# The Appleton Wetland;
# Its Decline, Cause and Recommended Action

## Appendix G: MVFN 2011 Tree Project

**Report prepared by**


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## MVFN 2011 Tree Project

### Introduction

By 2006, extensive damage to the trees in the Appleton Wetland had become very obvious and both the Ministry of Natural Resources (MNR) and the Mississippi Valley Conservation Authority (MVCA) received complaints about the problem. Many possible causes for the die-off were suggested, including insects and disease, toxins in the water, higher water levels in the river as a result of increased water flow in the river, and higher water levels resulting from changes in the operation of the downstream Enerdu GS.

There was little immediate action on the part of government agencies to determine the real cause of the problem, or to find a solution to the problem, and the complaints from the public about the state of the Appleton Wetland continued. Finally, in 2011, the MVCA approached the Mississippi Valley Field Naturalists (MVFN) to investigate the situation in the wetland and to report further on their findings. This project was undertaken by MVFN members Cliff Bennett and Howard Robinson.

After consideration of the possible causes of tree mortality, increased river water levels at Appleton seemed to be the most likely cause, and a program of water level measurement at the Appleton Wetland and in Almonte was developed. It was also planned to include some comparative observations of the Lavallee Wetland, a nearby wetland on the Mississippi River that has remained in a healthy state.

For information, the chart below (from Appendix D) shows the variation in river flow rate and water level at Almonte in 2011. The flow rate during the spring flood (April and May) is synchronized with water level increases in this period. Both flow and level decline in unison during June after the flood. Then in July, as the flow reaches its summer low, the levels change to rapidly fluctuating values between 117.6 and 117.7 masl, levels that are much higher than would be expected with a flow of around 10 cms through the whole summer. It was expected that this typical excessive level in Almonte would have an influence on levels in Appleton and may contribute to the wetland die-off. This project was expected to provide a better understanding of what controls the wetland water levels.

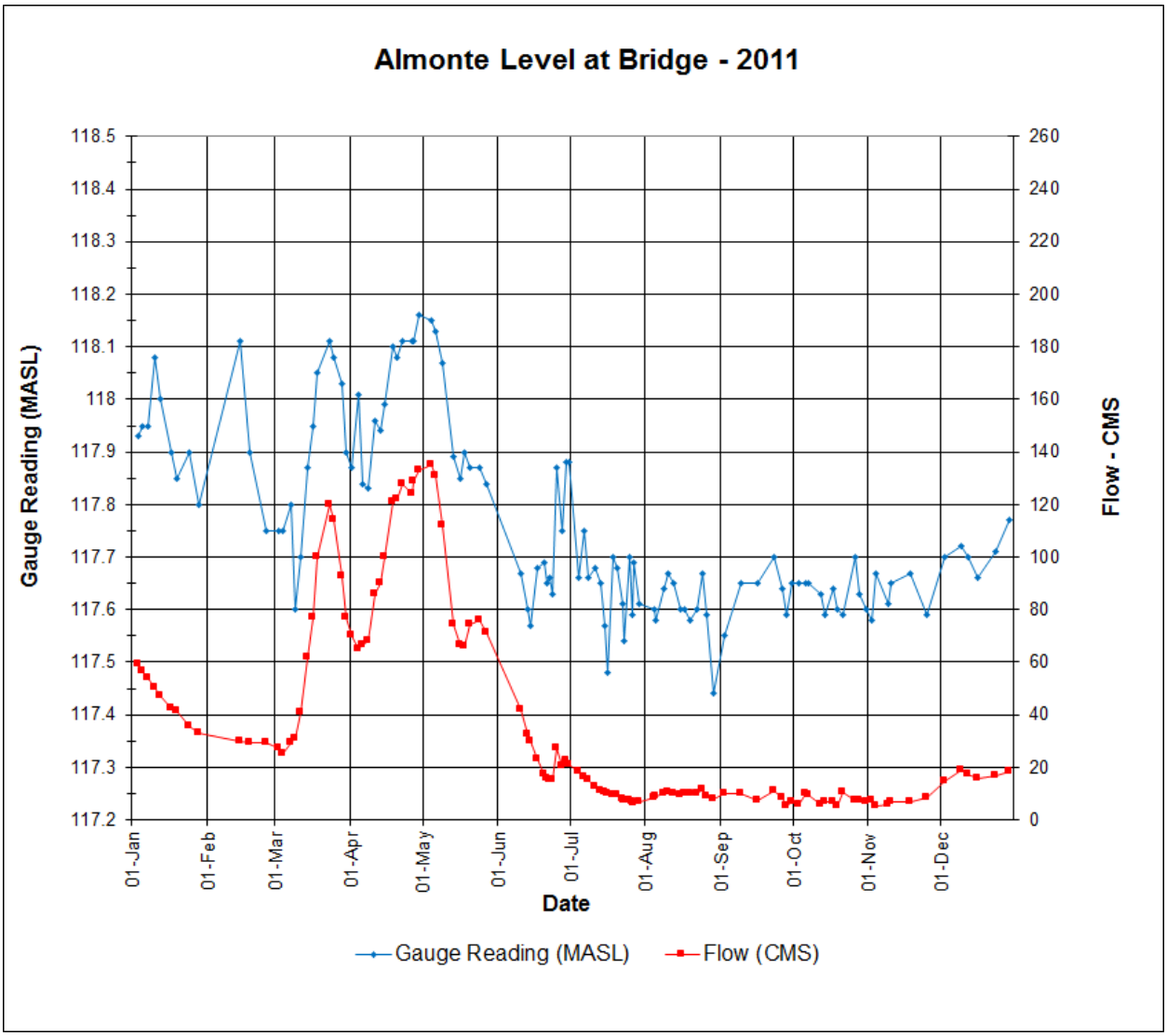


**Figure G-1 Chart of water level and flow rate at the bridge in Almonte in 2011**

**Project Design**

The project was intended to measure water level in the wetland at several sampling points and compare that to the water levels as measured at the staff gauge on the Bridge Street bridge in Almonte over a segment of the tree growing season from a high-water stage to a low-water stage later in the summer. The sample stations needed to be at the water's edge for easy canoe access, on a solid reference that would remain stable over the summer, and that would remain immersed as the water level dropped over the summer. Large trees, dead or alive, that were located at the shore line with ground level about a metre below the initial water level were selected and designated Tree 1 through Tree 6.

On the starting day, May 31, 2011, wide, red plastic ribbons were wrapped around the designated trees with the bottom of the ribbon aligned exactly with the level of the water. The ribbons were firmly attached with staples in the tree bark, and large numbers 1 through 6 were spray painted on the respective trunks to aid in finding them later in the project.

The trees were revisited three times through the summer and the distance from the bottom of the ribbon to the water surface was measured. The dates for these observations included June 30, July 28 and August 16.

Coinciding with each step from the initial setup on May 31 through to the final observations on August 16, the water level at the Almonte bridge staff gauge was recorded along with notes on the status of the flashboards on the weir. Any other noteworthy items at Appleton and Almonte were also recorded. In addition, the water flow rate as recorded at the Appleton Stream Gauge, and as reported on the Environment Canada website, was also noted for each observation set.

**Tree locations**

The locations of the six tree stations, as finally selected and marked, were measured with a handheld GPS receiver, a 1998 Magellan GPS 320 unit. The manufacturer's nominal accuracy for this device is within 15 metres. The unit did not support Wide Area Augmentation System (WAAS) corrections, nor waypoint average readings. The results are tabulated below.

| Tree Designation | Latitude | Longitude |
|---|---|---|
| Tree 1 | N 45° 11.187' | W 076° 07.686' |
| Tree 2 | N 45° 11.199' | W 076° 07.805' |
| Tree 3 | N 45° 11.161' | W 076° 08.390' |
| Tree 4 | N 45° 11.111' * | W 076° 08.530' * |
| Tree 5 | N 45° 11.060' | W 076° 08.473' |
| Tree 6 | N 45° 11.059' * | W 076° 08.455' * |
| Tree H * | N 45° 11.984' | W 076° 08.278' |
| *Notes: 1) There appeared to be errors in transcribing the readings for Tree 4 and Tree 6. Corrected values based on Google Earth map scaling are shown above.<br>2) Tree H has been added – the location of a Healthy Tree sample | | |

The position of the designated trees is plotted on the Google Earth image below.

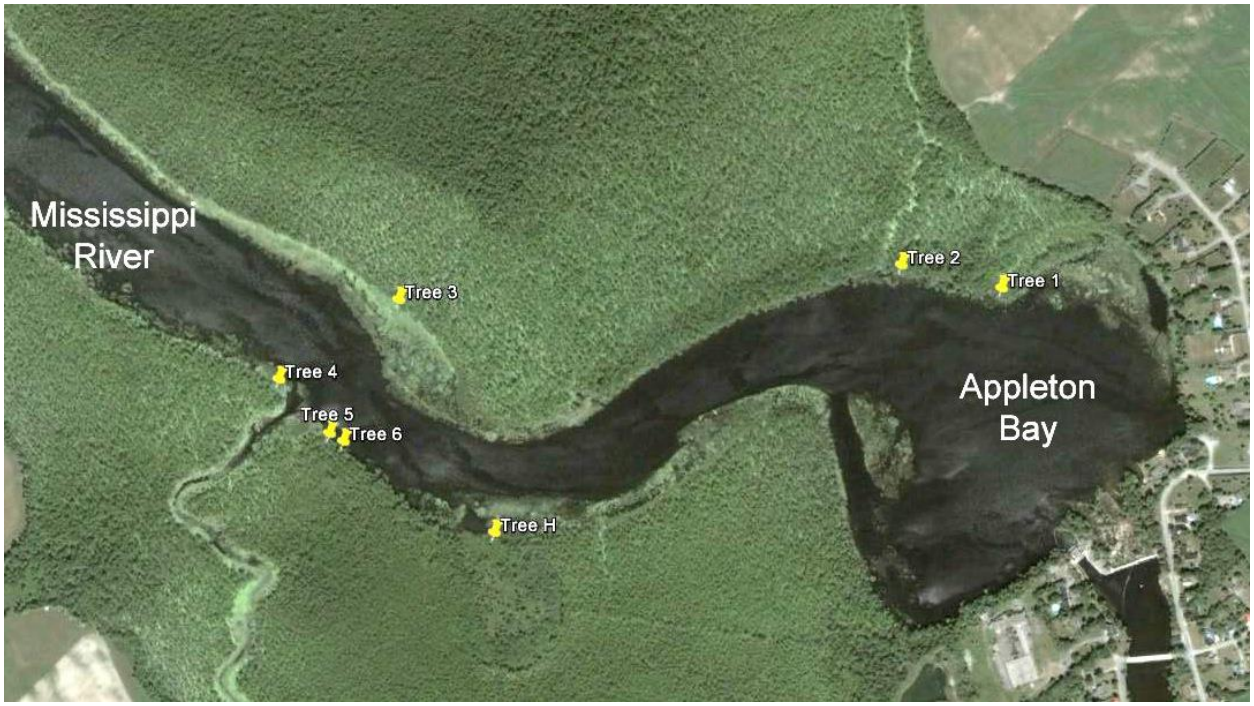


**Figure G-2 Google Earth image of the Appleton Wetland with tree stations added**

The images that follow show the six tree stations as set up on May 31, 2011.

**Figure G-3 Tree 1**

**Figure G-4 Tree 2**

**Figure G-5 Tree 3**

**Figure G-6 Tree 4**

**Figure G-7 Tree 5**

**Figure G-8 Tree 6**

May 31, 2011 Observations

- All Tree water levels were at bottom of the ribbons.
- Almonte bridge staff gauge reading was 117.82 masl.
- Field notes indicate that some flashboards on the weir were absent. The reported flow and staff gauge levels are consistent with no flashboards, and the 2011 Almonte Level chart included above in the Introduction to this Appendix does not show the signature of flashboard installation prior to May 31, but it does show their installation just prior to June 30. The conclusion is that there were no flashboards on May 31.
- Appleton Stream Gauge registered 75.8 cms.

June 30, 2011 Observations

- All Tree water levels were 20 cm below the bottom of the ribbons.
- Almonte bridge staff gauge reading was 117.76 masl (6 cm below the May 31 reading).
- All flashboards on the weir were installed.
- Appleton Stream Gauge registered 21.1 cms.
- The following composite image from June 30 illustrates some of the above.

**Figure G-9 Composite image from June 30, 2011**

July 28, 2011 Observations

- All Tree water levels were 30 cm below the bottom of the ribbons.
- Almonte bridge staff gauge reading was 117.70 masl (12 cm below May 31 reading).
- All flashboards on the weir were installed.
- Appleton Stream Gauge registered 7.15 cms.
- The following composite image from July 28 illustrates some of the above.

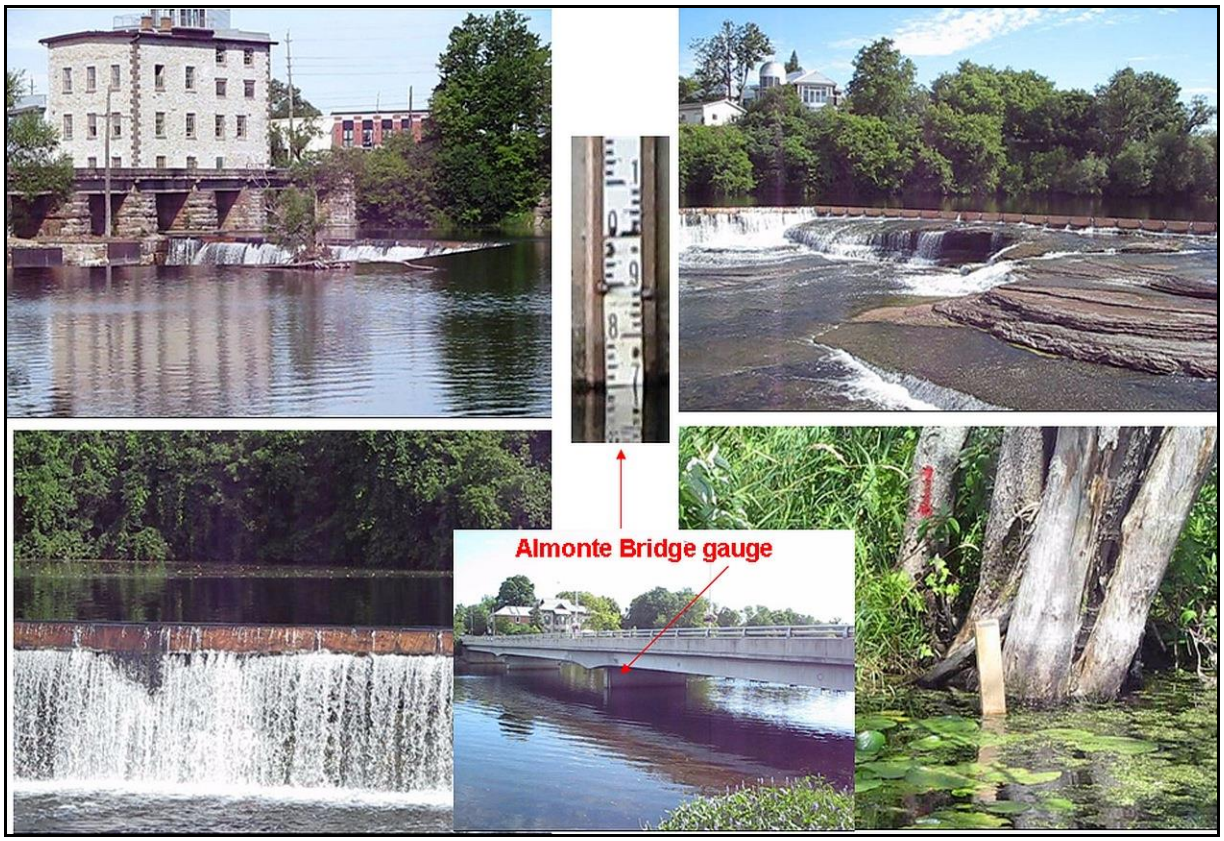


**Figure G-10 Composite image from July 28, 2011**

August 16, 2011 Observations

- All Tree water levels were 38 cm below the bottom of the ribbons.
- Almonte bridge staff gauge reading was 117.62 masl (20 cm below May 31 reading).
- All flashboards on the weir were installed.
- Appleton Stream Gauge registered 9.54 cms.
- The following composite image from August 16 illustrates some of the above.


**Figure G-11 Composite image from August 16, 2011**

## Results

From the raw observations it is clear that there is a relationship between Appleton water levels and the level observed in Almonte. Unfortunately in 2011 there was no readily available elevation reference, accurately calibrated to the CGVD28 standard, which would make it possible to compare the Appleton measurements to those at Almonte. That changed in the summer of 2013 with the unearthing of a geodetic benchmark in Appleton, and using it to establish a benchmark near the shoreline of Appleton Bay, and setting up a staff gauge at Tree 1 for direct measurement of wetland water levels. The details are covered in Appendix F.

The essential piece of information from Appendix F is that the reference level of the bottom of the tree ribbons is 118.00 masl. With that now in place it is possible to go back and complete a detailed comparison of the Appleton and Almonte water level for this project. The table below summarizes those results.

| Tree Project Data Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date 2011** | **Appleton Flow cms** | **Relative Tree Water Levels cm** | **Tree Water Levels masl** | **Appleton Change cm** | **Almonte Level masl** | **Almonte Change cm** | **Appleton to Almonte Difference cm** |
| May 31 | 75.8 | Ribbon | 118.00 | - | 117.82 | - | 18 |
| June 30 | 21.2 | Ribbon - 20 | 117.80 | 20 | 117.76 | 6 | 4 |
| July 28 | 7.15 | Ribbon - 30 | 117.70 | 10 | 117.70 | 6 | 0 |
| Aug 16 | 9.54 | Ribbon - 38 | 117.62 | 8 | 117.62 | 8 | 0 |

The diagram below will help in visualizing the water level changes between Appleton and Almonte on the four dates of the project.

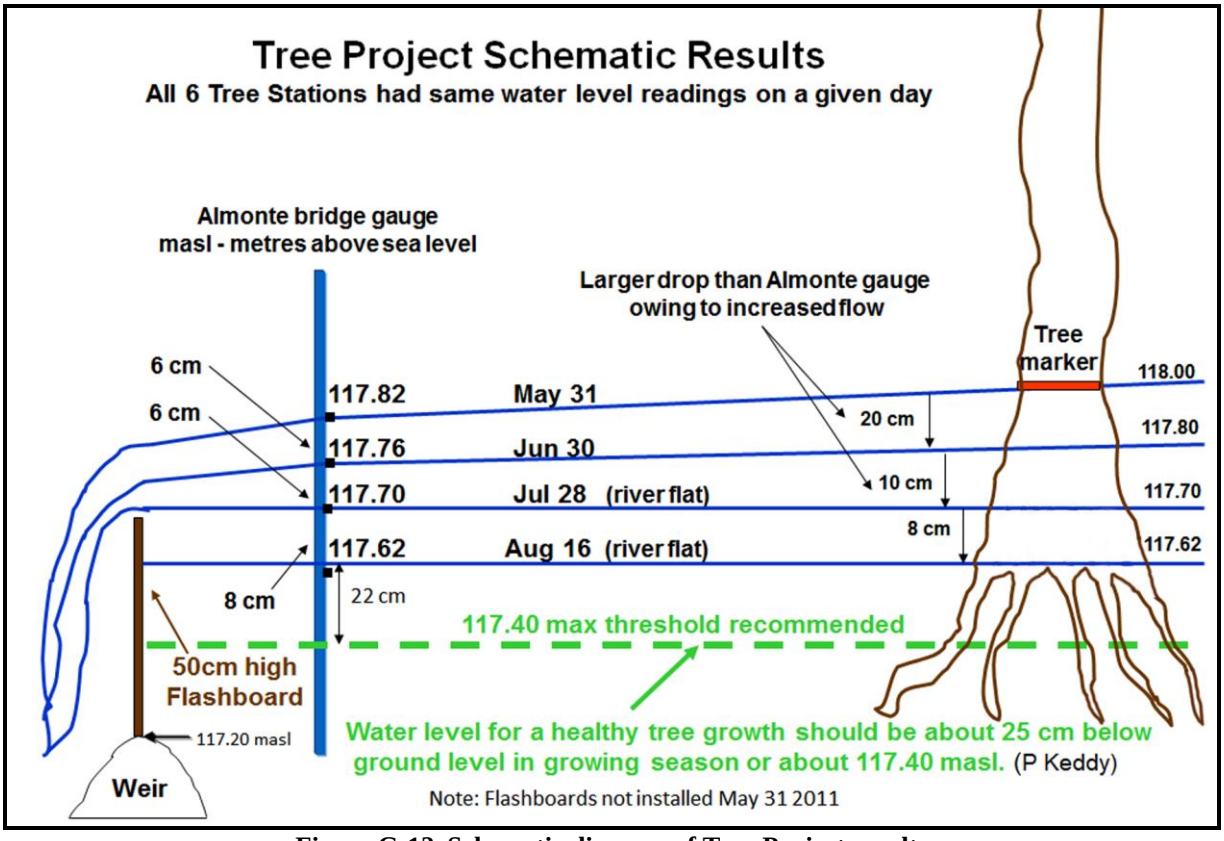


**Figure G-12 Schematic diagram of Tree Project results**

As detailed in Section 3.5 of this report, *Characteristics of Maple Swamps*, the maple species involved (silver maple, red maple and Freeman's maple) require low water levels for a significant part of the growing season for healthy growth. In particular, the water level should be at least 25 cm below the ground level where the trees are growing, and should stay at that level continuously for approximately 80 days in the summer. From observing the water levels around the tree stations, and the associated ground levels during the 2011 Tree Project, it was concluded that after the spring flood subsides, water levels in the Appleton Wetland should be maintained at or below 117.40 masl through the summer growing season.

Figure G-13 below illustrates the above conclusion about the optimum summer water level for healthy tree growth. In this case, Tree 1 is used as a typical example.

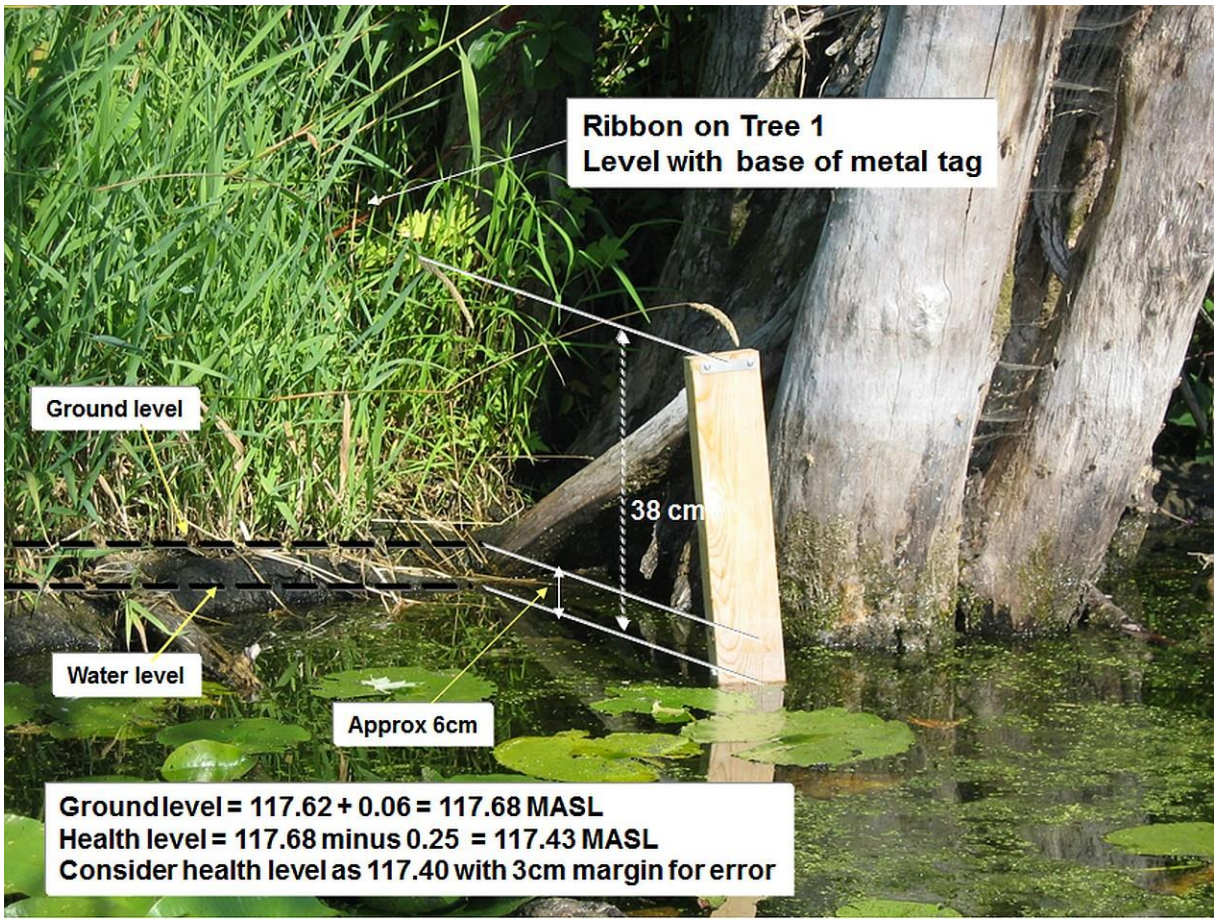


**Figure G-13 Diagram of derivation of healthy water level at Tree 1 (August 16, 2011)**

**Other observations in the Appleton Wetland**

There is a small area, with a slightly elevated ground level, adjacent to the south shore of the river just west of Appleton Bay. Tree H is located here, as shown on the Google Earth image at the beginning of this Appendix. The image below shows this healthy Tree H along with another stressed tree with submerged roots on slightly lower ground. This does show the importance of a small differential in water level at the tree roots.

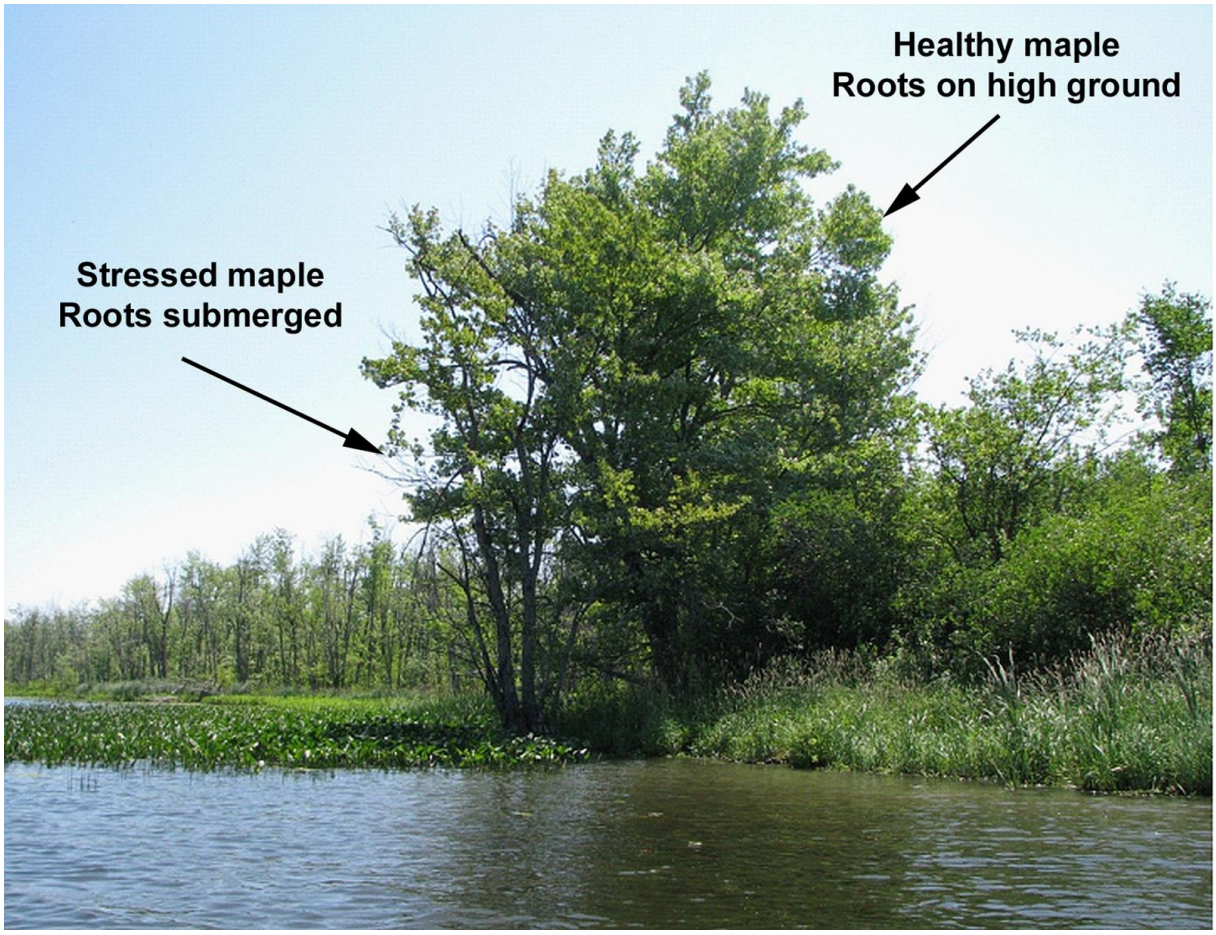


**Figure G-14 Tree H, a healthy tree on high ground with a submerged and stressed neighbour tree**

**Comparison to other wetlands**

The Innisville and Mud Lake Wetlands above Mississippi Lake are known to be healthy maple swamps. The yearly water level cycle follows normal seasonal water flow fluctuations without human intervention. The spring flood is followed by dry summer conditions and the trees are in good condition. The Innisville Wetland is shown below as photographed on July 10, 2014, at a location about 200 metres upriver from the Ferguson Falls boat launch, on the north side of the Mississippi River.

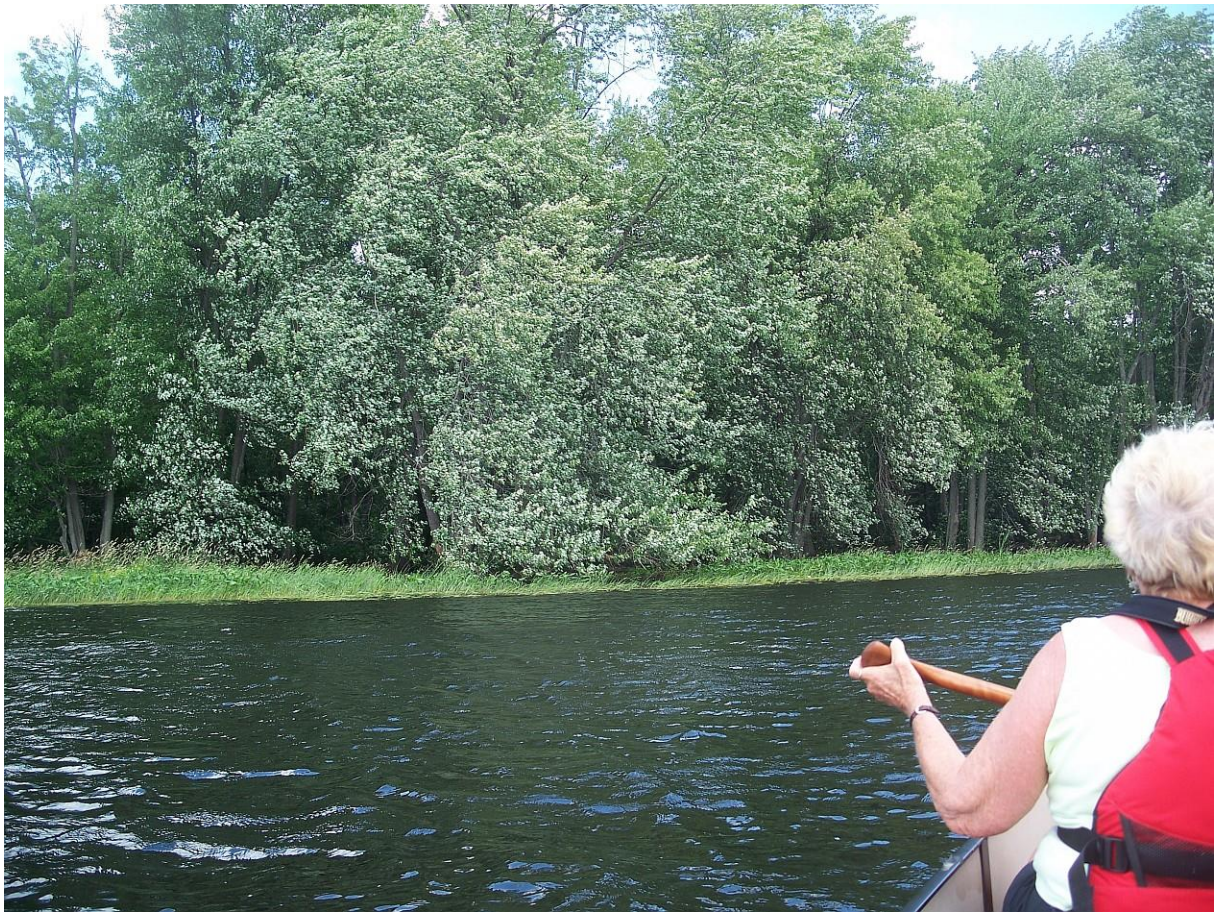

**Figure G-15 The Innisville Wetland on July 10, 2014 (CB-100_2807.jpg)**

During the 2011 Tree Project, the Lavallee Wetland was also observed. It is located a short distance upstream from Appleton and shares essentially the same seasonal water flow variations that apply to the Appleton Wetland. The difference is that the Appleton GS operates as a run of river facility and does not influence water levels at Lavallee Wetland. That wetland experiences natural flooding in the spring, but dries out in early summer through to the fall, and the maple trees are thriving. On the other hand, water levels in the Appleton Wetland are completely controlled by operations at the Enerdu GS. The Appleton Wetland also floods during the spring, but does not dry out in the summer, and trees are dying.

The composite image below shows the healthy maple stand in the Lavallee Wetland along with views of the spring flood and dry summer conditions.

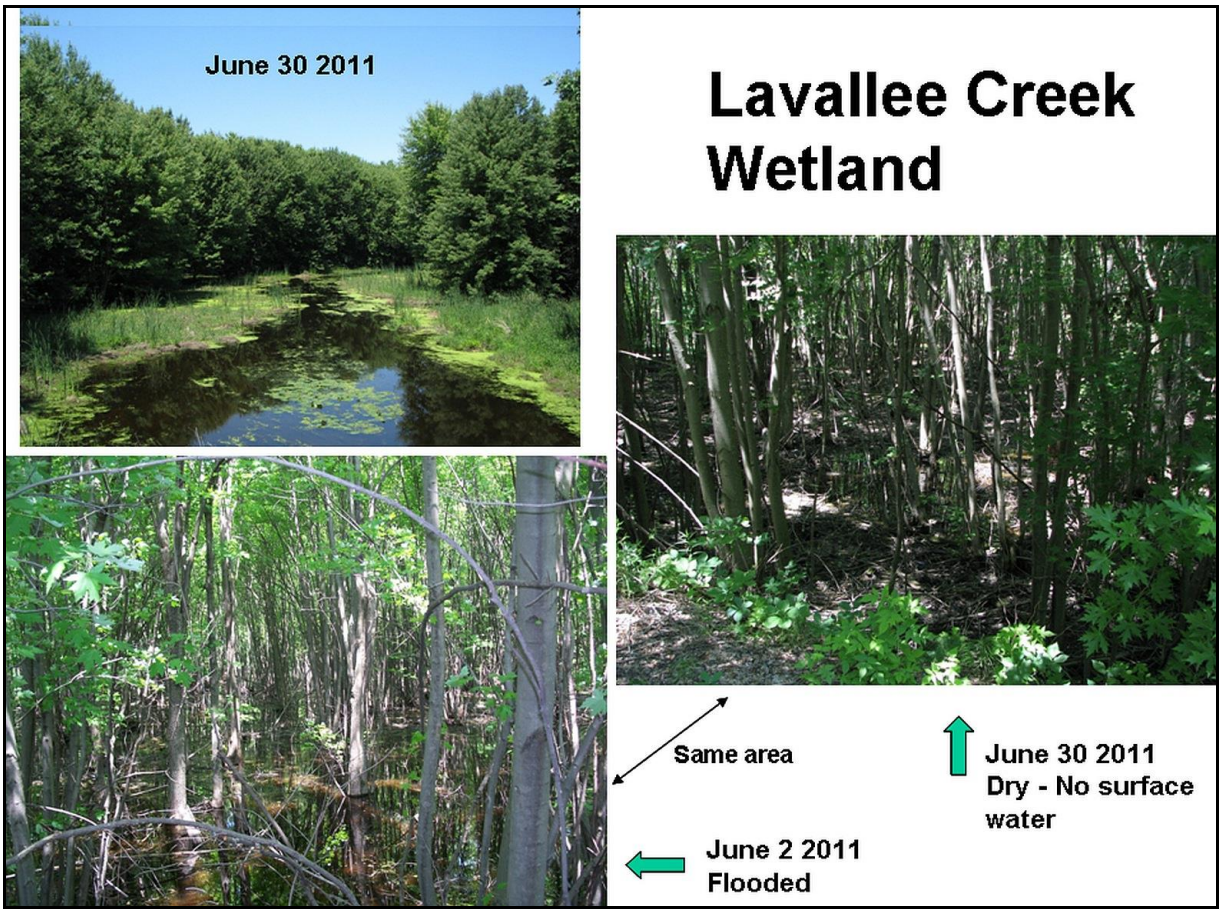


**Figure G-16 Composite image of the Lavallee Wetland**

**Summary**

From observing the water levels around the tree stations, and the associated ground levels during the 2011 Tree Project, it was concluded that after the spring flood subsides water levels in the Appleton Wetland should be maintained at or below 117.40 masl through the summer growing season.

A review of the water level records at Almonte, as covered in Appendix D, shows that for the entire period of the recorded data (2006 to 2012) the Almonte water levels in summer were in the range of 117.70 to 117.90 masl when flows exceeded 17cms, and would have been somewhat higher in Appleton. In periods when flow was less than 17 cms there were frequent short term dips to as low as 117.50 masl at Almonte that would probably yield a similar level at Appleton. Such short term dips do not benefit the maple trees since the soil does not have enough time to dry out in those brief periods. The water levels throughout the summer were thus effectively at or above 117.70 masl throughout the whole growing season.

The conclusion from the 2011 Tree Project is that Enerdu operations (high flashboards and generator cycling strategy) are responsible for the excessive water levels in the Appleton Wetland, are causing the current die-off of the maple trees, and must be modified to yield a continuous water level of 117.40 masl, as measured at Appleton, through the summer growing period.