Jemseg Grand Lake Watershed Association
Water Monitoring Program Report – 2022

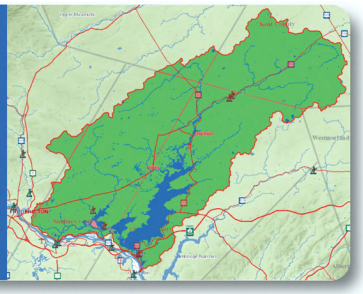
by

Eric Luiker, Mikael Gyllström and Brad Nickerson

March 1, 2023

Jemseg Grand Lake Watershed Association Report 23-02

Jemseg Grand Lake Watershed Association



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New Nouveau Brunswick

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Luiker, E. Gyllström, M. and Nickerson, B. "Jemseg Grand Lake Watershed Association Water Monitoring Program Report – 2022", Jemseg Grand Lake Watershed Association report 23-02, March 1, 2023, 66 pages.

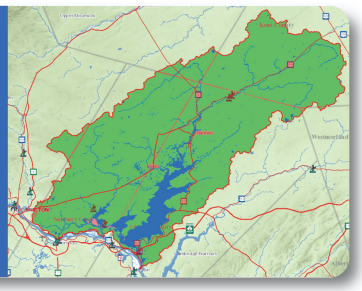
Jemseg Grand Lake Watershed Association
Water Monitoring Program Report – 2022

Eric Luiker, Mikael Gyllström and Brad Nickerson

Final Report for N.B. Environmental Trust Fund Project 220286
March 1, 2023

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1.0 Introduction

The Jemseg Grand Lake Watershed Association (JGLWA) was formed in the fall of 2019 by committed volunteers to initiate activities to build public interest and to work together for the benefit of our environment and the watershed area. In 2020 the JGLWA initiated a water quality monitoring program and reported in through the New Brunswick Environmental Trust program. We continued our monitoring program in 2021, building on the program that we initiated the year before, and including a few additional monitoring components to allow us to better assess the water quality of Grand Lake.

Our program was initially designed to examine the water quality of Grand Lake, its main inflows as well as the outflow (Jemseg River). Feedback from the results of previous years continue to guide the evolution and improvement of the program. During 2020 some of the water chemistry parameters were highest near sections of Grand Lake close to river inflows. Therefore, three river stations were added to the program in 2021 to determine the quality of waters inflowing to the lake. During 2022 the investigation into the nature of the influence of the different tributaries focused on the lakes in the southwestern tributaries. The goal was to see if more light could be shed on sources of the relatively high nutrient levels entering Grand Lake from these sub catchments. To allow for the sampling of the three lakes in the SW tributaries, as well as the three river stations established previously, the number of stations in Grand Lake were reduced to a total of three sites. One subcontractor (Aaron Fraser, Willowbrook Watershed Services) and volunteers were engaged to measure biophysical parameters at surface and at depth and to collect water samples to measure major ions, nutrients, trace metals and chlorophyll *a* (*Chl a*) in a total of ten stations.
The *Escherichia coli* (*E. coli*) sampling program was revised in 2021 to include shoreline areas along the perimeter of Grand Lake. The highest concentrations during 2021 were found in Douglas harbour and the sampling during 2022 was intensified in this area increasing the total number of stations from 14 to 21.

2.0 Methods

Water Quality
Grand Lake is the largest lake in New Brunswick and is fed by three main inflows: Salmon River, New Castle Creek, and the Maquapit Thoroughfare Exit (Maquapit Exit). Outflow is through the Jemseg River to the Saint John River. Three river stations at Salmon River, Newcastle Creek, and Lakeville Corner are designed to capture the influence of these inflows (Figure 1). To get a better picture of the dynamics in the catchments feeding into the Maquapit Thoroughfare Exit four stations were established, one in the outlet of Indian Lake, two on French Lake and one on Maquapit Lake (Figure 1).

Site ID	Location	Depth (m)
JGLP04	Grand Point Bar	25
JGLP05	Jemseg River	8
JGLP06	Maquapit Exit	4
JGLP07	Maquapit Lake	8
JGLP08	French Lake	3.5
JGLP09	French Lake South	8
JGLP10	Indian Lake Outlet	5.5
JGLR01	Salmon River	
JGLR02	Newcastle Creek	
JGLR03	Lakeville Corner	

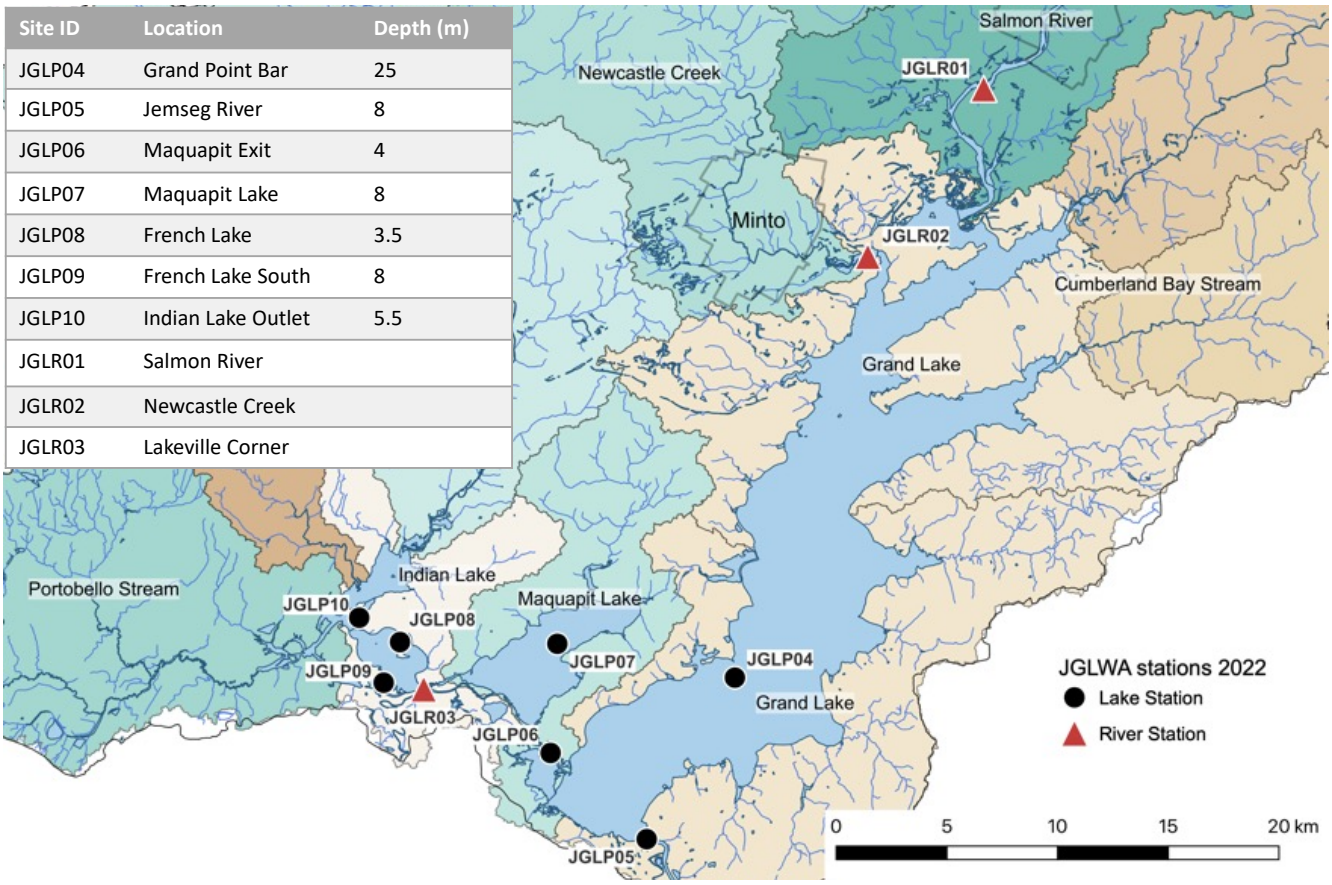


Figure 1. Jemseg Grand Lake Watershed water quality sampling stations. Legend indicates station site name, location, and depth at site. Hydrography: NB DERD (2022, open government license) Sub-watersheds are colour shaded (NCC, 2019 CC BY-NC 3.0).

In Grand Lake only the three southern of the six established stations were included this year. The Maquapit Exit station near the inflow of the southwestern tributaries was kept so that it could be related to the samples from these tributaries but the stations near the two northern inflows were not visited in 2022. Of the two mid-lake, deep stations only the Grand Point Bar station was sampled to represent the conditions in the main part of the lake. The station near the outlet to Jemseg river was sampled to give an idea of the quality of the water discharged from the lake. All in all, seven lake stations and three river stations were sampled during 2022 (Figure 1).

Led by Mary Murdoch and Eric Luiker the water quality sampling was conducted by a team of four volunteers including John Pugh who captained his own 20-foot boat which was used for the sampling in Grand Lake. In addition to the volunteers, Aaron Fraser (Willowbrook Watershed Services) was contracted to assist with monitoring. His smaller boat was used to access the shallow sites of Indian Lake, French Lake, and Maquapit Lake.

Stations were sampled one to three times during the summer of 2022 (July 17 & 18, August 28-30, October 1 & 3). Stations were accessed using a boat and positioned using a Garmin GPS/depth sounder. At each station pH, conductivity, temperature, and oxygen were measured at 1 m intervals using a YSI multimeter During the first sampling in July the YSI multimeter was out for repair and the substitute did not have a cable long enough to sample the entire profile at the deep station (JGLP04). During the

August and October sampling, the YSI pH meter was not working. Secchi disk depth was taken at each site. Surface water samples were collected for general water chemistry, nutrients, metals, chl *a.* At the deep-water station (JGLP04), we took samples at 20 m using a 2L Niskin water sampler to determine whether water chemistry was different below the thermocline. Surface water samples and measurements were taken at the three river sites, with similar methods to those used at the lake stations. River sites were accessed by road. Water samples were kept cold and transported to the Research and Productivity Council Laboratories (RPC) within 24 hours of collection for analysis.

Cyanobacteria

In partnership with Atlantic Coastal Action Plan Saint John (ACAP Saint John), we established seven cyanobacteria monitoring stations (Figure 2) and deployed solid phase adsorption toxin tracking (SPATT) collectors. ACAP Saint John will report data collected from these stations separately.

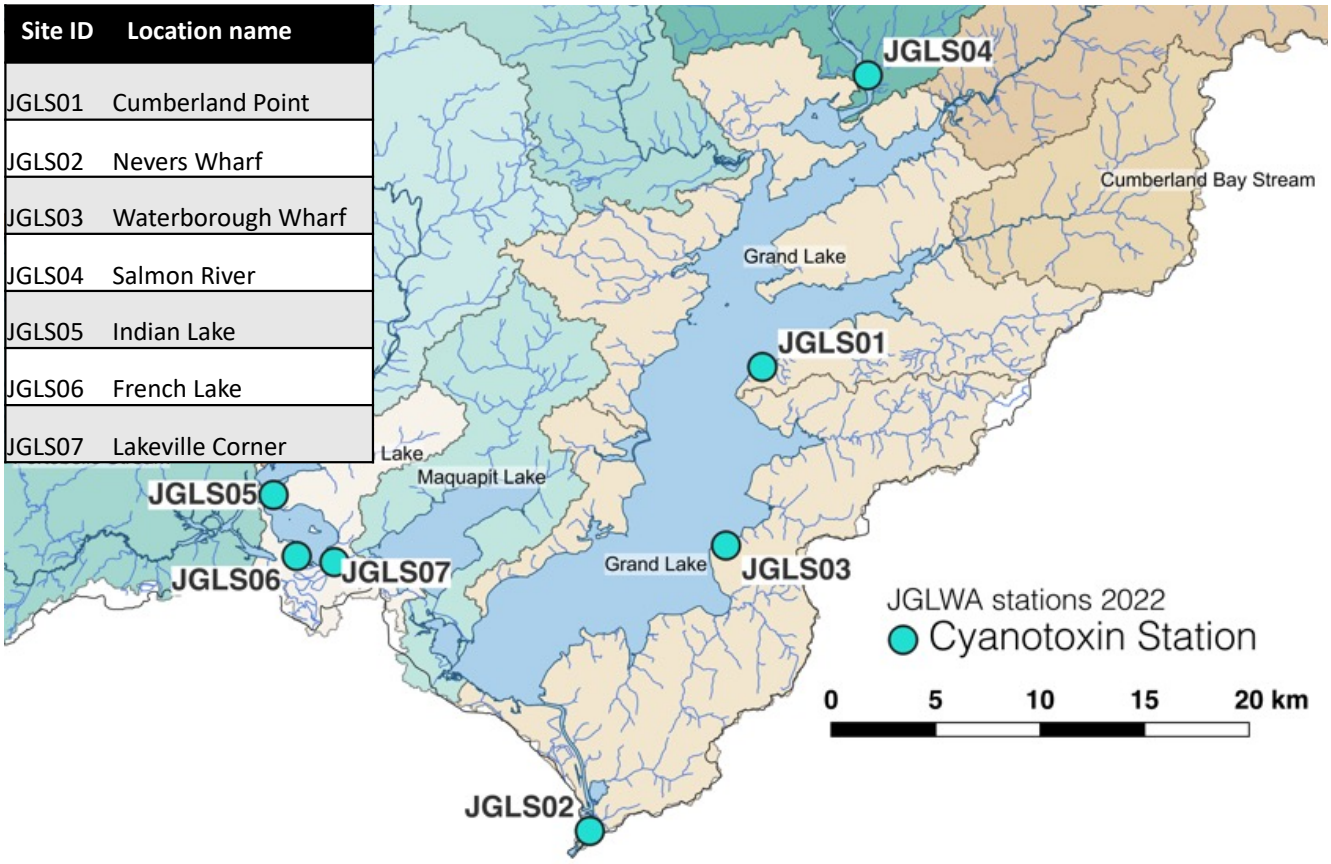


Figure 2. Jemseg Grand Lake Watershed Cyanotoxin sampling stations. Hydrography: NB DERD (2022, open government license). Sub-watersheds are colour shaded (NCC, 2019 CC BY-NC 3.0).

Temperature loggers

A string of three datalogger to measure temperature continuously at surface, 13 metres depth, and two metres above the bottom was deployed at site JGLP04 on June 9, 2022. The loggers were reported missing a month later and are assumed to be lost or stolen. An additional temperature logger was deployed near Cumberland Point during 2021, logging surface water temperature every 30 minutes

between January 1 and September 10, 2022. No temperature logger was deployed in the Jemseg River in 2022.

E. coli

On August 28 and 29, surface water at 21 sites were sampled for analysis of *E. coli* content by RPC (Figure 7). The inset map details the additional 7 stations added in 2022 to investigate the Douglas Harbour area more thoroughly.

Data analysis

To display the range of parameters sampled with the YSI probe (Conductivity, oxygen, and temperature), results are summarized as average, maximum and minimum values. They are also presented in graphs by depth to show their vertical distribution at the deep mid lake sampling site. Temperature was also measured with the temperature logger. The logger data are summarized per month for the period July to September in order to provide comparison with previous years and presented as a time-line graph to provide more detail.

Water chemistry results were also used to generate a water quality index for each individual station, as well as to compile an overall water quality index for the whole lake using the Canadian Council of Ministers of the Environment (CCME) approach (CCME, 2001). The CCME water quality index (WQI) provides a method to summarize water quality data to facilitate communication about water quality to a general audience. The WQI incorporates three elements: *scope* - the number of variables not meeting water quality objectives; *frequency* - the number of times these objectives are not met; and *amplitude* - the amount by which the objectives are not met. The WQI produces a score between 0 (worst water quality) and 100 (best water quality). These scores are divided into five descriptive categories to simplify presentation (CCME, 2001). We used parameters similar to those used by the New Brunswick Department of Environment and Local Government (NBDELG) for their watershed "Report Cards", which incorporate information about levels of ammonia, arsenic, chloride, copper, dissolved oxygen, iron, nitrate, pH, phosphorus, turbidity, zinc in water. The guidelines provided by the CCME, and the Atlantic Water Network recommend a minimum or four samples to calculate the WQI. However, only three or fewer samples were retrieved from most sites in 2022. The station in Indian Lake only had two samples and was omitted from calculations. The five samples from the two sites in French Lake were pooled together. All other sites had three samples each. Because of the lower number of samples, comparisons with previous years run the risk of being misleading and should be made with caution.

To determine trophic status of the lake, we adapted a trophic state index (TSI) equation originally developed by Carlson and Simpson (1996) and commonly used for lake management, using, phosphorus and chl *a*. TSI provides an estimate of relative biological productivity of the aquatic ecosystem.

3.0 Results

3.1 Surface temperature

Surface temperature in Grand Lake started rising slowly in March, increased more rapidly in May, and started to decline again in August. The highest rate of change of temperature occurred in the beginning of May when temperature increased as much as 5 centigrades in a single week. Temperature data collected from the Grand Lake logger was compiled and summarized in Table 1. For Grand Lake, overall average temperature was 22 ºC for the period of July 1 to early September in 2022, similar to the average temperature of previous years, with August having the warmest average temperatures of 23ºC (Table 1). In 2022, maximum temperature (26 ºC) was reached in early August. Daily temperature fluctuation during July-September was approximately 1 ºC. In 2022, there was a total of 31 days with temperatures reaching above 23 ºC, 25 of these days in August.

Table 1. Lake surface temperature summary statistics from Cumberland Point.

	Max Temp (ºC)		Min Temp (ºC)		Average (ºC)		No. days >23ºC	
Month	Previous years*	2022	Previous years*	2022	Previous years*	2022	Previous years*	2022
July	27	25	18	19	23	22	14	11
August	28	26	19	21	23	23	25	19
September	24	23	16	20**	20	22**	1	1
Overall	28	26	13	19	22	22	40	31

* average of 2020 and 2021

** Comparisons with previous years should be made with caution as only part of September was monitored in 2022.

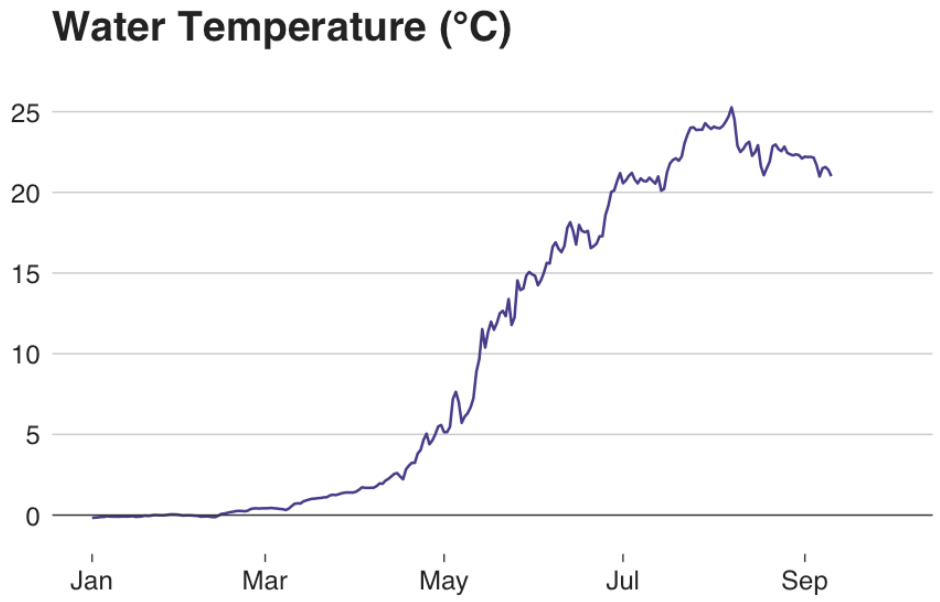


Figure 3. Daily average temperature from January 1 to September 10 at Cumberland Point.

3.2 Grand Lake Surface Water Biophysical Characteristics

Biophysical characteristics of Grand Lake surface water taken during our three sampling sessions are provided in Table 2 and summarized in the following bullet points.

Lake sites

- Warmest average temperatures were found in the two French Lake stations (20.8 °C and 21.4 °C), and the coolest at the deep site in Grand Lake (19.3 °C).
- Average pH for most stations was around neutral, from 6.6 to 7. Indian Lake had the lowest pH; it was 6.3 on October 1. Indian Lake also had the lowest buffering capacity against acidification (measured as alkalinity, Table 3)
- Conductivity was lower in the three lakes in the southwestern tributaries to Grand Lake compared to that of Grand Lake itself (Table 2). In these tributary lakes, average conductivity ranged from 37 µS/cm in the outlet of Indian Lake to 40 µS/cm in Maquapit Lake. This low conductivity affects Grand Lake locally near the inlet at Maquapit Exit. However, at the deep Grand Lake site and in the outlet to Jemseg river conductivity is higher, 65 and 66 µS/cm respectively.
- Transparency in Grand Lake is moderate and secchi disk readings averaged around 3 m in the deep site at Grand Point Bar and the outlet to Jemseg River. The lakes in the southwestern Tributaries have a much lower secchi disk depth ranging between 0.8 and 0.9 m. The lower transparency in Indian, French and Maquapit lakes compared to Grand Lake is probably mostly due to the higher water colour. However, turbidity and chlorophyll concentration are also higher in these smaller lakes, contributing to the reduced transparency (Table 3). As for conductivity, the Maquapit Exit station in Grand Lake is affected by the inflow and had an intermediate secchi disk reading (Table 2).

River Sites

- Average concentration of dissolved oxygen ranged from 6 mg/L at Salmon River to just over 7 mg/L at Newcastle Creek and Lakeville Corner.
- Just like in 2021, the warmest average temperature was found at Lakeville Corner. Temperatures were lower than in 2021 in all three rivers stations.
- Average pH was close to neutral in all three station which is higher than in 2021 when they were ranging from 6.2 to 6.5.
- Average conductivity was around 40 µS/cm in Lakeville Corner and Salmon River but significantly higher in Newcastle Creek (113 µS/cm). Newcastle Creek had the highest conductivity in 2021 (86 µS/cm) as well but much lower than during 2022. All values are within the range of background levels.

Table 2. Summary statistics of Grand Lake Surface Water Biophysical Characteristics in 2022. Due to problems with the YSI probe, few measures of Oxygen saturation were made, and the parameter is not presented here.

Station ID	Station Name	Dissolved Oxygen mg/L			Water Temp ° C			pH			Conductivity µS/cm			Secchi (m)		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
JGLP04	Grand Point Bar	8.7	9.5	7.8	19.3	21.8	15.7	7.3	7.4	7.2	65	70	60	3.0	3.3	2.8
JGLP05	Jemseg River	8.9	10.0	8.2	20.4	23.5	15.6	7.4	7.5	7.3	66	73	60	2.8	3.1	2.5
JGLP06	Maquapit Exit	8.2	9.7	6.9	19.5	23.3	14.0	7.1	7.2	7.0	40	41	39	1.2	1.5	0.9
JGLP07	Maquapit Lake	8.2	10.1	7.3	20.4	23.7	14.7	7.1	7.2	7.0	40	41	38	0.9	1.1	0.8
JGLP08	French Lake	8.1	9.5	7.1	20.8	24.5	14.6	6.9	7.1	6.8	39	41	37	0.9	0.9	0.8
JGLP09	French Lake South	6.4	6.4	6.4	21.4	21.4	21.4	6.8	6.8	6.8	41	41	41	0.8	0.8	0.8
JGLP10	Indian Lake Outlet	8.0	8.6	7.3	18.8	23.1	14.4	6.6	6.8	6.3	37	41	32	0.8	0.9	0.8
JGLR01	Salmon River	6.2	8.0	5.3	19.5	23.7	12.5	7.1	7.2	7.0	43	48	36			
JGLR02	Newcastle Creek	7.1	8.7	6.2	19.3	24.4	10.4	7.2	7.3	7.0	113	123	94			
JGLR03	Lakeville Corner	7.1	8.5	6.0	21.5	25.5	13.9	6.9	7.0	6.7	39	42	37			

3.3 Vertical Profiles

Besides Grand Point Bar (JGLP04) none of the other lake stations had a depth greater than 8 m and are shallow enough that wind can easily disrupt the formation of thermoclines. Despite that a weak thermocline was shown from 5 m depth to the bottom at the southern station in French lake (JGLP09) on August 29. Oxygen concentrations dropped to near zero at depths under 5 m. Temperature was only measured once with the probe at this site.

At the deep station in Grand Lake (>25 m at Grand Point), a thermal stratification was found in August but it was gone again in October, In August, at depths below 16 m, oxygen concentrations decreased to below the critical 5.5 mg/L concentration and conductivity increased (Figure 4, Table 2). In October, the thermocline was completely gone, and temperature, conductivity, and oxygen concentrations were more or less uniform from surface to bottom.

3.4 Water Quality

Water quality sampling results for key parameters used to score the WQI are found in Table 3 along with a few other key parameters. For a complete set of analytical results, refer to Appendix 1. Results were compared with CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG; CCME, 1999). Observed nutrient concentrations were compared with proposed total nitrogen and total phosphorus guidelines for the Saint John River Watershed (Culp et. al. 2005).

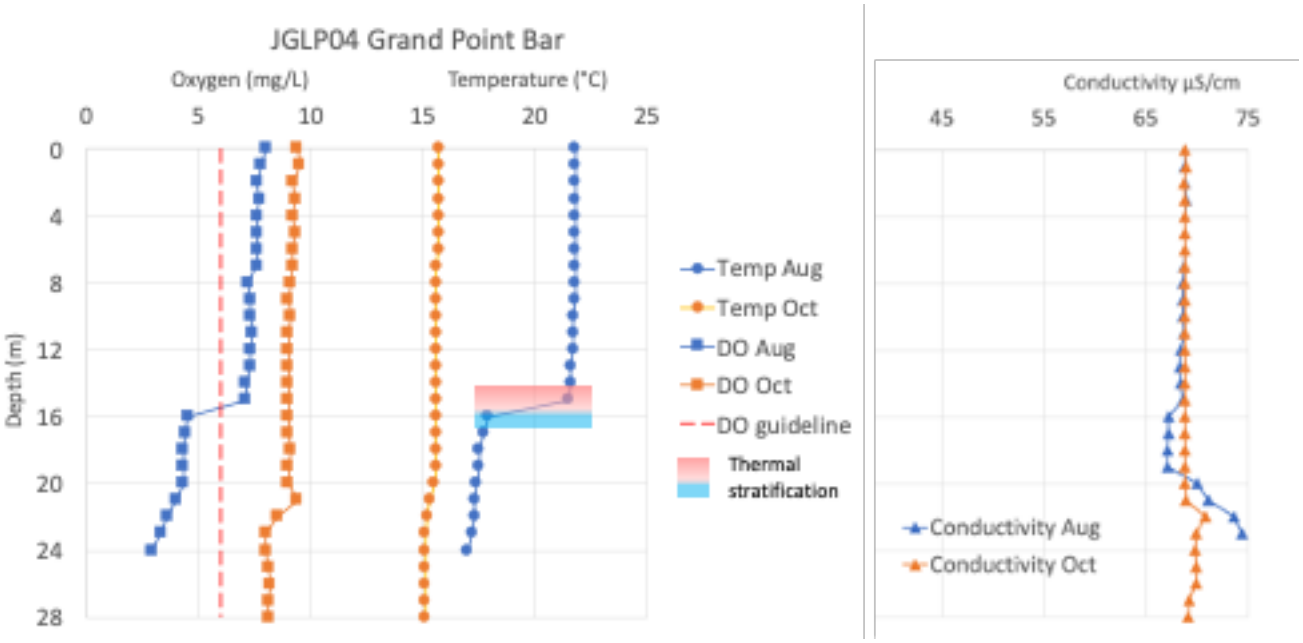


Figure 4. Vertical profiles of temperature and oxygen concentrations versus depth (left panel) and conductivity (right panel) at Grand Point Bar for August and October, 2022. Red dashed line indicates critical oxygen concentration of 5.5 mg/L.

In the surface water samples, only two parameters had exceedances of the CWQG. Total phosphorus and iron exceeded guidelines at all river sites, in Indian, French and Maquapit Lake and in the Grand Lake site Maquapit Exit which appears to be heavily influenced by the water inflow from the southwestern tributaries. There were no exceedances at the deep mid-lake station, or at the Jemseg River site, except for the low oxygen concentration found at 20 m depth at the Grand Point Bar site. Iron is a parameter that frequently exceeds the CWQG in freshwater bodies across Canada, and since the concentrations were just above the CWQG, they are currently not a big concern; iron is more of an aesthetic concern and less of a concern to the health of aquatic life. The exceedances for phosphorus are a concern as they can lead to eutrophic conditions in the lake. More information on this is described under the TSI section.

Aluminum was not included in the WQI but exceeded the CWQG at all stations except for the deep-water site and the outlet in Grand Lake (Table 3). This raises a warning flag but does not necessarily mean that there is a strong reason for concern. Aluminum often shows a high variability in many water bodies and frequently exceeds CCME guidelines. It has complex dynamics with mobilisation and speciation depending on other aspects of lake chemistry, for example, pH. One driver of the aluminum dynamics in this system could be transport of aluminum bound to humic substances. There was a strong correlation between TOC and aluminum in the data from 2021 and 2022 suggesting that precipitation-driven flushing of humic substances can be an important driver of the aluminum dynamics in the tributaries of Grand Lake. This is only a correlation and more data on for example precipitation would be needed to establish if this is an important mechanism. If a majority the aluminum found in our samples is bound to humic substances, it is less likely to be dangerous to aquatic animals. However, pH also plays a role but in general the of pH in 2022 was within a range where it probably does not exacerbate any aluminum problems. One exception could be the low pH (6.3) found during the date when the highest aluminum concentration (0.27 mg/L) was found at JGLP10.

Table 3. Average water quality results from surface water samples collected between July – October 2022. CWQG = Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG; CCME, 1999), and for nutrients, compared with proposed total nitrogen and total phosphorus guidelines for the Saint John River Watershed (Culp et. al. 2005). Parameters with no value in the CWQG column were not included in the WQI analysis. Shaded values denote exceedance of CCME guidelines.

				Grand Lake sites				Other lakes				River sites		
Analytes	Units	Reporting Limit	CWQG	JGLP04	JGLP04D	JGLP05	JGLP06	JGLP07	JGLP08	JGLP09	JGLP10	JGLR01	JGLR02	JGLR03
Alkalinity	mg/L			14	13	18	8	8	7	7	6	14	16	7
Aluminum	mg/L	0.001	0.01	0.05	0.08	0.06	0.11	0.11	0.16	0.12	0.22	0.17	0.16	0.14
Chloride	mg/L	0.5	120	4.3	4.1	4.3	3.3	3.6	3.3	3.2	2.9	3.8	6.6	3.4
Ammonia (as N)	mg/L	0.05	1.54	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	mg/L	0.05	13	0.08	0.12	0.04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus - Total	mg/L	0.002	0.03	0.01	0.02	0.01	0.04	0.05	0.05	0.05	0.04	0.03	0.04	0.05
Colour	TCU			43	44	50	90	81	131	123	167	175	166	131
Turbidity	NTU	0.1	10	0.6	1.2	1.2	3.7	4.5	4.3	3.1	2.5	2.3	5.0	3.7
Chlorophyll-a	µg/L			2.8	2.3	1.8	2.2	5.2	5.5	3.9	6.1	7.0	3.4	5.3
Arsenic	mg/L	0.001	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	mg/L	0.02	0.3	0.1	0.2	0.2	0.6	0.5	0.7	0.5	0.6	0.7	1.0	0.6
Zinc	mg/L	0.001	0.03	<0.001	0.0	<0.001	<0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dissolved Oxygen	mg/L	-	5.5	8.7	3.3	8.9	8.2	8.2	8.1	6.4	8.0	6.2	7.1	7.1

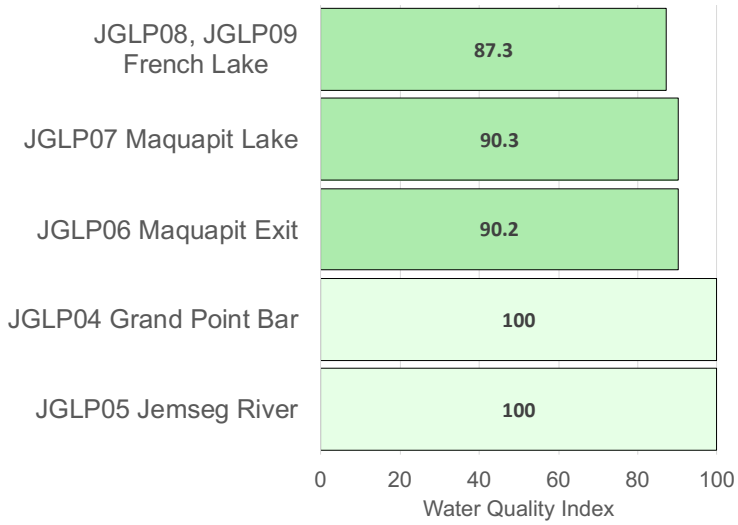
3.5 Water quality Index

Using the CCME Water quality index (WQI) manual (CCME, 2001), the WQI of six samples from sampling sites in three lakes was calculated using the following parameters: arsenic, ammonia, chloride, dissolved oxygen (surface measurement), iron, nitrate, pH, total phosphorus, turbidity, and zinc.

The CCME recommends a minimum of four samples for the use of the Water Quality Index, but most sites were only visited three times and Indian Lake only twice during 2022. For this reason, Indian Lake was not included in the calculations and the two sites in French Lake were pooled for a total of four samples. We chose to calculate WQI for the Grand Lake stations with only three samples, but the results should be evaluated with care and comparisons with previous years are not recommended, they are likely to be misleading.

The average water quality index for all stations in all lakes for 2022 was calculated to be 93.6, which lands it in the "Excellent" category. Both French and Maquapit lake were in this excellent category whereas the average of all three Grand Lake stations was 96.7 putting the lake in the "pristine" category (Table 4, Figure 5).

Table 4. Water quality index determined from the six Grand Lake sampling sites for three sampling periods, from July to October 2022. Score colour can be compared to the legend in Figure 5.



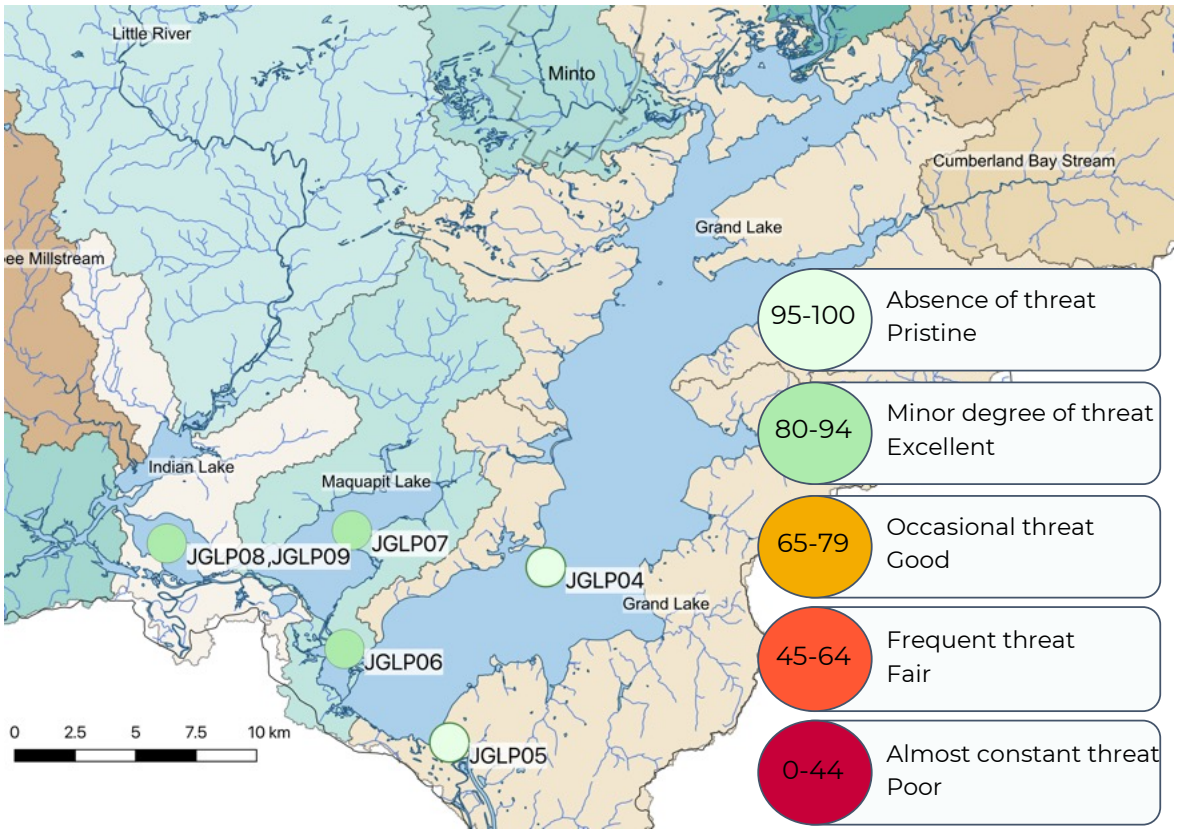


Figure 5. Water quality index colour score indicated inside circle for the six sampling locations Score ranking is found in legend of Table 4.

3.6 Trophic State Index

The TSI score is intended to reflect the biological productivity of a lake. Each trophic class supports different aquatic ecosystems, including fish and other organisms.

HyperEutrophic lakes (TSI >70) are rarely found naturally and can be considered severely nutrient polluted. They have frequent algal blooms and can during periods, depending on depth and season, display either very low or very high oxygen concentrations.
Eutrophic lakes (TSI 50-70) have a high-level biological productivity. Due to excessive nutrients, especially nitrogen and phosphorus, these water bodies can support an abundance of aquatic plants.
Mesotrophic lakes (TSI 40-50) have a moderate level of productivity and fair water quality. Attributes include clear water with increasing probability of low oxygen levels (anoxia) during the summer.
Oligotrophic lakes (TSI <40) have low primary productivity due to low nutrients. They generally have good water quality.

We determined the TSI score for each station using total phosphorus, total nitrogen and chl *a* measurements. The deep mid-lake and outlet station in Grand Lake, (Grand Point Bar and Jemseg River) had scores indicating oligotrophic conditions (Figure 6). Indian, French, and Maquapit Lake all had TSI scores ranging from 51-53 putting them just above the cut-off for the eutrophic category. Of the three Grand Lake statins, Grand Point Bar, and the outlet to Jemseg River had scores of 39, placing them in the oligotrophic category but bordering on mesotrophic. The Maquapit Exit station TSI appears to be influenced by the inflow from the southwestern tributaries and had an intermediate mesotrophic ranking.

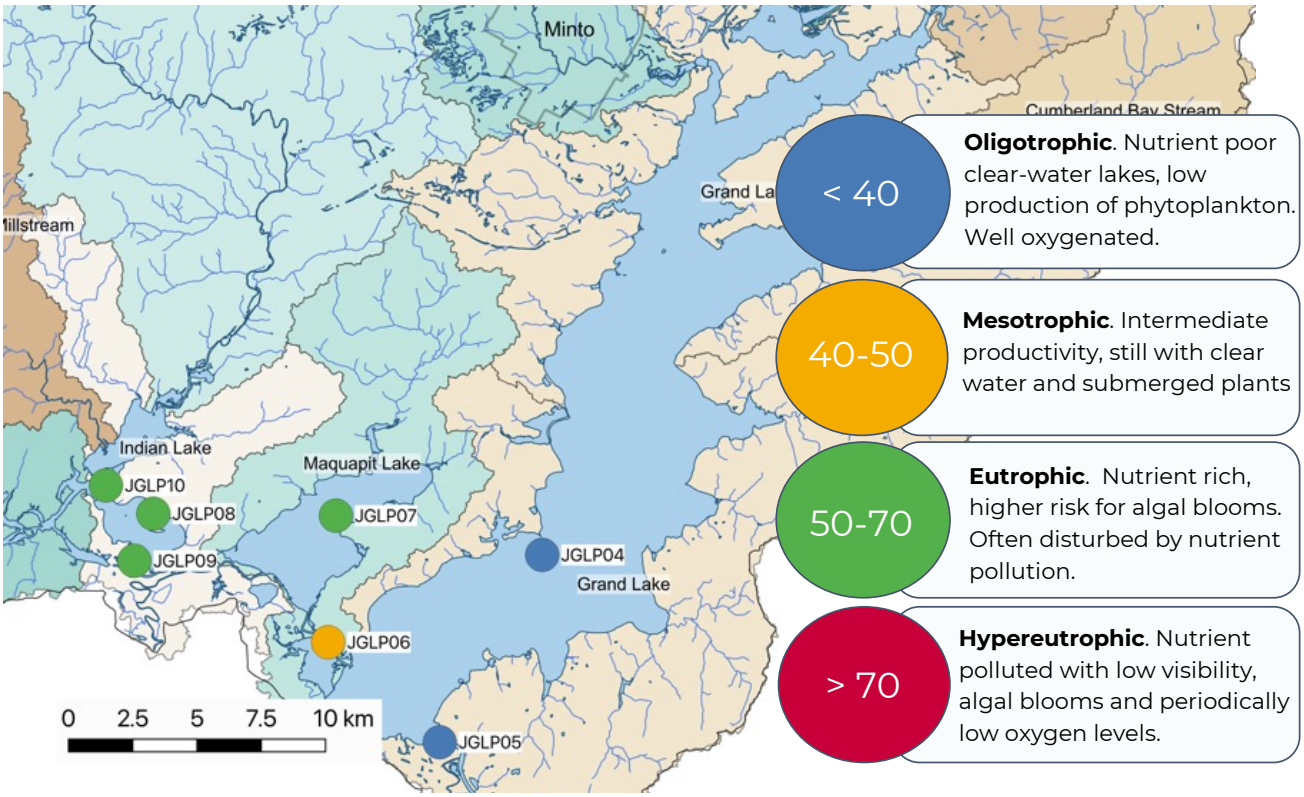


Figure 6. Trophic State Index colour score for the six sampling locations on Grand Lake in 2022.

3.7 E. coli sampling

To test freshwater for faecal material from sewage discharge, stormwater, or agricultural runoff, water samples were collected from 21 sites around the perimeter of Grand Lake and analyzed for *E. coli*. Elevated levels of *E. coli* do not necessarily cause health issues in humans. It is, however, used as an indicator of faecal contamination and signals the potential presence of pathogenic microrganisms. (CCME, 1999). The recreational water quality guideline for *E. coli* established by CCME is ≤ 400 MPN/100 ml.

E. coli concentrations were all well below the CCME guideline for Canadian recreational water quality of less than 400 per 100 ml of sample (Figure 7). Of the 21 samples, the highest concentration of 108 MPN/100 ml was found at Salmon River (JGLE12), with the second highest of 59 MPN/100 ml at Twin Bridges (JGLE14). In 2021 the highest concentrations were found in Douglas Harbour, but this was not the case in 2022. Concentrations of *E. coli* were very low and among the seven stations in Douglas harbour the maximum concentration was 3.1 MPN/100 ml at JGLE20.
E. coli concentrations vary substantially and rapidly over time, and it is easy to miss an increase in *E. coli* concentrations. In 2023 the Association plans to reduce E. coli monitoring to 2 sites based on results from this and previous years.

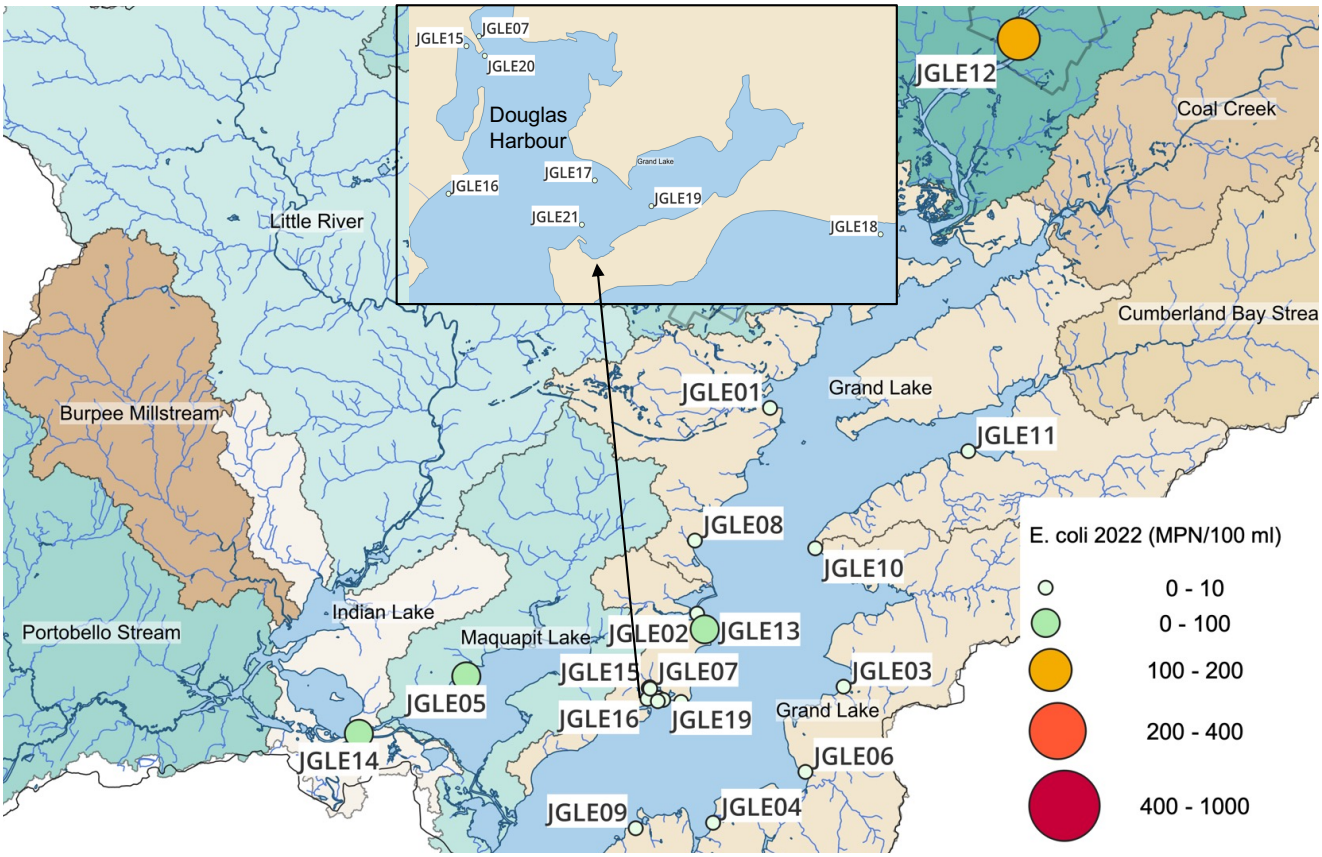


Figure 7. *E. coli* concentrations from 21 near-shore locations around the perimeter of Grand Lake.

4.0 Discussion

Results from the third year of the Grand Lake watershed water quality monitoring program once again indicate that Grand Lake has reasonably good water quality with only a couple of parameters that indicate potential for concern.

The mid-lake water sampling station and the outlet to Jemseg River had pristine WQI scores, indicating no exceedances of parameters that have CCME guidelines. TSI scores at the same two stations indicate oligotrophic waters, but near the limit for mesotrophic. The results suggest that biological productivity is relatively low, limited by the nutrient concentrations in the water. During the late summer a thermocline was observed at the deep mid-lake station. This is a natural occurrence that has been observed all three years of the program. Oxygen concentrations in all three years have declined below the thermocline and gone below 5 mg/L in August, which is below the CWQG for warm water biota of 5.5 mg/L, indicating a potential hazard to fish.

Increases in nitrate, turbidity and zinc and decreases in pH and oxygen compared to the surface samples that have been seen previous years were observed again in 2022. Unlike in 2021 pH was similar both above and below the thermocline. However, because only one of the deep stations were visited this year and only once, it is hard to draw conclusions with any certainty.

The three river stations, introduced into the program in 2021 again showed a slightly worse quality than that of Grand Lake, as showed by the lower WQI score, higher TSI and in some other parameters. The water that flows into Grand Lake typically has higher nutrient concentrations, higher colour and turbitiy as well as lower pH and oxygen concentrations. That the water flowing out of Grand Lake has a better quality than that which enters it is indicative of the many ecosystem services that the lake provides.

In 2020 and 2021, the sampling station draining the Maquapit lake subwatershed in the southwestern part of the Grand Lake watershed was observed to have a different chemistry profile compared to other stations. It had the lowest average pH, lowest conductivity, lowest Secchi disk depth, and highest colour and phosphorus readings. This profile reflects the slow moving, high organic dark water, characteristics of bog/wetland systems. This subwatershed was examined a bit more in detail during 2022 with stations in the three lakes draining into Grand Lake via the Maquapit Inlet: Indian Lake, French Lake and Maquapit Lake. The plan was to see if any of these lakes' sub-watersheds could be singled out as the major influence on the observed water chemistry. However, all three lakes displayed similar values for the above-mentioned parameters and no specific source could be found.

The *E. coli* program was redesigned for 2021, with focus on collecting samples from bays and areas of cottage development, where potential for *E. coli* contamination is greatest. In 2022 the same stations were sampled as during 2021. In addition, the program was also extended to investigate see if the source of the slightly elevated concentrations of *E. coli* found in Douglas Harbour during 2021 could be more specifically pinpointed and if contaminations could pose a risk to human health. However, concentrations of *E. coli* in all seven of the stations in Douglas Harbour were extremely low during the one date sampled during 2022. Next year the program will be scaled down to fewer stations.

Overall water quality in Grand Lake is good, and sampling in the inflow rivers provide additional information to allow for better assessment. Nutrients are currently at acceptable concentrations in the main body of the lake, with TSI scores varying between years around the cut-off between oligotrophy and mesotrophy.

5.0 Acknowledgements

The authors would like to thank the New Brunswick Environmental Trust Fund, ACAP Saint John and New Brunswick Alliance of Lake Associations for supporting this program. Special thanks to Joy Thomas, Robert Thomas, John Pugh, Aaron Fraser, Eric Luiker, Mike Kelly, and Mary Murdoch for being part of the sampling program.

6.0 References

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Appendix A – Water Analysis Analytical Results from RPC – by Month

Appendix – 2022 RPC Water Sample Analysis Results for the Jemseg Grand Lake Watershed Association

Table of Contents

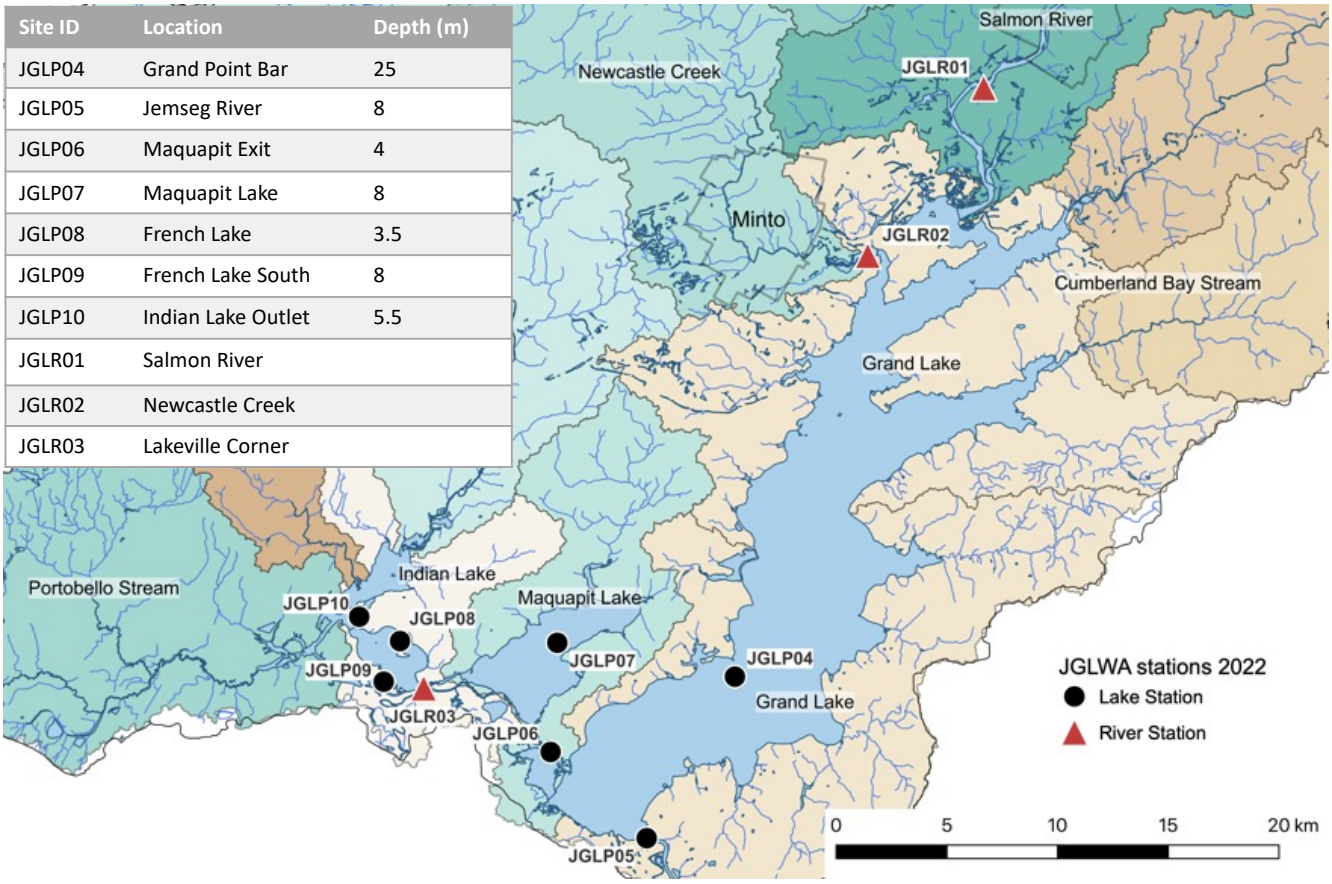
Results ..... page

Surface water sampled July 17 and 18, 2022 ..... A3
Surface and 1 deep water sampled August 28, 29 and 30, 2022 ..... A14
E. coli for 21 sites sampled August 29 and 30, 2022 ..... A31
Surface water sampled October 1 and 3, 2022 ..... A33

Cross reference table, NBDELG field numbers to JGLWA site ID and sampling date.

Sampling Date	Site	NBDELG field number	RPC report + date
2022-07-17	JGLR01 Salmon River at Camp Wegesegum	17/22/19000	449354 2022-07-26
2022-07-17	JGLR02 Newcastle Creek at Newcastle Centre	17/22/19001	449354 2022-07-26
2022-07-17	JGLP04 Grand Point	17/22/19002	449354 2022-07-26
2022-07-17	JGLP06 Maquapit Exit	17/22/19003	449354 2022-07-26
2022-07-17	JGLP05 Jemseg River	17/22/19004	449354 2022-07-26
2022-07-17	JGLR03 Main Thoroughfare Lakeville Corner	17/22/19005	449354 2022-07-26
2022-07-18	JGLP07 Maquapit Lake	17/22/19006	449414 2022-07-26
2022-07-18	JGLP08 French Lake	17/22/19007	449414 2022-07-26
2022-08-30	JGLR01 Salmon River at Camp Wegesegum	17/22/19008	455417 2022-09-12
2022-08-30	JGLR02 Newcastle Creek at Newcastle Centre	17/22/19009	455417 2022-09-12
2022-08-28	JGLP04 Grand Point	17/22/19010	455010 2022-09-07
2022-08-28	JGLP04D Grand Point	17/22/19011	455010 2022-09-07
2022-08-28	JGLP06 Maquapit Exit	17/22/19012	455010 2022-09-07
2022-08-28	JGLP05 Jemseg River	17/22/19013	455010 2022-09-07
2022-08-30	JGLR03 Main Thoroughfare Lakeville Corner	17/22/19014	455417 2022-09-12
2022-08-29	JGLP07 Maquapit Lake	17/22/19015	455163 2022-09-08
2022-08-29	JGLP08 French Lake	17/22/19016	455163 2022-09-08
2022-08-29	JGLP09 French Lake (outlet)	17/22/19017	455163 2022-09-08
2022-08-29	JGLP10 Indian Lake (outlet)	17/22/19018	455163 2022-09-08
2022-10-03	JGLR01 Salmon River at Camp Wegesegum	17/22/19019	459632 2022-10-13
2022-10-03	JGLR02 Newcastle Creek at Newcastle Centre	17/22/19020	459632 2022-10-13
2022-10-03	JGLP04 Grand Point	17/22/19021	459632 2022-10-13
2022-10-01	JGLP06 Maquapit Exit	17/22/19022	459525 2022-10-13
2022-10-01	JGLP05 Jemseg River	17/22/19023	459511 2022-10-13
2022-10-01	JGLR03 Main Thoroughfare Lakeville Corner	17/22/19024	459511 2022-10-13
2022-10-01	JGLP07 Maquapit Lake	17/22/19025	459511 2022-10-13
2022-10-01	JGLP08 French Lake	17/22/19026	459525 2022-10-13
	JGLP09 French Lake (outlet)	17/22/19027	
2022-10-01	JGLP10 Indian Lake (outlet)	17/22/19028	459511 2022-10-13
2022-08-30	JGLE01 Wuhr's Beach	17/22/19030	455417 2022-09-01
2022-08-30	Grand Lake Park (formerly Princess Park) and Sunnyside Beach)	17/22/19031	455417 2022-09-01
2022-08-30	JGLE03 Wiggins Cove, near Mohawk Campground	17/22/19032	455417 2022-09-01
2022-08-30	JGLE04 Whites Cove, sandy beach	17/22/19033	455417 2022-09-01
2022-08-30	JGLE05 Maquapit Lake, Denton Pond	17/22/19034	455417 2022-09-01
2022-08-30	JGLE06 Mill Cove, Sunset Bay Road, Saunders Brook	17/22/19035	455417 2022-09-01
2022-08-29	JGLE07 Douglas Harbour	17/22/19036	455160 2022-08-31
2022-08-29	JGLE15 Douglas Harbour	17/22/19037	455160 2022-08-31
2022-08-29	JGLE16 Douglas Harbour	17/22/19038	455160 2022-08-31
2022-08-29	JGLE17 Douglas Harbour	17/22/19039	455160 2022-08-31
2022-08-29	JGLE18 Douglas Harbour	17/22/19040	455160 2022-08-31
2022-08-29	JGLE19 Douglas Harbour	17/22/19041	455160 2022-08-31
2022-08-29	JGLE20 Douglas Harbour	17/22/19042	455160 2022-08-31
2022-08-29	JGLE21 Douglas Harbour	17/22/19043	455160 2022-08-31
2022-08-30	JGLE08 Camp Rotary, Doyle Road, Sunnyside Beach	17/22/19044	455417 2022-09-01
2022-08-30	JGLE09 Dykeman Cove (near Robertson Point)	17/22/19045	455417 2022-09-01
2022-08-30	JGLE10 Cumberland Point	17/22/19046	455417 2022-09-01
2022-08-30	JGLE11 Cumberland Bay (where?)	17/22/19047	455417 2022-09-01
2022-08-30	JGLE12 Salmon River, Chipman Waterfront Campground	17/22/19048	455417 2022-09-01
2022-08-30	JGLE13 Grand Lake Park	17/22/19049	455417 2022-09-01
2022-08-30	JGLE14 Twin Bridges, Lakev	17/22/19050	455417 2022-09-01

Site ID	Location	Depth (m)
JGLP04	Grand Point Bar	25
JGLP05	Jemseg River	8
JGLP06	Maquapit Exit	4
JGLP07	Maquapit Lake	8
JGLP08	French Lake	3.5
JGLP09	French Lake South	8
JGLP10	Indian Lake Outlet	5.5
JGLR01	Salmon River	
JGLR02	Newcastle Creek	
JGLR03	Lakeville Corner	



Report ID: 449354-IAS
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CERTIFICATE OF ANALYSIS

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Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			449354-1	449354-2	449354-3
Client Sample ID:			17/22/19000	17/22/19001	17/22/19002
Date Sampled:			17-Jul-22	17-Jul-22	17-Jul-22
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.26	4.97	3.53
Potassium	mg/L	0.02	0.29	0.47	0.37
Calcium	mg/L	0.05	4.96	13.9	6.20
Magnesium	mg/L	0.01	0.73	2.35	1.01
Alkalinity (as $CaCO_3$)	mg/L	2	15	17	13
Chloride	mg/L	0.5	3.9	6.8	4.3
Fluoride	mg/L	0.05	0.23	0.21	0.12
Sulfate	mg/L	1	4	35	11
Bromine	mg/L	0.01	0.01	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	0.08
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	0.08
Nitrogen - Total	mg/L	0.2	0.4	0.4	0.4
Phosphorus - Total	mg/L	0.002	0.032	0.038	0.011
Carbon - Total Organic	mg/L	0.5	14.3	11.0	7.2
Colour	TCU	5	147	122	51
Conductivity	µS/cm	1	44	123	60
pH	units	-	7.2	7.3	7.2
Turbidity	NTU	0.1	2.5	5.2	0.7
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	15.0	17.0	13.0
Carbonate (as $CaCO_3$)	mg/L	-	0.022	0.032	0.019
Hardness (as $CaCO_3$)	mg/L	0.2	15.4	44.4	19.6
TDS (calc)	mg/L	-	41	86	42
Saturation pH (20°C)	units	-	9.4	9.0	9.4
Langelier Index (20°C)	-	-	-2.22	-1.66	-2.20

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

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RPC Sample ID:			449354-4	449354-5	449354-6
Client Sample ID:			17/22/19003	17/22/19004	17/22/19005
Date Sampled:			17-Jul-22	17-Jul-22	17-Jul-22
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	2.51	3.37	2.50
Potassium	mg/L	0.02	0.41	0.37	0.39
Calcium	mg/L	0.05	3.94	8.26	3.74
Magnesium	mg/L	0.01	0.66	1.12	0.62
Alkalinity (as $CaCO_3$)	mg/L	2	9	22	7
Chloride	mg/L	0.5	3.5	4.3	3.8
Fluoride	mg/L	0.05	0.12	0.13	0.16
Sulfate	mg/L	1	5	8	5
Bromine	mg/L	0.01	< 0.01	< 0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.4	0.3	0.5
Phosphorus - Total	mg/L	0.002	0.031	0.016	0.043
Carbon - Total Organic	mg/L	0.5	9.0	7.0	12.7
Colour	TCU	5	82	53	126
Conductivity	µS/cm	1	39	64	38
pH	units	-	7.1	7.4	7.0
Turbidity	NTU	0.1	3.6	1.6	3.9
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	9.0	21.9	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.011	0.052	0.007
Hardness (as $CaCO_3$)	mg/L	0.2	12.6	25.2	11.9
TDS (calc)	mg/L	-	31	46	34
Saturation pH (20°C)	units	-	9.7	9.0	9.9
Langelier Index (20°C)	-	-	-2.64	-1.65	-2.87

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Client Sample ID:			17/22/19000	17/22/19001	17/22/19002
Date Sampled:			17-Jul-22	17-Jul-22	17-Jul-22
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.135	0.108	0.065
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.034	0.020	0.018
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.006	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	4.96	13.9	6.20
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0002	0.0003	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.55	0.90	0.13
Lead	mg/L	0.0001	0.0002	0.0002	< 0.0001
Lithium	mg/L	0.0001	0.0011	0.0026	0.0007
Magnesium	mg/L	0.01	0.73	2.35	1.01
Manganese	mg/L	0.001	0.087	0.332	0.006
Molybdenum	mg/L	0.0001	< 0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	0.001	< 0.001
Potassium	mg/L	0.02	0.29	0.47	0.37
Rubidium	mg/L	0.0001	0.0008	0.0010	0.0007
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	3.26	4.97	3.53
Strontium	mg/L	0.001	0.042	0.294	0.077
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.002	0.002	0.001

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Client Sample ID:			17/22/19003	17/22/19004	17/22/19005
Date Sampled:			17-Jul-22	17-Jul-22	17-Jul-22
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.099	0.066	0.124
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.013	0.014	0.014
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.003	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	0.00001
Calcium	mg/L	0.05	3.94	8.26	3.74
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001	0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.56	0.28	0.76
Lead	mg/L	0.0001	0.0003	0.0001	0.0005
Lithium	mg/L	0.0001	0.0006	0.0006	0.0008
Magnesium	mg/L	0.01	0.66	1.12	0.62
Manganese	mg/L	0.001	0.041	0.031	0.068
Molybdenum	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.41	0.37	0.39
Rubidium	mg/L	0.0001	0.0011	0.0007	0.0011
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	2.51	3.37	2.50
Strontium	mg/L	0.001	0.042	0.077	0.044
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	< 0.001	0.001	0.002

Report ID: 449354-IAS
Report Date: 26-Jul-22
Date Received: 18-Jul-22

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Water

RPC Sample ID:			449354-1	449354-2	449354-3
Client Sample ID:			17/22/19000	17/22/19001	17/22/19002
Date Sampled:			17-Jul-22	17-Jul-22	17-Jul-22
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	12.9	5.8	1.7

Report ID: 449354-IAS
Report Date: 26-Jul-22
Date Received: 18-Jul-22

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Attention: Brad Nickerson
Project #: Not Available

Analysis of Water

RPC Sample ID:			449354-4	449354-5	449354-6
Client Sample ID:			17/22/19003	17/22/19004	17/22/19005
Date Sampled:			17-Jul-22	17-Jul-22	17-Jul-22
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	0.9	1.5	3.9

Report ID: 449354-IAS
Report Date: 26-Jul-22
Date Received: 18-Jul-22

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Jemseg, NB E4C 4L7

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Fax: 506.452.0594
www.rpc.ca

Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 449414-IAS
Report Date: 26-Jul-22
Date Received: 18-Jul-22

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27 Pine Grove Lane
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Canada E3B 6Z9
Tel: 506.452.1212
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Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			449414-1	449414-2
Client Sample ID:			17/22/19006	17/22/19007
Date Sampled:			18-Jul-22	18-Jul-22
Analytes	**Units**	**RL**		
Sodium	mg/L	0.05	2.48	2.57
Potassium	mg/L	0.02	0.43	0.39
Calcium	mg/L	0.05	3.89	3.89
Magnesium	mg/L	0.01	0.64	0.64
Alkalinity (as $CaCO_3$)	mg/L	2	8	8
Chloride	mg/L	0.5	3.9	3.6
Fluoride	mg/L	0.05	0.09	0.12
Sulfate	mg/L	1	5	5
Bromine	mg/L	0.01	< 0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.4	0.5
Phosphorus - Total	mg/L	0.002	0.042	0.050
Carbon - Total Organic	mg/L	0.5	10.2	14.2
Colour	TCU	5	81	130
Conductivity	µS/cm	1	40	40
pH	units	-	7.2	7.1
Turbidity	NTU	0.1	5.2	5.4
Calculated Parameters				
Bicarbonate (as $CaCO_3$)	mg/L	-	8.0	8.0
Carbonate (as $CaCO_3$)	mg/L	-	0.012	0.009
Hardness (as $CaCO_3$)	mg/L	0.2	12.3	12.3
TDS (calc)	mg/L	-	32	36
Saturation pH (20°C)	units	-	9.8	9.8
Langelier Index (20°C)	-	-	-2.59	-2.69

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 449414-IAS
Report Date: 26-Jul-22
Date Received: 18-Jul-22

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for
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Tel: 506.452.1212
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www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			449414-1	449414-2
Client Sample ID:			17/22/19006	17/22/19007
Date Sampled:			18-Jul-22	18-Jul-22
Analytes	**Units**	**RL**		
Aluminum	mg/L	0.001	0.117	0.150
Antimony	mg/L	0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.015	0.016
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.002	0.003
Cadmium	mg/L	0.00001	0.00001	0.00001
Calcium	mg/L	0.05	3.89	3.89
Chromium	mg/L	0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	0.0001
Copper	mg/L	0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.60	1.04
Lead	mg/L	0.0001	0.0003	0.0005
Lithium	mg/L	0.0001	0.0006	0.0008
Magnesium	mg/L	0.01	0.64	0.64
Manganese	mg/L	0.001	0.031	0.080
Molybdenum	mg/L	0.0001	< 0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.43	0.39
Rubidium	mg/L	0.0001	0.0011	0.0012
Selenium	mg/L	0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	2.48	2.57
Strontium	mg/L	0.001	0.041	0.047
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.004	0.003

Report ID: 449414-IAS
Report Date: 26-Jul-22
Date Received: 18-Jul-22

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
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rpc
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Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Water

RPC Sample ID:			449414-1	449414-2
Client Sample ID:			17/22/19006	17/22/19007
Date Sampled:			18-Jul-22	18-Jul-22
Analytes	**Units**	**RL**		
Chlorophyll-a	µg/L	0.5	7.6	4.3

Report ID: 449414-IAS
Report Date: 26-Jul-22
Date Received: 18-Jul-22

CERTIFICATE OF ANALYSIS
for
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
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pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 455010-IAS
Report Date: 07-Sep-22
Date Received: 29-Aug-22

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

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Tel: 506.452.1212
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www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455010-1	455010-2	455010-3
Client Sample ID:			17/22/19010	17/22/19011	17/22/19012
Date Sampled:			28-Aug-22	28-Aug-22	28-Aug-22
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.76	3.66	2.46
Potassium	mg/L	0.02	0.39	0.39	0.37
Calcium	mg/L	0.05	7.03	6.71	3.95
Magnesium	mg/L	0.01	1.10	1.04	0.64
Alkalinity (as $CaCO_3$)	mg/L	2	14	13	7
Chloride	mg/L	0.5	4.3	4.1	3.2
Fluoride	mg/L	0.05	0.16	0.18	0.16
Sulfate	mg/L	1	12	11	6
Bromine	mg/L	0.01	0.01	< 0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	0.09	0.12	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	0.09	0.12	< 0.05
Nitrogen - Total	mg/L	0.2	0.3	0.4	0.3
Phosphorus - Total	mg/L	0.002	0.011	0.017	0.037
Carbon - Total Organic	mg/L	0.5	6.8	6.9	9.5
Colour	TCU	5	41	44	91
Conductivity	µS/cm	1	70	66	41
pH	units	-	7.4	7.3	7.2
Turbidity	NTU	0.1	0.5	1.2	2.9
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	14.0	13.0	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.033	0.024	0.010
Hardness (as $CaCO_3$)	mg/L	0.2	22.1	21.0	12.5
TDS (calc)	mg/L	-	38	36	21
Saturation pH (20°C)	units	-	9.3	9.4	9.8
Langelier Index (20°C)	-	-	-1.92	-2.06	-2.65

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 455010-IAS
Report Date: 07-Sep-22
Date Received: 29-Aug-22

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455010-4
Client Sample ID:			17/22/19013
Date Sampled:			28-Aug-22
Analytes	**Units**	**RL**	
Sodium	mg/L	0.05	3.39
Potassium	mg/L	0.02	0.36
Calcium	mg/L	0.05	6.42
Magnesium	mg/L	0.01	0.97
Alkalinity (as $CaCO_3$)	mg/L	2	13
Chloride	mg/L	0.5	4.1
Fluoride	mg/L	0.05	0.13
Sulfate	mg/L	1	9
Bromine	mg/L	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.3
Phosphorus - Total	mg/L	0.002	0.013
Carbon - Total Organic	mg/L	0.5	7.2
Colour	TCU	5	58
Conductivity	µS/cm	1	60
pH	units	-	7.3
Turbidity	NTU	0.1	1.1
Calculated Parameters			
Bicarbonate (as $CaCO_3$)	mg/L	-	13.0
Carbonate (as $CaCO_3$)	mg/L	-	0.024
Hardness (as $CaCO_3$)	mg/L	0.2	20.0
TDS (calc)	mg/L	-	33
Saturation pH (20°C)	units	-	9.4
Langelier Index (20°C)	-	-	-2.08

Report ID: 455010-IAS
Report Date: 07-Sep-22
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455010-1	455010-2	455010-3
Client Sample ID:			17/22/19010	17/22/19011	17/22/19012
Date Sampled:			28-Aug-22	28-Aug-22	28-Aug-22
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.046	0.077	0.125
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.018	0.019	0.014
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.003	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	7.03	6.71	3.95
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.12	0.16	0.68
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0004
Lithium	mg/L	0.0001	0.0007	0.0007	0.0006
Magnesium	mg/L	0.01	1.10	1.04	0.64
Manganese	mg/L	0.001	0.009	0.065	0.039
Molybdenum	mg/L	0.0001	0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.39	0.39	0.37
Rubidium	mg/L	0.0001	0.0008	0.0008	0.0010
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	3.76	3.66	2.46
Strontium	mg/L	0.001	0.085	0.084	0.047
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	< 0.001	0.006	0.001

Report ID: 455010-IAS
Report Date: 07-Sep-22
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Jemseg, NB E4C 4L7

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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455010-4
Client Sample ID:			17/22/19013
Date Sampled:			28-Aug-22
Analytes	**Units**	**RL**	
Aluminum	mg/L	0.001	0.066
Antimony	mg/L	0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001
Barium	mg/L	0.001	0.016
Beryllium	mg/L	0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001
Boron	mg/L	0.001	0.003
Cadmium	mg/L	0.00001	< 0.00001
Calcium	mg/L	0.05	6.42
Chromium	mg/L	0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001
Iron	mg/L	0.02	0.28
Lead	mg/L	0.0001	0.0001
Lithium	mg/L	0.0001	0.0007
Magnesium	mg/L	0.01	0.97
Manganese	mg/L	0.001	0.015
Molybdenum	mg/L	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001
Potassium	mg/L	0.02	0.36
Rubidium	mg/L	0.0001	0.0008
Selenium	mg/L	0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001
Sodium	mg/L	0.05	3.39
Strontium	mg/L	0.001	0.074
Tellurium	mg/L	0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001
Zinc	mg/L	0.001	0.001

Report ID: 455010-IAS
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Attention: Brad Nickerson
Project #: Not Available

Analysis of Water

RPC Sample ID:			455010-1	455010-2	455010-3
Client Sample ID:			17/22/19010	17/22/19011	17/22/19012
Date Sampled:			28-Aug-22	28-Aug-22	28-Aug-22
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	3.5	2.3	2.4

Report ID: 455010-IAS
Report Date: 07-Sep-22
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Attention: Brad Nickerson
Project #: Not Available

Analysis of Water

RPC Sample ID:			455010-4
Client Sample ID:			17/22/19013
Date Sampled:			28-Aug-22
Analytes	**Units**	**RL**	
Chlorophyll-a	µg/L	0.5	1.2

Report ID: 455010-IAS
Report Date: 07-Sep-22
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 455163-IAS
Report Date: 08-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455163-1	455163-2	455163-3
Client Sample ID:			17/22/19016	17/22/19015	17/22/19017
Date Sampled:			29-Aug-22	29-Aug-22	29-Aug-22
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	2.49	2.53	2.43
Potassium	mg/L	0.02	0.28	0.39	0.29
Calcium	mg/L	0.05	3.98	3.69	3.83
Magnesium	mg/L	0.01	0.64	0.64	0.63
Alkalinity (as $CaCO_3$)	mg/L	2	7	7	7
Chloride	mg/L	0.5	3.3	3.4	3.2
Fluoride	mg/L	0.05	0.20	0.15	0.23
Sulfate	mg/L	1	7	6	6
Bromine	mg/L	0.01	0.01	< 0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.4	0.3	0.4
Phosphorus - Total	mg/L	0.002	0.045	0.044	0.045
Carbon - Total Organic	mg/L	0.5	13.1	8.8	12.1
Colour	TCU	5	127	77	123
Conductivity	µS/cm	1	41	41	41
pH	units	-	6.9	7.2	6.8
Turbidity	NTU	0.1	3.4	3.7	3.1
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	7.0	7.0	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.005	0.010	0.004
Hardness (as $CaCO_3$)	mg/L	0.2	12.6	11.8	12.2
TDS (calc)	mg/L	-	23	21	22
Saturation pH (20°C)	units	-	9.8	9.9	9.9
Langelier Index (20°C)	-	-	-2.95	-2.68	-3.06

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 455163-IAS
Report Date: 08-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455163-4
Client Sample ID:			17/22/19018
Date Sampled:			29-Aug-22
Analytes	**Units**	**RL**	
Sodium	mg/L	0.05	2.30
Potassium	mg/L	0.02	0.24
Calcium	mg/L	0.05	4.32
Magnesium	mg/L	0.01	0.63
Alkalinity (as $CaCO_3$)	mg/L	2	7
Chloride	mg/L	0.5	3.0
Fluoride	mg/L	0.05	0.23
Sulfate	mg/L	1	8
Bromine	mg/L	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.4
Phosphorus - Total	mg/L	0.002	0.042
Carbon - Total Organic	mg/L	0.5	14.3
Colour	TCU	5	154
Conductivity	µS/cm	1	41
pH	units	-	6.8
Turbidity	NTU	0.1	2.7
Calculated Parameters			
Bicarbonate (as $CaCO_3$)	mg/L	-	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.004
Hardness (as $CaCO_3$)	mg/L	0.2	13.4
TDS (calc)	mg/L	-	24
Saturation pH (20°C)	units	-	9.8
Langelier Index (20°C)	-	-	-3.01

Report ID: 455163-IAS
Report Date: 08-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

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Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455163-1	455163-2	455163-3
Client Sample ID:			17/22/19016	17/22/19015	17/22/19017
Date Sampled:			29-Aug-22	29-Aug-22	29-Aug-22
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.135	0.098	0.120
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.016	0.014	0.015
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.004	0.003	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	3.98	3.69	3.83
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	< 0.0001	0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.48	0.37	0.54
Lead	mg/L	0.0001	0.0004	0.0003	0.0004
Lithium	mg/L	0.0001	0.0009	0.0006	0.0008
Magnesium	mg/L	0.01	0.64	0.64	0.63
Manganese	mg/L	0.001	0.055	0.027	0.082
Molybdenum	mg/L	0.0001	0.0001	< 0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.28	0.39	0.29
Rubidium	mg/L	0.0001	0.0009	0.0010	0.0009
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	2.49	2.53	2.43
Strontium	mg/L	0.001	0.051	0.043	0.048
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.002	0.001	0.003

Report ID: 455163-IAS
Report Date: 08-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455163-4
Client Sample ID:			17/22/19018
Date Sampled:			29-Aug-22
Analytes	**Units**	**RL**	
Aluminum	mg/L	0.001	0.175
Antimony	mg/L	0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001
Barium	mg/L	0.001	0.019
Beryllium	mg/L	0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001
Boron	mg/L	0.001	0.003
Cadmium	mg/L	0.00001	0.00001
Calcium	mg/L	0.05	4.32
Chromium	mg/L	0.001	< 0.001
Cobalt	mg/L	0.0001	0.0001
Copper	mg/L	0.001	< 0.001
Iron	mg/L	0.02	0.51
Lead	mg/L	0.0001	0.0003
Lithium	mg/L	0.0001	0.0011
Magnesium	mg/L	0.01	0.63
Manganese	mg/L	0.001	0.101
Molybdenum	mg/L	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001
Potassium	mg/L	0.02	0.24
Rubidium	mg/L	0.0001	0.0008
Selenium	mg/L	0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001
Sodium	mg/L	0.05	2.30
Strontium	mg/L	0.001	0.058
Tellurium	mg/L	0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001
Zinc	mg/L	0.001	0.001

Report ID: 455163-IAS
Report Date: 08-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

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Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Water

RPC Sample ID:			455163-1	455163-2	455163-3
Client Sample ID:			17/22/19016	17/22/19015	17/22/19017
Date Sampled:			29-Aug-22	29-Aug-22	29-Aug-22
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	5.2	4.1	3.9

Report ID: 455163-IAS
Report Date: 08-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

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Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
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Attention: Brad Nickerson
Project #: Not Available

Analysis of Water

RPC Sample ID:			455163-4
Client Sample ID:			17/22/19018
Date Sampled:			29-Aug-22
Analytes	**Units**	**RL**	
Chlorophyll-a	µg/L	0.5	9.0

Report ID: 455163-IAS
Report Date: 08-Sep-22
Date Received: 30-Aug-22

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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 455417-IAS
Report Date: 12-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

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Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
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Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455417-14	455417-15	455417-16
Client Sample ID:			17/22/19008	17/22/19009	17/22/19014
Date Sampled:			30-Aug-22	30-Aug-22	30-Aug-22
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.30	5.02	2.34
Potassium	mg/L	0.02	0.33	0.50	0.25
Calcium	mg/L	0.05	5.56	14.4	3.72
Magnesium	mg/L	0.01	0.82	2.27	0.61
Alkalinity (as $CaCO_3$)	mg/L	2	15	19	6
Chloride	mg/L	0.5	3.9	7.1	3.2
Fluoride	mg/L	0.05	0.27	0.30	0.19
Sulfate	mg/L	1	< 1	34	5
Bromine	mg/L	0.01	0.01	0.01	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.6	0.5	0.6
Phosphorus - Total	mg/L	0.002	0.042	0.043	0.055
Carbon - Total Organic	mg/L	0.5	15.5	13.9	13.0
Colour	TCU	5	179	175	128
Conductivity	µS/cm	1	48	122	42
pH	units	-	7.2	7.2	7.0
Turbidity	NTU	0.1	2.5	3.6	3.8
Chlorophyll-a	µg/L	0.5	6.3	2.4	10.0
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	15.0	19.0	6.0
Carbonate (as $CaCO_3$)	mg/L	-	0.022	0.028	0.006
Hardness (as $CaCO_3$)	mg/L	0.2	17.3	45.3	11.8
TDS (calc)	mg/L	-	40	90	33
Saturation pH (20°C)	units	-	9.4	8.9	9.9
Langelier Index (20°C)	-	-	-2.17	-1.70	-2.94

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 455417-IAS
Report Date: 12-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

for
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			455417-14	455417-15	455417-16
Client Sample ID:			17/22/19008	17/22/19009	17/22/19014
Date Sampled:			30-Aug-22	30-Aug-22	30-Aug-22
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.151	0.136	0.115
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.038	0.022	0.014
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.006	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	5.56	14.4	3.72
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0001	0.0004	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.75	1.03	0.53
Lead	mg/L	0.0001	0.0002	0.0002	0.0004
Lithium	mg/L	0.0001	0.0011	0.0025	0.0007
Magnesium	mg/L	0.01	0.82	2.27	0.61
Manganese	mg/L	0.001	0.074	0.306	0.061
Molybdenum	mg/L	0.0001	< 0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.33	0.50	0.25
Rubidium	mg/L	0.0001	0.0008	0.0010	0.0008
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	3.30	5.02	2.34
Strontium	mg/L	0.001	0.046	0.289	0.048
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.001	0.003	< 0.001

Report ID: 455417-IAS
Report Date: 12-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS
for
Jemseg Grand Lake Watershed Association
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 455160-ML-W1
Report Date: 31-Aug-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

for

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Tel: 506.452.1368
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Attention: Brad Nickerson / Jemseg Grandlake / Erin Douthwright / Kelli-Nicole Croucher

Microbiological Examination of Water

Analytes:				E. coli
Units:				MPN/100mL
Method ID:				FFA10
Date Analyzed:				30-Aug-22
RPC Sample ID	Client Sample ID	Date Sampled	Time Sampled	
455160-1	17/22/19040	29-Aug-22	10:30:00 AM	<1
455160-2	17/22/19042	29-Aug-22	11:00:00 AM	3.1
455160-3	17/22/19041	29-Aug-22	11:10:00 AM	1
455160-4	17/22/19039	29-Aug-22	11:20:00 AM	<1
455160-5	17/22/19038	29-Aug-22	11:35:00 AM	2
455160-6	17/22/19037	29-Aug-22	11:45:00 AM	3
455160-7	17/22/19043	29-Aug-22	11:50:00 AM	1
455160-8	17/22/19036	29-Aug-22	12:20:00 PM	9.8

This report relates only to the sample(s) and information provided to the laboratory.

Cathy Hay
Microbiology Supervisor
Applied and Experimental Bioscience

Estela Terruel
Microbiology Technician
Applied and Experimental Bioscience

Report ID: 455417-ML-W1
Report Date: 01-Sep-22
Date Received: 30-Aug-22

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1368
Fax: 506.452.1395
www.rpc.ca

Attention: Brad Nickerson / Jemseg Grandlake / Erin Douthwright / Kelli-Nicole Croucher

Microbiological Examination of Water

Analytes:				E. coli
Units:				MPN/100mL
Method ID:				FFA10
Date Analyzed:				30-Aug-22
RPC Sample ID	Client Sample ID	Date Sampled	Time Sampled	
455417-01	17/22/19045	30-Aug-22	9:30:00 AM	<1
455417-02	17/22/19033	30-Aug-22	9:50:00 AM	<1
455417-03	17/22/19035	30-Aug-22	10:13:00 AM	5.2
455417-04	17/22/19032	30-Aug-22	10:30:00 AM	2
455417-05	17/22/19046	30-Aug-22	10:50:00 AM	1
455417-06	17/22/19047	30-Aug-22	11:05:00 AM	1
455417-07	17/22/19048	30-Aug-22	12:15:00 PM	108.1
455417-08	17/22/19030	30-Aug-22	1:27:00 PM	6.3
455417-09	17/22/19044	30-Aug-22	1:40:00 PM	<1
455417-10	17/22/19031	30-Aug-22	1:55:00 PM	1
455417-11	17/22/19049	30-Aug-22	2:00:00 PM	28.8
455417-12	17/22/19034	30-Aug-22	2:20:00 PM	38.3
455417-13	17/22/19050	30-Aug-22	2:45:00 PM	59.1

This report relates only to the sample(s) and information provided to the laboratory.

Cathy Hay
Microbiology Supervisor
Applied and Experimental Bioscience

Adrienne Fortin
Microbiology Technician
Applied and Experimental Bioscience

Report ID: 459511-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			459511-1	459511-2	459511-3
Client Sample ID:			JGLP05-Jemseg Rive 17/22/19023	JGLR03-Lakeville Corner 17/22/19024	GLP07-Maquapit Lak 17/22/19025
Date Sampled:			1-Oct-22	1-Oct-22	1-Oct-22
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.94	2.46	2.44
Potassium	mg/L	0.02	0.44	0.33	0.34
Calcium	mg/L	0.05	8.03	3.74	3.70
Magnesium	mg/L	0.01	1.11	0.57	0.60
Alkalinity (as $CaCO_3$)	mg/L	2	20	7	8
Chloride	mg/L	0.5	4.6	3.2	3.4
Fluoride	mg/L	0.05	0.13	0.23	0.13
Sulfate	mg/L	1	10	6	5
Bromine	mg/L	0.01	< 0.01	0.02	0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	0.08	< 0.05	0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	0.08	< 0.05	0.05
Nitrogen - Total	mg/L	0.2	0.3	0.5	0.4
Phosphorus - Total	mg/L	0.002	0.013	0.048	0.058
Carbon - Total Organic	mg/L	0.5	6.7	15.6	10.0
Colour	TCU	5	40	139	85
Conductivity	µS/cm	1	73	37	38
pH	units	-	7.5	6.7	7.0
Turbidity	NTU	0.1	0.9	3.3	4.6
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	19.9	7.0	8.0
Carbonate (as $CaCO_3$)	mg/L	-	0.059	0.003	0.008
Hardness (as $CaCO_3$)	mg/L	0.2	24.6	11.7	11.7
TDS (calc)	mg/L	-	41	21	21
Saturation pH (20°C)	units	-	9.1	9.9	9.8
Langelier Index (20°C)	-	-	-1.61	-3.17	-2.82

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 459511-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

CERTIFICATE OF ANALYSIS

for
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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			459511-4
Client Sample ID:			JGLP10- Indian Lake 17/22/19028
Date Sampled:			1-Oct-22
Analytes	**Units**	**RL**	
Sodium	mg/L	0.05	1.70
Potassium	mg/L	0.02	0.27
Calcium	mg/L	0.05	3.51
Magnesium	mg/L	0.01	0.50
Alkalinity (as $CaCO_3$)	mg/L	2	5
Chloride	mg/L	0.5	2.8
Fluoride	mg/L	0.05	0.28
Sulfate	mg/L	1	5
Bromine	mg/L	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.5
Phosphorus - Total	mg/L	0.002	0.030
Carbon - Total Organic	mg/L	0.5	18.7
Colour	TCU	5	180
Conductivity	µS/cm	1	32
pH	units	-	6.3
Turbidity	NTU	0.1	2.3
Calculated Parameters			
Bicarbonate (as $CaCO_3$)	mg/L	-	5.0
Carbonate (as $CaCO_3$)	mg/L	-	0.001
Hardness (as $CaCO_3$)	mg/L	0.2	10.8
TDS (calc)	mg/L	-	18
Saturation pH (20°C)	units	-	10.0
Langelier Index (20°C)	-	-	-3.74

Report ID: 459511-IAS
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Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			459511-1	459511-2	459511-3
Client Sample ID:			JGLP05-Jemseg Rive 17/22/19023	JGLR03-Lakeville Corner 17/22/19024	GLP07-Maquapit Lak 17/22/19025
Date Sampled:			1-Oct-22	1-Oct-22	1-Oct-22
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.035	0.190	0.103
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.015	0.018	0.013
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.004	0.003	0.003
Cadmium	mg/L	0.00001	< 0.00001	0.00004	< 0.00001
Calcium	mg/L	0.05	8.03	3.74	3.70
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	0.0002	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.13	0.55	0.45
Lead	mg/L	0.0001	< 0.0001	0.0003	0.0004
Lithium	mg/L	0.0001	0.0006	0.0008	0.0005
Magnesium	mg/L	0.01	1.11	0.57	0.60
Manganese	mg/L	0.001	0.014	0.084	0.031
Molybdenum	mg/L	0.0001	0.0001	< 0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.44	0.33	0.34
Rubidium	mg/L	0.0001	0.0007	0.0008	0.0008
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	3.94	2.46	2.44
Strontium	mg/L	0.001	0.079	0.046	0.042
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	< 0.001	0.002	< 0.001

Report ID: 459511-IAS
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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			459511-4
Client Sample ID:			JGLP10- Indian Lake 17/22/19028
Date Sampled:			1-Oct-22
Analytes	**Units**	**RL**	
Aluminum	mg/L	0.001	0.270
Antimony	mg/L	0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001
Barium	mg/L	0.001	0.025
Beryllium	mg/L	0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001
Boron	mg/L	0.001	0.003
Cadmium	mg/L	0.00001	0.00002
Calcium	mg/L	0.05	3.51
Chromium	mg/L	0.001	< 0.001
Cobalt	mg/L	0.0001	0.0003
Copper	mg/L	0.001	< 0.001
Iron	mg/L	0.02	0.61
Lead	mg/L	0.0001	0.0003
Lithium	mg/L	0.0001	0.0010
Magnesium	mg/L	0.01	0.50
Manganese	mg/L	0.001	0.119
Molybdenum	mg/L	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001
Potassium	mg/L	0.02	0.27
Rubidium	mg/L	0.0001	0.0007
Selenium	mg/L	0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001
Sodium	mg/L	0.05	1.70
Strontium	mg/L	0.001	0.043
Tellurium	mg/L	0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001
Zinc	mg/L	0.001	0.003

Report ID: 459511-IAS
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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: Not Available

Analysis of Water

RPC Sample ID:			459511-1	459511-2	459511-3
Client Sample ID:			JGLP05-Jemseg Rive 17/22/19023	JGLR03-Lakeville Corner 17/22/19024	GLP07-Maquapit Lak 17/22/19025
Date Sampled:			1-Oct-22	1-Oct-22	1-Oct-22
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	2.6	2.0	4.0

Report ID: 459511-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

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Attention: Eric Luiker
Project #: Not Available

Analysis of Water

RPC Sample ID:			459511-4
Client Sample ID:			JGLP10- Indian Lake 17/22/19028
Date Sampled:			1-Oct-22
Analytes	**Units**	**RL**	
Chlorophyll-a	µg/L	0.5	3.2

Report ID: 459511-IAS
Report Date: 13-Oct-22
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 459525-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

CERTIFICATE OF ANALYSIS

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Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			459525-1	459525-2
Client Sample ID:			JGLP06-Maquapit Exi	JGLP08-French Lake
			17/22/19022	17/22/19026
Date Sampled:			1-Oct-22	1-Oct-22
Analytes	**Units**	**RL**		
Sodium	mg/L	0.05	2.51	2.39
Potassium	mg/L	0.02	0.33	0.33
Calcium	mg/L	0.05	3.86	3.98
Magnesium	mg/L	0.01	0.62	0.60
Alkalinity (as $CaCO_3$)	mg/L	2	8	7
Chloride	mg/L	0.5	3.3	3.1
Fluoride	mg/L	0.05	0.13	0.23
Sulfate	mg/L	1	6	6
Bromine	mg/L	0.01	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.4	0.5
Phosphorus - Total	mg/L	0.002	0.055	0.042
Carbon - Total Organic	mg/L	0.5	10.8	15.0
Colour	TCU	5	96	136
Conductivity	µS/cm	1	39	37
pH	units	-	7.0	6.8
Turbidity	NTU	0.1	4.6	4.1
Calculated Parameters				
Bicarbonate (as $CaCO_3$)	mg/L	-	8.0	7.0
Carbonate (as $CaCO_3$)	mg/L	-	0.008	0.004
Hardness (as $CaCO_3$)	mg/L	0.2	12.2	12.4
TDS (calc)	mg/L	-	22	22
Saturation pH (20°C)	units	-	9.8	9.8
Langelier Index (20°C)	-	-	-2.80	-3.04

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 459525-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

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Attention: Eric Luiker
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			459525-1	459525-2
Client Sample ID:			JGLP06-Maquapit Exi	JGLP08-French Lake
			17/22/19022	17/22/19026
Date Sampled:			1-Oct-22	1-Oct-22
Analytes	**Units**	**RL**		
Aluminum	mg/L	0.001	0.119	0.206
Antimony	mg/L	0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.014	0.019
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.003
Cadmium	mg/L	0.00001	< 0.00001	0.00001
Calcium	mg/L	0.05	3.86	3.98
Chromium	mg/L	0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	0.0002
Copper	mg/L	0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.56	0.70
Lead	mg/L	0.0001	0.0005	0.0004
Lithium	mg/L	0.0001	0.0006	0.0008
Magnesium	mg/L	0.01	0.62	0.60
Manganese	mg/L	0.001	0.046	0.088
Molybdenum	mg/L	0.0001	< 0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.33	0.33
Rubidium	mg/L	0.0001	0.0008	0.0008
Selenium	mg/L	0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	2.51	2.39
Strontium	mg/L	0.001	0.046	0.049
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	< 0.001	0.002

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Attention: Eric Luiker
Project #: Not Available

Analysis of Water

RPC Sample ID:			459525-1	459525-2
Client Sample ID:			JGLP06-Maquapit Exi	JGLP08-French Lake
			17/22/19022	17/22/19026
Date Sampled:			1-Oct-22	1-Oct-22
Analytes	**Units**	**RL**		
Chlorophyll-a	µg/L	0.5	3.2	7.0

Report ID: 459525-IAS
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 459632-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

CERTIFICATE OF ANALYSIS

for
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Fax: 506.452.0594
www.rpc.ca

Attention: Brad Nickerson
Project #: Not Available

Analysis of Surface Water

RPC Sample ID:			459632-1	459632-2	459632-3
Client Sample ID:			17/22/19021	17/22/19020	17/22/19019
Date Sampled:			3-Oct-22	3-Oct-22	3-Oct-22
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.88	4.03	2.70
Potassium	mg/L	0.02	0.38	0.48	0.31
Calcium	mg/L	0.05	6.84	10.9	4.26
Magnesium	mg/L	0.01	1.04	1.73	0.66
Alkalinity (as $CaCO_3$)	mg/L	2	15	13	11
Chloride	mg/L	0.5	4.3	6.0	3.7
Fluoride	mg/L	0.05	0.13	0.33	0.31
Sulfate	mg/L	1	12	28	3
Bromine	mg/L	0.01	< 0.01	0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	0.06	< 0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	0.06	< 0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.2	0.4	0.4
Phosphorus - Total	mg/L	0.002	0.011	0.043	0.024
Carbon - Total Organic	mg/L	0.5	6.1	16.9	18.7
Colour	TCU	5	38	202	200
Conductivity	µS/cm	1	66	94	36
pH	units	-	7.4	7.0	7.0
Turbidity	NTU	0.1	0.6	6.2	1.8
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	15.0	13.0	11.0
Carbonate (as $CaCO_3$)	mg/L	-	0.035	0.012	0.010
Hardness (as $CaCO_3$)	mg/L	0.2	21.4	34.3	13.4
TDS (calc)	mg/L	-	38	61	22
Saturation pH (20°C)	units	-	9.3	9.2	9.6
Langelier Index (20°C)	-	-	-1.90	-2.18	-2.62

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 459632-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

CERTIFICATE OF ANALYSIS
for
Jemseg Grand Lake Watershed Association
27 Pine Grove Lane
Jemseg, NB E4C 4L7

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Fredericton NB
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Analysis of Surface Water

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Client Sample ID:			17/22/19021	17/22/19020	17/22/19019
Date Sampled:			3-Oct-22	3-Oct-22	3-Oct-22
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.031	0.236	0.220
Antimony	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Arsenic	mg/L	0.001	< 0.001	0.001	< 0.001
Barium	mg/L	0.001	0.016	0.022	0.037
Beryllium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001	< 0.001	< 0.001
Boron	mg/L	0.001	0.003	0.005	0.003
Cadmium	mg/L	0.00001	< 0.00001	0.00002	0.00001
Calcium	mg/L	0.05	6.84	10.9	4.26
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	< 0.0001	0.0007	0.0002
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.10	1.01	0.67
Lead	mg/L	0.0001	< 0.0001	0.0005	0.0002
Lithium	mg/L	0.0001	0.0007	0.0020	0.0009
Magnesium	mg/L	0.01	1.04	1.73	0.66
Manganese	mg/L	0.001	0.015	0.324	0.095
Molybdenum	mg/L	0.0001	0.0001	0.0001	< 0.0001
Nickel	mg/L	0.001	< 0.001	0.001	< 0.001
Potassium	mg/L	0.02	0.38	0.48	0.31
Rubidium	mg/L	0.0001	0.0007	0.0009	0.0006
Selenium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	3.88	4.03	2.70
Strontium	mg/L	0.001	0.081	0.203	0.035
Tellurium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.001	0.005	0.003

Report ID: 459632-IAS
Report Date: 13-Oct-22
Date Received: 03-Oct-22

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for

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Analysis of Water

RPC Sample ID:			459632-1	459632-2	459632-3
Client Sample ID:			17/22/19021	17/22/19020	17/22/19019
Date Sampled:			3-Oct-22	3-Oct-22	3-Oct-22
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	3.1	2.0	1.8

Report ID: 459632-IAS
Report Date: 13-Oct-22
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M57	APHA 5310 B	Combustion/NDIR
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES