



Keeyask Generation Project
Aquatic Effects Monitoring Plan

Fish Winterkill Survey in Little Gull Lake Report

AEMP-2023-08



KEYYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2023-08

FISH WINTERKILL SURVEY IN LITTLE GULL LAKE: YEAR 2 MONITORING

Prepared for

Manitoba Hydro

By

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SUMMARY

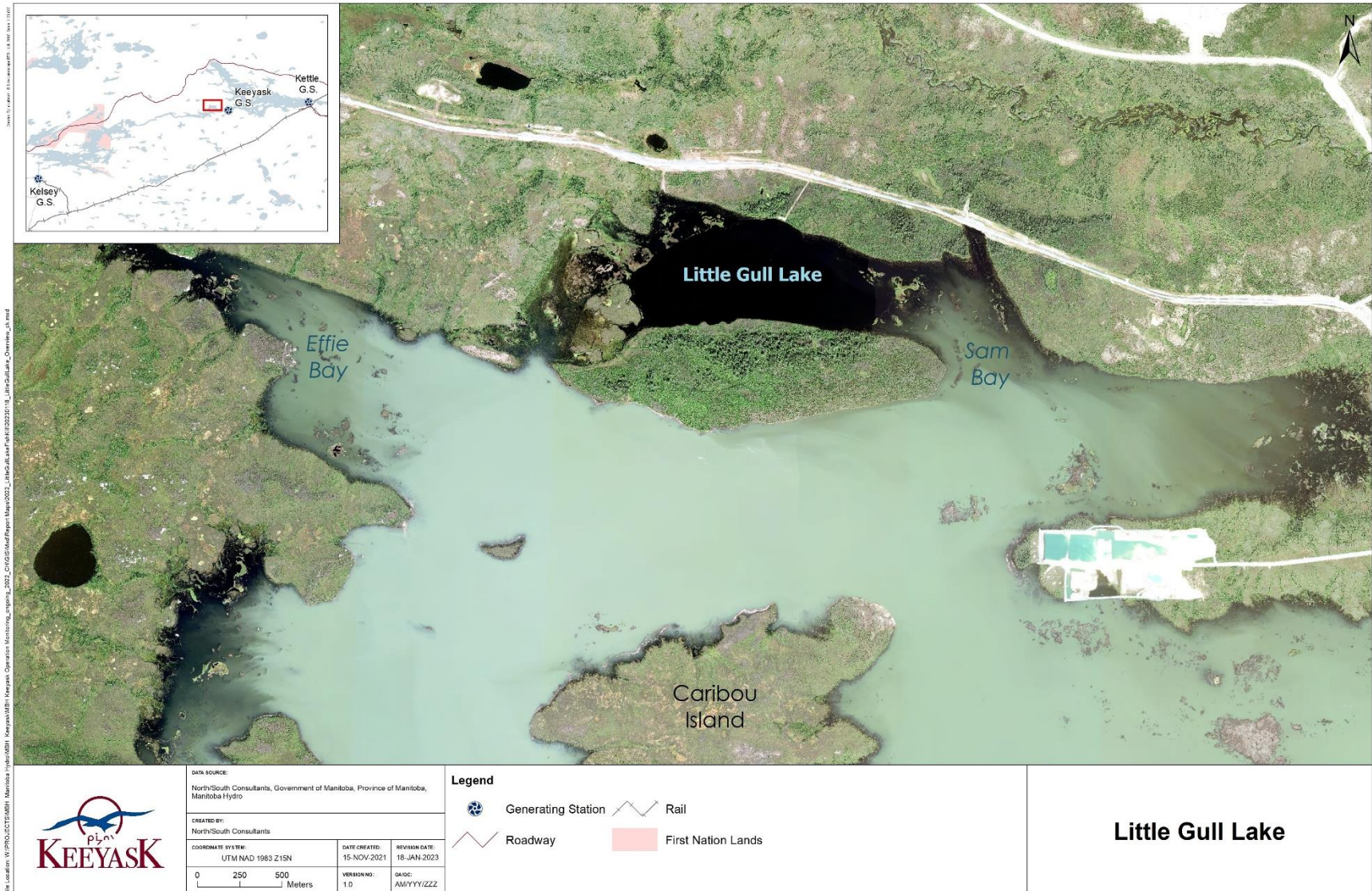
Background

The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the Keeyask Generating Station (GS) on the environment. Besides measuring the accuracy of the predictions made and actual effects of the GS on the environment, monitoring results will provide information on how construction and operation of the GS will affect the environment and if more needs to be done to reduce harmful effects.

Construction of the Keeyask GS began in mid-July 2014 and instream work was completed in 2020. The reservoir was impounded with water levels being raised to full supply level between August 31 and September 5, 2020. Commissioning of the powerhouse turbines was initiated after impoundment. They were brought into service one at a time with the final of seven turbines completed on March 9, 2022.

Little Gull Lake was a small, shallow, isolated lake immediately to the north of Gull Lake. Before formation of the Keeyask reservoir, oxygen levels in Little Gull Lake dropped to critically low levels each winter and the only fish present were brook stickleback and fathead minnow, which can tolerate low concentrations of oxygen. After flooding of the Keeyask reservoir, Little Gull Lake became connected to the reservoir, but low oxygen levels are expected to continue to develop because of its organic bottom and a lack of through flow from the rest of the reservoir. Fish can now enter from other parts of the Keeyask reservoir and during winter the connecting channels could freeze to the bottom, potentially trapping fish and resulting in a winterkill. To keep dissolved oxygen in the water at concentrations where fish could survive, an aeration system was installed prior to impoundment of the Keeyask reservoir.

This report presents results of a survey of Little Gull Lake following the second winter post-impoundment to determine if there was a fish kill in the area.



Location of Little Gull Lake in the Keyyask reservoir.

Why is the study being done?

The survey of Little Gull Lake was done to answer the following question:

Is the aeration system installed in Little Gull Lake effective in preventing winterkill in this portion of the reservoir?

This question is important because if the aeration system does not work, any fish trapped in Little Gull Lake during the winter may die due to a lack of oxygen. If this happened, an alternative method would be used to prevent the death of fish.

What was done?

A visual survey was conducted on May 25 and 26 by walking along shorelines and boating throughout the extent of the Lake to look for dead fish.

What was found?

No dead fish were observed in Little Gull Lake in spring 2022.

Dissolved oxygen (DO) was measured in Little Gull Lake by Manitoba Hydro during winter 2021/2022. Dissolved oxygen levels dropped over the fall and measured 0 mg/L (no oxygen) between January and April, 2022. It is unusual for oxygen levels to be zero and the logger may have been located in the mud at the bottom of the lake. Ice formed over top of the area where the logger was installed. There were areas that remained ice-free all winter (see photo below) and it is unclear whether these areas had higher oxygen levels.



Image showing where the dissolved oxygen meter was installed during winter 2021/2022 (indicated by the star) and areas near the aeration system that remained ice-free all winter.

What does it mean?

This means that a fish kill did not occur during winter 2021/2022 in Little Gull Lake.

Fish surveys show that fish use Little Gull Lake during the summer. During summer 2021 and 2022 a net was set in Little Gull Lake during the fish community survey. Thirty-one jackfish (Northern Pike) were caught in 2021 and 24 Cisco, 46 jackfish, and one White Sucker were caught in 2022. It is not known if these fish remain in Little Gull Lake year-round or if they move out before winter.

It is not known if areas around the aeration system had DO levels that were high enough for fish to live in Little Gull Lake over winter.

What will be done next?

A third survey will be conducted in spring 2023 following the third winter after impoundment to make sure that the system continues to work. Manitoba Hydro will continue to monitor DO in the area.

ACKNOWLEDGEMENTS

We would like to thank Manitoba Hydro for the opportunity and resources to conduct this study.

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1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station at Gull Rapids on the lower Nelson River in northern Manitoba. The Project is approximately 725 kilometres (km) northeast of Winnipeg, 35 km upstream of the existing Kettle Generating Station, where Gull Lake flows into Stephens Lake, 60 km east of the community of Split Lake, 180 km east-northeast of Thompson and 30 km west of Gillam. Construction of the Project began in July 2014.

The *Keeyask Generation Project: Response to EIS Guidelines*, completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the aquatic environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs, is provided in the *Keeyask Generation Project Environmental Impact Statement: Aquatic Environment Supporting Volume* (AE SV). As part of the licensing process for the Project, an *Aquatic Effects Monitoring Plan* (AEMP) was developed detailing the monitoring activities of various components of the aquatic environment for the construction and operation phases of the Project.

Little Gull Lake was a small, shallow, heavily vegetated waterbody to the north of Gull Lake that was anticipated to winterkill in most years. A fish inventory of Little Gull Lake was conducted using seine nets in summer 2002 (Richardson and Holm 2005) and 2015 (Lavergne *et al.* 2016). Results indicated that the fish community consisted of two forage species, Fathead Minnow and Brook Stickleback, species that are generally adapted to low dissolved oxygen (DO) conditions.

The EIS predicted that flooding associated with impoundment of the Keeyask reservoir would inundate Little Gull Lake, and that low oxygen levels may develop in this area during ice covered periods due to existing high concentrations of organic material in sediments, a lack of flow, long periods of ice cover, and long residence times. Although low oxygen conditions were predicted to be characteristic of many areas of the reservoir during winter, this area is of particular concern due to predictions that shallow sections of flooded land on either end of Little Gull Lake will freeze to the bottom and potentially prevent fish from escaping when DO reaches critically low levels in winter, resulting in fish winterkill. To maintain sufficient DO to support fish, an aeration system was installed prior to impoundment of the Keeyask reservoir.

DO was monitored throughout winter 2020/2021 by Manitoba Hydro, using both discrete measurements and continuous monitoring (Manitoba Hydro 2022). Discrete DO readings were collected monthly along transects outside aeration field at the limit of safe ice approximately 5–10 m outside of the aeration field. Two HOBO DO loggers were deployed approximately 10 m outside of the aeration field for continuous monitoring. Data collected from the HOBO loggers were not useable as deployment methods meant that the loggers were positioned within the sediment and the moorings were damaged by ice. The system was also monitored via visual inspection of the aeration area (UAV photography). Continuous DO monitoring continued during

winter 2021/2022 (Manitoba Hydro 2023). Two HOBO DO loggers were deployed within the aeration field between the internal and external ring of aeration heads.

The perimeter of Little Gull Lake was surveyed immediately following ice-off in spring 2021, following the first winter post-impoundment. No fish mortalities were observed. The perimeter of Little Gull Lake was surveyed immediately following ice-off again in spring 2022.

Fish winterkill monitoring in the vicinity of Little Gull Lake is being conducted to address the following key question, as described in the AEMP:

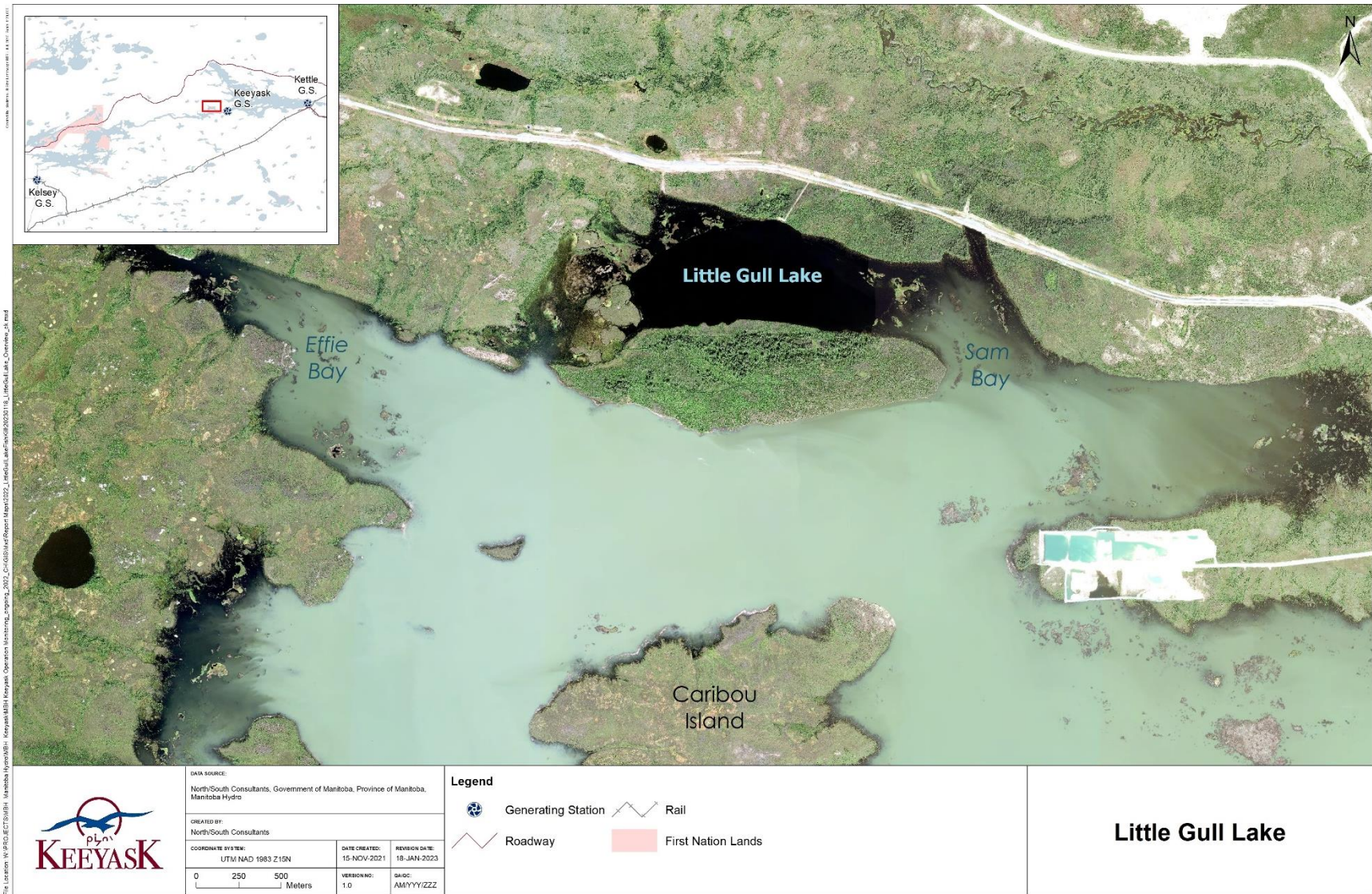
- Is the aeration system installed in Little Gull Lake effective in preventing winterkill in this portion of the reservoir?

Fish winterkill data will be collected again in 2023.

2.0 STUDY SETTING

A fish winterkill survey was conducted in Little Gull Lake. Prior to fall 2020 (reservoir impoundment), Little Gull Lake was a shallow, 68 ha isolated lake approximately 900 m north of the Nelson River in Gull Lake (Map 1). Submerged vegetation is abundant, and the substrate consists mainly of fines with organic material. Little Gull Lake is fed by bogs and fens and drains into the Nelson River by way of a short, unnamed creek.

In fall 2020, Gull Lake was impounded by the Keeyask GS and became part of the Keeyask reservoir. The Keeyask reservoir is comprised of the mainstem of the original Nelson River from the outlet of Clark Lake as far as the Keeyask GS, plus 45 km² of adjacent, flooded terrestrial area. Reservoir impoundment formed relatively shallow bays due to flooding of terrestrial areas, which generally have low water velocities and limited mixing with the mainstem flow. Reservoir impoundment resulted in the connection of Little Gull Lake to the Keeyask reservoir, via flooded terrestrial habitat.



Map 1: Map of the Keeyask reservoir showing the location of Little Gull Lake

3.0 METHODS

Visual surveys were conducted on May 25 and 26, 2022. Surveys were conducted by walking along shorelines and boating throughout the extent of the Lake. During boat-based surveys, a track was taken using a Garmin GPSMAP 78 (Garmin International Inc., Olathe, KS). Photos were taken during both sampling events.

4.0 RESULTS AND DISCUSSION

On May 25, 2022, Little Gull Lake was largely ice-free in the eastern extent. A survey was conducted by walking the north shore, no dead fish were observed (Photo 1).



Photo 1: Little Gull Lake on May 25, 2022, from the North shore facing Southwest. Open water with ice cover in the western portion.

On May 26, 2022, Little Gull Lake was largely ice-free over its entire extent, however, the western extent remained largely covered by ice except of the area around the North shore. An aluminum Jon boat was driven around the perimeter of open water (Photos 2–10; Map 2).

No fish mortalities were observed on either of the survey days. Based on this observation, it does not appear that a fish kill occurred in Little Gull Lake during winter 2021/2022.



Photo 2: Little Gull Lake on May 26, 2022, on the North shore facing West with ice cover and open water along the shoreline.



Photo 3: Little Gull Lake on May 26, 2022, on the North shore facing West showing ice cover.



Photo 4: Little Gull Lake on May 26, 2022, on the West side showing an open water bay.



Photo 5: Inlet to Little Gull Lake on the West side, May 26, 2022.



Photo 6: Ice cover to shore on the West side of Little Gull Lake looking south, May 26, 2022.



Photo 7: Open water surrounding aerator and dissolved oxygen monitoring station, May 26, 2022.



Photo 8: Little Gull Lake on the South shore looking East, May 26, 2022.



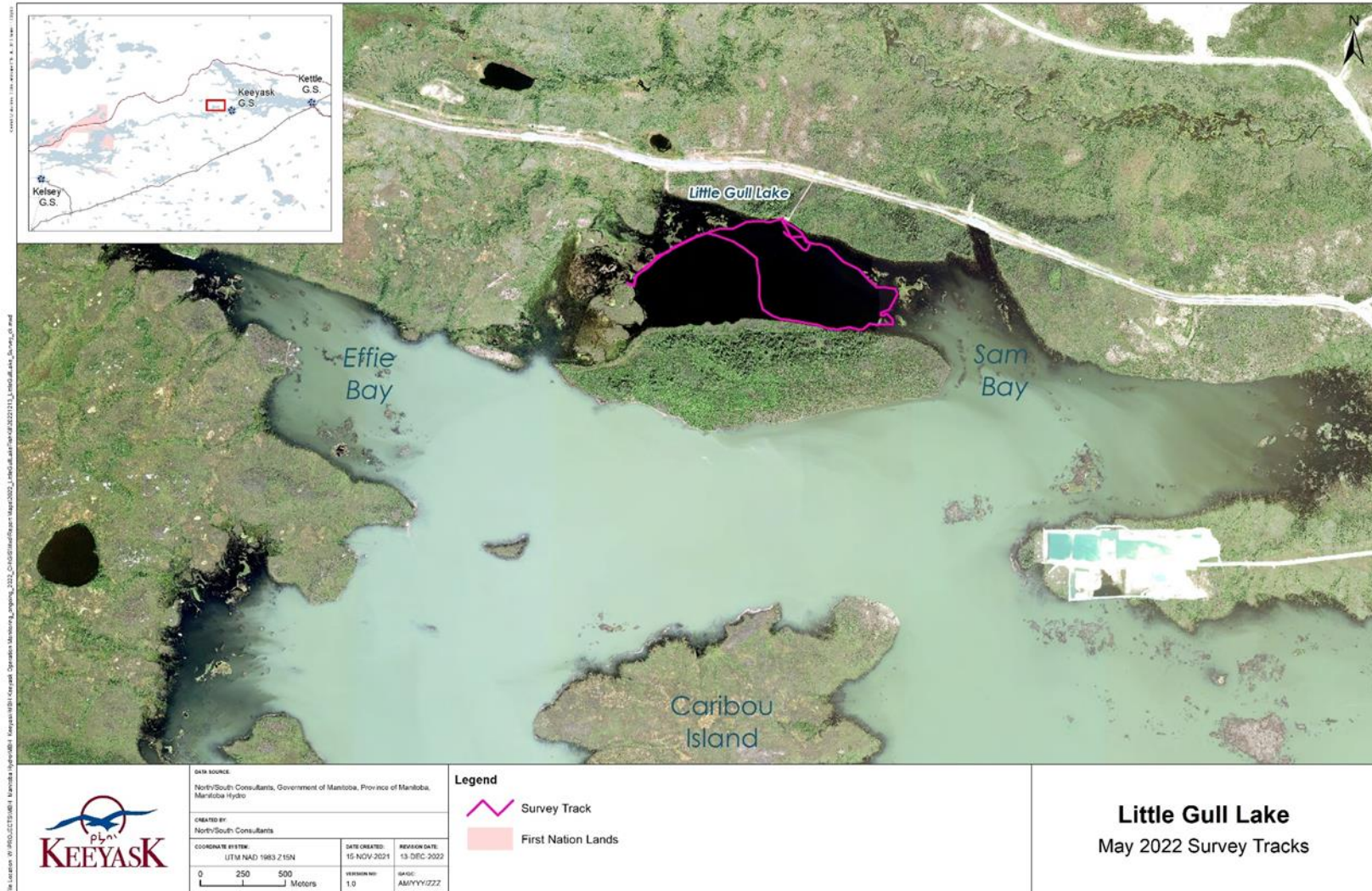
Photo 9: Little Gull Lake at the Southeast corner showing the connection to the Nelson River, May 26, 2022.



Photo 10: Little Gull Lake along the Northeast shore looking West, May 26, 2022.

A single gill net was set in Little Gull Lake the fish community survey in both August 2021 and 2022. A total of 31 Northern Pike were captured in 2021 (Loeppky and Hrenchuk 2022). In 2022, three species were captured including Cisco (n = 24), Northern Pike (n = 46) and White Sucker (n = 1) (Slongo and Hrenchuk 2023). It is unclear if these fish leave before winter or if the aeration system provided sufficient oxygen levels for these fish to remain in the area year-round.

Monitoring of DO within Little Gull Lake was conducted by Manitoba Hydro from October 22, 2021, to May 22, 2022 (Manitoba Hydro 2023). DO levels were high (13 mg/L) when monitoring began in October 2022 but quickly dropped, ranging from <1 mg/L to 8 mg/L in November and December. Between January and April, 2023, DO measured 0 mg/L. It is possible that the loggers were installed within or too close to the lake bed to record DO levels within the water column. Stable ice cover formed over the area where the loggers were installed while other areas remained open through the winter. It is not clear whether DO levels were higher in the open water areas.



Map 2: Location of survey of little Gull Lake conducted on May 26, 2022, to monitor for a winter fish kill.

4.1 NEXT STEPS

Sampling conducted in 2022 represents the second year of monitoring following impoundment of the Keeyask GS reservoir. Winterkill monitoring will be conducted within Little Gull Lake again in spring 2023. DO monitoring will be conducted by Manitoba Hydro during winter 2022/2023.

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