

Manitoba Hydro Grand Rapids Generating Station Licence Implementation Guide for Water Levels

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Manitoba Hydro
Grand Rapids Generating Station
Licence Implementation Guide for Water Levels



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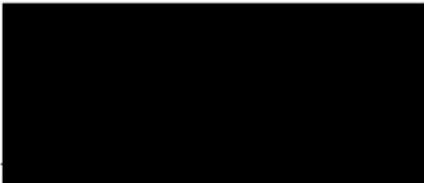
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Executive Summary

Introduction

Manitoba Hydro prepared this guide to document a common understanding of compliance with the water regime terms of the Grand Rapids Water Power Act Licence. This document sets out the mutually understood and agreed to:

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

Grand Rapids Forebay Water Level

Data from gauge 05KL005 located on Cedar Lake near Oleson Point is used to determine the Grand Rapids forebay water level.

Compliance

The forebay water level shall be in compliance with the limit described above if the **Grand Rapids Mean Daily Water Level (with wind and wave effects eliminated)** does not exceed 256.64 m (842.0 ft).

Reporting

In the event that the Grand Rapids forebay water level is not in compliance with the licence limit, Manitoba Hydro will notify Manitoba Sustainable Development within one week of the incident. A follow-up report on causes contributing to the event and changes to operations, if any are needed to prevent such an event in the future, will be provided to Manitoba Sustainable Development. A record of water levels and licence compliance will also be provided in an annual report.

Change Management

Proposed revisions to this Guide will be drafted by Manitoba Hydro as required or directed by Manitoba Sustainable Development. Following review and approval of revisions by Manitoba Sustainable Development, a revised copy of this Guide will be produced and distributed by Manitoba Hydro.

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1. Introduction

Grand Rapids Generating Station is located on the Saskatchewan River approximately 400 km northwest of Winnipeg. Access to the station is via Highway 6 from Winnipeg and a local gravel airstrip for light aircraft.

Built between 1960 and 1968, Grand Rapids Generating Station is the first hydroelectric generating station Manitoba Hydro built after the Winnipeg River had been fully developed. Grand Rapids is Manitoba Hydro's only generating station on the Saskatchewan River and is operated with a dam and reservoir with a waterfall drop of 36.6 m. Grand Rapids currently has a licenced capacity of 478.7 megawatts (642,000 horsepower).

Manitoba Hydro currently operates the Grand Rapids Generating Station with a Short-Term Extension of the Final Licence. The Short-Term Extension Licence (STEL) was issued in accordance with the provisions of The Water Power Act on December 12, 2014. The STEL is in effect from January 2, 2015 to and including January 1, 2020.

1.1 Definitions

For the purposes of this guide, unless the context otherwise requires, the following terms shall have the respective meanings set out below and grammatical variations of such terms shall have corresponding meanings:

ASL means above sea level

Controlling Benchmarks

Grand Rapids Site

62M220 (G13). This is a brass cap in a boulder between Dyke 1 and 2 North. This benchmark was established on site in 1962 and the elevation used is 259.87 m Geodetic Survey of Canada (GS of C) Canadian Government Vertical Datum 1928 (CGVD28) (1929 Adjustment, 1964 Local Adjustment).

Water Level Gauge 05KL005 - Cedar Lake near Oleson Point

Water Survey of Canada (WSC) benchmark M65051. This is a brass cap in bedrock 7.6 m east of recording shelter and 0.9 m from the top of bank with an angle iron for marker. Benchmark M65051 was established by water level transfer from B.M. 1 in Easterville, referenced to the Geodetic Survey of Canada (GS of C) Canadian Government Vertical Datum 1928 (CGVD28) (1929 Adjustment, 1974 Local Adjustment).

Grand Rapids Gauge means WSC gauge 05KL005 - Cedar Lake near Oleson Point.

Grand Rapids Mean Daily Water Level (with wind and wave effects eliminated) means the water level at the **Grand Rapids Gauge** averaged over a five-day period to eliminate wind and wave effects.

1.2 Datum

Article 16 of the Grand Rapids Water Power Act Licence indicates that water level information for the operation of the Grand Rapids Project shall be measured in terms of elevations **ASL**, referenced to GS of C CGVD28 (1929 Adjustment). The controlling benchmark at site is 62M220 and the elevation used is 259.87 m GS of C CGVD28 (1929 Adjustment, 1964 Local Adjustment).

During a period of zero discharge from Grand Rapids in March and April 1992, the forebay levels as measured at the station were compared to the levels of 05KL005 - Cedar Lake near Oleson Point. It was determined that a +0.085 m adjustment is required to bring the water levels measured at 05KL005 - Cedar Lake near Oleson Point to the controlling benchmark on site 62M220.

1.3 Quality Control

1.3.1 Benchmarks

Vertical control surveys have been performed to establish appropriate local benchmarks around the **Grand Rapids Gauge**.

Grand Rapids benchmarks were established by level transfer from **Controlling Benchmarks** using spirit levelling methods.

1.3.2 Direct Water Level Measurements

Field staff visit the water level gauges bi-monthly with additional visits as necessary to maintain gauge performance. Direct water level measurements are taken during these visits and compared to the level indicated by the water level sensor. Direct water level measurements for lakes of this size are typically accurate to within 5 mm depending on weather conditions.

1.3.3 Gauge Readings

WSC and Manitoba Hydro use pressure sensors to determine water levels at their existing hydrometric gauging stations. The error in the reading provided by the pressure sensor is about 5 to 7.5 mm depending on the type of sensor used. If the technician visiting the site determines that the sensor reading is more than 10 mm different from the direct water level measured in accordance with Subsection 1.3.2, the logger is reset to the direct water level measurement. If the sensor reading is less than 10 mm different from the direct water level measured in accordance with Subsection 1.3.2, no change is made to the logger.

1.4 Quality Assurance Procedure for Water Level Data

Water level data exists in three degrees of quality assurance – raw, provisional and final.

Raw data is real-time data that has been transmitted from the field. The only level of quality assurance is that built in to the data collection system, described in Section 1.3. This level of data is used in the daily operation of the Grand Rapids Generating Station.

Provisional data is data processed by a qualified data assurance technician who reviews the field data and corrects obvious errors. The data is compared to all available relevant data in the area to verify its accuracy.

Final data has been through two levels of review by qualified technicians and a final review by a professional engineer. This data is considered publishable and has met the quality assurance standards of the National Hydrometric Program of Environment Canada. This data will be used for annual reporting described in Subsection 3.2.3 of this guide.

2. Grand Rapids Forebay Water Level

The water level elevation of the Grand Rapids forebay is recorded on Cedar Lake at Oleson Point (05KL005). This gauge is operated by Manitoba Hydro on behalf of WSC under the terms of the Canada-Manitoba Cost Sharing Agreement on Water Quantity and Quality Surveys. A detailed gauge description is included in Appendix A.

2.1 Wind-Eliminated Water Level Calculation Procedure

Article 5 of the Final Water Power Act licence places a limit on the Grand Rapids forebay water level. Cedar Lake water levels will be influenced by Grand Rapids operations, local meteorological events and non-project hydraulic effects. Significant local weather impacts can result from heavy precipitation, the movement of high and low pressure cells and large wind events. Non-project hydraulic impacts may result from upstream storage and release of water caused by changing ice conditions, operation of upstream control structures in Saskatchewan, and rapid spring runoff. To properly evaluate the wind-eliminated water level, averaging techniques are used to remove these temporary effects. Small, short-term weather and hydraulic events can be smoothed out by calculating a daily average water level. Larger, long-term events require a longer duration averaging technique. For a lake of this size, a five-day moving mean is appropriate.

The first step to calculate the **Grand Rapids Mean Daily Water Level (with wind and wave effects eliminated)** is to calculate a daily average water level from the continuous (e.g. 5 minute) water levels.

$$GRDW = \frac{\sum_{i=1}^n GRW_i}{n} + 0.085 \text{ m} \quad [1]$$

Where

GRW = Grand Rapids Water Level, measured at time *i* at 05KL005

GRDW = Grand Rapids Daily Average Water Level

n = Number of available water level measurements for that calendar day

0.085 m adjustment added to get to licence datum GS of C CGVD28 (1929 Adjustment, 1964 Local Adjustment)

A centred five-day moving mean as shown in equation 2 is then applied to the Grand Rapids Daily Average Water Level data to produce the **Grand Rapids Mean Daily Water Level (with wind and wave effects eliminated)**.

$$GWEWL_l = \frac{GRDW_{l-2} + GRDW_{l-1} + GRDW_l + GRDW_{l+1} + GRDW_{l+2}}{5} \quad [2]$$

Where

$GWEWL_l$ = Grand Rapids Mean Daily Water Level (with wind and wave effects eliminated) for day l

3. Compliance

3.1 Grand Rapids Water Power Act Licensing Requirement

Maximum Water Level

Article 5 of the licence stipulates that:

“The Licensee shall not raise the headwater of its development to an elevation higher than 842.0. A higher elevation may be created only with prior written permission by the Director and in accordance with Section 72 of the Regulations.”

Given the size of the forebay in relation to the capacity of the generating station and uncertainty in predicting precipitation and inflows, Manitoba Hydro operates to maintain a 0.15 m buffer below the licence limit. Manitoba Hydro also operates the Grand Rapids Spillway with a Safety and Environmental Protocol where stakeholders are notified a minimum of 7 days in advance of the spillway being opened whenever possible.

The forebay water level shall be in compliance with the limit described above if the **Grand Rapids Mean Daily Water Level (with wind and wave effects eliminated)** does not exceed 256.64 m (842.0 ft).

3.2 Reporting

3.2.1 Compliance Reporting

In the event that the **Grand Rapids Mean Daily Water Level (with wind and wave effects eliminated)** is not in compliance with the licence limit as described in Section 3.1, notification shall be made to Manitoba Sustainable Development within one week of the incident. A follow-up report on causes contributing to the event and changes to operations, if any are required to prevent such an event in the future, will be provided to Manitoba Sustainable Development.

3.2.2 Maintenance and Emergencies

During maintenance and emergencies there may be times when Manitoba Hydro is required to deviate from a licence condition for safety or other purposes. Manitoba Hydro will be considered compliant with the licence as long as:

1. Advanced notification is provided to Manitoba Sustainable Development of the upcoming licence deviation together with the reason. This will include a description

of the operating plan, details of the expected licence deviation, a summary of anticipated impacts to stakeholders, and confirmation that stakeholders will also be notified; and

2. Advanced notification is provided to stakeholders of pertinent impacts to flow and water levels; and
3. Following the deviation, notification by letter is provided to Manitoba Sustainable Development on the details of the operation(s).

3.2.3 Regular Annual Reporting

Water levels and licence compliance will be reported annually to Manitoba Sustainable Development.

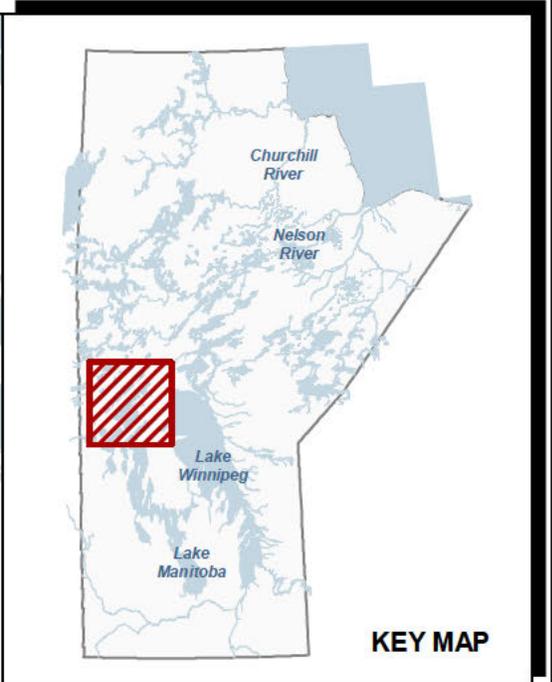
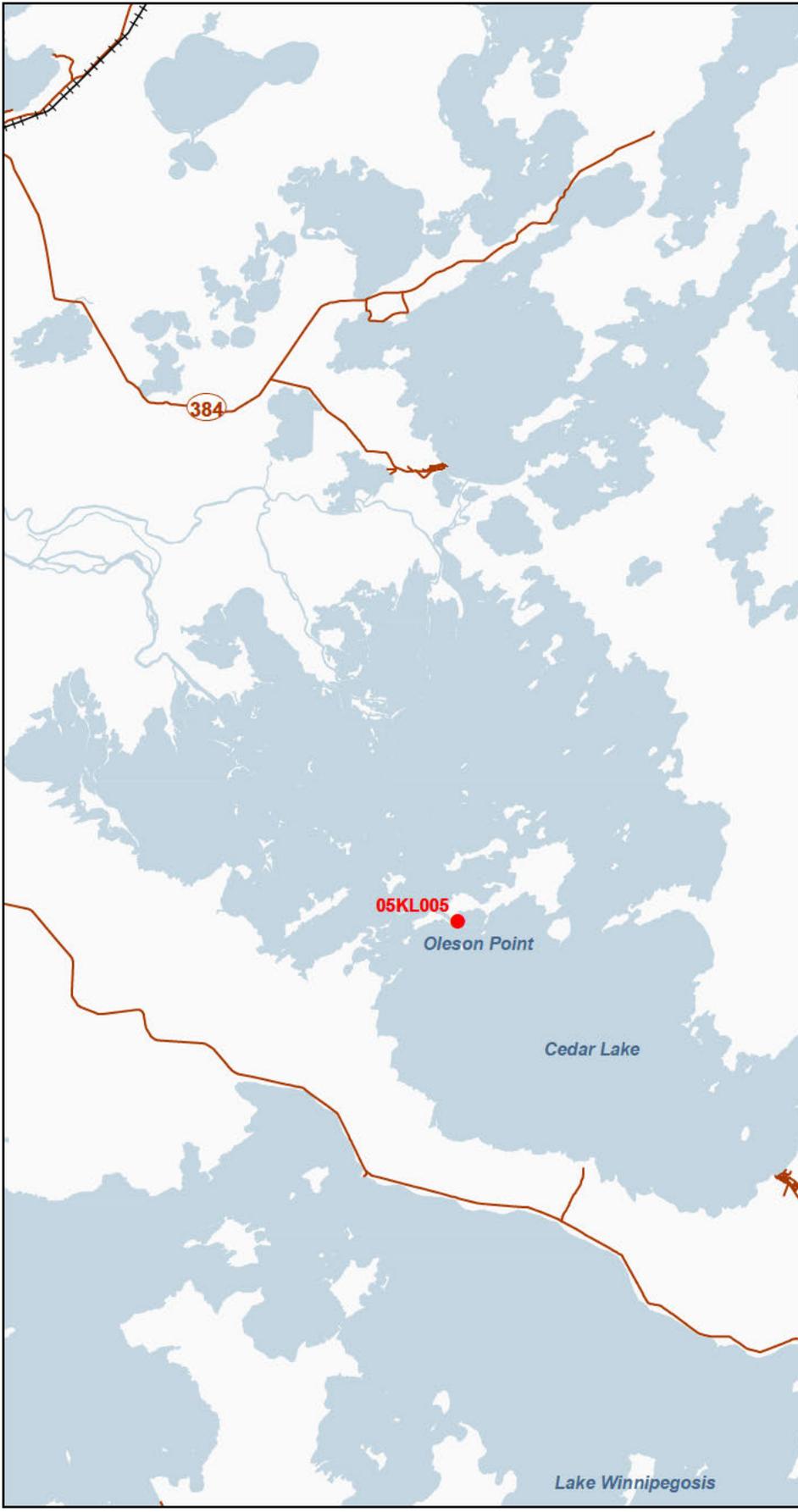
4. Change Management

4.1 Regular Updates

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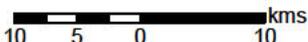
Appendix A

Site Map and Forebay Water Level Gauge Location

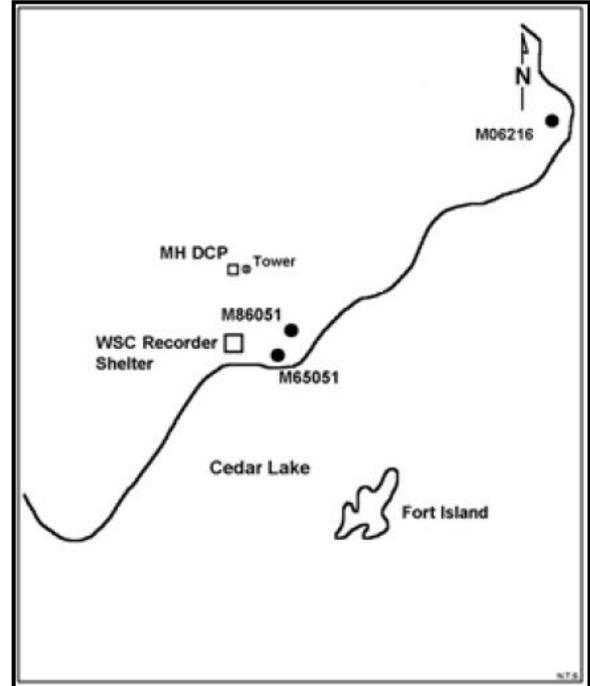
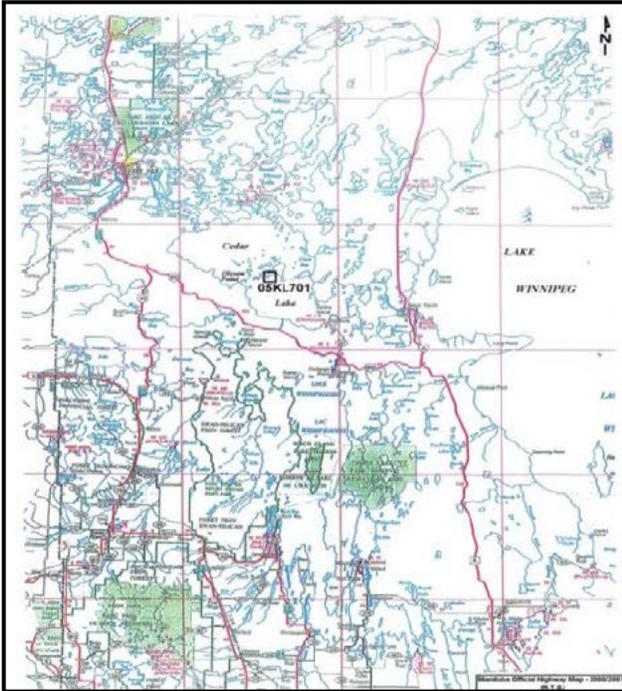


**GRAND RAPIDS G.S.
GENERAL ARRANGMENT**

	Generating Station		Road
	Gauge Location		Rail

 kms

Cedar Lake near Oleson Point (WSC)



Number: 05KL005

Name: Cedar Lake near Oleson Point

DCP Id: 4A0112BE **Drainage Area (km²):**

Latitude: 53° 19' 09.8" **Longitude:** -100° 16' 47.6"

UTM: 5908564.5 N 414743.4 E **Zone:** 14

Coordinate Source: NAD83

Operator: Manitoba Hydro

Established: June 23rd, 1965

Location: On the SE shore of Kokookuhoo Island across from Oleson Point and directly NW of Fort Island.

Equipment: Sutron Satlink 2 DCP, firmware version 7.47, with a Sutron Accubar pressure sensor and Water Log H-355 gas system powered by a 20 W solar panel and Sun saver voltage regulator connected to 2 – 12 volt Haze AGM HZB12-55 batteries in a walk-in shelter with a GOES directional antenna.

Metering: N/A

Access: Helicopter, snowmobile or boat.

Station Status: Active

Period of operation: 12 HR

Date: 2018-03-23

Datum: GS of C CGVD28, 1974 Local Adjustment

Benchmarks:

M65051 - Master - Elevation - 257.324 m A Water Survey of Canada brass cap in bedrock 7.6 m E of the recorder shelter and 0.9 m from the top of the bank and marked with an angle iron. The brass cap is approximately 1.0 m W of the marker.

M86051 - Elevation - 257.200 m. A Water Survey of Canada brass cap in bedrock 8.5 m E of the SE corner of the recorder shelter and 3.8 m NW of ledge (edge of lake) or 3.0 m NW of M65051.

M06216 – Elevation – 256.817 m. A Water Survey of Canada brass cap in bedrock on a point 210 m NNE of the shelter, marked with a rebar.

Additional Information:

Time Slot	00:19:30	Transmit Window	00:00:10
Transmitter	HDR	Baud Rate	300
Channel	137 East	Satellite Azimuth	156°
Archive Transmit	01:00:00	Antenna Angle	20°

A survey rod has been dedicated to this station and must remain on site to meet AIS requirements.

Shelf Codes: HG, VB, ZT

OSH Concerns: Steep (cliff) rock shoreline.

Compiled By: J.W. Hart