

Presentation Title: **Water Level Control on Lake Ontario and Plan 2014**
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Outline

- I. Great Lakes and Lake Ontario Hydrology
- II. Outflow and water level control on Lake Ontario
- III. Plan 2014
- IV. Coastal Resiliency planning and funding

Summary

Implementation in January 2107 of a change in the regulation of outflows from Lake Ontario will result in more frequent, extreme high and low water levels than under the previous regulation regime. This change is projected to result in an annual average \$2.5 million in damages to lakeshore property owners alone as well as additional damages to businesses and communities along the New York shoreline. Flooding that occurred along the Lake in 2017 highlighted the need for more resilient shoreline protection and public infrastructure. Several financial and regulatory hurdles must be overcome before this can be achieved.

I. Great Lakes and Lake Ontario Hydrology

The upper Great Lakes and surrounding watershed, consisting of Lakes Superior, Michigan, Huron and Erie, all drain to Lake Ontario. Lake Ontario, in turn, drains through the St. Lawrence River to the Atlantic Ocean. As a result of this cascading of flows down through the system, the outflows and water levels on Lake Ontario vary the most within the system, as illustrated in the following table:

	Water Level (in feet above mean sea level)	Outflow (in thousands of cubic feet per second)
Lake Superior		
Maximum	603.4	132
Average	601.7	74
Minimum	599.5	41
Range (feet)	3.9	91
Lake Michigan-Huron		
Maximum	582.3	238
Average	578.8	183
Minimum	576.0	106
Range (feet)	6.3	132
Lake Erie		
Maximum	574.3	280
Average	571.3	210
Minimum	568.2	118
Range (feet)	6.1	162
Lake Ontario		
Maximum	248.6	353
Average	245.2	245
Minimum	241.9	154
Range (feet)	6.6	200

Within each of the lakes, the hydrologic water balance is made up of inputs from precipitation on the lake surface, runoff and groundwater flows from the surrounding basin and inflow from the upstream lake while outflows consist of evaporation from the lake surface and outflow to the downstream lake through connecting rivers. All of these processes are highly variable and with very limited predictability. As a result, the water level on each of the lakes varies with both an annual cycle and longer term, larger amplitude fluctuations. The average annual fluctuation for Lake Ontario is approximately 1.8 feet.

Superimposed on the annual fluctuations are long-term, usually ten to twenty year, cycles of increased precipitation or drought that affect the entire Great Lakes basin. These long-term cycles generally result in much larger changes in water levels, as illustrated in the 6.6-foot historical range for Lake Ontario.

II. Outflow and water level control on Lake Ontario

The primary inflow to Lake Ontario comes from the upper Great Lakes via the Niagara River connecting Lake Erie to Lake Ontario and passing over Niagara Falls. This represents, on average, approximately 85% of the water supply to Lake Ontario with the remainder from the local drainage basin. Neither component of the net water supply is controlled and the total is highly variable on both short and long term time scales.

The outflow from Lake Ontario is through the St. Lawrence River. Originating at the northeastern end of Lake Ontario in the Thousand Islands area of northern New York, it flows just under 200 miles to Montreal and its confluence with the Ottawa River. It then continues for another approximately 850 miles to the Gulf of St. Lawrence in the Atlantic Ocean.

For over 300 years, there was the desire to by-pass or eliminate the large set of rapids in the St. Lawrence in northern New York in order to open up the Great Lakes to commercial navigation from the Atlantic Ocean. This became a reality in 1960 with the construction of the Moses-Saunders dam near Massena, New York and the locks and channels of the St. Lawrence Seaway.

Construction of this bi-national project was approved by the International Joint Commission or IJC. The IJC was created by the 1906 Boundary Waters Treaty between the US and Canada. Its charge is to review, approve and manage projects affecting the waters on or flowing across the border between the US and Canada. The Commission has six members, three US and three Canadian. On the US side, the commissioners are presidential appointees and generally turn over with changes in administration. To carry out its charge, the IJC has approximately 40 appointed boards dealing with boundary waters from Alaska to Maine.

The construction of the St. Lawrence power and seaway project allowed for the control of the outflow from Lake Ontario through the St. Lawrence, with much higher or lower flows possible than under the natural conditions with the rapids. Through outflow adjustments, the water level fluctuations on Lake Ontario could also be at least partially controlled.

In the 1956 Order of Approval for the project, the IJC specifically included goals for regulating the outflow. These goals, termed Criteria in the Order, included provisions to protect downstream Montreal, provide safe flows for navigation, provide adequate flows for power production and to try to avoid extreme high or low water levels on Lake Ontario. Specifically, the Criteria set a goal of limiting the Lake Ontario water level fluctuations to a four foot range with a maximum level of 247.3 feet and a minimum level

of 243.3 feet, both relative to mean sea level. The intent, as also stated, was regulate the flows “for the benefit of property owners on the shores of Lake Ontario in the United States and Canada so as to reduce extremes of stage...”.

The Order of Approval for the St. Lawrence power and navigation project also created a “Board of Engineers”, now called the International Lake Ontario-St. Lawrence River Board. Its original charge was to develop an operating plan for the outflows to meet the Criteria and other conditions of the Order of Approval. The Board is now charged with managing the system, again in accordance with the operating plan and the other provisions of the Order. The operating plan developed was called Plan 1958D and it was implemented in 1962. Later, the IJC granted the Board the authority to deviate from the outflows determined by the Plan in order to provide a benefit or benefits to some as long as it did not unduly harm any other interests.

The Board’s ten appointed members, five from the US and five from Canada, managed the system in accordance with Plan 1958D and its deviation authority for approximately 55 years until Plan 1958D was replaced with Plan 2014 in January 2017. Operations under Plan 1958D were generally successful in keeping the Lake water level to within its four foot range goal except during a few extreme supply conditions, particularly those in the early 1960’s, in 1973 and in 1993. As a result, the monthly average lake level had a total range of 6.2 feet over the regulation period.

III. Plan 2014

Within a few years of implementation of Plan 1958D various interests were calling for changes that would better serve their particular desires. Many times these changes would conflict with each other such as the desire for generally higher water levels for recreational boating, especially in the fall, and the call to lower the lake in the fall to protect riparian property owners from high late winter and spring high water. In addition, with each occurrence of extreme supplies and levels, high or low, there were calls to alter the plan to better deal with the fluctuating supplies. In the late 1980’s and 1990’s, environmental activists and agencies called for alterations in the operating plan to allow for more extreme water levels on the Lake, both high and low, with the goal of achieving better diversity in the wetlands bordering the Lake and the upper River.

In 1999 the IJC obtained funding from the US and Canadian governments to study whether and how the system could be better managed to balance the current demands of all the interests. With funding in hand, the IJC appointed a Study Board to examine the whole issue of outflow control on the St. Lawrence River. This Study acted in a transparent, open, and public way to develop guidelines and to come up with recommendations to the IJC, which were contained in a report delivered in March of 2006.

The Study recommended consideration of three plans:

Plan A+ - “ The Economic Plan”, which maximized economic benefits.
Plan B+ - “The Environmental Plan”, which maximized environmental benefits

and

Plan D+ - “The Balanced Plan”, which as the name implies, was balanced.

With completion of the study, the IJC announced a proposed new Order and Plan that consisted of a revised Plan D+ from Study (the balanced plan), renamed Plan 2008. The IJC stated at that time that:

“Plan (2008) is an improvement with respect to environmental and overall economic benefits, and takes a more balanced approach to all interests.”

The IJC further stated that:

The environmental benefits of Plan B+ (environmental plan) are desirable, but implementation of Plan B+ is not possible “without unduly reducing the benefits and protections currently accorded to other interests.”

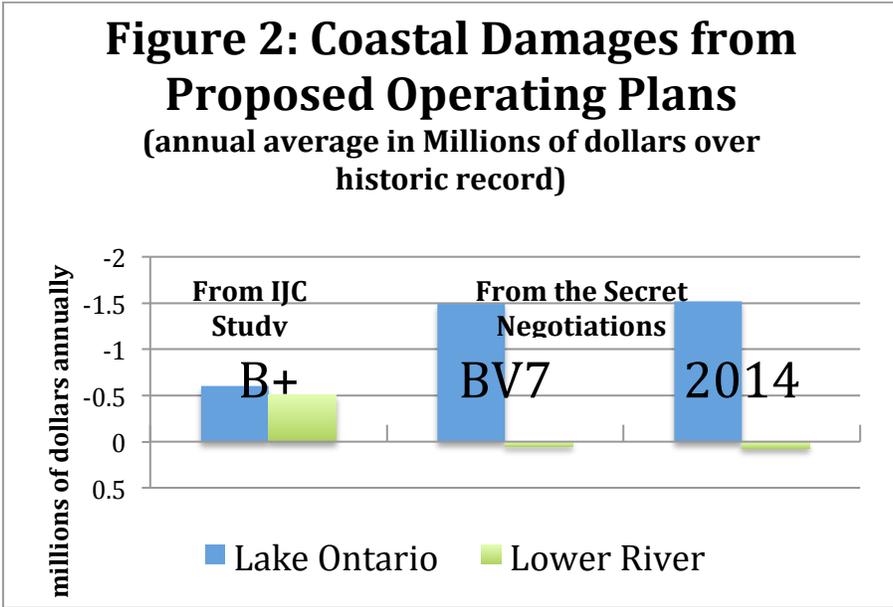
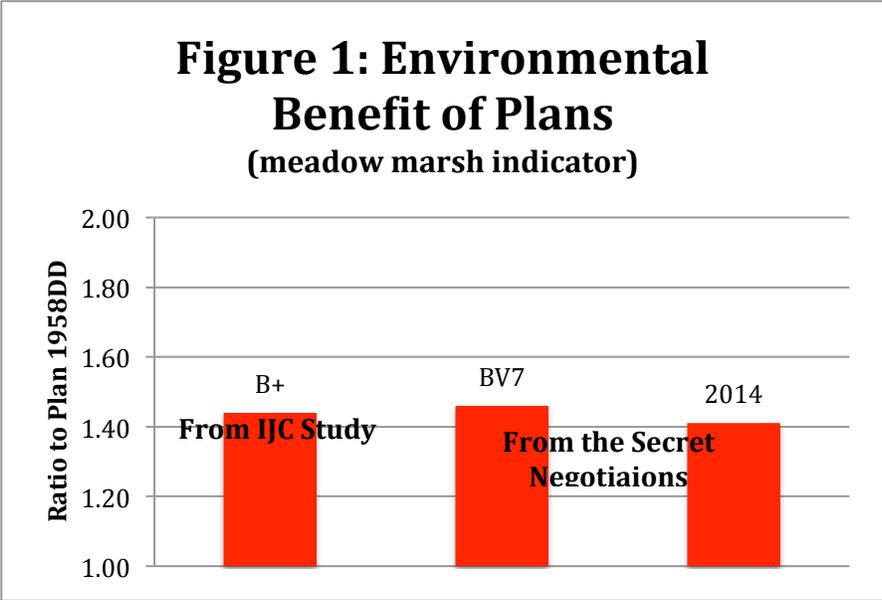
After holding public hearings, and facing demands from environmental groups and the NYS DEC that only the environmental plan would be acceptable to them, the IJC withdrew its proposal and formed a new, secret “Working Group” of government representatives only. Working in secret, this group recommended a new version of Plan B+, the environmental plan, which was termed Plan Bv7 for Plan B, version 7. After another round of public meetings by the IJC and further secret negotiations, the Working Group came up with Plan 2014, which is Plan Bv7 with a slight modification that added some protection against extreme water levels.

It is clear that Plan 2014 and its basis, Plan Bv7, are not one of the recommended plans from the IJC Study and, in fact, they violate three of the principle guidelines of the IJC Study.

Those guidelines stated that if damages result from any plan, they should not fall disproportionately on any one geographic area or interest group. Almost all the damages from Plan 2014 fall to the Lake Ontario shoreline. All other geographic areas and interests are held harmless or benefit. The guidelines also state that if damages are anticipated, mitigation and compensation measures should be in place prior to implementation. Plan 2014 has none. Finally, the guidelines state that any plan should be developed in an open process with wide public participation. Plan 2014 was developed in secret by a group that only consulted with environmental advocates.

When examining Plans Bv7 and Plan 2014, it is found that the environmental benefits are almost the same as the original Plan B+. However, the damages to the coastal areas of Lake Ontario are greatly increased. This resulted from the fact that the Province of Quebec stood by its commitment that its citizens in downstream areas of the St. Lawrence River should receive no less protection under any new plan than under the

previous plan of operation (Plan 1958D). As a result, all the damages were shifted to the Lake and, in particular, to the south shore bordering western New York. Apparently, the NYS government representatives, in particular the NYS DEC, participating as members of the secret Working Group were fine with this shift. The shift is clearly illustrated in the graphs in Figures 1 and 2. The environmental benefits remained the same during the secret negotiations while the damages to the Lake Ontario shoreline increased dramatically and those to the lower St. Lawrence River were eliminated.



With full knowledge of the damages to be expected, the IJC recommended approval of Plan 2014. With concurrence of the Canadian and US governments, the IJC adopted a new Order of Approval in December 2016 and implemented Plan 2014 in January 2017.

While the debate over Plan 2014 continues, it has been implemented and it will be very difficult to alter anytime soon.

IV. Coastal Resiliency planning and funding

As noted earlier, Plan 2014 allows for a much wider range in water level fluctuations on Lake Ontario, increasing the former four-foot target range to over seven feet including raising the maximum target level by over one foot compared to the previous target (248.46 feet versus 247.3 feet). It is also clear that Plan 2014 will not protect from even more extreme water levels, as promised by the IJC in promoting the Plan, as was clearly demonstrated several months after its implementation when the lake level reached an elevation a shade below 249. feet at the end of May 2017.

Thus, it is clear that operations under Plan 2014 will result in more extreme water levels, both higher and lower, than have been planned for or experienced in the past. And while no funding for compensation or mitigation was included in the Plan, the need to provide more resilience for lakeshore properties, waterfront businesses and lakeshore communities' infrastructure is evident. The high water event of 2017 alone is expected to result in damages in excess of \$100 million.

Improvements to provide better resiliency should include better shoreline protection structures, redesign and replacement of recreational boat launches, replacement of fixed docks at marinas with floating dock systems, sealing and/or moving sewer and water utilities and support structures and buying out and relocating residences located in particularly vulnerable locations. These measures apply equally well to the Lake Ontario communities and downstream areas of the St. Lawrence River.

Other measures could include navigational dredging in critical sections of the St. Lawrence Seaway and downstream near the Montreal Harbor, increased capacity to handle high flow rates through or around the various hydroelectric plants along the St. Lawrence River, and the relocation of water intakes and sewage outfalls in the St. Lawrence River.

The obstacles to these potential changes are both financial and regulatory. As an example, one of the best ways to provide better shoreline protection along the Lake is to replace existing, undersized vertical gabion or concrete structures with sloped, rip-rap revetments. The cost of this can easily exceed one thousand dollars per linear foot of shoreline and the regulatory hurdles can be formidable. The regulatory hurdles result from the fact that the combination of desired maximum height and slope will often result in a structure that extends well beyond the regulatory mean high water line, established as elevation 247.3 feet by both New York State and Federal agencies. The NYS DEC and the Army Corps of Engineers, both with approval authority for lakeshore protection structures, have severe limits on the occupation or placement of fill in areas beyond the mean high water line for two reasons. Such placement removes bottom habitat along the shoreline and also results in the occupation and use of public underwater land by an

adjacent riparian owner. These are both discouraged and/or prohibited by current regulation and policy.

Similar regulatory and financial hurdles apply to the other measures that could be utilized to make the entire system more resilient and better prepared to handle future extreme conditions.

As for now, New York State is providing limited grants and compensation to both businesses and individuals that suffered damages due to the 2017 flooding along the Lake Ontario and St. Lawrence shorelines. However, there is no stipulation that this funding be used to provide improved resiliency and not just a replacement in kind of what was damaged in the first place.

Hopefully, the damages from the 2017 flooding will not just result in more debate about Plan 2014, but will move both the New York state and Federal governments toward providing solutions to better prepare for the inevitable extreme water levels that will come in the future.