

Enerdu Power Systems Ltd.

Enerdu Monitoring Program Summary Report

HS00151

21 December 2017

CIMA+ HS00151

Table of Contents

Introduction 1

Background 1

Methodology 3

 Surface Water Logger Installation 3

 Groundwater Logger Installation 4

RESULTS and DISCUSSION 5

 Surface water 5

 Groundwater 8

Summary 9

List of Tables

Table 1: Available discharge structure during Enerdu redevelopment project construction 6

List of Figures

FIGURE 1: PROPOSED SURFACE WATER AND GROUNDWATER MONITORING LOCATIONS JULY 2016 11

FIGURE 2: DECEMBER 2016 INSTALLED SURFACE WATER MONITORING LOCATION LOWRY FARM 12

FIGURE 3: DECEMBER 2016 INSTALLED SURFACE WATER MONITORING LOCATION BRIDGE STREET BRIDGE ALMONTE 13

FIGURE 4: 2017 INSTALLED GROUNDWATER MONITORING LOCATIONS APPLETON WETLAND 14

FIGURE 5: WATER LEVEL DATA AT ALL SURFACE WATER MONITORING LOCATIONS 7

FIGURE 6: WATER LEVEL DATA AT ALL GROUNDWATER MONITORING LOCATIONS COMPARED TO ENERDU AND LOWRY FARM GAUGES 8

List of Appendices

- APPENDIX A: COMMUNICATIONS RECORD
- APPENDIX B: OHT ACCESS AGREEMENT
- APPENDIX C: PHOTO LOG
- APPENDIX D: BOREHOLE LOGS
- APPENDIX E: RECORDED WATER LEVEL AND PRECIPITATION DATA

Introduction

On June 23, 2016, the Director, MOECC, issued a Permit To Take Water, NUMBER 2527-A4EMK8 pursuant to Section 34.1 of the *Ontario Water Resources Act* (1990), in order to cancel and replace the existing Permit Number 8715-6F6NQG, issued on August 8, 2005 and which had expired in the fall of 2015. The PTTW NUMBER 2527-A4EMK8 authorized the continual taking of surface water from the Mississippi River by Enerdu Power Systems Ltd. (Enerdu) for the purpose of generating electricity at their waterpower facility located at 11 Main St. in Almonte, Mississippi Mills, County of Lanark. The June 23, 2016 Permit To Take Water, NUMBER 2527-A4EMK8 represented no change in the source, amount or location of water taking from the previous permit Number 8715-6F6NQG but was upgraded from a Category 1 to a Category 3 application due to local interest in the facility and the permit.

As with all documents of this type, there were conditions associated with the PTTW NUMBER 2527-A4EMK8. Condition No. 4 outlines the requirement for monitoring of nearby surface water features in order to address concerns raised by local stakeholders and the local conservation authority (MVCA) during the public consultation process associated with the issuance of the permit. As a result of this permit condition, a surface water and groundwater monitoring plan was established for the Enerdu facility. The purpose of the monitoring plan was to collect data that compares water levels and flows at the monitoring locations between Appleton and Almonte and within the Appleton Wetland to precipitation events and to the date and times flashboards on the weirs are installed and removed in order to determine how surface and ground water levels within the wetland respond to manipulation of the flashboards. A report providing an analysis of all data collected was to be submitted to the Director by December 31, 2017.

Therefore, this report is submitted in order to satisfy Condition 4.9 of the PTTW No. 2527-A4EMK8. It outlines the methodology by which the surface water and groundwater monitoring network was established and presents results from a five month monitoring period, along with an analysis of the data and information collected.

Background

Although, Condition 4 of the PTTW No. 2527-A4EMK8 requested that the monitoring network was to be established “as soon as practicable in order to capture monitoring data by mid-summer of 2016”, it was not completely established until the summer of 2017 for various reasons. These reasons are outlined below and are demonstrated by the record of communications presented in Appendix A.

The establishment of the groundwater monitoring network necessitated the acquiring of access permission from landowners as only one of the monitoring locations outlined in Schedule A – Table 1 of the PTTW No. 2527-A4EMK8 was situated on land owned by Enerdu Power Systems Ltd. (i.e. Monitoring Site #1 - Enerdu Facility Intake). Likewise, all groundwater monitoring sites were to be located within the Appleton Wetland; a land area

owned privately or by the Ontario Heritage Trust. The Ontario Heritage Trust lands are managed by the Mississippi Valley Conservation Authority, therefore, Enerdu was instructed to contact MVCA to acquire access rights for these locations.

Enerdu initiated contact with MVCA to gain access to the Ontario Heritage Trust properties in July 2016 with a proposed monitoring location map (Figure 1) and received notice of the three properties to consider via an email from MVCA on July 22nd, 2016. However, at the same timeframe a notice informing Enerdu that parties had filed with the Environmental Review Tribunal (ERT) was received. On July 14, 2016, an application for Leave to Appeal the Director's decision to approve the PTTW under s. 38 of the Environmental Bill of Rights, 1993 was filed by Mr. Young. This was quickly followed by another application for Leave to Appeal on July 19, 2016, filed by 25282086 Ontario Inc. ("Mississippi River Watchers" or "MRW") under s. 38 of the EBR. Therefore, in this uncertainty, all action in regard to access to the OHT properties was halted and any advancement on the monitoring program ceased as all parties were unsure of the outcome of these proceedings.

Approximately one month later, by mid-August 2016, Enerdu was anxious to follow-up with the land access item in order to be ready to proceed after the ERT decision was made. Enerdu contacted MVCA on August 17, 2016 (email correspondence Enerdu (Ron Campbell) to MVCA (John Price, Andy Moore and Paul Lehman). The MVCA informed Enerdu that instructions would be given at the end of August when key staff members had returned from summer holidays.

No further instructions were provided concerning access to the OHT lands until the ERT decision was received on September 30, 2016. The ERT Tribunal found that neither of the Applicants had satisfied the test for Leave to Appeal found in s. 41 of the EBR, in relation to Permit to Take Water No. 2527-A4EMK8. The applications for Leave to Appeal were therefore dismissed.

As a result, in early October Enerdu and their consultant CIMA contacted MVCA for further direction on access to the OHT properties. In early November the MVCA finally heard back from the OHT with instructions that a Permission to Enter Agreement signed by a signing officer of the company which is performing the work would be required along with the Company's insurance certificate. Enerdu submitted the required information to OHT via MVCA and a Permission to Enter Agreement was finalized on November 29, 2016 (Appendix B).

On December 14, 2016, Enerdu secured entry agreements with private landowners on both sides of the Mississippi River in order to access and install monitors at the Appleton wetland.

The installation field crews scouted the surface water monitors (water and barometer loggers) on December 14, 2016 and installation took place on December 19, 2016. The monitors at the retaining wall at the upstream side of Bridge Street bridge in Almonte and at the Appleton wetland area were installed (Appendix C). As the area upstream of the Enerdu facility was dewatered due to the construction of the new facility, the installation of the third logger at the facility's intake was deferred until 2017.

On December 19, 2016 a field crew visited the site the same day to work out the logistics of well drilling and to select the well locations. MOECC wanted to approve the locations prior to installations. Two locations were selected and proposed to the MOECC. The bush was very thick and difficult to pass through so the drilling contractor determined that a hand held portable drill rig would be used. Access would have to be from across the river by launching a boat from either the Lowry farm or the Appleton Bay area, as the bush was too dense to mobilize equipment and to operate survey equipment successfully from the east (Appendix C).

Between January 2017 and late June 2017 there were attempts to access the OHT Grace property for the installation of the groundwater monitors. However, a very warm winter resulted in the Mississippi River never freezing to a thickness that was safe to travel on. This was followed by unprecedented high spring water conditions in eastern Ontario. Ultimately, the river and wetland water levels did not retreat sufficiently in the wetland until July 2017. The reader is referred to Appendix A and C for communication records and photo logs, respectively, that document these efforts.

Methodology

The monitoring network was installed by a sub-contractor of CIMA's (BluMetric Environmental Inc.) licensed to install monitoring wells in Ontario. The following sections outline the methods for installation of the surface water loggers in December 2016 (one was re-located in June 2017 after being vandalized) and the groundwater piezometers in late July 2017. The surface water instruments began recording on June 14, 2017. The groundwater piezometers were set up with water level pressure transducers and began recording in August 8, 2017.

Surface Water Logger Installation

On December 19, 2016, water level pressure transducers with data logging capabilities (Solinst® "Levellogger" Model 3001 Levellogger Edge, M5), logging water levels twice daily, were installed in the Mississippi River adjacent to the Appleton Wetlands and adjacent to the Bridge Street Bridge in the town of Almonte.

The logger at the Appleton Wetlands was installed on the southwest shore of the river; permission was obtained from the landowner to access the river through his property (herein referred to as the "Lowry Farm"). The logger was secured to a cinder block, which in turn was secured via a chain attached to a nearby tree. The logger and cinder block were placed in the water through the ice, approximately 18 m away from the shore (see Appendix C – Lowry Farm Logger #1 and Figure 2). A Solinst 3001 Barologger Edge (M1.5) was attached to a nearby branch and set to record barometric pressure twice daily. As benchmarks, a metal rebar was installed and surveyed near a fence along the railway, and the top of a nearby fence post was also surveyed. All elevation measurements were collected using a Hemisphere S320 RTK GPS with GSM corrections.

A similar set-up was used for the second logger at the Bridge Street Bridge in Almonte. The logger and cinder block were anchored to a retaining wall on the northwest corner of a

property at the corner of Water Street and Queen Street (Appendix A – Bridge Street Logger #2 and Figure 3). A manhole on Queen Street was surveyed as a benchmark.

On April 24, 2017, it was discovered that the logger at the Bridge Street Bridge had been removed from the water.

The data from the levellogger and barologger at the Lowry Farm was downloaded on June 14, 2017. To facilitate future download events, the levellogger was connected to a data read cable extending to the shoreline, and the logger was placed back into the cinder block in the water.

As the river in the area upstream of the Enerdu facility had been restored in June 2017 by the completion of construction work in that area, the Bridge Street logger #2 was relocated at the patio of the Enerdu property on the north shore next to the rail bridge; as with the other loggers, the levellogger at the Enerdu property was programmed to record water levels twice daily. This logger was also connected with a data read cable extending into the nearby construction office on the Enerdu property. The barologger that was originally installed at the Lowry Farm was relocated to the Enerdu property where it could be more easily accessed and downloaded.

Data from the levelloggers and barologger were again downloaded on October 4 and November 15, 2017. Manual compensation for barometric pressure was performed for each data set using measurements collected for each reading interval.

Groundwater Logger Installation

Per the requirements of Permit to Take Water 2527-A4EMK8, groundwater level monitors were installed in the Appleton Wetlands once permission to do so was obtained from the landowners and once the MOECC approved the approach. One site was selected in an area that is normally dry during the summer months (MW1-1 and MW1-2), and the second was selected in a saturated area close to the shoreline (MW2). MW1-1 and MW1-2 are located on private property and MW2 on the Ontario Heritage Trust Grace property (Figure 4).

The wells and piezometers were installed on July 20, 2017. MW1, a nested well, was drilled at the rear (southwest portion) of the property at 4655 Appleton Side Road; the site was accessed from the private farm road. MW1-1 was advanced through peat and clay to a total depth of 2.84 m, and sealed with 3 feet of bentonite above the sand pack. MW1-2, located approximately 1 m southwest of MW1-1, was advanced through 2 feet of peat and into the top of the clay, with no bentonite seal.

MW2 was drilled near the shore of the Mississippi River, and was accessed by launching a boat from Appleton Bay and travelling approximately 3 km downstream to the site. MW2 was advanced through 6 feet of peat, and a pre-packed screen was advanced to the same depth. MW2 was sealed with 12 inches of bentonite.

Borehole logs for MW1-1-2 and MW2 are provided in Appendix D.

Water level pressure transducers with data logging capabilities (Solinst® “Levellogger” Model 3001 Levellogger Edge, M5) were installed in each of the piezometers on August 8, 2017, and programmed to record water levels twice daily. Water levels in the piezometers were measured manually on September 6, October 4 and November 15, 2017. The logger data was downloaded on October 4 and again on November 15, 2017; manual compensation for barometric pressure was performed for each data set using measurements collected for each reading interval.

RESULTS and DISCUSSION

Surface Water

Recorded water level data from the monitoring network can be found in Appendix E. Analysis of the result is limited to the period where data is available at all monitoring location, as the objective is to compare how water levels at the dam influence water levels at the wetlands.

For this analysis, it is important to mention that, on the entire period of the study, the existing powerhouse was not operational as the powerhouse site was under construction. As the facility was not in operation during that period, the flashboards were not installed (flashboards were last removed in fall of 2016) and the new pneumatically actuated gates were not operational. However, different construction phases have led to different discharge capacity at the dam site. The available spill structure during that process are summarized in Table 1.

TABLE 1: AVAILABLE DISCHARGE STRUCTURE DURING ENERDU REDEVELOPMENT PROJECT CONSTRUCTION

Site config. #	Dates	All loggers available	Old Structures	New structures
1	July 1 st , 2016 – November 1 st , 2016	No	Weirs D and E	
2	November 1 st , 2016 – January 22 nd , 2017	No	Weirs D and E	Weir C
3	January 22 nd , 2017 – March 12, 2017	No	Weirs D and E	Weirs B and C
4	March 12, 2017 – August 8th, 2017	Yes, from June 14th, 2017	Weirs D and E	Weirs A, B, C and bypass
5	August 8th, 2017 – Sept. 29th, 2017	Yes		Weirs A, B, C and bypass
6	Sept. 29th to date	Yes, up to November 15th, 2017		Weirs A, B, C, D, E and bypass

Bolded configurations indicate monitoring plan in effect

The results of the monitoring program are summarized in Figure 5. In this figure, it is important to note the following:

- WSC gauge 02KF006 has an assumed datum, and is located upstream of Appleton dam (upstream reach).
- MVCA gauge at Bridge Street is manually recorded approximately once a week.
- Precipitation data were obtained from the MVCA Automated Gauge Network (<http://mvc.on.ca/water-levels/>) at the Appleton gauge located in Reach 17 of the Mississippi River, upstream of the Appleton Dam.

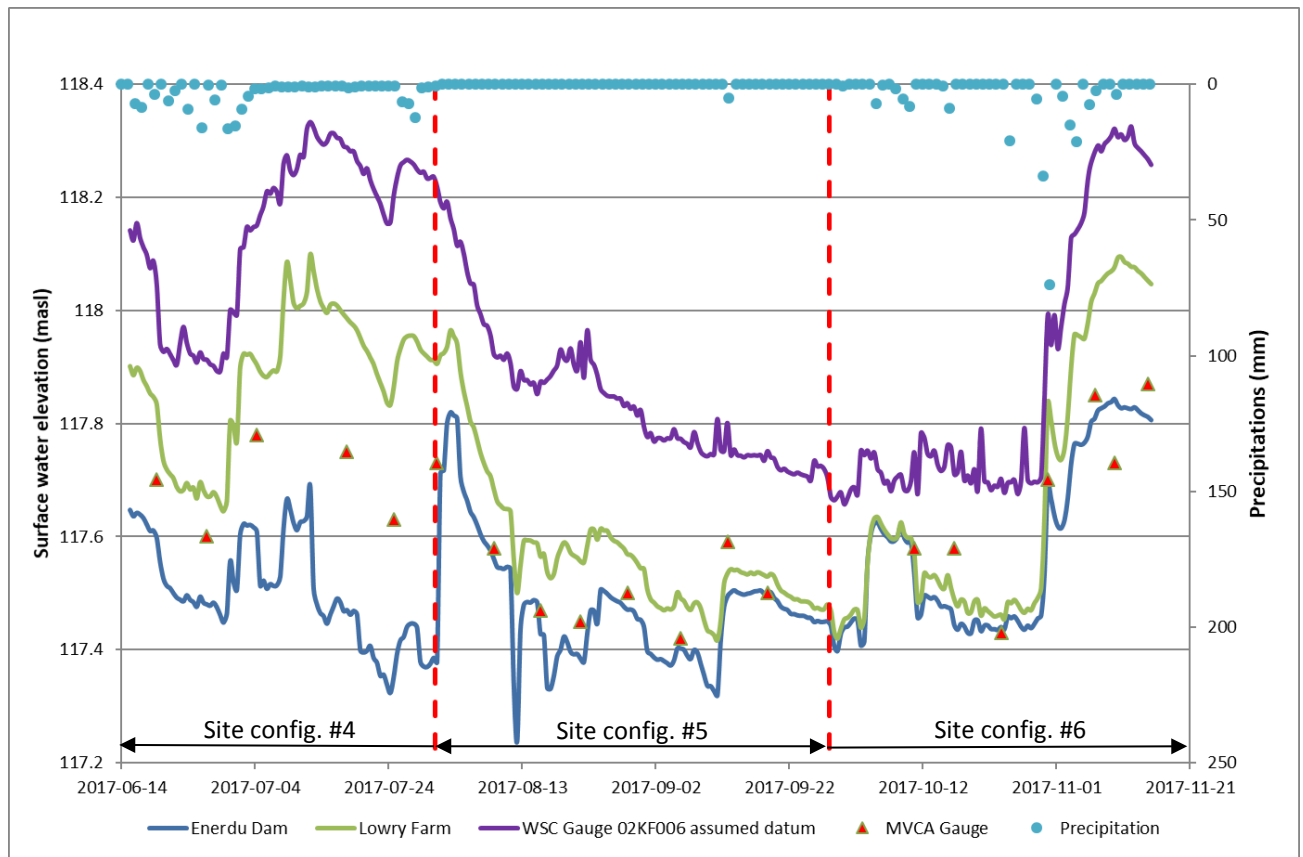


FIGURE 5: WATER LEVEL DATA AT ALL SURFACE WATER MONITORING LOCATIONS

On this graph, we note:

- Gauges at Lowry farm and Enerdu dam show similar trends. Lowry farm, being located approximately 9 km upstream of Enerdu, presents higher water levels. When the river flow is smaller, the difference between both gauges becomes smaller. This could be explained by the reduction of the slope of the water surface with smaller discharge.
- All gauges are correlated with rainfalls. Understanding the rainfall-runoff system is outside the scope of this analysis.
- WSC gauge, as well as Lowry farm and Enerdu gauges, show some increase in the water surface elevation that are not correlated with precipitation. This could be due to the operation of the Carleton Place dam during the dry summer to sustain flow in the system. Confirmation of operation of Carleton Place dam by MVCA at those dates is pending.
- Switch from site configuration #4 to site configuration #5 resulted in an increase of the water levels, as the discharge capacity at the site was reduced. Both Lowry farm gauge and Enerdu gauge show sudden increase in the water surface elevation. However, WSC gauge is not impacted, because it is located on the upstream reach.
- Switch from site configuration #5 to site configuration #6 resulted in a very few impact on the water levels. This could be explained by the fact that the flow in the system was very low.

Groundwater

The results of ground water monitoring are summarized in Figure 6. In this figure, it is important to note the following:

- Very few data exist at this time, so any conclusion derived from this analysis should be considered as preliminary.
- No significant changes at Enerdu occurred during the period of the monitoring, so impact of the facility's operation on the ground water at the wetland cannot be assess at this point.

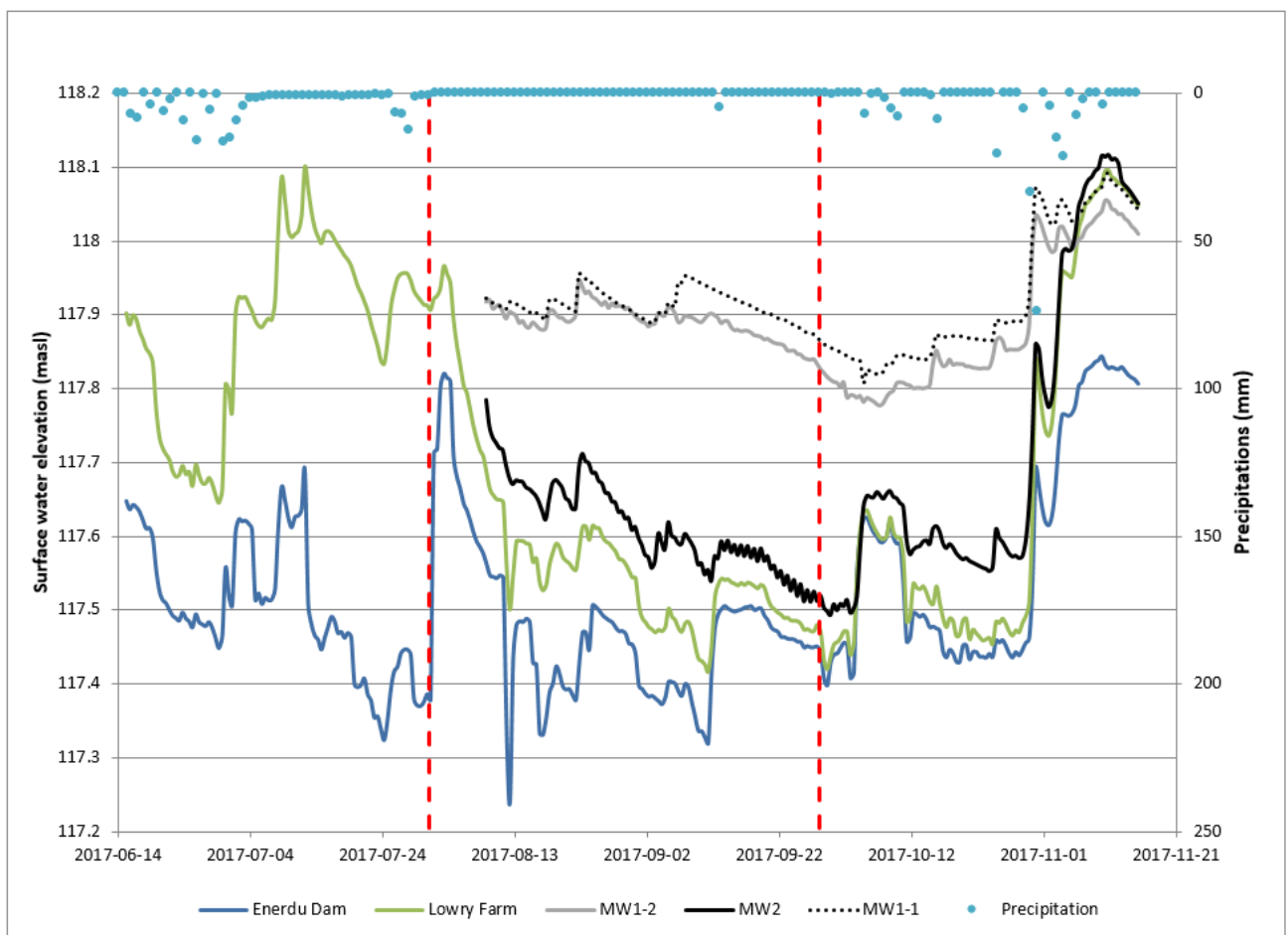


FIGURE 6: WATER LEVEL DATA AT ALL GROUNDWATER MONITORING LOCATIONS COMPARED TO ENERDU AND LOWRY FARM GAUGES

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On the graph, we note:

- Ground water and surface water data show similar trends.
- The ground water is correlated with rainfalls. Understanding the rainfall-infiltration-base flow system is outside the scope of this analysis.
- During the very high precipitation event that occurred in late October 2017, the groundwater in the muck and mineral layer were similar to surface water levels in the river.
- Although the groundwater flow direction cannot be demarcated, the groundwater horizontal gradient in the muck layer between MW1-2 location and MW2 indicates flow towards the river, as expected.
- There appears to be a slight upward gradient between the mineral and muck layers at the MW-1 location.
- The increased gap between MW1-1 and MW1-2 created September 8th, 2017, should be investigated to make sure the gauges have not moved.

Summary

In summary, surface water site measurements show that there is correlation between the water levels at Enerdu and at the wetlands. The hydraulic connection between those locations was also identified in the most recent flood mapping study done in the context of the Enerdu project; hydraulic modeling showed that the flow is subcritical from Enerdu upstream to the Appleton dam.

Measured surface water data also indicate that the operation of Carleton Place dam could also influence water levels at the wetlands. Information from MVCA is pending to complete this analysis.

In summary, groundwater monitoring should continue in order to be able to analyse the impacts of the dam operations on the groundwater in the wetland.

Respectively submitted,

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