International Lake Superior
Board of Control

Semi-Annual Progress Report to the International Joint Commission

Covering the period September 1, 2015 to February 29, 2016

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Cover photo: Remote control boat making discharge measurements in the U.S. Government plant head race, October 2015 (courtesy of U.S. Army Corps of Engineers, Detroit District).

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International Lake Superior Board of Control

Canada
Mr. Jaymie Gadal, Member
Mr. Rob Caldwell, Secretary

United States
BG Richard Kaiser, Member
Mr. Arun Heer, Secretary

International Joint Commission
Ottawa, Ontario
Washington, D.C.

April 11, 2016

Commissioners:

This semi-annual report covers the Board's activities from 1 September 2015 to 29 February 2016.

1. Highlights

From September 2015 through February 2016, the monthly mean water levels of Lake Superior ranged from 9 to 23 cm (4 to 9 in) above average, and from 11 cm (4 in) below to 2 cm (0.8 in) above last year's levels.

The monthly mean levels of Lake Michigan-Huron were also above average throughout the reporting period, ranging from 15 to 29 cm (6 to 11 in) above average, and from 0 to 19 cm (0 to 7 in) above the levels of the same period last year.

Lake Superior outflows through November 2015 continued to be determined according to a deviation strategy approved 16 April 2015 by the International Joint Commission (IJC). This deviation strategy, employed beginning May 2015, allows the International Lake Superior Board of Control (Board) to better manage operational limitations on hydropower flow capacity and reduce the potential for adverse impacts of high and fluctuating flows in the St. Marys Rapids. Lake Superior outflows as specified by Regulation Plan 2012 were again released from December 2015 through the remainder of the reporting period.

Flow through the Compensating Works continued to be managed by employing multiple, partially open gates in lieu of fully open gates, with the equivalent gate settings ranging from a high of five gates open in September, to the minimum setting of one-half gate open from November through February .

Since September, flows have been between 100 and 126 percent of average. Monthly outflows from Lake Michigan-Huron ranged from 103 to 124 percent of average.

In general, the past six months were relatively warm and wet across the upper Great Lakes basin. This contributed to water supplies to Lake Superior being below average in October, but above average throughout the remainder of the reporting period. Similarly, with the exception of October and January, water supplies to Lake Michigan-Huron were generally above average. A new record high net basin supply was set during the month of December for both the Lake Superior and Lake Michigan-Huron basins, due to a combination of well above-average

precipitation and unseasonably warm temperatures, which at this time of year contribute to increased basin runoff and reduced lake evaporation. The warm temperatures this winter also resulted in reduced ice cover throughout the Great Lakes system.

The Board continued an extensive field measurement study in the St. Marys Rapids that began in the spring of 2015. St. Marys Rapids discharge measurements were undertaken in October and November, and these were complemented by continuously measured water levels collected at a number of temporary gauge installations. The measured data will be used to calibrate a hydrodynamic model of the St. Marys Rapids, establish limits on the rates of Compensating Works gate changes to protect aquatic organisms, and develop flow relationships for partially open gate settings. The Lake Superior Board and the Great Lakes Adaptive Management (GLAM) Committee have identified reviewing the impacts of partially open gate settings, and evaluating the impacts of reduced maximum side-channel capacity, as work plan tasks for this year.

2. Monitor Hydrologic Conditions

The Board continuously monitors the water levels of lakes Superior and Michigan-Huron, and the water levels and flows in the St. Marys River. The regulation representatives' monthly reports to the Board provide hydrologic assessments and recommendations on the regulation of outflows from Lake Superior. These reports indicate the amount of water available for hydropower purposes, after the requirements for domestic use, navigation, and the fishery (St. Marys Rapids) are met.

Tables 1 and *2* show the recent monthly water levels, net basin supplies, and outflows for lakes Superior and Michigan-Huron, respectively. *Figures 1* and *2* compare monthly water levels over a two year period to long-term averages and extremes. *Figures 3* and *4* show the monthly precipitation over the Lake Superior and Michigan-Huron basins. Monthly net basin supplies are depicted in *Figures 5* and *6*.

In general, the past six months were characterized by relatively warm and wet conditions across the upper Great Lakes basin, in part due to the influence of one of the strongest El Nino events on record.

Lake Superior's monthly mean water level has been above chart datum (183.20 m or 601.1 ft) since June 2013 and ended the reporting period 29 cm (11 in) above datum. Lake Superior's monthly mean levels over the past six months ranged from 9 to 23 cm (4 to 9 in) above average. Levels were 11 cm (4 in) below to 2 cm (0.8 in) above those from last year during this same period. For the month of February, Lake Superior was at a mean elevation of 183.49 m (602.00 ft), which is 23 cm (9 in) above February's monthly average. This is 2 cm (0.8 in) higher than one year ago, and 29 cm (11 in) above chart datum.

Precipitation over the Lake Superior basin was between 79 and 159 percent of average from September through February and would be expected to be exceeded 32 percent of the time. The net basin water supplies (NBS) to Lake Superior, which are the net effect of precipitation, evaporation, and runoff to the lake, were below average in October, but near or above normal during the remainder of the reporting period. A record-high NBS occurred in December due to the combined effects of well above-average precipitation and unseasonably warm temperatures, which at this time of year contribute to increased basin runoff and reduced lake evaporation. This

also contributed to a reduced seasonal decline over the winter months. The September through February NBS to Lake Superior would be expected to be exceeded 13 percent of the time.

Monthly mean Lake Michigan-Huron levels ranged from 15 to 29 cm (6 to 11 in) above long-term average. Water levels ranged from 54 to 70 cm (21 to 28 in) above chart datum during the reporting period. Levels have been above average since August 2014, and this January and February mark the largest differences from monthly averages during that time. For comparison, just three years ago, a record low was set for January 2013, exactly 1 m (3.3 ft) less than January 2016. For the month of February, Lake Michigan-Huron was at an elevation of 176.56 m (579.27 ft), 29 cm (11in) above February's monthly average, 6 cm (2 in) higher than one year ago, and 56 cm (22 in) above chart datum.

Precipitation over the Lake Michigan-Huron basin was between 90 and 184 percent of average over the past six months and would be expected to be exceeded 36 percent of the time. Water supplies to Lake Michigan-Huron were generally above average during the reporting period, with the exception of October and January. Similar to Lake Superior, record high NBS occurred in the Lake Michigan-Huron basin in December. On average, the NBS for this reporting period would be expected to be exceeded about 17 percent of the time.

In addition to impacting water supplies, the relatively warm temperatures experienced during much of this winter have also affected snow and ice conditions observed within the basin. Modeled snow water equivalent (SWE) data from the National Operational Hydrologic Remote Sensing Center (NOHRSC) indicates that, as of the end of February, the SWE was approximately the same as that of last year's value for the Superior basin, but much less for the Lake Michigan-Huron basin, with little or no snow pack observed. Similarly, observed Snow Data Assimilation System (SNODAS) SWE in the Lake Superior basin at the end of February was 98 percent of average, and slightly below the 110 percent of average observed at this time last year. The averaged values are determined by modeled Advanced Hydrologic Prediction Service (AHPS) data from 1948 to present.

Total Great Lakes ice concentration peaked in mid-February at 34 percent, much less than last year's peak of 89 percent that occurred at the end of February. Lake Superior's ice concentration peaked at 18 percent in mid-February this year, far behind the 96 percent peak cover of the previous winter. Lake Michigan's ice concentration peaked at 27 percent, and Lake Huron's ice concentration peaked at 48 percent. Last year, ice concentrations on Lake Michigan and Lake Huron peaked at 73 percent and 96 percent, respectively. Lake Superior, Lake Michigan, and Lake Huron ended the reporting period with approximately 12 percent, 10 percent, and 16 percent ice cover, respectively. The total Great Lakes ice coverage was approximately 11 percent.

3. Regulation of Lake Superior

a. Outflows

On 16 April 2015, the Board received International Joint Commission (IJC) approval to deviate from Lake Superior Regulation Plan 2012 from May to November 2015 in order to better manage operational maintenance at the hydropower plants and limitations on maximum side-channel flow capacity, as well as to reduce the potential for adverse impacts of high and fluctuating water levels and flows in the St. Marys Rapids. Flows less than prescribed by Plan 2012 were released in the spring and fall when side-channel capacity was limited, and flows

greater than Plan 2012 were released during the summer months. During the reporting period, outflows were set according to the deviation strategy for September through November, and were set at the Plan 2012-prescribed normal winter maximum flow from December through February.

Lake Superior outflows were 118 percent of average over the last six months, with monthly flows ranging from 2,220 to 2,780 m^3/s (78,400 to 98,200 ft^3/s).

A few scheduled and unscheduled flow reductions occurred at the hydropower plants during the reporting period, most of which were comprised of maintenance and transmission line work (details are provided in *Section 6* of this report). Flow capacity limitations from September through November were addressed by adjusting the gate setting at the Compensating Works in accordance with the Board's approved deviation strategy. However, this is not possible during the winter months. From December to April the Compensating Works gates are typically maintained at the normal winter setting equivalent to one-half gate open, partially due to the difficulty of moving frozen gates. Additionally, natural factors, including seasonal water level fluctuations and ice conditions, can also result in reduced hydropower flows. However, mild weather and favorable water level conditions this winter meant the impacts of these capacity limitations were less than in recent years.

The Board's deviation strategy, hydropower maintenance activities, and uncontrollable hydrologic factors resulted in total outflows being, on average, less than the flow prescribed by Plan 2012 during the reporting period.

b. Compensating Works gate settings and St. Marys Rapids conditions

During the reporting period, the Board continued to work with the Commission, the hydropower entities, and other stakeholders, to try to address issues related to the gate settings of the Compensating Works, and the unusually high water level and flow conditions in the St. Marys Rapids, while adhering to the principles of the Boundary Waters Treaty and the Orders of Approval for Lake Superior regulation.

The gates at the Compensating Works supplying the main portion of the St. Marys Rapids were set to the equivalent of five gates open in September, and the equivalent of four gates open in October. The October gate setting was gradually reduced over three consecutive days to slow the rate of water level change and allow the Board to collect discharge measurements at various gate and flow settings. Similarly, the reduction of the gate setting from the equivalent of four to one-half gate open in November was also staged over three days to slow the rate of change and allow for flow measurements at different gate settings. The gate setting was maintained at one-half gate open for the remainder of the month to accommodate international railroad bridge pier inspections and to avoid additional, large fluctuations in St. Marys Rapids conditions.

The equivalent gate settings were achieved throughout the reporting period by using Gates 2 through 16 at various partially open settings (note that Gate 14 was kept closed beginning in June to allow for installation of a radar water level sensor as part of the 2015 field data collection project). The Compensating Works gates were set to the normal winter maximum setting of one-half gate open equivalent from the beginning of November through the remainder of the reporting period. The equivalent one-half gate setting was achieved using Gates 7 to 10 open

20 cm (8 in). Flow through Gate 1, which supplies water to the Fishery Remedial Works, was maintained at a rate of 15 m^3/s throughout the reporting period.

There remains concern regarding the effects of large and hasty changes to hydrodynamic conditions in the St. Marys Rapids due to Compensating Works gate movements, and the impacts on fish and other aquatic organisms. The Board has been working toward evaluating the effects of gate changes on water levels, flows and velocities in the rapids, and establishing operational guidelines to reduce the risk of adverse impacts, as directed in the IJC's 2014 Supplementary Order of Approval, Condition 8. Details can be found in *Section 11*.

A complete summary of gate settings for the period is provided in *Table 3*.

4. Governing Conditions during the Reporting Period

The monthly mean levels of Lake Superior ranged between 183.49 and 183.69 m (602.0 and 602.66 ft) during the reporting period, and within the limits of 182.76 and 183.86 m (599.61 and 603.22 ft) specified in the IJC's Orders of Approval.

During the reporting period, the daily mean water levels in the lower St. Marys River at the US Slip gauge downstream of the US Locks varied between 176.66 and 177.15 m (579.59 and 581.20 ft). Therefore, Criterion B (which restricts outflow to no more than pre-project values when the level at US Slip is above 177.94 m (583.79 ft) was not a concern. Furthermore, daily mean US Slip levels generally stayed well above the ponding restriction threshold (see *Section 10*) of 176.09 m (577.72 ft) for the reporting period. However, while ponding was permitted during the entire reporting period, there was no opportunity for the hydropower plants to perform ponding operations as they were running at full capacity.

5. Inspections and Repairs at the Compensating Works

Monthly inspections of the Compensating Works were conducted on the US portion by the United States Army Corps of Engineers' (USACE) Sault Ste. Marie Area Office. All gates, railings and locks were reported to be in good working order over the reporting period. Monthly inspections of the Compensating Works are not performed during the winter months.

Routine monthly maintenance inspections conducted on the Canadian portion of the Compensating Works by Brookfield Renewable Energy Partners (BREP) also found the structure to be in sound condition. Inspection observations include public safety features such as fencing and signs, the concrete and masonry structure, gates and mechanisms, on-site safety equipment such as life jackets and air horns, as well as anything unusual.

6. General Conditions, Repairs and Maintenance at the Hydropower Facilities

a. General conditions at the hydropower facilities

All three hydropower plants experience variations in flow capacity as a result of changing hydrologic conditions at any given time of the year, which can affect the plants' abilities to utilize their full allocations. Allocations were set at "maximum capacity" for each plant

throughout the reporting period. In addition to hydrologic constraints, maintenance activities at the plants also led to reduced capacity. The Board and the Great Lakes – St. Lawrence Adaptive Management (GLAM) Committee have recently begun to evaluate the potential impacts of reductions in hydropower flow capacity on regulated water levels and flows, and their effects on key interests throughout the upper Great Lakes system. More details regarding this can be found in *Section 12*. There were no reported ice-related issues this winter.

b. Brookfield Renewable Energy Partners

Planned unit outages at Brookfield's Clergue plant totaled 98 hours during the reporting period. Most of these occurred in November to allow Great Lakes Power Transmission to complete work on transmission lines and at the Clergue Transmission station. Unplanned outages during the reporting period were minimal. There were issues loading Unit 1 and 2 to maximum output beginning in mid-December due to the accumulation of debris in the trash racks; this was corrected by the end of the month.

Annual maintenance on the Clergue generating units in 2016 is expected to be completed in three stages during the months of April, May and June. Additionally, the city of Sault Ste. Marie will require "no-flow" conditions for a period of approximately five to seven days in the spring and summer of 2016 (dates to be confirmed) to support the closure and decommissioning of the north city intake well located on Brookfield property.

c. Cloverland Electric Co-operative

Canal repair work, which began in the spring of 2015 and was resumed 26 August, continued through the first three months of this reporting period, with flow capacity at the plant reduced by about 25 percent overall. Favorable weather conditions allowed the canal work to extend to 25 November. Repairs are expected to continue on a similar schedule in 2016, beginning late April through June, and resuming again in September through October. This work will again effect total plant output each month, with an estimated 595 to 625 m^3/s (21,000 to 22,000 ft^3/s) total outflow capacity expected.

d. US Government hydropower plant

Unit outages from September through February totaled 534 hours, with 434 of those hours attributed to transmission work. Anchor ice issues in February caused a 17-hour outage total in two units.

New programmable logic controller (PLC) panels will be commissioned on all units from spring through fall, with the estimation that each unit will require a two-day outage. A 12-day total outage on all units is planned for protective relay replacement in September.

7. Flow Verification Measurements

Discharge measurements were collected throughout 2015 at the Compensating Works under various partially open gate settings. The measurements were scheduled to coincide with normal regulatory operations in order to preclude the need for additional gate movements that would result in large, unnatural fluctuations in St. Marys Rapids conditions. From October through November, the gate setting was reduced in stages to ensure a gradual transition to the lower flows and water levels in the rapids required during the winter. This also provided opportunities to collect discharges at different gate settings during the transition period. Discharge

measurements were collected on 6 and 7 October and again from 3 to 5 November, with equivalent gate settings ranging from a high of four gates open to a low of one gate open. Flows were measured using a USACE remote boat in the US government plant's headrace canal and a Water Survey of Canada boat at a full cross-section upstream of the Compensating Works, with the difference in flow between these two measurement sections equal to the rapids flows. The flow measurements collected will aid in developing new rating equations for determining St. Marys Rapids flows under multiple partially open gates, and will also be used to develop and calibrate a hydrodynamic model of the St. Marys Rapids for use in further studies (*Section 12*).

8. Water Usage in the St. Marys River

The distribution of outflows from Lake Superior for January 2015 to February 2016 can be found in *Table 4* (*Table 5* in English units). Water uses are divided into four categories: domestic, navigation, fishery and hydropower. According to the 1979 Supplementary Order, after the first three water requirements are satisfied, the remaining outflow is shared equally between Canada and the United States for hydropower purposes. Any remainder, beyond the flow capacity of the hydropower plants, is discharged through the Compensating Works into the St. Marys Rapids.

As shown in the tables, water used for domestic and industrial purposes was about 3 m^3/s (106 ft^3/s) or about 0.1 percent of the total monthly outflow. The monthly flow through the locks depends on traffic volume and varied from 1 to 12 m^3/s (49 to 420 ft^3/s) over the past six months. The locks are closed for navigation in the winter months, beginning January 15th. Water used for navigation accounted for less than one percent of total river flow. Hydropower passed an average of 2,153 m^3/s (76,000 ft^3/s) each month and accounted for approximately 86 percent of the total outflow. All plants were requested to run at their maximum capacities throughout the reporting period.

In accordance with the IJC's orders to fulfill the fishery needs in the main rapids, a minimum gate setting of one-half gate open is required at all times at the Compensating Works. A setting equivalent to one-half gate open for the main rapids is maintained by having four gates partially open to supply the same quantity of water. This spreads the flow more evenly across the main rapids, and reduces potential damage from ice floes impacting the gates. In addition, a flow of at least 15 m^3/s (530 ft^3/s) is normally also maintained in the Fishery Remedial Works through Gate 1. The flow through the St. Marys Rapids, including that through the Fishery Remedial Works, ranged from 88 to 754 m^3/s (3,100 to 26,600 ft^3/s) over the last six months, or an average of approximately 13 percent of the total monthly outflow. The equivalent gate setting ranged from one-half to five gates open.

9. Long Lac and Ogoki Diversion

Ontario Power Generation (OPG) continued to provide the Board with information on the operations of the Long Lac and Ogoki Diversions. The Ogoki Diversions into Lake Nipigon (which flows into Lake Superior) averaged 141 m^3/s (4,970 ft^3/s) and the Long Lac Diversion averaged 34 m^3/s (1,200 ft^3/s) from September through February. Combined, these diversions were about 126 percent of average for the period 1944-2015.

Slots cut into Waboose Dam provide a minimum flow northward to the Ogoki River of approximately 2 m^3/s to meet fisheries requirements. This "slot flow" averaged 2.6 m^3/s (91 ft^3/s) from September through February.

Continuous minimum flows of at least 2 m^3/s (70 ft^3/s) are maintained from the Saturday of Victoria Day weekend (in May) through Labor Day from the northern outlet of Long Lake (Kenogami Dam) for environmental enhancement. Outflows through the Kenogami Dam during the reporting period averaged 0.7 m^3/s (31 ft^3/s).

10. Peaking and Ponding Operations at Hydropower Plants

Peaking and ponding operations are the within-day and day-to-day flow variations that enable the hydropower plants to better align their electricity production with demand. However, these variations cause the water levels in the St. Marys River downstream of the plants to fluctuate more than they otherwise would. The IJC has approved guidelines within which the Board may restrict peaking and ponding operations by the hydropower entities under certain conditions. Specifically, if the minimum level at the US Slip gauge on the lower river is expected to be below the threshold level of 176.09 m (577.72 ft) as a result of ponding operations, then the power entities are required to pass peak flows for at least an eight-hour period each weekend and holiday day to provide periods of relatively higher levels on the lower St. Marys River each day. The Board provides summaries of peaking and ponding in its semi-annual reports.

Above-average outflows from Lake Superior, combined with a rise in Lake Michigan-Huron levels resulted in levels at US Slip remaining above the established threshold, such that ponding was permitted during the entire reporting period. However, the power entities were unable to perform peaking and ponding operations as they were operating at maximum capacity.

To continue to provide timely information on expected flow variations, the USACE distributes monthly notices during the shipping season (March through January) on expected Lake Superior outflows, and a schedule of flow variations at the hydropower plants.

Figures 7a-7f compare the hourly Lake Superior outflow and the hourly levels at US Slip on the lower St. Marys River. In general, US Slip levels were slightly lower during the same period last year.

11. Gate Movement Limits Study

Starting in the spring of 2015, the Board began a study, led by the USACE Detroit District and partially funded through the IJC's International Watersheds Initiative (IWI), to measure and analyze flow, velocity, and water level data in the St. Marys Rapids under varying Compensating Works gate settings. The results of this study will be used to establish field-verified limits on the rate of gate changes in an effort to prevent harm to fish and other organisms caused by stranding or flushing.

During past flow measurement campaigns at the St. Marys Rapids, the Board has typically directed that the Compensating Works gates be adjusted over several consecutive days to allow measurements to be conducted at various gate settings within a relatively short period of time.However, in consideration of continued high flows and water levels and related concerns on the impacts of large fluctuations in hydraulic conditions in the St. Marys Rapids on fish and other aquatic organisms, the Board recommended an alternative strategy for the 2015 field measurement campaign. Water level sensors were installed in the spring as soon as conditions permitted, and left installed through November to continuously measure the effects on water

levels of both gate changes and natural factors (such as wind effects). Furthermore, flow measurements were collected throughout the field season at the beginning of those months when gate settings of the Compensating Works were expected to be changed as a result of normal regulatory operations. This avoided any additional negative impacts that would result from additional gate changes, while providing flow measurement information at a wider range of gate settings and flow conditions.

A two-dimensional Adaptive Hydraulics (AdH) model of the St. Marys River is currently being developed by the USACE Detroit District using the field data collected this year. The data will be used to calibrate the model, which will be used to gain a better understanding of the unique hydraulics of the St. Marys River, and also extend the analysis to a broader range of flow and water level conditions than has recently been observed. The model will be use to evaluate the hydraulic impacts in the St. Marys Rapids from different gate operations, and will also be able to address other questions and concerns as to the impacts of natural factors and operational decisions.

12. Great Lakes – St. Lawrence Adaptive Management (GLAM) Committee

In its year one work plan, the GLAM Committee outlined a number of tasks related to the ongoing evaluation of regulations plans. This includes two tasks previously identified by the Board as priorities for assessing the performance of the recently implemented Lake Superior Regulation Plan 2012 under actual operational conditions versus what was expected to occur based on modeled results.

Specifically, one of the tasks will review the impacts of reductions in maximum side-channel capacity due to hydropower outages and other limitations and the development of strategies to address them. Plan 2012 was developed and tested under the assumption that a maximum side-channel flow of 2,320 m^3/s (82,300 ft^3/s) would be possible each month. This was based on a review of physical capacities and limitations of the various flow control structures at the head of the St. Marys River, and this maximum flow is achievable only under “ideal” conditions. However, actual operational conditions vary from month-to-month, and hydropower plant capacity is, at times, limited due to hydrologic variations in water levels and ice conditions, as well as outages due to maintenance activities. Through this task, GLAM and the Board will develop a better understanding of the various factors affecting side-channel capacity, and incorporate this information into plan-evaluation tools. These will be used to review the impacts of reduced side-channel capacity on regulated water levels and flows, to determine the effects on key stakeholders, and to develop and evaluate potential strategies to address these impacts.

The second task will review the use of multiple partially open gate settings at the Compensating Works and their impacts on St. Marys River stakeholders. As a result of the recent rise in water levels in the upper Great Lakes, Lake Superior outflows through the St. Marys River have also increased, requiring multiple open gates to pass the total flow. The Board began employing multiple partially open gate settings starting in May 2014 based on feedback from stakeholders and their concerns about the impacts of high and fluctuating water level and flow conditions within the St. Marys Rapids. The goal will be to provide potential advantages over the more typical use of fully open gates. As part of this task, GLAM intends to develop a better understanding of the ecological and economic effects of partially open gate settings, and define areas for further study. Concurrently, the Board will use flow measurements collected over the past two years under partially open gate conditions to support development of improved flow

relationships. These findings will be incorporated into plan-evaluation tools and used to develop and evaluate guidelines for Compensating Works gate operations in the future.

13. Public Communications and Outreach

The Board intends to hold its annual public meeting on the afternoon of June 24 by teleconference and webinar. Two sessions were held last year to reach a broader audience, but based on low turnout at both sessions, it was deemed unnecessary to hold two sessions this year.

The Board will again have a presence this year at the Soo Locks in Sault Ste. Marie, Michigan, as part of the USACE's annual Engineer's Day festivities on 24 June. At the Board's information booth, Board representatives will have the chance to speak directly with the public regarding the regulation plan,current conditions and answer any specific questions they may have.

Throughout the reporting period, stakeholders voiced concerns regarding high water levels and flow conditions, and asked how the current regulation plan balances levels. Reports of erosion on Lake Superior and on Lake Michigan-Huron have been received. Stakeholders in the St. Marys River continue to express concerns over recent higher gate settings and the resulting high St. Marys River flows. Some citizens on both lakes remain concerned about potential impacts due to climate change and variability.

The Board continues to issue, at the beginning of each month (and before any significant change in outflows), news releases informing the public about Lake Superior regulation and water level conditions. These news releases are sent by both the Canadian and US regulation representative offices to e-mail distribution lists that include various agencies, stakeholders and media outlets. The Board also makes these news releases available to the public online through the Board's Website (ijc.org/en_/ilsbc) and the Board's Facebook page (facebook.com/InternationalLakeSuperiorBoardOfControl), both of which continue to grow in popularity. Additional content available online includes information on Board members and responsibilities, semi-annual reports, meeting minutes, regulation updates, and hydrologic data summaries. A recent addition to the Board's website is an interactive map, created using the IJC's online mapping portal, which describes some of the important features related to the regulation of outflows through the St. Marys River: (ijc.org/en_/ilsbc/Map_Journal). The Board also provides monthly media releases and hydrologic data updates and information to the IJC.

The regulation representatives' offices have finalized the operational guides for Regulation Plan 2012, which can be found on the IJC sharepoint site.

14. Board Membership and Meetings

There were no changes to membership in this reporting period.

The Board held its spring semi-annual meeting on 30 March 2016 in Detroit, Michigan. The next meeting is scheduled for October in Quebec City, Quebec.

Respectfully submitted,

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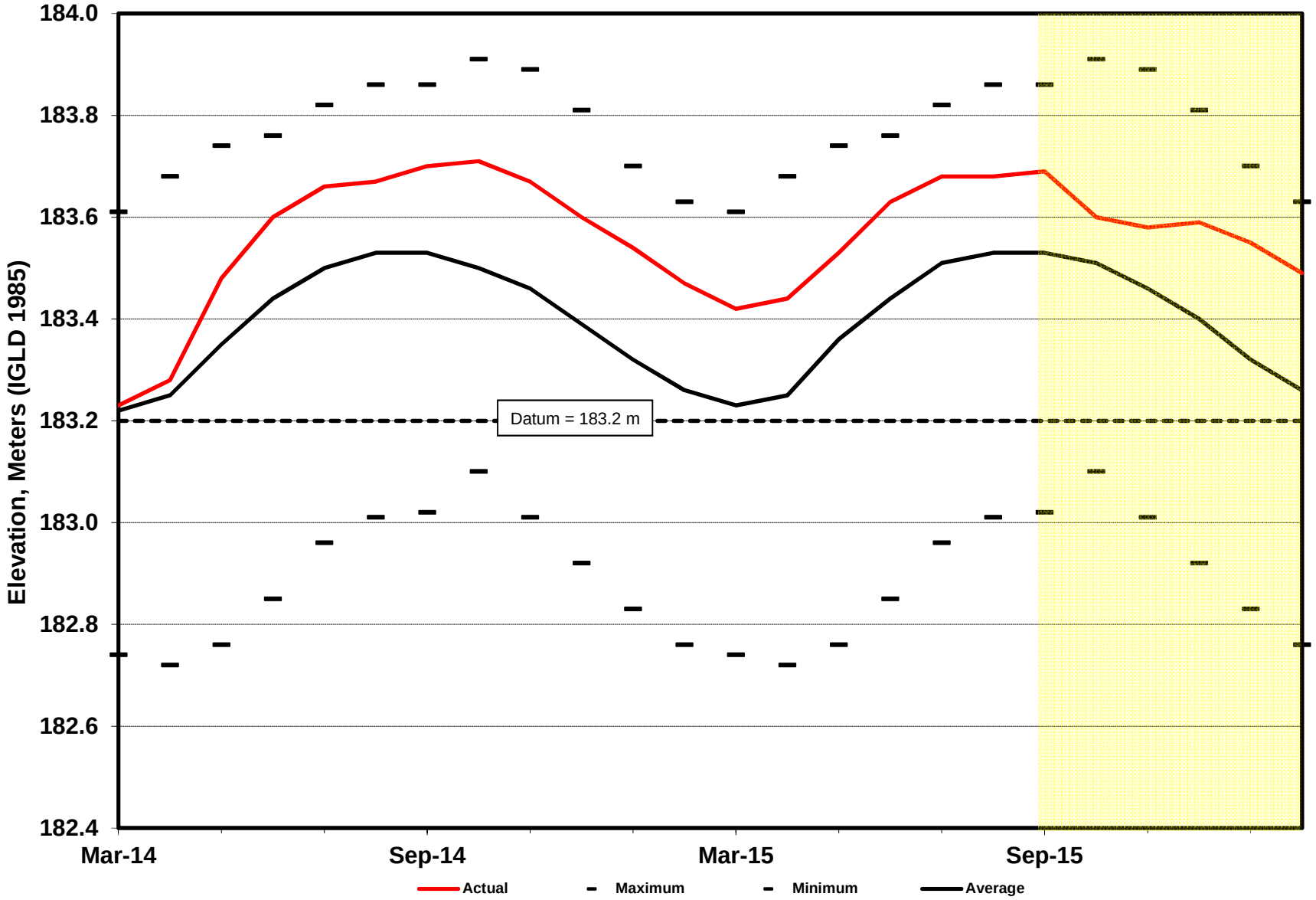
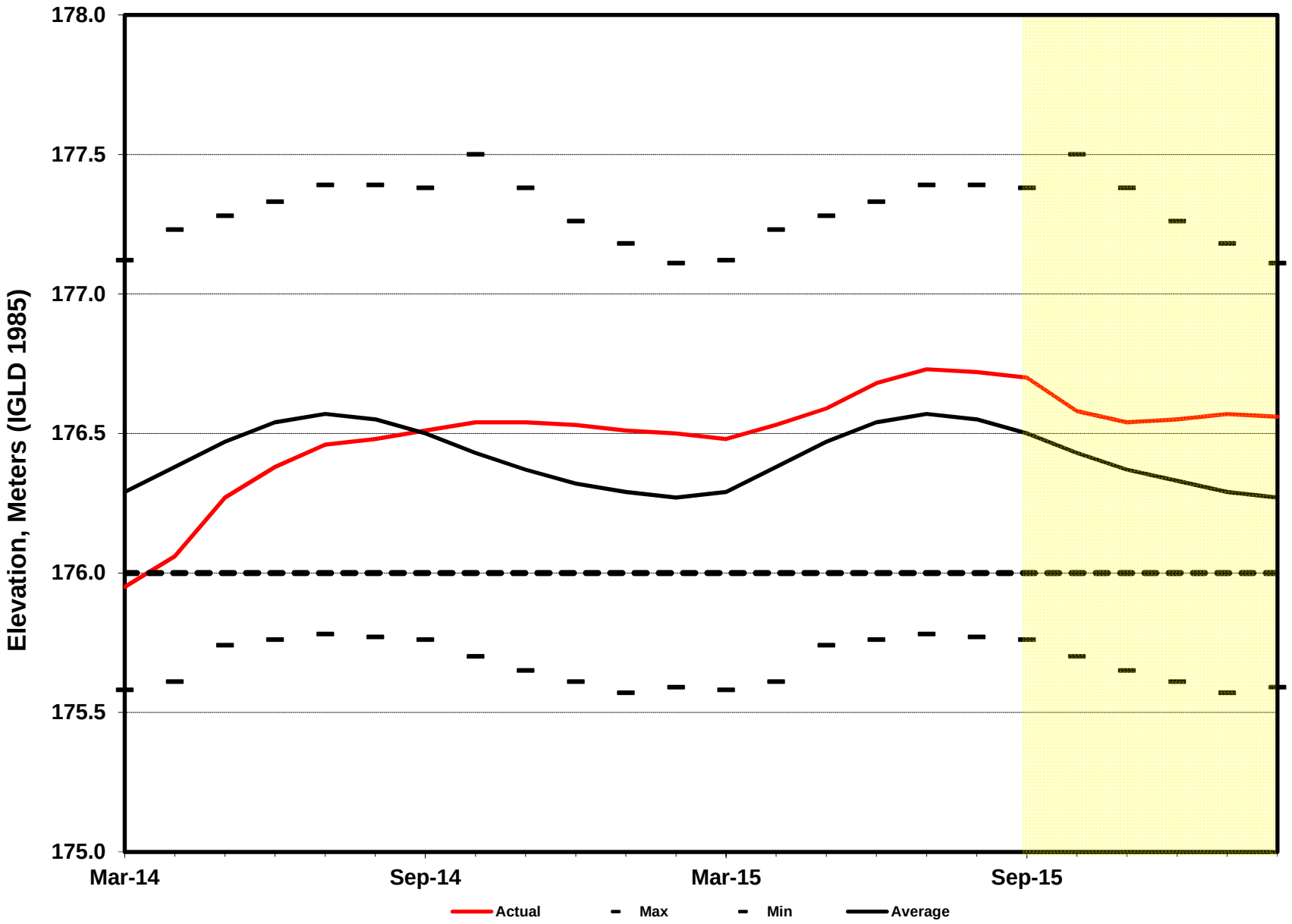
Mr. Jaymie Gadal	BG Richard Kaiser
Member for Canada	Member for United States

Figure 1: Monthly Mean Levels Lake Superior



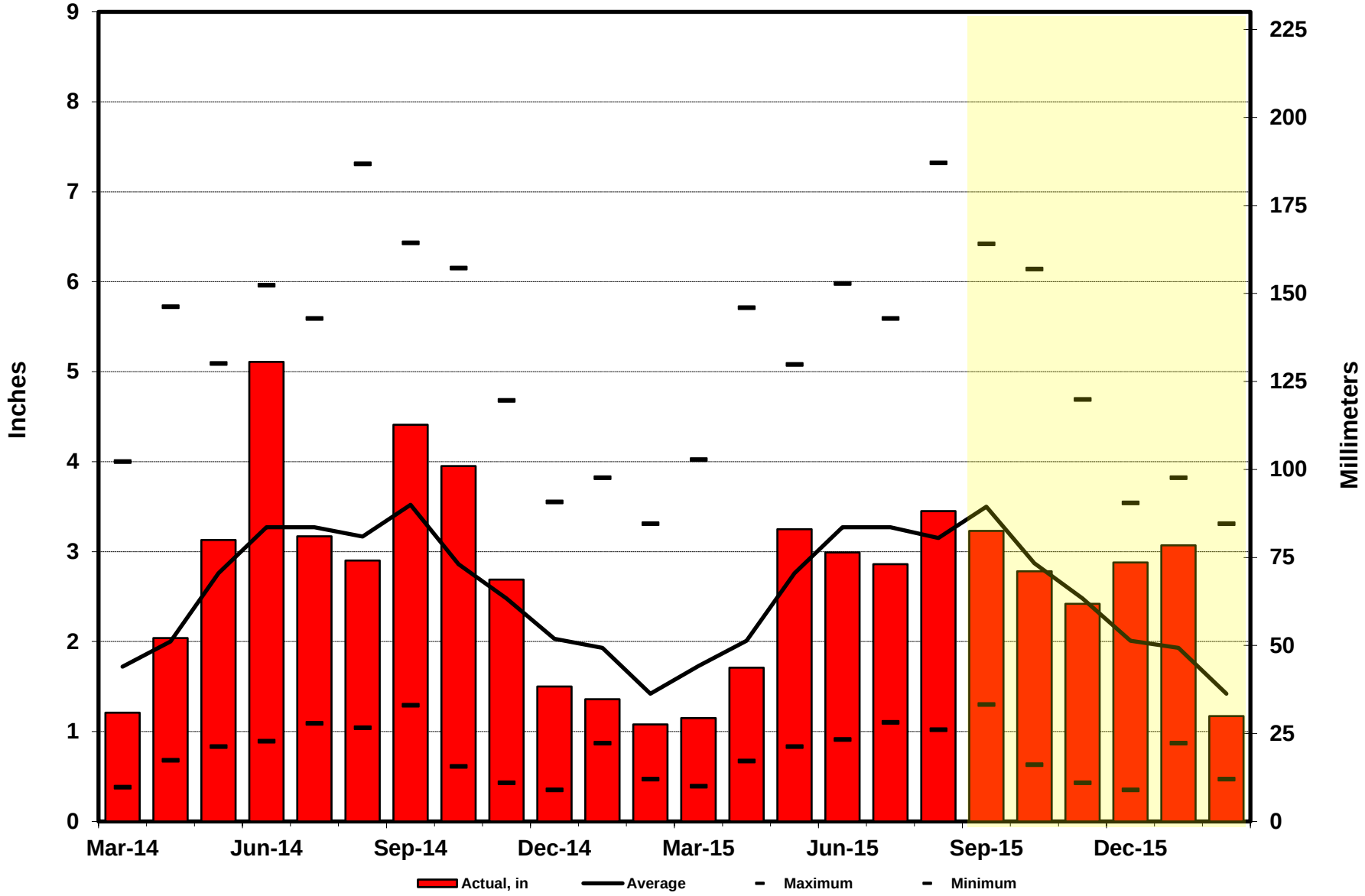
Based on a mean of 5 gages. Average, Maximum and Minimum values for the Period of Record 1918-2015

Figure 2: Monthly Mean Levels Lake Michigan-Huron



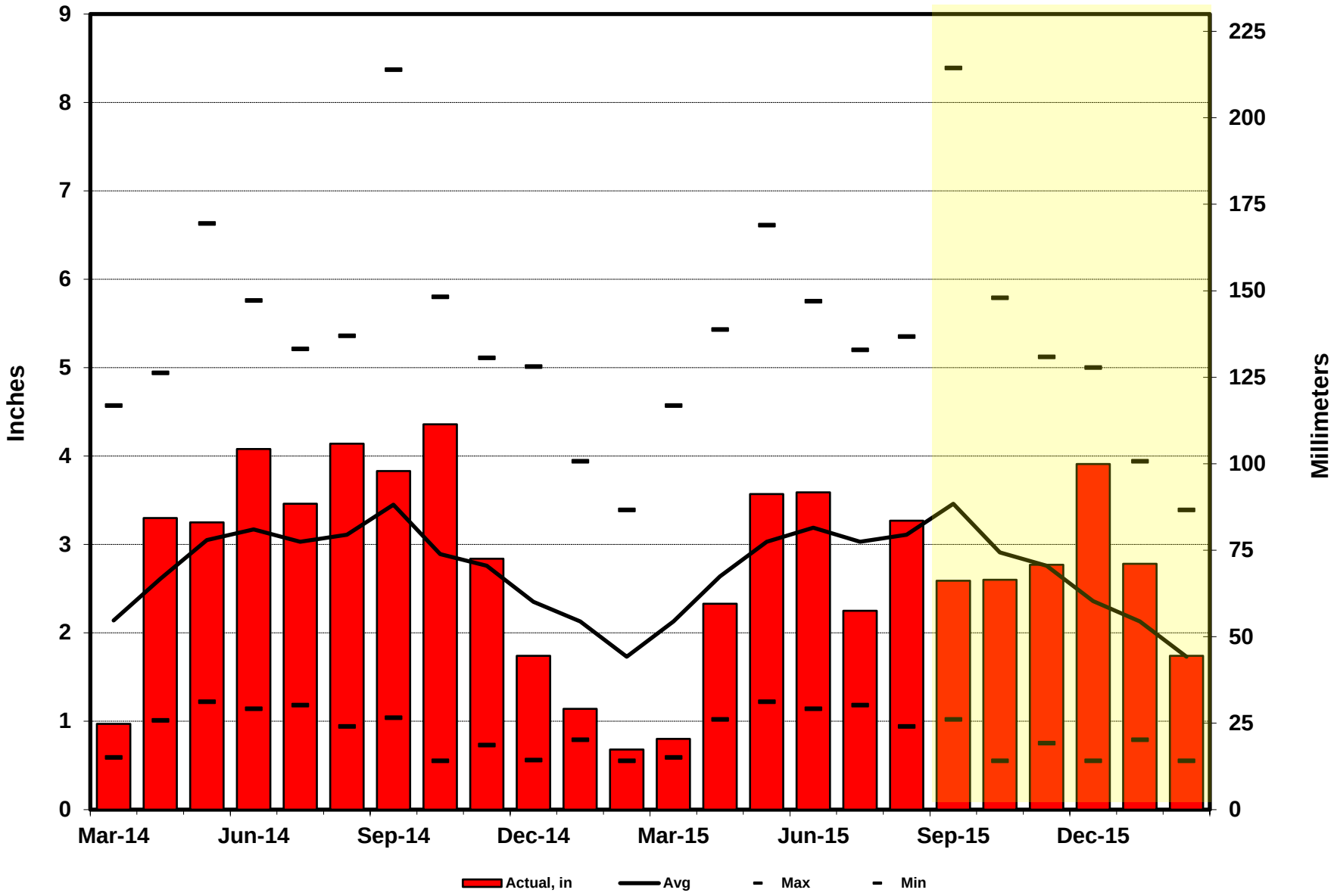
Based on a mean of 6 gages. Average, Maximum and Minimum values for the Period of Record 1918-2015

Figure 3: Monthly Precipitation Lake Superior



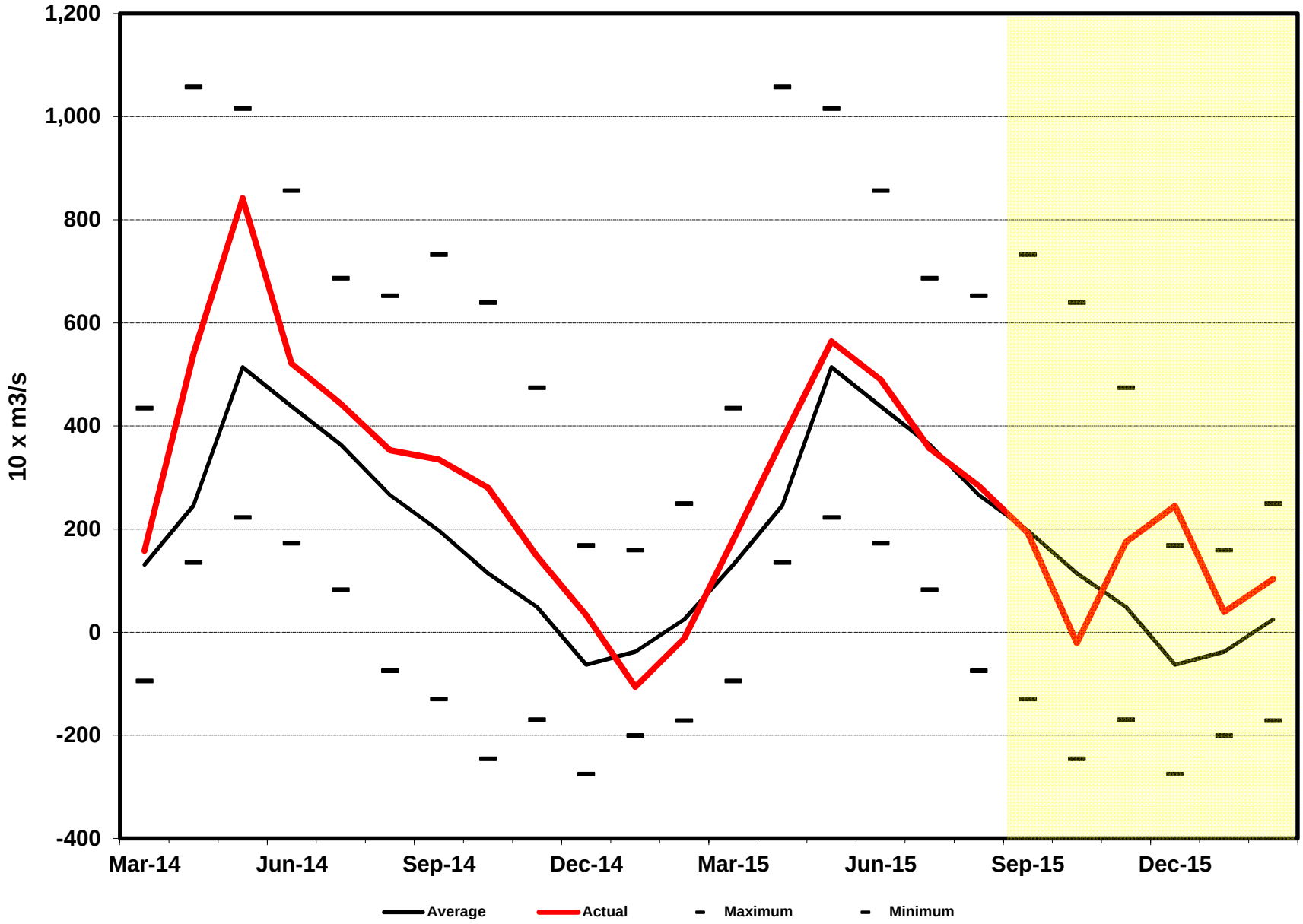
Maximum, Minimum and Average Precipitation Values based on Period of Record 1900 - 2012

Figure 4: Monthly Precipitation Lake Michigan-Huron



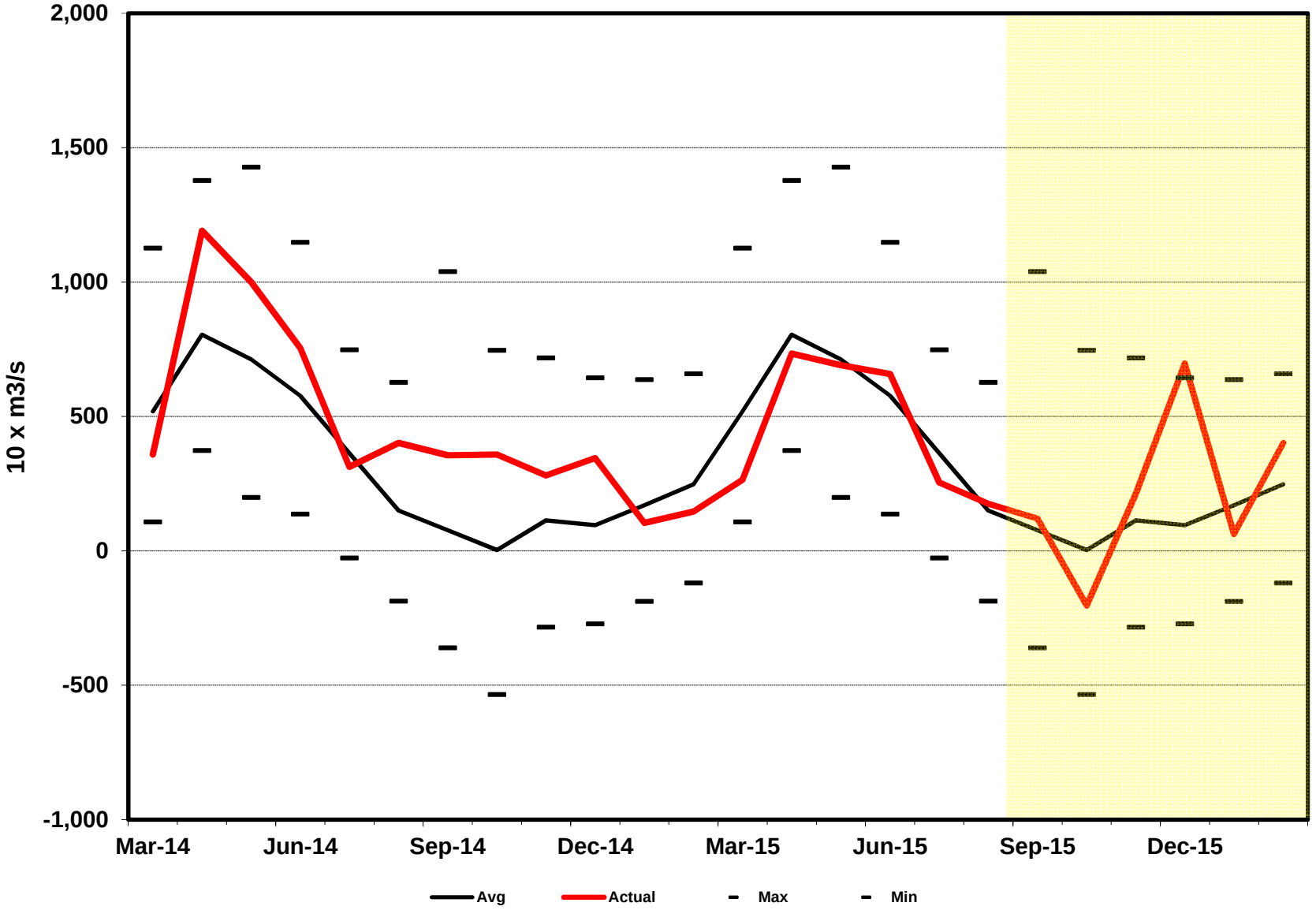
Maximum, Minimum and Average Precipitation Values based on Period of Record 1900 - 2012

Figure 5: Monthly Net Basin Supplies Lake Superior



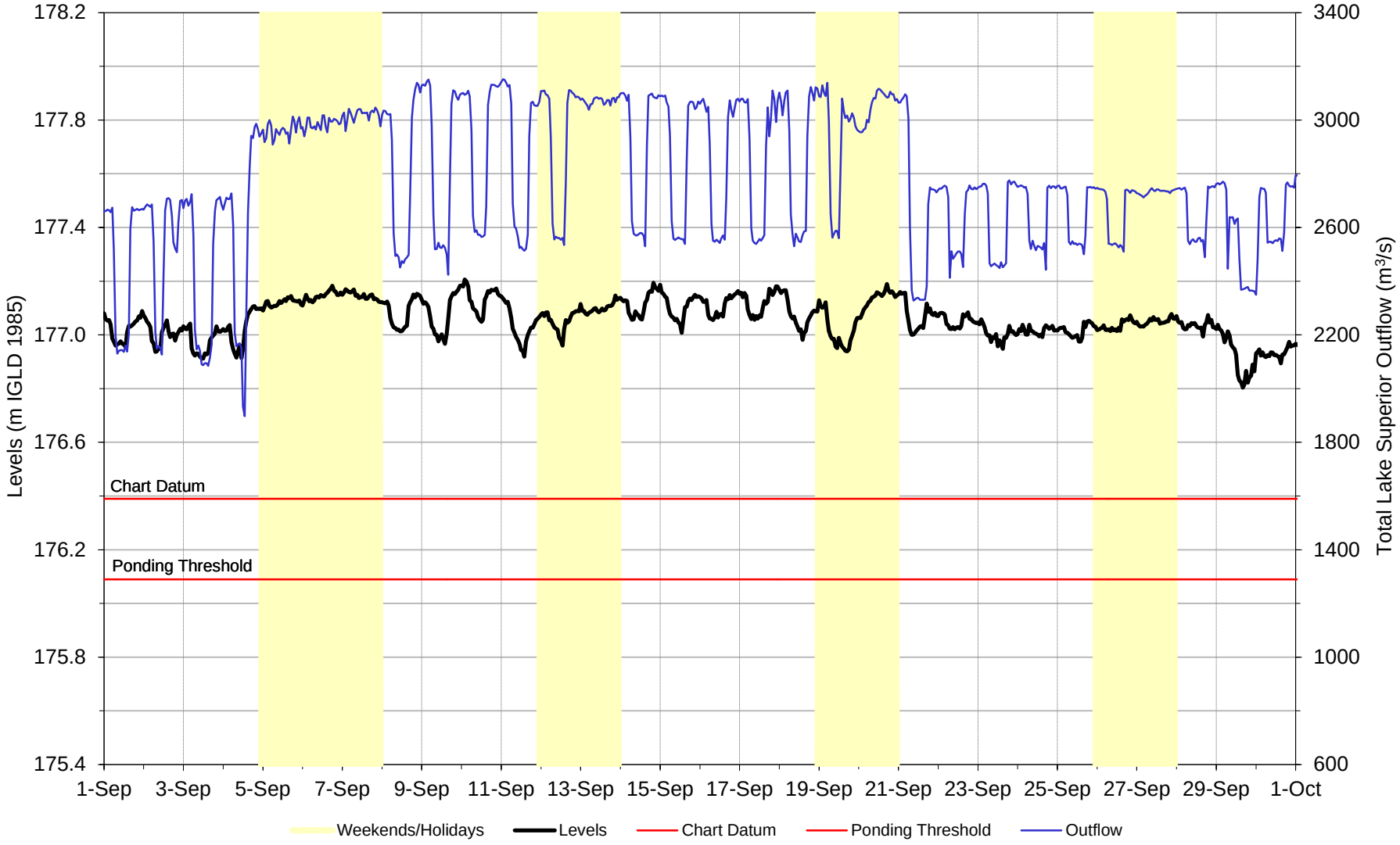
Average, Maximum and Minimum Based on Coordinated Period of Record 1900-2008

Figure 6: Monthly Net Basin Supplies Lake Michigan-Huron

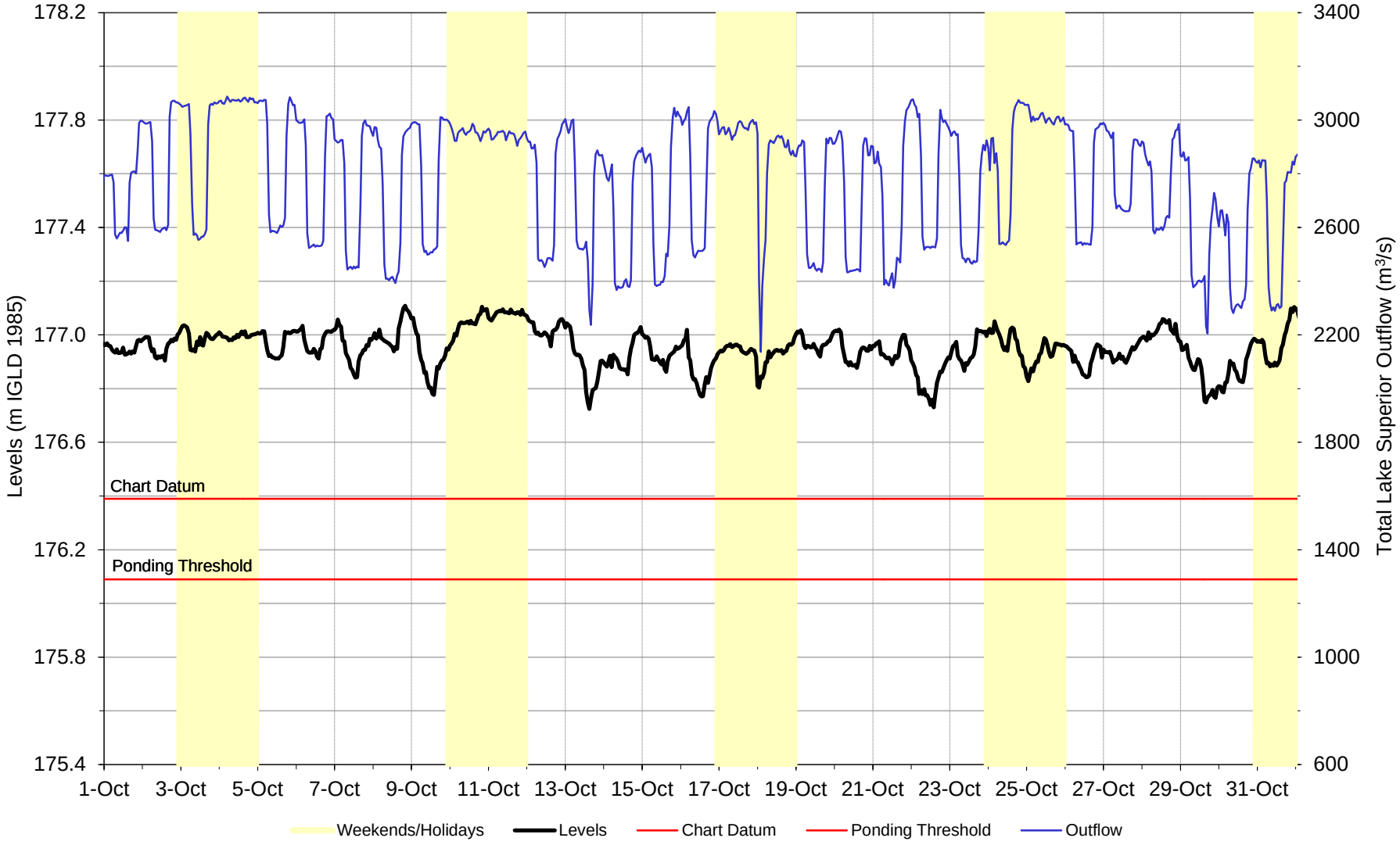


Average, Maximum and Minimum Based on Coordinated Period of Record 1900-2008

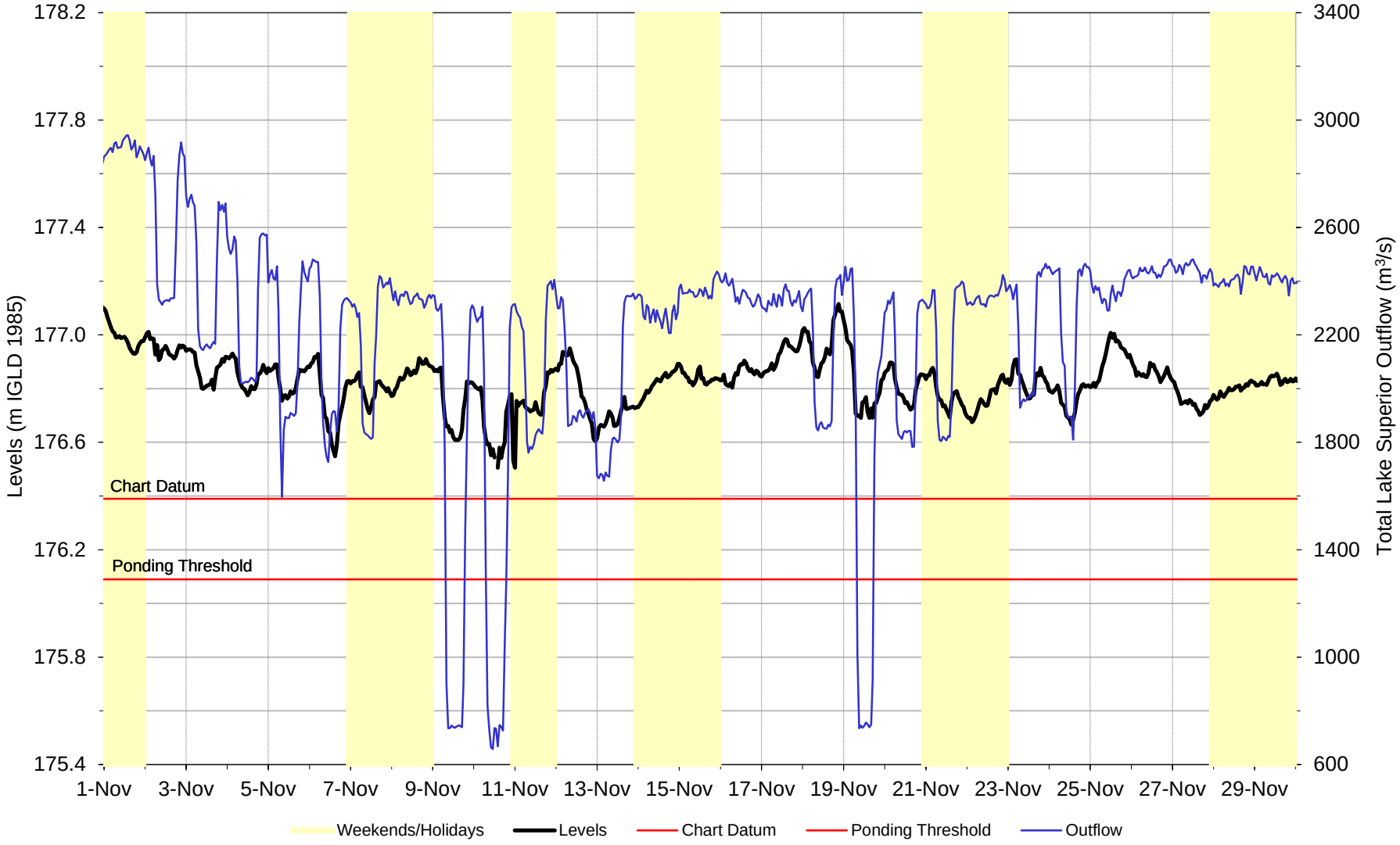
Hourly U.S. Slip Levels & Lake Superior Outflows
Figure 7a - September 2015



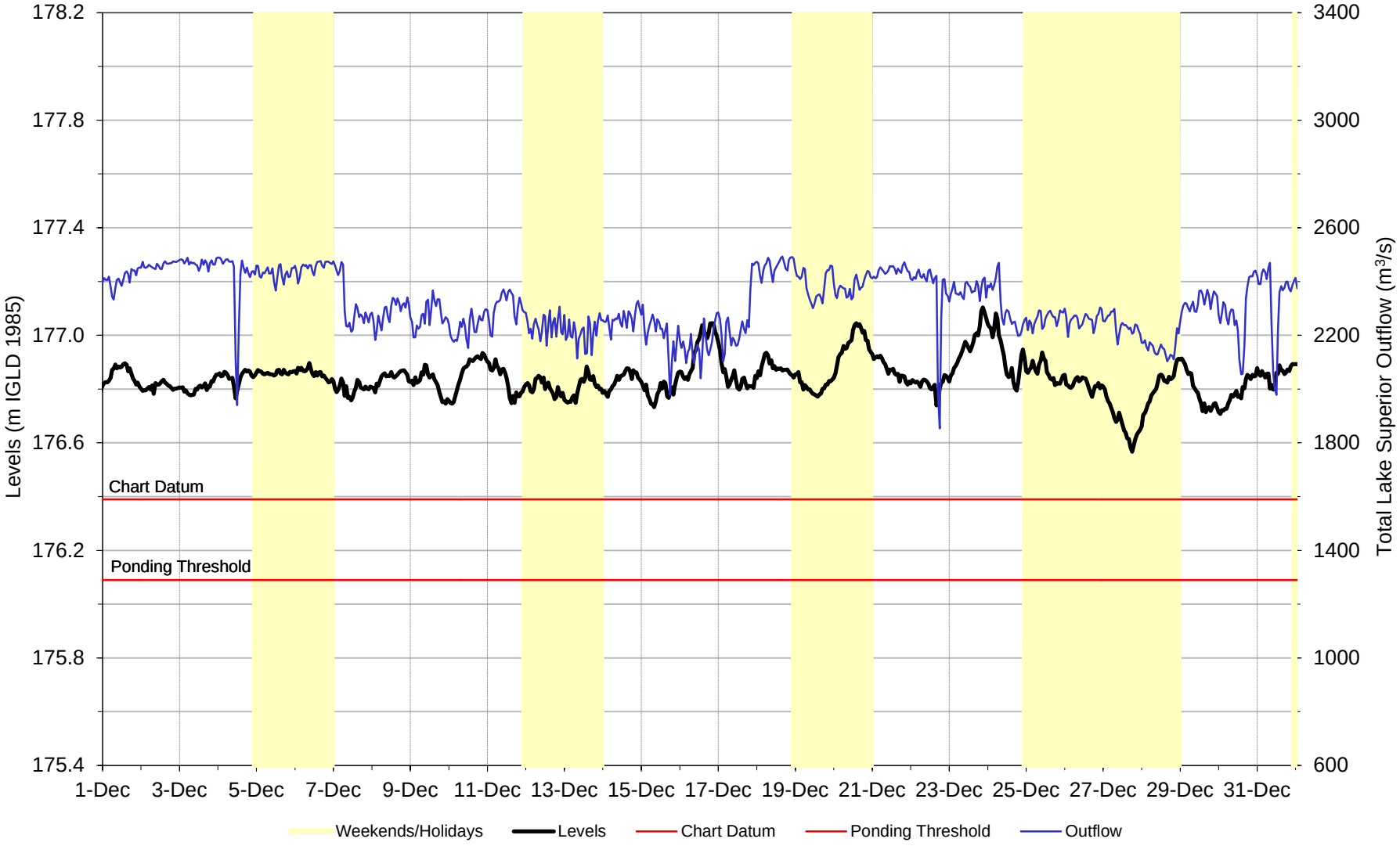
Hourly U.S. Slip Levels & Lake Superior Outflows
Figure 7b - October 2015



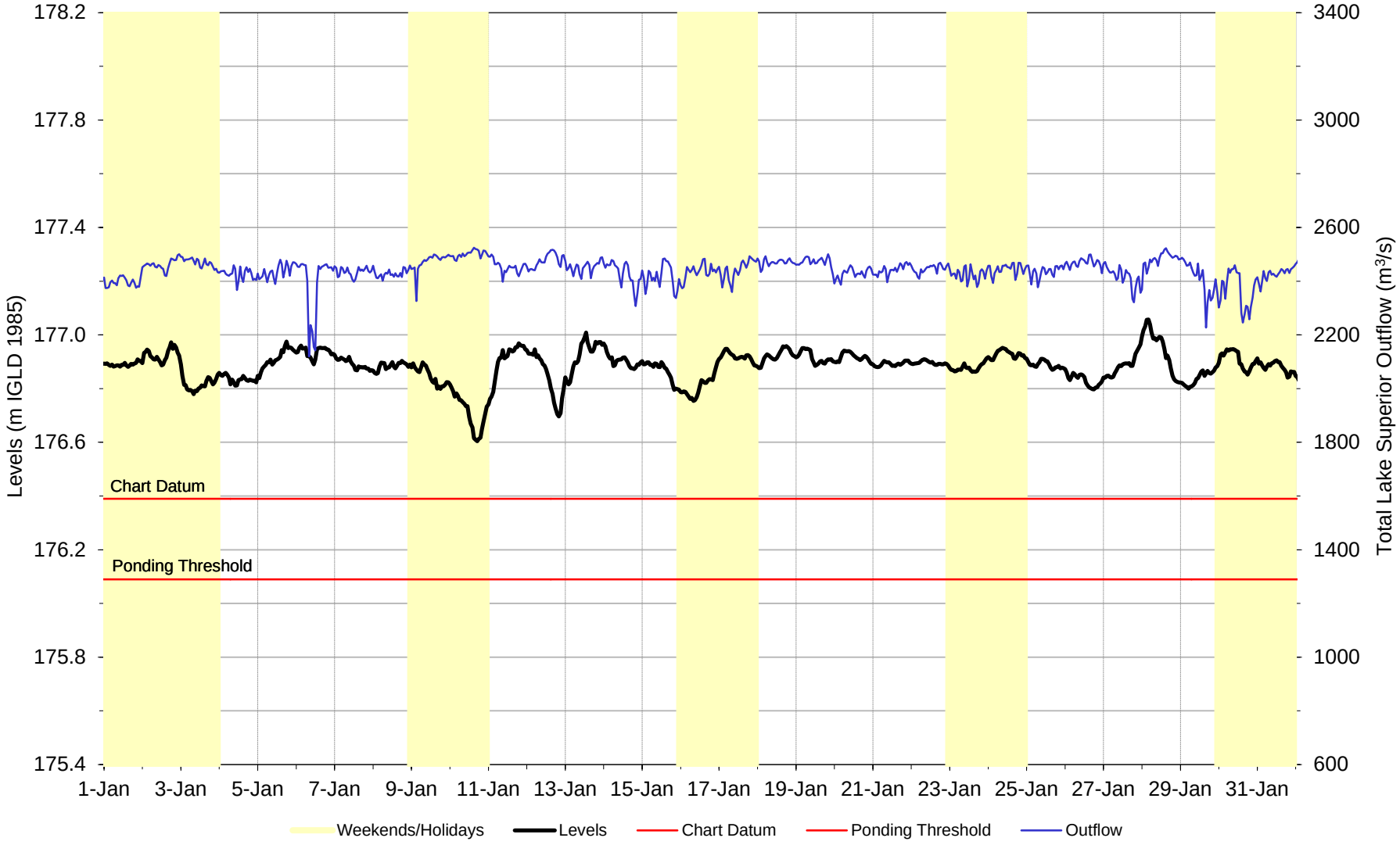
Hourly U.S. Slip Levels & Lake Superior Outflows
Figure 7c - November 2015



Hourly U.S. Slip Levels & Lake Superior Outflows
Figure 7d - December 2015



Hourly U.S. Slip Levels & Lake Superior Outflows
Figure 7e - January 2016



Hourly U.S. Slip Levels & Lake Superior Outflows
Figure 7f - February 2016

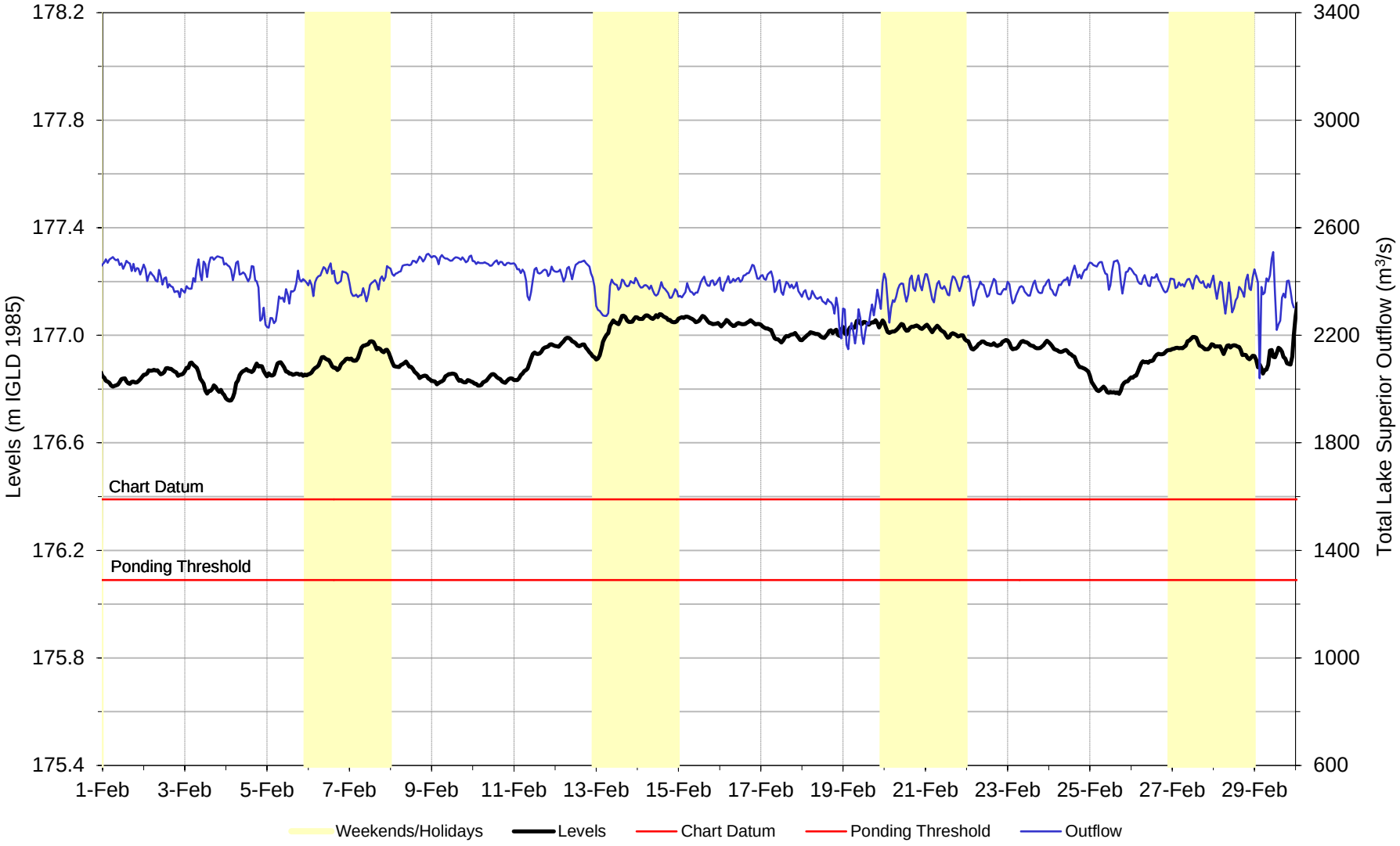


TABLE 1: 2015 - 2016 Lake Superior Hydrologic Factors

Month	Levels				Net Basin Supplies			Outflows		
	Monthly Mean Recorded[1]		Difference From Average[2]		Monthly Mean Recorded		Exceedance Probability[3]	Monthly Mean Recorded[4]		Percent of Average[5]
	Meters	Feet	Meters	Feet	m^3/s	tcfs	(%)	m^3/s	tcfs	
2015										
JAN	183.54	602.17	0.22	0.72	-1,060	-37	84	2,210	78	114
FEB	183.47	601.94	0.21	0.69	-120	-4	66	2,190	77	115
MAR	183.42	601.77	0.19	0.62	1,800	64	31	2,200	78	118
APR	183.44	601.84	0.19	0.62	3,730	132	63	1,950	69	101
MAY	183.53	602.13	0.17	0.56	5,640	199	37	2,450	87	116
JUN	183.63	602.46	0.19	0.62	4,900	173	34	2,720	96	124
JUL	183.68	602.62	0.17	0.56	3,560	126	50	3,080	109	135
AUG	183.68	602.62	0.15	0.49	2,840	100	42	3,070	108	131
SEP	183.69	602.66	0.16	0.52	1,920	68	48	2,770	98	119
OCT	183.60	602.36	0.09	0.30	-210	-7	83	2,780	98	123
NOV	183.58	602.30	0.12	0.39	1,750	62	15	2,220	78	100
DEC	183.59	602.33	0.19	0.62	2,450	87	<1	2,320	82	113
2016										
JAN	183.55	602.20	0.23	0.75	390	14	14	2,440	86	126
FEB	183.49	602.00	0.23	0.75	1,030	36	16	2,400	85	126

Notes: m^3/s = cubic meters per second tcfs = 1,000 cubic per second

[1] Water Levels are a mean of five gauges on Lake Superior, IGLD 1985

[2] Average levels are for the period 1918-2015, based on a mean of five gauges.

[3] Exceedance probabilities are based on 1900 - 2008.

[4] Outflows are rounded to the nearest 10 m^3/s.

[5] Average flows are for the period 1900 - 2008.

TABLE 2: 2015 - 2016 Lakes Michigan-Huron Hydrologic Factors

Month	Levels				Net Basin Supplies			Outflows		
	Monthly Mean Recorded[1]		Difference From Average[2]		Monthly Mean Recorded		Exceedance Probability[3]	Monthly Mean Recorded[4]		Percent of Average[5]
	Meters	Feet	Meters	Feet	m^3/s	tcfs	(%)	m^3/s	tcfs	
2015										
JAN	176.51	579.10	0.22	0.72	1,040	37	64	4,500	159	99
FEB	176.50	579.07	0.23	0.75	1,460	52	76	4,450	157	100
MAR	176.48	579.00	0.19	0.62	2,650	94	86	5,210	184	107
APR	176.53	579.17	0.15	0.49	7,340	259	59	5,630	199	109
MAY	176.59	579.36	0.12	0.39	6,910	244	51	5,700	201	106
JUN	176.68	579.66	0.14	0.46	6,580	232	32	5,640	199	103
JUL	176.73	579.82	0.16	0.52	2,540	90	76	5,530	195	100
AUG	176.72	579.79	0.17	0.56	1,750	62	43	5,620	198	102
SEP	176.70	579.72	0.20	0.66	1,200	42	38	5,670	200	104
OCT	176.58	579.33	0.15	0.49	-2,030	-72	86	5,570	197	103
NOV	176.54	579.20	0.17	0.56	2,130	75	29	5,600	198	104
DEC	176.55	579.23	0.22	0.72	6,970	246	<1	5,630	199	108
2016										
JAN	176.57	579.30	0.28	0.92	630	22	73	5,660	200	124
FEB	176.56	579.27	0.29	0.95	4,010	142	15	5,430	192	122

Notes: m^3/s = cubic meters per second tcfs= 1,000 cubic per second

[1] Water Levels are a mean of five gauges on Lake Superior, IGLD 1985

[2] Average levels are for the period 1918-2015, based on a mean of five gauges.

[3] Exceedance probabilities are based on 1900 - 2008.

[4] Outflows are rounded to the nearest 10 m^3/s.

[5] Average flows are for the period 1900 - 2008.

TABLE 3
COMPENSATING WORKS GATE CHANGES

Date	Gate Change	Final Gate Settings *	Gate Equivalent (approx.)	Notes
2015				
1-May	Opened 3 - 14	3 - 14 open 31 cm (12 in.)	2	To avoid ice issues
8-May	Further opened 3 - 14	3 - 14 open 62 cm (24 in.)	3	Deviation strategy to better manage operational limits on hydropower flow capacity
3-Jun	Further opened 9 - 13, closed 14, opened 15 and 16	3 - 8 open 62 cm (24 in.); 9 - 13 and 15 open 71 cm (28 in.); 16 open 5 cm (2 in.)	4	Continuing deviation strategy; Field measurements**; Sea Lamprey trapping***.
10-Jun	Further opened 3 - 8	3 - 13 and 15 open 71 cm (28 in.); 16 open 5 cm (2 in.)	4	
6-Jul	Opened 2	2 - 13 and 15 open 71 cm (28 in.); 16 open 5 cm (2 in.)	4	
14-Jul	Further opened 2 - 13 and 15	2 - 13 and 15 open 89 cm (35 in.); 16 open 5 cm	6	
5-Aug	Lowered 9-13 and 15	2 - 8 open 89 cm (35 in.); 9 - 13 and 15 open 76 cm (30 in.); 16 open 5 cm (2 in.)	5	
6-Aug	Lowered 2-8	2 - 13 and 15 open 76 cm (30 in.); 16 open 5 cm (2 in.)	5	
6-Oct	Lowered 2-8	2 - 8 open 63.5 cm (25 in.); 9 - 13 and 15 open 76 cm (30 in.); 16 open 5 cm (2 in.)	4	
7-Oct	Lowered 9-13 and 15, closed 16	2 - 13 and 15 open 63.5 cm (25 in.).	4	
29-Oct	Lowered 2-13 and 15	2 - 13 and 15 open 51 cm (20 in.).	3	
3-Nov	Lowered 2-13 and 15	2 - 13 and 15 open 33 cm (13 in.).	2	
4-Nov	Lowered 2-13 and 15	2 - 13 and 15 open 20 cm (8 in.).	1	
5-Nov	Closed 2-6, 11-13 and 15	7 - 10 open 20 cm (8 in.)	1/2	Continuing deviation strategy; International Rail Bridge pier inspections (5-Nov).

* Gate 1 remained open 20 cm (8 in.) throughout reporting period (fishery requirement of approximately 15 m^3/s)
** St. Marys Rapids flow measurements collected in 2015 on: 9-10 Jun; 13-14 Jul; 4 Aug; 6-7 Oct; 2-4 Nov.
*** Gate 16 set to 5 cm (2 in.) open at request of US Fish and Wildlife Service to allow for sea lamprey trapping (Jun - Aug).

TABLE 4
MONTHLY DISTRIBUTION OF LAKE SUPERIOR OUTFLOWS (cubic meters/second)

	POWER CANALS					NAVIGATION CANALS			DOMESTIC USAGE				FISHERY	TOTAL LAKE
Year and Month	U.S. Gov't Hydro	Cloverland	U.S. Total	Brookfield	Total Power	United States	Canada	Total Navigation	Sault Ste. Marie U.S. + CAN	Algoma Steel	St. Marys Paper	Total Domestic Usage	St. Marys Rapids	Superior Outflow
2015														
JAN	386	641	1,027	1,084	2,111	4.4	0.0	4	0.3	2.7	0	3	88	2,206
FEB	393	672	1,065	1,037	2,102	1.4	0.0	1	0.3	2.6	0	3	87	2,193
MAR	394	666	1,060	1,052	2,112	2.0	0.0	2	0.3	2.6	0	3	87	2,204
APR	402	697	1,099	756	1,855	8.3	0.0	8	0.3	2.7	0	3	87	1,953
MAY	397	625	1,022	907	1,929	11.4	0.3	12	0.3	2.8	0	3	506	2,450
JUN	398	625	1,023	1,030	2,053	11.4	1.1	12	0.3	2.9	0	3	650	2,718
JUL	399	823	1,222	1,043	2,265	11.6	1.9	14	0.3	2.9	0	3	796	3,078
AUG	399	798	1,197	1,080	2,277	10.6	1.7	12	0.3	2.9	0	3	776	3,068
SEP	400	557	957	1,044	2,001	11.1	1.2	12	0.3	2.8	0	3	754	2,770
OCT	392	586	978	1,137	2,115	9.4	0.3	10	0.2	2.4	0	3	653	2,781
NOV	403	637	1,040	1,043	2,083	8.8	0.0	9	0.2	2.4	0	3	128	2,223
DEC	351	799	1,150	1,070	2,220	8.2	0.0	8	0.2	2.5	0	3	89	2,320
2016														
JAN	402	797	1,199	1,145	2,344	2.8	0.0	3	0.2	2.5	0	3	88	2,438
FEB	398	762	1,160	1,145	2,305	1.4	0.0	1	0.2	2.4	0	3	88	2,397

NOTE: (1) Power canals columns include flows through power plants and spillways

TABLE 5
MONTHLY DISTRIBUTION OF LAKE SUPERIOR OUTFLOWS (cubic feet/second)

	POWER CANALS					NAVIGATION CANALS			DOMESTIC USAGE				FISHERY	TOTAL LAKE
Year and Month	U.S. Gov't Hydro	Cloverland	U.S. Total	Brookfield	Total Power	United States	Canada	Total Navigation	Sault Ste. Marie U.S. + CAN	Algoma Steel	St. Marys Paper	Total Domestic Usage	St. Marys Rapids	Superior Outflow
2015														
JAN	13,600	22,600	36,200	38,300	74,500	155	0	155	11	95	0	106	3,100	77,900
FEB	13,900	23,700	37,600	36,600	74,200	49	0	49	11	92	0	106	3,100	77,500
MAR	13,900	23,500	37,400	37,200	74,600	71	0	71	11	92	0	106	3,100	77,900
APR	14,200	24,600	38,800	26,700	65,500	293	0	293	11	95	0	106	3,100	69,000
MAY	14,000	22,100	36,100	32,000	68,100	403	11	413	11	99	0	106	17,900	86,500
JUN	14,100	22,100	36,200	36,400	72,600	403	39	441	11	102	0	106	23,000	96,100
JUL	14,100	29,100	43,200	36,800	80,000	410	67	477	11	102	0	106	28,100	108,700
AUG	14,100	28,200	42,300	38,100	80,400	374	60	434	11	102	0	106	27,400	108,300
SEP	14,100	19,700	33,800	36,900	70,700	392	42	434	11	99	0	106	26,600	97,800
OCT	13,800	20,700	34,500	40,200	74,700	332	11	343	7	85	0	106	23,100	98,200
NOV	14,200	22,500	36,700	36,800	73,500	311	0	311	7	85	0	106	4,500	78,400
DEC	12,400	28,200	40,600	37,800	78,400	290	0	290	7	88	0	106	3,100	81,900
2016														
JAN	14,200	28,100	42,300	40,400	82,700	99	0	99	7	88	0	106	3,100	86,000
FEB	14,100	26,900	41,000	40,400	81,400	49	0	49	7	85	0	106	3,100	84,700

NOTE: (1) Power canals columns include flows through power plants and spillways

(2) Flows for individual users were originally coordinated in m3/s, and are converted here to U.S. customary units (cfs) and rounded to 3 signficant figures.

(3) Total flow for each category and total Lake Superior flow in this table are computed from the individual flows in cfs.