



Keeyask Generation Project Aquatic Effects Monitoring Plan

Fish Winterkill Survey in Little Gull Lake Report

AEMP-2022-08



KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2022-08

FISH WINTERKILL SURVEY IN LITTLE GULL LAKE: YEAR 1 MONITORING

Prepared for

Manitoba Hydro

By

C.L. Hrenchuk

June 2022



North/South Consultants Inc.
Aquatic Environment Specialists

83 Scurfield Blvd.
Winnipeg, Manitoba, R3Y 1G4
Website: www.nscons.ca

Tel.: (204) 284-3366
Fax: (204) 477-4173
E-mail: nscons@nscons.ca

This report should be cited as:

Hrenchuk, C.L. 2022. Fish winterkill survey in Little Gull Lake: Year 1 monitoring. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2022-08. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2022. x + 15 pp.

SUMMARY

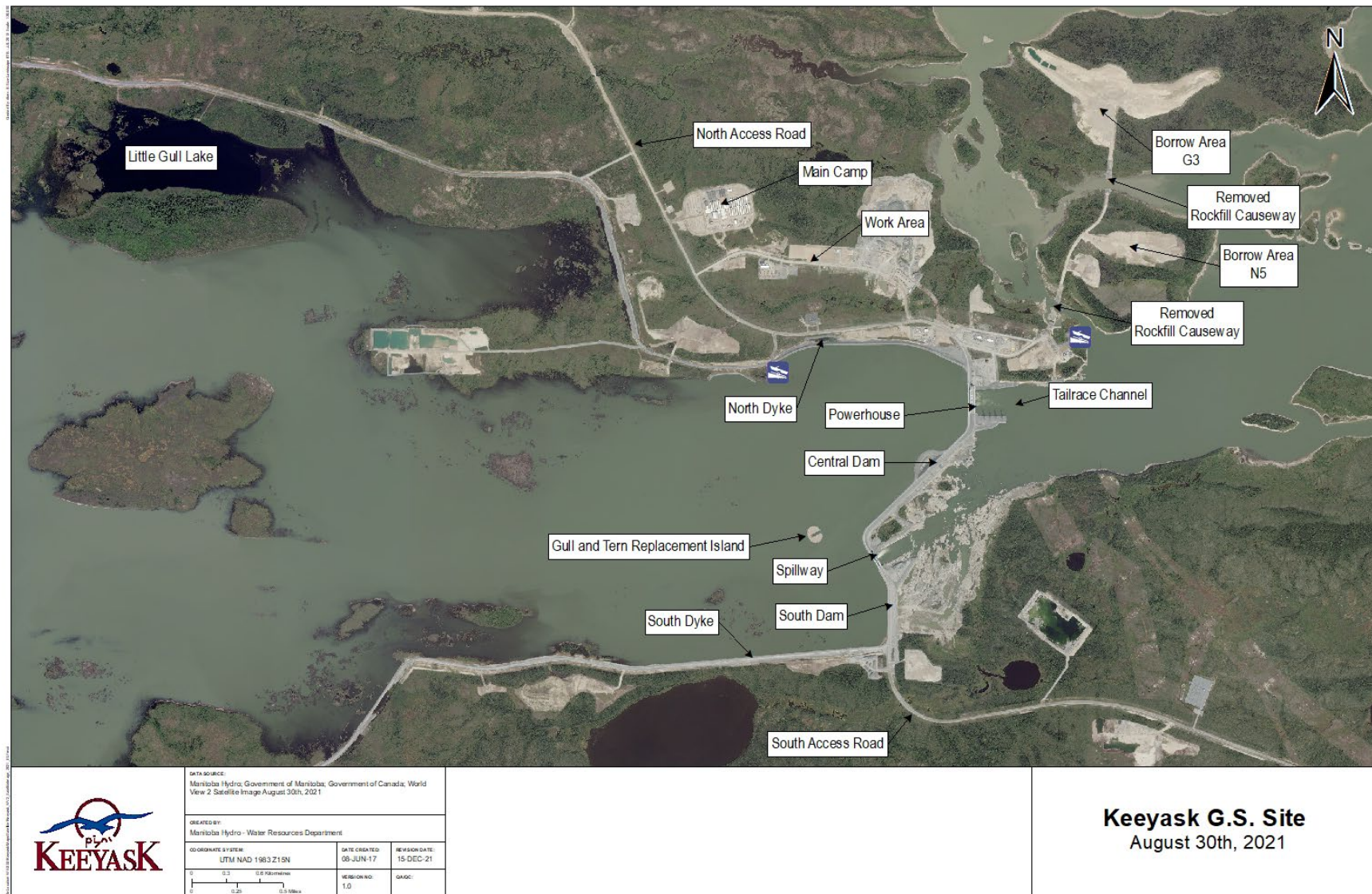
Background

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.

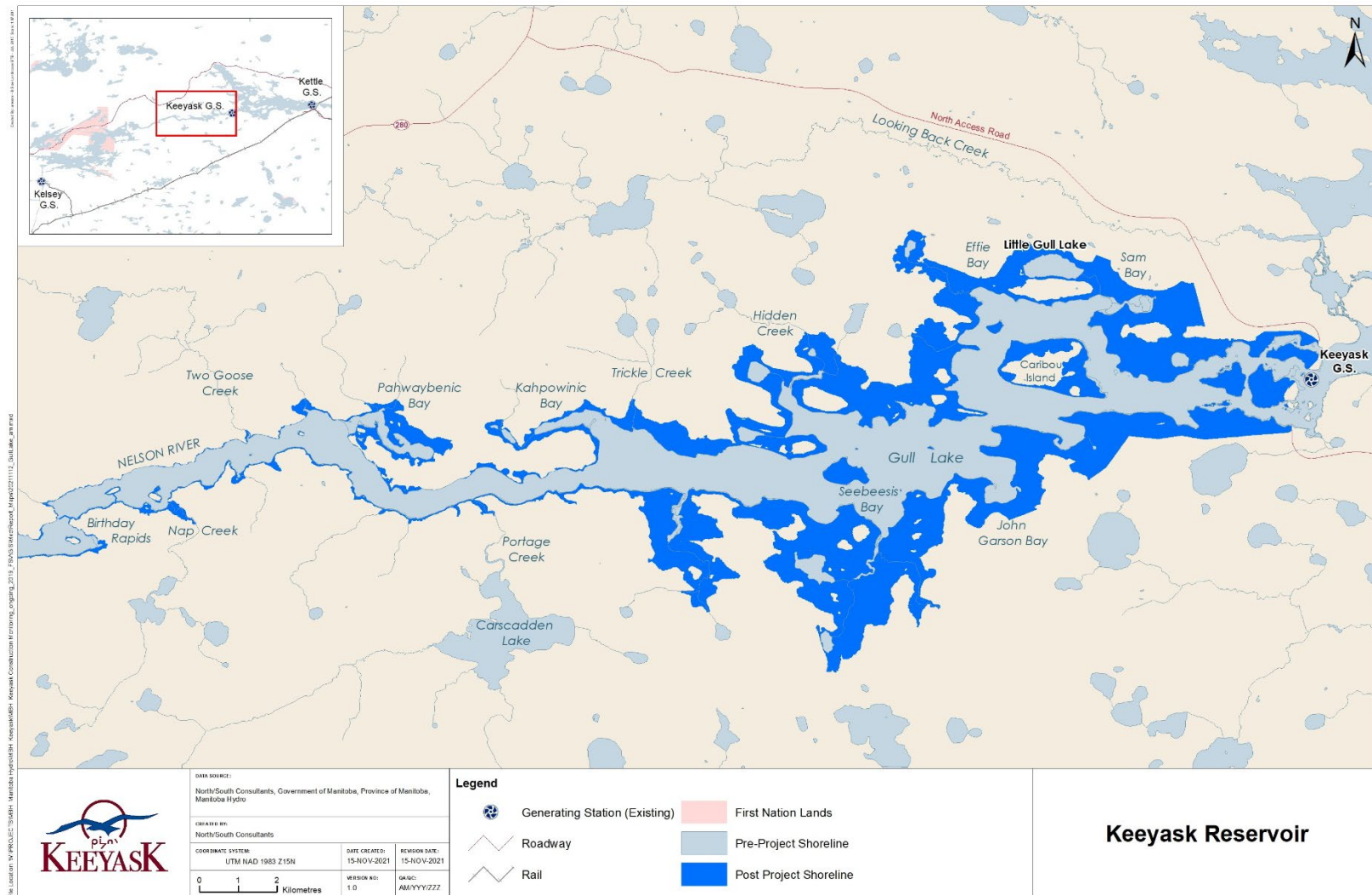
Impoundment of the Keeyask reservoir took place between August 31 and September 5, 2020. Commissioning of the first generator unit started on August 31, 2020 and was still underway at the end of 2020.

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 first winter post-impoundment to determine if there was a fish kill in the area.



Map illustrating in-stream structures at the Keeyask Generating Station site after reservoir flooding, August 2021.



Map of the post-impoundment reservoir including the location of Little Gull Lake.

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?

Visual surveys were conducted on May 27, 30, and 31, 2021 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 2021.

Dissolved oxygen (DO) was measured in Little Gull by Manitoba Hydro during winter 2020/2021. They found that DO was higher in the area immediately around the aeration system but not much farther. There was open water in the area around the aeration system for the entire winter.

What does it mean?

This means that a fish kill did not occur during winter 2020/2021 in Little Gull Lake. During summer a net was set in Little Gull Lake during the fish community survey and jackfish were captured, so fish were in the area at that time. It is not known if there were fish in the lake over winter or if the fish had moved out before winter began. Monitoring of by Manitoba Hydro suggests that DO may have been high enough for fish to live in Little Gull Lake over the winter, at least in the area immediately around the system.

What will be done next?

A second survey will be conducted in spring 2022 following the second winter after impoundment to ensure 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.

Leslie Flett and Terry Kitchekeesik of Tataskweyak Cree Nation are thanked for their local expertise and assistance in conducting the field work.

STUDY TEAM

Data Collection

Brock Kramble

Claire Hrenchuk

Duane Hudd

Leslie Flett

Zachary Thiessen

Data Analysis, Report Preparation, and Report Review

Claire Hrenchuk

Friederike Schneider-Vieira

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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 (Map 1). 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).

The perimeter of Little Gull Lake was surveyed immediately following ice-off in spring 2021, following the first winter post-impoundment. 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 2022.

2.0 STUDY SETTING

Fish winterkill monitoring 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.

2.1 FLOWS AND WATER LEVELS

From October 2020 to mid-June 2021 the calculated Split Lake outflow remained close to the median flow of 3,300 m³/s, ranging between about 3,000 m³/s and 3,900 m³/s. From mid-June to mid-August, the flows steadily decreased from ~3,700 m³/s to ~2,000 m³/s, which is approximately the 5th percentile low flow. Low flow conditions persisted from summer into winter, with flows dropping to a low of ~1,800 m³/s at the end of November 2021. These are the lowest flows that have occurred during Keeyask construction. Flows this low have not occurred on the Nelson River since 2005.

Water levels on Gull Lake have been held steady between 158.8-159.0 m since reservoir impoundment in September 2020. Upstream of Gull Lake at gauges below and above Birthday Rapids the levels were ~0.5 m and ~2.0 m higher than on Gull Lake, a smaller difference than would have occurred prior to the project. Upstream levels increased about 3-4 m at these sites in winter due to ice effects as in previous years. Due to low flows in summer 2021 the water surface was relatively flat from Gull Lake to the gauge just upstream of Birthday Rapids, with a difference of only about 0.8-0.9 m between the two.

Keeyask is transitioning from a construction project to an operating station. In 2021, the work at site has been focused on bringing units into service. By the end of April 2021, prior to the start of aquatic monitoring, Unit 1 and Unit 2 were in service. Throughout the open water period more units were being tested and brought into service one at a time. As units came into service, the distribution of flow between the spillway and powerhouse has gradually shifted. By the end of October 2021 five units were fully in service.

Discharges from the spillway and powerhouse are not measured but have been estimated based on performance design curves. For reference it is noted that the design discharge capacity of the

powerhouse is 4,000 m³/s, giving each turbine unit a discharge capacity of approximately 570 m³/s.

3.0 METHODS

Visual surveys were conducted on May 27, 30, and 31, 2021. 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 all sampling events.

4.0 RESULTS AND DISCUSSION

On May 27, 2021, Little Gull Lake was frozen, except for an area surrounding the aerator. Photos were taken from the north shore (Photos 1-3).

On May 30, 2021, Little Gull Lake was largely ice-free in the eastern extent. The connection to the Nelson River mainstem was still blocked by ice. A survey was conducted by walking the north shore, no dead fish were observed (Photos 4-6).

On May 31, 2021, Little Gull Lake was largely ice-free over its entire extent, however, the eastern extent and the connection to the Nelson River remained blocked by ice. An aluminum Jon boat was paddled around the perimeter of open water (Map 2; Photos 7-8).

No fish mortalities were observed on any of the three survey days. Based on this observation, it does not appear that a fish kill occurred in Little Gull Lake during winter 2020/2021. During the fish community survey in August 2021, a net set in Little Gull Lake captured Northern Pike, so it appears that fish did move into the area from the Keeyask reservoir after reservoir impoundment (Loeppky and Hrenchuk 2022).

Monitoring of DO within Little Gull Lake by Manitoba Hydro during winter 2020/2021 suggests that the system was elevating DO above background levels, however, increases to DO were limited outside of the immediate area of aeration field (Manitoba Hydro 2022). Surveys also confirmed that the system was capable of maintaining open water through the winter.

4.1 NEXT STEPS

Sampling conducted in 2021 represents the first year of monitoring following impoundment of the Keeyask GS reservoir. Winterkill monitoring will be conducted within Little Gull Lake again in spring 2022. DO monitoring will be conducted by Manitoba Hydro during winter 2021/2022. A new deployment method has been developed to ensure that the continuous DO data collected using the HOBO data loggers is useable.

5.0 LITERATURE CITED

- Lavergne, S.C., R.A. Remnant, and C.L. Hrenchuk. 2016. Fish community monitoring in the Nelson River from Split Lake to Stephens Lake, summer 2015. Keeyask Generation Project Aquatic Effects Monitoring Report #AEMP-2016-09. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2016.
- Loeppky, A.R. and C.L. Hrenchuk. 2022. Fish community monitoring in the Nelson River from Split Lake to Stephens Lake, summer 2021. Keeyask Generation Project Aquatic Effects Monitoring Report #AEMP-2022-07. A draft report prepared for Manitoba Hydro by North/South Consultants Inc.
- Manitoba Hydro. 2022. 2021-2022 Physical Environment Monitoring Report: Year 1 Operation. Keeyask Generation Project Physical Environment Monitoring Plan Report #PEMP-2022-01. June 2022.

PHOTOS



Photo 1: Little Gull Lake on May 27, 2021, from the North shore facing South. Open water surrounding the aerator is shown.



Photo 2: Little Gull Lake on May 27, 2021, on the North shore facing East towards the connection to the Nelson River.



Photo 3: Little Gull Lake on May 27, 2021, on the North shore facing West.



Photo 4: Little Gull Lake on May 30, 2021, on the North shore facing South.



Photo 5: Flooded shoreline along North shore of Little Gull Lake, May 30, 2021.



Photo 6: Flooded shoreline along North shore of Little Gull Lake, May 30, 2021.

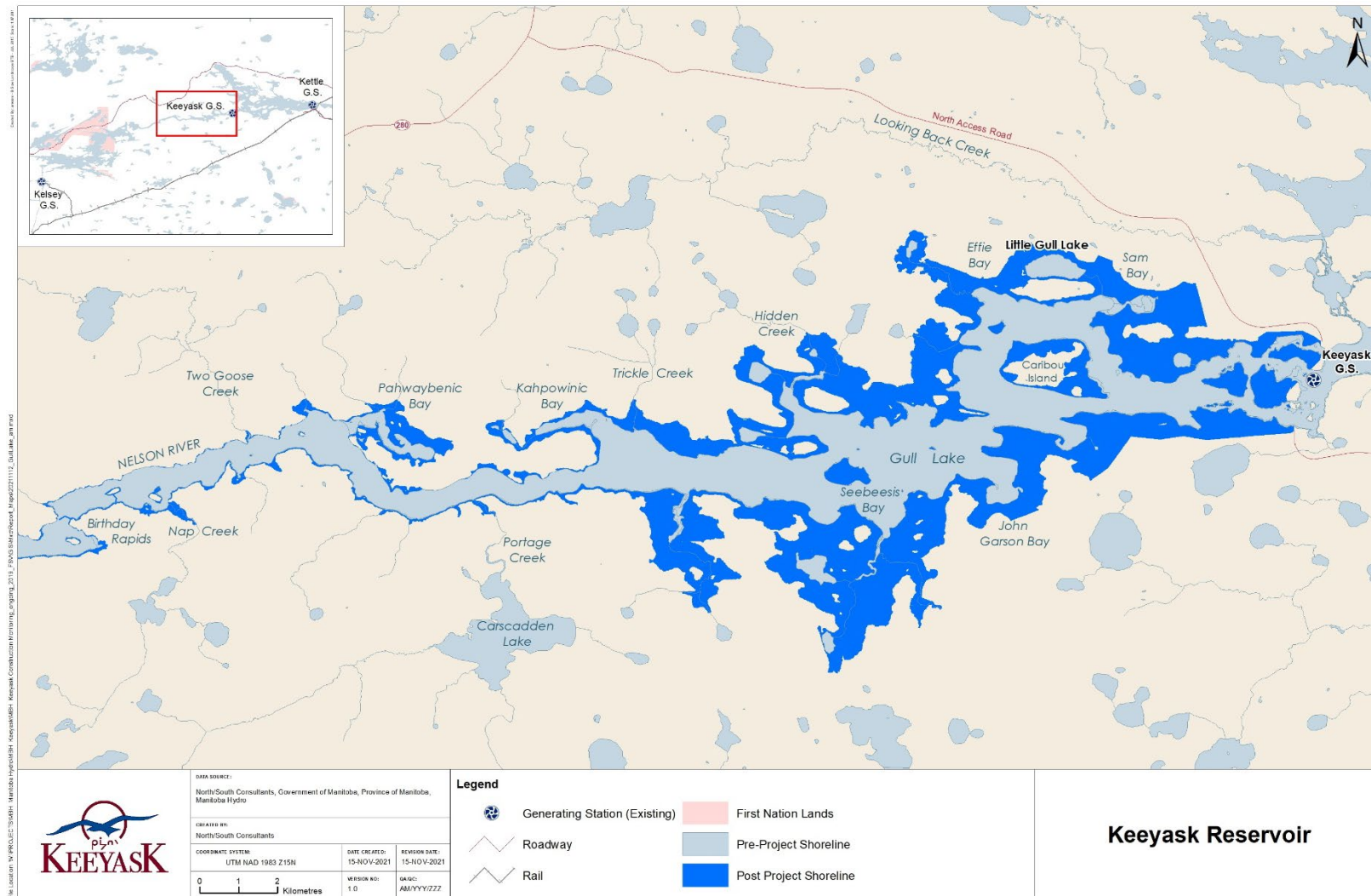


Photo 7: Little Gull Lake from South shore facing North, May 31, 2021.

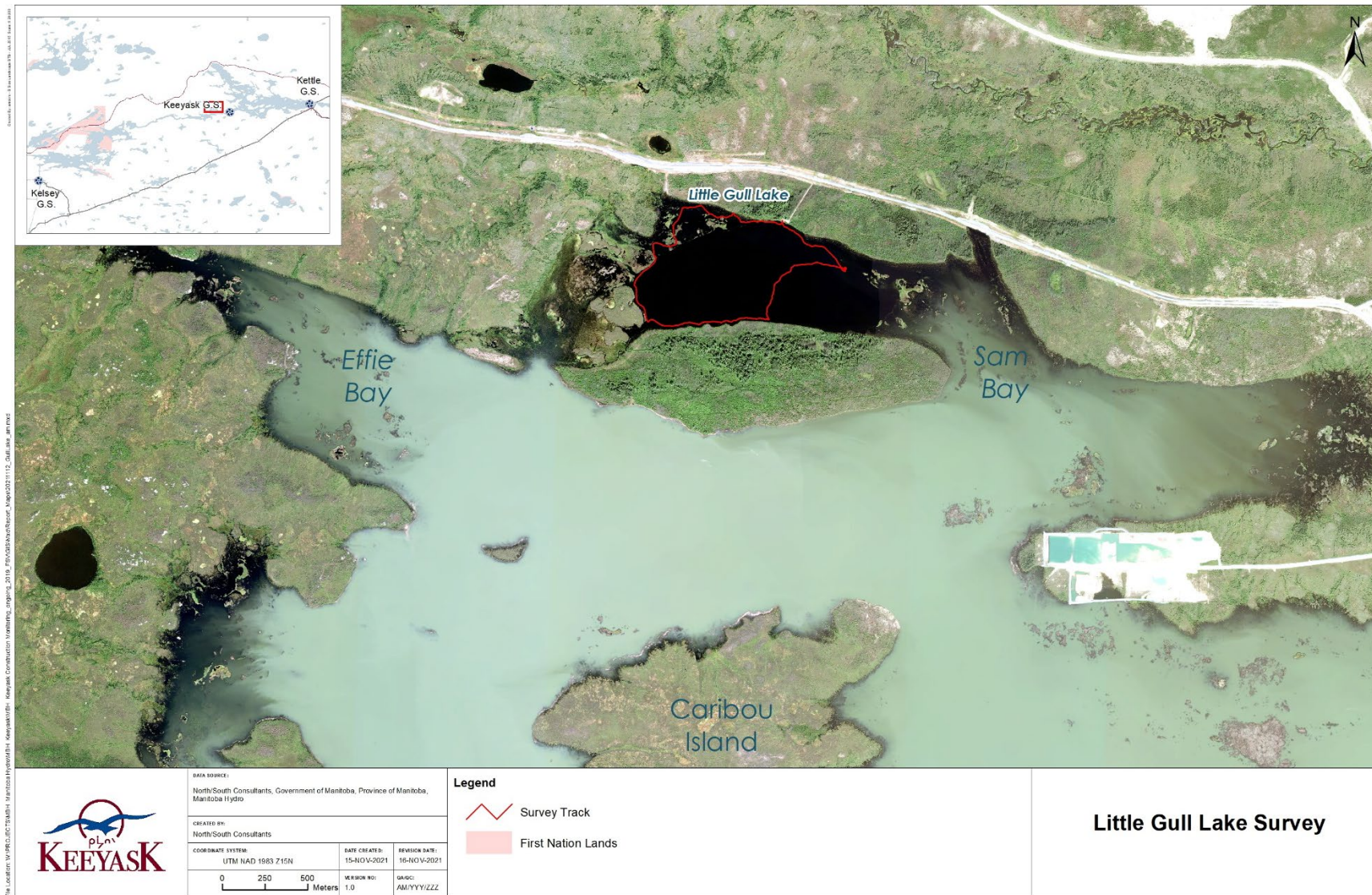


Photo 8: Little Gull Lake from South edge facing east towards connection to the Nelson River mainstem.

MAPS



Map 1: Map of the Keeyask reservoir showing the pre- and post-impoundment shorelines and the location of Little Gull Lake



Map 2: Location of survey of little Gull Lake conducted on May 31, 2021, to monitor for a winter fish kill.