The Appleton Wetland;
Its Decline, Cause and Recommended Action

Appendix D: Water Levels at Almonte

Report prepared by

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Water Levels at Almonte

There appears to be no formal record of water level in Almonte above the weir at the upper falls that goes back to the Flour Mill Era. This changed in July 2006, when the Mississippi Valley Conservation Authority (MVCA) installed a staff gauge on one of the piers of the Bridge Street bridge that enabled a manual measurement of water level from the Old Town Hall waterfront using binoculars. The staff gauge is calibrated to read levels directly in masl, and with care under good conditions (no waves, no ice, good lighting) levels can be read to 1 cm accuracy. It is read by MVCA staff on a nominal weekly basis, but is often read more frequently during periods of interest, and at some times less frequently than weekly. All measurements from July 2006 to the current date are logged to the MVCA website and are available to the public.

To access the data use following URL:

http://www.mvc.on.ca/water-levels-app/levels-table-option/table-option-weekly-lake-gauges.php

Once connected, select: *Almonte Bridge (Weekly Lake Gauge)*

Then, the dates for the beginning and end of the data can be entered, and a tabulation of level data for that period will be displayed.

We have downloaded all of that water level data and organized it into one calendar year batches for the years 2006 to 2013. For the 2006 to 2012 years, we have extracted from the Appleton Flow records (Appendix C) the daily flow rate recorded for every date corresponding to a water level measurement. The combined level and flow data sets for each year were then plotted on separate yearly charts, showing Almonte water level versus date, along with flow versus date. The charts provide a ready comparison of level and flow rate through each year. In the case of 2013, the flow data now available is near real time data at hourly intervals and it is not very convenient to extract flow data for combining with the level data. The result is that the 2013 chart shows level data only.

A number of things will be noted from these charts:

1. The flashboards are usually replaced sometime in the May-June time frame and this will be noted as a sudden rise in level without a corresponding rise in flow rate.
2. With the flashboards in, and flow rates less than approximately 17 cms, levels change erratically as the generators cycle on and off. The level changes do not display the full fluctuation pattern since the sample intervals are much longer than generator cycles, and the samples are usually taken around 7 AM rather than randomly through the day.
3. The flashboards are designed to break as levels exceed 118.0 masl, and this has a mitigating effect on maximum spring flood levels. The water level causing breakage varies slightly with individual panels in the flashboard structure with the result that they do not all break at the same time, and the mitigating effect may be spread over several days depending on the nature of an individual spring flood.
4. There are a number of distinct flow regimes through a typical year:

    a. Regime A: High flow (above 17 cms) with all flashboards operational – typically late fall and up to the peak of the spring flood. Levels will exceed 117.7 masl.

b. Regime B: High flow (above 17 cms) with all flashboards missing – typically from the peak of the spring flood until May or June when flashboards are replaced. Levels will vary widely depending on flow rate.
c. Regime C: Low flow (less than 17 cms) and with all flashboards operational.

In all cases, there is a further effect depending on whether or not the generators (with a maximum water demand of 14 cms) are on or off.

i. In regime A, the status of the generators is minor, and the water level will always be above the 117.7 masl level.
ii. In regime B, as the water flow drops to the order of 20 to 30 cms in May or June, the water level will be around 117.5 masl with the generators on. It is at this point that the flashboards are replaced, causing an immediate rise of about 25 cm and the beginning of operation in regime A.
iii. The regime C, with low flow and all flashboards in place, is an unstable operational mode.

1) With the generators off and a natural river flow that exceeds leakage through the flashboards, the level will rise to slightly over the top of the flashboards, 117.7 masl.
2) With the generators in full operation (14 cms) plus flashboard and Thoburn leakage, and a natural flow of less than 17 cms, water levels will be drawn down as stored water in the river is used to balance the deficit between in-flow and out-flow.
3) This generator on - off cycle appears to happen on a daily basis, but its exact profile is dependent upon the combination of exact river flow and water demand of the generators. Although the sampling interval used in collecting the level data is too long to record the full details of the daily level cycling, it does certainly display level fluctuations between approximately 117.4 to 117.7 masl.

5. It should be noted that the summer of 2013 was an anomaly, in that only a half of the flashboards were installed for a significant part of the summer. The two sections of flashboards immediately above and below the railway bridge (Sections 3 and 4) were installed in June, but before the remaining sections were added, the flow rate increased forcing a delay in completing that work. In mid-August with flow rate reduced to about 15 cms the level was at 117.5 masl although with full flashboards it would have been in the unstable mode with a maximum of 117.7 masl. Things remained stable near 117.5 masl until mid-September when the missing flashboards were finally replaced and operation resumed in regime A. Although this was a summer with record high flow rates, actual levels for at least part of the summer were lower than usual.
6. In the following pages the charts for each year are displayed along with relevant comments.

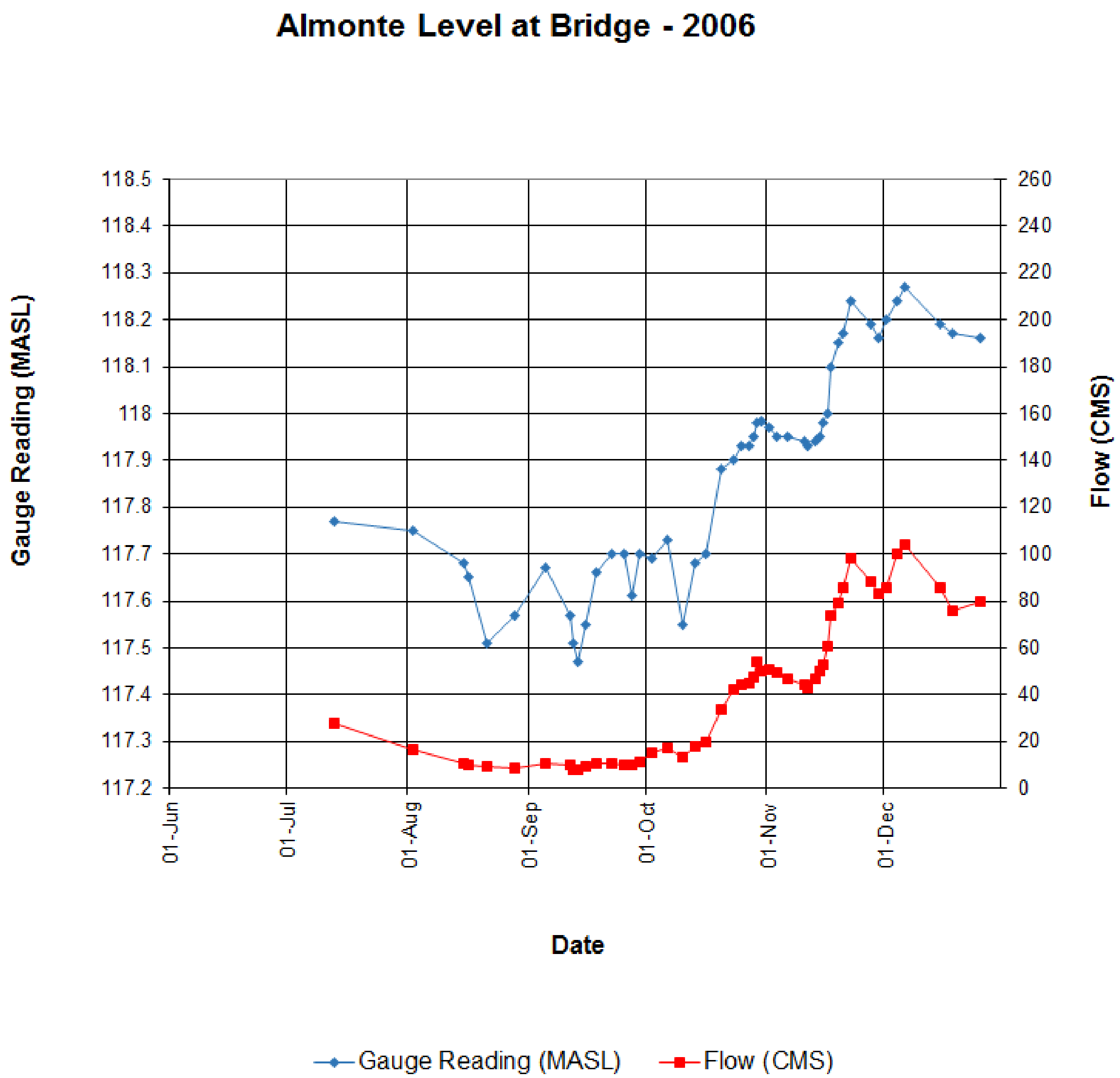

Figure D-1 Water level and flow rate at the Almonte bridge in 2006

Comments for 2006:

All flashboards were in place prior to the start of the data record. Operation from July to mid-August was in regime A. That is, water level was stable at a level exceeding the top of the flashboards, 117.7 masl.

In mid-August, flows dropped below 15 cms and operation reverted to regime C until mid-October with levels showing frequent oscillation between 117.5 and 117.7 masl.

In mid-October, operation in regime A began as flows increased to 20 cms and more, levels exceeded 117.7 masl and closely mirrored the pattern of flow rates. During the peak flow in early December with levels near 118.3 masl the flashboards may have broken.

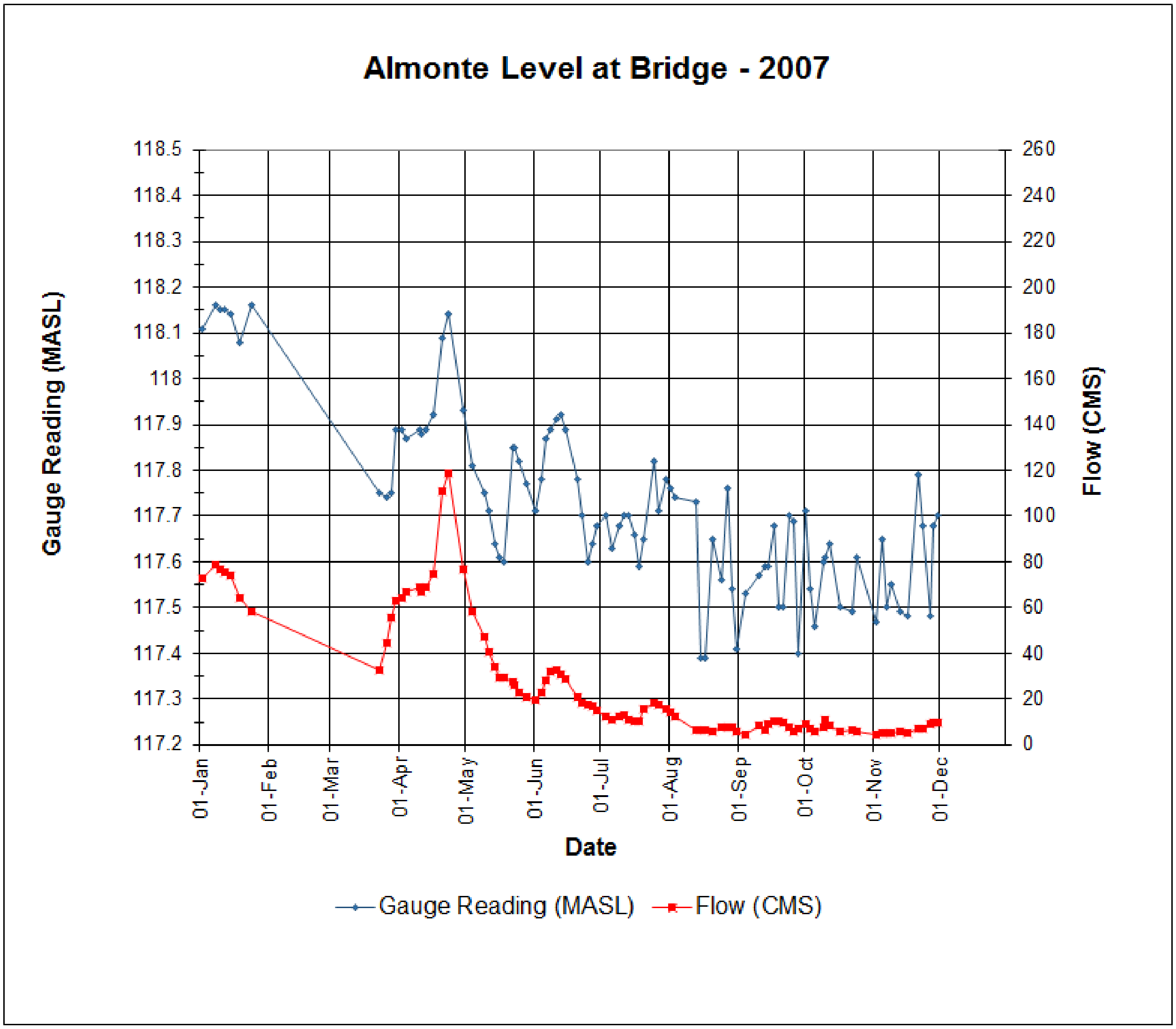

Figure D-2 Water level and flow rate at the Almonte bridge in 2007

Comments for 2007:

It appears that this year started with collapsed flashboards after peak flows in the previous December (see Figure D-1) and operation was in the regime B. There is a two month gap in the level records from late January to late March, but the flow records for this period (Appendix C) show a steady decline in flow rate so it is likely that levels in this period also showed a steady decline. The peak flood in late April had a somewhat higher flow rate than the prior peak in December (120 vs 100 cms), but peak levels were a bit lower (118.1 vs 118.3 masl), further indication that the boards broke in December.

In mid-May the flashboards were installed – note the instant rise in level from 117.6 to 117.85 masl with flow rates slowly declining around 30 cms – and operation in regime A started. Levels remained above 117.7 masl until late June when flow dropped to 15 cms, and a month operation with regime C fluctuations below 117.7 masl started. This reverted to regime A briefly in mid-July as flow increased to 20 cms. Then in August, flow dropped to around 10 cms and operation returned to regime C until November. No level data was recorded for December.

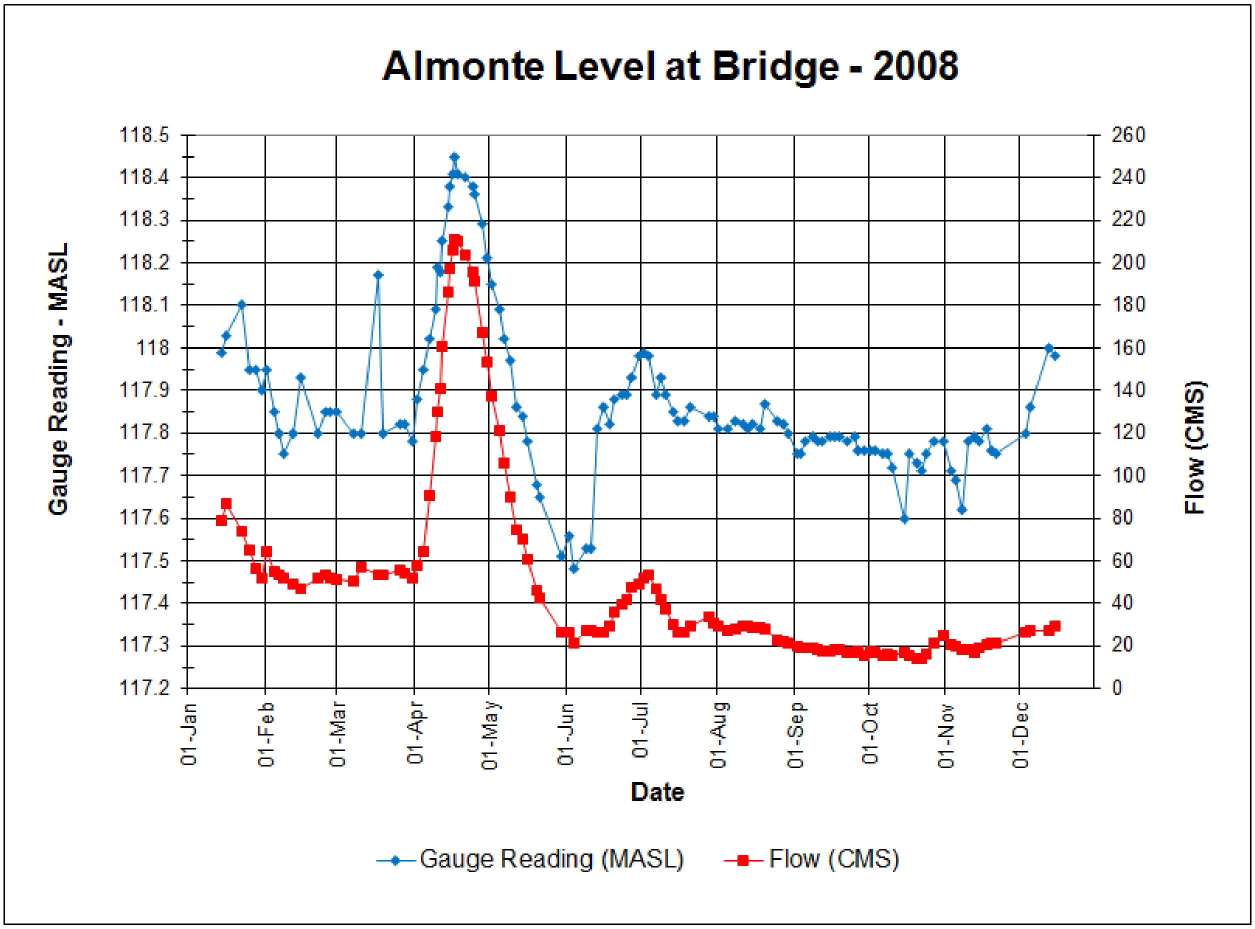

Figure D-3 Water level and flow rate at the Almonte bridge in 2008

Comments for 2008:

It appears that this year started with intact flashboards and operation continued in regime A until near the flood peak in mid-April. At a peak level of 118.4 masl, all flashboards would have broken and operation would have changed to regime B at that time. That continued until early June when flashboards were installed – shown by a sudden jump in level from 117.55 to 117.8 masl while the flow was stable around 23 cms – and operation reverted to regime A.

That continued through the summer and water levels stayed above 117.7 masl for the whole period except for two brief periods in October and November when flow rates dropped slightly below 20 cms.

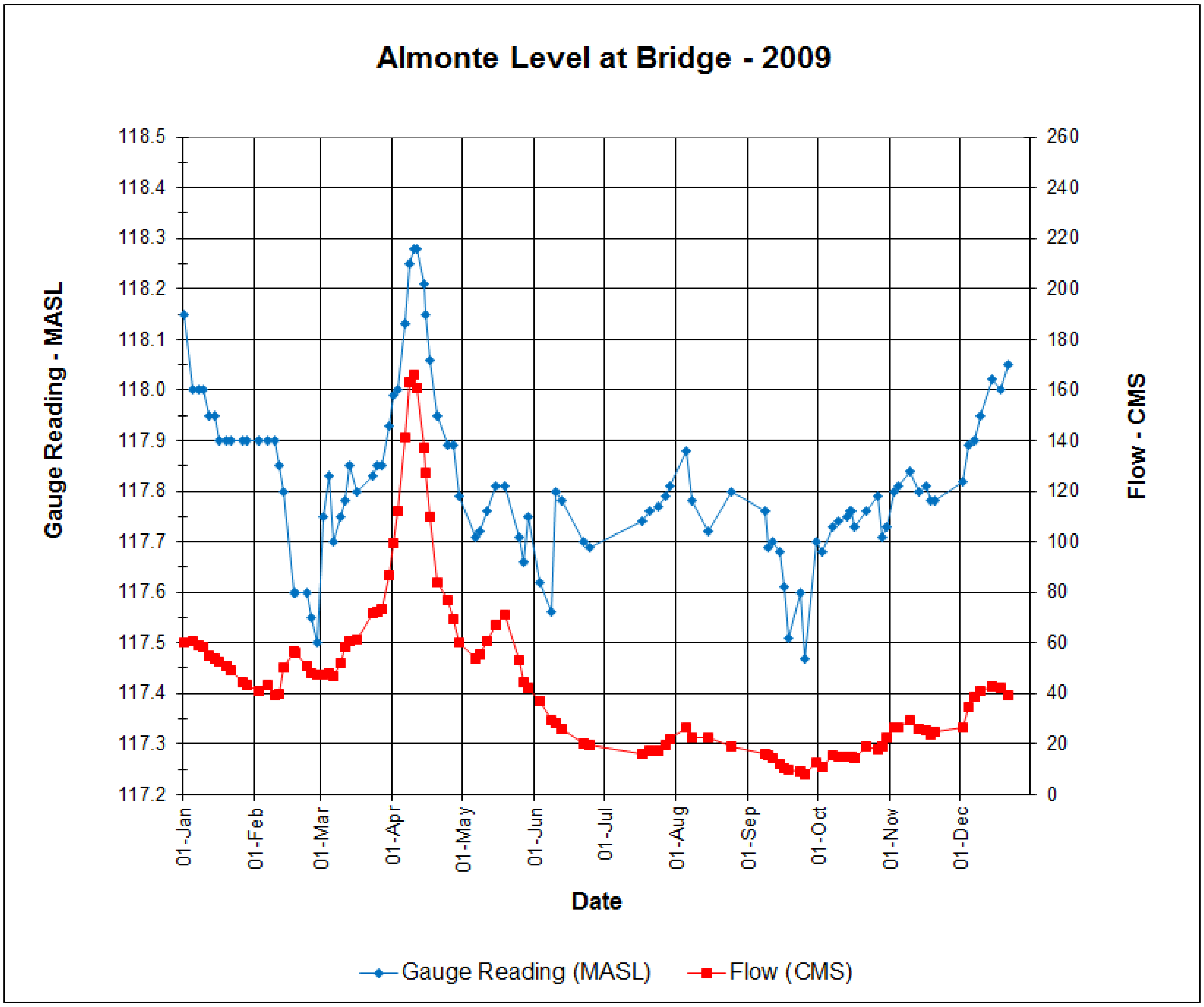

Figure D-4 Water level and flow rate at the Almonte bridge in 2009

Comments for 2009:

It appears that this year probably started with intact flashboards and operation continued in regime A until near the flood peak in early April. Unfortunately the level data for January and February appears garbled and not consistent with the flow data. Possibly a case of misreading the gauge due to ice conditions. In March more consistent readings resumed.

At a peak level of 118.3 masl, all flashboards would have broken and operation would have changed to regime B at that time. That continued until early June when flashboards were installed – shown by a sudden jump in level from 117.57 to 117.8 masl while the flow was stable around 23 cms – and operation reverted to regime A.

Regime A operation continued to the end of the year with level consistently over the 117.7 masl level except for a brief period in the second half of September when flow dropped to around 10 cms and operation changed briefly to regime C. During that period levels dropped as low as 117.5 masl.

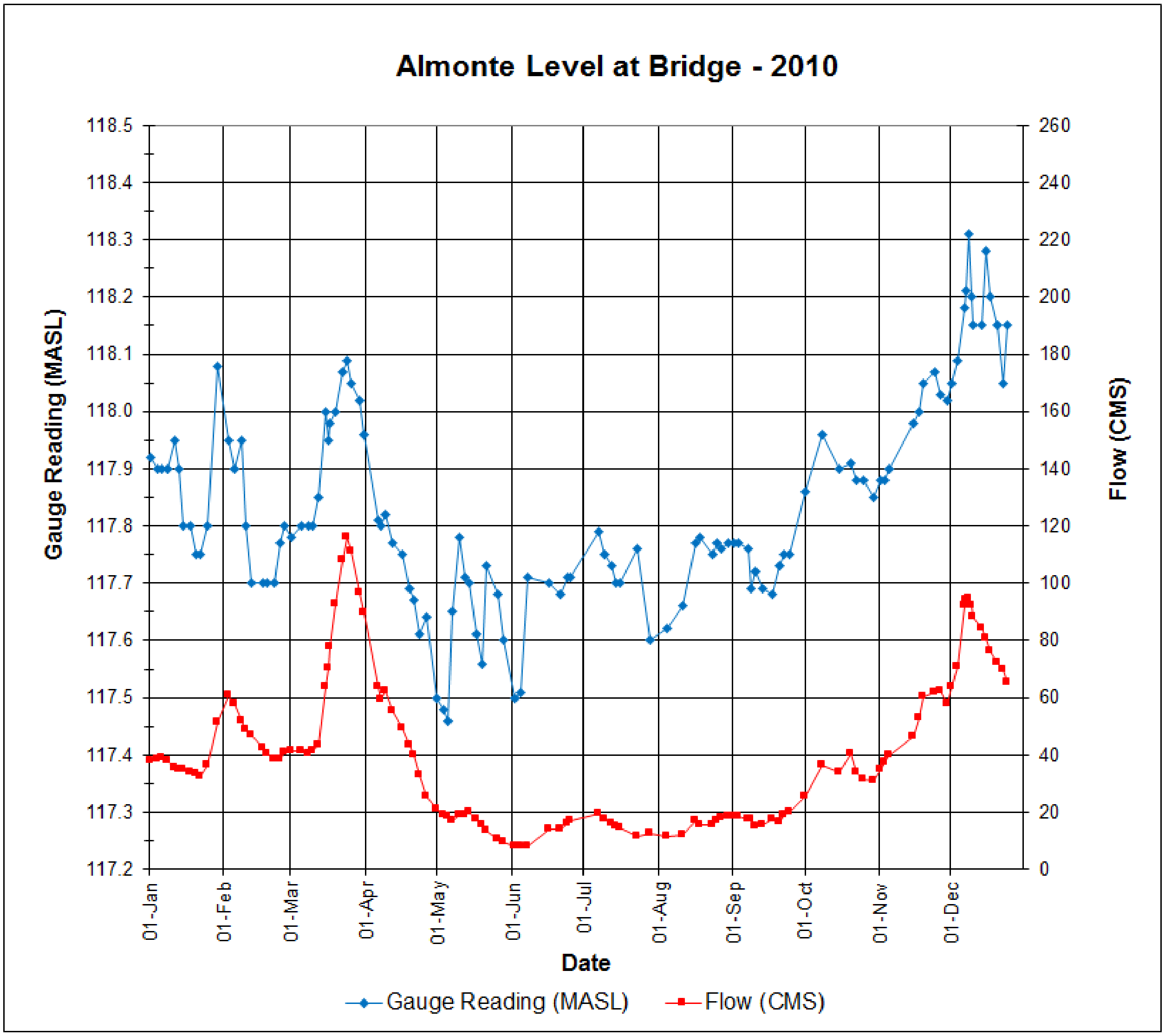

Figure D-5 Water level and flow rate at the Almonte bridge in 2010

Comments for 2010:

It appears that this year started with intact flashboards and operation continued in regime A until near the flood peak in late March. The level data for January to March appears a bit erratic, probably the result of ice conditions. At a peak level of 118.1 masl, all flashboards would have broken and operation would have changed to regime B at that time. That continued until early May when flashboards were installed – shown by a sudden jump in level from 117.55 to 117.65 masl while the flow was stable around 20 cms. From that point to mid-September flow rate varied from 10 to 20 cms and operation shifted from regime A to regime C in accord with level changes. Water levels in December appear erratic, probably the result of ice conditions. In view of the apparently high levels in December some flashboards may have been broken.

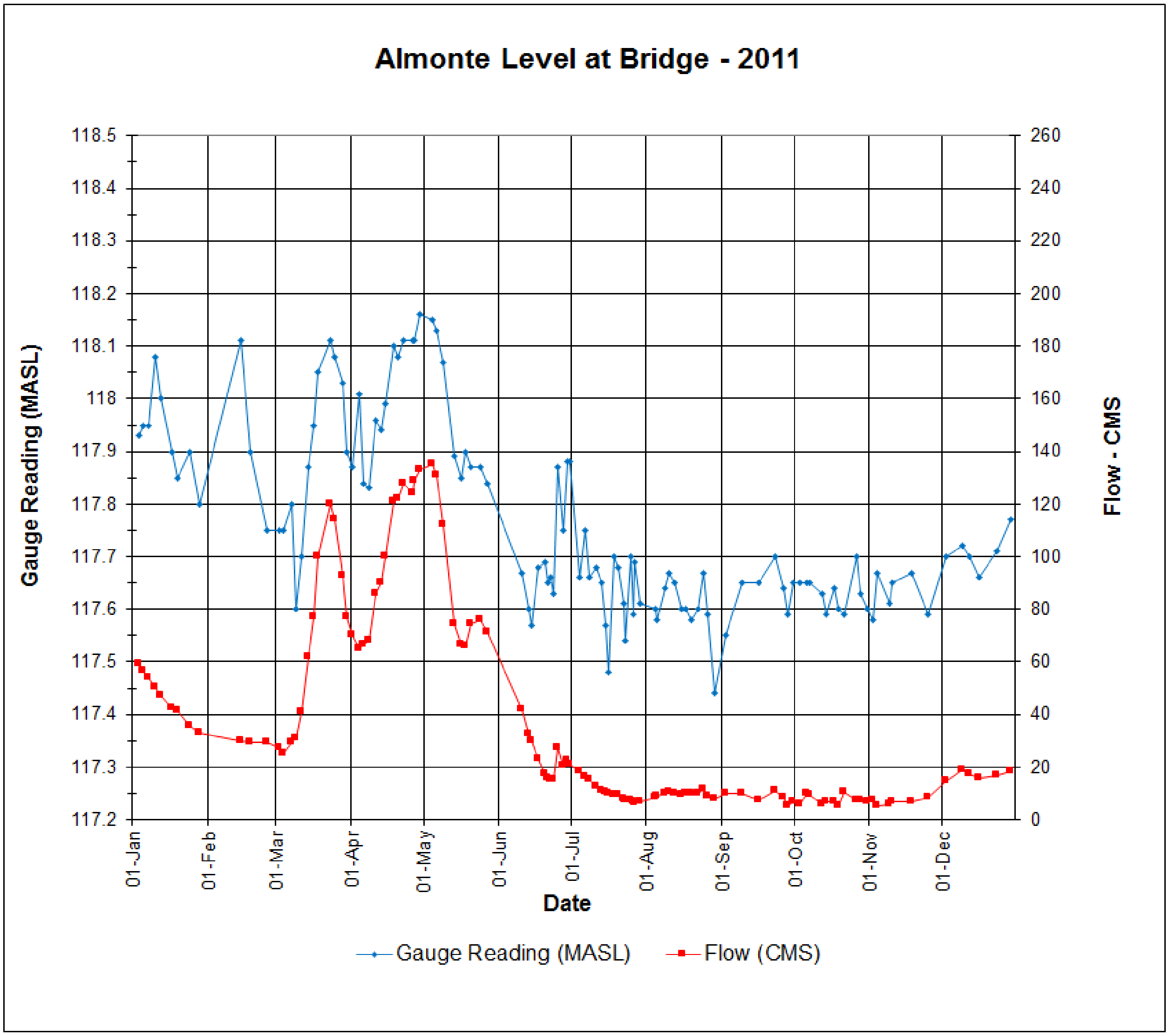

Figure D-6 Water level and flow rate at the Almonte bridge in 2011

Comments for 2011:

The January and February level readings appear very erratic, probably due to ice conditions, and operation appears to be in regime A until the flood peak in early May. It is probable that flashboards were missing after the flood peak and operation was in regime B until late June. There is a definite rise in water level at that time that is suggestive of flashboard installation, but the picture is a bit uncertain since there is also a jump in flow rate at the same time. In any case, this was a summer of low water level (below 10 cms) and the period from early July to beginning of December was clearly in continuous operation in regime C – oscillations of 10 to 20 cm in level but always below 117.7 masl.

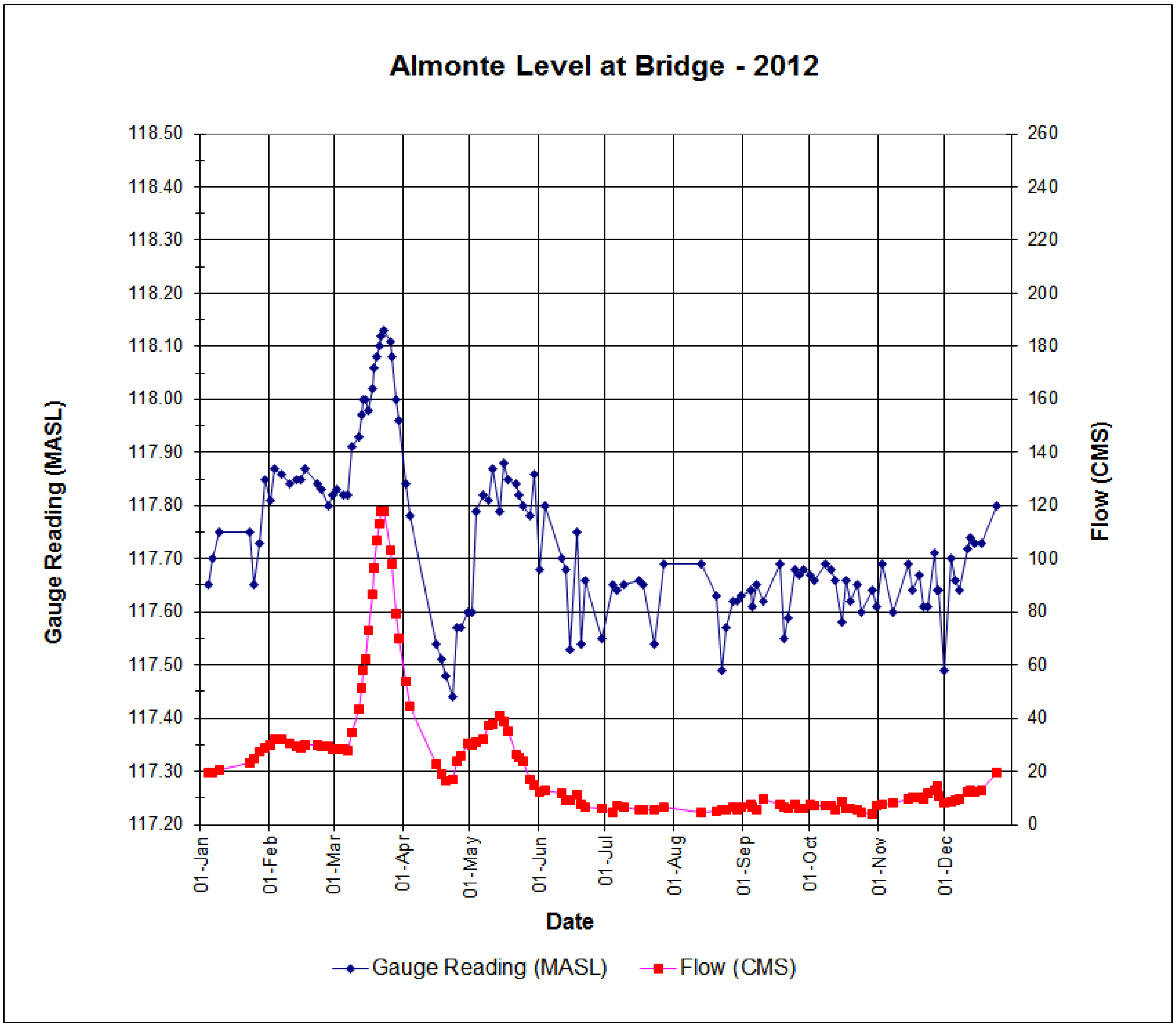

Figure D-7 Water level and flow rate at the Almonte bridge in 2012

Comments for 2012:

The January level readings are again erratic, probably due to ice conditions. It appears that operation was in regime A from the start of the year to the flood peak in late March. The flashboards probably broke at that point, and operation continued in regime B until the beginning of May when there is the clear signature of flashboard installation – a jump in level from 117.6 to 117.8 masl while the flow was stable around 30 cms. Operation continued in regime A though May with levels above 117.8 masl. Flow rates dropped below 20 cms in early June and stayed below 10 cms for most of the summer and fall. Operation was clearly regime C throughout this period into mid-December.

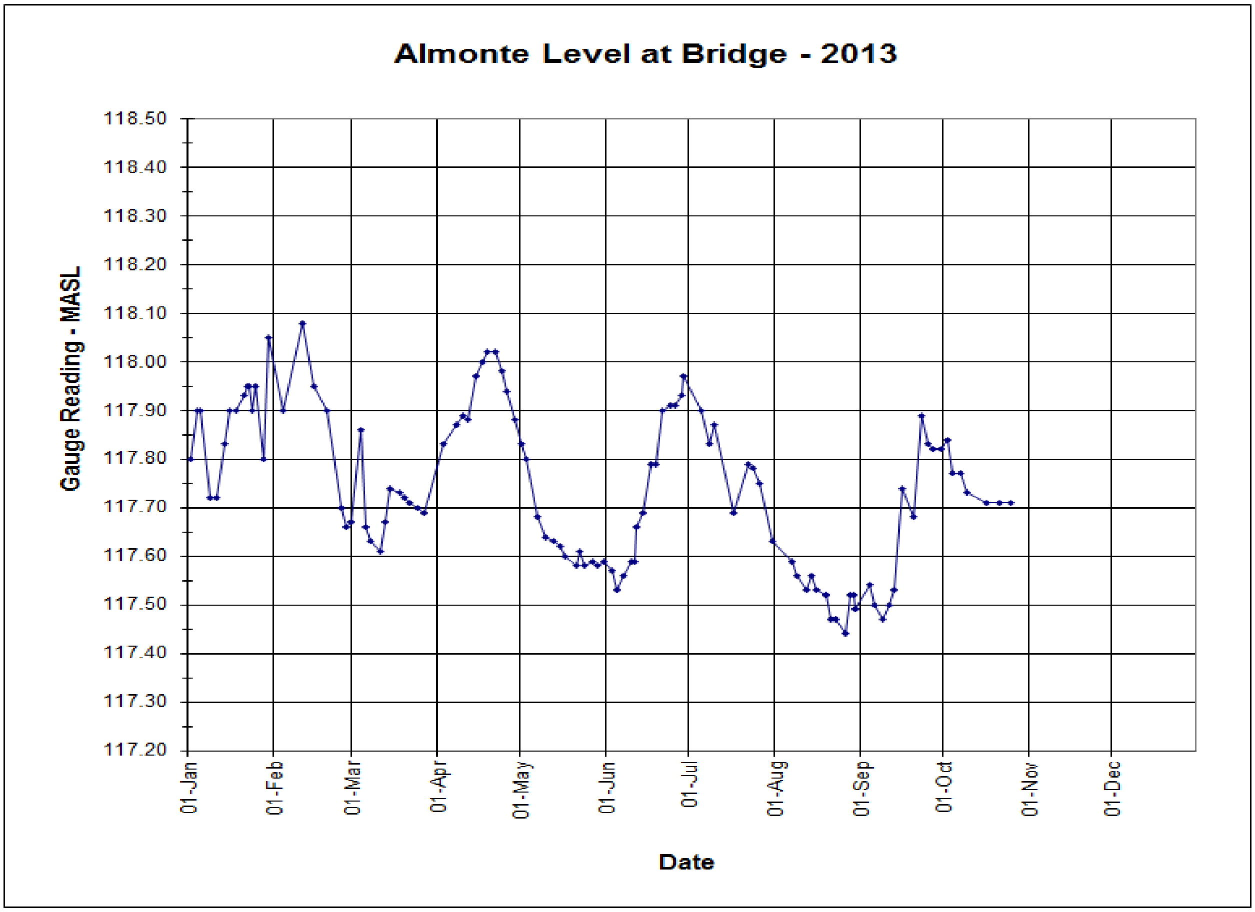

Figure D-8 Water level at the Almonte bridge in 2013

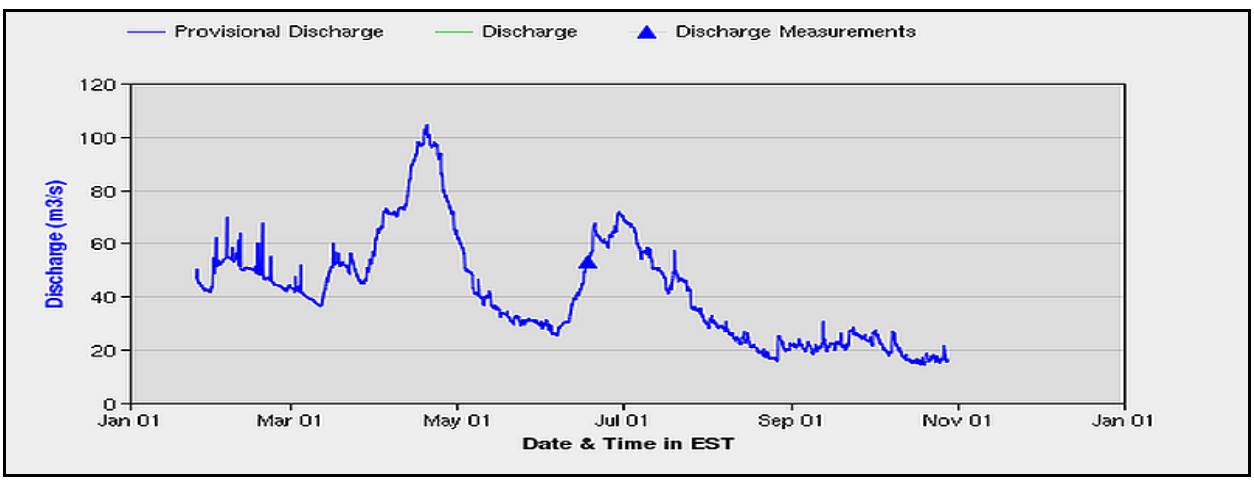

Figure D-9 Flow rate at the Almonte bridge in 2013

Comments for 2013:

The chart for this year departs from the earlier ones in that only provisional flow data is available from the Environment Canada (EC) website. The upper chart is the regular plot of level data without the flow data, and the lower chart is the provisional flow data for the same period from the EC website. Although a bit awkward, useful comparisons can be made.

From the beginning of the year to the flood peak in mid-April operation is in regime A. All flashboards were broken, flow and water levels began a steady decline, and operation was in regime B until June 8. At that time flashboards were installed on only section 3 and 4 of the weir. Operation was in some half way state between regimes A and B with half of the boards in and half missing. Then flow increased to over 60 cms around July 1 and there was a second flood peak close to 118.0 masl. As the flow rate subsided to around 30 cms on August 24 the missing boards on weir sections 1 and 2 were installed, only to be removed overnight by vandals. Finally on September 14, the missing boards were reinstalled and operation reverted to regime A and levels over 117.7 masl. Although water flows were unusually high through this summer, the absence of half the boards moderated levels significantly, and July and early August had lower water levels than experienced for that period than any year in the 2006 to 2012 records.

Summary

It is clear that the use of flashboards raises the water levels to approximately the level of the top of the boards, with the exact level determined by the combination of river flow and GS water demand. With high flow rates (17 cms and over) levels will exceed the flashboard height (117.7 masl) by an amount approximately proportional to excess flow. With low flow rates (17 cms and less) levels will oscillate between the flashboard tops and 20 to 30 cm lower depending on exact river flow rate and GS water demand. GS water demand in low-flow periods appears to be controlled by a strategy of maintaining levels as high as possible to maximize the GS head and so get the maximum power output from the available water.

It is also clear that in raising the flashboard height by 15 cm over those used in the Flour Mill Era, water levels will rise by 15 cm for identical combinations of river flow rate and operating strategy. There are no records of how water demand was managed by the Flour Mill, but it appears that their priority was not maintaining maximum head and power output, but was more aimed at maintaining continuous mill operation. Under low flow conditions that could result in greater drawdown than the 20 to 30 cm evident in current operations. It may also explain why the summer water levels observed up river were often much lower than that set by the flashboard top level.