A WATER QUALITY SURVEY

OF

TEN LAKES IN THE CARLETON RIVER WATERSHED AREA

YARMOUTH AND DIGBY COUNTIES

NOVA SCOTIA

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TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

A water quality investigation was undertaken on ten lakes in the vicinity of the Carleton River Watershed in Yarmouth County to address concerns related to recently reported impaired conditions. Turbid, green conditions, including floating or suspended algal masses were reported in Lake Fanning during the summer of 2007 and 2008. The intent of the current investigation was to provide a snapshot of water quality in the lakes during late summer 2009, and provide an indication of whether conditions had changed since the previous survey in 2008. Also, baseline water quality was determined in one additional lake (Sloans) to provide the basis for any subsequent assessment, due to proposed development in its watershed. A cursory shoreline survey was also undertaken of each lake to identify any obvious activities that may be impacting lake water quality in the immediate watershed. Tributary streams were assessed for nutrient loadings to determine relative contributions to each lake and to help prioritize any future source related work. This investigation could be used to identify additional assessment needs and possible management approaches to improve water quality in the future.

Chemical water quality was determined at mid lake locations of each of the ten lakes, and bacteriology as well as algal abundance, speciation, and toxins concentrations were determined at shoreline areas. Lakes were sampled during the late summer period to capture the worst case scenario of water quality conditions for the year – since algal populations tend to peak under high temperature and high light conditions.

Results from the current study suggest that water quality in the 10 lakes during the late summer varied considerably among lakes, ranging from near pristine to highly impacted. Three lakes (Nowlans, Placides, and Hourglass) were extremely productive, having hyper-eutrophic to eutrophic conditions due, at least in part, to nutrient inputs from human activities in one or more of the watersheds. Three lakes (Parr, Ogden, and Fanning) were also very productive having eutrophic to mesotrophic conditions. Three lakes (Provost, Porcupine, and Vaughan) were moderately productive having mesotrophic conditions. One of the ten study lakes (Sloans) had low productivity, was oligotrophic, and had near pristine conditions. Nowlans Lake was found to be extremely nutrient rich, biologically very productive with respect to algal growth, and had associated low transparency due to the significant algal populations present. This study confirms a significant overall increasing nutrient trend in area lakes since the mid 1980s and deteriorating water quality. Human related nutrient sources are likely contributing significantly to lake nutrient levels in certain watersheds and impacting lake water quality.

Bacteriological water quality was acceptable for body contact recreation in all lakes during the study.
Water quality generally met Recreational Water Quality Guidelines for blue green algae (cyanobacteria). However, recreational guidelines were exceeded in one instance (Nowlans Lake) when cyanobacteria cell counts were greater than 100,000. Concurrent samples however, indicated no significant levels of cyanobacteria toxins, with concentrations generally below or near laboratory detection limits.

Lake shoreline surveys identified no additional significant sources of nutrients beyond those found in the previous survey of 2008. The 2008 survey identified three large nutrient sources which could potentially be stimulating algal production in these lakes. These potential sources were mink farms and a mink food processing facility on Nowlans Lake and an aquaculture operation on Hourglass

Lake. Otherwise, shoreline and watershed surveys to identify pollutant sources noted only a few small farms, limited commercial or industrial land use, and clustered residential development.

Rough nutrient loads from tributary streams provide an indication of relative contributions of nutrients from sub-watersheds of each lake. These loading estimates can be used to help prioritize any future work to identify and mitigate nutrient sources. No in-depth assessment of nutrient or pollutant sources from these watersheds was undertaken, since this was beyond the scope of the current investigation and available resources.

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BACKGROUND & INTRODUCTION

During the period of September to October of 2009 a water quality survey was undertaken on the selected lakes of concern in, or adjoining, the Carleton River watershed. This survey was initiated as a follow up to a previous survey undertaken in 2008 which was in response to concerns brought forward by local residents relating to impaired water quality. Background information leading to this initiative is outlined in the following text.

In the summer of 2007 turbid, green water conditions, including algal masses were reported in Lake Fanning. This resulted in follow up water quality sampling, which identified a cyanobacteria (blue green algae) bloom, and subsequent temporary posting of the lake as unsafe for recreational use and as a drinking water supply for a YMCA camp located on its shoreline. The following year similar conditions existed and additional lakes in the area were also reported as having turbid, green waters with surface scums – indicative of algal blooms. Local community groups had suggested that mink farms in the area might be impacting lakes in the area and the cause of such blooms. NSE Regional staff investigated to determine if any point source discharges were present and possibly impacting these lakes. The provincial Department of Agriculture assessed farm practices on area farms to ensure best practices are used and water resources in the area are not impacted.

In 2008 a water quality survey of 9 area lakes was undertaken by NSE to determine the status of water quality in the lakes of concern, particularly in terms of nutrient concentrations and trophic status, and to assess trends relative to any baseline water quality previously established. Additionally, the status of algal populations was estimated base on cyanobacteria abundance, speciation, and toxin concentrations at shoreline areas. Water quality was compared to existing benchmarks including OECD trophic categories, historic water quality, and Health Canada Guidelines for Canadian Recreational Water Quality.

The current study was not intended to be a comprehensive water quality assessment, but rather to provide an indication of 2009 lake water quality and algal populations relative to the 2008 results, and to determine nutrient loadings from tributary streams and on a sub-watershed basis. This information could serve as the basis for subsequent discussions about actions or management which could be implemented to improve water quality in these watersheds. Also in the current study, baseline water quality was determined in one additional lake (Sloans) to provide the basis for any subsequent assessment, due to proposed development in its watershed.

STUDY AREA

The Carleton River watershed is located in south-western Nova Scotia, lying northeast of Yarmouth and is tributary to the Tusket River. The Carleton River is in the Southern Upland region of the province, draining approximately 200 km^2 of watershed, and contains nearly 100 lakes, 8 of which are included in this survey. These lakes, listed in drainage order, are as follows; 1) Hourglass (a headwater lake), 2)Placides, 3)Porcupine, 4)Parr, 5)Ogden, 6)Fanning , 7) Sloans, and 8)Vaughan. Two additional lakes from neighbouring watersheds are also included: 1) Nowlans Lake, a headwater lake in the Meteghan River system, and 2) Provost Lake a headwater lake in the Sissaboo River system. The study area, including the three major watersheds and lakes of concern are shown on Figure 1A, Appendix A. Land use in these watersheds is mixed, consisting largely of forested land, limited agricultural use, and generally sparsely populated rural residential land use. Wetlands are interspersed throughout the area, imparting colour to adjoining surface waters through dissolved organic substances. This area of Nova Scotia is exposed to acidifying emissions from the northeastern US and eastern Canada, and subsequently 'acid rain' conditions. This situation, in conjunction with poorly buffered soils, results in acidified surface waters with low pH values.

METHODS

During September-October of 2009, a sampling program was undertaken in the study area lakes whereby physical and chemical characteristics of water quality were investigated, primarily to determine nutrient levels and associated trophic state[1]. On one or two occasions per lake, sampling was performed to determine late summer water chemistry and algal population status. Water temperature and dissolved oxygen profiles were determined in the field using a model 57 YSI meter while transparency or clarity was determined using a standard 20 cm Secchi disk. Water samples were taken at both a shoreline location and at a mid-lake location (generally at the deepest spot on the lake). These samples were collected at the lake surface (i.e. 0.5 meter depth) and at depth using a 2 litre Van Dorn type water sampler and placed in new clean 500 ml polyethylene bottles and further rinsed with lake water. Shoreline samples were expected to reflect conditions where recreational water use might occur – and followed standard protocols to assess blue green algae (cyanobacteria) in swimming areas {Recreational Water Quality Guidelines – Health Canada 2007 (in press)}. Mid-lake samples were expected to reflect overall lake condition and were used for comparison to generally accepted OECD trophic state indicators and water quality data from the previous year. Procedures followed standard protocols derived for the Nova Scotia Lake Survey Program and standard approaches for characterizing lakes in northern temperate climates.

Sampling methods for assessing lake condition followed standard protocols established for the NS Lake Survey program administered by NSE and NSDFA, and Health Canada's Recreational Water Quality Guidelines in order to provide consistent results for comparison purposes.

Sampling stations are shown on outline or bathymetric maps for each lake as presented on Figures 2 to 11, Appendix A.

Nutrient and chlorophyll a concentrations were determined in samples taken at a depth of 0.5 m below the surface (hereafter referred to as surface samples) at all lake stations. In addition, a sample was collected at a mid-depth (thermocline) and at 1 m above the bottom (hereafter referred to as bottom samples) to assess any water quality differences over depth. Secchi disk transparency was also determined at mid lake stations for each of the study lakes. Metal and major ion concentrations were also determined from all samples taken at mid-lake stations in the study lakes.

Cyanobacteria samples were collected at shoreline locations on all lakes to determine algal population density, speciation, and cell counts, and to assess spatial variation. Similarly,

[1]Trophic state refers to the level of biological productivity in a waterbody.

bacteriological samples were collected at shoreline locations and tested for Total Coliform and E. Coli bacteria.

All samples were kept cool and in the dark prior to lab analysis. Subsequently, samples were shipped to the lab such that analysis was performed within 24 hours of collection, as per APHA standard protocols.

Chemical analysis was performed at the Environmental Chemistry Laboratory of the Queen Elizabeth II Health Science Center (QE II) where analytical procedures were undertaken in accordance with established protocols outlined in "Standard Methods for the Examination of Water and Waste Water" (APHA Latest Edition). Algal analysis was performed at ALS Laboratory in Winnipeg, where analytical procedures were undertaken in accordance with established protocols such that comparison with Health Canada's Guidelines for Canadian Recreational Water Quality was possible.

Cursory shoreline and watershed surveys were undertaken to identify large pollutant sources and activities which may impact lake water quality. Visual observations were noted in field reports.

Streams tributary to study lakes were sampled for chemical water quality and flows were estimated. From nutrient concentrations and flow estimates, rough nutrient loads were calculated for sub-watersheds of study lakes – enabling determination of relative contributions of nutrients from various watersheds.

RESULTS AND DISCUSSION

The chemical water quality characteristics or parameters which were measured during this study can be divided into three broad categories. These include parameters necessary to determine trophic state (i.e. nutrients, chlorophyll, transparency), major ions and metals. Trophic state was given primary consideration due to the nature of the expressed concerns as well as potential impacts from local land uses. Major ions and metals were included in order to provide quality assurance of the data set, to fully characterize water quality, and to facilitate further assessment if required. Chemical data are presented in Tables 2A-C, in Appendix C.

Physical characteristics, as outlined in the previous section, were investigated in terms of water temperature and dissolved oxygen profiles for all mid-lake stations. Physical data are presented in Tables 3A-B, in Appendix C.

Baseline water quality data from 2008 existed for all but one study lake (Sloans). These data were used for comparison of water quality changes over time and are presented in Table 4, Appendix C.

The biological water quality parameters measured during this study were related to algal populations and primary production in the lake. Blue green algae (cyanobacteria) populations were identified in terms of genus and /or species for major groups in the lake at time of sampling, and were quantified both in general terms (small / medium/ large amount) and numerically (cell count / ml of sample).

Blue green algae toxin levels were also measured in terms of concentrations of Microcystin LR in collected samples. Algal data are presented in Table 5 in Appendix D.

During 2008 lake shoreline surveys identified only three large potential nutrient sources which could be stimulating algal production in these lakes. These potential sources were mink farms, a mink food processing facility, and an aquaculture operation. No additional potential sources were identified during this study. Shoreline and watershed surveys to identify pollutant sources noted only a few small farms, limited commercial or industrial land use, and clustered residential development.

Tributary stream nutrient loads were estimated for the sampling dates to provide an indication of relative contributions of nutrients from sub-watersheds of each study lake. Results are shown in Table 6, Appendix E. No in-depth assessment of nutrient or pollutant sources from these watersheds was undertaken, since this was beyond the scope of the current investigation and available resources.

Results from each of the main areas of investigation (trophic state, temperature and dissolved oxygen, blue green algae, bacteria, major ions and metals, shoreline survey, and tributary stream nutrient loads) are discussed below.

LAKE CONDITIONS

Trophic State

Trophic state refers to the level of biological productivity within a lake gauged over a range of very unproductive (oligotrophic) conditions to very productive (eutrophic) conditions. Conditions midway between these two extremes are termed mesotrophic. A progression from very unproductive to very productive conditions typifies the natural lake aging process and is termed eutrophication. This process, which involves the lake basin gradually infilling with silt and organic matter, takes thousands of years to complete and eventually causes the lake to evolve back to dry land. Manmade influences that contribute additional nutrients, organic matter and sediment to a lake can greatly accelerate this process and cause the lake to infill at a much faster rate. This accelerated process is termed cultural eutrophication.

Three key indicators of trophic state have been established. They are generally recognized as being chlorophyll a, nutrient concentrations (typically total phosphorus or nitrogen), and transparency as determined by a Secchi disk.

Chlorophyll a concentration has been shown to correlate well with levels of algal biomass (Nicholls and Dillon 1978). Additionally, strong correlations between chlorophyll a, total nutrient concentration and transparency have been shown, based on mean annual or mean ice-free season concentrations (Dillon and Rigler 1974, Vollenweider and Kerekes 1980, Clark and Hutchison 1992).

Total nutrient concentrations represent the chemical response of a lake to eutrophication while chlorophyll a concentrations represent the biological response, and transparency represents the physical response. Together these water quality parameters provide an excellent indication of trophic state when monitored over a full growing season and taken in the context of the lake as a whole.

However, due to both time and resource constraints mean annual or ice-free season concentrations could not be determined for this study. As a surrogate, nutrient, chlorophyll, and transparency values were determined during the end of summer period when associated peak water temperatures for the year are expected. This period was chosen to represent the "worst case scenario" situation, where algal production and chlorophyll concentrations should be at peak values for the year.

These water quality parameters are addressed in the following text - where 2009 data and baseline water quality from 2008 are compared to established values for trophic state categories (OECD 1982) as shown in Table 1 below and as presented in Figures 10A, 11A, and 12A, Appendix B.

Table 1

PROPOSED BOUNDARY VALUES FOR TROPHIC CATEGORIES (OECD 1982)
(fixed boundary system)

Trophic Category	(P)	(chl)	(max chl)	(Sec)	(min sec)
	mg/m^3 (ug/l) *			Meters	
Ultra-oligotrophic	< 4.0	<1.0	<2.5	>12.0	>6.0
Oligotrophic	<10.0	<2.5	<8.0	>6.0	>3.0
Mesotrophic	10 - 35	2.5 - 8	8 - 25	6 - 3	3 - 1.5
Eutrophic	35 -100	8 - 25	25 - 75	3 - 1.5	1.5 - 0.7
Hypertrophic	>100	>25	>75	<1.5	<0.7

(P) annual mean in-lake total phosphorus concentration
(chl) annual mean chlorophyll a concentration
(max chl) annual maximum chlorophyll a
(sec) annual mean Secchi disk transparency
(min sec) annual minimum Secchi disk transparency
* Note: mg/m^3 and ug/l are equivalent units = parts per billion

Nutrients

Nutrients investigated in this study include two forms of phosphorus – ortho phosphorus and total phosphorus (Total P), and three species of nitrogen - nitrate + nitrite, ammonia, and total nitrogen (Total N). Results for these parameters are found in Tables 2A-C, Appendix C.

Total nutrient concentrations (i.e. both organic and inorganic species, as in Total P and Total N) are considered to be the best chemical indicators of trophic state (OECD 1982, Clark & Hutchison 1992) and therefore, are of primary interest to this investigation. Ratios of Total N to Total P concentrations can be used to determine which nutrient is in shortest supply and therefore is the limiting nutrient for plant growth in any given lake. It has been shown that if the Total N/Total P ratio is greater than 17:1 phosphorus is limiting; less than 17:1 nitrogen is limiting (OECD 1982). In the study area lakes during the 2009 survey, TN/ TP ratios ranged from 2/1 in Nowlans Lake to 36/1 in Sloans Lake, with a mean of 13/1 for all ten lakes surveyed. All lakes during 2009 appear to be nitrogen limited except one (Sloans). This is in contrast to the 2008 survey where, 4 lakes appeared to be nitrogen limited (Nowlans, Hourglass, Placides, and Parr) and phosphorus appeared limiting in the remaining 5 lakes (Provost, Porcupine, Ogden, Fanning, and Vaughan). Calculated ratios are shown in Tables 2A-B and Table 4, Appendix C.

Phosphorus is generally in shortest supply in natural lakes, and therefore is typically the limiting nutrient controlling biological production. Low TN to TP ratios in some study lakes suggest significant inputs of phosphorus to these lake systems.

Total P concentrations during the 2009 sampling period for all sample locations ranged from a minimum of < 5 ug/l at various locations on Sloans Lake on September 10th to a maximum of 5400 ug/l at the surface of shoreline station #3 and inlet stream #1of Nowlans Lake both on October 15th. Total P concentrations from samples taken at mid-lake stations of study lakes ranged from <5 ug/l at Sloans Lake to 720 ug/l at Placides Lake, with an overall mean of 149 ug/l TP for all 10 study lakes.

Nutrient levels in the 10 lakes during the late summer of 2009 varied considerably among lakes, ranging from near pristine to highly impacted. Six lakes (Nowlans, Placides, Hourglass, Parr, Ogden, and Fanning) were very productive, with nutrient concentrations indicating eutrophic or hyper-eutrophic conditions. Three lakes (Provost, Porcupine, and Vaughan) were moderately productive having mesotrophic conditions. One lake (Sloans) appeared near pristine with low productivity and oligotrophic conditions. These results are shown in Figure 10A, Appendix B. Placides Lake Total P values (720 ug/l) were exceptionally high– nearly twice the value found in Nowlans Lake (380ug/l) – suggesting a likely significant nutrient source in the immediate watershed. This occurance was similarly found during the 2008 survey.

Total P concentrations from samples taken at mid-lake stations of study lakes during the summer of 2009 are compared to those taken in the previous survey in 2008 as well as established trophic categories, and are presented in Figure 10A, Appendix B.

The Total P values shown in Figure 10A indicate that study area lakes nutrient concentrations overall have much the same pattern and relative values among lakes as in the 2008 survey. However, Total P concentrations found in 2009 have changed greatly in some lakes and very little in others. Three lakes (Hourglass , Placides, and Nowlans) showed little change from 2008, while the remaining six lakes in the 2008 survey showed significantly increased Total P levels (from 2 to 6 times Total P values of 2008).This apparent trend of increasing Total P concentrations in most study lakes may not be reflective of actual differences in annual conditions, but rather due to seasonal influences and differences, since early lake turnover and fall temperatures were experienced in 2009. Regardless, two lakes (Placides and Nowlans) had extremely high Total P levels, 720 ug/l and 380 ug/l respectively. These were comparable to levels found in 2008. Nowlans lake was also observed to be turbid green during the 2009 sampling period, similarly to 2008.

Chlorophyll

Primary productivity can be defined for the purpose of this study as being the extent of microscopic plant life or algal production in the water column as a result of available nutrients. The most commonly accepted indicator to quantify this primary productivity or algal biomass is obtained by measuring the chlorophyll a concentration in representative water samples. Chlorophyll a concentrations have been shown to correlate extremely well with algal biomass (Nicholls and Dillon 1978). Therefore, an increase in Chlorophyll a concentrations indicate an associated and proportional increase in algal biomass or density.

As in the case of nutrients, algal population growth can vary significantly, over time and space. Therefore, the sampling protocol was designed to address this natural variability as much as possible.

Chlorophyll concentrations recorded at the mid-lake stations are most representative of a lake as a whole and are presented in Figure 11A. Mid-lake chlorophyll values ranged from 0.6ug/l in Placides Lake on October 21st to 57.7 ug/l in Nowlans Lake on October 15th. When compared with the OECD eutrophication tables (Table 2), current chlorophyll values indicate that study area lakes fall into a range of trophic categories from a very unproductive, oligotrophic state to the very productive hyper-eutrophic state. Headwater lakes higher in the watershed tended to be more productive (Nowlans – eutrophic) (Hourglass and Provost – showing mesotrophic tendencies) with other lakes significantly less productive and falling into an oligotrophic category. The head water lake which was an exception was Sloans Lake which appeared unproductive, oligotrophic, and had relatively pristine water quality. Study lakes generally showed a progressively lowering productivity as they flowed downstream from headwater lakes to an oligotrophic Vaughan Lake at the bottom of the watershed, as indicated in Figure11A.

Chlorophyll data compared to the 2008 survey was significantly lower in all lakes with exception of Nowlans Lake, which had lower values but not significantly so. Lower chlorophyll values were likely the results of lower water temperatures and lake turnover experienced during this survey compared to conditions during the previous survey. Although chlorophyll concentrations were lower in all lakes during the current survey, chlorophyll values overall had much the same pattern and relative values among lakes as in the 2008 survey.

Shoreline samples were also analysed for chlorophyll to assess spatial differences within selected lakes. Chlorophyll values were roughly comparable between mid-lake and shoreline sampling locations, as indicated in Tables 2A-B. Chlorophyll concentrations in shoreline samples were 0.6 ug/l at the shoreline station of Lake Vaughan on October 28th compared to 1.3 ug/l at mid-lake. Chlorophyll concentrations in shoreline samples at Sloans Lake were 1.3 ug/l on September 10th and 1.6 ug/l on November 5th , compared to mid-lake values of 1.9 ug/l and 1.6 ug/l respectively on the same dates.

Transparency

Transparency, as determined by a Secchi disk depth, is considered a good indicator of productivity and trophic state when suspended sediment and highly coloured waters are not present to bias results

(OECD 1982). During this study, mid-lake surface samples, which are representative of overall lake conditions, exhibited a range of colour values from 20 True Colour Units (TCU) in Sloans Lake on September 19th to 190 TCU in Placides Lake, on October 21st , with an overall mean for all lakes of 104 TCU. These colour values are quite high and somewhat above average for Nova Scotia lakes which are usually less than 45 TCU (see Major Ions, Colour section- Appendix F). Colour is significantly higher in all lakes compared to the 2008 survey and may be due to significant rainfall in the weeks prior to the survey and leaching of organic substances from the watershed particularly where wetlands are found. Secchi measurements were not taken during or immediately following any major rain event. At least 24 hours following any significant rain event was used as a requirement of any given sampling date. Given these conditions, Secchi depth transparency might be considered to be an appropriate indicator of algal production and therefore trophic state, although data should be interpreted with caution, due to the high colour in some study lakes.

Secchi depths ranged from a minimum of 0.45 meters at the mid-lake station of Placides Lake on October 21st to a maximum of 3.8 meters on Sloans Lake on September 10th. The Secchi disk transparency values reported appear to be related to both chlorophyll concentrations and colour at the respective sampling locations. Stations having colour less than 45 TCUs would have transparencies driven by algal productivity and chlorophyll concentrations, while those with colour greater than 45 TCUs are likely to be more greatly influenced by colour from natural organic compounds. Transparency values recorded at mid-lake stations of all lakes are presented in Figure 12A and compared to OECD trophic categories, but should be interpreted with caution. When compared with the OECD eutrophication tables (Table 1), current transparency values indicate that study area lakes fall into a range of trophic categories from a very unproductive oligotrophic state (Sloans) to an extremely productive hypertrophic state (Placides and Parr) (see Figure 12 A, Appendix B). However, the transparency results for Placides and Parr lakes are not thought to be reflective of productivity due to their extremely high colour values (190 TCUs and 176 TCU respectively, and therefore the trophic categories as suggested by transparency do not apply. However transparency results for Sloans Lake and Nowlans Lake, with colour values reported of 20 TCUs and 33 TCUs respectively, are thought to be reflective of productivity due to their low colour – with oligotrophic and eutrophic conditions respectively determined.

Figure 12A presents transparency for study lakes for the current survey as well as that of 2008. Transparency data indicate that 2009 values were significantly lower than values from the previous survey of 2008. Nevertheless, overall patterns and relative values among lakes were similar to the 2008 results. Despite the influences of colour, there appeared to be a generally increasing trend in lake transparency relative to the position in the watershed. That is, transparency increased in the series of lakes as one progressed downstream in the watershed.

In summary, the primary indicators of trophic state, chlorophyll a, total phosphorus, and transparency, suggest that study area lakes ranged from very unproductive oligotrophic conditions to very productive hyper-eutrophic conditions during this study. All three indicators agreed that 1 lake (Sloans) was oligotrophic or nearly pristine, unproductive, had nearly no algal growth, and had high transparency; also that 1 lake (Nowlans) was very eutrophic, highly productive with high algal growth and very low transparency. The remaining lakes fell between these conditions and indicators were not in good agreement. Although the primary indicators of trophic state are all relevant indicators of trophic state, due to the conditions encountered during this study period with an early fall and colder weather, Total P is likely the best overall indicator of productivity. Based on Total P concentrations 1 of the ten study lakes (Sloans) was oligotrophic, 3 lakes (Provost, Porcupine, and Vaughan) were mesotrophic, 4 lakes (Hourglass, Parr, Ogden, and Fanning) were eutrophic, and 2 lakes (Nowlans and Placides) were found to be hyper-eutrophic. Nowlans Lake was found to be extremely nutrient rich, biologically very productive with respect to algal growth, and had associated low transparency due to the significant algal populations present.

Nowlans Lake had the highest chlorophyll values of all lakes in the study, and consistent ratings with the other trophic state indicators – having the second highest nutrient levels (Total P) and very low transparency – all indicating eutrophic or hyper-eutrophic conditions. This was also consistent with the results of the 2008 study.

The Total P values shown in Figure 10A indicate that study area lakes nutrient values have changed greatly in some lakes and very little in others. The apparent trend though is increasing Total P concentrations in all lakes compared to the 2008 study. Moreover, as found in the 2008 study, current Total P levels have significantly increased in several lakes compared to historic data from 1983 (see previous report). Two lakes in particular (Nowlans and Hourglass) had significant increases in Total P levels. Nowlans Lake showed increases from 6 ug/l (1983) to 400 ug/l (2008) and 380 ug/l (2009), while Hourglass Lake showed increases from 12 ug/l (1983) to 69 ug/l (2008) and 78 ug/l (2009).

<u>Temperature</u>:

Temperature profiles were recorded for the entire water column on each lake at a mid-lake station. From this data it was determined whether thermal stratification existed at that time. This information, in association with dissolved oxygen concentrations, was primarily used to interpret analytical results.

Nearly all lakes were found to be unstratified and well mixed during the sampling period. Although Sloans Lake was unstratified during the November 5^{th} sampling date, it was found to be stratified during the earlier September 10^{th} sampling date. This indicates that lake turnover occurred between these two dates within Sloans Lake.

<u>Dissolved Oxygen</u>:

Dissolved oxygen profiles were recorded concurrently with water temperature at all mid-lake stations. As indicated above, dissolved oxygen concentrations were primarily used in interpreting analytical results but were additionally used to determine probability of nutrient reintroduction from bottom sediments.

Minimum concentrations of dissolved oxygen were recorded as approximately 2.1 mg/l at the 8 meter level of the mid-lake station on Sloans Lake on September 10^{th}. The lowest dissolved oxygen concentration recorded of any other lake in the study was 8.6 mg/l at 7 meters depth in Placides lake on October 21^{st}.

In summary, temperature and dissolved oxygen profiles indicated significant thermal stratification in only one lake (Sloans) during the sampling period of 2009. All other lakes were well oxygenated at the time of sampling. Lake turnover apparently occurred between the two sampling dates at Sloans Lake (ie September 10^{th} and November 5^{th}). It is likely that stratification had occurred at the other lakes earlier in the season, similar to the situation reported during the previous study in 2008.

In 2008 dissolved oxygen concentrations approached 0 mg/l in bottom waters of deeper lakes. Therefore, the reintroduction of nutrients from the bottom sediments as a result of hypolimnetic oxygen depletions is likely to occur in those deeper lakes.

Blue Green Algae (Cyanobacteria):

Blue green algae concentrations ranged from <1 cell /ml in Vaughan Lake on October 28th to 175,000 cells /ml in Nowlans Lake on October 15th. All lakes had low levels of blue green algae with the exception of Nowlans Lake. The next highest concentration was found in Sloans Lake with 5110 cells /ml on September 9th. Results for all lakes are presented in Table 5, Appendix D and Figure 13A, Appendix B.

Water quality met Recreational Water Quality Guidelines on all lakes and on all sampling dates except one. Recreational guidelines were exceeded in one instance (Nowlans Lake) when cyanobacteria cell counts were greater than 100,000 / ml on October 15th. Concurrent samples however, indicated no cyanobacteria toxins, with concentrations below laboratory detection limits. Microcystin toxin results for all lakes are presented in Table 5, Appendix D and Figure 13B, Appendix B.

Recreational water quality indicators (microcystin toxin level and cyanobacteria cell count) may show differing results, as in the case of Nowlans Lake. The former indicator measures algal toxins already present in water and the latter indicator measures the potential for toxin release to water from algae. Microcystin toxin concentration is a more reliable indicator, since it is a direct measure of toxicity to humans. Nevertheless, cyanobacteria cell count can be a valuable indicator as well, since it is a measure of the potential for toxin release from those cells. Toxin levels can increase in a lake with an algal population crash and associated toxin release from these algal cells. Therefore, it might be prudent to take a conservative approach and favour the cell count indicator.

Previously during the 2008 survey a mink farm was observed near the shoreline of Nowlans Lake , up-gradient in the watershed, and with diffuse overland runoff from the site towards the lake. This was deemed to be a significant potential nutrient source. Samples were taken at three shoreline locations on Nowlans Lake on August 28, 2008. One sample was taken at a boat launch (SL1), one near the diffuse flow from the farm (SL2), and one down wind of the farm (SL3), as indicated in Figure 3, Appendix A. Both nutrients and chlorophyll showed high values with a progression of increasing concentrations from the boat launch to the down wind station past the mink farm shoreline during the 2008 study. The results indicated the highest values located in the lake location down wind of the suspect nutrient source (see 2008 study for details).

Blue green algae cell counts were determined in 2009 at the three shoreline locations (SL1, SL2, and SL3) on Nowlans Lake as described above**.** Values at the shoreline locations sampled on

October 15th were 120,000, 127,000, and 175,000 cells/ml, respectively, and are presented in Figure 13C. These results were consistent with the findings of the 2008 study, where values at the shoreline locations sampled on August 28, 2008 were 104,000, 78,800, and 95,600 cells/ml, respectively.

Bacteriology (E. coli):

Bacteriological sample results ranged from 0 counts / 100mls in Hourglass Lake to 56 counts / 100mls in Placides Lake, and therefore met recreational water use guidelines (200 / 100mls) throughout the study.

Major Ions

Ions are both negatively and positively charged particles which are found dissolved in water. These include substances which may be considered to be nutrients and metals, but for the purpose of this study refer to all other common substances found in solution.

A list of these water quality parameters and associated results are found in Table 2A, Appendix C. Concentrations of these parameters are presented for 2009, with summary statistics calculated (i.e. minimum, maximum, and mean values). Major ion results confirm quality of the data set for this study, and are provided to facilitate any further assessment if required. No further analysis or interpretation of these parameters are provided at this time.

However, a brief explanation of these parameters was provided in the previous 2008 report, and can be found in Appendix F.

Metals

Dissolved metals which were investigated during this study are listed, along with results, in Table 2A, Appendix C. As with major ions, concentrations of specific metals are presented, with summary statistics calculated (i.e. minimum, maximum, and mean values). Dissolved metals results confirm quality of the data set for this study, more fully characterize water quality, and are provided to facilitate any further assessment if required. No further analysis or interpretation of these parameters is provided at this time.

WATERSHED / SHORELINE SURVEY

Lake shoreline surveys undertaken in 2009 identified no additional large nutrient sources beyond those identified during the 2008 survey. Previously three large nutrient sources were identified which could potentially be stimulating algal production in the study lakes. These potential sources included mink farms and a mink food processing facility on Nowlans Lake and an aquaculture operation on Hourglass Lake. Otherwise, shoreline and watershed surveys to identify pollutant sources noted only a few small farms, limited commercial or industrial land use, and clustered residential development.

TRIBUTARY STREAM NUTRIENT LOADS

Nutrient concentrations, steam flow estimates, and an associated 'snapshot' of nutrient loadings determined in streams tributary to study lakes are shown in Table 6, Appendix E. Nutrient loadings were highly variable among all tributary streams assessed and among tributary streams for individual lakes. Stream loadings of phosphorus, generally the limiting nutrient driving productivity in lakes, ranged from a minimum of 0.0015 kg Total Phosphorus (TP) / day in a tributary stream of Hourglass Lake to a high of 223.86 kg TP / day in a tributary stream to Placides Lake. No further assessment of nutrient or pollutant sources from these watersheds was undertaken, since this was beyond the scope of the current investigation and available resources.

CONCLUSIONS

Based on the results of this study, it can be concluded that the 10 lakes surveyed fall into a range of trophic categories from a very unproductive, oligotrophic state to the very productive hyper-eutrophic state. Two lakes (Nowlans and Placides) were extremely productive, having hyper-eutrophic conditions due, at least in part, to nutrient inputs from human activities in one or more of the watersheds. Four lakes (Hourglass, Parr, Ogden, and Fanning) were also very productive having eutrophic conditions. Three lakes (Provost, Porcupine, and Vaughan) were moderately productive having mesotrophic conditions, and one of the ten study lakes (Sloans) was oligotrophic, having near pristine conditions.

Headwater lakes higher in the watershed tended to be more productive (Nowlans and Placides – hyper-eutrophic, Hourglass - eutrophic) with other lakes less productive as they flowed downstream (Parr, Ogden, and Fanning – eutrophic to mesotrophic), (Provost, Porcupine, and Vaughan – mesotrophic). However, Sloans, also a headwater lake, was oligotrophic due to the relative lack of development in its watershed.

The presence of relatively more productive headwater lakes (eg Nowlans, Placides, and Hourglass) suggests significant nutrient sources in their immediate watersheds. Typically, headwater lakes are lower in nutrients and productivity than lakes lower in the same watershed, when only natural nutrient sources and processes are at play.

Rough comparisons of nutrient related water quality parameters between the mid 1980s and the previous 2008 study indicated an overall increasing nutrient trend and somewhat deteriorating conditions. The current study confirms this situation, with continued impacted and poor water quality in some lakes. There are also some indications that water quality may be further declining in some lakes (ie increasing phosphorus levels, decreasing Total Nitrogen / Total Phosphorus ratios, and increasing blue green algae production). Two lakes in particular had significant increases in nutrient levels over time {Nowlans Lake with Total Phosphorus of 6 ug/l (1983), 400 ug/l (2008), and 380 ug/l (2009), and Hourglass Lake with Total Phosphorus of 12 ug/l (1983), 69 ug/l (2008), and 78 ug/l (2009)}. One lake was exceptionally nutrient rich (Placides Lake with Total Phosphorus value of 720 ug/l) and had nearly twice the nutrients of any other lake, including the extremely high values found in Nowlans Lake (380ug/l). This occurance was similarly found during the 2008 survey where Placides Lake had a nearly identical Total Phosphorus value of 740 ug/l at that time. The exceptionally high nutrient levels found in these three lakes suggest likely significant nutrient sources in their immediate watersheds. One lake (Sloans) by comparison, had very low nutrient concentrations (Total Phosphorus of 5 ug/l) which is indicative of near pristine water quality.

Several large nutrient sources were identified in the study area which may be major contributors to the observed increase in nutrients, high chlorophyll levels, and decrease in transparency observed in some lakes.

Reintroduction of nutrients from bottom sediments to the water column as a result of hypolimnetic oxygen depletions may occur due to the fairly strong thermal stratification observed.

Bacteriological water quality met recreational water use guidelines in all lakes throughout the study.

The algal assessment indicated that cyanobacteria populations were generally low in all lakes tested, with the exception of Nowlans Lake, which had high algal populations or bloom conditions (high cell counts and turbid green coloration) but little or no toxin production. This was consistent with findings in the 2008 study.

Recreational use guidelines for blue green algae (cyanobacteria) (< 100,000 cell count) were exceeded on Nowlans Lake again in 2009. Concurrent samples however, indicated no significant levels of cyanobacteria toxins, with concentrations generally below laboratory detection limits. Toxin guideline levels for recreational use were not exceeded at any time in any lake.

The two recreational water use guidelines did not support the same conclusion regarding safe use for swimming in Nowlans Lake. It might be prudent to take a conservative approach and consider water quality in that lake as unsuitable for recreational water use based on the cell count indicator. Toxin levels could increase in the lake with an algal population crash and associated toxin release from algal cells.

It should be noted that due to the limitations of this survey, seasonal peak blue green algae populations as well as chlorophyll concentrations, may not have been fully captured. Values for these parameters during the current study should be viewed as conservative estimates due to the onset of early fall conditions in 2009. Very high nutrient concentrations in some lakes suggest that algal blooms may continue to be a concern in these watersheds.

Lake shoreline surveys undertaken in 2009 identified no additional large nutrient sources beyond those identified during the 2008 survey. In 2008 cursory lake shoreline surveys identified several large nutrient sources which could potentially be stimulating the observed algal production in some of the study area lakes. These potential sources included mink farms and a mink food processing facility on Nowlans Lake and an aquaculture operation on Hourglass Lake. Other unidentified point and non-point pollutant sources may be contributing to deteriorating water quality of lakes in the study area.

The ‘snapshot’ of nutrient loadings determined for tributary streams during this study provide a rough indication of nutrient inputs to study lakes, including relative contributions from each lake’s sub-watersheds. The relative importance and potential ranking of phosphorus contributions to each study lake can be determined from data shown in Table 6 - with higher stream loadings suggestive of higher priority for attention. The most significant Total Phosphorus loading calculated during the study was in a tributary to Placides Lake (223.8 Kg TP / day) – which may merit further investigation. Calculated nutrient loads are indicative of nutrient inputs during the study period only, and it should be understood that these loads are based on limited data. Annual loads based on more complete seasonal data may differ and could therefore suggest different priorities for nutrient reduction strategies.

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APPENDIX A

Figure 1

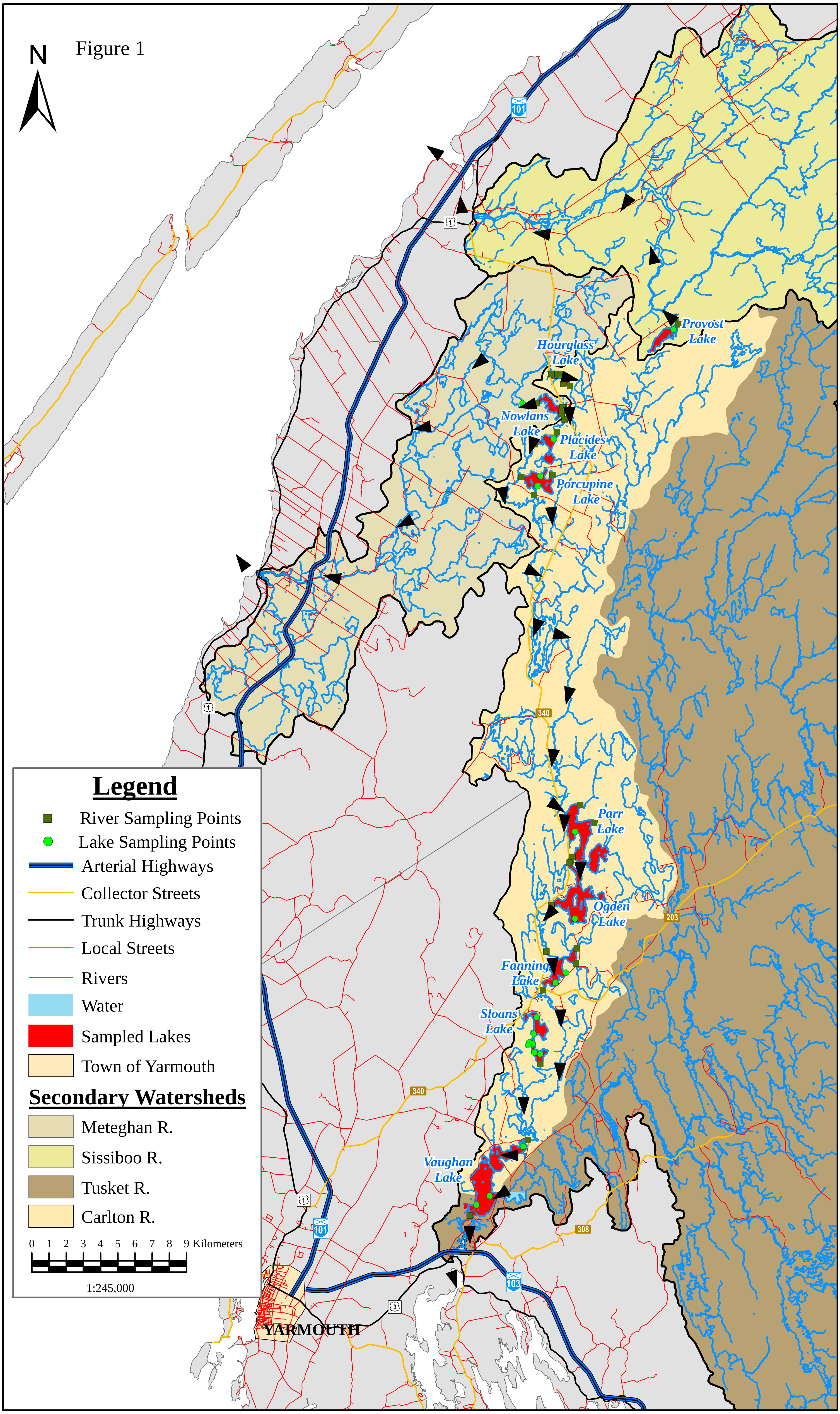
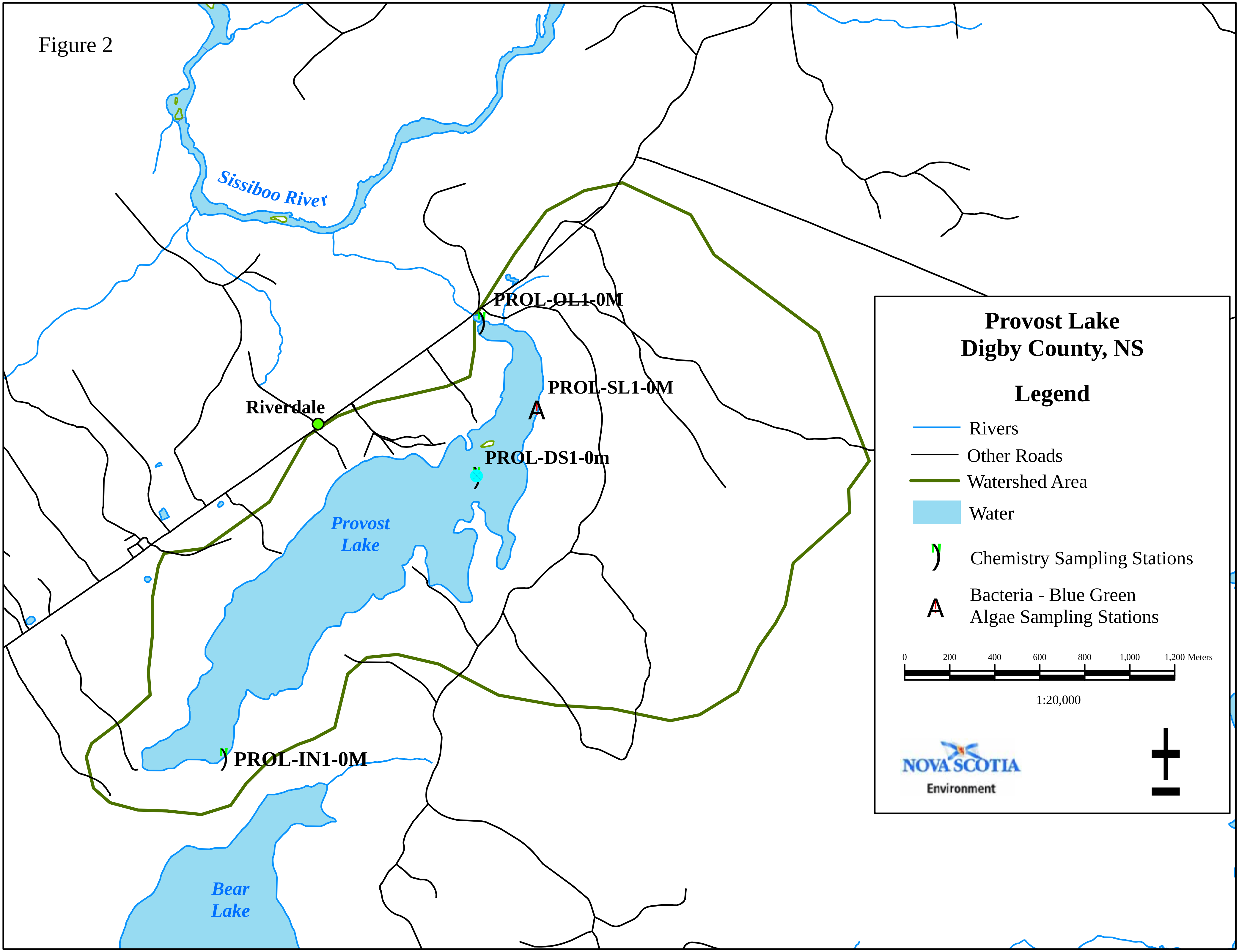

N
Provost Lake
Hourglass Lake
Nowlans Lake
Placides Lake
Porcupine Lake
Parr Lake
Ogden Lake
Fanning Lake
Sloans Lake
Vaughan Lake
YARMOUTH
101
1
340
203
308
103
3
Legend
River Sampling Points
Lake Sampling Points
Arterial Highways
Collector Streets
Trunk Highways
Local Streets
Rivers
Water
Sampled Lakes
Town of Yarmouth
Secondary Watersheds
Meteghan R.
Sissiboo R.
Tusket R.
Carlton R.
0 1 2 3 4 5 6 7 8 9 Kilometers
1:245,000

Figure 2



Sissiboo River
PROL-OL1-0M
PROL-SL1-0M
Riverdale
PROL-DS1-0m
Provost Lake
PROL-IN1-0M
Bear Lake
Provost Lake
Digby County, NS
Legend
Rivers
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green Algae Sampling Stations
0
200
400
600
800
1,000
1,200 Meters
1:20,000
NOVA SCOTIA
Environment

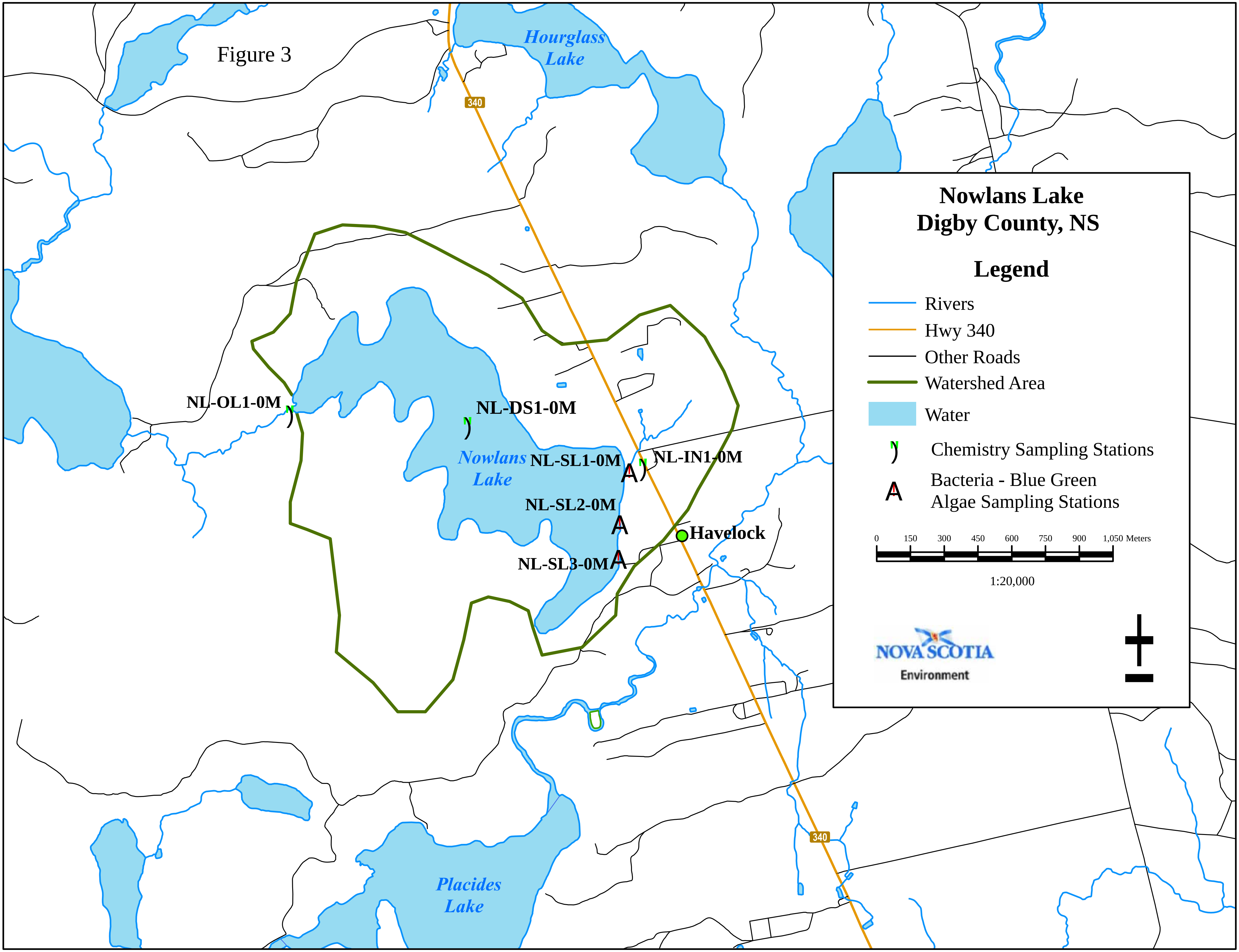
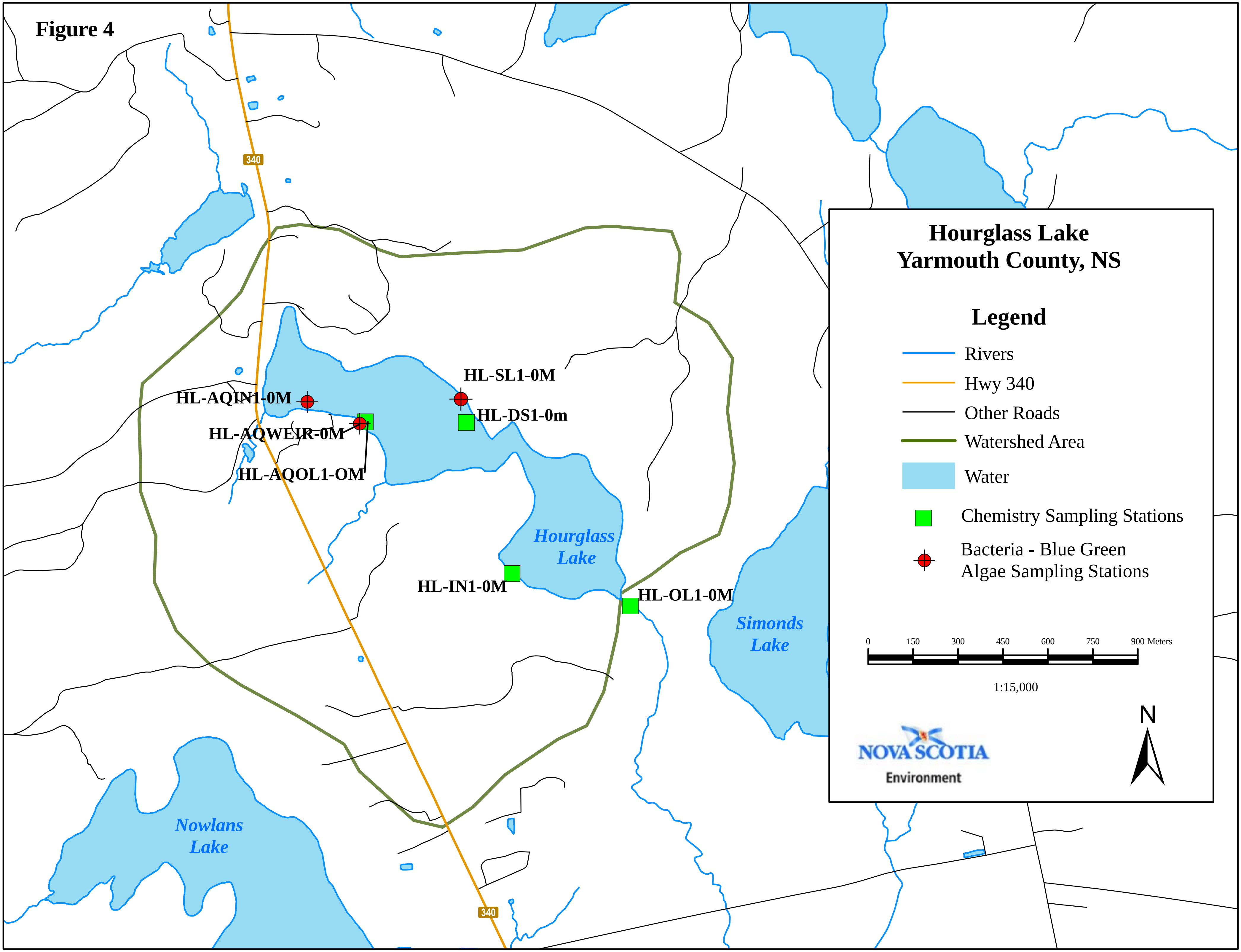


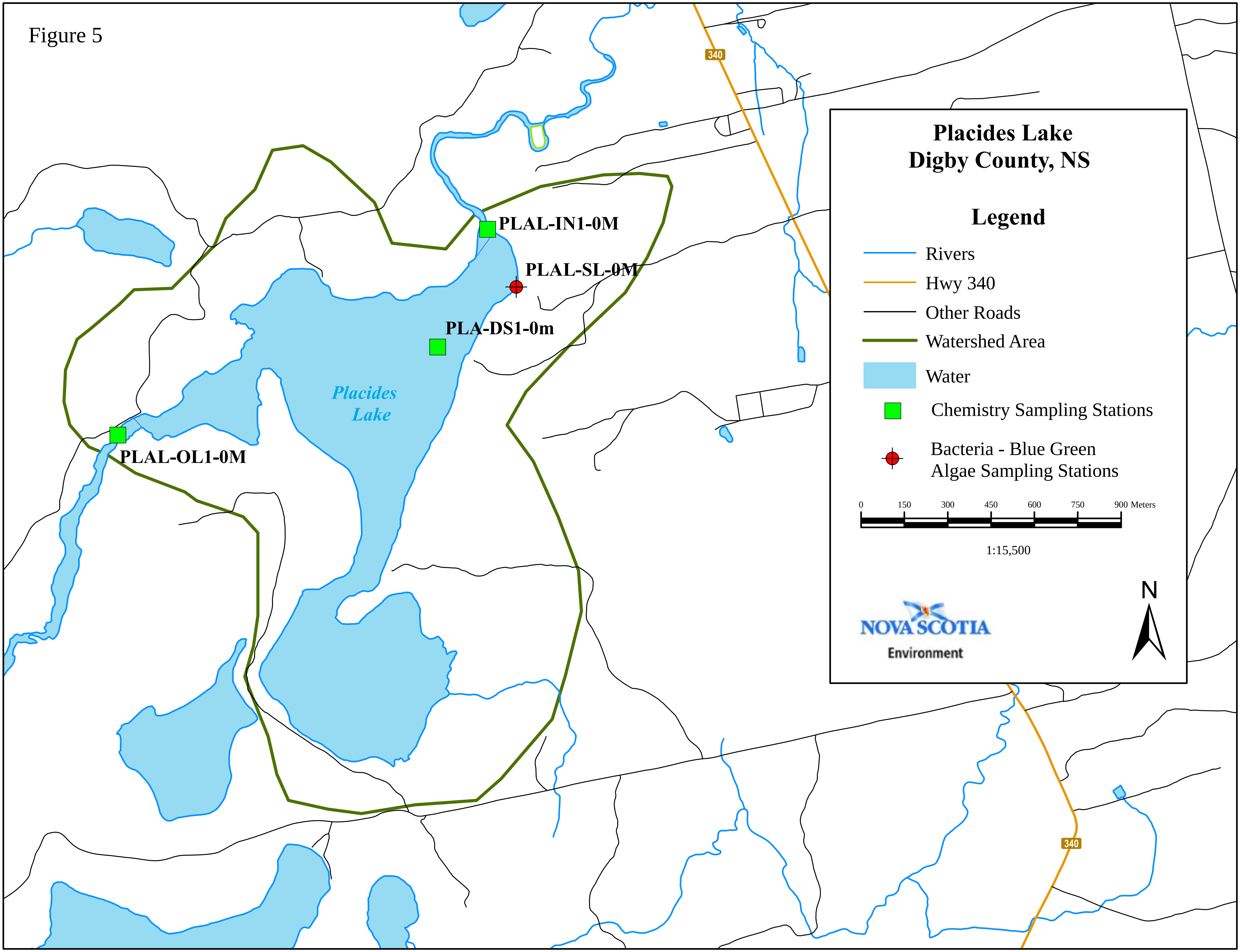
Figure 3
Hourglass Lake
340
NL-OL1-0M
NL-DS1-0M
Nowlans Lake
NL-SL1-0M
NL-IN1-0M
NL-SL2-0M
Havelock
NL-SL3-0M
Placides Lake
Nowlans Lake
Digby County, NS
Legend
Rivers
Hwy 340
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green Algae Sampling Stations
0 150 300 450 600 750 900 1,050 Meters
1:20,000
NOVA SCOTIA
Environment

Figure 4



Hourglass Lake
Yarmouth County, NS
Legend
Rivers
Hwy 340
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green Algae Sampling Stations
0 150 300 450 600 750 900 Meters
1:15,000
N
NOVA SCOTIA
Environment
HL-AQIN1-0M
HL-AQWEIR-0M
HL-AQOL1-OM
HL-SL1-0M
HL-DS1-0m
HL-IN1-0M
HL-OL1-0M
Hourglass Lake
Simonds Lake
Nowlans Lake
340
340

Figure 5



340
PLAL-IN1-0M
PLAL-SL-0M
PLA-DS1-0m
Placides Lake
PLAL-OL1-0M
Placides Lake
Digby County, NS
Legend
Rivers
Hwy 340
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green Algae Sampling Stations
0 150 300 450 600 750 900 Meters
1:15,500
N
NOVA SCOTIA
Environment

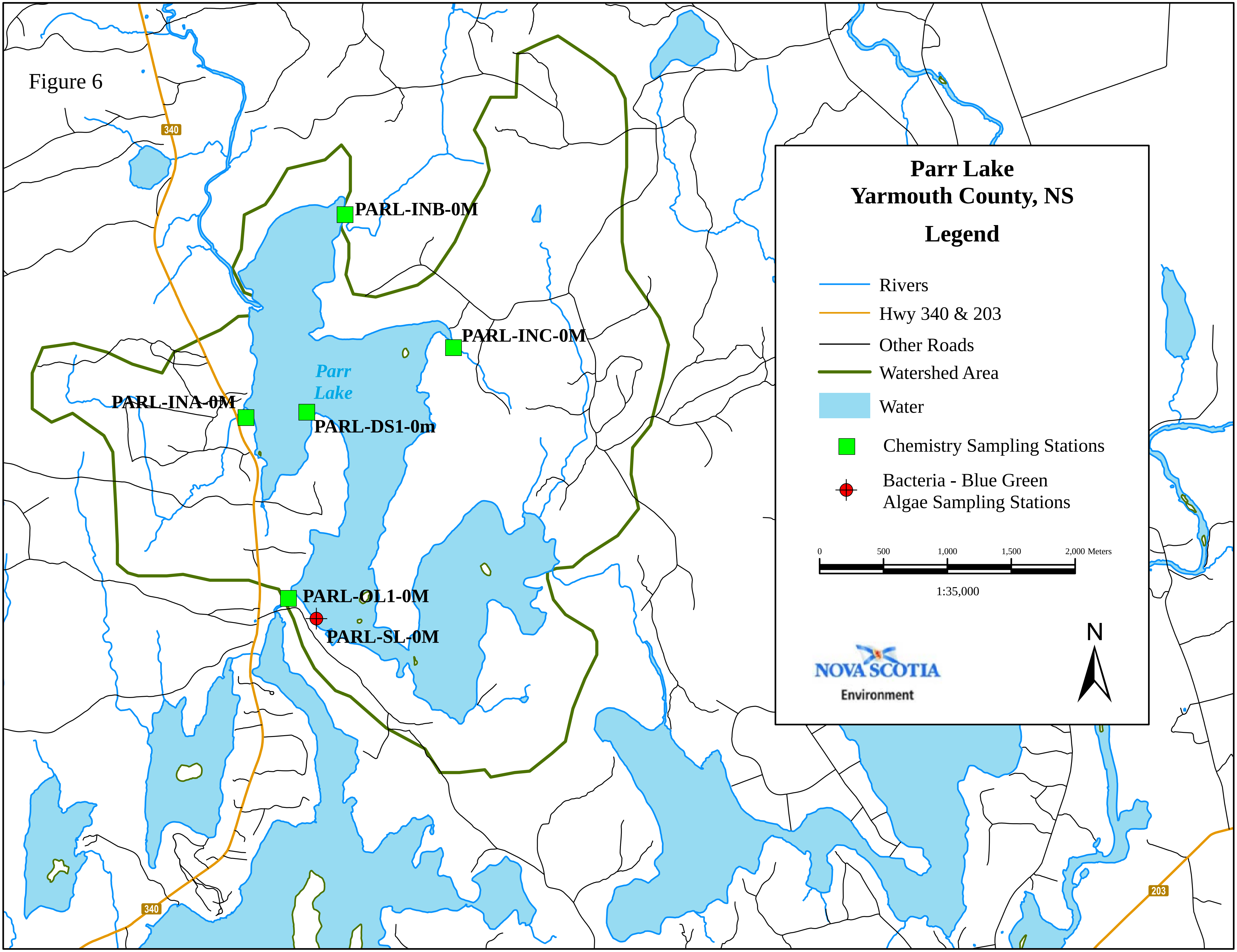


Figure 6
340
PARL-INB-0M
PARL-INC-0M
Parr
Lake
PARL-INA-0M
PARL-DS1-0m
PARL-OL1-0M
PARL-SL-0M
340
203
Parr Lake
Yarmouth County, NS
Legend
Rivers
Hwy 340 & 203
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green
Algae Sampling Stations
0
500
1,000
1,500
2,000 Meters
1:35,000
NOVA SCOTIA
Environment
N

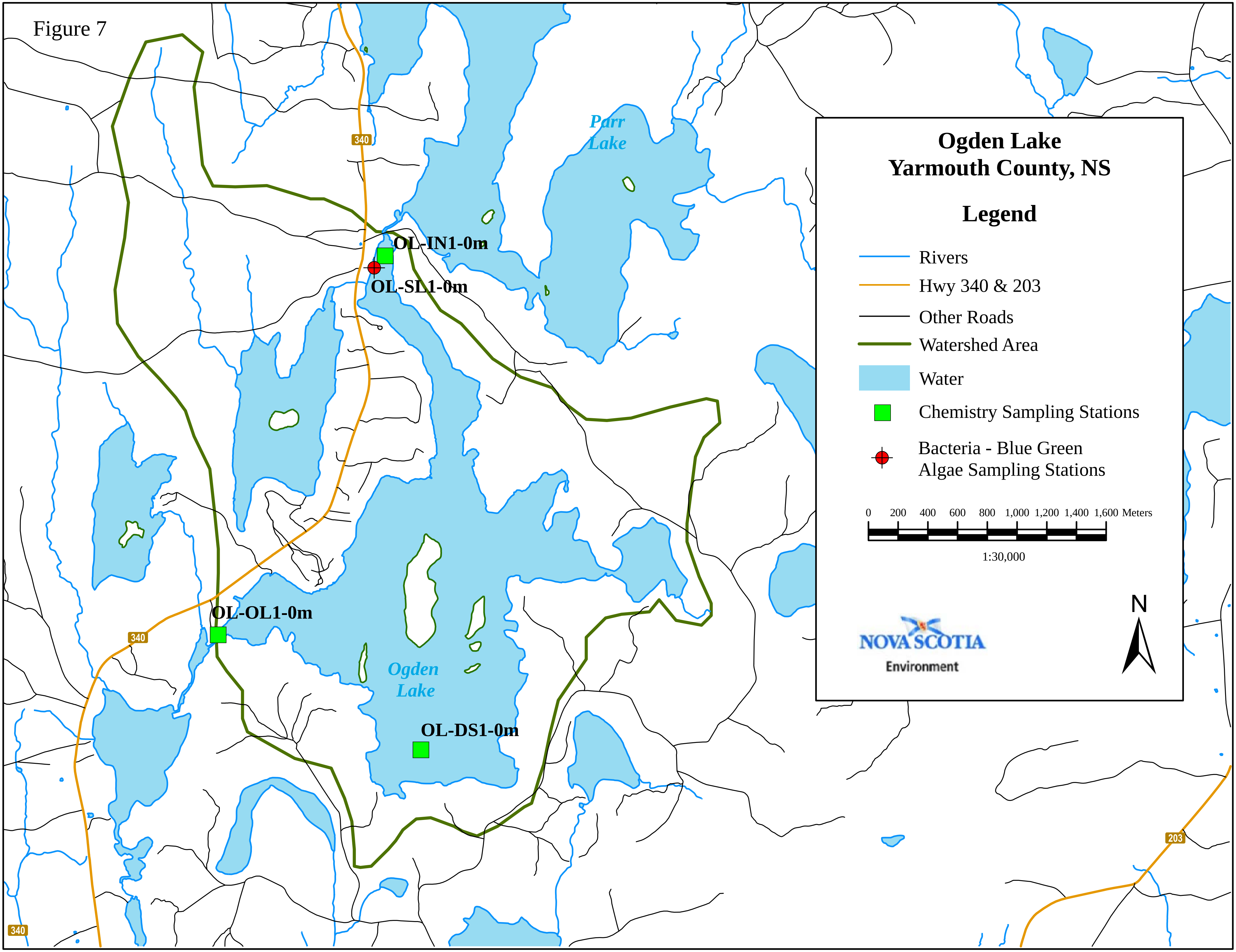
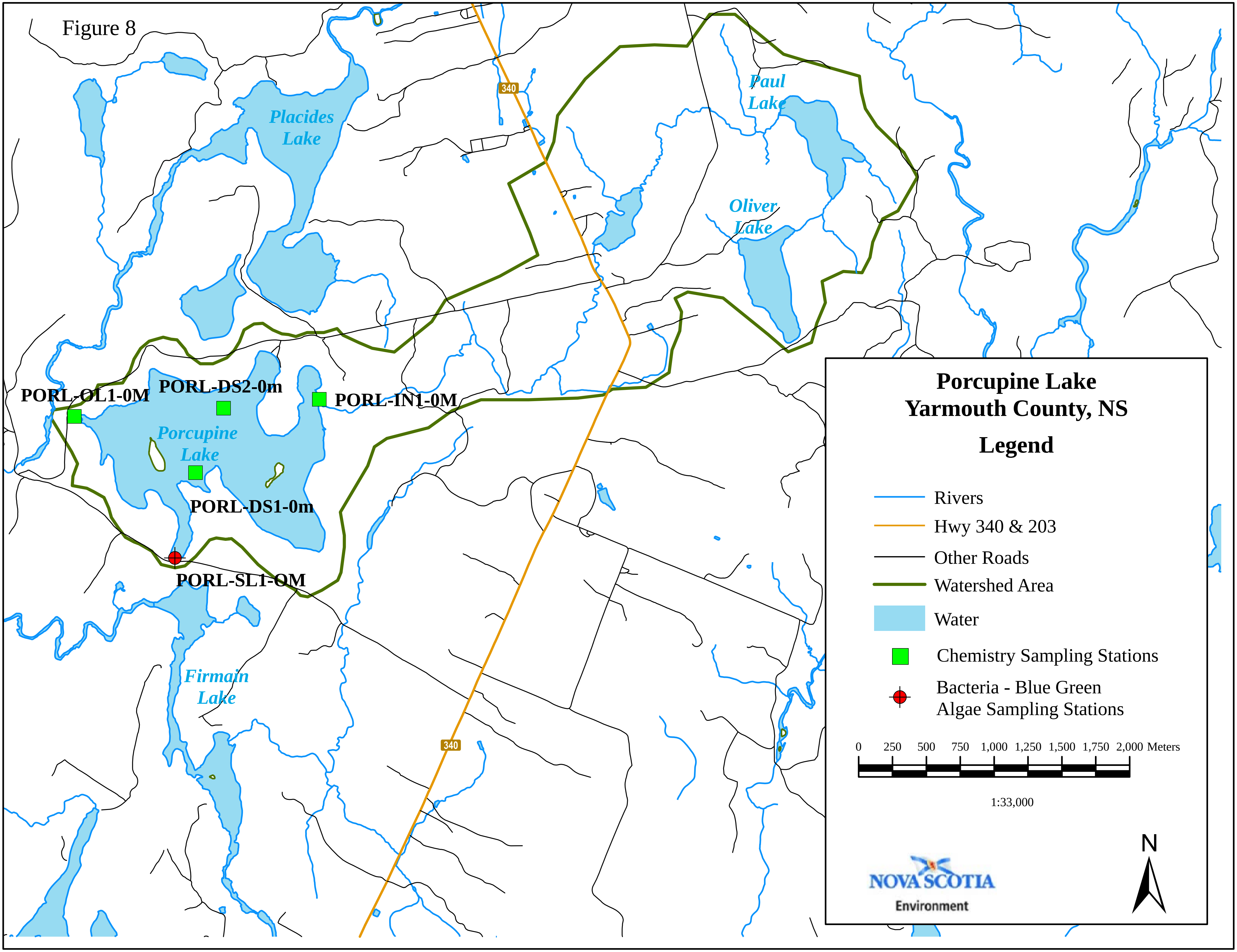


Figure 7
Ogden Lake
Yarmouth County, NS
Legend
Rivers
Hwy 340 & 203
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green
Algae Sampling Stations
0 200 400 600 800 1,000 1,200 1,400 1,600 Meters
1:30,000
N
NOVA SCOTIA
Environment
Parr Lake
Ogden Lake
OL-IN1-0m
OL-SL1-0m
OL-OL1-0m
OL-DS1-0m
340
203

Figure 8


Placides Lake
Paul Lake
Oliver Lake
Porcupine Lake
Firmain Lake
340
PORL-OL1-0M
PORL-DS2-0m
PORL-IN1-0M
PORL-DS1-0m
PORL-SL1-OM
Porcupine Lake
Yarmouth County, NS
Legend
Rivers
Hwy 340 & 203
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green Algae Sampling Stations
0 250 500 750 1,000 1,250 1,500 1,750 2,000 Meters
1:33,000
N
NOVA SCOTIA
Environment

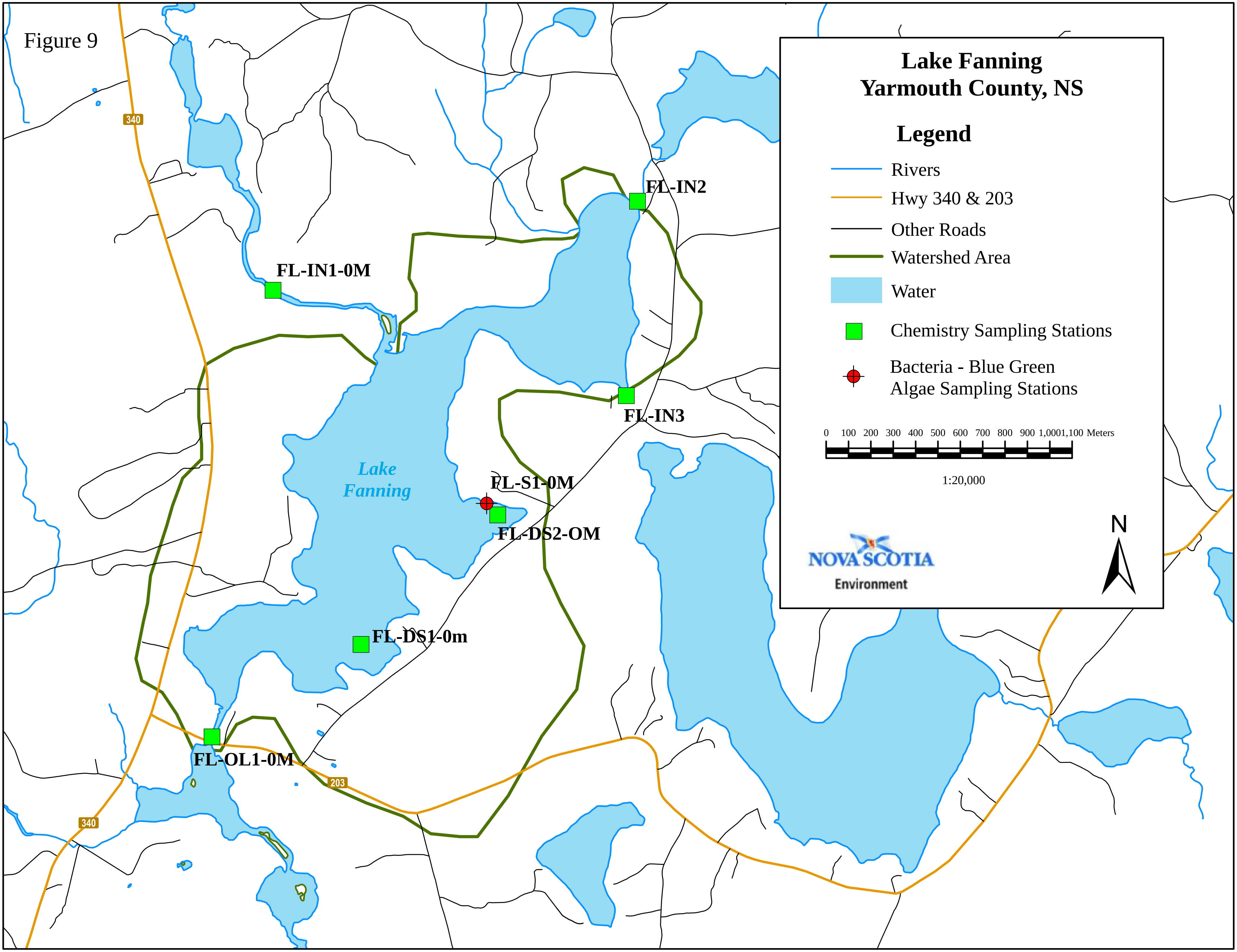
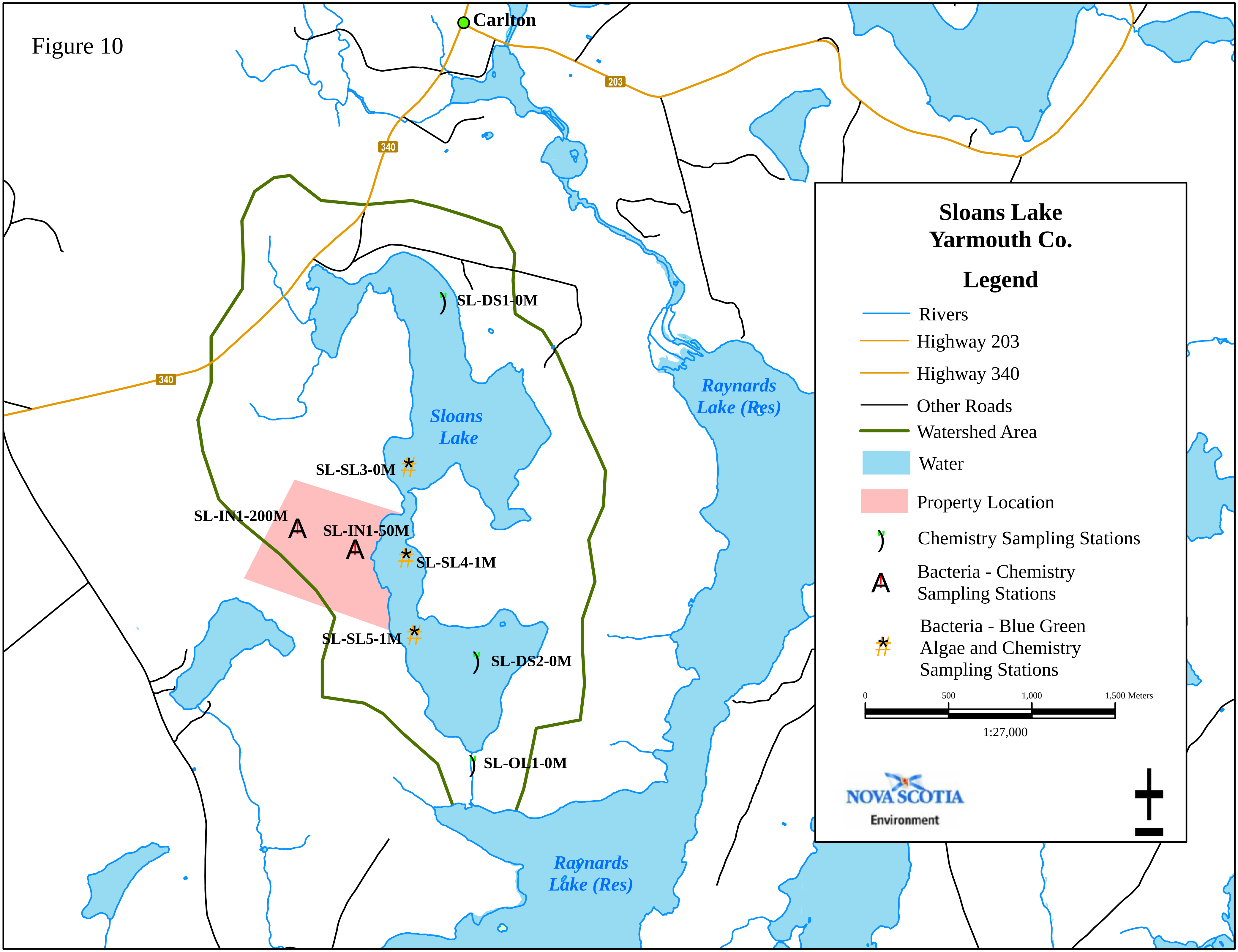

Lake Fanning
Yarmouth County, NS
Legend
Rivers
Hwy 340 & 203
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green Algae Sampling Stations
0 100 200 300 400 500 600 700 800 900 1,000 1,100 Meters
1:20,000
N
NOVA SCOTIA
Environment
Lake Fanning
FL-IN1-0M
FL-IN2
FL-IN3
FL-S1-0M
FL-DS2-OM
FL-DS1-0m
FL-OL1-0M
340
203

Figure 9

Figure 10


Carlton
203
340
340
Sloans Lake
Raynards Lake (Res)
Raynards Lake (Res)
SL-DS1-0M
SL-SL3-0M
SL-IN1-200M
SL-IN1-50M
SL-SL4-1M
SL-SL5-1M
SL-DS2-0M
SL-OL1-0M
Sloans Lake
Yarmouth Co.
Legend
Rivers
Highway 203
Highway 340
Other Roads
Watershed Area
Water
Property Location
Chemistry Sampling Stations
Bacteria - Chemistry Sampling Stations
Bacteria - Blue Green Algae and Chemistry Sampling Stations
0
500
1,000
1,500 Meters
1:27,000
NOVA SCOTIA
Environment

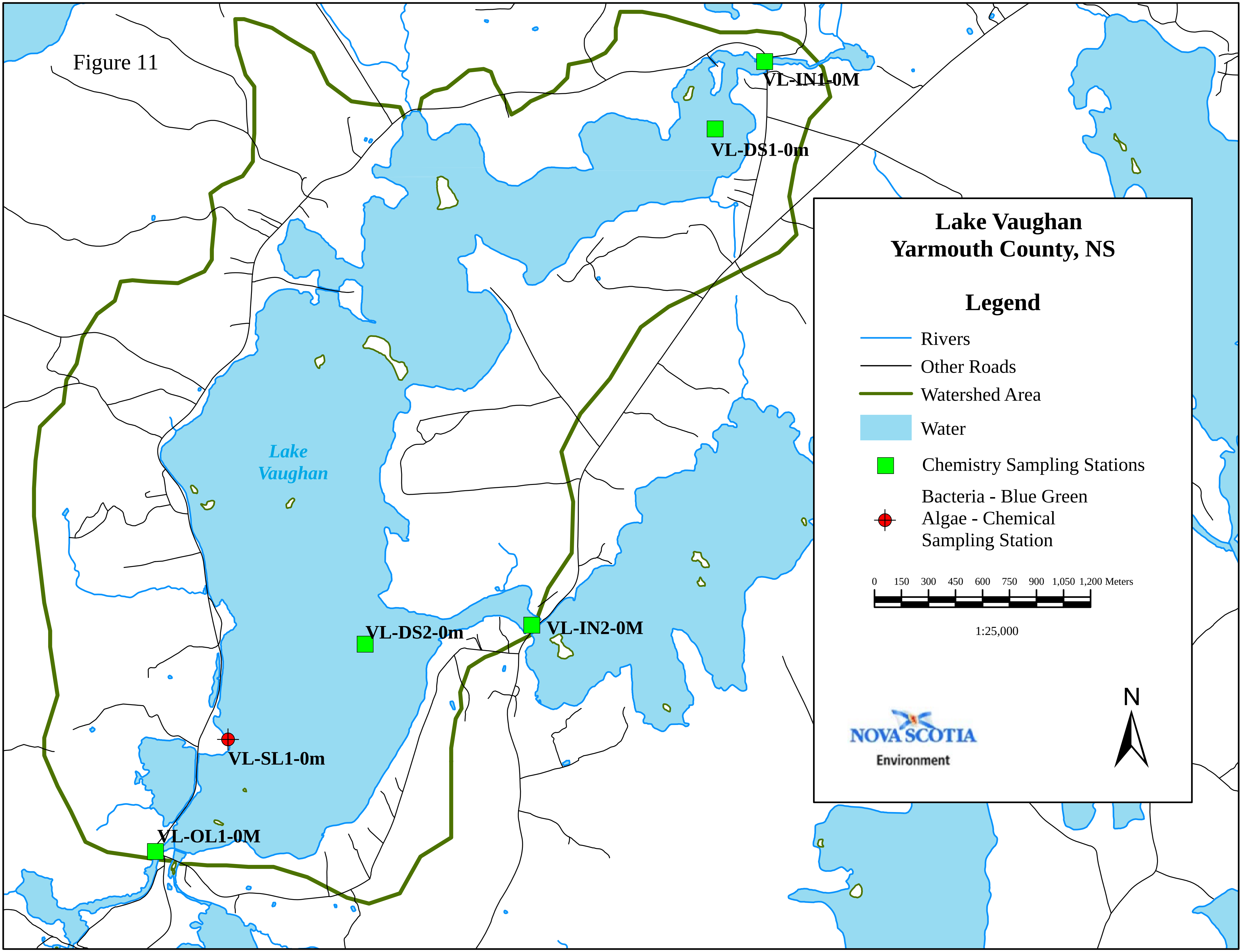
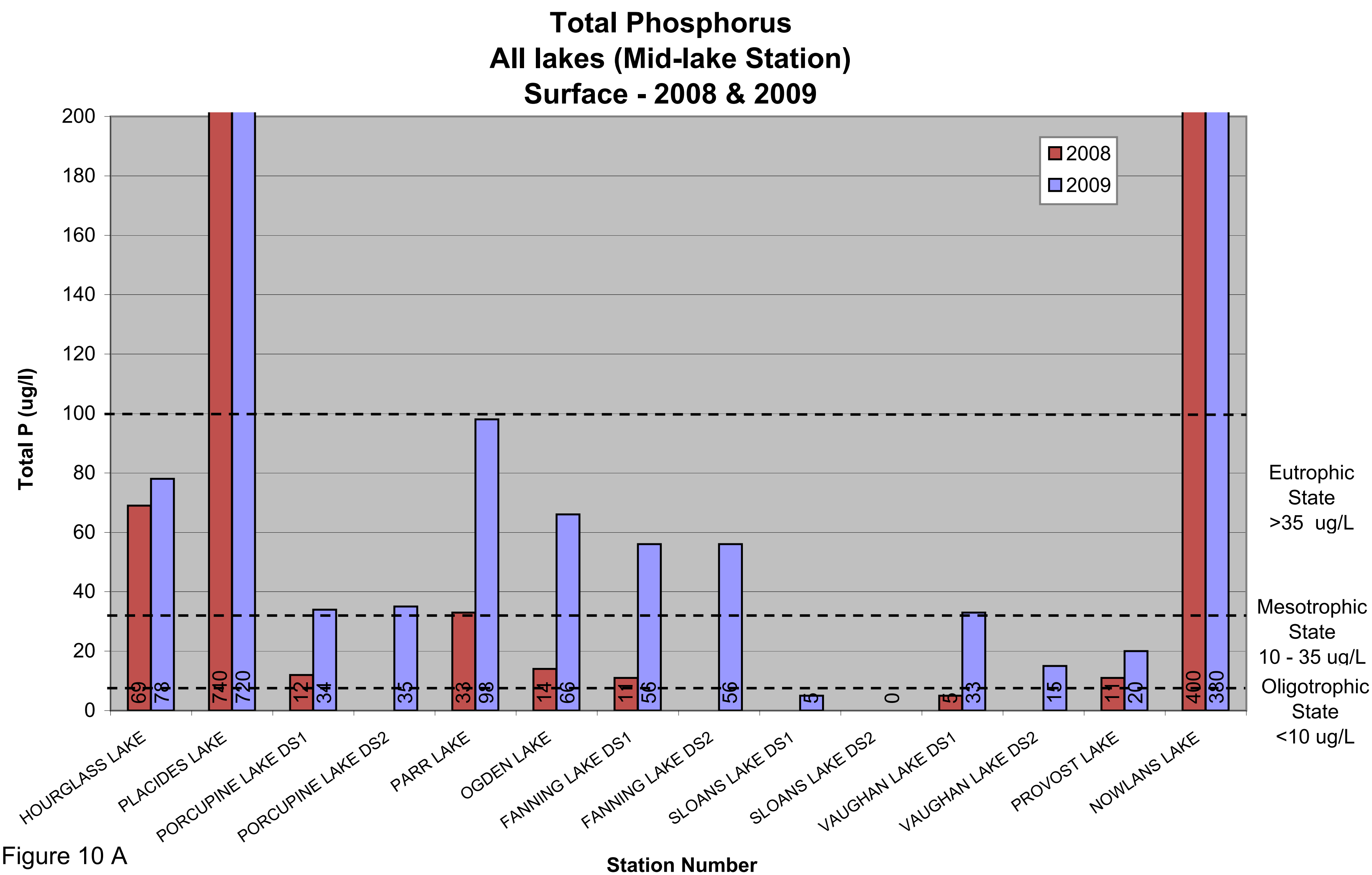


Figure 11
Lake Vaughan
VL-IN1-0M
VL-DS1-0m
VL-DS2-0m
VL-IN2-0M
VL-SL1-0m
VL-OL1-0M
Lake Vaughan
Yarmouth County, NS
Legend
Rivers
Other Roads
Watershed Area
Water
Chemistry Sampling Stations
Bacteria - Blue Green Algae - Chemical Sampling Station
0 150 300 450 600 750 900 1,050 1,200 Meters
1:25,000
N
NOVA SCOTIA
Environment

APPENDIX B



Total Phosphorus
All lakes (Mid-lake Station)
Surface - 2008 & 2009
Total P (ug/l)
2008
2009
Eutrophic State >35 ug/L
Mesotrophic State 10 - 35 ug/L
Oligotrophic State <10 ug/L
HOURGLASS LAKE
PLACIDES LAKE
PORCUPINE LAKE DS1
PORCUPINE LAKE DS2
PARR LAKE
OGDEN LAKE
FANNING LAKE DS1
FANNING LAKE DS2
SLOANS LAKE DS1
SLOANS LAKE DS2
VAUGHAN LAKE DS1
VAUGHAN LAKE DS2
PROVOST LAKE
NOWLANS LAKE
Station Number

Figure 10 A

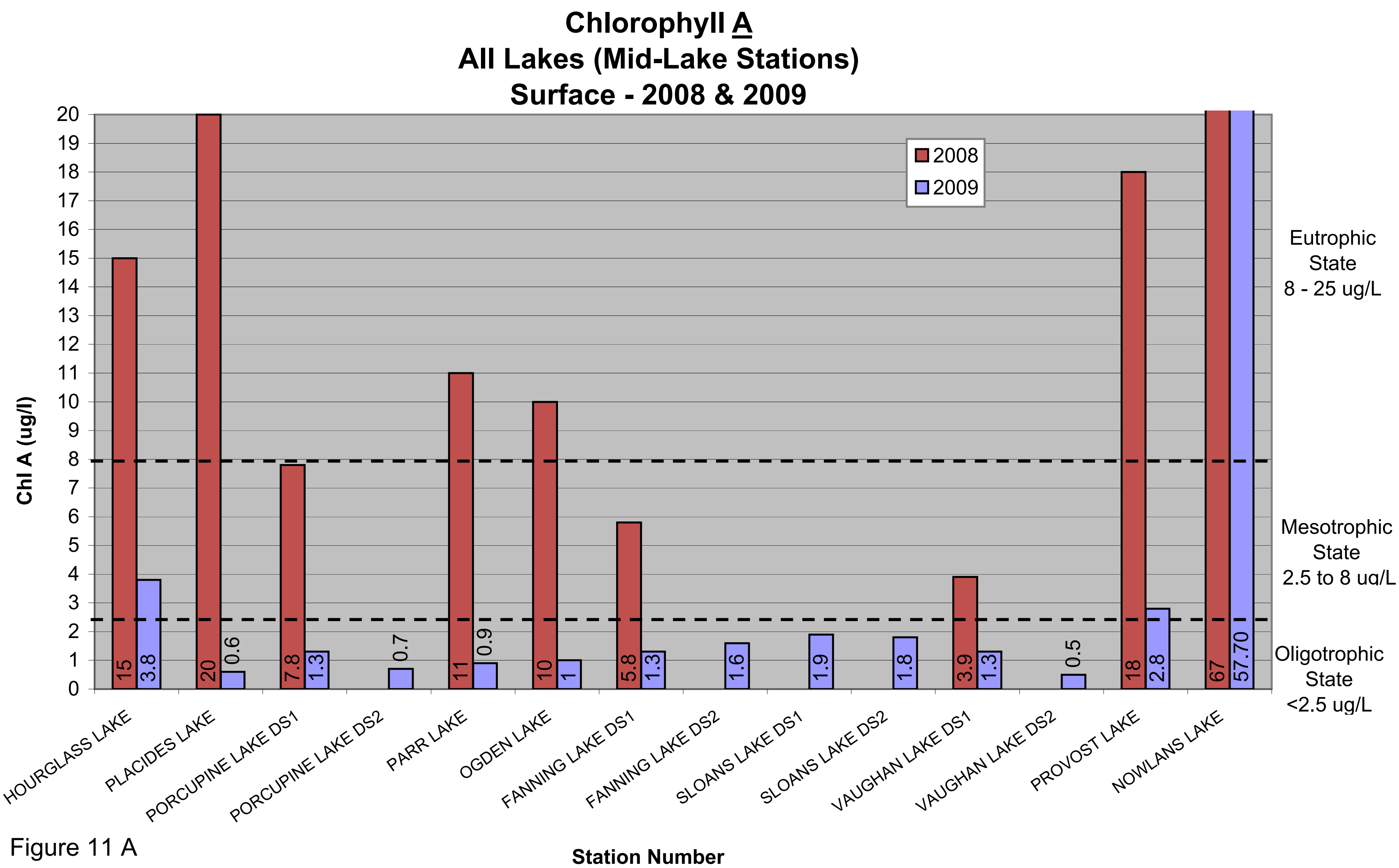
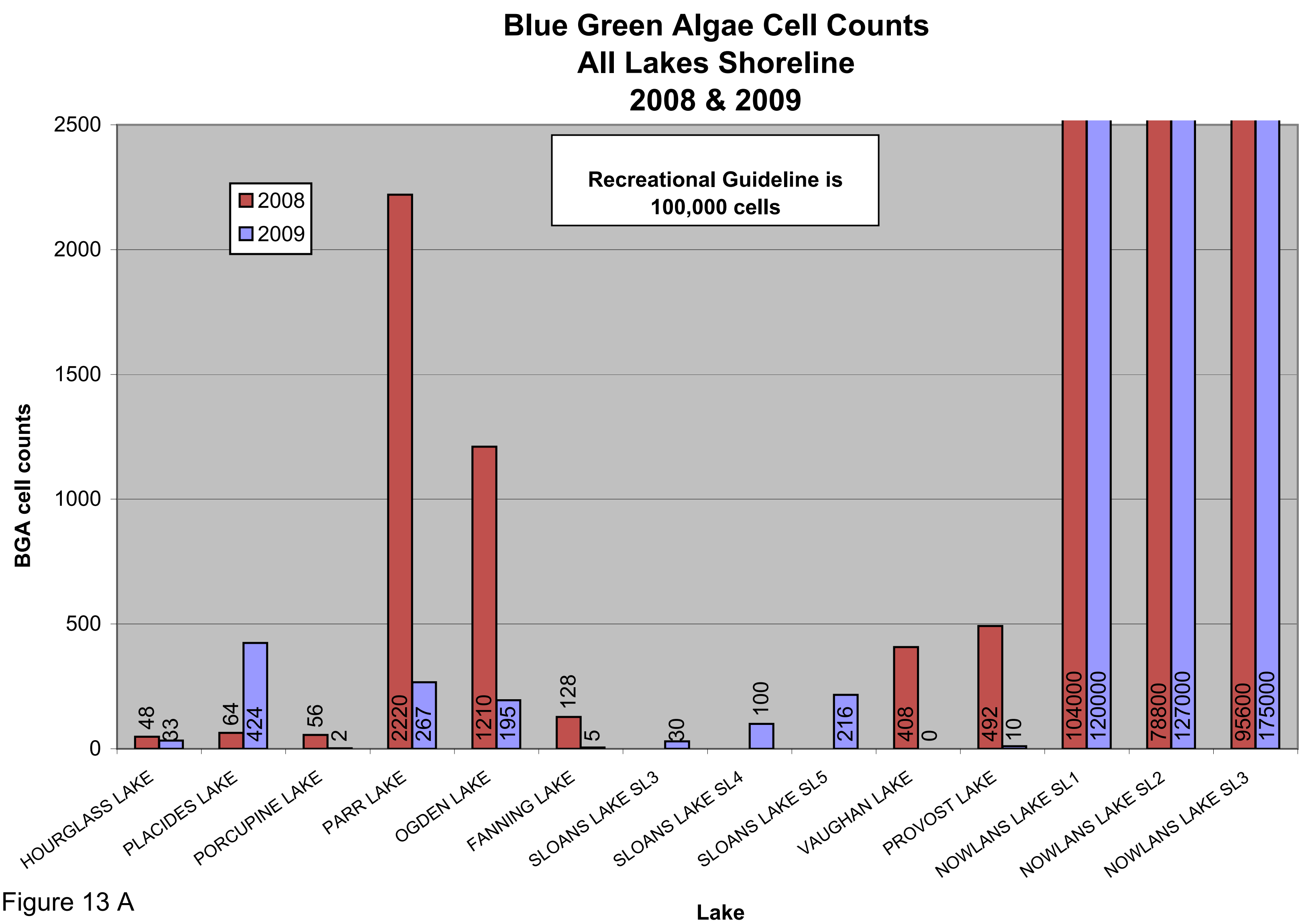

Chlorophyll A
All Lakes (Mid-Lake Stations)
Surface - 2008 & 2009
2008
2009
Chl A (ug/l)
Eutrophic State 8 - 25 ug/L
Mesotrophic State 2.5 to 8 ug/L
Oligotrophic State <2.5 ug/L
15
3.8
20
0.6
7.8
1.3
0.7
11
0.9
10
1
5.8
1.3
1.6
1.9
1.8
3.9
1.3
0.5
18
2.8
67
57.70
HOURGLASS LAKE
PLACIDES LAKE
PORCUPINE LAKE DS1
PORCUPINE LAKE DS2
PARR LAKE
OGDEN LAKE
FANNING LAKE DS1
FANNING LAKE DS2
SLOANS LAKE DS1
SLOANS LAKE DS2
VAUGHAN LAKE DS1
VAUGHAN LAKE DS2
PROVOST LAKE
NOWLANS LAKE
Station Number

Figure 11 A



Blue Green Algae Cell Counts
All Lakes Shoreline
2008 & 2009
Recreational Guideline is
100,000 cells
2008
2009
BGA cell counts
0
500
1000
1500
2000
2500
48
33
64
424
56
2
2220
267
1210
195
128
5
30
100
216
408
0
492
10
104000
120000
78800
127000
95600
175000
HOURGLASS LAKE
PLACIDES LAKE
PORCUPINE LAKE
PARR LAKE
OGDEN LAKE
FANNING LAKE
SLOANS LAKE SL3
SLOANS LAKE SL4
SLOANS LAKE SL5
VAUGHAN LAKE
PROVOST LAKE
NOWLANS LAKE SL1
NOWLANS LAKE SL2
NOWLANS LAKE SL3
Lake

Figure 13 A

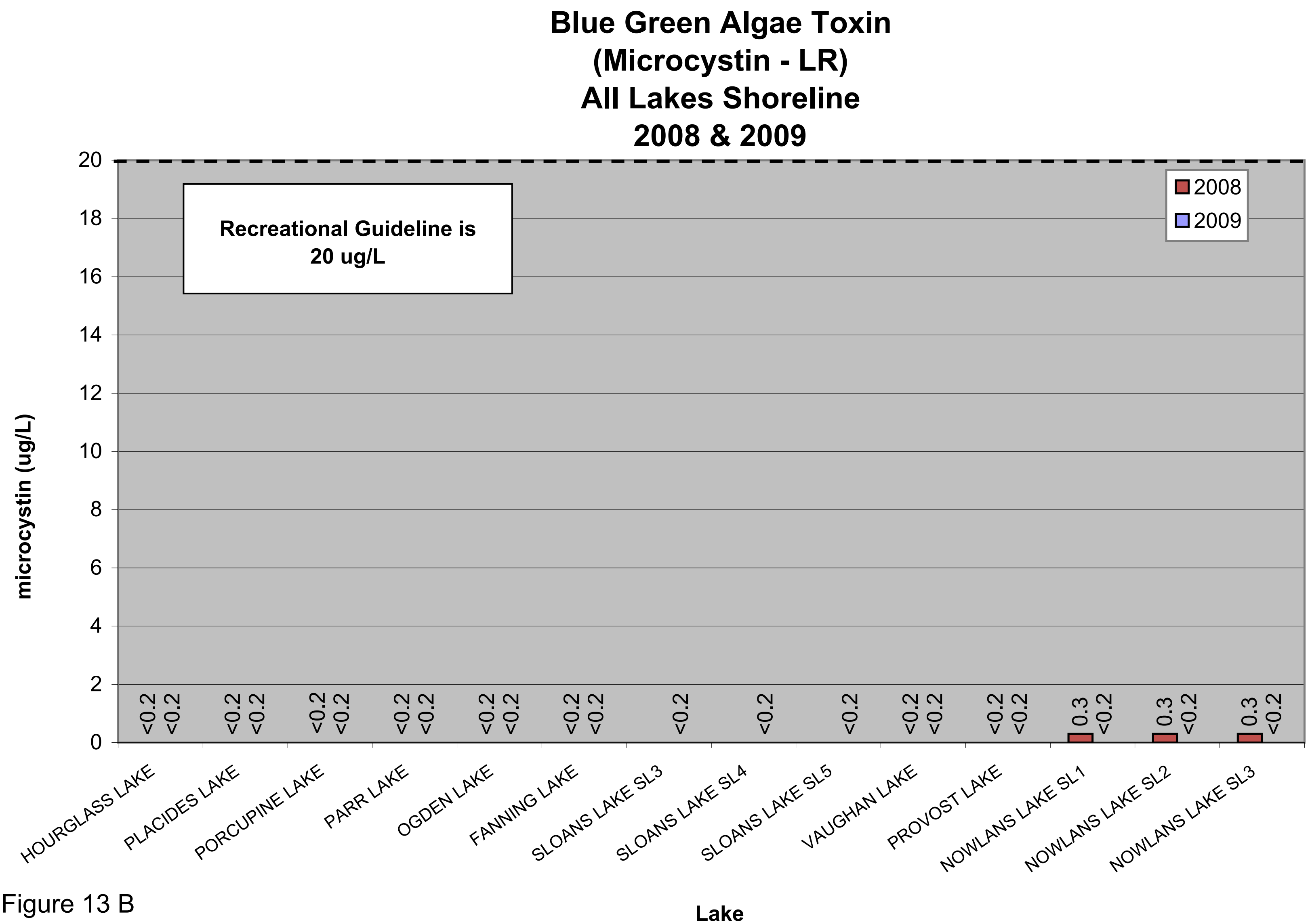

Blue Green Algae Toxin
(Microcystin - LR)
All Lakes Shoreline
2008 & 2009
Recreational Guideline is 20 ug/L
2008
2009
microcystin (ug/L)
0
2
4
6
8
10
12
14
16
18
20
<0.2 <0.2
<0.2 <0.2
<0.2 <0.2
<0.2 <0.2
<0.2 <0.2
<0.2 <0.2
<0.2
<0.2
<0.2
<0.2 <0.2
<0.2 <0.2
0.3 <0.2
0.3 <0.2
0.3 <0.2
HOURGLASS LAKE
PLACIDES LAKE
PORCUPINE LAKE
PARR LAKE
OGDEN LAKE
FANNING LAKE
SLOANS LAKE SL3
SLOANS LAKE SL4
SLOANS LAKE SL5
VAUGHAN LAKE
PROVOST LAKE
NOWLANS LAKE SL1
NOWLANS LAKE SL2
NOWLANS LAKE SL3
Lake

Figure 13 B

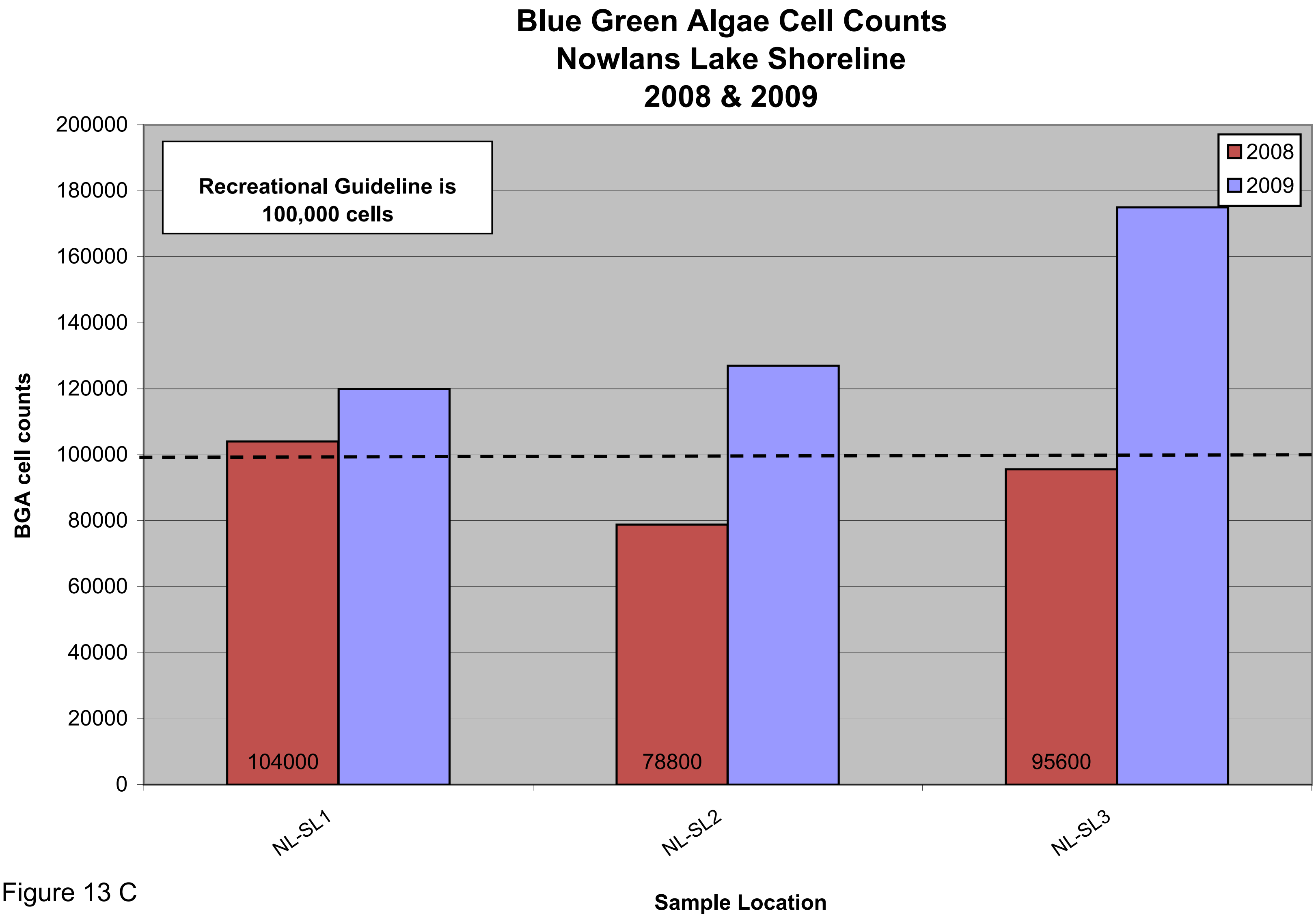

Blue Green Algae Cell Counts
Nowlans Lake Shoreline
2008 & 2009
Recreational Guideline is 100,000 cells
2008
2009
BGA cell counts
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
104000
78800
95600
NL-SL1
NL-SL2
NL-SL3
Sample Location

Figure 13 C

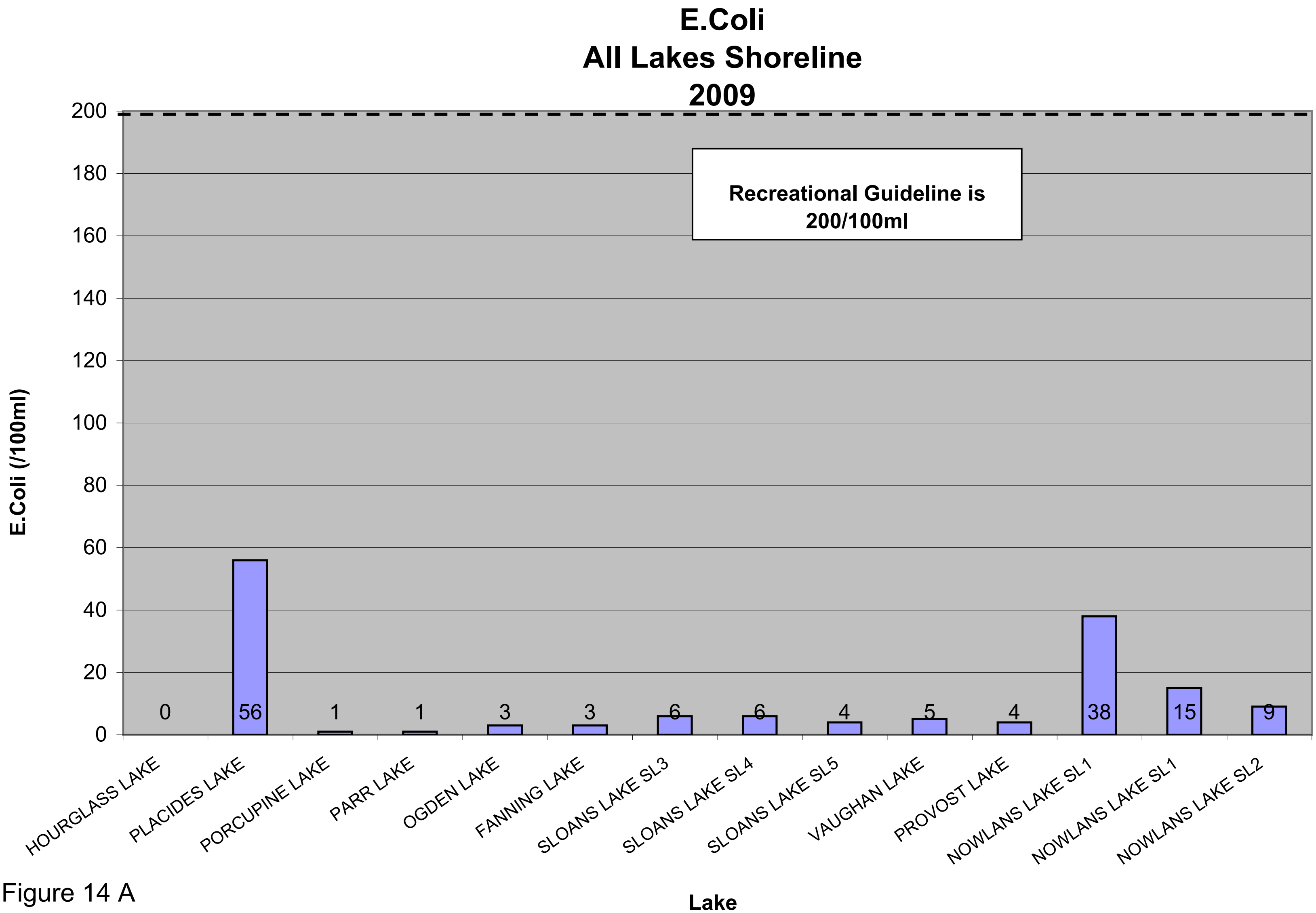
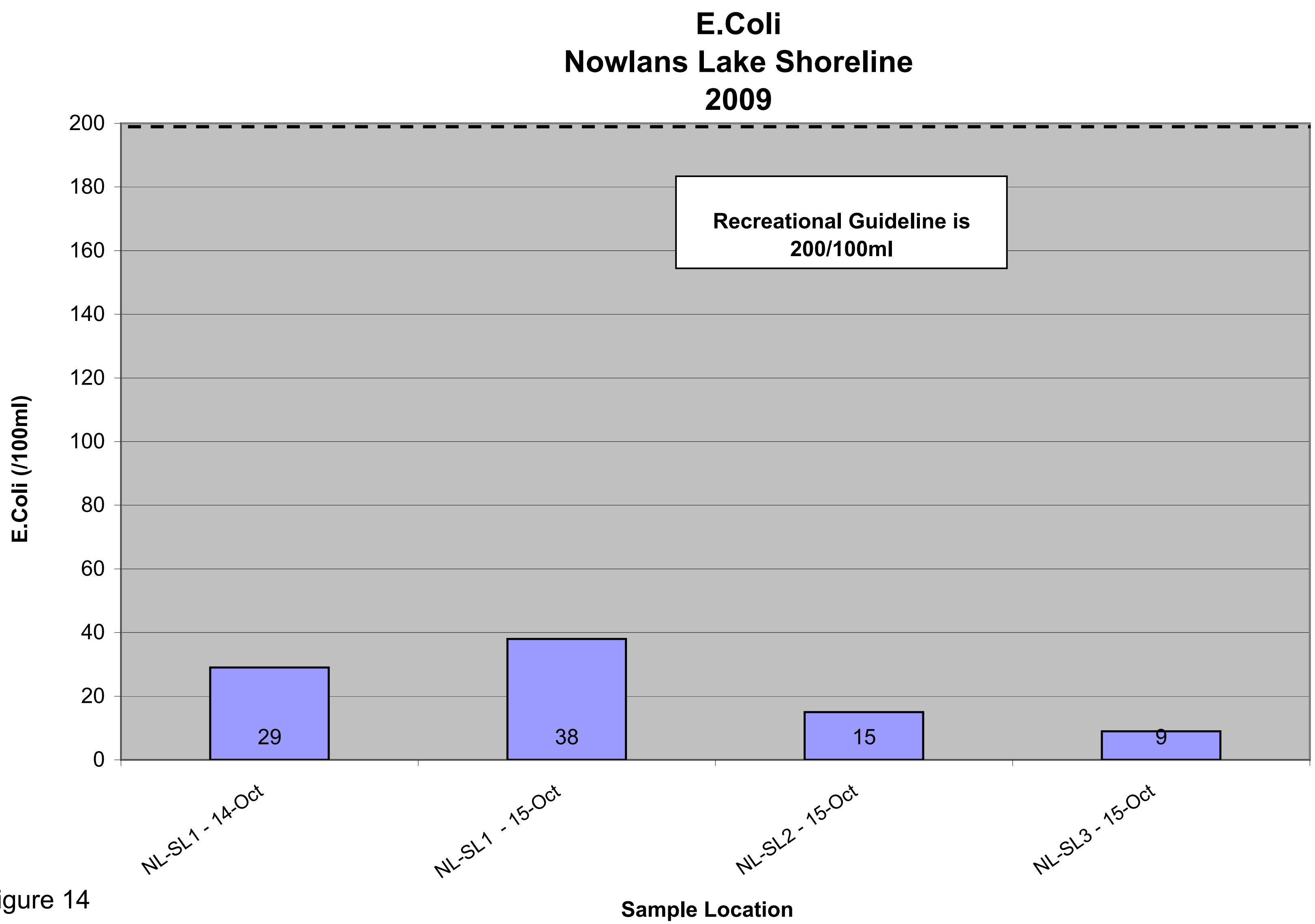

E.Coli
All Lakes Shoreline
2009
Recreational Guideline is
200/100ml
E.Coli (/100ml)
0
20
40
60
80
100
120
140
160
180
200
0
56
1
1
3
3
6
6
4
5
4
38
15
9
HOURGLASS LAKE
PLACIDES LAKE
PORCUPINE LAKE
PARR LAKE
OGDEN LAKE
FANNING LAKE
SLOANS LAKE SL3
SLOANS LAKE SL4
SLOANS LAKE SL5
VAUGHAN LAKE
PROVOST LAKE
NOWLANS LAKE SL1
NOWLANS LAKE SL1
NOWLANS LAKE SL2
Lake

Figure 14 A



E.Coli
Nowlans Lake Shoreline
2009
E.Coli (/100ml)
200
180
160
140
120
100
80
60
40
20
0
Recreational Guideline is 200/100ml
29
38
15
9
NL-SL1 - 14-Oct
NL-SL1 - 15-Oct
NL-SL2 - 15-Oct
NL-SL3 - 15-Oct
Sample Location

Figure 14

APPENDIX C

Table 2A

SL- Shoreline Sample | ML-Mid Lake Sample | ST- Stream Sample

Selected Water Quality Parameters 2009 (Lake & Stream Stations)

			Lake	HOURGLASS LAKE					PLACIDES LAKE							PORCUPINE LAKE						PARR LAKE			PARR LAKE				OGDEN LAKE				
			Sample Location	ML	ML	SL	ST	ST	ML	ML	SL	ST	ST	ST	ST	ML	ML	ML	SL	ST	ST	ML	ML	SL	ST	ST	ST	ST	ML	ML	SL	ST	ST
			``	HL-DS1	HL-DS1	HL-SL1	HL-IN1	HL-OL1	PLAL-DS1	PLAL-DS1	PLAL - SL1	PLAL-IN1 above mink farm creek	PLAL-IN1 below mink farm creek	PLAL-IN1	PLAL-OL1	PORL-DS1	PORL-DS1	PORL-DS2	PORL-SL1	PORL-IN1	PORL-OL1	PARL DS1	PARL DS1	PARL-SL1	PARL-INA	PARL-INB	PARL-INC	PARL-OL1	OL-DS1	OL-DS1	OL-SL1	OL-IN1	OL-OL1
			Depth (m)	0	6.3	0	0	0	0	5.8	0	0	0	0	0	0	12.7	0	0	0	0	0	6.2	0	0	0	0	0	0	18.6	0	0	0
			Date Sampled	20-Oct	20-Oct	20-Oct	20-Oct	20-Oct	21-Oct	21-Oct	21-Oct	21-Oct	21-Oct	21-Oct	21-Oct	27-Oct	27-Oct	27-Oct	27-Oct	27-Oct	27-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct
Water Quality Parameters	**Min**	**Max**	**Mean**																														
Aluminum (ug/L)	40.00	596.00	207.28	308	315		596	304	297	306		281	285	283	295	99	105	102		219	103	323	314		344	207	273	305	292	297		299	295
Antimony (ug/L)	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Barium (ug/L)	2.00	8.00	3.74	5			6	5	5			5	5	5	5	3		3		4	3	4			2	3	4	4	4			4	4
Beryllium (ug/L)	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Boron (ug/L)	<5	8.00	3.85	6			6	6	5			6	6	6	6	<5		5		<5	<5	6			<5	5	<5	5	6			5	6
Cadmium (ug/L)	<1	<1	<1	<1			<1	<1	<1			<1	<1	<1	<1	<1		<1		<1	<1	<1			<1	<1	<1	<1	<1			<1	<1
Calcium (mg/L)	0.90	11.70	1.82	1.6	1.6		1.9	1.6	2.8	2.8		2.8	3	3	2.7	1.5	1.5	1.5		1.8	1.5	1.3	1.3		1.7	1.1	1.2	1.3	1.3	1.2		1.3	1.3
Chromium (ug/L)	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Cobalt (ug/L)	<2	16.00	0.48	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Copper (ug/L)	<2	23.00	0.40	<2	<2		<2	<2	<2	<2		<2	<2	<2	<2	<2	<2	<2		<2	<2	<2	<2		<2	<2	<2	<2	<2	<2		<2	<2
Iron (ug/L)	<50	1943.00	574.76	960	960		620	762	1201	1186		784	797	826	1238	744	809	784		1278	783	869	856		714	245	470	790	812	827		784	821
Lead (ug/L)	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Magnesium (mg/L)	0.50	5.00	0.99	0.9	0.9		0.7	1	1.4	1.4		1.4	1.4	1.4	1.3	1	1	1		1.1	1	0.8	0.8		0.8	0.6	0.7	0.8	0.8	0.8		0.8	0.8
Manganese (ug/L)	8.00	2770.00	142.55	79	79		33	61	125	123		89	90	86	128	53	56	54		36	50	56	56		35	40	92	55	60	61		55	61
Nickel (ug/L)	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Potassium (mg/L)	<0.5	6.80	0.58	0.7	0.7		1	0.5	2.2	2.2		1.7	1.8	1.9	1.8	0.6	0.6	0.6		0.7	0.6	0.6	0.6		<0.5	<0.5	<0.5	0.6	0.5	0.5		0.6	0.5
Selenium (ug/L)	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Sodium (mg/L)	3.40	20.80	5.74	6.7	6.7		9.3	6.5	7.7	7.9		7.5	7.7	8	7.2	5.6	5.5	5.5		5.2	5.4	4.7	4.9		4.3	4	4.2	4.8	4.8	4.8		4.8	5
Tin (ug/L0	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Vanadium (ug/L0	<2	<2	<2	<2			<2	<2	<2			<2	<2	<2	<2	<2		<2		<2	<2	<2			<2	<2	<2	<2	<2			<2	<2
Zinc (ug/L)	<5	11.00	1.42	6	6		10	<5	8	7		7	7	8	7	<5	<5	<5		<5	<5	<5	<5		<5	<5	<5	<5	<5	<5		<5	<5
Hardness as CaCO3 (mg/L)	4.60	49.80	8.50	7.7	7.7		7.6	8.1	12.8	12.8		12.8	13.3	13.3	12.1	7.9	7.9	7.9		9	7.9	6.5	6.5		7.5	5.2	5.9	6.5	6.5	6.3		6.5	6.5
Conductivity (umho/cm)	34.70	303.00	54.09	55.2	55.4		65.8	54.2	78.4	77.3		78.1	79.1	82	74.2	50.1	49.8	49.2		49.1	49	42.3	42.6		37	34.8	37	40.9	41	42		41.6	40.8
pH	4.30	7.50	6.23	6.2	6.2		5.7	6.4	6.5	6.4		6	6.1	6.2	6.3	6.6	6.7	6.6		6	6.6	5.4	5.4		6.2	5.1	5	5.5	5.8	5.9		5.5	5.8
Turbidity (NTU)	0.23	10.60	1.53	1.18	1.34		0.95	0.95	5.4	5.85		1.4	1.73	1.54	5.52	1.15	1.3	1.11		1.74	1.03	1.19	1.23		0.66	0.23	0.26	1.04	1.11	1.28		1.12	1.14
Alkalinity as CaCO3 (mg/L)	<1.0	67.40	3.84	2.1	2.1		2.8	2.9	4.1	3.6		2.2	2.6	3	2.9	3	3	2.6		2.2	2.6	<1.0	<1.0		2.4	<1.0	<1.0	<1.0	1.2	1.6		1.1	1.6
Chloride (mg/L)	5.70	36.00	9.64	11	11		14	11	13	13		13	13	14	12	9.7	9.8	9.8		9.6	9.5	8.1	8.3		7.2	6.2	6.7	7.9	7.5	7.5		7.7	7.6
Colour (TCU)	14.00	269.00	104.39	134	147		224	123	190	207		187	184	187	187	75	79	77		180	78	176	178		142	130	183	168	140	159		164	140
Silica (mg/L)	<1.0	12.00	3.77	3.5	3.6		5.4	4	5.8	5.8		5.9	5.9	6	5.7	3.1	3	3		5.1	3	4.9	4.9		7.3	4.6	6.4	4.5	4.2	4.2		4.5	4.2
Sulfate (mg/L)	<5	11.00	0.16	<5.00	<5.00		<5.00	<5.00	<5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00		<5.00	<5.00	<5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00	<5.00		<5.00	<5.00
Total Nitrogen (mg/L)	0.11	11.33	0.82	0.86	0.86		0.63	0.59	11.33	2.8		2.6	2.57	2.95	2.38	0.46	0.4	0.41		0.53	0.4	0.56	0.56		0.38	0.3	0.33	0.52	0.46	0.48		0.49	0.48
Total Phosphorus (mg/L)	<0.005	5.40	0.17	0.078	0.079		0.17	0.049	0.72	0.7		0.63	0.61	0.61	0.66	0.034	0.033	0.035		0.079	0.031	0.098	0.095		0.018	0.011	0.016	0.076	0.066	0.067		0.076	0.066
Nitrate + Nitrite (mg/L)	<0.01	3.40	0.18	0.21	0.22		<0.01	0.14	1.1	1.1		1.26	1.26	1.28	0.95	0.06	0.07	0.07		0.1	0.06	0.07	0.07		<0.01	<0.01	<0.01	0.06	0.06	0.06		0.06	0.06
Ammonia (mg/L)	<0.01	9.10	0.21	0.11	0.11		0.02	0.04	0.76	0.88		0.63	0.63	0.67	0.56	0.06	0.03	0.03		0.02	0.03	0.02	0.02		0.02	0.02	0.02	0.03	0.03	0.02		0.02	0.02
Ortho Phosphorus (mg/L)	<0.005	5.10	0.15	0.057	0.05		0.115	0.027	0.661	0.68		0.58	0.58	0.58	0.62	0.011	0.017	0.017		0.055	0.015	0.075	0.075		<0.005	<0.005	<0.005	0.056	0.046	0.047		0.043	0.047
Total Dissolved Solids (mg/L)	42.50	62.50	52.50																														
Suspended Solids (mg/L)	<1.5	11.00	1.12	3			4	<3.0	3			3	<3.0	<3.0	<3.0	<2.0		<2.0		<3.0	<3.0	4			<3.0	<3.0	<3.0	3	3			<3.0	<3.0
Total Organic Carbon (mg/L)	3.40	29.30	12.26	15.1	15.1		27.5	14	18.8	18.8		19.3	19.4	19.4	18.3	8.4	8.4	8.6		16.4	8.6	18.4	18.4		16.6	15.2	19.9	17	15.3	15.6		16.9	15.4
Chlorophyll A (ug/L)	<0.1	57.70	2.88	3.8			11.1	0.4	0.6			0.2	0.2	0.2	1	1.3		0.7		0.3	1.4	0.9			0.1	<0.1	<0.1	1.1	1			1.2	0.8
SD Transparency (m)	0.45	3.80	1.99	0.60					0.45									1.20				0.53							0.63				
TN / TP Ratio	2/1	37/1	13/1	11/1					16/1							14/1						6/1							7/1				
Total Coliforms (/100mL)	27.00	>4838	722.00			120					1414	>2419	1556						>200					146							187		
E. Coli (/100mL)	0.00	56.00	12.30			0					56	51	38						1					1							3		

Table 2A — SL- Shoreline Sample | ML-Mid Lake Sample | ST- Stream Sample

Selected Water Quality Parameters 2009 (Lake & Stream Stations)

Lake				FANNING LAKE								SLOANS LAKE																	SLOANS LAKE					
Sample Location				ML	ML	ML	SL	ST	ST	ST	ST	ML	ML	ML	ML	ML	ML	ML	ML	SL	ML	SL	ML	ML	SL	ST	ST	ST	ML	ML	ML	ML	ML	ML
``				FL-DS1	FL-DS1	FL-DS2	FL-SL1	FL-IN1	FL-IN2	FL-IN3	FL-0L1	SL-DS1	SL-DS1	SL-DS1	SL-DS2	SL-DS2	SL-DS2	SL-S3	SL-S3	SL-SL3	SL-S4	SL-SL4	SL-S5	SL-S5	SL-SL5	SL-OL1	SL-IN1-50M	SL-IN1-200M	SL-DS1	SL-DS1	SL-DS2	SL-DS2	SL-S3	SL-S3
Depth (m)				0	7.9	0	0	0	0	0	0	0	8	19	0	8	16	1	8	1	1	1	1	5	1	0	0	0	0	22	0	17.6	0	7.5
Date Sampled				13-Oct	13-Oct	13-Oct	13-Oct	14-Oct	14-Oct	14-Oct	14-Oct	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov
Water Quality Parameters	**Min**	**Max**	**Mean**																															
Aluminum (ug/L)	40.00	596.00	207.28	256	261	252		265	290	124	255	44		57	48		60	40			41		48			50	351	391	40	77	45	46	40	
Antimony (ug/L)	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Barium (ug/L)	2.00	8.00	3.74	4		4		4	4	4	4	3			3			3			3		3			3	5	6	2		2		2	
Beryllium (ug/L)	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Boron (ug/L)	<5	8.00	3.85	<5		<5		5	6	<5	<5	5			<5			5			5		6			5	6	5	6		6		5	
Cadmium (ug/L)	<1	<1	<1	<1		<1		<1	<1	<1	<1	<1			<1			<1			<1		<1			<1	<1	<1	<1		<1		<1	
Calcium (mg/L)	0.90	11.70	1.82	1.2	1.2	1.3		1.2	1.5	1.4	1.2	2		1.7	1.6		1.7	1.8			1.7		1.8			1.9	2.9	2.9	1.7	1.9	1.5	1.5	1.7	
Chromium (ug/L)	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Cobalt (ug/L)	<2	16.00	0.48	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	10	16	<2		<2		<2	
Copper (ug/L)	<2	23.00	0.40	<2	<2	<2		<2	<2	<2	<2	<2		<2	<2		23	<2			<2		<2			<2	<2	<2	<2	<2	<2	<2	<2	
Iron (ug/L)	<50	1943.00	574.76	794	795	755		829	641	92	796	<50		158	<50		122	<50			<50		<50			<50	1258	1943	54	1411	65	61	51	
Lead (ug/L)	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Magnesium (mg/L)	0.50	5.00	0.99	0.8	0.8	0.8		0.8	0.7	0.8	0.8	1		1.1	0.9		1	0.9			0.9		1			0.9	1.4	1.5	1	1.1	0.9	0.9	1	
Manganese (ug/L)	8.00	2770.00	142.55	62	63	60		61	76	34	69	17		156	12		144	16			12		8			14	1878	2770	62	818	55	51	57	
Nickel (ug/L)	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Potassium (mg/L)	<0.5	6.80	0.58	<0.5	<0.5	<0.5		0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5			<0.5		<0.5			<0.5	1.1	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	
Selenium (ug/L)	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Sodium (mg/L)	3.40	20.80	5.74	4.9	4.9	4.9		4.7	3.9	5.9	4.8	5.9			5.6			5.8			5.7		5.9			5.5	5.2	5	6		5.6	5.6	5.8	
Tin (ug/L0	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Vanadium (ug/L0	<2	<2	<2	<2		<2		<2	<2	<2	<2	<2			<2			<2			<2		<2			<2	<2	<2	<2		<2		<2	
Zinc (ug/L)	<5	11.00	1.42	<5	<5	<5		<5	6	<5	<5	<5			<5			<5			<5		<5			<5	<5	<5	<5		<5	<5	<5	
Hardness as CaCO3 (mg/L)	4.60	49.80	8.50	6.3	6.3	6.5		6.3	6.6	6.8	6.3	9.1			7.7			8.2			7.9		8.6			8.4	13	13.4	8.4		7.5	7.5	8.4	
Conductivity (umho/cm)	34.70	303.00	54.09	40.6	41.1	41.5		40.6	34.7	49.4	40.1	50		53.5	47.6		49.5	50			50.6		47.8			47.3	56.7	60	52	59.1	48	48	51	
pH	4.30	7.50	6.23	5.9	5.9	6		5.9	6.3	6.4	6	6.9		6.8	6.8		6.7	6.8			6.9		6.8			6.8	7.1	7.2	6.9	7	6.8	6.8	6.9	
Turbidity (NTU)	0.23	10.60	1.53	1.11	1.23	1.26		1.18	1.46	0.31	1.14	0.42		0.41	0.5		0.32	0.41			0.35		0.47			0.43	1.1	1.61	0.48	4.53	0.5	0.36	0.62	
Alkalinity as CaCO3 (mg/L)	<1.0	67.40	3.84	1.6	1.5	1.7		1.6	2.5	1.6	1.8	3.2		3.7	3.1		3.4	3.4			3.6		3			3.1	12.5	14.1	4.1	6.7	3.5	3	3.8	
Chloride (mg/L)	5.70	36.00	9.64	7.6	7.7	7.6		7.5	5.8	11	8	9.7		10	9.2		9.6	9.6			9.8		9			9.1	7.6	7.8	10	10	9.2	9.2	9.8	
Colour (TCU)	14.00	269.00	104.39	120	122	117		130	113	37	120	20		15	20		14	20			19		21			20	114	132	21	44	21	21	21	
Silica (mg/L)	<1.0	12.00	3.77	3.7	3.7	3.6		3.9	3.6	2.4	3.8	1.2		2.8	1.2		2.4	1.2			1.2		1.2			1.2	6.9	6.4	1.9	3.2	1.8	1.8	1.9	
Sulfate (mg/L)	<5	11.00	0.16	<5.00	<5.000	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00		<5.00	<5.00		<5.00	<5.00			<5.00		<5.00			<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	
Total Nitrogen (mg/L)	0.11	11.33	0.82	0.4	0.4	0.44		0.46	0.38	0.26	0.45	0.18		0.19	0.15		0.15	0.16	0.11		0.15		0.16	0.12		0.15	0.35	0.37	0.22	0.25	0.14	0.14	0.14	0.17
Total Phosphorus (mg/L)	<0.005	5.40	0.17	0.056	0.06	0.056		0.064	0.02	0.007	0.059	0.005	0.006	0.007	<0.005	0.006	<0.005	0.005	0.006		<0.005		<0.005	0.005		<0.005	0.038	0.044	0.006	0.012	<0.005	<0.005	<0.005	<0.005
Nitrate + Nitrite (mg/L)	<0.01	3.40	0.18	0.06	0.06	0.06		0.06	0.01	0.01	0.05	<0.01		0.06	<0.01		0.03	<0.01	<0.01		<0.01		<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (mg/L)	<0.01	9.10	0.21	0.02	0.02	0.03		0.02	0.02	<0.01	0.02	0.02		0.02	<0.01		0.01	0.01	0.01		<0.01		<0.01	0.02		<0.01	0.03	0.02	0.02	0.06	0.02	0.01	0.01	0.01
Ortho Phosphorus (mg/L)	<0.005	5.10	0.15	0.037	0.037	0.035		0.043	<0.005	<0.005	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Dissolved Solids (mg/L)	42.50	62.50	52.50																							42.5	62.5							
Suspended Solids (mg/L)	<1.5	11.00	1.12	1.5		<3.0		<3.0	<3.0	<3.0	<3.0	3			2						<1.5		<1.5			3	7		<3.0	<3.0	<3.0		<3.0	
Total Organic Carbon (mg/L)	3.40	29.30	12.26	13	13.3	12.8		13.9	13.8	6.3	12.9	4.8		3.5	4.8		3.4				4.7		4.8			4.7	16.4		4.5	4.1	4.3	4.3	4.3	
Chlorophyll A (ug/L)	<0.1	57.70	2.88	1.3		1.6		1	1.2	0.7	1.1	1.9	0.7		1.8	0.7					0.9		1.3			1.2	<0.1		1.2		1.5		1.8	
SD Transparency (m)	0.45	3.80	1.99	0.75		0.7						3.8			3.8			3.6					3.75						3.15		3.7		3.1	
TN / TP Ratio	2/1	37/1	13/1	7/1								36/1																	37/1					
Total Coliforms (/100mL)	27.00	>4838	722.00				291													115		139			117		>4838							
E. Coli (/100mL)	0.00	56.00	12.30				3													6		6			4		10							

Table 2A SL- Shoreline Sample | ML-Mid Lake Sample | ST- Stream Sample

Selected Water Quality Parameters 2009 (Lake & Stream Stations)

Lake				SLOANS LAKE											VAUGHAN LAKE							PROVOST LAKE					NOWLANS LAKE							
Sample Location				SL	ML	ML	ML	SL	SL	ST	ST	ST	ST	ST	ML	ML	ML	SL	ST	ST	ST	ML	ML	SL	ST	ST	ML	ML	SL	SL	SL	SL	ST	ST
``				SL-SLS3	SL-S4	SL-S5	SL-S5	SL-SLS5	SL-SL near creek	SL-OL6	SL-IN1-50M	IN1B-200M	SL-IN1-50M	IN1B-200M	VL-DS1	VL-DS1	VL-DS2	VL-SL1	VL-IN1	VL-IN2	VL-OL1	PROL-DS1	PROL-DS1	PROL-SL1	PROL-IN1	PROL-OL1	NL-DS1	NL-DS1	NL-SL1	NL-SL1	NL-SL2	NL-SL3	NL-IN1	NL-OL1
Depth (m)				0	0	0	5.6	0	0	0	0	0	0	0	0	18.5	0	0	0	0	0	0	4.1	0	0	0	0	5.7	0	0	0	0	0	0
Date Sampled				6-Nov	5-Nov	5-Nov	5-Nov	6-Nov	6-Nov	5-Nov	5-Nov	5-Nov	6-Nov	6-Nov	28-Oct	28-Oct	28-Oct	28-Oct	28-Oct	28-Oct	28-Oct	27-Oct	27-Oct	28-Oct	27-Oct	27-Oct	15-Oct	15-Oct	14-Oct	15-Oct	15-Oct	15-Oct	15-Oct	15-Oct
Water Quality Parameters	**Min**	**Max**	**Mean**																															
Aluminum (ug/L)	40.00	596.00	207.28		46	46				45	228	230			202	202	396	344	202	404	346	235	246		222	255	40	40					152	79
Antimony (ug/L)	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Barium (ug/L)	2.00	8.00	3.74		2	2				2	2	3			3		4	4	3	3	4	5			4	5	3						8	3
Beryllium (ug/L)	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Boron (ug/L)	<5	8.00	3.85		5	5				5	<5	<5			5		5	<5	5	<5	<5	5			<5	5	5						8	5
Cadmium (ug/L)	<1	<1	<1		<1	<1				<1	<1	<1			<1		<1	<1	<1	<1	<1	<1			<1	<1	<1						<1	<1
Calcium (mg/L)	0.90	11.70	1.82		1.6	1.6				1.5	1.3	1.3			1.2	1.2	1	1.1	1.2	1	1.1	0.9	1		1.2	1.1	3.1	3					11.7	3.1
Chromium (ug/L)	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Cobalt (ug/L)	<2	16.00	0.48		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Copper (ug/L)	<2	23.00	0.40		<2	<2				<2	<2	<2			<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	4	<2	<2					<2	<2
Iron (ug/L)	<50	1943.00	574.76		72	59				111	372	488			593	595	431	461	582	428	466	354	382		453	378	334	339					489	377
Lead (ug/L)	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Magnesium (mg/L)	0.50	5.00	0.99		0.9	1				0.9	0.8	0.8			0.7	0.7	0.5	0.6	0.8	0.5	0.6	0.7	0.6		0.8	0.6	1.5	1.5					5	1.5
Manganese (ug/L)	8.00	2770.00	142.55		39	53				52	188	269			54	56	22	32	52	21	31	44	46		14	40	53	50					135	92
Nickel (ug/L)	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Potassium (mg/L)	<0.5	6.80	0.58		<0.5	<0.5				<0.5	0.7	0.7			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.5		<0.5	0.6	1.7	1.6					6.8	1.6
Selenium (ug/L)	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Sodium (mg/L)	3.40	20.80	5.74		5.5	5.6				5.5	4.3	4.2			4.8	4.8	3.6	3.8	4.7	3.4	3.8	4.5	4.6		4.2	4.6	8.3	8.3					20.8	8
Tin (ug/L0	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Vanadium (ug/L0	<2	<2	<2		<2	<2				<2	<2	<2			<2		<2	<2	<2	<2	<2	<2			<2	<2	<2						<2	<2
Zinc (ug/L)	<5	11.00	1.42		<5	<5				<5	<5	<5			<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	11	<5	<5					8	<5
Hardness as CaCO3 (mg/L)	4.60	49.80	8.50	`	7.7	8.1				7.5	6.5	6.5			5.9	5.9	4.6	5.2	6.3	4.6	5.2	5.1	5		6.3	5.2	13.90	13.7					49.8	13.9
Conductivity (umho/cm)	34.70	303.00	54.09		49.5	48.3				48.2	38.8	38.7			40.5	40.8	37.8	37.8	40.7	38	38.4	40.4	39.1		53	38.8	82.40	83.2					303	80.6
pH	4.30	7.50	6.23		6.9	6.8				6.8	6.7	6.7			6.2	6.2	4.7	4.9	6.2	4.6	4.8	5.9	5.6		4.3	5.4	7.30	7.3					7.5	7.2
Turbidity (NTU)	0.23	10.60	1.53		0.37	0.41				0.4	0.63	1.25			0.95	0.93	0.68	0.7	1	0.66	0.69	1.19	1.09		0.36	1.15	10.60	6.67					1.96	9.22
Alkalinity as CaCO3 (mg/L)	<1.0	67.40	3.84		3.8	3.2				3.5	3.4	4.1			1.8	1.9	<1.0	<1.0	1.8	<1.0	<1.0	1.1	<1.0		<1.0	<1.0	9.50	9.8					67.4	9.8
Chloride (mg/L)	5.70	36.00	9.64		9.6	9.5				9.3	7.2	7.2			7.9	8	6	6.8	8.2	5.7	6.4	7.6	7.7		8.4	7.4	15.00	15					36	14
Colour (TCU)	14.00	269.00	104.39		21	21				22	67	69			88	88	180	177	94	194	175	68	70		269	75	33.00	31					86	45
Silica (mg/L)	<1.0	12.00	3.77		1.8	1.8				1.8	5.3	5.1			3.1	3.1	4.5	4	3.1	4.6	4	<1.0	<1		5.5	1.4	3.90	3.9					12	3.9
Sulfate (mg/L)	<5	11.00	0.16		<5.00	<5.00				<5.00	<5.00	<5.00			<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00		<5.00	<5.00	<5.00	<5.00					11	<5.00
Total Nitrogen (mg/L)	0.11	11.33	0.82		0.14	0.15	0.15			0.15	0.25	0.25			0.4	0.39	0.4	0.42	0.41	0.41	0.42	0.31	0.28		0.52	0.3	0.68	0.61					10.28	0.85
Total Phosphorus (mg/L)	<0.005	5.40	0.17		0.006	0.006	0.006			0.005	0.014	0.014			0.033	0.034	0.015	0.023	0.034	0.014	0.022	0.02	0.02		0.014	0.018	0.38	0.38					5.4	0.4
Nitrate + Nitrite (mg/L)	<0.01	3.40	0.18		<0.01	<0.01	<0.01			<0.01	<0.01	<0.01			0.06	0.06	0.02	0.03	0.06	0.05	0.03	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01					3.4	0.06
Ammonia (mg/L)	<0.01	9.10	0.21		0.01	0.02	0.01			<0.01	0.02	0.02			0.03	0.02	0.02	0.03	0.03	0.02	0.03	0.02	0.02		0.02	0.01	0.05	0.06					9.1	0.1
Ortho Phosphorus (mg/L)	<0.005	5.10	0.15		<0.005	<0.005	<0.005			<0.005	<0.005	<0.005			0.014	0.016	<0.005	0.005	0.014	<0.005	0.006	0.006	0.006		<0.005	<0.005	0.29	0.26					5.1	0.36
Total Dissolved Solids (mg/L)	42.50	62.50	52.50																															
Suspended Solids (mg/L)	<1.5	11.00	1.12		<3.0	<3.0				<3.0	<3.0	3			<3.0		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0			<3.0	<2.0	6.00						<3.0	11
Total Organic Carbon (mg/L)	3.40	29.30	12.26		4.3	4.3				4.2	10.4	10.8			10.4	10.5	19.4	18.7	10.8	19.9	19	9	9.2		29.3	10	8.10	8.2					11.8	9.3
Chlorophyll A (ug/L)	<0.1	57.70	2.88		1	1.6				1.6	<0.1	<0.1			1.3		0.5	0.6	0.9	0.4	0.5	2.8			<0.1	2.1	57.70						0.1	38.4
SD Transparency (m)	0.45	3.80	1.99			3.25									0.9							1.05					0.80							
TN / TP Ratio	2/1	37/1	13/1												12/1		27.00					16/1					2/1							
Total Coliforms (/100mL)	27.00	>4838	722.00	27				30	62				687	816				>200						>200					980	1046	613	411		
E. Coli (/100mL)	0.00	56.00	12.30	1				0	1				0	2				5						4					29	38	15	9		

Table 2B SL- Shoreline Sample | ML-Mid Lake Sample

Selected Water Quality Parameters 2009 (Lake Stations)

Lake				HOURGLASS LAKE			PLACIDES LAKE			PORCUPINE LAKE				PARR LAKE			OGDEN LAKE			FANNING LAKE			
Sample Location				ML	ML	SL	ML	ML	SL	ML	ML	ML	SL	ML	ML	SL	ML	ML	SL	ML	ML	ML	SL
Sample ID				HL-DS1	HL-DS1	HL-SL1	PLAL-DS1	PLAL-DS1	PLAL - SL1	PORL-DS1	PORL-DS1	PORL-DS2	PORL-SL1	PARL DS1	PARL DS1	PARL-SL1	OL-DS1	OL-DS1	OL-SL1	FL-DS1	FL-DS1	FL-DS2	FL-SL1
Depth (m)				0	6.3	0	0	5.8	0	0	12.7	0	0	0	6.2	0	0	18.6	0	0	7.9	0	0
Date Sampled				20-Oct	20-Oct	20-Oct	21-Oct	21-Oct	21-Oct	27-Oct	27-Oct	27-Oct	27-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	13-Oct	13-Oct	13-Oct	13-Oct
Water Quality Parameters	**Min**	**Max**	**Mean**																				
Aluminum (ug/L)	40.00	396.00	164.17	308	315		297	306		99	105	102		323	314		292	297		256	261	252	
Antimony (ug/L)	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Barium (ug/L)	2.00	5.00	3.30	5			5			3		3		4			4			4		4	
Beryllium (ug/L)	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Boron (ug/L)	<5	6.00	4.17	6			5			<5		5		6			6			<5		<5	
Cadmium (ug/L)	<1	<1	<1	<1			<1			<1		<1		<1			<1			<1		<1	
Calcium (mg/L)	0.90	3.10	1.62	1.6	1.6		2.8	2.8		1.5	1.5	1.5		1.3	1.3		1.3	1.2		1.2	1.2	1.3	
Chromium (ug/L)	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Cobalt (ug/L)	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Copper (ug/L)	<2	23.00	0.64	<2	<2		<2	<2		<2	<2	<2		<2	<2		<2	<2		<2	<2	<2	
Iron (ug/L)	<50	1411.00	497.06	960	960		1201	1186		744	809	784		869	856		812	827		794	795	755	
Lead (ug/L)	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Magnesium (mg/L)	0.50	1.50	0.93	0.9	0.9		1.4	1.4		1	1	1		0.8	0.8		0.8	0.8		0.8	0.8	0.8	
Manganese (ug/L)	8.00	818.00	79.00	79	79		125	123		53	56	54		56	56		60	61		62	63	60	
Nickel (ug/L)	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Potassium (mg/L)	<0.5	2.20	0.39	0.7	0.7		2.2	2.2		0.6	0.6	0.6		0.6	0.6		0.5	0.5		<0.5	<0.5	<0.5	
Selenium (ug/L)	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Sodium (mg/L)	3.60	8.30	5.61	6.7	6.7		7.7	7.9		5.6	5.5	5.5		4.7	4.9		4.8	4.8		4.9	4.9	4.9	
Tin (ug/L0	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Vanadium (ug/L0	<2	<2	<2	<2			<2			<2		<2		<2			<2			<2		<2	
Zinc (ug/L)	<5	8.00	0.82	6	6		8	7		<5	<5	<5		<5	<5		<5	<5		<5	<5	<5	
Hardness as CaCO3 (mg/L)	4.60	13.90	7.82	7.7	7.7		12.8	12.8		7.9	7.9	7.9		6.5	6.5		6.5	6.3		6.3	6.3	6.5	
Conductivity (umho/cm)	37.80	83.20	50.37	55.2	55.4		78.4	77.3		50.1	49.8	49.2		42.3	42.6		41	42		40.6	41.1	41.5	
pH	4.70	7.30	6.37	6.2	6.2		6.5	6.4		6.6	6.7	6.6		5.4	5.4		5.8	5.9		5.9	5.9	6	
Turbidity (NTU)	0.32	10.60	1.63	1.18	1.34		5.4	5.85		1.15	1.3	1.11		1.19	1.23		1.11	1.28		1.11	1.23	1.26	
Alkalinity as CaCO3 (mg/L)	<1.0	9.80	2.88	2.1	2.1		4.1	3.6		3	3	2.6		<1.0	<1.0		1.2	1.6		1.6	1.5	1.7	
Chloride (mg/L)	6.00	15.00	9.44	11	11		13	13		9.7	9.8	9.8		8.1	8.3		7.5	7.5		7.6	7.7	7.6	
Colour (TCU)	14.00	207.00	82.08	134	147		190	207		75	79	77		176	178		140	159		120	122	117	
Silica (mg/L)	<1.0	5.80	2.91	3.5	3.6		5.8	5.8		3.1	3	3		4.9	4.9		4.2	4.2		3.7	3.7	3.6	
Sulfate (mg/L)	<5.00	<5.00	<5.00	<5.00	<5.00		<5.00	<5.00		<5.00	<5.00	<5.00		<5.00	<5.00		<5.00	<5.00		<5.00	<5.00	<5.00	
Total Nitrogen (mg/L)	0.11	11.33	0.67	0.86	0.86		11.33	2.8		0.46	0.4	0.41		0.56	0.56		0.46	0.48		0.4	0.4	0.44	
Total Phosphorus (mg/L)	<0.005	0.72	0.08	0.078	0.079		0.72	0.7		0.034	0.033	0.035		0.098	0.095		0.066	0.067		0.056	0.06	0.056	
Nitrate + Nitrite (mg/L)	<0.01	1.10	0.09	0.21	0.22		1.1	1.1		0.06	0.07	0.07		0.07	0.07		0.06	0.06		0.06	0.06	0.06	
Ammonia (mg/L)	<0.01	0.88	0.07	0.11	0.11		0.76	0.88		0.06	0.03	0.03		0.02	0.02		0.03	0.02		0.02	0.02	0.03	
Ortho Phosphorus (mg/L)	<0.005	0.68	0.06	0.057	0.05		0.661	0.68		0.011	0.017	0.017		0.075	0.075		0.046	0.047		0.037	0.037	0.035	
Total Dissolved Solids (mg/L)	0.00	0.00																					
Suspended Solids (mg/L)	<1.5	6.00	1.11	3			3			<2.0		<2.0		4			3			1.5		<3.0	
Total Organic Carbon (mg/L)	3.40	19.40	9.99	15.1	15.1		18.8	18.8		8.4	8.4	8.6		18.4	18.4		15.3	15.6		13	13.3	12.8	
Chlorophyll A (ug/L)	<0.1	57.70	3.69	3.8			0.6			1.3		0.7		0.9			1			1.3		1.6	
SD Transparency (m)	0.45	3.80	1.99	0.60			0.45					1.20		0.53			0.625			0.75		0.7	
TN / TP Ratio	2/1	37/1	13/1																				
Carbonaceous BOD (mg/L)	0.00	0.00																					
Total Coliforms (/100mL)	27	1414	350			120			1414				>200			146			187				291
E. Coli (/100mL)	0	56	10			0			56				1			1			3				3

Table 2B SL- Shoreline Sample ML-Mid Lake Sample

Selected Water Quality Parameters 2009 (Lake Stations)

Lake				SLOANS LAKE														SLOANS LAKE											
Sample Location				ML	ML	ML	ML	ML	ML	SL	SL	SL	SL	SL	SL	SL	SL	ML	ML	ML	ML	SL	SL	SL	SL	SL	SL	SL	SL
Sample ID				SL-DS1	SL-DS1	SL-DS1	SL-DS2	SL-DS2	SL-DS2	SL-S3	SL-S3	SL-SL3	SL-S4	SL-SL4	SL-S5	SL-S5	SL-SL5	SL-DS1	SL-DS1	SL-DS2	SL-DS2	SL-S3	SL-S3	SL-SLS3	SL-S4	SL-S5	SL-S5	SL-SLS5	SL-SI near creek
Depth (m)				0	8	19	0	8	16	1	8	1	1	1	1	5	1	0	22	0	17.6	0	7.5		7.5	0	5.6		
Date Sampled				10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	10-Sep	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	5-Nov	6-Nov	5-Nov	5-Nov	5-Nov	6-Nov	6-Nov
Water Quality Parameters	**Min**	**Max**	**Mean**																										
Aluminum (ug/L)	40.00	396.00	164.17	44		57	48		60	40			41		48			40	77	45	46	40			46	46			
Antimony (ug/L)	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Barium (ug/L)	2.00	5.00	3.30	3			3			3			3		3			2		2		2			2	2			
Beryllium (ug/L)	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Boron (ug/L)	<5	6.00	4.17	5			<5			5			5		6			6		6		5			5	5			
Cadmium (ug/L)	<1	<1	<1	<1			<1			<1			<1		<1			<1		<1		<1			<1	<1			
Calcium (mg/L)	0.90	3.10	1.62	2		1.7	1.6		1.7	1.8			1.7		1.8			1.7	1.9	1.5	1.5	1.7			1.6	1.6			
Chromium (ug/L)	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Cobalt (ug/L)	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Copper (ug/L)	<2	23.00	0.64	<2		<2	<2		23	<2			<2		<2			<2	<2	<2	<2	<2			<2	<2			
Iron (ug/L)	<50	1411.00	497.06	<50		158	<50		122	<50			<50		<50			54	1411	65	61	51			72	59			
Lead (ug/L)	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Magnesium (mg/L)	0.50	1.50	0.93	1		1.1	0.9		1	0.9			0.9		1			1	1.1	0.9	0.9	1			0.9	1			
Manganese (ug/L)	8.00	818.00	79.00	17		156	12		144	16			12		8			62	818	55	51	57			39	53			
Nickel (ug/L)	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Potassium (mg/L)	<0.5	2.20	0.39	<0.5		<0.5	<0.5		<0.5	<0.5			<0.5		<0.5			<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5			
Selenium (ug/L)	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Sodium (mg/L)	3.60	8.30	5.61	5.9			5.6			5.8			5.7		5.9			6		5.6	5.6	5.8			5.5	5.6			
Tin (ug/L0	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Vanadium (ug/L0	<2	<2	<2	<2			<2			<2			<2		<2			<2		<2		<2			<2	<2			
Zinc (ug/L)	<5	8.00	0.82	<5			<5			<5			<5		<5			<5		<5	<5	<5			<5	<5			
Hardness as CaCO3 (mg/L)	4.60	13.90	7.82	9.1			7.7			8.2			7.9		8.6			8.4		7.5	7.5	8.4			7.7	8.1			
Conductivity (umho/cm)	37.80	83.20	50.37	50		53.5	47.6		49.5	50			50.6		47.8			52	59.1	48	48	51			49.5	48.3			
pH	4.70	7.30	6.37	6.9		6.8	6.8		6.7	6.8			6.9		6.8			6.9	7	6.8	6.8	6.9			6.9	6.8			
Turbidity (NTU)	0.32	10.60	1.63	0.42		0.41	0.5		0.32	0.41			0.35		0.47			0.48	4.53	0.5	0.36	0.62			0.37	0.41			
Alkalinity as CaCO3 (mg/L)	<1.0	9.80	2.88	3.2		3.7	3.1		3.4	3.4			3.6		3			4.1	6.7	3.5	3	3.8			3.8	3.2			
Chloride (mg/L)	6.00	15.00	9.44	9.7		10	9.2		9.6	9.6			9.8		9			10	10	9.2	9.2	9.8			9.6	9.5			
Colour (TCU)	14.00	207.00	82.08	20		15	20		14	20			19		21			21	44	21	21	21			21	21			
Silica (mg/L)	<1.0	5.80	2.91	1.2		2.8	1.2		2.4	1.2			1.2		1.2			1.9	3.2	1.8	1.8	1.9			1.8	1.8			
Sulfate (mg/L)	<5.00	<5.00	<5.00	<5.00		<5.00	<5.00		<5.00	<5.00			<5.00		<5.00			<5.00	<5.00	<5.00	<5.00	<5.00			<5.00	<5.00			
Total Nitrogen (mg/L)	0.11	11.33	0.67	0.18		0.19	0.15		0.15	0.16	0.11		0.15		0.16	0.12		0.22	0.25	0.14	0.14	0.14	0.17		0.14	0.15	0.15		
Total Phosphorus (mg/L)	<0.005	0.72	0.08	0.005	0.006	0.007	<0.005	0.006	<0.005	0.005	0.006		<0.005		<0.005	0.005		0.006	0.012	<0.005	<0.005	<0.005	<0.005		0.006	0.006	0.006		
Nitrate + Nitrite (mg/L)	<0.01	1.10	0.09	<0.01		0.06	<0.01		0.03	<0.01	<0.01		<0.01		<0.01	<0.01		<0.01	0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01		
Ammonia (mg/L)	<0.01	0.88	0.07	0.02		0.02	<0.01		0.01	0.01	0.01		<0.01		<0.01	0.02		0.02	0.06	0.02	0.01	0.01	0.01		0.01	0.02	0.01		
Ortho Phosphorus (mg/L)	<0.005	0.68	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		
Total Dissolved Solids (mg/L)	0.00	0.00																											
Suspended Solids (mg/L)	<1.5	6.00	1.11	3			2						<1.5		<1.5			<3.0	<3.0	<3.0		<3.0			<3.0	<3.0			
Total Organic Carbon (mg/L)	3.40	19.40	9.99	4.8		3.5	4.8		3.4				4.7		4.8			4.5	4.1	4.3	4.3	4.3			4.3	4.3			
Chlorophyll A (ug/L)	<0.1	57.70	3.69	1.9	0.7		1.8	0.7					0.9		1.3			1.2		1.5		1.8			1	1.6			
SD Transparency (m)	0.45	3.80	1.99	3.8			3.8			3.6					3.75			3.15		3.7		3.1				3.25			
TN / TP Ratio	2/1	37/1	13/1																										
Carbonaceous BOD (mg/L)	0.00	0.00																											
Total Coliforms (/100mL)	27	1414	350									115		139			117							27				30	62
E. Coli (/100mL)	0	56	10									6		6			4							1				0	1

Table 2B SL- Shoreline Sample | ML-Mid Lake Sample

Selected Water Quality Parameters 2009 (Lake Stations)

Lake				VAUGHAN LAKE				PROVOST LAKE			NOWLANS LAKE					
Sample Location				ML	ML	ML	SL	ML	ML	SL	ML	ML	SL	SL	SL	SL
Sample ID				VL-DS1	VL-DS1	VL-DS2	VL-SL1	PROL-DS1	PROL-DS1	PROL-SL1	NL-DS1	NL-DS1	NL-SL1	NL-SL1	NL-SL2	NL-SL3
Depth (m)				0	18.5	0	0	0	4.1	0	0	5.7	0	0	0	0
Date Sampled				28-Oct	28-Oct	28-Oct	28-Oct	27-Oct	27-Oct	28-Oct	15-Oct	15-Oct	14-Oct	15-Oct	15-Oct	15-Oct
Water Quality Parameters	**Min**	**Max**	**Mean**													
Aluminum (ug/L)	40.00	396.00	164.17	202	202	396	344	235	246		40	40				
Antimony (ug/L)	<2	<2	<2	<2		<2	<2	<2			<2					
Barium (ug/L)	2.00	5.00	3.30	3		4	4	5			3					
Beryllium (ug/L)	<2	<2	<2	<2		<2	<2	<2			<2					
Boron (ug/L)	<5	6.00	4.17	5		5	<5	5			5					
Cadmium (ug/L)	<1	<1	<1	<1		<1	<1	<1			<1					
Calcium (mg/L)	0.90	3.10	1.62	1.2	1.2	1	1.1	0.9	1		3.1	3				
Chromium (ug/L)	<2	<2	<2	<2		<2	<2	<2			<2					
Cobalt (ug/L)	<2	<2	<2	<2		<2	<2	<2			<2					
Copper (ug/L)	<2	23.00	0.64	<2	<2	<2	<2	<2	<2		<2	<2				
Iron (ug/L)	<50	1411.00	497.06	593	595	431	461	354	382		334	339				
Lead (ug/L)	<2	<2	<2	<2		<2	<2	<2			<2					
Magnesium (mg/L)	0.50	1.50	0.93	0.7	0.7	0.5	0.6	0.7	0.6		1.5	1.5				
Manganese (ug/L)	8.00	818.00	79.00	54	56	22	32	44	46		53	50				
Nickel (ug/L)	<2	<2	<2	<2		<2	<2	<2			<2					
Potassium (mg/L)	<0.5	2.20	0.39	<0.5	<0.5	<0.5	<0.5	0.5	0.5		1.7	1.6				
Selenium (ug/L)	<2	<2	<2	<2		<2	<2	<2			<2					
Sodium (mg/L)	3.60	8.30	5.61	4.8	4.8	3.6	3.8	4.5	4.6		8.3	8.3				
Tin (ug/L0	<2	<2	<2	<2		<2	<2	<2			<2					
Vanadium (ug/L0	<2	<2	<2	<2		<2	<2	<2			<2					
Zinc (ug/L)	<5	8.00	0.82	<5	<5	<5	<5	<5	<5		<5	<5				
Hardness as CaCO3 (mg/L)	4.60	13.90	7.82	5.9	5.9	4.6	5.2	5.1	5		13.90	13.7				
Conductivity (umho/cm)	37.80	83.20	50.37	40.5	40.8	37.8	37.8	40.4	39.1		82.40	83.2				
pH	4.70	7.30	6.37	6.2	6.2	4.7	4.9	5.9	5.6		7.30	7.3				
Turbidity (NTU)	0.32	10.60	1.63	0.95	0.93	0.68	0.7	1.19	1.09		10.60	6.67				
Alkalinity as CaCO3 (mg/L)	<1.0	9.80	2.88	1.8	1.9	<1.0	<1.0	1.1	<1.0		9.50	9.8				
Chloride (mg/L)	6.00	15.00	9.44	7.9	8	6	6.8	7.6	7.7		15.00	15				
Colour (TCU)	14.00	207.00	82.08	88	88	180	177	68	70		33.00	31				
Silica (mg/L)	<1.0	5.80	2.91	3.1	3.1	4.5	4	<1.0	<1		3.90	3.9				
Sulfate (mg/L)	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00		<5.00	<5.00				
Total Nitrogen (mg/L)	0.11	11.33	0.67	0.4	0.39	0.4	0.42	0.31	0.28		0.68	0.61				
Total Phosphorus (mg/L)	<0.005	0.72	0.08	0.033	0.034	0.015	0.023	0.02	0.02		0.38	0.38				
Nitrate + Nitrite (mg/L)	<0.01	1.10	0.09	0.06	0.06	0.02	0.03	<0.01	<0.01		<0.01	<0.01				
Ammonia (mg/L)	<0.01	0.88	0.07	0.03	0.02	0.02	0.03	0.02	0.02		0.05	0.06				
Ortho Phosphorus (mg/L)	<0.005	0.68	0.06	0.014	0.016	<0.005	0.005	0.006	0.006		0.29	0.26				
Total Dissolved Solids (mg/L)	0.00	0.00														
Suspended Solids (mg/L)	<1.5	6.00	1.11	<3.0		<3.0	<3.0	<3.0			6.00					
Total Organic Carbon (mg/L)	3.40	19.40	9.99	10.4	10.5	19.4	18.7	9	9.2		8.10	8.2				
Chlorophyll A (ug/L)	<0.1	57.70	3.69	1.3		0.5	0.6	2.8			57.70					
SD Transparency (m)	0.45	3.80	1.99	0.9				1.05			0.80					
TN / TP Ratio	2/1	37/1	13/1													
Carbonaceous BOD (mg/L)	0.00	0.00														
Total Coliforms (/100mL)	27	1414	350				>200			>200			980	1046	613	411
E. Coli (/100mL)	0	56	10				5			4			29	38	15	9

Table 2C ST- Stream Sample

Selected Water Quality Parameters 2009 (Stream Stations)

			Lake	HOURGLASS LAKE		PLACIDES LAKE				PORCUPINE LAKE		PARR LAKE				OGDEN LAKE		FANNING LAKE			
			Sample ID	HL-IN1	HL-OL1	PLAL-IN1 above mink farm creek	PLAL-IN1 below mink farm creek	PLAL-IN1	PLAL-OL1	PORL-IN1	PORL-OL1	PARL-INA	PARL-INB	PARL-INC	PARL-OL1	OL-IN1	OL-OL1	FL-IN1	FL-IN2	FL-IN3	FL-0L1
			Depth (m)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Date Sampled	20-Oct	20-Oct	21-Oct	21-Oct	21-Oct	21-Oct	27-Oct	27-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	22-Oct	14-Oct	14-Oct	14-Oct	14-Oct
Water Quality Parameters	**Min**	**Max**	**Mean**																		
Aluminum (ug/L)	45.00	596.00	257.35	596	304	281	285	283	295	219	103	344	207	273	305	299	295	265	290	124	255
Antimony (ug/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Barium (ug/L)	2.00	8.00	4.06	6	5	5	5	5	5	4	3	2	3	4	4	4	4	4	4	4	4
Beryllium (ug/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron (ug/L)	<5	8.00	3.61	6	6	6	6	6	6	<5	<5	<5	5	<5	5	5	6	5	6	<5	<5
Cadmium (ug/L)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Calcium (mg/L)	1.00	11.70	2.05	1.9	1.6	2.8	3	3	2.7	1.8	1.5	1.7	1.1	1.2	1.3	1.3	1.3	1.2	1.5	1.4	1.2
Chromium (ug/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Cobalt (ug/L)	<2	16.00	0.84	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Copper (ug/L)	<2	4.00	0.13	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Iron (ug/L)	<50	1943.00	665.00	620	762	784	797	826	1238	1278	783	714	245	470	790	784	821	829	641	92	796
Lead (ug/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Magnesium (mg/L)	0.50	5.00	1.06	0.7	1	1.4	1.4	1.4	1.3	1.1	1	0.8	0.6	0.7	0.8	0.8	0.8	0.8	0.7	0.8	0.8
Manganese (ug/L)	14.00	2770.00	216.35	33	61	89	90	86	128	36	50	35	40	92	55	55	61	61	76	34	69
Nickel (ug/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Potassium (mg/L)	<0.5	6.80	0.80	1	0.5	1.7	1.8	1.9	1.8	0.7	0.6	<0.5	<0.5	<0.5	0.6	0.6	0.5	0.5	<0.5	<0.5	<0.5
Selenium (ug/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sodium (mg/L)	3.40	20.80	5.88	9.3	6.5	7.5	7.7	8	7.2	5.2	5.4	4.3	4	4.2	4.8	4.8	5	4.7	3.9	5.9	4.8
Tin (ug/L0	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Vanadium (ug/L0	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Zinc (ug/L)	<5	11.00	2.06	10	<5	7	7	8	7	<5	<5	<5	<5	<5	<5	<5	<5	<5	6	<5	<5
Hardness as CaCO3 (mg/L)	4.60	49.80	9.51	7.6	8.1	12.8	13.3	13.3	12.1	9	7.9	7.5	5.2	5.9	6.5	6.5	6.5	6.3	6.6	6.8	6.3
Conductivity (umho/cm)	34.70	303.00	58.41	65.8	54.2	78.1	79.1	82	74.2	49.1	49	37	34.8	37	40.9	41.6	40.8	40.6	34.7	49.4	40.1
pH	4.30	7.50	6.07	5.7	6.4	6	6.1	6.2	6.3	6	6.6	6.2	5.1	5	5.5	5.5	5.8	5.9	6.3	6.4	6
Turbidity (NTU)	0.23	9.22	1.41	0.95	0.95	1.4	1.73	1.54	5.52	1.74	1.03	0.66	0.23	0.26	1.04	1.12	1.14	1.18	1.46	0.31	1.14
Alkalinity as CaCO3 (mg/L)	<1.0	67.40	4.95	2.8	2.9	2.2	2.6	3	2.9	2.2	2.6	2.4	<1.0	<1.0	<1.0	1.1	1.6	1.6	2.5	1.6	1.8
Chloride (mg/L)	5.70	36.00	9.87	14	11	13	13	14	12	9.6	9.5	7.2	6.2	6.7	7.9	7.7	7.6	7.5	5.8	11	8
Colour (TCU)	20.00	269.00	130.29	224	123	187	184	187	187	180	78	142	130	183	168	164	140	130	113	37	120
Silica (mg/L)	1.20	12.00	4.75	5.4	4	5.9	5.9	6	5.7	5.1	3	7.3	4.6	6.4	4.5	4.5	4.2	3.9	3.6	2.4	3.8
Sulfate (mg/L)	<5.00	11.00	0.35	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Total Nitrogen (mg/L)	0.15	10.28	1.01	0.63	0.59	2.6	2.57	2.95	2.38	0.53	0.4	0.38	0.3	0.33	0.52	0.49	0.48	0.46	0.38	0.26	0.45
Total Phosphorus (mg/L)	<0.005	5.40	0.30	0.17	0.049	0.63	0.61	0.61	0.66	0.079	0.031	0.018	0.011	0.016	0.076	0.076	0.066	0.064	0.02	0.007	0.059
Nitrate + Nitrite (mg/L)	<0.01	3.40	0.29	<0.01	0.14	1.26	1.26	1.28	0.95	0.1	0.06	<0.01	<0.01	<0.01	0.06	0.06	0.06	0.06	0.01	0.01	0.05
Ammonia (mg/L)	<0.01	9.10	0.39	0.02	0.04	0.63	0.63	0.67	0.56	0.02	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	<0.01	0.02
Ortho Phosphorus (mg/L)	<0.005	5.10	0.28	0.115	0.027	0.58	0.58	0.58	0.62	0.055	0.015	<0.005	<0.005	<0.005	0.056	0.043	0.047	0.043	<0.005	<0.005	0.03
Total Dissolved Solids (mg/L)	42.50	62.50	52.50																		
Suspended Solids (mg/L)	<2	11.00	1.13	4	<3.0	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Organic Carbon (mg/L)	4.20	29.30	14.91	27.5	14	19.3	19.4	19.4	18.3	16.4	8.6	16.6	15.2	19.9	17	16.9	15.4	13.9	13.8	6.3	12.9
Chlorophyll A (ug/L)	<0.1	38.40	2.24	11.1	0.4	0.2	0.2	0.2	1	0.3	1.4	0.1	<0.1	<0.1	1.1	1.2	0.8	1	1.2	0.7	1.1
SD Transparency (m)	0.00	0.00																			
TN / TP Ratio																					
Carbonaceous BOD (mg/L)																					
Total Coliforms (/100mL)	115.00	>4838	1354			>2419	1556														
E. Coli (/100mL)	2.00	51.00	16.57			51	38														

Table 2C ST- Stream Sample

Selected Water Quality Parameters 2009 (Stream Stations)

Lake				SLOANS LAKE				SLOANS LAKE					VAUGHAN LAKE			PROVOST LAKE			NOWLANS LAKE	
Sample ID				SL-OL1	SL-IN1-50M	SL-IN1-200M	SL-IN1	SL-OL6	SL-IN1-50M	SL-IN1B-200M	SL-IN1-50M	SL-IN1B-200M	VL-IN1	VL-IN2	VL-OL1	PROL-SL1	PROL-IN1	PROL-OL1	NL-IN1	NL-OL1
Depth (m)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Date Sampled				10-Sep	10-Sep	10-Sep	10-Sep	5-Nov	5-Nov	5-Nov	6-Nov	6-Nov	28-Oct	28-Oct	28-Oct	28-Oct	27-Oct	27-Oct	15-Oct	15-Oct
Water Quality Parameters	**Min**	**Max**	**Mean**																	
Aluminum (ug/L)	45.00	596.00	257.35	50	351	391		45	228	230			202	404	346		222	255	152	79
Antimony (ug/L)	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Barium (ug/L)	2.00	8.00	4.06	3	5	6		2	2	3			3	3	4		4	5	8	3
Beryllium (ug/L)	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Boron (ug/L)	<5	8.00	3.61	5	6	5		5	<5	<5			5	<5	<5		<5	5	8	5
Cadmium (ug/L)	<1	<1	<1	<1	<1	<1		<1	<1	<1			<1	<1	<1		<1	<1	<1	<1
Calcium (mg/L)	1.00	11.70	2.05	1.9	2.9	2.9		1.5	1.3	1.3			1.2	1	1.1		1.2	1.1	11.7	3.1
Chromium (ug/L)	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Cobalt (ug/L)	<2	16.00	0.84	<2	10	16		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Copper (ug/L)	<2	4.00	0.13	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	4	<2	<2
Iron (ug/L)	<50	1943.00	665.00	<50	1258	1943		111	372	488			582	428	466		453	378	489	377
Lead (ug/L)	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Magnesium (mg/L)	0.50	5.00	1.06	0.9	1.4	1.5		0.9	0.8	0.8			0.8	0.5	0.6		0.8	0.6	5	1.5
Manganese (ug/L)	14.00	2770.00	216.35	14	1878	2770		52	188	269			52	21	31		14	40	135	92
Nickel (ug/L)	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Potassium (mg/L)	<0.5	6.80	0.80	<0.5	1.1	1.1		<0.5	0.7	0.7			<0.5	<0.5	<0.5		<0.5	0.6	6.8	1.6
Selenium (ug/L)	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Sodium (mg/L)	3.40	20.80	5.88	5.5	5.2	5		5.5	4.3	4.2			4.7	3.4	3.8		4.2	4.6	20.8	8
Tin (ug/L0	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Vanadium (ug/L0	<2	<2	<2	<2	<2	<2		<2	<2	<2			<2	<2	<2		<2	<2	<2	<2
Zinc (ug/L)	<5	11.00	2.06	<5	<5	<5		<5	<5	<5			<5	<5	<5		<5	11	8	<5
Hardness as CaCO3 (mg/L)	4.60	49.80	9.51	8.4	13	13.4		7.5	6.5	6.5			6.3	4.6	5.2		6.3	5.2	49.8	13.9
Conductivity (umho/cm)	34.70	303.00	58.41	47.3	56.7	60		48.2	38.8	38.7			40.7	38	38.4		53	38.8	303	80.6
pH	4.30	7.50	6.07	6.8	7.1	7.2		6.8	6.7	6.7			6.2	4.6	4.8		4.3	5.4	7.5	7.2
Turbidity (NTU)	0.23	9.22	1.41	0.43	1.1	1.61		0.4	0.63	1.25			1	0.66	0.69		0.36	1.15	1.96	9.22
Alkalinity as CaCO3 (mg/L)	<1.0	67.40	4.95	3.1	12.5	14.1		3.5	3.4	4.1			1.8	<1.0	<1.0		<1.0	<1.0	67.4	9.8
Chloride (mg/L)	5.70	36.00	9.87	9.1	7.6	7.8		9.3	7.2	7.2			8.2	5.7	6.4		8.4	7.4	36	14
Colour (TCU)	20.00	269.00	130.29	20	114	132		22	67	69			94	194	175		269	75	86	45
Silica (mg/L)	1.20	12.00	4.75	1.2	6.9	6.4		1.8	5.3	5.1			3.1	4.6	4		5.5	1.4	12	3.9
Sulfate (mg/L)	<5.00	11.00	0.35	<5.00	<5.00	<5.00		<5.00	<5.00	<5.00			<5.00	<5.00	<5.00		<5.00	<5.00	11	<5.00
Total Nitrogen (mg/L)	0.15	10.28	1.01	0.15	0.35	0.37		0.15	0.25	0.25			0.41	0.41	0.42		0.52	0.3	10.28	0.85
Total Phosphorus (mg/L)	<0.005	5.40	0.30	<0.005	0.038	0.044		0.005	0.014	0.014			0.034	0.014	0.022		0.014	0.018	5.4	0.4
Nitrate + Nitrite (mg/L)	<0.01	3.40	0.29	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01			0.06	0.05	0.03		<0.01	<0.01	3.4	0.06
Ammonia (mg/L)	<0.01	9.10	0.39	<0.01	0.03	0.02		<0.01	0.02	0.02			0.03	0.02	0.03		0.02	0.01	9.1	0.1
Ortho Phosphorus (mg/L)	<0.005	5.10	0.28	<0.005	<0.005			<0.005	<0.005	<0.005			0.014	<0.005	0.006		<0.005	<0.005	5.1	0.36
Total Dissolved Solids (mg/L)	42.50	62.50	52.50	42.5	62.5															
Suspended Solids (mg/L)	<2	11.00	1.13	3	7			<3.0	<3.0	3			<3.0	<3.0	<3.0		<3.0	<2.0	<3.0	11
Total Organic Carbon (mg/L)	4.20	29.30	14.91	4.7	16.4			4.2	10.4	10.8			10.8	19.9	19		29.3	10	11.8	9.3
Chlorophyll A (ug/L)	<0.1	38.40	2.24	1.2	<0.1			1.6	<0.1	<0.1			0.9	0.4	0.5		<0.1	2.1	0.1	38.4
SD Transparency (m)	0.00	0.00																		
TN / TP Ratio																				
Carbonaceous BOD (mg/L)																				
Total Coliforms (/100mL)	115.00	>4838	1354	115			>4838				687	816	>200			>200				
E. Coli (/100mL)	2.00	51.00	16.57	6			10					2	5			4				

Table 3A   Dissolved Oxygen/ Temperature Profiles 2009 (Mid Lake Stations)

Sample Site	DS1 HOURGLASS LAKE					
Date	20-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	9.31	10.11	88.7	6.02	53.6	0
1	9.31	10.10	88.8	6.01	53.9	0
2	9.31	10.07	88.5	5.99	53.8	0
3	9.30	10.04	88.2	5.97	53.6	0
4	9.32	10.03	88.1	5.96	53.6	0
5	8.61	9.81	84.8	5.92	53.4	0
6	8.53	9.77	84.2	5.9	53.7	0
7	8.49	9.76	84.1	5.88	53.6	0
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Sample Site	DS1 PLACIDES LAKE					
Date	21-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	8.86	9.90	86.1	6.06	73.5	0.3
1	8.84	9.91	86.1	6.02	73.3	0.4
2	8.78	9.90	85.9	6.02	73.4	0.3
3	8.70	9.88	85.8	6.03	73.2	0.5
4	8.69	9.87	85.5	6.01	73.1	0.7
5	8.67	9.73	83.9	6.01	73.2	0.8
6	8.27	9.27	79.2	5.99	78.1	1.0
7	8.12	8.65	73.3	5.99	81.5	1.9
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Sample Site	DS1 PORCUPINE LAKE					
Date	27-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	9.45	10.94	96.5	6.30	46.2	0
1	9.43	10.95	96.5	6.30	46.5	0
2	9.38	10.91	95.9	6.30	46.5	0
3	9.39	10.90	96.0	6.29	46.5	0
4	9.40	10.85	95.5	6.29	46.4	0
5	9.32	10.84	95.4	6.29	46.3	0
6	9.32	10.81	95.0	6.29	46.1	0
7	9.30	10.80	94.9	6.30	46.5	0
8	9.29	10.80	94.8	6.29	46.3	0
9	9.28	10.77	94.5	6.29	46.3	0
10	9.26	10.74	94.3	6.31	46.3	0
11	9.21	10.68	93.7	6.31	46.4	0
12	9.15	10.64	93.2	6.29	46.4	0
13	9.10	10.63	92.9	6.29	46.3	0
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Sample Site	DS1 PARR LAKE					
Date	22-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	9.01	10.48	91.5	5.37	40.0	0
1	9.02	10.48	91.4	5.36	40.1	0
2	9.02	10.46	91.3	5.35	39.8	0
3	9.01	10.43	91.0	5.35	39.8	0
4	9.02	10.42	90.9	5.34	40.0	0
5	9.02	10.40	90.9	5.33	40.0	0
6	9.02	10.38	90.6	5.33	39.9	0
7	9.02	10.37	90.4	5.32	40.0	0
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Sample Site	DS1 OGDEN LAKE					
Date	22-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	9.99	10.30	91.9	5.67	38.1	0
1	9.99	10.28	91.8	5.66	38.1	0
2	10.00	10.27	91.8	5.65	38.0	0
3	10.00	10.26	91.7	5.63	38.1	0
4	10.01	10.24	91.5	5.63	38.1	0
5	10.01	10.22	91.3	5.64	38.1	0
6	10.01	10.21	91.3	5.62	37.9	0
7	10.00	10.16	90.8	5.62	37.9	0
8	10.00	10.16	90.7	5.61	38.1	0
9	10.00	10.12	90.3	5.61	38.0	0
10	10.00	10.12	90.3	5.62	38.1	0
11	9.99	10.08	90.1	5.61	38.0	0
12	9.99	10.07	89.9	5.62	38.1	0
13	9.98	10.05	89.8	5.62	38.0	0
14	9.96	10.01	89.3	5.60	38.0	0
15	9.94	9.98	89.0	5.61	38.0	0
16	9.93	9.98	88.9	5.60	38.1	0
17	9.94	9.94	88.7	5.60	38.1	0
18	9.94	9.93	88.6	5.59	38.1	0
19	9.91	9.90	88.2	5.59	38.1	0
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Sample Site	DS1 FANNING LAKE					
Date	13-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	12.04	9.57	94.5	5.73	38.2	0
1	12.88	9.51	91.4	5.75	38.3	0
2	12.87	9.54	91.1	5.73	38.2	0
3	12.85	9.49	90.5	5.72	38.5	0
4	12.84	9.47	90.3	5.72	37.9	0
5	12.83	9.46	90.0	5.71	38.5	0
6	12.83	9.40	89.6	5.72	38.2	0
7	12.83	9.40	89.5	5.72	38.3	0
8	12.83	9.34	89.0	5.71	38.3	0
9	12.81	9.29	88.5	5.74	38.1	0
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Sample Site	DS2 FANNING LAKE					
Date	13-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	12.71	9.54	90.6	5.81	38.2	0
1	12.71	9.53	90.5	5.81	38.5	0
2	12.48	9.54	90.3	5.81	38.5	0
3	12.46	9.48	89.6	5.81	38.5	0
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Table 3A **Dissolved Oxygen/ Temperature Profiles 2009 (Mid Lake Stations)**

Sample Site	DS1 SLOANS LAKE				DS2 SLOANS LAKE			
Date	10-Sep-09				10-Sep-09			
Depth (m)	Temp (C)	DO (mg/L)	pH	Cond (mmhos/cm)	Temp (C)	DO (mg/L)	pH	Cond (mmhos/cm)
0	19.9	7.90	6.53	51.0	21.0	7.90	6.43	48.1
1	20.0	7.90	6.50	51.1	21.0	7.97	6.40	48.3
2	20.0	7.86	6.45	50.8	20.6	7.92	6.36	47.8
3	19.9	7.91	6.42	51.0	20.3	7.74	6.31	48.1
4	19.9	7.87	6.38	51.0	20.2	7.66	6.25	48.3
5	19.9	7.84	6.34	50.9	20.1	7.73	6.14	48.3
6	19.9	7.60	6.28	50.9	19.3	7.03	5.81	48.3
7	18.4	5.09	5.62	50.8	17.7	4.36	5.38	50.1
8	15.6	3.80	5.59	52.5	13.5	2.12	5.24	49.8
9	13.3		5.36	53.1	11.8		5.15	51.8
10	11.9		5.29	53.5	10.6		5.02	50.3
11	11.4		5.29	53.1	10.0		4.88	48.9
12	11.0		5.26	53.0	9.4		4.77	49.3
13	10.6		5.20	55.1	9.4		4.65	48.9
14	10.4		5.20	53.8	9.3		4.56	49.6
15	10.3		5.18	52.8	9.3		4.21	49.7
16	10.2		5.15	54.1	9.2		4.08	50.8
17	9.7		5.22	54.3	9.2		3.99	50.8
18	9.1		5.17	53.1				
19	8.5		5.14	53.1				
20	7.9		5.13	53.9				
21								
22								

Sample Site	DS1 SLOANS LAKE						DS2 SLOANS LAKE					
Date	05-Nov-09						05-Nov-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat)	pH	Cond (mmhos/cm)	Turbid. (NTUs)	Temp (C)	DO (mg/L)	DO (% sat)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	10.23	10.19	91.40	6.42	48.9	0	9.75	10.49	93.20	6.51	46.3	0
1												
2												
3												
4												
5	10.13	10.12	90.7	6.4	49.0	0	9.77	10.4	92.4	6.49	46.2	0
6												
7												
8												
9												
10	10.1	10.07	90.2	6.39	49.0	0	9.77	10.31	91.6	6.5	46.4	0
11												
12												
13												
14												
15	10.04	9.97	89.1	6.38	49.3	0	9.47	10.18	89.7	6.47	46.2	0
16												
17												
18							9.42	10.17	89.6	6.46	46.4	0
19												
20												
21												
22	10.03	9.95	88.9	6.37		0						

Sample Site	DS1 VAUGHAN LAKE						DS1 PROVOST LAKE						DS1 NOWLANS LAKE					
Date	28-Oct-09						27-Oct-09						15-Oct-09					
Depth (m)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)	Temp (C)	DO (mg/L)	DO (% sat.)	pH	Cond (mmhos/cm)	Turbid. (NTUs)
0	9.94	10.90	97.1	6.07	38.4	0	9.51	10.73	94.8	5.64	36.8	0	10.86	9.75	88.9	6.93	75.4	31.94
1	9.94	10.87	97.0	6.05	38.4	0	9.49	10.71	94.5	5.64	36.6	0	10.86	9.77	89.0	6.95	75.4	11.4
2	9.95	10.86	96.9	6.09	38.4	0	9.45	10.68	94.2	5.61	36.9	0	10.84	9.67	88.1	6.96	75.2	8.8
3	9.93	10.87	97.0	6.04	38.1	0	9.44	10.65	93.9	5.61	37.2	0	10.83	9.61	87.5	6.96	75.4	6.7
4	9.91	10.85	96.7	6.02	38.4	0	9.43	10.61	93.5	5.60	36.9	0	10.81	9.49	86.5	6.95	75.1	9.5
5	9.87	10.85	96.6	6.01	38.4	0	9.38	10.56	92.9	5.56	36.9	0	10.81	9.47	86.1	6.94	75.1	6.7
6	9.86	10.85	96.5	6.01	38.3	0							10.81	9.33	85.0	6.93	75.4	5.3
7	9.86	10.84	96.0	6.01	38.4	0												
8	9.84	10.82	96.2	6.01	38.3	0												
9	9.87	10.78	96.0	6.01	38.4	0												
10	9.84	10.78	96.0	6.01	38.2	0												
11	9.85	10.76	95.8	6.01	38.3	0												
12	9.85	10.74	95.6	6.01	38.4	0												
13	9.84	10.73	95.5	6.01	38.3	0												
14	9.85	10.72	95.4	6.00	38.4	0												
15	9.84	10.71	95.3	5.99	38.3	0												
16	9.84	10.72	95.3	6.00	38.3	0												
17	9.84	10.68	95.0	6.01	38.4	0												
18																		
19																		
20																		
21																		
22																		

Table 3B

Dissolved Oxygen/ Temperature Profiles 2009 (Lake Shoreline Stations)

Sample Site	S3 Sloans Lake				S4 Sloans Lake				S5 Sloans Lake				OL Sloans Lake				S3 Sloans Lake						S4 Sloans Lake						S5 Sloans Lake					
Date	10-Sep-09				10-Sep-09				10-Sep-09				10-Sep-09				05-Nov-09						05-Nov-09						05-Nov-09					
Depth (m)	Temp (C)	DO (mg/L)	pH	Cond (mmhos/cm)	Temp (C)	DO (mg/L)	pH	Cond (mmhos/cm)	Temp (C)	DO (mg/L)	pH	Cond (mmhos/cm)	Temp (C)	DO (mg/L)	pH	Cond (mmhos/cm)	Temp (C)	DO (mg/L)	DO (% sat)	pH	Cond. (mmhos/cm)	Turbid. (NTUs)	Temp (C)	DO (mg/L)	DO (% sat)	pH	Cond. (mmhos/cm)	Turbid. (NTUs)	Temp (C)	DO (mg/L)	DO (% sat)	pH	Cond. (mmhos/cm)	Turbid. (NTUs)
0	20.4	7.90	6.45	50.9	21.0	7.70	6.39	50.3	21.1	7.74	6.41	22.8	21.7	8.03	6.43	49.5	10.14	10.40	93.10	6.65	48.9	0	9.6	10.57	93.70	6.64	47.1	0	9.8	10.53	93.5	6.52	46.4	0
1	20.3	7.78	6.41	51.1	20.7	7.88	6.32	50.2	21.0	7.59	6.44	48.7											9.59	10.57	93.5	6.6	47	0	9.8	10.52	93.4	6.52	46.2	0
2	20.3	7.69	6.37	50.9	20.2	7.69	6.24	49.6	20.9	7.61	6.36	48.3											9.59	10.56	93.4	6.58	47.1	0	9.81	10.51	93.5	6.52	45.9	0
3	20.2	7.79	6.29	51.6	19.9	7.28	6.24	50.1	20.8	7.65	6.30	48.1											9.6	10.54	93.2	6.58	47.1	0.0	9.81	10.5	93.4	6.51	46.30	0
4	20.2	7.64	6.25	50.7					20.6	7.95	6.19	48.2																	9.81	10.49	93.3	6.5	46.3	0
5	20.2	7.55	6.20	50.8					20.3	7.77	6.18	48.2					10.14	10.33	92.6	6.61	49.00	0							9.8	10.47	93	6.5	46.4	0
6	20.2	7.41	6.20	51.8					20.1	7.90	6.15	51.3																	9.8	10.49	93.10		46.7	0
7	17.7	4.37	5.52	51.3																														
8	14.4	3.20	5.29	53.2													10.14	10.28	92.10	6.58	49	0												
9	12.2		5.25	53.9																														
10																																		
11																																		
12																																		
13																																		
14																																		
15																																		
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22																																		

Table 4 | *SL- Shoreline Sample* | *ML - Mid-Lake Sample*

Selected Water Quality Parameters 2008

Lake				HOURGLASS LAKE		PLACIDES LAKE			PORCUPINE LAKE			PARR LAKE		OGDEN LAKE				FANNING LAKE				
Sample Location				*SL*	*ML*	*SL*	*ML*	*ML*	*SL*	*ML*	*ML*	*SL*	*ML*	*SL*	*ML*	*ML*	*ML*	*SL*	*SL*	*ML*	*ML*	*ML*
Sample ID				HL-SLI	HL-DSI	PLAL-SL1	PLAL-DS1	PLAL-DS1	PORL-NS1	PORL-DS1	PORL-DS1	PARL-SL1	PARL-DS1	OL-SL1	OL-DS1	OL-DS1	OL-DS1	FL-NS1	FL-SL	FL-DS1	FL-DS1	FL-DS1
Depth (m)				1.5	0	0.7	0	7	0.7	0	6	0.25	0	0.25	0	9	18	1.0	0.5	0	7	9
Date Sampled				27-Aug	14-Aug	27-Aug	14-Aug	14-Aug	28-Aug	13-Aug	13-Aug	4-Sep	14-Aug	4-Sep	15-Aug	15-Aug	15-Aug	28-Aug	15-Oct	13-Aug	13-Aug	13-Aug
Water Quality Parameters	**Min**	**Max**	**Mean**																			
Aluminum (ug/L)	13	449	108	126	123	61	90	**449**	23	**26**	53	129	138	105	86	140	245	60	91	67	149	207
Calcium (mg/L)	0.9	4.6	1.8	1	1.1	1.4	2	4.6	1.5	1.4	2	1.2	1.2	1.1	1.1	1.1	1.2	1.1	1.1	1.1	1.3	1.6
Copper (ug/L)	<2	45	27	<2	<2	<2	<2	23	<2	<2	25	<2	<2	<2	<2	19	35	<2	<2	<2	18	45
Iron (ug/L)	153	9661	1405	791	825	422	532	9661	207	217	3066	452	491	385	271	544	3432	168	286	187	1029	5138
Magnesium (mg/L)	0.6	1.8	0.99	1.1	1	1.2	1.4	1.7	1	0.9	1	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.7
Hardness as CaCO3 (mg/L)	5.1	18.5	8.6	7	6.8	8.4	10.8	18.5	7.8	7.2	9.1	5.9	5.9	5.6	5.6	5.2	5.9	5.6	5.6	5.2	6.1	6.9
Manganese (ug/L)	24	1774	342.9	88	128	56	61	642	24	38	1489	28	34	41	53	288	782	29	42	59	868	1366
Potassium (mg/L)	<0.5	2.1	1.1	0.6	0.6	1.4	1.7	1.9	0.6	0.6	0.7	0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	>0.5
Sodium (mg/L)	4.3	9.3	6.1	8.3	8.1	7.8	8.6	6.8	5.9	5.4	5.4	5.1	5	5.1	5	4.8	4.7	5.2	5.2	4.5	4.4	4.6
Zinc (ug/L)	<5	154	76.11	<5	<5	<5	<5	98	<5	<5	75	10	<5	<5	<5	68	58	<5	<5	<5	48	93
Conductivity (umho/cm)	37.7	88.66	56.44	61.35	62.5	63.58	74.2	87.8	51.23	51.9	59.8	42.6	43	42.8	41.9	42.1	45.1	42.22	45.13	42.3	45.7	50.6
pH	5.8	7.6	6.6	7.2	6.2	7.6	6.5	6.3	7.2	6.6	6.3	6.9	6.2	6.3	6.1	5.8	5.9	6.1	6.6	6.4	6.3	6.5
Turbidity (NTU)	0.53	25.2	7.49	0.95	1.09	1.69	2.02	16.5	0.53	0.95	25.2	1.13	1.38	1.15	1.28	10.15	11.8	0.8	2.24	0.85	3.5	7.72
Alkalinity as CaCO3 (mg/L)	<3	24	9.7	<3.0	3.4	4.2	3.4	24	<3.0	<3.0	9.5	<3.0	<3.0	<3.0	<3.0	<3.0	5	<3.0	<3.0	<3.0	4.2	10
Chloride (mg/L)	7.3	16	10.5	14	13	13	14	11	10	10	10	8.2	8.1	8	8	8.3	8.3	8.6	8.5	8.3	8.2	8.6
Colour (TCU)	16	202	59	53	60	52	68	202	23	25	87	55	64	42	39	45	152	29	40	31	57	137
Silica (mg/L)	1.1	5.1	1.8	1.2	1.2	<1.0	<1.0	5.1	1.5	1.3	2.8	1.7	1.5	1.2	<1.0	<1.0	1.6	<1.0	1.7	<1.0	1.1	2.1
Sulfate (mg/L)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5.	<5	<5.00	<5	<5	<5
Total Nitrogen (mg/L)	0.17	2.95	0.62	0.47	0.57	0.39	1.69	2.95	0.21	0.22	0.4	0.27	0.27	0.27	0.25	0.24	0.8	0.24	0.24	0.21	0.19	0.62
Total Phosphorus (mg/L)	0.005	5.2	0.29	0.051	0.069	0.39	0.74	**5.2**	0.009	0.012	0.021	0.021	0.033	0.017	0.014	0.018	0.097	0.009	0.014	0.011	0.023	0.097
Nitrate + Nitrite (mg/L)	<0.01	0.35	0.09	<0.01	0.03	<0.01	0.35	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (mg/L)	<0.01	1.93	0.19	0.08	0.12	0.04	0.11	1.93	<0.01	0.04	0.18	0.02	0.02	0.03	0.3	0.05	0.41	0.03	<0.01	0.02	0.02	0.39
Ortho Phosphorus (mg/L)	0.005	3.44	0.39	0.03	0.034	0.34	0.58	**3.44**	<0.005	<0.005	<0.005	<0.005	0.012	0.005	<0.005	0.008	0.051	<0.005	<0.005	<0.005	<0.005	0.055
Total Dissolved Solids (mg/L)	6	100	56.43	62.5	52.5	60	100		42.5	50		45	57.5	50	47.5			60		80		
Suspended Solids (mg/L)	<3.0	16	6.50	<3.0	<3.0	<3.0	<3.0		<3.0	<3.0		5	<3.0	<3.0	<3.0			<3.0	3	<3.0		
Total Organic Carbon (mg/L)	4.2	16.7	6.70	7.1	7.6	8.6	9.9	16.7	4.2	4.6	5.3	7.2	8.2	6.3	5.9	5.5	8.8	4.9	6.2	5.4	6	7.6
Chlorophyll A (ug/L) *<corrected>*	1.9	84	22.2	4.5	15	8.1	20		1.9	7.8		9.1	11	11	10			4.4	7	5.8		
SD Transparency (m)	0.85	3.0	1.57		1.3		1.3			2.5			1.5		1.8					2.3		
TN / TP Ratio					8/1		2/1			18/1			8/1		18/1					19/1		

Table 4

SL- Shoreline Sample | *ML - Mid-Lake Sample*

Selected Water Quality Parameters 2008

Lake				VAUGHAN LAKE				PROVOST LAKE		NOWLANS LAKE				
Sample Location				*SL*	*ML*	*ML*	*ML*	*SL*	*ML*	*SL*	*SL*	*SL*	*SL*	*ML*
Sample ID				VL-SL1	VL-DS1	VL-DS1	VL-DS1	PROL-SL1	PROL-DS1	NL-SL1	NL-SL2	NL-SL3	NL-SL1	NL-DS1
Depth (m)				0.25	0	9.5	14	1.5	0	0.6	0.6	0.6	0.5	0
Date Sampled				5-Sep	5-Sep	5-Sep	5-Sep	27-Aug	15-Aug	28-Aug	28-Aug	28-Aug	15-Oct	14-Aug
Water Quality Parameters	**Min**	**Max**	**Mean**											
Aluminum (ug/L)	13	449	108	152	51	144	192	105	105	29	39	29	24	**13**
Calcium (mg/L)	0.9	4.6	1.8	1.1	1.1	1.5	1.5	0.9	0.9	4.2	4	3.9	3.5	3.7
Copper (ug/L)	<2	45	27	<2	<2	18	31	<2	<2	<2	<2	<2	<2	<2
Iron (ug/L)	153	9661	1405	250	160	3779	6899	354	452	739	500	451	153	323
Magnesium (mg/L)	0.6	1.8	0.99	0.6	0.7	0.8	0.8	0.7	0.7	1.8	1.8	1.7	1.7	1.8
Hardness as CaCO3 (mg/L)	5.1	18.5	8.6	5.2	5.6	7	7	5.1	5.1	17.9	17.4	16.7	15.7	16.6
Manganese (ug/L)	24	1774	342.9	28	39	1774	1317	37	63	213	256	194	40	211
Potassium (mg/L)	<0.5	2.1	1.1	<0.5	<0.5	<0.5	0.5	0.5	0.5	2.1	1.9	2	2	1.8
Sodium (mg/L)	4.3	9.3	6.1	4.3	4.9	4.7	4.7	5	4.9	9.2	9.1	9.3	9.3	8.8
Zinc (ug/L)	<5	154	76.11	<5	<5	81	154	<5	<5	<5	<5	<5	<5	<5
Conductivity (umho/cm)	37.7	88.66	56.44	37.7	41.4	50.3	48.8	41.06	43	87.1	86.75	87.23	88.66	85.3
pH	5.8	7.6	6.6	7.2	6.3	6.3	6.3	6.2	6.1	7	7.5	7.5	7.6	6.5
Turbidity (NTU)	0.53	25.2	7.49	0.64	0.71	12.8	7	2.47	2.6	22.1	20.7	24.3	20.8	19.6
Alkalinity as CaCO3 (mg/L)	<3	24	9.7	<3.0	<3.0	8.1	9.1	<3.0	<3.0	13	14	13	13	12
Chloride (mg/L)	7.3	16	10.5	7.3	8	8.7	8.4	8.2	8.4	16	16	16	16	15
Colour (TCU)	16	202	59	52	22	94	148	35	32	20	52	19	32	16
Silica (mg/L)	1.1	5.1	1.8	<1.0	<1.0	1.5	1.7	<1.0	<1.0	1.7	1.6	1.7	3.2	1.5
Sulfate (mg/L)	<5	<5	<5	<5	<5	<5	<5	<5	<5.	<5	<5	<5	<5.00	<5
Total Nitrogen (mg/L)	0.17	2.95	0.62	0.21	0.17	0.45	0.73	0.36	0.45	1.59	0.86	1.17	1.24	1.01
Total Phosphorus (mg/L)	0.005	5.2	0.29	0.007	0.005	0.012	0.045	0.011	0.011	0.35	0.34	0.46	0.23	0.4
Nitrate + Nitrite (mg/L)	<0.01	0.35	0.09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01
Ammonia (mg/L)	<0.01	1.93	0.19	0.02	<0.01	0.26	0.56	0.08	0.03	0.01	0.02	0.06	<0.01	<0.01
Ortho Phosphorus (mg/L)	0.005	3.44	0.39	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.28	0.24	0.3	0.17	0.3
Total Dissolved Solids (mg/L)	6	100	56.43	45	25	6	7.9	70	60	90	62.5	82.5		85
Suspended Solids (mg/L)	<3.0	16	6.50	<3.0	<3.0	<3.0	<3.0	<3.0		<3.0	<3.0		12	6
Total Organic Carbon (mg/L)	4.2	16.7	6.70	6.7	4.4	-	-	5.8	5.2	6.1	6.1	6.1	6.3	6.2
Chlorophyll A (ug/L) *<corrected>*	1.9	84	22.2	6.8	3.9	-	-	7.5	18	58	60	68	84	67
SD Transparency (m)	0.85	3.0	1.57		3.0				1.7					0.85
TN / TP Ratio					34/1				41/1					3/1

APPENDIX D

Table 5 **Algae Speciation, Cell Counts, & Toxin Levels 2009 (Lake Stations)**

Lake	HOURGLASS LAKE	PLACIDES LAKE	PORCUPINE LAKE	PARR LAKE	OGDEN LAKE	FANNING LAKE	VAUGHAN LAKE	PROVOST LAKE	NOWLANS LAKE			SLOANS LAKE			SLOANS LAKE		
Sample ID	HL-SLI	PLAL-SL1	PORL-SL1	PARL-SL1	OL-SL1	FL-S1	VL-SL1	PROL-SL1	NL-SL1	NL-SL2	NL-SL3	SL-NB	SL-SB	SL-S4	SL-S3	SL-S4	SL-S5
Depth (m)	0	0	0	0	0	0	0	0	0	0	0	0.7	0.7	0.7	0	0	0
Date Sampled	20-Oct	21-Oct	27-Oct	22-Oct	22-Oct	13-Oct	28-Oct	27-Oct	15-Oct	15-Oct	15-Oct	09-Sep	09-Sep	09-Sep	05-Nov	05-Nov	05-Nov
Taxonomy																	
Actinastrum (Chlorophyceae)																	
Anabaena (Myxophyceae)																	
Anabaena (Myxophyceae)																	
Ankistrodesmus (Chlorophyceae)																	
Aphanizomenon (Myxophyceae)				6		1			120000	122000	175000						4
Aphanizomenon (Myxophyceae)																	
Aphanocapsa (Myxophyceae)										5000					100		50
Aphanothece (Myxophyceae)												1250	2500	1250			
Asterionella (Bacillariophyceae)																	
Blue Green Algae	33	424	2	267	195	5	<1	10	120000	127000	175000	3880	5110	2070	30	100	216
Ceratium (Peridineae)																	
Chlamydomonas (Chlorophyceae)																	
Closterium (Chlorophyceae)																	
Coelastrum (Chlorophyceae)																	
Cosmarium (Chlorophyceae)																	
Crucigenia (Chlorophyceae)																	
Cryptomonas (Cryptophyceae)																	
Cyclotella (Bacillariophyceae)																	
Dictyosphaerium (Chlorophyceae)																	
Dinobryon (Chrysophyceae)																	
Eudorina (Chlorophyceae)																	
Fragilaria (Bacillariophyceae)																	
Gomphosphaeria (Myxophyceae)												2500	2500	324		30	162
Gomphosphaeria (Myxophyceae)																	
Kirchneriella (Chlorophyceae)																	
Mallomonas (Chrysophyceae)																	
Melosira (Bacillariophyceae)																	
Microcystis (Myxophyceae)																	
Microcystis (Myxophyceae)																	
Monoraphidium (Chlorophyceae)																	
Navicula (Bacillariophyceae)																	
Nitzschia (Bacillariophyceae)																	
Oocystis (Chlorophyceae)																	
Oscillatoria (Myxophyceae)																	
Pediastrum (Chlorophyceae)																	
Peridinium (Peridineae)																	
Pseudoanabaena (Myxophyceae)		65		98	130			10	30			125	16	-			
Pseudoanabaena (Myxophyceae)																	
Rhodomonas (Cryptophyceae)																	
Scenedesmus (Chlorophyceae)																	
Small Chrysophytes (Chrysophyceae)																	
Spondylosium (Chlorophyceae)																	
Staurastrum (Chlorophyceae)																	
Synedra (Bacillariophyceae)																	
Synura (Chrysophyceae)																	
Tabellaria (Bacillariophyceae)																	
Trachelomonas (Euglenophyceae)																	
Ulothrix (Chlorophyceae)																	
Organic Parameters																	
Microcystin	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
XNo class																	
Planktolyngbya (Myxophyceae)	33	359	2	163	65	4			20								
Planktolyngbya (Myxophyceae)												-	97	500			

APPENDIX E

TABLE 6 **STREAM NUTRIENT LOADING ESTIMATES (TOTAL PHOSPHORUS) 2009**

LAKES	HOURGLASS LAKE		PLACIDES LAKE			PORCUPINE LAKE		PARR LAKE			
Streams Station ID	HL-IN1	HL-OL1	PLAL-IN1 above mink farm creek	PLAL-IN1 at lake	PLAL-OL1	PORL-IN1	PORL-OL1	PARL-INA	PARL-INB	PARL-INC	PARL-OL1
Width (m)		1.53	2.44	7.62	4.57	3.05	1.83	0.91	3.05	1.22	7.62
Depth (m)		0.20	0.91	1.22	1.22	0.91	0.46	0.30	0.91	0.20	2.44
Velocity	Springfed	5 sec/4 ft	1 ft/sec	8 sec/ 12 ft	5 sec/ 6 ft	4 ft/ 5 sec	10 ft/3 sec	2 sec/3 ft	11 sec/ 10 f	1 ft/sec	4 sec/ 10 ft
Velocity (m/s)		0.24	0.30	0.46	0.37	0.24	1.02	0.46	0.28	0.30	0.76
Flow (m^3/s)	0.0001	0.08	0.68	4.25	2.04	0.68	0.85	0.13	0.77	0.08	14.16
P Conc (mg/L)	0.17	0.05	0.63	0.61	0.66	0.08	0.03	0.02	0.01	0.02	0.08
P Loading (kg/d)	0.0015	0.32	37.02	223.86	116.26	4.64	2.28	0.20	0.73	0.10	92.97

LAKES	OGDEN LAKE		FANNING LAKE				VAUGHAN LAKE			PROVOST LAKE		NOWLANS LAKE		SLOANS LAKE	
Streams Station ID	OL-IN1	OL-OL1	FL-IN1 inlet from Ogden Lake	FL-IN2 inlet from Crowlay Lake	FL-IN3 inlet from mink Lake	FL-OL1	VL-IN1	VL-IN2 at bridge	VL-OL1	PROL-IN1-0M	PROL-OL1	NL-IN1 at boat launch	NL-OL1	SL-IN1-0M 50m from lake	SL-OL6-0M
Width (m)	6.10	7.62	5.49	1.22	1.22	7.62	14.63	24.38	20.00	1.22	1.52	1.52	2.44	0.6096	1.8288
Depth (m)	2.20	1.22	1.22	0.30	0.61	2.44	2.44	2.20	3.08	0.30	0.61	0.30	1.22	1.524	0.1524
Velocity	sec/ 12	5 ft/sec	1 m/s	1 ft/sec	1 ft/sec	6 ft/sec	2 sec/3 ft	1 ft/sec	2 ft/sec	7 sec/ 4 ft	5 sec/ 4 ft	15 sec/ ft	15 sec/ 4 ft	6 sec/ft	6 sec/ft
Velocity (m/s)	0.91	1.52	1.00	0.30	0.30	1.83	0.46	0.30	0.61	0.17	0.24	0.02	0.08	0.0508	0.0508
Flow (m^3/s)	12.26	14.16	6.69	0.11	0.23	33.98	16.31	16.35	37.55	0.06	0.23	0.01	0.24	0.047	0.014
P Conc (mg/L)	0.08	0.07	0.06	0.02	0.01	0.06	0.03	0.01	0.02	0.01	0.02	5.40	0.40	0.038	0.005
P Loading (kg/d)	80.53	80.74	36.99	0.20	0.14	173.22	47.91	19.78	71.38	0.08	0.35	4.40	8.35	0.15	0.01

APPENDIX F

Major Ions

Ions are both negatively and positively charged particles which are found dissolved in water. These include substances which may be considered to be nutrients and metals, but for the purpose of this study refer to all other common substances found in solution.

A list of these water quality parameters and associated results are found in Table 2 (Appendix C). Concentrations of these parameters are presented for 2009, with summary statistics calculated (i.e. minimum, maximum, and mean values). A brief explanation of these parameters, as provided in the previous 2008 report, is as follows.

pH:

The pH of a solution refers to the hydrogen ion concentration or the relative acidic/basic nature of the solution expressed on a scale of 0 to 14, with a neutral pH at 7.

In natural aquatic systems, the pH usually results from the geology and geochemistry of the rocks and soils of the watershed or drainage basin. For surface waters, the pH range of interest is typically 4 to 11 (CCME 1987).

Alkalinity:

Alkalinity refers to the capacity of a solution to neutralize acid and in natural waters is primarily the result of carbonate and bicarbonate ions. Because of the predominant effect of carbonate, alkalinity is expressed in equivalent amounts of calcium carbonate (CaCO3). Concentrations of carbonate and bicarbonate in surface waters result in large part from the natural weathering of rock in the watershed. Greater concentrations are found, and therefore, higher alkalinity exists where sedimentary or metamorphic bedrock is present.

In natural surface waters alkalinity varies greatly. In Nova Scotia concentrations are generally less than 50 mg/l unless limestone deposits are in close proximity. In such cases concentrations can more than double. Conversely, in areas of non-carbonate bedrock, alkalinities below detectable limits are common.

Conductivity:

Conductivity refers to the ability of a substance to conduct an electric current. In an aqueous solution this measurement is dependent upon the total concentration of dissolved substances and the solution's temperature.

The conductivity of natural fresh waters varies greatly and may range from less than 20 umhos/cm in dilute waters to over several hundred or more in waters influenced by limestone or salt deposits.

Colour:

The true colour of water refers to the colour resulting from substances which are totally dissolved in the solution. It is not to be mistaken for apparent colour resulting from suspended or colloidal matter. The colour in natural waters are primarily due to coloured organic substances, known as humic substances, resulting from the decay or aqueous extraction of vegetation. The presence of metals such as iron, manganese, and copper which are weathered from rock can also contribute to colour, but this situation predominates in groundwater.

Natural surface waters in Nova Scotia may range in colour from less than detectable limits, in many cases, to over 100 True Colour Units (TCU), in a very limited number of cases where bog lakes are encountered. Average colour values are usually less than 45 TCU.

Turbidity:

Turbidity measurements provide an approximation for concentrations of suspended material such as clay, sand, silt, finely divided organic and inorganic matter, plankton and other microorganisms in water.

Total Organic Carbon:

Total organic carbon (TOC) refers to the total of suspended and dissolved organic constituents of water. Elevated levels of TOC are primarily indicative of naturally occurring organic matter such as humic substances but also can reflect high algal concentrations. Levels of organic carbon in surface waters vary widely, ranging from non-detectable in newly risen rivers supplied by limestone springs to greater than 100 mg/l in peaty swamp waters (Croll 1972).

Hardness:

Hardness is a traditional measure of the capacity of water to react with soap and is expressed in terms of mg/l of $CaCO_3$.

In fresh water the principal hardness-causing ions are calcium and magnesium which naturally leach from rock and soils. Soft water is considered to have a value of 0 to 60 mg/l, medium hard 60 to 120 mg/l, hard 120 to 180 mg/l, and very hard 180 mg/l and above (Health and Welfare Canada 1980).

Natural fresh waters in Nova Scotia are almost invariably soft, if not in close proximity to limestone or salt deposits.

Sodium:

Sodium is a non-toxic metal which is abundant, widely distributed in nature, and present to some extent in all natural waters. The principal sources of sodium are from the weathering of igneous rock and salt deposits, as well as the leaching of soils. Deicing salt used on highways can also significantly contribute to overall sodium levels in nearby watercourses. Concentrations in pristine surface waters vary greatly, ranging from less than 1 mg/l to over 300 mg/l, depending upon amount of rainfall and evaporation, and geologic formations present. Typical undisturbed lakes in Nova Scotia however would have sodium concentrations generally less than 50 mg/l.

Potassium:

Potassium is a widely distributed non-toxic element which is essential to plant and animal nutrition. The primary natural source is from the weathering of rock. Although potassium may be found in many rocks, those with significant amounts (e.g. granite) are resistant to weathering. Commercial chemical fertilizers contain substantial concentrations of this element and may be a significant cultural source from the watershed.

Concentrations of potassium in natural surface waters seldom reach 20 mg/l and are generally less than 10 mg/l (CCME 1987).

Calcium:

Calcium is one of the most abundant cations (positively charged ions) found in surface or groundwaters. It is readily soluble in water and enters the aquatic environment through the weathering of rocks, especially limestone, and from the soil, through seepage and run-off. Calcium salts, along with those of magnesium, are primarily responsible for the hardness of water. This element is considered to be essential for nearly all living organisms.

The concentrations of calcium in natural fresh waters vary according to the proximity of calcium-rich geological formations. Typical concentrations are less than 15 mg/l, whereas waters close to carbonate rocks may have concentrations in the range of 30-100 mg/l. (CCME 1987)

Magnesium:

Magnesium is the eighth most abundant natural element in the earth's crust and is a common constituent of natural water (CCME 1987). The principal sources of magnesium are ferromagnesium minerals in igneous rocks and magnesium carbonates in sedimentary rocks. Along with calcium, it is one of the main contributors to water hardness, and is also considered to be an essential element for all living organisms.

Water in watersheds with magnesium-containing rock may have magnesium in the concentration range of 1 to 100 mg/l.

Sulphate:

Sulphate is widely distributed and is an ionic component of all natural waters. It may be leached from most sedimentary rocks, including shales, with the most appreciable contributions from such sulphate deposits as gypsum and anhydrite. Acid rain can also contribute to sulphate concentrations in surface waters.

Concentrations normally vary from 10 to 80 mg/l in naturally occurring surface waters (CCME 1987).

Chloride:

Chloride is widely distributed in the environment, generally as sodium chloride, potassium chloride, and calcium chloride (CCME 1987). The weathering and leaching of sedimentary rocks and soils and the dissolution of salt deposits release chlorides to water (Mc Neely et al. 1979). In natural waters, chlorides are present in low concentrations, commonly less than 50 mg/l. Deicing salts applied to highways can contribute significantly to chloride concentrations where extensive urbanization has occurred.

Silica:

Silicon is a stable, relatively light chemical element that does not occur free in nature, but combines with oxygen and other elements to form oxides of silicates (CCME 1987). The term "silica" refers to silicon in natural waters, and is usually represented by the hydrated form of the oxide. Silica is present in most rocks, but many are resistant to chemical weathering. Although relatively unreactive chemically, silicon is considered an essential micronutrient to some algal species, most notably the diatoms. Therefore, silicon concentrations in freshwaters are significantly influenced by diatom cycling.

Most natural waters contain less than 5 mg/l of silica, although a range of 1 to 30 mg/l is not uncommon. Typical surface waters have a silica concentration of 3 to 4 mg/l (McNeely et al. 1979).