Lake Michigan National Monitoring Network Demonstration Pilot

Preliminary Results and Future Plans

National Monitoring Conference
April 27th, 2010
Presentation outline

- Lake Michigan Information
- Lake Michigan Pilot Study
  - Differences between Great Lakes and other Coasts
  - Monitoring Inventory
- Lake Michigan Demonstration Effort
  - 2008 – nutrients in water column (partial year) and Semi-permeable membrane devices for polar organics at 20 sites
  - 2009 – nutrients in water column at 20 sites (full year)
  - 2010 – test automated underwater vehicle in near shore and tributary mouth for field parameters
- Other coordinated monitoring efforts
## Lake Michigan Basin

### Size Statistics (Lake Michigan)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>307 miles</td>
</tr>
<tr>
<td>Width</td>
<td>118 miles</td>
</tr>
<tr>
<td>Land Drainage Area</td>
<td>45,600 square miles</td>
</tr>
<tr>
<td>Depth</td>
<td>925 feet maximum depth</td>
</tr>
<tr>
<td></td>
<td>279 feet average depth</td>
</tr>
<tr>
<td>Shoreline</td>
<td>1,660 miles</td>
</tr>
</tbody>
</table>
Primary Management Issues in the Lake Michigan Basin

- Aquatic invasive species
- Nutrient enrichment
- Beach Health
- Contaminants – in Sediments, Fish and Drinking Water
- Nuisance algal blooms
- Habitat degradation
- Loss and Alteration of Coastal Wetlands
- Fisheries and food web changes
Lake Michigan Pilot

- Lake Michigan Monitoring Coordination Council coordinated the pilot study via nine resource component work groups
- The Great Lakes Commission (GLC) led the effort
- Work group members represented:
  - States (ILEPA, INDEM, MIDEQ, WIDNR, WI GNHS), Feds (USEPA, USGS, NPS, NOAA), Universities (Sea Grant, MSU, UW Milwaukee, Purdue), GLOS, and others
- Only pilot conducted in the Great Lakes. There are some NMN design differences between the Great Lakes coast and other coasts
NMN Compartments vs. the Great Lakes “Fresh Coast” Compartments

- Estuaries
- Nearshore
- Offshore
- Great Lakes
- Rivers
- Ground Water
- Atmospheric Deposition
- Beaches
- Wetlands

- Fresh Water Embayments
- GL Shallow Nearshore
- GL Medium Nearshore
- GL Offshore
- Rivers
- Ground Water
- Atmospheric Deposition
- Beaches
- Wetlands
NMN Design Rivers

- National design based on Hydrologic Unit Code (HUC) 6
- Great Lakes and Lake Michigan on HUC 8
Great Lakes Near-shore/Off-shore

<table>
<thead>
<tr>
<th>Lake</th>
<th>Shallow/Medium Near-shore Boundary (m)</th>
<th>% of Area</th>
<th>Near shore/Off-shore Boundary (m)</th>
<th>% of area within Near-shore</th>
<th>Mean Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior</td>
<td>30</td>
<td>10.0</td>
<td>150</td>
<td>50.0</td>
<td>149</td>
</tr>
<tr>
<td>Michigan</td>
<td>30</td>
<td>25.9</td>
<td>80</td>
<td>51.4</td>
<td>85</td>
</tr>
<tr>
<td>Huron</td>
<td>20</td>
<td>25.1</td>
<td>50</td>
<td>51.9</td>
<td>59</td>
</tr>
<tr>
<td>Erie</td>
<td>10</td>
<td>19.5</td>
<td>20</td>
<td>54.8</td>
<td>19</td>
</tr>
<tr>
<td>Ontario</td>
<td>30</td>
<td>24.0</td>
<td>80</td>
<td>50.4</td>
<td>86</td>
</tr>
</tbody>
</table>
Great Lakes Monitoring Inventory

- Conducted by the Great Lakes Commission in 2004, indicated:
  - Approximately 300 programs have conducted monitoring in some portion of the Lake Michigan Basin
  - A large majority of the monitoring programs were/are conducted by State and Federal Agencies
## Lake Michigan Monitoring

<table>
<thead>
<tr>
<th>Category</th>
<th>Major effort</th>
<th>Minor effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estuaries/Embayments</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Near-shore</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Off-shore</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Rivers</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Ground Water</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Atmospheric deposition</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Wetlands</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Beaches</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

**Cost:** Major is over $1.0 million. Minor is less than $1.0 million.

**Duration:** Major is three or more years of ongoing monitoring. Minor is less than three years in duration.

**Geographic Extent:** Major indicates that an organization uses standard procedures and protocols over large areas.
2008
- All 20 river sites were sampled at the proposed NMN Tier 1 monitoring design for nutrient constituents and frequency
- Semi Permeable Membrane Devices (SPMDs) deployed at 20 sites for one month during base flow. SPMDs are passive samplers for assessing trace levels of hydrophobic organic contaminants - designed to mimic biological membranes, such as the gills of fish.

2009
- All 20 river sites were sampled at the proposed NMN Tier 1 monitoring design for nutrient constituents.
- Completed full year of sampling monthly and for 6 storm events. Only completed 6 months during FY08 due to late start.
- Provides sufficient information for statistics and load estimates for Lake Michigan basin
Lake Michigan Rivers Network

- Twenty sites
- Includes a representative variety of land uses
- Includes 72% of tributary inflow, relative to 90% for NMN on other coasts

![Lake Michigan Monitor Sites]

Legend:
- purple circle: Aug Tier 1 Sample + SPMD
- yellow circle: SPMD Only
### Lake Michigan Tributary Demonstration Project

#### Summary statistics — Peshtigo River

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica, mg/l</td>
<td>11.7</td>
<td>7.1</td>
<td>9.271</td>
</tr>
<tr>
<td>Ammonia, mg/l as N</td>
<td>0.274</td>
<td>&lt;0.020</td>
<td>0.055</td>
</tr>
<tr>
<td>NO3+NO2, mg/l as N</td>
<td>0.82</td>
<td>0.12</td>
<td>0.424</td>
</tr>
<tr>
<td>Nitrite, mg/l as N</td>
<td>0.026</td>
<td>0.002</td>
<td>0.007</td>
</tr>
<tr>
<td>Orthophosphate, mg/l as P</td>
<td>0.011</td>
<td>&lt;0.016</td>
<td>0.007</td>
</tr>
<tr>
<td>Phosphorus, diss mg/l</td>
<td>0.016</td>
<td>0.006</td>
<td>0.011</td>
</tr>
<tr>
<td>Phosphorus, tot mg/l</td>
<td>0.031</td>
<td>0.012</td>
<td>0.02</td>
</tr>
<tr>
<td>Total nitrogen, diss mg/l</td>
<td>1.16</td>
<td>0.5</td>
<td>0.781</td>
</tr>
<tr>
<td>Total nitrogen, tot mg/l</td>
<td>1.12</td>
<td>0.57</td>
<td>0.845</td>
</tr>
</tbody>
</table>
Lake Michigan Tributary Demonstration Project
Summary statistics — Fox River at Mouth

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica, mg/l</td>
<td>22.4</td>
<td>3.1</td>
<td>13.929</td>
</tr>
<tr>
<td>Ammonia, mg/l as N</td>
<td>0.278</td>
<td>0.025</td>
<td>0.158</td>
</tr>
<tr>
<td>NO3+NO2, mg/l as N</td>
<td>0.8</td>
<td>0.34</td>
<td>0.529</td>
</tr>
<tr>
<td>Nitrite, mg/l as N</td>
<td>0.041</td>
<td>0.018</td>
<td>0.026</td>
</tr>
<tr>
<td>Orthophosphate, mg/l as P</td>
<td>0.063</td>
<td>0.004</td>
<td>0.04</td>
</tr>
<tr>
<td>Phosphorus, diss mg/l</td>
<td>0.09</td>
<td>0.014</td>
<td>0.056</td>
</tr>
<tr>
<td>Phosphorus, tot mg/l</td>
<td>0.151</td>
<td>0.061</td>
<td>0.104</td>
</tr>
<tr>
<td>Total nitrogen, diss mg/l</td>
<td>1.49</td>
<td>1.04</td>
<td>1.294</td>
</tr>
<tr>
<td>Total nitrogen, tot mg/l</td>
<td>1.9</td>
<td>1.26</td>
<td>1.55</td>
</tr>
</tbody>
</table>
Results of the Microtox acute toxicity screening of replicate SPMDs

- Manitowoc and Escanaba SPMDs lost to vandals.
- Of 18 remaining sites, only the Grand River had total PAHs above the reporting limit.
- Only Grand River, Paw Paw and White River indicated some toxicity. The source of toxicity is more than likely other than PAHs.
- Anticipated that more sites would show toxicity.
Planned 2010 Activity

- Test approaches to connect water chemistry in tributaries to embayment and near shore (Milwaukee and Green Bay areas)
  - Autonomous Underwater Vehicle (AUV)
  - Water Quality Monitoring Survey (3-D)
  - Bathymetric Survey
Water Quality Sensor Suite

- Turbidity
- Temperature
- Conductivity
- Chlorophyll
- Dissolved Oxygen
- pH
- ORP
Near Shore Monitoring (NeMo) work group formed to organize a coordinated tributary, embayment, near shore effort
- EPA National Coastal Assessment
- WI, IN, MI State tributary monitoring
- EPA medium near-shore Triaxis Tow
- University near shore activities

Great Lakes Restoration Initiative (GLRI) tributary monitoring at all 59 NMN sites
- Nutrients at 30 sites
- Emerging contaminants (15 sites) and water borne viruses (8 sites)
- Passive samplers and wet chemistry for legacy and emerging contaminants at 59 sites – will get concentration information from passives
- Sensors for surrogate regression development 30 sites
- Beach Health and other embayment and near-shore monitoring by Federal Agencies and others
- Develop Chromoformic Dissolved Organic Matter (CDOM) sensor technology for embayment and near-shore chemistry
- Coordinated database development
Special Thanks To:

- GLC: John Hummer
- USGS: Kevin Richards, Norm Grannemann, Dale Robertson, Steve Blumer, Sandy Morrison
- IDEM: Art Garceau
- WDNR: Jim Baumann, Steve Galarneau
- MDEQ: Gary Kohlhepp, Tracy Collin, Julie Sims
- IEPA: Gregg Good, Joe Marencik
- UW-Milwaukee: Harvey Bootsma
- And others