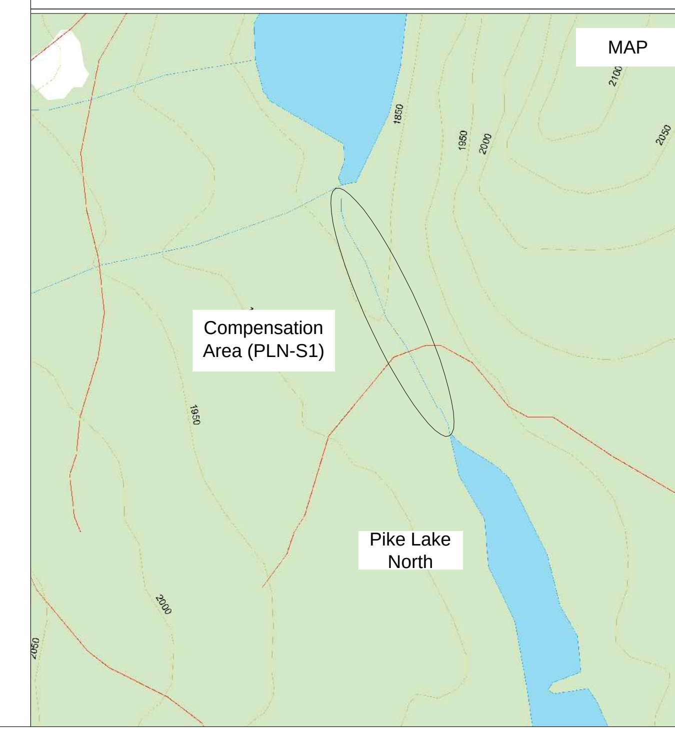
FIGURE. No. A3

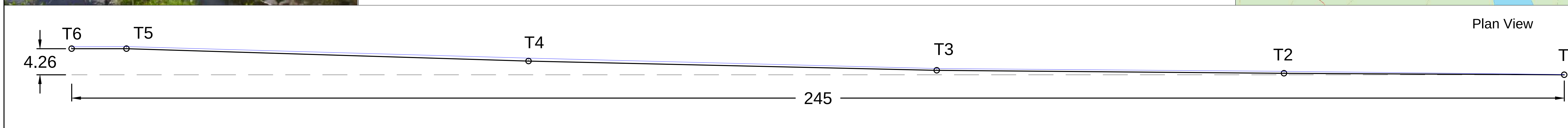
DRAWING No. TF1280801-003











NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

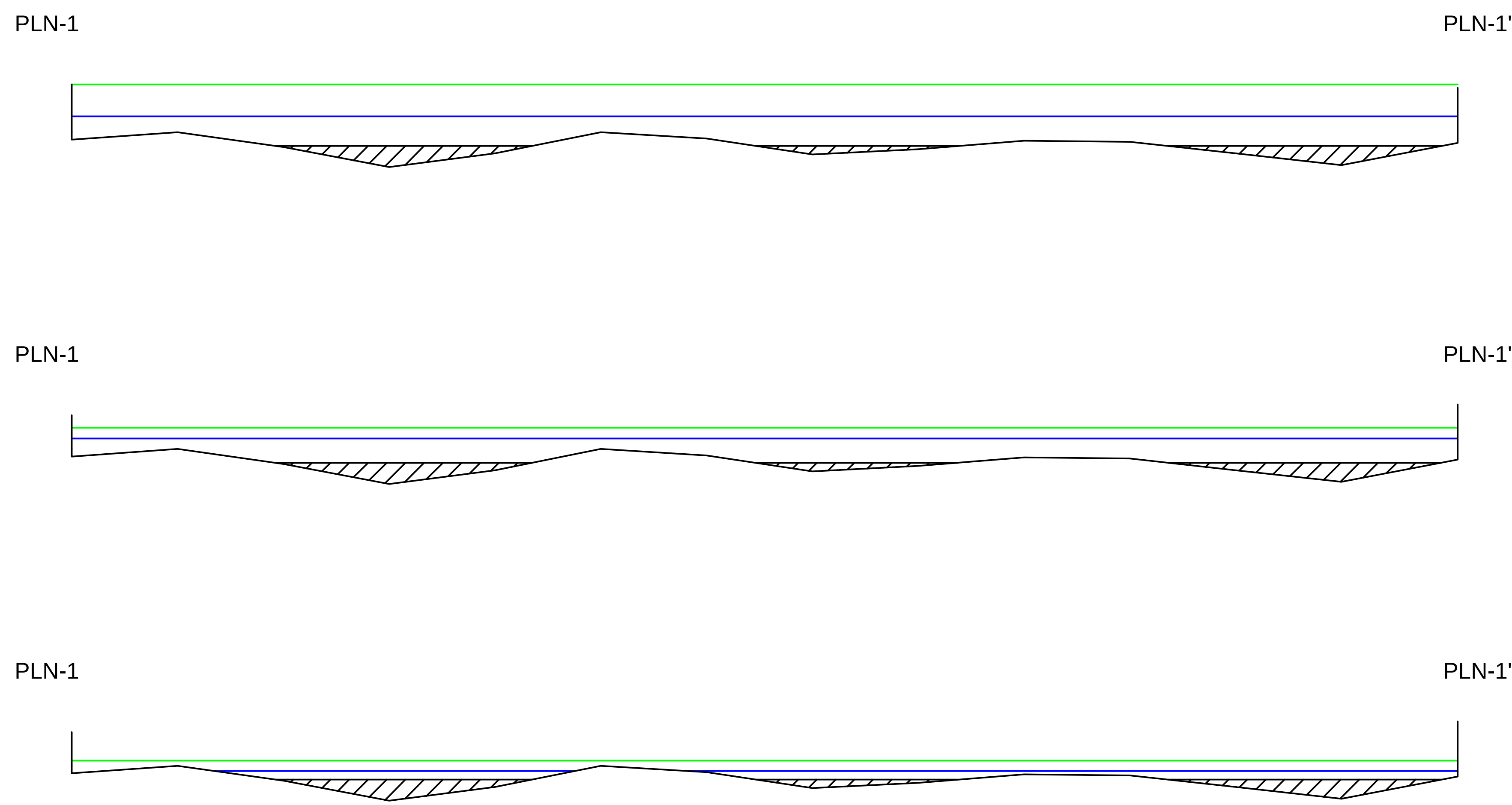
ALDERON RESOURCE CORP.

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

DWN BY:	M.Gosse
CHK'D BY:	J. McCarthy
SCALE:	As Shown
PROJECT	Freshwater Offsetting Plan Kami Iron Ore Mine
TITLE	A4 - Pike Lake North Outflow (PLN-S1) Offsetting Areas Preliminary Design and Site Layout
DATE	July 2013
PROJECT No.	TF1280801
FIGURE No.	A4
DRAWING No.	TF1280801-004

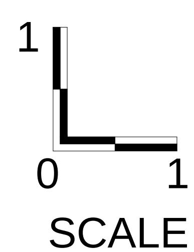
Cross sections indicate the varying water levels, for similar discharges, under existing conditions and with enhancements (gravel placement).



Probable Maximum Flood (1.55m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.242	0.537
Mean Depth (m)	0.494	0.251
Max Depth (m)	0.780	0.280

Mean High Flow (0.85m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.193	0.387
Mean Depth (m)	0.344	0.151
Max Depth (m)	0.530	0.180

Mean Spawning Flow (0.42m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.144	0.316
Mean Depth (m)	0.219	0.111
Max Depth (m)	0.380	0.140



LEGEND

- Existing (Modeled) Water Level
- Enhanced (Modeled) Water Level
- Assumed Bank
- Placed Gravels

NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. NOTED DISCHARGES OBTAINED FROM PRORATED HYDROGRAPHS DEVELOPED FOR EACH TRIBUTARY.
6. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

ALDERON RESOURCE CORP.

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

DWN BY: M.Gosse

CHK'D BY: J. McCarthy

SCALE: As Shown

PROJECT: Freshwater Offsetting Plan
Kami Iron Ore Mine

TITLE: A5 - Pike Lake North Outflow (Reach 1, Transect 2)
Cross Sections and Post Enhancement Model

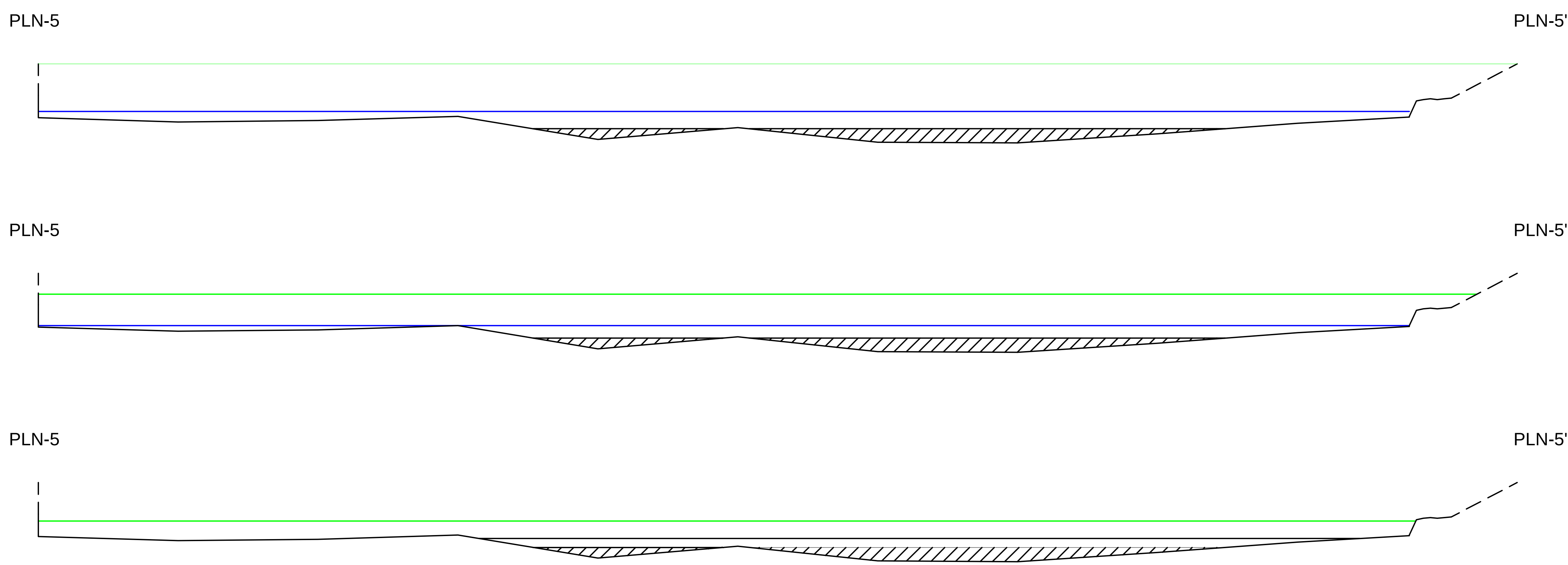
DATE: July 2013

PROJECT No. TF1280801

FIGURE No. A5

DRAWING No. TF1280801-005

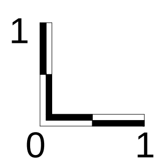
Cross sections indicate the varying water levels, for similar discharges, under existing conditions and with enhancements (gravel placement).



Probable Maximum Flood (1.55m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.083	0.457
Mean Depth (m)	0.950	0.191
Max Depth (m)	1.130	0.250

Mean High Flow (0.85m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.065	0.339
Mean Depth (m)	0.620	0.121
Max Depth (m)	0.830	0.180

Mean Spawning Flow (0.42m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.051	0.284
Mean Depth (m)	0.377	0.093
Max Depth (m)	0.580	0.130



SCALE

LEGEND

- Existing (Modeled) Water Level
- Enhanced (Modeled) Water Level
- Assumed Bank
- Placed Gravels

NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. NOTED DISCHARGES OBTAINED FROM PRORATED HYDROGRAPHS DEVELOPED FOR EACH TRIBUTARY.
6. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

ALDERON RESOURCE CORP.

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

DWN BY: M.Gosse

CHK'D BY: J. McCarthy

SCALE: As Shown

PROJECT: Freshwater Offsetting Plan
Kami Iron Ore Mine

TITLE: A6 - Pike Lake North Outflow (Reach 1, Transect 5)
Cross Sections and Post Enhancement Model

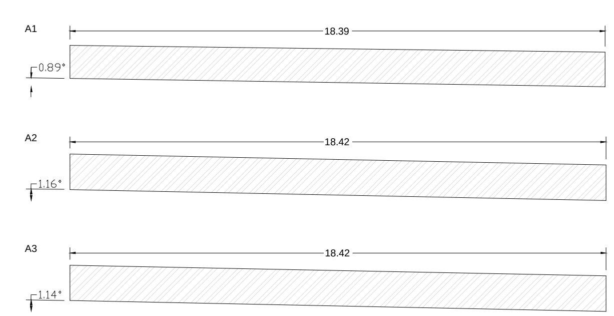
DATE: July 2013

PROJECT No. TF1280801

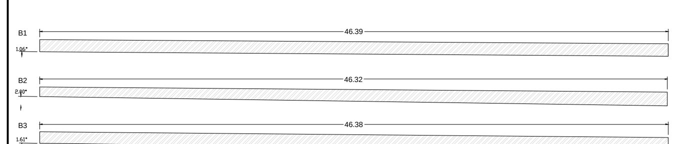
FIGURE. No. A6

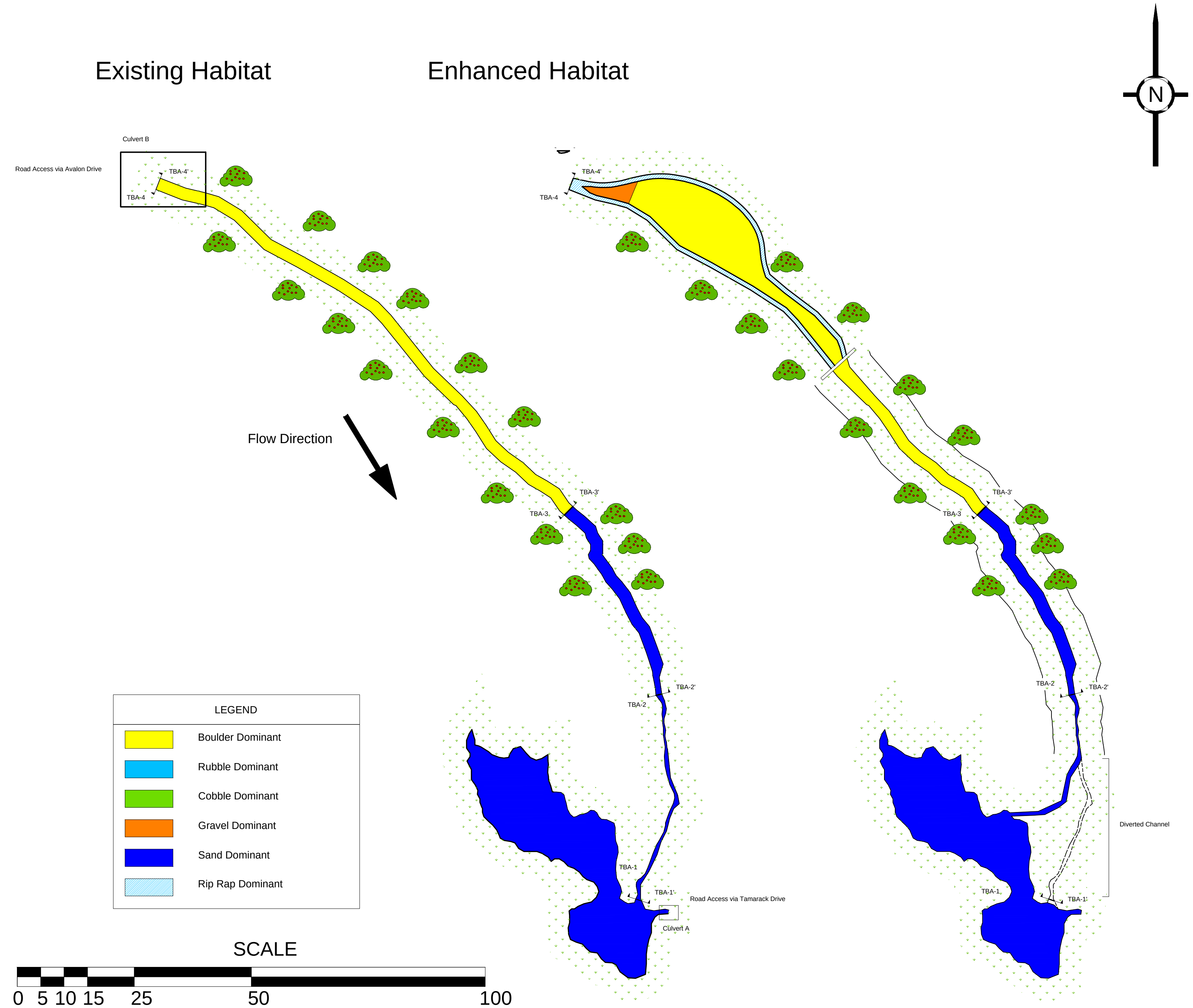
DRAWING No. TF1280801-006

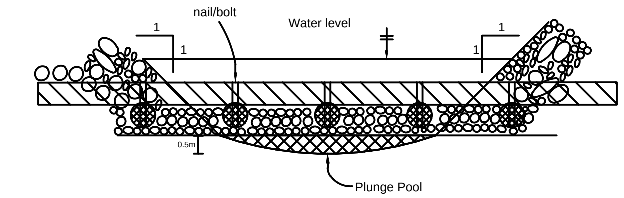
Culvert A

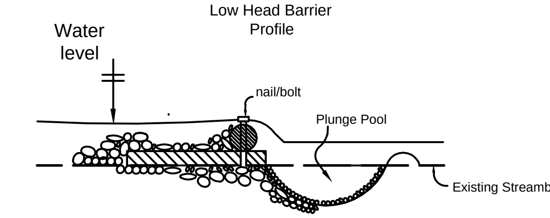


Culvert B

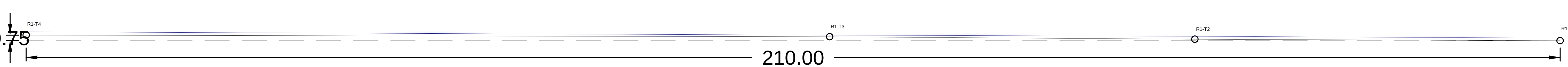








Plan View



NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

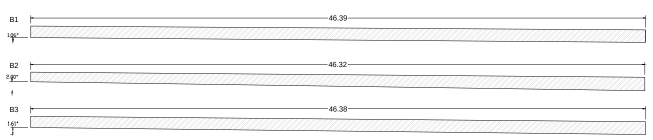
ALDERON RESOURCE CORP.

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

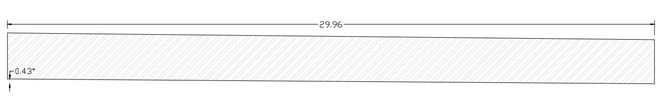
amec

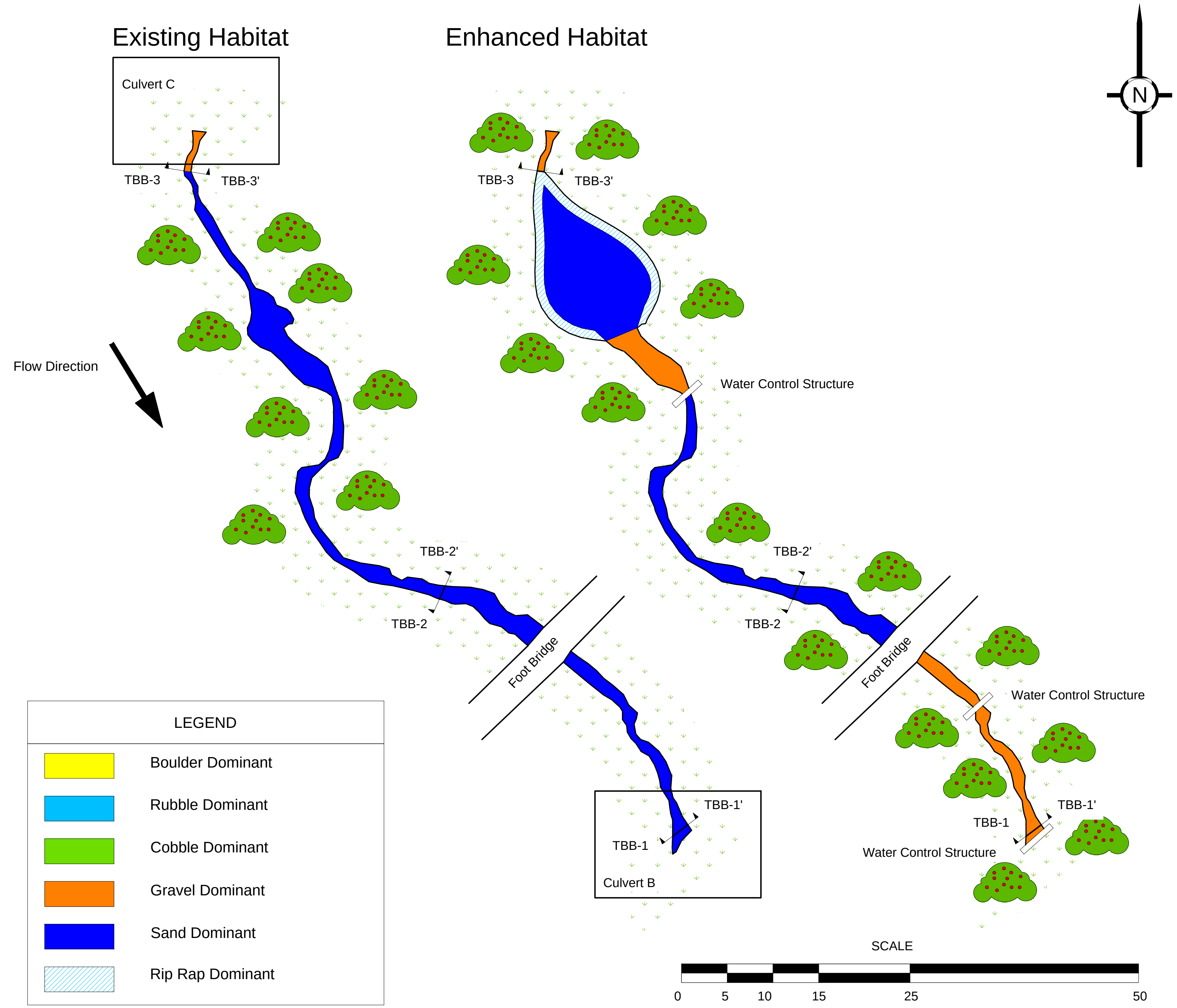
DWN BY:	M.Gosse
CHK'D BY:	J. McCarthy
SCALE:	As Shown
PROJECT	Freshwater Offsetting Plan Kami Iron Ore Mine
TITLE	A7 - Tamarack Brook Offsetting Areas and Site Layout
DATE	July 2013
PROJECT No.	TF1280801
FIGURE No.	A7
DRAWING No.	TF1280801-007

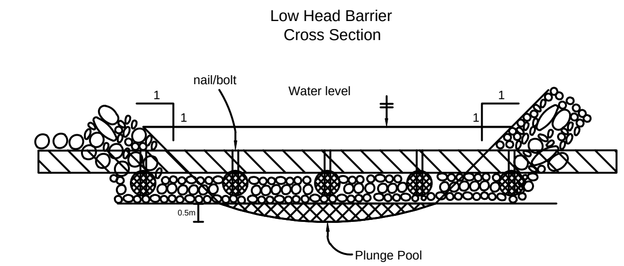
Culvert B

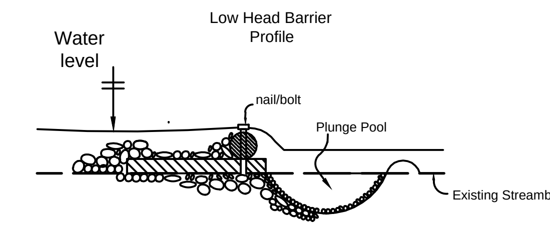


Culvert C

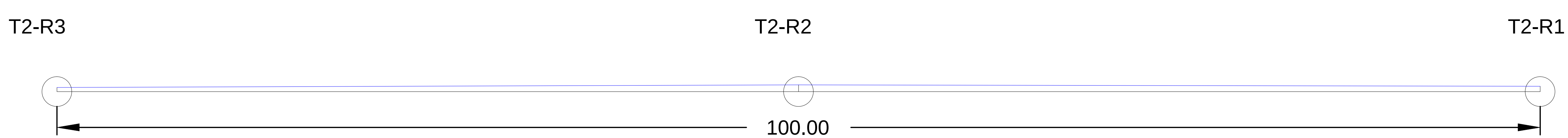








Plan View



NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

ALDERON RESOURCE CORP.

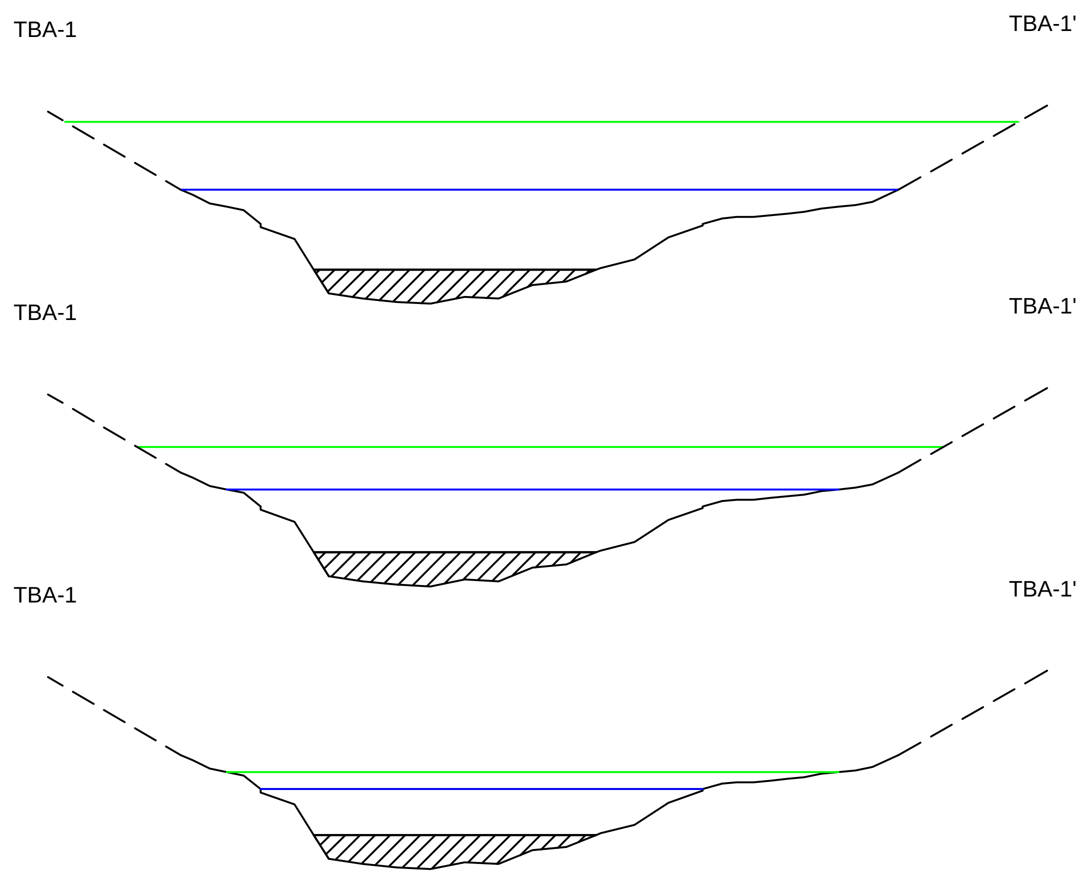
AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

DWN BY:	M.Gosse
CHK'D BY:	J. McCarthy
SCALE:	As Shown
PROJECT	Freshwater Offsetting Plan Kami Iron Ore Mine
TITLE	A8 - Tamarack Brook Offsetting Areas and Site Layout
DATE	July 2013
PROJECT No.	TF1280801
FIGURE. No.	A8
DRAWING No.	TF1280801-008

Cross sections indicate the varying water levels, for similar discharges, under existing conditions and with enhancements (gravel placement).

Reach 1, Transect 4

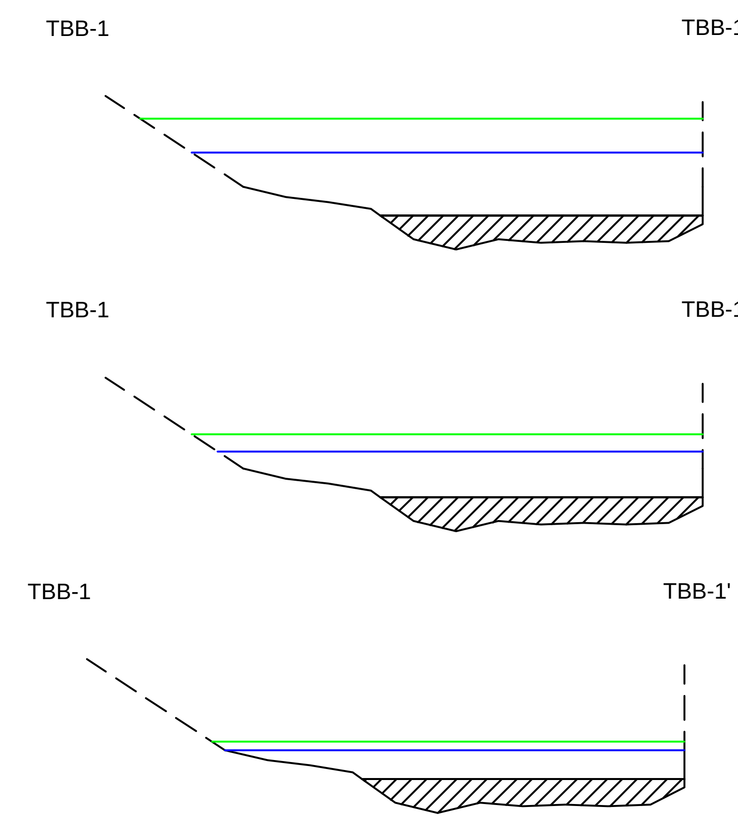


Probable Maximum Flood (0.65m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.193	0.508
Mean Depth (m)	0.606	0.302
Max Depth (m)	1.070	0.407

Mean High Flow (0.35m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.158	0.440
Mean Depth (m)	0.446	0.243
Max Depth (m)	0.820	0.370

Mean Spawning Flow (0.20m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.136	0.408
Mean Depth (m)	0.356	0.220
Max Depth (m)	0.670	0.270

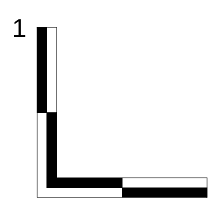
Reach 2, Transect 1



Probable Maximum Flood (0.65m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.366	0.654
Mean Depth (m)	0.584	0.318
Max Depth (m)	0.770	0.370

Mean High Flow (0.35m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.307	0.542
Mean Depth (m)	0.417	0.232
Max Depth (m)	0.570	0.270

Mean Spawning Flow (0.20m^3/s)		
	Existing	Enhanced
Mean Velocity (m/s)	0.247	0.393
Mean Depth (m)	0.288	0.142
Max Depth (m)	0.420	0.170



SCALE

LEGEND

Existing (Modeled) Water Level	Assumed Bank
Enhanced (Modeled) Water Level	Placed Gravels

NOTE:

1. ALL DIMENSIONS ARE IN METERS.
2. DO NOT SCALE FROM DRAWING.
3. ALL LOCATIONS, DIMENSIONS, AND ORIENTATIONS ARE APPROXIMATE.
4. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OTHER THAN THOSE OUTLINED ABOVE.
5. NOTED DISCHARGES OBTAINED FROM PRORATED HYDROGRAPHS DEVELOPED FOR EACH TRIBUTARY.
6. DRAWING CONTAINS INTELLECTUAL PROPERTY OF ALDERON IRON ORE CORPORATION, AND SHOULD NOT BE REPRODUCED WITHOUT CONSENT.

Alderon Iron Ore Corporation

ALDERON RESOURCE CORP.

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd
133 Crosbie Road
St. John's, NL.
A1B 4A5
709-722-7023

amec

DWN BY: M.Gosse

CHK'D BY: J. McCarthy

SCALE: As Shown

PROJECT: Freshwater Offsetting Plan
Kami Iron Ore Mine

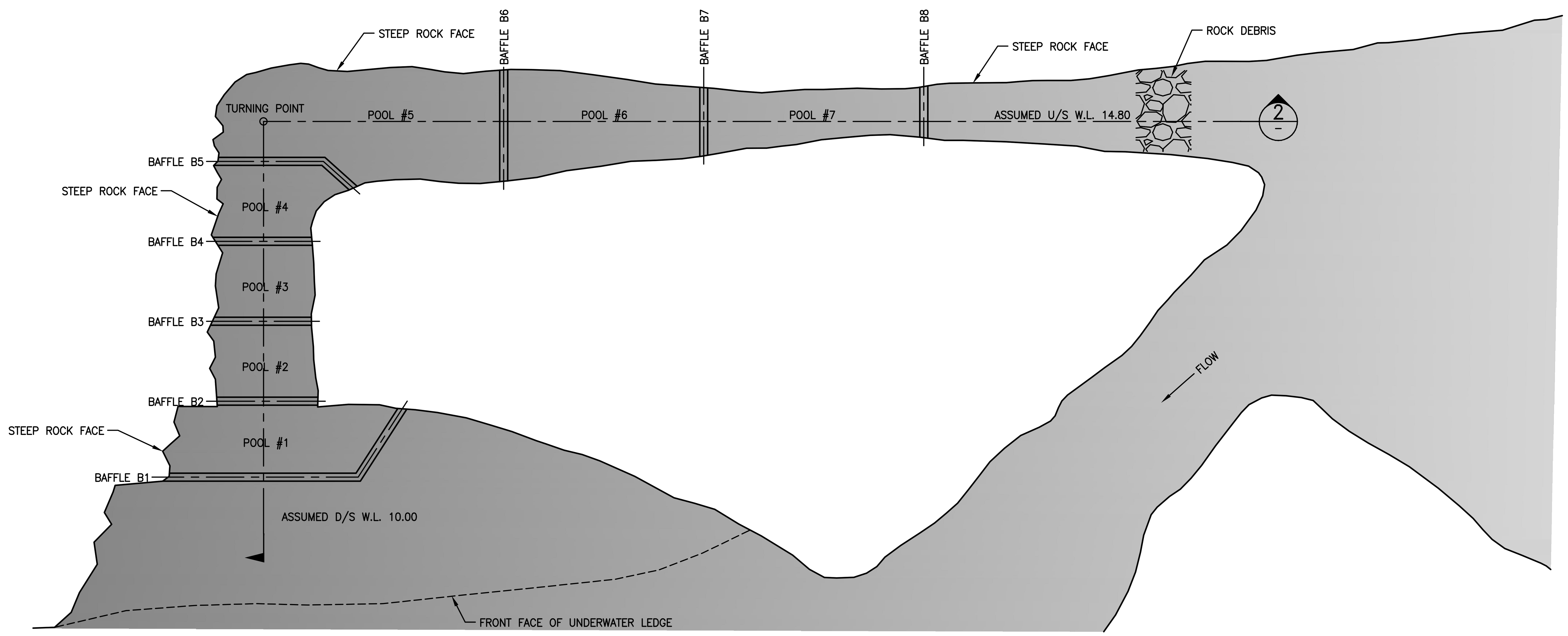
TITLE: A9 - Tamarack Brook
Post Enhancement Model

DATE: July 2013

PROJECT No. TF1280801

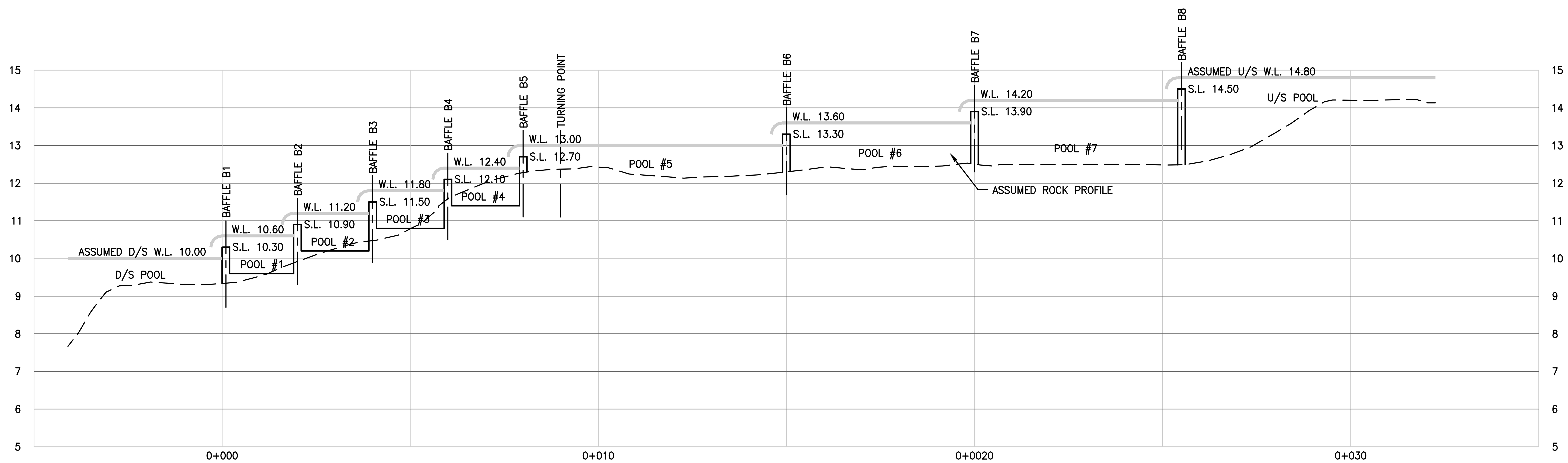
REV. No. A9

FIGURE No. TF1280801-009



PLAN – PROPOSED FISHWAY (1)
1:75

0m 1 2 3 4
1:75



PROFILE – PROPOSED FISHWAY (2)
1:75

0m 1 2 3 4
1:75

LEGEND

U/S	UPSTREAM
D/S	DOWNSTREAM
W.L.	WATER LEVEL
S.L.	SILL LEVEL

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
A	27FEB18	ISSUED FOR REVIEW	ME	RG	JM			

REF	NUMBER	TITLE
		REFERENCES

STAMP/SEAL

ISSUED FOR REVIEW

CLIENT PROJECT MGR | DEPARTMENT MGR | PROJECT MGR

PROJECT PHASE

PROJECT NO. TF1691801

SCALE 1:75

	BY	DDMMMYY
DES	R. GOOSENEY	31DEC17
DRN	M. ENGRAM	27FEB18
CHK	J. MCCARTHY	27FEB18
APP		

SUBJECT

CIVIL
PLAN AND PROFILE
ST. LEWIS RIVER
UPPER FISHWAY

amec foster wheeler
AMEC FOSTER WHEELER
36 PIPPY PLACE
ST. JOHN'S, NL A1B 3X4
709-722-7023

AREA

CLIENT DWG NO.

DRAWING NO. TF1691801-DD10-PAP-0100 REV A wsp.com