Restoring water levels on Lake Michigan-Huron

A Cost-Benefit Analysis

CGLR
COUNCIL OF THE GREAT LAKES REGION

Introduction

What's happening?

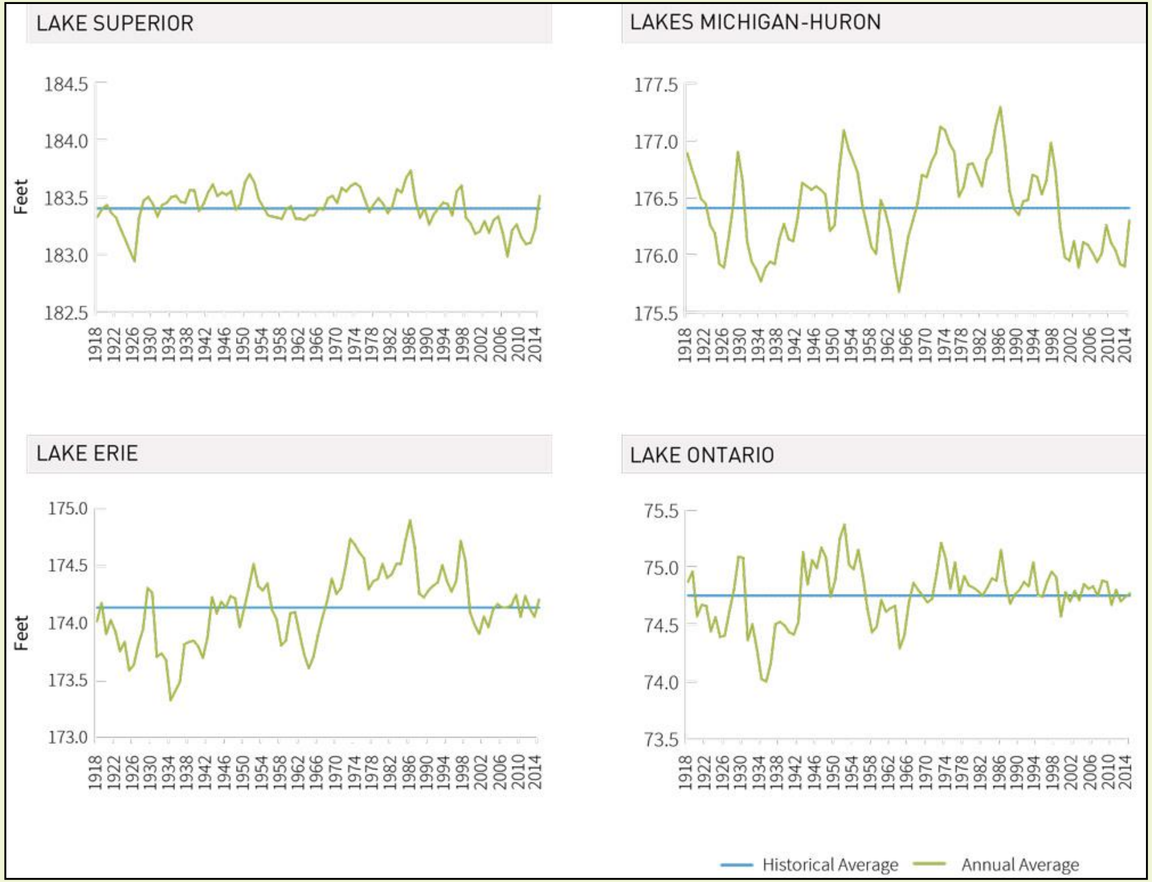
1999 to 2013: Persistently low water levels

In January 2013, Lake Michigan-Huron hit the lowest level since consistent measurement began in 1918; Lake Superior hit record low in 2007.

Since mid-2014: Surging water levels

Water levels are above their long-term monthly historic average on all lakes.

Water levels across the Great Lakes (1918 to 2014)



Our analysis

CBA of direct economic impacts of **restoring** water levels on Lake Michigan-Huron under a low-water level scenario. Michigan-Huron was the hardest hit of the Great Lakes during low-water period.

A worst-case low-water level scenario provides a useful boundary case: If interventions aren’t viable under this scenario, then they’re unlikely to be viable at all.

We also conducted qualitative analyses of **multi-lake regulation** and **adaptive management (AM)** and assessed their political viability.

Economic impacts

Economic sectors

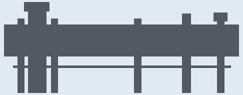
- We analyze direct economic costs to four sectors:
  - commercial shipping and harbours;
  - tourism and recreational water activities (marinas);
  - waterfront properties; and
  - hydroelectric generation

Economic sectors

Selected impacts of low water levels

Shipping

Loss of carrying capacity, requiring increased number of voyages



Hydro Power Generation

Loss of production in run-of-the-river hydro plants

Property Values

Loss of value of waterfront properties due to accessibility, aesthetics

General Methodology

- Worst-case low-water level scenario (CCCma 2050 data)
- Two time horizons: 2015 to 2064 and 2015 to 2084 (for delayed construction scenario)
- Values are in 2014 US$ in the report (presented here in C$),
- Discount rate: 4 per cent (2 per cent and 6 per cent for sensitivity analysis)

General methodology

For most options, we consider four sets of costs:

- materials, labour and other construction costs;
- engineering and design, real estate purchases, planning and program management and other construction-related costs;
- maintenance and operations; and
- the costs of temporarily lower water levels downstream (Lake Erie and the Niagara River).

General methodology

We also consider the effects of four policy scenarios:

- Construction begins immediately and takes place in five stages, with each stage taking five years
- Construction delayed 20 years and takes place in five stages, with each stage taking five years
- Construction begins immediately and takes place in one stage
- Construction delayed 20 years and takes place in one stage

Interventions

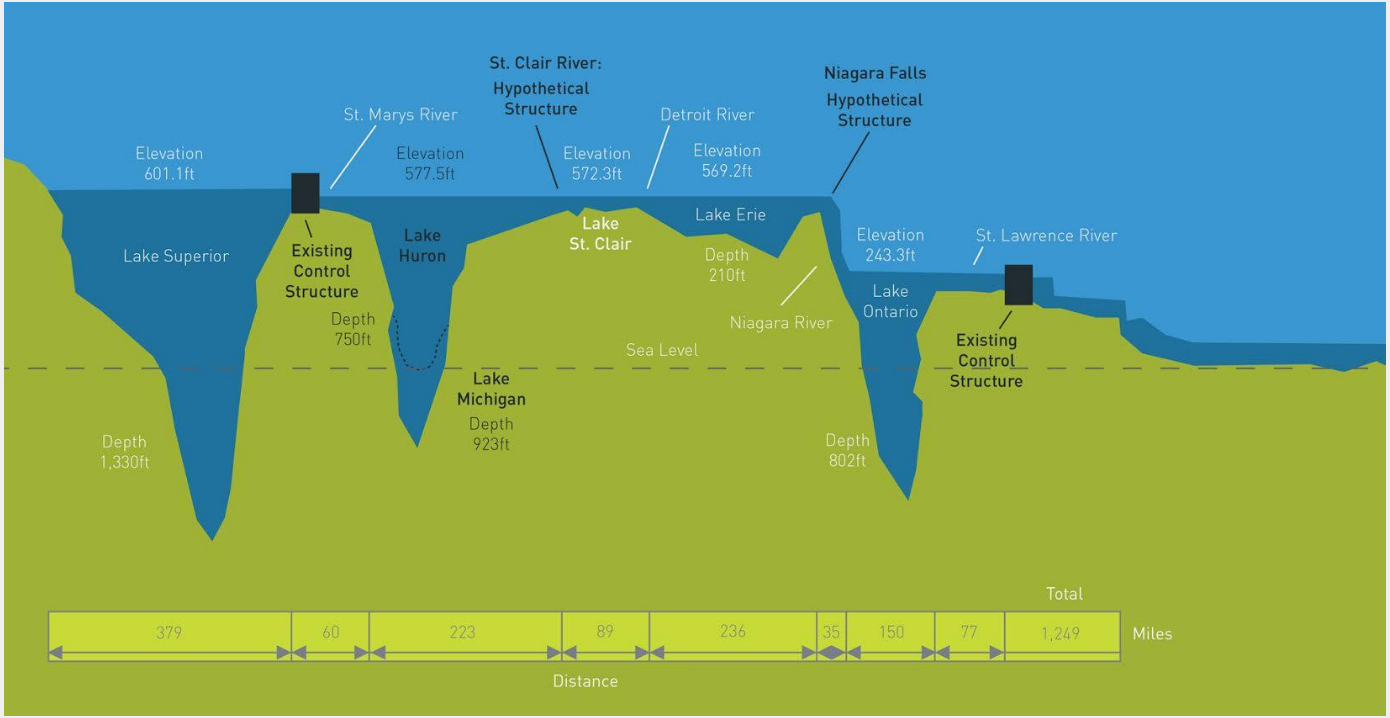
Interventions

- **Restoration:** Raise water levels on Michigan-Huron with fixed structures in and around the St. Clair River.
- **Multi-lake regulation:** Increase or decrease water levels, as conditions dictate, on the entire Great Lakes-St. Lawrence system using dam-like structures and channel excavation.
- **Adaptive management:** Adapt to water levels through practical measures and long-term monitoring, modelling and assessment of hydrological trends and their economic and ecological impacts.

Interventions

- Our quantitative analysis focuses on three restorative and two semi-restorative structures:
    1. Submerged sills in the upper St. Clair River
    2. Parallel dikes and weirs extending into Lake Huron
    3. Fixed rock-filled dikes across eastern channels at Stag and Fawn islands
    4. Adjustable inflatable flap gates in eastern channels at Stag and Fawn islands
    5. Hydrokinetic turbines in upper St. Clair River
- Qualitative analyses of multi-lake regulation and adaptive management also conducted.
- Political feasibility is assessed for all approaches

Great Lakes- St. Lawrence River System



Restorative structures would raise water levels in Lake Michigan-Huron by restricting the conveyance capacity of the St. Clair River.

Great Lakes- St. Lawrence River System

1) Submerged sills in the upper St. Clair River
2) Parallel dikes and weirs extending to Lake Huron
3) Fixed rock filled dikes and adjustable flap gates across east channel at Stag Island
4) Fixed rock filled dikes and adjustable inflatable flap gates across east channel at Fawn Island

Results

Most promising restoration option

Series of sills in upper St. Clair River:

- These would raise water levels on Lake Michigan-Huron by restricting outflows.
- It would generate highest net positive benefits: roughly $292M over 50 years, if construction is staged and begun immediately. Benefits would fall to $152M, however, if construction were delayed 20 years.

Table 4.2: Estimated net present value for sills (figures expressed in millions of 2014 CAD)

Adaptation Option	No policy delay, one step construction	No policy delay, staged construction	20 year policy delay, one stage construction	20 year policy delay, staged construction
Option A 6cm/2.36in	4.330125978	88.55880441	-6.517740994	39.7992
Option B 21cm/8.27in	238.6733051	291.8927855	63.52883037	152.2884
Option C 8cm/3.15in	-20.49036704	100.6754088	63.52883037	47.95442
Option D 23cm/9.06in	106.2520396	216.8850501	-77.14308468	120.6812

Note: 4 per cent discount rate

Other findings

- **Redistributive impacts broadly similar across each option**
  - hydroelectric producers on Niagara River lose
  - property owners and commercial shippers on Huron-Michigan win
  - impacts on marinas negligible

- **Staging generates higher benefits than one-shot construction**
  - Benefits of staging on Niagara outweigh costs of staging on Michigan-Huron

Policy implications

Despite potential benefits, we stop short of recommending specific interventions for three reasons:

1) Estimated impacts are modest.
2) Impacts of water levels and interventions remain uncertain.
3) Restoration faces significant hurdles politically.

Alternatives: Multi-Lake regulation

- **Advantages:**
  - Helps cope with uncertainty over water levels
  - Eases redistributive tensions between flood-prone and non-flood prone regions

- **Disadvantages:**
  - Dams and channel excavations are expensive
  - Ecological risks are high
  - Benefits are largely unknown

Alternatives: Adaptive Management

- **Advantages:**
  - Politically feasible (not explicitly redistributive)
  - Addresses uncertainty by providing (1) better information for adapting to changing water levels and (2) a basis for more thorough analysis of engineering options

- **Disadvantages:**
  - Does not limit frequency of extreme water levels

Policy conclusions and recommendations

Conclusions

- **The economic viability of restoration structures requires further research.**
  - Including: ecological impacts, more economic impacts, more hydraulic scenarios, more sophisticated modelling of economic outcomes and updated cost estimates of existing proposals

- **Future research needs to grapple with the politics of restoration.**
  - Decisions over transboundary water levels taken by unofficial consensus, where virtually any group can veto measures expected to harm their interests.
  - Need to find policies and structures capable of eliminating or limiting redistributive conflicts and environmental risks.

Policy recommendation

- **We encourage the Canadian and U.S. governments to approve the IJC's proposal to strengthen adaptive management on a bi-national basis.**
  - Specifically, we support approval of a Levels Advisory Board to facilitate monitoring and modeling of hydrological trends and their impacts.
  - This would provide (1) actors with vital adaptive information and (2) the foundation for a more robust analysis of engineering options.