Waterway Approvals and Monitoring Department, Manitoba Hydro
On behalf of: Keeyask Hydropower Limited Partnership

WATER POWER ACT & ENVIRONMENT ACT LICENCES 2021-22 ANNUAL WATER LEVEL COMPLIANCE REPORT FOR KEEYASK GENERATING STATION

[redacted]

PREPARED BY: [redacted]
P.G. CHANEL

REVIEWED BY: [redacted]
B.W. GIESBRECHT

APPROVED BY: [redacted]
W.V. PENNER

DATE: 2022-07-28

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EXECUTIVE SUMMARY

Manitoba Hydro operates the Keeyask Generating Station on behalf of Keeyask Hydropower Limited Partnership in accordance with the Water Power Act and Environment Act licences issued by the Province of Manitoba. These licences constrain the water level in the Keeyask forebay.

The Keeyask Licence Implementation Guide for Water Levels indicates that an annual water level report will be produced for each fiscal year (April-March). This report addresses the water level constraints imposed by both the Water Power Act and Environment Act licences. The report contains information on data collection, validation, and reporting, as well as a summary of licence limit exceedances during the year.

This first report will cover slightly more than one fiscal year beginning on February 16, 2021, when the first unit was commissioned at Keeyask. During the period from February 16, 2021 to March 31, 2022, forebay water levels were in compliance with the licence limits 100 percent of the time. A summary of Keeyask forebay compliance is provided below.

Location	Constraint	Variable	Exceedances	Number of Readings	% Compliance
Keeyask Forebay	Max/Min Elevation	Mean Daily Water Level	0	410	100 %
Keeyask Forebay	Max/Min Elevation	Hourly Water Level	0	9840	100 %

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1.0 INTRODUCTION

1.1 Background

Keeyask Hydropower Limited Partnership (KHLP) is a limited partnership consisting of 5022649 Manitoba Ltd., a wholly owned subsidiary of Manitoba Hydro, and general partner of the KHLP and four limited partners being the Manitoba Hydro-Electric Board, Cree Nation Partners Limited Partnership, comprised of Tataskweyak Cree Nation and War Lake First Nation, as well as York Factory First Nation Limited Partnership and Fox Lake Cree Nation Keeyask Investments Inc. Manitoba Hydro operates the station as part of the Manitoba power grid on behalf of KHLP.

KHLP received licences under The Water Power Act and The Environment Act for the development of the Keeyask Generating Station (GS). The Interim Water Power Act licence and Environment Act Licence No. 3107 stipulate a maximum and minimum allowable water level in the Keeyask forebay.

Manitoba Hydro prepared the Keeyask GS Licence Implementation Guide for Water Levels to establish and document the water regime terms specified by the Keeyask licences. The guide was reviewed and approved by the Province of Manitoba and is available at:

https://www.gov.mb.ca/sd/pubs/water/licensing/keeyask/keeyask_implementation_guide.pdf

The Licence Implementation Guide forms the basis for content of this report and provides the following details:

- Methodology to be used for determining critical water levels;
- Definition of licence compliance; and
- Protocol for reporting.

1.2 Objective

This report documents Keeyask GS licence compliance by summarizing the Water Power Act and Environment Act licence requirements and providing the relevant water level data for the 2021-2022 reporting period. In the case of any licence limit exceedance, this report provides the reason for the exceedance, actions taken to prevent such an event from occurring in the future, and proof of regulator notification.

1.3 Outline

Section 1.0 contains the introduction to the report, including background information on licence and reporting requirements, objective and outline of the report. Following the introduction is section 2.0, which provides the Keeyask GS project location and description. Section 3.0 summarizes the water level data collection process including

data transfer, storage and validation. Section 4.0 includes information about data sources, definition of compliance, and compliance reporting. Section 5.0 describes the data analysis used to prepare this report, includes a summary of deviations from licence constraints during the 2021-22 reporting period, and provides reasons for any licence deviations. Section 6.0 includes major system upgrades and Section 7.0 summarizes Manitoba Hydro's commitment to dam safety. Finally, Section 8.0 provides conclusions and closure to the report.

2.0 KEEYASK GENERATING STATION

2.1 Project Location

The Keeyask Generating Station is located on the lower Nelson River at Gull Rapids, approximately 725 km north of Winnipeg and 210 km from Thompson in the Split Lake Resource Management Area. The geographical location of the station is shown in Figure 1. A photograph of the station showing the location of the two forebay gauges is provided in Figure 2.

2.2 Project Description

The Keeyask Generating Station includes:

- 7 unit powerhouse/service bay complex on the north side of Gull Rapids;
- 7 bay spillway on the south side of Gull Rapids;
- more than 2 km of dams across Gull Rapids;
- 23 km of dikes built on the north and south side of the reservoir.

Tables 1 and 2 summarize the operating parameters and construction specifications of the Keeyask Generating Station.

Table 1: Construction Specifications and Operating Parameters of the Keeyask Generating Station

Construction Period	2014 to 2022
Licensed Capacity	695 MW
Average Generation	4,400 million kW-h
Waterfall Drop (head)	18.3 m
Maximum Licence Forebay Elevation	159.0 m
Minimum Licence Forebay Elevation	158.0 m

Table 2: Principal Structures for the Keeyask Generating Station

Powerhouse	Number of Units	7
	Length	248 m
	Discharge Capacity*	4,100 m^3/s
	Power Production	7 units @ 99.3 MW/unit TOTAL = 695 MW
Spillway	Number of Bays	7
	Total Length	119 m
	Discharge Capacity (Forebay @ 159.0 m)	8,700 m^3/s
Dams	Material	Impervious fill and granular fill
	Crest Elevation	161.9 - 162.4 m

*when the forebay is at its full supply level (FSL) of 159.0 m, the station is operated at full gate discharge and Kettle Generating Station is at a forebay level of 139.6 m

The reservoir at Keeyask Generating Station has a total area of 93.1 km^2. The reservoir normal maximum water level is 159.0 m while the forebay normal minimum water level is 158.0 m. The incremental flooded area due to the project is 45.1 km^2. During the first 30 years of operation, the reservoir is projected to increase approximately 7-8 km^2 due to shoreline erosion and peatland disintegration.

Inflow to Keeyask is largely regulated by flow releases from Lake Winnipeg as part of Lake Winnipeg Regulation and flow releases at Notigi Control Structure as part of the Churchill River Diversion. The generating station operates in a daily cycling mode within the allowed 1.0 m forebay water level range.

The operators and maintenance personnel of the Keeyask Generating Station are located on site during the day. During after-hour emergencies personnel will travel to site from Gillam.

3.0 DATA COLLECTION

3.1 Water Level Gauges

Waterway Approvals and Monitoring staff compiled data from two forebay water level gauges, located in the Keeyask Powerhouse, to evaluate licence compliance for the 2021-22 reporting period. The location of the water level gauges is included in Figure 2. Further details about the water level gauges are included in the Licence Implementation Guide which is available at:

https://www.gov.mb.ca/sd/pubs/water/licensing/keeyask/keeyask_implementation_guide.pdf

Manitoba Hydro uses the recorded water level data to measure compliance with the licence conditions as they apply to hourly and mean daily water levels (with wind and wave effects eliminated) in the Keeyask forebay.

3.2 Data Transmission and Storage

The water level data at each Keeyask gauge is recorded in a wet well using a guided wave radar transmitter. Electromagnetic pulses are propagated through a waveguide, and reflections of the pulses are measured and processed to determine the water level in the stilling well. The levels are electrically transmitted to the Station's Unit Control and Monitoring System, which converts the levels to elevations for local display/recording and sends the elevations to the Remote Transmittal Unit for transmission to Manitoba Hydro's System Control Centre.

Data is collected on site and signed off by the operating supervisor. Data is then sent to the Energy Supply Planning Department of Manitoba Hydro, uploaded into a database and checked for errors. Data errors are then corrected or verified by plant operating staff with technical assistance from Energy Supply Planning staff as needed. Once data has been verified, it may be used for operations planning, studies, model development and reporting. Figure 3 shows the data transmission and storage process.

4.0 WATER POWER ACT AND ENVIRONMENT ACT DATA REPORTING

4.1 Monitoring & Reporting Process

The Keeyask Licence Implementation Guide indicates that an annual water level report for each fiscal year (April 1 – March 31) will be provided to Manitoba Environment, Climate and Parks to document compliance with the Keeyask Interim Water Power Act and Environment Act licences. This report uses final data from the Keeyask forebay water level gauges. It also contains any compliance reports issued in the reporting period. Due to the quality assurance processing time, this report will be issued by July 31 of the following fiscal year.

4.2 Compliance

Section 4.2 of the Keeyask Interim Water Power Act licence states that:

> *The Licensee shall not raise the forebay of its development above an elevation of 159.0 metres ASL as measured at the powerhouse, except as ordered by the Minister under Clause 72(b) of the Water Power Regulation or as fixed by the Minister under Clause 72(c) of the Water Power Regulation.*

Section 4.3 of the Keeyask Interim Water Power Act licence states that:

> *The Licensee shall not lower the forebay of its development below an elevation of 158.0 metres ASL as measured at the powerhouse, except as ordered by the*

Minister under Clause 72(b) of the Water Power Regulation or as fixed by the Minister under Clause 72(c) of the Water Power Regulation.

Clause 48 of Environment Act Licence No. 3107 states that:

The Licence shall, during normal operation of the Development, regulate Keeyask Generating Station to maintain a maximum reservoir level in the immediate forebay of 159 m above sea level and a minimum operating level of 158 m above sea level.

4.3 Compliance Reporting

Compliance for Keeyask GS has been defined and agreed upon with Manitoba Environment, Climate and Parks using the maximum and minimum water level limits stated by the Water Power Act and Environment Act licences. More precisely the Keeyask forebay water level shall be in compliance with the upper limit defined by both licences if:

1. The Keeyask Mean Daily Water Level (with wind and wave effects eliminated) does not exceed 159.0 meters, and
2. The Keeyask Hourly Water Level does not exceed 159.1 meters more than two times for two consecutive hours each time in any 24 hour period.

Furthermore, the Keeyask Lake water level is in compliance with the lower limit defined by both licences if:

1. The Keeyask Mean Daily Water Level (with wind and wave effects eliminated) does not recede below 158 meters, and
2. The Keeyask Hourly Water Level does not recede below 157.9 meters more than two times for two consecutive hours each time in any 24 hour period.

In the event that the Keeyask forebay water levels are not in compliance with the licence limits as described above, notification will be made to Manitoba Environment, Climate and Parks within one week of the incident. A follow up compliance report on causes contributing to the event and changes to operations, if any will also be provided.

KHLP publishes annual compliance reports on its web site at www.keeyask.com.

5.0 SUMMARY OF FINDINGS

5.1 Data Analysis

Manitoba Hydro analyzed water level data to prepare charts outlining water levels in the Keeyask forebay during the 2021-22 reporting period. All readings were evaluated against licence limits to identify violations based on the definition of licence compliance given in Section 4.3.

Keeyask forebay hourly and daily mean water levels are shown in Figures 4 and 5 for the 2021-22 reporting period.

5.2 Licence Exceedances

During the 2021-22 reporting period, there were no recorded instances of water levels outside of the licence limits described in Section 4.3. The maximum number of possible instances was calculated as the sum of instances pertaining to each licence constraint and was based on the station operating from February 16, 2021 to March 31, 2022. Each licence constraint yields the following number of possible instances:

- Maximum/Minimum Keeyask Forebay Mean Daily Water Level – 410 days of possible instances,
- Maximum/Minimum Keeyask Forebay Hourly Water Level – 410 days * 24 hours = 9840 possible instances.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

As this was the first year of project operation, there are no major upgrades or changes to report.

7.0 DAM SAFETY

Manitoba Hydro operates and maintains the generating station and associated structures at Keeyask based on the Canadian Dam Association Dam Safety Guidelines. In future years, a summary of dam safety activities will be provided in an appendix.

8.0 CONCLUSIONS & CLOSURE

During the period from February 16, 2021 to March 31, 2022, there were no events where water levels deviated from the Water Power Act and Environment Act licence limits. Manitoba Hydro operated in compliance with the licences as shown in Table 3.

Table 3: Summary of 2021-22 Compliance

Location	Constraint	Variable	Exceedances	Number of Readings	% Compliance
Keeyask Forebay	Max/Min Elevation	Mean Daily Water Level	0	410	100 %
Keeyask Forebay	Max/Min Elevation	Hourly Water Level	0	9840	100 %

Manitoba Hydro continues to operate the Keeyask Generating Station in accordance with the Interim Licence under the Water Power Act for the development of water power at the Keeyask Site on the Nelson River and Environment Act Licence No. 3107.

Date of satellite imagery September 5, 2020A

Hydraulic Licensing and Support Section Waterway Approval and Monitoring Asset Management DivisionA Asset Planning & DeliveryA

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KEEYASK G.S. GEOGRAPHICAL LOCATIONA

FIGURE - 1A

Generating Station

DamA

Forebay water level gauges are located in the service bay north of Unit 1A

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FIGURE - 2A

KEEYASK GENERATING STATION
FOREBAY WATER LEVEL
GAUGE LOCATIONA

Gauge at G.S.

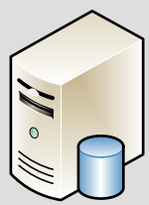
System Control Centre

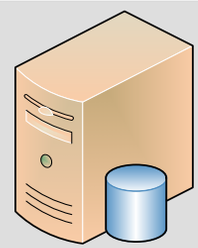
MERIDIUM

Station Operators

Energy Supply Planning

HyDams Database





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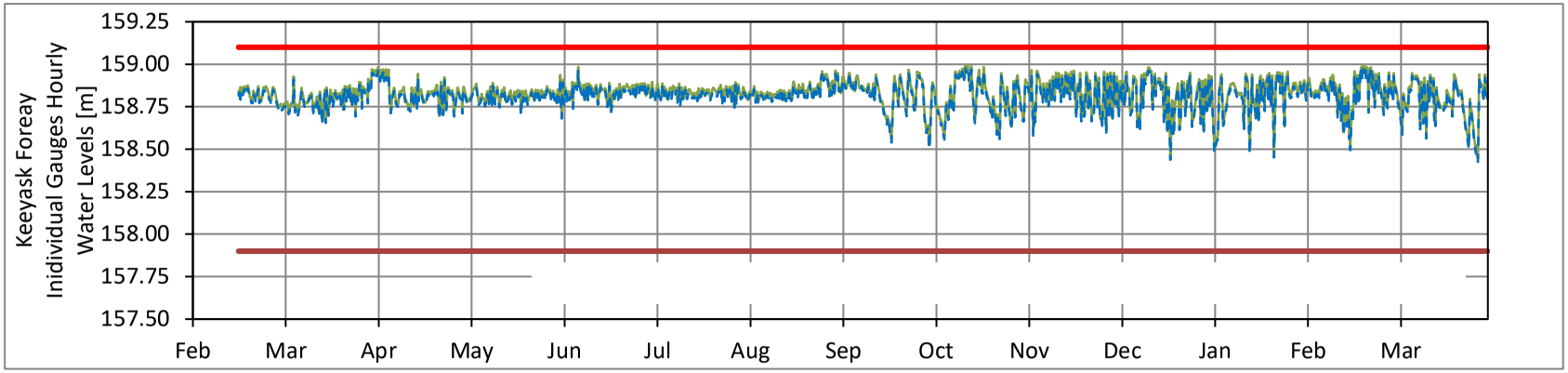
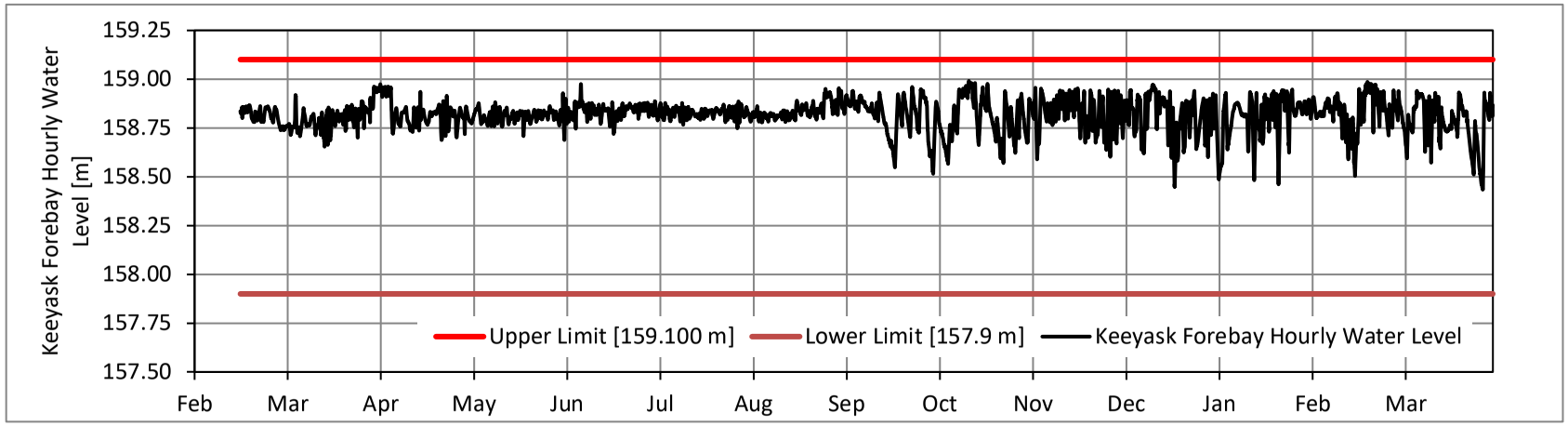
	WATERWAY APPROVALS AND MONITORING DEPARTMENT	
	HYDROLOGIC DATA ACQUISITION AND MANAGEMENT SYSTEM	
	GENERATING STATION DATA PROCESS MAP	
	PROJECT KEEYASK ANNUAL COMPLIANCE REPORT	FIGURE 3

Keeyask Generating Station - Forebay Hourly Water Levels
Compliance Report for 2021-22

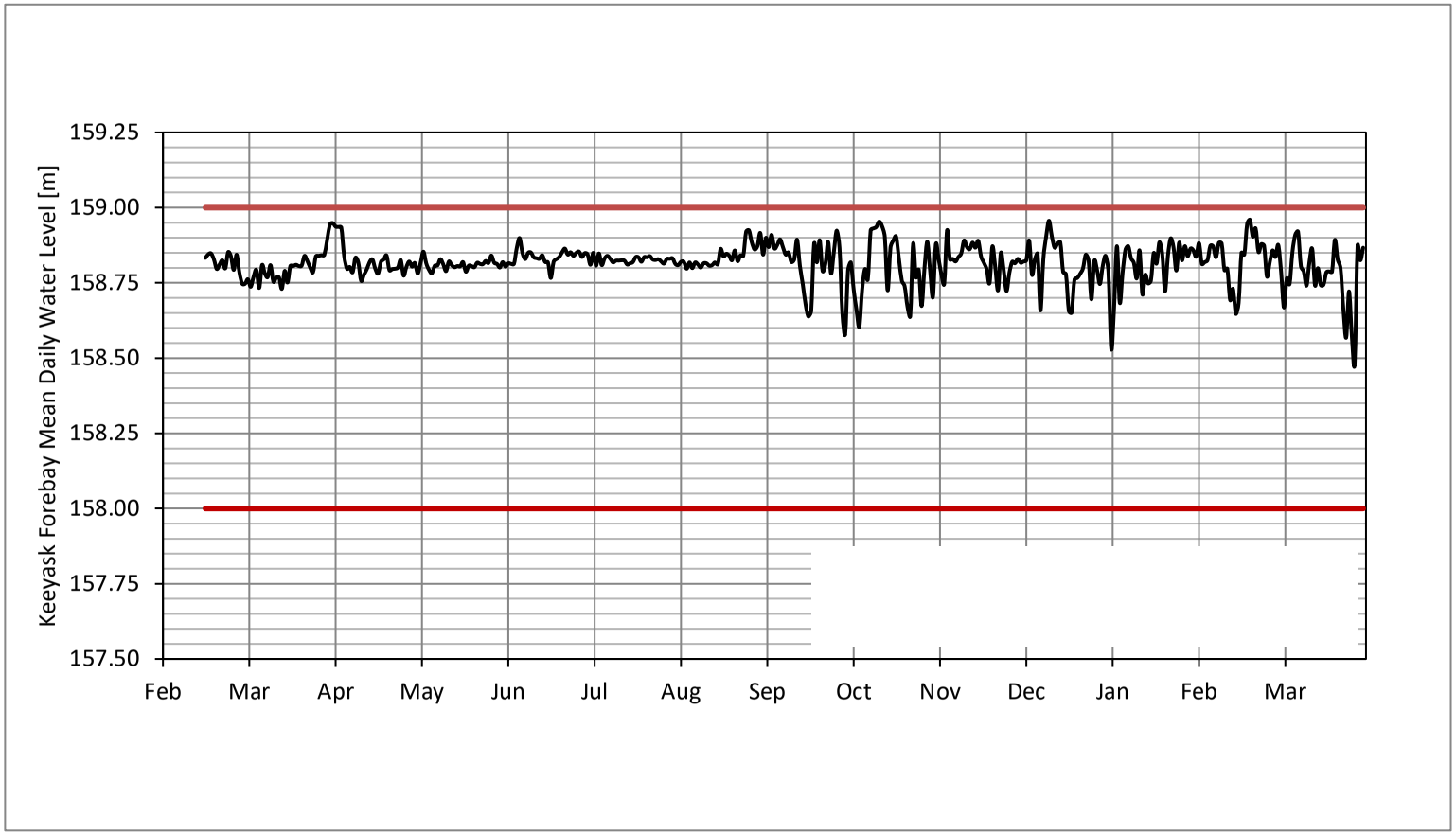




Note:
Keeyask Hourly Water Level is calculated using two forebay gauges HF1 and HF2

Manitoba Hydro	MANITOBA HYDRO
	WATERWAY APPROVALS AND MONITORING
	KEEYASK GENERATING STATION
	KEEYASK LAKE HOURLY WATER LEVELS (2021-22)
	PROJECT ANNUAL COMPLIANCE REPORT — FIGURE 4

Keeyask Generating Station - Forebay Mean Daily Water Level
Compliance Report for 2021-22



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	WATERWAY APPROVALS AND MONITORING
	KEEYASK GENERATING STATION
	KEEYASK LAKE MEAN DAILY WATER LEVEL (2021-22)
	PROJECT: ANNUAL COMPLIANCE REPORT — FIGURE 5