Niagara River

Brad Hill
Environment Canada
• Created by Wisconsin glaciation, about 10,000 years ago
• Approximately 56 km (35 mi) long
• Peak season flow ~ 5,720 m³/s (200,000 ft³/s)
• Total drainage area ~ 684,000 sq km (264,000 sq mi)
• Empties approx. 2/5ths of the fresh water in North America
• Currently divert 50% - 75% of flow for power generation
Historical Context

- 1950s: IJC reports on pollution problems
- 1973: IJC designates Niagara River as “Problem Area”
- Late 1970s: Love Canal
- 1981: IJC Special Report on Pollution of the Niagara River
- 1987: Niagara River Declaration of Intent - NRTMP
Programs

• **3 main components:**
  – Upstream/Downstream
    • Water and suspended sediment
  – Biomonitoring
    • Mussels and fish
  – Tributary screening & trackdown
    • Sediment investigations in tributaries

• **Additional components:**
  – Point & Non-point Sources
    • Landfills, STPs, HWS
Objectives

- Establish the existence and relative concentrations of contaminants
- Distinguish between Niagara River contaminant sources and upstream sources
- Identify exceedences to existing criteria
- Examine long term trends
- Quantify loadings to Lake Ontario
- Measure concentrations in fish, mussels and other wildlife
<table>
<thead>
<tr>
<th>Chemical</th>
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<tbody>
<tr>
<td>1,3-Dichlorobenzene</td>
<td>1,4-Dichlorobenzene</td>
<td>1,2-Dichlorobenzene</td>
<td>1,2,3-Trichlorobenzene</td>
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<td>Pentachlorobenzene</td>
<td>Hexachlorobenzene</td>
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<td>1,2,3,4-Tetrachlorobenzene</td>
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<td>Octachlorocyclopentadiene</td>
<td>Heptachlor</td>
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<td>Hexachlorobutadiene</td>
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<td>p,p'-DDD</td>
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<td>α-BHC</td>
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<td>Total Chlordane</td>
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<td>Fluoranethene</td>
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<tr>
<td>Chrysene/Triphenylene</td>
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<td>Benzo(b+k)fluoranthene</td>
<td>Benzo(a)anthracene</td>
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<tr>
<td>Indeno(1,2,3-c,d)pyrene</td>
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<td>Dibenzo(a,h)anthracene</td>
<td>Benzo(a)pyrene</td>
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<td>Manganese</td>
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<td>Lead</td>
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<td>Tellurium</td>
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<td>Vanadium</td>
<td></td>
<td>Zinc</td>
<td>Mercury</td>
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</tbody>
</table>
Hexachlorobenzene

p,p'-DDE

p,p'-DDT

Mirex

DDT Total

Mirex

Total Chlordane

Dieldrin

TCPCB

Benzo(b+k)fluoranthene

Chrysene/Triphenylene

Indeno(1,2,3-c,d)pyrene

Benz(a)anthracene

Benz(a)pyrene

Benzo(g,h,i)perylene

Aluminum

Benz(b+k)fluoranthene

Aluminum

Iron

Iron

Mercury
Hexachlorobenzene
Mirex
Chrysene/Triphenylene
Benzo(a)pyrene
Iron
Niagara River Benzo(a)Pyrene (RWW)

![Graph showing concentration trends for NOTL, FE, and NYSDEC](image_url)
Biomonitoring

- Contaminant sources within the River as well as basin-wide

- Potential watershed sources for:
  - HCB, PAHs, Dioxins/Furans

- Wildlife criteria exceedences of:
  - PCB, DDT, Mirex and Photomirex
  - Most likely related to residual sediment contamination

- Fish consumption advisories continue
  - Species and location specific (PCBs, Dioxins/Furans, Mirex, Mercury)

- Total PCBs and total DDT levels are declining

- Mercury was detected at concentrations similar to other sites in the Great Lakes
Tributary Screening

- DEC/EPA study of 4 tributaries in 2004
- No “hot spots” found that trigger immediate action
- Certain areas may deserve further attention
  - Guideline exceedences of PCBs, Mercury, Lindane and Zinc
  - Low levels and non-detects validate effectiveness of remediation
- On going monitoring by MOE and assessment by RAP show some tributaries may no longer be sources of contaminants
Monitoring Summary

• Significant decreases in concentrations for most compounds between 1986 and 2005

• Some compounds still exceed strictest agency criteria

• Local sources continue to contribute contaminants to the Niagara River

• Upstream and/or basin-wide sources may be more significant for certain chemicals
Niagara’s Influence On Lake Ontario

- >80% input water budget
- ~50% incoming fine grain sediment
- a primary source of contaminants
Lake Ontario Circulation

Modified after Beletsky, et. al (1999)
Lake Ontario Bathymetry

LAKE ONTARIO

depth contours in metres

0 10 20 30 nm

0 20 40 60 km

TORONTO

NIAGARA BASIN

MISSISSAUGA BASIN

ROCHESTER BASIN

ST. LAWRENCE RIVER

BAY OF QUINTE

NORTHEAST OUTLET REGION

NIAGARA RIVER

ST. CATHARINES

NIAGARA FALLS

BUFFALO

ROCHESTER

SYRACUSE

LAKE ERIE
## Phase Distribution

<table>
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<tr>
<th>Compound</th>
<th>% in dissolved phase</th>
<th>% in particulate phase</th>
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<tbody>
<tr>
<td>Mirex</td>
<td>0</td>
<td>100</td>
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<tr>
<td>Benzo(a)pyrene</td>
<td>6</td>
<td>94</td>
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<tr>
<td>1,2,4-TCB</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>94</td>
<td>6</td>
</tr>
<tr>
<td>1,2,3,4-TTCB</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>Atrazine</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Metolachlor</td>
<td>100</td>
<td>0</td>
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</tbody>
</table>
Current Knowledge
Hexachlorobenzene (ng/L)
Metolachlor (ng/L)

- 9.29
- 8.56
- 13.30
- 18.6
- 9.57
- 15.81
- 14.76
- 18.6
- 9.29
- 13.30
Dieldrin (ng/L)
Dieldrin (ng/g)

- 1.490
- 1.599

Legend:
- Green: < 2.00 Below TEL
- Yellow: 2.00 - 2.85 Below LEL
- Orange: 2.85 - 6.67 Below PEL
- Red: > 6.67 Exceeds PEL
Benzo(a)pyrene (ng/g)

425.8

320.9

Benzo(a) Pyrene ng/g
- < 31.9: Below TEL
- 31.9 - 370: Below LEL
- 370 - 782: Below PEL
- > 782: Exceeds PEL
Benzo(a)pyrene (ng/g)
Conclusions

• Niagara River is the primary source of water and a significant source of fine grain sediment for Lake Ontario

• Niagara River has been significantly impacted by contaminants

• Contamination levels in the Niagara River have been reduced over the past two decades

• There is insufficient data to establish a firm influence of the Niagara River on nearshore contaminant levels

• Dissolved phase contaminants appear to show higher concentrations in the nearshore zone

• Evidence suggests majority of sediment bound contaminants are found in offshore depositional areas
Future Directions

• More analysis with existing data sources

• Nearshore monitoring

• Current suite of compounds

• New & emerging compounds

• Future of the NRTMP
Acknowledgements

- Water Quality Monitoring & Surveillance
- EC, OMOE, NYSDEC, USEPA, DFO
- Niagara River Secretariat
- River Monitoring Committee