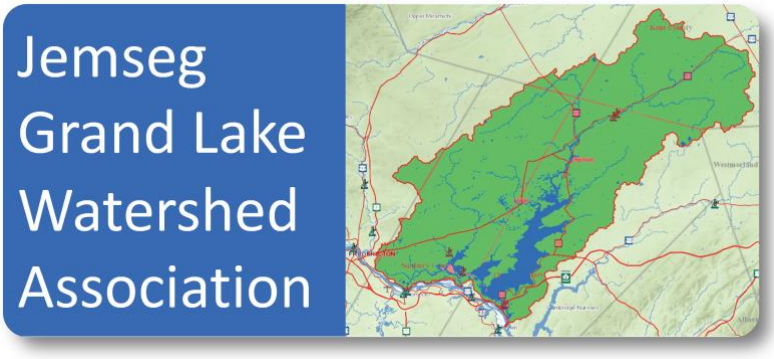
Jemseg Grand Lake Watershed Association
Water Monitoring Program Report – 2020

by
Eric Luiker, Jillian Hudgins and Brad Nickerson
March 1, 2021

Jemseg Grand Lake Watershed Association Report 21-01



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Luiker, E, Hudgins, J. and Nickerson, B. "Jemseg Grand Lake Watershed Association Water Monitoring Program Report – 2020", Jemseg Grand Lake Watershed Association report 21-01, March 1, 2021, 44 pages.

Jemseg Grand Lake Watershed Association
Water Monitoring Program Report – 2020

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Jemseg Grand Lake Watershed Association
Water Monitoring Program Report – 2020

1.0 Introduction

The Jemseg Grand Lake Watershed Association 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. Three initial projects were chosen to engage people directly and to offer opportunities for participation in hands-on activities that help protect the environment. These three projects were: (a) environmental awareness workshops in four communities around Grand Lake, (b) water quality monitoring, and (c) riparian zone tree planting appropriate for private and government owned properties.

This summary report describes the activities of the JGWLA – 2020 water quality monitoring program.

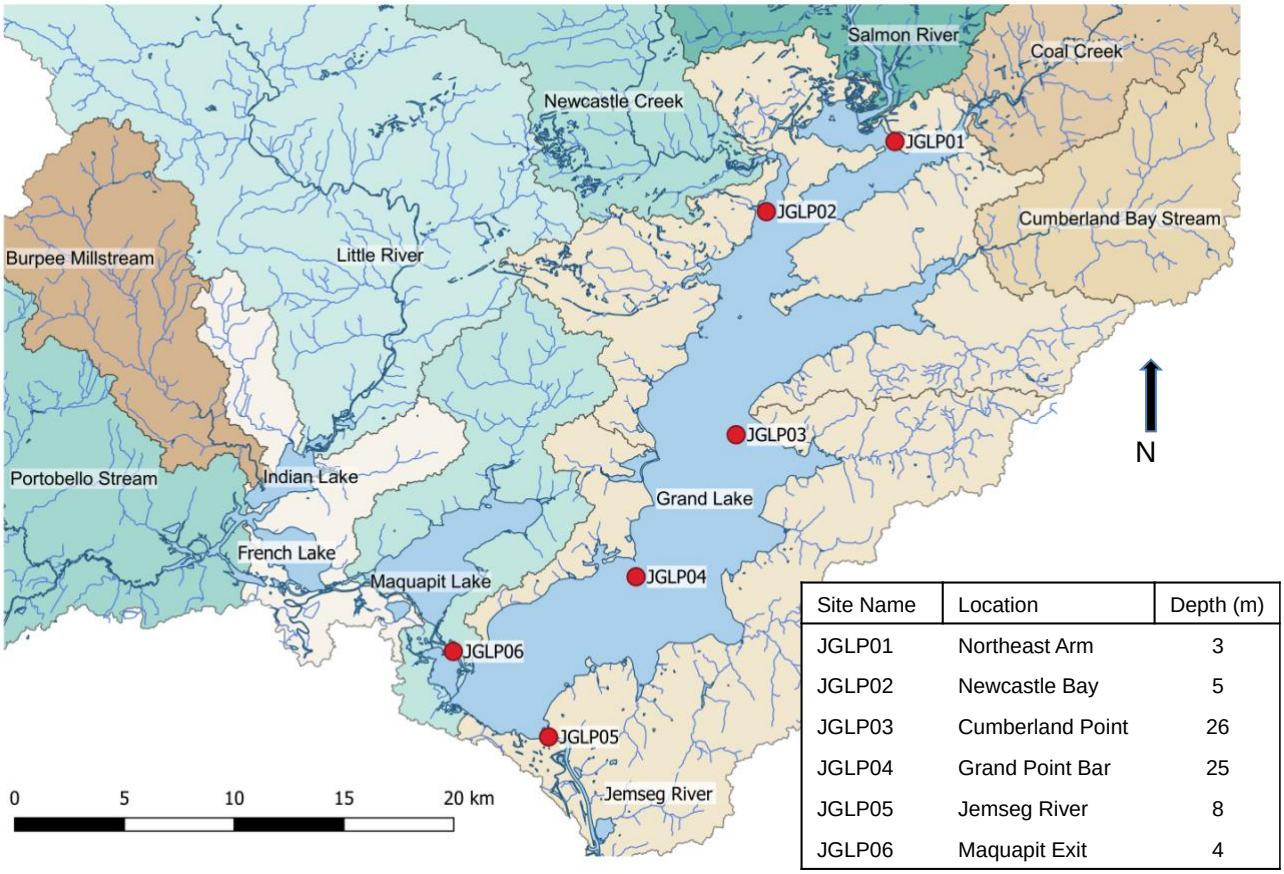
Water quality is important to the health of any aquatic ecosystem. It affects humans, as well as the flora and fauna of the watershed. Our program is designed to examine the water quality of Grand Lake, its main inflows as well as the outflow (Jemseg River). Volunteers were engaged to measure biophysical parameters at surface and at depth and to collect water samples to measure major ions, nutrients, trace metals, chlorophyll *a* (chl *a*) and *Escherichia coli* (*E. coli*). Sampling was conducted monthly from July to October in 2020. Our goal is to make this an annual monitoring program, with adjustments made for continual improvement in the quality of the data collected, and to focus on areas of concern.

2.0 Methods

Grand Lake is the largest lake in the province of 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. Our sampling locations were designed to obtain water quality data from locations on Grand Lake close to these inflow sources and the outflow, as well as from two mid-lake, deep basin locations. A total of six water quality sampling sites were established (Figure 1). In addition, in partnership with Atlantic Coastal Action Plan Saint John (ACAP Saint John), we established two cyanobacteria monitoring stations (Jemseg River, Grand Lake) and deployed solid phase adsorption toxin tracking (SPATT) collectors and temperature loggers at these stations. ACAP Saint John will report data collected from these two stations separately. An additional temperature logger was deployed near Cumberland Point from June 28 until October 5, 2020 logging surface water temperature every 30 minutes.

Water quality sampling was conducted by two volunteer teams, with one team sampling the three southwest sampling stations and the other team sampling the three northeast stations. Stations were sampled four times during the summer/fall of 2020 (July 19, August 10, September 7, October 3-4). Stations were accessed using a boat and positioned using a Garmin GPS/depthsounder. At each station pH, conductivity, temperature and

oxygen were measured at 1 m intervals using a YSI multimeter. Secchi disk depth was taken at each site. Surface water samples were collected for general water chemistry, nutrients, metals, chl *a* and *E. coli*. Samples were kept cold and transported to the Research and Productivity Council Laboratories (RPC) within 24 hours of collection for analysis.



Site Name	Location	Depth (m)
JGLP01	Northeast Arm	3
JGLP02	Newcastle Bay	5
JGLP03	Cumberland Point	26
JGLP04	Grand Point Bar	25
JGLP05	Jemseg River	8
JGLP06	Maquapit Exit	4

Figure 1. Jemseg Grand Lake Watershed sampling stations. Legend indicates station location and depth at site. Subwatersheds are colour shaded.

Conductivity, pH, oxygen and temperature date results are presented in graphs by depth to show vertical profiles at each of the six lake stations. Water quality results from RPC were 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 way 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. 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 nitrogen, phosphorus and chl *a*. TSI provides an estimate of relative biological productivity of the aquatic ecosystem.

3.0 Results

3.1 Surface temperature

A temperature profile from surface temperature measurements at Cumberland Point is shown in Figure 2. Overall average temperature was 21.3 ºC for the period of deployment (June 28 to October 5), with August having the warmest average temperature of 23.3 ºC (Table 1). Maximum temperature (28.8 ºC) was reached in mid August, and coolest temperature (8.1 ºC) was reached in October. Daily temperature fluctuation was approximately 2 ºC. There was a total of 46 days with temperatures reaching above 23ºC, 24 of these in August and 20 of these in July.

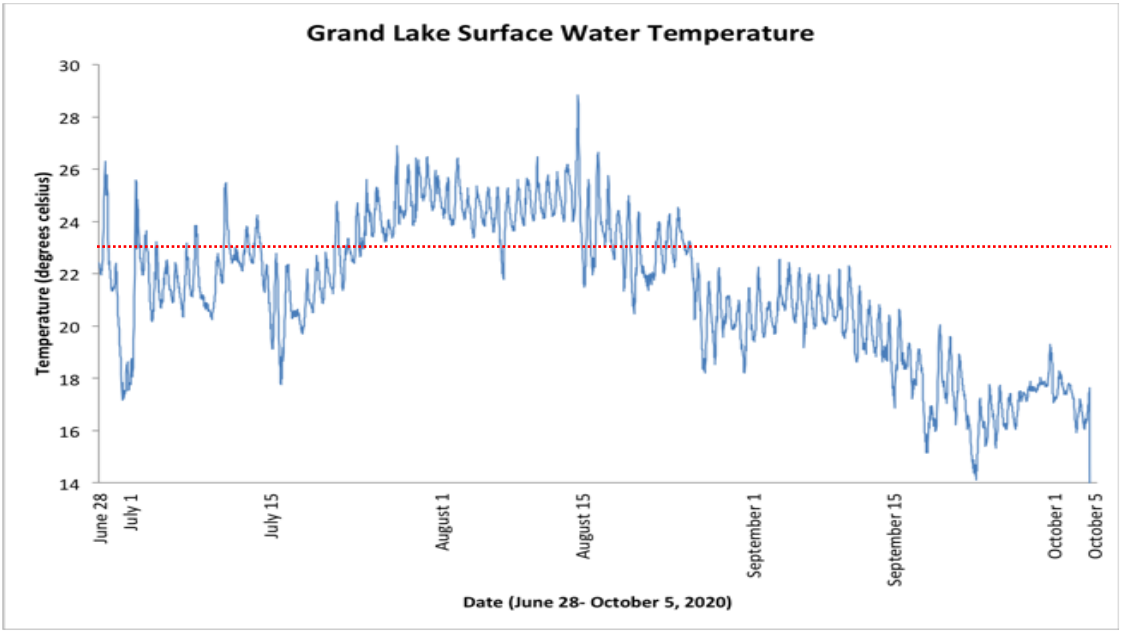


Figure 2. Surface water temperatures from Cumberland Point, Grand Lake. Temperature was taken every 30 minutes from June 28 to October 5, 2020.

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

Month	Average (ºC)	Min Temp (ºC)	Max (ºC)	No. days >23ºC
July	22.6	17.8	26.9	20
August	23.3	18.2	28.8	24
September	18.8	14.1	22.6	0
Overall	21.3	8.1	28.8	46

3.2 Grand Lake Surface Water Biophysical Characteristics

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

- Average percentage of dissolved oxygen ranged from 87% at Northeast Arm to 102% at Jemseg.
- Warmest average temperatures were at Maquapit Exit and Jemseg River, with temperatures of 22.9 °C and 22.0 °C respectively.
- pH for most stations was slight above neutral, from 7.2 to 7.5. A high reading at Jemseg River raised the average pH at that station to 8.1. This high pH reading may be an anomaly given that other measurements at the site were more aligned with other locations.
- Average conductivity was lowest at Maquapit (46 µS/cm) and highest at Northeast Arm (151 µS/cm). This shows the variation in the lake inflow from the Salmon River into Northeast Arm, and the very dark/boggy water of the Maquapit Lake region.
- Secchi disk readings for the lake are naturally low due to the background colour of the water. Secchi disk readings averaged between 1 and 2.3 m, with highest averages from the mid-lake stations.

Table 2. Summary statistics of Grand Lake Surface Water Biophysical Characteristics.

Station	Dissolved Oxygen (mg/l)			Dissolved Oxygen (%)			Water Temp ° C			pH			Conductivity microS/cm			Secchi		
	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
Northeast Arm (JGLP01)	7.8	8.1	7.3	87	95	80	21.0	25.2	16.3	7.5	7.6	7.4	151	170	133	1.0	1.1	1.0
Newcastle Bay (JGLP02)	8.1	8.3	7.9	89	94	83	20.5	24.5	16.5	7.3	7.4	7.2	89	92	88	1.3	1.5	1.0
Cumberland Pt (JGLP03)	8.2	8.6	7.9	91	96	87	20.2	23.6	16.6	7.3	7.3	7.2	75	82	68	2.3	3.0	1.8
Grand Pt Bar (JGLP04)	8.7	9.4	8.2	97	103	88	20.8	24.6	16.7	7.2	7.3	7.2	75	85	68	2.0	2.0	2.0
Jemseg River (JGPL05)	8.9	9.7	7.9	102	117	84	22.0	24.7	16.7	8.1	8.7	7.4	97	182	68	1.9	2.1	1.8
Maquapit Exit (JGLP06)	8.0	8.5	6.9	94	106	81	22.9	26.3	16.2	7.2	7.4	6.9	46	55	42	0.9	1.5	0.8

3.3 Vertical Profiles

For the inflow and outflow stations (Northeast Arm, Newcastle Bay, Maquapit Exit and Jemseg River), water depth was not deep enough at these sites to establish thermoclines. At the mid-lake deep stations (>25 m at Cumberland Point and Grand Point), thermal stratification began in July, and became more delineated in August. Oxygen concentrations did decrease with depth, especially in August. At depths below 20 m at Cumberland Pt and Grand Bar Pt, oxygen concentrations did reach the critical 5 mg/L concentration. In September, the thermocline (the depth at which there is a sudden change in temperature) was less obvious, and while sampling in October, the thermocline was completely gone, and temperature and oxygen concentrations were similar from surface to bottom.

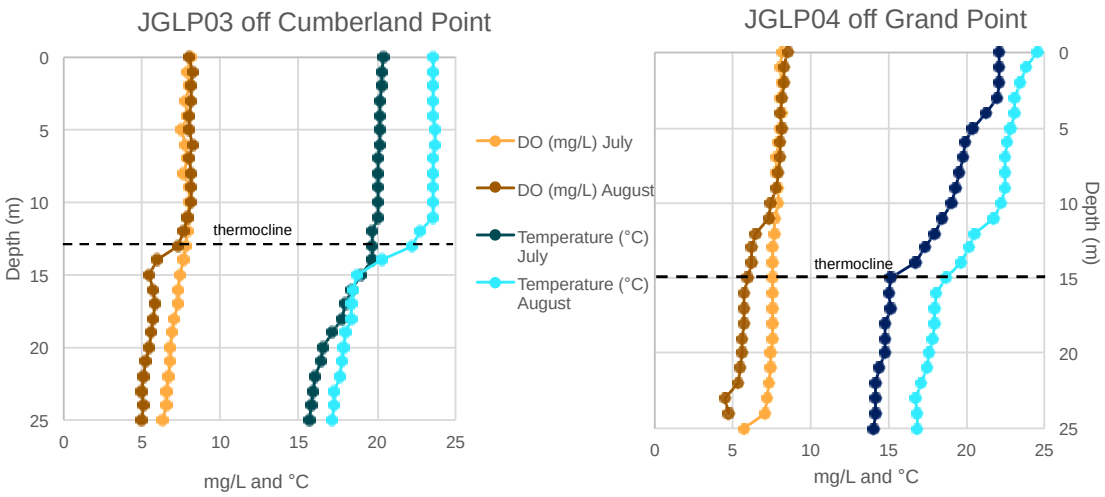


Figure 3. Vertical profiles of temperature and oxygen concentrations versus depth at Cumberland Point and Grand Bar Point for July and August, 2020. Thermocline is indicated as dashed line.

3.4 Water Quality

Water quality sampling results for key parameters of concern that were used to score the WQI are summarized in Table 3. 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 (Freshwater)(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).

There were only two parameters that had exceedances of the CWQG, including total phosphorus at three stations, and iron at two stations. All exceedances were at stations adjacent to inflows. There were no exceedances at the two mid-lake stations, or at the Jemseg River 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.

Table 3. Average water quality results from Grand Lake surface water samples collected between June – October 2020. RL = recording limits of a parameter, 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), shaded values are those that had at least one exceedance, number in brackets = the number of results/4 that were above CCME guideline.

Analytes	Units	RL	CWQG	JGLP01	JGLP02	JGLPO3	JGLP04	JGLP05	JGLP06
Chloride	mg/L	0.5	120	4.6	4.4	4.9	5.6	10.1	3.7
Ammonia (as N)	mg/L	0.05	1.54	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05
Nitrate (as N)	mg/L	0.05	13	< 0.05	< 0.05	< 0.05	< 0.05	0.07	< 0.05
Phosphorus - Total	mg/L	0.002	0.03	0.030(2)	0.026(1)	0.011	0.011	0.013	0.044(3)
pH	units	-	6.5-9	7.6	7.5	7.4	7.4	7.7	7.4
Turbidity	NTU	0.1	10	3.2	2.2	0.5	0.8	0.9	4.6
Arsenic	mg/L	0.001	0.005	< 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
Iron	mg/L	0.02	0.3	0.288(2)	0.225	0.083	0.090	0.095	0.483(4)
Zinc	mg/L	0.001	0.03	0.002	0.003	0.003	< 0.001	< 0.001	< 0.001
Dissolved oxygen	mg/L		5.5	7.7	8.1	8.2	9.0	8.8	8.4

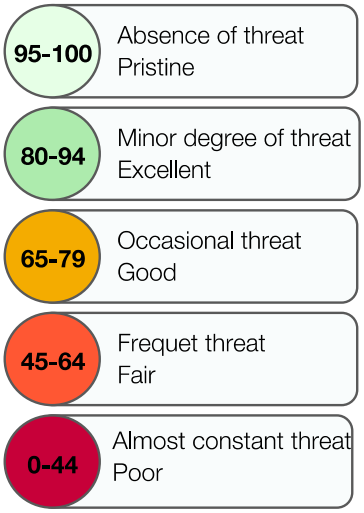
3.5 Water quality Index

Using the CCME Water quality index (WQI) manual (CCME, 2001), the WQI of the six sampling sites was calculated using the following parameters: arsenic, ammonia, chloride, dissolved oxygen (surface measurement), iron, nitrate, pH, total phosphorus, turbidity, and zinc. The WQI score for each station is provided in Table 4 and identified on the watershed map (Figure 4).

The overall average WQI score for 2020 in Grand Lake was calculated to be 92.4 or “excellent”.

Table 4. Water quality index determined from the six Grand Lake sampling sites for four sampling periods, monthly from July to October 2020. Score colour can be compared to legend.

Site	WQI	Score
Northeast Arm (JGLP01)	86	
Newcastle Bay (JGLP02)	92.5	
Cumberland Point (JGLP03)	100	
Grand Point Bar (JGLP04)	100	
Jemseg River (JGLP05)	100	
Maquapit Exit (JGLP06)	81.6	



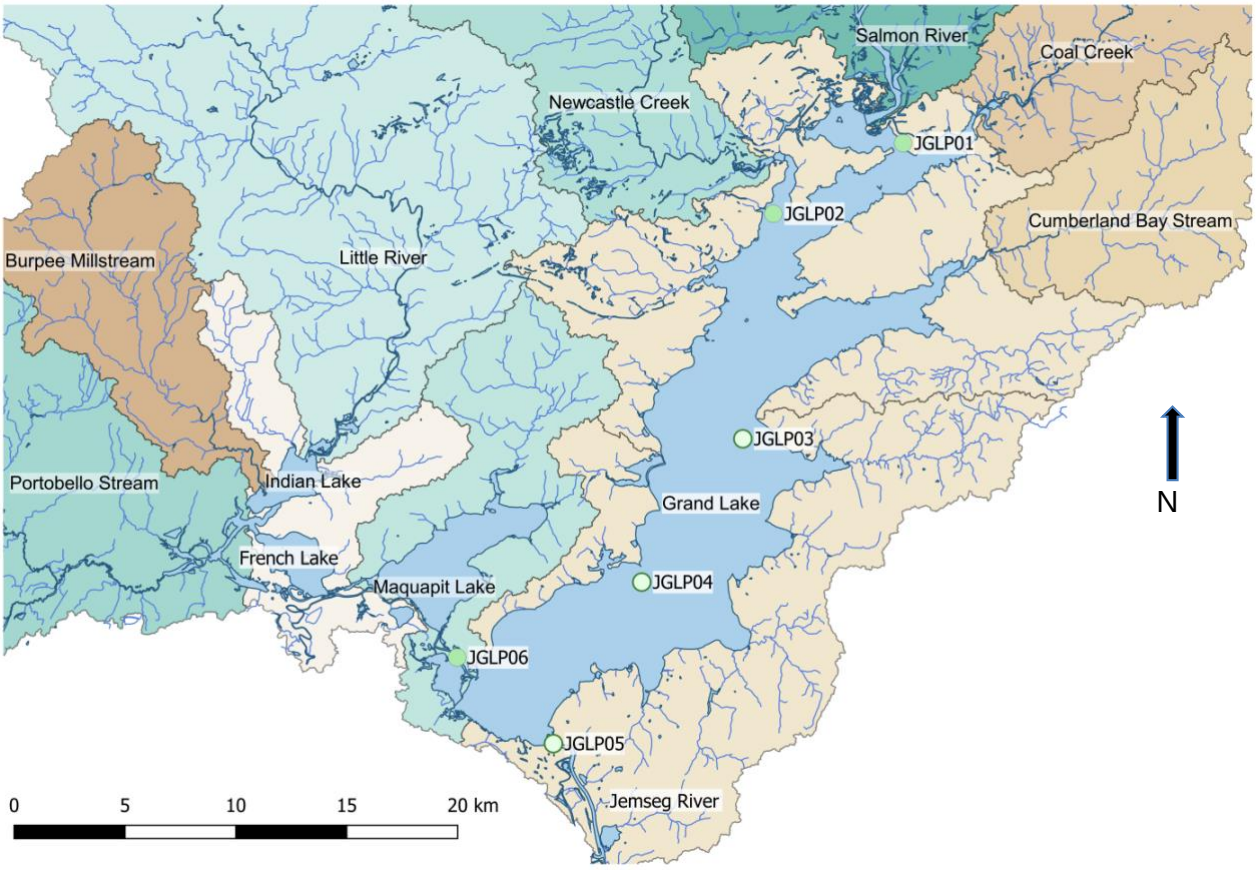


Figure 4. Water quality index colour score indicated inside circle for the six sampling locations on Grand Lake. Score ranking is found in legend of Table 4.

3.6 Trophic Status 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. We determined the TSI score for each station using total phosphorus, total nitrogen and chl *a* measurements.

Eutrophic lakes (TSI 50-70) has 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.
For Grand Lake, the open water sites (Cumberland Point, Grand Bar Point), and Jemseg River all had scores indicating oligotrophic conditions (Table 5, Figure 5). The inflow sites (Northeast Arm, Newcastle Bay and Maquapit Exit all had scores indicating mesotrophic conditions.

Table 5. Trophic Status Index (TSI) scores for the six Grand Lake sampling stations. Score is based on total nitrogen, total phosphorus, and chl *a* measurements. TSI scores fall into three categories:
Eutrophic lakes (TSI 50-70). Mesotrophic lakes (TSI 40-50) Oligotrophic lakes (TSI <40)

Site	**TSI**	**Status**
Northeast Arm (JGP01)	46.3	Mesotrophic
Newcastle Bay (JGLP02)	48.4	Mesotrophic
Cumberland Point (JGLP03)	38.7	Oligotrophic
Grand Point Bar (JGLP04)	38.5	Oligotrophic
Jemseg River (JGLP05)	36.9	Oligotrophic
Maquapit Exit (JGLP06)	49.4	Mesotrophic
Overall	**43.0**	**Mesotrophic**

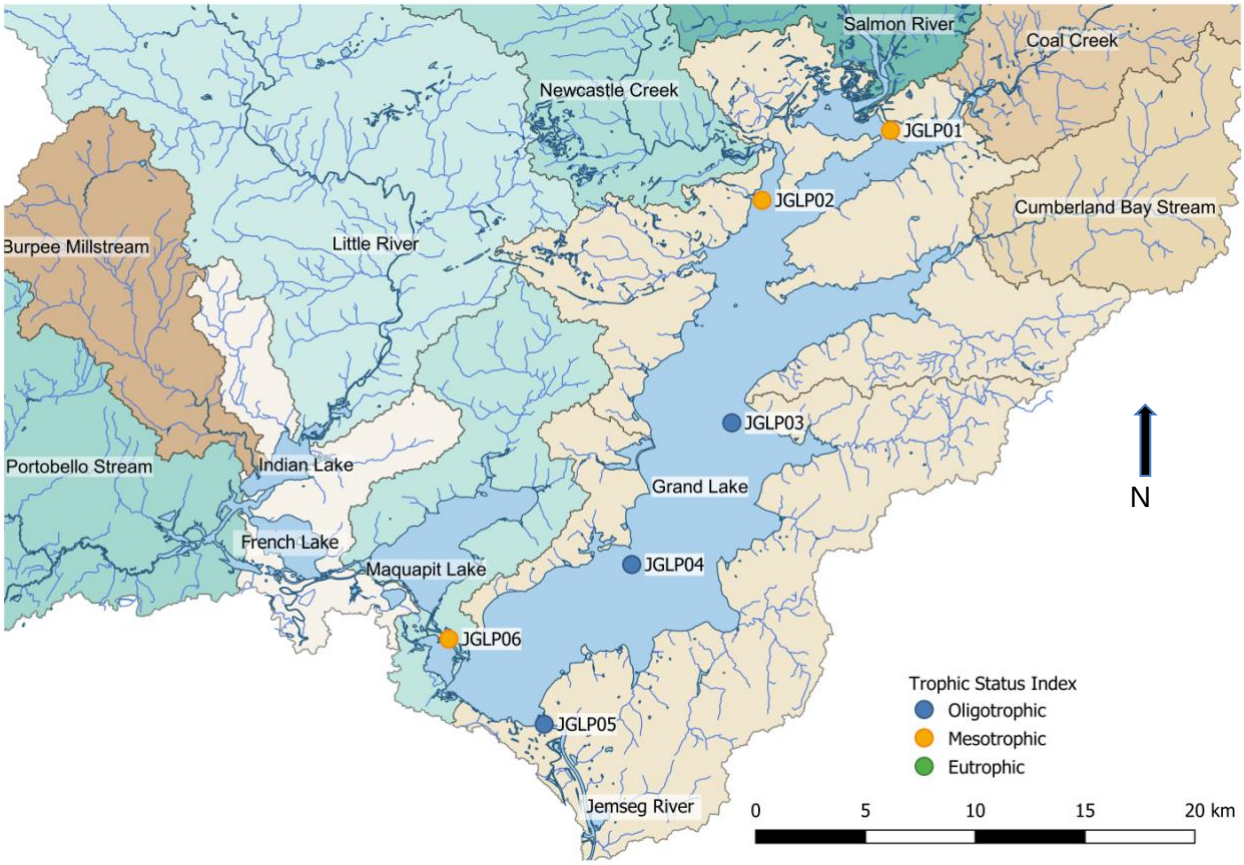


Figure 5. Trophic Status Index colour score indicated inside circle for the six sampling locations on Grand Lake. Score ranking is found in legend of Table 5.

3.7 E. coli sampling

To test freshwater for faecal material from sewage discharge, stormwater, or agricultural runoff, water samples were collected and analyzed for *E. coli*. Elevated levels of *E. coli* does not necessarily cause health issues in humans, however it is used as an indicator of faecal contamination and signals the potential presence of pathogenic microrganisms. Elevated numbers of these indicator bacteria in the aquatic environment are indicative of faecal contamination and therefore suggest the possible presence of enteric pathogens (CCME, 1999). The recreational water quality guideline for *E. coli* established by CCME is $\leq$ 400 MPN/100 ml.

E. coli results from our sampling program were well below the 400 MPN/100 ml guideline, with results ranging from below detection level to 16 MPN/100 ml at the Maquapit Exit in October. These results indicate that faecal contamination is very low at Grand Lake sampling stations,.

4.0 Discussion

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

The mid-lake water sampling stations had excellent WQI scores, indicating that there were no exceedances of parameters that have CCME guidelines. TSI scores indicated oligotrophic waters, which suggest that biological productivity is limited by the nutrient concentrations in the water. During the summer thermoclines were established at these two stations, which is a natural occurrence that is expected for deep lakes like Grand Lake. Oxygen concentrations declined below the thermocline and approached 5 mg/L, which is below the CWQG for warm water biota of 5.5 mgL, indicating a potential hazard to fish.

The sampling stations near sources of inflow had greater variability in surface water chemistry then the mid-lake channels and were the only stations with CWQG exceedances. The Northeast Arm Station is close to the mouth of the Salmon River and has water chemistry similar to that of the river. It has higher conductivity then the other stations, and two exceedances of phosphorus were recorded. This is an indication of potential nutrient sources within the Salmon River flowing into Grand Lake. The sampling program for 2021 will include a sampling station within the Salmon River to further study phosphorus levels.

The sampling station draining the Maquapit lake subwatershed had a different water chemistry profile than other stations. It had the lowest average pH, lowest conductivity, lowest Secchi disk depth, and highest colour readings. This profile reflects the slow moving, high organic dark water, characteristics of bog/wetland systems. This station also had the highest phosphorus concentrations from our sampling program. The sampling program for 2021 will include a station in Maquapit Lake to further examine phosphorus levels.

The outlet station at Jemseg River tended to mirror water quality from the main body of the lake. There were no CWQG exceedances, however there was some oxygen supersaturation, indicating the potential for high aquatic primary productivity. This is likely attributed to the sampling station being located adjacent to Grand Lake Meadows.

E. coli concentrations were acceptable at all six sampling stations. Our sampling stations were positioned to provide the best representation of water quality for that portion of the lake. However, these stations were not optimal to detect *E. coli* sources. Potential faecal contamination sources include sewage/septic tank runoff, agriculture sources or effluent discharges, which are all shore-based. The sampling program for 2021 will include shoreline sampling locations that are nearer to potential faecal contamination sources.

Overall water quality in Grand Lake is good, although the elevated concentrations of phosphorus at two stations signals nutrient inputs that should be further studied. Nutrients in other lakes of the Saint John River, and the river itself, have had nutrient enrichment and algal blooms including cyanobacteria. Nutrients are currently at acceptable concentrations in the main body of the lake, however, at times from the inflow stations they do exceed our nutrient guidelines. The TSI scores for these sites are at the mesotrophic level. Future monitoring will add stations to further study nutrients in areas of inflow.

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 Robert Thomas, Alex Thomas, Hazen Hughes, Mike Kelly, and Mary Murdoch for being part of the sampling program.

6.0 References

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Appendix A – Analytical Results from RPC

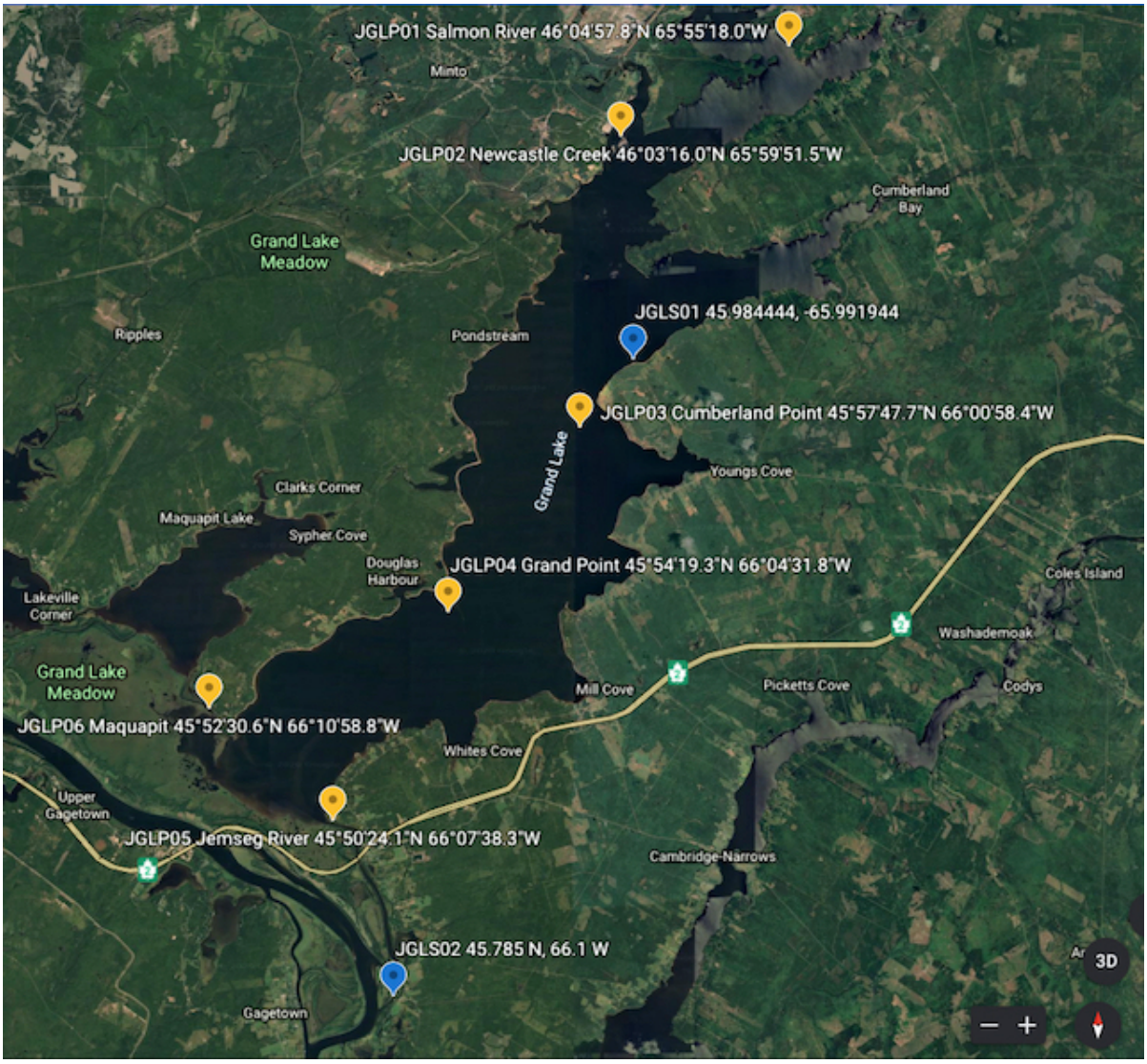
Organized by Month of Sampling

Appendix – 2020 RPC Surface Water Analysis Results for the Jemseg Grand Lake Watershed Association

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Report/Rapport: 360456-ML-W1
Date: 21-Jul-20
Date Received/Reçu: 20-Jul-20

CERTIFICATE OF ANALYSIS / CERTIFICAT D'ANALYSE

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Erin Douthwright / Jemseg Grandlake

Client Location: Grand Lake

Microbiological Examination of Water/Qualité microbiologique de l'eau potable

RPC Sample ID/No. d'échantillon de RPC:				360456-1	360456-2	360456-3
Client Sample ID/ID d'échantillon du client:				JGLPO1	JGLPO2	JGLPO3
Date collected/Date du prélèvement				19-Jul-20	19-Jul-20	19-Jul-20
Analytes/Paramètre(s)	**Method/Méthode**	**Date Analyzed Date Analysé**	**Units Unités**			
E. coli	FFA10	20-Jul-20	MPN/100mL	3.0	2.0	<1.0

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

Le présent rapport ne s'applique qu'aux échantillons et à l'information transmis au laboratoire.

Cathy Hay
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Food, Fisheries & Aquaculture

Lindsey Boone
Micro Technician
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Report/Rapport: 359691-ML-W1
Date: 15-Jul-20
Date Received/Reçu: 14-Jul-20

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Brad Nickerson / Erin Douthwright

Client Location: Grand Lake

Microbiological Examination of Water/Qualité microbiologique de l'eau potable

RPC Sample ID/No. d'échantillon de RPC:				359691-1	359691-2	359691-3
Client Sample ID/ID d'échantillon du client:				JGLP04	JGLP05	JGLP06
Date collected/Date du prélèvement				13-Jul-20	13-Jul-20	13-Jul-20
Time sampled/Heure du prélèvement				9:00:00 AM	10:50:00 AM	10:30:00 AM
Analytes/Paramètre(s)	**Method/Méthode**	**Date Analyzed Date Analysé**	**Units Unités**			
E. coli	FFA10	14-Jul-20	MPN/100mL	1.0	<1.0	2.0

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

Le présent rapport ne s'applique qu'aux échantillons et à l'information transmis au laboratoire.

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Micro Technician
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Report ID: 360456-IAS
Report Date: 31-Jul-20
Date Received: 20-Jul-20

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Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			360456-1	360456-2	360456-3
Client Sample ID:			JGLPO1	JGLPO2	JGLPO3
Date Sampled:			19-Jul-20	19-Jul-20	19-Jul-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	9.57	4.78	3.62
Potassium	mg/L	0.02	0.49	0.45	0.37
Calcium	mg/L	0.05	12.1	8.54	6.61
Magnesium	mg/L	0.01	1.85	1.40	1.03
Alkalinity (as $CaCO_3$)	mg/L	2	24	14	12
Chloride	mg/L	0.5	4.1	4.1	3.9
Fluoride	mg/L	0.05	0.12	0.12	0.12
Sulfate	mg/L	1	29	19	12
Bromine	mg/L	0.01	0.01	< 0.01	< 0.01
Ammonia (as N)	mg/L	0.05	< 0.05	< 0.05	0.06
Un-ionized @ 20ºC	mg/L	-	< 0.001	< 0.001	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	0.07
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	0.07
Nitrogen - Total	mg/L	0.2	0.2	0.2	0.3
Phosphorus - Total	mg/L	0.002	0.030	0.016	0.008
Carbon - Total Organic	mg/L	0.5	5.7	6.6	6.7
Colour	TCU	5	35	40	44
Conductivity	µS/cm	1	132	88	68
pH	units	-	7.4	7.5	7.4
Turbidity	NTU	0.1	2.7	2.3	0.5
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	23.9	13.9	12.0
Carbonate (as $CaCO_3$)	mg/L	-	0.056	0.041	0.028
Hardness (as $CaCO_3$)	mg/L	0.2	37.8	27.1	20.7
TDS (calc)	mg/L	-	78	54	42
Saturation pH (20°C)	units	-	8.9	9.2	9.4
Langelier Index (20°C)	-	-	-1.47	-1.74	-2.01

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

Krista Skinner
Chemical Technician
Inorganic Analytical Chemistry

Report ID: 360456-IAS
Report Date: 31-Jul-20
Date Received: 20-Jul-20

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

rpc
921 College Hill Rd
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			360456-1	360456-2	360456-3
Client Sample ID:			JGLPO1	JGLPO2	JGLPO3
Date Sampled:			19-Jul-20	19-Jul-20	19-Jul-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.094	0.095	0.058
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	0.028	0.022	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	0.006	0.004	0.003
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	12.1	8.54	6.61
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	0.38	0.29	0.10
Lead	mg/L	0.0001	0.0002	0.0002	< 0.0001
Lithium	mg/L	0.0001	0.0012	0.0011	0.0007
Magnesium	mg/L	0.01	1.85	1.40	1.03
Manganese	mg/L	0.001	0.063	0.053	0.009
Molybdenum	mg/L	0.0001	0.0002	0.0003	0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.49	0.45	0.37
Rubidium	mg/L	0.0001	0.0011	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	9.57	4.78	3.62
Strontium	mg/L	0.001	0.204	0.133	0.084
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	0.0002	< 0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Zinc	mg/L	0.001	0.003	0.006	0.001

Report ID: 360456-IAS
Report Date: 31-Jul-20
Date Received: 20-Jul-20

CERTIFICATE OF ANALYSIS
for
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 359691-IAS
Report Date: 24-Jul-20
Date Received: 14-Jul-20

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
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			359691-1	359691-2	359691-3
Client Sample ID:			JGLP04	JGLP05	JGLP06
Date Sampled:			13-Jul-20	13-Jul-20	13-Jul-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.64	3.70	2.39
Potassium	mg/L	0.02	0.41	0.39	0.42
Calcium	mg/L	0.05	6.56	6.32	3.78
Magnesium	mg/L	0.01	1.12	1.09	0.66
Alkalinity (as $CaCO_3$)	mg/L	2	15	14	9
Chloride	mg/L	0.5	3.9	4.3	3.3
Fluoride	mg/L	0.05	0.08	0.08	0.06
Sulfate	mg/L	1	11	11	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	0.3	0.3	0.3
Phosphorus - Total	mg/L	0.002	0.009	0.009	0.029
Carbon - Total Organic	mg/L	0.5	6.9	7.0	7.8
Colour	TCU	5	45	47	57
Conductivity	µS/cm	1	66	70	42
pH	units	-	7.5	7.3	7.2
Turbidity	NTU	0.1	1.0	0.8	3.7
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	14.9	14.0	9.0
Carbonate (as $CaCO_3$)	mg/L	-	0.044	0.026	0.013
Hardness (as $CaCO_3$)	mg/L	0.2	21.0	20.3	12.2
TDS (calc)	mg/L	-	43	43	29
Saturation pH (20°C)	units	-	9.3	9.4	9.8
Langelier Index (20°C)	-	-	-1.81	-2.06	-2.56

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

Krista Skinner
Chemical Technician
Inorganic Analytical Chemistry

Report ID: 359691-IAS
Report Date: 24-Jul-20
Date Received: 14-Jul-20

CERTIFICATE OF ANALYSIS

for
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www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			359691-1	359691-2	359691-3
Client Sample ID:			JGLP04	JGLP05	JGLP06
Date Sampled:			13-Jul-20	13-Jul-20	13-Jul-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.073	0.068	0.114
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	0.017	0.017	0.012
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	6.56	6.32	3.78
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	0.13	0.11	0.34
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0003
Lithium	mg/L	0.0001	0.0007	0.0007	0.0006
Magnesium	mg/L	0.01	1.12	1.09	0.66
Manganese	mg/L	0.001	0.013	0.013	0.026
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	0.39	0.42
Rubidium	mg/L	0.0001	0.0007	0.0007	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	3.64	3.70	2.39
Strontium	mg/L	0.001	0.085	0.086	0.043
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	< 0.001

Report ID: 359691-IAS
Report Date: 24-Jul-20
Date Received: 14-Jul-20

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for
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 363432-ML-W1
Report Date: 12-Aug-20
Date Received: 11-Aug-20

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
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rpc
921 College Hill Rd
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Canada E3B 6Z9
Tel: 506.452.1368
Fax: 506.452.1395
www.rpc.ca

Attention: Eric Luiker / Brad Nickerson / Erin Douthwright / Jemseg Grandlake

Client Location: Grand Lake

Microbiological Examination of Water

Analytes:			E. coli
Units:			MPN/100mL
Method ID:			FFA10
Date Analyzed:			11-Aug-20
RPC Sample ID	Client Sample ID	Date Sampled	
363432-1	JGLP01	10-Aug-20	1.0
363432-2	JGLP02	10-Aug-20	2.0
363432-3	JGLP03	10-Aug-20	1.0
363432-4	JGLP04	10-Aug-20	<1.0
363432-5	JGLP05	10-Aug-20	<1.0
363432-6	JGLP06	10-Aug-20	1.0

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

Cathy Hay
Microbiology Supervisor
Food, Fisheries & Aquaculture

Corrie Maston
Microbiology Technician
Food, Fisheries & Aquaculture

Report ID: 363432-IAS
Report Date: 25-Aug-20
Date Received: 11-Aug-20

CERTIFICATE OF ANALYSIS

for
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Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			363432-1	363432-2	363432-3
Client Sample ID:			JGLP01	JGLP02	JGLP03
Date Sampled:			10-Aug-20	10-Aug-20	10-Aug-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	12.3	5.03	3.83
Potassium	mg/L	0.02	0.48	0.44	0.39
Calcium	mg/L	0.05	14.2	9.42	6.97
Magnesium	mg/L	0.01	2.25	1.41	1.13
Alkalinity (as $CaCO_3$)	mg/L	2	30	20	14
Chloride	mg/L	0.5	4.5	4.2	4.0
Fluoride	mg/L	0.05	0.08	0.06	0.05
Sulfate	mg/L	1	38	18	13
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	0.06
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	< 0.05	0.06
Nitrogen - Total	mg/L	0.2	0.2	0.3	0.3
Phosphorus - Total	mg/L	0.002	0.036	0.027	0.020
Carbon - Total Organic	mg/L	0.5	5.7	5.8	6.1
Colour	TCU	5	22	30	38
Conductivity	µS/cm	1	162	90	71
pH	units	-	7.7	7.4	7.4
Turbidity	NTU	0.1	3.5	1.7	0.4
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	29.8	19.9	14.0
Carbonate (as $CaCO_3$)	mg/L	-	0.140	0.047	0.033
Hardness (as $CaCO_3$)	mg/L	0.2	44.7	29.3	22.1
TDS (calc)	mg/L	-	96	57	44
Saturation pH (20°C)	units	-	8.7	9.0	9.3
Langelier Index (20°C)	-	-	-1.02	-1.64	-1.92

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

Krista Skinner
Chemical Technician
Inorganic Analytical Chemistry

Report ID: 363432-IAS
Report Date: 25-Aug-20
Date Received: 11-Aug-20

CERTIFICATE OF ANALYSIS

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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			363432-4	363432-5	363432-6
Client Sample ID:			JGLP04	JGLP05	JGLP06
Date Sampled:			10-Aug-20	10-Aug-20	10-Aug-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	3.74	3.74	2.51
Potassium	mg/L	0.02	0.38	0.34	0.34
Calcium	mg/L	0.05	6.95	7.00	4.16
Magnesium	mg/L	0.01	1.10	1.12	0.68
Alkalinity (as $CaCO_3$)	mg/L	2	14	14	9
Chloride	mg/L	0.5	4.0	3.9	3.3
Fluoride	mg/L	0.05	0.05	0.05	< 0.05
Sulfate	mg/L	1	12	12	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	0.06	< 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	0.3	0.2	0.3
Phosphorus - Total	mg/L	0.002	0.017	0.018	0.049
Carbon - Total Organic	mg/L	0.5	6.2	5.7	6.6
Colour	TCU	5	37	37	48
Conductivity	µS/cm	1	71	71	43
pH	units	-	7.3	8.2	7.5
Turbidity	NTU	0.1	0.8	0.5	3.4
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	14.0	13.7	9.0
Carbonate (as $CaCO_3$)	mg/L	-	0.026	0.204	0.027
Hardness (as $CaCO_3$)	mg/L	0.2	21.9	22.1	13.2
TDS (calc)	mg/L	-	43	42	29
Saturation pH (20°C)	units	-	9.3	9.3	9.7
Langelier Index (20°C)	-	-	-2.02	-1.13	-2.22

Report ID: 363432-IAS
Report Date: 25-Aug-20
Date Received: 11-Aug-20

CERTIFICATE OF ANALYSIS

for
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Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			363432-1	363432-2	363432-3
Client Sample ID:			JGLP01	JGLP02	JGLP03
Date Sampled:			10-Aug-20	10-Aug-20	10-Aug-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.087	0.063	0.045
Antimony	mg/L	0.0001	0.0002	0.0002	< 0.0001
Arsenic	mg/L	0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.030	0.022	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	0.008	0.005	0.004
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	14.2	9.42	6.97
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	0.30	0.21	0.08
Lead	mg/L	0.0001	0.0002	0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0012	0.0010	0.0007
Magnesium	mg/L	0.01	2.25	1.41	1.13
Manganese	mg/L	0.001	0.069	0.047	0.008
Molybdenum	mg/L	0.0001	0.0002	0.0003	0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.48	0.44	0.39
Rubidium	mg/L	0.0001	0.0012	0.0009	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	12.3	5.03	3.83
Strontium	mg/L	0.001	0.250	0.127	0.090
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	< 0.001

Report ID: 363432-IAS
Report Date: 25-Aug-20
Date Received: 11-Aug-20

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

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

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			363432-4	363432-5	363432-6
Client Sample ID:			JGLP04	JGLP05	JGLP06
Date Sampled:			10-Aug-20	10-Aug-20	10-Aug-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.042	0.050	0.097
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	0.016	0.010
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	0.004	0.004
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	6.95	7.00	4.16
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	0.08	0.09	0.45
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0004
Lithium	mg/L	0.0001	0.0007	0.0007	0.0005
Magnesium	mg/L	0.01	1.10	1.12	0.68
Manganese	mg/L	0.001	0.006	0.008	0.038
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	0.34	0.34
Rubidium	mg/L	0.0001	0.0007	0.0007	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	3.74	3.74	2.51
Strontium	mg/L	0.001	0.088	0.088	0.046
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	< 0.001

Report ID: 363432-IAS
Report Date: 25-Aug-20
Date Received: 11-Aug-20

CERTIFICATE OF ANALYSIS
for
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35 Pinecone Lane
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 367039-ML-W1
Report Date: 09-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
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Canada E3B 6Z9
Tel: 506.452.1368
Fax: 506.452.1395
www.rpc.ca

Attention: Eric Luiker / Brad Nickerson / Erin Douthwright / Jemseg Grandlake

Client Location: Grand Lake

Microbiological Examination of Water

Analytes:			E. coli
Units:			MPN/100mL
Method ID:			FFA10
Date Analyzed:			8-Sep-20
RPC Sample ID	Client Sample ID	Date Sampled	
367039-1	JGLP01	7-Sep-20	1.0
367039-2	JGLP02	7-Sep-20	1.0
367039-3	JGLP03	7-Sep-20	<1.0
367039-4	JGLP04	7-Sep-20	<1.0
367039-5	JGLP05	7-Sep-20	<1.0
367039-6	JGLP06	7-Sep-20	5.2

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

Corrie Maston
Acting Microbiology Supervisor
Food, Fisheries & Aquaculture

Julia Khoury
Micro Technician
Food, Fisheries & Aquaculture

Report ID: 367039-IAS
Report Date: 21-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
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Tel: 506.452.1212
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www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			367039-1	367039-2	367039-3
Client Sample ID:			JGLP01	JGLP02	JGLP03
Date Sampled:			7-Sep-20	7-Sep-20	7-Sep-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	13.0	5.17	4.71
Potassium	mg/L	0.02	0.54	0.43	0.43
Calcium	mg/L	0.05	15.4	8.39	7.39
Magnesium	mg/L	0.01	2.37	1.42	1.25
Alkalinity (as $CaCO_3$)	mg/L	2	34	16	14
Chloride	mg/L	0.5	4.8	4.1	5.5
Fluoride	mg/L	0.05	0.14	0.09	0.10
Sulfate	mg/L	1	38	18	13
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	0.3	0.3	0.3
Phosphorus - Total	mg/L	0.002	0.025	0.038	0.008
Carbon - Total Organic	mg/L	0.5	4.5	5.3	5.6
Colour	TCU	5	16	23	30
Conductivity	µS/cm	1	174	89	80
pH	units	-	7.5	7.4	7.2
Turbidity	NTU	0.1	3.6	2.1	0.6
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	33.9	15.9	14.0
Carbonate (as $CaCO_3$)	mg/L	-	0.101	0.038	0.021
Hardness (as $CaCO_3$)	mg/L	0.2	48.2	26.8	23.6
TDS (calc)	mg/L	-	100	53	47
Saturation pH (20°C)	units	-	8.6	9.2	9.3
Langelier Index (20°C)	-	-	-1.13	-1.79	-2.10

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

Krista Skinner
Chemical Technician
Inorganic Analytical Chemistry

Report ID: 367039-IAS
Report Date: 21-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
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rpc
921 College Hill Rd
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Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			367039-4	367039-5	367039-6
Client Sample ID:			JGLP04	JGLP05	JGLP06
Date Sampled:			7-Sep-20	7-Sep-20	7-Sep-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	5.86	6.69	2.71
Potassium	mg/L	0.02	0.47	0.51	0.39
Calcium	mg/L	0.05	7.59	7.85	4.48
Magnesium	mg/L	0.01	1.40	1.51	0.76
Alkalinity (as $CaCO_3$)	mg/L	2	15	17	9
Chloride	mg/L	0.5	7.7	11.2	3.5
Fluoride	mg/L	0.05	0.09	0.09	0.07
Sulfate	mg/L	1	13	12	6
Bromine	mg/L	0.01	0.02	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	< 0.05	< 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	0.3	0.3	0.3
Phosphorus - Total	mg/L	0.002	0.008	0.012	0.042
Carbon - Total Organic	mg/L	0.5	5.6	5.6	6.2
Colour	TCU	5	28	30	47
Conductivity	µS/cm	1	89	95	48
pH	units	-	7.3	7.4	7.2
Turbidity	NTU	0.1	0.6	1.1	4.2
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	15.0	16.9	9.0
Carbonate (as $CaCO_3$)	mg/L	-	0.028	0.040	0.013
Hardness (as $CaCO_3$)	mg/L	0.2	24.7	25.8	14.3
TDS (calc)	mg/L	-	51	56	30
Saturation pH (20°C)	units	-	9.3	9.2	9.7
Langelier Index (20°C)	-	-	-1.96	-1.79	-2.49

Report ID: 367039-IAS
Report Date: 21-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

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

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			367039-1	367039-2	367039-3
Client Sample ID:			JGLP01	JGLP02	JGLP03
Date Sampled:			7-Sep-20	7-Sep-20	7-Sep-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.078	0.065	0.035
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	0.036	0.021	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	0.008	0.004	0.004
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	15.4	8.39	7.39
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	0.22	0.18	0.07
Lead	mg/L	0.0001	0.0002	0.0001	< 0.0001
Lithium	mg/L	0.0001	0.0011	0.0009	0.0008
Magnesium	mg/L	0.01	2.37	1.42	1.25
Manganese	mg/L	0.001	0.059	0.045	0.015
Molybdenum	mg/L	0.0001	0.0002	0.0003	0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.54	0.43	0.43
Rubidium	mg/L	0.0001	0.0010	0.0008	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	13.0	5.17	4.71
Strontium	mg/L	0.001	0.259	0.125	0.090
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	< 0.001

Report ID: 367039-IAS
Report Date: 21-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

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

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			367039-4	367039-5	367039-6
Client Sample ID:			JGLP04	JGLP05	JGLP06
Date Sampled:			7-Sep-20	7-Sep-20	7-Sep-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.034	0.045	0.112
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	0.017	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	0.005	0.005	0.004
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	7.59	7.85	4.48
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	0.07	0.10	0.55
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0005
Lithium	mg/L	0.0001	0.0008	0.0007	0.0005
Magnesium	mg/L	0.01	1.40	1.51	0.76
Manganese	mg/L	0.001	0.018	0.023	0.079
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	0.47	0.51	0.39
Rubidium	mg/L	0.0001	0.0008	0.0008	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	5.86	6.69	2.71
Strontium	mg/L	0.001	0.091	0.090	0.052
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	< 0.001

Report ID: 367039-IAS
Report Date: 21-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
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921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Water

RPC Sample ID:			367039-1	367039-2	367039-3
Client Sample ID:			JGLP01	JGLP02	JGLP03
Date Sampled:			7-Sep-20	7-Sep-20	7-Sep-20
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	1.6	3.3	3.8

Report ID: 367039-IAS
Report Date: 21-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS

for

Jemseg Grand Lake Watershed Association
35 Pinecone Lane
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Water

RPC Sample ID:			367039-4	367039-5	367039-6
Client Sample ID:			JGLP04	JGLP05	JGLP06
Date Sampled:			7-Sep-20	7-Sep-20	7-Sep-20
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	2.9	1.2	1.8

Report ID: 367039-IAS
Report Date: 21-Sep-20
Date Received: 08-Sep-20

CERTIFICATE OF ANALYSIS
for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
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Tel: 506.452.1212
Fax: 506.452.0594
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report ID: 370498-ML-W1
Report Date: 06-Oct-20
Date Received: 05-Oct-20

CERTIFICATE OF ANALYSIS

for

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35 Pinecone Lane
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Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1368
Fax: 506.452.1395
www.rpc.ca

Attention: Eric Luiker / Brad Nickerson / Erin Douthwright / Jemseg Grandlake

Client Location: Grand Lake

Microbiological Examination of Water

Analytes:			E. coli
Units:			MPN/100mL
Method ID:			FFA10
Date Analyzed:			5-Oct-20
RPC Sample ID	**Client Sample ID**	**Date Sampled**	
370498-1	JGLP01 17/20/19023	4-Oct-20	<1.0
370498-2	JGLP02 17/20/19022	4-Oct-20	<1.0
370498-4	JGLP04 17/20/19018	3-Oct-20	<1.0
370498-5	JGLP05 17/20/19020	3-Oct-20	6.3
370498-6	JGLP06 17/20/19019	3-Oct-20	16.0

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

Cathy Hay
Microbiology Supervisor
Food, Fisheries & Aquaculture

Breannah Collins
Micro Technician
Food, Fisheries & Aquaculture

Report ID: 370498-IAS
Report Date: 16-Oct-20
Date Received: 05-Oct-20

CERTIFICATE OF ANALYSIS

for
Jemseg Grand Lake Watershed Association
35 Pinecone Lane
Waterborough, NB E3C 0A5

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

Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			370498-1	370498-2	370498-3
Client Sample ID:			JGLP01 17/20/19023	JGLP02 17/20/19022	JGLP03 17/20/19021
Date Sampled:			4-Oct-20	4-Oct-20	4-Oct-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	10.2	6.17	5.45
Potassium	mg/L	0.02	0.64	0.49	0.51
Calcium	mg/L	0.05	13.1	9.43	7.98
Magnesium	mg/L	0.01	2.21	1.59	1.41
Alkalinity (as $CaCO_3$)	mg/L	2	26	16	15
Chloride	mg/L	0.5	5.1	5.1	6.0
Fluoride	mg/L	0.05	0.10	0.07	0.07
Sulfate	mg/L	1	29	19	14
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	0.029	0.023	0.009
Carbon - Total Organic	mg/L	0.5	4.4	5.0	5.2
Colour	TCU	5	18	22	28
Conductivity	µS/cm	1	146	146	101
pH	units	-	7.9	7.6	7.6
Turbidity	NTU	0.1	2.9	2.8	0.6
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	25.8	15.9	14.9
Carbonate (as $CaCO_3$)	mg/L	-	0.193	0.060	0.056
Hardness (as $CaCO_3$)	mg/L	0.2	41.8	30.1	25.7
TDS (calc)	mg/L	-	81	57	50
Saturation pH (20°C)	units	-	8.8	9.1	9.2
Langelier Index (20°C)	-	-	-0.91	-1.54	-1.64

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

Krista Skinner
Chemical Technician
Inorganic Analytical Chemistry

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Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			370498-4	370498-5	370498-6
Client Sample ID:			JGLP04 17/20/19018	JGLP05 17/20/19020	JGLP06 17/20/19019
Date Sampled:			3-Oct-20	3-Oct-20	3-Oct-20
Analytes	**Units**	**RL**			
Sodium	mg/L	0.05	5.85	12.8	3.63
Potassium	mg/L	0.02	0.50	1.18	0.48
Calcium	mg/L	0.05	8.31	18.8	5.26
Magnesium	mg/L	0.01	1.48	3.26	0.93
Alkalinity (as $CaCO_3$)	mg/L	2	15	52	11
Chloride	mg/L	0.5	6.8	21.1	4.5
Fluoride	mg/L	0.05	0.07	0.06	0.07
Sulfate	mg/L	1	13	11	7
Bromine	mg/L	0.01	0.02	0.06	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	0.07	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05	0.07	< 0.05
Nitrogen - Total	mg/L	0.2	0.4	0.4	0.5
Phosphorus - Total	mg/L	0.002	0.010	0.013	0.054
Carbon - Total Organic	mg/L	0.5	5.3	4.7	5.0
Colour	TCU	5	25	12	38
Conductivity	µS/cm	1	93	200	60
pH	units	-	7.6	7.7	7.6
Turbidity	NTU	0.1	0.8	1.1	7.2
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	-	14.9	51.7	10.9
Carbonate (as $CaCO_3$)	mg/L	-	0.056	0.244	0.041
Hardness (as $CaCO_3$)	mg/L	0.2	26.8	60.4	17.0
TDS (calc)	mg/L	-	51	105	34
Saturation pH (20°C)	units	-	9.2	8.4	9.5
Langelier Index (20°C)	-	-	-1.62	-0.66	-1.94

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Project #: Not Available
Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			370498-1	370498-2	370498-3
Client Sample ID:			JGLP01 17/20/19023	JGLP02 17/20/19022	JGLP03 17/20/19021
Date Sampled:			4-Oct-20	4-Oct-20	4-Oct-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.084	0.076	0.029
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	0.033	0.021	0.017
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	0.007	0.005	0.004
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	13.1	9.43	7.98
Chromium	mg/L	0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0001	0.0002	0.0001	< 0.0001
Copper	mg/L	0.001	< 0.001	< 0.001	< 0.001
Iron	mg/L	0.02	0.25	0.22	0.08
Lead	mg/L	0.0001	0.0002	0.0002	< 0.0001
Lithium	mg/L	0.0001	0.0009	0.0008	0.0007
Magnesium	mg/L	0.01	2.21	1.59	1.41
Manganese	mg/L	0.001	0.046	0.044	0.022
Molybdenum	mg/L	0.0001	0.0002	0.0003	0.0002
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.64	0.49	0.51
Rubidium	mg/L	0.0001	0.0010	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	10.2	6.17	5.45
Strontium	mg/L	0.001	0.207	0.130	0.099
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	0.004

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Attention: Eric Luiker
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Location: Grand Lake

Analysis of Surface Water

RPC Sample ID:			370498-4	370498-5	370498-6
Client Sample ID:			JGLP04 17/20/19018	JGLP05 17/20/19020	JGLP06 17/20/19019
Date Sampled:			3-Oct-20	3-Oct-20	3-Oct-20
Analytes	**Units**	**RL**			
Aluminum	mg/L	0.001	0.029	0.027	0.137
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	0.017	0.012	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	0.009	0.004
Cadmium	mg/L	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	mg/L	0.05	8.31	18.8	5.26
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	0.08	0.08	0.59
Lead	mg/L	0.0001	< 0.0001	< 0.0001	0.0005
Lithium	mg/L	0.0001	0.0007	0.0006	0.0005
Magnesium	mg/L	0.01	1.48	3.26	0.93
Manganese	mg/L	0.001	0.024	0.025	0.055
Molybdenum	mg/L	0.0001	0.0002	0.0002	< 0.0001
Nickel	mg/L	0.001	< 0.001	< 0.001	< 0.001
Potassium	mg/L	0.02	0.50	1.18	0.48
Rubidium	mg/L	0.0001	0.0008	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	5.85	12.8	3.63
Strontium	mg/L	0.001	0.098	0.132	0.057
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	0.001

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Attention: Eric Luiker
Project #: Not Available
Location: Grand Lake

Analysis of Water

RPC Sample ID:			370498-1	370498-2	370498-3
Client Sample ID:			JGLP01 17/20/19023	JGLP02 17/20/19022	JGLP03 17/20/19021
Date Sampled:			4-Oct-20	4-Oct-20	4-Oct-20
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	5.1	4.4	2.9

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Client Sample ID:			JGLP04 17/20/19018	JGLP05 17/20/19020	JGLP06 17/20/19019
Date Sampled:			3-Oct-20	3-Oct-20	3-Oct-20
Analytes	**Units**	**RL**			
Chlorophyll-a	µg/L	0.5	3.0	1.4	3.0

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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	4.M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	4.M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	4.M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	4.M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57.01	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	4.M06	APHA 2130 B	Nephelometry
Colour	4.M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	4.M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES