



**INTERNATIONAL
Upper Great Lakes
STUDY**

Michigan Briefing



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Presentation Outline

- > The Issue
- > Mandate of the Study Board
- > Resources
- > Public involvement
- > Independent Peer Review
- > Study Strategy
- > Findings
 - > Glacial Isostatic Adjustment
 - > Sediment
 - > Hydraulics
 - > Hydroclimatology
- > Synthesis
- > Recommendations
- > Next steps

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What is the Issue?

- GBA Foundation invested \$325K to investigate declining upper lakes levels
- Findings:
 - 1962 navigational dredging caused channel erosion
 - The erosion is ongoing
 - Dismissed hydroclimate and Glacial Isostatic Adjustment as factors
- Influenced the Plan of Study

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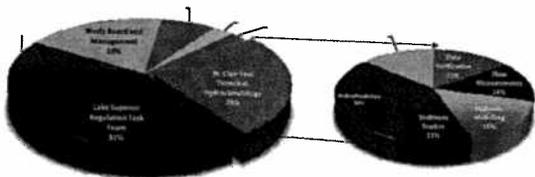
Study Mandate

The Study has two major objectives:

1. *Examine physical processes and possible ongoing changes in the St. Clair River and their impacts on levels of Lake Michigan-Huron and, if applicable, evaluate and recommend potential remedial options; and*
2. Review the regulation of Lake Superior outflows and assess the need for changes to address the evolving needs of and conditions affecting the interests of the upper Great Lakes.

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Study Resources



Total \$4.6M Canadian or \$3.8 US

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Public Plays Critical Role

- > Public Interest Advisory Group (PIAG) provides important input to the Study
 - > values associated with different Great Lakes water levels.
 - > advises on outreach and communications
 - > vehicle to provide information to many diverse interest groups
- > PIAG co-chairs serve on Study Board
- > Hosted 15 public meetings attended by more than 1,500 residents.



Midland Public Meeting
August 11, 2008

PIAG Membership

Canada

James Bruce Co-Chair
 James Anderson, Ducks Unlimited
 Doug Cuddy, Lake Superior Conservancy
 Dick Hibma, Conservation Ontario
 Kenneth Higgs, Property Owner
 William Hryb, Lakehead Shipping Co.
 John Jackson, Great Lakes United
 Don Marles, Lake Superior Advisory Committee
 Mary Muter, Georgian Bay Association
 First Nation Representative

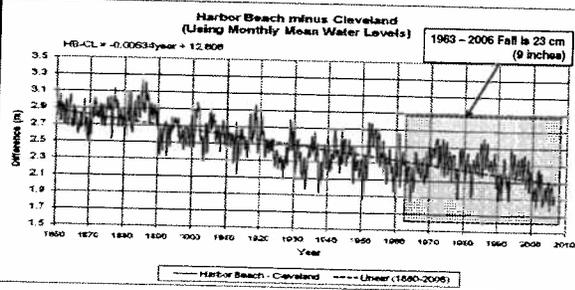
United States

Kay Felt Co-Chair
 David Powers – Save our Shoreline
 Roger Smithe – International Great Lakes Coalition
 Dan Tadjerson – Sault Ste. Marie Tribe, Chippewa Indians
 Alan Stelman – Annis WRI
 Kate Bartter – Ohio State University
 Jim Weakley – Lake Carriers' Assn.
 Jeff Vito – Cities Initiative
 Dan Thomas –GL Sport Fishing Council
 David Irish – Boat shop owner

Independent Peer Review

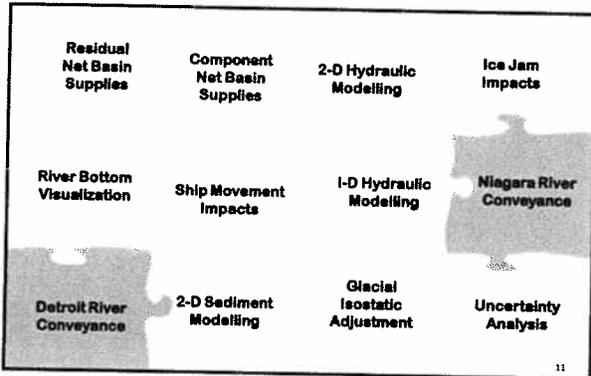
- ◆ Two key Associations involved:
 - ◆ Canadian Water Resources Association
 - ◆ American Society of Civil Engineers
- ◆ Summary
 - ◆ Three Methodological Reviews:
 - ◆ Hydraulics/Sediment (4 peer reviewers)
 - ◆ Hydroclimatic (6 peer reviewers)
 - ◆ Scientific Uncertainty (4 peer reviewers)
- ◆ Report /Product Reviews
- ◆ Chapter Reviews
- ◆ Final Report Review

Quantifying the Issue



Lake Michigan-Huron To Lake Erie Fall

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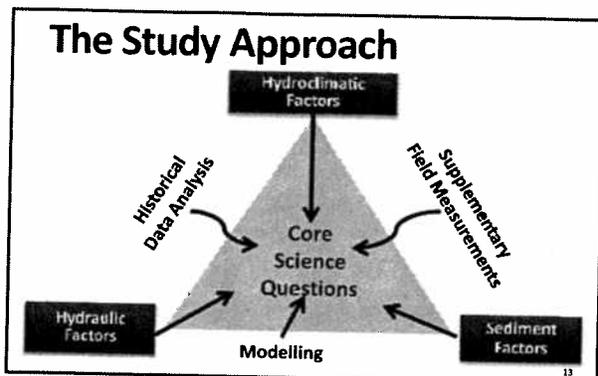
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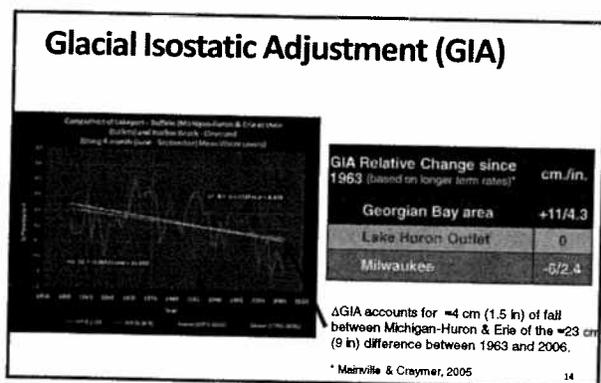
What are we Solving?

$$\Delta Head_{(MH-E)} = function \left\{ \begin{array}{l} \Delta Conveyance_{St.Claire}, \\ \Delta NTS_{MH}, \Delta NTS_{(E-MH)}, \\ \Delta GIA, \\ \Delta Conveyance_{Detroit/Niagara} \end{array} \right\} \pm \epsilon$$

$\Delta Head_{(MH-E)}$ = Change in lake-to-lake fall, between Harbor Beach & Cleveland.
 $\Delta Conveyance_{St.Claire}$ = Change in fall from hydraulic property change
 ΔNTS_{MH} = Change in lake-wide surplus or deficit from Net Total Supplies
 $\Delta NTS_{(E-MH)}$ = Change in the fall due to differential in NTS between Erie & MH
 ΔGIA = Change in fall from Glacial Isostatic Adjustment
 $\Delta Conveyance_{Detroit/Niagara}$ = Change in fall between Erie & MH from Niagara/Detroit
 ϵ = Rounding errors & unknowns

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Sediment

- Science Questions:
 - Has the "Morphology" of the St. Clair River been altered since the 1962 dredging?
 - a) Is the St. Clair River bed stable or eroding?
 - b) If the bed of the St Clair river is eroding, what initiated it, and when?
- Key Findings:
 - Bathymetry changed between 1971 and 2000 (an enlarged channel).
 - Since 2000 there has been no net change in the bathymetry.
 - There is a limited bed mobility (bed forms) but no net change.
 - Shear stresses along entire river are insufficient to erode the bed (next slide).
 - Shipping, ice jams can increase shear stress.

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Bed Morphology

Mobile Bed
(flow transverse
bedforms)

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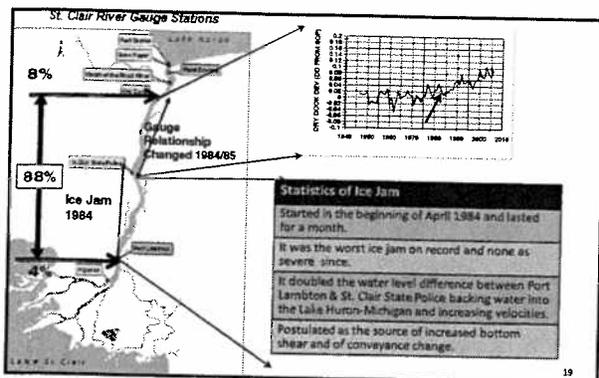
Hydraulic

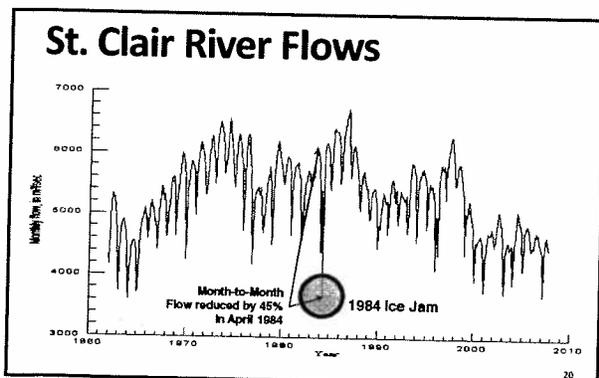
- Science Questions:
 - What is causing the declining head difference between Lake Michigan/Huron - Erie?
 - a) Has the "Conveyance" of the St. Clair River changed since the 1962 dredging?
 - b) If the conveyance has changed what were the causes?
- Key Findings:
 - Increase in conveyance accounts for 11 cm (4.3 in) decrease in Lake Huron level between 1971 and 2000 and is now stable.
 - Conveyance has increased the corresponding flow by about 270 m³/s (73,000 g/s) (less than 5% of the mean flow).
 - About 88% of the change in conveyance has occurred in the lower river. The mouth of the river is not a control section.
 - Conveyance probably changed in mid 1980s due to ice jam (1984).

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Head Drop – Lake Huron Outlet

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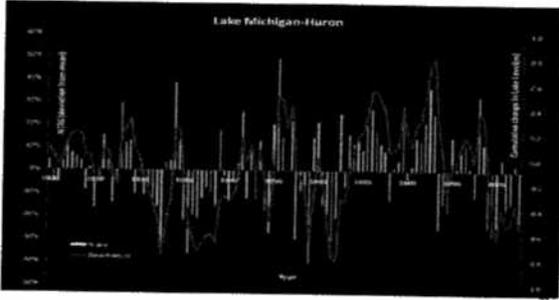




Hydroclimatic

- Science Question:
How has climate affected the change in lake level relationship between Lake Michigan-Huron and Lake Erie?
- Key Findings:
 1. Hydroclimatic models suggest an increase conveyance change (8-9 cm or about 3.5 in) and climatic factors (9-27 cm or 3.5-10.5 in) account for a drop of Lake Michigan-Huron between 1986-2005.
 2. The climate was by far the major factor for 1996 to 2005 period.
 3. From 1962 to 1986 both climate and conveyance were major factors.

Net Total Supply Deficit & Lake Levels



Synthesis

$$\Delta Head_{(MH-E)} = function \left\{ \begin{array}{l} \Delta Conveyance_{St. Clair}, \\ \Delta NTS_{MH}, \Delta NTS_{(E-MH)}, \\ \Delta GIA, \\ \Delta Conveyance_{Detroit/Niagara} \end{array} \right\} \pm \epsilon$$

- $\Delta Head_{(MH-E)} \approx 23 \text{ cm (9 in)}$ [1962 – 2005] as high as 51 cm (20 in) [1986 – 2005]
- $\Delta Conveyance_{St. Clair} \approx 10 - 12 \text{ cm (3.9 - 4.7 in)}$
- $\Delta NTS_{MH}, \Delta NTS_{(E-MH)} = 9 - 27 \text{ cm (3.9 - 10.6 in)}$
- $\Delta GIA = 4 \text{ cm (1.6 in)}$
- $\Delta Conveyance_{Detroit/Niagara} = \text{Small \& included in } \Delta NTS_{(E-MH)}$
- $\epsilon = \text{Unknown}$

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Interim Board Recommendations

1. Remediation measures not be undertaken on the St. Clair River at this time.
2. The need for mitigative measures in the St. Clair River be examined as part of the comprehensive assessment of the future effects of climate change on water supplies in the upper Great Lakes basin in Report 2 of the Study, on Lake Superior regulation.

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Recommendations for Government Action

Key Data Collection Programs

- Support the operation of the Study's new stream flow gauging stations after the Study
- Maintain the operation of two eddy co-variance (evaporation) gauges after the Study
- Conduct bathymetric surveys every five years to monitor any changes in the bed of the St. Clair River

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Recommendations for Government Action

Scientific Knowledge through Implementing Improved Models and Methodologies

- Integrate new hydraulic and hydrological models developed as part of the Study into the operational framework to provide improved estimates of the water balance in the upper Great Lakes
- Strengthen the standardization of data collection, analysis and reporting

Accountability Structure

- Formalize the existing ad-hoc Coordinating Committee on Great Lakes Hydrology and Hydraulics

Next Steps

- Draft report Impacts on Upper Great Lakes Water Levels: St. Clair River was released on May 01, 2009.
- 60-day period for public review and comments
- Public meetings (14) throughout the upper Great Lakes basin
- Further analyses:
 - Navigation and shipping impacts
 - Investigations of ice jam impacts
 - Maintenance dredging impacts
 - Scientific uncertainty analysis
- Incorporate comments from the public review and any additional findings and submitted final report to the International Joint Commission October 1, 2009.

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Public Meeting Date	Location
May 18, 2009	Sarnia, ON (Live) - Hub
May 19, 2009	Grosse Pointe Farms, MI (Satellite)
May 19, 2009	Owen Sound, ON (Satellite)
May 20, 2009	Cleveland, OH (Live) - Hub
May 20, 2009	Manitoulin Island, ON (Satellite)
May 20, 2009	Evanston, IL (Satellite)
May 20, 2009	Thunder Bay, ON (Satellite)
June 9, 2009	Muskegon, MI (Live) - Hub
June 9, 2009	Parry Sound, ON (Satellite)
June 9, 2009	Sault Ste. Marie, ON (Satellite)
June 11, 2009	Midland, ON (Live) - Hub
June 11, 2009	Traverse City, MI (Satellite)
June 11, 2009	Superior, WI (Satellite)
June 11, 2009	Bay City, MI (Satellite)

Questions



Contacts

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