Whitefish River Watershed
Assessment Report

Lakehead Region Conservation Authority
Conserve Today...For A Better Tomorrow

2012

Whitefish River Watershed Assessment Report

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Written and Published by:

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Conserve Today...For A Better Tomorrow

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Acknowledgements

The Lakehead Region Conservation Authority would like to acknowledge the residents of the Whitefish River watershed, who allowed the Lakehead Region Conservation Authority Staff access to their property and who were eager to share valuable information about the condition and health of the Whitefish River.

The 2012 Whitefish River Watershed Assessment was completed by Neal Zago and Blair Gutta, Assistant Water Resource Technologists. Scott Drebit, GIS Technician/Planner, Michelle Sixsmith, Water Resources Technologist and Tammy Cook, Watershed Manager of the Lakehead Region Conservation Authority provided guidance, input and revisions towards the completion of the report.

This report has been prepared in-house at the Lakehead Region Conservation Authority for internal purposes to document the condition of the Whitefish River in 2012.

Executive Summary

The Whitefish River Watershed is located within the Municipalities of Oliver Paipoonge and Neebing (Geographic Township of Scoble), the organized Townships of Gillies, O'Connor and Conmee, and the unorganized Townships of Adrian, Marks, Lybster, Fraleigh, Aldina, Strange and Jean. The watershed covers a drainage area of approximately 594.25 square kilometers. The Whitefish River is 45 kilometres in length and originates in the unorganized Township of Jean. The river meanders in an easterly direction through forested areas before joining the Kaministiquia River and further flowing into Lake Superior. The general slope of the watershed is 1.02 percent. The Whitefish River is fed by many lakes which include: Head, Sun, Tower, Echo, Pete, Marks and Twist Lake.

The majority of the Whitefish River watershed is privately owned land (56.6 percent). Provincially owned crown land constitutes 43 percent of the watershed and 0.4 percent of the watershed is a Federal First Nations Reserve. The only significant feature of the watershed is the Sitch Creek Clay Till Plain, which is an Area of Natural and Scientific Interest situated in the Township of Gillies.

The surficial geology of the Whitefish River watershed is mainly glaciolacustrine plains from the Rove Formation. Other landform features that are present in the watershed include bedrock, organic accumulations and alluvial deposits. The prevailing soil type throughout the watershed is shallow till over bedrock. The Whitefish River watershed is composed of sixteen different soil types. The most abundant type of soil is Rockland which covers 134.33 square kilometres of the watershed. Jarvis River, Oskondoga and Nolalu soils comprise a significant portion of the watershed, covering 282.70 square kilometres. The remaining soil is made up of Lappe, Marsh, Current River, Dorion, Formal, McKellar, Muck, Paipoonge, Slate River, Wolfpup, and Organic – Baird and Organic – Penassen, which covers 89.15 square kilometres. Soil information for the west portion of the Whitefish River watershed (80.07 square kilometres) was unavailable.

The Whitefish River watershed is located within the boundaries of the Great Lakes Forest Region but the vegetation resembles the neighboring Boreal Forest Region. The most common tree species in the watershed are white spruce, trembling aspen, black ash and balsam fir. There are a variety of other plants present in the watershed including ferns, shrubs, herbs, mosses and lichens.

For this report, ten sample sites located within the Whitefish River watershed were chosen based on a variety of attributes including: accessibility, physical features, land use designation, and proximity to man-made features that may alter water quality, as well as headwaters used as a base reference.

At each of the ten sample locations, surface water samples and field measurements were collected on June 13-14 and July 10-11, 2012. Surface water samples were analyzed by ALS Laboratory Group for conductivity, total dissolved solids, turbidity, total ammonia, nitrate, nitrite, total phosphorus, *Escherichia coli (E. coli)* and metals. Field measurements included water temperature, pH, conductivity and dissolved oxygen. Field and laboratory results were compared to the Ministry of Environment's *Provincial Water Quality Objec104tives* (PWQO), 1994. When sampling was conducted for the Whitefish River watershed, some parameters exceeded the PWQO including: *E.coli,* total coliforms, aluminum and iron.

PWQO criterion for *E. coli* bacteria is that levels be below 100 counts per 100 millilitres (mL) of water for safe swimming and bathing. During the June, 2012 sampling, all sample sites were below the PWQO criterion, with the exception of Site 3 (150 counts/100mL). In July, 2012, Site 2 (140 counts/100 mL) and Site 10 (150 counts/100 mL) exceeded the criterion. In 2012, E. coli ranged from 23 to 150 counts per 100 mL.

Total coliforms exceeded the pre-1994 PWQO criterion (1,000 MPN/100 mL) at every site in 2012 for both sampling periods. No current PWQO exists for total coliforms. The total coliform concentrations in 2012 ranged from 1,300 to greater than 2,420 MPN/100 mL for the watershed.

All sites were above the PWQO criterion of 0.075 mg/L for aluminum during both sampling periods, with the exception of Sites 2, 3 and 4 in July. Aluminum concentrations ranged from 0.0423 mg/L to 0.469 mg/L.

All sites were above the PWQO criterion of 0.30 mg/L for iron during both the sampling periods. Iron concentrations ranged from 0.510 mg/L to 1.02 mg/L.

The high aluminum and iron concentrations are most likely due to natural sources.

Stream bank erosion was a prominent feature of the Whitefish River. The area between the mouth of the river and the Village of Nolalu was experiencing the greatest amount of erosion. These areas consist of steep banks and sinuous meandering bends in the river. Some of the erosion was located outside the Area of Jurisdiction of the Lakehead Region Conservation Authority, within the unorganized Townships which is within the jurisdiction of the Ontario Ministry of Natural Resources.

At the time of sampling in 2012, the Whitefish River Watershed was considered to be in good health.

Upon completion of the 2012 Whitefish River Watershed Assessment, the following recommendations have been made for consideration:

- Staff and funding permitting, it is recommended that an update to the 2012 Whitefish River Watershed Assessment be completed in the next five to ten years.
- Benthic analysis indicates water quality over an extended period of time and should be considered for future watershed assessments.
- 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 Townships of Gillies, Conmee and O'Connor and the Municipalities of Neebing and Oliver Paipoonge for reference purposes. The Ontario Ministry of Natural Resources, Thunder Bay District Office should also be provided a copy of the report as the unorganized Townships are within their jurisdiction. The Report should be kept on file at the LRCA Administration Office for review by interested parties.

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1 Introduction

The Whitefish River watershed is located within the Municipalities of Oliver Paipoonge and Neebing (Geographic Township of Scoble), the organized Townships of Gillies, O'Connor and Conmee and the unorganized Townships of Adrian, Marks, Lybster, Fraleigh, Aldina, Strange and Jean as shown on the Map M-1: Key Plan. Areas regulated by the Lakehead Region Conservation Authority and Township boundaries can be found on Map M-2: Regulated Areas. It is noted that the area of jurisdiction and areas regulated by the Authority only include the organized Municipalities and Townships.

A watershed can be defined as all land and water within the confines of a drainage divide. There are nine main tributaries (North River, Beaver Creek, Silver Falls Creek, Sitch Creek, Silver Creek, Whitewood Creek, Cedar Creek, Pitch Creek and Tinpail Creek) and seven lakes (Head, Sun, Tower, Echo, Pete, Marks and Twist Lake) which all drain into the Whitefish River. The Whitefish River flows in an easterly direction into Kaministiquia River which flows into Lake Superior. In essence, the Whitefish River watershed consists of all the surrounding land that naturally drains its lakes, streams, wetlands and precipitation runoff into the Whitefish River. The headwaters of the main branch originate in the Township of Jean from Head Lake. The watershed covers a drainage area of approximately 594.25 square kilometres. The prevailing soil type throughout the watershed is Rockland soils. Most of the watershed is dominated by white spruce, trembling aspen, black ash and balsam fir. The Whitefish River runs approximately 45 kilometres in length and meanders through mainly forested areas, agricultural land and the villages of Nolalu and Hymers.

The goal of this report is to document the conditions of the watershed, especially surface water quality, as observed in June and July of 2012. The reported information can 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 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 including the flora and fauna observed within the watershed
- Conduct an inventory of soil, stream bed substrate and stream bank cover observed within the watershed
- Document active erosion sites
- Document the physical condition of all Whitefish River water crossings (bridges/culverts)
- Interpret results to record the health status of the watershed

2 Background

2.1 Physical Attributes

2.1.1 Topography

The Whitefish River waters originate in Head Lake. The outlet from Head Lake meanders in a north easterly direction to the Kaministiquia River, which further flows into Lake Superior. The highest elevation in the watershed is approximately 670 metres above sea level on the northwest boundary of the watershed (5355138 N 270629 E). The lowest point of elevation can be found near the confluence at 210 metres above sea level (5360121 N 308639 E). The general slope of the watershed is 1.02 percent. This area is characterized by predominantly forested rolling land. Map M-3 illustrates the Whitefish River watershed topography.

2.1.2 Geology and Soils

Bedrock

The Whitefish River watershed's bedrock geology is a product of two geological eras. The first is the Precambrian era which took place between 600,000 and over 3.5 billion years ago. The second is the Pleistocene period which ended approximately 10,000 years ago. The area was underlain by ancient Precambrian rocks of the Canadian Shield. The Gunflint and Rove formations of the Animikie series are one of the rock formations that make up the Canadian Shield seen within the Whitefish River watershed. The Gunflint formations are made up of taconite, algalchert, chert-carbonate, sandstone, shale, minor limestone and small amounts of volcanic rock. Rove formations are made up of greywacke and black shale. The Keweenawan intrusion of igneous material intruded the Gunflint formation rock masses and was the most recent episode in the Proterozoic era, which occurred approximately 100 to 110 million years ago. This intrusion formed vertical diabase dikes and horizontal diabase sills which are responsible for the relief of the immediate and surrounding area. The dikes stick up as massive ridges trending north-easterly and the sills are formed as resistant caprocks that form the large mesa landforms known as the Nor'wester Mountains.

The watershed is comprised of sedimentary rocks from the Paleoproterozoic era (2,500 – 1,600 million years ago), mafic intrusive rocks from the Mesoproterozoic era (1,600 – 900 million years ago), metasedimentary rocks from the Neo-Archean era (2,500 – 2,900 million years ago) and Mafic metavolcanic rocks from the Neo-to Mesoarchean era (2,500 – 3,400 million years ago). More specifically, 52 percent of the rock type within the Whitefish River watershed was from the Paleoproterozoic era and composed of the Animikie Group rocks which include wacke, shale, iron formation, limestone and minor volcanic rocks. Rocks that made up 39.8 percent of the rock types within the watershed formed during the Neo-to Mesoarchean era and included massive to foliated granodiorite to granite, foliated to massive tonalite to granodiorite, metasedimentary rocks, mafic rocks, ultramafic rocks and metavolcanic rocks. Eight percent of rocks formed during the Mesoproterozoic era included the Logan and Nipigon sills, diabase sills, ultramafic, gabbroic and granophyric intrusions. The remaining 0.2 percent of the rocks formed during the Neo-Archean era and mainly included coarse clastic metasedimentary rocks, with minor alkalic mafic to felsic metavolcanic flows, tuffs and breccias. Map M-4: Bedrock Geology illustrates the rock types present in the watershed.

Surficial Geology and Soils

Throughout northwestern Ontario there is a close relationship between landform features and sediment types. During the advance of the Laurentide Ice Sheet, sub-glacial till was deposited in the form of drumlins, drumlinoid ridges, crag and tail features and undifferentiated ground moraines which have resulted in a structured topographic landscape. Approximately 20,000 years ago when the ice sheet began to recede, entrained materials in the ice melted out as ablation till. Melt-waters left behind sand and gravel within esker outwash systems and moraines. These esker outwash systems cover about 7.3 percent of the watershed while the moraines cover about 28.50 percent. In addition to these glacial features, 1.84 percent of the watershed was slope/talus piles, 27.75 percent is composed of glaciolacustrine plains and 23.74 percent was bedrock. Other landform features not associated with glacial activity that are present in the watershed include organic accumulations and alluvial deposits. A visual representation of the surficial geology of the watershed is shown on map M-5: Surficial Geology. Due to the large occurrence of bedrock, many of the surficial deposits are relatively thin throughout the area and were usually less than 14 metres thick.

The Whitefish River watershed is composed of 16 different soil types. The most abundant type of soil is Rockland which covers 134.33 square kilometres of the watershed. Jarvis River, Oskondoga and Nolalu soils cover 282.70 square kilometres of the watershed. The remaining soil was made up of Lappe, Marsh, Current River, Dorion, Formal, McKellar, Muck, Paipoonge, Slate River, Wolfpup, and Organic – Baird and Organic – Penassen which cover 89.15 square kilometres. Soil information for the western portion of the Whitefish River watershed (80.07 square kilometres) was unavailable. The distribution of soil types throughout the watershed was illustrated on Map M-6: Soils and a description of each type of soil present are given in Appendix H.

2.1.3 Climate

The climate within the Whitefish 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 July to March the westerly winds prevail whereas the easterly winds prevail the rest of the year (LRCA, 1985). These winds modify the climate of Thunder Bay and the surrounding regions. The mean daily temperatures and precipitation levels, measured in degrees Celsius and millilitres, respectively, were recorded at the Thunder Bay Airport from 1971 to 2000 (Environment Canada, 2011) as shown in Table 2.1-1. This table also summarizes the extreme daily precipitation in millimetres recorded within a 24-hour period as well as the year in which it occurred and the duration of the event in days.

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily (ºC)	-14.8	-12	-5.5	2.9	9.5	14	17.6	16.6	11	5	-3	-11.6
Precipitation												
Total Precip (mm)	31.3	24.9	41.6	41.5	66.5	85.7	89	87.5	88	62.6	55.6	37.5
Extreme Daily Precip (mm)	51.6	33.5	41.9	69.3	76.2	49.3	53.8	87.1	131.2	47.8	63	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) for Thunder Bay were recorded at the Thunder Bay Airport for 2012 (Environment Canada, 2012), as shown below. Precipitation is also recorded by a tipping bucket at the stream flow gauge location in the Village of Nolalu. The gauge is maintained by Environment Canada in partnership with the Lakehead Region Conservation Authority.

Table 2.1-2: The Average Monthly Temperature and Total Precipitation for Thunder Bay International Airport Climate Station and Whitefish River Gauge Station, January-July 2012

	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature							
Daily (ºC)	-9.9	-5.9	1.1	3.0	10.7	16.5	20.6
Precipitation							
Total Precipitation (mm) Airport	18.1	7.9	51.3	51.4	192.1	88.6	56.8
Total Precipitation (mm) Whitefish River Gauge	NA	NA	NA	70.8	146.4	107	103

The average monthly precipitation for the sampling periods in June and July, 2012 was 72.7 millimetres in Thunder Bay and 105 millimetres at the Whitefish gauge in Nolalu. The average temperature recorded in Thunder Bay in June and July was 18.55 degrees Celsius. In comparison with the historical data, the 2012 temperature was three degrees Celsius higher than the average for June and July. The 2012 precipitation level recorded in Thunder Bay was near normal in June; however, below average in July. Recorded precipitation at the Whitefish gauge was 17 percent higher in June and 45 percent higher in July than the precipitation recorded in Thunder Bay.

2.1.4 Hydrology

The Whitefish River is 45 kilometres in length, from the headwaters of Head Lake to the confluence with the Kaministiquia River. The drainage area of the watershed is 594.25 square kilometres. The general slope of the watershed is 1.02 percent. The Whitefish River is fed by seven named lakes covering an area of 1.51 square kilometres which include: Head, Sun, Tower, Echo, Pete, Marks and Twist Lake. The ten tributaries that connect to the Whitefish River are listed in the table below.

Table 2.1-3: Tributaries to the Whitefish River

Watercourse Name	Length (km)	Area (km^2)
North River	15.78	70.38
Beaver Creek	12.18	21.24
Silver Falls Creek	12.56	29.59
Sitch Creek	9.39	16.42
Silver Creek	17.17	32.36
Whitewood Creek	18.47	38.19
Cedar Creek	28.46	74.33
Pitch Creek	28.75	70.17
Tinpail Creek	8.63	7.27

Wetlands are also present throughout the watershed and cover an area of 12.23 square kilometres. In total, wetlands make up two percent of the drainage area of the watershed, and water bodies make up ten percent of the drainage area.

Environment Canada, in partnership with the Lakehead Region Conservation Authority, maintains a hydrometric monitoring station on the Whitefish River in the Village of Nolalu (Station ID: 02AB017). It has been in operation since 1980 and records stream flow (January 1980-December 2011) and water level (January 2002-December 2011). Appendix L contains the Environment Canada monthly extreme statistics as well as the stage/discharge curve for the Whitefish River gauge station.

Historical development, mostly in the Village of Nolalu and Hymers, was located within the floodplain of the Whitefish River. Two large floods occurred in 1977 and 2008, which required evacuations. Significant damage to infrastructure also occurred during both events.

2.2 Biological Attributes

2.2.1 Flora

The Whitefish River watershed is located within the boundaries of the Great Lakes Forest Region, but is adjacent to the Boreal Forest Region boundary as shown on the Forest Regions of Canada map (Refer to Figure 1). 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 the Boreal Forest Region. The tree species present are predominantly white spruce, trembling aspen, black ash and balsam fir as opposed to the white pine, red pine and yellow birch of the Great Lakes Forest Region. This discrepancy is likely due to the fact that the watershed was relatively close to the Boreal Forest Region and mechanisms such as local climate (slope, aspect, etc.), site condition (soil characteristics), disturbance regimes and species interaction can affect the species distribution in the area. The coarse scale of the Forest Regions of Canada distribution map was only a basic division of the forest types, and there is no discrete line which separates the two zones. Factors such as the ones mentioned above could easily alter forest types which are located between two zones.

There are a variety of other plant species present in the Whitefish River watershed including ferns, shrubs, herbs, mosses and lichens. Plant species' common and Latin names are listed in Appendix D.

2.2.2 Fauna

The Whitefish River watershed provides breeding grounds for a variety of wildlife. Some of the more common species that live in the watershed include otters, beavers, white-tailed deer, black bear, muskrat, pileated woodpecker and various migratory birds. The Whitefish River watershed includes many other mammals, birds, fish and insects that are commonly found in the Great Lakes and Boreal Forest Regions.

2.3 Socio-Economic Attributes

2.3.1 Planning and Development Controls

Land Tenure

The majority of the Whitefish River watershed is privately owned land, which covers 56.5 percent of the watershed. Provincially owned crown land constitutes 43 percent of the watershed and 0.5 percent of the watershed is a Federal Land Indian Reserve. Land ownership in the watershed is illustrated on Map M-7: Land Use.

Areas of Jurisdiction

The hydrological boundaries of the Whitefish River watershed fall within various Municipalities/Townships including the organized Municipalities of Neebing (Geographic Township of Scoble) and Oliver Paipoonge, the organized Townships of Gillies, O'Connor and Conmee, and the unorganized Townships of Lybster, Fraleigh, Strange, Adrian, Marks, Aldina and Jean. Map M-8: Site Plan, illustrates the location of the Whitefish River watershed within the Geographic Township boundaries. Table 2.3-1 outlines the watershed area within each Township boundary.

Table 2.3-1: Areas of Jurisdiction within the Whitefish River Watershed

Geographic Boundaries	Total Municipal Area (km^2)	Municipal Area within Whitefish River Watershed (km^2)	Municipal Area within Whitefish River Watershed (%)
Township of Gillies	93.86	59.86	10.20
Township of O'Connor	108.67	104.61	17.83
Township of Conmee	160.84	15.56	2.65
Municipality of Oliver Paipoonge	354.99	12.06	2.06
Municipality of Neebing			
Township of Scoble	102.05	15.79	2.69
Unorganized Townships			
Unorganized Township of Lybster	93.45	83.93	14.30
Unorganized Township of Fraleigh	71.58	4.48	0.76
Unorganized Township of Strange	99.55	81.31	13.86
Unorganized Township of Adrian	91.69	25.59	4.36
Unorganized Township of Marks	108.16	94.41	16.09
Unorganized Township of Aldina	91.69	28.56	4.87
Unorganized Township of Jean	92.45	60.57	10.32
Total	1468.98	586.73	100

Within the boundaries of the Whitefish River watershed the Lakehead Region Conservation Authority (LRCA) Area of Jurisdiction extends only to the eastern portion of the watershed. Of the total Whitefish River watershed area, 594.25 square kilometers (65 percent) is outside of the LRCA Area of Jurisdiction. Conversely, 207.88 square kilometers (35 percent) of the watershed is located within the LRCA Area of Jurisdiction. Within the LRCA Area of Jurisdiction the Authority administers the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses O. Reg. 180/06 under the *Conservation Authorities Act*. Areas that are considered regulated include: Provincially Significant Wetlands and their 120 meter buffer radius, all watercourses, all land zoned as Hazard Land or Use Limitation, steep slopes and inland lake shorelines. Development within the approximate regulated area may require a permit from the Authority.

Land Use Designation/Zoning

Municipal Official Plans contain long term goals and policies that serve as guidelines for future land use and development. The Whitefish River is affected by four Official Plans, each maintained by the organized Townships/Municipalities within the watershed.

The policies of Official Plans 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 which must be satisfied. Within the Whitefish River watershed the organized Townships/Municipalities have zoned the land either rural or hazard land/use limitation, depending on the proximity to the river and tributaries. Each Township has differing definitions for each designation; however, they all aim to restrict development within the floodplain hazard of the river and permit rural character development in the area adjacent to the floodplain.

Within the unorganized Townships of Lybster, Fraleigh, Strange, Jean, Aldina, Marks and Adrian, there is no official designation or zoning on the land. Development is not regulated by any municipal structure and building permits are not required within the unorganized townships. Consent applications to sever the land are administered by the Province through the Ministry of Municipal Affairs and Housing.

Land use designations within the Whitefish River watershed can be found on Map M-9: Zoning.

2.2.1 Areas of Natural and Scientific Interest

Areas of Natural and Scientific Interest (ANSI) are defined as "areas of land and water containing natural landscapes or features which have been identified for protection, natural heritage appreciation, scientific study or education" (Ontario Ministry of Natural Resources, 1983). The Whitefish River Watershed contains one ANSI, the Sitch Creek Clay Till Plain ANSI. The Sitch Creek Clay Till Plain is situated in the Township of Gillies and is approximately 197 hectares. The site was classified as Provincially Significant and was privately owned without any public access. This site was an excellent representation of a glacially formed clay plain with a characteristic, dendritic drainage pattern.

3 Methods and Materials

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

3.1 Site Selection

Ten sites were chosen along the Whitefish River to assess the overall health of the watershed. Each site was chosen based on its accessibility and its proximity to natural or man-made features that may alter water quality. Site 1 was located as close as possible to the confluence of the Whitefish River with the Kaministiquia River in order to represent the cumulative water quality data for the entire watershed. Site 2 was located on Cedar Creek upstream of the confluence with the Whitefish River. From this site, water samples would reflect the upper watershed draining from Cedar Creek into the Whitefish River. Site 3 was located on Harstone Drive near the confluence of Pitch Creek and the Whitefish River. These water samples would represent the water quality from Tinpail, Whitewood and Pitch Creeks entering the Whitefish River. Site 4 was located on Highway 595 on Pitch Creek. Pitch Creek was a main tributary within the Whitefish River watershed. This site was chosen to represent the cumulative water quality from the upper middle watershed. Site 5 was located at the end of Diana Road off of Blaikie Road. This site was chosen for the water it receives from the lower east drainage area of the Whitefish River watershed which includes Silver Creek. Site 6 was located on Highway 595 in the Village of Hymers and was chosen based on its location within a rural developed area. Site 7 was located on Highway 588 adjacent to Leeper Road. Site 8 was located on Old Mill Road in the Village of Nolalu to represent impacts of the rural developed area. Site 9 was located on Highway 588 and was chosen based on accessibility. Site 10 was located on North Side Road in order to obtain water samples from the far west portion of the watershed. The UTM coordinates and elevation of each site were marked using the Trimble Geo XH GPS unit as shown on Map M-8: Site Plan.

3.2 Quantitative Assessment

Several parameters were measured to assess surface water quality of the Whitefish River. The LRCA staff and summer students collected the surface water samples in new bottles provided by ALS Laboratory. The samples were transported, on ice, to the ALS Laboratory at 1081 Barton Street, Thunder Bay, Ontario for analysis of conductivity, total dissolved solids (TDS), turbidity, nutrients (ammonia-total nitrogen, nitrate, nitrite and phosphorus), bacteria (*Escherichia coli* and total coliforms) and total metals. Sampling for the first data set was conducted on June 13 and 14, 2012. The second set of samples was collected on July 9 and 10, 2012.

Methodology for water sample collection was based on the Provincial Water Quality Monitoring Network (PWQMN), and Ministry of the Environment 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 opposite directions (influenced by wind direction), samples were still collected facing upstream. Samples were collected at a depth of 0.3 metres below the surface of water to avoid capturing any floating debris.

ALS Laboratory Group provided four collection bottles for each site: routine, nutrient, metal and bacterial analysis. The sample bottles and lids were rinsed twice before a true sample was collected. Sulfuric acid and nitric acid were added as preservatives on site to the nutrient and metal bottles, respectively. Bottles for bacterial analysis were 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 filled. All filled sample bottles were transported on ice for delivery to the laboratory.

Field parameters of water temperature, pH, conductivity and dissolved oxygen were measured using an YSI 6000 QS multi-parameter water quality sampler at the same time as 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, stop watch and appropriate calculations. Velocity was only measured for water running downstream (not in ponds producing only windblown results). Description of the water quality parameters are attached in Appendix A.

3.3 Applicable Criteria

Surface water quality results were compared to applicable criteria published in the Provincial Water Quality Objectives (PWQO) by the Ontario Ministry of Environment and Energy (MOEE), July 1994. The goal of the PWQO is to “ensure that the surface waters of the province are of the quality which is satisfactory for aquatic life and recreation”. Applicable criteria published in the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary Table by the Canadian Council of Resource and Environment Ministers (CCREM), September 2007, were also used for comparison to surface water quality results for the Whitefish River watershed. The information in these guidelines and supporting text is used to complement the PWQO and Interim Objectives. The applicable criteria published in the PWQO and CCREM water quality guidelines are attached in Appendix B. Total Coliform results were compared to the pre-1994 PWQO, as there are no current criteria.

3.4 Qualitative Assessment

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 capability of the watershed to provide suitable habitat. Several 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 in a 10 by 10 metre transect using a dichomotus 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 and differences and inconsistencies between the V-types should be expected. Vegetation types for each site are attached in Appendix E. Fauna were assessed by identifying the species and numbers of individuals observed at each site.

An inventory of Whitefish River water crossings (bridges and culverts) 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: Bridges and Culverts Sites. The bridge and culvert assessments are attached in Appendices F and G.

3.5 Materials

Materials used during the assessment included:
- Chest waders
- Cooler and ice packs
- Clipboard and observation chart paper
- Dip net
- Digital camera
- Field guides
- Fluorescent orange vests
- Latex gloves
- Measuring tape reel
- Measuring tape reel with lead weights (for measuring depths)
- Mercury thermometer
- Metre stick
- Pens and pencils
- Reaching pole
- Road map
- Sampling bottles and preservative provided by ALS Laboratory Group
- Scissors

- Shovel
- Stick (to measure velocity)
- Stopwatch
- Trimble Geo XH GPS
- Tweezers
- YSI 556 MPS metre
- Ziploc bags

Field Guides:
- Field Guide to the Forest Ecosystem Classification for Northwestern Ontario (Sims et al., 1997)
- Field Guide to Trees and Shrubs 2nd Edition (Petrides, 1958)
- Native Trees of Canada 8th Edition (Hosie, 1990)
- ROM Field Guide to Wildflowers of Ontario (Dickinson et al., 2004)
- Wetland Plants of Ontario (Newsmaster et al., 1997)
- Atlas of the Breeding Birds of Ontario (Cadman et al., 2007)

4 Results

Site photos and site descriptions from each sampling site are attached in Appendix I. The original Laboratory Certificates of Analysis and Analytical Reports have been attached in Appendix J. A summary of all laboratory water quality results for all sampled sites are summarized in Appendix K.

Figures 2-9 graphically represents and compares the following parameters: elevation, water temperature, pH, dissolved oxygen, total dissolved solids, conductivity, turbidity and *E. coli* for both sampling periods.

Results for each site are summarized in the following tables.

4.1 Site 1

Table 4.1-1: Location Reference for Site 1

Location Description	Whitefish River, upstream of confluence with the Kaministiquia River, Sideen Road
UTM Coordinates	5359903.97 metres north / 308453.65 metres east
Altitude/Elevation	212.61 metres above sea level

Table 4.1-2: Field Measurements for Site 1

Field Parameter	Date: June 14, 2012 Time: 13:10	Date: July 10, 2012 Time: 15:15
Water Temperature (ºC)	16.88	23.1
Conductivity (µS/cm)	122.0	140
Turbidity (NTU)	4.01	1.42
Dissolved Oxygen (mg/L)	9.54	8.73
Dissolved Oxygen (%)	98.5	102
pH	7.96	7.99
Air Temperature (ºC)	16.0	26
Channel Width (m)	-	-
Channel Depth (m)	0.6	0.3
Velocity (m/s)	0.31	0.8

Table 4.1-3: Laboratory Water Quality Results for Site 1

Variable	PWQO Guidelines	Date: June 14, 2012	Date: July 10, 2012
Conductivity (µS/cm)	N/A	171	187
Total Dissolved Solids (mg/L)	N/A	111	134
Turbidity (NTU)	<10% of Natural	7.03	4.12
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0122	0.0089
Escherichia coli (MPN/100mL)	100	24	66
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**>2420**	**2400**
Aluminum (Al) (mg/L)	0.075	**0.221**	**0.115**
Cadmium (Cd) (mg/L)	0.0001(interim)	0.000025	<0.000025
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	<0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0026	0.0025
Iron (Fe) (mg/L)	0.300	**0.638**	**0.528**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	8.05	8.06

Bold indicates exceedance above PWQO guidelines

Table 4.1-4: Flora and Fauna Observed at Site 1

FEC V-Type	V2 Black Ash Hardwood and Mixwood	
Terrestrial	Trees	Black ash Balsam poplar Balsam fir
	Shrubs	Green alder Willow Red-osier dogwood
	Herbs	Cow parsnip Buttercup American vetch
	Ferns/Horsetails/ Mosses	Lawn moss
	Mammals	-
	Birds	-
	Insects	Black flies Mosquitoes
Aquatic	Plants	Stiff arrowhead Horsetail Floating-leaved bur reed
	Fish/Reptiles	Minnows

*Dominant Species

Table 4.1-5: Physical Features Observed at Site 1

In-stream Material	Aquatic plants Woody debris
Stream Bed Description	Muck Gravel
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Partly open – stream 10% cover along banks
Soil Type (Texture/Drainage)	Clayey loam

Site 1 was located near the confluence of the Whitefish River and the Kaministiquia River. The river was flowing at a slow sustained speed with small traces of woody debris scattered near the banks and within the riverbed. The riverbed contained mostly gravel and muck. The banks appeared stable and were covered by abundant shrub and herb growth on clayey loam soil. The shrubs and herbs observed at the site included green alder, willow, cow parsnip and buttercups. There were many insects and minnows observed at the site.

Aluminum, iron and total coliform exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 milligrams per litre (mg/L) on both June 14, 2012 and July 10, 2012 with values of 0.221 mg/L and 0.115 mg/L, respectively. The iron PWQO criterion of 0.3 mg/L was exceeded on June 14, 2012 and July 10, 2012 with values of 0.638 mg/L and 0.528 mg/L, respectively. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of >2,420 MPN/100 mL in June and 2,400 MPN/100 mL in July. Nutrient and *E. coli* for this site were all within their PWQO guideline for both sample dates.

4.2 Site 2

Table 4.2-1: Location Reference for Site 2

Location Description	Cedar Creek near confluence with the Whitefish River, Harstone Drive
UTM Coordinates	5359295.01 metres north / 304625.75 metres east
Altitude/Elevation	221.52 metres above sea level

Table 4.2-2: Field Measurements for Site 2

Field Parameter	Date: June 14, 2012 Time: 12:20	Date: July 9, 2012 Time: 15:15
Water Temperature (ºC)	15.52	20.89
Conductivity (µS/cm)	117.0	125
Turbidity (NTU)	1.9	1.84
Dissolved Oxygen (mg/L)	9.91	8.97
Dissolved Oxygen (%)	99.7	100.4
pH	7.90	8.09
Air Temperature (ºC)	15.0	25
Channel Width (m)	6.5	6.4
Channel Depth (m)	0.3	0.34
Velocity (m/s)	0.87	1.6

Table 4.2-3: Laboratory Water Quality Results for Site 2

Variable	PWQO Guidelines	Date: June 14, 2012	Date: July 9, 2012
Conductivity (µS/cm)	N/A	165	184
Total Dissolved Solids (mg/L)	N/A	104	129
Turbidity (NTU)	<10% of Natural	4.47	2.38
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0193	0.0109
Escherichia coli (MPN/100mL)	100	86	**140**
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**>2420**	**>2420**
Aluminum (Al) (mg/L)	0.075	**0.139**	0.0710
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000017	<0.000017
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0015	0.0013
Iron (Fe) (mg/L)	0.300	**0.586**	**0.510**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	8.09	8.09

Bold indicates exceedance above PWQO guidelines.

Table 4.2-4: Flora and Fauna Observed at Site 2

FEC V-Type	V2 Black Ash Hardwood and Mixwood	
Terrestrial	Trees	Black ash Trembling aspen Balsam poplar White elm
	Shrubs	Chokecherry Willow Red-osier dogwood Slender Willow
	Herbs	Macouns buttercup
	Ferns/Horsetails/ Mosses	Horsetail Lady fern
	Mammals	-
	Birds	-
	Insects	Grasshoppers Mosquitoes Blackflies Red ants Cabbage white butterfly
Aquatic	Plants	-
	Fish/Reptiles	-

*Dominant Species

Table 4.2-5: Physical Features Observed at Site 2

In-stream Material	No aquatic plants No woody debris
Stream Bed Description	Gravel Cobbles
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Approximately 70% stream cover
Soil Type (Texture/Drainage)	Sandy loam

Site 2 was located on Cedar Creek just off of Harstone Drive. The site was at the confluence of Cedar Creek and the Whitefish River. The water was moving at a high velocity especially between the bridge and the confluence with the Whitefish River. The dominant substrate observed was gravel and cobbles with muck being present under the bridge and upstream of the creek. The banks were armoured with rip rap. The aquatic and terrestrial vegetation were abundant with many shrubs and herbs present along the banks of the creek. During the sampling period there were no terrestrial or aquatic fauna observed.

Aluminum, iron, total coliform and *E. coli* exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on June 14, 2012 with a value of 0.139 mg/L. Iron which has a PWQO criterion of 0.3 mg/L was exceeded on June 14, 2012 (0.586 mg/L) and on July 9, 2012 (0.510 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of >2,420 MPN/100 mL in both June and July. During the July sampling period *E.coli* exceeded the PWQO criterion of 100 MPN/100 mL with a value of 140 MPN/100 mL. Nutrients for this site were all within their PWQO criteria for both sample dates.

4.3 Site 3

Table 4.3-1: Location Reference for Site 3

Location Description	Pitch Creek near Whitefish River confluence, Harstone Drive (below confluence with Tinpail and Whitewood Creeks)
UTM Coordinates	5358182.52 metres north / 303166.37 metres east
Altitude/Elevation	223.70 metres above sea level

Table 4.3-2: Field Measurements for Site 3

Field Parameter	Date: June 14, 2012 Time: 11:35	Date: July 9, 2012 Time: 15:15
Water Temperature (ºC)	16.16	22.96
Conductivity (µS/cm)	122.0	137
Turbidity (NTU)	2.27	1.76
Dissolved Oxygen (mg/L)	9.89	8.87
Dissolved Oxygen (%)	100.5	103.3
pH	7.96	7.76
Air Temperature (ºC)	16.0	24
Channel Width (m)	9.0	10.2
Channel Depth (m)	0.3	0.4
Velocity (m/s)	0.54	1.02

Table 4.3-3: Laboratory Water Quality Results for Site 3

Variable	PWQO Guidelines	Date: June 14, 2012	Date: July 9, 2012
Conductivity (µS/cm)	N/A	172	183
Total Dissolved Solids (mg/L)	N/A	104	131
Turbidity (NTU)	<10% of Natural	3.88	3.57
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0111	0.0103
Escherichia coli (MPN/100mL)	100	**150**	62
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**>2420**	**>2420**
Aluminum (Al) (mg/L)	0.075	**0.0902**	0.0605
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000024	<0.000017
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	<0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0017	0.0019
Iron (Fe) (mg/L)	0.300	**0.514**	**0.605**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	8.14	8.16

Bold indicates exceedance above PWQO guidelines

Table 4.3-4: Flora and Fauna Observed at Site 3

FEC V-Type	V2 Black Ash Hardwood and Mixwood	
Terrestrial	Trees	Black ash* Jack pine White spruce Red maple
	Shrubs	Red-osier dogwood
	Herbs	Cow parsnip Red clover Wiregrass Buttercup Ox-eye daisy Dandelion Yellow hawkweed
	Ferns/Horsetails/ Mosses	Fire moss
	Mammals	White tailed deer
	Birds	-
	Insects	Red ants Bumble bees Blackflies Mosquitoes
Aquatic	Plants	Horsetail
	Fish/Reptiles	-

*Dominant Species

Table 4.3-5: Physical Features Observed at Site 3

In-stream Material	Aquatic plants Woody debris
Stream Bed Description	Large boulders Cobbles
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Approximately 20% stream cover
Soil Type (Texture/Drainage)	Sandy loam

Site 3 was located on Harstone Drive west of Site 2 within Pitch Creek. This site was downstream of the confluence with Tinpail and Whitewood Creeks. The creek bed was composed of cobbles and gravel. The water was flowing at a moderately fast velocity. There was a small build-up of woody debris within the river and along the banks. The banks appeared stable and had abundant vegetation with a sandy loam soil type. No fauna were observed at the site.

Aluminum, iron, total coliforms and *E. coli* exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on June 14, 2012 with a value of 0.0902 mg/L. Iron which has a PWQO criterion of 0.3 mg/L exceeded on June 14, 2012 (0.514 mg/L) and on July 9, 2012 (0.605 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1000 MPN/100 mL with a concentration of >2,420 MPN/100 in June and July. During the June sampling period *E.coli* exceeded the PWQO guideline of 100 MPN/100 mL with a value of 150 MPN/100mL. Nutrients for this site were all within their PWQO criterion for both sample dates.

4.4 Site 4

Table 4.4-1: Location Reference for Site 4

Location Description	Pitch Creek near Flint Road
UTM Coordinates	5357738.24 metres north / 300068.70 metres east
Altitude/Elevation	262.17 metres above sea level

Table 4.4-2: Field Measurements for Site 4

Field Parameter	Date: June 14, 2012 Time: 10:25	Date: July 9, 2012 Time: 15: 15
Water Temperature (ºC)	15.10	19.75
Conductivity (μS/cm)	94.0	118
Turbidity (NTU)	3.13	2.08
Dissolved Oxygen (mg/L)	9.88	9.09
Dissolved Oxygen (%)	98.5	99.5
pH	7.83	7.87
Air Temperature (ºC)	15.0	20
Channel Width (m)	7.6	7.6
Channel Depth (m)	0.7	0.55
Velocity (m/s)	N/A	N/A

Table 4.4-3: Laboratory Water Quality Results for Site 4

Variable	PWQO Guidelines	Date: June 14, 2012	Date: July 9, 2012
Conductivity (µS/cm)	N/A	133	159
Total Dissolved Solids (mg/L)	N/A	90	118
Turbidity (NTU)	<10% of Natural	3.10	3.69
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0098	0.0137
Escherichia coli (MPN/100mL)	100	27	51
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**1600**	**>2420**
Aluminum (Al) (mg/L)	0.075	**0.0831**	0.0423
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000017	<0.000017
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	<0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0013	0.0012
Iron (Fe) (mg/L)	0.300	**0.690**	**0.87**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5 to 8.5	7.93	7.91

Bold indicates exceedance above PWQO guidelines.

Table 4.4-4: Flora and Fauna Observed at Site 4

FEC V-Type	V2 Black Ash Hardwood and Mixwood	
Terrestrial	Trees	Eastern white cedar Black ash Red pine White birch Mountain maple
	Shrubs	Green alder Thorn bush Red-osier dogwood
	Herbs	Buttercup Dandelions Red top Hooked spur violet
	Ferns/Horsetails/ Mosses	Horsetail Fire moss Feather moss
	Mammals	-
	Birds	-
	Insects	Dragonflies Blackflies Red ant Bumblebees Mosquitoes
Aquatic	Plants	Horsetail Floating-leaved bur reed
	Fish/Reptiles	-

*Dominant Species

Table 4.4-5: Physical Features Observed at Site 4

In-stream Material	Aquatic plants Woody debris
Stream Bed Description	Muddy closer to river, Sandy further
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Approximately 20% stream cover
Soil Type (Texture/Drainage)	Sandy loam

Site 4 was located on Pitch Creek which was a main tributary of the Whitefish River located on Highway 595 at Flint Road. The site had apparent erosion along the banks, causing the river to appear brown and murky. No measureable velocity could be determined due to the nearly stagnant water. There was approximately 20 percent stream cover from the grasses, herbs and shrubs along the river banks. There was no aquatic plants observed at the site; however, dead brush and scattered logs were found within the water. The soil type at the site was a sandy loam which was contributing to the turbid murky water within the creek.

Aluminum, iron and total coliforms exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on June 14, 2012 with a value of 0.0831 mg/L. On July 9, 2012 the aluminum value (0.0423 mg/L) was within the PWQO guideline of 0.075 mg/L. Iron exceeded the PWQO criterion of 0.3 mg/L, on June 14, 2012 (0.690 mg/L) and on July 9, 2012 (0.87 mg/L). Total coliforms also exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 1600 MPN/100 mL on June 14, 2012 and >2420 MPN/100 mL on July 9, 2012. Nutrients and *E. coli* for this site were within their PWQO criteria for both sample dates.

4.5 Site 5

Table 4.5-1: Location Reference for Site 5

Location Description	Whitefish River, End of Diana Road off of Blaikie Road
UTM Coordinates	5357420.70 metres north /301455.27 metres east
Altitude/Elevation	235.90 metres above sea level

Table 4.5-2: Field Measurements for Site 5

Field Parameter	Date: June 14, 2012 Time: 14:05	Date: July 10, 2012 Time: 15:15
Water Temperature (ºC)	17.12	17
Conductivity (µS/cm)	108.0	103.2
Turbidity (NTU)	3.4	2.11
Dissolved Oxygen (mg/L)	9.59	9.32
Dissolved Oxygen (%)	99.5	89.9
pH	7.92	7.81
Air Temperature (ºC)	14	28
Channel Width (m)	-	-
Channel Depth (m)	0.7	0.4
Velocity (m/s)	0.38	0.31

Table 4.5-3: Laboratory Water Quality Results for Site 5

Variable	PWQO Guidelines	Date: June 14, 2012	Date: July 10, 2012
Conductivity (µS/cm)	N/A	153	169
Total Dissolved Solids (mg/L)	N/A	100	119
Turbidity (NTU)	<10% of Natural	9.32	4.75
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0115	0.0087
Escherichia coli (MPN/100mL)	100	35	23
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**>2420**	**2400**
Aluminum (Al) (mg/L)	0.075	**0.336**	**0.132**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000032	<0.000028
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0029	0.0032
Iron (Fe) (mg/L)	0.300	**0.751**	**0.559**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	8.02	8.04

Table 4.5-4: Flora and Fauna Observed at Site 5

FEC V-Type	V15 White Spruce Mixwood	
Terrestrial	Trees	White spruce* Trembling aspen Balsam fir
	Shrubs	Green alder Red-osier dogwood Thorn bush Chokecherry Pin cherry
	Herbs	Buttercup
	Ferns/Horsetails/ Mosses	Horsetail
	Mammals	-
	Birds	-
	Insects	Bumblebees Blackflies Black ants Mosquitoes
Aquatic	Plants	Horsetail
	Fish/Reptiles/ Amphibians	Bass Frog

*Dominant Species

Table 4.5-5: Physical Features Observed at Site 5

In-stream Material	Aquatic plants Woody debris Muddy
Stream Bed Description	Muck Clay
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Approximately 10% stream cover
Soil Type (Texture/Drainage)	Clayey loam

Site 5 was located at the end of Diana Road off of Blaikie Road. Clay and muck were the two dominate substrate components within the river. The river was deep, maintained a slow velocity and had an excessive amount of shrub and herb growth along the banks. There was little debris within the channel. There was no apparent erosion along the banks. During the June sampling, a smallmouth bass and a few frogs were seen swimming through the channel.

Aluminum, iron and total coliforms exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on both June 14, 2012 and July 10, 2012 with values of 0.336 mg/L and 0.132 mg/L, respectively. Iron which has a PWQO criterion of 0.3 mg/L was exceeded on June 14, 2012 (0.751 mg/L) and on July 10, 2012 (0.559 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 2,400 MPN/100 mL in July and >2,420 MPN/100 mL in June. Nutrients and *E. coli* for this site were within their PWQO criteria for both sample dates.

4.6 Site 6

Table 4.6-1: Location Reference for Site 6

Location Description	On Highway 595 at bridge in Village of Hymers
UTM Coordinates	5353713.55 metres north / 299415.64 metres east
Altitude/Elevation	262.54 metres above sea level

Table 4.6-2: Field Measurements for Site 6

Field Parameter	Date: June 13, 2012 Time: 13:45	Date: July 9, 2012 Time: 15:15
Water Temperature (ºC)	18.49	22.70
Conductivity (µS/cm)	93.0	111
Turbidity (NTU)	6.47	3.83
Dissolved Oxygen (mg/L)	9.57	8.74
Dissolved Oxygen (%)	102.2	101.3
pH	7.81	7.92
Air Temperature (ºC)	23.0	22
Channel Width (m)	12.6	11
Channel Depth (m)	1	0.7
Velocity (m/s)	0.92	0.62

Table 4.6-3: Laboratory Water Quality Results for Site 6

Variable	PWQO Guidelines	Date: June 13, 2012	Date: July 9, 2012
Conductivity (µS/cm)	N/A	132	149
Total Dissolved Solids (mg/L)	N/A	90	112
Turbidity (NTU)	<10% of Natural	11.0	7.33
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0161	0.0104
Escherichia coli (MPN/100mL)	100	30	24
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**2400**	**2400**
Aluminum (Al) (mg/L)	0.075	**0.440**	**0.217**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000029	<0.000026
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0030	0.0026
Iron (Fe) (mg/L)	0.300	**0.918**	**0.743**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	7.97	8.00

Bold indicates exceedance above PWQO guidelines.

Table 4.6-4: Flora and Fauna Observed at Site 6

FEC V-Type	V2 Black Ash Hardwood and Mixwood	
Terrestrial	Trees	Black ash* Trembling aspen Jack pine Red pine White birch
	Shrubs	Willow Red-osier dogwood
	Herbs	Cow parsnip
	Ferns/Horsetails/ Mosses	Horsetail
	Mammals	-
	Birds	-
	Insects	Blackflies Horse flies Mosquitoes
Aquatic	Plants	Horsetail Green algae
	Fish/Reptiles	-

*Dominant Species

Table 4.6-5: Physical Features Observed at Site 6

In-stream Material	Woody debris
Stream Bed Description	Few large boulders Cobbles
Bank Stability/Erosion	100ft bank eroding into water
Stream Cover/ Forest Density	Approximately 15% stream cover
Soil Type (Texture/Drainage)	Silty loam

Site 6 was located in the Village of Hymers, upstream from the bailey bridge. The stream bed consisted of cobbles with a few large boulders. The murky water was shallow and fast moving with the velocity increasing farther downstream. There was a small build-up of woody debris and no aquatic plants present; however, there was an abundant amount of horsetail and green algae growing along the riverbank. The soil type determined at the site was a silty loam. Upstream of the sample site a 30 metre high bank which was eroding into the river.

Aluminum, iron and total coliforms exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on both June 13, 2012 and July 9, 2012 with values of 0.440 mg/L and 0.217 mg/L, respectively. The iron PWQO criterion of 0.3 mg/L was exceeded on June 13, 2012 (0.918 mg/L) and on July 9, 2012 (0.743 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 2,400 MPN/100 mL in June and July. Nutrients and *E. coli* for this site were all within their PWQO criteria for both sample dates.

4.7 Site 7

Table 4.7-1: Location Reference for Site 7

Location Description	Whitefish River, on Highway 588, next to Leeper Road
UTM Coordinates	5351882.92 metres north / 295735.24 metres east
Altitude/Elevation	285.23 metres above sea level

Table 4.7-2: Field Measurements for Site 7

Field Parameter	Date: June 13, 2012 Time: 13:09	Date: July 9, 2012 Time: 15:15
Water Temperature (ºC)	18.08	22.66
Conductivity (µS/cm)	86.0	52
Turbidity (NTU)	5.82	3.51
Dissolved Oxygen (mg/L)	9.44	8.54
Dissolved Oxygen (%)	100.1	98.9
pH	7.64	7.57
Air Temperature (ºC)	24	23
Channel Width (m)	13.6	11.9
Channel Depth (m)	0.6	0.4
Velocity (m/s)	1.1	0.37

Table 4.7-3: Laboratory Water Quality Results for Site 7

Variable	PWQO Guidelines	Date: June 13, 2012	Date: July 9, 2012
Conductivity (µS/cm)	N/A	122	138
Total Dissolved Solids (mg/L)	N/A	80	104
Turbidity (NTU)	<10% of Natural	10.6	6.27
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0132	0.0112
Escherichia coli (MPN/100mL)	100	32	29
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**1600**	**1600**
Aluminum (Al) (mg/L)	0.075	**0.413**	**0.162**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000024	<0.000020
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0026	0.0020
Iron (Fe) (mg/L)	0.300	**0.904**	**0.723**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	7.94	7.95

Bold indicates exceedance above PWQO guidelines.

Table 4.7-4: Flora and Fauna Observed at Site 7

FEC V-Type		V15 White Spruce Mixwood
Terrestrial	Trees	White spruce Slender willow Balsam poplar Black ash
	Shrubs	Green alder Willow Blueberry Wild Raspberry Pin Cherry
	Herbs	Dandelions
	Ferns/Horsetails/ Mosses	Horsetail
	Mammals	-
	Birds	Chickadee
	Insects	Dragonflies Blackflies Monarch butterfly Mosquitoes
Aquatic	Plants	Horsetail Green algae Floating-leaved bur reed
	Fish/Reptiles	Frog Toad

*Dominant Species

Table 4.7-5: Physical Features Observed at Site 7

In-stream Material	Aquatic plants Woody debris
Stream Bed Description	Large boulders Cobbles
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Approximately 5% stream cover
Soil Type (Texture/Drainage)	Sandy loam

Site 7 was located on Highway 588 adjacent to Leeper Road. The water level was significantly lower upstream compared to downstream. Site 7 had the fastest recorded water velocity of all the sample sites. The streambed consisted of sand, large boulders and cobbles. Site 7 had the least amount of stream cover compared to the other sample sites (0-5 percent). The banks appeared stable and had abundant vegetation growth along the river bank. Unlike most of the sample sites, Site 7 had an abundant amount of aquatic vegetation including green algae, floating-leaved bur reed, and horsetail. Numerous frogs, toads and chickadees were seen along the river.

Aluminum, iron and total coliforms exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on both June 13, 2012 and July 9, 2012 with values of 0.413 mg/L and 0.162 mg/L, respectively. Iron which has a PWQO criterion of 0.3 mg/L, was exceeded on June 13, 2012 (0.904 mg/L) and on July 9, 2012 (0.723 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 1,600 MPN/100 mL in June and July. Nutrients and *E. coli* for this site were all within their PWQO criteria for both sample dates.

4.8 Site 8

Table 4.8-1: Location Reference for Site 8

Location Description	Whitefish River in Village of Nolalu at bridge three on Old Mill Road
UTM Coordinates	5352539.49 metres north / 291651.15 metres east
Altitude/Elevation	324.09 metres above sea level

Table 4.8-2: Field Measurements for Site 8

Field Parameter	Date: June 13, 2012 Time: 12:30	Date: July 10, 2012 Time: 15:15
Water Temperature (ºC)	17.05	21.8
Conductivity (µS/cm)	75.0	87
Turbidity (NTU)	5.84	3.54
Dissolved Oxygen (mg/L)	9.87	9.02
Dissolved Oxygen (%)	102.4	102.8
pH	7.64	7.94
Air Temperature (ºC)	21	27
Channel Width (m)	12.1	9.7
Channel Depth (m)	0.2	0.2
Velocity (m/s)	0.66	0.64

Table 4.8-3: Laboratory Water Quality Results for Site 8

Variable	PWQO Guidelines	Date: June 13, 2012	Date: July 10, 2012
Conductivity (µS/cm)	N/A	107	116
Total Dissolved Solids (mg/L)	N/A	74	86
Turbidity (NTU)	<10% of Natural	11.0	9.21
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0160	0.0133
Escherichia coli (MPN/100mL)	100	35	66
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**>2420**	**>2420**
Aluminum (Al) (mg/L)	0.075	**0.430**	**0.290**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000018	<0.000020
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0022	0.0020
Iron (Fe) (mg/L)	0.300	**0.965**	**0.943**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	7.90	7.88

Bold indicates exceedance above PWQO guidelines.

Table 4.8-4: Flora and Fauna Observed at Site 8

FEC V-Type		Not Applicable, within the Village of Nolalu
Terrestrial	Trees	Red pine Jack pine Tamarack
	Shrubs	Green alder, Hawthorn Willow, Raspberry Red-osier dogwood, Mountain maple Choke cherry
	Herbs	Cow parsnip Wild rose Buttercup
	Ferns/Horsetails/ Mosses	Horsetail Sensitive fern
	Mammals	-
	Birds	-
	Insects	Monarch butterfly Mosquitoes Red weevil
Aquatic	Plants	-
	Fish/Reptiles	-

*Dominant Species

Table 4.8-5: Physical Features Observed at Site 8

In-stream Material	Aquatic plants
Stream Bed Description	Bedrock Sand Cobbles
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Approximately 10% stream cover
Soil Type (Texture/Drainage)	Moist sandy loam

Site 8 was located in the Village of Nolalu just upstream of the bridge on Old Mill Road and was characterized by the smooth bedrock within the channel and along the river bank. The terrestrial substrate adjacent to the river bank was mostly sand. Site 8 was the shallowest of all the sites but had a high velocity. A small set of rapids were observed downstream of the bridge. The banks appeared to be stable and were covered by abundant shrub and herb growth, with no apparent erosion. There was little debris found within the channel and there was little stream cover (10 percent). No fauna was observed at this site.

Aluminum, iron and total coliforms exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on both June 13, 2012 and July 10, 2012 with values of 0.430 mg/L and 0.290 mg/L, respectively. Iron which has a PWQO of 0.3 mg/L, was exceeded on June 13, 2012 (0.965 mg/L) and on July 10, 2012 (0.943 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of >2,420 MPN/100 mL in June and July. Nutrients and *E. coli* for this site were all within their PWQO criteria for both sample dates.

4.9 Site 9

Table 4.9-1: Location Reference for Site 9

Location Description	Whitefish River on Highway 588, West of 5th Side Road
UTM Coordinates	5351909.87 metres north / 289098.60 metres east
Altitude/Elevation	337 metres above sea level

Table 4.9-2: Field Measurements for Site 9

Field Parameter	Date: June 13, 2012 Time: 11:50	Date: July 10, 2012 Time: 15:15
Water Temperature (ºC)	16.26	20.88
Conductivity (µS/cm)	66.0	78
Turbidity (NTU)	6.26	5.66
Dissolved Oxygen (mg/L)	9.81	9.01
Dissolved Oxygen (%)	99.8	100.8
pH	7.64	7.86
Air Temperature (ºC)	19	26
Channel Width (m)	11.3	7.3
Channel Depth (m)	0.5	0.45
Velocity (m/s)	1.06	0.49

Table 4.9-3: Laboratory Water Quality Results for Site 9

Variable	PWQO Guidelines	Date: June 13, 2012	Date: July 10, 2012
Conductivity (µS/cm)	N/A	92.9	106
Total Dissolved Solids (mg/L)	N/A	65	89
Turbidity (NTU)	<10% of Natural	12.4	9.4
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0169	0.0131
Escherichia coli (MPN/100mL)	100	52	86
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**1300**	**2400**
Aluminum (Al) (mg/L)	0.075	**0.469**	**0.289**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000017	<0.000017
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0022	0.0018
Iron (Fe) (mg/L)	0.300	**1.02**	**0.966**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	7.79	7.83

Bold indicates exceedance above PWQO guidelines.

Table 4.9-4: Flora and Fauna Observed at Site 9

FEC V-Type		V14 Balsam Fir Mixedwood
Terrestrial	Trees	White spruce Balsam fir* Trembling aspen Maple
	Shrubs	Green alder Willow Wild strawberry Saskatoon berry Red-osier dogwood Mountain maple
	Herbs	White daises Spreading dogbane Cow vetch Buttercup American vetch
	Ferns/Horsetails/ Mosses	-
	Mammals	-
	Birds	-
	Insects	Dragonflies Black flies Monarch butterfly Mosquitoes
Aquatic	Plants	-
	Fish/Reptiles	Tadpoles Water beetle

*Dominant Species

Table 4.9-5: Physical Features Observed at Site 9

In-stream Material	Aquatic plants Woody debris
Stream Bed Description	Gravel Muck
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Partly open – stream 5% cover along banks
Soil Type (Texture/Drainage)	Silty loam

Site 9 was located on Highway 588, west of 5th Side Road, and was characterized by a concrete bridge constructed in 1976. Upstream of the concrete bridge was the remains of an old wooden bridge. The river was filled with dead brush and logs as well as a stick dam downstream. Site 9 had a high velocity which decreased downstream. The banks appeared to be very stable and had abundant vegetation including shrub and herb growth. The substrate for the channel was mainly gravel and muck with no apparent erosion. There was very little stream cover at the site. During the June sampling period there was an abundance of tadpoles in the calmer section of the channel. No other fauna was observed at this site.

Aluminum, iron and total coliforms exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on both June 13, 2012 and July 10, 2012 with values of 0.469 mg/L and 0.289 mg/L, respectively. Iron which has a PWQO of 0.3 mg/L, was exceeded on June 13, 2012 (1.02 mg/L) and on July 10, 2012 (0.966 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 1,300 MPN/100 mL in June and 2,400 MPN/100 mL in July. Nutrients and *E. coli* for this site were all within their PWQO criterion for both sample dates.

4.10 Site 10

Table 4.10-1: Location Reference for Site 10

Location Description	Whitefish River, North Side Road
UTM Coordinates	5351224.51 metres north / 283559.33 metres east
Altitude/Elevation	405.13 metres above sea level

Table 4.10-2: Field Measurements for Site 10

Field Parameter	Date: June 13, 2012 Time: 10:45	Date: July 10, 2012 Time: 15: 15
Water Temperature (ºC)	15.8	20.30
Conductivity (µS/cm)	54	67
Turbidity (NTU)	3.76	3.72
Dissolved Oxygen (mg/L)	9.1	8.3
Dissolved Oxygen (%)	92.1	92.4
pH	7.49	7.91
Air Temperature (ºC)	17	24
Channel Width (m)	17.3	17.2
Channel Depth (m)	1.9	1.7
Velocity (m/s)	nil	nil

Table 4.10-3: Laboratory Water Quality Results for Site 10

Variable	PWQO Guidelines	Date: June 13, 2012	Date: July 10, 2012
Conductivity (µS/cm)	N/A	77.4	91.2
Total Dissolved Solids (mg/L)	N/A	60	77
Turbidity (NTU)	<10% of Natural	5.61	6.12
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0136	0.0100
Escherichia coli (MPN/100mL)	100	51	**150**
Total Coliforms (MPN/100ml)	1000 (prior to 1994)	**>2420**	**>2420**
Aluminum (Al) (mg/L)	0.075	**0.208**	**0.177**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000017	<0.000017
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	<0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0011	0.0011
Iron (Fe) (mg/L)	0.300	**0.798**	**0.992**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010
pH	6.5-8.5	7.54	7.64

Table 4.10-4: Flora and Fauna Observed at Site 10

Terrestrial	Trees	White spruce* Trembling aspen Balsam poplar Balsam fir
	Shrubs	Green alder, Wild Strawberry, Wild Blueberry Willow, Beaked hazel, Wild rose Red-osier dogwood, Raspberry Saskatoon berry, Elderberry
	Herbs	Cow vetch, Large leaf aster Buttercup, Bluebell Yarrow, Red clover Dandelions, American vetch
	Ferns/Horsetails/ Mosses	Horsetail Feather moss
	Mammals/Reptiles	Garter snakes Tree frog
	Birds	Whiskey jack
	Insects	Dragonflies Blackflies Red ants Bumble bee Mosquitoes
Aquatic	Plants	Horsetail Green algae Yellow pond lily Large fruited bur reed Floating-leaved bur reed
	Fish/Reptiles	Minnow Eastern garter snakes Frog

*Dominant Species

Table 4.10-5: Physical Features Observed at Site 10

In-stream Material	Aquatic plants Woody debris
Stream Bed Description	Sand Clay
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Partly open – stream 15% cover along banks
Soil Type (Texture/Drainage)	Clayey, loamy moist

Site 10 was located on North Side Road within the unorganized Township of Strange and was the farthest upstream sample site. There was an abundant amount of large pieces of woody debris stuck under the bridge. The main substrate within the riverbed was muck; however, on the banks there was a mixture of both muck and clay. The main soil type on land was clayey, moist loam. The water was considerably deep compared to other sites. There was negligible flow at Site 10. The river banks had minimal signs of erosion with plenty of vegetation. Site 10 had the most diverse fauna and flora. Frogs, minnows and snakes were abundant at the site.

Aluminum, iron and total coliforms exceeded the PWQO criteria of their respective values. Aluminum exceeded the PWQO criterion of 0.075 mg/L on both June 13, 2012 and July 10, 2012 with values of 0.208 mg/L and 0.177 mg/L, respectively. Iron which has a PWQO criterion of 0.3 mg/L was exceeded on June 13, 2012 (0.798 mg/L) and on July 10, 2012 (0.992 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of >2,420 MPN/100 mL in June and July. During the July sampling period *E.coli* exceeded the PWQO guideline of 100 MPN/100 mL with a value of 150 MPN/100mL. Nutrients for this site were within their PWQO criteria for both sample dates.

5 Discussion

The highest point of elevation sampled in the Whitefish River watershed was at Site 10 which was 405.13 metres above the mean sea level. Site 1 had the lowest elevation at 212.62 metres above sea level. Elevation plays an important role in direction of water drainage and stream velocity. The Whitefish River watershed has an average slope of 1.02 percent.

The Whitefish River ranged from 6.5 to 17.3 metres wide with an average width of 10.1 metres. The average depth of the Whitefish River was 0.61 metres during the time of sampling. Sites 1 and 5 had widths which could not be measured due to not being able to cross the channel. Average stream velocity was 0.731 metres per second. This average was calculated from Sites 1 to 3 and Sites 5 to 9. Velocity was not measurable at Site 4 and Site 10 due to a lack of flow.

On June 13 and 14, 2012 the average water temperature was 16.6 degrees Celsius with an average air temperature of 16.4 degrees Celsius. Weather conditions were a mix of sun and cloud. On July 9 and 10, 2012 the average water temperature was 21.2 degrees Celsius with an average air temperature of 24.5 degrees Celsius. Weather conditions during the July sampling period was a mix of sun and cloud with some rain.

The pH for all sites during both sampling periods fell within the PWQO criteria of 6.5 to 8.5 for healthy aquatic life. During the sampling period pH ranged from 7.49 to 8.16.

Total dissolved solids (TDS) were lowest at Site 10 during both sampling periods with an average of 68.50 mg/L between the two months. The highest levels of total dissolved solids were observed at Site 1 in both June (111 mg/L) and in July (134 mg/L). On average, the total dissolved solids were fairly consistent between the other eight sampling sites during both sampling periods. The average TDS for June was 87.8 mg/L and the average TDS for July was 109.9 mg/L. Since TDS is highly variable due to underlying geology, the only objective in place is <500 mg/L for drinking water published in the *Canadian Drinking Water Quality* guidelines to prevent unpalatable tastes and excessive scaling in water pipes and boilers (Health Canada, 1996).

Nitrogen was analyzed in three biologically-usable forms: nitrate (NO_3), nitrite (NO_2), and ammonia (NH_3). All three forms of nitrogen in the Whitefish River watershed were below the maximum concentrations published in the PWQO and CCREM guidelines. All nitrate concentrations at the sampled sites were <0.030 mg/L (with a CCREM criterion of 2.9 mg/L). All nitrite concentrations at the sampled sites were <0.020 mg/L (with a CCREM criterion of 0.060 mg/L). Total ammonia stayed constant at <0.020 mg/L throughout all the sampled sites.

Observed conductivity concentrations were highest at Site 1 on July 10, 2012 (187 µS/cm). Conductivity was the lowest at Site 10 on June 13, 2012 (77.4 µS/cm). Turbidity in the Whitefish River watershed ranged from 1.42 to 12.4 NTU. All sites were well below the *Canadian Recreational Water Quality* guidelines of 50 NTU (Health Canada, 1992). The lowest turbidity was recorded on July 9, 2012 at Site 2 with a reading of 2.38 NTU and the highest from Site 9 with a reading of 12.4 NTU on June 13, 2012. In general, the water observed was coloured; however, fairly clear.

Phosphorus was within the PWQO criterion at every site ranging from 0.0087 mg/L at Site 5 on July 10, 2012 to 0.0193 mg/L at Site 2 on June 13, 2012.

The PWQO recommend *E. coli* bacteria levels be below 100 counts per 100 mL of water for safe swimming and bathing. During the June sampling, all sites except Site 3 (150 MPN/100ml) were below the PWQO criterion. During the July sampling, Sites 2 and 10 were above the criterion with 140 and 150 counts per 100 mL of water, respectively. In 2012, *E. coli* ranged from 23 to 150 counts per 100 ml of water. *E. coli* is found in the intestines of warm-blooded mammals such as livestock, humans and wildlife. It is indicative of recent fecal contamination. The presence of farm animals near a stream can significantly influence bacterial counts. *E. coli* could also potentially enter the watershed from leaking residential septic tanks.

Coliforms can indicate the presence of fecal contaminants and is therefore still important in testing. Total coliforms exceeded the pre-1994 PWQO criterion (1,000 MPN/100 mL) at every site in 2012 for both sampling months. No current PWQO criterion exists for total coliforms. The total coliform concentrations in 2012 ranged from 1,300 to greater than 2,420 MPN/100 mL for the watershed.

All the sites, except Site 2, 3 and 4 in July were above the PWQO criterion of 0.075 mg/L for aluminum during both sampling months. The aluminum concentrations ranged from 0.0423 mg/L at Site 4 on July 9, 2012 to 0.469 mg/L at Site 9 on June 13, 2012.

All sites were above the PWQO criterion of 0.3 mg/L for iron during both the sampling periods. Iron concentrations ranged between 0.510 mg/L at Site 2 on July 9 and 1.02 mg/L at Site 9 on June 13, 2012. The high aluminum and iron levels may be caused by the underlying geology. These metals may naturally dissociate from mineral-rich rocks along banks and shorelines.

Forest composition was characteristic of the Boreal Forest Region. Similar tree and shrub species were identified at each sampling site. The most common tree species observed included balsam fir, white spruce, trembling aspen, red pine, jack pine, tamarack, white spruce, balsam poplar, white birch and black ash. The shrub layer was dominated by red osier dogwood, slender willow, choke cherry, pin cherry, mountain maple and green alder. Dogwood and green alder shrubs are characteristic of wetland/riparian zone habitat and are most valuable in preventing stream bank erosion. The most common herb species discovered during sampling were cow vetch, green clover, wild rose, blue bells, wild strawberries, ox-eye daisy, choke cherry, horsetail, dandelions and velvet leaf blueberry. Eastern white cedar was observed at sample Site 4, it was the only site to possess this terrestrial tree.

Aquatic species were not observed at most sites; however Site 10 had several aquatic species noted including: large fruited bur reed, floating leaved bur reed, stiff arrowhead and yellow pond lily. More data should be collected on the benthic macro invertebrate community, as its composition changes in response to ecosystem stress faster than other members of the aquatic community.

The Whitefish River watershed had a diverse population of birds, terrestrial animals and insects. The most common species of birds observed during the site visits were black-capped chickadee, american robin and blue jay. The terrestrial animals that were seen included white tailed deer, eastern garter snakes, toads and frogs.

Overall, the stream banks documented at the sample sites within the Whitefish River watershed were stable. The silty clay loam and muddy clay loam did not display significant erosion, as it is a cohesive type of soil which aids in river bank stability. Two of the ten sites did not have defined channels and therefore had minimal potential for erosion. Upstream of Site 6 is a heavily eroded stream bank as seen in Figure 10. Site 10 had a steep bank on one side of the channel but had minimal signs of erosion. Despite the stable slopes observed at the sampling sites, the Whitefish River is known for its steep erodible banks. The area from the Village of Nolalu to the mouth of the river is where the greatest amount of erosion was occurring.

Bridges assessed within the watershed appeared to be in good condition and were well maintained. All the bridges appeared to have appropriate fill to protect against erosion, which included cobbles, boulders and other types of rock fill. If the bridge did not use rock fill as a stabilizer, a wooden retaining wall was present on the banks at each end of the bridge. Culvert 1 was in excellent condition and evidence from the rust line indicated it is able to sustain the fluctuating water levels flowing through it.

6 Conclusion

The overall health of the Whitefish River watershed was in excellent condition at the time of sampling. The majority of water quality parameters, with the exception of those that are naturally affected by the geology of the area, were relatively low and at acceptable levels based on the PWQO criterion. The flora and fauna indicated that the watershed was a sustainable habitat for many forms of life. The bridges and culverts were in very stable condition. There did not appear to be any anthropogenic activities (industrial or agricultural) significantly affecting the watershed.

7 Recommendations

Upon completion of the 2012 Whitefish River Watershed Assessment, the following recommendations have been made for consideration:
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- Staff and funding permitting, it is recommended that an update to the 2012 Whitefish River Watershed Assessment be completed in the next five to ten years.
- Benthic analysis indicates water quality over an extended period of time and should be considered for future watershed assessments.
- 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 Townships of Gillies, Conmee and O'Connor and the Municipalities of Neebing and Oliver Paipoonge for reference purposes. The Ontario Ministry of Natural Resources, Thunder Bay District Office should also be provided a copy of the report as the unorganized Townships are within their jurisdiction. The Report should be kept on file at the LRCA Administration Office for review by interested parties.

References

Agriculture and Agri-Food Canada. (1998). Canada Land Inventory, National Soil Database. [Online] Available: http://sis.agr.gc.ca/cansis/nsdb/cli/intro.html

Cadman, M., Sutherland, D., Beck, G., Lepage, D. & A. Couturier (eds.) (2007). Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature: Toronto, Ontario.

Canadian Council of Ministers of the Environment (CCREM) (2007). Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated September, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Forest Service, Natural Resources Canada. (2004). Map of the Forest Regions of Canada. [Online] Available: http://atlas.nrcan.gc.ca/site/ english/ learning resources/theme_modules/borealforest/forest_regions.jpg/image_view

Dickinson, T., Metsger, D., Bull, J., & R. Dickinson. (2004). the ROM Field Guide to Wildflowers of Ontario. Royal Ontario Museum and McClelland and Stewart Ltd.: Toronto, Ontario.

Environment Canada. (2008). *Canadian Daily Climate Data* (CDCD). [Online] Available:
http://www.climate.weatheroffice.ec.gc.ca [September 02, 2008].

Health Canada. (1992). Guidelines for Canadian Recreational Water Quality. Ministry of National Health and Family Welfare. Ottawa: Supply and Services Canada. [Online] Available: http://www.hc-sc.gc.ca [September 02, 2008].

Health Canada. (1996). *Guidelines for Canadian Drinking Water Quality* (6th Edition). Ministry of National Health and Family Welfare. Federal-Provincial Subcommittee on Drinking Water. Ottawa: Supply and Services Canada. [Online] Available: http://www.hc-sc.gc.ca [September 02, 2008].

James F. MacLaren Limited. (1970). Report on a Water Use Study for the Lakehead Region Conservation Authority.

Lakehead Region Conservation Authority. (1982). Watershed Inventory – Report Two of the Watershed Plan.

Lakehead Source Protection Area Watershed Characterization Report. (2008). Lakehead Region Conservation Authority.

Ministry of the Environment and Energy (MOEE). (1994). *Provincial Water Quality Objectives*. Ontario: Queen's Printer. [Online]. Available: http://www.ene.gov.on.ca/envision/gp/3303e.htm#AppA

Petrides, G. (1958). A Field Guide to Trees and Shrubs. 2nd Edition. The Peterson Field Guide Series. Houghton Mifflin Company, Boston, USA.

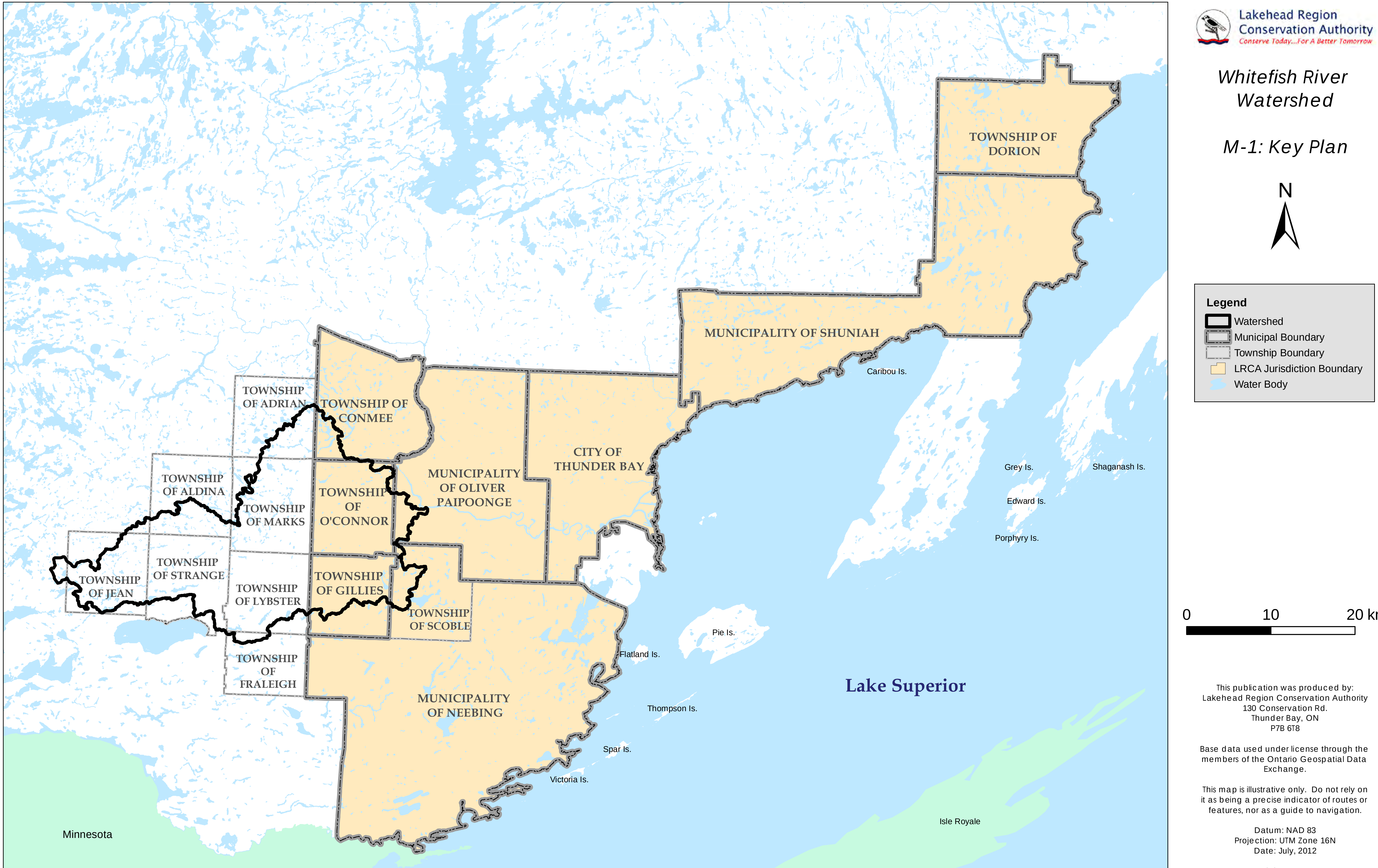
Rosatelli, M. Assessment Report on the 2002 Lithogeochemical Rock Sampling Survey Program Pigeon River Block. 2002. McVicar Minerals LTD., BHP Billiton World Exploration Inc. and Falconbridge Limited.

The Council for the Corporation of the Township of Gillies. (2009). Official Plan for the Township of Gillies. Kakabeka Falls, Ontario.

Water Management Policies Guidelines Provincial Water Quality Objectives. (1994). Ministry of Environment and Energy.

Shankie, S. Factors Controlling Erosion on the Whitefish River, North-western Ontario (2008). Lakehead University.

MAPS



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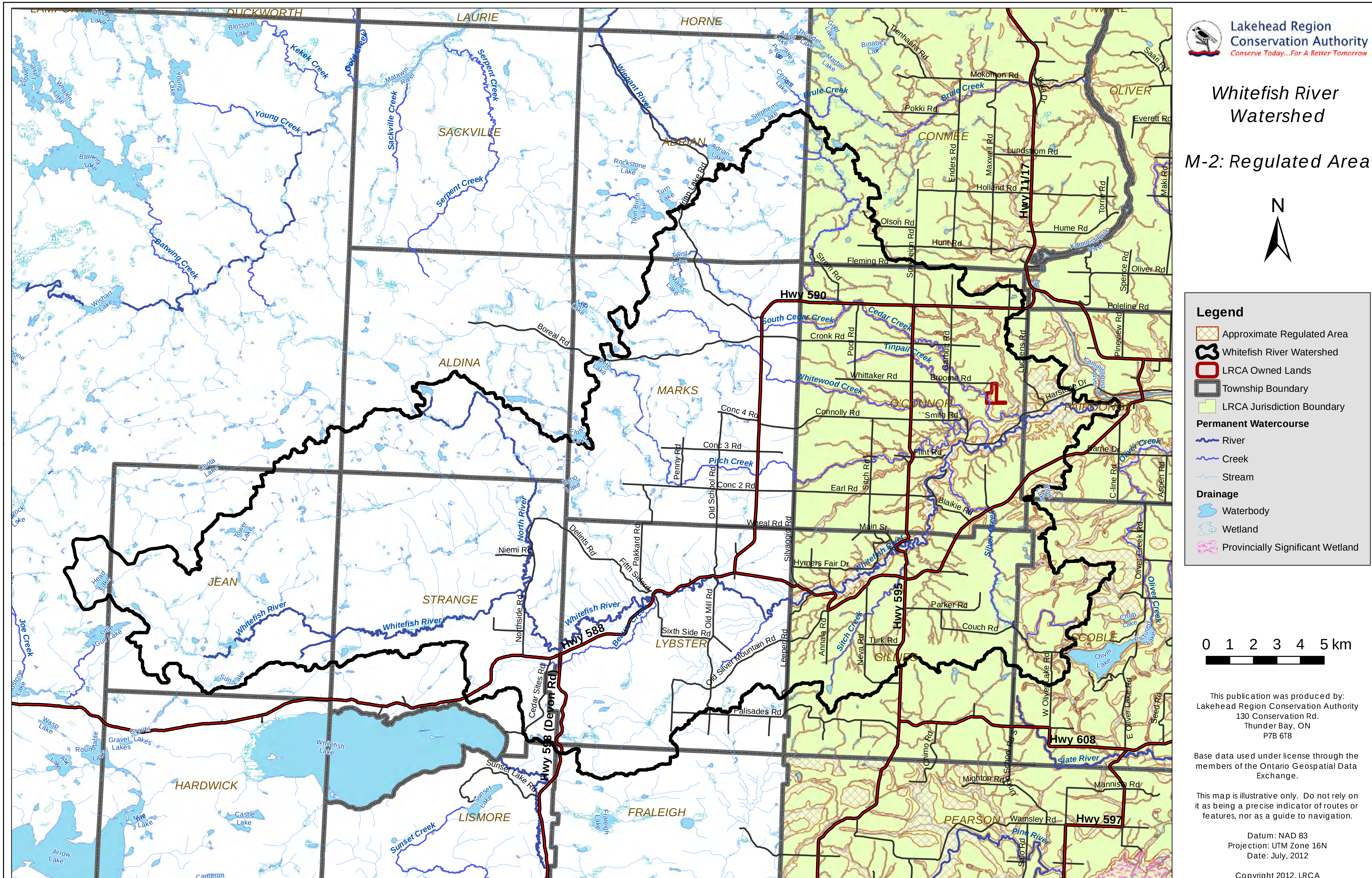
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Conserve Today...For A Better Tomorrow
Whitefish River Watershed
M-2: Regulated Area
N
Legend
Approximate Regulated Area
Whitefish River Watershed
LRCA Owned Lands
Township Boundary
LRCA Jurisdiction Boundary
Permanent Watercourse
River
Creek
Stream
Drainage
Waterbody
Wetland
Provincially Significant Wetland
0 1 2 3 4 5 km
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Date: July, 2012
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DUCKWORTH
LAURIE
HORNE
OLIVER
SACKVILLE
ADRIAN
CONMEE
ALDINA
MARKS
O'CONNOR
PAIPOONGE
JEAN
STRANGE
LYBSTER
GILLIES
SCOBLE
HARDWICK
LISMORE
FRALEIGH
PEARSON
Whitefish River
Hwy 590
Hwy 588
Hwy 595
Hwy 608
Hwy 597
Hwy 11/17
Hwy 588 (Devon Rd)
Whitefish Lake
Kaministiquia River
Slate River
Pine River
South Cedar Creek
Cedar Creek
Whitewood Creek
Tinpail Creek
Pitch Creek
Silver Creek
Sitch Creek
Oliver Creek
Brule Creek
Young Creek
Batwing Creek
Serpent Creek
Sackville Creek
Kekek Creek
Sunset Creek
Joe Creek
Matawin River
North River
Wiegand River

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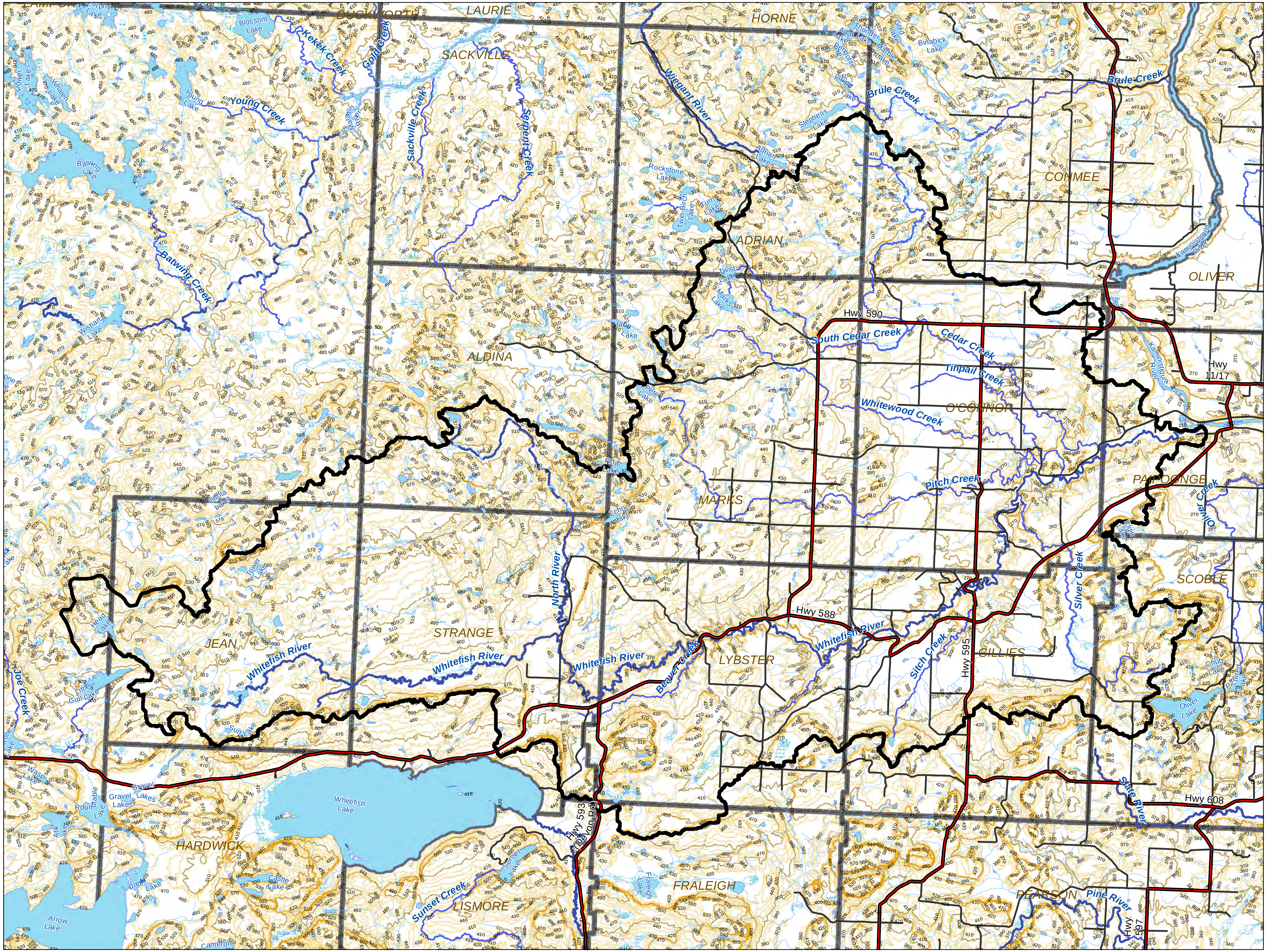
Whitefish River Watershed

M-3: Topography



N

Legend

- Whitefish River Watershed
- Township Boundary

Contour Lines

- 10m Contour Intervals
- 50m Contour Intervals

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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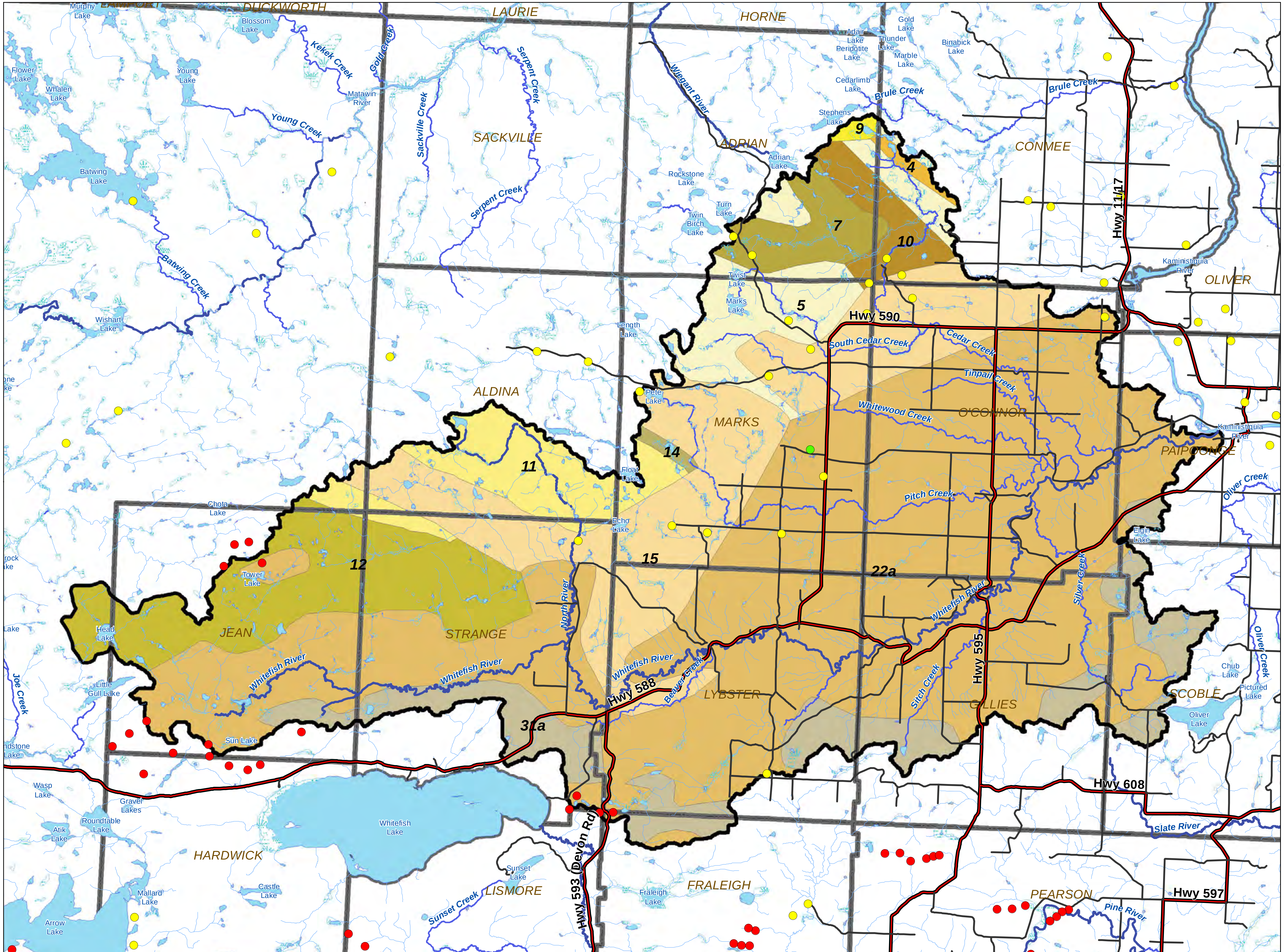
Whitefish River Watershed

M-4: Bedrock Geology



N

Legend

- Whitefish River Watershed
- Township Boundary

Surficial Points Features

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

Bedrock Formation

MESOPROTEROZOIC

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

NEO-ARCHEAN

- 9, Coarse clastic metasedimentary rocks

NEO-TO MESOARCHEAN

- 10, Mafic and ultramafic rocks
- 11, Gneissic tonalite suite
- 12, Foliated tonalite suite
- 14, Diorite - monzonite - granodiorite suite
- 15, Massive granodiorite to granite
- 4, Mafic to ultramafic metavolcanic rocks
- 5, Mafic to intermediate metavolcanic rocks
- 7, Metasedimentary rocks

PALEOPROTEROZOIC

- 22a, Sedimentary rocks

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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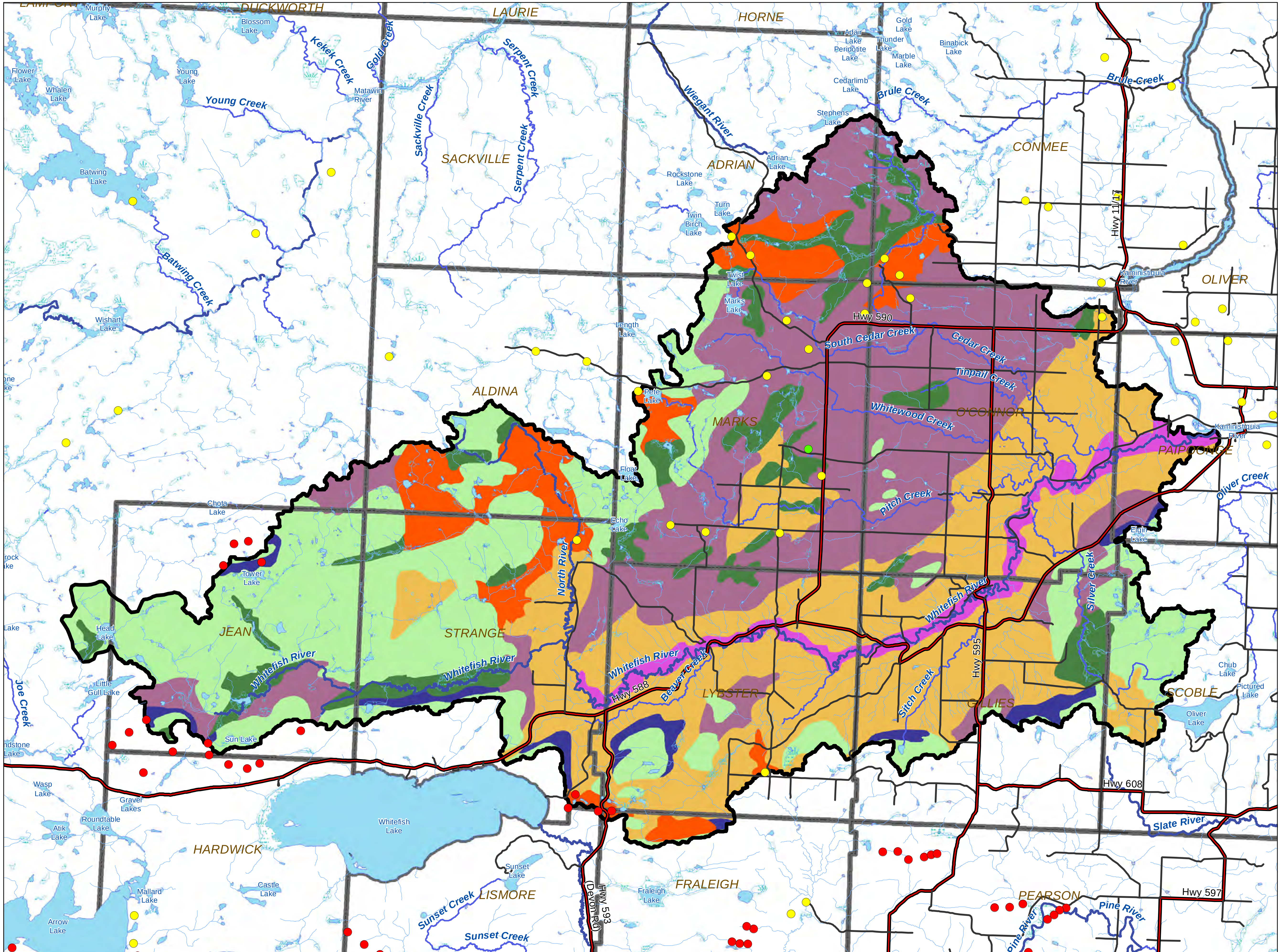

Lakehead Region Conservation Authority

Conserve Today...For A Better Tomorrow

Whitefish River Watershed

M-5: Surficial Geology

N

Legend

Whitefish River Watershed

Township Boundary

Surficial Points Features

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

Surficial Geology

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

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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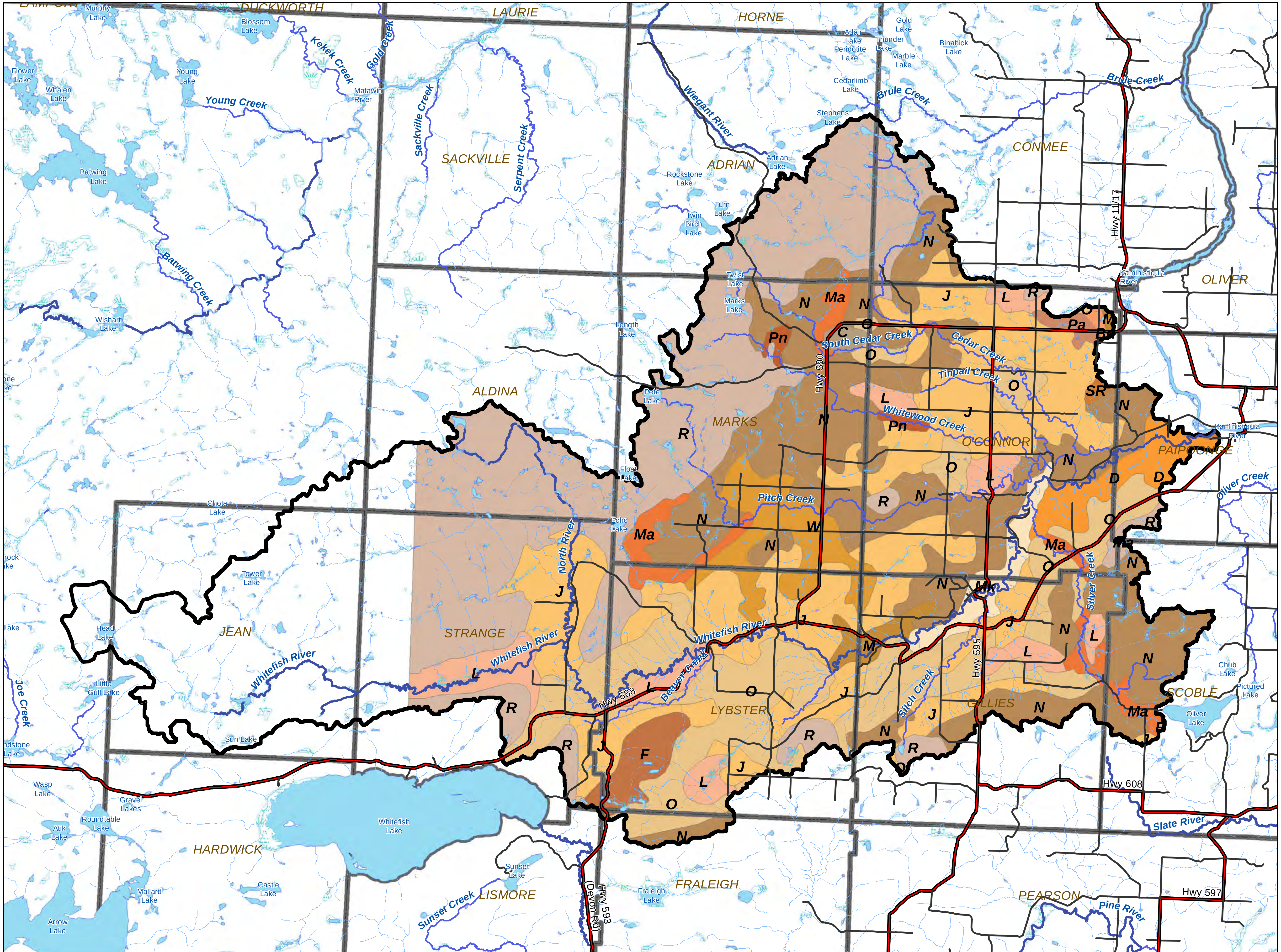

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Whitefish River Watershed

M-6: Soils

N

Legend

- Whitefish River Watershed
- Township Boundary

Thunder Bay Soils

- CURRENT RIVER (C)
- DORION (D)
- FORMAL (F)
- JARVIS RIVER (J)
- LAPPE (L)
- MARSH (Ma)
- MCKELLAR (Mk)
- MUCK (M)
- NOLALU (N)
- ORGANICS - BAIRD (Bd)
- ORGANICS - PENASSEN (Pn)
- OSKONDOGA (O)
- PAIPOONGE (Pa)
- ROCKLAND (R)
- SLATE RIVER (SR)
- WOLFPUP (W)

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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Date: August, 2011

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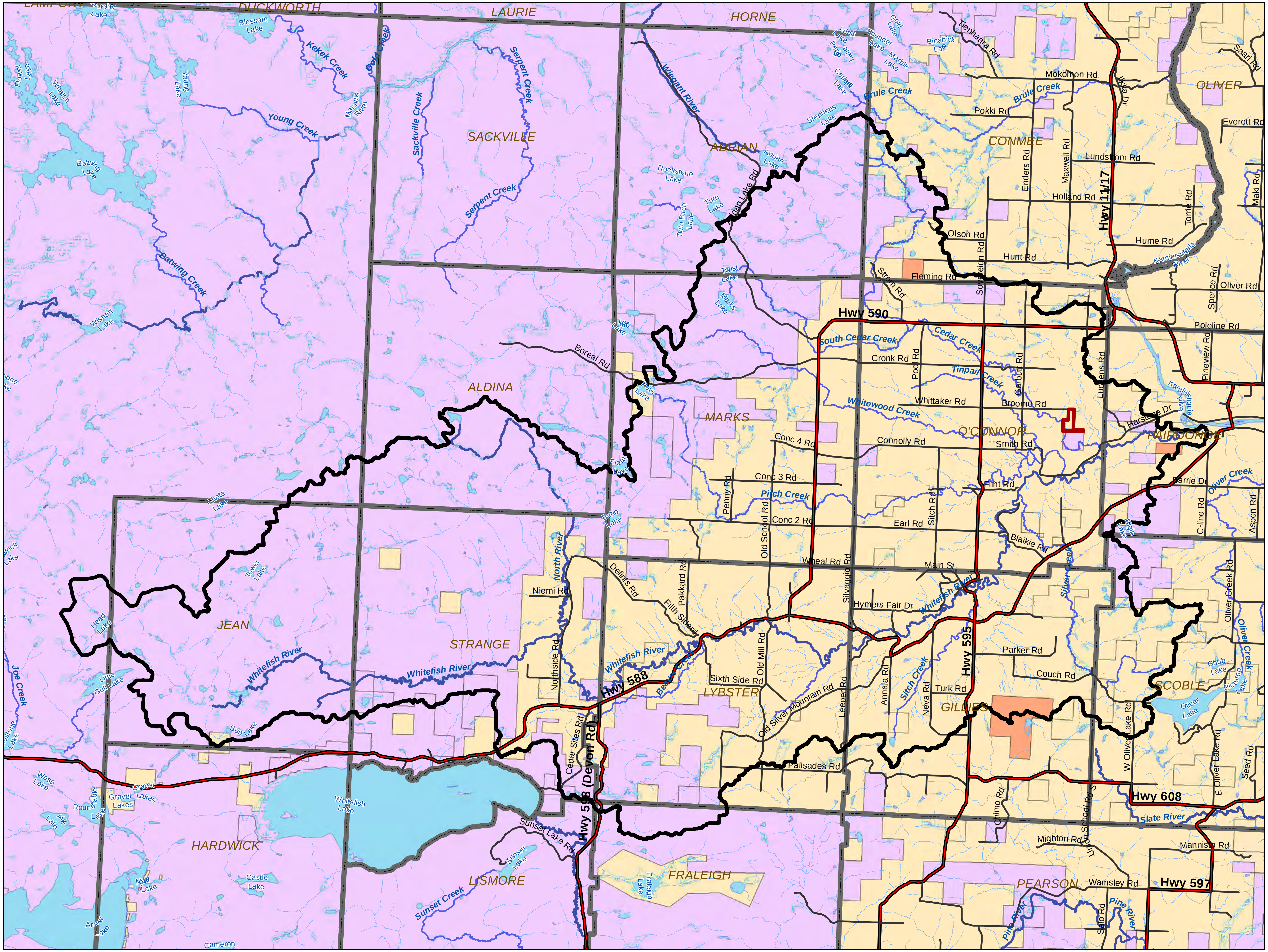
Whitefish River Watershed

M-7: Land Ownership



Legend

- Whitefish River Watershed
- Township Boundary
- LRCA Owned Lands

Land Ownership

- Crown Land
- Federal Land Indian Reserve
- Private Land

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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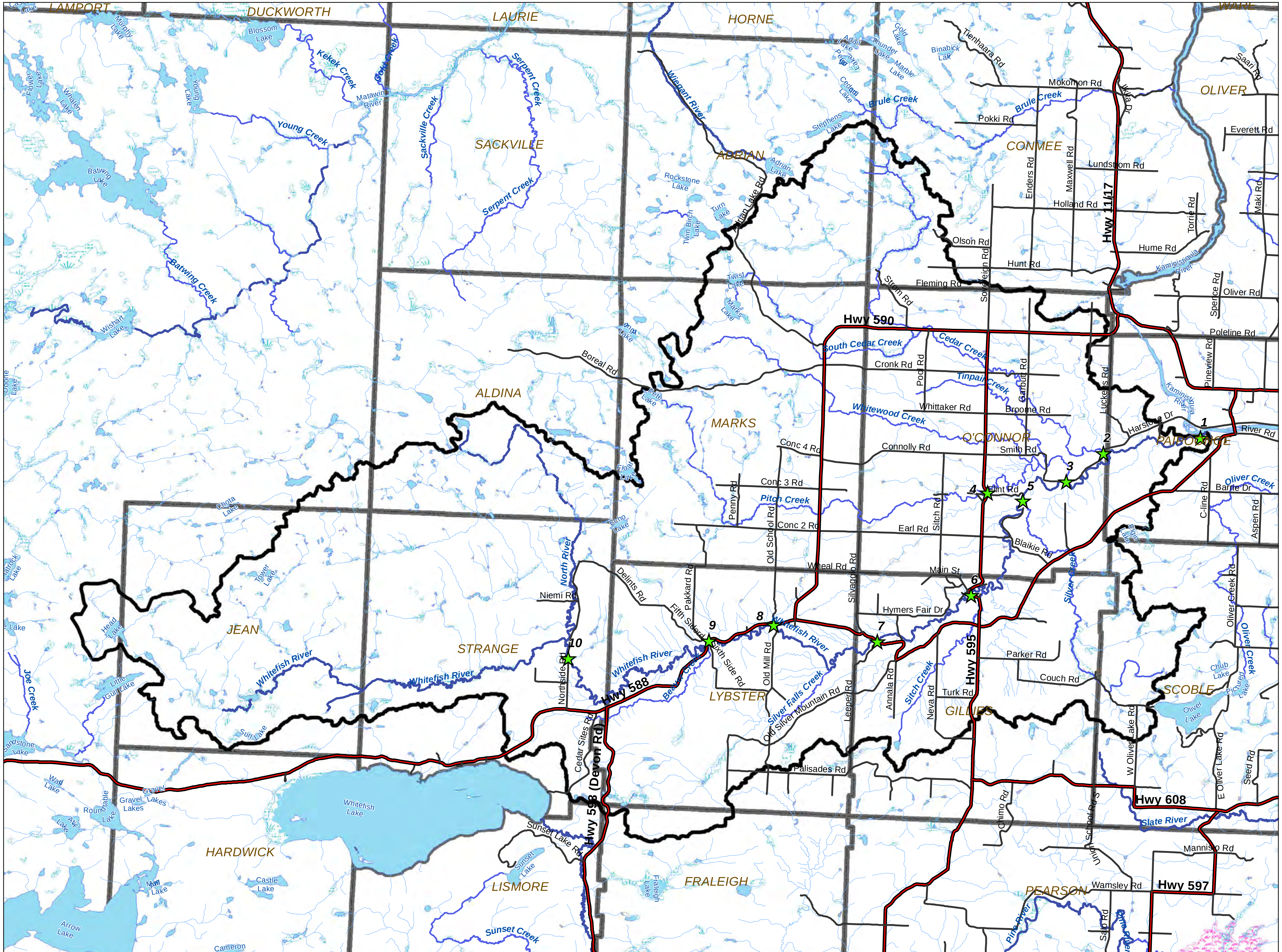

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Whitefish River Watershed

M-8: Site Plan

N

Legend

- Sampling Sites
- Whitefish River Watershed
- Township Boundary

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland
- Provincially Significant Wetland

0 1 2 3 4 5 km

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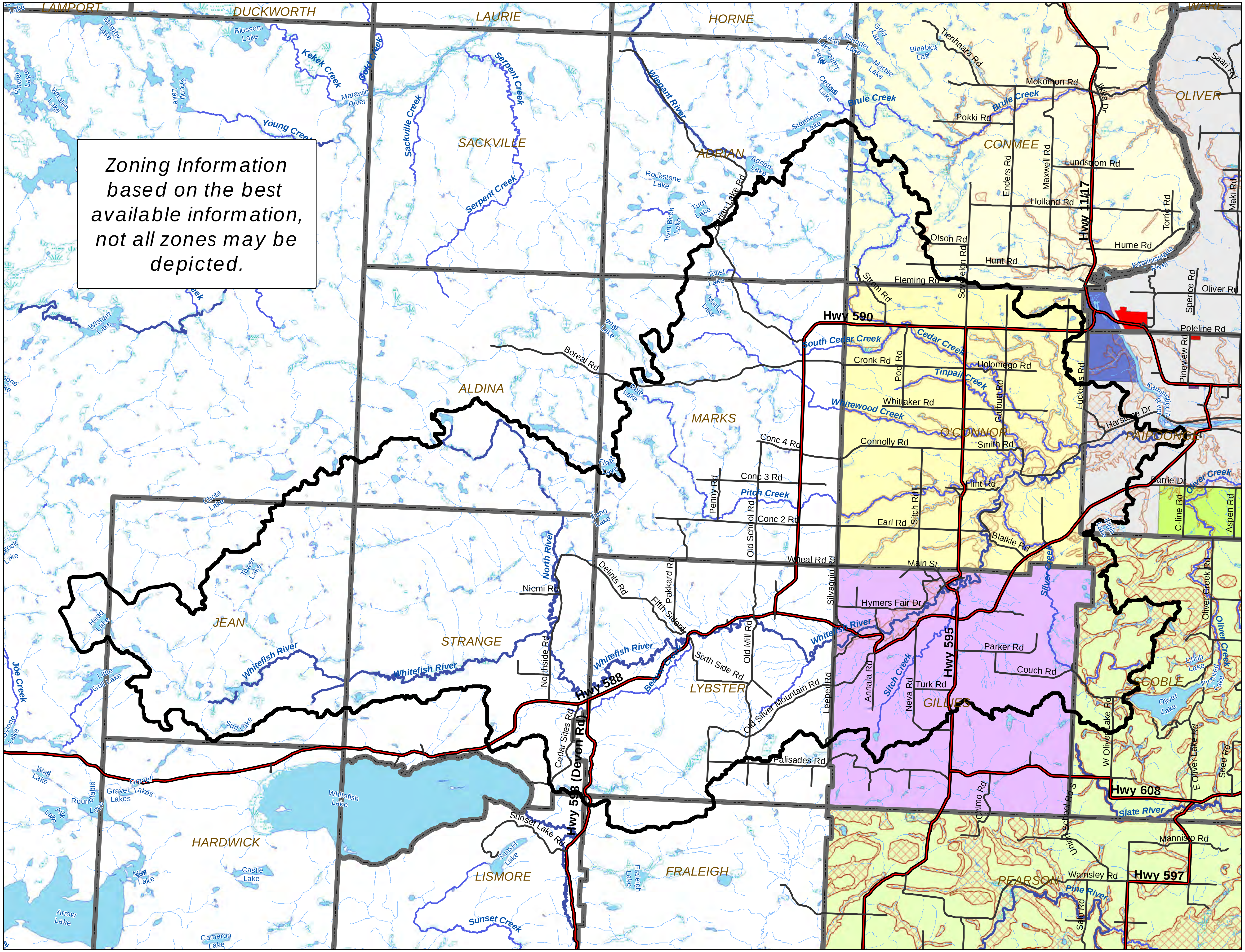

Whitefish River Watershed
M-9: Zoning

N

Legend

- Whitefish River Watershed
- Township Boundary

Municipality of Oliver Paipoonge Zoning

- AG, Agricultural
- CM, Commercial
- ER, Estate Residential
- HAM, Hamlet
- IND, Industrial
- R, Rural
- RC, Recreational
- WR, Watershed Reserve
- UL - Use Limitation Zone

Municipality of Neebing Zoning

- Rural Zone
- UL - Use Limitation Zone

Township of Conmee Zoning

- Rural Zone
- UL - Use Limitation Zone

Township of O'Connor Zoning

- Rural Zone
- UL - Use Limitation Zone

Township of Gillies Zoning

- Rural Zone
- UL - Use Limitation Zone

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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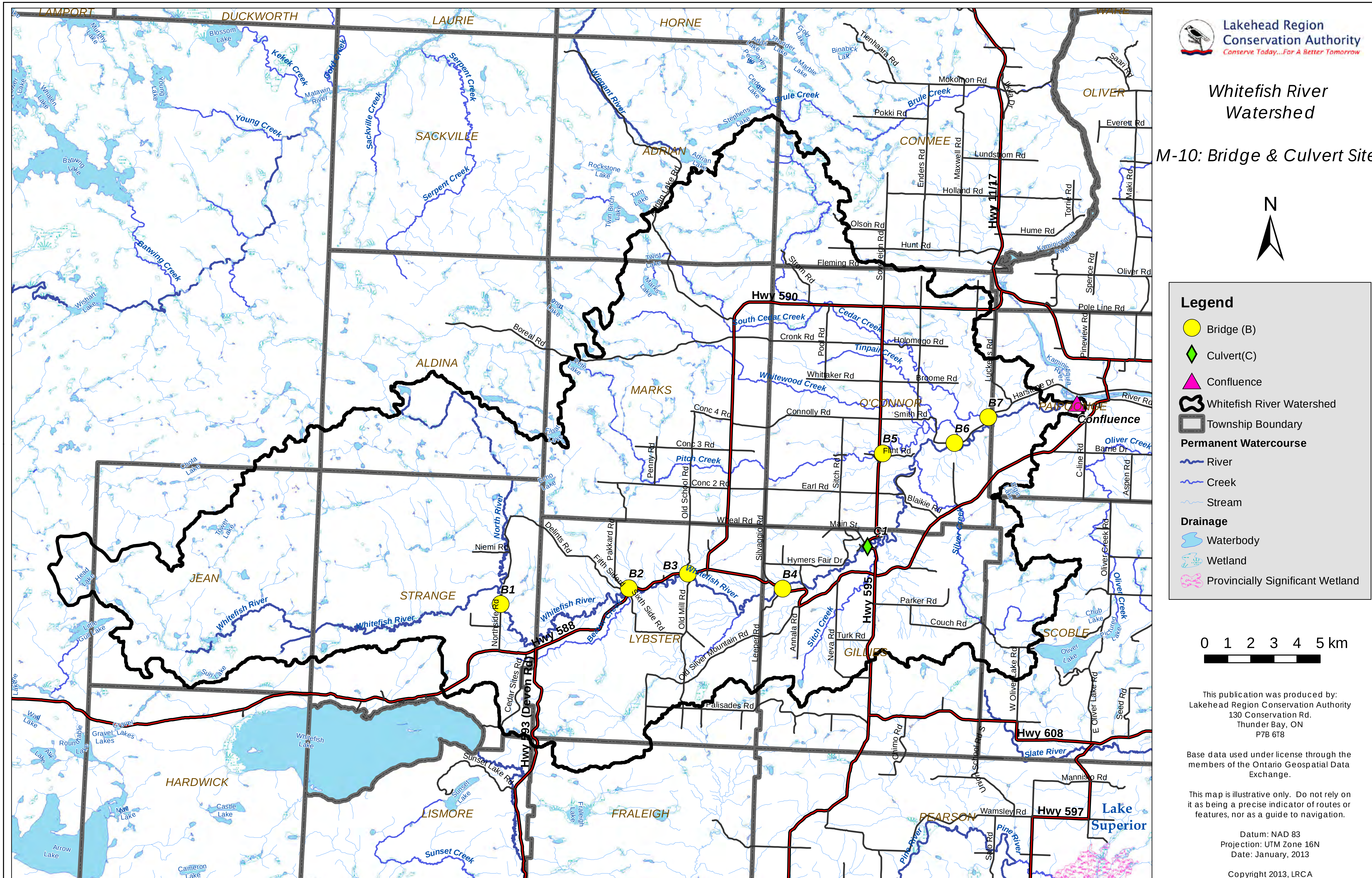
Date: October, 2012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Whitefish River Watershed
M-10: Bridge & Culvert Sites
N
Legend
Bridge (B)
Culvert(C)
Confluence
Whitefish River Watershed
Township Boundary
Permanent Watercourse
River
Creek
Stream
Drainage
Waterbody
Wetland
Provincially Significant Wetland
0 1 2 3 4 5 km
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Projection: UTM Zone 16N
Date: January, 2013
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B1
B2
B3
B4
B5
B6
B7
C1
Confluence
Whitefish River
Whitefish Lake
Lake Superior
Hwy 590
Hwy 588
Hwy 595
Hwy 608
Hwy 597
Hwy 11/17
DUCKWORTH
LAURIE
HORNE
SACKVILLE
ADRIAN
CONMEE
OLIVER
ALDINA
MARKS
O'CONNOR
JEAN
STRANGE
LYBSTER
GILLIES
SCOBLE
HARDWICK
LISMORE
FRALEIGH
PEARSON
PAIPOONGE

FIGURES

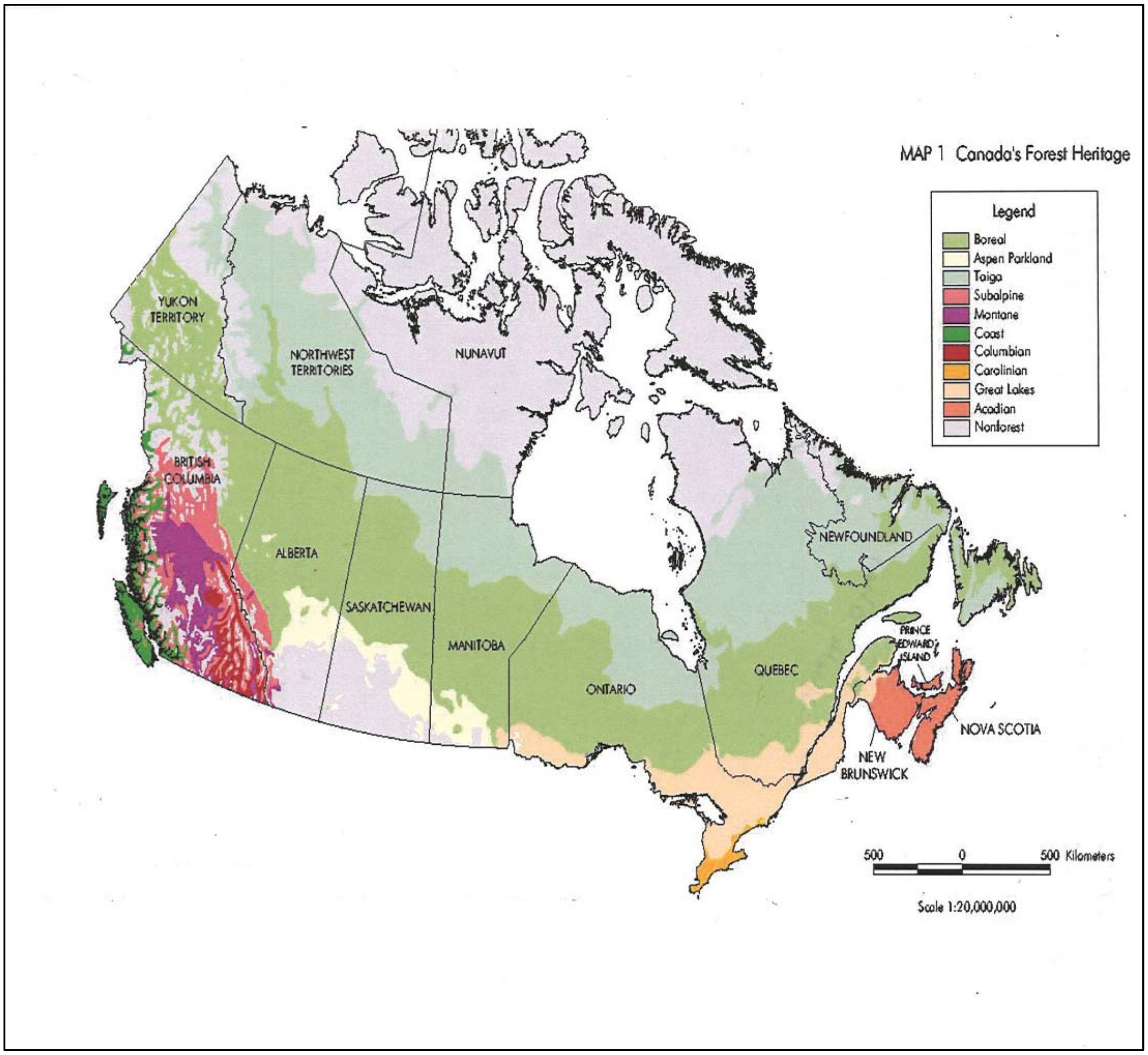


Figure 1: Canada's Forest Heritage (Global Forest Watch, 1977)

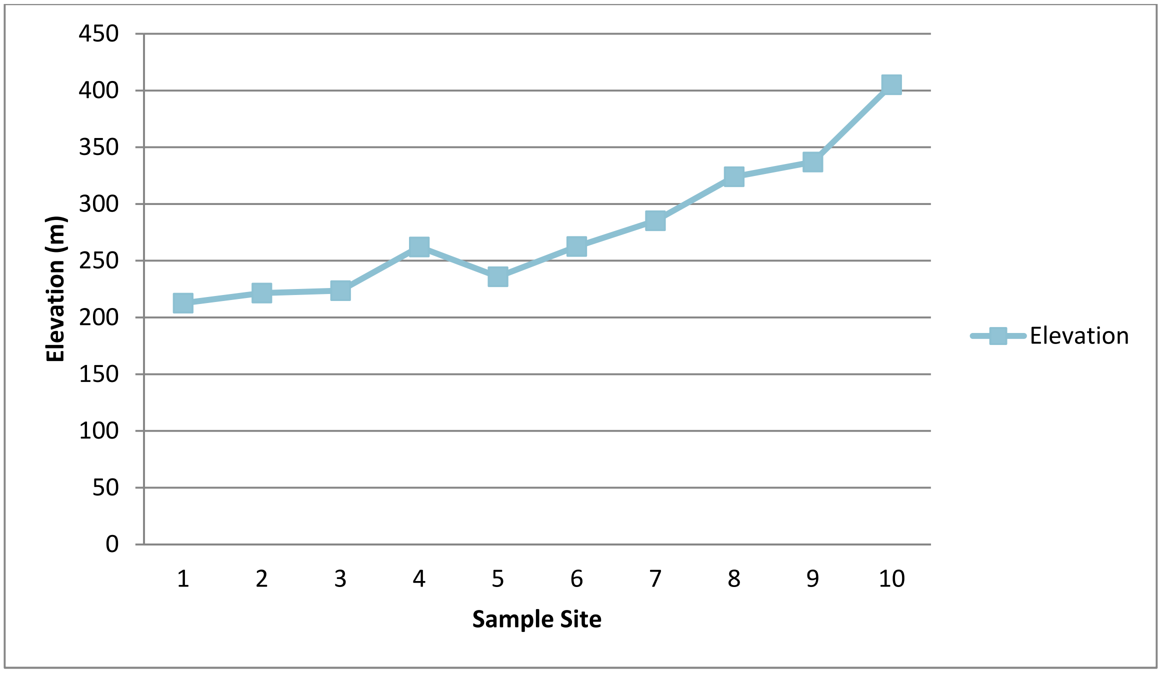


Figure 2: Whitefish River Stream Gradient

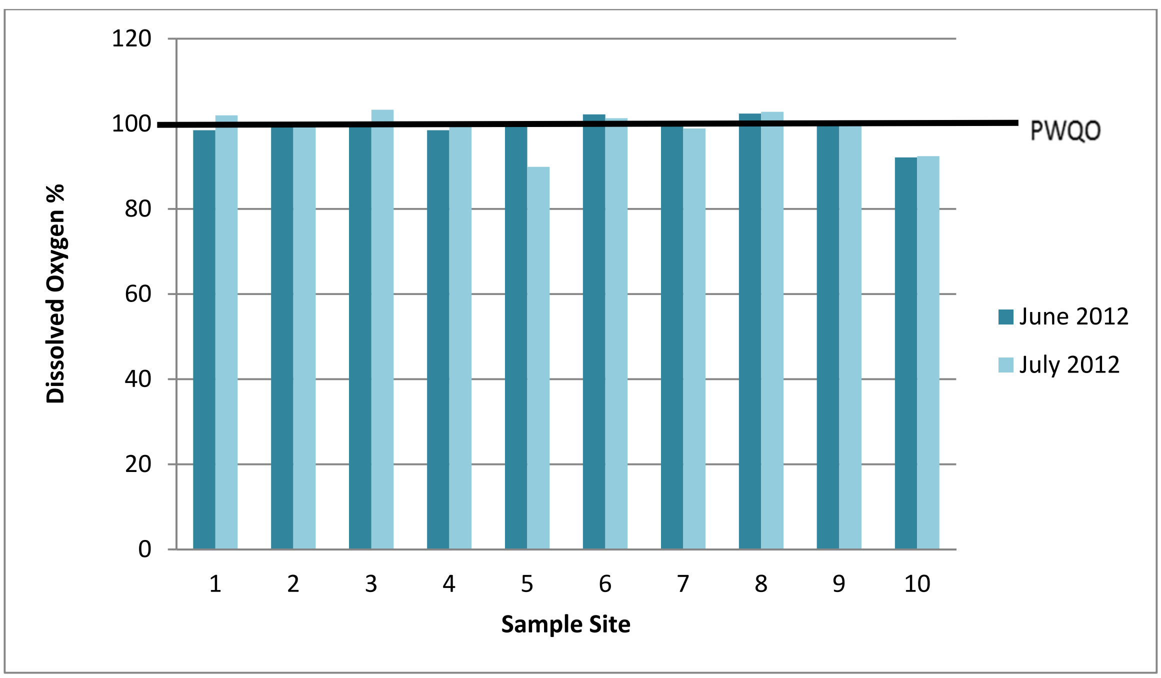


Figure 3: Dissolved Oxygen (%) at Whitefish River Sample Sites

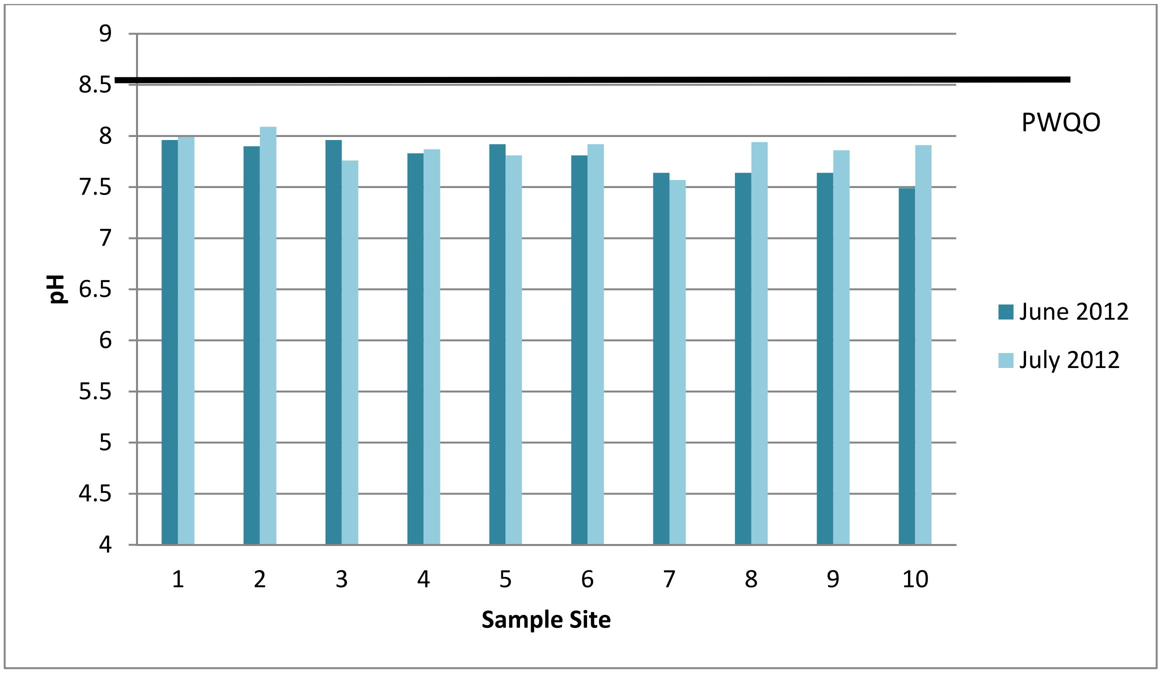


Figure 4: pH Level at Whitefish River Sample Sites

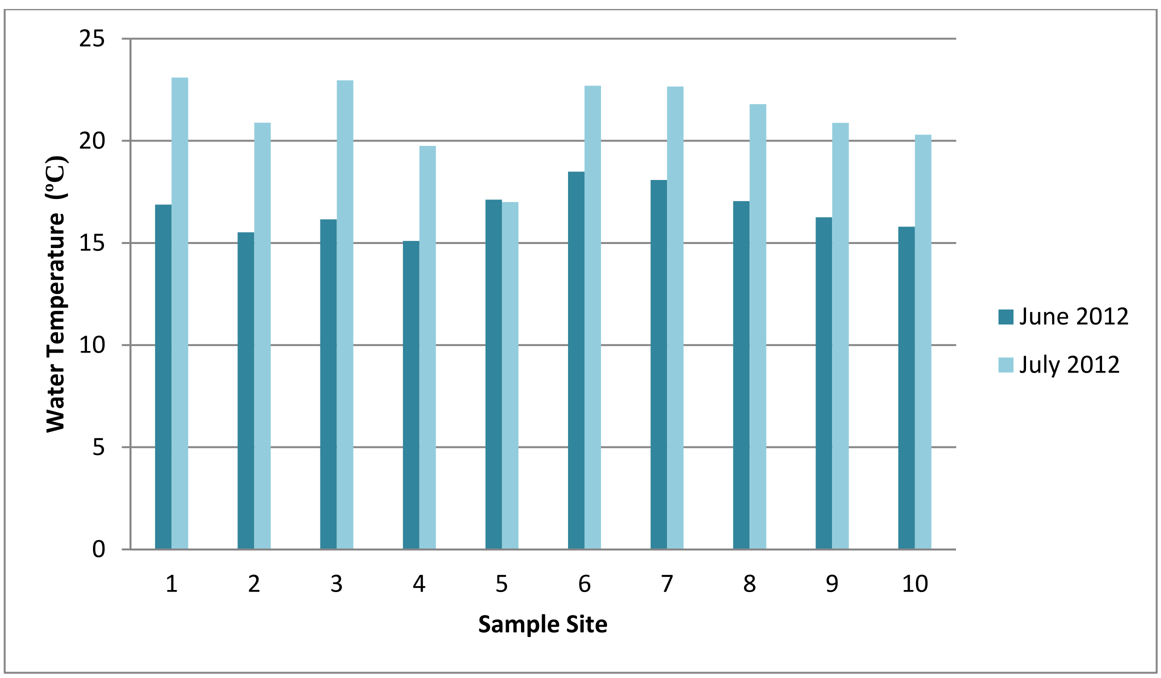


Figure 5: Water Temperature at Whitefish River Sample Sites

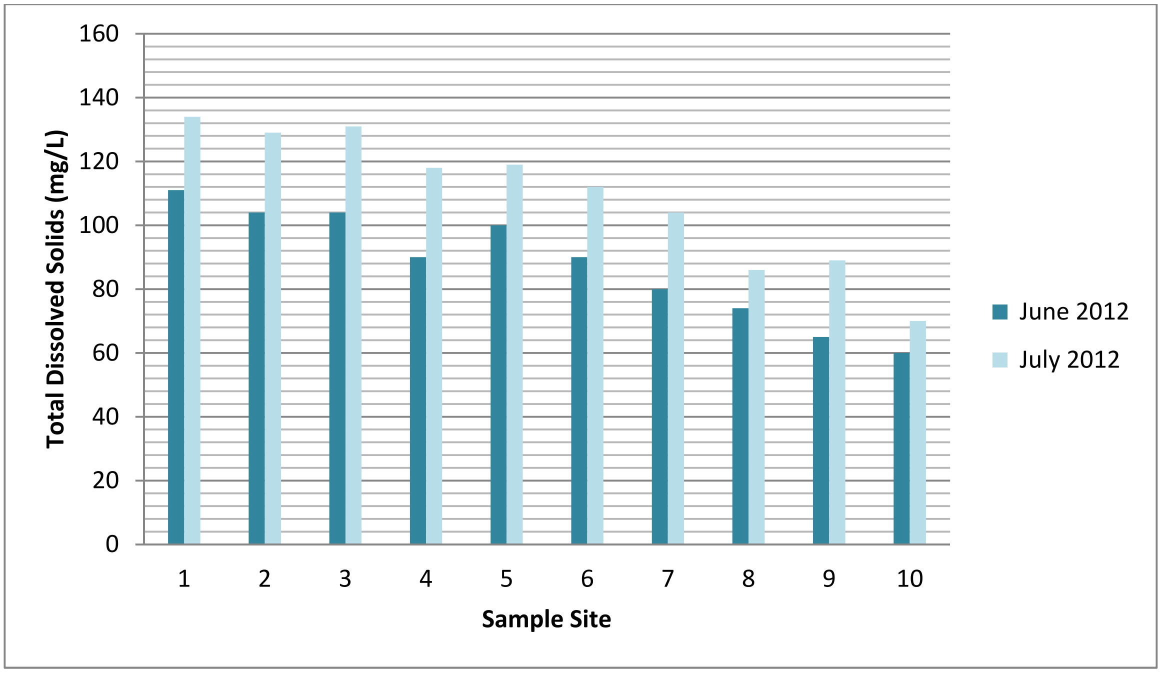


Figure 6: Total Dissolved Solids at Whitefish River Sample Sites

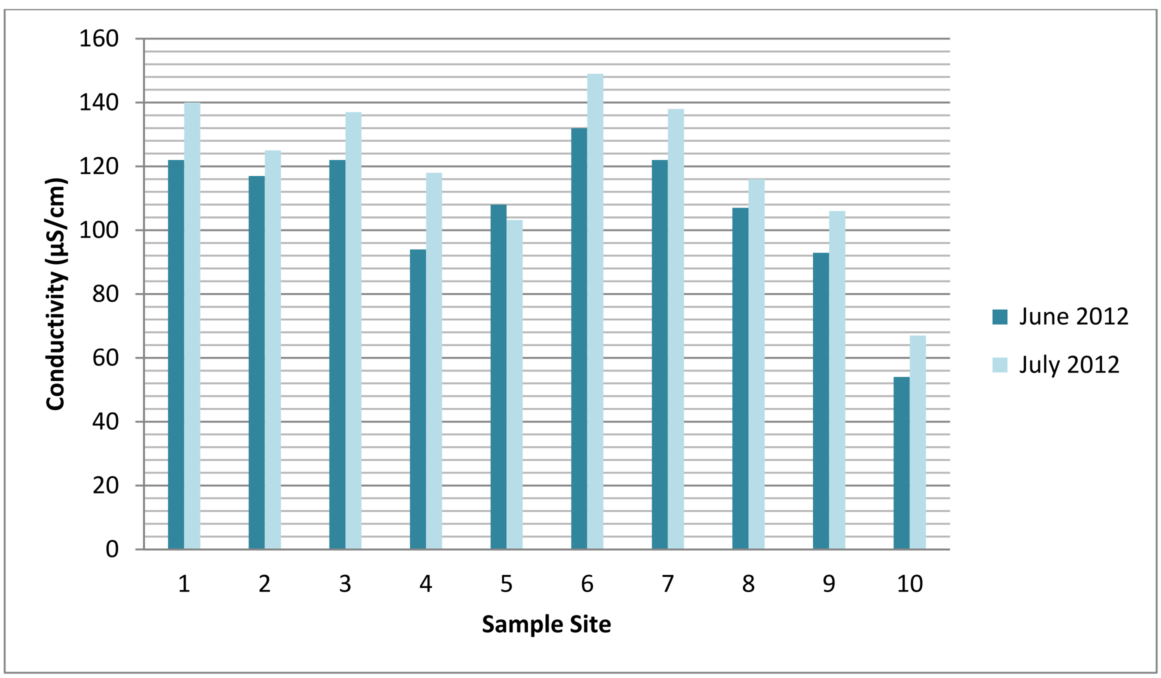


Figure 7: Conductivity at Whitefish River Sample Sites

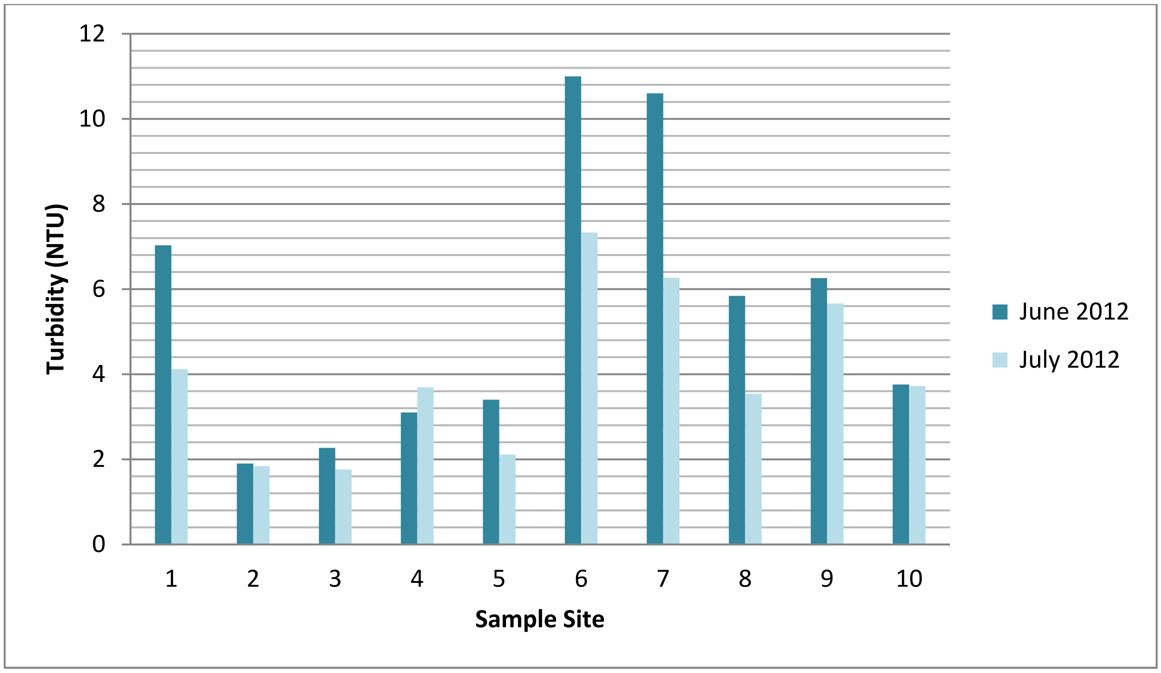


Figure 8: Turbidity at Whitefish River Sample Sites

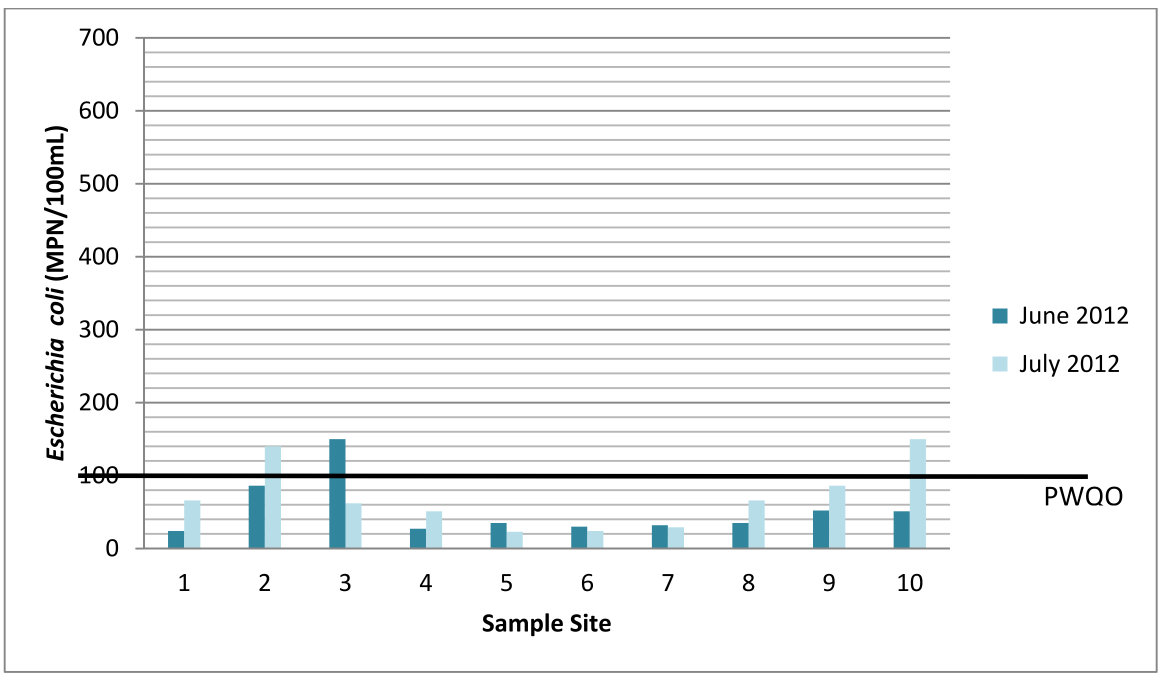


Figure 9: *Escherichia coli* Bacterial Counts at Whitefish River Sample Sites

Figure 10: Bank Erosion Upstream at Site 6

Appendix A:

WATER QUALITY PARAMETRES

Appendix A: Water Quality Parameters

Physical Properties
The abiotic factors of water quality are very influential on aquatic plants and animals and can create varying habitats. Some of these habitats have specialized species which can tolerate extremes in the following parameters.

Temperature
Water temperature is important because it dictates the types 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, then the number of individuals of species will decrease. Temperature also influences water chemistry, which in turn affects biological activity. Chemical reactions generally speed up with warmer temperatures. Temperature is important, as warmer water holds less dissolved oxygen and warmer water will allow bacteria to reproduce and grow more quickly, which increases the biological oxygen demand and further decreases dissolved oxygen. Temperature can vary depending on the source of the water, depth and velocity of the stream, sunlight intensity and the amount of shade provided by the shoreline vegetation.

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 if the water is colder, turbulent (mixing at the air-water interface) and during the day when aquatic plants have had time to produce oxygen during photosynthesis. PWQO's have an acceptable range for dissolved oxygen in water, dependent upon temperature. At 20 degrees Celsius, the minimum amount of dissolved oxygen is 5 milligrams per liter.

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 chemical constituents such as nutrients (e.g. nitrogen, phosphorus) and heavy metals (e.g. lead, copper). Geology of the watershed can give the river some buffering capacity to resist changes in pH, if carbonates are present, but overall the range has to stay between 6.5 and 8.5 to protect aquatic life.

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 road salts, runoff from agricultural areas and erosion from exposed soil/no stream bank vegetation. There is currently no PWQO for TDS.

Conductivity
Conductivity is the measure of the ability of water to carry an electrical current expressed in micro Siemens per centimeter. The reading is related to the total dissolved solids (TDS) in the water sample. There is currently no PWQO for conductivity.

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 scatter the sunlight. The diversity of species will be affected by how far the sunlight can penetrate the water column. Fish gills will become clogged with a lot of suspended material, as well the material can settle on top of fish spawning grounds (and their eggs), causing lower reproductive success. Highly turbid water will appear murky or dirty. Turbidity will be higher after heavy rainfall, but high levels may also indicate soil erosion.

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

Phosphorus
Total phosphorus gives a measurement of all forms of phosphorus in the water, but the most important form within this measurement is soluble inorganic phosphate (PO_4) or orthophosphate ion (PO_4^{-3}) because it is the fraction utilized by aquatic plants.

While phosphorus is essential to life, too much of it will increase algae growth. Excessive growths of attached algae can use up 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 the most ecologically sensitive species. Natural decomposition of organic matter such as leaves, twigs, 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 from developed watersheds. Milk house waste from dairy farms is also a large source of phosphorus and has become one of the main environmental issues surrounding dairy farming.

Nitrogen
Nitrogen (N) is one of the most common gases in our atmosphere. It makes up approximately 78% of the earth's atmosphere. Like phosphorus, these nutrients are often applied to agricultural crops as fertilizers and having too much in the river can increase plant growth and productivity to unhealthy levels. Nitrogen is constantly being cycled through the natural environment via the nitrogen cycle including processes such as decomposition. The most important forms that plants can readily use are ammonia, nitrate (NO_3) and nitrite (NO_2). There are many different ways to report nitrogen so it is necessary to note that the 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).

Bacteria
Escherichia coli (E. coli) are 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 water combined with its short survival time in water environments 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. beavers and Canadian Geese). These bacteria can cause irritation of the skin and eyes when contact is made and can cause gastro-intestinal disorders when ingested.

Metals
The following is a complete list of the metals analysis performed on the water samples:

Aluminum (Al)
Antimony (Sb)
Arsenic (As)
Barium (Ba)
Beryllium (Be)
Bismuth (Bi)
Boron (B)
Cadmium (Cd)
Chromium (Cr)
Cobalt (Co)
Copper (Cu)
Iron (Fe)
Lead (Pb)
Manganese (Mn)
Molybdenum (Mo)
Nickel (Ni)
Selenium (Se)
Silicon (Si)
Silver (Ag)
Strontium (Sr)
Thallium (TI)
Tin (Sn)
Titanium (Ti)
Tungsten (W)
Uranium (U)
Vanadium (V)
Zinc (Zn)
Zirconium (Zr)

Most of these metals are found naturally within the earth's crust and weathering of rock can transport them into surface water.

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 and exposure is inevitable. 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, in 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, its role in Alzheimer's disease, Parkinson's disease and Lou Gehrig's disease. The intake of large amounts of aluminum can also cause anemia, osteomalacia (brittle or soft bones), glucose intolerance, and cardiac arrest in humans. The PWQO guideline for aluminum varies with pH, the maximum concentration being 75μg/L.

Antimony

Antimony is a metallic element that is a blue-white colour in its stable form. 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. The maximum concentration of antimony under PWQO guidelines is 20μg/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. 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 PWQO guidelines 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 plastics, rubber, electronics and textiles industries. At high concentrations, barium causes strong vasoconstriction by its direct stimulation of arterial muscle, peristalsis 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 CaCO3 is >75 mg/L the maximum concentration of beryllium is 1100 μg/L and if the CaCO3 is <75 mg/L the maximum concentration of Beryllium is 11 μg/L.

Bismuth

Bismuth is a brittle metal with a pinkish color, 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, 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 a number of compounds. 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 and brain, and may eventually lead to death. The maximum level of boron under PWQO guidelines is 200 μg/L.

Cadmium
Cadmium is an extremely toxic metal even in low concentrations. It is used commercially as a stabilizer in plastic, fungicides for golf courses, television picture tube phosphors, nickel–cadmium batteries, motor oils, and curing agents for rubber. Cadmium poisoning can lead to itai-itai disease, which initiates bone softening, joint pain and kidney failure. The maximum concentration of cadmium under PWQO guidelines is 0.2 μg/L. The interim PWQO guideline states if hardness as $CaCO_3$ is 0-100 the maximum cadmium concentration is 0.1 μg/L and if hardness is >100, the maximum cadmium concentration is 0.5μg/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, hard metal. Chromium (III) is an essential nutrient, but higher intake may cause skin rashes. Chromium (VI) is known to cause various health effects such as skin rashes, upset stomachs and ulcers, 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. 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 in minerals. Copper is an essential element to human metabolism, although intake at higher doses can cause adverse health effects. Acute copper poisoning health effects include vomiting, diarrhea, jaundice, hemolysis, haemoglobinuria, hematuria, and oliguria. In severe cases, the stool and saliva may

appear green or blue. In the terminal phases, anuria, hypotension, and coma precede death. The maximum concentration of copper under PWQO guidelines is 5 μg/L.

Iron

Iron is also an abundant metal found in rock. The precipitation of excessive iron creates an objectionable reddish-brown color to water. Iron may also stain laundry and plumbing fixtures, produce undesirable tastes in beverages, and promote the growth of certain iron-bacteria, leading 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, causing neurological damage and even death. Although natural occurrences can occur 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 25 μg/L.

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 a by-product of copper and tungsten mining. It is used as an alloy for various metals and occurs naturally in soil and rock. Potential health impacts associated with molybdenum include neurotoxicity and reproductive toxicity. The maximum concentration of molybdenum under PWQO guidelines is 40μg/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 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 surface of the earth. It occurs naturally in the environment and is also released by human activities. The health effects of various forms of selenium can vary from brittle hair and deformed nails, to rashes, heat, swelling of the skin and severe pains. Selenium poisoning may become so severe in some cases that it can even cause death. The maximum concentration of selenium under PWQO guidelines is 100 μg/L.

Silicon
Silicon is the most abundant element on earth after oxygen. In drinking water only silicic acid is present, which is relatively safe. However, there are a number of silicon compounds that are carcinogenic. There are currently no PWQO guidelines for silicon.

Silver
Silver does not react with pure water. It is stable in both water and air. Moreover, it is acid and base resistant, but it corrodes when it comes in contact with sulphur compounds. Silver oxide is harmful upon swallowing, because it irritates the eyes, 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.

Strontium
Strontium is a bright silvery metal that is softer than calcium and even more reactive in water. 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.

Thallium
Thallium is a silvery-grey metal that is very toxic by inhalation, ingestion and skin absorption. 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 color 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. Overdoses do not occur very often. Symptoms include nausea, vomiting, dizziness, fevers and diarrhea. The maximum concentration of zinc under PWQO guidelines is 20µg/L.

Zirconium
Zirconium is a very strong, malleable, ductile, 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 B:

WATER QUALITY GUIDELINES

Appendix B: Water Quality Guidelines

The following are taken from the Ministry of the Environment water quality guidelines, Provincial Water Quality Objectives (PWQO), July 1994.

<u>Physical</u>

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 hypo limnetic 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 maintained 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 MOEE 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).*

Turbidity:
Suspended matter should not be added to surface water in concentrations that will change the natural Secchi disc reading by more than 10 percent.

<u>Nutrients</u>

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

The percentages of un-ionized ammonia (NH_3) in aqueous ammonia solution for different temperature and pH conditions are listed in the table below. For example, at 20°C 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 and percentages have been rounded to two significant figures. The equations may be used to interpolate values between those given in the table:

$f = 1/(10^{pKa-pH} + 1)$, where f is the fraction of NH_3

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.
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.

Temp.	**pH**								
°C	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
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 $CaCO_3$ (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 0.2 µg/L.

Hardness as $CaCO_3$ (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 5 µg/L.

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

***Iron**:*
The amount of Iron should not exceed 300µg/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.

Anions and Nutrients

The following are taken from the Canadian Council of Resource and Environment Ministers (CCREM) Canadian water quality guidelines for the protection of aquatic life: Summary table, September 2007.

The information in these guidelines and supporting text is used to complement the Provincial Water Quality Objectives and Interim Objectives.

Nitrate:
The amount of nitrate in freshwater should not exceed 2900 μg NO_3-N/ L.
For protection from direct toxic effects: the guidelines do not consider indirect effects due to eutrophication.

Nitrite:
The amount of nitrite in freshwater should not exceed 60 μg NO_2-N/L.
For protection from direct toxic effects: the guidelines do not consider indirect effects due to eutrophication.

Appendix C:
TECHNIQUES FOR DATA COLLECTION

Appendix C: Techniques for Data Collection

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.

Latitude, Longitude, and Elevation
The Universal Transverse Mercator (UTM) coordinates for each site were measured with a Trimble Geo XH 2005 hand held GPS unit.

Photographs
Photographs were taken at each site using both the Stylus 1030SW shock and water proof camera and the Capilo 500SE GPS Camera. Upstream and downstream photographs as well as culvert, bridge, and outstanding litter or erosion photographs were all taken at each site. Substrate photographs were attempted at each site with the waterproof camera.

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.

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.

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

Water Temperature
Water temperature was measured with the YSI 600 QS. The readings were taken after the probe was submerged and all variables on the meter were stabilized.

Conductivity
Conductivity was measured with the YSI 600 QS. 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.

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

Dissolved Oxygen
The YSI 600 QS measured dissolved oxygen for the samples. The readings were recorded once the probe was submerged in the water and all variables were stabilized.

Tree, Shrub & Herb Species
Identification was made in the vicinity of the sample sites, no transects were made. Observations were made approximately 50 metres from either stream edge.

Aquatic Plants
Aquatic plants were determined through careful observation and identification via a field guide.

OBBN In-Stream Materials Key

Stream Bed Description
The bed description was given a set of 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
Muck	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 five 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

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 Northwestern Ontario.

Appendix D:

PLANT SPECIES COMMON AND LATIN NAMES

Appendix D: Plant Species Common and Latin Names

Trees	
Common Names	Latin Names
Balsam fir	*Abies balsamea*
Balsam poplar	*Populus balsamifera*
Black ash	*Fraxinus nigra*
Black spruce	*Picea mariana*
Eastern white cedar	*Thuja occidentalis*
Jack pine	*Pinus banksiana*
Manitoba maple	*Acer negundo*
Mountain ash	*Sorbus americana*
Mountain maple	*Acer spicatum*
Red ash	*Fraxinus pennsylvanica*
Red pine	*Pinus resinosa*
Speckled alder	*Alnus rugosa*
Tamarack/Eastern larch	*Larix laricina*
Trembling aspen	*Populus tremuloides*
White birch	*Betula papyrifera*
White pine	*Pinus strobus*
White spruce	*Picea glauca*

Shrubs	
Common Names	Latin Names
Balsam poplar	*Populus balsamifera*
Beaked hazel	*Corylus cornuta*
Bear berry	*Arctostaphylos uva-ursi*
Velvetleaf blueberry	*Vaccinium myrtilloides*
Buffalo berry	*Shepherdia canadensis*
Bush honeysuckle	*Diervilla lonicera*
Canada elderberry	*Sambucus canadensis*
Chokecherry	*Prunus virginiana*
Currant spp.	*Ribes spp.*
Gooseberry	*Ribes spp.*
Hairy honeysuckle	*Lonicera hispidula*
High-bush cranberry	*Viburnum trilobum*
Honeysuckle spp.	*Lonicera spp.*
Ninebark	*Physocarpus Spp.*

Pincherry	*Prunus pensylvanica*
Prickly wild rose	*Rosa acicularis*
Pussy willow	*Salix discolor*
Red berried elder	*Sambucus racemosa*
Red-osier dogwood	*Cornus stolonifera*
Saskatoon (serviceberry)	*Amelanchier alnifolia*
Slender willow	*Salix petiolaris*
Swamp red currant	*Ribes triste*
Sweet gale	*Myrica gale*
Wild red raspberry	*Rubus idaeus var. strigosus*
Willow	*Salix spp.*
Leatherleaf	*Chamaedaphne calyculata*

Herbs	
Common Names	Latin Names
Aster	*Symphyotrichum spp.*
Birdsfoot trefoil	*Lotus corniculatus*
Meadowsweet	*Spirea alba var. latifolia*
Bunch berry	*Cornus canadensis*
Buttercup	*Ranunculus repens*
Canada anemone	*Anemone canadensis*
Canada goldenrod	*Solidago canadensis*
Canada mayflower	*Maianthemum canadense*
Canada thistle	*Cirsium arvense*
Common evening primose	*Oenothera biennis*
Common plantain	*Plantago major*
Common strawberry	*Fragaria virginiana*
Common yarrow	*Achillea millefolium*
Corn sow thistle	*Sonchus arvensis*
Cow parsnip	*Heracleum maximum*
Cow vetch	*Vicia cracca*
Cream colored vetchling	*Lathyrus ochroleucus*
Creeping bellflower	*Campanula rapunculoides*
Crown vetch	*Coronilla varia*
Dandelion	*Taraxacum officinale*
Dwarf raspberry	*Rubus pubescens*
Early meadow-rue	*Thalictrum dioicum*
Heal-all	*Prunella vulgaris*

Hop clover	*Trifolium aureum*
Kidney-leaved violet	*Viola renifolia*
Jewelweed	*Impatiens capensis*
Large leaf aster	*Aster macrophyllus*
Fragrant bedstraw	*Galium triflorum*
Goldenrod	*Solidago spp.*
Grasses	*Poaceae spp.*
Lily	*Liliaceace spp.*
Lupine	*Lupinus polyphyllus*
Meadow-rue	*Thalictrum spp.*
Mountain blueeyed Grass	*Sisyrinchium montanum*
Naked mitrewort	*Mitella nuda*
Narrowleaf spirea	*Spiraea alba*
Northern bluebell	*Mertensia paniculata*
Northern blueflag	*Iris versicolor*
Northern blue Violet	*Viola septentrionalis*
Northern marsh Violet	*Viola epipsila*
Northern sweet coltsfoot	*Petasites frigidus*
Nodding trillum	*Trillium cernuum*
Orange hawkweed	*Hieracium aurantiacum*
Ox-eye daisy	*Leucanthemum vulgare*
Pearly everlasting	*Anaphalis margaritacea*
Pineapple weed	*Matricaria discoidea*
Pink pyrola	*Pyrola asarifolia*
Red clover	*Trifolium pratense*
Rose-twisted stalk	*Streptopus amplexifolius*
Wild sasparilla	*Aralia nudicaulis*
Sedges	*Cyperaceae spp.*
Silverwort	*Hepatica triloba*
Stone crop	*Sedum spp.*
Sweet coltsfoot	*Petasites frigidus*
Tall white bog orchid	*Platanthera dilatata*
Twinflower	*Linnaea borealis*
Thyme leaved sandwort	*Arenaria serpyllifolia*
Violet	*Viola spp.*
Wild columbine	*Aquilegia canadensis*
Wild lily-of-the-valley	*Maianthemum canadense*
Wood lily	*Lilium philadelphicum*

White baneberry	*Actaea pachypoda*
White pea	*Lathyrus sativus*
White sweet-clover	*Melilotus albus*
Wild chamomile	*Matricaria chamomilla*
Wild chives	*Allium schoenoprasum*
Wood anemone	*Anemone quinquefolia*
Woodland strawberry	*Fragaria Vesca*

Ferns/Mosses	
Common Names	Latin Names
Spike moss	*Selaginella spp.*
Central peat moss	*Sphagnum centrale*
Cinnamon fern	*Osmunda cinnamomea*
Common fern moss	*Thuidium delicatulum*
Wood horsetail	*Equisetum sylvaticum*
Lady fern	*Athyrium filix-femina*
Meadow horsetail	*Equisetum pratense*
Plume moss	*Ptilium crista-castrensis*
Sensitive fern	*Onoclea sensibilis*
Stair step moss	*Hylocomium splendens*
Wavy moss	*Dicranum polysetum*
Field horsetail	*Equisetum arvense*
Water horsetail	*Equisetum fluviatile*

Aquatic Plants	
Common Names	Latin Names
Broad-leaved arrowhead	*Sagittaria latifolia*
Common cattail	*Typha latifolia*
Green algae	*Chlorophyta spp.*
Pondweed	*Potamogeton spp.*
Water smartweed	*Polygonum amphibium*
Yellow pond lily	*Nuphar lutea*
Common bladderwort	*Utricularia vulgaris*
Water plantain	*Alisma plantago-aquatica*
Floating arrowhead	*Sagittaria cuneata*
Broad leaved arrowhead	*Sagittaria latifolia*
Water arum/ Wild calla	*Calla palustris*
Pickerelweed	*Pontederia cordata*

Floating leaved burreed	*Sparganium fluctuans*
Duckweed	*Lemna spp*
Large leaved pondweed	*Potamogeton amplifolius*
Floating leaved pondweed	*Potamogeton natans*
Submerged water starwort	*Callitriche hermaphroditica*
Coontail	*Ceratophyllum demersum*
Small yellow water crowfoot	*Ranunculus gmelinii*

Appendix E:
FOREST ECOSYSTEM CLASSIFICATION VEGETATION TYPE

Appendix E: Forest Ecosystem Classification Vegetation Type

Site 1: V2 Black Ash Hardwood and Mixed wood

Description: Hardwood mixed wood stands containing black ash in the over story. The understory is typically dense and floristically diverse. Of limited areal extent; occurring in low-lying locations on deep moist to wet soils, usually non-calcareous.

Common Over story Species:

black ash, balsam fir, trembling aspen, white birch, white spruce, white cedar, red ash, american elm, balsam poplar

Common Understory Species:

Shrubs: *Rubus pubescens, Acer spicatum, Abies balsamea, Ribes triste, Prunus virginiana, Cornus stolonifera, Alnus rugosa, Corylus cornuta, Rubus idaeus*

Herbs: *Viola spp., Mitella nuda, Athyrium filix-femina, Galium triflorum, Maianthemum canadense, Dryopteris austriaca, Circaea alpine, Streptopus roseus, Aralia nudicaulis, Aster macrophyllus, Trientalis borealis, Equisetum sylvaticum*

Mosses: *Plagiomnium cuspidatum, Climacium-dendroides*

Forest Floor Cover (%):

Broadleaf litter: 39 Moss: 20 Humus: 12 Water: 11 Graminoid litter: 11 Wood: 6

Site 2: V2 Black Ash Hardwood and Mixed wood

Description: Hardwood mixed wood stands containing black ash in the over story. The understory is typically dense and floristically diverse. Of limited areal extent; occurring in low-lying locations on deep moist to wet soils, usually non-calcareous.

Common Over story Species:

black ash, balsam fir, trembling aspen, white birch, white spruce, white cedar, red ash, american elm, balsam poplar

Common Understory Species:

Shrubs: *Rubus pubescens, Acer spicatum, Abies balsamea, Ribes triste, Prunus virginiana, Cornus stolonifera, Alnus rugosa, Corylus cornuta, Rubus idaeus*

Herbs: *Viola spp., Mitella nuda, Athyrium filix-femina, Galium triflorum, Maianthemum canadense, Dryopteris austriaca, Circaea alpine, Streptopus roseus, Aralia nudicaulis, Aster macrophyllus, Trientalis borealis, Equisetum sylvaticum*

Mosses: *Plagiomnium cuspidatum, Climacium-dendroides*

Forest Floor Cover (%):

Broadleaf litter: 39 Moss: 20 Humus: 12 Water: 11 Graminoid litter: 11 Wood: 6

Site 3: V2 Black Ash Hardwood and Mixed wood

Description: Hardwood mixed wood stands containing black ash in the over story. The understory is typically dense and floristically diverse. Of limited areal extent; occurring in low-lying locations on deep moist to wet soils, usually non-calcareous.

Common Over story Species:

black ash, balsam fir, trembling aspen, white birch, white spruce, white cedar, red ash, american elm, balsam poplar

Common Understory Species:

Shrubs: *Rubus pubescens*, *Acer spicatum*, *Abies balsamea*, *Ribes triste*, *Prunus virginiana, Cornus stolonifera, Alnus rugosa, Corylus cornuta*, *Rubus idaeus*

Herbs: *Viola spp., Mitella nuda, Athyrium filix-femina, Galium triflorum, Maianthemum canadense, Dryopteris austriaca, Circaea alpine, Streptopus roseus, Aralia nudicaulis, Aster macrophyllus, Trientalis borealis, Equisetum sylvaticum*

Mosses: *Plagiomnium cuspidatum, Climacium-dendroides*

Forest Floor Cover (%):

Broadleaf litter: 39 Moss: 20 Humus: 12 Water: 11 Graminoid litter: 11 Wood: 6

Site 4: V2 Black Ash Hardwood and Mixed wood

Description: Hardwood mixed wood stands containing black ash in the over story. The understory is typically dense and floristically diverse. Of limited areal extent; occurring in low-lying locations on deep moist to wet soils, usually non-calcareous.

Common Over story Species:

black ash, balsam fir, trembling aspen, white birch, white spruce, white cedar, red ash, american elm, balsam poplar

Common Understory Species:

Shrubs: *Rubus pubescens, Acer spicatum, Abies balsamea, Ribes triste, Prunus virginiana, Cornus stolonifera, Alnus rugosa, Corylus cornuta, Rubus idaeus*

Herbs: *Viola spp., Mitella nuda, Athyrium filix-femina, Galium triflorum, Maianthemum canadense, Dryopteris austriaca, Circaea alpine, Streptopus roseus, Aralia nudicaulis, Aster macrophyllus, Trientalis borealis, Equisetum sylvaticum*

Mosses: *Plagiomnium cuspidatum, Climacium-dendroides*

Forest Floor Cover (%):

Broadleaf litter: 39 Moss: 20 Humus: 12 Water: 11 Graminoid litter: 11 Wood: 6

Site 5: V15 White Spruce Mixed wood

Description: A variable mixed wood type with white spruce as the main canopy species. The understory ranges from herb and shrub rich to poor, with balsam fir commonly abundant in the shrub layer. Occurring over a broad range of soil and site conditions but primarily on deep, fresh to moist, mineral soils.

Common Over story Species:

white spruce, balsam fir, trembling aspen, white birch, black spruce, balsam poplar, red maple, jack pine

Common Understory Species:

Shrubs: *Abies balsamea, Acer spicatum, Rubus pubescens, Corylus cornuta, Sorbus décor, Linnaea borealis, Diervilla lonicera, Rose acicularis, Amelanchier spp., Populus tremuloides*

Herbs*: Aralia nudicaulis, Cornus canadensis, Clintonia borealis, Maianthemum canadense, Streptopus roseus, Trientalis borealis, Galium triflorum, Aster macrophyllus, Mitella nuda, Viola renifolia, Anemone quinquefolia, Petasites palmatus*

Mosses*: Pleurozium schreberi, Ptilium crista-castrensis, Rhytidiadelphus triquetrus, Plagiomnium cuspidatum*

Forest Floor Cover (%):

Broadleaf litter: 61 Moss: 16 Conifer litter: 13 Wood: 5

Site 6: V2 Black Ash Hardwood and Mixed wood

Description: Hardwood mixed wood stands containing black ash in the over story. The understory is typically dense and floristically diverse. Of limited areal extent; occurring in low-lying locations on deep moist to wet soils, usually non-calcareous.

Common Over story Species:

black ash, balsam fir, trembling aspen, white birch, white spruce, white cedar, red ash, american elm, balsam poplar

Common Understory Species:

Shrubs: *Rubus pubescens, Acer spicatum, Abies balsamea, Ribes triste, Prunus virginiana, Cornus stolonifera, Alnus rugosa, Corylus cornuta, Rubus idaeus*

Herbs: *Viola spp., Mitella nuda, Athyrium filix-femina, Galium triflorum, Maianthemum canadense, Dryopteris austriaca, Circaea alpine, Streptopus roseus, Aralia nudicaulis, Aster macrophyllus, Trientalis borealis, Equisetum sylvaticum*

Mosses: *Plagiomnium cuspidatum, Climacium-dendroides*

Forest Floor Cover (%):

Broadleaf litter: 39 Moss: 20 Humus: 12 Water: 11 Graminoid litter: 11 Wood: 6

Site 7: V15 White Spruce Mixed wood

Description: A variable mixed wood Type with white spruce as the main canopy species. The understory ranges from herb and shrub rich to poor, with balsam fir commonly abundant in the shrub layer. Occurring over a broad range of soil and site conditions but primarily on deep, fresh to moist, mineral soils.

Common Over story Species:

white spruce, balsam fir, trembling aspen, white birch, black spruce, balsam poplar, red maple, jack pine

Common Understory Species:

Shrubs: *Abies balsamea, Acer spicatum, Rubus pubescens, Corylus cornuta, Sorbus décor, Linnaea borealis, Diervilla lonicera, Rose acicularis, Amelanchier spp., Populus tremuloides*

Herbs*: Aralia nudicaulis, Cornus Canadensis, Clintonia borealis, Maianthemum canadense, Streptopus roseus, Trientalis borealis, Galium triflorum, Aster macrophyllus, Mitella nuda, Viola renifolia, Anemone quinquefolia, Petasites palmatus*

Mosses*: Pleurozium schreberi, Ptilium crista-castrensis, Rhytidiadelphus triquetrus, Plagiomnium cuspidatum*

Forest Floor Cover (%):

Broadleaf litter: 61 Moss: 16 Conifer litter: 13 Wood: 5

Site 8: Village of Nolalu – Forest Type not applicable

Site 9: V14 Balsam Fir Mixed wood

Description: An extremely variable mixed wood type. The canopy, comprising mainly balsam fir, may contain a mixture of several species. The understory varies from shrub rich to moderately herb and shrub poor. Usually on deep, fresh to moist, mineral soils but encompassing a wide range of soil and site conditions.

Common Over story Species:

balsam fir, trembling aspen, white birch, white spruce, white cedar, black spruce, balsam poplar, jack pine

Common Understory Species:

Shrubs: *Abies balsamea, Acer spicatum, Rubus pubescens, Linnaea borealis, Diervilla lonicera, Sorbus decora, Populus tremuloides, Corylus cornuta, Amelanchier spp., Rosa acicularis*

Herbs*: Aralia nudicaulis, Cornus Canadensis, Clintonia borealis, Maianthemum canadense, Streptopus roseus, Trientalis borealis, Galium triflorum, Aster macrophyllus, Mitella nuda, Viola renifolia, Anemone quinquefolia, Petasites palmatus*

Mosses*: Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Plagiomnium cuspidatum*

Forest Floor Cover (%):

Broadleaf litter: 61 Moss: 16 Conifer litter: 13 Wood: 5

Site 10: V15 White Spruce Mixed wood

Description: A variable mixed wood type with white spruce as the main canopy species. The understory ranges from herb and shrub rich to poor, with balsam fir commonly abundant in the shrub layer. Occurring over a broad range of soil and site conditions but primarily on deep, fresh to moist, mineral soils.

Common Over story Species:

white spruce, balsam fir, trembling aspen, white birch, black spruce, balsam poplar, red maple, jack pine

Common Understory Species:

Shrubs: *Abies balsamea*, *Acer spicatum*, *Rubus pubescens*, *Corylus cornuta, Sorbus décor, Linnaea borealis, Diervilla lonicera, Rosa acicularis, Amelanchier spp., Populus tremuloides*

Herbs*: Aralia nudicaulis, Cornus Canadensis*, *Clintonia borealis, Maianthemum canadense, Streptopus roseus, Trientalis borealis, Galium triflorum, Aster macrophyllus, Mitella nuda, Viola renifolia, Anemone quinquefolia, Petasites palmatus*

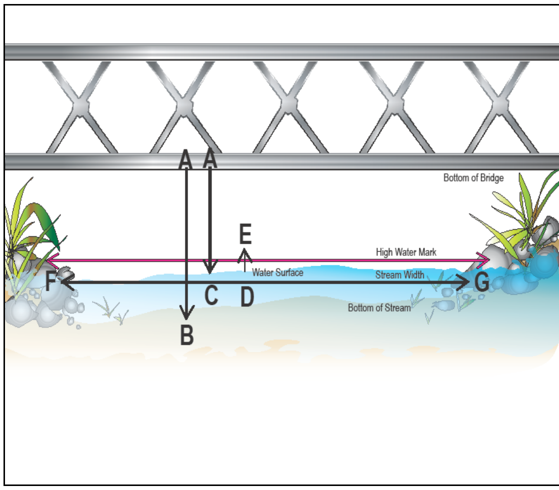
Mosses*: Pleurozium schreberi, Ptilium crista-castrensis, Rhytidiadelphus triquetrus, Plagiomnium cuspidatum*

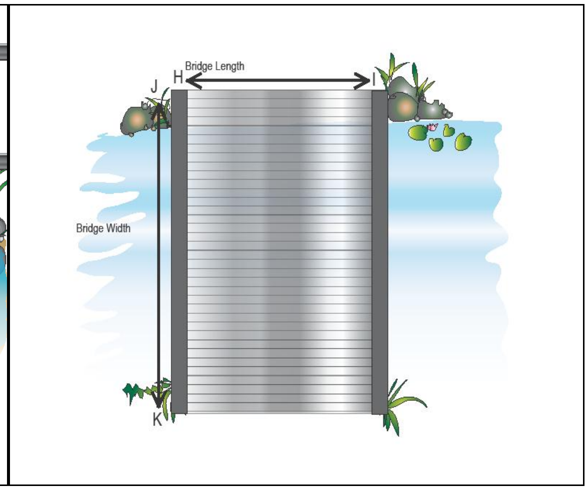
Forest Floor Cover (%):

Broadleaf litter: 61 Moss: 16 Conifer litter: 13 Wood: 5

Appendix F:
BRIDGE ASSESSMENTS

Appendix F: Bridge Assessments





Bridge Measurement Parameters **Bridge Length/Width**

Whitefish River 2012 Bridge Measurements

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)
1 (Site 10)	2.6	4.0	0.4	17.2	30.0	5.6
2 (Site 9)	4.95	5.5	N/A	7.3	29.0	10.6
3 (Site 8)	3.0	3.5	0.5	11.9	31.0	6.1
4 (Site 7)	4.3	4.6	0.3	11.0	58.0	9.4
5 (Site 4)	4.0	5.1	0.3	7.6	44.0	8.2
6 (Site 3)	3.8	4.1	0.2	10.2	22.8	17.0
7 (Site 2)	3.0	3.35	0.25	6.5	18.4	12.4
Maximum Value	4.95	5.5	0.5	17.2	58.0	17.0
Minimum Value	2.6	3.35	0.3	6.5	18.4	5.6
Average	3.66	4.3	0.33	10.24	33.31	9.9

Bridge 1

Location: North Side Road (Site 10)

GPS Coordinates: 5351224.51 metres north / 283559.33 metres east

Description: This bridge was located on a gravel surfaced road north east of Whitefish Lake and appeared to be in good condition. The bridge was built of metal and wood. The height of the single land bridge did not appear to alter the natural channel characteristics. The banks surrounding the bridge were fairly steep, and appeared to be very stable due to the abundant vegetation. A snake pit was discovered below the bridge within the marsh.

Upstream Downstream

Bridge 2

Location: 5th Side Road (Site 9)

GPS Coordinates: 5351909.87 metres north / 289098.60 metres east

Description: The bridge at Site 9 was constructed in 1976 and was composed of concrete and steel. The bridge contained two concrete guard railings which extended the entire length of the bridge. Shrubs and grasses dominated each side of the banks along with trembling aspen and white spruce. A stick dam was observed downstream of the bridge and many dead logs were observed upstream. The debris did not seem to affect the velocity of the river. Overall, the bridge was in very good condition.

Upstream

Downstream

Bridge 3

Location: Old Mill Road, Village of Nolalu (Site 8)

GPS Coordinates: 5352539.49 metres north / 291651.15 metres east

Description: The bridge at Site 8 was a bailey bridge design and was in excellent condition. The bridge was located in the middle of the Village of Nolalu adjacent to the Whitefish River stream flow gauge. There was a metal guard rail located on each side of the bridge. The bridge appeared to be well maintained with minimal erosion along the banks.

Upstream

Downstream

Bridge 4

Location: On Highway 588/ Leeper Rd (Site 7)

GPS Coordinates: 5351882.92 metres north / 295735.24 metres east

Description: This bridge was identical to the bridge located at Site 9, composed of concrete and steel. The overall bridge and road were in excellent condition. There were concrete slabs on both sides of the bridge providing the support along with the double rail. This bridge was located in a very rocky area and was dominated by many terrestrial herbs, shrubs and grasses.

Upstream

Downstream

Bridge 5

Location: Highway 595, Village of Hymers (Site 6)

GPS Coordinates: 5357738.24 metres north / 300068.70 metres east

Description: The bridge was a bailey bridge design, with a fenced walkway attached to the side of the bridge. The steel frame on the bridge had no apparent rust and appeared to be in good condition. This bridge was installed in 2008 after the June 6, 2008 extreme rainfall event which damaged the previous bridge. The bridge was located in an area dominated by a thick layer of grasses, shrubs and trees.

Upstream

Downstream

Bridge 6

Location: Pitch Creek, Harstone Drive (Site 3)

GPS Coordinates: 5358182.52 metres north / 303166.37 metres east

Description: This simple bridge was made of concrete and appeared to be in excellent condition. The deck of the bridge was covered in gravel and appeared to have no signs of erosion. The bridge was well maintained and looked to be fairly new. Mud and gravel fill was used underneath the two ends of the bridge for support. The sides of the bridge were dominated by shrubs and grasses.

Upstream

Downstream

Bridge 7

Location: Cedar Creek, Harstone Drive (Site 2)

GPS Coordinates: 5359295.01 metres north / 304625.75 metres east

Description: The water crossing at Site 2 was a steel pipe arch design. The vegetation was abundant at Site 2, with willow and trembling aspen as the dominant species that surrounded the bridge. The stream cover was the greatest of all sites (70 percent stream cover). Rock fill had been placed along the banks of the bridge. A rapid increase in velocity at the downstream side of the bridge was observed during both visits.

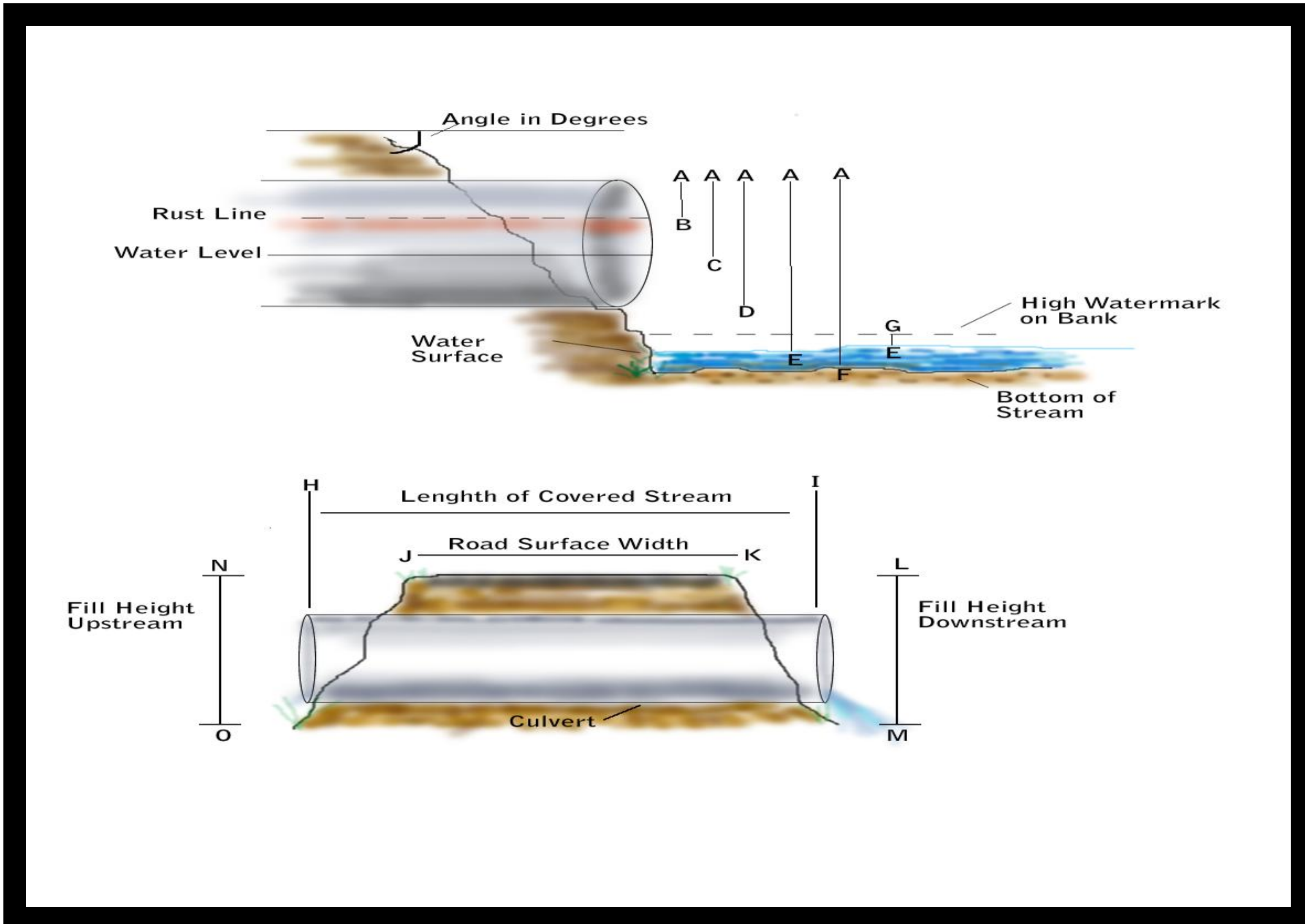
Upstream

Downstream

Appendix G:

CULVERT ASSESSMENTS

Appendix G: Culvert Assessments



Whitefish River 2012 Culvert Measurements

Culvert Number	**J-K** Road Surface Width (m)	**H-I** Length of Covered Stream (m)	**N-O** Fill Height Downstream (m)	**L-M** Fill Height Downstream (m)		**A-D** Width of Opening (cm)	**A-B** Inside Top to Water Surface (cm)	**A-C** Inside Top to Water Surface (cm)	**A-E** Height Above Outlet Pool (cm)	**E-G** Water Surface to High Water Mark (cm)	**A-F** Inside Top to Bottom of Stream (cm)
1	8.70	32.5	4.9	4.3	Upstream	6.1	2.6	3.2	3.2	N/A	4.4
					Downstream	6.1	2.35	2.9	2.9	N/A	3.73

Culvert 1

Location: Pitch Creek on Highway 595 (Site 4)

GPS Coordinates: 5353713.55 metres north / 299415.64 metres east

Description: The watercrossing at Site 4 was a concrete box culvert. There was a dam located on the upstream side of the bridge which made a significant difference in water depth between both sides of the bridge. Abundant vegetation growth was present around the bridge and surrounding area.

Upstream

Downstream

Appendix H:
SOILS

Appendix H: Soils

Soil Name	***Surface Texture***	***Soil Materials***	***Drainage***
Arthur	fine sandy loam, loam	Noncalcareous very fine sand lacustrine 10 to 20 cm thick over calcareaous lacustrine silt and clay	Imperfect
Jarvis River	clay, clay loam, silt loam	Calcareous reddish clay loam, clay or silty clay, varved lacustrine	Moderately well
Lappe	clay, clay loam, silt loam, peaty phase	Calcareous reddish clay loam, clay or silty clay varved lacustrine	Poor
Marsh	N/A	Shallow inundated land, less than 30 cm of organic material over mineral material	Very poor
Nolalu	loam, silt loam, sandy loam, gravelly sandy loam	Noncalcareous fine sandy loam stony glacial till derived from shale	Good
Oskondoga	clay, silty clay loam, silt loam, sand	Calcareous reddish clay loam, clay or silty clay varved lacustrine	Imperfect
Organics-Cabett	N/A	Well decomposed organic material derived from sedges underlain by clay at 30 to 150 cm	Very poor
Organic-Penassen	N/A	Partially decomposed organic material derived from Hypnum moss and reeds 40 to 90 cm thick underlain by lacustrine clay	Very poor

Appendix I:
SITE PHOTOGRAPHY

Appendix I: Site Photography and Descriptions

Site 1 – Near confluence of the Whitefish River and the Kaministiquia River, near the Village of Stanley

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

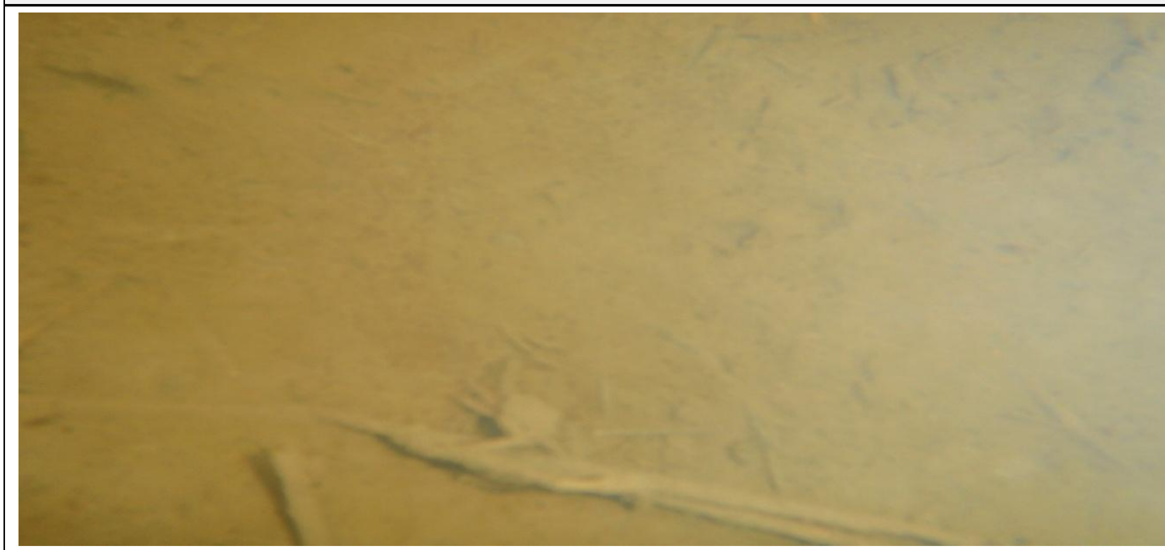
Site 1 was located on Highway 588 in the Village of Stanley; and was chosen to represent the confluence of the Whitefish River and the Kaministiquia River. It was characterized by an island causing the river to split. The water was murky with a dark brown colour. There was some clarity in the shallower parts of the river. The dominant substrate observed was muck and cobbles with small boulders visible on the banks. Terrestrial vegetation was abundant with many shrubs and herbs present along the banks. There were horsetails, arrowheads and green algae present in the water. The terrestrial soil was silty clay.

Site 2 – Cedar Creek upstream confluence with Whitefish River, Harstone Drive	
A: Upstream Photo	**B: Downstream Photo**
	
C: Substrate Photo	
	

Comments:
Site 2 was located on Cedar Creek just upstream of the confluence with the Whitefish River. The banks were armored with rip rap, which was placed during the bridge replacement following the 2008 rainfall event. The water was a light brown colour with a high velocity. The dominant substrate observed was cobbles with gravel. Terrestrial vegetation was abundant with many shrubs and herbs present along the banks of the river. There were many lady ferns, mountain buttercups, choke cherry and a few trees such as black ash, slender willow and white elm present along the banks and on land. The aquatic vegetation did not appear healthy; however, appeared to be in better health then the other sample sites. Logs, trees and sticks were seen along the banks.

Site 3 – Pitch Creek confluence upstream with Whitefish River confluence, Harstone Drive	
A: Upstream Photo	**B: Downstream Photo**
	
C: Substrate Photo	
	

Comments:
Site 3 was located on Harstone Drive and was chosen to represent the confluence of the Whitefish River with Pitch Creek**.** This site was downstream of the confluence of Pitch and Tinpail and Whitewood creeks. The water was flowing at a moderately quick pace. The banks appeared stable and had abundant vegetation growth along the river bank. The dominate substrate was cobbles and gravel. A small amount of woody debris was observed within the creek and along the banks. The terrestrial vegetation included black ash, jack pine, white spruce and red-osier dogwood. The soil type at this site was a sandy loam.

Site 4 – Highway 595, Pitch Creek	
A: Upstream Photo	B: Downstream Photo
	
C: Substrate Photo	
	

Comments:
Site 4 was located on Highway 595 at Pitch Creek and was characterized by erosion along the banks. The water at this site was a grey brown color with some clarity. The main substrate was clay. There were many soil color changes at this site during both site visits. The erosion along the banks may have caused the color change in the water. The river banks were very steep and consisted of boulders with an abundant herb and shrub growth. Two types of moss were observed at the site; fire moss and feather moss. The slope of the banks at Site 4 was at 45 degrees. No velocity was able to be recorded due to the stagnant water flow. The river was generally shallow and had a width of 7.6 meters.

Site 5 – End of Diana Road off of Blaikie Road	
A: Upstream Photo	**B: Downstream Photo**
	

C: Substrate Photo

Comments:
Site 5 was located on Diana Road and was characterized by a large beaver dam. The soil type was clayey silty loam, and the main substrate was clay muck and silt. The water was murky with a dark brown colour. Little aquatic vegetation was observed in the slow flowing water; however, a few floating-leaved bur reed plants were observed. There was little to no shading on this site; however, there was abundant vegetation along the sides of the river banks. There were many trees, shrubs, herbs and grasses adjacent to the river which included balsam fir, white spruce and trembling aspen. The river downstream appeared to increase in velocity.

Site 6 – Highway 595, Village of Hymers	
A: Upstream Photo	**B: Downstream Photo**
	
C: Aquatic Vegetation Photo	
	

Comments:
Site 6 was located within the Village of Hymers in a lowland area and was characterized by a 30 metre high bank eroding into the river. The eroding river bank may have caused the change in water colour downstream. The substrate at this site was fine, silty loam with cobbles. There was little stream cover (15 percent) along the banks. The dominant vegetation observed in the lowland area was red-osier dogwood, floating arrowheads and slender willows. The dominate trees found along the river were black ash, jack pine and balsam fir. The river was one metre deep and 12.6 metre wide; compared to the majority of the sample sites in the watershed this was the second widest. The velocity at this site was very fast compared to the other sample sites. The water was a golden yellow with little to no clarity within the channel.

Site 7 – Highway 588 & Leeper Road	
A: Upstream Photo	**B: Downstream Photo**
	
C: Substrate Photo	
	

Comments:
Site 7 was located on Highway 588 close to Leeper Road. The site was characterized by having a substantial amount of boulders and cobbles along the river. The water was slightly murky with an apparent golden brown colour. The downstream water level was deeper compared to the upstream side where the water was fairly shallow. The velocity at the site was very fast compared to the other sample sites. There was no significant bank erosion observed; however, a high water mark was observed within the bank vegetation. The river had the lowest stream cover (five percent) compared to the other sample sites. The stream cover came from trees and shrubs which were growing tall enough to cover a small portion of the river.

Site 8 – Old Mill Road, Village of Nolalu

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

Site 8 was located on Old Mill Road within the Village of Nolalu. The site was characterized by the rapids underneath the clear span bridge. The water at this site was flowing over bedrock. No defined banks were observed on either side of the river. There were no apparent aquatic plants growing in the water; however, some dead trees were observed throughout the channel. Site 8 had an abundant growth of terrestrial plants including green alder, red-osier dogwood, prickly wild rose and chokecherry. Many trees such as red pine, jack pine, mountain maple and tamarack were observed along the river. There was little stream cover at this site (10 percent). The stream cover came from planted tamarack and dead trees along the river. The majority of the trees were situated further back from the river on terrestrial soil and therefore did not greatly affect the stream cover. The terrestrial soil was a sandy loam and the river channel consisted of bedrock. The water had a high velocity and had an apparent golden bronze colour. The Environment Canada/LRCA stream flow and precipitation gauge was located at this site adjacent to the bridge.

Site 9 – 5th Side Road	
A: Upstream Photo	B: Downstream Photo
	
C: Substrate Photo	
	

Comments:
Site 9 was located near the 5th Side Road outside the Village of Nolalu. The site was characterized by a bridge constructed in 1976 and the remains of the previous bridge. There did not seem to be significant erosion present and no aquatic plants were observed within the channel of the river. There was dead brush and logs scattered along the channel. The buildup of both the brush and logs caused a minor stick dam downstream. Site 9 had little to no shading; however, there was an abundance of terrestrial vegetation which included herbs, shrubs and grasses. The terrestrial vegetation included creeping butter cups, red-osier dogwood, slender willow and green alder. The dominate substrate observed was muck and gravel. The velocity of the river was the fastest velocity recorded at 1.06 metres per second. The water had an apparent clear golden colour. The soil type at this site was a silty loam.

Site 10 – North Side Rd

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

Site 10 was located on North Side Road northeast of Whitefish Lake and represented the furthest upstream sample site. The site was characterized by a beaver dam upstream as well as a snake breeding ground. There was abundant herb and shrub growth downstream of the bridge; however, there was little stream cover (five percent). The upstream side of the bridge was much wider compared to the downstream side. Site 10 possessed many taller trees closer to the channels edge; which may result in more stream cover upstream. The upstream side of the bridge had an open area with significant tree growth close to the water's edge. Grasses and herbs were the dominant vegetation on the downstream side of the bridge. The upland soil type and river substrate was a clayey moist loam. There was no measureable velocity present at the site; however, water movement was present downstream. Site 10 had the widest channel width of all the sites that were measured (17.3 meters wide and two meters deep). Unlike most of the sample sites, Site 10 had abundant aquatic vegetation including yellow pond lily, large fruited bur reed and floating leaved bur reed within the channel.

Appendix J:
LABORATORY CERTIFICATES OF ANALYSIS AND ANALYTICAL REPORTS

New file
14B - 13 - 2

LAKEHEAD REGION CONSERVATION AUTHORITY
ATTN: TAMMY COOK
130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Date Received: 14-JUN-12
Report Date: 29-JUN-12 13:49 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L1162503
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: L1162503
Legal Site Desc:

LAURA DOWSWELL
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1162503-1	L1162503-2	L1162503-3	L1162503-4	L1162503-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12
	Sampled Time	10:45	11:50	12:30	13:15	13:50
	Client ID	WHITEFISH RIVER - SITE #10	WHITEFISH RIVER - SITE #9	WHITEFISH RIVER - SITE #8	WHITEFISH RIVER - SITE #7	WHITEFISH RIVER - SITE #6
Grouping	Analyte					
WATER						
Physical Tests	Color, True (T.C.U.)	67.7	66.6	63.3	60.6	57.5
	Conductivity (EC) (uS/cm)	77.4	92.9	107	122	132
	Hardness (as CaCO3) (mg/L)	39.7	49.3	54.5	63.6	67.3
	pH (pH)	7.54	7.79	7.90	7.94	7.97
	Total Dissolved Solids (mg/L)	60	65	74	80	90
	Turbidity (NTU)	5.61	12.4	11.0	10.6	11.0
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L CaCO3)	32.4	40.5	44.6	50.8	55.3
	Ammonia, Total (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	0.28	0.52	0.89	1.20	1.28
	Nitrate (as N) (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Nitrite (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	0.574	0.521	0.549	0.546	0.526
	Phosphorus (P)-Total (mg/L)	0.0136	0.0169	0.0160	0.0132	0.0161
	Sulfate (SO4) (mg/L)	2.47	2.76	2.97	4.93	5.91
Bacteriological Tests	Escherichia Coli (MPN/100mL)	51	52	35	32	30
	Total Coliforms (MPN/100mL)	> 2420	1300	> 2420	1600	2400
Total Metals	Aluminum (Al)-Total (mg/L)	0.208	0.469	0.430	0.413	0.440
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Barium (Ba)-Total (mg/L)	<0.010	0.013	0.013	0.014	0.015
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	<0.000017	<0.000017	0.000018	0.000024	0.000029
	Calcium (Ca)-Total (mg/L)	11.3	13.7	14.9	17.1	18.0
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (Cu)-Total (mg/L)	0.0011	0.0022	0.0022	0.0026	0.0030
	Iron (Fe)-Total (mg/L)	0.798	1.02	0.965	0.904	0.918
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Total (mg/L)	2.77	3.64	4.21	5.04	5.44
	Manganese (Mn)-Total (mg/L)	0.0629	0.0348	0.0286	0.0230	0.0195
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Potassium (K)-Total (mg/L)	<0.50	<0.50	<0.50	0.55	0.61

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1162503-6	L1162503-7	L1162503-8	L1162503-9	L1162503-10
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12
	Sampled Time	14:38	14:10	10:26	11:36	12:20
	Client ID	CEDAR CREEK - SITE #11	WHITEFISH RIVER - SITE #5	WHITEFISH RIVER - SITE #4	WHITEFISH RIVER - SITE #3	WHITEFISH RIVER - SITE #2
WATER						
Physical Tests	Color, True (T.C.U.)	74.7	53.2	44.9	40.3	46.7
	Conductivity (EC) (uS/cm)	227	153	133	172	165
	Hardness (as CaCO3) (mg/L)	113	77.5	68.8	76.7	80.7
	pH (pH)	7.76	8.02	7.93	8.14	8.09
	Total Dissolved Solids (mg/L)	149	100	90	104	104
	Turbidity (NTU)	2.12	9.32	3.10	3.88	4.47
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L CaCO3)	97.3	60.9	61.0	74.1	72.6
	Ammonia, Total (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	7.43	2.36	0.98	4.05	2.23
	Nitrate (as N) (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Nitrite (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	0.910	0.531	0.510	0.504	0.545
	Phosphorus (P)-Total (mg/L)	0.0271	0.0115	0.0098	0.0111	0.0193
	Sulfate (SO4) (mg/L)	1.49	8.39	2.38	3.41	4.69
Bacteriological Tests	Escherichia Coli (MPN/100mL)	56	35	27	150	86
	Total Coliforms (MPN/100mL)	1700	> 2420	1600	> 2420	> 2420
Total Metals	Aluminum (Al)-Total (mg/L)	0.0472	0.336	0.0831	0.0902	0.139
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Barium (Ba)-Total (mg/L)	0.016	0.017	0.011	0.013	0.011
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	0.000020	0.000032	<0.000017	0.000024	<0.000017
	Calcium (Ca)-Total (mg/L)	27.7	20.6	17.4	19.6	22.0
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (Cu)-Total (mg/L)	0.0024	0.0029	0.0013	0.0017	0.0015
	Iron (Fe)-Total (mg/L)	0.739	0.751	0.690	0.514	0.586
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Total (mg/L)	10.7	6.29	6.15	7.21	6.24
	Manganese (Mn)-Total (mg/L)	0.0994	0.0180	0.0331	0.0126	0.0324
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Potassium (K)-Total (mg/L)	1.14	0.66	0.73	0.92	0.93

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1162503-11				
	Description	WATER				
	Sampled Date	13-JUN-12				
	Sampled Time	13:10				
	Client ID	WHITEFISH RIVER - SITE #1				
Grouping	Analyte					
WATER						
Physical Tests	Color, True (T.C.U.)	46.7				
	Conductivity (EC) (uS/cm)	171				
	Hardness (as CaCO3) (mg/L)	86.3				
	pH (pH)	8.05				
	Total Dissolved Solids (mg/L)	111				
	Turbidity (NTU)	7.03				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L CaCO3)	70.2				
	Ammonia, Total (as N) (mg/L)	<0.020				
	Chloride (Cl) (mg/L)	3.03				
	Nitrate (as N) (mg/L)	<0.030				
	Nitrite (as N) (mg/L)	<0.020				
	Total Kjeldahl Nitrogen (mg/L)	0.533				
	Phosphorus (P)-Total (mg/L)	0.0122				
	Sulfate (SO4) (mg/L)	7.47				
Bacteriological Tests	Escherichia Coli (MPN/100mL)	24				
	Total Coliforms (MPN/100mL)	> 2420				
Total Metals	Aluminum (Al)-Total (mg/L)	0.221				
	Antimony (Sb)-Total (mg/L)	<0.00060				
	Arsenic (As)-Total (mg/L)	<0.0010				
	Barium (Ba)-Total (mg/L)	0.017				
	Beryllium (Be)-Total (mg/L)	<0.0010				
	Bismuth (Bi)-Total (mg/L)	<0.0010				
	Boron (B)-Total (mg/L)	<0.050				
	Cadmium (Cd)-Total (mg/L)	0.000025				
	Calcium (Ca)-Total (mg/L)	22.7				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00050				
	Copper (Cu)-Total (mg/L)	0.0026				
	Iron (Fe)-Total (mg/L)	0.636				
	Lead (Pb)-Total (mg/L)	<0.0010				
	Lithium (Li)-Total (mg/L)	<0.050				
	Magnesium (Mg)-Total (mg/L)	7.22				
	Manganese (Mn)-Total (mg/L)	0.0307				
	Molybdenum (Mo)-Total (mg/L)	<0.0010				
	Nickel (Ni)-Total (mg/L)	<0.0020				
	Potassium (K)-Total (mg/L)	0.86				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1162503-1	L1162503-2	L1162503-3	L1162503-4	L1162503-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12
	Sampled Time	10:45	11:50	12:30	13:15	13:50
	Client ID	WHITEFISH RIVER - SITE #10	WHITEFISH RIVER - SITE #9	WHITEFISH RIVER - SITE #8	WHITEFISH RIVER - SITE #7	WHITEFISH RIVER - SITE #6
Grouping	Analyte					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	1.15	1.39	1.74	1.91	1.96
	Strontium (Sr)-Total (mg/L)	0.0241	0.0296	0.0313	0.0367	0.0381
	Tellurium (Te)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	0.0064	0.0135	0.0128	0.0117	0.0121
	Tungsten (W)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)	<0.0010	0.0013	0.0013	0.0013	0.0013
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0041	0.0031	0.0041	0.0040
	Zirconium (Zr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1162503-6	L1162503-7	L1162503-8	L1162503-9	L1162503-10
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12	13-JUN-12
	Sampled Time	14:36	14:10	10:25	11:35	12:20
	Client ID	CEDAR CREEK - SITE #11	WHITEFISH RIVER - SITE #5	WHITEFISH RIVER - SITE #4	WHITEFISH RIVER - SITE #3	WHITEFISH RIVER - SITE #2
Grouping	Analyte					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	6.37	2.43	2.13	3.16	2.41
	Strontium (Sr)-Total (mg/L)	0.0476	0.0464	0.0314	0.0351	0.0348
	Tellurium (Te)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	<0.0020	0.0087	0.0026	0.0026	0.0049
	Tungsten (W)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1162503-11 WATER 13-JUN-12 13:10 WHITEFISH RIVER - SITE #1				
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010				
	Silver (Ag)-Total (mg/L)	<0.00010				
	Sodium (Na)-Total (mg/L)	2.76				
	Strontium (Sr)-Total (mg/L)	0.0461				
	Tellurium (Te)-Total (mg/L)	<0.0010				
	Thallium (Tl)-Total (mg/L)	<0.00030				
	Tin (Sn)-Total (mg/L)	<0.0010				
	Titanium (Ti)-Total (mg/L)	0.0063				
	Tungsten (W)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	<0.0050				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Aluminum (Al)-Total	MS-B	L1162503-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L1162503-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1162503-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L1162503-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L1162503-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters 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-TOT-CAP-TB	Water	Alkalinity, Total (as CaCO3)	APHA 2320 B-Auto-Pot. Titration
CL-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
COLOUR-TB	Water	Colour, True	CPPA H.5P Spectrophotometry
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-ELECTRODE
HARDNESS-CALC-TB	Water	Hardness (as CaCO3)	CALCULATION
MET-T-MS-TB	Water	Total Metals by ICPMS	APHA 3030E/EPA 6020A

This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

ALS Test Code	Matrix	Test Description	Method Reference**
N-TOTKJ-TB	Water	Total Kjeldahl Nitrogen by Colourimetry	APHA 4500-Norg B (modified)

Total Kjeldahl Nitrogen in aqueous matrices is analyzed using an autoanalyzer with colourimetric detection.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
NO2-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
NO3-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
PH-CAP-TB	Water	pH	APHA 4500-H-ELECTRODE
SO4-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C (modified)

Aqueous matrices are analyzed using gravimetry and evaporation

ALS Test Code	Matrix	Test Description	Method Reference**
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B C18
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

Chain of Custody Numbers:

Reference Information

L1162503

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
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-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
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.

ALS Environmental

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Stell Brothers Limited Company www.alsglobal.com

L1162503-COFC

L1162503

Company:	Lake Region Conservat
Contact:	Tammy Cook
Address:	130 Conservtion Rd. P7B 6T8
Phone:	807-344-5827
Fax:	807-345-9156
Email:	tammy@lakeheadca.com,tammy@lakeheadca.com,info@
Project:	
PO:	
Quote #	Q34863
Invoice To:	Same as Report: ☑ Yes ☐ No
Company:	
Contact:	
Address:	
Email:	
Account Manager	
Sampler:	Neil Zago

Regulatory Information

☐ O. Reg 153 (O. Reg 511 Amend) Table:____

Record of Site Condition ☐ Yes ☐ No

PWQO ☑ MISA ☐ MMER ☐ CCME ☐

Guideline Required:

TCLP Regulation 558 ☐ Other:

Service Requested

☑ Regular TAT (7 Days)

☐ Priority TAT 50% Surcharge (3-5 Days)

☐ Emergency TAT 100% Surcharge (1-2 Days)

Specify Date Required:

All TAT quoted material is in business days which exclude statutory holidays and weekends. Samples received past 3:00pm or Saturday/Sunday begin the next day.

Both questions below must answered for water samples

Are any samples taken from a regulated DW System? ☐ Yes ☑ No

If yes, an authorized DW COC must be used.

Is the water sampled intended for human consumption? ☐ Yes ☑ No

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Routine	Nutrients (P)	Total Metals (P)	TC,EC-18QT97-TB (P)	Number of Containers
WR10	Whitefish River - Site #10	JUN 13/12	10:45	Grab	x	x	x	x	4
WR9	Whitefish River - Site #9	JUN 13/12	11:50	Grab	x	x	x	x	4
WR8	Whitefish River - Site #8	JUN 13/12	12:30	Grab	x	x	x	x	4
WR7	Whitefish River - Site #7	JUN 13/12	13:15	Grab	x	x	x	x	4
WR6	Whitefish River - Site #6	JUN 13/12	13:50	Grab	x	x	x	x	4
CC11	Cedar Creek - Site #11	JUN 13/12	14:38	Grab	x	x	x	x	4
WR5	Whitefish River - Site #5	JUN 14/12	14:10	Grab	x	x	x	x	4
WR4	Whitefish River - Site #4	JUN 14/12	10:25	Grab	x	x	x	x	4
WR3	Whitefish River - Site #3	JUN 14/12	11:35	Grab	x	x	x	x	4
WR2	Whitefish River - Site #2	JUN 14/12	12:20	Grab	x	x	x	x	4
WR1	Whitefish River - Site #1	JUN 14/12	13:10	Grab	x	x	x	x	4

Special Instructions / Comments

SHIPMENT RELEASE (client use)		SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)		
Released by:	Date & Time	Received by:	Date & Time	Temp	Cooling Initiated	Verified by:	Date & Time	Observations:
[signature]	June 14/12 3:40	[signature]	14-JUN-12 15:35	3.1	☑ Yes ☐ No	[signature]	14/06/12 3:50	Yes / No? If Yes add SIF

Failure to complete all portions of this form may delay analysis. **TAT may vary dependant on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs. Any known or suspected hazards relating to a sample must be noted on the chain of custody in the comments section. By use of the form the user acknowledges and agrees with the Terms and Conditions as specified on the back page.

ALS Environmental

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ALS CANADA LIMITED Part of the ALS Group A Campbell Brothers Limited Company www.alsglobal.com

Company:	Lake Region Conservation Authority
Contact:	Tammy Cook
Address:	130 Conservtion Rd. P7B 6T8
Phone:	807-344-5827 Fax: 807-345-9156
Email:	tammy@lakeheadca.com,tammy@lakeheadca.com,info@
Project:	PO:
Quote #	Q34863
Invoice To:	Same as Report: ☑ Yes ☐ No
Company:	
Contact:	
Address:	
Email:	
Account Manager	Sampler: Neil Zago

Regulatory Information

☐ O. Reg 153 (O. Reg 511 Amend) Table:_____
Record of Site Condition ☐ Yes ☐ No
PWQO ☑ MISA ☐ MMER ☐ CCME ☐
Guideline Required:
TCLP Regulation 558 ☐ Other:

Service Requested

☑ Regular TAT (7 Days)
☐ Priority TAT 50% Surcharge (3-5 Days)
☐ Emergency TAT 100% Surcharge (1-2 Days)
Specify Date Required:

All TAT quoted material is in business days which exclude statutory holidays and weekends. Samples received past 3:00pm or Saturday/Sunday begin the next day.

Both questions below must answered for water samples

Are any samples taken from a regulated DW System? ☐ Yes ☑ No
If yes, an authorized DW COC must be used.
Is the water sampled intended for human consumption? ☐ Yes ☑ No

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Routine	Nutrients (P)	Total Metals (P)	TC,EC-18QT97-TB (P)	Number of Containers
WR10	Whitefish River - Site #10	JUN 13/12	10:45	Grab	x	x	x	x	4
WR9	Whitefish River - Site #9	JUN 13/12	11:50	Grab	x	x	x	x	4
WR8	Whitefish River - Site #8	JUN 13/12	12:30	Grab	x	x	x	x	4
WR7	Whitefish River - Site #7	JUN 13/12	13:15	Grab	x	x	x	x	4
WR6	Whitefish River - Site #6	JUN 13/12	13:50	Grab	x	x	x	x	4
CC11	Cedar Creek - Site #11	JUN 13/12	14:38	Grab	x	x	x	x	4
WR5	Whitefish River - Site #5	JUN 14/12	14:10	Grab	x	x	x	x	4
WR4	Whitefish River - Site #4	JUN 14/12	10:25	Grab	x	x	x	x	4
WR3	Whitefish River - Site #3	JUN 14/12	11:35	Grab	x	x	x	x	4
WR2	Whitefish River - Site #2	JUN 14/12	12:20	Grab	x	x	x	x	4
WR1	Whitefish River - Site #1	JUN 14/12	13:10	Grab	x	x	x	x	4

Special Instructions / Comments

SHIPMENT RELEASE (client use)		SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)		
Released by:	Date & Time	Received by:	Date & Time	Temp	Cooling Initiated	Verified by:	Date & Time	Observations: Yes / No ? If Yes add SI
NZ (signature)	June 14/12 3:40	(signature)	14-JUN-12 15:35	3.1	☑ Yes ☐ No			

***Failure to complete all portions of this form may delay analysis.* **TAT may vary dependant on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs. Any known or suspected hazards relating to a sample must be noted on the chain of custody in the comments section. By use of the form the user acknowledges and agrees with the Terms and Conditions as specified on the back page

LAKEHEAD REGION CONSERVATION AUTHORITY
ATTN: ENV. SUPVR.
130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Date Received: 10-JUL-12
Report Date: 20-JUL-12 07:32 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: **L1175717**
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: L1175717
Legal Site Desc:

LAURA DOWSWELL
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1175717-1	L1175717-2	L1175717-3	L1175717-4	L1175717-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	10-JUL-12	10-JUL-12	10-JUL-12	09-JUL-12	09-JUL-12
	Sampled Time	10:10	10:55	11:15	13:23	13:50
	Client ID	WR10 WHITEFISH RIVER- SITE#10	WR9 WHITEFISH RIVER- SITE#9	WR8 WHITEFISH RIVER- SITE#8	WR7 WHITEFISH RIVER- SITE#7	WR6 WHITEFISH RIVER- SITE#6
Grouping	Analyte					
WATER						
Physical Tests	Color, True (T.C.U.)	65.8	58.8	57.2	53.2	49.5
	Conductivity (EC) (uS/cm)	91.2	106	116	138	149
	Hardness (as CaCO3) (mg/L)	44.4	52.3	56.6	67.2	72.0
	pH (pH)	7.64	7.83	7.88	7.95	8.00
	Total Dissolved Solids (mg/L)	77	89	86	104	112
	Turbidity (NTU)	6.12	9.40	9.21	6.27	7.33
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L CaCO3)	41.3	48.2	51.9	60.4	64.9
	Ammonia, Total (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	0.43	0.83	1.14	1.58	1.67
	Nitrate (as N) (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Nitrite (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	0.582	0.596	0.597	0.571	0.529
	Phosphorus (P)-Total (mg/L)	0.0100	0.0131	0.0133	0.0112	0.0104
	Sulfate (SO4) (mg/L)	2.10	2.47	2.90	4.84	6.14
Bacteriological Tests	Escherichia Coli (MPN/100mL)	150	86	66	29	24
	Total Coliforms (MPN/100mL)	> 2420	2400	> 2420	1600	2400
Total Metals	Aluminum (Al)-Total (mg/L)	0.177	0.289	0.290	0.162	0.217
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Barium (Ba)-Total (mg/L)	0.010	0.013	0.013	0.014	0.016
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	<0.000017	<0.000017	0.000020	0.000020	0.000026
	Calcium (Ca)-Total (mg/L)	12.9	14.9	15.9	18.6	19.7
	Chromium (Cr)-Total (mg/L)	<0.0010	0.0020	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (Cu)-Total (mg/L)	0.0011	0.0018	0.0020	0.0020	0.0026
	Iron (Fe)-Total (mg/L)	0.992	0.966	0.943	0.723	0.743
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Total (mg/L)	2.98	3.66	4.10	5.03	5.53
	Manganese (Mn)-Total (mg/L)	0.0492	0.0301	0.0255	0.0199	0.0144
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Potassium (K)-Total (mg/L)	<0.50	<0.50	<0.50	0.54	0.60

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1175717-6 WATER 10-JUL-12 13:40 WR5 WHITEFISH RIVER- SITE#5	L1175717-7 WATER 09-JUL-12 14:25 WR4 WHITEFISH RIVER- SITE#4	L1175717-8 WATER 09-JUL-12 14:50 WR3 WHITEFISH RIVER- SITE#3	L1175717-9 WATER 09-JUL-12 15:20 WR2 WHITEFISH RIVER- SITE#2	L1175717-10 WATER 10-JUL-12 13:02 WR1 WHITEFISH RIVER- SITE#1
Grouping	**Analyte**					
WATER						
Physical Tests	Color, True (T.C.U.)	41.6	51.4	43.7	36.7	39.5
	Conductivity (EC) (uS/cm)	169	159	183	184	187
	Hardness (as CaCO3) (mg/L)	83.5	80.7	91.1	92.9	91.1
	pH (pH)	8.04	7.91	8.16	8.09	8.06
	Total Dissolved Solids (mg/L)	119	118	131	129	134
	Turbidity (NTU)	4.75	3.69	3.57	2.38	4.12
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L CaCO3)	71.0	77.1	86.6	87.7	83.4
	Ammonia, Total (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	2.88	1.14	3.34	1.37	3.29
	Nitrate (as N) (mg/L)	<0.030	0.036	<0.030	<0.030	<0.030
	Nitrite (as N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	0.500	0.585	0.537	0.455	0.506
	Phosphorus (P)-Total (mg/L)	0.0087	0.0137	0.0103	0.0109	0.0089
	Sulfate (SO4) (mg/L)	8.55	1.37	2.24	4.67	7.18
Bacteriological Tests	Escherichia Coli (MPN/100mL)	23	51	62	140	66
	Total Coliforms (MPN/100mL)	2400	> 2420	> 2420	> 2420	2400
Total Metals	Aluminum (Al)-Total (mg/L)	0.132	0.0423	0.0605	0.0710	0.115
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Barium (Ba)-Total (mg/L)	0.018	0.013	0.014	0.012	0.018
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	0.000028	<0.000017	<0.000017	<0.000017	0.000025
	Calcium (Ca)-Total (mg/L)	22.7	20.8	23.0	25.8	24.4
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (Cu)-Total (mg/L)	0.0032	0.0012	0.0019	0.0013	0.0025
	Iron (Fe)-Total (mg/L)	0.559	0.870	0.605	0.510	0.528
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Total (mg/L)	6.50	6.99	8.15	6.91	7.31
	Manganese (Mn)-Total (mg/L)	0.0138	0.0397	0.0135	0.0226	0.0216
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Potassium (K)-Total (mg/L)	0.72	0.79	0.99	1.12	0.91

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1175717-1 WATER 10-JUL-12 10:10 WR10 WHITEFISH RIVER- SITE#10	L1175717-2 WATER 10-JUL-12 10:55 WR9 WHITEFISH RIVER- SITE#9	L1175717-3 WATER 10-JUL-12 11:15 WR8 WHITEFISH RIVER- SITE#8	L1175717-4 WATER 09-JUL-12 13:23 WR7 WHITEFISH RIVER- SITE#7	L1175717-5 WATER 09-JUL-12 13:50 WR6 WHITEFISH RIVER- SITE#6
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	1.18	1.43	1.63	1.93	2.02
	Strontium (Sr)-Total (mg/L)	0.0285	0.0345	0.0361	0.0432	0.0446
	Tellurium (Te)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	0.0057	0.0083	0.0088	0.0050	0.0059
	Tungsten (W)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)	<0.0010	0.0012	0.0012	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0033	0.0031	<0.0030	0.0035
	Zirconium (Zr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L1175717-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L1175717-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1175717-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L1175717-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L1175717-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L1175717-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L1175717-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters 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-TOT-CAP-TB	Water	Alkalinity, Total (as CaCO3)	APHA 2320 B-Auto-Pot. Titration
CL-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
COLOUR-TB	Water	Colour, True	CPPA H.5P Spectrophotometry
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-ELECTRODE
HARDNESS-CALC-TB	Water	Hardness (as CaCO3)	CALCULATION
MET-T-MS-TB	Water	Total Metals by ICPMS	APHA 3030E/EPA 6020A

This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

ALS Test Code	Matrix	Test Description	Method Reference**
N-TOTKJ-TB	Water	Total Kjeldahl Nitrogen by Colourimetry	APHA 4500-Norg B (modified)

Total Kjeldahl Nitrogen in aqueous matrices is analyzed using an autoanalyzer with colourimetric detection.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
NO2-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
NO3-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
PH-CAP-TB	Water	pH	APHA 4500-H-ELECTRODE
SO4-IC-TB	Water	Anions by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

ALS Test Code	Matrix	Test Description	Method Reference**
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C (modified)

Aqueous matrices are analyzed using gravimetry and evaporation

ALS Test Code	Matrix	Test Description	Method Reference**
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B C18
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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1175717-6	L1175717-7	L1175717-8	L1175717-9	L1175717-10
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	10-JUL-12	09-JUL-12	09-JUL-12	09-JUL-12	10-JUL-12
	Sampled Time	13:40	14:25	14:50	15:20	13:02
	Client ID	WR5 WHITEFISH RIVER- SITE#5	WR4 WHITEFISH RIVER- SITE#4	WR3 WHITEFISH RIVER- SITE#3	WR2 WHITEFISH RIVER- SITE#2	WR1 WHITEFISH RIVER- SITE#1
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	2.59	1.93	2.96	2.07	2.64
	Strontium (Sr)-Total (mg/L)	0.0554	0.0384	0.0434	0.0403	0.0540
	Tellurium (Te)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	0.0039	<0.0020	<0.0020	0.0022	0.0040
	Tungsten (W)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	0.0037	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Chain of Custody Numbers:

L1175717

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
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-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
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.

ALS Environmental

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Company:	Lakehead Region Conservation Authority
Contact:	Tammy Cook
Address:	130 Conservation Rd. P7B 6T8
Phone:	807-344-5857 Fax: 807-345-9156
Email:	tammy@lakeheadca.com,info@lakeheadca.com
Project:	PO:
Quote #	Q34863
Invoice To:	Same as Report: ☑ Yes ☐ No
Company:	
Contact:	
Address:	
Email:	
Account Manager	Sampler: Neal Zago

Regulatory Information

☐ O. Reg 153 (O. Reg 511 Amend) Table:____

Record of Site Condition ☐ Yes ☐ No

PWQO ☑ MISA ☐ MMER ☐ CCME ☐

Guideline Required:

TCLP Regulation 558 ☐ Other:

Service Requested

☑ Regular TAT (7 Days)

☐ Priority TAT 50% Surcharge (3-5 Days)

☐ Emergency TAT 100% Surcharge (1-2 Days)

Specify Date Required:

All TAT quoted material is in business days which exclude statutory holidays and weekends. Samples received past 3:00pm or Saturday/Sunday begin the next day.

Both questions below must answered for water samples

Are any samples taken from a regulated DW System? ☐ Yes ☑ No

If yes, an authorized DW COC must be used.

Is the water sampled intended for human consumption? ☐ Yes ☑ No

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Alkalinity, Conductivity, Ph	Colour, TDS, Turbidity (P)	Cl, SO4, NO2, NO3 (P)	TC,EC-18QT97-TB (P)	Nutrients (TKN, NH4, TP)	Total Metals							Number of Containers
WR10	Whitefish River - Site # 10	July 10/12	10:10	Grab	x	x	x	x	x	x							4
WR9	Whitefish River - Site # 9	July 10/12	10:55	Grab	x	x	x	x	x	x							4
WR8	Whitefish River - Site # 8	July 10/12	11:15	Grab	x	x	x	x	x	x							4
WR7	Whitefish River - Site # 7	July 9/12	13:23	Grab	x	x	x	x	x	x							4
WR6	Whitefish River - Site # 6	July 9/12	13:50	Grab	x	x	x	x	x	x							4
WR5	Whitefish River - Site # 5	July 10/12	13:40	Grab	x	x	x	x	x	x							4
WR4	Whitefish River - Site # 4	July 9/12	14:25	Grab	x	x	x	x	x	x							4
WR3	Whitefish River - Site # 3	July 9/12	14:50	Grab	x	x	x	x	x	x							4
WR2	Whitefish River - Site # 2	July 9/12	15:20	Grab	x	x	x	x	x	x							4
WR1	Whitefish River - Site # 1	July 10/12	13:02	Grab.	x	x	x	x	x	x							4
					x	x	x	x	x	x							4

Special Instructions / Comments

SHIPMENT RELEASE (client use)		SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)		
Released by:	Date & Time	Received by: [signature]	Date & Time: 10-JUL-12 15:10	Temp: 10.6	Cooling Initiated ☐ Yes ☐ No	Verified by:	Date & Time	Observations: Yes / No ? If Yes add SIF

Failure to complete all portions of this form may delay analysis. **TAT may vary dependant on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs. Any known or suspected hazards relating to a sample must be noted on the chain of custody in the comments section. By use of the form the user acknowledges and agrees with the Terms and Conditions as specified on the back page.

Appendix K:
LABORATORY WATER QUALITY RESULTS

Laboratory Water Quality Results for June 13-14, 2012

Parameter	Units	PWQO Criterion	WR1-Site #1	WR2-Site #2	WR3-Site #3	WR4 - Site #4	WR5-Site #5	WR6-Site #6	WR7-Site #7	WR8-Site #8	WR9-Site 9	WR10-Site 10
			14-Jun-12	13-Jun-12	14-Jun-12	14-Jun-12	14-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12
Physical Tests												
Conductivity (EC)	(uS/cm)	N/A	171	165	172	133	153.0	132.0	122	107.0	92.9	77.4
pH		6.5-8.5	8.05	8.09	8.14	7.93	8.02	7.97	7.94	7.90	7.79	7.54
Total Dissolved Solids	(mg/L)	N/A	111	104	104	90	100	90	80	74	65	60
Turbidity	(NTU)	<10% of natural	7.03	4.47	3.88	3.10	9.32	11.0	10.6	11.0	12.40	5.61
Anions and Nutrients												
Alkalinity, Total (as CaCO3)	(mg/L)	25% of natural	70.2	72.6	74.1	61.0	60.9	55.3	50.8	44.6	40.5	32.4
Ammonia-N, Total	(mg/L)	N/A	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Chloride (Cl)	(mg/L)	N/A	3.03	2.23	4.05	0.98	2.36	1.28	1.20	0.89	0.52	0.28
Nitrate-N (NO3-N)	(mg/L)	N/A	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Nitrite-N (NO2-N)	(mg/L)	N/A	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total Kjeldahl Nitrogen	(mg/L)	N/A	0.533	0.545	0.504	0.510	0.531	0.528	0.546	0.549	0.521	0.574
Phosphorus (P)-Total	(mg/L)	0.03	0.0122	0.0193	0.0111	0.0098	0.0115	0.0161	0.0132	0.0160	0.0169	0.0136
Sulphate (SO4)	(mg/L)	N/A	7.47	4.69	3.41	2.38	8.39	5.91	4.93	2.97	2.76	2.47
Bacteriological Tests												
Escherichia Coli	(MPN/100mL)	100	24	86	**150**	27	35	30	32	35	52	51
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	**>2420**	**>2420**	**>2420**	**1600**	**>2420**	**2400**	**1600**	**> 2420**	**1300**	**>2420**
Total Metals												
Aluminum (Al)-Total	(mg/L)	0.075	**0.221**	**0.139**	**0.0902**	**0.0831**	**0.336**	**0.440**	**0.413**	**0.430**	**0.469**	**0.208**
Antimony (Sb)-Total	(mg/L)	0.02	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
Arsenic (As)-Total	(mg/L)	0.005 (interim)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Barium (Ba)-Total	(mg/L)	N/A	0.017	0.011	0.013	0.011	0.017	0.015	0.014	0.013	0.013	<0.010
Beryllium (Be)-Total	(mg/L)	0.011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth (Bi)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron (B)-Total	(mg/L)	0.2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium (Cd)-Total	(mg/L)	0.0001	0.000025	<0.000017	0.000024	<0.000017	0.000032	0.000029	0.000024	0.000018	<0.000017	<0.000017
Calcium (Ca)-Total	(mg/L)	N/A	22.7	22.0	19.6	17.4	20.6	18.00	17.1	14.9	13.7	11.3
Chromium (Cr)-Total	(mg/L)	N/A	<0.0010	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	(mg/L)	0.0009	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	(mg/L)	0.005 (interim)	0.0026	0.0015	0.0017	0.0013	0.0029	0.0030	0.0026	0.0022	0.0022	0.0011
Iron (Fe)-Total	(mg/L)	0.3	**0.638**	**0.586**	**0.514**	**0.690**	**0.751**	**0.918**	**0.904**	**0.965**	**1.02**	**0.798**
Lead (Pb)-Total	(mg/L)	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	(mg/L)	N/A	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Magnesium (Mg)-Total	(mg/L)	N/A	7.22	6.24	7.21	6.15	6.29	5.44	5.04	4.21	3.64	2.77

Laboratory Water Quality Results for June 13-14, 2012

Parameter	Units	PWQO Criterion	WR1-Site #1	WR2-Site #2	WR3-Site #3	WR4 - Site #4	WR5-Site #5	WR6-Site #6	WR7-Site #7	WR8-Site #8	WR9-Site #9	WR10-Site #10
			14-Jun-12	13-Jun-12	14-Jun-12	14-Jun-12	14-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12
Total Metals Continued												
Manganese (Mn)-Total	(mg/L)	N/A	0.0307	0.0324	0.0126	0.0331	0.018	0.0195	0.023	0.0286	0.0348	0.0629
Molybdenum (Mo)-Total	(mg/L)	0.004	<0.0010	<0.0010	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	(mg/L)	0.025	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.002	<0.0020
Potassium (K)-Total	(mg/L)	N/A	0.86	0.93	0.92	0.73	0.66	0.61	0.55	<0.50	<0.50	<0.50
Selenium (Se)-Total	(mg/L)	0.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver (Ag)-Total	(mg/L)	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)-Total	(mg/L)	N/A	2.76	2.41	3.18	2.13	2.43	1.96	1.91	1.74	1.39	1.15
Strontium (Sr)-Total	(mg/L)	N/A	0.0461	0.0348	0.0351	0.0314	0.0464	0.0381	0.0367	0.0313	0.0296	0.0241
Tellurium (Te)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Thallium (Tl)-Total	(mg/L)	0.0003	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tin (Sn)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	(mg/L)	N/A	0.0063	0.0049	0.0026	0.0026	0.0087	0.0121	0.0117	0.0128	0.0135	0.0064
Tungsten (W)-Total	(mg/L)	0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	(mg/L)	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vanadium (V)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0013	0.0013	0.0013	0.0013	<0.0010
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0040	0.0041	0.0031	0.0041	<0.0030
Zirconium (Zr)-Total	(mg/L)	0.004	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Laboratory Water Quality Results for July 9-10, 2012

Parameter	Units	PWQO Criterion	WR1-Site #1	WR2-Site #2	WR3-Site #3	WR4 - Site #4	WR5-Site #5	WR6-Site #6	WR7-Site #7	WR8-Site #8	WR9-Site #9	WR10-Site #10
			10-Jul-12	09-Jul-12	09-Jul-12	09-Jul-12	10-Jul-12	09-Jul-12	09-Jul-12	10-Jul-12	10-Jul-12	10-Jul-12
Physical Tests												
Conductivity (EC)	(uS/cm)	N/A	187	184	183	159	169	149	138	116	106	91.2
pH		6.5-8.5	8.06	8.09	8.16	7.91	8.04	8	7.95	7.88	7.83	7.64
Total Dissolved Solids	(mg/L)	N/A	134	129	131	118	119	112	104	86	89	77
Turbidity	(NTU)	<10% of natural	4.12	2.38	3.57	3.69	4.75	7.33	6.27	9.21	9.4	6.12
Anions and Nutrients												
Alkalinity, Total (as CaCO3)	(mg/L)	N/A	83.4	87.7	86.6	77.1	71	64.9	60.4	51.9	48.2	41.3
Ammonia-N, Total	(mg/L)	N/A	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Chloride (Cl)	(mg/L)	N/A	3.29	1.37	3.34	1.14	2.88	1.67	1.58	1.14	0.83	0.43
Nitrate-N (NO3-N)	(mg/L)	N/A	<0.030	<0.030	<0.030	<0.020	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Nitrite-N (NO2-N)	(mg/L)	N/A	<0.020	<0.020	<0.020	0.036	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total Kjeldahl Nitrogen	(mg/L)	N/A	0.506	0.455	0.537	0.585	0.5	0.529	0.571	0.597	0.596	0.582
Phosphorus (P)-Total	(mg/L)	0.03	0.0089	0.0109	0.0103	0.0137	0.0087	0.0104	0.0112	0.0133	0.0131	0.01
Sulphate (SO4)	(mg/L)	N/A	7.18	4.67	2.24	1.37	8.55	6.14	4.84	2.9	2.47	2.1
Bacteriological Tests												
Escherichia Coli	(MPN/100mL)	100	66	**140**	62	51	23	24	29	66	86	**150**
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	**2400**	**>2420**	**>2420**	**>2420**	**2400**	**2400**	**1600**	**>2420**	**2400**	**>2420**
Total Metals												
Aluminum (Al)-Total	(mg/L)	0.075	**0.115**	0.071	0.0605	0.0423	**0.132**	**0.217**	**0.162**	**0.29**	**0.289**	**0.177**
Antimony (Sb)-Total	(mg/L)	0.02	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
Arsenic (As)-Total	(mg/L)	0.005 (interim)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Barium (Ba)-Total	(mg/L)	N/A	0.018	0.012	0.014	0.013	0.018	0.016	0.014	0.013	0.013	0.01
Beryllium (Be)-Total	(mg/L)	0.011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth (Bi)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron (B)-Total	(mg/L)	0.2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium (Cd)-Total	(mg/L)	0.0001	0.000025	<0.000017	<0.000017	<0.000017	0.000028	<0.000026	<0.000020	0.00002	<0.000017	<0.000017
Calcium (Ca)-Total	(mg/L)	N/A	24.4	25.8	23	20.8	22.7	19.7	18.6	15.9	14.9	12.9
Chromium (Cr)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0020	<0.0010
Cobalt (Co)-Total	(mg/L)	0.0009	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	(mg/L)	0.005 (interim)	0.0025	0.0013	0.0019	0.0012	0.0032	0.0026	0.002	0.002	0.0018	0.0011
Iron (Fe)-Total	(mg/L)	0.3	**0.528**	**0.51**	**0.605**	**0.87**	**0.559**	**0.743**	**0.723**	**0.943**	**0.966**	**0.992**
Lead (Pb)-Total	(mg/L)	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	(mg/L)	N/A	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Total	(mg/L)	N/A	7.31	6.91	8.15	6.99	6.5	5.53	5.03	4.1	3.66	2.98

Laboratory Water Quality Results for July 9-10, 2012

Parameter	Units	PWQO Criterion	WR1-Site #1	WR2-Site #2	WR3-Site #3	WR4 - Site #4	WR5-Site #5	WR6-Site #6	WR7-Site #7	WR8-Site #8	WR9-Site #9	WR10-Site #10
			10-Jul-12	09-Jul-12	09-Jul-12	09-Jul-12	10-Jul-12	09-Jul-12	09-Jul-12	10-Jul-12	10-Jul-12	10-Jul-12
Total Metals Continued												
Manganese (Mn)-Total	(mg/L)	N/A	0.0216	0.0226	0.0135	0.0397	0.0138	0.0144	0.0199	0.0255	0.0301	0.0492
Molybdenum (Mo)-Total	(mg/L)	0.004	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	(mg/L)	0.025	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Potassium (K)-Total	(mg/L)	N/A	0.91	1.12	0.99	0.79	0.72	0.6	0.54	<0.5	<0.5	<0.5
Selenium (Se)-Total	(mg/L)	0.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver (Ag)-Total	(mg/L)	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)-Total	(mg/L)	N/A	2.64	2.07	2.96	1.93	2.59	2.02	1.93	1.63	1.43	1.18
Strontium (Sr)-Total	(mg/L)	N/A	0.054	0.0403	0.0434	0.0384	0.0554	0.0446	0.0432	0.0361	0.0345	0.0285
Tellurium (Te)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Thallium (Tl)-Total	(mg/L)	0.0003	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tin (Sn)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	(mg/L)	N/A	0.004	0.0022	<0.0020	<0.0020	0.0039	0.0059	0.005	0.0088	0.0083	0.0057
Tungsten (W)-Total	(mg/L)	0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	(mg/L)	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vanadium (V)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	0.0012	<0.0010
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	<0.0030	<0.0030	<0.0030	<0.0030	0.0037	0.0035	<0.0030	0.0031	0.0033	<0.0030
Zirconium (Zr)-Total	(mg/L)	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Bold indicates exceedance of PWQO criteria

Appendix L:

WHITEFISH RIVER WATER LEVEL AND STREAMFLOW STATISTICS

Environment Canada Environnement Canada

Canada

WHITEFISH RIVER AT NOLALU

Water Survey of Canada
Burlington, Ontario

Station No. 02AB017
226 km^2

Monthly Extremes of Daily Levels in meters for the Period January 2002 - December 2011

	Maximum Daily	Minimum Daily	
JAN	1.016 m on Jan 16, 2003	0.450 m on Jan 10, 2007	JAN
FEB	1.594 m on Feb 07, 2007	0.401 m on Feb 15, 2007	FEB
MAR	1.588 m on Mar 25, 2007	0.496 m on Mar 26, 2005	MAR
APR	1.501 m* on Apr 17, 2009	0.505 m on Apr 27, 2010	APR
MAY	1.209 m on May 10, 2005	0.495 m on May 29, 2010	MAY
JUN	1.560 m on Jun 06, 2008	0.469 m on Jun 27, 2006	JUN
JUL	1.062 m on Jul 21, 2011	0.379 m on Jul 22, 2006	JUL
AUG	0.707 m on Aug 12, 2003	0.322 m on Aug 20, 2007	AUG
SEP	1.074 m on Sep 20, 2007	0.340 m on Sep 04, 2006	SEP
OCT	1.367 m on Oct 19, 2007	0.397 m on Oct 10, 2006	OCT
NOV	1.170 m on Nov 07, 2008	0.433 m on Nov 24, 2006	NOV
DEC	0.941 m on Dec 03, 2005	0.440 m on Dec 03, 2006	DEC
EXTREME	1.594 m on Feb 07, 2007	0.322 m on Aug 20, 2007	EXTREME

Extremes of Monthly Mean Levels in meters for the Period January 2002 - December 2011

	Maximum Monthly Mean	Minimum Monthly Mean	
JAN	0.732 m in 2009	0.521 m in 2010	JAN
FEB	1.027 m in 2007	0.510 m in 2005	FEB
MAR	1.330 m in 2007	0.527 m in 2005	MAR
APR	0.964 m in 2008	0.553 m in 2010	APR
MAY	0.853 m in 2009	0.561 m in 2007	MAY
JUN	0.892 m in 2008	0.539 m in 2006	JUN
JUL	0.626 m in 2008	0.431 m in 2006	JUL
AUG	0.565 m in 2003	0.364 m in 2007	AUG
SEP	0.725 m in 2007	0.383 m in 2006	SEP
OCT	0.893 m in 2007	0.447 m in 2006	OCT
NOV	0.835 m in 2008	0.454 m in 2006	NOV
DEC	0.730 m in 2002	0.466 m in 2006	DEC
EXTREME	1.330 m in 2007	0.364 m in 2007	EXTREME

Monthly Mean Levels in meters for the Period January 2002 - December 2011

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	PERIOD	
2002	0.657	0.563	0.713	0.800	0.655	0.649	0.534	0.479	0.431	0.499	0.513	0.730	------	2002
2003	------	------	------	------	0.633	0.596	0.582	0.565	0.553	0.588	0.664	0.673	------	2003
2004	0.635	0.640	------	------	0.705	0.709	0.521	0.443	0.451	0.491	0.543	0.596	------	2004
2005	0.594	0.510	0.527	0.894	0.828	0.639	0.504	0.433	0.456	0.566	0.687	0.653	------	2005
2006	0.566	0.745	0.686	0.893	0.789	0.539	0.431	0.424	0.383	0.447	0.454	0.466	------	2006
2007	0.551	1.027	1.330	0.883	0.561	0.642	0.488	0.364	0.725	0.893	0.693	0.649	------	2007
2008	0.577	0.769	0.782	0.964	0.827	0.892	0.626	0.483	0.543	0.633	0.835	0.668	------	2008
2009	0.732	0.768	0.692	0.952	0.853	0.605	0.482	0.489	0.438	0.485	0.550	0.648	------	2009
2010	0.521	0.549	0.686	0.553	0.582	0.540	0.451	0.403	0.484	0.513	0.575	0.675	------	2010
2011	0.563	0.526	0.551	0.884	0.754	0.583	0.600	0.471	0.414	0.463	0.457	0.531	------	2011

Water Survey of Canada
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	Mean Monthly Level in meters	Median Level in meters	Lower Quartile in meters	Upper Quartile in meters	
JAN	0.600	0.577	0.557	0.646	JAN
FEB	0.678	0.640	0.537	0.768	FEB
MAR	0.746	0.689	0.585	0.765	MAR
APR	0.853	0.888	0.821	0.937	APR
MAY	0.719	0.730	0.620	0.827	MAY
JUN	0.639	0.622	0.572	0.664	JUN
JUL	0.522	0.512	0.474	0.586	JUL
AUG	0.456	0.457	0.419	0.485	AUG
SEP	0.488	0.453	0.427	0.545	SEP
OCT	0.558	0.506	0.480	0.599	OCT
NOV	0.597	0.563	0.499	0.688	NOV
DEC	0.629	0.651	0.580	0.673	DEC
PERIOD	------	------	------	------	PERIOD

This report was produced on July 19, 2013 using the Water Level and Streamflow Statistics application located at http://www.wsc.ec.gc.ca /stafloindex_e.cfm?cname=main_e.cfm

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WHITEFISH RIVER AT NOLALU

Water Survey of Canada
Burlington, Ontario

Station No. 02AB017
226 km^2

Monthly Extremes of Daily Discharges in m^3/s for the Period January 1980 - December 2011

	Maximum Daily	Minimum Daily	
JAN	1.65 m^3/sec on Jan 01, 1985	0.090 m^3/sec on Jan 31, 2003	JAN
FEB	0.970 m^3/sec* on Feb 27, 2000	0.028 m^3/sec on Feb 28, 2003	FEB
MAR	7.90 m^3/sec* on Mar 26, 2000	0.012 m^3/sec* on Mar 19, 2003	MAR
APR	65.0 m^3/sec* on Apr 21, 2003	0.050 m^3/sec on Apr 07, 2003	APR
MAY	40.5 m^3/sec on May 18, 1996	0.371 m^3/sec on May 27, 1998	MAY
JUN	47.5 m^3/sec on Jun 06, 2008	0.177 m^3/sec on Jun 29, 1987	JUN
JUL	26.7 m^3/sec on Jul 05, 1999	0.094 m^3/sec on Jul 27, 1998	JUL
AUG	14.8 m^3/sec* on Aug 13, 1987	0.043 m^3/sec on Aug 24, 1990	AUG
SEP	21.0 m^3/sec on Sep 14, 1980	0.045 m^3/sec* on Sep 11, 1990	SEP
OCT	38.1 m^3/sec on Oct 18, 1998	0.149 m^3/sec on Oct 05, 1998	OCT
NOV	22.7 m^3/sec* on Nov 07, 2008	0.242 m^3/sec on Nov 22, 2002	NOV
DEC	13.9 m^3/sec on Dec 03, 1983	0.175 m^3/sec* on Dec 31, 2000	DEC
EXTREME	65.0 m^3/sec* on Apr 21, 2003	0.012 m^3/sec* on Mar 19, 2003	EXTREME

Extremes of Monthly Mean Discharges in m^3/s for the Period January 1980 - December 2011

	Maximum Monthly Mean	Minimum Monthly Mean	
JAN	0.668 m^3/sec* in 2002	0.148 m^3/sec in 1982	JAN
FEB	0.470 m^3/sec in 1984	0.056 m^3/sec in 2003	FEB
MAR	2.18 m^3/sec in 2010	0.029 m^3/sec in 2003	MAR
APR	14.7 m^3/sec in 2001	1.03 m^3/sec in 2010	APR
MAY	16.7 m^3/sec in 1996	1.04 m^3/sec in 1998	MAY
JUN	10.2 m^3/sec* in 2008	0.560 m^3/sec in 1998	JUN
JUL	5.53 m^3/sec in 1982	0.214 m^3/sec in 1998	JUL
AUG	2.96 m^3/sec in 1987	0.088 m^3/sec in 1998	AUG
SEP	6.47 m^3/sec in 1980	0.110 m^3/sec in 1998	SEP
OCT	9.75 m^3/sec in 2007	0.293 m^3/sec in 1997	OCT
NOV	5.93 m^3/sec in 1982	0.298 m^3/sec* in 2002	NOV
DEC	4.07 m^3/sec in 1983	0.236 m^3/sec in 1989	DEC
EXTREME	16.7 m^3/sec in 1996	0.029 m^3/sec* in 2003	EXTREME

Monthly Mean Discharges in m^3/s for the Period January 1980 - December 2011

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	PERIOD	
1980	0.350	0.223	0.174	5.27	1.75	0.573	0.484	0.523	6.47	2.23	1.55	0.602	1.67	1980
1981	0.411	0.421	0.785	12.4	4.21	4.39	0.674	0.320	0.199	1.02	0.797	0.306	2.15	1981
1982	0.148	0.128	0.148	7.18	6.28	1.23	5.53	0.838	1.05	6.37	5.93	1.83	3.07	1982
1983	0.521	0.436	0.578	5.35	5.40	2.53	3.87	0.719	0.549	1.84	2.47	4.07	2.37	1983

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Monthly Mean Discharges in m^3/s for the Period January 1980 - December 2011

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	PERIOD	
1984	0.550	0.470	0.365	7.65	5.97	3.79	1.01	0.809	0.456	1.09	1.14	2.23	2.12	1984
1985	0.549	0.179	0.531	7.26	4.18	4.64	2.69	1.20	3.22	5.22	2.27	0.845	2.74	1985
1986	0.528	0.407	0.614	13.7	6.41	1.37	0.756	0.491	0.513	0.640	1.94	0.494	2.32	1986
1987	0.320	0.289	0.347	1.48	1.24	0.731	0.534	2.96	1.81	1.25	0.985	0.379	1.03	1987
1988	0.175	0.123	0.403	5.04	3.14	0.941	0.324	1.70	2.12	1.02	3.07	1.01	1.58	1988
1989	0.511	0.294	0.239	7.45	7.79	3.19	0.988	0.346	0.625	0.343	0.414	0.236	1.87	1989
1990	0.157	0.103	0.273	4.33	3.28	3.80	2.86	0.394	0.291	0.936	1.16	0.552	1.51	1990
1991	0.297	0.225	0.568	7.14	5.04	1.03	0.950	0.125	0.260	0.603	1.70	0.656	1.55	1991
1992	0.382	0.300	0.166	4.30	11.9	1.23	1.59	0.894	2.43	1.23	1.10	0.588	2.18	1992
1993	0.263	0.209	0.525	6.05	5.83	2.65	5.04	1.50	0.763	0.787	0.620	0.275	2.05	1993
1994	0.201	0.197	0.217	8.64	5.76	3.21	2.36	0.690	0.503	0.758	1.94	0.575	2.09	1994
1995	0.165	0.151	0.454	3.39	5.02	0.978	1.92	0.315	0.237	3.53	1.91	0.613	1.57	1995
1996	0.404	0.376	0.369	6.93	16.7	3.07	4.57	1.34	0.595	1.64	2.41	0.796	3.29	1996
1997	0.369	0.264	0.251	8.98	5.65	1.79	3.45	0.276	0.162	0.293	0.832	0.275	1.88	1997
1998	0.187	0.139	0.413	4.63	1.04	0.560	0.214	0.088	0.110	4.89	2.70	1.56	1.38	1998
1999	0.331	0.263	0.697	11.7	4.14	1.47	5.39	1.69	1.75	2.36	1.25	0.554	2.64	1999
2000	0.349	0.428	1.73	3.43	4.52	2.68	0.989	0.287	0.479	0.367	0.842	0.246	1.36	2000
2001	0.165	0.160	0.162	14.7	8.43	3.35	0.957	1.16	0.435	0.768	1.91	1.95	2.84	2001
2002	0.668	0.335	0.225	4.89	2.10	2.11	0.815	0.422	0.187	0.530	0.298	0.302	1.07	2002
2003	0.162	0.056	0.029	6.54	2.07	1.58	1.42	1.26	1.20	1.45	1.10	0.658	1.46	2003
2004	0.436	0.310	------	------	3.30	3.94	0.840	0.296	0.330	0.635	0.755	0.266	1.53	2004
2005	0.195	0.160	0.258	7.60	7.26	2.24	0.733	0.283	0.385	1.21	2.32	1.62	2.03	2005
2006	0.579	0.310	0.617	8.01	5.82	0.986	0.342	0.326	0.137	0.351	0.314	0.333	1.51	2006
2007	0.235	0.114	0.105	1.48	1.08	2.48	0.554	0.121	5.33	9.75	1.98	0.868	2.02	2007
2008	0.480	0.289	0.275	9.76	8.21	10.2	1.60	0.386	0.981	1.62	5.47	1.13	3.35	2008
2009	0.529	0.409	0.461	9.90	7.60	1.46	0.436	0.485	0.251	0.427	0.765	0.491	1.94	2009
2010	0.309	0.236	2.18	1.03	1.47	0.935	0.412	0.219	0.575	1.16	0.966	0.682	0.853	2010
2011	0.369	0.223	0.388	9.35	5.11	1.30	2.35	0.406	0.201	0.415	0.309	0.248	1.72	2011

	Mean Monthly Discharge in m^3/s	Median Discharge in m^3/s	Lower Quartile in m^3/s	Upper Quartile in m^3/s	Median Cumulative Runoff Depth in mm	
JAN	0.353	0.350	0.197	0.504	4.46	JAN
FEB	0.258	0.250	0.160	0.329	7.35	FEB
MAR	0.469	0.369	0.225	0.568	12.46	MAR
APR	6.96	7.14	4.63	8.98	99.92	APR
MAY	5.24	5.07	3.17	6.38	169.97	MAY
JUN	2.39	1.95	1.08	3.20	199.12	JUN
JUL	1.77	0.989	0.584	2.61	236.72	JUL
AUG	0.715	0.454	0.301	1.09	243.90	AUG
SEP	1.08	0.508	0.253	1.16	248.52	SEP
OCT	1.77	1.05	0.611	1.79	268.11	OCT
NOV	1.66	1.20	0.806	2.20	281.39	NOV
DEC	0.852	0.595	0.313	0.974	286.77	DEC
PERIOD	1.95	1.91	1.51	2.28		PERIOD

This report was produced on July 19, 2013 using the Water Level and Streamflow Statistics application located at http://www.wsc.ec.gc.ca/staflo

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Home > Real Time Graph > Rating Curve >

Stage/Discharge Curve

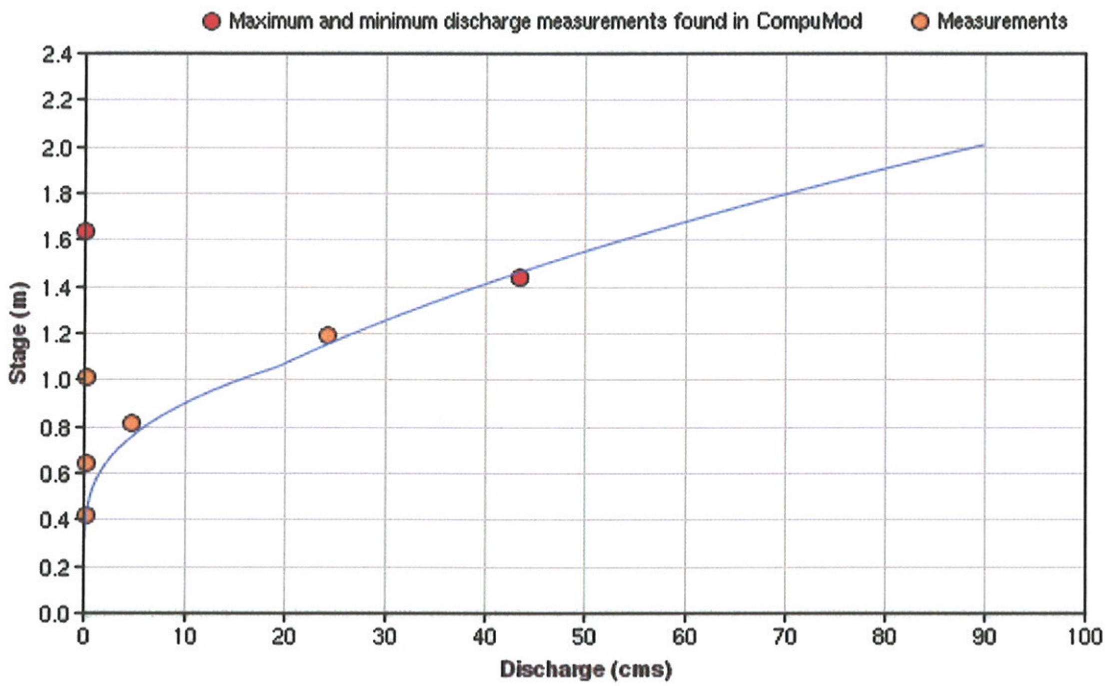
WHITEFISH RIVER AT NOLALU (02AB017) [ON]

Data Category:

Real Time Go

Available Curves:

14: 2012-10-04 00:00:00 - 3000-01-01 00:00:00 View Curve Download



Max.

Min.

Discharge: 43.4 (cms) **Stage**: 1.444 (m)

Discharge: 0.02 (cms) **Stage**: 1.637 (m)

Field Measurements for the Past 12 Months

Date	Water Level	Discharge	Deviation	Details	Remarks
2013-05-28 10:45:00	0.813	4.54	-28.40% (Curve 14)		

Date	Water Level	Discharge	Deviation	Details	Remarks
2013-05-21 12:50:00	1.444	43.4	3.29% (Curve 14)		
2013-05-07 13:43:00	1.189	24.2	-7.20% (Curve 14)		
2013-02-25 15:46:00	1.014	N/A	N/A		Complete ice cover - lots of glaciation.
2013-02-25 15:40:00	1.014	N/A	N/A		Complete ice cover - lots of glaciation.
2013-02-25 15:30:00	1.012	N/A	N/A		Complete ice cover - lots of glaciation.
2013-02-25 15:15:00	1.009	N/A	N/A		Complete ice cover - lots of glaciation.
2013-02-25 15:14:00	1.009	0.1955	-98.77% (Curve 14)	width = 3.9 area = 0.694 velocity = 0.2815	Complete ice cover - lots of glaciation.
2013-02-25 15:00:00	1.007	N/A	N/A		Complete ice cover - lots of glaciation.
2013-01-10 15:22:00	0.64	0.2668	-87.02% (Curve 14)	width = 4.95 area = 0.9385 velocity = 0.2843	
2012-10-04 09:29:00	0.408	N/A	N/A		Did not conduct wading measurement, water level was very close to last visit and measurement conducted.
2012-10-04 09:25:00	0.408	N/A	N/A		Did not conduct wading measurement, water level was very close to last visit and measurement conducted.
2012-10-04 09:23:00	0.408	N/A	N/A		Did not conduct wading measurement, water level was very close to last visit and measurement conducted.
2012-09-04 14:10:15	0.416	0.1924	-3.99% (Curve 14)	width = 7 area = 1.796 velocity = 0.1071	

Date Modified: 2013-04-15

Real-time Data - Subject to Revision

Stage/Discharge Curve for: 02AB017 WHITEFISH RIVER AT NOLALU
Rating Table: 14 Valid Period: 2012-10-04 00:00:00 To 3000-01-01 00:00:00

Description of Parameters:

Stage	Discharge
0.3	0
0.31	0
0.32	0
0.33	0.039
0.34	0.05
0.35	0.063
0.36	0.078
0.37	0.094
0.38	0.113
0.39	0.134
0.4	0.157
0.41	0.183
0.42	0.212
0.43	0.243
0.44	0.277
0.45	0.314
0.46	0.355
0.47	0.398
0.48	0.444
0.49	0.494
0.5	0.548
0.51	0.605
0.52	0.672
0.53	0.75
0.54	0.834
0.55	0.924
0.56	1.021
0.57	1.124
0.58	1.235
0.59	1.352
0.6	1.477
0.61	1.609
0.62	1.75
0.63	1.898
0.64	2.055
0.65	2.22
0.66	2.394

0.67	2.578
0.68	2.77
0.69	2.972
0.7	3.184
0.71	3.407
0.72	3.639
0.73	3.882
0.74	4.136
0.75	4.4
0.76	4.677
0.77	4.964
0.78	5.264
0.79	5.576
0.8	5.899
0.81	6.236
0.82	6.585
0.83	6.948
0.84	7.324
0.85	7.713
0.86	8.116
0.87	8.534
0.88	8.966
0.89	9.412
0.9	9.874
0.91	10.35
0.92	10.842
0.93	11.35
0.94	11.873
0.95	12.413
0.96	12.969
0.97	13.542
0.98	14.133
0.99	14.74
1	15.365
1.01	16.007
1.02	16.668
1.03	17.347
1.04	18.045
1.05	18.761
1.06	19.385
1.07	19.87
1.08	20.361
1.09	20.858
1.1	21.36
1.11	21.868
1.12	22.381
1.13	22.901

1.14	23.425
1.15	23.956
1.16	24.492
1.17	25.033
1.18	25.58
1.19	26.133
1.2	26.691
1.21	27.255
1.22	27.824
1.23	28.399
1.24	28.979
1.25	29.565
1.26	30.157
1.27	30.754
1.28	31.356
1.29	31.964
1.3	32.578
1.31	33.197
1.32	33.821
1.33	34.451
1.34	35.087
1.35	35.728
1.36	36.374
1.37	37.026
1.38	37.683
1.39	38.346
1.4	39.014
1.41	39.688
1.42	40.367
1.43	41.051
1.44	41.741
1.45	42.437
1.46	43.137
1.47	43.843
1.48	44.555
1.49	45.272
1.5	45.994
1.51	46.722
1.52	47.455
1.53	48.194
1.54	48.937
1.55	49.687
1.56	50.441
1.57	51.201
1.58	51.967
1.59	52.737
1.6	53.513

1.61	54.295
1.62	55.081
1.63	55.873
1.64	56.671
1.65	57.473
1.66	58.281
1.67	59.094
1.68	59.913
1.69	60.737
1.7	61.566
1.71	62.401
1.72	63.24
1.73	64.086
1.74	64.936
1.75	65.792
1.76	66.653
1.77	67.519
1.78	68.39
1.79	69.267
1.8	70.149
1.81	71.036
1.82	71.929
1.83	72.827
1.84	73.73
1.85	74.638
1.86	75.551
1.87	76.47
1.88	77.394
1.89	78.323
1.9	79.258
1.91	80.197
1.92	81.142
1.93	82.092
1.94	83.048
1.95	84.008
1.96	84.974
1.97	85.945
1.98	86.921
1.99	87.902
2	88.889
2.01	89.88