Fox River

1. The problem

2. Decisions (i.e., RODs)

3. Work
   a. Dredging projects and lessons
   b. Contractors advice
Fox River PCBs: from papermills
PCB fish consumption advisories

Enjoy your day of fishing and have a tasty, healthy meal of fresh-water fish. For the health of your kids, please follow this health advice. Eat the following fish with caution from this water. These fish contain PCBs.

1) Eat no more than 1 meal per week (3 meals per year) of...

2) Eat no more than one meal per month (12 meals per year) of...

3) Eat no more than one meal every two months (6 meals per year) of...

4) Do NOT EAT...

When preparing fish from these waters, remove the skin and all fat before cooking. Do not eat joints from the coiled meat.

See your fishing regulations book for legal size limits.

Recommended by the Wisconsin Department of Natural Resources and the Division of Public Health. Call the local DNR office for a copy of the state-wide advisory.
Fox River decisions

ROD #1
December 2002

ROD #2
June 2003

OU1 Little Lake Butte des Morts

OU2 Appleton to Little Rapids

OU3 Little Rapids to De Pere

OU4 De Pere to Green Bay

OU5 Green Bay

ROD #1
ROD #2

Contaminated Sediments

Lake Winnebago

Appleton

Salman

Outagamie

Brown

Manitowoc

Deposit N Dredging Project

Deposit N Dredging Project

Contaminated Sediments

Lake Winnebago
Cleanup level & time to Acceptable Fish Tissue Levels* for OU 1

Potential Remedial Action Levels

- No Action
- 5 ppm
- 1 ppm
- 0.5 ppm
- 0.25 ppm
- 0.125 ppm

* For unlimited fish consumption for young-of-year fish
Fox River PCB cleanup goals

- More dredging
  - No
  - 1 ppm “footprint” removed?
    - No
    - 0.25 ppm SWAC* for OU?
      - No
      - Sand cover
    - Yes
    - Achieved
  - Yes
  - Achieved
  - Capping contingency

*Surface Weighted Average Concentration
# Dredging versus Capping

<table>
<thead>
<tr>
<th></th>
<th>Dredging</th>
<th>Capping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term releases</td>
<td>Small</td>
<td>Smaller</td>
</tr>
<tr>
<td>Contaminant disposition</td>
<td>Mostly removed to landfill</td>
<td>Contained*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in river</td>
</tr>
<tr>
<td>Habitat</td>
<td>Altered/disrupted (eventual recovery)</td>
<td>Permanent change</td>
</tr>
</tbody>
</table>

**Preferred**  

*Assumes long-term stability*
# Dredging versus Capping

<table>
<thead>
<tr>
<th></th>
<th>Dredging</th>
<th>Capping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction impacts</td>
<td>Larger “footprint”</td>
<td>Smaller “footprint”</td>
</tr>
<tr>
<td></td>
<td>Some noise, traffic, odors</td>
<td>Less noise, traffic, odors</td>
</tr>
<tr>
<td>Monitoring &amp; maintenance</td>
<td>Limited monitoring</td>
<td>More monitoring &amp; institutional controls</td>
</tr>
<tr>
<td>Cost</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Water depth</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
</tbody>
</table>

**Preferred**
## Post-dredging residuals

<table>
<thead>
<tr>
<th>Project</th>
<th>Contaminant</th>
<th>Average % Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasse River</td>
<td>PCBs</td>
<td>79*</td>
</tr>
<tr>
<td>GM Massena</td>
<td>PCBs</td>
<td>99*</td>
</tr>
<tr>
<td>Cumberland Bay</td>
<td>PCBs</td>
<td>97*</td>
</tr>
<tr>
<td>New Bedford</td>
<td>PCBs</td>
<td>97*</td>
</tr>
<tr>
<td>Marathon Battery</td>
<td>Cadmium</td>
<td>92*</td>
</tr>
<tr>
<td>Lake Jarnsjon</td>
<td>PCBs</td>
<td>99*</td>
</tr>
<tr>
<td><strong>SMU 56/57 (Fox)</strong></td>
<td>PCBs</td>
<td>96</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td></td>
<td><strong>94</strong></td>
</tr>
</tbody>
</table>

* From: Hudson River Record of Decision, Responsiveness Summary White Paper (312663), Post-Dredging PCB Residuals

Total cost: $400 million
- Dredging: $350 million
- MNR: $50 million

Dredging/disposal – 7.2 million cubic yards

Natural Recovery
OU 1 and OU 2
December 2002 ROD

OU 1
OU 2
OU 3
OU 4

Winnebago
Calumet
Appleton

Contaminated Sediments

Lake Winnebago

Manitowoc
1. Dredge 800,000 cubic yards with PCBs more than 1 ppm
2. Mechanical dewatering
3. Trucking
4. Disposal
   • Capping contingency
Capping: possible dredging supplement

1. Post-capping water depth 3-feet+

2. Not in navigation channel

3. Avoid pipelines, utilities, etc.

4. PCBs less than 50 ppm
OU 2 decision

- Natural Recovery (i.e., burial, breakdown, dilution)
- Monitoring to track “recovery”
PCBs by river segment (pounds)

OU2: relatively small PCB mass

OU1 (upstream)

OU3

OU4 (downstream)

91%

0.3% (OU2)

6%

3%
# Fox River PCB concentrations

<table>
<thead>
<tr>
<th>Media</th>
<th>Operable Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sediments (ppm)</td>
<td></td>
</tr>
<tr>
<td>Average(^1)</td>
<td>15</td>
</tr>
<tr>
<td>Surface average</td>
<td>3.7</td>
</tr>
<tr>
<td>Water (ppt)</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>28</td>
</tr>
</tbody>
</table>

\(^1\) All depths

Sediment goal: 0.25 ppm
Lower Fox River profile (side view)

OU1 Little Lake Butte des Mort
OU2 Appleton to Little Rapids
OU3 Little Rapids to De Pere
OU4 De Pere to Green Bay
OU5 Green Bay

OU 2 - steep slope (thin sediment - faster flow)
Bedrock under contaminated sediments

Can’t “over-dredge” remaining thin layer

Photo courtesy of WDNR
# Difficult conditions for dredging

<table>
<thead>
<tr>
<th>Project</th>
<th>Site conditions</th>
<th>Underlying bedrock</th>
<th>Debris</th>
<th>Wood</th>
<th>Rock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manistique</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Grasse River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Deposit N</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Wood debris
Manistique River, MI
Rock debris
Grasse River, NY
Monitored Natural Recovery for OU 2

1. Relatively small PCB mass

2. Lower PCB concentrations

3. Dredging not selected
   a. Bedrock
   b. Access
OU 3, OU 4 Decision

1. Dredge 6.5 million cubic yards with PCBs greater than 1 ppm
2. Pipeline to settling basins and landfill
3. Passive Dewatering
4. Landfill disposal
   - Capping Contingency
OU 5 Decision (Green Bay)

- Monitored Natural Recovery
- More modeling
- Dredging near river mouth
# Green Bay and Fox River contamination levels

<table>
<thead>
<tr>
<th>Media</th>
<th>Fox River</th>
<th>Green Bay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediments (ppm)</td>
<td>Mean¹</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>SWAC²</td>
<td>2.6</td>
</tr>
<tr>
<td>Water (ppt)</td>
<td>Mean</td>
<td>37</td>
</tr>
<tr>
<td>Walleye (ppm)</td>
<td>Mean</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Sediment goal: 0.25 ppm

¹ All sediments, all depths
² Surface Weighted Average Concentration
Green Bay decision rationale

• Large volume – disposal “impracticable”

• Relatively low concentrations

• Removal of highest concentrations near river mouth
Remedy considerations

Summary

• Risk reduction: concentrations and mass

• Results on Fox River and other dredging projects

• Site conditions (e.g. bedrock)
Fox River
Dredging projects

Deposit N
(1998-1999)

SMU 56/57
(1999-2000)

OU1
(2004-2010)
# Fox River dredging projects

<table>
<thead>
<tr>
<th></th>
<th>OU 1</th>
<th>Deposit N</th>
<th>SMU 56/57</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume - CY</strong></td>
<td>800,000</td>
<td>8,000</td>
<td>80,000</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td>$60 million (estimate)</td>
<td>$4 million</td>
<td>$17 million</td>
</tr>
<tr>
<td><strong>Cost/CY</strong></td>
<td>$75</td>
<td>$500</td>
<td>$340</td>
</tr>
</tbody>
</table>
Fox River
SMU 56/57

- Water depth: 10 – 20’
- 6.5 acres
- PCBs
SMU 56/57 Process schematic

Sand removal tank and debris screen

Storage tanks

Hydrocyclones

Polymer & press feed pumps

SMU 56/57

Dewatering

Plate and frame Presses
OBJECTIONS ACHIEVED

• Met cleanup standards

• 2000: removed 50,000 cubic yards (670 lbs PCBs)*

• Completed on schedule (69 days)

*Total removal for 1999-2000 dredging: 80,000 cubic yards and 2,111 pounds PCBs
Things that worked

1. Clear goals and flexibility in how to achieve

2. Production objectives & schedule

Things that worked

3. Daily meeting with company, agencies and contractors
   a. Issue identification
   b. Problem resolution

3. One contractor for most work
   a. Equipment flexibility
   b. Proven dredging experience
Things that worked

5. Over-design treatment capacity relative to dredge

6. Extra dredges
Things that didn’t work (1999 dredging)

1. No “meeting of the minds” between agency and companies doing work

2. Multiple contractors
Fox River
OU 1 dredging
OU 1 dredging

1. Dredge sediments (800,000 cubic yards)

2. Dewater sediment

3. Treat dredge water

4. Dispose at landfill

Notes:
1. Ortho-photography Supplied by Winnebago County, WI. Flown in April 2003.
Hydraulic Dredge

- “8-inch”
- Swinging ladder
- Spud barge
- Photo courtesy of WDNR
2005
2 hydraulic dredges
(no silt curtains)

Photo courtesy of WDNR
Cutterhead cleaning

Photo courtesy of Boldt
Sediment processing facility - 2005

- Truck disposal route
- Water treatment plant
- Geotubes
- Dredge dock

Photo courtesy of Little Lake Cleanup Team
Geotubes for dewatering dredge slurry

- Gravity drainage – collect and treat water
- Reduces overhead costs
- “Decouples” dredging & dewatering
- Less potential air release
Storage pad for geotextile tubes

From: Little Lake Cleanup Team
Solids captured & water drains out
Geotube dewatering assistance

Photo courtesy of Boldt
Geotube dewatering assistance

Photo courtesy of Boldt
Geotubes: they’re big

- 200 feet long
- 80 foot circumference
- Contains 1600 cubic yards
Stacked tubes

From: Little Lake Cleanup Team
Mechanical dewatering schematic

Geotube problems

1. Breakage

2. “Blinding” of pad

3. Space

4. “Workability” issues – increase disposal costs
Tube break
Possible causes for geotube breaks

• Added ports

• Hole burned by vibration

• Layout and stacking

• Overfilling bag
Pad blinding
Pad blinding
Water treatment

- Carbon filters
- Air flotation
- Sand/gravel filters
Water treatment plant operating panel

Photo courtesy of Boldt
Landfill disposal*

* Engineered for contaminant containment

From: Little Lake Cleanup Team
Things that worked

1. Geotubes

2. *Multiple* contractors

3. Property purchase
Things that worked

4. Full scale test in 2004

5. Agency flexibility in how to achieve cleanup standards

6. Cooperative relationship
## Fox River dredging projects

<table>
<thead>
<tr>
<th></th>
<th>OU 1</th>
<th>SMU 56/57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractors</td>
<td>Multiple</td>
<td>One</td>
</tr>
<tr>
<td>Dewatering</td>
<td>Geotubes</td>
<td>Plate and frame presses</td>
</tr>
<tr>
<td>Dredges</td>
<td>Two operating</td>
<td>One operating &amp; backup</td>
</tr>
</tbody>
</table>
LOCAL NEWS
Posted Sept. 24, 2004

PCB dredging a smooth operation

Little Lake Butte des Morts cleanup surpasses expectations

By Duke Behnke
Post-Crescent staff writer

TOWN OF MENASHA — Engineers and contractors are all smiles three weeks into the six-year, $62 million cleanup of PCBs from Little Lake Butte des Morts.

A high-tech hydraulic dredge has been removing PCB-contaminated soil from Little Lake Butte des Morts.

Clean up at a glance

Who: The Little Lake Cleanup Team consists of GW Partners and its contractors. Representatives can be reached at 920-912-5065 or by e-mail at littlelakecleanup@execpc.com.
Lessons from contractors:
  
- Enough data & the “right” data
- Practical cleanup objectives

….gives better bids (i.e. lower cost)
Sampling lessons

- RI Cores were tied to water bottom (mistake)
- Dredgers need elevation
- Get engineering data early
Sampling lessons (continued)

- Get engineering data early

- Money for lots of data is “money well spent” (to reduce dredging footprint)
Pre-design sampling
## Pre-design sampling

<table>
<thead>
<tr>
<th></th>
<th>OU 1 (upstream)</th>
<th>OU 2-5 (downstream)</th>
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</thead>
<tbody>
<tr>
<td>River length (miles)</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Horizontal sample density</td>
<td>1 sample every 1 – 2 acres</td>
<td>1 sample every 1.5 – 6 acres</td>
</tr>
<tr>
<td>Vertical interval</td>
<td>every 6 inches</td>
<td></td>
</tr>
<tr>
<td>Number of samples</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCBs</td>
<td>5800</td>
<td>9700</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>550</td>
<td>780</td>
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