# ATTACHMENT 30

## LTWP Fish and Fish Habitat Report

ARCADIS

City of Iqaluit

# Fish & Fish Habitat Report

## Long Term Water Project – Supply and Storage

July 2025

*View of eastern point of Lake Qikiqtalik*

# Fish and Fish Habitat Report

**Long Term Water Project – Supply and Storage**

July 2025

**Prepared By:**
Arcadis Canada Inc.
8133 Warden Avenue, Unit 300
Markham, Ontario L6G 1B3
Canada
Phone: 905 763 2322

**Prepared For:**
City of Iqaluit
1085 Mivvik Street, P.O. Box 460
Iqaluit, Nunavut,
Canada, X0A 0H0
Phone: 867 979 5600

**Our Ref:**
30192375

Olivia Dalati, MSc IWRM, OTPQ
Environmental Professional

Arman Ospan, PhD, R.P.Bio
Senior Aquatic Habitat Specialist

Fred Bernard, M.A. Geo
Senior Environmental Specialist

# Version Control (optional)

| Issue | Revision No. | Date Issued | Page No. | Description | Reviewed By |
|---|---|---|---|---|---|
| 00 | - | 2024-12-18 | - | Final Draft | Michael Kehle and Fred Bernard |
| | | | | | |
| | | | | | |

# Contents

# In-text Figures



# In-text Tables



# Figures........ I



# Tables........ II



# Appendices

# Acronyms, Abbreviations & Terms

| | |
|---|---|
| AR | Apex River |
| AVG | Average |
| BVL | Bureau Veritas Laboratories |
| CIRNAC | Crown–Indigenous Relations and Northern Affairs Canada |
| CTRL | Control |
| DFO | Department of Fisheries and Oceans |
| eDNA | Environmental DNA analysis |
| LG | Lake Geraldine |
| LQ | Lake Qikiqtalik |
| LTWP | Long Term Water Project |
| New Reservoir | Secondary proposed reservoir |
| P1 | Pond 1 |
| P2 | Pond 2 |
| P3 | Pond 3 |
| P4 | Pond 4 |
| P5 | Pond 5 |
| P6 | Pond 6 |
| RWPS | Raw Water Pumping Station |
| SG | Sylvia Grinnell River |
| SME | Subject Matter Experts |
| WTP | Water Treatment Plant |

# Executive Summary

The Long-Term Water Project (LTWP) aims to address the growing demand for potable water in Iqaluit by expanding the city's water supply and storage infrastructure. Key components of the project include constructing a new reservoir (referred to as the New Reservoir) adjacent to Lake Geraldine (the existing reservoir), drawing water from Lake Qikiqtalik and Apex River, and connecting these water sources via pipelines to convey water from the New Reservoir to Lake Geraldine as needed. The project's primary objectives are to enhance water supply capacity, secure future water resources, and minimize environmental impacts on local aquatic ecosystems.

A comprehensive Fish and Fish Habitat assessment was conducted from July 15 to 19, 2024, to evaluate the potential impacts of the LTWP on waterbodies in the project area, including Lake Qikiqtalik, Apex River, Lake Geraldine, and several smaller ponds located within the footprint of the New Reservoir and along the proposed Access Road. These ponds are planned to be dewatered during construction. The assessment incorporated environmental DNA (eDNA) sampling, water quality analyses, and fish habitat surveys.

The eDNA survey confirmed the presence of fish in Lake Qikiqtalik and the Apex River but found no evidence of fish in Lake Geraldine or in the ponds within the New Reservoir footprint and along the Access Road. Water quality assessments showed that Lake Qikiqtalik and the Apex River provide suitable conditions for cold-water species such as Arctic Char, with favorable temperature, dissolved oxygen, and pH levels. The warmer, isolated ponds, with low nutrient levels and limited vegetation, are unlikely to support fish populations, confirming they are not viable fish habitats. While no fish were detected in Lake Geraldine, its similar water quality to Lake Qikiqtalik suggests that the presence of fish cannot be entirely ruled out.

Mitigation measures have been developed to minimize the environmental impact of construction and operational activities. These include habitat protection and restoration, fish salvage during construction, erosion and sediment control, provision of water intakes with screens to prevent fish entrainment and impingement, and water quality protection. These measures aim to ensure that residual effects on fish and aquatic habitats remain minimal, especially in fish-bearing waterbodies like Lake Qikiqtalik and the Apex River. The construction of the New Reservoir will enhance water storage capacity with minimal long-term impacts on aquatic ecosystems.

While some unavoidable impacts on fish and fish habitats, such as habitat loss and temporary minor water quality changes, are expected during construction, these will be offset by the development of the larger New Reservoir, which can serve to develop new aquatic habitat, and mitigated by the application of appropriate measures. Erosion, sedimentation, and the potential introduction of harmful substances during construction, particularly in the Apex River and Lake Qikiqtalik, are key concerns. Mitigation measures such as sediment control, fish salvage operations, and strict construction practices will be implemented to minimize these impacts. Overall, with effective mitigation, residual effects on fish and fish habitats are anticipated to be minimal and not significant.

# 1 Introduction

## 1.1 Background

The City of Iqaluit is addressing challenges with its drinking water supply due to population growth by advancing the Long-Term Water Project (LTWP). This project includes upgrades to the City's water supply and distribution infrastructure to meet projected drinking water needs. The plan involves extracting water from Lake Qikiqtalik and the Apex River and conveying it through pipelines to a new secondary reservoir (New Reservoir), located next to Lake Geraldine, the City's current reservoir. The New Reservoir will be connected to Lake Geraldine to supply water based on demand.

The LTWP site is within Iqaluit's municipal boundary and includes Lake Geraldine (LG), the Niaqunnguk River (Apex River), Lake Qikiqtalik (LQ), and several ponds in the proposed New Reservoir footprint and along the access road. The surrounding area primarily consists of undeveloped tundra with ground cover over rocky substrate, multiple wetlands, and isolated waterbodies. The project involves dewatering the ponds in the New Reservoir footprint and along the access road, constructing a rock-fill dam connecting the New Reservoir to LG, source water pumping stations at LQ and Apex River, and an aboveground covered pipeline to transfer water.

The construction components of the project will have a specific and measurable footprint on the natural environment of Iqaluit. To provide evidence that this footprint will not significantly impact biodiversity or key habitats, ecological field studies are needed. A field program was developed and conducted by the Arcadis biology team during Summer 2024 to assess the landscape within the LTWP footprint.

## 1.2 Project Description

The LTWP consists of developing a permanent water conveyance system from Lake Qikiqtalik to the Lake Geraldine Reservoir, as well as an expansion of the capacity of a New Reservoir, and other associated structural requirements (Figure 1-1). The primary objectives of the LTWP are to:

- Establish a new long-term water source and the necessary infrastructure to address the City's present and future water demands, ensuring that the water supply system supports economic growth, and
- Construct a new reservoir to secure sufficient year-round water storage capacity by adding a minimum 1.5-fold increase in the over-winter storage capacity and meeting the current and projected needs of the City.

The main LTWP components include:

- Intake at Lake Qikiqtalik.
- Raw Water Pumping Station (RWPS) at Lake Qikiqtalik and the Apex River.
- New water conveyance pipeline.
- Upgrading as required of the existing road and culverts located between Lake Qikiqtalik and the Road to Nowhere.
- Pipeline crossing of the Apex River.
- New access road from the Road to Nowhere to the New Reservoir requiring the dewatering and filling of existing ponds.

- Intake at the Apex River.
- Laydown areas near the RWPS and shooting range.
- Concrete plant at the RWPS.
- Eight retention structures creating the New Reservoir.
- One spillway to the Apex River.
- Valve access building at the New Reservoir.
- Buried conveyance pipeline between the New Reservoir and Lake Geraldine.
- Quarries for rock at the New Reservoir and the construction laydown area.
- Borrows for sand materials.
- Electrical distribution line to the RWPS at LQ and Apex River and the control building at the New Reservoir, and
- Backup power generation is needed at these locations to maintain the thermal protection pipes in winter.

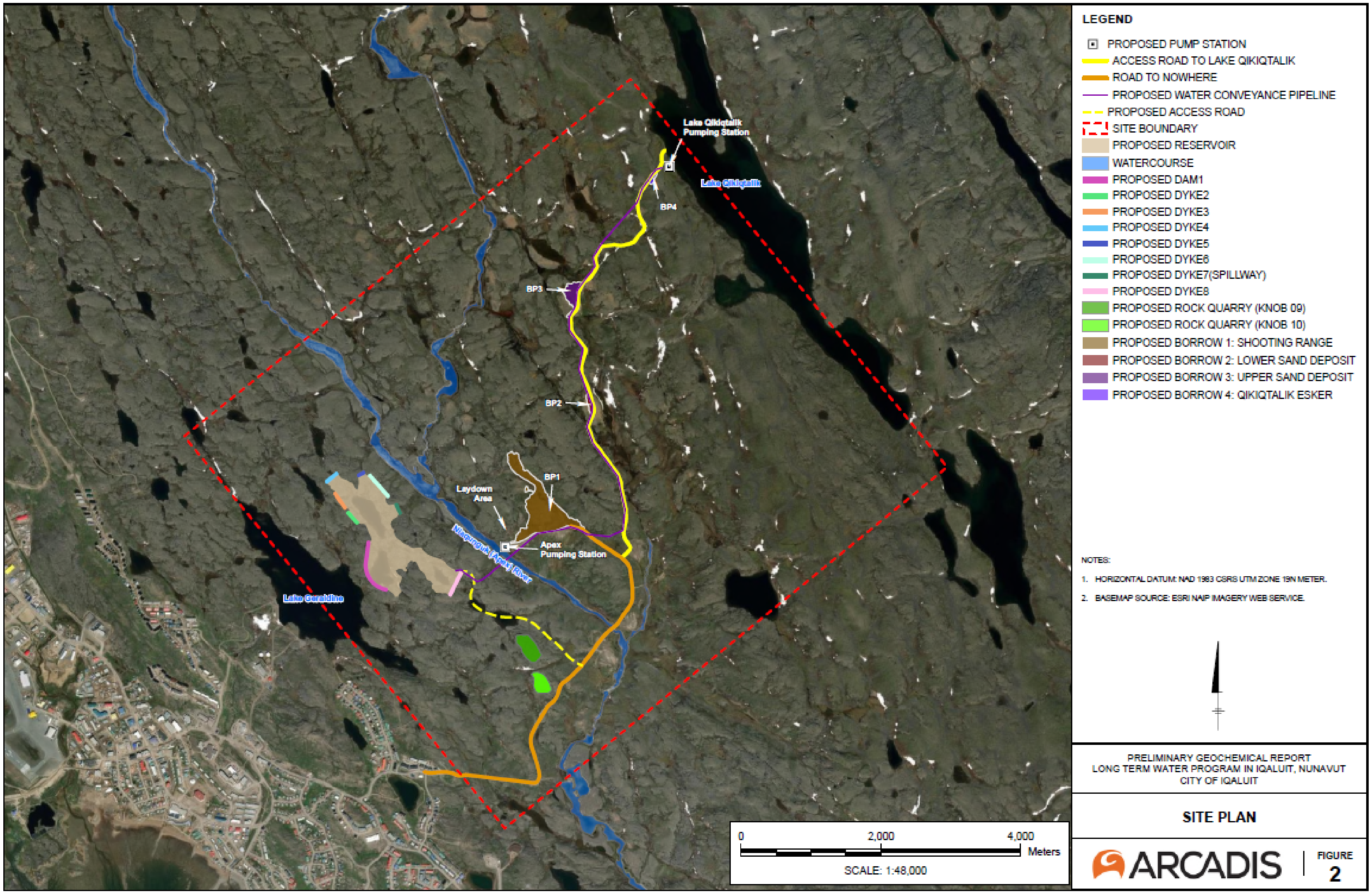


*Figure 1-1 LTWP General Project Components*

## 1.3 Objectives

This program included a fish and fish habitat assessment to assess existing aquatic conditions and identify fish presence and any environmental risks or concerns to fish populations in the waterbodies within the LTWP.

The objectives of this Fish and Fish Habitat Report are to:

- Identify and evaluate the presence and distribution of fish populations and their habitats within the project area.
- Assess the potential impacts of the proposed project on these populations and propose mitigation measures to minimize negative impacts. And,
- Ensure compliance with relevant environmental regulations and guidelines.

# 2 Desktop Review and Preliminary Studies

## 2.1 Desktop Review

A description of the current aquatic communities and habitats has been prepared based on an analysis of existing scientific and technical literature, reported traditional knowledge as well as anecdotal information. The review focuses on Lake Qikiqtalik, Apex River, the ponds that constitute the New Reservoir and Lake Geraldine.

The fish community on Baffin Island and particularly in the project area is relatively limited compared to mainland Nunavut, primarily due to the island's high latitude and isolation (Richardson *et al.* 2002). The primary freshwater fish species reported in the area include Arctic Char (*Salvelinus alpinus*) and Ninespine Stickleback (*Pungitius pungitius*), with Arctic Char being particularly noteworthy. Although there has been no recorded fishing activity in the project area, the presence of these species, especially Arctic Char, is significant as they play a vital role in the subsistence and traditional practices of northern communities, including those in Iqaluit (Reist *et al*. 2006).

Arctic Char is a highly valued species on Baffin Island and throughout Nunavut, known for its adaptability and diverse life history traits. It exists in both landlocked and anadromous forms, with some populations exhibiting a mix of these traits within the same waterbody (Richardson *et al.* 2002). This species is particularly vulnerable to environmental changes, such as lake drawdowns and reductions in streamflow, which can impact their shallow spawning habitats. Additionally, Arctic Char are susceptible to the effects of climate change, including the northward migration of Atlantic salmon, which may outcompete Arctic Char in overlapping habitats.

Previous studies on fish habitat and the presence of fish have been conducted in the water bodies potentially affected by the project. A summary of these studies is provided below. For the locations of the waterbodies and overview of survey points, refer to Figure 1 – Fish & Fish Habitat Survey Stations at the end of this report.

### 2.1.1 Lake Qikiqtalik

Lake Qikiqtalik has been the subject of several studies to assess its fish community and habitat suitability. In 2021, WSP investigated following a 2019 bathymetric survey by Tetra Tech, which revealed the lake's significant size and volume. Water quality tests by Nunami Stantec in 2019 indicated low levels of metals and total dissolved solids, meeting the Canadian Council of Ministers of Environment (CCME) guidelines for aquatic life, suggesting the lake's potential to support local fish species. Although an Iqaluit resident reported the presence of Arctic Char and

Ninespine Stickleback, there has been no recorded fishing activity in the lake. WSP's assessments in 2020 and 2021 identified potential juvenile rearing habitats for Arctic Char along the shoreline.

An eDNA analysis in 2021 consisted of four water samples collected from different locations and depths. The analysis detected a small amount of fish DNA in one sample, identified down to the genus Salvelinus (char or trout). Based on that result, the identification of suitable habitat, and local resident information, it was concluded that Arctic Char were present in the lake, albeit in low abundance (WSP 2021). It remains unclear why Arctic Char eDNA was detected in such low abundance or whether the detection could be a false positive.

### 2.1.2 Apex River

The Niaqunnguk or Apex River is reported to be effectively isolated from Frobisher Bay due to a 2-meter high waterfall near Koojesse Inlet, making it unlikely to support anadromous Arctic Char, which are not able to jump fish ladders of this height (Klemetsen *et al.* 2003). However, it is known to host a resident population of landlocked Arctic Char, despite the absence of a recognized fishery. A comprehensive assessment conducted by Nunami Stantec in 2016 (Nunami Stantec 2017) confirmed the presence of this resident population, capturing several Arctic Char, including two adults. The study highlighted that the river provides favorable rearing, spawning, and overwintering habitats for the resident Arctic Char. These conditions are supported by complex habitat features such as riffles with gravel and cobble, deep pools, wide impounded areas, and cascade/step pool habitats, all of which contribute to the production of aquatic invertebrates essential for the fish's diet.

Interestingly, no Ninespine Stickleback were captured during the previously mentioned surveys, even though suitable habitat exists in the river. This absence is likely due to the higher gradient sections of the river that were sampled, which may restrict fish access. Despite this, the overall habitat within the Apex River is well-suited to support its resident Arctic Char population, ensuring the sustainability of this isolated fish community.

### 2.1.3 Lake Geraldine

Although Lake Geraldine possesses habitat suitable for supporting Stickleback or land-locked Arctic Char species, there has been no documented presence of fish in the lake, and any information is anecdotal. The survey conducted by Nunami Stantec (2017) did not yield any captured fish, though it is worth noting that the sampling effort may not be sufficient to definitively determine the absence or presence of fish. Arctic Char were captured in the drainage channel below the Lake Geraldine Dam.

Although the Nunami Stantec report and anecdotal evidence suggested a low likelihood of fish presence in the lake, the data, now over seven years old and inconclusive, have prompted the need for further studies.

### 2.1.4 New Reservoir and Access Road Ponds

No previous data were available on fish presence in the ponds that will comprise the New Reservoir, nor the ponds that are within the footprint of the Access Road. Anecdotal information suggested a very low probability of fish being present and little to no community usage of these waterbodies. However, conducting field studies was necessary to gather more definitive evidence regarding the presence or absence of fish in the existing ponds present within the footprint of the New Reservoir and Access Road since they will be permanently altered or removed.

## 2.2 Initial Site Reconnaissance

A site reconnaissance was undertaken from September 19 to 23, 2023, by Arcadis subject matter experts (SME) to determine the baseline conditions at the project site. Included in this reconnaissance team were Arcadis' terrestrial biologist and permitting specialist, which surveyed the water bodies to be included in the project.

It was concluded that it was too late in the season to effectively evaluate vegetation species and abundance or observe fish, bird, and terrestrial wildlife. No Species at Risk (SAR) were identified during the visit. The following high-level observations were made:

- Arctic ground vegetation was present across the undisturbed areas of the project area. This vegetation is typically slow growing and may take decades to regenerate following disturbance.
- Various berries and other edible terrestrial plant species were observed growing on the site. However, the City of Iqaluit noted they were not aware of any specific traditional foraging areas.
- Bones (likely from caribou) were observed at the area of the planned pumphouse (RWPS), pipeline pathway and New Reservoir. No caribou were observed during the site reconnaissance.
- Wetlands were present at various locations where construction is planned.

Among the conclusions drawn was the importance of limiting ground and wetland disturbances caused by construction activities where possible. Since the initial reconnaissance, two public consultation sessions have been held, and Arcadis has received feedback from the community. Based on this input, no additional environmental surveys are required. Observations collected during the 2023 site reconnaissance were used to develop the scope of work for the ecological investigation.

# 3 Field Surveys

## 3.1 Methods

Assessments of the waterbodies impacted by the LTWP were undertaken to determine the presence of fish and the quality of available fish habitat in Iqaluit during the week of July 15$^{th}$ to 19$^{th}$, 2024. All survey GPS points were collected using a Bad Elf Flex Mini Handheld GPS device with a precision of approximately 1 metre.

The information on fish presence/absence in Apex River and Lake Geraldine was outdated (collected eight years ago), based on limited effort and partly anecdotal information, and thus required verification with new field studies. No data were available for the ponds in the New Reservoir footprint and along the access road, aside from anecdotal information suggesting a low probability of fish presence. Therefore, studies on fish presence in these lakes were also necessary.

The scope and objectives of the Summer 2024 Fish and Fish Habitat study were as follows:

- **Lake Qikiqtalik**: Conduct a shoreline fish habitat assessment and verify fish presence/absence and water quality. The objective was to collect sufficient data to confirm whether the lake is currently inhabited by fish and to support the assessment of potential impacts on fish and fish habitat from RWPS construction and operation, including water drawdown of the proposed source water.
- **Apex River**: Evaluate the current condition of the Apex River and its watershed, with a focus on fish populations and habitat conditions. This includes a general assessment of habitat suitability and water quality, confirmation of fish presence, and an evaluation of connectivity with other water bodies in relation

to Arctic Char movements and migrations (e.g., with the ocean and Lake Qikiqtalik). The assessment will also determine whether habitat has been disturbed by anthropogenic or natural activities. The data collected will support the evaluation of potential impacts on fish and fish habitat from the Long-Term Water Project (LTWP), particularly concerning pump construction, operation, and water drawdown.

- **The ponds in the footprint of the New Reservoir**: Confirm existence of each pond (Pond 3-6), evaluate their hydraulic connectivity, water quality, fish presence/absence and the fish habitat quality in each pond. The objective was to collect sufficient data to confirm whether fish or fish habitat would be impacted by the construction and flooding of the New Reservoir Area.
- **Lake Geraldine**: Conduct a shoreline fish habitat assessment and verify fish presence/absence and water quality. The objective was to confirm if fish have established in Lake Gerladine that may be impacted by construction activities.
- **Ponds and/or streams along the proposed Access Road**: Survey all ponds and streams within the Access Road footprint to determine if they contain fish or suitable fish habitat that will be affected by dewatering activities. The objective was to collect sufficient data to confirm whether additional actions or interventions are required prior to removal of these waterbodies for the construction of the Access Road.
- **Pipeline Pathway**: Walk the pathway of the aboveground covered pipeline to identify additional waterbodies that may be impacted by LTWP construction activities. Additionally, walk the proposed spillway connection from LG to Apex River to assess feasibility.

Each waterbody underwent the following assessments:

- Presence of fish using environmental DNA (eDNA) sampling.
- Water quality assessment using multiparameter probe analysis.
- Fish habitat assessment using a visual inspection and description of the substrate and shoreline.
- General stream survey of Apex River.

### 3.1.1 eDNA Assessment

eDNA refers to genetic material shed by organisms into their environment through excretions, sloughed skin cells, scales, feathers, and other bodily excretions. In aquatic environments, this DNA can be captured from water samples and analyzed to determine the presence of species without physical capture of the animals.

eDNA sampling was selected as the method for assessing the fish population in the LTWP waterbodies. Gillnetting and electrofishing were determined to be logistically difficult to implement and posed elevated health and safety risks for the ecology team. Transport of a boat and equipment to the new reservoir ponds posed logistic challenges. Given the ease of use of the sampling technology, eDNA was selected as a suitable sampling method.

Table 3-1 shows the number of sampling stations surveyed during the study, determined by the length of the shoreline of each waterbody, with a minimum of one station per waterbody. Sampling stations at each lake/pond were distributed as evenly as possible by visual approximation along the shoreline to provide a representative distribution (Figures 2 through 7). For example, for Ponds 1 and 2 (P1 and P2), which were connected by an open channel, two samples were collected from opposite shores, and one sample was collected at the connection channel on the P1 side, as P1 was the larger of the two ponds. Two sampling stations were positioned near the proposed intake and RWPS at Lake Qikiqtalik (LQ-1) and the inflow into Lake Geraldine from the New Reservoir

(LG-1). Samples from Lake Qikiqtalik were collected only from the western shore, as the eastern shore was steep and less accessible.

Pond 4 was identified during the desktop analysis, but no samples were collected as the pond was determined to be non-existent during the survey (see Section 3.2.3.3 for more details).

Two samples from the Apex (AR) and Sylvia Grinnell (CTRL) rivers (Figures 6 and 7) were collected as positive control samples, as both rivers are known fish habitats.

*Table 3-1 eDNA Sampling and Fish Habitat Transects Done at Each Waterbody*

| Waterbody Name | Area ($km^2$) | # of Sample Stations | Feature ID |
|---|---|---|---|
| Lake Qikiqtalik (Source Water) | 5.24 | 6 | LQ |
| Lake Geraldine (Current Reservoir) | 1.71 | 4 | LG |
| Apex River (Source Water) | 58.5[1] | 1 | AR |
| Pond 1 (Access Road) | 0.057 | 2 | P1 |
| Pond 2 (Access Road) | 0.030 | 1 | P2 |
| Pond 3 (New Reservoir) | 0.031 | 2 | P3 |
| Pond 4 (New Reservoir) | 0.002 | 0 | P4 |
| Pond 5 (New Reservoir) | 0.112 | 3 | P5 |
| Pond 6 (New Reservoir) | 0.124 | 3 | P6 |
| Sylvia Grinnell River | 2,980[1] | 1 | CTRL |

Each lake/pond sampling station and CTRL represented a transect along the shoreline, with one 1-L sample collected at each station, consisting of five 200 mL subsamples of water from evenly spaced (~20 m) locations along the transect (pooled sample). An exception was P6-3, where only four subsamples (800 mL) were collected due to potential hydrocarbon contamination at the planned location of the fifth substation (Photo # 33). The sample from the Apex River (AR) was collected from five evenly spaced subsamples along a transect across the river (Figure 6). All samples were collected using a length-adjustable dipstick.

Fish habitat surveys were conducted at each sampling station, and water quality measurements were taken at one substation per station, as described in the following sections. A habitat survey was not conducted at Sylvia Grinnell; only water was sampled for eDNA analysis (Figure 7).

The equipment for eDNA sampling included kits pre-ordered from Bureau Veritas Laboratories (BVL) prior to arrival in Iqaluit. Each kit included a 1L HDPE water collection bottle, a Nalgene filter funnel with a cellulose nitrate filter (pore size: 0.45 µm; diameter: 47 mm), a paper coin envelope, silica desiccant, and a plastic zipper-seal bag. Field materials also included an adjustable dipstick with a fastener for the collection bottle, an electric vacuum pump system, nitrile gloves, alcohol solution, and forceps. The BVL sampling and filtering procedure, as detailed in Appendix C, was followed.

Between each sampling station, all sampling equipment that came into contact with water was wiped and sterilized with an alcohol solution. Each 1000 mL water sample was subsequently filtered using a small, sterile mobile setup, and the filter was preserved in a labeled and securely sealed envelope, which was placed in a plastic bag with silica beads. The preserved filters were sent to BVL for a general fish detection assay, eFish1 Assay.

[1] Watershed area from Environment and Climate Change Canada: https://wateroffice.ec.gc.ca/

### 3.1.2 Water Quality Assessment

The quality of a waterbody has an impact on the suitability of fish and other aquatic organism habitat. In order to gain an understanding of the processes occurring in the different waterbodies studied, water quality data were collected at each sample transect. A Horiba U52-2M Multimeter was used to obtain water quality data. The device was calibrated prior and rinsed in between stations (see the calibration certificate in Appendix C).

At the subsample station 2 of each transect, the pH, temperature, turbidity, dissolved oxygen and conductivity readings were recorded in triplicate. Water sample collection for the eDNA assessment always took place prior to placing the probe in the water and the probe was rinsed in between each transect. The average water quality for each waterbody is displayed in Figures 2 to 6.

### 3.1.3 Fish Habitat Assessment – Lakes

The fish habitat surveys for the lakes and ponds within the project area were conducted by walking around the shorelines of all the waterbodies, except for the northeast side of Lake Qikiqtalik, where access was limited due to challenging terrain and poor weather conditions. The ponds within the footprint of the New Reservoir and along the proposed Access Road were surveyed by traversing the area from the Road to Nowhere. The survey of Lake Geraldine was conducted over two days: the northeast shore was accessed on foot from the ponds' locations, and the southwest shore was reached by driving to the lake's gate in the WTP for better access. However, the northwest part of Lake Geraldine was not surveyed due to time constraints. Each pond and lake shoreline was carefully examined for fish habitat potential and hydrological connections with nearby waterbodies.

The assessment involved a visual qualitative evaluation of both the physical (substrate) and biological (vegetation) features of the aquatic and shoreline habitats. Substrate classification was based on the composition observed along the shoreline and nearshore areas. A simple classification of substrate types (e.g., cobble, boulders, gravel) and vegetation types (e.g., mosses, sedges) was recorded (Table 3-2), with the percent coverage of dominant and subdominant features noted. Photographs were taken at each sample substation for documentation and to provide visual support for habitat classification.

The assessment was conducted by visually inspecting the area along each transect and at each station where eDNA samples were collected. The team was restricted to land, so only the visible substrate and vegetation within the vicinity of the survey stations were evaluated. This limited view was sufficient to assess fish habitat suitability, as the dominant features of the substrate and vegetation were consistently observed across multiple sections of each waterbody.

In addition to substrate and vegetation assessments, the survey included identifying hydrological connections to fish-bearing waterbodies, such as the Apex River and Lake Qikiqtalik. Any potential obstructions or natural barriers were noted, with a focus on determining whether fish could use the waterbodies for spawning, feeding, or juvenile rearing.

For more specific information on the terrestrial vegetation profile at each site, please refer to the LTWP Terrestrial Wildlife and Habitat Report (Arcadis 2024).

*Table 3-2 Fish Habitat Composition Classification*

| Acronym | Label | Description |
|---|---|---|
| **R** | Bedrock | Solid rock |
| **B** | Boulder | >25 cm diameter |
| **C** | Cobble | 6-25 cm diameter |
| **P** | Pebble / Gravel | 0.02-6 cm diameter |
| **S** | Sand or Silt | <0.02 cm diameter |
| **O** | Soil | Mineral and/or Organic soil |
| **G** | Grasses / Herbaceous plants | Non-woody vascular plants |
| **M** | Mosses | Non-vascular bryophytes |
| **L** | Lichen | Non-vascular plant-like |
| **na** | Not applicable | - |
| **nd** | No data | - |

### 3.1.4 Fish Habitat Assessment – Apex River

The assessment of the Apex River was conducted to evaluate the current fish habitat conditions, with a focus on potential impacts from the Long-Term Water Project (LTWP). The evaluation began with an observation of river conditions at the emergency pump station, focusing on habitat suitability for fish and potential impacts from the proposed water draw location. This included assessing stream morphology, streambed composition, riparian habitat, and identifying any visible obstructions or disturbances that might affect fish movements, as well as evaluating potential disturbances from the existing facilities.

A walk-down survey was conducted along the Apex River, starting from the existing emergency pump station and the proposed pipeline crossing and water draw site location, down to the section of the river below the bridge on the Road to Nowhere, just upstream of the confluence of the Lake Qikiqtalik drainage stream. Habitat conditions were assessed along this stretch, including observations of stream morphology, substrate types, riparian vegetation, and any potential anthropogenic or natural disturbances. This provided a continuous assessment of habitat suitability and fish passage along the river corridor.

At the river's estuary, where it connects to Frobisher Bay, an assessment was conducted to identify potential fish passage barriers. A survey was performed from the estuary upstream for approximately 1 km to evaluate the connectivity between the river and Frobisher Bay, particularly with regards to Arctic Char migrations. The survey focused on identifying potential barriers such as water falls or human-made obstructions that might hinder fish passage between the river and the bay.

Additionally, a more detailed stream habitat survey was conducted at the location where an eDNA sample was collected. This survey took place along an approximately 50-meter-long reach located about 40 meters south of the Road to Nowhere bridge crossing. Physical habitat features were recorded, including stream morphology, width and depth at four transects across the river, stream velocity, stream slope, as well as eDNA sampling and water quality measurements (see 3.1.1 and 3.1.2, respectively).

The transect survey procedure consisted of a technician in waders measuring the depth of the stream at measured intervals in a perpendicular direction across the stream width with another technician holding a measuring tape on the shore for the distance from the starting point.

Stream velocity was determined by timing a floating object over a measured distance, repeated three times to obtain a representative average. The formula for stream velocity is:

$$Velocity = \frac{Distance\ travelled\ (m)}{Time\ (s)}$$

The slope was calculated as the average of three measurements taken over 10-meter lengths along the reach using a clinometer and a fixed point at the technician's eyelevel.

Figure 6 provides a summary data table of the averages from the four transects at the survey location.

Using the averages from the four-stream survey transects, the average stream discharge or flow was calculated using the equation:

$$Discharge = \frac{A \times L \times C}{T}$$

where, A = Average cross-sectional Area of the stream ($m^2$)

L = Length or Distance travelled (m)

C = Correction factor for type of substrate (0.8 for rocky bottom streams)

T = Time for the travel over L distance (s)

### 3.1.5 Quality Assurance/ Quality Control (QA/QC)

To ensure the accuracy, consistency, and reliability of data collected during the surveys, a comprehensive QA/QC protocol was implemented throughout the fieldwork and data management processes. The following measures were applied:

**Field Sampling QA/QC**

- **Control Samples for eDNA**: Positive control eDNA samples were collected from the Apex River (AR) and Sylvia Grinnell River (CTRL), both known fish habitats. These control samples served to validate the accuracy of the eDNA assay and ensure reliability of the detection process.
- **Equipment Sterilization**: All eDNA sampling equipment that came into contact with water was sterilized between stations using an alcohol solution to prevent cross-contamination.
- **eDNA Sampling Procedure**: The eDNA water samples were collected before any other activity at each station to avoid contamination.
- **Field Equipment Calibration**: The Horiba U52-2M Multimeter used for water quality measurements was calibrated prior to field use (see calibration certificate in Appendix C) and rinsed thoroughly between the sites.
- **Triplicate Sampling**: Water quality measurements (pH, temperature, turbidity, dissolved oxygen, and conductivity) were collected in triplicate at each station to ensure the reliability of the data and minimize the effect of outliers.
- **Position Verification**: The precise location of each sampling station was recorded using a Bad Elf Flex Mini Handheld GPS device, accurate to approximately 1 meter. Additionally, the phone app Solocator was used to capture photos, automatically tagging each image with GPS coordinates to provide a visual and geographic reference for each sampling site.

- **Photographic Records**: Geotagged photographs with GPS coordinates were taken at each sampling station to visually document site conditions and provide a backup for field records.
- **Fish Habitat Survey QA/QC**: A standardized substrate and vegetation classification system (see Table 2-2) was used for fish habitat surveys, and the percentage coverage of dominant and subdominant substrate types was recorded at each station. Photographs were taken to document habitat conditions and provide a visual record for post-survey analysis.

**Data Entry and Verification**

- **Dual Data Entry**: Data were recorded both in hand-written field notes and digital formats. This dual-entry method provided a backup record for cross-verification, ensuring that data were not lost or misinterpreted during transfer to digital systems. Additionally, photographs were taken at each location to support and verify field records.
- **Position Verification**: GPS coordinates were verified in real-time using both the GPS device and the Solocator app. This ensured that sampling stations were accurately located, and photographic evidence further supported the verification of site locations.
- **Peer or Senior Personnel Review**: All data collected in the field, including hand-written notes and digital entries, were reviewed and verified by a peer or senior personnel at the end of each survey day. This review ensured accuracy, consistency, and completeness of the data, with any discrepancies corrected immediately.

**Data Management and Storage**

- **Field Data Management**: During the fieldwork, data recorded on digital devices, including GPS coordinates and water quality measurements, were regularly backed up to prevent data loss. Hand-written notes were also digitized at the end of each day, ensuring that both digital and hard-copy records were maintained.
- **Post-Survey Data Storage**: After fieldwork was completed, all digital data, including data sheets, GPS coordinates, water quality measurements, eDNA sampling records, and photographic evidence, were securely stored on the office server. Data was organized by survey location and method to facilitate future analysis and reporting. Hand-written notes and physical documentation were scanned and stored digitally, with hard copies retained in secure, designated storage.
- **Laboratory QA/QC**: The laboratory (BVL) adhered to strict QA/QC procedures for eDNA analysis, including the use of internal standards and controls. Further details on BVL's QA/QC procedures are provided in Appendix C.

## 3.2 Results

### 3.2.1 eDNA Analysis

BVL conducted a qPCR analysis on 23 individual filters collected from various waterbodies. The eFish1 assay used was designed to non-specifically detect the presence of any fish species, including target species for this project: Arctic Char and Ninespine Stickleback. Refer to the BVL Fish Species Assay Validation Information sheet in Appendix C for species details.

The results of the eFish1 assay confirm the presence of fish species at certain waterbodies within the project area. Each filter sample underwent analysis with eight technical replicates in the lab, and the results are reported as the number of positive detections out of the total eight replicates. For detailed results, refer to Table 1 at the end of the document. eFish1 Assay results are also displayed graphically in the figures, and the laboratory certificate of eDNA analysis is available in Appendix B.

Of the seven waterbodies and one river sampled, one waterbody and one river yielded positive results. This does not include the positive control sample from the Sylvia Grinnell River, which produced the expected positive detection result of n=8/8 (Photo #32). A summary of results is shown in Table 3-3.

Lake Qikiqtalik showed positive fish detections at sample transects LQ-4 and LQ-5, each yielding n=1/8 positive eDNA detection (Photos #4-6). The limited number of positive detections may suggest the presence of fish, but with a potentially low abundance in the lake.

*Table 3-3 eFish1 Positive Detection Results at each Sample Transect*

| Waterbody | Sample Station Transect ID | eFish1 Assay (positive detection replicates= n/8) | Fish Presence (Y/N) |
|---|---|---|---|
| Lake Qikiqtalik | LQ-1 | 0 | N |
| Lake Qikiqtalik | LQ-2 | 0 | N |
| Lake Qikiqtalik | LQ-3 | 0 | N |
| Lake Qikiqtalik | LQ-4 | **1** | **Y** |
| Lake Qikiqtalik | LQ-5 | **1** | **Y** |
| Lake Qikiqtalik | LQ-6 | 0 | N |
| Lake Geraldine | LG-1 | 0 | N |
| Lake Geraldine | LG-2 | 0 | N |
| Lake Geraldine | LG-3 | 0 | N |
| Lake Geraldine | LG-4 | 0 | N |
| Pond 1 | P1-1 | 0 | N |
| Pond 1 | P1-2 | 0 | N |
| Pond 2 | P2-1 | 0 | N |
| Pond 3 | P3-1 | 0 | N |
| Pond 3 | P3-2 | 0 | N |
| Pond 5 | P5-1 | 0 | N |
| Pond 5 | P5-2 | 0 | N |
| Pond 5 | P5-3 | 0 | N |
| Pond 6 | P6-1 | 0 | N |
| Pond 6 | P6-2 | 0 | N |
| Pond 6 | P6-3 | 0 | N |
| Apex River | AR-1 | **2** | **Y** |
| Sylvia Grinnell River | CTRL | **8** | **Y** |

None of the other lakes or ponds sampled yielded positive results, indicating the likely absence of fish species. The waterbodies that showed no evidence of fish presence include Lake Geraldine, Pond 1, Pond 2, Pond 3, Pond 5, and Pond 6.

The Apex River, known from previous studies to support fish populations, produced a positive detection with an eDNA result of n=2/8 (Photos #28-29). Some surveyed locations upstream exhibited shallow areas and sections where the streambed became dispersed (Photos #26-27), which could affect habitat availability but did not hinder the detection of fish presence in the lower reaches of the river.

### 3.2.2 Water Quality

Water quality summary data presented in Water temperatures ranged from 7°C to 16°C. The smaller waterbodies, Pond 1, Pond 2, and Pond 3 had the highest temperatures (13°C–16°C). The larger lakes, Lake Qikiqtalik and Lake Geraldine, ranged from 8°C to 11°C, while Apex River recorded the lowest average temperature at 7.8°C. These cooler waters are more favorable for species like Arctic Char, whereas the warmer ponds may be less suitable for cold-water species.

The pH across waterbodies ranged from neutral to slightly basic, between 7 and 8. The lowest pH was recorded at LG-2 in Lake Geraldine (6.2), while the average pH across all stations in Lake Geraldine was 7.06. The highest pH was observed at LQ-2 in Lake Qikiqtalik (8.9). These pH levels are generally within the suitable range for freshwater fish species and align with the Canadian Council of Ministers of the Environment (CCME) Guidelines, which recommend a pH range of 6.5 to 9.0 for the protection of aquatic life. The slightly lower pH at LG-2 falls below the recommended range, but since it was recorded at only one of four stations, the overall habitat in Lake Geraldine remains within the acceptable range for fish.

Turbidity was low across all waterbodies, averaging below 4 NTU. Higher turbidity values, ranging from 11 NTU to 29 NTU, were recorded at LQ-2, LG-2, and P5-2, likely due to accidental disturbance of the substrate during sampling. These occasional turbidity spikes are not expected to significantly impact fish habitat suitability, as the overall water clarity in most waterbodies allowed visibility of the substrate several meters from the shoreline, as seen in the field and in Appendix A (Photograph Log).

Dissolved oxygen levels were consistently high across all waterbodies, with averages ranging from 10.55 mg/L to 15.04 mg/L. These elevated DO levels suggest well-oxygenated waters, which are favorable for supporting fish, particularly species such as Arctic Char, which thrive in oxygen-rich environments. Anomalous readings (e.g., 40 mg/L) were removed from the dataset to provide more accurate averages.

Conductivity values were low across all waterbodies, ranging from 0.025 mS/cm to 0.050 mS/cm. These levels are typical of freshwater systems with low dissolved matter, including metals, indicating good water quality for fish.

Based on the water quality data, most of the waterbodies surveyed exhibit conditions that are conducive to supporting fish populations, particularly species like Arctic Char that prefer cooler, oxygen-rich environments. The colder waters of the Apex River (7.8°C) and Lake Qikiqtalik (8.1°C) combined with high dissolved oxygen levels suggest favorable habitats for cold-water species. However, the warmer temperatures observed in Pond 1, Pond 2, and Pond 3 (13°C to 16°C) may make these shallow waterbodies less suitable for Arctic Char, which typically avoid warmer waters. Additionally, the low conductivity values across all waterbodies indicate a lack of significant dissolved contaminants, further enhancing the suitability of these habitats for fish.

Table 3-4 was calculated by averaging the sample stations for each waterbody. The complete data for all replicates can be found in Table 2 at the end of this document. Also, the results tables displayed in each Figure represent the averages of the 3 recorded readings from each sample station.

Water temperatures ranged from 7°C to 16°C. The smaller waterbodies, Pond 1, Pond 2, and Pond 3 had the highest temperatures (13°C–16°C). The larger lakes, Lake Qikiqtalik and Lake Geraldine, ranged from 8°C to 11°C, while Apex River recorded the lowest average temperature at 7.8°C. These cooler waters are more favorable for species like Arctic Char, whereas the warmer ponds may be less suitable for cold-water species.

The pH across waterbodies ranged from neutral to slightly basic, between 7 and 8. The lowest pH was recorded at LG-2 in Lake Geraldine (6.2), while the average pH across all stations in Lake Geraldine was 7.06. The highest pH was observed at LQ-2 in Lake Qikiqtalik (8.9). These pH levels are generally within the suitable range for freshwater fish species and align with the Canadian Council of Ministers of the Environment (CCME) Guidelines, which recommend a pH range of 6.5 to 9.0 for the protection of aquatic life. The slightly lower pH at LG-2 falls below the recommended range, but since it was recorded at only one of four stations, the overall habitat in Lake Geraldine remains within the acceptable range for fish.

Turbidity was low across all waterbodies, averaging below 4 NTU. Higher turbidity values, ranging from 11 NTU to 29 NTU, were recorded at LQ-2, LG-2, and P5-2, likely due to accidental disturbance of the substrate during sampling. These occasional turbidity spikes are not expected to significantly impact fish habitat suitability, as the overall water clarity in most waterbodies allowed visibility of the substrate several meters from the shoreline, as seen in the field and in Appendix A (Photograph Log).

Dissolved oxygen levels were consistently high across all waterbodies, with averages ranging from 10.55 mg/L to 15.04 mg/L. These elevated DO levels suggest well-oxygenated waters, which are favorable for supporting fish, particularly species such as Arctic Char, which thrive in oxygen-rich environments. Anomalous readings (e.g., 40 mg/L) were removed from the dataset to provide more accurate averages.

Conductivity values were low across all waterbodies, ranging from 0.025 mS/cm to 0.050 mS/cm. These levels are typical of freshwater systems with low dissolved matter, including metals, indicating good water quality for fish.

Based on the water quality data, most of the waterbodies surveyed exhibit conditions that are conducive to supporting fish populations, particularly species like Arctic Char that prefer cooler, oxygen-rich environments. The colder waters of the Apex River (7.8°C) and Lake Qikiqtalik (8.1°C) combined with high dissolved oxygen levels suggest favorable habitats for cold-water species. However, the warmer temperatures observed in Pond 1, Pond 2, and Pond 3 (13°C to 16°C) may make these shallow waterbodies less suitable for Arctic Char, which typically avoid warmer waters. Additionally, the low conductivity values across all waterbodies indicate a lack of significant dissolved contaminants, further enhancing the suitability of these habitats for fish.

Table 3-4 Water Quality Summary Data by Waterbody

| Waterbody | Temperature (°C) | pH | Turbidity (NTU) | Dissolved Oxygen (mg/L) | Conductivity (mS/cm) |
|---|---|---|---|---|---|
| Lake Qikiqtalik | 8.10 | 7.71 | 4.63 | 11.34 | 0.048 |
| Lake Geraldine | 8.39 | 7.06 | 3.18 | 11.47 | 0.035 |
| Pond 1 | 14.65 | 8.02 | 0.00 | 12.09 | 0.033 |
| Pond 2 | 14.67 | 7.87 | 0.63 | 12.22 | 0.036 |
| Pond 3 | 15.56 | 7.54 | 0.50 | 10.55 | 0.038 |
| Pond 5 | 10.96 | 7.54 | 2.67 | 13.68 | 0.028 |
| Pond 6 | 10.56 | 7.09 | 1.07 | 13.07 | 0.033 |
| Apex River | 7.80 | 7.42 | 1.00 | 15.04 | 0.046 |

## 3.2.3 Fish Habitat – Lakes

The uniform tundra natural environment found near Iqaluit extends across most of the project site (see Photo #1). The inland waterbodies present follow the topography of the land and appear to mostly be a function of snow and ice melt, with many tributaries connecting the various waterbodies, but also many isolated ponds or pools.

The habitat survey of Lake Qikiqtalik, the ponds within the footprint of the New Reservoir, the ponds along the proposed Access Road, and Lake Geraldine revealed sparse shoreline vegetation typical of the tundra environment. Mosses, lichens, low-growing vascular plants, dominated the shoreline and much of the terrestrial habitat, with permafrost influencing the terrain and contributing to uneven ground. The bottom substrate was primarily rocky, consisting of boulders and cobble, with gravel or sand in some areas and exposed bedrock in others. Benthic invertebrates, mainly amphipods, were observed in some of the ponds, while submerged aquatic vegetation was scarce or absent, likely due to the cold, nutrient-poor water conditions. Erosion features and frost-related ground disturbances were also present along sections of the shoreline. For the full tabular results of the Fish Habitat Survey, see Table 3 at the end of this document.

### 3.2.3.1 Lake Qikiqtalik

Lake Qikiqtalik, located at a higher elevation within the LTWP project area, offers potential fish habitat, including juvenile rearing habitats for Arctic Char. The shallow areas along the shoreline provide suitable conditions for young fish, with the cobble, gravel, and boulder substrate offering refuge and potentially serving as spawning and feeding grounds. Additionally, marshy areas were observed at the mouths of small lake tributaries, which could offer additional cover and foraging opportunities for juvenile fish, particularly during the early life stages.

However, fish populations in Lake Qikiqtalik may be limited due to several environmental constraints. The cold, nutrient-poor water, primarily fed by snow and ice melt, restricts the productivity of the aquatic ecosystem, potentially limiting food availability for fish. Furthermore, while the lake offers suitable habitat for fish, its isolation from major fish-bearing water bodies, such as the Apex River, restricts natural fish migration into the lake.

A small tributary flowing from Lake Qikiqtalik toward the Apex River valley was observed near the LQ-3 survey transect. Although moderate flow was audible, the water itself was not visible in some locations where it flowed beneath cobble and boulders. The steep slope of the terrain and the subsurface flow in certain sections make it unlikely that fish can use this tributary for passage, particularly during the survey season. Therefore, it is improbable that fish can migrate from the Apex River to Lake Qikiqtalik. This lack of a hydrologic connection may also contribute to the scarcity of fish in the lake, as natural recruitment from other fish populations is unlikely. Despite the presence of potential habitat, the combination of isolation, cold temperatures, and nutrient scarcity suggests that fish populations in Lake Qikiqtalik could remain small.

#### 3.2.3.2 Pond 1 and Pond 2

Pond 1 and Pond 2 are small, shallow waterbodies located within the proposed Access Road footprint. They are connected by a short open channel approximately 20 meters in length. The morphology of these ponds suggests they are largely formed by snowmelt and rainwater accumulation in depressions shaped by permafrost. Both ponds are isolated from known fish-bearing waterbodies, with no hydrologic connections that would allow for fish passage to the Apex River or Lake Qikiqtalik. The substrate in both ponds consists primarily of cobble and boulders, with patches of exposed bedrock and sand. As with other waterbodies in the area, shoreline vegetation is sparse, dominated by tundra plants such as mosses and sedges. The absence of submerged aquatic vegetation and poor nutrient conditions further reduce the likelihood of these ponds supporting fish populations. No fish were observed in either Pond 1 or Pond 2, and their isolation makes it highly improbable for fish to inhabit them.

#### 3.2.3.3 Pond 3, Pond 4, Pond 5 and Pond 6

Pond 3, Pond 5, and Pond 6 are small, isolated waterbodies located within the proposed New Reservoir footprint. These ponds, like others in the area, are likely formed by snowmelt and rainwater accumulation in permafrost depressions. They are not connected to any known fish-bearing waterbodies, such as the Apex River or Lake Qikiqtalik, and have no hydrologic connections that would allow fish passage. Pond 4, originally identified in desktop analysis, was found to be a small erosion depression with water, rather than a substantial pond.

The substrate of Ponds 3, 5, and 6 is similar to other ponds in the area, consisting primarily of cobble and boulders with patches of gravel, sand, and exposed bedrock. Vegetation is sparse along the shorelines, with tundra plants like mosses, lichens, and sedges dominating the landscape. While submerged aquatic vegetation is largely absent, some benthic invertebrates, particularly crustaceans such as amphipods, were observed in these ponds. These invertebrates contribute to the broader ecosystem but do not indicate the presence of fish.

During the survey, evidence of contamination was observed in Pond 6, where an oil slick was visible on the water's surface along a section of the shore (Photos #33). Two 19-liter empty transmission oil drums were found in the water, and another empty drum of the same type was discovered nearby on land. Due to the oil contamination, the planned eDNA subsample collection at this location was not conducted.

Given their isolation, lack of significant vegetation, and poor nutrient conditions, these ponds are unlikely to support fish populations.

#### 3.2.3.4 Lake Geraldine

Lake Geraldine, which serves as the current water supply reservoir for the City of Iqaluit, was assessed during the habitat survey. The lake has a larger surface area compared to the other waterbodies in the LTWP area and is bordered by rocky shorelines. The substrate along the shoreline primarily consists of boulders and cobble, with some sections containing gravel. Similar to Lake Qikiqtalik, the sparse tundra vegetation and cold, nutrient-poor water conditions limit the presence of submerged aquatic vegetation. While no evidence of fish presence was observed in Lake Geraldine during the survey, it cannot be entirely ruled out as potential fish habitat. The lake's characteristics suggest that it could support fish populations under certain conditions, similar to Lake Qikiqtalik. Arctic Char were captured in the drainage channel below the Lake Geraldine Dam, though the dam obstructs fish passage, preventing any direct hydrologic connection between the lake and fish-bearing waterbodies like the Apex River.

#### 3.2.3.5 Pipeline Pathway

A thorough survey of the proposed pipeline pathway was conducted to assess the presence of any additional waterbodies or potential fish habitats. No ponds, other than those already described in this report, were found along the pipeline route. While there were some small streams or water-filled depressions observed, none of these exhibited a fish-passable connection to known fish-bearing waterbodies, such as the Apex River or Lake Qikiqtalik. These features are likely a result of snowmelt and rainwater accumulation, and given their isolation and lack of hydrologic connection, they are not considered viable fish habitats.

### 3.2.4 Fish Habitat – Apex River

The Apex River offers a range of aquatic habitats that could support fish populations, depending on the characteristics of different sections. The river features a mix of fast-flowing and slower-moving sections, influenced by its gradient and substrate composition. The substrate is primarily composed of cobble, gravel, and boulders, with occasional sections of exposed bedrock, particularly near the estuary at Frobisher Bay. Riparian vegetation is sparse, mainly consisting of tundra plants like sedges and mosses, which help stabilize the riverbanks.

Within the surveyed sections (identified with a pink dotted line symbology in the Figures), the river exhibits a variety of aquatic habitats, including shallow riffles, deeper pools, and intermittent runs. Most sections have a cobble and gravel substrate, which is suitable for spawning, though large boulders and bedrock may impede fish movement in certain areas. Riparian vegetation characteristic of tundra environments stabilizes the banks. Overall, the river appears to provide suitable conditions for fish, though some areas may pose challenges for movement or habitat.

The area at the existing emergency water pump, which is also the proposed permanent LTWP pump station, intake and pipeline crossing site, shows distinct characteristics compared to other sections of the river. This location currently contains three diesel-powered submersible pumps connected to a distribution line that runs southwest to the Lake Geraldine reservoir, passing near Pond 5 (Photo #16, #17, #23). A fenced platform on the north shore houses various equipment, including shipping containers and a portable toilet (Photo #24).

This section of the river exhibits a deeper cross-section with fewer boulders and a more uniform substrate than other surveyed sections. This suggests that past dredging may have occurred to create a deeper pool for the pumps and provide fill for the storage platform.

The proposed location for an emergency spillway from the New Reservoir to Apex River lies at a natural low point on the ridge separating the two waterbodies. This area remains relatively undisturbed, with no apparent risks or obstructions, and the existing pipeline from the emergency pumps already passes through this location. Constructing the spillway here seems feasible without significant additional environmental impact.

Cross-sectional diagrams of the four detailed stream survey transects conducted downstream of the Road to Nowhere bridge (Figure 6) are provided in Figure 3-1. This location was chosen mainly for the ease of access as well as for the fact that reinforcement works are planned for the bridge and so data directly downstream will provide a baseline for changes made after. The average channel width at this location was 26.6 meters, with a maximum width of 34 meters (Table 3-5) and a maximum depth of 0.8 meters. Morphologically, this section of the river consists of a riffle-pool habitat with a gravel and cobble substrate interspersed with boulders, causing riffles, rapids, and varying water depths.

The average slope of the riverbed at this reach was 1°, and the estimated flow velocity for the three trials (Table 3-6) averaged 0.5 m/s. The calculated discharge at this location, just above the confluence with the tributary from Lake Qikiqtalik, was 3.63 m³/s (Table 3-7).

*Table 3-5 Apex River Stream Survey Transect Channel Widths*

| Waterbody Name | Station ID | Stream Transect # | Total Stream Width (m) |
|---|---|---|---|
| Apex River | AR-hab-1 | 1 | 34 |
| Apex River | AR-hab-2 | 2 | 29 |
| Apex River | AR-hab-3 | 3 | 22 |
| Apex River | AR-hab-4 | 4 | 21.5 |

*Table 3-6 Stream Velocity Measurement Data*

**STREAM VELOCITY USING TIMED TRAVEL METHOD**

| TRIAL | 1 | 2 | 3 | AVG |
|---|---|---|---|---|
| Length (m) | 20 | 20 | 20 | 20 |
| Time (s) | 32.5 | 42 | 45.5 | 40 |
| AVG (m/s) | 0.615 | 0.476 | 0.440 | **0.510** |

*Table 3-7 Stream Survey Area AR-hab Summary Data*

**AR-hab AREA SUMMARY DATA**

| | |
|---|---|
| Average depth (m) | 0.34 |
| Mean depth (m) | 0.31 |
| Average width (m) | 26.63 |
| Mean width (m) | 26.13 |
| Average cross-sectional Area = A ($m^2$) | 9.08 |
| Length = L (m) | 20 |
| Coefficient factor (rocky bottom) | 0.80 |
| Average Stream Discharge = ALC/T ($m^3$/s) | **3.63** |

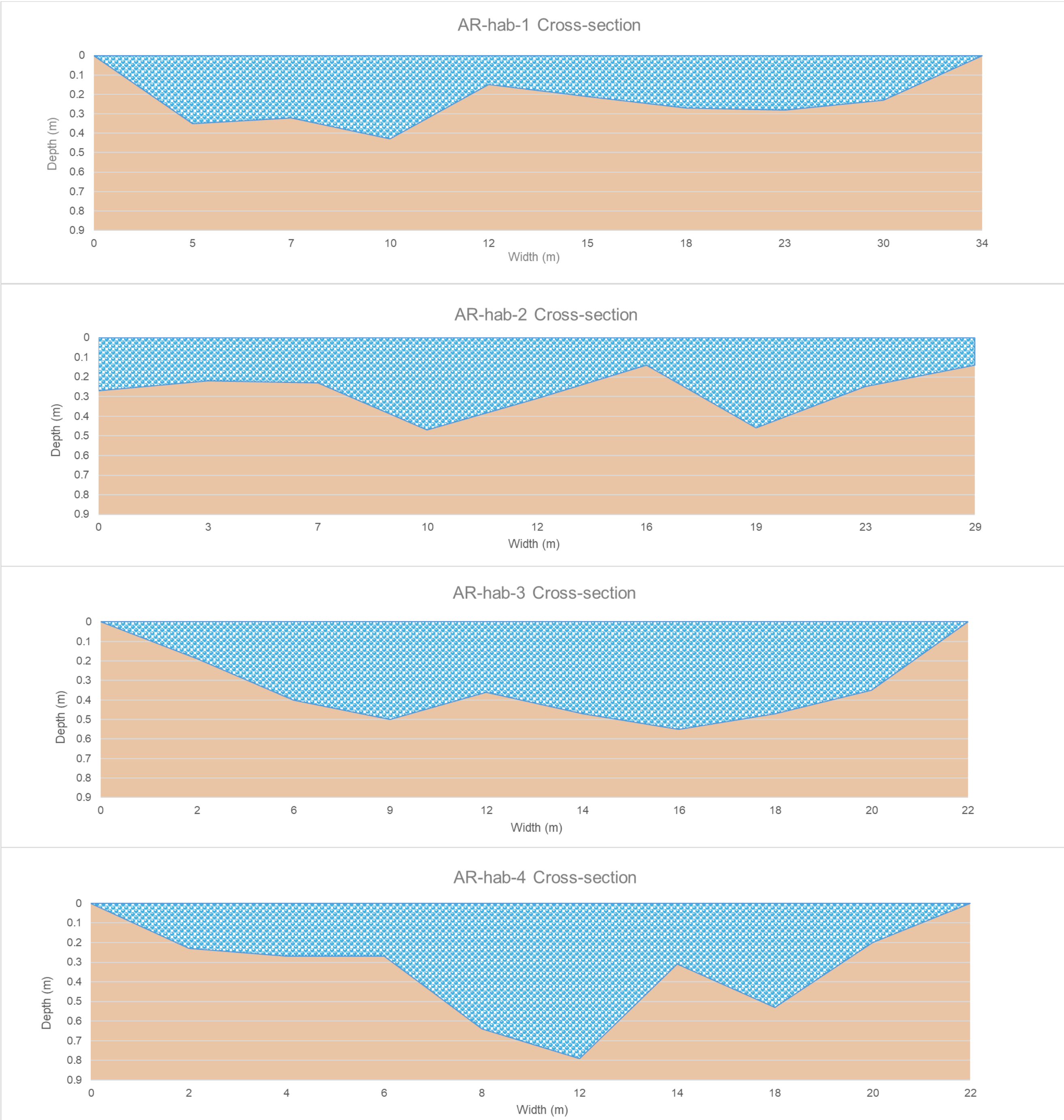


*Figure 3-1 Cross-sectional View of Apex River Stream Survey Transects*

## 3.4 Discussion

The eDNA survey conducted across seven waterbodies and one river confirmed the presence of fish in Lake Qikiqtalik and the Apex River, while the other lakes and ponds showed no evidence of fish. The eFish1 assay revealed limited positive detections in Lake Qikiqtalik, with transects LQ-4 and LQ-5 yielding low positive results (n=1/8), suggesting the presence of fish, though likely in low abundance. Apex River, a known fish-bearing river, produced positive detections at AR-1 (n=2/8), consistent with past studies confirming fish presence. No fish were detected in Lake Geraldine or the isolated ponds (Pond 1, Pond 2, Pond 3, Pond 5, and Pond 6), indicating the probable absence of fish in these waterbodies.

The water quality survey identified key factors affecting fish habitat suitability. Temperatures ranged from 7°C to 16°C, with the coolest waters recorded in Apex River (7.8°C) and Lake Qikiqtalik (8.1°C), both providing favorable conditions for cold-water species like Arctic Char. In contrast, the warmer temperatures in Pond 1, Pond 2, and Pond 3 (13°C to 16°C) make them less suitable for this species. Dissolved oxygen levels were high across all waterbodies, averaging between 10.55 mg/L and 15.04 mg/L, indicating well-oxygenated waters conducive to supporting fish. pH levels ranged from neutral to slightly basic, generally remaining within the acceptable range for fish as recommended by CCME Guidelines, while turbidity remained low overall, aside from localized disturbances at some stations. Low conductivity levels, indicating minimal dissolved matter, further support the good water quality in cooler waterbodies like Apex River and Lake Qikiqtalik.

The fish habitat survey evaluated shoreline conditions, substrate types, and hydrological connectivity. Lake Qikiqtalik displayed potential juvenile rearing habitats for Arctic Char along its shoreline, with substrates like cobble, gravel, and boulders providing suitable conditions. However, the lake's isolation, cold, nutrient-poor waters, and lack of a passable hydrological connection to Apex River likely limit its fish populations. Apex River offered various suitable fish habitats, including riffles, pools, and runs, with substrate conditions favorable for spawning. However, sections with large boulders and cascades pose challenges for fish movement, particularly blocking anadromous Arctic Char from accessing the river from the ocean (Photo #30).

In contrast, the surveyed ponds (Pond 1, Pond 2, Pond 3, Pond 5, and Pond 6) showed no signs of fish presence or suitable fish habitat, mainly due to their isolation and lack of hydrological connections to fish-bearing waterbodies. While some benthic invertebrates were observed, the absence of submerged vegetation and nutrient-poor conditions further reduce the likelihood of these ponds supporting fish. Lake Geraldine, although sharing environmental characteristics with Lake Qikiqtalik, showed no evidence of fish, and the dam obstructs any potential fish passage from downstream waters. However, we cannot completely rule out Lake Geraldine as a possible fish habitat due to its similar conditions to Lake Qikiqtalik and the potential for deeper waters to support fish, despite the absence of direct evidence during the survey.

# 4 Potential Effects on Fish and Fish Habitat

The project has the potential to impact fish and fish habitat in Lake Qikiqtalik, Apex River, the ponds in the footprint of the New Reservoir, ponds and streams along the proposed Access Road, Lake Geraldine, and other minor waterbodies within the LTWP area. The assessment of potential impacts to aquatic species and habitats was conducted using the Department of Fisheries and Oceans (DFO) pathways of effect framework.

## 4.1 Construction Phase

Key construction activities, such as building intake/discharge pipes, constructing the new reservoir (including berms/dykes and blasting), dewatering areas for construction, and developing pipelines, roads, and utilities, may result in the following effects:

- **Direct Mortality:** Blasting, in-water material placement, and dewatering activities during the construction of intake structures, pipelines, and the New Reservoir could result in the direct mortality of fish and aquatic organisms. Fish may be stranded in dewatered areas or harmed by the physical impact of blasting and heavy machinery. While fish presence in the ponds within the footprint of the New Reservoir and along the proposed Access Road is unlikely, there a low possibility of their presence, and potential impacts remain a concern.
- **Habitat Loss:** The construction of the New Reservoir and Access Road, including the dewatering and filling of ponds within the footprint, could result in habitat loss. While no fish presence has been confirmed and the likelihood of fish in the ponds is low, the loss of the aquatic habitat remains a concern, as these areas may still support aquatic invertebrates that play a crucial role in the broader aquatic ecosystem and indirectly support fish populations in nearby waterbodies.
- **Water quality changes - Sediment and Erosion:** Construction activities—especially excavation, pipeline installation, and the creation of access roads—could increase sedimentation in the Apex River, Lake Qikiqtalik, and other waterbodies. Increased sedimentation from construction activities can smother fish eggs and larvae, reducing oxygen availability and causing developmental issues or mortality. Sediment can also reduce habitat quality for spawning areas by covering gravel beds used for egg laying. These factors could also disrupt aquatic ecosystems, impacting the survival and reproduction of fish populations.
- **Water quality changes - Introduction of Deleterious Substances:** The release of nitrogen compounds from explosives, hydrocarbons from machinery, and other pollutants can degrade water quality and introduce toxic substances into the aquatic environment. This can have harmful effects on fish, causing mortality and health issues, particularly during sensitive life stages such as eggs and larvae, changes in behavior and reduction of reproductive success. Additionally, degraded water quality may reduce the availability of suitable habitats for feeding and spawning affecting long-term sustainability of fish populations.
- **Physical disturbance:** Construction may disrupt spawning grounds and migratory paths, leading to displacement of critical habitats and interference with fish behaviors during reproductive and migratory phases. Physical disturbance can also affect invertebrate communities reducing food availability. These pathways can negatively impact fish recruitment and survival and cause long-term negative effects on fish populations.
- **Introduction of invasive species:** Construction activities may introduce invasive species, which could outcompete native species for resources, disrupt ecosystems, and alter aquatic habitats. This could lead to declines in native species and a significant threat to the long-term health and sustainability of the aquatic ecosystem.

## 4.2 Operation Phase

Potential negative effects on aquatic species and habitats during the Operation Phase of the project may include the following:

- **Entrainment and Impingement:** During the operation phase, fish and other aquatic organisms may be at risk of entrainment or impingement in pumping equipment at Lake Qikiqtalik and Apex River causing potential injuries and mortality.
- **Habitat Loss and Flow Alteration:** The LTWP operation could cause habitat loss due to drawdown in waterbodies like Lake Qikiqtalik, Lake Geraldine, and the New Reservoir. Fluctuating water levels may strand fish and aquatic organisms, and reduce feeding, rearing, or reproduction habitat. Reduction in flow in Apex River can reduce fish habitat and affect fish movement, feeding, spawning and rearing.
- **Water Temperature Changes:** Water discharge from the New Reservoir may alter water temperatures in Lake Gerladine and the Apex River, especially if there is a significant difference in temperature between the reservoir and these water bodies. Changes in temperature in excess of limits set by CCME Guidelines can affect fish and other organisms' metabolism, growth, reproduction, and the timing of critical life events like spawning. Changes in temperature can also lead to ecological changes, such as algal blooms, impacting fish and the surrounding aquatic environment.
- **Sediment and Erosion:** Water flows from the New Reservoir into Geraldine Lake may cause bed erosion in the discharge channel, leading to increased sedimentation in the lake. This could affect aquatic habitat by degrading water quality and smothering benthic environments.
- **Water Quality:** The introduction of deleterious substances in Lake Geraldine and the Apex River from the New Reservoir, aside from potential temperature changes, is not a primary concern, as the water in the New Reservoir is expected to comply with CCME Guidelines for the Protection of Aquatic Life.

# 5 Mitigation Measures

The potential effects on the Aquatic Species and Habitat during the Construction Phase of the Project will be avoided or minimized by adhering to industry best practices, guidelines, and recommendations (e.g., DFO and CIRNAC). The following mitigation measures will be implemented:

## 5.1 Construction Phase

The potential effects on the Aquatic Species and Habitat during the Construction Phase of the Project will be avoided or minimized by adhering to industry best practices, guidelines, and recommendations (e.g., DFO and CIRNAC). The mitigation measures outlined in the sections below will be implemented.

### 5.1.1 General Mitigation Measures

Mitigation measures applicable to all waterbodies during general works for all project components and activities during the construction phase, such as excavation, site preparation, earth-moving activities, construction of pipelines for water conveyance, development of new or existing access roads, upgrading the existing road and culverts, quarrying, blasting, and heavy machinery operations, include the following:

**Habitat Loss**

- Enforce a 30-meter setback from the high water mark distance for non-essential construction activities around key waterbodies, including Lake Qikiqtalik, Apex River, and Lake Geraldine. This setback is not applicable to the ponds within the footprint of the New Reservoir and along the proposed Access Road as these ponds will be dewatered during construction.
- When construction within the setback is necessary, minimize the removal of riparian vegetation and use existing trails, roads, or cut lines to avoid disturbing vegetation and compacting soil.
- Where construction activities result in disturbance or loss of aquatic and riparian habitats, habitat restoration efforts should be undertaken to restore these areas to their natural conditions. This includes replanting native riparian vegetation, stabilizing stream banks, and enhancing aquatic habitats by reconstructing physical features such as gravel beds or natural riffles that support spawning and feeding. These measures aim to promote the recovery of disturbed habitats and ensure the long-term sustainability of aquatic ecosystems.

**Water Quality Changes - Sediment and Erosion**

- Implement an Erosion and Sediment Control Plan for all construction activities near waterbodies. Use silt fences, sediment traps, and erosion control blankets, which will be inspected and maintained regularly to prevent sediment entry into the water.
- Build a water treatment reservoir/ settling ponds to collect water from dewatering and construction areas and remove harmful substances, including suspended sediment before discharge.

**Water Quality Changes - Introduction of Deleterious Substances**

- Develop and implement a Spill Contingency Plan for all construction areas to mitigate the risk of accidental spills or leaks of harmful substances.
- Regularly maintain machinery will be to prevent leaks, and strictly adhere to good housekeeping practices on-site to prevent accidental spills. All operations will follow industry best management practices, ensuring that harmful substances such as hydrocarbons or chemicals are not introduced into waterbodies.
- Use biodegradable hydraulic fluids in machinery and maintain equipment to prevent leaks.
- Monitor water quality for pollutants such as nitrogen compounds and hydrocarbons and treat construction water through water treatment/settling ponds before release.

**Dust and Air Quality Control**

- Implement dust suppression techniques, such as spraying water on construction roads and work sites, to minimize dust and particulate matter that could impact nearby waterbodies.

**Waste Management**

- Ensure proper storage and disposal of all waste materials, including construction debris, hazardous materials, and other waste, to prevent contamination of nearby waterbodies.
- Follow established waste management guidelines to ensure all materials are handled and disposed of in a manner that minimizes environmental impact.

**Construction Scheduling and Sequencing**

- Schedule construction activities during periods of low precipitation or outside of sensitive environmental periods (e.g., fish spawning or migration seasons) to reduce the risk of environmental impacts. Arctic char spawning is in the Fall and DFO restricted activity times in Iqaluit are from September 1 to June 30. All construction activities that may affect fish and fish habitat should occur between July 1 and August 31 only.
- Implement phased construction to reduce the overall footprint of active construction sites at any given time.

**Invasive Species Prevention**

- Ensure that all machinery and equipment used on-site is clean and well-maintained to prevent the introduction of invasive species.
- Conduct regular monitoring of waterbodies during and after construction for signs of invasive species and implement rapid response measures if detected.

**Environmental Monitoring and Compliance**

- Conduct environmental monitoring by a qualified environmental monitor or team to oversee construction activities, ensuring compliance with environmental protection measures and responding quickly to any issues that arise.
- Conduct regular inspections and monitoring of erosion control measures, water quality, and fish habitat to ensure the effectiveness of mitigation strategies.

**Post-Construction Monitoring**

- Post-construction monitoring will be conducted to assess the effectiveness of mitigation measures in protecting fish and fish habitat. Monitoring activities may include habitat assessment and fish presence and use studies.
- Post-construction monitoring will be conducted in year 1, year 3 and year 5 post-construction.
- Monitoring timelines and methodologies will be agreed upon with regulators to ensure alignment with project requirements and ecological considerations.
- Findings will be summarized in reports submitted to regulatory agencies, with recommendations for any corrective actions if adverse effects are identified.
- Adaptive management strategies will be developed and implemented in consultation with regulators if necessary.

### 5.1.2 Lake Qikiqtalik

During the construction phase of the LTWP, activities in and around Lake Qikiqtalik that will require mitigation measures to minimize impacts on the aquatic environment include the construction of water intake infrastructure and RWPS, excavation, and the construction of access and staging areas. The mitigation measures are as follows:

**Direct Mortality**

- Schedule in-water work outside of critical fish spawning and migration periods, adhering to the Nunavut Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (September 1 to June 30 for fall-spawning arctic char).

- Use the cofferdam method where needed to prevent water from entering the work area and to protect aquatic environments from sedimentation, debris, or other potential pollutants.

**Habitat Loss**

- Maintain a 30-meter setback measured from the high-water mark for non-essential activities. When construction within the setback or is necessary minimize the removal of riparian vegetation and use existing trails, roads, or cut lines to avoid disturbing vegetation and compacting soil.

**Water Quality – Sediment and Erosion**

- Use erosion and sediment control measures such as silt fences and sediment traps to prevent sediment from entering the lake. Regular inspections and maintenance of these controls will be conducted.

**Water Quality – Introduction of Deleterious Substances**

- Monitor machinery for leaks and use environmentally friendly hydraulic fluids. Develop and implement a Spill Contingency Plan and monitor water quality for pollutants like nitrogen compounds and hydrocarbons.

### 5.1.3 New Reservoir and Access Road

Mitigation measures applicable to the New Reservoir and Access Road construction, including dewatering of the ponds, blasting, excavation, material placement, construction of retention structures and the spillway to the Apex River, construction of the water conveyance pipeline to Lake Geraldine, filling the New Reservoir with water, and construction of on-site infrastructure, include the following:

**Direct Mortality, Entrainment and Impingement**

- Although there is no evidence of fish in the ponds within the footprint of the New Reservoir and along the proposed Access Road, fish salvage operations using electrofishing may be conducted before dewatering to relocate any fish to suitable habitats if found.
- To prevent fish entrainment and impingement during ponds dewatering, install fish barriers or screens to prevent fish from entering areas where pumping equipment is located.
- Implement a slow and controlled dewatering process to allow fish time to migrate out of the area and avoid being stranded.
- Continuously monitor the dewatering process and the waterbody for signs of fish distress or stranding. Implement immediate fish rescue operations if necessary.

**Physical Disturbance and Water Quality Changes**

- Build a water treatment reservoir/ settling ponds to collect water from dewatering and construction areas and remove harmful substances, including nitrogen compounds, hydrocarbons and suspended sediment before discharge.
- Conduct blasting operations in accordance with best practices to minimize vibrations, noise, and physical disturbances that could affect waterbodies.
- Where blasting can affect fish habitat avoid blasting during sensitive periods for fish, such as spawning or migration seasons. In the case of Arctic char, the restricted activity timing windows is September 1 to June 30.
- Employ controlled or precision blasting methods to reduce the force of explosions and minimize the amount of debris, vibrations, and noise generated. This helps reduce the potential for harming aquatic life and disturbing habitats.

- Use blast mats or similar materials to cover the blast area and prevent the spread of debris into nearby waterbodies, reducing the risk of sedimentation and physical harm to aquatic species.
- Conduct pre-blasting surveys to identify the presence of and salvage fish or other aquatic organisms. Conduct blasting only after the ponds have been dewatered and any remaining fish salvaged and safely relocated from the area.
- Where possible, use low-toxicity or environmentally friendly explosives to minimize the release of harmful chemicals, such as nitrogen compounds, into the surrounding water and soil.
- Restore any disturbed areas, including aquatic and riparian habitats, following the completion of blasting activities. This may involve replanting vegetation, stabilizing banks, or improving in-stream habitats.

### 5.1.4 Apex River and Its Watershed

Mitigation measures applicable to protection of the Apex River and its watershed during such activities, as installation of the water intake and RWPS, pipeline crossing and construction of other on-site infrastructure, include the following:

**Physical Disturbance and Water Quality Changes**

- During the installation of the water intake and RWPS, use cofferdams, if needed, to isolate the construction area and prevent the release of sediment and debris into the river.
- Schedule in-water work outside of critical fish spawning and migration periods. Adhere to the Nunavut Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat, particularly for Arctic char (September 1 to June 30 for fall-spawning Arctic char).
- Avoid construction activities that alter flow, water levels, or obstruct fish movement or migration.
- Where possible, limit the amount of in-water work to reduce direct impacts on the river ecosystem. Use temporary bypass channels or maintain instream flows during construction to allow fish passage and minimize disruption to aquatic habitats.

### 5.1.5 Lake Geraldine

Mitigation measures during construction in Lake Geraldine to mitigate effects from activities such as the installation of the water conveyance pipeline from the New Reservoir include the following:

**Physical Disturbance and Water Quality Changes**

- Use a cofferdam to isolate the construction area during the installation of the water conveyance pipeline to prevent the release of sediment and debris into Lake Geraldine.

## 5.2 Operation Phase

The mitigation measures in the sections below will be implemented during the operation phase of the project to protect aquatic species and habitats.

### 5.2.1 General Mitigation Measures

Mitigation measures applicable to all waterbodies during operational phase for all project components and activities, such as water drawdown, regular maintenance and discharges as needed, include the following:

**Water Quality Monitoring**

- Regularly monitor water quality in all waterbodies to ensure compliance with CCME Guidelines for the Protection of Aquatic Life.

**Sediment and Erosion Control**

- Stabilize stream banks and discharge areas using vegetation or engineered solutions to prevent erosion. Implement sediment control measures to reduce the risk of sedimentation during the operation phase.

**Invasive Species Monitoring**

- Continue to monitor for invasive species and implement rapid response measures if detected.

### 5.2.2 Lake Qikiqtalik

**Entrainment and Impingement**

- Equip water intakes with screens in accordance with DFO's Freshwater Intake End-of-Pipe Fish Screen Guideline (1995) to prevent fish entrainment and impingement.
- Ensure intake screens are designed to prevent the uptake of sediment and benthic organisms and conduct regular maintenance to avoid fouling with debris.
- Shut down pumps during intake screen cleaning, and schedule regular inspections to ensure their proper functioning.

**Habitat Loss and Volume Alteration**

- Water withdrawals from Lake Qikiqtalik will be subject to the terms and limits of a Water Board Permit under the City of Iqaluit's responsibility. Based on the *Qikiqtalik Lake Water Balance for Withdrawals* Final Report (Tetra Tech, Dec 2024) and supporting studies (Golder 2021; Nunami Stantec), the planned annual withdrawal volume is approximately 1.1 million cubic metres, representing about 20% of the lake's open water volume. The project will comply with regulatory requirements, and any future modifications to the withdrawal regime will be addressed through the appropriate permitting process..

**Temperature Changes**

- Discharge water temperature will be monitored to ensure compliance with CCME Guidelines. Discharges that exceed temperature limits will be suspended until corrective measures are implemented.

### 5.2.3 New Reservoir

**Water Quality**

- Ongoing monitoring of the New Reservoir's water quality will ensure it complies with CCME Guidelines for the Protection of Aquatic Life or stricter guidelines before its discharge into the New Reservoir or Apex River.

**Habitat Loss**

The New Reservoir is not intended to function as fish habitat. It is designed as a long-term water storage facility and is not expected to support fish populations. However, to protect downstream aquatic environments, precautionary measures will be incorporated at the outlet to prevent unintended impacts. These may include:

- Fish screens, in accordance with DFO's *Freshwater Intake End-of-Pipe Fish Screen Guideline* (1995), if monitoring or future conditions suggest a risk of fish presence;

- Erosion and sediment control measures at the outfall;
- Energy dissipation structures to reduce discharge velocity and prevent channel scouring;
- Stabilized spillway routing to appropriate receiving environments;
- Monitoring of discharge flows to ensure compliance with applicable water quality standards.
- These measures will help ensure that downstream fish-bearing systems, such as Lake Geraldine and the Apex River, remain protected during reservoir operations.
-

### 5.2.4 Lake Geraldine

**Water Quality – Temperature Changes**

- Discharge water temperature will be monitored to ensure it remains within the acceptable range according to CCME Guidelines.
- Address temperature changes in the receiving water bodies (Lake Geraldine and the Apex River) exceeding CCME Guidelines for the Protection of Aquatic Life due to discharge. This may include temporarily suspending discharge until appropriate mitigation measures are implemented.

### 5.2.5 Apex River and Its Watershed

**Entrainment and Impingement**

- Water intakes in the Apex River will be equipped with screens in line with DFO guidelines to prevent fish entrainment and impingement. These screens will undergo regular maintenance to prevent fouling and ensure proper function.

**Flow Alteration**

- Minimum flow rates in the Apex River will be maintained to ensure sufficient fish habitat is preserved, in accordance with regulatory expectations and DFO guidance. The previously issued DFO approval for emergency pumping (March 25, 2024), which permits withdrawal of up to 20% of instantaneous flow, applies only to the temporary emergency infrastructure and is governed by a separate authorization. It does not apply to the Long-Term Water Project (LTWP).
- A new Request for Review (RFR) will be submitted to DFO as part of the LTWP permitting process. This will outline the proposed permanent withdrawal volumes and infrastructure. The City is committed to maintaining appropriate minimum flows in the Apex River as part of the project's environmental protection measures.

**Temperature Changes**

- Discharge temperature into the Apex River will be monitored to ensure it complies with CCME Guidelines. Any temperature changes that exceed acceptable limits will trigger corrective measures, including suspension of discharge until conditions are rectified.

# 6 Residual Effects

After the implementation of mitigation measures, the following sections shows the residual effects on fish and fish habitat that are anticipated during the construction and operation phases of the LTWP.

## 6.1 Construction Phase

### 6.1.1 Lake Qikiqtalik

**Water Quality Changes**

- Minor short-term increases in turbidity due to sedimentation and erosion may occur during construction activities such as pipeline installation, though these are expected to dissipate quickly without significant long-term impacts on fish habitat. Residual effects are considered low.

**Deleterious Substances**

- Despite mitigation measures like the Spill Contingency Plan and use of environmentally friendly fluids, a minimal residual risk of contamination remains. However, the impact on Lake Qikiqtalik is anticipated to be negligible.

### 6.1.2 Apex River

**Direct Mortality**

- There remains a low residual risk of accidental mortality for fish or aquatic organisms, particularly due to sediment movement or in-water activities. However, the risk is minimized through using cofferdams, silts screens and timing construction outside of critical periods.

**Physical Disturbance**

- Residual effects on fish movement and spawning behavior in the Apex River may occur, especially where temporary bypass channels are used. Some temporary habitat displacement is expected, though these effects are short-term.

**Water Quality Changes**

- Minor increases in sedimentation and erosion during construction may temporarily affect water quality, but these impacts are expected to be short-lived and minimal with effective control measures in place.

### 6.1.3 Ponds within the New Reservoir and Access Road Footprint

**Habitat Loss**

- Habitat loss in the ponds within the footprint of the New Reservoir and along the Access Road is unavoidable. Given the low likelihood of fish presence, the residual effects are considered minor. However, the loss of aquatic invertebrate habitat may have minor effects on the food chain, indirectly impacting fish populations in connected waterbodies like the Apex River. The residual effects of habitat loss will be offset by the construction of the New Reservoir which represents a larger aquatic habitat than the ponds.

**Deleterious Substances**

- A minimal residual risk of pollution from hydrocarbons or other contaminants persists despite the use of environmentally friendly fluids and spill response plans, though this risk is expected to be very low.

### 6.1.4 Lake Geraldine

**Sediment and Erosion**

- There may be minor, localized sedimentation during pipeline installation at Lake Geraldine, but effective erosion and sediment control measures will minimize long-term impacts. Residual effects on water quality and aquatic habitat are expected to be minimal.

## 6.2 Operation Phase

### 6.2.1 Lake Qikiqtalik

**Entrainment and Impingement**

- While the risk of fish being entrained or impinged in water intake systems is minimal with the use of intake screens that comply with DFO guidelines, there remains a small residual risk of harm to smaller organisms. However, this is unlikely to affect fish populations significantly.

**Habitat Loss and Flow Alteration**

- Residual effects from flow alterations in Lake Qikiqtalik are expected to be low, with proper management of water withdrawals. Some localized habitat impacts during drawdown are anticipated to be reversible and short-term.

### 6.2.2 Apex River

**Entrainment and Impingement**

- The risk of entrainment or impingement of fish in the water intake systems remains minimal with compliant intake screens, although a minor residual impact on small organisms may occur.

**Flow Alteration and Habitat Loss**

- Reduced flow rates may temporarily reduce habitat quality in localized areas of the Apex River. However, maintaining minimum flow rates should minimize any significant long-term impact.

**Water Temperature Changes**

- Although the ponds within the New Reservoir footprint currently exhibit higher temperatures than the Apex River, this is typical of smaller waterbodies, which tend to warm more quickly. Given that the New Reservoir will be much larger than the dewatered ponds, the temperature difference between the reservoir and the river is expected to be less pronounced. As a result, any residual effects on the river's temperature are anticipated to be minor. Ongoing temperature monitoring will ensure compliance with CCME guidelines, and if necessary, discharge may be temporarily suspended to address any potential temperature deviations.

**Sediment and Erosion**

- Despite erosion control measures, some residual risk of sedimentation in discharge areas remains, particularly at the outflow into the Apex River. Regular monitoring and stabilization efforts will minimize long-term impacts.

### 6.2.3 New Reservoir and Access Road Footprint

**Habitat Loss and Flow Alteration**

- The ponds currently located within the footprint of the New Reservoir are not considered fish habitat. Field surveys confirmed the absence of fish and determined that these shallow, isolated, and nutrient-poor waterbodies lack hydrologic connectivity to known fish-bearing systems. They will be dewatered prior to construction and do not provide meaningful habitat functions for fish.

- As the New Reservoir is not designed to support fish, its construction does not represent a replacement or offset for aquatic habitat loss. However, with the application of outlet protection measures and compliance with regulatory permits, residual effects to downstream fish habitat are expected to be minimal and not significant..

### 6.2.4 Lake Geraldine

**Water Temperature Changes**

- While temperatures in the ponds within the New Reservoir footprint are notably higher than in Lake Geraldine, this pattern is consistent with smaller waterbodies, which often experience elevated temperatures. Since the New Reservoir will be significantly larger than the dewatered ponds, the temperature difference between it and Lake Geraldine is expected to be minimal. Therefore, any temperature changes in Lake Geraldine due to the discharge from the New Reservoir are likely to result in only minor residual effects. Continuous monitoring of water temperature will ensure compliance with temperature guidelines and help mitigate any potential impacts.

# 7 Conclusion

After the implementation of mitigation measures, the residual effects of the Long-Term Water Project (LTWP) on fish and fish habitat are expected to be minimal across the various waterbodies. In Lake Qikiqtalik and Apex River, the primary risks include minor sedimentation, temporary increases in turbidity, and localized habitat disruptions. However, these impacts are anticipated to be short-term and reversible, with no long-term damage to fish populations. In the ponds within the New Reservoir footprint and along the Access Road, where the likelihood of fish presence is low and the ponds do not present viable fish habitats, the residual effects are expected to be minimal. The ponds are unlikely to support fish populations, and any habitat loss will be offset by the larger New Reservoir.

During the operation phase, residual effects such as entrainment, impingement, and potential water temperature changes in Lake Qikiqtalik and Apex River are expected to be well-managed through the use of intake screens, flow control, and temperature monitoring. In Lake Geraldine, which is also unlikely to be home to fish, potential risks such as sedimentation and temperature changes remain minimal. Continued monitoring will ensure that any deviations are promptly addressed. Overall, the residual effects on fish habitats are assessed as minimal and not significant, with effective mitigation measures in place to prevent long-term impacts.

# Sources

Arcadis, 2024, *Long-Term Water Project Iqaluit - Terrestrial Wildlife and Habitat Report*, Report to City of Iqaluit, Project no. 30192375.

Department of Fisheries and Oceans Canada, 2013*, Nunavut Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat,* Government of Canada Webpage, Accessed on 2024-11-14 at https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/nu-eng.html

Klemetsen A., Amundsen P.-A., Dempson J.B., Jonsson B., Jonsson N, O'Connell MF, Mortensen E., 2003, *Atlantic salmon Salmo salar L., brown trout Salmo trutta L. and Arctic charr Salvelinus alpinus (L.): A review of aspects of their life histories*. Ecology of Freshwater Fish. 12: 1–59.

Nunami Stantec Limited, September 2017, *Fish and Fish Habitat Assessment of the Niaqunnguk (Apex) River, Lake Geraldine, and the Lake Geraldine Drainage Channel*, Submitted to City of Iqaluit, Project no. 144930051

Nunami Stantec Limited, October 2019, *City of Iqaluit 2019 Emergency Water Supplementation Program – Water Quality Sampling Unnamed Lake*, Memo to City of Iqaluit, Project no. 144902884

Nunami Stantec Limited, December 2019, *Unnamed Lake Data Collection Summary Memorandum*, Memo to City of Iqaluit, Project no. 144930114

Reist, J.D., F.J. Wrona, T.D. Prowse, M. Power, J.B. Dempson, R.J. Beamish and C. D. Sawatsky, 2006, *General Effects of Climate Change on Arctic Fish and Fish Populations*. AMBIO: A Journal of the Human Environment, 35(7), 370-380.

Richardson, E.S., J.D. Reist and C.K. Minns, 2001, *Life history characteristics of freshwater fishes occurring in the Northwest Territories and Nunavut, with major emphasis on lake habitat requirements*. Can. MS Rpt. Fish. Aquat. Sci. 2569: vii+146p

WSP Canada Inc., February 2021, *Unnamed Lake Fish and fish Assessment Technical Report*, Submitted to City of Iqaluit, Project no. 201-09405-00, 64 pp.

# Figures

# Tables

# Appendix A

## PHOTOGRAPH LOG

# Appendix B

## LABORATORY eDNA CERTIFICATE

# Appendix C

## OTHER DOCUMENTATION

Arcadis Canada Inc.
8133 Warden Avenue, Unit 300
Markham, Ontario L6G 1B3
Canada
Phone: 905 763 2322
www.arcadis.com