Little Pine River Watershed

Assessment Report

LAKEHEAD REGION
CONSERVATION AUTHORITY

LAKEHEAD REGION
CONSERVATION AUTHORITY

Little Pine River Watershed

Assessment Report
2019

PREPARED BY:

Lydia Johnson (Assistant Water Resources Technologist)
Rachael Kuipery (Assistant Water Resources Technologist)

ACKNOWLEDGEMENTS

The 2019 Little Pine River Watershed Assessment was prepared by Lydia Johnson and Rachael Kuipery, Assistant Water Resources Technologists of the Lakehead Region Conservation Authority. Scott Drebit, GIS/Water Resources Technologist of the Lakehead Region Conservation Authority, produced the maps for this report and provided input and revisions towards the final copy. Tammy Cook, Chief Administrative Officer, and Gail Willis, Watershed Manager, also provided guidance, input and revisions towards the completion of this report

This report has been prepared in-house at the Lakehead Region Conservation Authority for internal purposes to document the condition of the Little Pine River Watershed in 2019.

EXECUTIVE SUMMARY

The Little Pine River Watershed Assessment Report provides baseline data to track progress and water quality over time, and provides the LRCA with a better understanding of the local environment to focus future actions where needed. The results from the collected data were analyzed, and the Little Pine River Watershed was given an overall watershed grade rating; thereby, determining the health status of the watershed.

Background

The Little Pine River Watershed is located within the Municipality of Neebing and covers a drainage area of approximately 25.3 square kilometres. The Little Pine River runs approximately 7.6 kilometres in length from its headwaters at Lenore Lake to its confluence with Lake Superior at Pine Bay in the southeastern area of the watershed. The general slope of the watershed is approximately 1.12 percent.

The majority of the Little Pine River Watershed is privately owned land (88.9 percent) with the remainder crown land (11.1 percent). The watershed is mainly zoned as a Rural and Use Limitation within Municipality of Neebing's Zoning By-Law. The Little Pine River outlets to Lake Superior at Pine Bay, which is designated as part of the Western Lake Superior Conservation Reserve by the Ministry of Natural Resources and Forestry. The Western Lake Superior Conservation Reserve was selected under *Ontario's Living Legacy* due to significant features such as provincially significant wetlands and various forest communities. The Conservation Reserve also holds cultural and historical significance as well as recreational value. Within Pine Bay are two Thunder Bay Field Naturalist (TBFN) nature reserves. Pine Bay Reserve I covers 369 hectares and Pine Bay Reserve II covers 159 hectares. The two TBFN reserves surround a parcel of Crown Land regulated as the Western Lake Superior Conservation Reserve. Together these two TBFN parcels of conservation land protect the west half of the Pine Bay shoreline on Lake Superior, and much of the Pine Bay Provincially Significant Wetland, one of few large wetlands along Lake Superior's north shore. These reserves lie within the Ministry of Natural Resource's Great Lakes Heritage Coast Signature Site which protect a large area of Lake Superior shoreline with many significant natural features.

Physical and Biological Attributes

The surficial geology distribution of the Little Pine River Watershed quickly changes from bedrock in the headwaters area, to a mix of slope/talus pile and glaciolacustrine plain in the upper central area. A ribbon of bedrock splits glaciolacustrine plain in the central area, which leads to organics until the confluence. A small band of moraine is included within the watershed area. The bedrock formation is mostly composed of sedimentary rocks; however, there is a significant presence of mafic and related intrusive rocks in the watershed.

The Little Pine River Watershed is located within the boundaries of the Great Lakes and Boreal forest regions. The most common tree species in the watershed are black spruce, trembling aspen, balsam fir, white birch and white spruce. There are a variety of other plants present in the watershed including ferns, shrubs, herbs, mosses and lichens.

Watershed Site Assessment

Four sample sites located within the Little Pine River Watershed were chosen based on a variety of attributes including: accessibility, physical features, land use designation, proximity to man-made features (that may alter water quality), as well as headwaters used for baseline conditions. Site 1 is located upstream of the confluence of the Little Pine River at Lake Superior and Site 4 is located at the headwaters of the Little Pine River in Lenore Lake. Site 2 was located on the main channel whereas Site 3 was located on a tributary of the main channel.

Surface Water Quality – PWQO Comparison

At each of the four sample locations, surface water samples and field measurements were collected in 2019 on June 11th, and July 10th. Subsequently, the surface water samples were analyzed by ALS Laboratory Group for physical parameters (conductivity, pH, total dissolved solids, and turbidity), nutrients and anions (alkalinity, total ammonia, chloride, nitrate, nitrite, total Kjeldahl Nitrogen, total phosphorus, and sulfate), bacteriological tests (*Escherichia coli* (*E. coli*), total coliforms), and a full metal scan. Field measurements were taken using an YSI Pro DSS Multi-Parameter Probe, which included sampling of water temperature, pH, conductivity, turbidity, total dissolved solids, oxidation-reduction potential and dissolved oxygen. Field and laboratory results were compared to the Ministry of Environment and Energy's Provincial Water Quality Objectives (PWQO), 1994. Parameters that exceeded the PWQOs include *E. coli*, total coliforms, phosphorus, aluminum, copper and iron.

a) Bacteriological Exceedance

PWQO criterion for *E. coli* bacteria levels is 100 counts per 100 mL. *E. coli*. Counts greater than the criterion indicate that bacterial contamination may be an issue within a waterbody. During the June sampling period no sites exceeded the criterion. During the July sampling period all sites exceeded the PQWO criterion; Site 1 (210 MPN/100 mL), Site 2 (116 MPN/100 mL), Site 3 (276 MPN/100 mL) and Site 4 (125 MPN/100 mL).

As there is no current PWQO for total coliforms, results were compared to the pre-1994 PWQO criterion (1,000 MPN/100 mL). During the June sampling period, Sites 1, 2, and 3 were above the criterion. During the July sampling period all sites were above the PWQO criterion. Total coliform concentrations in 2019 ranged from 42 MPN/100 mL (Site 4 June sampling) to >2,420 MPN/100 mL (multiple sites) for the watershed.

Coliform bacteria are living organisms and can multiply quickly when conditions are favorable for growth, or die in large numbers when conditions are not. Additionally, coliform bacteria is a common occurrence in nature from the predatory community. Bacterial concentrations are dependent on specific conditions such as precipitation, temperature, and stream substrate. The 2019 average temperature during the sampling period was approximately 1.5 degrees Celsius higher than the Thunder Bay historical average. The total precipitation during the 2019 sampling period was approximately 12.0 millimetre below average compared to the historical total precipitation. As such, higher temperatures and lower precipitation in the Little Pine River Watershed could affect bacteriological counts.

b) Nutrient and Anions Exceedance

The PQWO criterion for phosphorus is 0.03 mg/L. During the June sampling period Site 1 was above the criterion. During the July sampling period Sites 1, 2 and 3 were all above the criterion. Phosphorous concentrations ranged from 0.0113 mg/L (Site 2 June sampling) to 0.0456 mg/L (Site 1 July sampling).

c) Metals Exceedance

The PWQO criterion for aluminum is 0.075 mg/L. During both the June and July sampling periods all sites were above the criterion. Aluminum concentrations ranged from 0.099 mg/L (Site 3 June sampling) to 1.480 mg/L (Site 1 July sampling). These values are typically associated with fine-grained sediments.

The PWQO criterion for copper is 0.001 mg/L (0-20 mg/L CaCO3) and 0.005 mg/L (>20 mg/L CaCO3). During the June sampling period Site 2 was above the criterion. During the July sampling period no sites were above the criterion. Copper concentrations ranged from 0.00166 mg/L (Site 3 June sampling) to 0.00552 mg/L (Site 2 June sampling).

The PWQO criterion for iron is 0.30 mg/L. During the June sampling period Sites 1, 2 and 4 were all above the criterion. During the July sampling period Sites 1, 2 and 3 were all above the criterion. Iron concentrations ranged from 0.117 mg/L (Site 3 June sampling) to 1.710 mg/L (Site 1 July sampling) for the watershed. Iron exceedances are common in the region, due to natural sources.

Site Observations

The flora and fauna inventory indicated that the Little Pine River Watershed supports a healthy population of diverse plants and animals. The stream banks were stable and showed little signs of erosion although Site 1 showed some signs of erosion on the stream

bank in the form of overhanging trees. Both the culvert and bridge located at Site 2 and 4 were in good and stable condition and the culvert at Site 3 showed some rust damage which may cause problems in the future.

Watershed Report Card Rating

The Little Pine River Watershed was also assessed using the *Guide to Developing Conservation Authority Watershed Report Cards*, 2017. Using the guide, surface water quality, forest conditions, and wetland conditions for the Little Pine River Watershed were used to determine a grade rating for the watershed. Surface water quality maintained a good rating with a few exceedances of *E. coli* present and some exceedances for nutrients and metals within the Little Pine River Watershed. Forest condition scored an overall good rating with high forest coverage, moderate forest interior, and moderate to low riparian forest cover. Wetland conditions scored a good rating with moderate wetland coverage.

Overall the quality of the Little Pine River Watershed in 2019 was determined to be in good health, and has a grade of 'B' based on the surface water quality, a 'B' based on the forest conditions, and a 'B' based on the wetland conditions.

Recommendations

Upon completion of the watershed assessment, the following recommendations are provided for consideration:

- Staff and funding permitting, it is recommended that an update to the 2019 Little Pine River Watershed Assessment be completed in the next five to ten years.
- Benthic sampling and monitoring should be considered for future watershed assessments as it is a useful indicator of water quality over time.
- Additional sampling should be conducted in the spring to observe the water quality differences between high and low flow seasons.
- A copy of this report should be provided to the Municipality of Neebing for reference purposes. The Report should be kept on file at the LRCA Administration Office for review by interested parties.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

LIST OF APPENDICES

1 INTRODUCTION

The Little Pine River Watershed is located within the Municipality of Neebing as shown on Map M-1: Key Plan Map. Areas regulated by the Lakehead Region Conservation Authority (LRCA) and Municipal boundaries can be found on Map M-2: Regulated Area Map.

A watershed can be defined as all the land and water within the confines of a drainage divide. In essence, the Little Pine River Watershed consists of all the surrounding land that naturally drains its lakes, streams, wetlands and precipitation runoff into the Little Pine River which then flows into Lake Superior.

The headwaters of the main branch begin at Lenore Lake, which lies within the boundaries of the Municipality of Neebing. The watershed covers a drainage area of approximately 25.3 square kilometres. Most of the watershed is dominated by black spruce, balsam fir, white spruce and trembling aspen. The Little Pine River runs approximately 7.6 kilometres in length through well-defined drainage courses and valleys.

The goal of this report is to document the conditions of the watershed, especially surface water quality, as observed in June and July of 2019. Four sampling sites were chosen to access the health of the watershed as a whole. This information will ultimately be used to develop and maintain programs to sustain a healthy ecosystem consistent with the Natural Hazards and Natural Heritage Policies of the Province of Ontario.

The main objectives of this assessment report are to:

- Summarize the physical, biological and socio-economic attributes of the watershed,
- Collect surface water quality data,
- Collect field measurements,
- Conduct an inventory of the forest ecosystem and fauna observed within the watershed,
- Conduct an inventory of soil, streambed substrate and stream bank cover observed within the watershed,
- Document active erosion sites,
- Document the physical condition of all Little Pine River water crossings (bridges/culverts), and
- Interpret results to record the health status of the watershed.

2 BACKGROUND

2.1 Physical Attributes

2.1.1 Topography

The Little Pine River originates in the northwestern area of the watershed and flows in a southeast direction through to its confluence at Pine Bay in Lake Superior. The highest elevation is approximately 461 metres above sea level (303348 E, 5324595 N) to the northwest, which is underlain by sedimentary rock. The lowest elevation is approximately 183 metres above sea level (312458 E, 5323012 N) at the mouth of the Little Pine River at Pine Bay in Lake Superior. The overall slope of the Little Pine River is approximately 1.12 percent, having a channel length of 7.6 kilometres. The overall Little Pine River Watershed topography is shown on Map M-3: Topography.

2.1.2 Geology & Soils

2.1.2.1 Bedrock

Map M-4: Bedrock Geology shows the bedrock geology of the Little Pine River and the surrounding area. The Little Pine River Watershed headwater area is composed of Paleoproterozoic sedimentary rocks. There are two prominent bands of Mesoproterozoic mafic and related intrusive rocks throughout both the northwestern boundary and along the lower boundary of the watershed. Both the central portion and the confluence at Lake Superior are comprised of Paleoproterozoic sedimentary rocks.

2.1.2.2 Surficial Geology

Map M-5: Surficial Geology shows the surficial geology of the Little Pine River watershed and the surrounding area. The surficial geology distribution of the Little Pine River Watershed quickly changes from bedrock in the headwaters area, to a mix of slope/talus pile and glaciolacustrine plain in the upper northeastern central area. A ribbon of bedrock splits glaciolacustrine plain in the central area, which leads to organics until the confluence with Lake Superior. Within the watershed area includes a small band of moraine. The bedrock formation is mostly composed of sedimentary rocks; however, there is a significant presence of mafic and related intrusive rocks in the watershed.

2.1.2.3 Soils

Soil logging for this Watershed Assessment Report was completed to test the extent of the Northern Ontario Engineering Geology Terrain Study (NOEGTS) soil types. The soil logging was completed using criteria derived from the “Field Guide to the Substrates of Ontario” (MNRF, March 2015). Soil samples were taken and logged using a 1.2 metre soil

auger. The depth of the organic layer as well as the depth, composition and characteristics of the A, B and C soil horizons were logged at the four sampling sites along Little Pine River. Map M-6: Soils illustrates the location of the four soil sampling sites.

Clay loam soils were encountered at Site 3, this suggests that the provincial soils data is fairly accurate in the central part of the watershed. After extensive attempts to sample via auger at Site 4, loamy sand was encountered at the edge of Lenore Lake. This suggests that the provincial soils data rock classification is accurate in the northwestern part of the watershed. The large organic area mapped could not be established in this study as none of the soils tested had a well-developed organic layer. The majority of soils consist of clay loam with areas of moderately fine loam with occurrences of silty clay loam. The soil testing results and photographs of each soil profile are shown in Appendix A: Soil Logging Summary and Photography.

2.1.3 Climate

The climate of the Little Pine River Watershed is similar to the Thunder Bay region, in that it is a modified continental climate influenced by Lake Superior. From the months of March to July the westerly winds prevail, whereas the easterly winds prevail the remainder of the year (LRCA, 1985). These winds modify the climate of Thunder Bay and the surrounding regions. The mean daily temperatures (degrees Celsius) and precipitation levels (millimetres) were recorded at the Thunder Bay Airport from 1971 to 2000 (Environment Canada, 2019) as shown in Table 2.1-1. This table also summarizes the extreme daily precipitation in millimetres recorded within a 24-hour period and the date it occurred.

Table 2.1-1: Average Monthly Temperature and Precipitation for Thunder Bay, 1971-2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily (° C)	-14.8	-12.0	-5.5	2.9	9.5	14.0	17.6	16.6	11.0	5.0	3.0	-11.6
Precipitation												
Total Precipitation (millimetres)	31.3	24.9	41.6	41.5	66.5	85.7	89	87.5	88	62.6	55.6	37.5
Extreme Max. Daily Precipitation (millimetres)	51.6	33.5	41.9	69.3	76.2	49.3	53.8	87.1	131.2	47.8	63.0	42.7
Date (yyyy /dd)	1956 /20	1951 /26	1957 /14	1954 /30	1971 /24	1947 /04	1973 /27	1973 /19	1977 /08	1968 /09	1973 /21	1948 /05

The average monthly temperatures (degrees Celsius) and precipitation levels (millimetres) were recorded at the Thunder Bay Airport for 2019 (Environment Canada, 2019), as shown below.

Table 2.1-2: Average Monthly Temperature and Precipitation for Thunder Bay, January-July 2019

	Jan	Feb	Mar	Apr	May	June	July
Average Temperature							
Daily (° C)	-15.9	-13.9	-5.4	2.2	7.5	13.7	19.2
Precipitation							
Total Precipitation (millimetres)	29.5	37.2	32.1	63.6	43.1	67.5	83.2

The average monthly temperature for the June and July sampling periods was 16.5 degrees Celsius and the average monthly precipitation was 75.4 millimetres. In comparison with the historical data, the 2019 temperature was approximately 1.0 degree Celsius higher than the average for June and July. The 2019 precipitation for June was 12.0 millimetres lower than the historical average precipitation. In general, temperatures in June and July were near normal while the received precipitation for June and July was below average.

Additionally, the average precipitation for the February, March and April was higher than the historical average, and thus the Lakehead Region Conservation Authority did not declare any Low Water Conditions from January 2019 to June 2019.

2.1.4 Hydrology

The main channel of the Little Pine River Watershed is 7.6 kilometres in length and the watershed itself covers an area of approximately 25.3 square kilometres which flows, generally, in a south-easterly direction to its confluence with Lake Superior. The surface water drainage area has been estimated at 2.4 square kilometres and the wetland area has been estimated to be 1.6 square kilometres. There are 0.7 square kilometres of identified provincially significant wetlands within the watershed.

2.2 Biological Attributes

2.2.1 Flora

The Little Pine River Watershed is located within the boundaries of the Great Lakes forest region and the Boreal forest region as shown on the Canada's Forest Regions map (Figure 2: Canada's Forest Regions). The trees, which comprise the Great Lakes forest region, are primarily white pine, red pine and yellow birch. Although the watershed is geographically located in this forest region, the tree species observed are more indicative of a Boreal forest region, as the trees present are predominantly black spruce, balsam fir, white spruce, white birch and trembling aspen. This discrepancy is likely due to the fact that the watershed is relatively close to the Boreal forest region and mechanisms such as local climate (slope, aspect), site condition (soil characteristics), disturbance regimes and species interaction can affect the species distribution in the area. The coarse scale of the Canada's Forest Regions distribution map is only a basic division of the forest

types, and there is no discrete line that separates the two zones. Factors mentioned above could easily alter forest types, which are located between two zones.

There are a variety of other plant species present in the Little Pine River Watershed including ferns, shrubs, herbs, mosses and lichens. Plant species identified at the sample sites are listed in Appendix B: Common and Scientific Names of Identified Flora and Fauna.

2.2.2 Fauna

The Little Pine River Watershed provides breeding grounds for a variety of wildlife. Species of amphibians, reptiles, and butterflies that have been sighted in the watershed and surrounding area historically, and recently, are listed below in Table 2.2-1. The Little Pine River Watershed is part of the Ontario Ministry of Natural Resources and Forestry (OMNRF) Wildlife Management Unit 13 and Fisheries Management Zone 6.

A complete list of the wildlife observed in the watershed is shown in Appendix B: Common and Scientific Names of Identified Flora and Fauna.

Table 2.2-1 : Common Reptiles, Amphibians, and Butterflies

Species Name	
Common Name	**Scientific Name**
Amphibians and Reptiles	
Blue-Spotted Salamander	*Ambystoma laterale*
Jefferson Salamander	*Ambystoma jeffersonianum*
Snapping Turtle	*Chelydra serpentine*
Western Painted Turtle	*Chrysemys picta bellii*
Eastern Garter Snake	*Thamnophis sirtalis*
Eastern Newt	*Notophthalmus viridescens*
Mudpuppy	*Necturus maculosus*
American Toad	*Anaxyrus americanus*
Boreal Chorus Frog	*Pseudacris maculata*
Gray Tree Frog	*Hyla versicolor*
Green Frog	*Lithobates clamitans*
Mink Frog	*Lithobates septentrionalis*
Northern Leopard Frog	*Lithobates pipiens*
Spring Peeper	*Pseudacris crucifer*
Wood Frog	*Lithobates sylvaticus*
Butterflies	
Juvenal's Duskywing	*Erynnis juvenalis*
European Skipper	*Thymelicus lineola*
Common Branded Skipper	*Hesperia comma*
Long Dash Skipper	*Polites mystic*
Canadian Tiger Swallowtail	*Papilio canadensis*
Mustard White	*Pieris oleracea*
Cabbage White	*Pieris oleracea*
Clouded Sulphur	*Colias philodice*

Table 2.2-1 : Common Reptiles, Amphibians, and Butterflies	
Species Name	
Common Name	**Scientific Name**
Atlantis Fritillary	*Speyeria atlantis*
Northern Crescent	*Phyciodes cocyta*
Satyr Comma	*Polygonia satyrus*
Mourning Cloak	*Nymphalis antiopa*
Milbert's Tortoiseshell	*Algais milberti*
American Lady	*Vanessa virginiensis*
Painted Lady	*Vanessa cardui*
Red Admiral	*Vanessa atalanta*
White Admiral	*Limenitis arthemis*
Northern Pearly-Eye	*Lethe anthedon*
Common Wood-Nymph	*Cercyonis pegala*
Monarch	*Danaus plexippus*

Source: Ontario Butterfly Atlas & Reptile and Amphibian Atlas, 2015

2.2.3 Species at Risk

Ontario has more than 200 species at risk living in its forests and lakes, all at varying degrees of risk. There are approximately 19 species at risk in the Thunder Bay region that have potential to exist within the Little Pine River Watershed. In addition to the watershed boundary limits, the surrounding area is considered Boreal forest region, which would allow for movement of individuals in and out of the watershed boundary.

Table 2.2-2, below, shows the species at risk in the Thunder Bay and Northern Ontario region

Table 2.2-2: Species at Risk		
Species Name		Status of Risk
Common Name	**Scientific Name**	
American Badger *jacksoni* subspecies	*Tixidea taxus jacksoni*	Endangered
American White Pelican	*Pelecanus erythrorhynchos*	Threatened
Bald Eagle	*Haliaeetus leucocephalus*	Special Concern
Bank Swallow	*Riparia riparia*	Threatened
Barn Swallow	*Hirundo rustica*	Threatened
Black Tern	*Chlidonias niger*	Special Concern
Blanding's Turtle	*Emydoidea blandingii*	Threatened
Bobolink	*Dolichonyx oryzivorus*	Threatened
Canada Warbler	*Cardellina canadensis*	Special Concern
Chimney Swift	*Chaetura pelagica*	Threatened
Common Nighthawk	*Chordeiles minor*	Special Concern
Cougar (Mountain Lion)	*Puma concolor*	Endangered
Deepwater Sculpin	*Myoxocephalus thompsonii*	Special Concern
Eastern Meadowlark	*Sturnella magna*	Threatened
Eastern Milksnake	*Lampropeltis triangulum*	Special Concern

Table 2.2-2: Species at Risk		
Species Name		Status of Risk
Common Name	Scientific Name	
Eastern Whip-poor-will	*Antrostomas vociferus*	Threatened
Eastern Wolf	*Canis lupus lycaon*	Special Concern
Eastern Wood-pewee	*Contopus virens*	Special Concern
Golden Eagle	*Aquila chrysaetos*	Endangered
Golden-winged Warbler	*Vermivora chrysoptera*	Special Concern
Gray Fox	*Urocyon cinereoargenteus*	Threatened
Horned Grebe	*Podiceps auritus*	Special Concern
Kiyi	*Coregonus kiyi kiyi*	Special Concern
Lake Sturgeon	*Acipenser fulvescens*	Threatened and Special Concern
Least Bittern	*Ixobrychus exilis*	Threatened
Little Brown Bat	*Myotis lucifugus*	Endangered
Loggerhead Shrike	*Lanius ludovicianus*	Endangered
Monarch Butterfly	*Danaus plexippus*	Special Concern
Northern Brook Lamprey	*Ichthyomyzon fossor*	Special Concern
Northern Map Turtle	*Graptemys geographica*	Special Concern
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern
Peregrine Falcon	*Falco peregrinus anatum/tundrius*	Special Concern
Piping Plover	*Charadrius melodus circumcinctus*	Endangered
Pitcher's Thistle	*Cirsium pitcheri*	Threatened
Pygma Snaketail	*Ophiogomphus howei*	Endangered
Red Knot *rufa* subspecies	*Calidris canutus rufa*	Endangered
Red-necked Phalarope	*Phalarope lobatus*	Special Concern
Rusty Blackbird	*Euphagus carolinus*	Special Concern
Short-eared Owl	*Asio flammeus*	Special Concern
Shortjaw Cisco	*Coregonus zenithicus*	Threatened
Showy Goldenrod	*Solidago speciose*	Threatened and Endangered
Small-flowered Lipocarpha	*Licocarpha micrantha*	Threatened
Snapping Turtle	*Chelydra serpentina*	Special Concern
Wolverine	*Gulo gulo*	Threatened
Woodland Caribou, Boreal population	*Rangifer tarandus caribou*	Threatened
Wood Thrush	*Hylocichla mustelina*	Special Concern
Western Silvery Aster	*Symphyotrichum sericeum*	Endangered
Yellow Rail	*Coturnicops noveboracensis*	Special Concern

Source: Ontario Ministry of Natural Resources and Forestry - Species at Risk in Thunder Bay Region, 2016 and Ontario Nature- Species at Risk in Northern Ontario, 2017.

2.2.4 Invasive Species

Invasive species are a threat to native plants and animals and can disturb entire ecosystems. They are introduced and spread as a result of movement of people and goods around the world, increased urbanization, improved transportation routes and through recreational activities.

Some of the ways invasive species can enter Ontario include, but are not limited to,

- All-terrain vehicles,

- Aquarium, water garden and pet trades,
- Ballast water of ships,
- Canals and changes to waterways,
- Gardening and landscaping,
- Release of live fish and bait,
- Transport of topsoil,
- Recreational and commercial boating,
- Transport of animal carcasses or products made from them, and
- Transport of raw wood and other forest products.

Invasive species that were observed in the Lake Superior or District of Thunder Bay area may be present in the Little Pine River Watershed according to the Canada/Ontario Invasive Species Centre, OMNRF and the Ontario Federation of Anglers and Hunters' Early Detection and Distribution Mapping System. These invasive species are listed below in Table 2.2-3.

Table 2.2-3 : Invasive Species

Species Name	
Common Name	**Scientific Name**
Canada Thistle	*Cirsium arvense*
Chinese Mitten Crab	*Eriocheir sinensis*
Common Reed	*Phragmites australis*
Dog-Strangling Vine	*Cynanchum rossicum & C. nigrum*
Emerald Ash Borer	*Agrilus planipennis*
Eurasian Ruffe	*Gymnocephalus cernua*
European Common Reed	*Phragmites australis ssp. australis*
European Flounder	*Platichthys flesus*
Flowering-Rush	*Butomus umbellatus*
Garlic Mustard	*Alliaria Petiolata*
Giant Hogweed	*Heracleum mantegazzianum*
Goldfish	*Carassius auratus*
Goutweed	*Aegopodium podagraria*
Glossy Buckthorn	*Rhamnus frangula*
Himalayan Balsam	*Impatiens glandulifera*
Hybrid Cattail	*Typha x glauca*
Japanese Knotweed	*Reynoutria japonica*
Manitoba Maple	*Acer negundo*
Narrow-leaved Cattail	*Typha angustifolia*
New Zealand Mud Snail	*Potamopyrgus antipodarum*
Non-native Bush Honeysuckle	*Lonicera spp.*
Norway Maple	*Acer platanoides*
Periwinkle	*Vinca minor*
Phragmites	*Phragmites australis*
Purple Loosestrife	*Lythrum salicaria*
Rainbow Smelt	*Osmerus mordax*
Round Goby	*Neogobius melanostomus*
Rusty Crayfish	*Orconectes rusticus*

Table 2.2-3 : Invasive Species	
Species Name	
Common Name	**Scientific Name**
Spiny Water Flea	*Bythotrephes longimanus*
Tatarian honeysuckle	*Lonicera tatarica*
Three Spine Stickleback	*Gasterosteus aculeatus*
Tubenose Goby	*Proterorhinus marmoratus*
White Perch	*Morone Americana*
Wild Chervil	*Anthriscus sylvestris*
Wild Parsnip	*Pastinaca sativa*
Winged Euonymus	*Euonymus alatus*
Yellow Sweet-Clover	*Melilotus officinalis*
Yellow Iris	*Iris pseudacorus*
Zebra Mussel	*Dreissena polymorpha*

Source: Early Detection & Distribution Mapping System for Ontario, 2019

2.3 Socio-Economic Attributes

2.3.1 Planning & Development Controls

Land Tenure

The majority of the Little Pine River Watershed is designated as privately owned land (89.0 percent) with the remainder designated as provincially owned Crown land (11.1 percent). Land ownership in the watershed is illustrated on Map M-7: Land Ownership.

Areas of Jurisdiction

The hydrological boundaries of the Little Pine River Watershed fall within the Municipality of Neebing, which includes the Geographic Townships of Crooks and Pardee. Map M-7: Land Ownership, illustrates the location of the Little Pine River Watershed within these areas.

Within Regulated Areas, the Lakehead Region Conservation Authority administers the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses O. Reg 180/06 under the *Conservation Authorities Act*, 2006. Areas considered regulated include: Provincially Significant Wetlands and 120 metres adjacent, all watercourses, all land zoned Hazard Land, Use Limitation or Environmental Protection, steep slopes, and 15 metres landward and one kilometre lakeward from the 100-year flood level on Lake Superior (i.e. 184.0 metres Geodetic Survey of Canada), as shown on Map M-2: Regulated Area. Activities within the approximate regulated area may require a permit from the Authority.

2.3.1.1 Land Use Designation/Zoning

Municipal Official Plans contain long term goals and policies that serve as guidelines for future land use and development. The Little Pine River Watershed is affected by the Municipality of Neebing Official Plan and Zoning by-laws. Land use designations within the Little Pine River Watershed can be found on Map M-8: Zoning.

The policies of the Official Plan and all land use designations are implemented through zoning by-laws. Zoning provides an additional level of detail, particularly with respect to the range of permitted uses and any specific conditions that must be satisfied such as buffering, suitable distances between uses and parking requirements.

Within the Municipality of Neebing, the Little Pine River Watershed has been identified for the following land-use zones:

- Use Limitation (UL) Zone,
- Rural (R) Zone,
- Recreation Commercial (C2) Zone,
- Seasonal (S) Zone, and
- Open Space (OS) Zone.

The following definitions are taken from the Municipality of Neebing Zoning By-Law No. 2017-030, dated September 2017.

Use Limitation (UL) Zone

The Use Limitation (UL) Zone is always a dual zone, which is applied together with an underlying main Zone. The purpose of the Use Limitation (UL) Zone is to control land uses near watercourses, wetlands, areas requiring protection, and other hazards, such as talus slopes. This Zone is under the jurisdiction of the Lakehead Region Conservation Authority. That public authority has the jurisdiction to regulate and/or prohibit development in these areas. Lands controlled in this regard include the lands falling within the Use Limitation (UL) Zone areas on the Schedules to this By-Law, and also include: i) Land within 45 metres of a watercourse, ii) Land within 45 metres of a wetland, or iii) Land within 45 metres of other hazards or area of protection regulated by the Lakehead Region Conservation Authority.

Rural (R) Zone

No person shall, within any Rural (R) Zone, use any lot or erect, alter or use any building or structure for any purpose except for one of the following uses: (1) a single dwelling, (2) a modular dwelling, (3) an agricultural use, (4) a forestry use, (5) a stable, (6) watershed management and conservation areas, (7) a home occupation, (8) a home industry, (9) a guest cottage, (10) a bed and breakfast establishment, (11) mineral exploration, or (12)

buildings or structures that would be accessory buildings to any of the above uses, had those uses been established prior to the erection of the accessory building or structure.

Recreation Commercial (C2) Zone

No person shall, within any Recreation Commercial (C2) Zone, use any lot or erect, alter or use any building or structure for any purpose except for one of the following uses: (1) a tourist park, (2) a tourist commercial resort, (3) a marina, (4) commercial recreation facilities, (5) ski facilities, (6) a restaurant, (7) a hotel, (8) a convention centre; or (9) an accessory dwelling to the uses listed above.

Seasonal (S) Zone

No person shall, within any Seasonal (S) Zone, use any lot or erect, alter or use any building or structure for any purpose except for one or more of the following uses: (1) a recreational dwelling, (2) a recreational modular dwelling, (3) a guest cottage, (4) a bed and breakfast establishment; or (5) a boat house.

Open Space (OS) Zone

No person shall, within any Open Space (OS) Zone, use any lot or erect, alter or use any building or structure for any purpose except for one of the following uses: (1) a public and/or private parks, playgrounds, playing fields and sports and recreation facilities, nature and hiking trails, (2) recreation centers or community centers, (3) passive recreation, (4) outdoor commercial recreation facilities, (5) outdoor recreation facilities, (6) picnic facilities, (7) a boat launch, (8) a public dock, (9) conservation uses, (10) fairgrounds; or (11) a scenic lookout

3 WATERSHED SITE ASSESSMENT

A summary of the sampling techniques used is included in Appendix C: Techniques for Data Collection.

3.1 Site Selection

Four sites were chosen within the Little Pine River Watershed to assess the health of the watershed as a whole. Each site was chosen based on its accessibility and its proximity to natural or man-made features that may alter water quality. Site locations can be found on Map M-9: Site Plan.

3.2 Quantitative Assessment – Surface Water Quality

Several parameters were measured to assess surface water quality of the Little Pine River. Surface water samples were collected in laboratory supplied bottles by LRCA staff and summer students and transported on ice, to ALS Laboratory Group, 1081 Barton Street, Thunder Bay, Ontario. An analysis was conducted on the samples to determine conductivity, total dissolved solids (TDS), turbidity, nutrients (ammonia-N total nitrogen, alkalinity, chloride, sulfate, nitrate, nitrite and phosphorus), bacteria (*E. coli* and total coliforms) and total metals.

Sampling was conducted on two separate occasions for each site, to enable comparisons and reveal discrepancies. The first data set was collected on June 11, 2019. The second data set was collected on July 10, 2019.

Methodology for water sample collection was based on the Provincial Water Quality Monitoring Network (PWQMN), Ministry of the Environment, Conservation and Parks protocol. Grab samples were collected away from the stream bank in the main current by wading or by using a reaching pole. Effort was taken to enter the stream downstream of the sampling location in order to disturb as little sediment as possible. Additionally, samples were taken upstream from any water crossings and/or outlet culverts and were taken facing upstream into the current. In cases where current was not detectable (stagnant water) or current was flowing in the opposite direction (influenced by wind direction), samples were still collected facing upstream. Samples were collected at a depth of 0.3 metres below the surface of the water to avoid capturing any floating debris.

ALS Laboratory Group provided six collection bottles for each site to conduct the following tests: physical parameters (routine and solids), anions and nutrients, bacteriological, dissolved metals and total metals. The physical analysis sample bottles and lids were rinsed three times before a true sample was collected. The ALS Laboratory Group pre-charged the anion and nutrients sample bottles with sulfuric acid and the total

metals bottles were pre-charged with nitric acid to preserve the samples taken, and were not rinsed before filling. Bottles for bacteriological analysis were also not rinsed as they were pre-charged with sodium thiosulphate preservative and special care was taken not to open the bottle until the true sample was to be filled. All filled sample bottles were transported on ice for delivery to the laboratory.

Field parameters of water temperature, pH, conductivity, turbidity, dissolved oxygen, total dissolved solids, and oxygen reduction potential were measured using an YSI ProDSS multi-parameter water quality sampler at the time of water sample collection. The following additional field parameters were also measured: air temperature by mercury thermometer, channel width using a measuring-tape reel, channel depth using a weighted measuring tape reel and velocity was measured using a stick, measuring tape, stopwatch and appropriate calculations. Velocity was only measured for water running downstream (not in ponds producing only windblown results). A description of the water quality parameters is attached in Appendix D: Summary of Water Quality Parameters.

3.3 Applicable Criteria – Provincial Water Quality Objectives

Surface water quality results from the Little Pine River Watershed were compared to applicable criteria published in the *Provincial Water Quality Objectives* (PWQO) by the Ontario Ministry of Environment and Energy, July 1994. The goal of the PWQO is to ensure that the surface waters of the province are of the quality that is satisfactory for aquatic life and recreation.

The applicable criteria published in the PWQO water quality guidelines are attached in Appendix E: Water Quality Guidelines. Total Coliform results were compared to the pre-1994 PWQO, as there are no current criteria.

3.4 Qualitative Assessment – Site Observations

Watershed health can also be assessed by qualitative monitoring (i.e. visual inspection). The composition of in-stream substrate, forest soil, stream bank riparian community, shoreline vegetation and condition of the stream bank can all affect water quality. The presence or absence of certain flora and fauna can indicate the status of the watershed to provide suitable habitat. Seven field guides were used to identify terrestrial and aquatic species. Each site was given a Vegetation Type (V-type) allocation based on the *Field Guide to the Forest Ecosystem Classification for Northwestern Ontario* (Sims *et al.* 1997). Sites were assessed based on vegetation that could be seen from the site, with no distinct sample area, using a dichotomous key. It is important to note that these classifications are a general overview of a larger area and no site was exactly the same as another. Differences or inconsistencies between the V-types should be expected.

Vegetation Types for each site are attached in Appendix F: Forest Ecosystem Classification. Common and Latin names of plant species are attached in Appendix B: Common and Scientific Names of Identified Flora and Fauna. Fauna was assessed by identifying the species and number of individuals observed at each site.

An inventory of the Little Pine River water crossings (culverts and bridges) was conducted. Physical dimensions were measured, Universal Transverse Mercator (UTM) coordinates and pictures were taken and general observations were noted including high water marks, stability of fill and any restriction of flow. Culvert and bridge locations can be found on Map M-10: Bridge & Culvert Sites. The culvert assessments are attached in Appendix G: Culvert Assessments and the bridge assessments are attached in Appendix H: Bridge Assessments.

3.5 Watershed Report Card Rating

The Conservation Authorities in Ontario have developed the Watershed Report Card (WRC) as a means of reporting and designating watershed health through the use of environmental indicators and to utilize the information to better target programs and measure environmental change. Four resource categories are measured in the Watershed Report Cards, which include surface water quality, forest conditions, wetland conditions, and groundwater quality. The grading system for each resource category is recognized as A-Excellent; B-Good; C-Fair; D-Poor; F-Very Poor.

Surface water quality, forest conditions, and wetland cover was measured for the Little Pine River Watershed. The three indicators used to assess surface water quality for the watershed are total phosphorus, *Escherichia coli* (*E. coli*), and benthic macroinvertebrates. Benthic macroinvertebrates were not studied in this watershed assessment so the data is not available for assessment. The average point score of the surface water indicators is used to determine the overall surface water quality grade. No groundwater data was available for the watershed.

Forest conditions utilize three indicators to determine the grade for the quality of the forest, which include forest coverage, forest interior percentage and percentage of riparian zone forested. Forest cover is the percentage of the watershed that is forested. Forest interior is the area of forest that lies more than 100 metres from a forest edge. Forest riparian zone measures the amount of forest cover within 30 metres adjacent to all open watercourses. Northern Ontario Forest Cover criteria requires a different scoring system because the targets used for the Watershed Report Card were set by Environment Canada for southern Ontario. The minimum threshold set by Environment Canada for forest cover in Northern Ontario is probably well over 30 percent because it must be able to sustain species such as bear, moose, and boreal birds. A preliminary grading system for percentage forest cover in Northern Ontario has been suggested for the Watershed Report Card.

Percent wetland cover is the percentage of the watershed that is in wetland cover. Wetlands include swamps (treed and thicket), bogs, fens, and marshes.

Table 3.5-1: 2011 Surface Water Quality Indicator Guidelines

					Overall Surface Water Quality Grade	
Total Phosphorus (mg/L)	*E. coli* (#100 mL)	Benthic Invertebrates	Point Score	Grade	Final Points	Final Grade
<0.020	0-30	0.00-4.25	5	A	>4.4	A
0.020-0.030	31-100	4.26-5.00	4	B	3.5 - 4.4	B
0.031-0.060	101-300	5.01-5.75	3	C	2.5 - 3.4	C
0.061-0.180	301-1000	5.76-6.50	2	D	1.5 - 2.4	D
>0.180	>1000	6.51-10.00	1	F	<1.5	F

Table 3.5-2: 2011 Forest Conditions Indicator Guidelines

					Overall Forest Conditions	
% Forest Cover (N. Ontario Grading Option 1)	% Forest Interior	% Riparian Zone Forested	Point Score	Grade	Final Points	Final Grade
>75.0	>11.5	>57.5	5	A	>4.4	A
65.1 - 75.0	8.6 - 11.5	42.6- 57.5	4	B	3.5 - 4.4	B
55.1 - 65.0	5.6 - 8.5	27.6 - 42.5	3	C	2.5 - 3.4	C
45.1 – 55.0	2.5 - 5.5	12.5 - 27.5	2	D	1.5 - 2.4	D
<45.1	<2.5	<12.5	1	F	<1.5	F

Table 3.5-3: 2017 Grading system for Percentage Wetland Cover

Grade	% Wetland Cover
A	>11.5
B	8.6-11.5
C	5.6-8.5
D	2.5-5.5
F	<2.5

3.6 Materials

Materials used during the assessment included:

- Auger,
- Chest waders,
- Clipboard and observation chart paper,
- Cooler and ice packs,
- Digital underwater camera,
- Field guides,
- High visibility vests,
- Latex gloves,
- Measuring tape reel,

- Mercury thermometer,
- Metre stick,
- Road map,
- Sampling bottles and preservative provided by ALS Laboratory Group,
- Stopwatch,
- Tarp,
- Trimble Geo XH GPS,
- Writing utensils, and
- YSI Pro DSS metre.

Field Guides:

- Field Guide to the Forest Ecosystem Classification for Northwestern Ontario (Sims *et al.,* 1997),
- Wetland Plants of Ontario (Newmaster *et al.*, 1997),
- Forest Plants of Northeastern Ontario (Legasy *et al*.,1995),
- Bugs of Ontario (Acorn, 2003),
- Forest Plants of Central Ontario (Chambers *et al.*,1996),
- Birds of Ontario (Bezener, 2000), and
- INaturalist app (California Academy of Sciences, 2008).

4 RESULTS

Site photos from each sampling site are attached in Appendix I: Site Photography. The laboratory water quality results and PWQO criteria have been compared and attached in Appendix J: Laboratory Water Quality Results Summary Tables June and Appendix K: Laboratory Water Quality Results Summary Tables July. The original Laboratory Certificates of Analysis and Analytical Reports have been attached in Appendix L: Laboratory Certificates of Analysis and Test Results. The results for the Little Pine River Watershed are summarized in the tables below for each site.

4.1 Site 1

Site 1 was located approximately 1.5 kilometres upstream of the confluence of the Little Pine River with Lake Superior on Little Pigeon Bay Road to reflect the confluence. The actual confluence was not accessible. Site 1 was accessed at the intersection of Little Pigeon Bay Road and Little Pine Road. The substrate at this site consisted of predominantly silt mixed with clay. The banks of the creek were steep with abundant vegetation in the riparian zone including: black spruce, balsam fir, speckled alder and mountain maple. Overhanging and fallen trees may indicate bank erosion along the banks. The soil type present at this site was a clay loam in the "C" Horizon.

The laboratory results from both the June and July 2019 sampling periods showed that phosphorus, aluminum, total coliforms and iron exceeded the PWQO guidelines. During the July sampling period there was an additional exceedance in *E. coli*.

Aluminum results exceeded the PWQO criterion (0.075 mg/L) with a value of 0.992 mg/L on June 11, 2019 and 1.480 mg/L on July 10, 2019.

Iron results exceeded the PWQO criterion (0.3 mg/L) with a value of 1.10 mg/L on June 11, 2019 and a value of 1.71 mg/L on July 10, 2019.

Phosphorous results exceeded the PWQO criterion (0.03 mg/L) with a value of 0.0314 mg/L on June 11, 2019 and 0.0456 mg/L on July 10, 2019.

Total Coliforms were above the pre-1994 PWQO criterion (1,000 MPN/100 mL) with a value of 1,410 (MPN/100 mL) on June 11, 2019 and >2,420 (MPN/100 mL) on July 10, 2019

E. coli results exceeded the PWQO criterion (100 MPN/100 mL) with a value of 210 MPN/100 mL on July 10, 2019.

Table 4.1-1: Location References for Site 1	
Location Description	1.5 kilometres upstream of the confluence of the Little Pine River with Lake Superior at the intersection of Little Pigeon Bay Road and Little Pine Road.
UTM Coordinates	Northing 5323584 Easting 311078
Altitude/Elevation	190 metres above sea level

Table 4.1-2: Field Measurements for Site 1			
Parameter	**Unit**	**Date:** 11-JUN-19 **Time:** 12:20	**Date**: 10-JUL-19 **Time**: 12:45
Water Temperature	°C	16.0	18.2
Conductivity	uS/cm	146.0	182.0
Dissolved Oxygen	mg/L	9.73	8.64
Dissolved Oxygen	%	98.5	92.8
pH		7.92	8.01
Turbidity	NTU	18.8	35.5
Air Temperature	°C	17	20
Total Dissolved Solids	mg/L	94.750	118.393
Channel Width	m	N/A	N/A
Channel Depth	m	0.60	0.45
Velocity	m/s	0.91	0.09

Table 4.1-3: Select Laboratory Water Quality Results for Site 1				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**11-JUN-19 **Time:** 12:20	**Date:** 10-JUL-19 **Time:** 12:45
Bacteriological				
Escherichia coli	MPN/100mL	100	35	**210**
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	**1410**	**>2,420**
Physical				
Conductivity (EC)	uS/cm	-	133	161
pH		6.5-8.5	7.66	7.30
Total Dissolved Solids	mg/L	-	97	121
Turbidity	NTU	-	18.2	36.7
Anions and Nutrients				
Alkalinity, Total (as $CaCO_3$)	mg/L	37.4 (June); 37.6 (July)	57.5	72.1
Ammonia-N, Total	mg/L	-	0.011	<0.020
Un-ionized Ammonia	mg/L	0.02	0.005	N/A
Chloride (Cl)	mg/L	-	4.29	4.21
Nitrate-N (NO3-N)	mg/L	-	0.026	0.021
Nitrite-N (NO2-N)	mg/L	-	<0.010	<0.010
Phosphorus (P)-Total	mg/L	0.03	**0.0314**	**0.0456**
Sulfate (SO4)	mg/L	-	3.75	4.08
Total Metals				
Aluminum (Al)	mg/L	0.075	**0.992**	**1.480**
Cadmium (Cd)	mg/L	0.0001 (0-100 mg/L $CaCO_3$)	0.0000231	0.0000176
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	-
Cobalt (Co)	mg/L	0.0009	0.00055	0.00085
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	-	-
	mg/L	0.005 (>20 mg/L $CaCO_3$)	0.00429	0.00464
Iron (Fe)	mg/L	0.300	**1.10**	**1.71**
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	-	-
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	0.000339	0.000483
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	-

Table 4.1-3: Select Laboratory Water Quality Results for Site 1				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**11-JUN-19 **Time:** 12:20	**Date:** 10-JUL-19 **Time:** 12:45
Sodium (Na)	mg/L	-	4.87	4.86
Vanadium (V)-Total	mg/L	0.006	0.00298	0.00449
Zinc (Zn)-Total	mg/L	0.02 (interim)	0.0037	0.0054

Bold indicates exceedance above PWQO guidelines

Table 4.1-4: Flora Observed at Site 1			
FEC V-Type: V7 Trembling Aspen Balsam Fir/Balsam Fir Shrub			
Forest Density / Stream Cover	30% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Black Spruce Balsam Fir White Spruce	Bush Honeysuckle Green Alder Mountain Maple Pin Cherry Prickly Wild Rose Red-osier Dogwood Speckled Alder Wild Red Raspberry	Fragrant Bedstraw Large Leaf Aster Northern Bluebells Wild Sarsaparilla	Meadow Horsetail Sedge spp. Quack Grass.
Aquatic Macrophytes and Algae			
Emergent	-	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.1-5: Fauna Observed at Site 1	
Fauna Species	
Amphibians	-
Birds	-
Crustaceans	-
Fish	Minnow spp.
Insects/Arachnids	Mosquito, Black fly, Canadian Tiger Swallowtail, Dragonfly, Deer fly
Mammals	-
Mollusca	-
Reptiles	Wood Frog
Animal Tracks	-

Table 4.1-6: Physical Features Observed at Site 1							
In-stream Substrate							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	-	-	-	-	90%	-	10%
Bank Stability/Erosion	Steep, vegetated, overhanging trees may indicate erosion						

4.2 Site 2

Site 2 was located approximately 1.1 kilometres south-east from Highway 61 on Little Pigeon Bay Road. The substrate at this site included silt and clay. The banks of the river were stable with abundant vegetation in the riparian zone including: black spruce, balsam fir, trembling aspen, red osier dogwood and Canada bluegrass. In July upstream banks flooded due to the presence of a beaver dam, which may present erosion issues in the future. The soil type present at this site in the "A" and "C" Horizon was silty clay.

The laboratory results from both the June and July 2019 sampling periods showed that iron, aluminum, and total coliforms exceeded the PWQO guidelines. During the June sampling period copper exceeded the PWQO guidelines. During the July sampling period phosphorous and *E. coli* also exceeded the PWQO guidelines.

Aluminum results exceeded the PWQO criterion (0.075 mg/L) with a value of 1.320 mg/L on June 11, 2019 and 0.606 mg/L on July 10, 2019

Phosphorous results exceeded the PWQO criterion (0.03 mg/L) with a value of 0.0362 mg/L on July 10, 2019.

Iron results exceeded the PWQO criterion (0.3 mg/L) with a value of 1.620 mg/L on June 11, 2019 and a value of 0.831 mg/L on July 10, 2019.

Copper results exceeded the PWQO criterion (0.005 when >20 mg/L $CaCO_3$) with a value of 0.00552 mg/L on June 11, 2019.

Total coliforms were above the pre-1994 PWQO criterion (1,000 MPN/100 mL) with a value of 1,300 MPN/100 mL on June 11, 2019 and a value of >2,420 MPN/100 mL on July 10, 2019.

E. coli results exceeded the PWQO criterion (100 MPN/100 mL) with a value of 116 MPN/100 mL on July 10, 2019

Table 4.2-1: Location References for Site 2	
Location Description	Approximately 1.1 kilometres south-east from Highway 61 on Little Pigeon Bay Road.
UTM Coordinates	Northing 5324055 Easting 311131
Altitude/Elevation	201 metres above sea level

Table 4.2-2: Field Measurements for Site 2			
Parameter	**Unit**	**Date:** 11-JUN-19 **Time:** 12:45	**Date**: 10-JUL-19 **Time**: 12:05
Water Temperature	°C	16.6	18.7
Conductivity	uS/cm	125.5	148.5
Dissolved Oxygen	mg/L	9.64	7.98
Dissolved Oxygen	%	99.0	85.6
pH		7.94	7.73
Turbidity	NTU	10.4	23.9
Air Temperature	°C	17.0	17.0
Total Dissolved Solids	mg/L	81.577	96.480
Channel Width	m	N/A	N/A
Channel Depth	m	0.50	0.15
Velocity	m/s	0.22	N/A

Table 4.2-3: Select Laboratory Water Quality Results for Site 2				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**11-JUN-19 **Time:** 12:45	**Date:** 10-JUL-19 **Time:** 12:05
Bacteriological				
Escherichia coli	MPN/100mL	100	21	**116**
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	**1300**	**>2,420**
Physical				
Conductivity (EC)	uS/cm	-	116	132
pH		6.5-8.5	7.78	7.13
Total Dissolved Solids	mg/L	-	78	85
Turbidity	NTU	-	8.67	24.2
Nutrients and Anions				
Alkalinity, Total (as $CaCO_3$)	mg/L	37.4 (June); 37.6 (July)	54.5	60.7
Ammonia-N, Total	mg/L	-	0.013	<0.020
Un-ionized Ammonia	mg/L	0.02	0.0004	N/A
Chloride (Cl)	mg/L	-	1.28	1.29
Nitrate-N (NO3-N)	mg/L	-	0.039	<0.020
Nitrite-N (NO2-N)	mg/L	-	<0.010	<0.010
Phosphorus (P)-Total	mg/L	0.03	0.0113	**0.0362**
Sulfate (SO4)	mg/L	-	4.13	4.27
Metals				
Aluminum (Al)	mg/L	0.075	**1.320**	**0.606**
Cadmium (Cd)	mg/L	0.0001 (0-100 mg/L $CaCO_3$)	0.0000253	0.0000188
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	-
Cobalt (Co)	mg/L	0.0009	0.00069	0.00045
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	-	-
	mg/L	0.005 (>20 mg/L $CaCO_3$)	**0.00552**	0.00325
Iron (Fe)	mg/L	0.300	**1.620**	**0.831**
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	-	-
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	0.000449	0.000291
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	-
Sodium (Na)	mg/L	-	11.0	2.67
Vanadium (V)-Total	mg/L	0.006	0.00423	0.00284
Zinc (Zn)-Total	mg/L	0.02 (interim)	0.0050	0.0032

Bold indicates exceedance above PWQO guidelines

Table 4.2-4: Flora Observed at Site 2			
FEC V-Type: V7 Trembling Aspen-Balsam Fir/Balsam Fir Shrub			
Forest Density / Stream Cover	<10% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Balsam Fir Black Ash Black Spruce Paper Birch Trembling Aspen White Spruce	Speckled Alder Wild Red Raspberry Willow spp.	Buttercup Canada Anemone Common Toadflax Cow Parsnip Cow Vetch Dandelion Forget Me Not Spp. Fringed Bindweed Philadelphia Fleabane Spotted Joe Pye Weed Spreading Dogbane Sweet Coltsfoot Tansy Yarrow Yellow Avens	Canada Bluegrass Meadow Horsetail Sedge spp. Timothy
Aquatic Macrophytes and Algae			
Emergent	Broadleaf Arrowhead	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.2-5: Fauna Observed at Site 2	
Fauna Species	
Amphibians	Toad spp.
Birds	-
Crustaceans	-
Fish	-
Insects/Arachnids	Black Fly, Mosquito, Canadian Tiger Swallowtail, Monarch
Mammals	-
Mollusca	-
Reptiles	-
Animal Tracks	-

Table 4.2-6: Physical Features Observed at Site 2							
In-stream Substrate (%)							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	-	-	-	-	60%	-	35%
Bank Stability/ Erosion	Low bank, heavily vegetated Placed boulders, may be from culvert installation Flooded upstream banks due to a new beaver dam (July)						

4.3 Site 3

Site 3 was located approximately 300 metres southeast from Highway 61 on Anderson Road. The substrate at this site included: silt, clay and some boulders. The banks of the creek were stable with abundant vegetation in the riparian zone including: black spruce, white spruce, trembling aspen, wild red raspberry, and Canada anemone. The soil type present at this site in both the "A and C" Horizon was a clay loam; and loamy sand in the "B" Horizon.

The laboratory results from both the June and July 2019 sampling periods showed that aluminum and total coliforms exceeded the PWQO guidelines. In July, iron, phosphorus and *E. coli* exceeded the PWQO guidelines.

Aluminum results exceeded the PWQO criterion (0.075 mg/L) with a value of 0.099 mg/L on June 11, 2019 and 0.730 mg/L on July 10, 2019.

Phosphorous results exceeded the PWQO criterion (0.03mg/L) with a value of 0.0447 mg/L July 10, 2019.

Iron results exceeded the PWQO criterion (0.300 mg/L) with a value of 1.200 mg/L on July 10, 2019.

Total coliforms were above the pre-1994 PWQO criterion (1,000 MPN/100 mL) with a value of >2,420 MPN/100 mL on June 11, 2019 and >2,420 MPN/100 mL on July 10, 2019.

E. coli results exceeded the PWQO criterion (100 MPN/100 mL) with a value of 276 MPN/100 mL on July 10, 2019

Table 4.3-1: Location References for Site 3

Location Description	Approximately 300 metres southeast from Highway 61 on Anderson Road
UTM Coordinates	Northing 5323781 Easting 309913
Altitude/Elevation	202 metres above sea level

Table 4.3-2: Field Measurements for Site 3

Parameter	**Unit**	**Date:** 11-JUN-19 **Time:** 11:30	**Date**: 10-JUL-19 **Time**: 11:30
Water Temperature	°C	17.0	18.7
Conductivity	uS/cm	192.3	327.5
Dissolved Oxygen	mg/L	9.42	7.97
Dissolved Oxygen	%	97.1	85.5
pH		7.77	7.91
Turbidity	NTU	31.1	31.5
Air Temperature	°C	17	17
Total Dissolved Solids	mg/L	124.907	212.894
Channel Width	m	2.92	2.49
Channel Depth	m	0.45	0.18
Velocity	m/s	0.81	0.15

Table 4.3-3: Select Laboratory Water Quality Results for Site 3				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**11-JUN-19 **Time:** 11:30	**Date:**10-JUL-19 **Time:** 11:30
Bacteriological				
Escherichia coli	MPN/100mL	100	64	**276**
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	**>2420**	**>2420**
Physical				
Conductivity (EC)	uS/cm	-	178	285
pH		6.5-8.5	7.65	7.51
Total Dissolved Solids	mg/L	-	127	178
Turbidity	NTU	-	24.7	31.0
Nutrient and Anions				
Alkalinity, Total (as $CaCO_3$)	mg/L	37.4 (June); 37.6 (July)	63.1	114
Ammonia-N, Total	mg/L	-	0.017	<0.020
Un-ionized Ammonia	mg/L	0.02	0.0005	N/A
Chloride (Cl)	mg/L	-	14.0	21.1
Nitrate-N (NO3-N)	mg/L	-	0.081	<0.020
Nitrite-N 2-N)	mg/L	-	<0.010	0.012
Phosphorus (P)-Total	mg/L	0.03	0.0214	**0.0447**
Sulfate (SO4)	mg/L	-	5.85	4.31
Metals				
Aluminum (Al)	mg/L	0.075	**0.0986**	**0.730**
Cadmium (Cd)	mg/L	0.0001 (0-100 mg/L $CaCO_3$)	<0.0000050	-
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	0.0000321
Cobalt (Co)	mg/L	0.0009	<0.00010	0.00066
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	-	-
	mg/L	0.005 (>20 mg/L $CaCO_3$)	0.00166	0.00387
Iron (Fe)	mg/L	0.300	0.117	**1.200**
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	-	-
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	0.000059	-
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	0.000334
Sodium (Na)	mg/L	-	1.99	17.7
Vanadium (V)-Total	mg/L	0.006	0.00055	0.00395
Zinc (Zn)-Total	mg/L	0.02 (interim)	<0.0030	0.0032

Bold indicates exceedance above PWQO guidelines

Table 4.3-4: Flora Observed at Site 3			
FEC V-Type: V19 Black Spruce Mixedwood/Herb Rich			
Forest Density / Stream Cover	<10% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Black Spruce Trembling Aspen White Spruce	Chokecherry Red Osier Dogwood Speckled Alder Wild Red Raspberry Willow spp.	Alsike Clover Aster spp. Buttercup Canada Anemone Cow Parsnip Cow Vetch Dandelion Goldenrod spp. Hop Trefoil Northern Bluebell Ox-Eye Daisy Spotted Joe-Pye Weed Sweet Coltsfoot Thistle spp. White Sweetclover Yarrow	Canada Bluegrass Meadow Horsetail Sedge spp. Wood Horsetail
Aquatic Macrophytes and Algae			
Emergent	-	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.3-5: Fauna Observed at Site 3	
Fauna Species	
Amphibians	Toad spp.
Birds	-
Crustaceans	-
Fish	Minnow spp.
Insects/Arachnids	Black Fly, Mosquito, Deer Fly, Dragonfly, Stonefly
Mammals	-
Mollusca	-
Reptiles	-
Animal Tracks	Moose

Table 4.3-6: Physical Features Observed at Site 3							
In-stream Substrate							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	2%	-	-	-	60%	-	38%
Bank Stability/ Erosion	Slight undercutting, vegetated with herbs						

4.4 Site 4

Site 4 was located approximately 3.5 kilometres west of Highway 61 on Lake Lenore Road at the edge of Lenore Lake. The substrate at this site included cobbles and gravel. The banks of the creek were stable with abundant vegetation in the riparian zone including: white pine, eastern white cedar, trembling aspen, bush honeysuckle, giant goldenrod and yarrow. The soil type present at this site in the "C" Horizon was a loamy sand.

The laboratory results from both the June and July 2019 sampling periods showed that aluminum exceeded the PWQO guidelines. During the June sampling period iron also exceeded the PWQO guidelines. During the July sampling period *E. coli* and total coliforms also exceeded the PWQO guidelines.

Aluminum results exceeded the PWQO criterion (0.075 mg/L) with a value of 0.502 mg/L on June 11, 2019 and 0.108 mg/L on July 10, 2019.

Iron results exceeded the PWQO criterion (0.300 mg/L) with a value of 0.531 mg/L on June 11, 2019.

E. coli exceeded the PWQO criterion (100 MPN/100 mL) with a value of 125 MPN/100 mL on July 10, 2019.

Total coliforms were above the pre-1994 PWQO criterion (1,000 MPN/100 mL) with a value of >2,420MPN/100 mL on July 10, 2019.

Table 4.4-1: Location References for Site 4

Location Description	Approximately 3.5 kilometres west of Highway 61 on Lenore Road at edge of Lenore Lake.
UTM Coordinates	Northing 5324762 Easting 307993
Altitude/Elevation	332 metres above sea level

Table 4.4-2: Field Measurements for Site 4

Parameter	**Unit**	**Date:** 11-JUN-19 **Time:** 10:30	**Date**: 10-JUL-19 **Time**: 10:30
Water Temperature	°C	16.8	22.5
Conductivity	uS/cm	97.8	122.7
Dissolved Oxygen	mg/L	9.87	8.09
Dissolved Oxygen	%	101.6	93.4
pH		7.95	8.05
Turbidity	NTU	3.0	2.9
Air Temperature	°C	16	16
Total Dissolved Solids	mg/L	75.455	79.731
Channel Width	m	2.18	2.60
Channel Depth	m	0.20	0.12
Velocity	m/s	0.99	0.62

Table 4.4-3: Select Laboratory Water Quality Results for Site 4				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**11-JUN-19 **Time:** 10:30	**Date:**10-JUL-19 **Time:** 10:30
Bacteriological				
Escherichia coli	MPN/100mL	100	0	**125**
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	42	**>2420**
Physical				
Conductivity (EC)	uS/cm	-	107	109
pH		6.5-8.5	7.56	7.08
Total Dissolved Solids	mg/L	-	69	64
Turbidity	NTU	-	2.47	5.90
Nutrients and Anions				
Alkalinity, Total (as $CaCO_3$)	mg/L	37.4 (June); 37.6 (July)	49.9	50.1
Ammonia-N, Total	mg/L	-	0.010	<0.020
Un-ionized Ammonia	mg/L	0.02	0.0003	N/A
Chloride (Cl)	mg/L	-	0.53	0.70
Nitrate-N (NO3-N)	mg/L	-	0.025	<0.020
Nitrite-N (NO2-N)	mg/L	-	<0.010	<0.010
Phosphorus (P)-Total	mg/L	0.03	0.0131	0.0155
Sulfate (SO4)	mg/L	-	3.94	4.50
Metals				
Aluminum (Al)	mg/L	0.075	**0.502**	**0.108**
Cadmium (Cd)	mg/L	0.0001 (0-100 $CaCO_3$)	0.0000122	<0.0000050
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	-
Cobalt (Co)	mg/L	0.0009	0.00028	0.00012
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	-	-
	mg/L	0.005 (>20 mg/L $CaCO_3$)	0.00272	0.00207
Iron (Fe)	mg/L	0.300	**0.531**	0.184
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	-	-
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	0.000176	0.000142
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	-
Sodium (Na)	mg/L	-	2.46	2.00
Vanadium (V)-Total	mg/L	0.006	0.00175	0.00065
Zinc (Zn)-Total	mg/L	0.02 (interim)	<0.0030	<0.0030

Bold indicates exceedance above PWQO guidelines

Table 4.4-4: Flora Observed at Site 4			
FEC V-Type: V12- White Pine Mixedwood			
Forest Density / Stream Cover	50% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Black Spruce Eastern White Cedar Trembling Aspen White Birch White Pine White Spruce	Mountain Ash Northern Bush Honeysuckle Red-Osier Dogwood Speckled Alder Willow spp.	Blue Flag Iris Buttercup Canada Mayflower Cow Vetch Dandelion Giant Goldenrod Large Leaf Aster Oxeye Daisy Red Clover Red Hawkweed Self-Heal Wild Strawberry White Clover Yarrow Yellow Hawkweed	Canada Bluegrass Meadow Horsetail Reed Canary Grass Sedge spp. Timothy
Aquatic Macrophytes and Algae			
Emergent	-	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.4-5: Fauna Observed at Site 4	
Fauna Species	
Amphibians	Northern Leopard Frog
Birds	American Robin, Turkey Vulture, Raven
Crustaceans	-
Fish	Minnow spp.
Insects/Arachnids	Black Fly, Deer Fly, Mosquito, Grasshopper spp., Dragonfly spp.
Mammals	-
Mollusca	-
Reptiles	-
Animal Tracks	-

Table 4.4-6: Physical Features Observed at Site 4							
In-stream Substrate							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	-	40%	60%	-	-	-	-
Bank Stability/ Erosion	Stable/abundant vegetation/Mild slope						

4.5 Watershed Report Card Results

The overall surface water quality for the Little Pine River Watershed maintained a total averaged point score of 3.6. With four exceedances for phosphorus and four exceedances for *E. coli*, the rating of the surface water quality for the Little Pine River Watershed was determined to have a grade of B, which is considered good quality.

The forest coverage for the Little Pine River Watershed was 20.8 square kilometres (82.4 percent), interior forest coverage was 16.1 square kilometres (63.8 percent) and the riparian forest cover was 1.8 square kilometres (38.8 percent). These percentages generated a total point score of thirteen (average of 4.3) for the forest conditions, which is determined to have a grade of B, and is considered to be of good quality.

The wetland coverage for the Little Pine River Watershed was 2.3 square kilometres (9.1 percent). This generated a grade of B, which is considered to be good quality.

Table 4.5-1: Little Pine River Watershed Surface Water Indicators and Overall Grade Calculation

Site Number	Average Total Phosphorus (mg/L)	Average *E. coli* (MPN/ 100mL)	Average of Benthic Invertebrates	Total Point Score	Grade	Overall Surface Water Quality Grade	
						Final Points	Grade
1	0.0385	123	-	6	C	3	C
2	0.02375	69	-	8	B	4	B
3	0.03305	170	-	6	C	3	C
4	0.0143	63	-	9	A	4.5	A
					Overall	**3.6**	**B**

Table 4.5-2: Little Pine River Watershed Forest Conditions and Overall Grade Calculation

					Overall Forest Conditions	
% Forest Cover	% Forest Interior	% Riparian Zone Forested	Total Point Score	Grade	Final Points	Final Grade
82.4	63.8	38.8	13	B	**4.3**	**B**

Table 4.5-3: Little Pine River Watershed Wetland Conditions

% Wetland cover	Final Grade
9.1	B

5 DISCUSSION

The Little Pine River Watershed was sampled at four different locations, chosen based on accessibility and possible contamination sources, as well as attempting to reach all areas of the watershed. The first sampling period was on June 11, 2019 and the second sampling period on July 10, 2019.

The average air temperature for the June 11, 2019 sampling period was 16.8 degrees Celsius, which exceeded the monthly average temperature of 13.7 degrees Celsius for June 2019 as well as the historical average of 14.0 degrees Celsius for June 1971-2000 in Thunder Bay. The average air temperature for the July 10, 2019 sampling period was 17.5 degrees Celsius, which was below both the monthly average temperature of 19.2 degrees Celsius and the historical average of 17.6 degrees Celsius for July 1971-2000.

Precipitation for the month of June totaled 67.5 millimetres, which was below the historical monthly average of 85.7 millimetres for Thunder Bay from June 1971-2000. In July, precipitation totaled 83.2 millimetres, which was below the historical monthly average of 89.0 millimetres for July 1971-2000. LRCA staff noted minimal rain locally two days prior to June and July sampling periods.

Furthermore, the average precipitation for the February, March and April was higher than the historical average, and thus the Lakehead Region Conservation Authority did not declare any Low Water Conditions from January 2019 to June 2019.

Water temperatures ranged from 16.0 to 17.0 degrees Celsius in June and 18.2 to 22.5 degrees Celsius in July, which can be seen on Figure 3: Water Temperature at Little Pine River Sampling Sites. The site with the lowest recorded water temperature, 16.0 degrees Celsius, was Site 1 in June most likely attributed to the close proximity of its confluence point with Lake Superior. The stream depths observed ranged from 0.12 metres to 0.60 metres for both June and July. The shallowest of all the stream depths was located at Site 4 in July (0.12 metres) and the deepest at Site 1 in July (0.60 metres).

Three of the sample locations were water crossings that required either a culvert or bridge to support the road. The culverts present at Sites 2 and 3 were made of galvanized steel and in good, stable condition. Site 3 should be monitored in the future as some rust damage was present. The small bridge at Site 4 was made of timber and was in good stable condition. Monitoring of the culverts and bridge should be carried out to ensure no vegetation blockages cause problems in the future.

A vegetation assessment was carried out at each site, recording species present within view of each site. A summary of each site is included in Appendix F: Forest Ecosystem Classification. Forest Ecosystem Classification (FEC) type V-7 Trembling Aspen-Balsam

Fir/Balsam Fir Shrub, was the most common and occurred at Sites 1 and 2. The remaining sites had a similar mixedwood forest type favouring coniferous species, like black spruce and white spruce. The dominant tree species within the Little Pine River Watershed included: black spruce, trembling aspen, balsam fir, white birch, and white spruce. The shrub layer was very diverse throughout the watershed, with many species present. Some commonly observed species in the shrub layer were: green alder, prickly wild rose, red osier dogwood, speckled alder, and wild red raspberry. The most commonly observed herb and wildflower species included northern bluebells, sweet coltsfoot, meadow horsetail, cow vetch, and large leaf aster.

No invasive plant species were observed at the sample sites within the Little Pine River Watershed and one species at risk was observed (Monarch Butterfly).

Overall, the stream banks documented within the Little Pine River Watershed were stable, the only indication of erosion was seen at Site 1 in the form of overhanging trees. The main soil types were clay loam and silty clay. Site 1 was identified as silty sand and clay loam and showed signs of erosion. Based on Map 6-Soils this site is situated on the border of rock and organic soil. Due to potential shallow soil future monitoring should be done to ensure a small mass wasting event does not occur here. Clay loam soils that were seen at Sites 2 and 3 aid the banks by helping with slope stability and keeping erosion to a minimum.

The PWQO acceptable pH range is 6.5-8.5. The range within the Little Pine River Watershed was 7.08 to 7.78, as illustrated on Figure 4: pH Level at Little Pine River Sample Sites. The average pH of the watershed was within an acceptable water quality range.

Total Dissolved Solids (TDS) can be related to conductivity since the dissolved solids help to conduct an electric current through the water. The more dissolved solids present in a solution, the greater the conductive potential, as there are more ions present to carry the charge. The relationship can be seen in the watershed data when comparing between Figure 5: Total Dissolved Solids at Little Pine River Sample Sites and Figure 6: Conductivity at Little Pine River Sample Sites. The highest measured levels of TDS and conductivity were at Site 3, and the lowest for both parameters were at Site 4. In regards to drinking water, TDS levels are a secondary drinking water standard, meaning that this standard is based on aesthetic properties such as odour, colour, taste, corrosivity, foaming, and staining, and not based on health considerations.

Monitoring of bacterial levels in surface water is often limited to *E. coli*, as this is the most common water-borne pathogen that can cause illness and death. During the June sampling period no exceedances of *E. coli* occurred and all sites were below the PWQO of 100 MPN/100 mL, as illustrated on Figure 7: *Escherichia coli* Bacteria Counts at Little Pine River Sample Sites. During the July sampling period the levels of *E. coli* at all site were in

exceedance of the PWQO criterion with values ranging from 116 MPN/100 mL at Site 2 to 276 MPN/100 mL at Site 3.

Presence of *E. coli* generally indicates a fecal contamination source nearby and many studies have shown that the presence of farm animals near a stream can significantly influence bacteria counts. *E. coli* could also enter the watershed from leaking residential septic tanks and/or from manure. The *E. coli* exceedances during the July sampling period could be attributed to the higher than average temperature and little rainfall which may have caused favourable conditions for the *E. coli*. Residential homes and camps along the Little Pine River may also be cause for higher levels of *E.coli* from either pets or human waste.

Total coliforms are among the flora present in the intestinal tract of animals and are often present in much greater numbers than potential pathogens, such as *E. coli*. Therefore, coliforms are easier to isolate and identify within a water sample. In order to better determine the possibility of contamination, total coliforms are measured in surface water as indicators of pathogenic bacteria contamination. No current PWQO exists for total coliforms; however, total coliforms exceeded the pre-1994 PWQO of 1,000 MPN/100 mL at Sites 1, 2 and 3 during the June 2019 sampling period and at all of the sites during the July 2019 sampling period. The highest level of total coliforms present was >2,420 MPN/100 mL at Site 3 on June 11, 2019 and all of the sites on July 10, 2019. Total coliforms for all sampling results ranged from 42 MPN/100 mL to >2,420 MPN/100 mL.

The PWQO criterion of 0.075 mg/L for aluminum was exceeded at all the sites during the June and July sampling periods. Aluminum concentrations ranged from 0.099 mg/L at Site 3 on June 11, 2019 to 1.480 mg/L at Site 1 on July 10, 2019. The average concentration of aluminum was 0.728 mg/L for all sites during the June sampling period and 0.731 mg/L during the July sampling period, which are both above the PWQO criterion.

The PWQO criterion for iron is 0.30 mg/L. During the June sampling period Sites 1, 2 and 4 were all above the criterion. During the July sampling period Sites 1, 2 and 3 were all above the criterion. Iron concentrations ranged from 0.117 mg/L (Site 3 in June) to 1.710 mg/L (Site 1 in July) for the watershed. The average concentration of iron was calculated to be 0.842 mg/L for the June sampling period and 0.981 mg/L for the July sampling period, which are both above the PWQO criterion.

High aluminum and iron levels may be caused by the underlying geology. These metals may naturally dissociate from mineral-rich rocks. The exceedances are likely a result of natural sources and are commonly high within the region.

The PWQO criterion of 0.03 mg/L for phosphorous was exceeded at Site 1 during the June sampling period and at Sites 1, 2 and 3 during the July sampling period.

Phosphorous concentrations ranged between 0.0113 mg/L at Site 2 on June 11, 2019 and 0.0456 mg/L at Site 1 on July 10, 2019. The average concentration of phosphorous was calculated to be 0.0193 mg/L for the June sampling period, which is not over the PWQO criterion and 0.0355 mg/L for the July sampling period, which is above the PWQO criterion.

The PWQO criterion of 0.005 mg/L for copper when $CaCO_3$ is <20 mg/L was exceeded at Site 2 during the June sampling period and was not exceeded during the July sampling period. Copper concentrations ranged between 0.00166 mg/L at Site 3 on June 11, 2019 and 0.00552 mg/L at Site 2 on June 14, 2019. The average concentration of copper was calculated to be 0.00355 mg/L for the June sampling period and 0.00346 mg/L for the July sampling period.

The overall health of the Little Pine River Watershed was determined using the ratings from surface water quality, forest conditions, and wetland conditions, which are combined to give a grade rating for the Watershed Report Card. Given that there were four exceedances of *E. coli* and phosphorus, the overall health of the Little Pine River Watershed surface water quality has received a rating of 'B' for its Watershed Report Card rating which is of good quality. The Little Pine River forest conditions based on forest coverage, forest interior, and riparian zone forested, were determined to result in a rating of 'B'. The Little Pine River wetland conditions based on percentage wetland cover was determined to result in a rating of 'B'.

Based on these rating and other observed conditions, the Little Pine River Watershed has been determined to be in good overall health.

6 CONCLUSION

The Little Pine River Watershed was determined to be in good overall health. Surface water quality at the time of the study was good, with the exceedances of the Provincial Water Quality Objectives being mostly attributed to natural sources. Plant species composition seems characteristic of the boreal forest, with diversity at each site among the overstory, understory, and herb layer. A more comprehensive fauna study would give a clear indication of the species and populations present, but at the time of the study multiple species were observed giving a good representation of a typical boreal forest area. Water levels appeared consistent with previous water markings. Erosion was not a major concern, as most the stream banks were stable. Stream cover was often provided by shrubs and trees growing along the river banks which also helped prevent erosion. The bridge and both culverts were in stable condition with no immediate concern for maintenance.

7 RECOMMENDATIONS

Upon completion of the 2019 Little Pine River Watershed Assessment Report, the following recommendations are provided for consideration:

- Staff and funding permitting, it is recommended that an update to the 2019 Little Pine River Watershed Assessment be completed in the next five to ten years.
- Benthic sampling and monitoring should be considered for future watershed assessments because it is a useful indicator of water quality over time.
- Additional sampling should be conducted in the spring to observe the water quality differences between high and low flow seasons.
- A copy of this report should be provided to the Municipality of Neebing for reference purposes. The Report should be kept on file at the LRCA Administration Office for review by interested parties.

8 REFERENCES

Beatty, J. M., & Russo, G. A. (2014). *Ambient Water Quality Guidelines for Selenium Technical Report Update* (Tech.). Retrieved August 7, 2019, from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/bc_moe_se_wqg.pdf

CCME 2013. *Canadian Soil Quality Guidelines for Barium: Protection of Human Health. Scientific Criteria Document.* Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment. 2009. *Canadian water quality guidelines for the protection of aquatic life: Boron*. In: Canadian environmental quality guidelines, 2009, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment. 2001. *Canadian water quality guidelines for the protection of aquatic life: Arsenic.* Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment. 1999. *Canadian water quality guidelines for the protection of aquatic life: Chromium — Hexavalent chromium and trivalent chromium.* In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment. 1999. *Canadian water quality guidelines for the protection of aquatic life: Molybdenum*. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment. 1999. *Canadian water quality guidelines for the protection of aquatic life: Thallium*. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Conservation Ontario. “2011 Guide to Developing Conservation Authority Watershed Report Cards”. 2011. Print.

Cudmore, Becky and Nicholas E. Mandrak. “The Baitfish Primer”. Fisheries and Oceans Canada. Winnipeg, Manitoba. 2011. Print.

Dickinson, T., Metsger, D., Bull, J., & R. Dickinson. "The ROM Field Guide to Wildflowers of Ontario". Royal Ontario Museum and McClelland and Stewart Ltd., Toronto, Ontario. 2004. Print.

Early Detection and Distribution Mapping System Ontario Thunder Bay. (2019, August). Retrieved August 13, 2019, from http://www.eddmaps.org/ontario/distribution/results.cfm?ontarioid=7&ontarioname=Thunder Bay

Environment and Climate Change. (2017, May 5). *Canadian Water Quality Guidelines for the Protection of Aquatic Life - Aluminium (Withdrawn)* (Rep.). Retrieved August 2, 2019, from Government of Canada website: http://ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=A456381D-1&printfullpage=true

Environment Canada. Canadian Climate Normals 1971-2000 Station Data. Online. Accessed: August 2019. Available: http://climate.weather.gc.ca/climate_normals/results_e.html?stnID=4055&autofwd=1

Environment Canada. "Daily Data Report - Thunder Bay". Online. Accessed: August 2019. Available:http://climate.weather.gc.ca/climate_data/daily_data_e.html?StationID=30682

Federal-Provincial-Territorial Committee on Drinking Water. (2019, May). *Strontium in Drinking Water - Guideline Technical Document for Public Consultation* (Tech.). Retrieved August 7, 2019, from Government of Canada website: https://www.canada.ca/en/health-canada/programs/consultation-strontium-drinking-water/document.html#4

Filella, M., Belzile, N., & Chen, Y. (2001, May 21). *Antimony in the environment: A review focused on natural waters* (Rep.). Retrieved August 2, 2019, from Earth-Sciences Review website: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.463.2405&rep=rep1&type=pdf

Frondriest Environmental Inc. (n.d.). *PH of Water*. Retrieved August 2, 2019, from https://www.fondriest.com/environmental-measurements/parameters/water-quality/ph/

Harris, Allan G., S.C. McMurray, P.W.C. Uhlig, J.K. Jeglum, R.F. Foster and G.D. Racey. "Field Guide to Wetland Ecosystem Classification for Northwestern Ontario". Queen's Printer for Ontario, Ontario, Canada. 1996. Print.

Health Canada. "Guidelines for Canadian Recreational Water Quality – Third Edition". Ministry of National Health and Family Welfare. 1992. Ottawa: Supply and Services Canada. Online. Accessed: June 2017. Available: <https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-recreational-water-quality-third-edition.html>

Health Canada. (n.d.). (Tech.). Retrieved August 2, 2019, from https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-cadmium.html

Health Canada. (1987). (Tech.). Retrieved August 8, 2019, from https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-zinc.html

Lakehead Region Conservation Authority. "Thunder Bay Aquifer Characterization, Groundwater Management and Protection Study". July 2005. Print.

Lakehead Region Conservation Authority. "Lakehead Source Protection Area Watershed Characterization Report". March 2008. Print.

Legasy, Karen, Shayna LaBelle-Beadman, and Brenda Chambers. "Forest Plants of Northeastern Ontario". Canada. Lone Pine Publishing & Queen's Printer for Ontario. 1995. Print.

Lenntech B.V. "Aluminum and water: reaction mechanisms, environmental impact and healtheffects" .Online. Accessed: June2017. Available: <http://www.lenntech.com/periodic/water/aluminium/aluminum-and-water.htm#ixzz2bJ86RbwN>

Ministry of the Environment and Climate Change (MOECC). "Policies, Guidelines, Provincial Water Quality Objectives". Toronto, Ontario. Queen's Printer. July 1994. Online. Accessed: July 2019. Available: <https://www.ontario.ca/document/water-management-policies-guidelines-provincial-water-quality-objectives>

Ministry of Natural Resources, Thunder Bay District. (2004, May). Western Lake Superior Conservation Reserve (C2260) Statement of Conservation Interest. Retrieved July 23, 2019.

Municipality of Neebing. "Municipality of Neebing Zoning By-Law No. 806-2010". Online. Accessed: June 2019. Available: <http://www.neebing.org/by-laws-and-policies.html>

Nagpal, N.K., Ph.D., P.Ag. (2004). Technical Report- Water Quality Guidelines for Cobalt (Tech.). Victoria, BC: Water Protection Section Water, Air and Climate Change Branch Ministry of Water, Land and Air Protection.

Natural Resources Canada. Forest Classification. Online. Accessed: August 2019. Available: <https://www.nrcan.gc.ca/forests/measuring-reporting/classification/13179>

Newmaster, Steven G., Allen G. Harris, and Linda J. Kershaw. "Wetland Plants of Ontario". Toronto, Ontario. Queen's Printer. 1997. Print.

Ontario Geological Survey. "Map 2545 Bedrock geology of Ontario, explanatory notes and legend". Ontario. Queen's Printer. 1991. Print.

Ontario Ministry of Natural Resources and Forestry. "Species at Risk in Thunder Bay Region." Queen's Printer for Ontario. Online. Accessed: November 2016. Available: <https://www.ontario.ca/environment-and-energy/species-risk-region?name=Thunder%20Bay>

Ontario Nature. 2016. Ontario Reptile and Amphibian Atlas. Online. Accessed: August 2019. Available: <https://ontarionature.org/programs/citizen-science/reptile-amphibian-atlas/>

Pine Bay Nature Reserve - Part I & II. (n.d.). Retrieved from http://www.tbfn.net/pine-bay-ii

R. J. Burnside and Associates Limited, AMEC Earth and Environmental, and Lakehead Region Conservation Authority. "The Lakehead Region Conservation Authority Thunder Bay Area Aquifer Characterization Groundwater Management and Protection Study Final Report". July 2005. Print.

Sims, Richard A., William D. Towill, Kenneth A. Baldwin, and Gregory M. Wickware. "Field Guide to Forest Ecosystem Classification for Northwestern Ontario". Twin Offset Ltd., Ontario, Canada. 1997. Print.

Toronto Entomologists' Association. Ontario Butterfly Atlas Online. Online. Accessed: June 2019. Available: <http://www.ontarioinsects.org/atlas_online.htm>

United States Geographical Survey (USGS). Hem, John D. "Study and interpretation of the chemical characteristics of natural water". 3rd ed. U.S. Geological Survey Water-supply Paper 2254. Department of the Interior. United States Government Printing Office. 1985. Print.

World Health Organization. (2009). *Potassium in drinking-water - Background document for development of WHO Guidelines for Drinking-water Quality* (Rep.). Switzerland: World Health Organization.

Figures

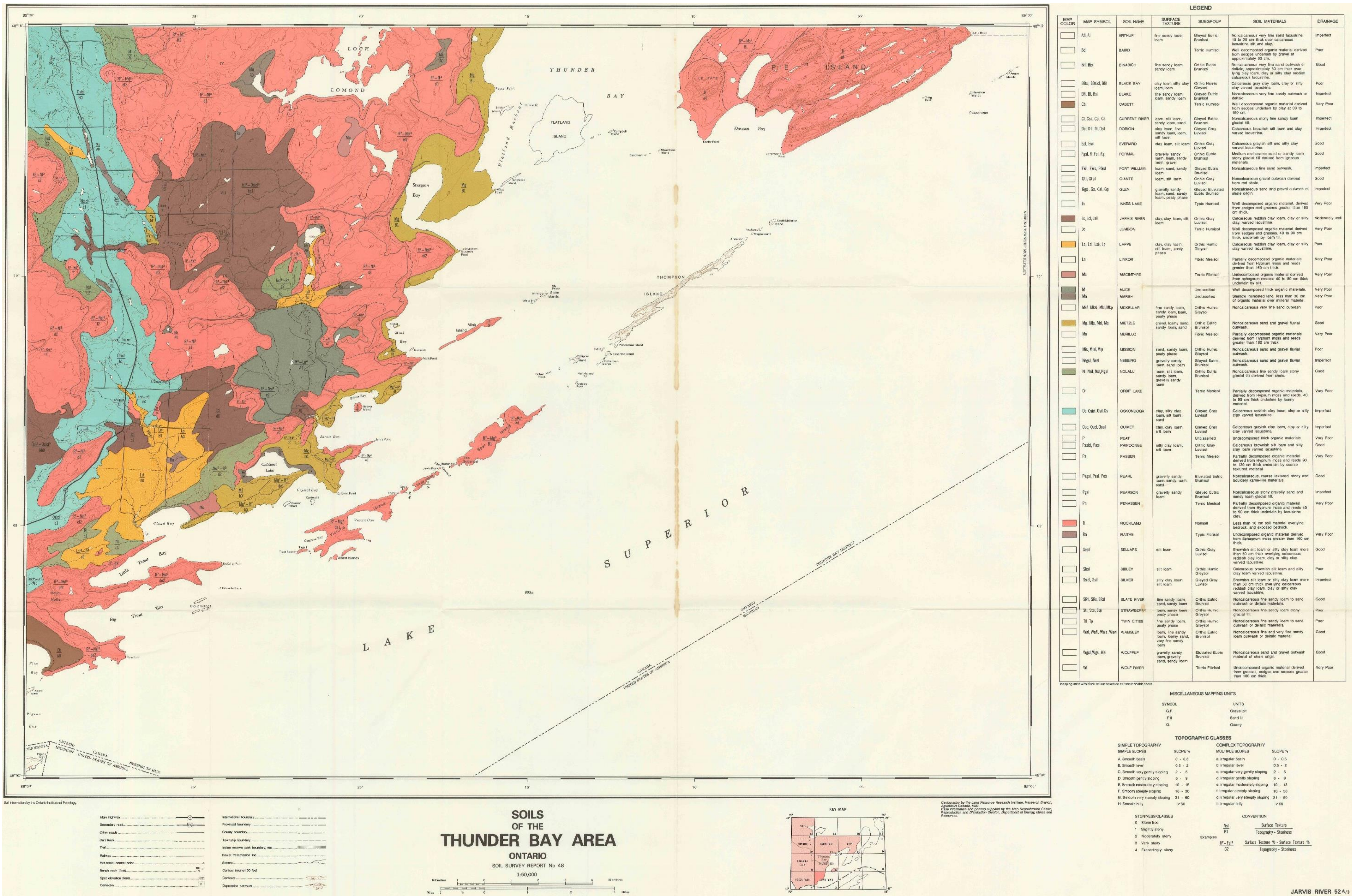


Figure 1: Soils of the Thunder Bay Area

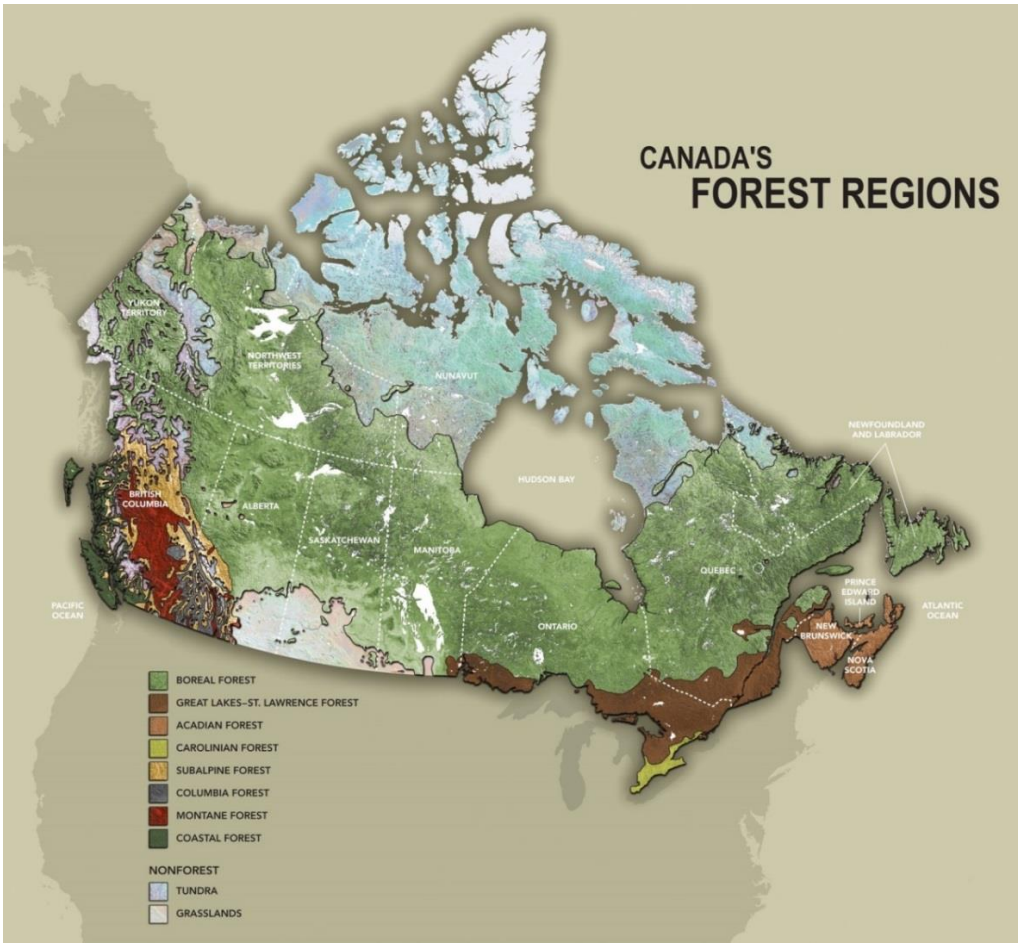


Figure 2: Canada's Forest Regions (Canadian Forest Service, 2013)

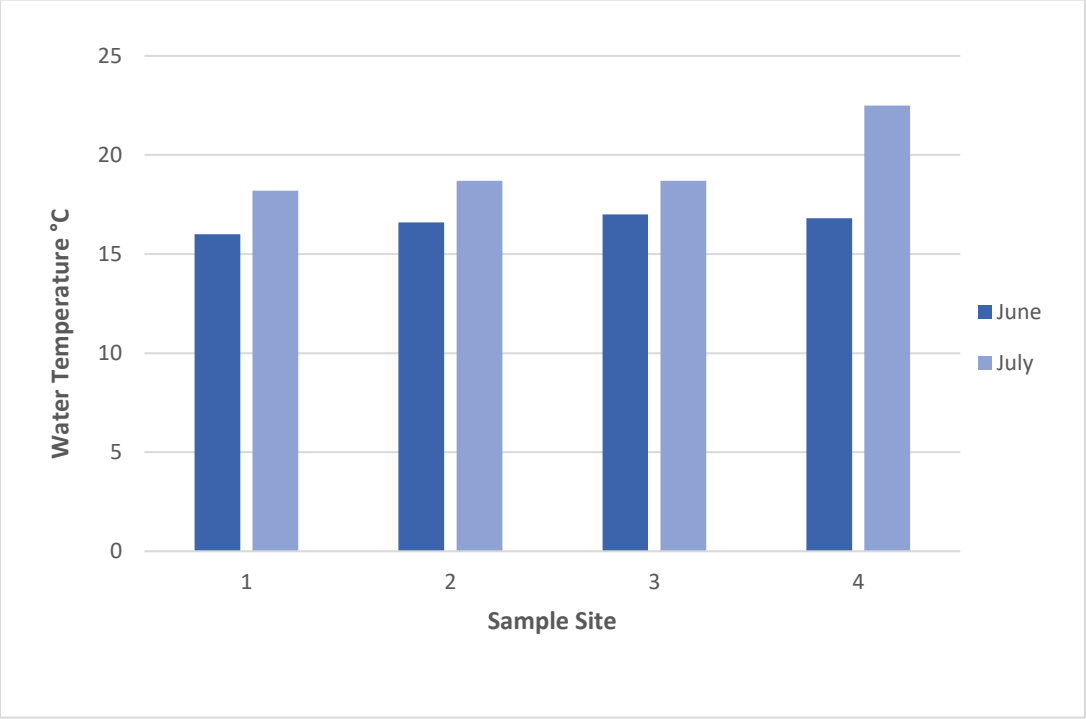


Figure 3: Water Temperature at Little Pine River Sample Sites

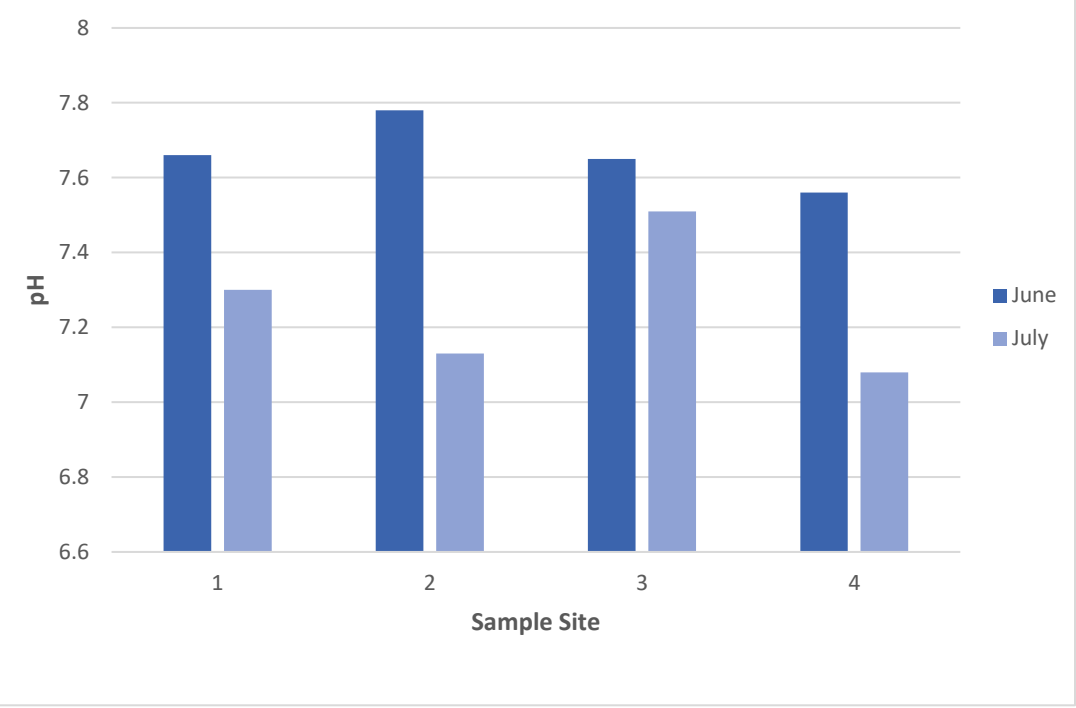


Figure 4: pH Level at Little Pine River Sample Sites

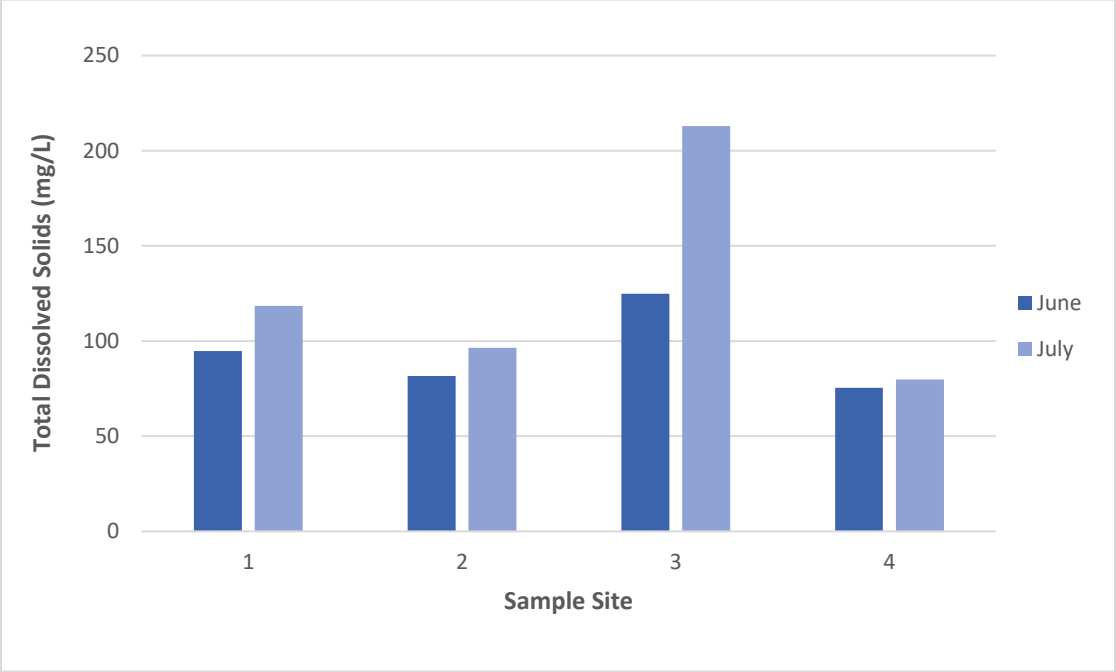


Figure 5: Total Dissolved Solids at Little Pine River Sample Sites

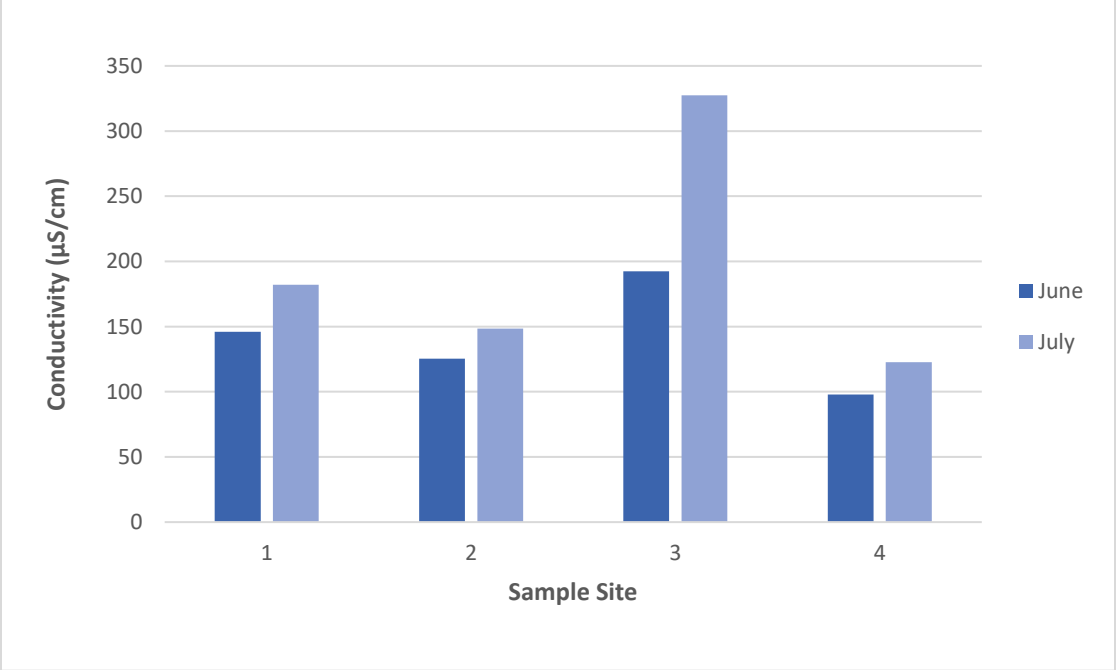


Figure 6: Conductivity at Little Pine River Sample Sites

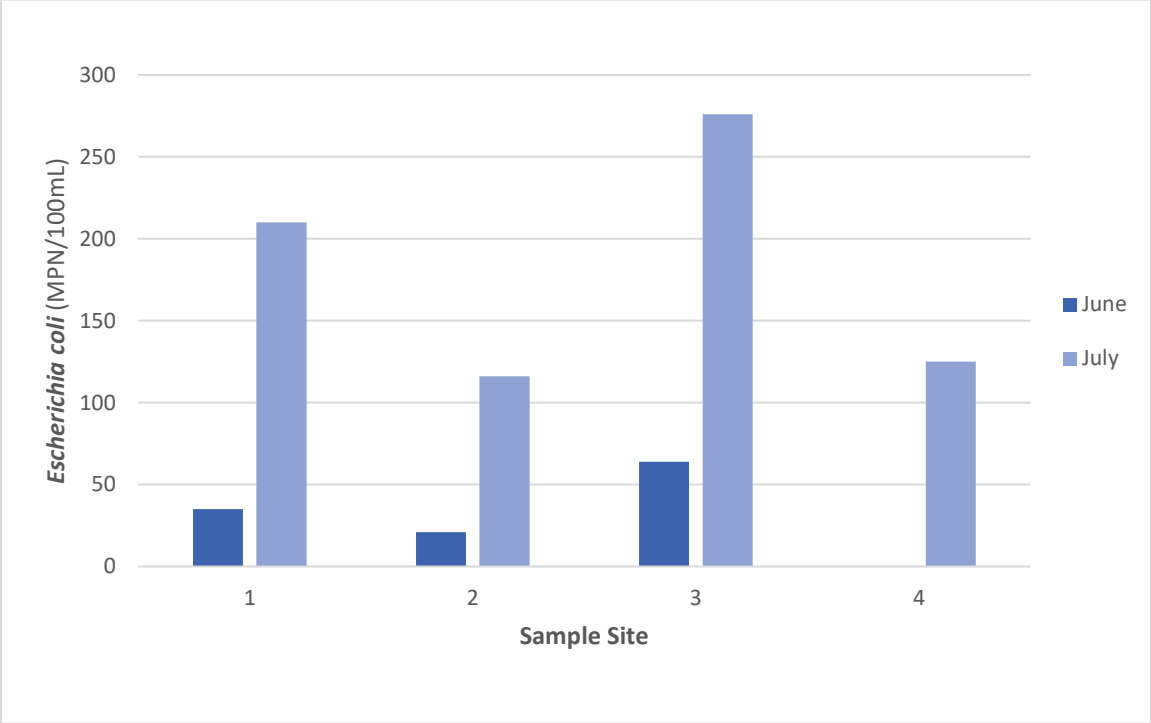


Figure 7: *Escherichia coli* Bacteria Counts at Little Pine River Sample Sites

Maps

LAKEHEAD REGION
CONSERVATION AUTHORITY

Little Pine River Watershed

M-1: Key Plan

N

TOWNSHIP OF DORION

MUNICIPALITY OF SHUNIAH

TOWNSHIP OF CONMEE

CITY OF THUNDER BAY

MUNICIPALITY OF OLIVER PAIPOONGE

TOWNSHIP OF O'CONNOR

TOWNSHIP OF GILLIES

MUNICIPALITY OF NEEBING

Little Pine River Watershed

Caribou Is.

Brodeur Is.

Grey Is.

Shaganash Is.

Edward Is.

Porphyry Is.

Pie Is.

Flatland Is.

Thompson Is.

Spar Is.

Victoria Is.

Isle Royale

Michigan

Minnesota

Lake Superior

Legend

- Little Pine River Watershed
- Municipal Boundary
- LRCA Jurisdiction Boundary
- Water Body

0 10 20 km

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

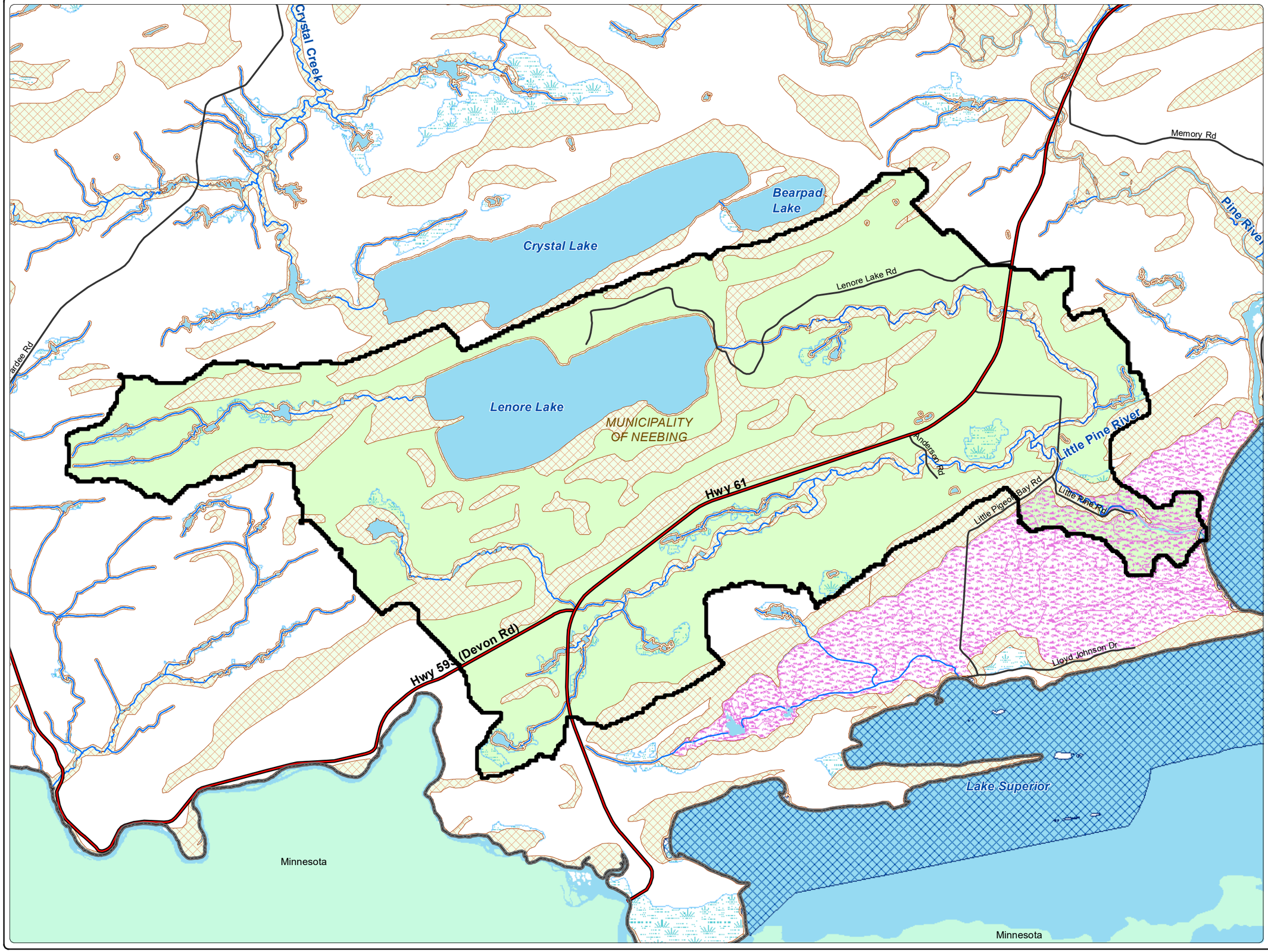
This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

Datum: NAD 83
Projection: UTM Zone 16N
Date: June, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-2: Regulated Area



N

Legend

- Approximate Regulated Area
- Approximate Regulated Area within Lake Superior
- Little Pine River Watershed
- Municipal Boundary

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street

0 500 1,000 1,500 m

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

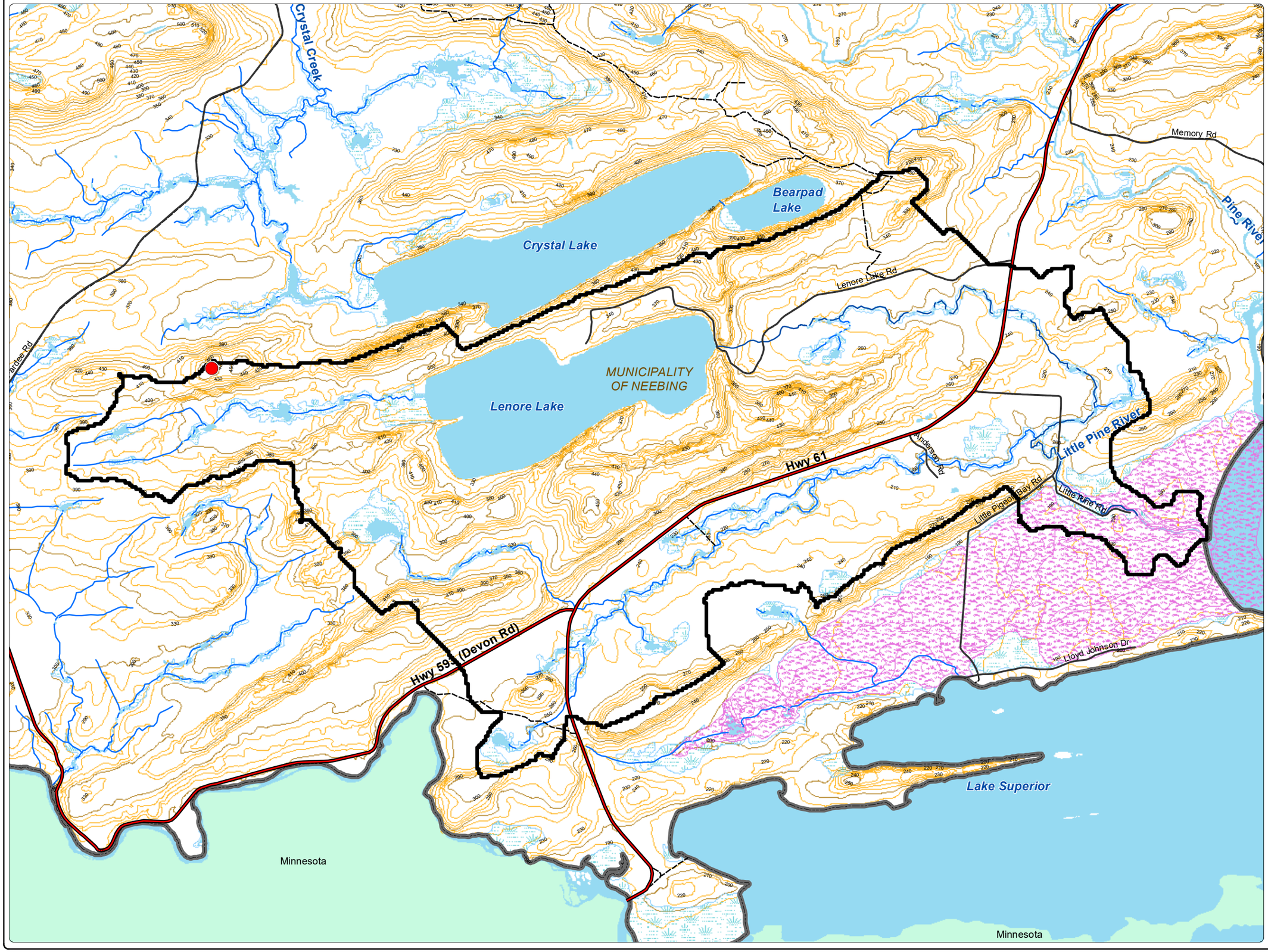
Datum: NAD 83
Projection: UTM Zone 16N
Date: June, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-3: Topography

N



Legend

- Highest Point in Watershed
- Little Pine River Watershed
- Municipal Boundary

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Contour Lines

- 10m Contour Intervals
- 50m Contour Intervals

Roads

- Highway
- Road
- Street
- Bush Roads

0 500 1,000 1,500 m

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

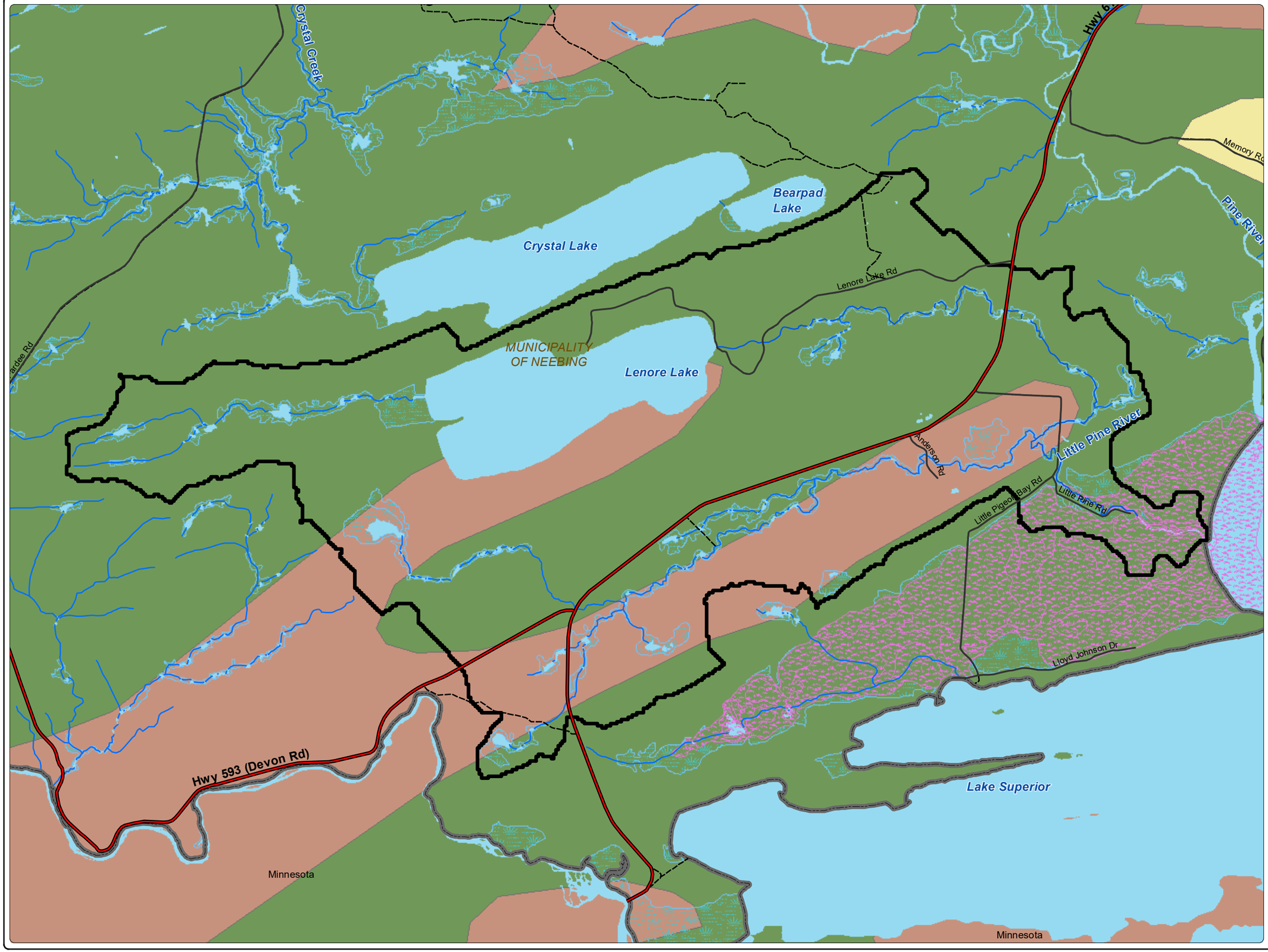
Datum: NAD 83
Projection: UTM Zone 16N
Date: June, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-4: Bedrock Geology

N



Legend

- Abandoned Mines Points
- Little Pine River Watershed
- Municipal Boundary

Bedrock Formation

PALEOPROTEROZOIC

- 22a, Sedimentary rocks

MESOPROTEROZOIC

- 31c, Mafic and related intrusive rocks (Keweenawan age)
- 31a, Mafic and related intrusive rocks (Keweenawan age)

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 500 1,000 1,500 m

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

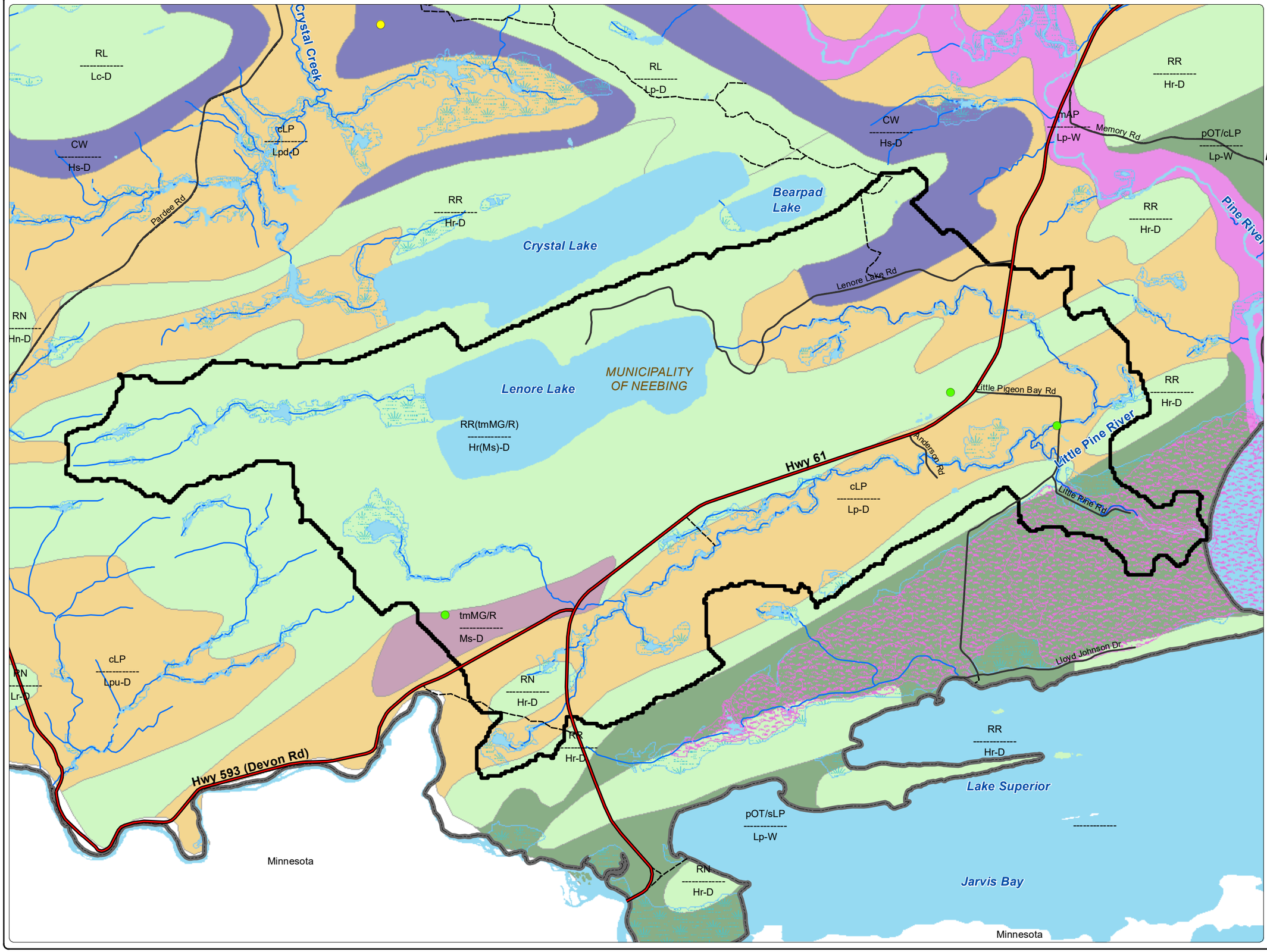
Datum: NAD 83
Projection: UTM Zone 16N
Date: June, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-5: Surficial Geology

N



Legend

- Little Pine River Watershed
- Municipal Boundary

Surficial Geology

- Alluvial
- Bedrock
- Esker/Kame/Outwash plain
- Glaciolacustrine plain
- Moraine
- Organics
- Slope/Talus pile

Surficial Points Features

- QUARRY/MINE WORKINGS
- SAND/GRAVEL PIT
- TALUS

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 500 1,000 1,500 m

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

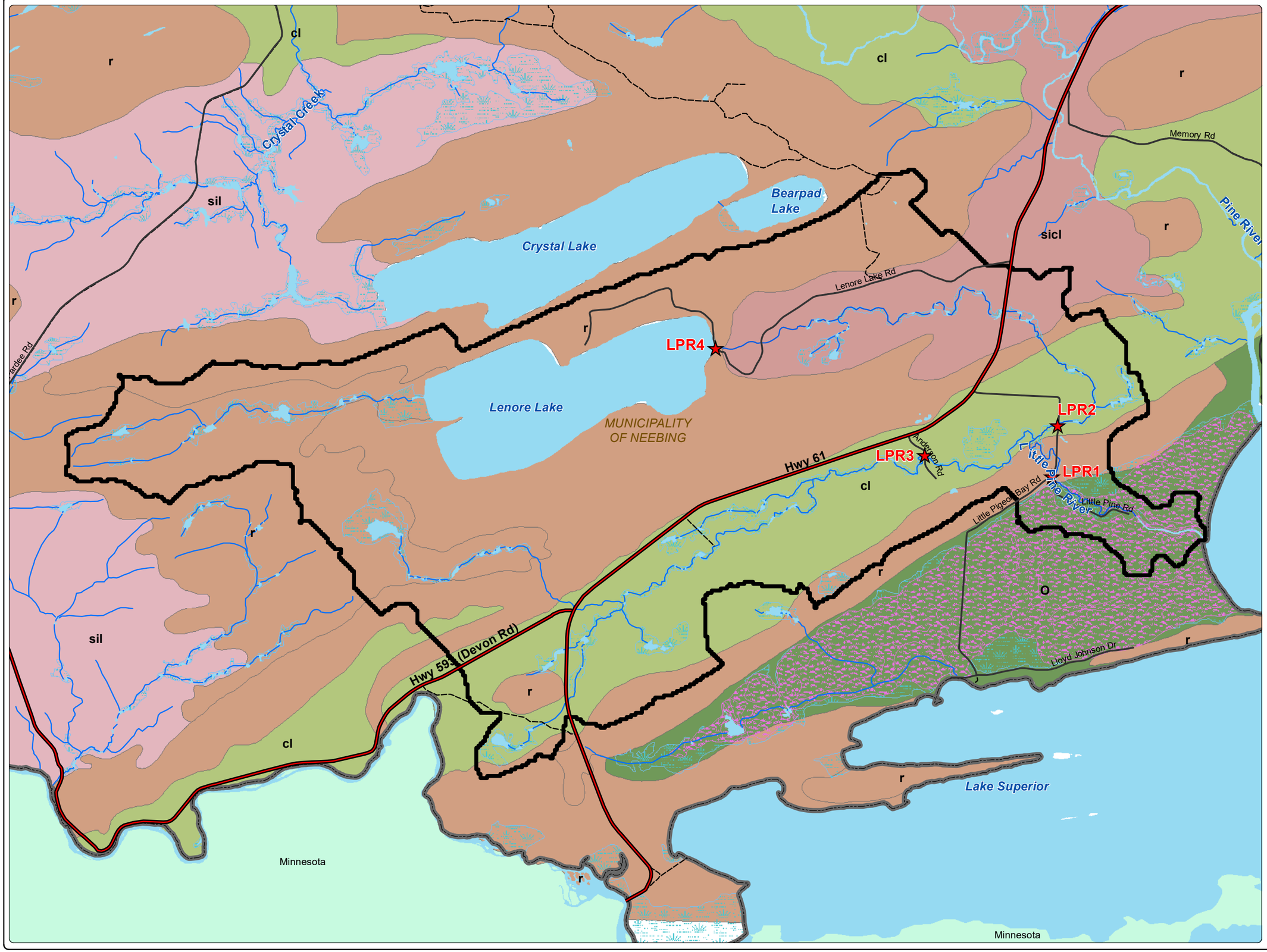
This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

Datum: NAD 83
Projection: UTM Zone 16N
Date: June, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-6: Soils



N

Legend

- Sampling Sites
- Little Pine River Watershed
- Municipal Boundary

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

OMAFRA Soils

- Organic (O)
- Clay (c)
- Clay Loam (cl)
- Fine Sandy Loam (fsl)
- Gravel (g)
- Gravelly Sand (gs)
- Gravelly Sand Loam (gsl)
- Medium to Moderately Fine Loam (l)
- Loamy Sand (ls)
- Peaty Phase (pp)
- Rock (r)
- Coarse Sand and Loamy Sand (s)
- Silty Clay Loam (sicl)
- Silt Loam (sil)
- Moderately Coarse Sandy Loam (sl)
- Very Fine Sandy Loam (vfsl)

Roads

- Highway
- Road
- Street
- Bush Roads

0 500 1,000 1,500 m

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

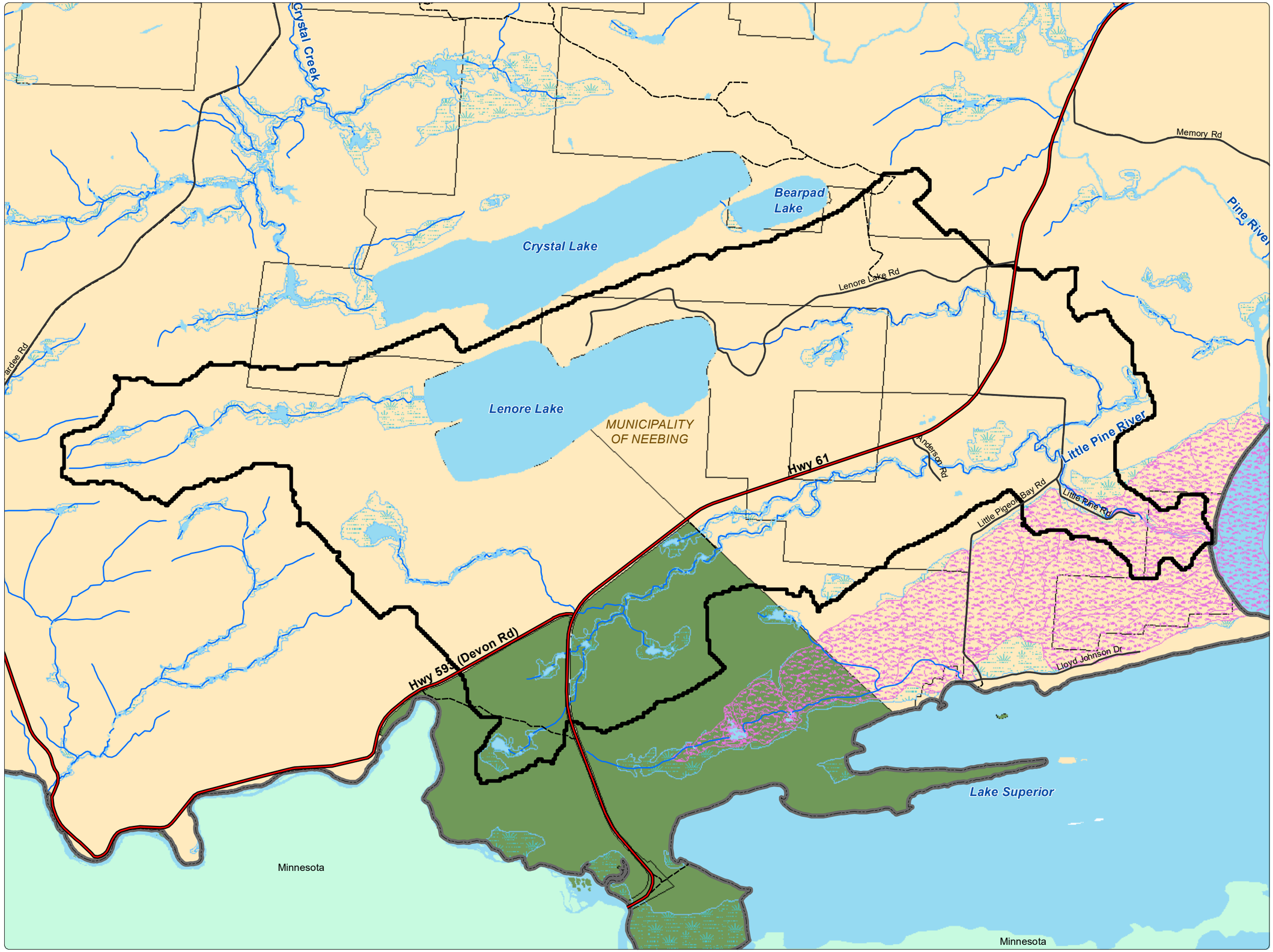
Datum: NAD 83
Projection: UTM Zone 16N
Date: August, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-7: Land Ownership

N



Legend

- Little Pine River Watershed
- Municipal Boundary

Land Ownership

- Crown Land
- Private Land

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 500 1,000 1,500 m

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

Datum: NAD 83
Projection: UTM Zone 16N
Date: June, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-8: Zoning

N

Crystal Creek
Bearpad Lake
Crystal Lake
Lenore Lake
MUNICIPALITY OF NEEBING
Memory Rd
Pine River
Lenore Lake Rd
Hwy 61
Anderson Rd
Little Pine River
Little Pigeon Bay Rd
Little Pine Rd
Lloyd Johnson Dr
Hwy 593 (Devon Rd)
Lake Superior
Minnesota
Minnesota

Legend

- Little Pine River Watershed

Municipality of Neebing Zoning

- A - Agricultural Zone
- C1 - General Commercial Zone
- C2 - Recreation Commercial Zone
- D - Disposable Industrial Zone
- E - Extractive Industrial Zone
- I - Institutional Zone
- M1 - Light Industrial Zone
- OS - Open Space Zone
- S - Seasonal
- WR - Watershed Reserve Zone
- UL - Use Limitation Zone
- RU - Rural Zone

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 500 1,000 1,500 m

Zoning Information based on the best available information, not all zones may be depicted.

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

Datum: NAD 83
Projection: UTM Zone 16N
Date: August, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-9: Site Plan

N

Legend

- Sampling Sites
- Municipal Boundary

Drainage

- Water Body
- Wetland
- Provincially Significant Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 0.5 1 1.5 km

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

Datum: NAD 83
Projection: UTM Zone 16N
Date: July, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

Little Pine River Watershed

M-10: Bridge & Culvert Sites

N

Legend

- Confulence
- Bridge
- Culvert
- Little Pine River Watershed
- Municipal Boundary

Drainage

- Water Body
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street

0 500 1,000 1,500 m

This publication was produced by:
Lakehead Region Conservation Authority
130 Conservation Rd.
Thunder Bay, ON
P7B 6T8

Base data used under license through the members of the Ontario Geospatial Data Exchange.

This map is illustrative only. Do not rely on it as being a precise indicator of routes or features, nor as a guide to navigation.

Datum: NAD 83
Projection: UTM Zone 16N
Date: July, 2019

Appendix A:

Soil Logging Summary and Photography

Appendix A: Soil Logging Summary and Photography

Soil Logging Summary

SITE ID	Organic Layer "O"	"A" Horizon	"B" Horizon	"C" Horizon
LPR1		0-38cm Silty Sand		38-cm Clay Loam
LPR2		0-27cm Silty Clay		27-50cm Silty Clay
LPR3		0-36cm Clay Loam	36-50 cm Loamy Sand	50-65 cm Clay Loam
LPR4				0-28cm Sandy Loam

Soil Photography

Site 1

Site 2

Site 3

Site 4

Appendix B:

Common and Scientific Names of Identified Flora and Fauna

Appendix B: Common and Scientific Names of Identified Flora and Fauna

Flora	
Common Name	**Scientific (Latin) Name**
Trees	
Balsam fir	*Abies balsamea*
Black ash	*Fraxinus nigra*
Black spruce	*Picea mariana*
Eastern White Cedar	*Thuja occidentalis*
Mountain ash	*Sorbus aucuparia*
Trembling aspen	*Populus tremuloides*
White birch	*Betula papyrifera*
White pine	*Pinus strobus*
White spruce	*Picea glauca*
Shrubs	
Chokecherry	*Prunus virginiana*
Green alder	*Alnus viridis*
Mountain maple	*Acer spicatum*
Northern bush honeysuckle	*Diervilla lonicera*
Pin cherry	*Prunus pensylvanica*
Prickly wild rose	*Rosa acicularis*
Red-osier dogwood	*Cornus stolonifera*
Speckled alder	*Alnus rugosa*
Wild red raspberry	*Rubus idaeus*
Willow spp.	*Salix spp.*
Herbs	
Alsike clover	*Trifolium hybridum*
Aster spp.	*Asteraceae spp.*
Bird's-foot trefoil	*Lotus corniculatus*
Canada anemone	*Anemone canadensis*
Canada mayflower	*Maiantheum canadense*
Common toadflax	*Linaria vulgaris*
Cow parsnip	*Heracleum*
Cow vetch	*Vicia cracca*
Dandelion	*Taraxacum officinale*
Forget me not spp.	*Myosotis spp.*
Fragrant bedstraw	*Galium triflorum*
Fringed bindweed	*Fallopia cilinodis*
Giant goldenrod	*Solidago gigantea*
Goldenrod spp.	*Solidago spp.*
Heal-all	*Prunella vulgaris*

Flora	
Common Name	**Scientific (Latin) Name**
Herbs	
Hop trefoil	*Trifolium campestre*
Large leaved aster	*Eurybia macrophyllus*
Northern bluebells	*Mertensia paniculata*
Northern blue flag	*Iris versicolor*
Ox-eye daisy	*Leucanthemum vulgare*
Philadelphia fleabane	*Erigeron philadelphicus*
Red clover	*Trifolium pratense*
Spotted joe-pye weed	*Eutrochium maculatum*
Spreading dogbane	*Apocynum androsaemifolium*
Sweet coltsfoot	*Petasites frigidus*
Tansy	*Tanacetum vulgare*
Tall buttercup	*Ranunculus acris*
Thistle spp.	*Cirsium spp.*
White clover	*Trifoliuim repens*
White sweetclover	*Melilotus albus*
Wild sarsaparilla	*Aralia nudicaulis*
Woodland strawberry	*Fragaria vesca*
Yarrow	*Achillea millefolium*
Yellow avens	*Geum aleppicum*
Yellow hawkweed	*Hieracium pratense*
Ferns/Mosses/Graminoids/Lichens	
Canada bluegrass	*Poa compressa*
Horsetail - field	*Equisetum arvense*
Horsetail - woodland	*Equisetum sylvaticum*
Quack grass	*Elymus repens*
Reed canary grass	*Phalaris arundinacea*
Sedge spp.	*Cyperaceae spp.*
Timothy grass	*Phleum pratense*
Aquatic Plants	
Broadleaf arrowhead	*Sagittaria latifolia*

Fauna	
Common Name	**Scientific (Latin) Name**
Fish	
Minnow spp.	*Phoxinus spp.*
Invertebrates	
Black fly	*Simuliidae spp.*
Canadian tiger swallowtail	*Papilio canadensis*

Invertebrates	
Deer fly	*Chrysops spp.*
Dragonfly spp.	*Anisoptera spp.*
Grasshopper spp.	*Melanoplus spp.*
Horse fly	*Hybomitra spp.*
Monarch	*Danaus plexippus*
Mosquito	*Culicidae spp.*
Stonefly spp.	*Plecoptera spp.*
Aves	
American robin	*Turdus migratorius*
Common raven	*Corvus corax*
Turkey vulture	*Cathartes aura*
Mammals	
Moose	*Alces alces*
Amphibians	
Northern leopard frog	*Lithobates pipiens*
Toad spp.	*Bufo spp.*
Wood Frog	*Lithobates sylvaticus*

Appendix C:

Techniques for Data Collection

Appendix C: Techniques for Data Collection

Air Temperature
The air temperature was measured with a basic mercury thermometer.

Channel Width & Depth
The width of the stream was measured using a nylon measuring-tape reel. Channel depth was measured by using a stainless steel meter stick.

Conductivity
Conductivity was measured with the YSI Pro DSS. The accuracy of the reading was ±0.001 mS/cm or ±1.0%; whichever was greater. The readings were recorded once the probe was completely submerged and all readings stabilized. In addition to conductivity readings taken in the field, laboratory analysis of the samples provided a second reading of conductivity which is included within the results.

Dissolved Oxygen
The YSI Pro DSS measured dissolved oxygen for the samples. The readings were recorded once the probe was submerged in the water and all variables were stabilized.

Flora and Fauna Identification
Identification was made in the vicinity of the sample sites, no transects were made. Observations were made approximately 50 metres from either stream edge. Field guides and the INaturalist app were used to accurately identify species.

Flow
The velocity of river flow at sites was measured using a stick and nylon measuring-tape reel. Distances measured varied depending upon stream obstructions and variable depth. The flow was then calculated using the equation **Q=V*A**, where **Q** is flow/ discharge, **V** is velocity (distance divided by time), and **A** is the cross sectional area of the stream.

Latitude, Longitude, and Elevation
The Universal Transverse Mercator (UTM) coordinates for each site were measured with a Trimble Geo XH 2008 hand held GPS unit.

Location
The sample sites were chosen using a 1:50,000 scale topographic map. The sample sites were also described in terms of road access and road crossings.

pH
The YSI Pro DSS measured pH for the water sample sites. The readings were recorded once the probe was submerged in the water and all the variables were stabilized. A pH reading was also taken during the analysis at the laboratory.

Photographs
Photographs were taken at each site using the Olympus Tough TG-5 shock and water proof camera. Upstream, downstream, soil, and vegetation photographs as well as culvert and outstanding litter or erosion photographs were all taken at each site. Substrate photographs were attempted at each site with the waterproof camera.

Surface Water Sampling
Samples were taken at the same position at each site wherever possible. Grab sampling technique was used when conducting surface water sampling. Sample bottles were pre-charged with preservatives, so this did not have to be done in the field. Sample bottles were submerged 15 to 30 centimetres below the surface of the water body and positioned towards the flow of the water source. Samples were kept cool and delivered to ALS Laboratory for analyzing.

Total Dissolved Solids
The total dissolved solids (TDS) were measured in laboratory.

Turbidity
Turbidity of the water was measured with the YSI Pro DSS. The readings were taken after the probe was submerged and all variables on the meter were stabilized.

Water Temperature
Water temperature was measured with the YSI Pro DSS. The readings were taken after the probe was submerged and all variables on the meter were stabilized.

OBBN In-Stream Materials Key

Soil Type
Like stream bed description, soil type on land will impact vegetation and erosion potential. Soil type was categorized based on its grain size using the FEC Manual for North Western Ontario.

Stream Bed Description

The bed description was described by means of a visual scan of the sample site area, with percentages assigned to the appropriate categories of varying grain sizes:

Grain Size	Description
Boulder	> 25.6 cm in diameter
Cobbles	6.4 - 25.6 cm in diameter
Gravel	0.2 – 6.4 cm in diameter
Sand	< 0.2 cm in diameter
Silt	Finer inorganic material than sand
Organic	Mainly organic combination of silt and clay
Clay	Inorganic origin with no apparent structure

Stream Cover

Stream cover describes the vegetation density along the river bank no more than 5 metres from the water's edge. Stream cover was divided into three categories of density:

Description	% Cover
Dense	75-100% shaded by canopy
Partly Open	25-75% shaded by canopy
Open	0-25% shaded by canopy

Appendix D:

Summary of Water Quality Parameters

Appendix D: Summary of Water Quality Parameters

Physical Properties

The abiotic factors of water quality are very influential on aquatic plants and animals and can have a significant impact on the ecosystem. The following physical parameters were measured either in the field or in the laboratory.

Conductivity
Conductivity is the measure of the ability of water to carry an electrical current expressed in micro seimens per centimeter (µS/cm). The reading is used to determine the total dissolved solids (TDS) in the water sample. There is no Provincial Water Quality Objective (PWQO) for conductivity.

Dissolved Oxygen
Like terrestrial animals, fish and other aquatic species require oxygen to breathe. It is not the mere presence of dissolved oxygen that is important; the gas has to be above a certain concentration in order to sustain life. As well, oxygen is required to decompose organic matter in the stream. Dissolved oxygen levels will be highest and during the day when aquatic plants have had time to produce oxygen during photosynthesis, as well as in cold and turbulent (a lot of mixing at the air-water interface) water. PWQO's have an acceptable range for dissolved oxygen in water dependent upon temperature. At 15 degrees Celsius the minimum amount of dissolved oxygen is 5 mg/L and at 20 degrees Celsius the minimum amount of dissolved oxygen is 4 milligrams per litre for cold water biota.

pH
The pH measures the concentration of hydrogen ions in the water based on a logarithmic scale of 0 to 14. Lower pH is acidic (many free hydrogen ions) and higher pH is alkaline (few free hydrogen ions). The pH of water determines the solubility and biological availability of chemicals constituents such as nutrients (eg. nitrogen, phosphorus) and heavy metals (eg. lead, copper). Extreme pH levels can increase the solubility of elements and compounds and it can make potentially toxic chemicals more mobile and increase the risk of absorption by aquatic life (Frondriest Environmental Inc.). The natural factors that can affect pH are interactions with surrounding rocks and other materials, precipitation (especially acid rain), and CO_2 concentrations. The anthropogenic factors that influence pH include wastewater and mining discharges, acid rain as a result of emissions from mining or fossil fuel combustion, and point source pollution from agricultural runoff (Frondriest Environmental Inc.). Geology of the watershed can give the river some buffering capacity to resist changes in pH but overall the range should stay between 6.5 and 8.5 to protect aquatic life, and avoid irritation to anyone using the water for recreational purposes.

Temperature

Water temperature is important because it dictates the kind of aquatic life that can live in a stream. Fish, insects, plankton and other aquatic species all have a preferred temperature range. If the temperature goes too far above or below their preferred range, the number of species may decrease. Temperature also influences water chemistry, generally causing chemical reactions to increase with higher temperatures. Temperature can also affect biological activity because warmer water holds less dissolved oxygen which can harm fish and aquatic life that require a high dissolved oxygen to live. Warmer temperatures also encourage bacteria to reproduce and grow more quickly. Temperature can vary depending on the source of the water, depth, and velocity of the stream, sunlight intensity and the amount of shade by the shoreline vegetation. There is no PWQO for temperature.

Total Dissolved Solids

Total dissolved solids (TDS) measure the amount of inorganic salts and small amounts of organic matter that is dissolved in water. The principal constituents are usually calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate, and nitrate (from agricultural use). Most of these originate from natural geological sources yet high levels may indicate runoff from of road salts, runoff from agricultural and erosion from exposed soil/no stream bank vegetation. There is no PWQO for TDS.

Turbidity

Turbidity is the measure of the relative clarity of water. Turbidity in water is caused by suspended matter such as silt, clay and algae that can often be seen in the sunlight. The diversity of species can be affected by how far the sunlight can penetrate the water column. Fish gills can become clogged with this suspended material, and the material may also settle on top of fish spawning grounds (and their eggs). Highly turbid water appears murky or dirty. Turbidity will often become higher after heavy rainfall, but high levels may also indicate soil erosion. There is no PWQO for turbidity.

Nutrients

Like terrestrial plants, aquatic plants and algae require nutrients for growth and productivity. The main nutrients of concern are nitrogen and phosphorus.

Nitrogen

Nitrogen (N) is one of the most common gases in the earth's atmosphere making up approximately 78%. Nitrogen nutrients are often applied to agricultural crops as fertilizers, but having too much in a watershed can increase plant growth and productivity to unhealthy levels. Nitrogen is constantly being recycled through the environment through the nitrogen cycle which includes fixation, ammonification, nitrification, and denitrification. The most important forms that plants can readily use are ammonia, nitrate

(NO_3) and nitrite (NO_2). Nitrogen levels can be reported in several ways, results from ALS Laboratory Group were given in Total ammonia-nitrogen (mg/L), Nitrate-nitrogen (NO_3-N mg/L), and Nitrite-nitrogen (NO_2-N mg/L). There is no PWQO for ammonia total. The PWQO for un-ionized ammonia is 0.02 mg/L.

Phosphorus

Total phosphorus gives a measurement of all forms of phosphorus found in the watershed, but the most important form within this measurement is soluble inorganic phosphate (PO_4) or orthophosphate ion (PO_4^{-3}). These two forms are of utmost importance because they are utilized by aquatic plants. While phosphorus is essential to life, too much can increase algae growth within the watershed. Excessive growths or build ups of algae on abiotic features (like rocks) can use up all the dissolved oxygen leaving other species, like fish, with anoxic (no oxygen) conditions. Nutrient loading may cause a decrease in biodiversity and a decrease in ecologically sensitive species. Natural decomposition of organic matter such as leaves, twigs, and grass that is washed into the stream during the winter does constitute an important source of nutrients. However, high levels of phosphorus may indicate unnatural sources such as detergent, pesticide, and fertilizer runoff or waste from farms contaminating the watershed. The PWQO criteria for phosphorus is 0.03 mg/L.

Bacteria

Escherichia coli

Escherichia coli (*E. coli*) are bacteria naturally found in the intestines of humans and warm-blooded animals. Unlike other bacteria in this family, *E. coli* does not usually occur naturally on plants or in soil and water. The inability of *E. coli* to grow in aquatic environments, combined with its short survival time means that the detection of *E. coli* in a water system is a good indicator of recent fecal contamination. Potential sources of *E. coli* include: leaking septic systems, runoff from manure storage facilities, or wild animal waste (i.e. American beavers and Canadian geese). These bacteria can cause irritation of the skin and eyes when contact is made, and can cause gastro-intestinal disorders in humans. The PWQO for *E. coli* is 100 *E. coli* per 100 mL.

Total Coliforms

Total coliforms are a group of bacteria that are naturally found on plants, in soils, water, and the intestines of humans and warm-blooded animals. Due to the fact that total coliforms are widespread in the environment, they can be used as one of the many operational tools to determine the efficacy of a drinking water treatment system. The total coliform group contains various species of the genera *Escherichia, Klebsiella, Enterobacte, Citrobacter, Serratia,* and many others. There is no current PWQO for total coliforms; however, the previous guideline from prior to 1994 was 1000 MPN per 100 mL.

Metals

Most of the metals listed below are found naturally within the earth's crust and weathering of rock can transport them into surface water. The following is a complete list of the metals analysis performed on the water samples and their qualities.

Aluminum

Aluminum is the most abundant metal on Earth, comprising about 8% of the Earth's crust. It is found in a variety of minerals, such as feldspars and micas, which, with time, weather to clays. Aluminum in the aquatic environment comes from both natural and anthropogenic sources but the amount of aluminum found naturally in the environment exceeds aluminum from anthropogenic sources. Soil derived dusts from activities like farming, mining, and coal combustion can directly release aluminum into aquatic environments. Wind and water erosion from agricultural lands also releases aluminum into the aquatic environment. Acid rain can also lower environmental pH and make aluminum more soluble in the environment (Environment and Climate Change, 2017). High levels of aluminum will put strain on the kidneys of animals when they attempt to excrete it but it is not normally fatal. Aluminum and its compounds are often used in food as additives, in drugs, consumer products, and in the treatment of drinking water. Aluminum poisoning has been linked to neurological dementia in kidney dialysis patients and, in recent years, Alzheimer's disease, Parkinson's disease, and Lou Gehrig's disease. The intake of large amounts of aluminum can also cause anaemia, osteomalacia (brittle or soft bones), glucose intolerance, and cardiac arrest in humans. The PWQO guideline for aluminum varies with pH, the maximum concentration being 75 μg/L at pH >6.5.

Antimony

Antimony is a metallic element that is a blue-white colour in its stable form. Antimony is present in the aquatic environment as a result of rock weathering, soil runoff, and anthropogenic activities (Filella, M., Belzile, N., & Chen, Y., 2001). Acute intoxication is characterized by abdominal pain, vomiting, diarrhea, dehydration, muscular pain, shock, haemoglobinuria, anuria, and uraemia. In addition, severe myocardial symptoms and convulsions have been observed with acute doses of antimonials, as well some deaths were attributed to liver necrosis. Concentrations of Antimony in freshwater systems typically range from a few ng/l to a few μg/l (Filella, M., Belzile, N., & Chen, Y., 2001). The maximum concentration of antimony under PWQO guidelines is 20 μg/L.

Arsenic

Arsenic is a natural element abundantly found within the earth's crust. It may be found in some drinking water supplies, including wells. The largest natural source of arsenic is from weathered rocks and soils. The main anthropogenic source is from smelting and refining industries. Arsenic is used in manufacturing wood preservatives, herbicides, pharmaceuticals, glass manufacturing, and metallurgical applications (Canadian Council

of Ministers of the Environment, 2001). Long-term exposure (over many years or decades) to high levels of arsenic in drinking water may cause thickening and discoloration of the skin, nausea and diarrhea, decreased production of blood cells, abnormal heart rhythm and blood vessel damage, or numbness in the hands and feet. Short term exposure (days/weeks) to very high levels of arsenic can result in abdominal pain, vomiting and diarrhea, muscular cramping or pain, weakness and flushing of skin, skin rash, numbness, burning or tingling sensation on the palms of the hands and soles of the feet, or loss of movement and sensory response. The maximum concentration of arsenic under the PWQO guideline is 5 μg/L.

Barium

Barium is present as a trace element in both igneous and sedimentary rocks. Although it is not found free in nature, barium occurs in a number of compounds. Barium compounds have a wide variety of industrial applications. They are used in the plastic, rubber, electronic, and textile industries. Barium can anthropogenically enter surface water during coal processing as the effluent from a coal conversion plant contains high concentrations of barium, also through barium ore processing and subsequent industrial chemical processes involving barium. Barium can enter freshwater systems naturally through leaching and eroding of sedimentary rocks (CCME, 2013). At high concentrations, barium causes strong vasoconstriction (increase in blood pressure) by its direct stimulation of arterial muscle, peristalsis (radial contraction and relaxation of muscles) due to the violent stimulation of smooth muscle, and convulsions and paralysis following stimulation of the central nervous system. Depending on the dose and solubility of the barium salt, death may occur in a few hours or a few days. There are currently no PWQO guidelines for barium.

Beryllium

Beryllium is a hard grey metal that is extracted from the earth, refined, and reduced to a very fine powder. It occurs as a chemical component of certain rocks, coal and oil, soil, and volcanic dust. People exposed to beryllium are at risk of developing serious debilitating diseases. Chronic beryllium disease (CBD or berylliosis) is a painful scarring of the lung tissue. Less common than CBD, acute (short—term) beryllium disease, causes lung inflammation resembling pneumonia. In severe cases, both diseases may be fatal. The maximum concentration of beryllium under PWQO guidelines depends on hardness. If $CaCO_3$ is >75 mg/L, the maximum concentration of beryllium is 1100 μg/L, and if the $CaCO_3$ is <75 mg/L, the maximum concentration of Beryllium is 11 μg/L.

Bismuth

Bismuth is a brittle metal with a pinkish colour, often found in its native form. Exposure to bismuth at low doses may cause gastrointestinal disorders, low stomach acid, heartburn, bloating, calcification, warts, diarrhea, and gastric ulcers. At large doses it may cause mental confusion, memory problems, tremors, staggering gait, muscle twitching,

slurring speech, joint problems, hypoadrenalism (under activity of adrenal glands), hearing and visual disturbances, hallucinations, and coma. There are currently no PWQO guidelines limiting the intake of bismuth.

Boron

Boron is a non-metallic element that is not found in nature in its elemental form but can be found in over 80 compounds. High concentrations of boron are found in sediments and sedimentary rocks, especially in clay rich marine sediments. (Canadian Council of Ministers of the Environment, 2009). Natural sources of boron to the aquatic environment is through atmospheric deposition, natural weathering processes, volcanic emissions, soil dust, and plant aerosols. Anthropogenic sources of boron include fossil fuel combustion, biomass burning, municipal sewage, waste waters from coal-burning power plants, irrigation, copper smelters, and industries that use boron. Natural weathering of boron releases more boron into the environment than industrial sources due to the high occurrence of clay-rich sedimentary rocks on the Earth's surface. Boron concentrations in freshwater are more likely dependent on the leaching of boron from the surrounding geology than from waste water or pollution (Canadian Council of Ministers of the Environment, 2009). Exposure to boron in small doses may cause irritation to the nose, throat, and eyes. In larger doses, boron can affect the stomach, liver, kidneys, brain, and may eventually lead to death. The maximum level of boron under PWQO guidelines is 200 µg/L.

Cadmium

Cadmium is a relatively rare element and an extremely toxic metal even in low concentrations. It is used commercially as a stabilizer in plastic, in fungicides for golf courses, in televisions, in nickel–cadmium batteries, in motor oils, and in curing agents for rubber. Anthropogenic sources of cadmium are industrial wastes from metallurgical plants, plating works, plants manufacturing cadmium pigments, textile operations, cadmium-stabilized plastics, or nickel-cadmium batteries, or by effluents from sewage treatment plants (Health Canada). Natural sources of cadmium include dissolution of sediment containing cadmium, especially in more acidic waters (Health Canada). Cadmium poisoning can lead to itai-itai disease, which initiates bone softening, joint pain, and kidney failure. The interim PWQO guideline states if hardness as $CaCO_3$ is 0-100 mg/L, the maximum cadmium concentration is 0.1 µg/L, and if hardness is >100 mg/L, the maximum cadmium concentration is 0.5 µg/L.

Calcium

Calcium is the third most abundant metal in the Earth's crust. Calcium is also the most abundant metal in the human body and is the main constituent of bones. Calcium is a dietary requirement and there are no adverse health effects from intake of large doses of calcium. There are currently no PWQO guidelines for calcium.

Chromium

Chromium is a lustrous, grey metal. Natural sources of chromium include volcanic emissions, forest fires, vegetative debris, and marine aerosols (Canadian Council of Ministers of the Environment, 1999). Anthropogenic sources of chromium to the aquatic environment include tanneries, cooling towers, steel and nonferrous foundries, metal finishing and plating operations, flat glass and asbestos producing plants, wood treatment facilities, paint and chemical works, oil drilling and recovery rigs, as well as wastes from pulp and paper mills, cement and fertilizer plants, textile mills, power plants, chlor-alkali plants, petrochemical industries, as well as urban runoff and industrial storm waters (Canadian Council of Ministers of the Environment, 1999). Chromium (III) is an essential nutrient for the human body, but higher intake may cause skin rashes. Chromium (VI) is known to cause various health effects such as upset stomachs and ulcers, skin rashes, respiratory problems, weakened immune systems, kidney and liver damage, alteration of genetic material, lung cancer and death. The maximum concentration of chromium under PWQO guidelines is 1 μg/L for Chromium (VI) and 8.9 μg/L for Chromium (III).

Cobalt

Cobalt is a hard, lustrous, silver-grey metal and is found in various ores. Cobalt is an essential element for the growth of various marine algae species and it is shown to enhance the growth of plant at low concentrations. In high concentrations, cobalt can be toxic to humans as well as terrestrial and aquatic plants and animals. Cobalt is present naturally in rock, soil, water, plants, animals, and the air in small concentrations. It is often associated with nickel, silver, lead, copper, and iron ores. Cobalt can also have anthropogenic sources in the aquatic environment such as through cobalt mining, production of alloys and chemicals containing cobalt, sewage effluent, as well as urban and agricultural run-off (Nagpal, 2004). Health effects resulting from exposure to high concentrations include vomiting and nausea, vision problems, heart problems and thyroid damage. The maximum concentration of cobalt under PWQO guidelines is 0.9 μg/L.

Copper

Copper occurs in nature as a metal and can also be found in various minerals. Copper is an essential element to human metabolism, although intake at higher doses can cause adverse health effects. Acute copper poisoning can cause health effects including vomiting, diarrhea, and jaundice. In severe cases, stool and saliva may appear green or blue. In the terminal phases, anuria (kidney failure), hypotension (low blood pressure), and coma precede death. The PWQO criterion for copper is dependent upon the hardness of the water and so varies between 0.001 mg/L to 0.005 mg/L.

Iron

Iron is an abundant metal found in all types of rock. The precipitation of excessive iron creates an objectionable reddish-brown colour to water. Iron may stain plumbing fixtures, produce undesirable tastes in beverages, and promote the growth of certain iron-

bacteria, which can lead to the deposition of a slimy coating in water distribution pipes. The PWQO guideline stipulates that the levels of iron in the water must be below 300 μg/L.

Lead

Lead is a very toxic metal to all forms of life, and can cause neurological damage or death. Although natural occurrences can result from precipitation and the weathering of ores, the majority of lead in watercourses comes from anthropogenic sources. The PWQO requirement for lead varies with different alkalinity as $CaCO_3$ (mg/L). The maximum lead concentration is 5 μg/L.

Lithium

Lithium is a soft, silver-white metal belonging to the alkali metal group of chemical elements. Like all alkali metals, lithium is highly reactive and flammable. Lithium forms a minor part of igneous rocks, with the largest concentrations in granites. Lithium and its compounds have a range of effects on the human body. For instance, compounds of lithium tend to harm the kidneys and lithium carbonate can affect a person's mental health. There are no current PWQO guidelines for lithium.

Magnesium

Magnesium is very abundant in nature and is found in many minerals. It is a dietary requirement, but too much can lead to muscle weakness, lethargy and confusion. There are no current PWQO guidelines for magnesium.

Manganese

Manganese is a very common compound that can be found everywhere on earth. It is essential for humans to survive, but toxic when concentrations in the body are too high. Manganese can cause Parkinson's disease, lung embolism, and bronchitis. There are currently no PWQO guidelines for manganese.

Molybdenum

Molybdenum is an element that is found in minerals containing iron, bismuth, or copper and it is a by-product of copper and tungsten mining. It is commonly associated with coal or uranium deposits. Natural sources of molybdenum to the aquatic environment includes weathering of ores from igneous or sedimentary rocks (shale), and subsequent runoff to streams and lakes (Canadian Council of Ministers of the Environment, 1999). Anthropogenic sources of molybdenum to the aquatic environment includes use of fertilizers containing molybdenum, atmospheric wet deposition, leaching processes near molybdenum mines, and burning of fossil fuels It is used as an alloy for various metals and occurs naturally in soil and rock (Canadian Council of Ministers of the Environment, 1999). Potential health impacts associated with molybdenum include neurotoxicity and

Reproductive toxicity. The maximum concentration of molybdenum under PWQO guidelines is 40 µg/L.

Nickel

Nickel is a compound that occurs in the environment only at very low levels. An uptake of large quantities of nickel may cause higher risks of cancer, respiratory failure, birth defects and heart disorders. The maximum concentration of nickel under PWQO guidelines is 25 µg/L.

Potassium

Potassium is a soft silvery white metal, which is a key plant element and is found in most fertilizers. Potassium is an essential element in humans and is seldom found in drinking water at levels that could be a concern for healthy humans. It is present in all animal and plant tissues so it is found in all foods. Potassium is also a dietary requirement, but many potassium compounds may cause adverse health effects. Such compounds include potassium alum or potassium cyanide. There are currently no PWQO guidelines for potassium.

Selenium

Selenium is one of the rarer elements on the earth. It occurs naturally in the environment and is also released by human activities. Natural sources of selenium in the environment are volcanoes, biogenic processes, atmospheric release, and forest fires. The main source of selenium in surface water today is the result of weathering and sedimentary processes acting on volcanic parent rocks that have high concentrations of selenium (Beatty & Russo, 2014). Anthropogenic sources of selenium in the environment are industrial, agricultural, mining, and petrochemical operations, wastewater discharges from municipal sewage treatment plants, landfills, combustion of coal and fossil fuels, and emissions from smelting and manufacturing of pyritic ores (Beatty & Russo, 2014). Depending on the form of selenium varying health effects can occur including brittle hair and deformed nails, rashes, swelling of the skin, and severe pain. Selenium poisoning may become so severe that it may cause death. Background selenium concentrations in surface waters range from 0.1 to 0.4 µg/L (Beatty & Russo, 2014). The maximum concentration of selenium under PWQO guidelines is 100 µg/L.

Silver

Silver is stable in both water and air and is acid and base resistant, but corrodes when it comes in contact with sulphur compounds. Silver oxide may irritate the eyes and is harmful upon swallowing, affecting the respiratory tract and skin. Silver nitrate is much more harmful, because it is a strong oxidant. It causes corrosion, and an oral uptake can lead to vomiting, dizziness and diarrhea. The maximum concentration of silver under PWQO guidelines is 0.1 µg/L.

Sodium

Sodium is a soft, silvery-white, highly reactive metal. It is the sixth most abundant element in the Earth's crust, and exists in numerous minerals such as feldspars, sodalite and rock salt. Sodium has a number of important functions in plants, humans, and animals. In humans, it is involved in controlling the amount of fluid present in cells. An excess or lack of sodium can cause cells to gain or lose water. Either of these changes can prevent cells from carrying out their normal functions. There are currently no PWQO guidelines for sodium.

Strontium

Strontium is a bright silvery metal that is reactive in water. Natural sources of Strontium includes leaching from limestone. Anthropogenic sources of strontium include being released into the environment as a by-product of other mining operations, air deposition from coal burning and phosphate fertilizers (Federal-Provincial-Territorial Committee on Drinking Water, 2018). Acute effects of strontium include vomiting and diarrhea if ingested, and may also cause irritation to the skin. Chronic skin contact may cause dermatitis. There are currently no PWQO guidelines for strontium.

Tellurium

Tellurium is a brittle, mildly toxic, rare, silver-white metalloid. It is chemically related to selenium and sulfur. It is occasionally found in native form as elemental crystals. Tellurium is far more common in the universe as a whole than on Earth. When taken internally, tellurium can have harmful effects. It may cause nausea, vomiting, and damage to the central nervous system. There are currently no PWQO guidelines for tellurium.

Thallium

Thallium is a silvery-grey metal that is very toxic by inhalation, ingestion and skin absorption. Natural inputs of thallium into the aquatic environment includes weathering processes. Anthropogenic inputs of thallium into the aquatic environment includes potash, effluents production of sulphuric acid, the mining and smelting of copper, gold, zinc, lead, and cadmium, and combustion of coal and oil (Canadian Council of Ministers of the Environment, 1999). It may act as a systemic poison, neurotoxin, and may cause birth abnormalities. It is also a respiratory and eye irritant. The maximum concentration of thallium under PWQO guidelines is 0.3 μg/L.

Tin

Tin is a soft, pliable, silvery-white metal. Acute effects of tin include skin or eye irritation, headaches, stomach aches, dizziness, and breathlessness. Long-term effects include liver damage, malfunctioning of immune systems, chromosomal damage, shortage of red blood cells, and brain damage. There are currently no PWQO guidelines limiting the intake of tin.

Titanium
Titanium is a white-silvery metallic colour and is always found bound to other elements in nature. There are no known health hazards of titanium in water, but it is known to have adverse health effects in powder form. There are currently no PWQO guidelines for titanium.

Tungsten
Tungsten is a lustrous, silvery-white metal. Acute health effects include irritation to the skin and eyes causing watering and redness. There are no known long-term health effects. The maximum concentration of tungsten under PWQO guidelines is 30 μg/L.

Uranium
Uranium is a hard, dense, malleable, ductile, silver-white, radioactive metal. No harmful radiation effects of natural levels of uranium have been found. However, chemical effects may occur after the uptake of large amounts of uranium, which can cause health effects such as kidney disease. Exposure to uranium radionuclides that form during radioactive decay may cause cancer. The maximum concentration of uranium under PWQO guidelines is 5 μg/L.

Vanadium
Vanadium is a rare, soft, ductile grey-white element found combined in certain minerals and used mainly to produce certain alloys. The uptake of vanadium by humans mainly takes place through foodstuffs, such as buckwheat, soy beans, olive oil, sunflower oil, apples and eggs. Some acute health effects associated with the high intake of vanadium include inflammation of stomach and intestines, sickness and headaches, dizziness, skin rashes, nosebleeds and throat pain. Chronic exposure may cause eye, skin and respiratory problems. The maximum concentration of vanadium under PWQO guidelines is 6 μg/L.

Zinc
Zinc is a lustrous bluish-white metal. Zinc is an essential element for all living things (Health Canada, 1987) and overdoses do not occur very often. Anthropogenic sources of zinc include primary iron and steel production, primary copper and nickel production, fuel combustion, transportation, solid waste incineration, and pesticide applications (Health Canada, 1987). Symptoms include nausea, vomiting, dizziness, fevers, and diarrhea. The maximum concentration of zinc under PWQO guidelines is 20 μg/L.

Zirconium
Zirconium is a very strong, malleable, ductile, and lustrous, silver-grey metal. Zirconium and its salts generally have low systemic toxicity. The maximum concentration of Zinc under PWQO guidelines is 4 μg/L.

Appendix E:

Water Quality Guidelines

Appendix E: Water Quality Guidelines

The following are taken from the Ministry of the Environment, Provincial Water Quality Objectives (PWQO), July 1994 and was updated March 2019.

Physical

Alkalinity
Alkalinity should not be decreased by more than 25% of the natural concentration.

Dissolved Oxygen
Dissolved oxygen concentrations should not be less than the values specified below for cold water biota (e.g. salmonid fish communities) and warm water biota (e.g. centrarchid fish communities):

Dissolved Oxygen Concentration				
Temperature	Cold Water Biota		Warm Water Biota	
°C	% Saturation	mg/L	% Saturation	mg/L
0	54	8	47	7
5	54	7	47	6
10	54	6	47	5
15	54	6	47	5
20	57	5	47	4
25	63	5	48	4

In waters inhabited by sensitive biological communities, or in situations where additional physical or chemical stressors are operating, more stringent criteria may be required. For example, a sensitive species such as lake trout may require more specific water quality objectives.

In some hypolimnetic waters, dissolved oxygen is naturally lower than the concentrations specified in the above table. Such a condition should not be altered by adding oxygen-demanding materials causing a depletion of oxygen.

pH
The pH should be in the range of 6.5 – 8.5

- to protect aquatic life
- both alkaline and acidic waters may cause irritation to anyone using the water for recreational purposes

Temperature
The natural thermal regime of any body of water shall not be altered so as to impair the quality of the natural environment. In particular, the diversity, distribution and abundance of plant and animal life shall not be significantly changed.

Waste Heat Discharge

1. Ambient Temperature Changes

   The temperature at the edge of a mixing zone shall not exceed the natural ambient water temperature at a representative control location by more than 10°C (18°F). However, in special circumstances, local conditions may require a significantly lower temperature difference than 10°C (18°F). Potential dischargers are to apply to the MOECC for guidance as to the allowable temperature rise for each thermal discharge. This ministry will also specify the nature of the mixing zone and the procedure for the establishment of a representative control location for temperature recording on a case-by-case basis.

2. Discharge Temperature Permitted

   The maximum temperature of the receiving body of water, at any point in the thermal plume outside a mixing zone, shall not exceed 30°C (86°F) or the temperature of a representative control location plus 10°C (18°F) or the allowed temperature difference, whichever is the lesser temperature. These maximum temperatures are to be measured on a mean daily basis from continuous records.

3. Taking and Discharging of Cooling Water

   Users of cooling water shall meet both the Objectives for temperature outlined above and the "Procedures for the Taking and Discharge of Cooling Water" as outlined in the MOEE publication *Deriving Receiving-Water Based, Point-Source Effluent Requirements for Ontario Waters (1994).*

Nutrients

Ammonia (un-ionized)
The amount of un-ionized ammonia should not exceed 20 µg/L.

The percentages of un-ionized ammonia (NH3) in aqueous ammonia solution for different temperature and pH conditions are listed in the table below. For example, at 20ºC and pH

of 8.0, a total ammonia concentration of 500 µg/L would give an un-ionized ammonia concentration of 500 x 3.8/100 = 19 µg/L which is less than the un-ionized ammonia Objective of 20 µg/L.

The table below is taken from the PWQO; percentages are rounded to two significant figures. The equations given by may be used to interpolate values between those given in the table:

$f = 1/(10^{pKa-pH} +1)$, where **f is the fraction of NH3**

pKa = 0.09018 + 2729.92/T, where T = ambient water temperature in Kelvin (K = °C + 273.16)

Results should be converted to percent and rounded to two significant figures. Extrapolations should not be made beyond the ranges of the table.

Note: Under certain temperature and pH conditions, the total ammonia criteria for the protection of aquatic life may be less stringent than the criteria for other beneficial uses (e.g. public water supply).

Percent NH3 in aqueous ammonia solutions for 0-30 °C and pH 6-10

Temp.	**pH**								
°C	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
0	.0083	.026	.083	.26	.82	2.6	7.6	21.	45.
1	.0090	.028	.090	.28	.89	2.8	8.3	22.	47.
2	.0098	.031	.098	.31	.97	3.0	8.9	24.	49.
3	.011	.034	.11	.34	1.1	3.3	9.6	25.	52.
4	.012	.036	.12	.36	1.1	3.5	10.	27.	54.
5	.013	.040	.13	.39	1.2	3.8	11.	28.	56.
6	.014	.043	.14	.43	1.3	4.1	12.	30.	58.
7	.015	.046	.15	.46	1.5	4.4	13.	32.	60.
8	.016	.050	.16	.50	1.6	4.8	14.	34.	61.
9	.017	.054	.17	.54	1.7	5.2	15.	35.	63.
10	.019	.059	.19	.59	1.8	5.6	16.	37.	65.
11	.020	.064	.20	.63	2.0	6.0	17.	39.	67.
12	.022	.069	.22	.68	2.1	6.4	18.	41.	69.
13	.024	.074	.24	.74	2.3	6.9	19.	43.	70.
14	.025	.080	.25	.80	2.5	7.4	20.	45.	72.
15	.027	.087	.27	.86	2.7	8.0	22.	46.	73.
16	.030	.093	.29	.93	2.9	8.5	23.	48.	75.

Temp.	pH								
°C	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
17	.032	.10	.32	1.0	3.1	9.1	24.	50.	76.
18	.034	.11	.34	1.1	3.3	9.8	26.	52.	77.
19	.037	.11	.37	1.2	3.6	11.	27.	54.	79.
20	.040	.13	.40	1.2	3.8	11.	28.	56.	80.
21	.043	.14	.43	1.3	4.1	12.	30.	58.	81.
22	.046	.15	.46	1.4	4.4	13.	32.	59.	82.
23	.049	.16	.49	1.5	4.7	14.	33.	61.	83.
24	.053	.17	.53	1.7	5.0	14.	35.	63.	84.
25	.057	.18	.57	1.8	5.4	15.	36.	64.	85.
26	.061	.19	.61	1.9	5.8	16.	38.	66.	86.
27	.065	.21	.65	2.0	6.2	17.	40.	67.	87.
28	.070	.22	.70	2.2	6.6	18.	41.	69.	88.
29	.075	.24	.75	2.3	7.0	19.	43.	70.	88.
30	.081	.25	.80	2.5	7.5	20.	45.	72.	89.

Phosphorus

Current scientific evidence is insufficient to develop a firm objective at this time. Accordingly, the following phosphorus concentrations should be considered as general guidelines, which should be supplemented by site-specific studies:

- To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 20 µg/L;
- A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10 µg/L or less. This should apply to all lakes naturally below this value;
- Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 30 µg/L.

Bacteriological

Escherichia coli

The amount of *Escherichia coli* should not exceed 100 counts per 100 mL of water (based on a geometric mean of at least 5 samples).

Based on a recreational water quality guideline published by the Ontario Ministry of Health in 1992, this Ministry of Health guideline was specifically intended for application by the local Medical Officer of Health to swimming and bathing beaches. It is based upon a geometric mean of levels of *E. coli* determined from a minimum of 5 samples per site taken within a given swimming area and collected within a one month period. If the geometric mean *E. coli* level for

the sample series at a given site exceeds 100 per 100 mL, the site should be considered unsuitable for swimming and bathing. *E. coli* was selected for the guideline because studies have determined that, among bacteria of the coliform group, *E. coli* is the most suitable and specific indicator of fecal contamination.

An analytical test with a high degree of specificity for *E. coli* regardless of water sample source, requiring no confirmation procedures, and which produces results in 21 hours has been developed and adopted by both the Ministry of Health, and Ministry of Environment and Energy laboratories.

Where testing indicates sewage or fecal contamination, a site-specific judgment must be made as to the severity of the problem and the appropriate course of action.

As of May 1, 1994, MOEE staff has been advised to base all **new** compliance, enforcement and monitoring activities on the *E. coli* test. Some water managers may find it necessary to continue testing for fecal coliforms or total coliforms. For example, where testing at a long term water quality monitoring station requires a continuous record of results using either the fecal or total coliform test to monitor trends in water quality. As a benchmark for the long term monitoring results, the former objectives for fecal coliforms and total coliforms are referenced for your information. For fecal coliforms the objective was 100 counts per 100 ml (based on a geometric mean density for a series of water samples). For total coliforms the objective was 1000 counts per 100 ml (based on a geometric mean density for a series of water samples).

Metals

Aluminum

Aluminum amounts should not exceed the following:

PH values	Interim PWQO (µg/L)
4.5 to 5.5	15
>5.5 to 6.5	No more than 10 % of natural background
> 6.5 to 9.0	75

Antimony

The amount of Antimony should not exceed 20 µg/L.

Arsenic

The amount of Arsenic should not exceed 5 µg/L.

Barium

There are currently no PWQO guidelines for Barium.

Beryllium

Beryllium amounts should not exceed the following:

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
<75	11
>75	1100

Bismuth

There are currently no PWQO guidelines for Bismuth.

Boron

The amount of Boron should not exceed 200 µg/L.

Cadmium

Cadmium amounts should not exceed the following:

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
0 – 100	0.1
>100	0.5

Calcium

There are currently no PWQO guidelines for Calcium.

Chromium

Chromium amounts should not exceed the following:

	Interim PWQO (µg/L)
Hexavalent Chromium (Cr VI)	1
Trivalent Chromium (Cr III)	8.9

Cobalt

The amount of Cobalt should not exceed 0.9 µg/L.

Copper

The amount of Copper should not exceed the following:

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
0-20	1
>20	5

Iron

The amount of Iron should not exceed 300 µg/L.

Lead
Lead amounts should not exceed the following:

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
<30	1
30 to 80	3
>80	5

Lithium
There are currently no PWQO guidelines for Lithium.

Magnesium
There are currently no PWQO guidelines limiting the intake of Magnesium.

Manganese
There are currently no PWQO guidelines for Manganese.

Molybdenum
The amount of Molybdenum should not exceed 40 µg/L.

Nickel
The amount of Nickel should not exceed 25 µg/L.

Potassium
There are currently no PWQO guidelines for Potassium.

Selenium
The amount of Selenium should not exceed 100 µg/L.

Silicon
There are currently no PWQO guidelines for Silicon.

Silver
The amount of Silver should not exceed 0.1 µg/L.

Sodium
There are currently no PWQO guidelines for Sodium.

Strontium
There are currently no PWQO guidelines for Strontium.

Tellurium
There are currently no PWQO guidelines for Tellurium.

Thallium
The amount of Thallium should not exceed 0.3 μg/L.

Tin
There are currently no PWQO guidelines for Tin.

Titanium
There are currently no PWQO guidelines for Titanium.

Tungsten
The amount of Tungsten should not exceed 30 μg/L.

Uranium
The amount of Uranium should not exceed 5 μg/L.

Vanadium
The amount of Vanadium should not exceed 6 μg/L.

Zinc
The amount of Zinc should not exceed 20 μg/L.

Zirconium
The amount of Zirconium should not exceed 4 μg/L.

Appendix F:

Forest Ecosystem Classification

Appendix F: Forest Ecosystem Classification

Site 1, Site 2: V7 Trembling Aspen-Balsam Fir/Balsam Fir Shrub

Description: Hardwood mixedwoods, typically with a two-tiered canopy. In general, trembling aspen constitutes the overstory with balsam fir in the secondary canopy. Understory development is variable with balsam fir, *Aralia nudicaulis* and *Diervilla lonicera* often abundant. Occurring mainly on deep, fresh, well-drained mineral soils.

Site 1

Site 2

Common Overstory Species (in descending order):
Balsam fir, trembling aspen, white birch, white spruce, black spruce, jack pine

Common Understory Species:

Shrubs:	balsam fir, *Rubus pubescens, Diervilla lonicera, Acer spicatum, Rosa acicularis,* trembling aspen*, Corylus cornuta, Linnaea borealis, Sorbus decora*
Herbs:	*Maianthemum canadense, Aralia nudicaulis, Cornus canadensis, Clintonia borealis, Aster macrophyllus, Streptopus roseus, Trientalis borealis, Viola renifolia, Mitella nuda, Petasites palmatus, Anemone quinquefolia, Galium triflorum*
Mosses:	*Pleurozium schreberi, Rhytidiadelphus triquetrus*

Forest Floor Cover:

Species	Broadleaf Litter	Moss	Conifer Litter	Wood
Forest Floor Cover (%)	81	7	6	5

Site 3: V19 Black Spruce Mixedwood/ Herb Rich

Description: A black spruce mixedwood Type with several potential species in the overstory. The understory is typically dominated by an herb rich / dwarf shrub layer. The shrub stratum ranges from dense to open, usually with balsam fir and black spruce as important components. Forest floor cover varies from moss rich to mainly broadleaf litter. Occurring on a range on site conditions mostly on fresh to moist, mineral soils.

Common Overstory Species (in descending order):
Black spruce, trembling aspen, jack pine, balsam fir, white birch, white spruce, balsam poplar

Common Understory Species:

Shrubs:	*Linnae borealis,* balsam fir, *Rubus pubescens, Vaccinium myrtilloides,* black spruce, *Rosa acicularis, Amelanchier* spp., *Vaccinium angustifolium, Sorbus decora, Gaultheria bispidula, Diervilla lonicera, Ledum groenlandicum,* trembling aspen
Herbs:	*Cornus Canadensis, Maianthemum canadense, Clintonia borealis, Trientalis borealis, Aralia nudicaulis, Coptis trifolia, Petasites palmatus, Aster macrophyllus, Streptopus roseus, Viola renifolia*
Mosses:	*Pleurozium schreberi, Ptilium crista-castrensis, Dicranum polystum, Hylocomium splendens, Rhytidiadelphus triquestrus*

Forest Floor Cover:

Species	Broadleaf Litter	Moss	Conifer Litter
Forest Floor Cover (%)	33	49	12

Site 4: V12 White Pine Mixedwood

Description: Mixedwood stands, often with a tall overstory of white pine and a secondary canopy of other tree species. The understory is typically shrub and herb rich. Occurring on deep, fresh, non-calcareous, coarse textured, upland mineral sites.

Common Overstory Species (in descending order):
white birch, trembling aspen, balsam fir, white spruce, red pine, white cedar, black spruce, large-toothed aspen, jack pine, red maple

Common Understory Species:

Shrubs:	balsam fir, *Corylus cornuta Acer spicatum, Linnaea borealis, Amelanchier* spp., *Diervilla lonicera*, Diervilla lonicera, trembling aspen
Herbs:	*Aralia nudicaulis, Maianthemum canadense Aster macrophyllus, Cornus Canadensis, Trientalis borealis, Clintonia borealis, Streptopus roseus, Oryzopsis asperifolia*
Mosses:	*Pleurozium schreberi, Dicranum polysetum*

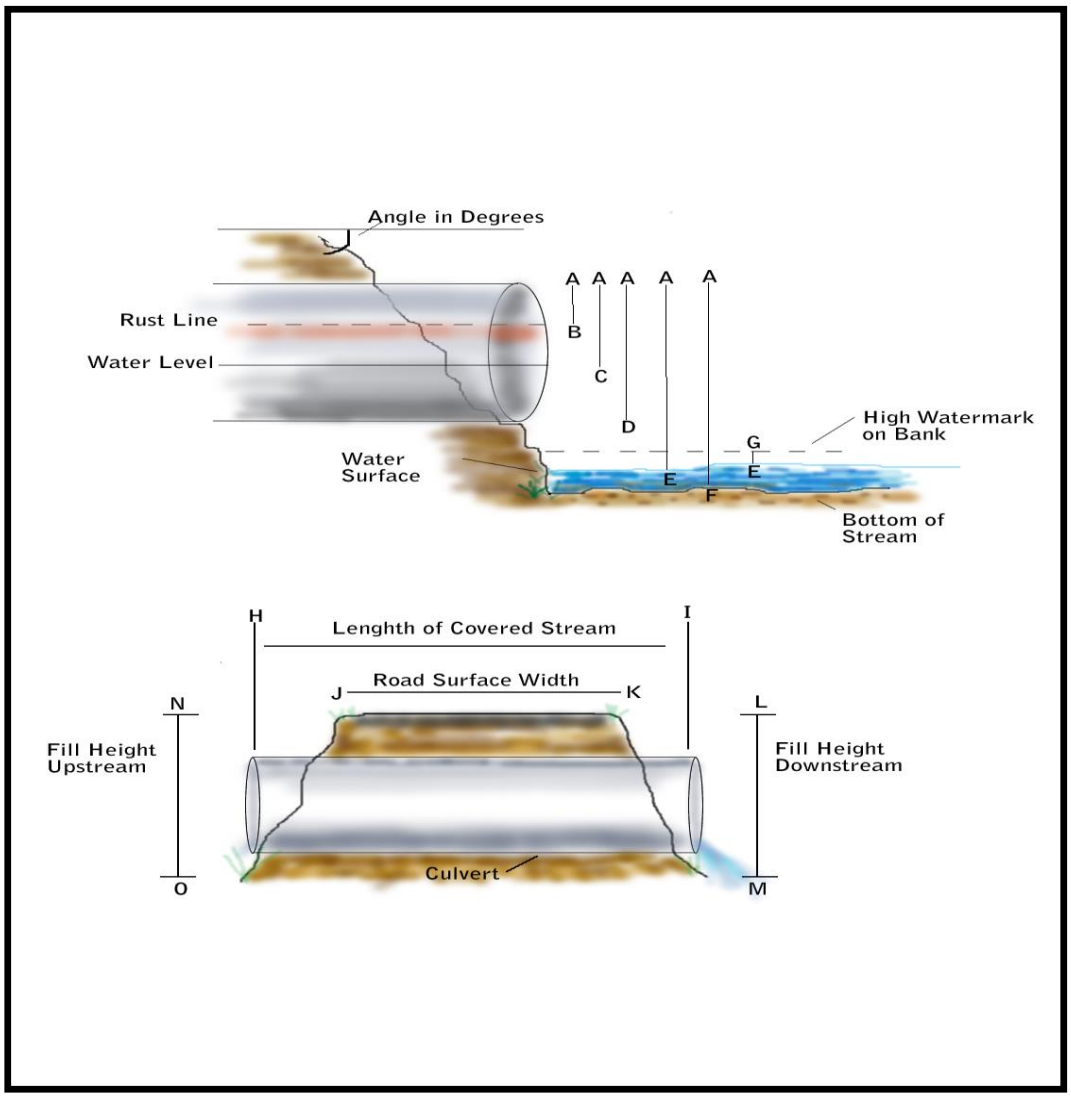
Forest Floor Cover:

Species	Broadleaf Litter	Conifer Litter
Forest Floor Cover (%)	50	40

Appendix G:

Culvert Assessments

Appendix G: Culvert Assessments



Little Pine River 2019 Culvert Assessments

Culvert Number/ Site Number	**J-K** Road Surface Width (m)	**H-I** Length of Covered Stream (m)	**N-O** Fill Height Upstream (m)	**L-M** Fill Height Downstream (m)		**A-D** Width of Opening (m)	**A-B** Inside Top to Rust Line (m)	**A-C** Inside Top to Water Surface (m)	**A-E** Height Above Outlet Pool (m)	**E-G** Water Surface to High Water Mark (m)	**A-F** Inside Top to Bottom of Stream (m)
C1/Site 3 – Anderson Road											
Culvert	3.096	8.872	2.294	2.370	Upstream	1.452	0.674	1.412	-	0.50	1.530
					Downstream	1.466	0.772	1.426	-	1.00	1.536
C2/Site 2- Little Pigeon Bay Road											
Culvert	6.776	17.686	3.526	4.234	Upstream	2.398	1.790	2.144	-	0.30	2.398
					Downstream	2.090	1.650	1.882	-	0.30	2.090

Culvert 1 / Site 3

Location: Approximately 1.5 kilometres upstream of the confluence of the Little Pine River with Lake Superior on Little Pigeon Bay Road to reflect the confluence. Access to the actual confluence was not accessible. Site 1 was accessed at the intersection of Little Pigeon Bay Road and Little Pine Road.

GPS Coordinates: Northing 5323781 Easting 309913

Description: The corrugated steel culvert is in good condition with no major structural damage on either the upstream or downstream opening. It appears to be large enough to be able to support water flow during times of both high and low water. The water level was very low compared to the size of the culvert opening, and rust was present on the lower half of the culvert. In the future rust may affect the integrity of the culvert. There was abundant vegetation surrounding the culvert and the banks appeared to be stable.

Upstream

Downstream

Culvert 2 / Site 2

Location: Approximately 1.1 kilometres south-east from Highway 61 on Little Pigeon Bay Road.

GPS Coordinates: Northing 5324055 Easting 311131

Description: The large corrugated steel culvert is in good condition with no major structural damage on either the upstream or downstream opening. It appears to be large enough to be able to support water flow during times of both high and low water. The water level was relatively low compared to the size of the culvert opening, and minimal rust was present. There was abundant vegetation surrounding the culvert and the banks appeared to be stable.

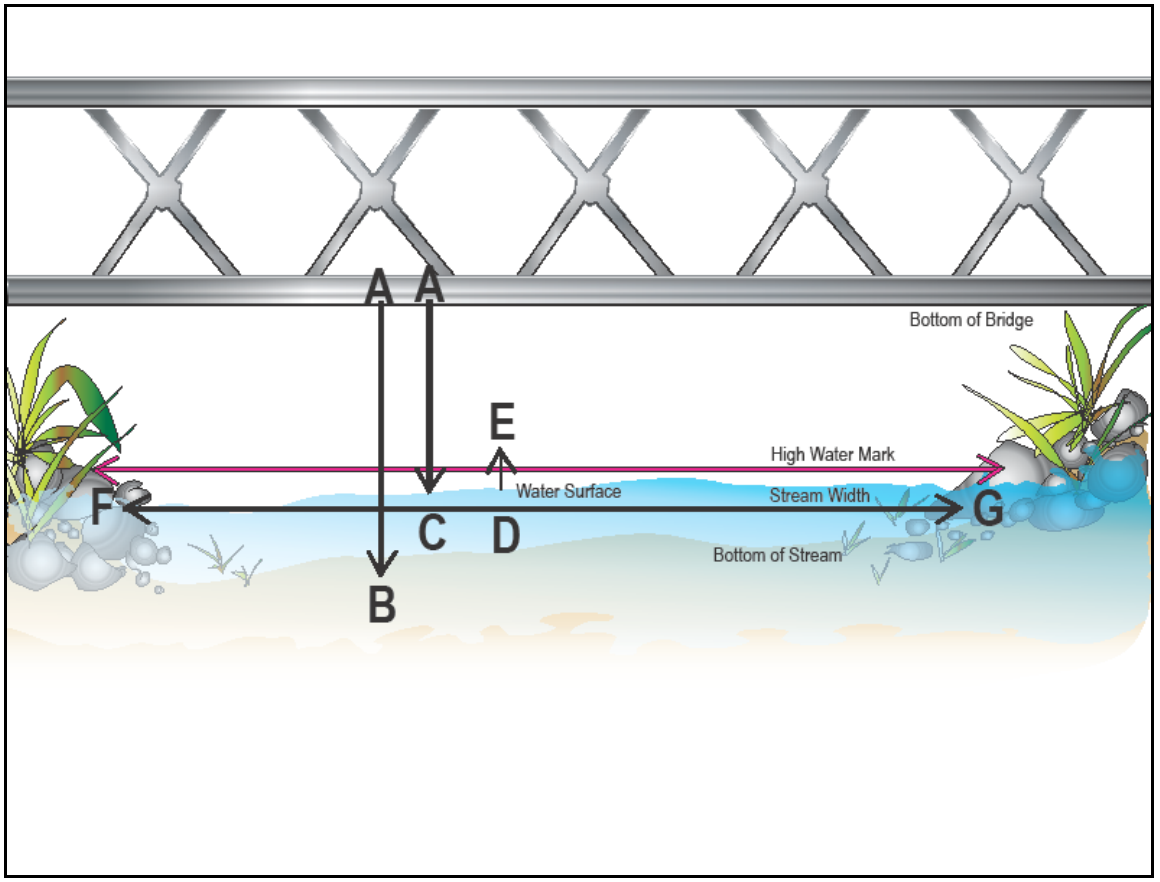
Upstream

Downstream

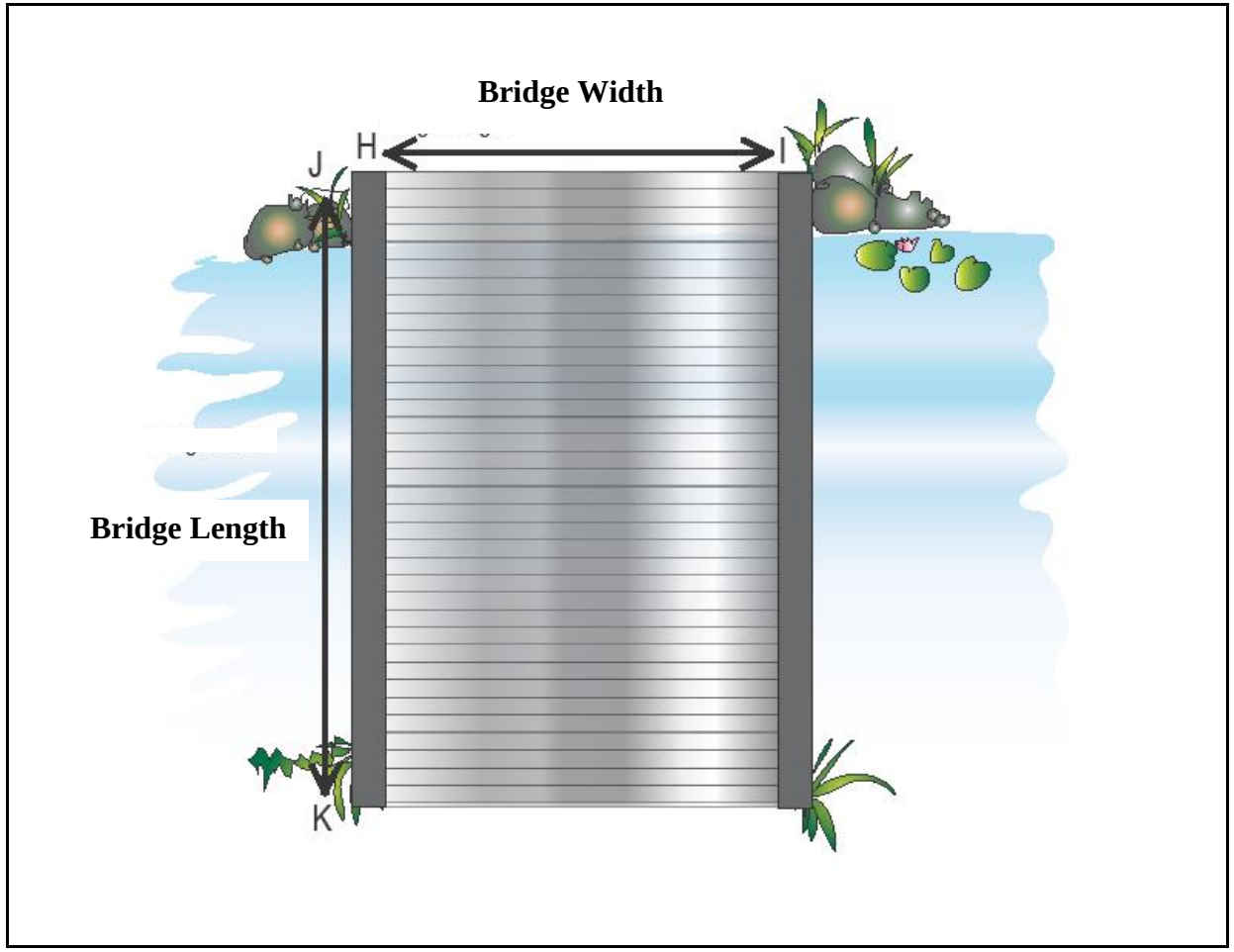
Appendix H:

Bridge Assessments

Appendix H: Bridge Assessments



Bridge Measurement Parameters


Bridge Width
H
I
J
K
Bridge Length

Little Pine River 2019 Bridge Measurements

Site Number	Bridge Number	**A-C** Bottom of Bridge to Water Surface (m)	**A-B** Bottom of Bridge to Bottom of Stream (m)	**D-E** Outlet Pool Water Surface to Outlet Pool High Water Mark (m)	**F-G** Width of Stream (m)	**H-I** Length of Bridge (m)	**J-K** Width of Bridge (m)
4- Lenore Lake Road	B1	0.79	0.85	0.40	1.450	5.676	2.046

Bridge 1 / Site 4

Location: Approximately 3.5 kilometres west on Highway 61 on Lenore Lake Road at lakes edge

GPS Coordinates: Northing 5324762 Easting 307993

Description: This small bridge is made entirely out of timber. The condition of the bridge was good and there was abundant vegetation on both banks.

Upstream

Downstream

Appendix I:

Site Photography

Appendix I: Site Photography

Site 1 – Approximately 1.5 kilometres upstream of confluence of Little Pine River with Lake Superior, Little Pigeon Bay Road	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Site 2 –1.1 kilometres south-east from Highway 61 Little Pigeon Bay Road	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Site 3 – Approximately 300 metres southeast from Highway 61 on Anderson Road	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Approximately 3.5 kilometres west of Highway 61 on Lenore Lake Road at edge of Lenore Lake	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Appendix J:

Laboratory Water Quality Results Summary Tables June

Little Pine River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables June

Laboratory Water Quality Results for June 11, 2019

Parameter	Units	PWQO Criterion	LPR1 Little Pine River - SITE#1	LPR2 Litle Pine River - SITE#2	LPR3 Little Pine River - SITE#3	LPR4 Little Pine River - SITE#4	Average
			11-Jun-19	11-Jun-19	11-Jun-19	11-Jun-19	June
Physical Tests							
Conductivity (EC)	(uS/cm)	N/A	133	116	178	107	134
pH		6.5-8.5	7.66	7.78	7.65	7.56	7.66
Total Dissolved Solids	(mg/L)	N/A	97	78	127	69	93
Turbidity	(NTU)	N/A	18.2	8.67	24.7	2.47	13.5
Anions and Nutrients							
Alkalinity, Total (as $CaCO_3$)*	(mg/L)	37.4	57.5	54.5	63.1	49.9	56.3
Ammonia-N, Total	(mg/L)	N/A	0.011	0.013	0.017	0.010	0.0128
Un-ionized Ammonia (calculated)**	(mg/L)	0.02	0.0050	0.0004	0.0005	0.0003	0.0016
Chloride (Cl)	(mg/L)	N/A	4.29	1.28	14.00	0.53	5.03
Nitrate-N (NO_3-N)	(mg/L)	N/A	0.026	0.039	0.081	0.025	0.04
Nitrite-N (NO_2-N)	(mg/L)	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Total Kjeldahl Nitrogen	(mg/L)	N/A	0.30	0.49	0.95	0.36	0.53
Phosphorus (P)-Total	(mg/L)	0.03	**0.0314**	0.0113	0.0214	0.0131	0.0193
Sulphate (SO_4)	(mg/L)	N/A	3.75	4.13	5.85	3.94	4.42
Bacteriological Tests							
Escherichia Coli	(MPN/100mL)	100	35	21	64	0	30
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	**1410**	**1300**	**>2420**	42	917
Total Metals							
Aluminum (Al)-Total***	(mg/L)	0.075	**0.992**	**1.320**	**0.099**	**0.502**	**0.728**
Antimony (Sb)-Total	(mg/L)	0.02	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	(mg/L)	0.005 (interim)	0.00054	0.00079	0.00031	0.00039	0.00051
Barium (Ba)-Total	(mg/L)	N/A	0.0165	0.0186	0.0095	0.0121	0.0142
Beryllium (Be)-Total****	(mg/L)	0.011 (<75 mg/L $CaCO_3$)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	(mg/L)	1.10 (>75 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Bismuth (Bi)-Total	(mg/L)	N/A	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	(mg/L)	0.2	0.012	0.014	<0.010	0.011	0.012
Cadmium (Cd)-Total****	(mg/L)	0.0001 (0-100 mg/L $CaCO_3$)	0.0000231	0.0000253	<0.0000050	0.0000122	0.0000202
	(mg/L)	0.0005 (>100 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Calcium (Ca)-Total	(mg/L)	N/A	15.5	16.4	12.7	13.9	14.6
Chromium (Cr)-Total	(mg/L)	0.0089	0.00165	0.00220	0.00023	0.00084	0.00123
Cobalt (Co)-Total	(mg/L)	0.0009	0.00055	0.00069	<0.00010	0.00028	0.00051
Copper (Cu)-Total****	(mg/L)	0.001 (0-20 mg/L CaCO3)	N/A	N/A	N/A	N/A	N/A
	(mg/L)	0.005 (>20 mg/L CaCO3)	0.00429	**0.00552**	0.00166	0.00272	0.00355

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

Little Pine River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables June

Laboratory Water Quality Results for June 11, 2019

Parameter	Units	PWQO Criterion	LPR1 Little Pine River - SITE#1	LPR2 Litle Pine River - SITE#2	LPR3 Little Pine River - SITE#3	LPR4 Little Pine River - SITE#4	Average
			11-Jun-19	11-Jun-19	11-Jun-19	11-Jun-19	June
Total Metals Continued							
Iron (Fe)-Total	(mg/L)	0.3	**1.100**	**1.620**	0.117	**0.531**	**0.842**
Lead (Pb)-Total****	(mg/L)	0.001 (<30 mg/L CaCO3)	N/A	N/A	N/A	N/A	N/A
	(mg/L)	0.003 (30-80 mg/L CaCO3)	0.000339	0.000449	0.000059	0.000176	0.000256
	(mg/L)	0.005 (>80 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Lithium (Li)-Total	(mg/L)	N/A	0.0021	0.0031	0.0012	0.0016	0.0020
Magnesium (Mg)-Total	(mg/L)	N/A	5.67	6.21	4.64	4.96	5.37
Manganese (Mn)-Total	(mg/L)	N/A	0.0246	0.0347	0.00646	0.0135	0.0198
Molybdenum (Mo)-Total	(mg/L)	0.04	0.000377	0.000787	0.000243	0.000268	0.000419
Nickel (Ni)-Total	(mg/L)	0.025	0.00235	0.00312	0.00076	0.00144	0.00192
Potassium (K)-Total	(mg/L)	N/A	1.05	1.29	0.776	0.895	1.003
Selenium (Se)-Total	(mg/L)	0.1	0.000113	0.000176	0.000093	0.000115	0.000124
Silver (Ag)-Total	(mg/L)	0.0001	<0.000010	0.000013	<0.000010	<0.000010	0.000013
Sodium (Na)-Total	(mg/L)	N/A	4.87	11.0	1.99	2.46	5.08
Strontium (Sr)-Total	(mg/L)	N/A	0.0325	0.0464	0.0233	0.0270	0.0323
Tellurium (Te)-Total	(mg/L)	N/A	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	(mg/L)	0.0003	0.000013	0.000015	<0.000010	<0.000010	0.000014
Tin (Sn)-Total	(mg/L)	N/A	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	(mg/L)	N/A	0.0268	0.0338	0.00281	0.0172	0.0202
Tungsten (W)-Total	(mg/L)	0.03	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	(mg/L)	0.005	0.000128	0.000186	0.000053	0.000075	0.000111
Vanadium (V)-Total	(mg/L)	0.006	0.00298	0.00423	0.00055	0.00175	0.00238
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	0.0037	0.0050	<0.0030	<0.0030	0.0044
Zirconium (Zr)-Total	(mg/L)	0.004	0.00034	0.00046	<0.00020	0.00029	0.00036

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

Appendix K:

Laboratory Water Quality Results Summary Tables July

Little Pine River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables July

Laboratory Water Quality Results for July 10, 2019

Parameter	Units	PWQO Criterion	LPR1 Little Pine River - SITE#1	LPR2 Little Pine River - SITE#2	LPR3 Little Pine River - SITE#3	LPR4 Little Pine River - SITE#4	Average
			10-Jul-19	10-Jul-19	10-Jul-19	10-Jul-19	July
Physical Tests							
Conductivity (EC)	(uS/cm)	N/A	161	132	285	109	172
pH		6.5-8.5	7.30	7.13	7.51	7.08	7.26
Total Dissolved Solids	(mg/L)	N/A	121	85	178	64	112
Turbidity	(NTU)	N/A	36.7	24.2	31.0	5.90	24.5
Anions and Nutrients							
Alkalinity, Total (as $CaCO_3$)*	(mg/L)	37.6	72.1	60.7	114	50.1	74.2
Ammonia-N, Total	(mg/L)	N/A	<0.020	<0.020	<0.020	<0.020	<0.020
Un-ionized Ammonia (calculated)**	(mg/L)	0.02	N/A	N/A	N/A	N/A	N/A
Chloride (Cl)	(mg/L)	N/A	4.21	1.29	21.1	0.70	6.83
Nitrate-N (NO_3-N)	(mg/L)	N/A	0.021	<0.020	<0.020	<0.020	0.021
Nitrite-N (NO_2-N)	(mg/L)	N/A	<0.010	<0.010	0.012	<0.010	0.012
Total Kjeldahl Nitrogen	(mg/L)	N/A	0.52	0.45	0.68	0.37	0.51
Phosphorus (P)-Total	(mg/L)	0.03	**0.0456**	**0.0362**	**0.0447**	0.0155	**0.0355**
Sulphate (SO_4)	(mg/L)	N/A	4.08	4.27	4.31	4.50	4.29
Bacteriological Tests							
Escherichia Coli	(MPN/100mL)	100	**210**	**116**	**276**	**125**	**182**
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**
Total Metals							
Aluminum (Al)-Total***	(mg/L)	0.075	**1.480**	**0.606**	**0.730**	**0.108**	**0.731**
Antimony (Sb)-Total	(mg/L)	0.02	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	(mg/L)	0.005 (interim)	0.00091	0.00069	0.00117	0.00041	0.00080
Barium (Ba)-Total	(mg/L)	N/A	0.0218	0.0161	0.0202	0.0102	0.0171
Beryllium (Be)-Total****	(mg/L)	0.011 (<75 mg/L $CaCO_3$)	N/A	<0.00010	N/A	<0.00010	<0.00010
	(mg/L)	1.10 (>75 mg/L $CaCO_3$)	<0.00010	N/A	<0.00010	N/A	<0.00010
Bismuth (Bi)-Total	(mg/L)	N/A	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	(mg/L)	0.2	0.014	0.013	0.021	0.011	0.015
Cadmium (Cd)-Total****	(mg/L)	0.0001 (0-100 mg/L $CaCO_3$)	0.0000176	0.0000188	N/A	<0.0000050	0.0000182
	(mg/L)	0.0005 (>100 mg/L $CaCO_3$)	N/A	N/A	0.0000321	N/A	0.0000321
Calcium (Ca)-Total	(mg/L)	N/A	18.7	16.5	29.0	13.1	19.3
Chromium (Cr)-Total	(mg/L)	0.0089	0.00249	0.00110	0.00141	0.00028	0.00132
Cobalt (Co)-Total	(mg/L)	0.0009	0.00085	0.00045	0.00066	0.00012	0.00052
Copper (Cu)-Total****	(mg/L)	0.001 (0-20 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
	(mg/L)	0.005 (>20 mg/L $CaCO_3$)	0.00464	0.00325	0.00387	0.00207	0.00346

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

Little Pine River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables July

Laboratory Water Quality Results for July 10, 2019

Parameter	Units	PWQO Criterion	LPR1 Little Pine River - SITE#1 10-Jul-19	LPR2 Little Pine River - SITE#2 10-Jul-19	LPR3 Little Pine River - SITE#3 10-Jul-19	LPR4 Little Pine River - SITE#4 10-Jul-19	Average July
Total Metals Continued							
Iron (Fe)-Total	(mg/L)	0.3	**1.710**	**0.831**	**1.200**	0.184	**0.981**
Lead (Pb)-Total****	(mg/L)	0.001 (<30 mg/L CaCO3)	N/A	N/A	N/A	N/A	N/A
	(mg/L)	0.003 (30-80 mg/L CaCO3)	0.000483	0.000291	N/A	0.000142	0.000305
	(mg/L)	0.005 (>80 mg/L $CaCO_3$)	N/A	N/A	0.000334	N/A	0.000334
Lithium (Li)-Total	(mg/L)	N/A	0.0028	0.0018	0.0038	0.0012	0.0024
Magnesium (Mg)-Total	(mg/L)	N/A	7.27	6.00	10.30	4.74	7.08
Manganese (Mn)-Total	(mg/L)	N/A	0.0400	0.0341	0.0822	0.0195	0.0440
Molybdenum (Mo)-Total	(mg/L)	0.04	0.000613	0.000388	0.001400	0.000246	0.000662
Nickel (Ni)-Total	(mg/L)	0.025	0.00297	0.00173	0.00270	0.00085	0.00206
Potassium (K)-Total	(mg/L)	N/A	1.27	1.01	1.14	0.774	1.05
Selenium (Se)-Total	(mg/L)	0.1	0.000093	0.000069	0.000140	0.000077	0.000095
Silver (Ag)-Total	(mg/L)	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	(mg/L)	N/A	4.86	2.67	17.7	2.00	6.81
Strontium (Sr)-Total	(mg/L)	N/A	0.0406	0.0302	0.0806	0.0241	0.0439
Tellurium (Te)-Total	(mg/L)	N/A	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	(mg/L)	0.0003	0.000019	0.000011	0.000011	<0.000010	0.000014
Tin (Sn)-Total	(mg/L)	N/A	0.00010	<0.00010	<0.00010	<0.00010	0.000100
Titanium (Ti)-Total	(mg/L)	N/A	0.0413	0.0173	0.0217	0.00384	0.0210
Tungsten (W)-Total	(mg/L)	0.03	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	(mg/L)	0.005	0.000170	0.000093	0.000342	0.000049	0.000164
Vanadium (V)-Total	(mg/L)	0.006	0.00449	0.00284	0.00395	0.00065	0.00298
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	0.0054	0.0032	0.0032	<0.0030	0.0039
Zirconium (Zr)-Total	(mg/L)	0.004	0.00037	0.00023	0.00048	<0.00020	0.00036

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

Appendix L:

Laboratory Certificates of Analysis and Test Results

LAKEHEAD REGION CONSERVATION AUTHORITY-TB
ATTN: Scott Drebit
130 Conservation Road
P.O. Box 10427
Thunder Bay ON P7B 6T8

Date Received: 12-JUN-19
Report Date: 26-JUN-19 15:15 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L2289691

Project P.O. #: 275
Job Reference: LITTLE PINE RIVER
C of C Numbers:
Legal Site Desc:

Christina Shepherd
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-1 LPR 1 - LITTLE PINE RIVER - SITE 1 Sampled By: Client on 11-JUN-19 @ 12:20 Matrix: Grab							
Physical Tests							
Conductivity (EC)	133		1.0	uS/cm		13-JUN-19	R4669774
Hardness (as CaCO3)	59.8		0.50			17-JUN-19	
pH	7.66		0.10	pH		13-JUN-19	R4669774
Total Dissolved Solids	97		13	mg/L		15-JUN-19	R4671088
Turbidity	18.2		0.10	NTU		12-JUN-19	R4665931
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	57.5		2.0	mg/L		13-JUN-19	R4669774
Ammonia, Total (as N)	0.011		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	4.29		0.10	mg/L		13-JUN-19	R4669833
Nitrate (as N)	0.026		0.020	mg/L		13-JUN-19	R4669833
Nitrite (as N)	<0.010		0.010	mg/L		13-JUN-19	R4669833
Total Kjeldahl Nitrogen	0.30		0.20	mg/L	19-JUN-19	20-JUN-19	R4678661
Phosphorus (P)-Total	0.0314		0.0030	mg/L		19-JUN-19	R4673866
Sulfate (SO4)	3.75		0.30	mg/L		13-JUN-19	R4669833
Bacteriological Tests							
Escherichia Coli	35		0	MPN/100mL		12-JUN-19	R4668068
Total Coliforms	1410		0	MPN/100mL		12-JUN-19	R4668068
Total Metals							
Aluminum (Al)-Total	0.992		0.0030	mg/L		21-JUN-19	R4679848
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Arsenic (As)-Total	0.00054		0.00010	mg/L		21-JUN-19	R4679848
Barium (Ba)-Total	0.0165		0.00010	mg/L		21-JUN-19	R4679848
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4679848
Boron (B)-Total	0.012		0.010	mg/L		21-JUN-19	R4679848
Cadmium (Cd)-Total	0.0000231		0.0000050	mg/L		21-JUN-19	R4679848
Calcium (Ca)-Total	15.5		0.050	mg/L		21-JUN-19	R4679848
Cesium (Cs)-Total	0.000091		0.000010	mg/L		21-JUN-19	R4679848
Chromium (Cr)-Total	0.00165		0.00010	mg/L		21-JUN-19	R4679848
Cobalt (Co)-Total	0.00055		0.00010	mg/L		21-JUN-19	R4679848
Copper (Cu)-Total	0.00429		0.00050	mg/L		21-JUN-19	R4679848
Iron (Fe)-Total	1.10		0.010	mg/L		21-JUN-19	R4679848
Lead (Pb)-Total	0.000339		0.000050	mg/L		21-JUN-19	R4679848
Lithium (Li)-Total	0.0021		0.0010	mg/L		21-JUN-19	R4679848
Magnesium (Mg)-Total	5.67		0.0050	mg/L		21-JUN-19	R4679848
Manganese (Mn)-Total	0.0246		0.00010	mg/L		21-JUN-19	R4679848
Molybdenum (Mo)-Total	0.000377		0.000050	mg/L		21-JUN-19	R4679848
Nickel (Ni)-Total	0.00235		0.00050	mg/L		21-JUN-19	R4679848
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4679848
Potassium (K)-Total	1.05		0.050	mg/L		21-JUN-19	R4679848
Rubidium (Rb)-Total	0.00172		0.00020	mg/L		21-JUN-19	R4679848
Selenium (Se)-Total	0.000113		0.000050	mg/L		21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-1 LPR 1 - LITTLE PINE RIVER - SITE 1 Sampled By: Client on 11-JUN-19 @ 12:20 Matrix: Grab							
Total Metals							
Silicon (Si)-Total	4.35		0.10	mg/L		21-JUN-19	R4679848
Silver (Ag)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4679848
Sodium (Na)-Total	4.87		0.050	mg/L		21-JUN-19	R4679848
Strontium (Sr)-Total	0.0325		0.00020	mg/L		21-JUN-19	R4679848
Sulfur (S)-Total	1.36		0.50	mg/L		21-JUN-19	R4679848
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4679848
Thallium (Tl)-Total	0.000013		0.000010	mg/L		21-JUN-19	R4679848
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Titanium (Ti)-Total	0.0268		0.00030	mg/L		21-JUN-19	R4679848
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Uranium (U)-Total	0.000128		0.000010	mg/L		21-JUN-19	R4679848
Vanadium (V)-Total	0.00298		0.00050	mg/L		21-JUN-19	R4679848
Zinc (Zn)-Total	0.0037		0.0030	mg/L		21-JUN-19	R4679848
Zirconium (Zr)-Total	0.00034		0.00020	mg/L		21-JUN-19	R4679848
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					20-JUN-19	R4679166
Aluminum (Al)-Dissolved	0.155		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Arsenic (As)-Dissolved	0.00038		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Barium (Ba)-Dissolved	0.00996		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Boron (B)-Dissolved	0.012		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cadmium (Cd)-Dissolved	0.0000075		0.0000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Calcium (Ca)-Dissolved	15.2		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Cesium (Cs)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Chromium (Cr)-Dissolved	0.00035		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Copper (Cu)-Dissolved	0.00256		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Iron (Fe)-Dissolved	0.190		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Lead (Pb)-Dissolved	0.000065		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Lithium (Li)-Dissolved	0.0013		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Magnesium (Mg)-Dissolved	5.31		0.0050	mg/L	20-JUN-19	21-JUN-19	R4679848
Manganese (Mn)-Dissolved	0.00169		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Molybdenum (Mo)-Dissolved	0.000401		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Nickel (Ni)-Dissolved	0.00111		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Potassium (K)-Dissolved	0.908		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Rubidium (Rb)-Dissolved	0.00068		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Selenium (Se)-Dissolved	0.000103		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-1 LPR 1 - LITTLE PINE RIVER - SITE 1 Sampled By: Client on 11-JUN-19 @ 12:20 Matrix: Grab							
Dissolved Metals							
Silicon (Si)-Dissolved	2.92		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Sodium (Na)-Dissolved	4.73		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Strontium (Sr)-Dissolved	0.0323		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Sulfur (S)-Dissolved	1.37		0.50	mg/L	20-JUN-19	21-JUN-19	R4679848
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Titanium (Ti)-Dissolved	0.00545		0.00030	mg/L	20-JUN-19	21-JUN-19	R4679848
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Uranium (U)-Dissolved	0.000106		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Vanadium (V)-Dissolved	0.00131		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Zirconium (Zr)-Dissolved	0.00044		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
L2289691-2 LPR 2 - LITTLE PINE RIVER - SITE 2 Sampled By: Client on 11-JUN-19 @ 12:45 Matrix: Grab							
Physical Tests							
Conductivity (EC)	116		1.0	uS/cm		13-JUN-19	R4669774
Hardness (as CaCO3)	56.4		0.50			17-JUN-19	
pH	7.78		0.10	pH		13-JUN-19	R4669774
Total Dissolved Solids	78		13	mg/L		15-JUN-19	R4671088
Turbidity	8.67		0.10	NTU		12-JUN-19	R4665931
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	54.5		2.0	mg/L		13-JUN-19	R4669774
Ammonia, Total (as N)	0.013		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	1.28		0.10	mg/L		13-JUN-19	R4669833
Nitrate (as N)	0.039		0.020	mg/L		13-JUN-19	R4669833
Nitrite (as N)	<0.010		0.010	mg/L		13-JUN-19	R4669833
Total Kjeldahl Nitrogen	0.49		0.20	mg/L	19-JUN-19	20-JUN-19	R4678661
Phosphorus (P)-Total	0.0113		0.0030	mg/L		19-JUN-19	R4673866
Sulfate (SO4)	4.13		0.30	mg/L		13-JUN-19	R4669833
Bacteriological Tests							
Escherichia Coli	21		0	MPN/100mL		12-JUN-19	R4668068
Total Coliforms	1300		0	MPN/100mL		12-JUN-19	R4668068
Total Metals							
Aluminum (Al)-Total	1.32		0.0030	mg/L		21-JUN-19	R4679848
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Arsenic (As)-Total	0.00079		0.00010	mg/L		21-JUN-19	R4679848
Barium (Ba)-Total	0.0186		0.00010	mg/L		21-JUN-19	R4679848
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-2 LPR 2 - LITTLE PINE RIVER - SITE 2 Sampled By: Client on 11-JUN-19 @ 12:45 Matrix: Grab							
Total Metals							
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4679848
Boron (B)-Total	0.014		0.010	mg/L		21-JUN-19	R4679848
Cadmium (Cd)-Total	0.0000253		0.0000050	mg/L		21-JUN-19	R4679848
Calcium (Ca)-Total	16.4		0.050	mg/L		21-JUN-19	R4679848
Cesium (Cs)-Total	0.000114		0.000010	mg/L		21-JUN-19	R4679848
Chromium (Cr)-Total	0.00220		0.00010	mg/L		21-JUN-19	R4679848
Cobalt (Co)-Total	0.00069		0.00010	mg/L		21-JUN-19	R4679848
Copper (Cu)-Total	0.00552		0.00050	mg/L		21-JUN-19	R4679848
Iron (Fe)-Total	1.62		0.010	mg/L		21-JUN-19	R4679848
Lead (Pb)-Total	0.000449		0.000050	mg/L		21-JUN-19	R4679848
Lithium (Li)-Total	0.0031		0.0010	mg/L		21-JUN-19	R4679848
Magnesium (Mg)-Total	6.21		0.0050	mg/L		21-JUN-19	R4679848
Manganese (Mn)-Total	0.0347		0.00010	mg/L		21-JUN-19	R4679848
Molybdenum (Mo)-Total	0.000787		0.000050	mg/L		21-JUN-19	R4679848
Nickel (Ni)-Total	0.00312		0.00050	mg/L		21-JUN-19	R4679848
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4679848
Potassium (K)-Total	1.29		0.050	mg/L		21-JUN-19	R4679848
Rubidium (Rb)-Total	0.00211		0.00020	mg/L		21-JUN-19	R4679848
Selenium (Se)-Total	0.000176		0.000050	mg/L		21-JUN-19	R4679848
Silicon (Si)-Total	6.21		0.10	mg/L		21-JUN-19	R4679848
Silver (Ag)-Total	0.000013		0.000010	mg/L		21-JUN-19	R4679848
Sodium (Na)-Total	11.0		0.050	mg/L		21-JUN-19	R4679848
Strontium (Sr)-Total	0.0464		0.00020	mg/L		21-JUN-19	R4679848
Sulfur (S)-Total	1.62		0.50	mg/L		21-JUN-19	R4679848
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4679848
Thallium (Tl)-Total	0.000015		0.000010	mg/L		21-JUN-19	R4679848
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Titanium (Ti)-Total	0.0338		0.00030	mg/L		21-JUN-19	R4679848
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Uranium (U)-Total	0.000186		0.000010	mg/L		21-JUN-19	R4679848
Vanadium (V)-Total	0.00423		0.00050	mg/L		21-JUN-19	R4679848
Zinc (Zn)-Total	0.0050		0.0030	mg/L		21-JUN-19	R4679848
Zirconium (Zr)-Total	0.00046		0.00020	mg/L		21-JUN-19	R4679848
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					20-JUN-19	R4679166
Aluminum (Al)-Dissolved	0.0758		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Arsenic (As)-Dissolved	0.00033		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Barium (Ba)-Dissolved	0.00886		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-2 LPR 2 - LITTLE PINE RIVER - SITE 2 Sampled By: Client on 11-JUN-19 @ 12:45 Matrix: Grab							
Dissolved Metals							
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Boron (B)-Dissolved	0.011		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cadmium (Cd)-Dissolved	<0.0000050		0.0000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Calcium (Ca)-Dissolved	14.5		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Cesium (Cs)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Chromium (Cr)-Dissolved	0.00017		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Copper (Cu)-Dissolved	0.00190		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Iron (Fe)-Dissolved	0.087		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Lithium (Li)-Dissolved	0.0012		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Magnesium (Mg)-Dissolved	4.90		0.0050	mg/L	20-JUN-19	21-JUN-19	R4679848
Manganese (Mn)-Dissolved	0.00081		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Molybdenum (Mo)-Dissolved	0.000259		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Nickel (Ni)-Dissolved	0.00082		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Potassium (K)-Dissolved	0.814		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Rubidium (Rb)-Dissolved	0.00059		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Selenium (Se)-Dissolved	0.000083		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silicon (Si)-Dissolved	2.34		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Sodium (Na)-Dissolved	2.40		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Strontium (Sr)-Dissolved	0.0269		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Sulfur (S)-Dissolved	1.41		0.50	mg/L	20-JUN-19	21-JUN-19	R4679848
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Titanium (Ti)-Dissolved	0.00238		0.00030	mg/L	20-JUN-19	21-JUN-19	R4679848
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Uranium (U)-Dissolved	0.000066		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Vanadium (V)-Dissolved	0.00085		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Zirconium (Zr)-Dissolved	0.00022		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
L2289691-3 LPR 3 - LITTLE PINE RIVER - SITE 3 Sampled By: Client on 11-JUN-19 @ 11:30 Matrix: Grab							
Physical Tests							
Conductivity (EC)	178		1.0	uS/cm		13-JUN-19	R4669774
Hardness (as CaCO3)	65.8		0.50			17-JUN-19	
pH	7.65		0.10	pH		13-JUN-19	R4669774
Total Dissolved Solids	127		13	mg/L		15-JUN-19	R4671088

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-3 LPR 3 - LITTLE PINE RIVER - SITE 3 Sampled By: Client on 11-JUN-19 @ 11:30 Matrix: Grab							
Physical Tests							
Turbidity	24.7		0.10	NTU		12-JUN-19	R4665931
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	63.1		2.0	mg/L		13-JUN-19	R4669774
Ammonia, Total (as N)	0.017		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	14.0		0.10	mg/L		13-JUN-19	R4669833
Nitrate (as N)	0.081		0.020	mg/L		13-JUN-19	R4669833
Nitrite (as N)	<0.010		0.010	mg/L		13-JUN-19	R4669833
Total Kjeldahl Nitrogen	0.95		0.20	mg/L	19-JUN-19	20-JUN-19	R4678661
Phosphorus (P)-Total	0.0214		0.0030	mg/L		19-JUN-19	R4673866
Sulfate (SO4)	5.85		0.30	mg/L		13-JUN-19	R4669833
Bacteriological Tests							
Escherichia Coli	64		0	MPN/100mL		12-JUN-19	R4668068
Total Coliforms	>2420		0	MPN/100mL		12-JUN-19	R4668068
Total Metals							
Aluminum (Al)-Total	0.0986		0.0030	mg/L		21-JUN-19	R4681687
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681687
Arsenic (As)-Total	0.00031		0.00010	mg/L		21-JUN-19	R4681687
Barium (Ba)-Total	0.00951		0.00010	mg/L		21-JUN-19	R4681687
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681687
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4681687
Boron (B)-Total	<0.010		0.010	mg/L		21-JUN-19	R4681687
Cadmium (Cd)-Total	<0.0000050		0.0000050	mg/L		21-JUN-19	R4681687
Calcium (Ca)-Total	12.7		0.050	mg/L		21-JUN-19	R4681687
Cesium (Cs)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681687
Chromium (Cr)-Total	0.00023		0.00010	mg/L		21-JUN-19	R4681687
Cobalt (Co)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681687
Copper (Cu)-Total	0.00166		0.00050	mg/L		21-JUN-19	R4681687
Iron (Fe)-Total	0.117		0.010	mg/L		21-JUN-19	R4681687
Lead (Pb)-Total	0.000059		0.000050	mg/L		21-JUN-19	R4681687
Lithium (Li)-Total	0.0012		0.0010	mg/L		21-JUN-19	R4681687
Magnesium (Mg)-Total	4.64		0.0050	mg/L		21-JUN-19	R4681687
Manganese (Mn)-Total	0.00646		0.00010	mg/L		21-JUN-19	R4681687
Molybdenum (Mo)-Total	0.000243		0.000050	mg/L		21-JUN-19	R4681687
Nickel (Ni)-Total	0.00076		0.00050	mg/L		21-JUN-19	R4681687
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4681687
Potassium (K)-Total	0.776		0.050	mg/L		21-JUN-19	R4681687
Rubidium (Rb)-Total	0.00068		0.00020	mg/L		21-JUN-19	R4681687
Selenium (Se)-Total	0.000093		0.000050	mg/L		21-JUN-19	R4681687
Silicon (Si)-Total	2.16		0.10	mg/L		21-JUN-19	R4681687
Silver (Ag)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681687
Sodium (Na)-Total	1.99		0.050	mg/L		21-JUN-19	R4681687
Strontium (Sr)-Total	0.0233		0.00020	mg/L		21-JUN-19	R4681687

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-3 LPR 3 - LITTLE PINE RIVER - SITE 3 Sampled By: Client on 11-JUN-19 @ 11:30 Matrix: Grab							
Total Metals							
Sulfur (S)-Total	1.63		0.50	mg/L		21-JUN-19	R4681687
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681687
Thallium (Tl)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681687
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681687
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681687
Titanium (Ti)-Total	0.00281		0.00030	mg/L		21-JUN-19	R4681687
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681687
Uranium (U)-Total	0.000053		0.000010	mg/L		21-JUN-19	R4681687
Vanadium (V)-Total	0.00055		0.00050	mg/L		21-JUN-19	R4681687
Zinc (Zn)-Total	<0.0030		0.0030	mg/L		21-JUN-19	R4681687
Zirconium (Zr)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681687
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					21-JUN-19	R4681339
Aluminum (Al)-Dissolved	0.343	DTC	0.0010	mg/L	21-JUN-19	21-JUN-19	R4681565
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Arsenic (As)-Dissolved	0.00061	DTC	0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Barium (Ba)-Dissolved	0.0124		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	21-JUN-19	21-JUN-19	R4681565
Boron (B)-Dissolved	0.014		0.010	mg/L	21-JUN-19	21-JUN-19	R4681565
Cadmium (Cd)-Dissolved	0.0000135		0.0000050	mg/L	21-JUN-19	21-JUN-19	R4681565
Calcium (Ca)-Dissolved	16.6		0.050	mg/L	21-JUN-19	21-JUN-19	R4681565
Cesium (Cs)-Dissolved	0.000022		0.000010	mg/L	21-JUN-19	21-JUN-19	R4681565
Chromium (Cr)-Dissolved	0.00068	DTC	0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Cobalt (Co)-Dissolved	0.00014		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Copper (Cu)-Dissolved	0.00385	DTC	0.00020	mg/L	21-JUN-19	21-JUN-19	R4681565
Iron (Fe)-Dissolved	0.504	DTC	0.010	mg/L	21-JUN-19	21-JUN-19	R4681565
Lead (Pb)-Dissolved	0.000151		0.000050	mg/L	21-JUN-19	21-JUN-19	R4681565
Lithium (Li)-Dissolved	0.0020		0.0010	mg/L	21-JUN-19	21-JUN-19	R4681565
Magnesium (Mg)-Dissolved	5.90		0.0050	mg/L	21-JUN-19	21-JUN-19	R4681565
Manganese (Mn)-Dissolved	0.00460		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Molybdenum (Mo)-Dissolved	0.000748	DTC	0.000050	mg/L	21-JUN-19	21-JUN-19	R4681565
Nickel (Ni)-Dissolved	0.00173		0.00050	mg/L	21-JUN-19	21-JUN-19	R4681565
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	21-JUN-19	21-JUN-19	R4681565
Potassium (K)-Dissolved	1.10	DTC	0.050	mg/L	21-JUN-19	21-JUN-19	R4681565
Rubidium (Rb)-Dissolved	0.00099		0.00020	mg/L	21-JUN-19	21-JUN-19	R4681565
Selenium (Se)-Dissolved	0.000172		0.000050	mg/L	21-JUN-19	21-JUN-19	R4681565
Silicon (Si)-Dissolved	4.36	DTC	0.050	mg/L	21-JUN-19	21-JUN-19	R4681565
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	21-JUN-19	21-JUN-19	R4681565
Sodium (Na)-Dissolved	11.3	DTC	0.050	mg/L	21-JUN-19	21-JUN-19	R4681565
Strontium (Sr)-Dissolved	0.0459	DTC	0.00020	mg/L	21-JUN-19	21-JUN-19	R4681565

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-3 LPR 3 - LITTLE PINE RIVER - SITE 3 Sampled By: Client on 11-JUN-19 @ 11:30 Matrix: Grab							
Dissolved Metals							
Sulfur (S)-Dissolved	1.31		0.50	mg/L	21-JUN-19	21-JUN-19	R4681565
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	21-JUN-19	21-JUN-19	R4681565
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	21-JUN-19	21-JUN-19	R4681565
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Titanium (Ti)-Dissolved	0.0136	DTC	0.00030	mg/L	21-JUN-19	21-JUN-19	R4681565
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	21-JUN-19	21-JUN-19	R4681565
Uranium (U)-Dissolved	0.000170	DTC	0.000010	mg/L	21-JUN-19	21-JUN-19	R4681565
Vanadium (V)-Dissolved	0.00234	DTC	0.00050	mg/L	21-JUN-19	21-JUN-19	R4681565
Zinc (Zn)-Dissolved	0.0012	DTC	0.0010	mg/L	21-JUN-19	21-JUN-19	R4681565
Zirconium (Zr)-Dissolved	0.00087		0.00020	mg/L	21-JUN-19	21-JUN-19	R4681565
L2289691-4 LPR 4 - LITTLE PINE RIVER - SITE 4 Sampled By: Client on 11-JUN-19 @ 10:30 Matrix: Grab							
Physical Tests							
Conductivity (EC)	107		1.0	uS/cm		13-JUN-19	R4669774
Hardness (as CaCO3)	50.9		0.50			17-JUN-19	
pH	7.56		0.10	pH		13-JUN-19	R4669774
Total Dissolved Solids	69		13	mg/L		15-JUN-19	R4671088
Turbidity	2.47		0.10	NTU		12-JUN-19	R4665931
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	49.9		2.0	mg/L		13-JUN-19	R4669774
Ammonia, Total (as N)	0.010		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	0.53		0.10	mg/L		13-JUN-19	R4669833
Nitrate (as N)	0.025		0.020	mg/L		13-JUN-19	R4669833
Nitrite (as N)	<0.010		0.010	mg/L		13-JUN-19	R4669833
Total Kjeldahl Nitrogen	0.36		0.20	mg/L	19-JUN-19	20-JUN-19	R4678661
Phosphorus (P)-Total	0.0131		0.0030	mg/L		19-JUN-19	R4673866
Sulfate (SO4)	3.94		0.30	mg/L		13-JUN-19	R4669833
Bacteriological Tests							
Escherichia Coli	0		0	MPN/100mL		12-JUN-19	R4668068
Total Coliforms	42		0	MPN/100mL		12-JUN-19	R4668068
Total Metals							
Aluminum (Al)-Total	0.502		0.0030	mg/L		21-JUN-19	R4679848
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Arsenic (As)-Total	0.00039		0.00010	mg/L		21-JUN-19	R4679848
Barium (Ba)-Total	0.0121		0.00010	mg/L		21-JUN-19	R4679848
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4679848
Boron (B)-Total	0.011		0.010	mg/L		21-JUN-19	R4679848
Cadmium (Cd)-Total	0.0000122		0.0000050	mg/L		21-JUN-19	R4679848
Calcium (Ca)-Total	13.9		0.050	mg/L		21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-4 LPR 4 - LITTLE PINE RIVER - SITE 4 Sampled By: Client on 11-JUN-19 @ 10:30 Matrix: Grab							
Total Metals							
Cesium (Cs)-Total	0.000046		0.000010	mg/L		21-JUN-19	R4679848
Chromium (Cr)-Total	0.00084		0.00010	mg/L		21-JUN-19	R4679848
Cobalt (Co)-Total	0.00028		0.00010	mg/L		21-JUN-19	R4679848
Copper (Cu)-Total	0.00272		0.00050	mg/L		21-JUN-19	R4679848
Iron (Fe)-Total	0.531		0.010	mg/L		21-JUN-19	R4679848
Lead (Pb)-Total	0.000176		0.000050	mg/L		21-JUN-19	R4679848
Lithium (Li)-Total	0.0016		0.0010	mg/L		21-JUN-19	R4679848
Magnesium (Mg)-Total	4.96		0.0050	mg/L		21-JUN-19	R4679848
Manganese (Mn)-Total	0.0135		0.00010	mg/L		21-JUN-19	R4679848
Molybdenum (Mo)-Total	0.000268		0.000050	mg/L		21-JUN-19	R4679848
Nickel (Ni)-Total	0.00144		0.00050	mg/L		21-JUN-19	R4679848
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4679848
Potassium (K)-Total	0.895		0.050	mg/L		21-JUN-19	R4679848
Rubidium (Rb)-Total	0.00114		0.00020	mg/L		21-JUN-19	R4679848
Selenium (Se)-Total	0.000115		0.000050	mg/L		21-JUN-19	R4679848
Silicon (Si)-Total	3.08		0.10	mg/L		21-JUN-19	R4679848
Silver (Ag)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4679848
Sodium (Na)-Total	2.46		0.050	mg/L		21-JUN-19	R4679848
Strontium (Sr)-Total	0.0270		0.00020	mg/L		21-JUN-19	R4679848
Sulfur (S)-Total	1.49		0.50	mg/L		21-JUN-19	R4679848
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4679848
Thallium (Tl)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4679848
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Titanium (Ti)-Total	0.0172		0.00030	mg/L		21-JUN-19	R4679848
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4679848
Uranium (U)-Total	0.000075		0.000010	mg/L		21-JUN-19	R4679848
Vanadium (V)-Total	0.00175		0.00050	mg/L		21-JUN-19	R4679848
Zinc (Zn)-Total	<0.0030		0.0030	mg/L		21-JUN-19	R4679848
Zirconium (Zr)-Total	0.00029		0.00020	mg/L		21-JUN-19	R4679848
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					20-JUN-19	R4679166
Aluminum (Al)-Dissolved	0.0096		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Arsenic (As)-Dissolved	0.00026		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Barium (Ba)-Dissolved	0.00886		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Boron (B)-Dissolved	<0.010		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cadmium (Cd)-Dissolved	<0.0000050		0.0000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Calcium (Ca)-Dissolved	13.0		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289691-4 LPR 4 - LITTLE PINE RIVER - SITE 4 Sampled By: Client on 11-JUN-19 @ 10:30 Matrix: Grab							
Dissolved Metals							
Cesium (Cs)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Chromium (Cr)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Copper (Cu)-Dissolved	0.00134		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Iron (Fe)-Dissolved	0.015		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Lithium (Li)-Dissolved	0.0011		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Magnesium (Mg)-Dissolved	4.49		0.0050	mg/L	20-JUN-19	21-JUN-19	R4679848
Manganese (Mn)-Dissolved	0.00019		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Molybdenum (Mo)-Dissolved	0.000241		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Nickel (Ni)-Dissolved	0.00058		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Potassium (K)-Dissolved	0.755		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Rubidium (Rb)-Dissolved	0.00057		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Selenium (Se)-Dissolved	0.000091		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silicon (Si)-Dissolved	1.90		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Sodium (Na)-Dissolved	1.89		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Strontium (Sr)-Dissolved	0.0242		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Sulfur (S)-Dissolved	1.56		0.50	mg/L	20-JUN-19	21-JUN-19	R4679848
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Titanium (Ti)-Dissolved	<0.00030		0.00030	mg/L	20-JUN-19	21-JUN-19	R4679848
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Uranium (U)-Dissolved	0.000045		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Vanadium (V)-Dissolved	<0.00050		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Zirconium (Zr)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Dissolved	MES	L2289691-3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2289691-3
Matrix Spike	Boron (B)-Dissolved	MS-B	L2289691-3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2289691-3
Matrix Spike	Cobalt (Co)-Dissolved	MS-B	L2289691-3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2289691-3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2289691-3
Matrix Spike	Nickel (Ni)-Dissolved	MS-B	L2289691-3
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2289691-3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2289691-3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2289691-3
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2289691-3
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2289691-3
Matrix Spike	Aluminum (Al)-Total	MS-B	L2289691-1, -2, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2289691-1, -2, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2289691-3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2289691-1, -2, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2289691-3
Matrix Spike	Manganese (Mn)-Total	MS-B	L2289691-1, -2, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2289691-1, -2, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2289691-3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2289691-1, -2, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2289691-3
Matrix Spike	Sulfur (S)-Total	MS-B	L2289691-3

Sample Parameter Qualifier key listed:

Qualifier	Description
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-TB	Water	Alkalinity	APHA 2320B modified

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CL-L-IC-N-TB	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-TITR-TB	Water	Conductivity	APHA 2510 B

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-TB	Water	Hardness (as CaCO3)	CALCULATION

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-TOTKJ-WP	Water	Total Kjeldahl Nitrogen	APHA 4500 NorgD (modified)

Aqueous samples are digested in a block digester with sulfuric acid and copper sulfate as a catalyst. Total Kjeldahl Nitrogen is then analyzed using a discrete analyzer with colorimetric detection.

Reference Information

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

NO2-IC-N-TB	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-N-TB	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS-L

This analysis is carried out using procedures adapted from APHA METHOD 4500-P "Phosphorus". Total Phosphorus is determined colourmetrically after persulphate digestion of the sample.

PH-TITR-TB	Water	pH	APHA 4500-H

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

SO4-IC-N-TB	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TC,EC-QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture of hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

TDS-TB	Water	Total Dissolved Solids	APHA 2540 C (modified)

Aqueous matrices are analyzed using gravimetry and evaporation

TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

Aqueous matrices are analyzed using nephelometry with the light scatter measured at a 90” angle.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
TB	ALS ENVIRONMENTAL - THUNDER BAY, ONTARIO, CANADA
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: LAKEHEAD REGION CONSERVATION AUTHORITY-TB
130 Conservation Road P.O. Box 10427
Thunder Bay ON P7B 6T8
Contact: Scott Drebit

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-TB	**Water**							
Batch R4669774								
WG3075949-15 DUP		**L2289691-3**						
Alkalinity, Total (as CaCO3)		63.1	63.1		mg/L	0.0	20	13-JUN-19
WG3075949-11 LCS								
Alkalinity, Total (as CaCO3)			97.4		%		85-115	13-JUN-19
WG3075949-14 LCS								
Alkalinity, Total (as CaCO3)			101.1		%		85-115	13-JUN-19
WG3075949-17 LCS								
Alkalinity, Total (as CaCO3)			97.8		%		85-115	13-JUN-19
WG3075949-10 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	13-JUN-19
WG3075949-13 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	13-JUN-19
WG3075949-16 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	13-JUN-19
CL-L-IC-N-TB	**Water**							
Batch R4669833								
WG3075915-10 LCS								
Chloride (Cl)			99.6		%		90-110	13-JUN-19
WG3075915-9 MB								
Chloride (Cl)			<0.10		mg/L		0.1	13-JUN-19
EC-TITR-TB	**Water**							
Batch R4669774								
WG3075949-15 DUP		**L2289691-3**						
Conductivity (EC)		178	176		uS/cm	1.3	10	13-JUN-19
WG3075949-11 LCS								
Conductivity (EC)			98.7		%		90-110	13-JUN-19
WG3075949-14 LCS								
Conductivity (EC)			99.6		%		90-110	13-JUN-19
WG3075949-17 LCS								
Conductivity (EC)			98.9		%		90-110	13-JUN-19
WG3075949-10 MB								
Conductivity (EC)			<1.0		uS/cm		1	13-JUN-19
WG3075949-13 MB								
Conductivity (EC)			<1.0		uS/cm		1	13-JUN-19
WG3075949-16 MB								
Conductivity (EC)			<1.0		uS/cm		1	13-JUN-19
MET-D-CCMS-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch	**R4679848**							
WG3083474-2	**LCS**							
Aluminum (Al)-Dissolved			98.6		%		80-120	21-JUN-19
Antimony (Sb)-Dissolved			97.6		%		80-120	21-JUN-19
Arsenic (As)-Dissolved			95.1		%		80-120	21-JUN-19
Barium (Ba)-Dissolved			93.3		%		80-120	21-JUN-19
Beryllium (Be)-Dissolved			98.7		%		80-120	21-JUN-19
Bismuth (Bi)-Dissolved			101.0		%		80-120	21-JUN-19
Boron (B)-Dissolved			97.3		%		80-120	21-JUN-19
Cadmium (Cd)-Dissolved			101.2		%		80-120	21-JUN-19
Calcium (Ca)-Dissolved			100.2		%		80-120	21-JUN-19
Cesium (Cs)-Dissolved			97.9		%		80-120	21-JUN-19
Chromium (Cr)-Dissolved			95.2		%		80-120	21-JUN-19
Cobalt (Co)-Dissolved			99.9		%		80-120	21-JUN-19
Copper (Cu)-Dissolved			93.8		%		80-120	21-JUN-19
Iron (Fe)-Dissolved			96.2		%		80-120	21-JUN-19
Lead (Pb)-Dissolved			96.7		%		80-120	21-JUN-19
Lithium (Li)-Dissolved			98.5		%		80-120	21-JUN-19
Magnesium (Mg)-Dissolved			99.4		%		80-120	21-JUN-19
Manganese (Mn)-Dissolved			98.0		%		80-120	21-JUN-19
Molybdenum (Mo)-Dissolved			97.6		%		80-120	21-JUN-19
Nickel (Ni)-Dissolved			96.7		%		80-120	21-JUN-19
Phosphorus (P)-Dissolved			105.9		%		70-130	21-JUN-19
Potassium (K)-Dissolved			99.6		%		80-120	21-JUN-19
Rubidium (Rb)-Dissolved			100.0		%		80-120	21-JUN-19
Selenium (Se)-Dissolved			100.2		%		80-120	21-JUN-19
Silicon (Si)-Dissolved			107.0		%		60-140	21-JUN-19
Silver (Ag)-Dissolved			93.5		%		80-120	21-JUN-19
Sodium (Na)-Dissolved			98.1		%		80-120	21-JUN-19
Strontium (Sr)-Dissolved			99.8		%		80-120	21-JUN-19
Tellurium (Te)-Dissolved			95.4		%		80-120	21-JUN-19
Thallium (Tl)-Dissolved			98.2		%		80-120	21-JUN-19
Thorium (Th)-Dissolved			95.1		%		80-120	21-JUN-19
Tin (Sn)-Dissolved			96.1		%		80-120	21-JUN-19
Titanium (Ti)-Dissolved			91.1		%		80-120	21-JUN-19
Tungsten (W)-Dissolved			100.2		%		80-120	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4679848								
WG3083474-2 LCS								
Uranium (U)-Dissolved			102.0		%		80-120	21-JUN-19
Vanadium (V)-Dissolved			98.5		%		80-120	21-JUN-19
Zinc (Zn)-Dissolved			94.2		%		80-120	21-JUN-19
Zirconium (Zr)-Dissolved			96.1		%		80-120	21-JUN-19
WG3083474-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Beryllium (Be)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Boron (B)-Dissolved			<0.010		mg/L		0.01	21-JUN-19
Cadmium (Cd)-Dissolved			<0.000005C		mg/L		0.000005	21-JUN-19
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Cesium (Cs)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	21-JUN-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	21-JUN-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	21-JUN-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Potassium (K)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Rubidium (Rb)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4679848								
WG3083474-1 MB		**LF**						
Tellurium (Te)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Thorium (Th)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	21-JUN-19
Tungsten (W)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	21-JUN-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Zirconium (Zr)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Batch R4681565								
WG3084652-2 LCS								
Aluminum (Al)-Dissolved			100.7		%		80-120	21-JUN-19
Antimony (Sb)-Dissolved			98.0		%		80-120	21-JUN-19
Arsenic (As)-Dissolved			98.5		%		80-120	21-JUN-19
Barium (Ba)-Dissolved			107.5		%		80-120	21-JUN-19
Beryllium (Be)-Dissolved			91.8		%		80-120	21-JUN-19
Bismuth (Bi)-Dissolved			98.6		%		80-120	21-JUN-19
Boron (B)-Dissolved			95.0		%		80-120	21-JUN-19
Cadmium (Cd)-Dissolved			94.4		%		80-120	21-JUN-19
Calcium (Ca)-Dissolved			98.5		%		80-120	21-JUN-19
Cesium (Cs)-Dissolved			97.2		%		80-120	21-JUN-19
Chromium (Cr)-Dissolved			99.8		%		80-120	21-JUN-19
Cobalt (Co)-Dissolved			98.7		%		80-120	21-JUN-19
Copper (Cu)-Dissolved			97.0		%		80-120	21-JUN-19
Iron (Fe)-Dissolved			95.7		%		80-120	21-JUN-19
Lead (Pb)-Dissolved			102.4		%		80-120	21-JUN-19
Lithium (Li)-Dissolved			91.5		%		80-120	21-JUN-19
Magnesium (Mg)-Dissolved			96.8		%		80-120	21-JUN-19
Manganese (Mn)-Dissolved			100.8		%		80-120	21-JUN-19
Molybdenum (Mo)-Dissolved			103.4		%		80-120	21-JUN-19
Nickel (Ni)-Dissolved			97.4		%		80-120	21-JUN-19
Phosphorus (P)-Dissolved			99.8		%		70-130	21-JUN-19
Potassium (K)-Dissolved			98.9		%		80-120	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4681565								
WG3084652-2 LCS								
Rubidium (Rb)-Dissolved			105.9		%		80-120	21-JUN-19
Selenium (Se)-Dissolved			103.1		%		80-120	21-JUN-19
Silicon (Si)-Dissolved			103.7		%		60-140	21-JUN-19
Silver (Ag)-Dissolved			97.8		%		80-120	21-JUN-19
Sodium (Na)-Dissolved			101.8		%		80-120	21-JUN-19
Strontium (Sr)-Dissolved			101.7		%		80-120	21-JUN-19
Sulfur (S)-Dissolved			79.4	MES	%		80-120	21-JUN-19
Tellurium (Te)-Dissolved			97.7		%		80-120	21-JUN-19
Thallium (Tl)-Dissolved			99.4		%		80-120	21-JUN-19
Thorium (Th)-Dissolved			82.9		%		80-120	21-JUN-19
Tin (Sn)-Dissolved			98.4		%		80-120	21-JUN-19
Titanium (Ti)-Dissolved			93.8		%		80-120	21-JUN-19
Tungsten (W)-Dissolved			102.9		%		80-120	21-JUN-19
Uranium (U)-Dissolved			98.8		%		80-120	21-JUN-19
Vanadium (V)-Dissolved			99.6		%		80-120	21-JUN-19
Zinc (Zn)-Dissolved			98.2		%		80-120	21-JUN-19
Zirconium (Zr)-Dissolved			88.5		%		80-120	21-JUN-19
WG3084652-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Beryllium (Be)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Boron (B)-Dissolved			<0.010		mg/L		0.01	21-JUN-19
Cadmium (Cd)-Dissolved			<0.000005C		mg/L		0.000005	21-JUN-19
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Cesium (Cs)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	21-JUN-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4681565								
WG3084652-1 MB		**LF**						
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	21-JUN-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	21-JUN-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Potassium (K)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Rubidium (Rb)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	21-JUN-19
Tellurium (Te)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Thorium (Th)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	21-JUN-19
Tungsten (W)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	21-JUN-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Zirconium (Zr)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Batch R4682679								
WG3083474-2 LCS								
Sulfur (S)-Dissolved			84.7		%		80-120	21-JUN-19
MET-T-CCMS-VA	**Water**							
Batch R4679848								
WG3083443-3 DUP		**L2289691-2**						
Aluminum (Al)-Total		1.32	1.31		mg/L	0.8	20	21-JUN-19
Antimony (Sb)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	21-JUN-19
Arsenic (As)-Total		0.00079	0.00080		mg/L	1.5	20	21-JUN-19
Barium (Ba)-Total		0.0186	0.0187		mg/L	0.6	20	21-JUN-19
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4679848								
WG3083443-3 DUP		**L2289691-2**						
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	21-JUN-19
Boron (B)-Total		0.014	0.015		mg/L	1.4	20	21-JUN-19
Cadmium (Cd)-Total		0.0000253	0.0000271		mg/L	6.8	20	21-JUN-19
Calcium (Ca)-Total		16.4	16.6		mg/L	1.4	20	21-JUN-19
Cesium (Cs)-Total		0.000114	0.000118		mg/L	3.0	20	21-JUN-19
Chromium (Cr)-Total		0.00220	0.00220		mg/L	0.1	20	21-JUN-19
Cobalt (Co)-Total		0.00069	0.00068		mg/L	0.9	20	21-JUN-19
Copper (Cu)-Total		0.00552	0.00554		mg/L	0.3	20	21-JUN-19
Iron (Fe)-Total		1.62	1.62		mg/L	0.3	20	21-JUN-19
Lead (Pb)-Total		0.000449	0.000449		mg/L	0.1	20	21-JUN-19
Lithium (Li)-Total		0.0031	0.0032		mg/L	2.6	20	21-JUN-19
Magnesium (Mg)-Total		6.21	6.17		mg/L	0.6	20	21-JUN-19
Manganese (Mn)-Total		0.0347	0.0347		mg/L	0.1	20	21-JUN-19
Molybdenum (Mo)-Total		0.000787	0.000771		mg/L	2.1	20	21-JUN-19
Nickel (Ni)-Total		0.00312	0.00323		mg/L	3.7	20	21-JUN-19
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	21-JUN-19
Potassium (K)-Total		1.29	1.28		mg/L	0.9	20	21-JUN-19
Rubidium (Rb)-Total		0.00211	0.00213		mg/L	0.5	20	21-JUN-19
Selenium (Se)-Total		0.000176	0.000169		mg/L	4.5	20	21-JUN-19
Silicon (Si)-Total		6.21	6.12		mg/L	1.4	20	21-JUN-19
Silver (Ag)-Total		0.000013	0.000014		mg/L	1.8	20	21-JUN-19
Sodium (Na)-Total		11.0	11.1		mg/L	1.0	20	21-JUN-19
Strontium (Sr)-Total		0.0464	0.0468		mg/L	0.9	20	21-JUN-19
Sulfur (S)-Total		1.62	1.62		mg/L	0.3	20	21-JUN-19
Tellurium (Te)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	21-JUN-19
Thallium (Tl)-Total		0.000015	0.000015		mg/L	3.1	20	21-JUN-19
Thorium (Th)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	21-JUN-19
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	21-JUN-19
Titanium (Ti)-Total		0.0338	0.0334		mg/L	0.9	20	21-JUN-19
Tungsten (W)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	21-JUN-19
Uranium (U)-Total		0.000186	0.000185		mg/L	0.8	20	21-JUN-19
Vanadium (V)-Total		0.00423	0.00426		mg/L	0.7	20	21-JUN-19
Zinc (Zn)-Total		0.0050	0.0051		mg/L	1.3	20	21-JUN-19
Zirconium (Zr)-Total		0.00046	0.00044		mg/L	5.4	20	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch	**R4679848**							
WG3083443-2	**LCS**							
Aluminum (Al)-Total			104.1		%		80-120	20-JUN-19
Antimony (Sb)-Total			104.0		%		80-120	20-JUN-19
Arsenic (As)-Total			100.3		%		80-120	20-JUN-19
Barium (Ba)-Total			101.5		%		80-120	20-JUN-19
Beryllium (Be)-Total			101.5		%		80-120	20-JUN-19
Bismuth (Bi)-Total			101.9		%		80-120	20-JUN-19
Boron (B)-Total			108.2		%		80-120	20-JUN-19
Cadmium (Cd)-Total			104.7		%		80-120	20-JUN-19
Calcium (Ca)-Total			101.1		%		80-120	20-JUN-19
Cesium (Cs)-Total			103.7		%		80-120	20-JUN-19
Chromium (Cr)-Total			101.0		%		80-120	20-JUN-19
Cobalt (Co)-Total			104.5		%		80-120	20-JUN-19
Copper (Cu)-Total			101.8		%		80-120	20-JUN-19
Iron (Fe)-Total			102.6		%		80-120	20-JUN-19
Lead (Pb)-Total			100.1		%		80-120	20-JUN-19
Lithium (Li)-Total			101.9		%		80-120	20-JUN-19
Magnesium (Mg)-Total			103.4		%		80-120	20-JUN-19
Manganese (Mn)-Total			103.6		%		80-120	20-JUN-19
Molybdenum (Mo)-Total			99.7		%		80-120	20-JUN-19
Nickel (Ni)-Total			103.2		%		80-120	20-JUN-19
Phosphorus (P)-Total			98.2		%		80-120	20-JUN-19
Potassium (K)-Total			104.6		%		80-120	20-JUN-19
Rubidium (Rb)-Total			108.4		%		80-120	20-JUN-19
Selenium (Se)-Total			102.8		%		80-120	20-JUN-19
Silicon (Si)-Total			107.3		%		80-120	20-JUN-19
Silver (Ag)-Total			98.8		%		80-120	20-JUN-19
Sodium (Na)-Total			104.5		%		80-120	20-JUN-19
Strontium (Sr)-Total			101.2		%		80-120	20-JUN-19
Sulfur (S)-Total			87.4		%		80-120	20-JUN-19
Tellurium (Te)-Total			102.2		%		80-120	20-JUN-19
Thallium (Tl)-Total			101.8		%		80-120	20-JUN-19
Thorium (Th)-Total			98.4		%		80-120	20-JUN-19
Tin (Sn)-Total			101.3		%		80-120	20-JUN-19
Titanium (Ti)-Total			97.2		%		80-120	20-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4679848								
WG3083443-2 LCS								
Tungsten (W)-Total			103.4		%		80-120	20-JUN-19
Uranium (U)-Total			101.1		%		80-120	20-JUN-19
Vanadium (V)-Total			102.0		%		80-120	20-JUN-19
Zinc (Zn)-Total			101.6		%		80-120	20-JUN-19
Zirconium (Zr)-Total			99.6		%		80-120	20-JUN-19
WG3083443-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	20-JUN-19
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Arsenic (As)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Barium (Ba)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	20-JUN-19
Boron (B)-Total			<0.010		mg/L		0.01	20-JUN-19
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	20-JUN-19
Calcium (Ca)-Total			<0.050		mg/L		0.05	20-JUN-19
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	20-JUN-19
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	20-JUN-19
Iron (Fe)-Total			<0.010		mg/L		0.01	20-JUN-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	20-JUN-19
Lithium (Li)-Total			<0.0010		mg/L		0.001	20-JUN-19
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	20-JUN-19
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	20-JUN-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	20-JUN-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	20-JUN-19
Potassium (K)-Total			<0.050		mg/L		0.05	20-JUN-19
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	20-JUN-19
Selenium (Se)-Total			<0.000050		mg/L		0.00005	20-JUN-19
Silicon (Si)-Total			<0.10		mg/L		0.1	20-JUN-19
Silver (Ag)-Total			<0.000010		mg/L		0.00001	20-JUN-19
Sodium (Na)-Total			<0.050		mg/L		0.05	20-JUN-19
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	20-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4679848								
WG3083443-1 MB								
Sulfur (S)-Total			<0.50		mg/L		0.5	20-JUN-19
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	20-JUN-19
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	20-JUN-19
Thorium (Th)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Tin (Sn)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	20-JUN-19
Tungsten (W)-Total			<0.00010		mg/L		0.0001	20-JUN-19
Uranium (U)-Total			<0.000010		mg/L		0.00001	20-JUN-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	20-JUN-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	20-JUN-19
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	20-JUN-19
WG3083443-4 MS		**L2289691-1**						
Aluminum (Al)-Total			N/A	MS-B	%		-	21-JUN-19
Antimony (Sb)-Total			98.7		%		70-130	21-JUN-19
Arsenic (As)-Total			98.6		%		70-130	21-JUN-19
Barium (Ba)-Total			95.1		%		70-130	21-JUN-19
Beryllium (Be)-Total			96.2		%		70-130	21-JUN-19
Bismuth (Bi)-Total			95.7		%		70-130	21-JUN-19
Boron (B)-Total			94.8		%		70-130	21-JUN-19
Cadmium (Cd)-Total			100.0		%		70-130	21-JUN-19
Calcium (Ca)-Total			N/A	MS-B	%		-	21-JUN-19
Cesium (Cs)-Total			100.5		%		70-130	21-JUN-19
Chromium (Cr)-Total			96.6		%		70-130	21-JUN-19
Cobalt (Co)-Total			99.7		%		70-130	21-JUN-19
Copper (Cu)-Total			98.4		%		70-130	21-JUN-19
Iron (Fe)-Total			96.2		%		70-130	21-JUN-19
Lead (Pb)-Total			95.7		%		70-130	21-JUN-19
Lithium (Li)-Total			96.4		%		70-130	21-JUN-19
Magnesium (Mg)-Total			N/A	MS-B	%		-	21-JUN-19
Manganese (Mn)-Total			N/A	MS-B	%		-	21-JUN-19
Molybdenum (Mo)-Total			95.0		%		70-130	21-JUN-19
Nickel (Ni)-Total			98.1		%		70-130	21-JUN-19
Phosphorus (P)-Total			97.5		%		70-130	21-JUN-19
Potassium (K)-Total			99.2		%		70-130	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4679848								
WG3083443-4 MS		**L2289691-1**						
Rubidium (Rb)-Total			99.9		%		70-130	21-JUN-19
Selenium (Se)-Total			103.4		%		70-130	21-JUN-19
Silicon (Si)-Total			97.8		%		70-130	21-JUN-19
Silver (Ag)-Total			98.5		%		70-130	21-JUN-19
Sodium (Na)-Total			N/A	MS-B	%		-	21-JUN-19
Strontium (Sr)-Total			N/A	MS-B	%		-	21-JUN-19
Sulfur (S)-Total			102.2		%		70-130	21-JUN-19
Tellurium (Te)-Total			97.6		%		70-130	21-JUN-19
Thallium (Tl)-Total			96.8		%		70-130	21-JUN-19
Thorium (Th)-Total			100.4		%		70-130	21-JUN-19
Tin (Sn)-Total			96.4		%		70-130	21-JUN-19
Titanium (Ti)-Total			93.9		%		70-130	21-JUN-19
Tungsten (W)-Total			99.7		%		70-130	21-JUN-19
Uranium (U)-Total			97.1		%		70-130	21-JUN-19
Vanadium (V)-Total			99.0		%		70-130	21-JUN-19
Zinc (Zn)-Total			99.2		%		70-130	21-JUN-19
Zirconium (Zr)-Total			97.0		%		70-130	21-JUN-19
Batch R4681687								
WG3084496-2 LCS								
Aluminum (Al)-Total			102.1		%		80-120	21-JUN-19
Antimony (Sb)-Total			107.6		%		80-120	21-JUN-19
Arsenic (As)-Total			97.6		%		80-120	21-JUN-19
Barium (Ba)-Total			94.2		%		80-120	21-JUN-19
Beryllium (Be)-Total			98.9		%		80-120	21-JUN-19
Bismuth (Bi)-Total			96.0		%		80-120	21-JUN-19
Boron (B)-Total			99.5		%		80-120	21-JUN-19
Cadmium (Cd)-Total			96.9		%		80-120	21-JUN-19
Calcium (Ca)-Total			96.8		%		80-120	21-JUN-19
Cesium (Cs)-Total			107.0		%		80-120	21-JUN-19
Chromium (Cr)-Total			98.3		%		80-120	21-JUN-19
Cobalt (Co)-Total			98.4		%		80-120	21-JUN-19
Copper (Cu)-Total			97.1		%		80-120	21-JUN-19
Iron (Fe)-Total			102.1		%		80-120	21-JUN-19
Lead (Pb)-Total			101.0		%		80-120	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4681687								
WG3084496-2 LCS								
Lithium (Li)-Total			99.8		%		80-120	21-JUN-19
Magnesium (Mg)-Total			98.6		%		80-120	21-JUN-19
Manganese (Mn)-Total			101.7		%		80-120	21-JUN-19
Molybdenum (Mo)-Total			99.1		%		80-120	21-JUN-19
Nickel (Ni)-Total			97.6		%		80-120	21-JUN-19
Phosphorus (P)-Total			102.8		%		80-120	21-JUN-19
Potassium (K)-Total			99.5		%		80-120	21-JUN-19
Rubidium (Rb)-Total			96.7		%		80-120	21-JUN-19
Selenium (Se)-Total			100.1		%		80-120	21-JUN-19
Silicon (Si)-Total			104.1		%		80-120	21-JUN-19
Silver (Ag)-Total			104.2		%		80-120	21-JUN-19
Sodium (Na)-Total			102.1		%		80-120	21-JUN-19
Strontium (Sr)-Total			105.4		%		80-120	21-JUN-19
Sulfur (S)-Total			93.8		%		80-120	21-JUN-19
Tellurium (Te)-Total			95.7		%		80-120	21-JUN-19
Thallium (Tl)-Total			97.6		%		80-120	21-JUN-19
Thorium (Th)-Total			104.0		%		80-120	21-JUN-19
Tin (Sn)-Total			98.4		%		80-120	21-JUN-19
Titanium (Ti)-Total			95.1		%		80-120	21-JUN-19
Tungsten (W)-Total			103.0		%		80-120	21-JUN-19
Uranium (U)-Total			111.3		%		80-120	21-JUN-19
Vanadium (V)-Total			100.1		%		80-120	21-JUN-19
Zinc (Zn)-Total			95.7		%		80-120	21-JUN-19
Zirconium (Zr)-Total			100.0		%		80-120	21-JUN-19
WG3084496-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	21-JUN-19
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Arsenic (As)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Barium (Ba)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Boron (B)-Total			<0.010		mg/L		0.01	21-JUN-19
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	21-JUN-19
Calcium (Ca)-Total			<0.050		mg/L		0.05	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4681687								
WG3084496-1 MB								
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	21-JUN-19
Iron (Fe)-Total			<0.010		mg/L		0.01	21-JUN-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Lithium (Li)-Total			<0.0010		mg/L		0.001	21-JUN-19
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	21-JUN-19
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	21-JUN-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	21-JUN-19
Potassium (K)-Total			<0.050		mg/L		0.05	21-JUN-19
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	21-JUN-19
Selenium (Se)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Silicon (Si)-Total			<0.10		mg/L		0.1	21-JUN-19
Silver (Ag)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Sodium (Na)-Total			<0.050		mg/L		0.05	21-JUN-19
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	21-JUN-19
Sulfur (S)-Total			<0.50		mg/L		0.5	21-JUN-19
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	21-JUN-19
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Thorium (Th)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Tin (Sn)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	21-JUN-19
Tungsten (W)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Uranium (U)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	21-JUN-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	21-JUN-19
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	21-JUN-19
N-TOTKJ-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N-TOTKJ-WP	**Water**							
Batch R4678661								
WG3081456-11 DUP		**L2289691-1**						
Total Kjeldahl Nitrogen		0.30	0.50	J	mg/L	0.19	0.4	20-JUN-19
WG3081456-10 LCS								
Total Kjeldahl Nitrogen			93.1		%		75-125	20-JUN-19
WG3081456-6 LCS								
Total Kjeldahl Nitrogen			104.6		%		75-125	20-JUN-19
WG3081456-5 MB								
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	20-JUN-19
WG3081456-9 MB								
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	20-JUN-19
WG3081456-12 MS		**L2289691-1**						
Total Kjeldahl Nitrogen			120.1		%		70-130	20-JUN-19
NH3-COL-WP	**Water**							
Batch R4678331								
WG3083227-2 LCS								
Ammonia, Total (as N)			102.3		%		85-115	20-JUN-19
WG3083227-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	19-JUN-19
NO2-IC-N-TB	**Water**							
Batch R4669833								
WG3075915-10 LCS								
Nitrite (as N)			99.6		%		90-110	13-JUN-19
WG3075915-9 MB								
Nitrite (as N)			<0.010		mg/L		0.01	13-JUN-19
NO3-IC-N-TB	**Water**							
Batch R4669833								
WG3075915-10 LCS								
Nitrate (as N)			99.3		%		90-110	13-JUN-19
WG3075915-9 MB								
Nitrate (as N)			<0.020		mg/L		0.02	13-JUN-19
P-T-COL-WP	**Water**							
Batch R4673866								
WG3080808-7 DUP		**L2289691-1**						
Phosphorus (P)-Total		0.0314	0.0296		mg/L	6.0	20	19-JUN-19
WG3080808-6 LCS								
Phosphorus (P)-Total			98.6		%		80-120	19-JUN-19
WG3080808-5 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
P-T-COL-WP	**Water**							
Batch R4673866								
WG3080808-5 MB								
Phosphorus (P)-Total			<0.0030		mg/L		0.003	19-JUN-19
WG3080808-8 MS		**L2289691-2**						
Phosphorus (P)-Total			96.9		%		70-130	19-JUN-19
PH-TITR-TB	**Water**							
Batch R4669774								
WG3075949-15 DUP		**L2289691-3**						
pH		7.65	7.70	J	pH	0.05	0.2	13-JUN-19
WG3075949-11 LCS								
pH			7.04		pH		6.9-7.1	13-JUN-19
WG3075949-14 LCS								
pH			7.04		pH		6.9-7.1	13-JUN-19
WG3075949-17 LCS								
pH			7.04		pH		6.9-7.1	13-JUN-19
SO4-IC-N-TB	**Water**							
Batch R4669833								
WG3075915-10 LCS								
Sulfate (SO4)			104.1		%		90-110	13-JUN-19
WG3075915-9 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	13-JUN-19
TC,EC-QT97-TB	**Water**							
Batch R4668068								
WG3074847-2 DUP		**L2289691-1**						
Total Coliforms		1410	1990		MPN/100mL	34	65	12-JUN-19
Escherichia Coli		35	27		MPN/100mL	26	65	12-JUN-19
WG3074847-1 MB								
Total Coliforms			0		MPN/100mL		1	12-JUN-19
Escherichia Coli			0		MPN/100mL		1	12-JUN-19
TDS-TB	**Water**							
Batch R4671088								
WG3078248-2 LCS								
Total Dissolved Solids			94.8		%		85-115	15-JUN-19
WG3078248-1 MB								
Total Dissolved Solids			<10		mg/L		10	15-JUN-19
TURBIDITY-TB	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-TB	**Water**							
Batch R4665931								
WG3075310-3 DUP		**L2289691-3**						
Turbidity		24.7	25.6		NTU	3.6	15	12-JUN-19
WG3075310-2 LCS								
Turbidity			99.0		%		85-115	12-JUN-19
WG3075310-1 MB								
Turbidity			<0.10		NTU		0.1	12-JUN-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2289691-COFC

COC Number: 14 -

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Lakehead Region Conservation Authority	Select Report Format:	☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)	R ☒ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Scott Drebit	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	130 Conservation Rd.	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	807 - 344 - 5857	Email 1 or Fax	~~tammy@lakeheadca.com~~	Specify Date Required for E2,E or P:
		Email 2	Scott@lakeheadca.com	

Invoice To		Invoice Distribution	
	Same as Report To ☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
	Copy of Invoice with Report ☑ Yes ☐ No	Email 1 or Fax	
Company:		Email 2	
Contact:			

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q74345	Approver ID:	Cost Center:
Job #:	~~Jarvis River~~ Little Pine River.	GL Account:	Routing Code:
PO / AFE:	275	Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L2289691 | ALS Contact: | Sampler:

Analysis Request — indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Alkalinity, Conductivity, pH	Chloride, Nitrate, Nitrite, Sulphate	TDS, turbidity	NH_3, TKN, TP	Metals, Total, and Hardness	TC / EC	Number of Containers
	LPR # 1 - Little Pine River - Site # 1	11-Jun-19	12:20	Grab	X	X	X	X	X	X	6
	LPR # 2 - Little Pine River - Site # 2	11-Jun-19	12:45	Grab	X	X	X	X	X	X	6
	LPR # 3 - Little Pine River - Site # 3	11-Jun-19	11:30	Grab	X	X	X	X	X	X	6
	LPR # 4 - Little Pine River - Site # 4	11-Jun-19	10:30	Grab	X	X	X	X	X	X	6

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☒ No	
Are samples for human drinking water use? ☐ Yes ☒ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☑
Ice packs	Yes ☑	No ☐	Custody seal intact	Yes ☐ No ☐
Cooling Initiated	☐			

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
3.1					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Rachael	Date: 12-June-19	Time: 9:20	Received By: SF	Date: 12-06-19	Time: 9:20	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326e v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

LAKEHEAD REGION CONSERVATION AUTHORITY-TB
ATTN: Scott Drebit
130 Conservation Road
P.O. Box 10427
Thunder Bay ON P7B 6T8

Date Received: 11-JUL-19
Report Date: 23-JUL-19 12:04 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L2307942

Project P.O. #: 275
Job Reference: LITTLE PINE RIVER
C of C Numbers:
Legal Site Desc:

Christina Shepherd
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2307942-1 LPR1 - LITTLE PINE RIVER - SITE #1 Sampled By: Client on 10-JUL-19 @ 12:45 Matrix: Grab							
Physical Tests							
Conductivity (EC)	161		1.0	uS/cm		12-JUL-19	R4709098
Hardness (as CaCO3)	77.0		0.50			11-JUL-19	
pH	7.30		0.10	pH		12-JUL-19	R4709098
Total Dissolved Solids	121		13	mg/L		12-JUL-19	R4709492
Turbidity	36.7		0.10	NTU		11-JUL-19	R4708204
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	72.1		2.0	mg/L		12-JUL-19	R4709098
Ammonia, Total (as N)	<0.020		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	4.21		0.10	mg/L		11-JUL-19	R4708522
Nitrate (as N)	0.021		0.020	mg/L		11-JUL-19	R4708522
Nitrite (as N)	<0.010		0.010	mg/L		11-JUL-19	R4708522
Total Kjeldahl Nitrogen	0.52		0.15	mg/L	16-JUL-19	17-JUL-19	R4713795
Phosphorus (P)-Total	0.0456		0.0030	mg/L	12-JUL-19	14-JUL-19	R4709749
Sulfate (SO4)	4.08		0.30	mg/L		11-JUL-19	R4708522
Bacteriological Tests							
Escherichia Coli	210		0	MPN/100mL		11-JUL-19	R4708618
Total Coliforms	>2420		0	MPN/100mL		11-JUL-19	R4708618
Total Metals							
Aluminum (Al)-Total	1.48		0.0030	mg/L		12-JUL-19	R4712136
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Arsenic (As)-Total	0.00091		0.00010	mg/L		12-JUL-19	R4712136
Barium (Ba)-Total	0.0218		0.00010	mg/L		12-JUL-19	R4712136
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		12-JUL-19	R4712136
Boron (B)-Total	0.014		0.010	mg/L		12-JUL-19	R4712136
Cadmium (Cd)-Total	0.0000176		0.0000050	mg/L		15-JUL-19	R4712670
Calcium (Ca)-Total	18.7		0.050	mg/L		12-JUL-19	R4712136
Cesium (Cs)-Total	0.000150		0.000010	mg/L		12-JUL-19	R4712136
Chromium (Cr)-Total	0.00249		0.00010	mg/L		12-JUL-19	R4712136
Cobalt (Co)-Total	0.00085		0.00010	mg/L		12-JUL-19	R4712136
Copper (Cu)-Total	0.00464		0.00050	mg/L		12-JUL-19	R4712136
Iron (Fe)-Total	1.71		0.010	mg/L		12-JUL-19	R4712136
Lead (Pb)-Total	0.000483		0.000050	mg/L		12-JUL-19	R4712136
Lithium (Li)-Total	0.0028		0.0010	mg/L		12-JUL-19	R4712136
Magnesium (Mg)-Total	7.27		0.0050	mg/L		12-JUL-19	R4712136
Manganese (Mn)-Total	0.0400		0.00010	mg/L		12-JUL-19	R4712136
Molybdenum (Mo)-Total	0.000613		0.000050	mg/L		12-JUL-19	R4712136
Nickel (Ni)-Total	0.00297		0.00050	mg/L		12-JUL-19	R4712136
Phosphorus (P)-Total	<0.050		0.050	mg/L		12-JUL-19	R4712136
Potassium (K)-Total	1.27		0.050	mg/L		12-JUL-19	R4712136
Rubidium (Rb)-Total	0.00239		0.00020	mg/L		12-JUL-19	R4712136
Selenium (Se)-Total	0.000093		0.000050	mg/L		15-JUL-19	R4712670

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2307942-1 LPR1 - LITTLE PINE RIVER - SITE #1 Sampled By: Client on 10-JUL-19 @ 12:45 Matrix: Grab							
Total Metals							
Silicon (Si)-Total	4.86		0.10	mg/L		12-JUL-19	R4712136
Silver (Ag)-Total	<0.000010		0.000010	mg/L		12-JUL-19	R4712136
Sodium (Na)-Total	4.86		0.050	mg/L		12-JUL-19	R4712136
Strontium (Sr)-Total	0.0406		0.00020	mg/L		12-JUL-19	R4712136
Sulfur (S)-Total	1.67		0.50	mg/L		12-JUL-19	R4712136
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		12-JUL-19	R4712136
Thallium (Tl)-Total	0.000019		0.000010	mg/L		12-JUL-19	R4712136
Thorium (Th)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Tin (Sn)-Total	0.00010		0.00010	mg/L		12-JUL-19	R4712136
Titanium (Ti)-Total	0.0413		0.00030	mg/L		12-JUL-19	R4712136
Tungsten (W)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Uranium (U)-Total	0.000170		0.000010	mg/L		12-JUL-19	R4712136
Vanadium (V)-Total	0.00449		0.00050	mg/L		12-JUL-19	R4712136
Zinc (Zn)-Total	0.0054		0.0030	mg/L		12-JUL-19	R4712136
Zirconium (Zr)-Total	0.00037		0.00020	mg/L		12-JUL-19	R4712136
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					15-JUL-19	R4712171
Calcium (Ca)-Dissolved	18.8		0.050	mg/L	15-JUL-19	16-JUL-19	R4712554
Magnesium (Mg)-Dissolved	7.29		0.0050	mg/L	15-JUL-19	16-JUL-19	R4712554
L2307942-2 LPR2 - LITTLE PINE RIVER - SITE #2 Sampled By: Client on 10-JUL-19 @ 12:05 Matrix: Grab							
Physical Tests							
Conductivity (EC)	132		1.0	uS/cm		12-JUL-19	R4709098
Hardness (as CaCO3)	65.8		0.50			11-JUL-19	
pH	7.13		0.10	pH		12-JUL-19	R4709098
Total Dissolved Solids	85		13	mg/L		12-JUL-19	R4709492
Turbidity	24.2		0.10	NTU		11-JUL-19	R4708204
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	60.7		2.0	mg/L		12-JUL-19	R4709098
Ammonia, Total (as N)	<0.020		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	1.29		0.10	mg/L		11-JUL-19	R4708522
Nitrate (as N)	<0.020		0.020	mg/L		11-JUL-19	R4708522
Nitrite (as N)	<0.010		0.010	mg/L		11-JUL-19	R4708522
Total Kjeldahl Nitrogen	0.45		0.15	mg/L	16-JUL-19	17-JUL-19	R4713795
Phosphorus (P)-Total	0.0362		0.0030	mg/L	12-JUL-19	14-JUL-19	R4709749
Sulfate (SO4)	4.27		0.30	mg/L		11-JUL-19	R4708522
Bacteriological Tests							
Escherichia Coli	116		0	MPN/100mL		11-JUL-19	R4708618
Total Coliforms	>2420		0	MPN/100mL		11-JUL-19	R4708618
Total Metals							
Aluminum (Al)-Total	0.606		0.0030	mg/L		12-JUL-19	R4712136

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2307942-2 LPR2 - LITTLE PINE RIVER - SITE #2 Sampled By: Client on 10-JUL-19 @ 12:05 Matrix: Grab							
Total Metals							
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Arsenic (As)-Total	0.00069		0.00010	mg/L		12-JUL-19	R4712136
Barium (Ba)-Total	0.0161		0.00010	mg/L		12-JUL-19	R4712136
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		12-JUL-19	R4712136
Boron (B)-Total	0.013		0.010	mg/L		12-JUL-19	R4712136
Cadmium (Cd)-Total	0.0000188		0.0000050	mg/L		15-JUL-19	R4712670
Calcium (Ca)-Total	16.5		0.050	mg/L		12-JUL-19	R4712136
Cesium (Cs)-Total	0.000058		0.000010	mg/L		12-JUL-19	R4712136
Chromium (Cr)-Total	0.00110		0.00010	mg/L		12-JUL-19	R4712136
Cobalt (Co)-Total	0.00045		0.00010	mg/L		12-JUL-19	R4712136
Copper (Cu)-Total	0.00325		0.00050	mg/L		12-JUL-19	R4712136
Iron (Fe)-Total	0.831		0.010	mg/L		12-JUL-19	R4712136
Lead (Pb)-Total	0.000291		0.000050	mg/L		12-JUL-19	R4712136
Lithium (Li)-Total	0.0018		0.0010	mg/L		12-JUL-19	R4712136
Magnesium (Mg)-Total	6.00		0.0050	mg/L		12-JUL-19	R4712136
Manganese (Mn)-Total	0.0341		0.00010	mg/L		12-JUL-19	R4712136
Molybdenum (Mo)-Total	0.000388		0.000050	mg/L		12-JUL-19	R4712136
Nickel (Ni)-Total	0.00173		0.00050	mg/L		12-JUL-19	R4712136
Phosphorus (P)-Total	<0.050		0.050	mg/L		12-JUL-19	R4712136
Potassium (K)-Total	1.01		0.050	mg/L		12-JUL-19	R4712136
Rubidium (Rb)-Total	0.00144		0.00020	mg/L		12-JUL-19	R4712136
Selenium (Se)-Total	0.000069		0.000050	mg/L		15-JUL-19	R4712670
Silicon (Si)-Total	2.91		0.10	mg/L		12-JUL-19	R4712136
Silver (Ag)-Total	<0.000010		0.000010	mg/L		12-JUL-19	R4712136
Sodium (Na)-Total	2.67		0.050	mg/L		12-JUL-19	R4712136
Strontium (Sr)-Total	0.0302		0.00020	mg/L		12-JUL-19	R4712136
Sulfur (S)-Total	1.52		0.50	mg/L		12-JUL-19	R4712136
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		12-JUL-19	R4712136
Thallium (Tl)-Total	0.000011		0.000010	mg/L		12-JUL-19	R4712136
Thorium (Th)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Tin (Sn)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Titanium (Ti)-Total	0.0173		0.00030	mg/L		12-JUL-19	R4712136
Tungsten (W)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Uranium (U)-Total	0.000093		0.000010	mg/L		12-JUL-19	R4712136
Vanadium (V)-Total	0.00284		0.00050	mg/L		12-JUL-19	R4712136
Zinc (Zn)-Total	0.0032		0.0030	mg/L		12-JUL-19	R4712136
Zirconium (Zr)-Total	0.00023		0.00020	mg/L		12-JUL-19	R4712136
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					15-JUL-19	R4712171
Calcium (Ca)-Dissolved	15.9		0.050	mg/L	15-JUL-19	16-JUL-19	R4712554

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2307942-2 LPR2 - LITTLE PINE RIVER - SITE #2 Sampled By: Client on 10-JUL-19 @ 12:05 Matrix: Grab							
Dissolved Metals							
Magnesium (Mg)-Dissolved	6.32		0.0050	mg/L	15-JUL-19	16-JUL-19	R4712554
L2307942-3 LPR3 - LITTLE PINE RIVER - SITE #3 Sampled By: Client on 10-JUL-19 @ 11:30 Matrix: Grab							
Physical Tests							
Conductivity (EC)	285		1.0	uS/cm		12-JUL-19	R4709098
Hardness (as CaCO3)	122		0.50			11-JUL-19	
pH	7.51		0.10	pH		12-JUL-19	R4709098
Total Dissolved Solids	178		13	mg/L		12-JUL-19	R4709492
Turbidity	31.0		0.10	NTU		11-JUL-19	R4708204
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	114		2.0	mg/L		12-JUL-19	R4709098
Ammonia, Total (as N)	<0.020		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	21.1		0.10	mg/L		11-JUL-19	R4708522
Nitrate (as N)	<0.020		0.020	mg/L		11-JUL-19	R4708522
Nitrite (as N)	0.012		0.010	mg/L		11-JUL-19	R4708522
Total Kjeldahl Nitrogen	0.68		0.15	mg/L	16-JUL-19	17-JUL-19	R4713795
Phosphorus (P)-Total	0.0447		0.0030	mg/L	12-JUL-19	14-JUL-19	R4709749
Sulfate (SO4)	4.31		0.30	mg/L		11-JUL-19	R4708522
Bacteriological Tests							
Escherichia Coli	276		0	MPN/100mL		11-JUL-19	R4708618
Total Coliforms	>2420		0	MPN/100mL		11-JUL-19	R4708618
Total Metals							
Aluminum (Al)-Total	0.730		0.0030	mg/L		12-JUL-19	R4712136
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Arsenic (As)-Total	0.00117		0.00010	mg/L		12-JUL-19	R4712136
Barium (Ba)-Total	0.0202		0.00010	mg/L		12-JUL-19	R4712136
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		12-JUL-19	R4712136
Boron (B)-Total	0.021		0.010	mg/L		12-JUL-19	R4712136
Cadmium (Cd)-Total	0.0000321		0.0000050	mg/L		15-JUL-19	R4712670
Calcium (Ca)-Total	29.0		0.050	mg/L		12-JUL-19	R4712136
Cesium (Cs)-Total	0.000062		0.000010	mg/L		12-JUL-19	R4712136
Chromium (Cr)-Total	0.00141		0.00010	mg/L		12-JUL-19	R4712136
Cobalt (Co)-Total	0.00066		0.00010	mg/L		12-JUL-19	R4712136
Copper (Cu)-Total	0.00387		0.00050	mg/L		12-JUL-19	R4712136
Iron (Fe)-Total	1.20		0.010	mg/L		12-JUL-19	R4712136
Lead (Pb)-Total	0.000334		0.000050	mg/L		12-JUL-19	R4712136
Lithium (Li)-Total	0.0038		0.0010	mg/L		12-JUL-19	R4712136
Magnesium (Mg)-Total	10.3		0.0050	mg/L		12-JUL-19	R4712136
Manganese (Mn)-Total	0.0822		0.00010	mg/L		12-JUL-19	R4712136
Molybdenum (Mo)-Total	0.00140		0.000050	mg/L		12-JUL-19	R4712136

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2307942-3 LPR3 - LITTLE PINE RIVER - SITE #3 Sampled By: Client on 10-JUL-19 @ 11:30 Matrix: Grab							
Total Metals							
Nickel (Ni)-Total	0.00270		0.00050	mg/L		12-JUL-19	R4712136
Phosphorus (P)-Total	<0.050		0.050	mg/L		12-JUL-19	R4712136
Potassium (K)-Total	1.14		0.050	mg/L		12-JUL-19	R4712136
Rubidium (Rb)-Total	0.00145		0.00020	mg/L		12-JUL-19	R4712136
Selenium (Se)-Total	0.000140		0.000050	mg/L		15-JUL-19	R4712670
Silicon (Si)-Total	4.17		0.10	mg/L		12-JUL-19	R4712136
Silver (Ag)-Total	<0.000010		0.000010	mg/L		12-JUL-19	R4712136
Sodium (Na)-Total	17.7		0.050	mg/L		12-JUL-19	R4712136
Strontium (Sr)-Total	0.0806		0.00020	mg/L		12-JUL-19	R4712136
Sulfur (S)-Total	1.71		0.50	mg/L		12-JUL-19	R4712136
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		12-JUL-19	R4712136
Thallium (Tl)-Total	0.000011		0.000010	mg/L		12-JUL-19	R4712136
Thorium (Th)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Tin (Sn)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Titanium (Ti)-Total	0.0217		0.00030	mg/L		12-JUL-19	R4712136
Tungsten (W)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Uranium (U)-Total	0.000342		0.000010	mg/L		12-JUL-19	R4712136
Vanadium (V)-Total	0.00395		0.00050	mg/L		12-JUL-19	R4712136
Zinc (Zn)-Total	0.0032		0.0030	mg/L		12-JUL-19	R4712136
Zirconium (Zr)-Total	0.00048		0.00020	mg/L		12-JUL-19	R4712136
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					15-JUL-19	R4712171
Calcium (Ca)-Dissolved	30.5		0.050	mg/L	15-JUL-19	16-JUL-19	R4712554
Magnesium (Mg)-Dissolved	11.1		0.0050	mg/L	15-JUL-19	16-JUL-19	R4712554
L2307942-4 LPR4 - LITTLE PINE RIVER - SITE #4 Sampled By: Client on 10-JUL-19 @ 10:30 Matrix: Grab							
Physical Tests							
Conductivity (EC)	109		1.0	uS/cm		12-JUL-19	R4709098
Hardness (as CaCO3)	52.9		0.50			11-JUL-19	
pH	7.08		0.10	pH		12-JUL-19	R4709098
Total Dissolved Solids	64		13	mg/L		12-JUL-19	R4709492
Turbidity	5.90		0.10	NTU		11-JUL-19	R4708204
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	50.1		2.0	mg/L		12-JUL-19	R4709098
Ammonia, Total (as N)	<0.020		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	0.70		0.10	mg/L		11-JUL-19	R4708522
Nitrate (as N)	<0.020		0.020	mg/L		11-JUL-19	R4708522
Nitrite (as N)	<0.010		0.010	mg/L		11-JUL-19	R4708522
Total Kjeldahl Nitrogen	0.37		0.15	mg/L	16-JUL-19	17-JUL-19	R4713795
Phosphorus (P)-Total	0.0155		0.0030	mg/L	12-JUL-19	14-JUL-19	R4709749
Sulfate (SO4)	4.50		0.30	mg/L		11-JUL-19	R4708522

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2307942-4 LPR4 - LITTLE PINE RIVER - SITE #4 Sampled By: Client on 10-JUL-19 @ 10:30 Matrix: Grab							
Anions and Nutrients							
Bacteriological Tests							
Escherichia Coli	125		0	MPN/100mL		11-JUL-19	R4708618
Total Coliforms	>2420		0	MPN/100mL		11-JUL-19	R4708618
Total Metals							
Aluminum (Al)-Total	0.108		0.0030	mg/L		12-JUL-19	R4712136
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Arsenic (As)-Total	0.00041		0.00010	mg/L		12-JUL-19	R4712136
Barium (Ba)-Total	0.0102		0.00010	mg/L		12-JUL-19	R4712136
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		12-JUL-19	R4712136
Boron (B)-Total	0.011		0.010	mg/L		12-JUL-19	R4712136
Cadmium (Cd)-Total	<0.0000050		0.0000050	mg/L		15-JUL-19	R4712670
Calcium (Ca)-Total	13.1		0.050	mg/L		12-JUL-19	R4712136
Cesium (Cs)-Total	0.000013		0.000010	mg/L		12-JUL-19	R4712136
Chromium (Cr)-Total	0.00028		0.00010	mg/L		12-JUL-19	R4712136
Cobalt (Co)-Total	0.00012		0.00010	mg/L		12-JUL-19	R4712136
Copper (Cu)-Total	0.00207		0.00050	mg/L		12-JUL-19	R4712136
Iron (Fe)-Total	0.184		0.010	mg/L		12-JUL-19	R4712136
Lead (Pb)-Total	0.000142		0.000050	mg/L		12-JUL-19	R4712136
Lithium (Li)-Total	0.0012		0.0010	mg/L		12-JUL-19	R4712136
Magnesium (Mg)-Total	4.74		0.0050	mg/L		12-JUL-19	R4712136
Manganese (Mn)-Total	0.0195		0.00010	mg/L		12-JUL-19	R4712136
Molybdenum (Mo)-Total	0.000246		0.000050	mg/L		12-JUL-19	R4712136
Nickel (Ni)-Total	0.00085		0.00050	mg/L		12-JUL-19	R4712136
Phosphorus (P)-Total	<0.050		0.050	mg/L		12-JUL-19	R4712136
Potassium (K)-Total	0.774		0.050	mg/L		12-JUL-19	R4712136
Rubidium (Rb)-Total	0.00074		0.00020	mg/L		12-JUL-19	R4712136
Selenium (Se)-Total	0.000077		0.000050	mg/L		15-JUL-19	R4712670
Silicon (Si)-Total	2.00		0.10	mg/L		12-JUL-19	R4712136
Silver (Ag)-Total	<0.000010		0.000010	mg/L		12-JUL-19	R4712136
Sodium (Na)-Total	2.00		0.050	mg/L		12-JUL-19	R4712136
Strontium (Sr)-Total	0.0241		0.00020	mg/L		12-JUL-19	R4712136
Sulfur (S)-Total	1.77		0.50	mg/L		12-JUL-19	R4712136
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		12-JUL-19	R4712136
Thallium (Tl)-Total	<0.000010		0.000010	mg/L		12-JUL-19	R4712136
Thorium (Th)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Tin (Sn)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Titanium (Ti)-Total	0.00384		0.00030	mg/L		12-JUL-19	R4712136
Tungsten (W)-Total	<0.00010		0.00010	mg/L		12-JUL-19	R4712136
Uranium (U)-Total	0.000049		0.000010	mg/L		12-JUL-19	R4712136
Vanadium (V)-Total	0.00065		0.00050	mg/L		12-JUL-19	R4712136

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2307942-4 LPR4 - LITTLE PINE RIVER - SITE #4 Sampled By: Client on 10-JUL-19 @ 10:30 Matrix: Grab							
Total Metals							
Zinc (Zn)-Total	<0.0030		0.0030	mg/L		12-JUL-19	R4712136
Zirconium (Zr)-Total	<0.00020		0.00020	mg/L		12-JUL-19	R4712136
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					15-JUL-19	R4712171
Calcium (Ca)-Dissolved	13.0		0.050	mg/L	15-JUL-19	16-JUL-19	R4712554
Magnesium (Mg)-Dissolved	4.97		0.0050	mg/L	15-JUL-19	16-JUL-19	R4712554

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2307942-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2307942-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L2307942-1, -2, -3, -4

Sample Parameter Qualifier key listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-TB	Water	Alkalinity	APHA 2320B modified

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CL-L-IC-N-TB	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-TITR-TB	Water	Conductivity	APHA 2510 B

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-TB	Water	Hardness (as CaCO3)	CALCULATION
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-COL-TB	Water	Ammonia by Discrete Analyzer	APHA 4500-NH3 G. (modified)

Ammonia in aqueous matrices is analyzed using discrete analyzer with colourimetric detection.

NO2-IC-N-TB	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-N-TB	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-COL-TB	Water	Total Phosphorus by Discrete Analyzer	APHA 4500-P B, F, G (modified)

Phosphorus in aqueous matrices is analyzed using discrete Analyzer with colourimetric detection.

PH-TITR-TB	Water	pH	APHA 4500-H

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

SO4-IC-N-TB	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TC,EC-QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture of hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

TDS-TB	Water	Total Dissolved Solids	APHA 2540 C (modified)

Aqueous matrices are analyzed using gravimetry and evaporation

TKN-COL-TB	Water	Total Kjeldahl Nitrogen	APHA 4500-Norg (modified)

Total Kjeldahl Nitrogen in aqueous matrices is analyzed using a discrete analyzer with colourimetric detection.

TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

Aqueous matrices are analyzed using nephelometry with the light scatter measured at a 90” angle.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
TB	ALS ENVIRONMENTAL - THUNDER BAY, ONTARIO, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2307942 Report Date: 23-JUL-19

Client: LAKEHEAD REGION CONSERVATION AUTHORITY-TB
130 Conservation Road P.O. Box 10427
Thunder Bay ON P7B 6T8
Contact: Scott Drebit

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-TB	**Water**							
Batch R4709098								
WG3103533-2 LCS								
Alkalinity, Total (as CaCO3)			95.9		%		85-115	12-JUL-19
WG3103533-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	12-JUL-19
CL-L-IC-N-TB	**Water**							
Batch R4708522								
WG3102375-10 LCS								
Chloride (Cl)			102.4		%		90-110	11-JUL-19
WG3102375-9 MB								
Chloride (Cl)			<0.10		mg/L		0.1	11-JUL-19
EC-TITR-TB	**Water**							
Batch R4709098								
WG3103533-2 LCS								
Conductivity (EC)			98.0		%		90-110	12-JUL-19
WG3103533-1 MB								
Conductivity (EC)			<1.0		uS/cm		1	12-JUL-19
MET-D-CCMS-VA	**Water**							
Batch R4712554								
WG3105788-2 LCS								
Calcium (Ca)-Dissolved			94.6		%		80-120	16-JUL-19
Magnesium (Mg)-Dissolved			106.8		%		80-120	16-JUL-19
WG3105788-1 MB		**LF**						
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	16-JUL-19
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	16-JUL-19
MET-T-CCMS-VA	**Water**							
Batch R4712136								
WG3103733-2 LCS								
Aluminum (Al)-Total			99.9		%		80-120	12-JUL-19
Antimony (Sb)-Total			96.1		%		80-120	12-JUL-19
Arsenic (As)-Total			98.2		%		80-120	12-JUL-19
Barium (Ba)-Total			95.8		%		80-120	12-JUL-19
Beryllium (Be)-Total			96.0		%		80-120	12-JUL-19
Bismuth (Bi)-Total			88.4		%		80-120	12-JUL-19
Boron (B)-Total			94.6		%		80-120	12-JUL-19
Cadmium (Cd)-Total			98.5		%		80-120	12-JUL-19
Calcium (Ca)-Total			96.8		%		80-120	12-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4712136								
WG3103733-2 LCS								
Cesium (Cs)-Total			100.2		%		80-120	12-JUL-19
Chromium (Cr)-Total			101.1		%		80-120	12-JUL-19
Cobalt (Co)-Total			98.7		%		80-120	12-JUL-19
Copper (Cu)-Total			98.2		%		80-120	12-JUL-19
Iron (Fe)-Total			102.5		%		80-120	12-JUL-19
Lead (Pb)-Total			91.2		%		80-120	12-JUL-19
Lithium (Li)-Total			93.6		%		80-120	12-JUL-19
Magnesium (Mg)-Total			99.8		%		80-120	12-JUL-19
Manganese (Mn)-Total			99.5		%		80-120	12-JUL-19
Molybdenum (Mo)-Total			98.2		%		80-120	12-JUL-19
Nickel (Ni)-Total			98.7		%		80-120	12-JUL-19
Phosphorus (P)-Total			102.5		%		80-120	12-JUL-19
Potassium (K)-Total			96.6		%		80-120	12-JUL-19
Rubidium (Rb)-Total			96.6		%		80-120	12-JUL-19
Selenium (Se)-Total			100.3		%		80-120	12-JUL-19
Silicon (Si)-Total			105.3		%		80-120	12-JUL-19
Silver (Ag)-Total			91.3		%		80-120	12-JUL-19
Sodium (Na)-Total			101.6		%		80-120	12-JUL-19
Strontium (Sr)-Total			99.6		%		80-120	12-JUL-19
Sulfur (S)-Total			101.4		%		80-120	12-JUL-19
Tellurium (Te)-Total			97.8		%		80-120	12-JUL-19
Thallium (Tl)-Total			89.5		%		80-120	12-JUL-19
Thorium (Th)-Total			91.7		%		80-120	12-JUL-19
Tin (Sn)-Total			95.7		%		80-120	12-JUL-19
Titanium (Ti)-Total			95.3		%		80-120	12-JUL-19
Tungsten (W)-Total			95.3		%		80-120	12-JUL-19
Uranium (U)-Total			93.8		%		80-120	12-JUL-19
Vanadium (V)-Total			100.1		%		80-120	12-JUL-19
Zinc (Zn)-Total			102.2		%		80-120	12-JUL-19
Zirconium (Zr)-Total			91.4		%		80-120	12-JUL-19
WG3103733-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	12-JUL-19
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Arsenic (As)-Total			<0.00010		mg/L		0.0001	12-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4712136								
WG3103733-1 MB								
Barium (Ba)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	12-JUL-19
Boron (B)-Total			<0.010		mg/L		0.01	12-JUL-19
Calcium (Ca)-Total			<0.050		mg/L		0.05	12-JUL-19
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	12-JUL-19
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	12-JUL-19
Iron (Fe)-Total			<0.010		mg/L		0.01	12-JUL-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	12-JUL-19
Lithium (Li)-Total			<0.0010		mg/L		0.001	12-JUL-19
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	12-JUL-19
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	12-JUL-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	12-JUL-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	12-JUL-19
Potassium (K)-Total			<0.050		mg/L		0.05	12-JUL-19
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	12-JUL-19
Silicon (Si)-Total			<0.10		mg/L		0.1	12-JUL-19
Silver (Ag)-Total			<0.000010		mg/L		0.00001	12-JUL-19
Sodium (Na)-Total			<0.050		mg/L		0.05	12-JUL-19
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	12-JUL-19
Sulfur (S)-Total			<0.50		mg/L		0.5	12-JUL-19
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	12-JUL-19
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	12-JUL-19
Thorium (Th)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Tin (Sn)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	12-JUL-19
Tungsten (W)-Total			<0.00010		mg/L		0.0001	12-JUL-19
Uranium (U)-Total			<0.000010		mg/L		0.00001	12-JUL-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	12-JUL-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	12-JUL-19
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	12-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4712670								
WG3103733-1 MB								
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	15-JUL-19
Selenium (Se)-Total			<0.000050		mg/L		0.00005	15-JUL-19
NH3-COL-TB	**Water**							
Batch R4708981								
WG3103214-10 LCS								
Ammonia, Total (as N)			99.0		%		85-115	12-JUL-19
WG3103214-9 MB								
Ammonia, Total (as N)			<0.020		mg/L		0.02	12-JUL-19
NO2-IC-N-TB	**Water**							
Batch R4708522								
WG3102375-10 LCS								
Nitrite (as N)			103.2		%		90-110	11-JUL-19
WG3102375-9 MB								
Nitrite (as N)			<0.010		mg/L		0.01	11-JUL-19
NO3-IC-N-TB	**Water**							
Batch R4708522								
WG3102375-10 LCS								
Nitrate (as N)			100.6		%		90-110	11-JUL-19
WG3102375-9 MB								
Nitrate (as N)			<0.020		mg/L		0.02	11-JUL-19
P-T-COL-TB	**Water**							
Batch R4709749								
WG3103324-3 DUP		**L2307942-1**						
Phosphorus (P)-Total		0.0456	0.0448		mg/L	1.8	20	14-JUL-19
WG3103324-10 LCS								
Phosphorus (P)-Total			95.3		%		80-120	14-JUL-19
WG3103324-2 LCS								
Phosphorus (P)-Total			97.2		%		80-120	14-JUL-19
WG3103324-1 MB								
Phosphorus (P)-Total			<0.0030		mg/L		0.003	14-JUL-19
WG3103324-9 MB								
Phosphorus (P)-Total			<0.0030		mg/L		0.003	14-JUL-19
WG3103324-4 MS		**L2307942-2**						
Phosphorus (P)-Total			99.0		%		70-130	14-JUL-19
PH-TITR-TB	**Water**							

Quality Control Report

Workorder: L2307942 Report Date: 23-JUL-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-TITR-TB	**Water**							
Batch R4709098								
WG3103533-2 LCS								
pH			7.01		pH		6.9-7.1	12-JUL-19
SO4-IC-N-TB	**Water**							
Batch R4708522								
WG3102375-10 LCS								
Sulfate (SO4)			101.8		%		90-110	11-JUL-19
WG3102375-9 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	11-JUL-19
TC,EC-QT97-TB	**Water**							
Batch R4708618								
WG3102315-2 DUP		**L2307942-1**						
Total Coliforms		>2420	>2420		MPN/100mL	0.0	65	11-JUL-19
Escherichia Coli		210	166		MPN/100mL	23	65	11-JUL-19
WG3102315-1 MB								
Total Coliforms			0		MPN/100mL		1	11-JUL-19
Escherichia Coli			0		MPN/100mL		1	11-JUL-19
TDS-TB	**Water**							
Batch R4709492								
WG3103795-3 DUP		**L2307942-1**						
Total Dissolved Solids		121	102		mg/L	17	20	12-JUL-19
WG3103795-2 LCS								
Total Dissolved Solids			92.1		%		85-115	12-JUL-19
WG3103795-1 MB								
Total Dissolved Solids			<10		mg/L		10	12-JUL-19
TKN-COL-TB	**Water**							
Batch R4713795								
WG3105447-2 LCS								
Total Kjeldahl Nitrogen			94.6		%		75-125	17-JUL-19
WG3105447-1 MB								
Total Kjeldahl Nitrogen			<0.15		mg/L		0.15	17-JUL-19
TURBIDITY-TB	**Water**							
Batch R4708204								
WG3102588-3 DUP		**L2307942-4**						
Turbidity		5.90	5.91		NTU	0.2	15	11-JUL-19
WG3102588-2 LCS								
Turbidity			99.5		%		85-115	11-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-TB	**Water**							
Batch R4708204								
WG3102588-1 MB								
Turbidity			<0.10		NTU		0.1	11-JUL-19

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2307942-COFC

COC Number: 14 -

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Lakehead Region Conservation Authority	Select Report Format:	☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)	R ☐ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Scott Drebat	Quality Control (QC) Report with Report	☐ Yes ☒ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	130 conservation Road	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:		Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax	[redacted]	Specify Date Required for E2, E or P:
		Email 2	scott@lakeheadca.com	

Invoice To		Invoice Distribution	
	Same as Report To ☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
	Copy of Invoice with Report ☑ Yes ☐ No	Email 1 or Fax	
Company:		Email 2	
Contact:			

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q74345	Approver ID:	Cost Center:
Job #:	Jarvis River	GL Account:	Routing Code:
PO / AFE:	275	Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)	L230 7942	ALS Contact:	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Alkalinity, Conductivity, pH	Chloride, Nitrate, Nitrite, Sulphate	TDS, Turbidity	NH_3, TKN, TP	Metals, Total & Hardness	TC/EC	Number of Containers
	LPR1-LittlePine River - Site #1	10-Jul-19	12:45	Grab	X	X	X	X	X	X	6
	LPR2-LittlePine River - Site #2	10-Jul-19	12:05	Grab	X	X	X	X	X	X	6
	LPR3-Little Pine River - Site #3	10-Jul-19	11:30	Grab	X	X	X	X	X	X	6
	LPR4-LittlePine River - Site #4	10-July-19	10:30	Grab	X	X	X	X	X	X	6

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☒ No	
Are samples for human drinking water use? ☐ Yes ☒ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice packs Yes ☑ No ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
3.9					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Lydia Johnston	Date: July 11/19	Time:	Received By	Date 2019 07 11	Time 10:00	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326c v08 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1 If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

SD