Hydraulic Operations Department, Manitoba Hydro
On behalf of: **Wuskwatim Power Limited Partnership**

WATER POWER ACT & ENVIRONMENT ACT LICENCES 2017 ANNUAL WATER LEVELS REPORT FOR WUSKWATIM GENERATING STATION

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DATE: 2018-04-19

REPORT NO: WP&O 18-04

IMPORTANT

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EXECUTIVE SUMMARY

Manitoba Hydro operates the Wuskwatim GS on behalf of Wuskwatim Power 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 on Wuskwatim Lake, and the rate of change in water level on Birch Tree Lake.

Environment Act Licence No. 2699 for Wuskwatim GS requires an annual water level report for each calendar year. This report addresses all 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.

Monthly compliance reports recorded one Wuskwatim Lake and nineteen Birch Tree Lake licence limit exceedances during 2017. Investigation into these events concluded that eleven of the Birch Tree Lake events were not attributable to Wuskwatim operations. The reasons for the occurrence of these events are explained in Sections 5.2, 5.3 and Appendix I.

In summary, water levels deviated outside the licence limits as follows.

Location	Constraint	Variable	Exceedances Attributed to Wuskwatim Operations	Number of Readings	% Compliance
Wuskwatim Lake	Max Elevation	Mean Daily Water Level	1	365	99.73 %
Wuskwatim Lake	Max Elevation	Hourly Water Level	0	8784	100 %
Birch Tree Lake	Water Level Variation	Mean Daily Water Level	8	365	97.81 %

Refinements to operations continue in order to reduce the number of licence limit exceedances on Wuskwatim and Birch Tree lakes.

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1.0 INTRODUCTION

1.1 Background

Wuskwatim Power Limited Partnership (WPLP) is a legal entity involving Nisichawayasihk Cree Nation (NCN) and Manitoba Hydro, which developed and now owns the Wuskwatim Generating Station (GS). Manitoba Hydro operates the station as part of the Manitoba power grid on behalf of WPLP.

WPLP received licences under *The Water Power Act* and *The Environment Act* for the development of the Wuskwatim GS. The Interim Water Power Act licence stipulates a maximum and minimum allowable water level on Wuskwatim Lake. Environment Act Licence No. 2699 stipulates a maximum and minimum water level on Wuskwatim Lake, a maximum daily change in water level on Birch Tree Lake, as well as monthly and annual reporting requirements. This report fulfills the annual reporting requirement of Environment Act Licence No. 2699.

After 5 years of operation, Clause 34 of Environment Act Licence No. 2699 also requires a review of the appropriateness of the water level limits described above. The licence acknowledges the potential need for adjustments to reflect local hydrological conditions. Manitoba Hydro is currently conducting a review of the first five years of Wuskwatim operation from September 2012 through August 2017 and will provide a separate report to fulfill this requirement.

Manitoba Hydro prepared the Wuskwatim GS Licence Implementation Guide for Water Levels (http://www.gov.mb.ca/sd/waterstewardship/licensing/pdf/implementation_guide.pdf) to establish and document the water regime terms specified by the Wuskwatim licences. The guide was reviewed and approved by the Province of Manitoba. The Licence Implementation Guide forms the basis for content of this report and provides the following details:

- calculation methodology to be used for determining critical levels,
- protocol for reporting to meet licence requirements, and
- manner in which compliance will be defined and assessed

1.2 Objective

This report documents Wuskwatim GS licence compliance by summarizing the Water Power Act and Environment Act licence requirements and providing the relevant water level data for the 2017 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 Wuskwatim 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 table of deviations from licence constraints during the 2017 calendar year, and provides reasons for any licence deviations. Section 6.0 summarizes major system upgrades or changes during the 2017 calendar year, and finally Section 7.0 provides conclusions and closure to the report.

Appendix I provides copies of relevant correspondence with Manitoba Sustainable Development related to licence limit exceedances.

The enclosed CD contains final water level data for Wuskwatim Lake and Birch Tree Lake used in the preparation of this report.

2.0 WUSKWATIM GENERATING STATION

2.1 Project Location

The Wuskwatim Generating Station is located on the Burntwood River, in the Nelson House Resource Management Area, approximately 56 km southwest of Thompson, 35 km southeast of Nelson House, or approximately 830 km north by road from Winnipeg. The geographical location of the station is shown in Figure 1. A photograph of the station is shown in Figure 2. A general arrangement of the site is shown in Figure 3.

2.2 Project Description

The Wuskwatim Generating Station consists of a 3-unit powerhouse with a nameplate capacity of 209 MW, gravity dams and embankment structures, and a 3-bay spillway with heated gates. Tables 1 and 2 summarize the operating parameters and construction specifications of the Wuskwatim Generating Station.

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

Construction Period	2006 to 2012
Licensed Capacity	210 MW
2017 Generation	1,460 million kW-h
Waterfall Drop (head)	21.4 m
Maximum Licence Forebay Elevation	234.0 m
Minimum Licence Forebay Elevation	233.75 m

Table 2: Principal Structures for the Wuskwatim Generating Station

Powerhouse	Number of Units	3
	Length	75 m
	Discharge Capacity (at full gate)	1,100 m^3/s
	Power Production	3 units @ 69.7 MW/unit TOTAL = 209 MW
Spillway	Number of Bays	3
	Total Length	43.0 m
	Discharge Capacity (Wuskwatim L. @ 234.0 m)	2,310 m^3/s
Dams	Material	Impervious fill and granular fill
	Crest Elevation	236.69 – 237.80 m

The reservoir at Wuskwatim Generating Station has a total area of 88.41 km^2 and a fetch length of approximately 1.88 km. There is typically a 0.1 m drop between the reservoir level on Wuskwatim Lake and the forebay level of the station. The reservoir normal maximum water level is 234.0 m while the forebay normal maximum water level is 233.9 m. The incremental flooded area due to the project is 0.37 sq. km allowing the majority of the reservoir and forebay to be contained by natural river banks and minimizing the need for dykes.

Inflow to Wuskwatim is largely dependent on the Churchill River Diversion, as controlled by the Notigi Control Structure. The generating station operates in a daily cycling mode within the allowed 0.25 m water level range on Wuskwatim Lake.

The operators and maintenance personnel of the Wuskwatim Generating Station are located on site. Support and technical services are located in the nearby city of Thompson.

3.0 DATA COLLECTION

3.1 Water Level Gauges

Hydraulic Operations staff compiled data from three remote water level gauges located on Wuskwatim Lake, and two remote water level gauges located on Birch Tree Lake to evaluate licence compliance for the 2017 reporting period. The locations of the water level gauges as well as the gauge description sheets are contained in the Appendix A of the Licence Implementation Guide (http://www.gov.mb.ca/sd/waterstewardship/licensing/pdf/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) on Wuskwatim Lake, and daily average water level changes on Birch Tree Lake.

3.2 Data Transmission and Storage

Manitoba Hydro remote gauges on Wuskwatim and Birch Tree lakes use pressure transducers and data loggers to record, store and transmit water level data to satellites operated by the National Oceanic and Atmospheric Administration (NOAA). Manitoba Hydro retrieves the data from internet data sources offered by NOAA and United States Geological Survey as well as directly from the loggers during a site visit. Manitoba Hydro uses software applications that retrieve, decode and send the data to the HyDams database that is accessible to interested parties within Manitoba Hydro.

Water level data is collected and published according to the procedures and Quality Control Assurance processes established by Water Survey of Canada. Near real-time data is available but it is not recognized as official. Final data, or published data is generated through several levels of reviews to verify compliance with applicable standards and includes recognition of the impact of other related environmental and contextual factors.

Figure 4 shows the data transmission and storage process for remote gauge water level data used in the preparation of this report.

4.0 WATER POWER ACT AND ENVIRONMENT ACT DATA REPORTING

4.1 Monitoring & Reporting Process

As required by Clause 33 of Environment Act Licence No. 2699, an annual water level report for each calendar year, must be provided to Manitoba Sustainable Development. This report uses final data from the required water level gauges based on three levels of internal review. It also contains any compliance reports issued in the 2017 reporting period. Due to the quality assurance processing time, this report is issued by June 1 of the following year.

4.2 Data Sources

The water level data used in preparing this report was obtained from the Manitoba Hydro hydrometric database which contains water level data of various time steps including real-time (5-minute interval), hourly, daily average and mean daily (with wind and wave effects eliminated) data. Hourly water level and flow data from Wuskwatim can be used in determining the operational impact of the project on Birch Tree Lake in case the Birch Tree Lake daily change in water level exceeds the licence limit.

4.3 Compliance

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

> *The Licensee shall not raise the headwaters of its development above an elevation of 234.0 metres ASL as measured on Wuskwatim Lake, 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 30(a) of Environment Act Licence No. 2699 states that the Licensee shall operate the Development within the following parameters:

Maintain the mean daily water level on Wuskwatim Lake (wind and wave effects eliminated) between 233.75 meters and 234.0 meters Above Sea Level (ASL), as determined by measurements from a minimum of three water level monitoring stations on Wuskwatim Lake.

Clause 30(b) of Environment Act Licence No. 2699 states that the Licensee shall operate the Development within the following parameters:

Maintain mean daily water levels on Birch Tree Lake such that the daily water level variations shall be less than 0.10 meters and 0.15 meters in open water and winter conditions (wind and wave effects eliminated) respectively. Any exceptions to these fluctuations shall be reported within one week to Manitoba Sustainable Development.

4.4 Compliance Reporting

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

1. The Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated) does not exceed 234.0 meters, and
2. The Wuskwatim Hourly Water Level does not exceed 234.1 meters more than two times for two consecutive hours each time in any 24 hour period.

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

1. The Wuskwatim Mean Daily Water Level (with wind and wave effects eliminated) does not recede below 233.75 meters, and
2. The Wuskwatim Hourly Water Level does not recede below 233.65 meters more than two times for two consecutive hours each time in any 24 hour period.

For the purpose of licence compliance at Birch Tree Lake, open water will refer to the period from May 1 to October 31 and winter will refer to the period from November 1 to April 30. The Birch Tree Lake Daily Change in water level is in compliance when:

1. The Birch Tree Lake Daily Change is below these seasonal limits, or
2. The Birch Tree Lake Daily Change is above these seasonal limits but the change attributable to Wuskwatim Generating Station is below these seasonal limits.

In the event that the Wuskwatim Lake or Birch Tree Lake water levels are not in compliance with the licence limits as described above, notification will be made to Manitoba Sustainable Development 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.

WPLP publishes monthly and annual compliance reports on its web site at www.wuskwatim.ca.

5.0 SUMMARY OF FINDINGS

5.1 Data Analysis

Water level data was analyzed to prepare charts outlining water conditions at Wuskwatim Lake and Birch Tree Lake during the 2017 reporting period. All readings were evaluated against licence limits to identify violations based on the definition of licence compliance given in Section 4.4.

Wuskwatim Lake Hourly Water Level, Wuskwatim Lake Mean Daily Water Level, and Birch Tree Lake Daily Water Level Change is shown in Figure 5, 6, and 7 respectively, for the 2017 reporting period.

5.2 Licence Exceedances

During the 2017 reporting period, there were twenty recorded instances of water levels outside of the licence limits. 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 January 1 to December 31. Each licence constraint yields the following number of possible instances:

- Maximum/Minimum Mean Daily Water Level on Wuskwatim Lake – 365 days of possible instances,
- Maximum/Minimum Hourly Water Level on Wuskwatim Lake – 365 days * 24 hours = 8784 possible instances, and
- Maximum Daily Water Level Change on Birch Tree Lake – 365 days

Table 3 shows a breakdown of licence limit exceedances for Wuskwatim Lake and Birch Tree Lake for the 2017 reporting period. The Hydraulic Operations Department investigated the incidents to determine the reasons for their occurrence. Copies of correspondence notifying Manitoba Sustainable Development of these events, are included in Appendix I of this report.

Table 3: Wuskwatim Generating Station, Water Power Act and Environment Act Licences: Summary of Events for the reporting period of 2017

Date	Location	Constraint	Variable
January 19, 2017	Wuskwatim Lake	Max Elevation	Mean Daily Water Level
May 6-8, 2017*	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
May 25, 2017	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
June 4, 2017	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
June 9, 10, & 13, 2017	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
June 22 & 23, 2017	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
June 29, 2017*	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
July 19, 2017	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
August 2 & 5, 2017*	Birch Tree Lake	Water Level Variation	Mean Daily Water Level
August 20-24, 2017*	Birch Tree Lake	Water Level Variation	Mean Daily Water Level

**exceedance not attributable to Wuskwatim operation*

5.3 Licence Exceedances Explanation

The table below provides a brief explanation of the exceedances at Wuskwatim and Birch Tree lakes. These are further explained in detail in the correspondence included in Appendix I.

Table 4: Summary of Events and Explanation for the reporting period of 2017

Date	Location	Constraint	Explanation
January 19, 2017	Wuskwatim Lake	Max Elevation	Increased inflow due to warm weather
May 6-8, 2017*	Birch Tree Lake	Water Level Variation	Rapid increase in local inflow due to spring freshet
May 25, 2017	Birch Tree Lake	Water Level Variation	Change in cycling pattern due to declining inflows from upstream of Wuskwatim Lake
June 4, 2017	Birch Tree Lake	Water Level Variation	Change in cycling pattern due to declining inflows from upstream of Wuskwatim Lake
June 9, 10, & 13, 2017	Birch Tree Lake	Water Level Variation	Change in cycling pattern due to declining inflows from upstream of Wuskwatim Lake
June 22 & 23, 2017	Birch Tree Lake	Water Level Variation	Change in cycling pattern due to declining inflows from upstream of Wuskwatim Lake
June 29, 2017*	Birch Tree Lake	Water Level Variation	Increased local inflow due to rainfall event
July 19, 2017	Birch Tree Lake	Water Level Variation	Change in cycling due to declining inflows from upstream of Wuskwatim Lake
August 2 & 5, 2017*	Birch Tree Lake	Water Level Variation	Change in local inflow between Wuskwatim Lake and Birch Tree Lake
August 20-24, 2017*	Birch Tree Lake	Water Level Variation	Change in cycling pattern due to rapid increase in inflow from Notigi flow increases

**exceedance not attributable to Wuskwatim operation*

Manitoba Hydro continues to refine operations in an attempt to reduce the number of licence limit exceedances on Wuskwatim and Birch Tree Lakes.

6.0 MAJOR SYSTEM UPGRADES/CHANGES

Maintenance and construction activities that occurred during the 2017 calendar year include:

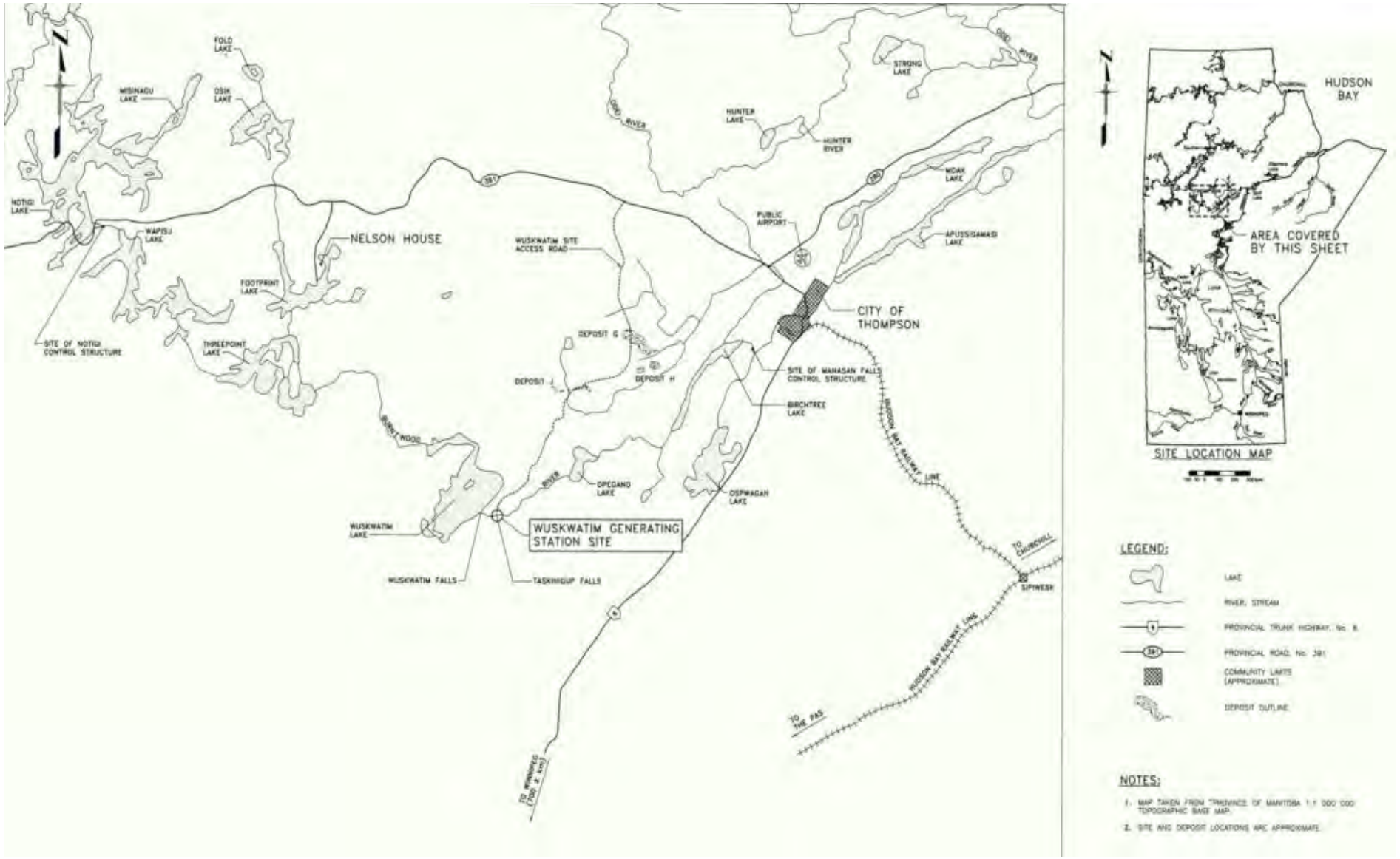
- Completion of bottom ring weld repairs on Units 1, 2 and 3
- Fuel transfer system upgrade
- Installation of accommodations

7.0 CONCLUSIONS & CLOSURE

During the January 1 to December 31, 2017 reporting period, there were twenty events when water levels deviated from the Water Power Act and Environment Act licence limits. Water levels were in compliance with the licences as follows:

Location	Constraint	Variable	Exceedances Attributed to Wuskwatim Operations	Number of Readings	% Compliance
Wuskwatim Lake	Max Elevation	Mean Daily Water Level	1	365	99.73 %
Wuskwatim Lake	Max Elevation	Hourly Water Level	0	8784	100 %
Birch Tree Lake	Water Level Variation	Mean Daily Water Level	8	365	97.81 %

Manitoba Hydro continues to operate the Wuskwatim Generating Station in accordance with the Interim Licence under the Water Power Act for the development of water power at the Wuskwatim Site on the Burntwood River and Environment Act Licence No. 2699.



Manitoba Hydro	MANITOBA HYDRO
	HYDRAULIC OPERATIONS DEPARTMENT
	WUSKWATIM GENERATING STATION
	LOCATION MAP
	PROJECT: ANNUAL WATER LEVEL REPORT — FIGURE 1

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPARTMENT	
	WUSKWATIM GENERATING STATION	
	PHOTOGRAPH OF GENERATING STATION	
	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 2

E SIZE – 671 x 952

1-00184-DE-07311-0003	SHT. 0001	REV. 02

1-00184-DE-07311-0003	SHT. 0001	REV. 02

LEGEND:

- GROUND SURFACE CONTOUR (SEE NOTE 5)
- SHORELINE (SEE NOTE 6)
- COORDINATE GRID MARKER (LOCATED AT 250 METRE INTERVALS)
- TUBULAR TRANSMISSION LINE TOWER
- SQUARE TRANSMISSION LINE TOWER

N

31 750 E

32 000 E

32 250 E

32 500 E

154 750 N

154 500 N

EXCAVATED MATERIALS PLACEMENT AREA

ACCESS ROAD

NORTH DIKE

EL 236.6

FULL SUPPLY LEVEL EL. 234.0

MAXIMUM FLOOD LEVEL EL. 235.5

SPILLWAY APPROACH CHANNEL

WALL B

SPILLWAY

WALL C

NON-OVERFLOW DAM

STAGE I UPSTREAM COFFERDAM (REMNANT)

FOREBAY

BEDROCK SURFACE

ACCESS RAMP

INTAKE CHANNEL

SERVICE BAY

WALL F

PARKING LOT EL. 224.5

SPILLWAY DISCHARGE CHANNEL

STAGE II UPSTREAM COFFERDAM

EL 229.3

WALL A

BEDROCK SURFACE

WALL E

EL 230.0

EL 236.6

EL 224.5

SOUTH TRANSITION STRUCTURE

WALL D

TAILRACE CHANNEL

AXIS OF PRINCIPAL STRUCTURES

INTAKE & POWERHOUSE

MAIN DAM

BURNTWOOD RIVER FLOW

TAILWATER LEVELS PRE-KEPUCHE

MAXIMUM (PMF)	217.80
NORMAL (WINTER)	213.20
NORMAL (SUMMER)	212.60
MINIMUM (1 UNIT)	209.80

SCALE 1:1000

20 0 20 40 60 80 100 METRES

NOTES:

1. COORDINATE AND ELEVATION VALUES SHOWN ARE IN METRES.
2. COORDINATES SHOWN ON THIS DRAWING ARE BASED ON MANITOBA HYDRO WUSKWATIM G. S. REVISED STATION GRID.
3. ELEVATIONS ARE BASED ON CANADIAN GOVERNMENT VERTICAL DATUM 1928 (GEODETIC SURVEY OF CANADA DATUM QUADRANGLE SHEET No. 55098, REVISION 3, MARCH 1971. ALSO REFERRED TO BY MANITOBA HYDRO AS GEODETIC SURVEY OF CANADA DATUM 1969 LOCAL ADJUSTMENT).
4. TOPOGRAPHY AND SURFACE FEATURES SHOWN WERE TABLE DIGITIZED FROM THE ORIGINAL MYLAR PLANS DRAWING NUMBER 07062-E-00008, WHICH WAS PRODUCED USING PHOTOGRAMMETRIC METHODS BASED ON 1:10,000 SCALE PHOTOGRAPHY DATED JUNE 16, 1986. SEE REFERENCE DRAWINGS BELOW.
5. LOCATIONS OF FOREBAY OUTLINE AND TAILWATER LEVEL BASED ON TOPOGRAPHY AND ARE APPROXIMATE.

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Manitoba Hydro

MANITOBA HYDRO

HYDRAULIC OPERATIONS DEPARTMENT

WUSKWATIM GENERATING STATION

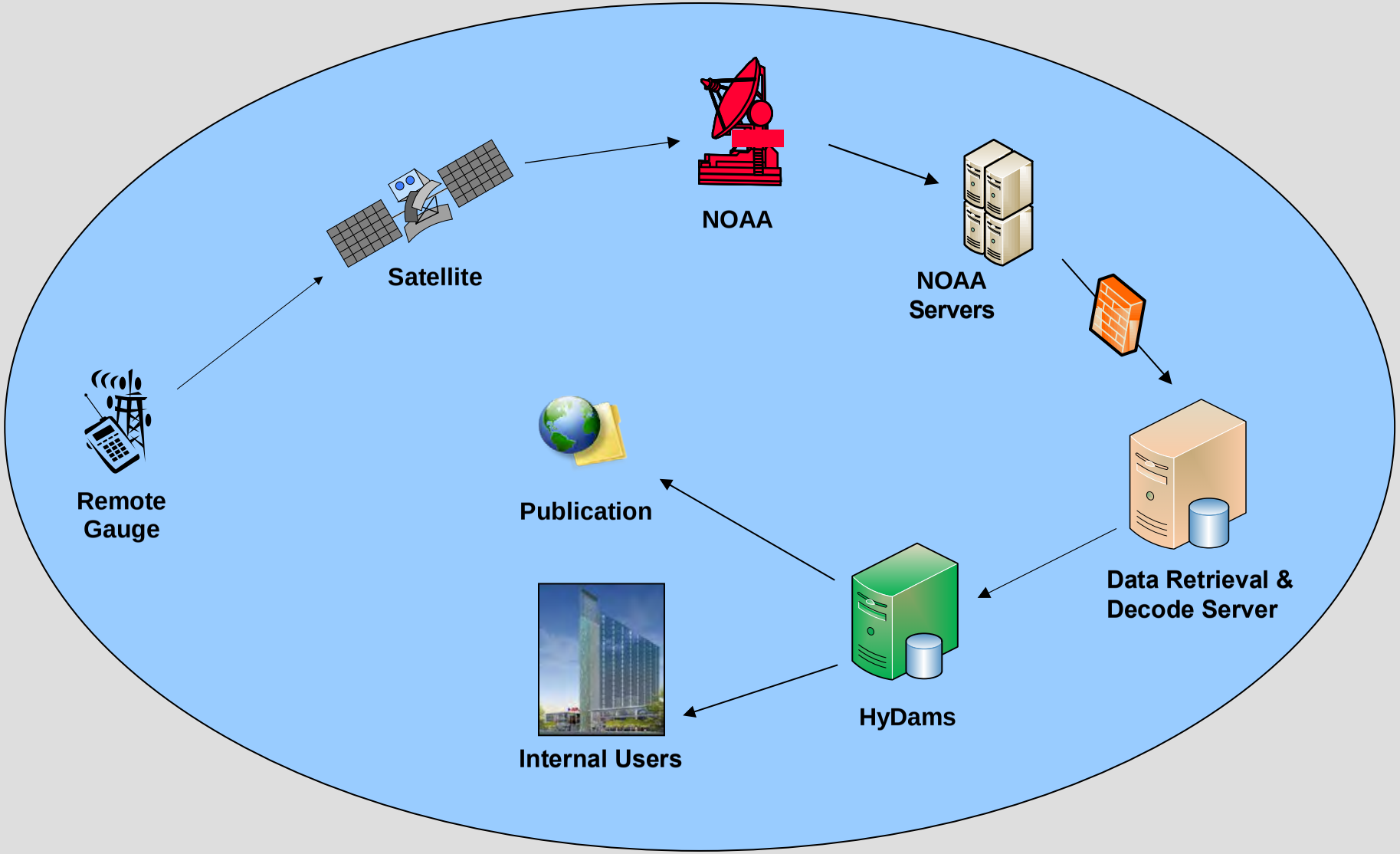
DRAWN BY

GENERAL ARRANGEMENT

YEAR 2017

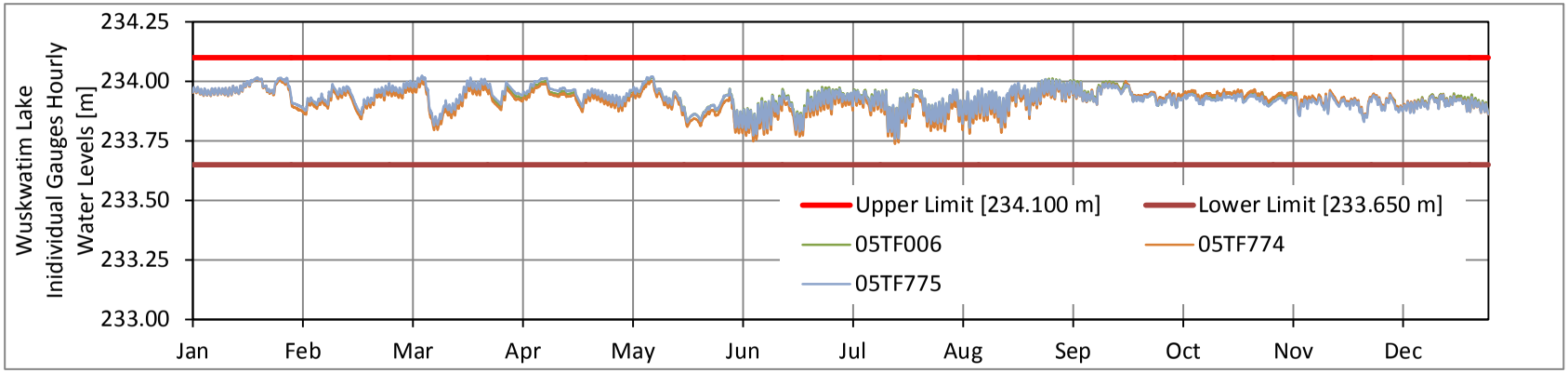
PROJECT ANNUAL WATER LEVEL REPORT

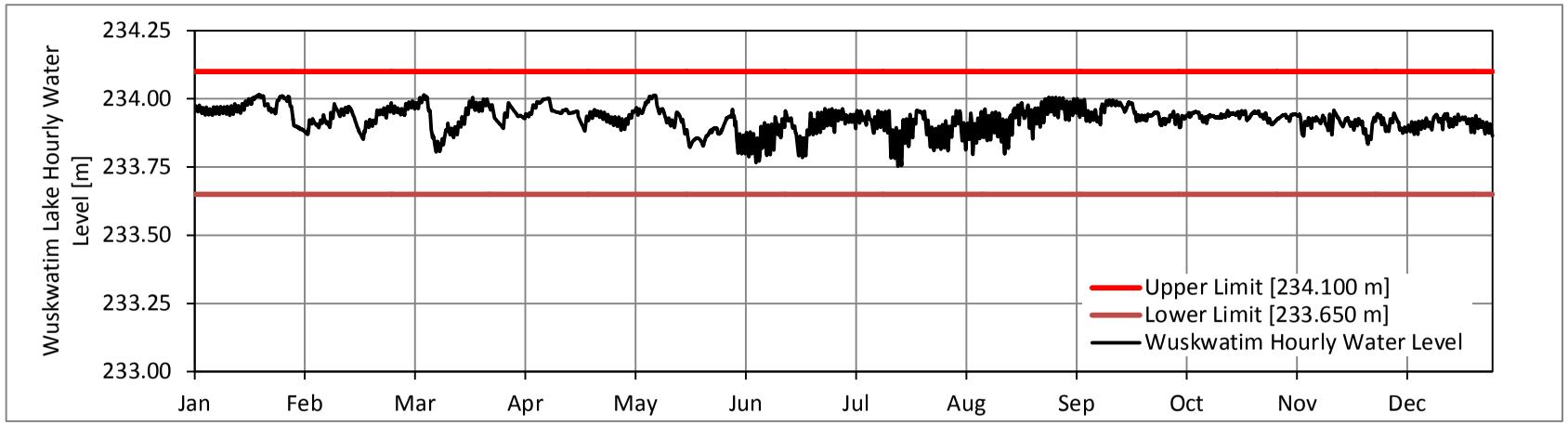
FIGURE 3



Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPARTMENT	
	HYDROLOGIC DATA ACQUISITION AND MANAGEMENT SYSTEM	
	REMOTE DATA PROCESS MAP	
	PROJECT ANNUAL WATER LEVELS REPORT	FIGURE 4

Wuskwatim Generating Station - Wuskwatim Lake Hourly Water Levels Compliance Report for 2017





Note:
Wuskwatim Hourly Water Level is calculated using Wuskwatim Lake gauges 05TF006, 05TF774 & 05TF775.

Manitoba Hydro	MANITOBA HYDRO
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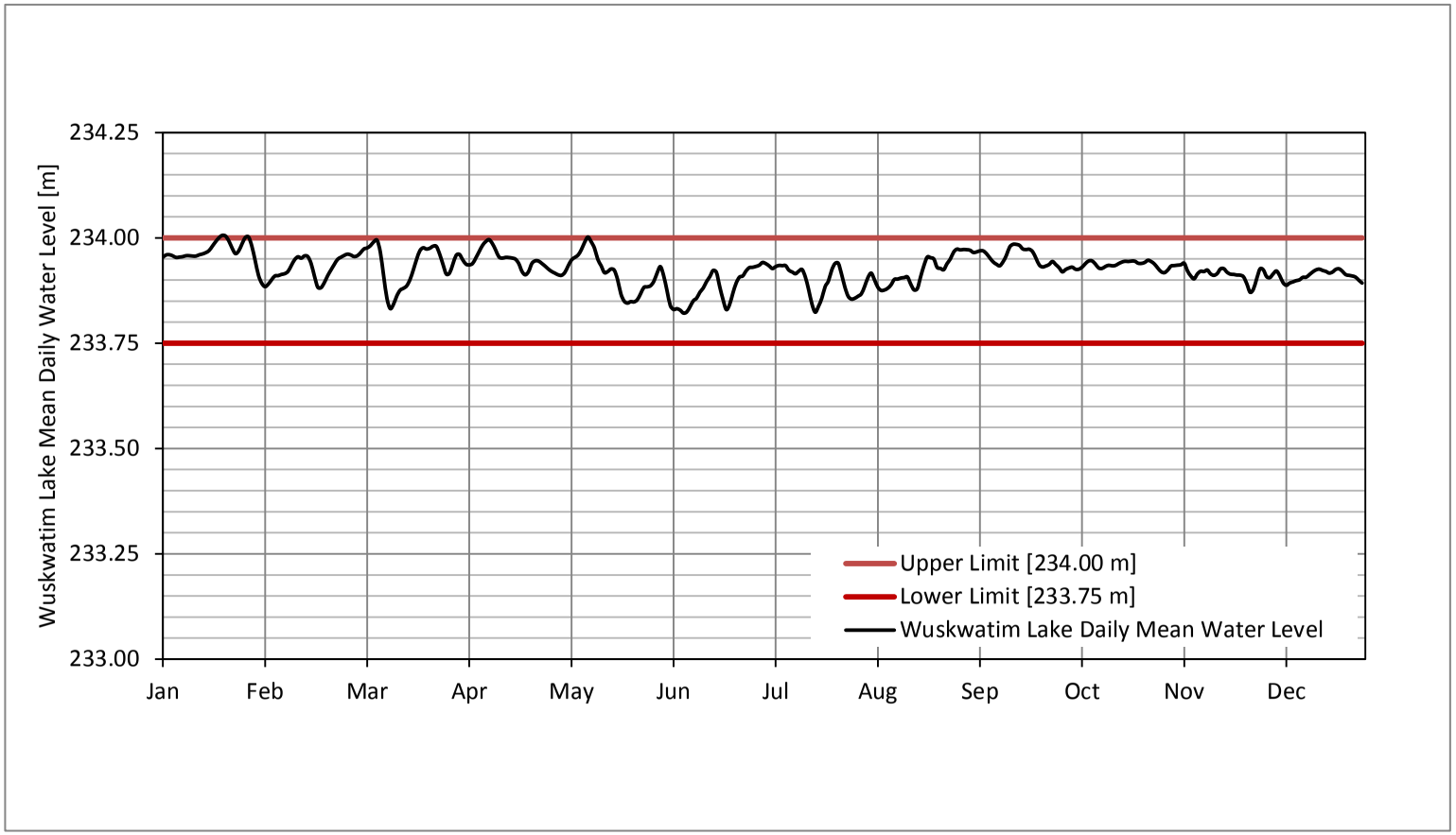
	WUSKWATIM GENERATING STATION
	WUSKWATIM LAKE HOURLY WL (2017)
	PROJECT ANNUAL WATER LEVEL REPORT — FIGURE 5

Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level Compliance Report for 2017



Note:
Wuskwatim Lake Mean Daily Water Level is calculated using Wuskwatim Lake gauges 05TF006, 05TF774 & 05TF775.

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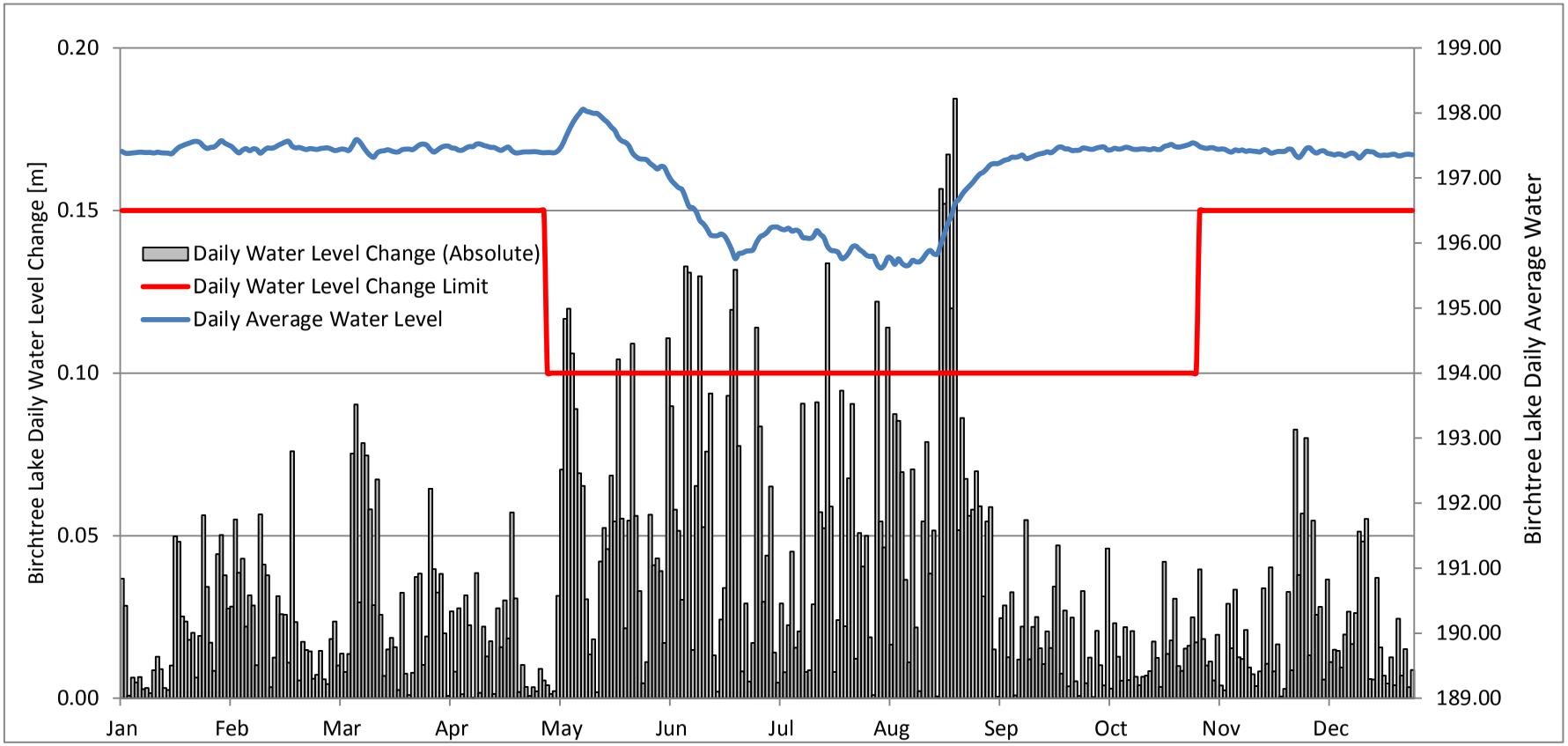
	WUSKWATIM GENERATING STATION
	WUSKWATIM LAKE MEAN DAILY WL (2017)
	PROJECT ANNUAL WATER LEVEL REPORT — FIGURE 6

Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change Compliance Report for 2017



Note:
The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701 & 05TG746.
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions

Manitoba Hydro	MANITOBA HYDRO	
	HYDRAULIC OPERATIONS DEPT.	
	WUSKWATIM GENERATING STATION	
	BIRCHTREE LAKE DAILY WL CHANGE (2017)	
	PROJECT ANNUAL WATER LEVEL REPORT	FIGURE 7

APPENDIX I

CORRESPONDENCE WITH MANITOBA SUSTAINABLE DEVELOPMENT

Manitoba Hydro

360 Portage Ave (16) • Winnipeg Manitoba Canada • R3C 0G8
Telephone / *N° de téléphone :* 204-360-3018 • Fax / *N° de télécopieur :* 204-360-6136
wpenner@hydro.mb.ca

2017 01 26

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - WATER POWER & ENVIRONMENT ACT LICENCES - DAILY AVERAGE LEVEL ABOVE LICENCE LIMIT

On January 19, 2017, the mean daily water level variation on Wuskwatim Lake was above the licence limit specified in Article 4 of the Wuskwatim Water Power Act Licence and clause 30 of *The Environment Act* Licence No. 2699.

The Wuskwatim Lake mean daily water level exceeded the upper licence limit of 234.0 metres by a maximum of 0.01 metre on this day. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

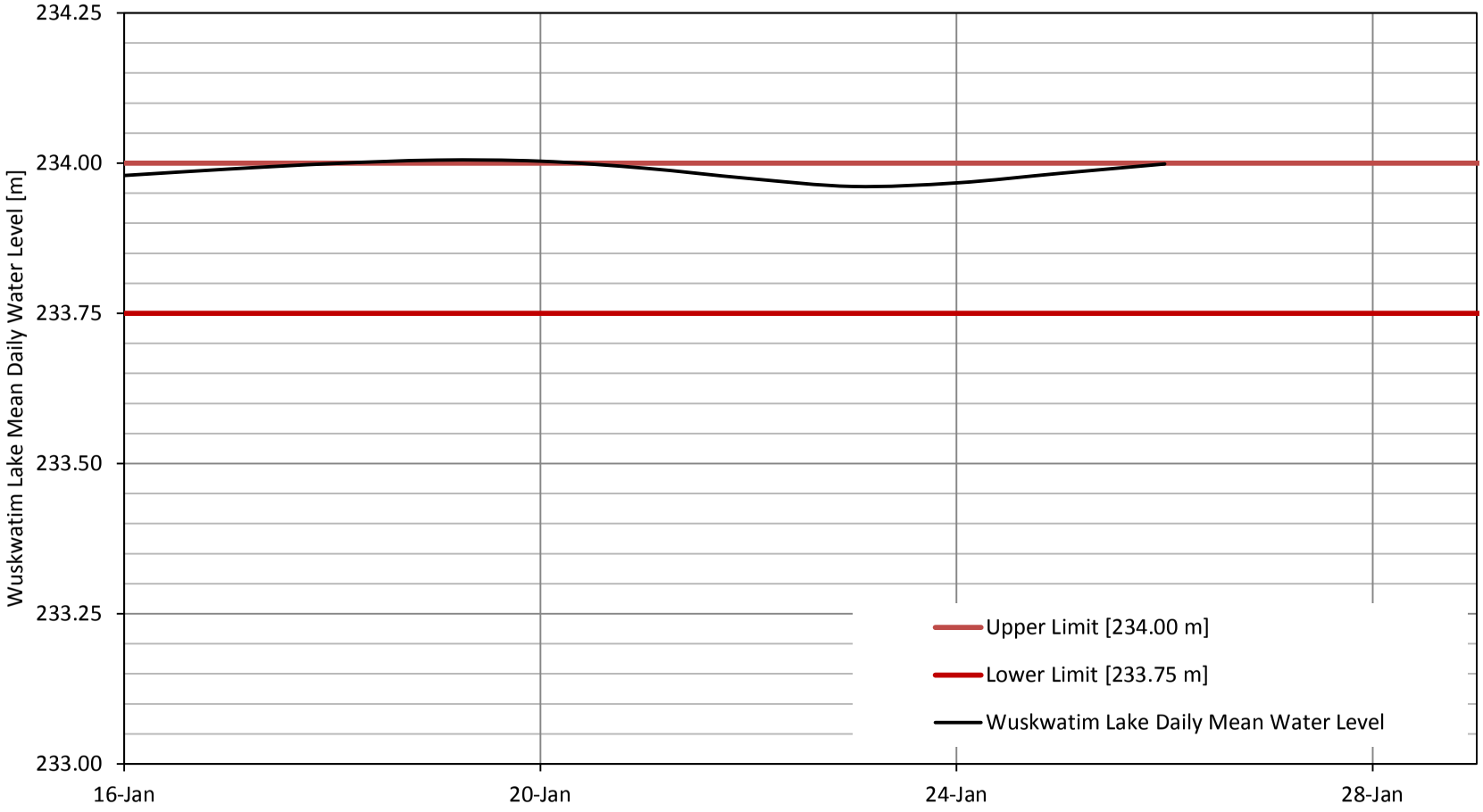
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl00184-07311-0055_00
Att.

Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level



Manitoba Hydro

360 Portage Ave (16) • Winnipeg Manitoba Canada • R3C 0G8
Telephone / *N° de téléphone :* 204-360-3018 • Fax / *N° de télécopieur :* 204-360-6136
wpenner@hydro.mb.ca

2017 02 24

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200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - WATER POWER AND ENVIRONMENT ACT LICENCES - DAILY AVERAGE LAKE LEVEL ABOVE LICENCE LIMIT

The following is an explanation of the event that caused the level of Wuskwatim Lake to rise above the licence limit specified in Article 4 of the Wuskwatim Water Power Act Licence and clause 30 of Environment Act Licence No. 2699 on January 19, 2017. This letter supplements our January 26, 2017 report regarding this incident.

There was an increase in inflow to Wuskwatim Lake from January 14 to 30 because of a warm weather period that caused the mean daily water level to exceed the upper licence limit of 234.0 metres (m) by a maximum of 0.01 m (Figure 1). The warm weather was enough to release water from storage upstream of the many sets of rapids between Wuskwatim Lake and Nelson House. This additional inflow without easing of lake outlet restriction caused Wuskwatim Lake to rise. Wuskwatim GS outflow was increased starting on Jan 15 to keep the Wuskwatim level below the upper licence limit but without knowing how much additional inflow there was, or the duration, site staff were unable to prevent this exceedance.

A similar incident occurred in January 2015 and Manitoba Hydro took steps to ensure that operating staff are aware of the lake level. In this case, staff were watching the lake level but our ability to respond to this type of incident remains limited due to concerns about creating a downstream licence exceedance at Birch Tree Lake and due to imperfect foreknowledge about the extent of these events.

If you have any questions about this matter, please call me at (204) 360-3018.

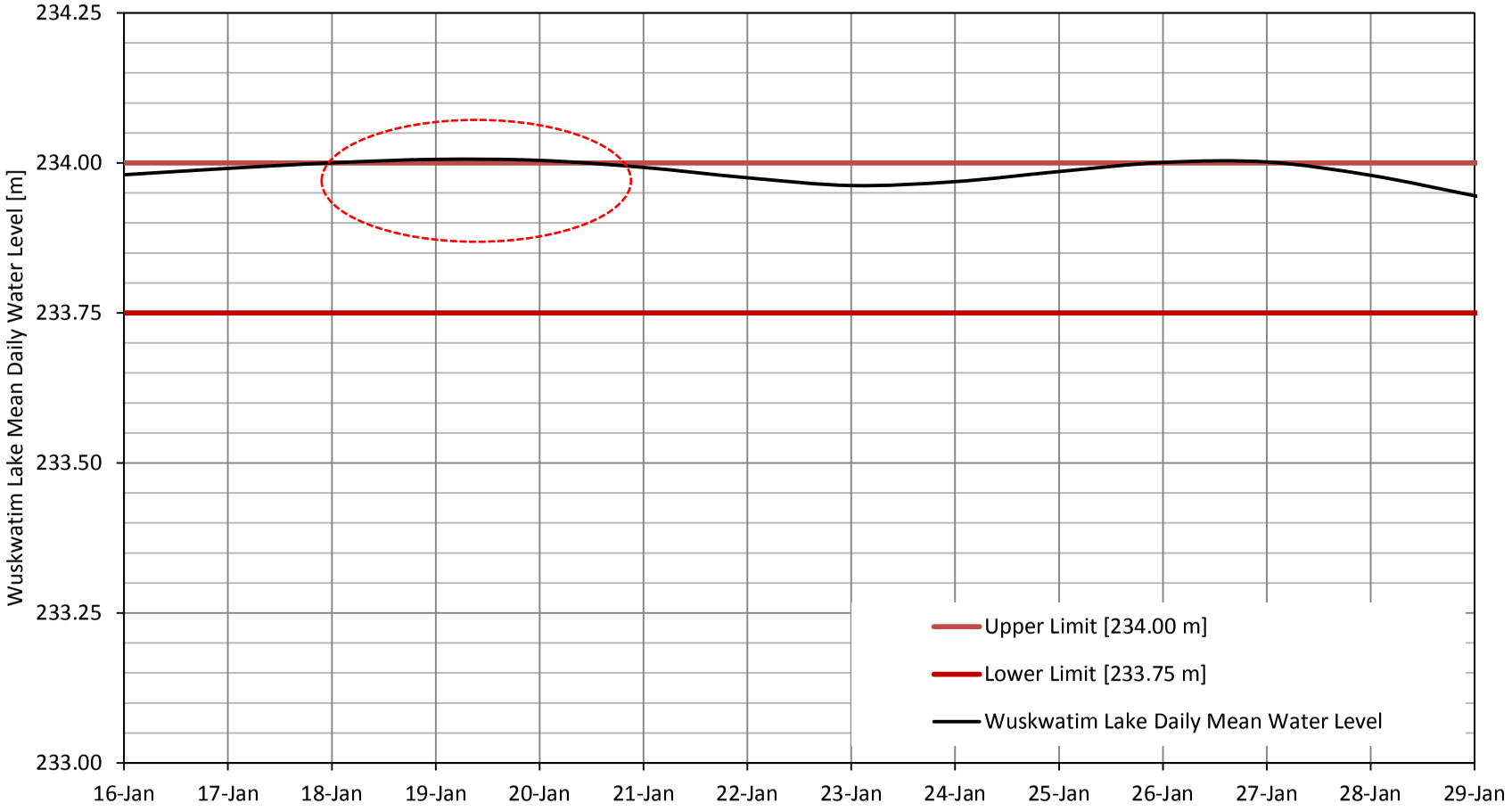
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0059_00
Att.

Figure 1: Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level



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wpenner@hydro.mb.ca

2017 05 10

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIAITON ABOVE LICENCE LIMIT

On May 6, 7 and 8, 2017, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level changes were 0.12, 0.12 and 0.11 metres on May 6, 7 and 8 respectively (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

Yours truly,

Original signed by, *Wesley Penner*

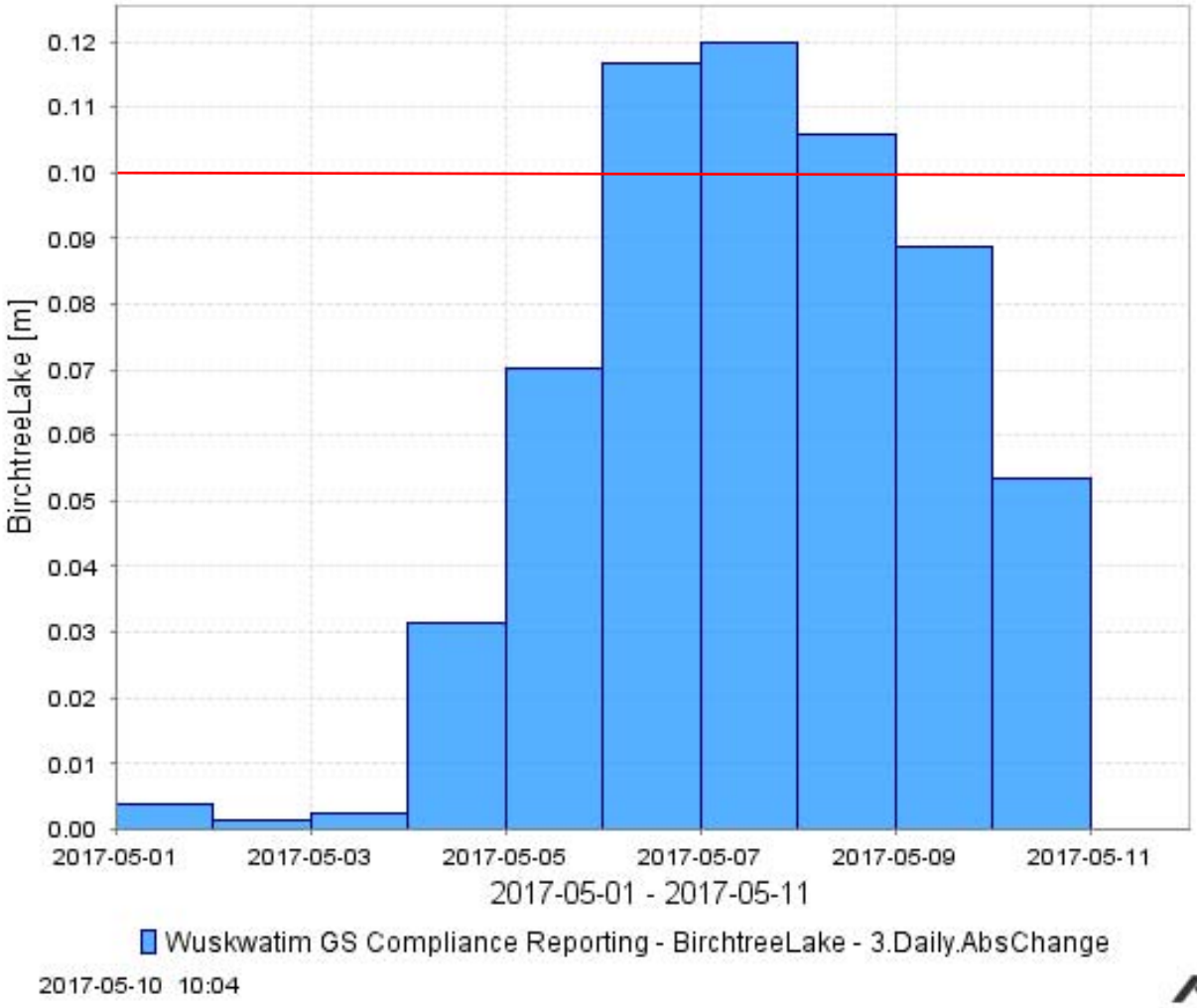
W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0060_00
Att.

Figure 1:

Manitoba Hydro

HyDams - Hydrological Data Acquisition & Management



Manitoba Hydro

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2017 05 31

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LIMIT

On May 25, 2017, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.11 metres on May 25, 2017 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

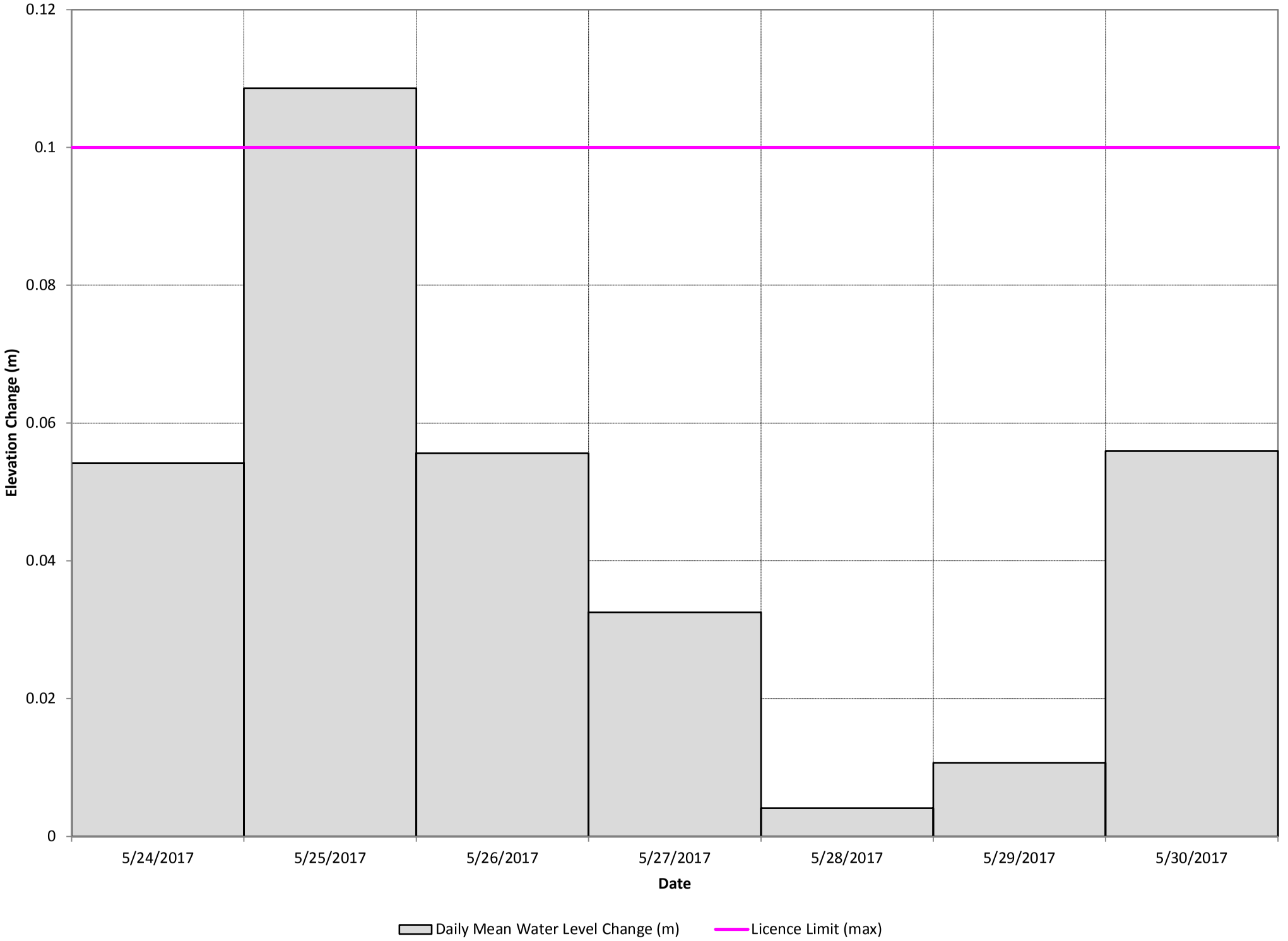
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

PCG/sl/00184-07311-0063_00
Att.

Figure 1: Birchtree Lake Daily Water Level Change -- 7 Day Elevation Licence Compliance



Manitoba Hydro

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wvpenner@hydro.mb.ca

2017 06 08

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On June 4, 2017, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.11 metres on June 4, 2017 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

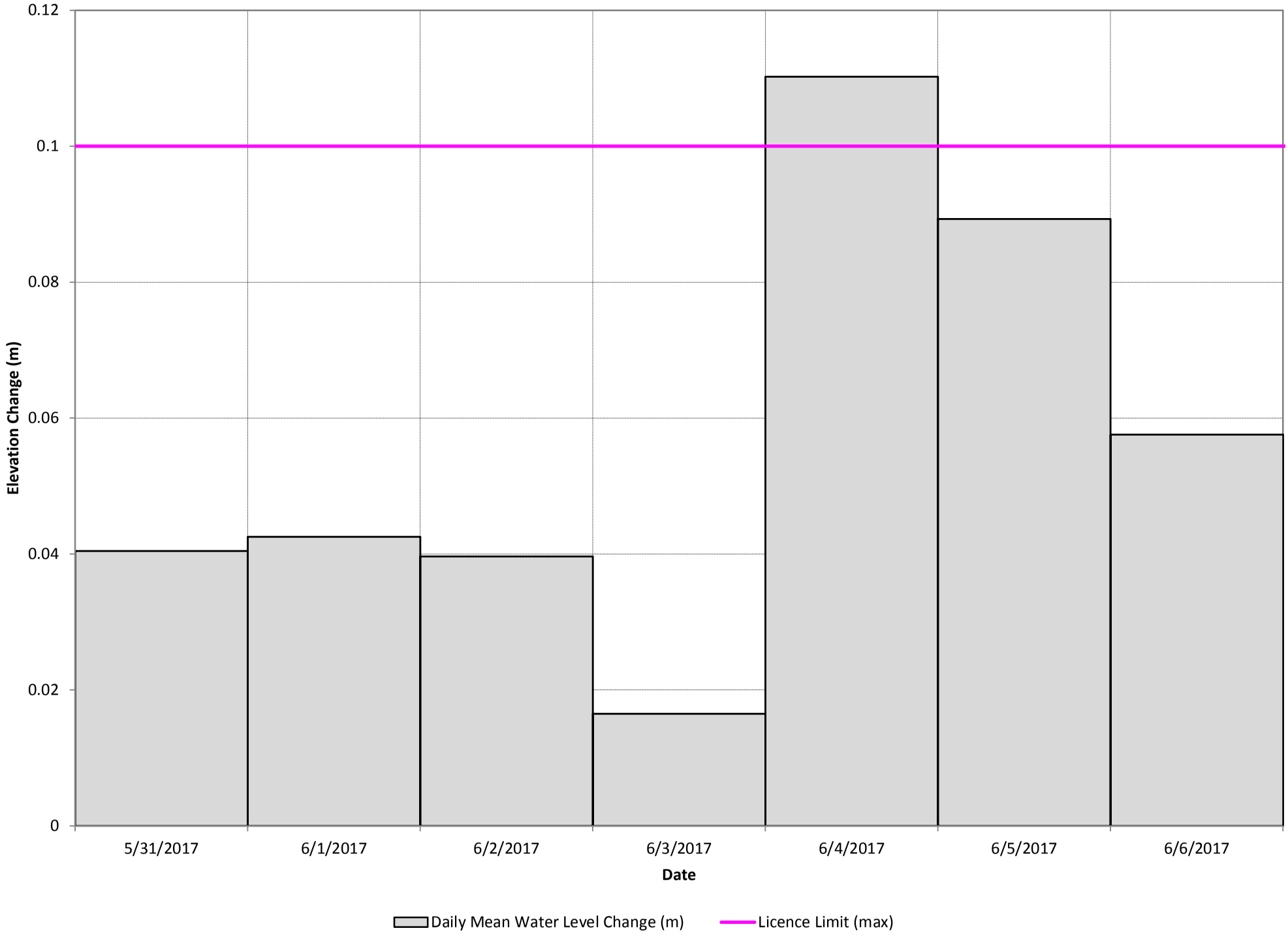
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

PGC/sl/00184-07311-0064_00
Att.

Figure 1: Birchtree Lake Daily Water Level Change - 7 Day Elevation Licence Compliance



Manitoba Hydro

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2017 06 15

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On June 9, 10, and 13, 2017, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.13 metres on June 9, 10, and 13, 2017 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

Yours truly,

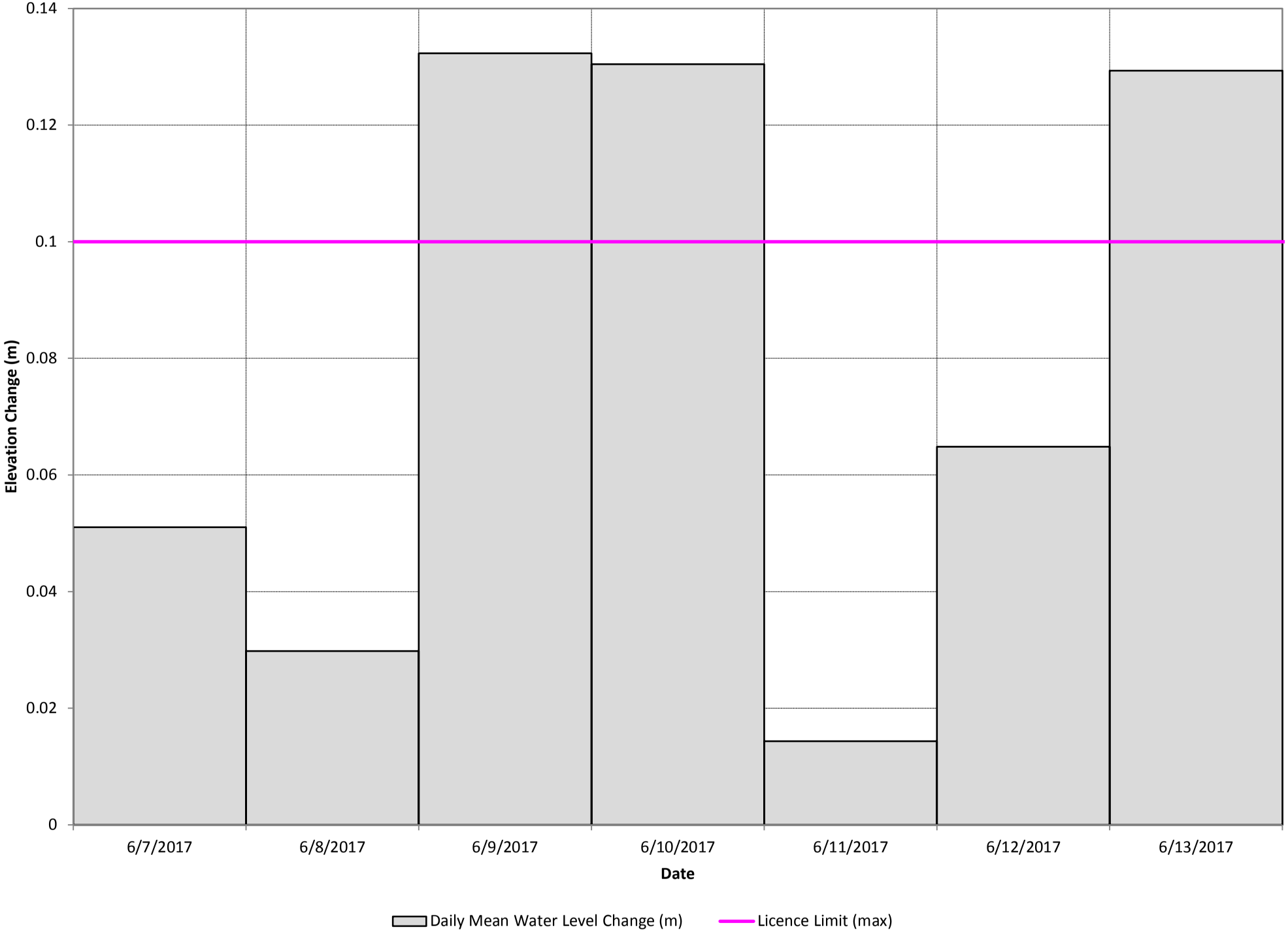
p.p. Original signed by, *Brian Giesbrecht*

Wesley Penner

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

PGC/sl/00184-07311-0065_00
Att.

Figure 1: Birchtree Lake Daily Water Level Change -- 7 Day Elevation Licence Compliance



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2017 06 26

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On June 22 and 23, 2017, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change were 0.12 and 0.13 metres on June 22 and 23 respectively (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

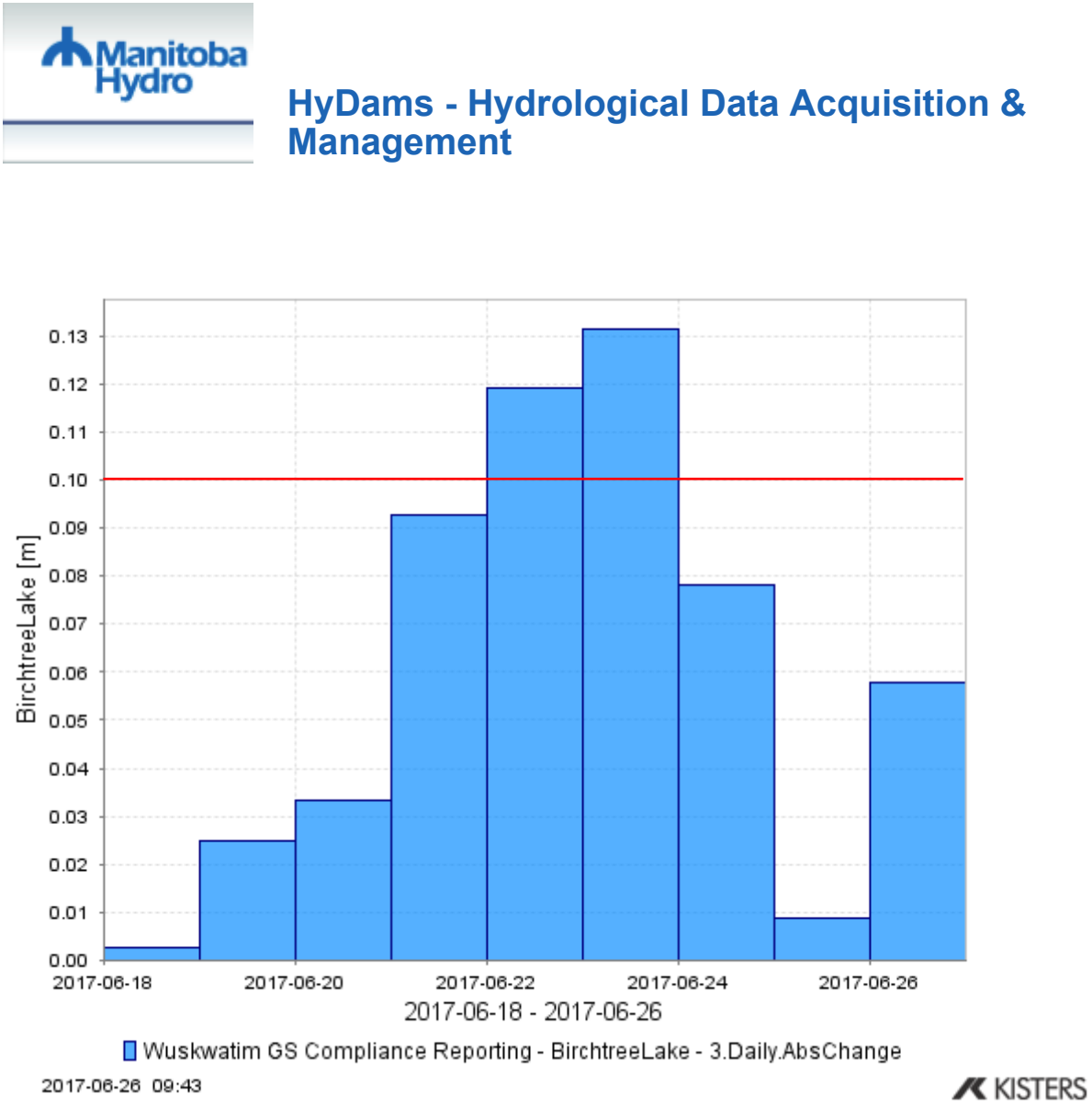
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0066_00
Att.

Figure 1:


Manitoba Hydro
HyDams - Hydrological Data Acquisition & Management
BirchtreeLake [m]
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2017-06-22
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2017-06-18 - 2017-06-26
Wuskwatim GS Compliance Reporting - BirchtreeLake - 3.Daily.AbsChange
2017-06-26 09:43
KISTERS

Manitoba Hydro

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wvpenner@hydro.mb.ca

2017 07 04

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On June 29, 2017, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.12 metres on June 29 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

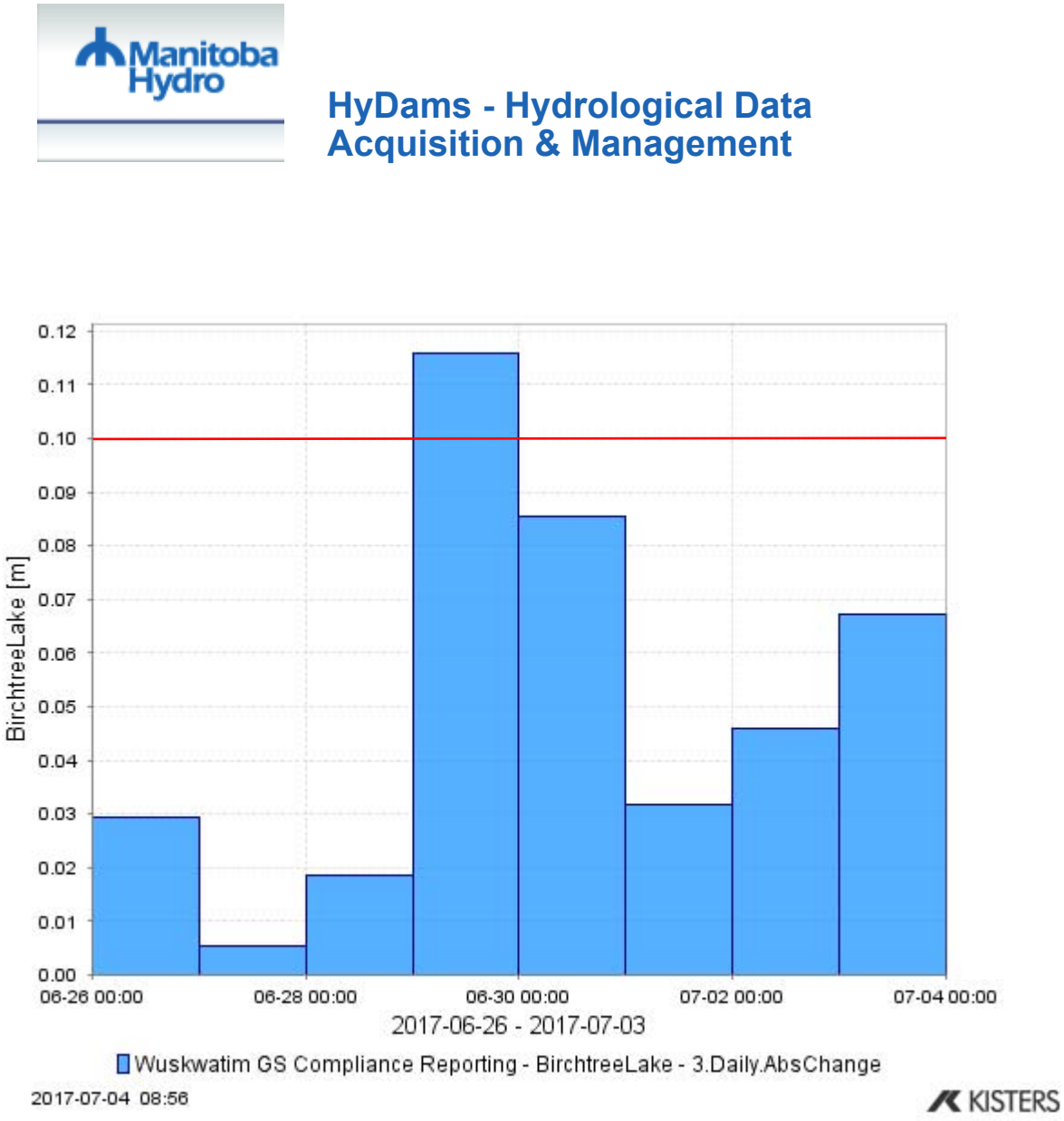
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0067_00
Att.

Figure 1:


Manitoba Hydro
HyDams - Hydrological Data Acquisition & Management
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BirchtreeLake [m]
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06-28 00:00
06-30 00:00
07-02 00:00
07-04 00:00
2017-06-26 - 2017-07-03
Wuskwatim GS Compliance Reporting - BirchtreeLake - 3.Daily.AbsChange
2017-07-04 08:56
KISTERS

Manitoba Hydro

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wvpenner@hydro.mb.ca

2017 08 03

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr. Matthews:

WUSKWATIM GENERATING STATION - BIRCH TREE LAKE ENVIRONMENT ACT LICENCE - MEAN DALILY WATER LEVEL ABOVE LICENCE LIMIT

On July 19, 2017, the mean daily water level variation on Birch Tree Lake was above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level change was 0.134 metres on July 19 (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

Yours truly,

p.p. Original signed by *Michael Baldaro*

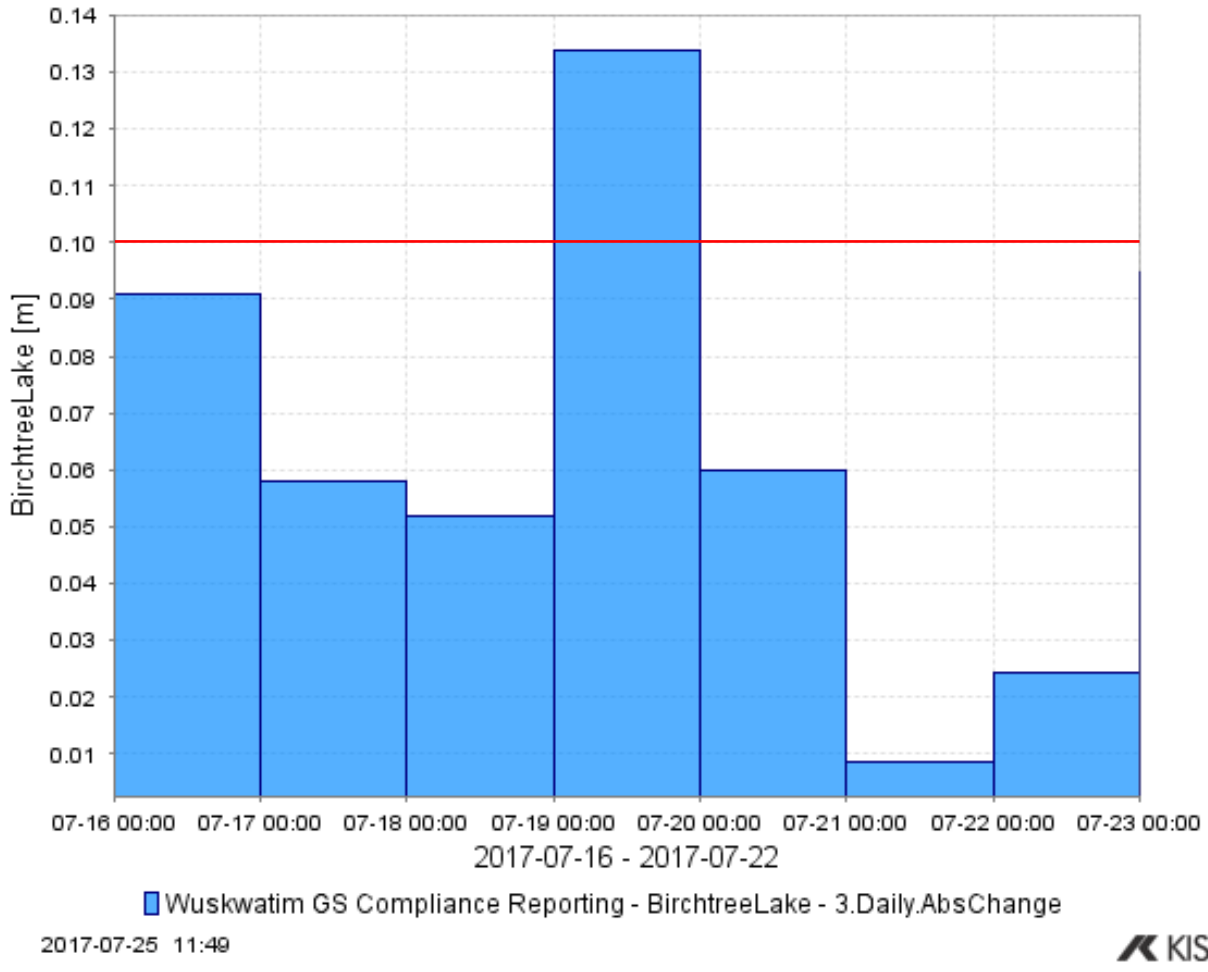
Wesley Penner

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0068_00
Att.

Manitoba Hydro

HyDams - Hydrological Data Acquisition & Management



Manitoba Hydro

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wvpenner@hydro.mb.ca

2017 08 09

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr Matthews:

WUSKWATIM GENERATING STATION ENVIRNOMENT ACT LICENCE - BIRCH TREE LAKE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On August 2 and 5, 2017, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level changes were 0.12 and 0.11 metres on August 2 and 5 respectively (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

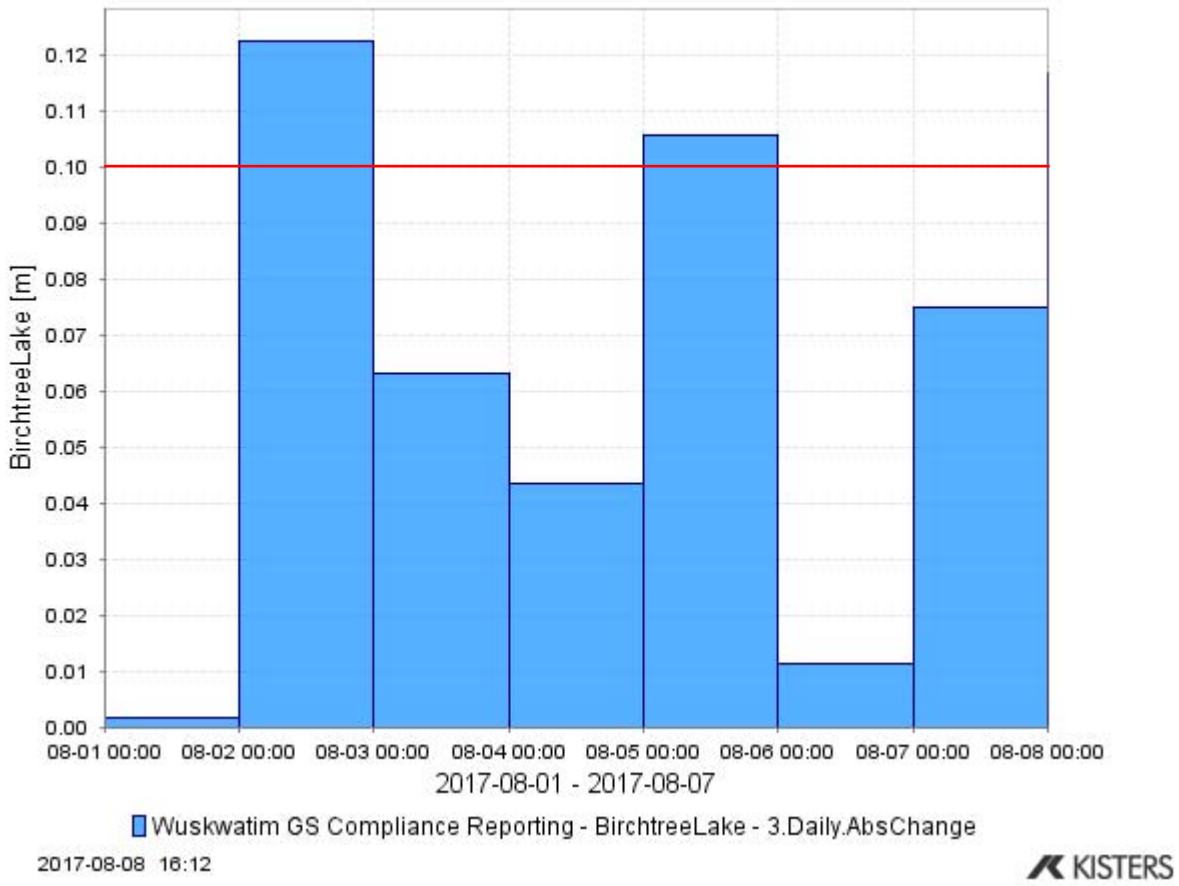
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0069_00
Att.

HyDams - Hydrological Data Acquisition & Management



Manitoba Hydro

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wvpenner@hydro.mb.ca

2017 08 17

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr Matthews:

WUSKWATIM GENERATING STATION ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On May 6, 7 and 8, 2017, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699 (Figure 1). With little storage available on Wuskwatim Lake between the upper and lower licence limits to store flood waters and dampen flood peaks, the rapidly rising inflow from the spring freshet was passed through the station and caused the daily water level change to exceed the licence limit on Birch Tree Lake for three consecutive days as explained below. These exceedances are not attributable to Wuskwatim operations. This letter supplements our May 10, 2017 letter regarding this incident.

May 6, 2017
Wuskwatim Lake level began rising on May 3 and on May 6, Wuskwatim Generating Station (WGS) stopped cycling and changed to sustained flow operation of the three units to avoid exceeding the Wuskwatim Lake Hourly and Mean Daily Water level licence limits. This caused the Birch Tree Lake water level to rise and exceed the daily water level change limit on May 6 by 0.02 metres (m).

May 7, 2017
The Wuskwatim Lake level continued to rise despite full gate operation of the three units. This prompted the WGS to initiate spill at around 7:00 pm. This caused the Birch Tree Lake water level to rise and exceed the daily water level change limit on May 7 by 0.02 m.

May 8, 2017
The WGS spill continued to affect the Birch Tree Lake water level and for the third day exceeded the Birch Tree Lake daily water level change limit on May 8 by 0.01 m.

In addition, model output indicates that the outflow from Birch Tree Lake was higher than the flow coming from Opegano Lake, located between Wuskwatim and Birch Tree Lake. This indicates that local run-off from the rapid melt also contributed to the Birch Tree Lake daily water level change limit exceedances.

The Wuskwatim Lake Mean Daily Water Level and Hourly level were maintained within the licence limits during this period (Figure 2 and 3).

If you have any questions about this matter, please call me at (204) 360-3018.

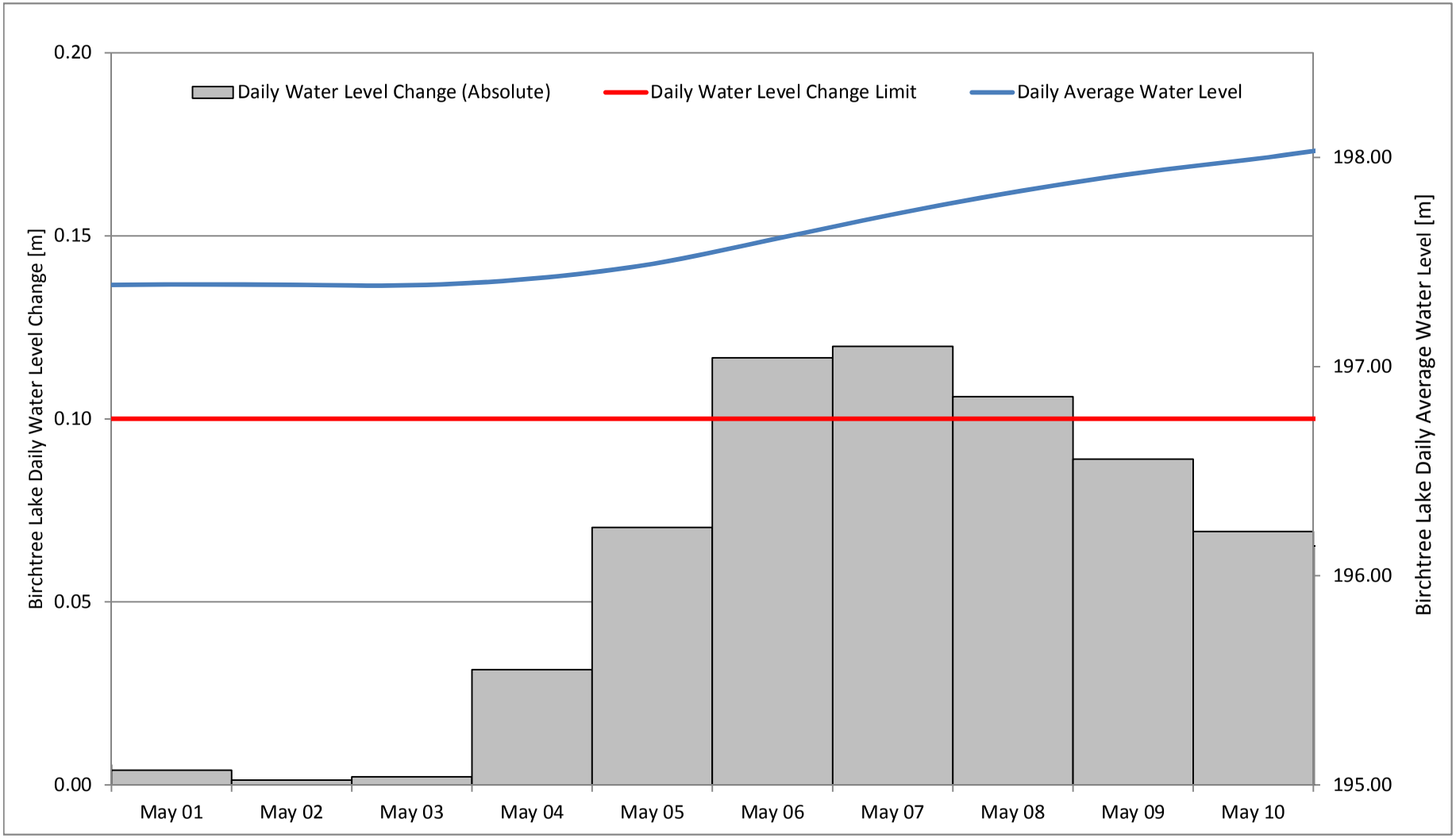
Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl00184-07311-0070_00
Att.

Figure 1: Wuskwatim Generating Station - Birchtree Lake Daily Water Level Change May 2017



Note: The Birchtree Lake Daily Water Level Change is calculated using Birchtree Lake gauges 05TG701 & 05TG746
The daily water level change limit is equal to 0.1 m in open water conditions (May 1 to October 31) and 0.15 m in winter conditions (November 1 to April 30)

Figure 2: Wuskwatim Generating Station - Wuskwatim Lake Mean Daily Water Level

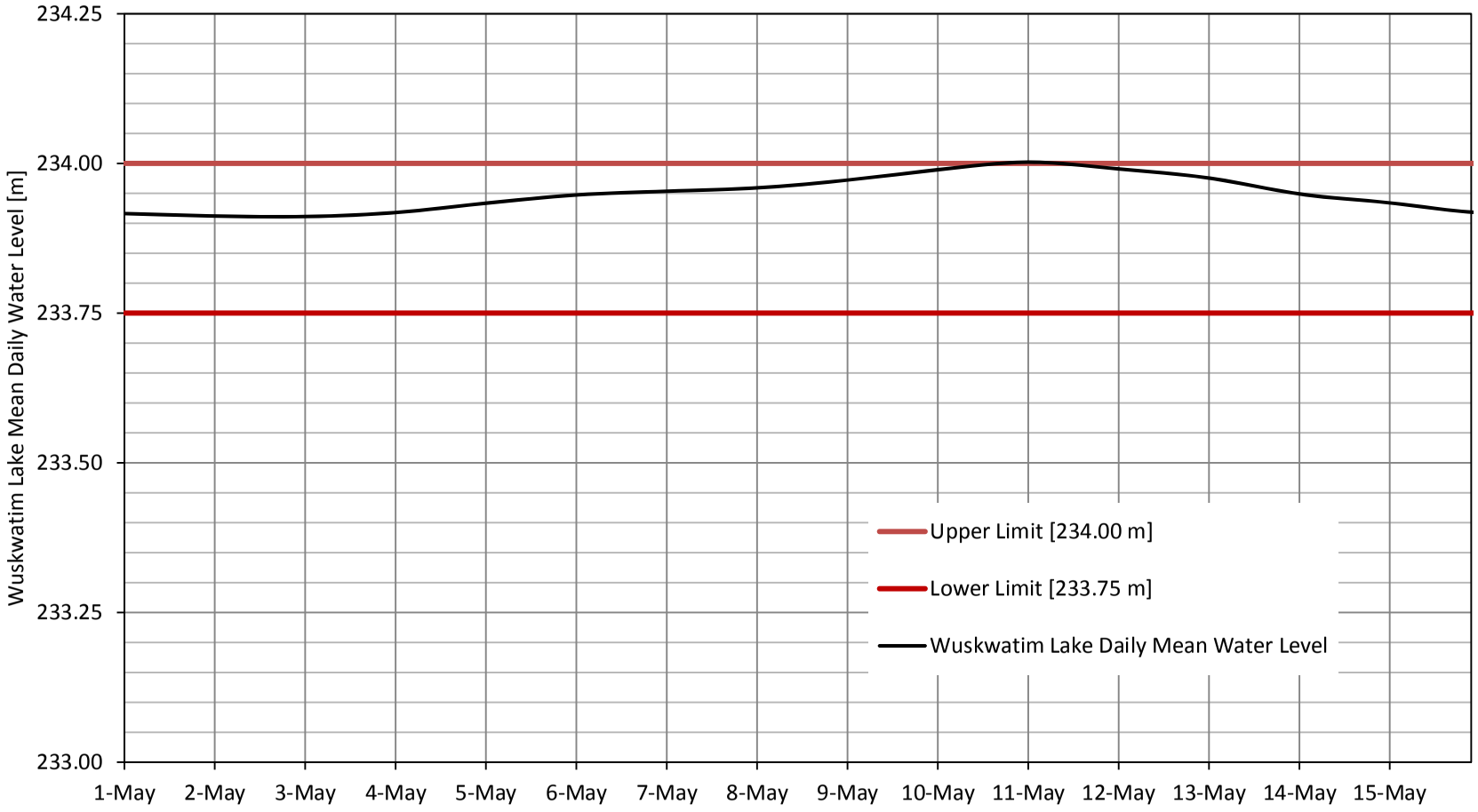
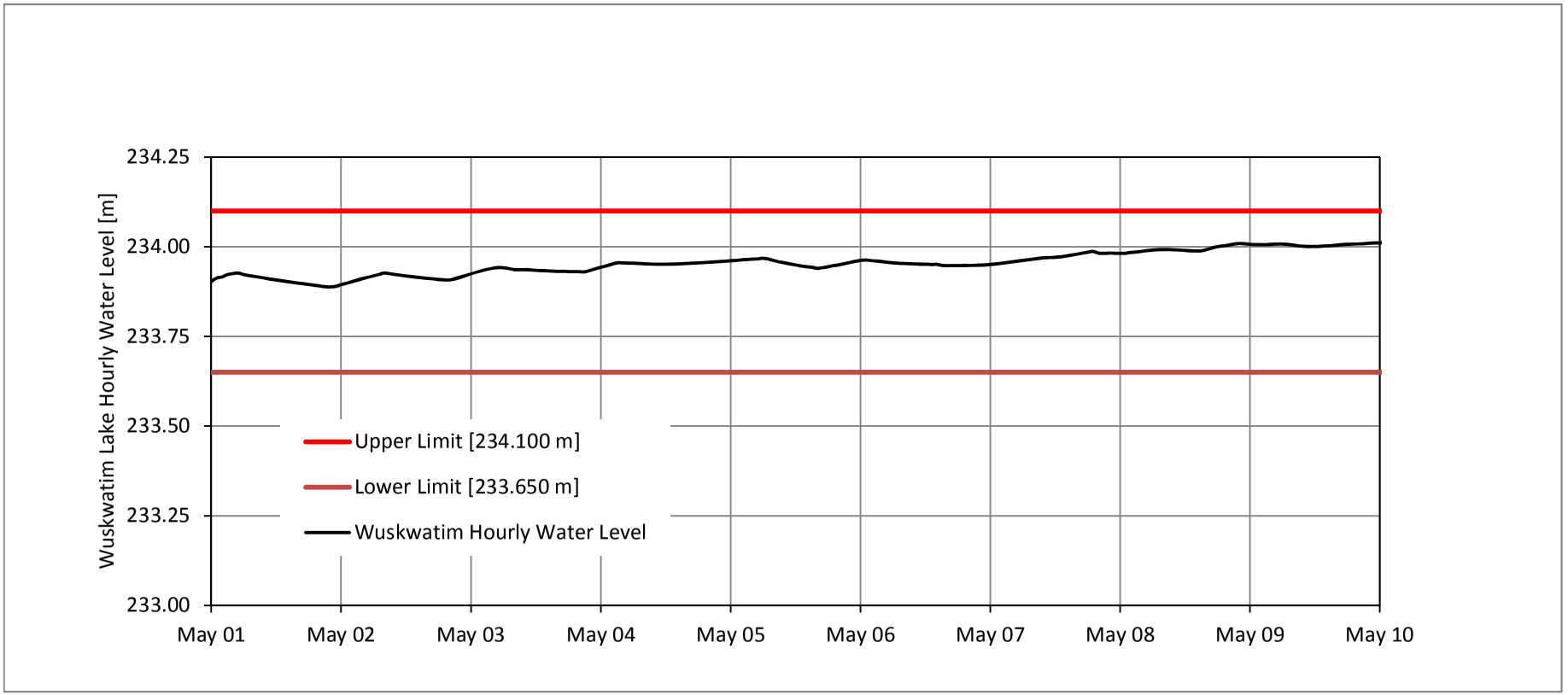


Figure 3: Wuskwatim Generating Station - Wuskwatim Lake Hourly Water Levels May 2017



Manitoba Hydro

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wvpenner@hydro.mb.ca

2017 08 28

R. Matthews, P.Geo.
Manager, Water Use Licensing
Manitoba Sustainable Development
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Dear Mr Matthews:

WUSKWATIM GENERATING STATION ENVIRONMENT ACT LICENCE - BIRCH TREE LAKE - MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

On August 20 to 24, 2017, the mean daily water level variations on Birch Tree Lake were above the licence limit specified in clause 30 (b) of *The Environment Act* Licence No. 2699.

The Birch Tree Lake daily water level changes were 0.157, 0.152, 0.167, 0.120 and 0.185 metres on August 20 to 24 respectively (Figure 1). Clause 30(b) of *The Environment Act* Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 m under open water conditions. Hydraulic Operations Department is investigating the incident and we will advise you of the outcome.

If you have any questions about this matter, please call me at (204) 360-3018.

Yours truly,

p.p. Original signed by, *Brian Giesbrecht*

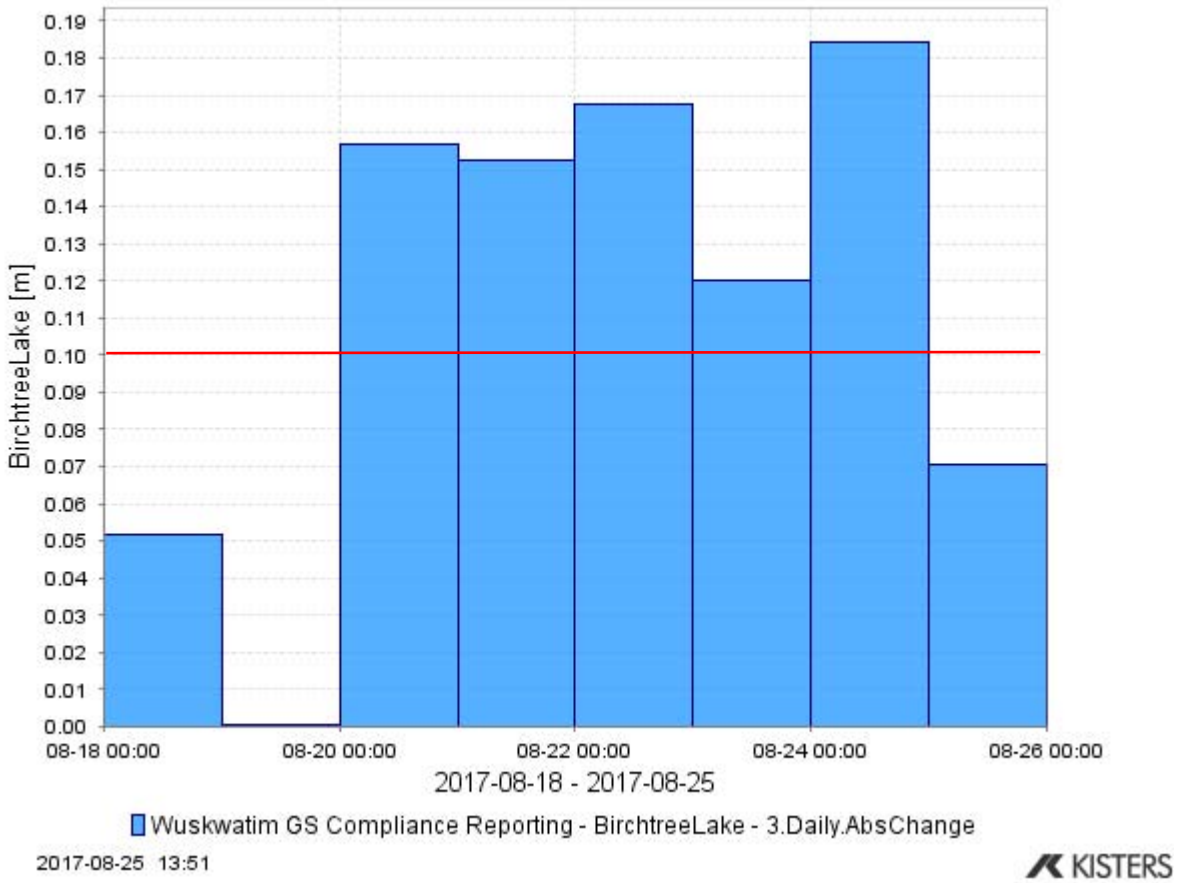
Wesley Penner

W.V. Penner, P. Eng.
Manager
Hydraulic Operations Department

MJD/sl/00184-07311-0071_00
Att.

Manitoba Hydro

HyDams - Hydrological Data Acquisition & Management



Manitoba Hydro

2018 02 01

Mr. R. Matthews, P. Geo.
Manager, Water Power Licensing
Manitoba Sustainable Development
200 Salteaux Crescent
Winnipeg, MB R3J 3W3

Dear Mr Matthews:

WUSKWATIM GENERATING STATION ENVIRONMENT ACT LICENCE – BIRCH TREE LAKE – MEAN DAILY WATER LEVEL VARIATION ABOVE LICENCE LIMIT

From May 25 to August 24, 2017, there were 16 incidents where the mean daily water level variation on Birch Tree Lake was above the licence limit. Clause 30 (b) of The Environment Act Licence No. 2699 limits mean daily water level variations on Birch Tree Lake to 0.10 metres (m) under open water conditions. This letter supplements our previous reports regarding these incidents.

The following table summarizes the 16 incidents where the Birch Tree Lake daily water level change was above the licence limit. As described below, 8 incidents are attributed to Wuskwatim operations and are considered licence violations, while the other 8 incidents are not attributed to Wuskwatim operations:

Incidents attributed to Wuskwatim operations	Incidents not attributed to Wuskwatim operations
May 25 (0.11 m)	June 29 (0.11 m)
June 4 (0.11 m)	August 2 (0.12 m)
June 9 (0.13 m)	August 5 (0.11 m)
June 10 (0.13 m)	August 20 (0.16 m)
June 13 (0.13 m)	August 21 (0.15 m)
June 22 (0.12 m)	August 22 (0.17 m)
June 23 (0.13 m)	August 23 (0.12 m)
July 19 (0.13 m)	August 24 (0.18 m)

Incidents attributed to Wuskwatim operations:
The seven exceedances between May 25 and June 23 occurred during a period of rapidly declining inflow to Wuskwatim due to a flow reduction at Notigi and a decline in local inflow. Notigi Control Structure outflow was reduced to a record low of 10,000 cfs in mid-May in response to a state of emergency declared by Tataskweyak Cree Nation on May 17 because of record high water levels on Split Lake. Manitoba Hydro modified the flow pattern at Wuskwatim Generating Station in an attempt to remain within the licence limits on both

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wvpenner@hydro.mb.ca

Wuskwatim and Birch Tree lakes. However, we were unsuccessful and there were still some exceedances as stated on the above dates.

On July 19, Wuskwatim Generating Station changed cycling patterns to deal with a decrease in local inflow. The change in cycling pattern caused Birch Tree Lake to exceed the mean daily water level variation limit by 0.03 m. Manitoba Hydro continues to investigate the cycling mode transitions that appear to be causing these licence exceedances.

Incidents not attributed to Wuskwatim operations:
Hydraulic modeling determined that Wuskwatim Generating Station operations would have caused a Birch Tree Lake daily change of 0.10 m on June 29, August 2, and August 5. Changes in local inflow can contribute to additional water level variation such that the total daily change is above the 0.10 m limit. Also, the August 20 to 24 exceedances occurred during a period of rapidly increasing inflow to Wuskwatim as Notigi outflow was increased back up to maximum. Hydraulic modeling determined that these exceedances were the result of the rapid increase in Notigi outflow and that Wuskwatim Generating Station could not have been operated to avoid the Birch Tree Lake exceedances. For these reasons, the June 29, August 2, August 5 and August 20 to 24 incidents are not considered licence violations.

If you have any questions about this matter, please call me at (204) 360-3018.

Yours truly,

Original signed by, *Wesley Penner*

W.V. Penner, P.Eng
Manager
Hydraulic Operations Department

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Att.