THE JEMSEG GRAND LAKE WATERSHED ASSOCIATION

Water Quality Report

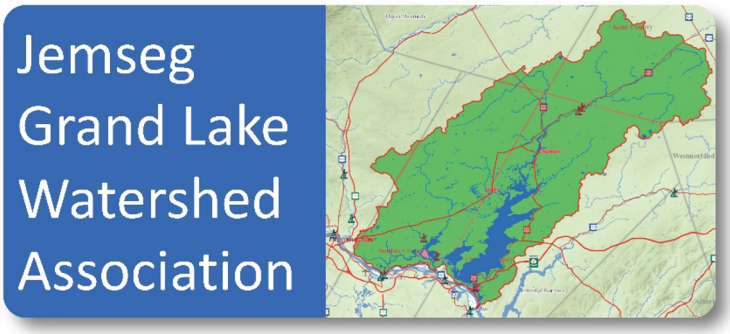
2021

OUR ORGANIZATION

The Jemseg Grand Lake Watershed Association (JGLWA) was formed in October 2019. The Jemseg Grand Lake watershed covers 3,950 km^2 and is home to Grand Lake, the largest freshwater lake in the Maritimes at 171 km^2.

Goal: a healthy Jemseg Grand Lake watershed ecosystem for all.

Mission: to engage the attention, enthusiasm, & support of people, communities, businesses, and organizations inside the Jemseg Grand Lake watershed to provide a healthy watershed for all.



OUR WATERSHED


Photo: Brian Smith

Clean water is one of New Brunswick's most important resources. We rely on it for drinking, growing food, manufacturing goods, producing electricity, and for recreational activities. Maintaining good quality surface water is extremely important for ensuring a healthy Jemseg Grand Lake watershed. The flora and fauna of the Jemseg Grand Lake watershed also rely on clean water.

The JGLWA began water quality monitoring in 2020. During 2021 water quality was monitored monthly throughout the field season at six sites in the lake and three sites in tributary rivers. In addition E. coli concentrations were monitored once in August at 14 stations. The JGLWA also partners with the Atlantic Coastal Action Program, Saint John to monitor cyanobacteria at two sites.

WHAT DO WE MEASURE?

Water Temperature	Water needs to be cool enough for some species (like salmon and trout) to survive
Dissolved Oxygen	All organisms in a lake, even plants, need some amount of oxygen to live.
Dissolved substances	Lake water naturally contains dissolved mineral salts and organic compounds. Elevated levels may indicate contaminated runoff and could be harmful to some species.
Metals	Metals are introduced into water from weathering or erosion of soils or rocks either naturally or at increased rates due to human activities
pH	This measures how acidic/basic the water is- neutral levels are best for fish. Changes to the natural pH might impact nutrients or toxins in the water
Nutrients	While some nutrients are needed to sustain life in lakes, excess nutrients (like phosphorus and nitrogen) can cause algal blooms and harm ecosystems.
Chlorophyll-a	This is a measure of the photosynthetic pigment that causes the green colour in phytoplankton. The concentration is directly related to the phytoplankton abundance and biomass.
Water transparency	A circular black and white disk is used to measure transparency of the water. The depth at which the disk is no longer visible is known as the Secchi depth and is an indicator of the amount of light available for organisms in the lake.
E. Coli	Escherichia coli (E. coli) bacteria, are found in the digestive tracts of animals and are a good indicator of fecal contamination with the potential to cause health issues in humans.





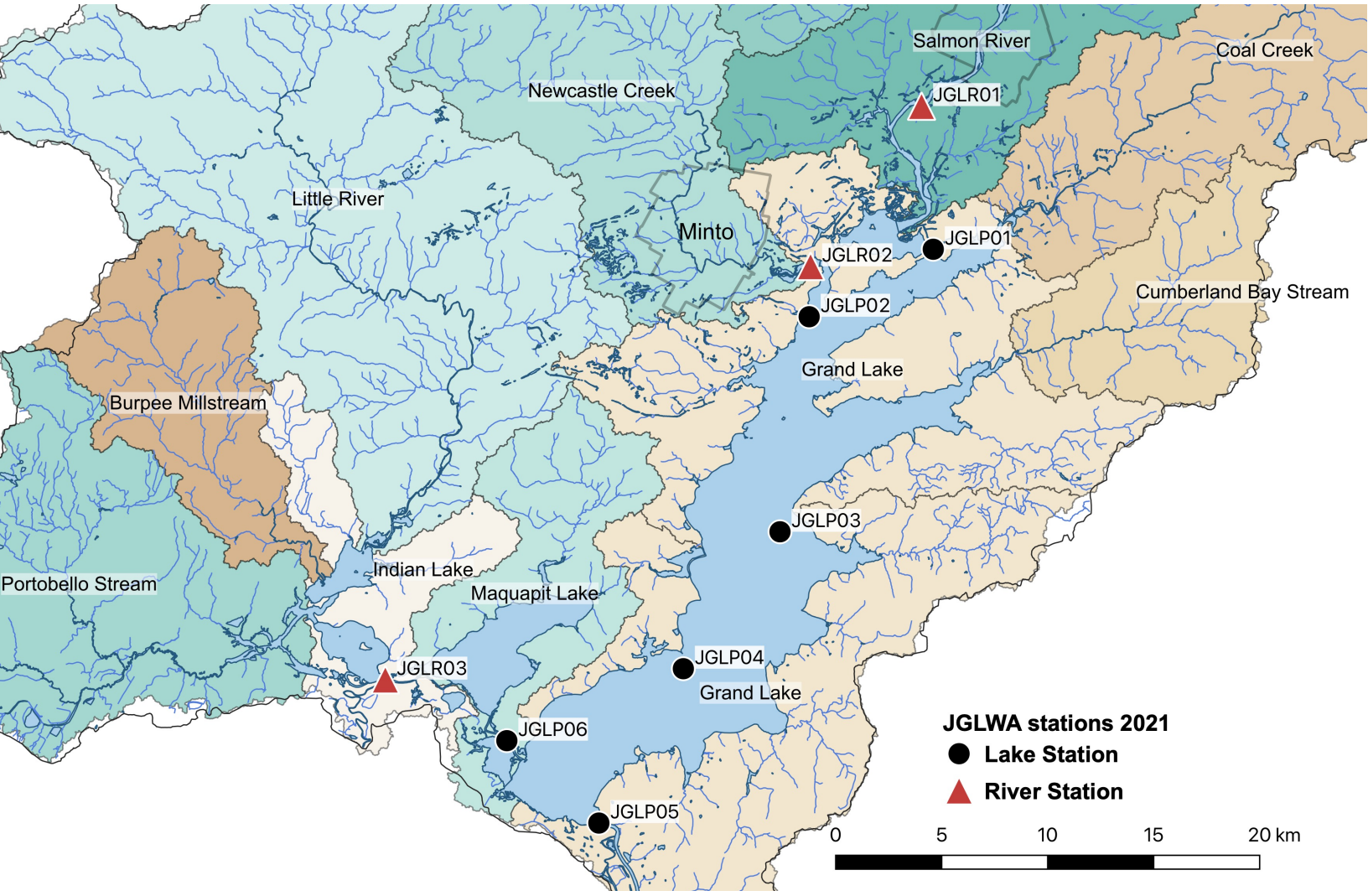

WATER QUALITY SAMPLING

WATER QUALITY SAMPLING SITES

Six sampling locations were established on Grand Lake in 2020. In 2021 three river locations were added in order to evaluate the influence of these tributaries on Grand Lake. Sites were sampled four times between July and October. The different coloured areas on the maps in this report indicate sub-watersheds of the Jemseg Grand Lake Watershed as defined by the National Hydrographic Network

LAKE	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

RIVER	Site Name	Location
	JGLR01	Salmon River
	JGLR02	Newcastle Creek
	JGLR03	Lakeville Corner

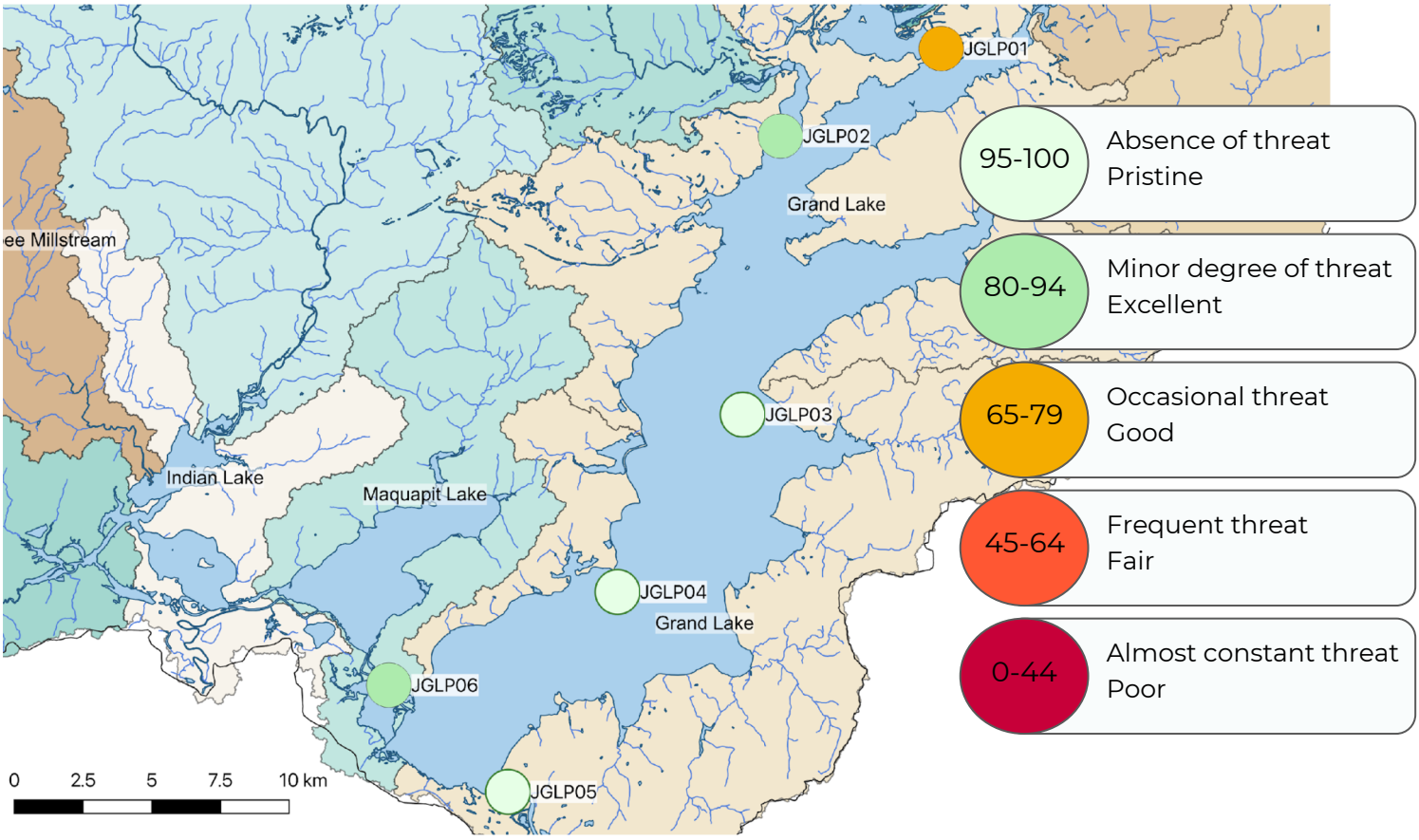


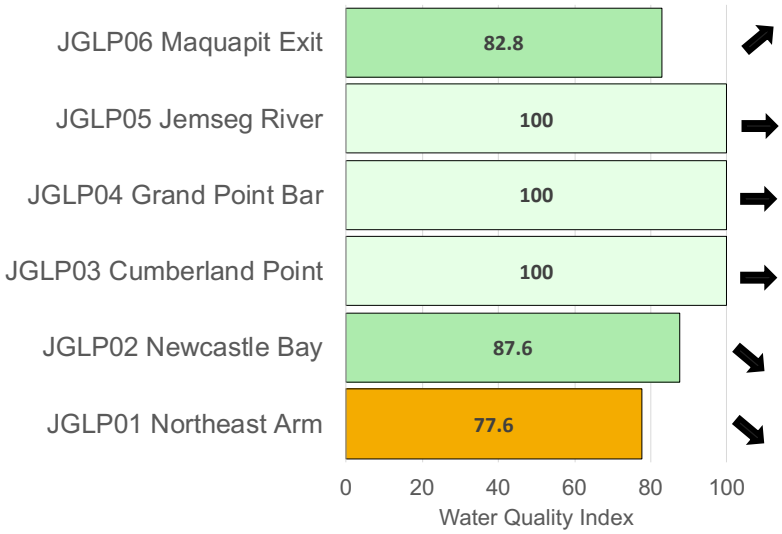
OVERALL WATER QUALITY

WATER QUALITY INDEX

Using the Canadian Council of Ministers of the Environment water quality guidelines, the Water Quality Index (WQI) combines multiple parameters into a single value that summarizes water quality at a site.

The WQI for each 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 calculation followed guidelines provided by the Atlantic Water Network.





↗ Increase compared to 2020
→ Same as 2020
↘ Decrease compared to 2020

The overall average water quality index for 2021 was calculated to be 91.3, slightly lower than last year but still in the ”Excellent” category.

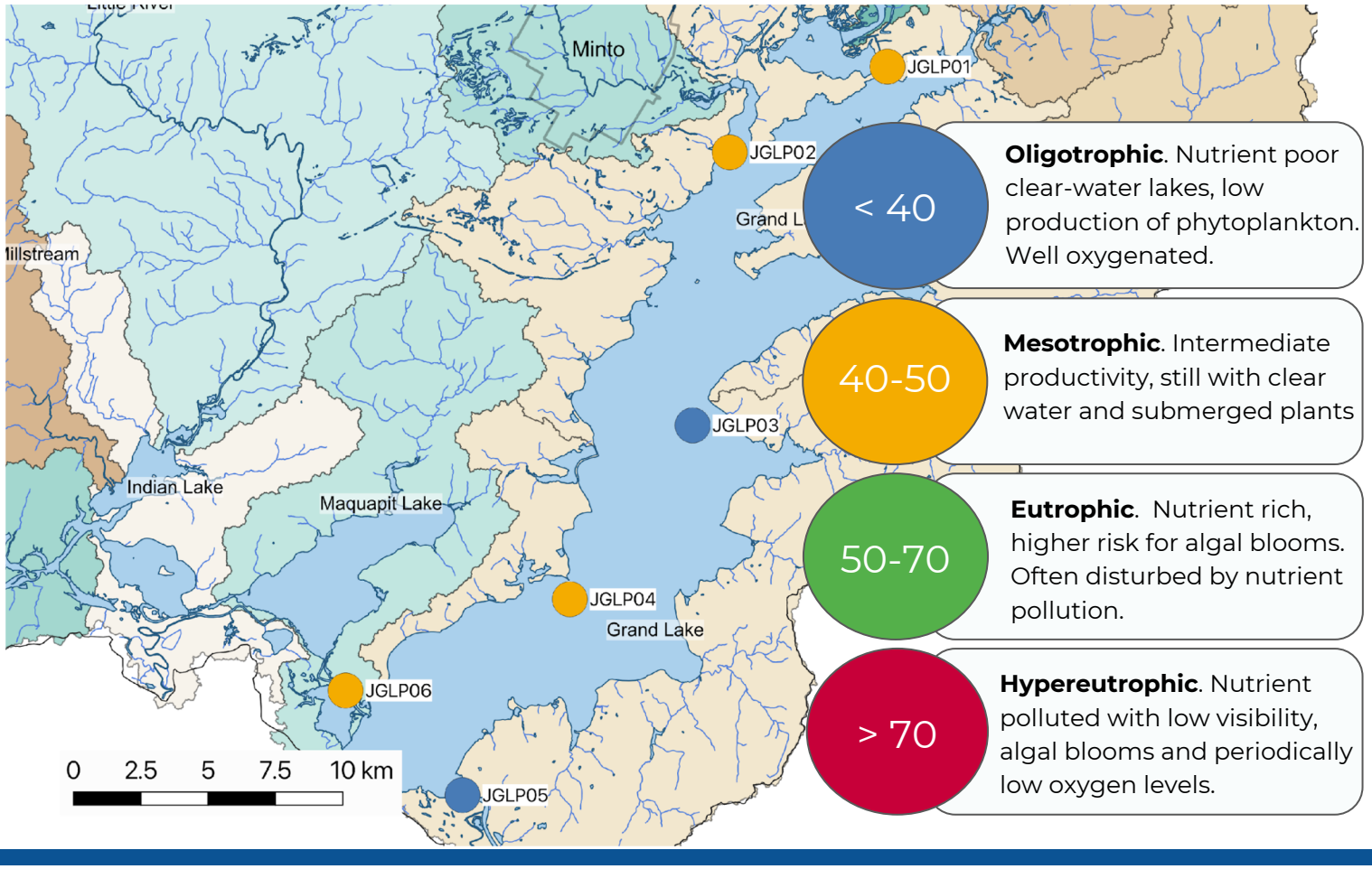
LAKE PRODUCTIVITY

TROPHIC STATUS INDEX

The Trophic State Index (TSI) describes the biological productivity of a lake. The higher the number, the higher the productivity.
Here we show the average TSI based on the total phosphorus, and chlorophyll-a content from June through September. Lake productivity affects both total number of organisms, for example fish, and which species that are favoured.

The TSI for both 2020 and 2021 indicate that Grand lake on average has a moderate level of productivity. The deeper stations and the outflow have a lower TSI than the inflows, indicating that the lake acts as a nutrient sink.
Overall the index is slightly lower for 2021 than 2020. However, the values are not really comparable because in 2020 only a few months could be used for TSI calculations. In future years comparisons will be possible.

Site	TSI	Status
JGLP01 Northeast Arm	46	Mesotrophic
JGLP02 Newcastle Bay	44	Mesotrophic
JGLP03 Cumberland Point	34	Oligotrophic
JGLP04 Grand Point Bar	41	Mesotrophic
JGLP05 Jemseg River	37	Oligotrophic
JGLP06 Maquapit Exit	46	Mesotrophic
Overall	**41**	**Mesotrophic**



LAKE TEMPERATURE & VERTICAL PROFILING

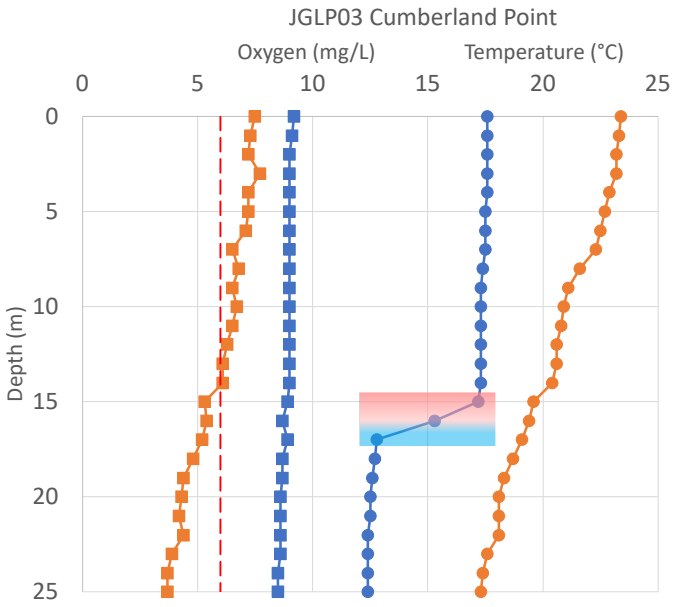
SURFACE TEMPERATURE

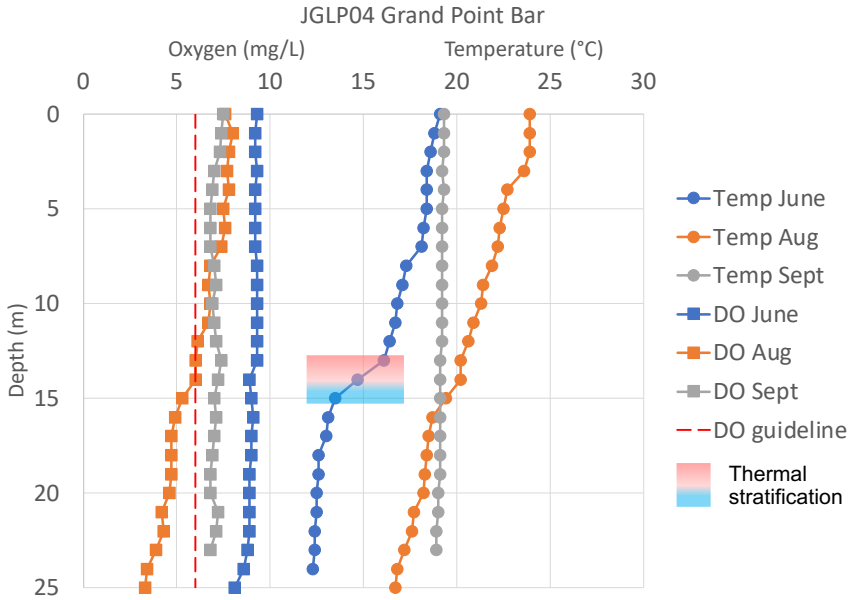
Between July 8 and October 12, surface water temperature (depth of 0.5 m) was measured every 30 minutes using a HOBO logger attached to a dock in Cumberland Bay. In order to support cyanobacterial sampling by ACAP, a second logger was placed near the mouth of the Jemseg river's outflow to the St John river. The Jemseg logger recorded between July 2 and October 12. Compared to 2020 the temperature in the lake was, on average, 1 degree warmer but had fewer extreme temperature conditions. For example, the number of days with temperatures above 23 °C were down from 46 in 2020 to 33 in 2021.

Month	Max Temp (°C)		Min Temp (°C)		Average (°C)		No. days >23°C	
	Lake	Jemseg	Lake	Jemseg	Lake	Jemseg	Lake	Jemseg
July	26	25	17	14	22	21	7	17
August	27	29	20	16	23	24	25	26
September	24	27	17	13	20	19	1	1
Overall	27	29	17	13	22	21	33	44

VERTICAL PROFILE

Measurements of temperature, pH, dissolved oxygen (DO), and conductivity were measured every metre from the surface to bottom at all six sites. Results are shown for Cumberland Point and Grand Point Bar, the two deepest sites. At both stations a clearly developed thermocline is found in June. This thermocline is slightly eroded during July and August and by September temperature is uniform from surface to bottom. Oxygen levels decline as the season progresses and are below the level of concern at greater depth during August. Oxygen concentration increases again in September when the water cools down and can circulate from surface to bottom.

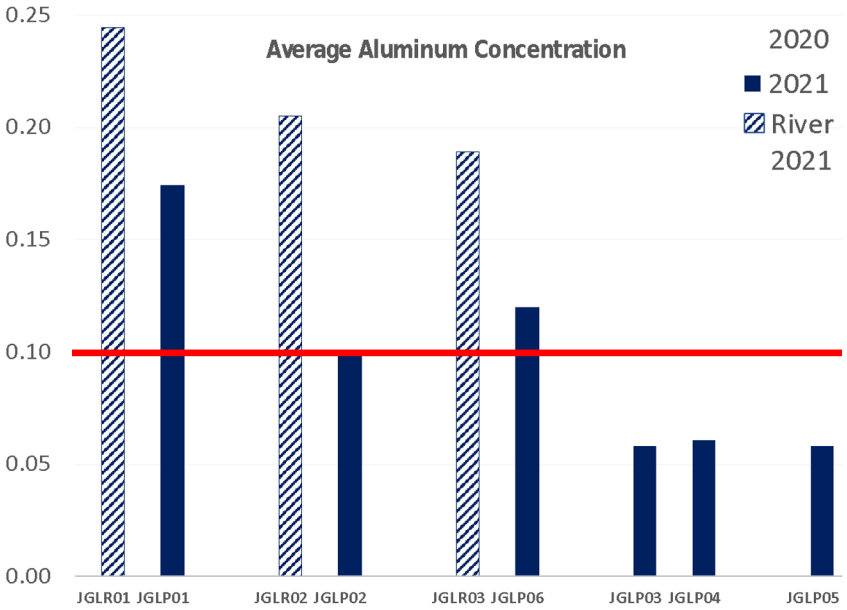


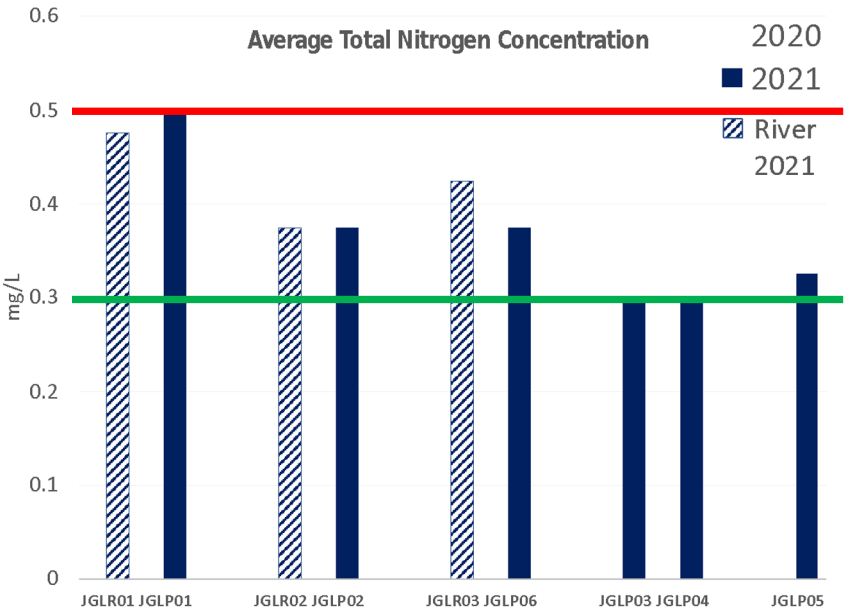


WATER QUALITY ANALYSIS

Average aluminum concentrations exceeded the CCME limit of 0.1 mg/L at all three river sites and at two of the lake sites: the Northeast arm (JGLP01) and Maquapit Exit (JGLP06). Levels were higher at all stations compared to 2021

Aluminum is found naturally in most rocks and soils and it can enter water via weathering (or erosion) of rocks. It can also be derived from mining, industrial processes, and wastewater. High levels of aluminum can negatively affect fish.



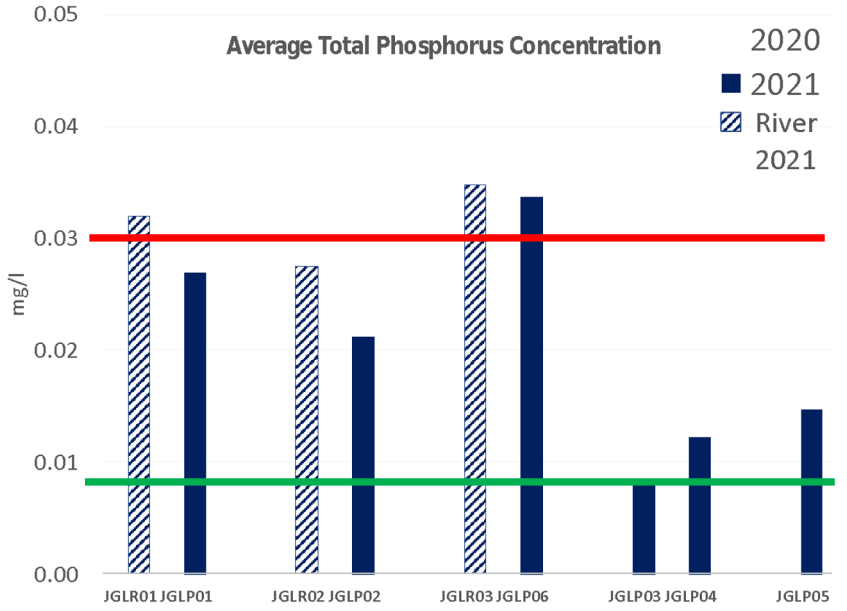


Total Nitrogen levels were ideal (at or below 0.3 mg/L, the green line) at the two deep sites and acceptable (0.31-0.5 mg/L) at the remaining sites and in the tributary rivers. Compared to 2020 concentrations were higher at all sites except the two deep ones.

Nitrogen is an essential nutrient for plant life but excess can lead to low levels of oxygen. Anthropogenic sources of nitrogen include fertilizers, wastewater, failing septic systems, and organic wastes.

Phosphorus levels were highest at the Maquapit Exit (JGLP06) (above the limit of "concern" of 0.03 mg/L). Salmon river (JGLR01) and Lakeville Corner (JGLR03) also exceeded the limit of concern. Average concentrations at all other sites fell into the "acceptable" value bounded by the red and green lines.

Phosphorus is an essential element for plant life. Anthropogenic sources of phosphorus include fertilizers, manure, and organic wastes. Elevated contents can lead to eutrophication and decreased oxygen levels.



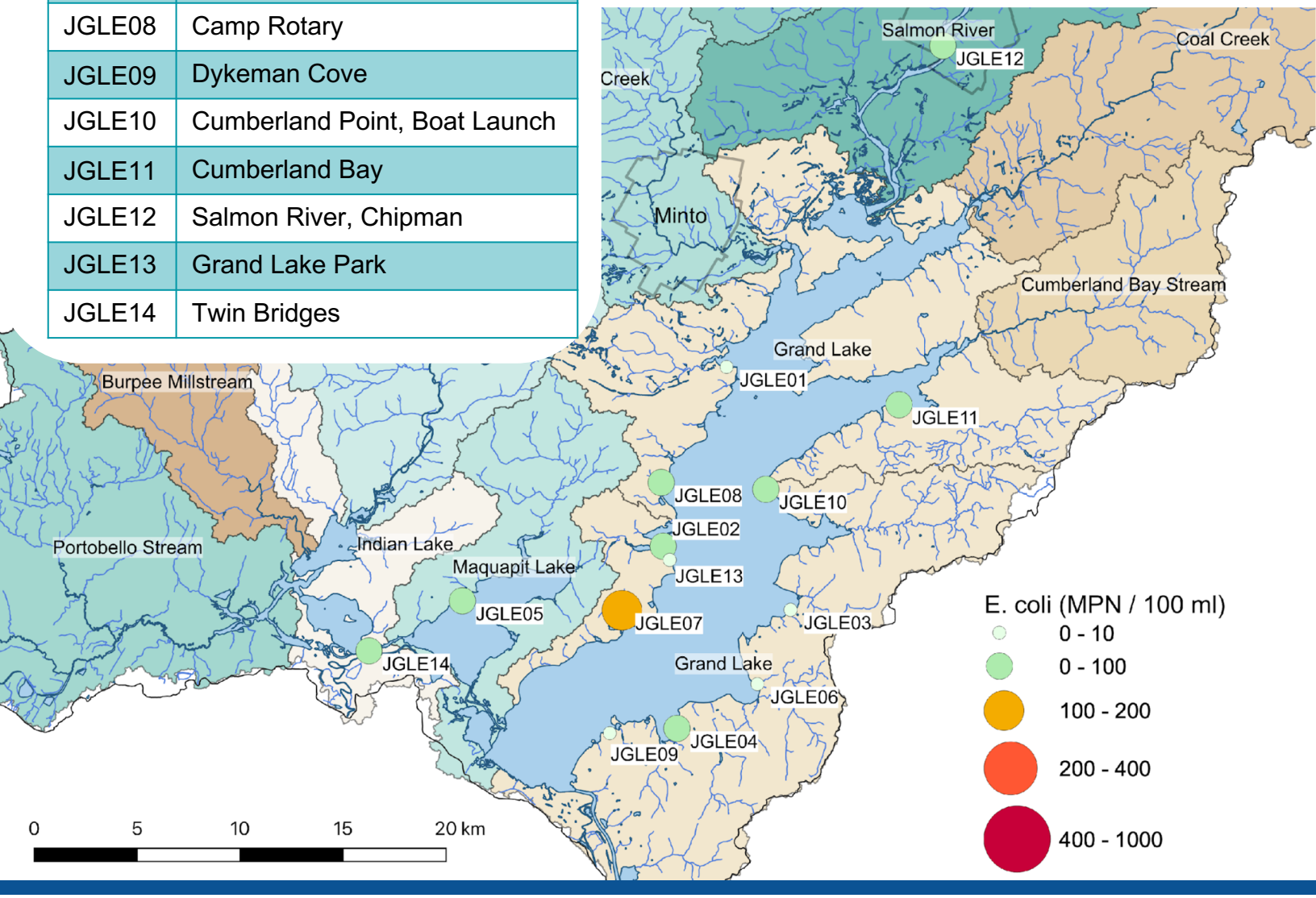
E. COLI SAMPLING & ANALYSIS

In 2021, 14 sampling locations were established on Grand Lake and tributary waters. Sites were sampled once in late August.

Site ID	Location name
JGLE01	Wuhr's Beach
JGLE02	Keyhole
JGLE03	Wiggins Cove
JGLE04	Whites Cove
JGLE05	Maquapit Lake west shore
JGLE06	Mill Cove
JGLE07	Douglas Harbour
JGLE08	Camp Rotary
JGLE09	Dykeman Cove
JGLE10	Cumberland Point, Boat Launch
JGLE11	Cumberland Bay
JGLE12	Salmon River, Chipman
JGLE13	Grand Lake Park
JGLE14	Twin Bridges

E. coli concentrations were all well below the CCME guideline for Canadian recreational water quality of less than 400 per 100 ml of sample. The highest concentrations of 140 MPN/100 ml were found at Douglas Harbour (JGLE07).

E. coli concentrations vary substantially over time. In 2022 our Association plans to monitor areas of concern several times during the summer season to better delineate the zone of influence and produce more reliable results.



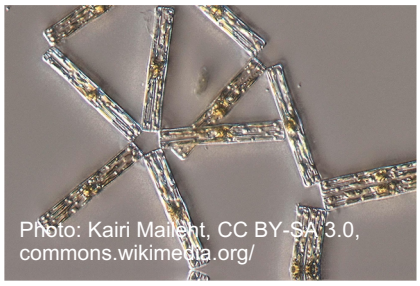
Plankton

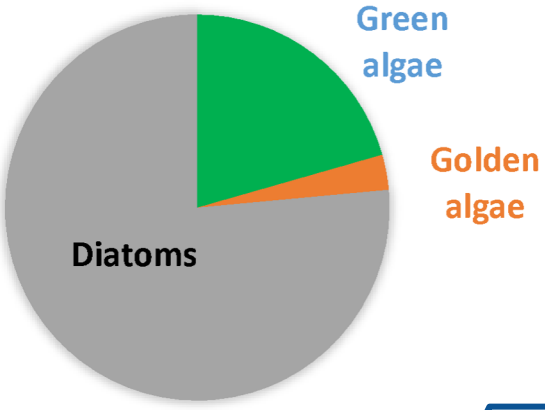
Plankton samples were collected in Grand Lake on October 11, 2021. During the fall season, the plankton community reflects seasonal influence more than ecosystem interactions. A late summer sample, which is planned for 2022, will give more insight into lake-specific influences .

Phytoplankton

In most lakes the the most important type of plant life are microscopic algae and cyanobacteria living out in the open water mass. Collectively referred to as phytoplankton, they harness energy from the sun, nutrients from the water and make up the base of the food web.

Tabellaria:
a diatom found in Grand Lake





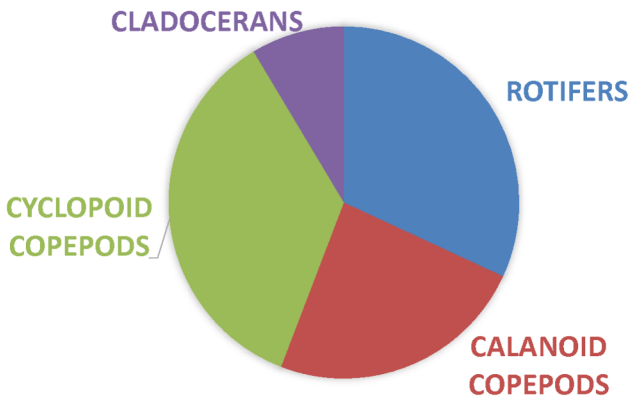
The phytoplankton community was dominated by diatoms. This is a typical situation in most lakes during fall turnover. Diatoms require silica to make their signature hard cases that surround their cells. During fall turnover, silica rich water from the bottom of the lake gets mixed throughout the lake creating good growth conditions. Some green algae and very small amounts of gold algae were also found. Overall, the community reflects the intermediate nutrient richness found in Grand Lake.

Zooplankton

Daphnia, a cladoceran zooplankton



Zooplankton are microscopic animals swimming around in the lake. Most of them feed on phytoplankton. They are a food source for many species of fish, and some species are efficient at filtering phytoplankton and can help control algal blooms.



The zooplankton community was dominated by small, herbivorous species. Some of the species, such as *Cyclops scutifer* and *Daphnia longiremis* are indicative of cold-water lakes or conditions. The community was a mix of species that prefer oligotrophic or mesotrophic conditions, and many that are indifferent to nutrient status. The relatively small size of the observed species, indicate that plankton-eating fish were the dominant predator on the zooplankton at the time of sampling.

GET INVOLVED IN YOUR WATERSHED!

How can you improve the water quality of the Jemseg Grand Lake watershed?

1. *Green the shoreline*: Plant native vegetation like willows along the shore to reduce erosion, filter run-off, provide habitat for wildlife, and shade the water.

2. *Keep sewage out of the river:* Ensure that your septic tanks are regularly maintained and clean up pet waste.

3. *Reduce pesticide and chemical use*: Use phosphate-free or biodegradable cleaning and personal care products. Reduce the use of pesticides on lawns and gardens.

4. *Improve water retention*: Use porous alternatives to pavement, collect runoff in a rain barrel or plant a rain garden.

5. Fence watercourses near farms: Livestock are a major source of E. coli and can erode riverbanks. Fencing the watercourse keeps our rivers and lakes healthier.

6. *Learn more about your watershed and its issues*.





Acknowledgements

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NEW BRUNSWICK ALLIANCE OF LAKE ASSOCIATIONS

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Your Environmental Trust Fund at Work