Using Dredging Lessons Learned in a Large Contaminated Sediment Feasibility Study

Presented by
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October 24, 2012
Presentation Outline

• Engineered Barriers
  - Best management practices for dredging
  - Engineered barriers overview
  - Rigid containment and silt curtain/silt screen case studies

• Dredge residuals management

Portland Harbor Draft Feasibility Study (FS) was transmitted to EPA, but substantive comments have not yet been received from EPA.
Best Management Practices for Dredging

Operational Controls
• Modify production rates
• Do not overcut banks or overfill buckets
• Control barge overflow

Engineered Barriers
• Rigid containment
• Silt curtains/silt screens
• Removable dams (e.g., geotubes)
• Bubble curtains
Engineered Barriers Overview

- Sheetpile or silt curtain/silt screen enclosures
- May include flow equalization or equipment access features
- Silt curtains extend to variable depths
- Silt curtains may be of permeable or “impermeable” textile
- Anchored to the mudline, shoreline, structures, and piles
Rigid Containment Case Studies

Variety of Case Studies
- Hudson River Phase 1 (New York)
- Tittabawassee River (Michigan)
- NW Natural Gasco Site (Oregon)
- Grasse River (New York)
- St. Lawrence River (New York)

Published Guidance by USEPA and USACE
Rigid Containment Case Studies — Limitations

- Slows remedy production rate
- Hazard to navigation; reduced flood capacity
- Often not impermeable
- Can drive contaminants into deeper sediments
- Concentration of dissolved-phase contaminants within containment area (hypoxia; air quality)
- Turbulent flow/sediment scour near outside wall
- Release of dissolved phase contaminants and/or residuals when removed
- High cost
Rigid Containment — Hudson River Example

- Concentration of PCBs within the containment
- Separation of sheetpile seams
- Flow through equalization windows
- PCB release from enclosure ranged from approximately 0.4% to 1.3% of dredged contaminant mass
  - Primarily dissolved phase
Flow Equalization Windows
Rigid Containment — Other Examples

Tittabawassee River Experience
• Sheetpile system enclosed dredging area
• Sediment scour greater than 10 feet deep occurred immediately offshore of sheetpile wall

Gasco Early Action Experience
• Extensive multi-curtain system used in river
• PAH water quality exceedances and elevated suspended sediment concentrations detected downstream of curtains

Multiple Other Lessons Learned
• Findings summarized in LWG Draft FS tables
Silt Curtain/Silt Screen Case Studies

Variety of Case Studies

• Hudson River (New York)
• NW Natural Gasco Site (Oregon)
• Grasse River (New York)
• St. Lawrence River (New York)
• Fox River (Wisconsin)
• New Bedford Harbor (Massachusetts)
• San Jacinto River (Texas)
• Five other projects summarized in LWG Draft FS

Published guidance by USEPA and USACE
Silt Curtain/Screen Case Studies — Limitations

- Best suited for more quiescent conditions
- Obstruction to navigation
- Can be difficult to install and maintain
- Not impermeable
- Velocities under curtain can cause scour
Hudson River Silt Curtains — Example

- Silt curtain used for east channel of Rogers Island during Phase 1 dredging
- Particulates visible on both sides of curtain
- Monitoring downstream of curtain detected elevated PCBs
- PCB release from enclosure averaged approximately 1.7% of dredged contaminant mass
  - Primarily dissolved phase
Silt Curtain Monitoring — Hudson River

July 10, 2009 Upstream of Silt Curtain

Total PCB=3929 ng/L

July 10, 2009 Downstream of Silt Curtain

Total PCB=5318 ng/L

Graph showing the concentration of PCBs over time. The left graph shows upstream data with a peak at around 3000 ng/L, while the right graph shows downstream data with a peak at around 4000 ng/L.
Conclusions – Engineered Containment

- Physical barriers have not completely controlled dissolved-phase (most bioavailable) dredging releases.
- Effectiveness limitations and unintended consequences are now well documented.
- The need for engineered barriers must be considered carefully.
  - No “one-size fits all” approach
  - Effective use limited to specific conditions
Dredge Residuals Management

- Large body of studies on dredge residuals
- Multiple management strategies have been used, with variable success
  - Repeated dredge cleanup passes
  - Dredge cleanup pass and residual management cover
  - Residual management cover
- LWG Draft FS includes an evaluation of different residual management approaches
## Dredging Release Case Studies*

<table>
<thead>
<tr>
<th>Project</th>
<th>Environmental Dredging Activity</th>
<th>BMPs</th>
<th>Source of Release Estimate</th>
<th>Contaminant Mass Released</th>
<th>Primary Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995 Grasse River</td>
<td>3,000 cy hydraulic</td>
<td>Operation BMPs/silt curtains</td>
<td>Caged fish monitoring</td>
<td>Fish tissue concentrations increased 5 to 50 times</td>
<td>NAS Panel Presentation, 1999.</td>
</tr>
<tr>
<td>2004 Duwamish/Diagonal</td>
<td>70,000 cy mechanical</td>
<td>Operation BMPs</td>
<td>Fate/transport and food web modeling to simulate measured fish tissue PCBs</td>
<td>Midpoint 3% (range: 1 to 6%)</td>
<td>Stern, J.H., 2007.</td>
</tr>
<tr>
<td>2005 Lower Passaic River</td>
<td>4,000 cy mechanical</td>
<td>Operation BMPs/rinse tank</td>
<td>Water quality monitoring</td>
<td>Average 3 to 4% (range: 1 to 6%)</td>
<td>Lower Passaic River Restoration Project Team, 2009.</td>
</tr>
<tr>
<td>2009 Hudson River</td>
<td>280,000 cy mechanical</td>
<td>Operation BMPs/silt curtains</td>
<td>Water quality monitoring</td>
<td>Average 3 to 4% (~80% dissolved)</td>
<td>Anchor QEA and ARCADIS, 2010.</td>
</tr>
<tr>
<td>2011 Hudson River</td>
<td>360,000 cy mechanical</td>
<td>Operation BMPs</td>
<td>Water quality monitoring</td>
<td>Average 1% (~80% dissolved)</td>
<td>GE and Anchor QEA, 2012. Unpublished data.</td>
</tr>
</tbody>
</table>

* Note: preliminary data summaries; subject to revision
LWG Draft Feasibility Study Residuals Management Approach

- Evaluated a range of potential variables for different dredging scenarios
- Mass balance approach consistent with USACE 2008 guidance and recent case studies
- Computed post-residuals management surface concentration for two different approaches
  - Clean cover placement only
  - Single dredge cleanup pass and clean cover placement
- Post-dredge and cover sediment quality projections compared to preliminary cleanup goals
Generated Residuals Case Studies

- Little Debris or Rock/Hardpan
- Substantial Debris and/or Rock/Hardpan

Generated Residuals (percent of last production cut)

Average Bulk Density of Last Production Cut (gms/cm³)
# LWG Draft Feasibility Study Residuals Management Mass Balance Input

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Source</th>
<th>Input Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>In situ bulk density of target dredge material</td>
<td>Computed from 1,859 synoptic specific gravity and total solids measurements in the Study Area</td>
<td>51 ± 17 pcf</td>
</tr>
<tr>
<td>Dredge cut thickness</td>
<td>Typical dredge cut for 10-cy bucket (e.g., Terminal 4 work)</td>
<td>2 to 4 feet deep</td>
</tr>
<tr>
<td>Residual loss</td>
<td>ERDC/EL TR-08-4 Figure 3 (USACE 2008b); this range is conservative for Portland Harbor based on Bridges et al. (2010), as it does not consider debris and other complications</td>
<td>2 to 5%</td>
</tr>
<tr>
<td>Depth of overdredge</td>
<td>Design variable - assumed based on USACE guidance for overdredge allowance (USACE 2007)</td>
<td>1 foot</td>
</tr>
<tr>
<td>In situ concentration of sediment below the dredge prism</td>
<td>Design variable - assumed that the dredge prism will be designed to clean up to the RAL</td>
<td>Value at or below the RAL</td>
</tr>
<tr>
<td>Thickness of cleanup pass dredge cut</td>
<td>Design variable - assumed 1 foot based on past project experience</td>
<td>1 foot</td>
</tr>
<tr>
<td>Thickness of post-dredge sand cover material</td>
<td>Design variable - assumed 6 inches to 1 foot based on past project experience</td>
<td>6 inches to 1 foot</td>
</tr>
<tr>
<td>Bulk density of post-dredge sand cover material</td>
<td>Assume porosity of 40% and specific gravity cover as 2.65</td>
<td>100 pcf</td>
</tr>
<tr>
<td>Chemical concentration of post-dredge cover material</td>
<td>Design variable - assumed that the design will control the quality of import cover material and require that the cover material be tested as essentially non-detect for contaminants.</td>
<td>Non-detect</td>
</tr>
</tbody>
</table>
LWG Draft Feasibility Study Residuals Management Mass Balance Results

6-inch Cover Scenarios

Cleanup Pass + 6-inch Cover Scenarios
Conclusions – Residuals Management

- Residuals can be most effectively controlled with limited “cleanup” dredge passes, followed by post-dredge cover placement
- Multiple dredge passes not effective
Questions?