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Defining the Effectiveness of Environmental Dredging

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Overview

- Environmental vs. Navigational Dredging
- Sediment Risk 101
- Risk-Based Framework
- Effectiveness Parameters
- Experience from Completed Projects

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Navigational Dredging

- Depth-based removal to deepen/maintain
- Typically large volumes
- High production rates
- Low cost
- Disposal varies

Environmental Dredging

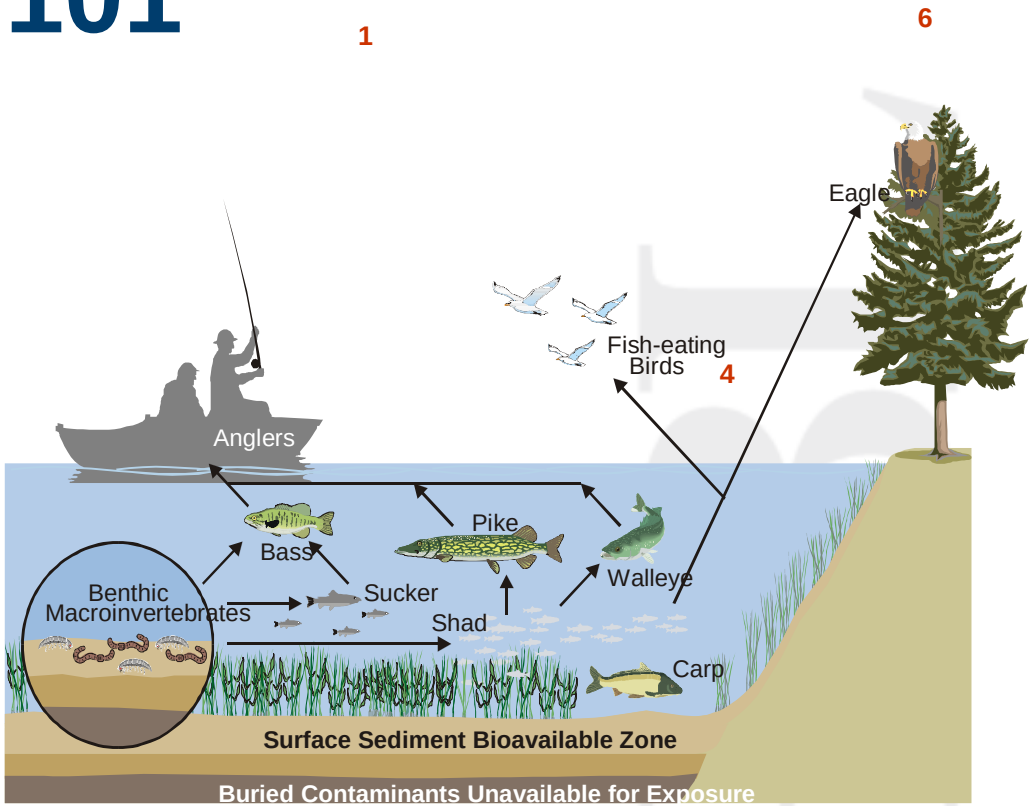
- Risk-based removal (Concentration driven)
- Higher environmental control
- Smaller volumes (lower production)
- High cost
- More restricted disposal

Dredging Effectiveness

Were the goals established at project inception accomplished?

Sediment Risk 101

- Understand unique aquatic environment
- Risk related to:
  - Exposure pathways
  - Chemical concentration
    - *Fish/other biota*
    - *Water column*
  - Bioavailable sediment (i.e., surface sediment)
- Sediment stability is important



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Interpretation Of Dredging Effectiveness

- Definition
  - The degree to which contaminated sediment removal via dredging achieves acceptable reduction in risk to human health and the environment
- Concept
  - Should be evaluated in context of “Net Risk Reduction”
  - “Effectiveness” ≠ quantity of contaminated sediment removed at all sites
  - Need to evaluate on a site-specific basis
  - Need to incorporate sediment stability into interpretation

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Interpretation Of Dredging Effectiveness (cont'd)

- Potential Issues:
  - Risk reduction-based remediation goals should be established as a measurement of effectiveness
  - Actual reduction in risk is often not stated in measurable terms
  - Volume reduction/mass removal is often automatically equated with risk reduction
  - Empirical performance data on extent of risk reduction post-dredging (e.g., fish tissue reductions) are lacking
  - While short-term impacts are quantifiable, long-term benefits are not readily verifiable

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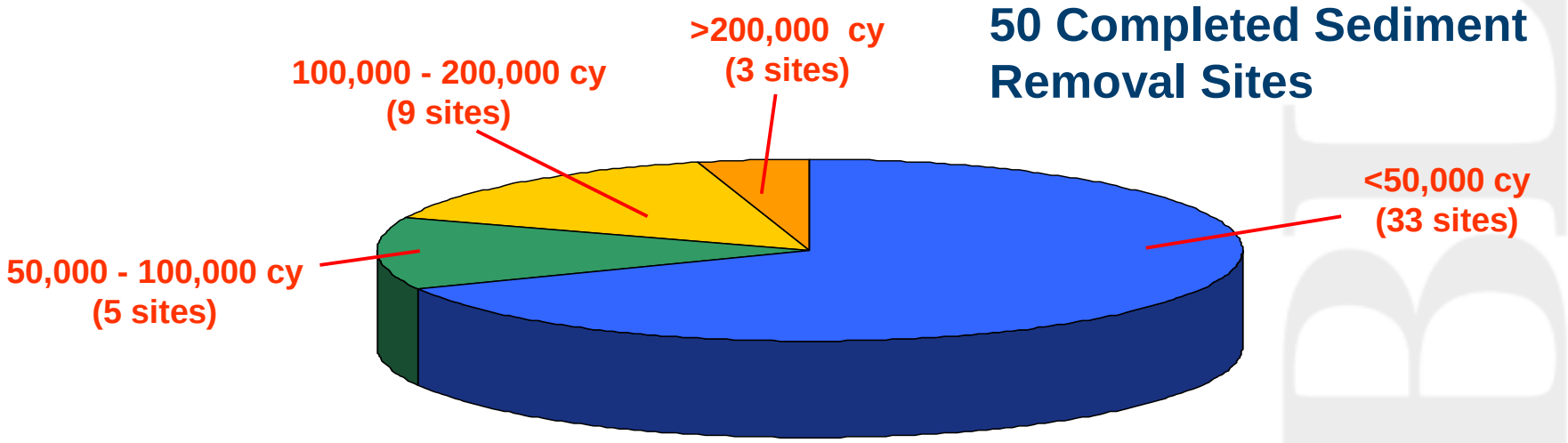
Effectiveness Parameters

- Important risk-reduction parameters
  - Fish tissue concentrations
  - Surface sediment concentrations
  - Water column concentrations
  - Air concentrations
  - Habitat quality
- Sediment stability
- Community concerns
- Schedule
- Cost/budget

Completed Projects



- Central repository: Major Contaminated Sediment Sites Database (Release 3.0) available at www.hudsonvoice.com

- Sites are relatively small
- Limited monitoring data
- Limited documentation

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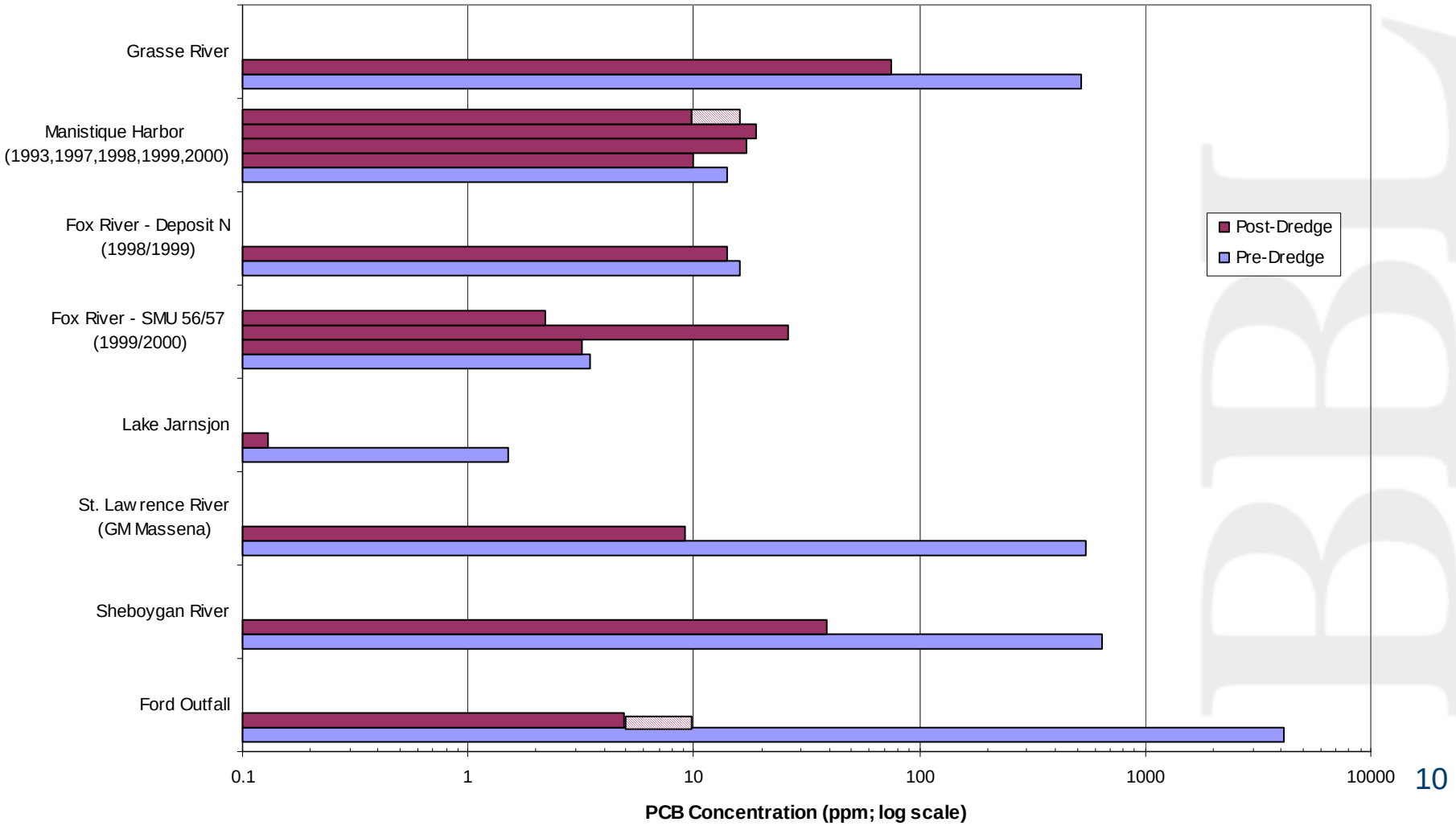
Average Surface Sediment PCB Data at Select Dredging Sites



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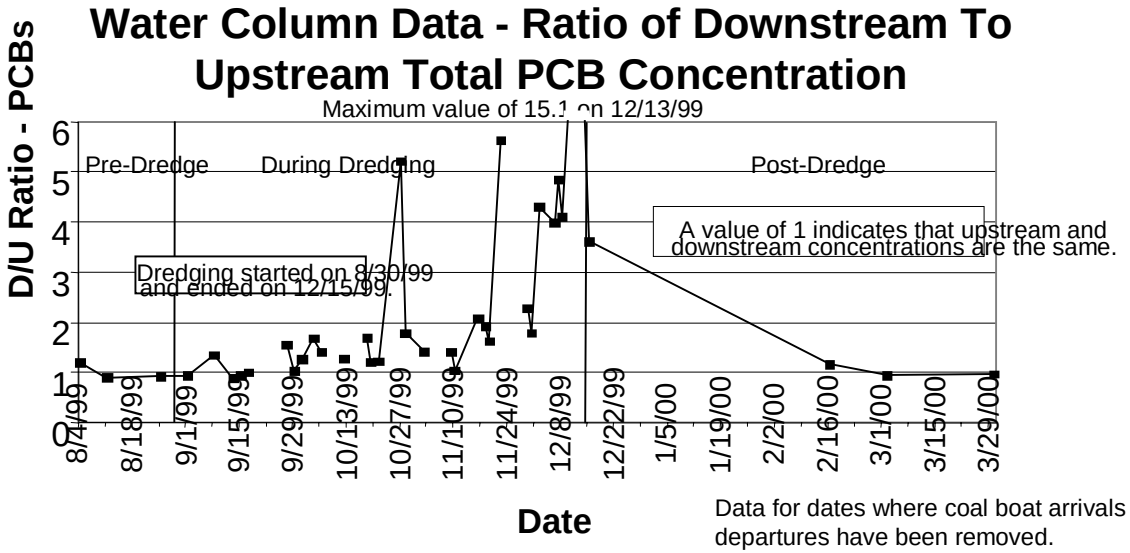
Water Column Data

- Limited long term data
- Most available data collected during dredging
- Available data indicate
  - TSS/turbidity controllable
  - Contaminant releases observed and bioavailable

Fox River, WI: SMU 56/57



Data for dates where coal boat arrivals and departures have been removed.

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Biota Data

- Surprising paucity of data
- Complications with interpretation:
  - Ongoing natural recovery
  - Distinguishing from other remedial efforts
    - Source Control
    - Containment
  - Sampling location comparability
  - Impacts from remedy itself
- Habitat data practically non-existent

Observations

- Most experience to date limited to relatively small sites
  - Limited available data
- Dredging has limitations in reducing surface layer contaminant concentrations
  - Some instances, capping necessary after dredging
- Resuspended solids can be controlled, however:
  - Elevated water column contaminant concentrations observed during dredging
- Effects of dredging on fish tissue concentrations not quantifiable
- Environmental dredging is distinctly different than navigational dredging

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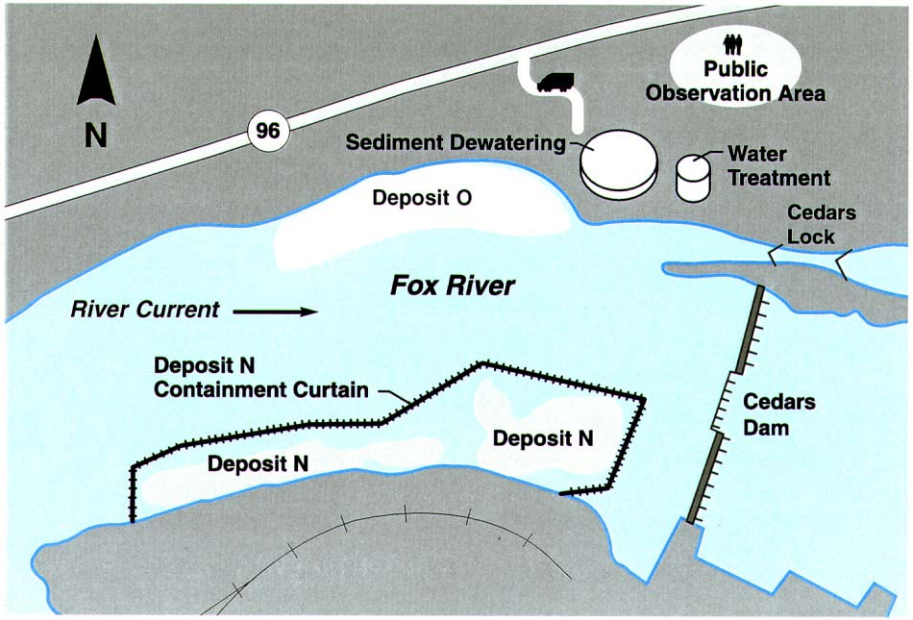
Fox River, WI – Deposit N

- 8,200 cy removed from November to December 1998 and August to November 1999 (WDNR) (1,000 cy removed from Deposit O)
- Removed via hydraulic dredging (cutterhead)
- Silt containment included a perimeter turbidity barrier (80 mil HDPE) and two deflection barriers (80 mil HDPE and a silt curtain used primarily in 1998)



- Sediment dewatered and disposed off site
- Goal→ Remove majority of contaminated sediment and leave thin residual layer (65% of volume targeted for removal due to bedrock conditions)
- Project cost = $4.3M ($525/cy)

Grasse River – Massena, NY

- 3,000 cy sediment and debris with PCBs removed in 1995 (Alcoa)
- Mechanical debris removal and hydraulic dredging (horizontal auger)
- Sediment dewatered and disposed on site
- Goal: Removal of “all” sediment
- Heavily studied/monitored program
- Performed as NTCRA
- Project cost = $4.9M ($1670/cy)

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Lake Järnsjön, Sweden – Hydraulic Dredging

- 62-acre lake in Sweden located on the Emån River.
- Lake bottom was dredged in 1993-1994 to depths of 1.3 - 5.3 feet (196,000 cy)
- Goal → 0.5 ppm PCBs
- Sediment dewatered and disposed locally (upland adjacent to lake)

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Ruck Pond – Cedar Creek, WI

- 1994 removal of close to 100% of soft sediment (7,730 cy) from a temporarily drained 1,000-foot section of impounded creek (Mercury Marine)
- Goal → remove all PCB-containing soft sediment
- Heroic removal efforts employed
- Available data include sediment and caged fish
- Pre-removal surface sediment PCBs (0-6" or 0-24") = ND - 2,500 ppm (average = 56 ppm)
- Residual sediment exhibited 9.2 - 300 ppm PCBs (average = 76 ppm)
- Project cost = $7.5M ($970/cy)

Sheboygan River, WI

- 3,800 in-situ cy sediment with PCBs
- Discrete pockets
- Closed clamshell removal (11/89-11/91) (Tecumseh)
- Interim storage at Tecumseh facility
- Dermal risk-based cleanup (removal action and pilot study)

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Shiawassee River – Mechanical & Hydraulic Removal

Shiawassee River - Looking upstream from Bowen Road

- 1982 removal action (1,805 cy): selective sediment removal in 1.5-mile stretch below the plant site
- Removal ceased when funds ran out
- Since PCBs extended beyond 1.5 miles, 8 miles of river downstream of the plant site were subsequently declared a Superfund Site (1983)
- Increased PCB levels in caged fish were measured after the 1982 removal

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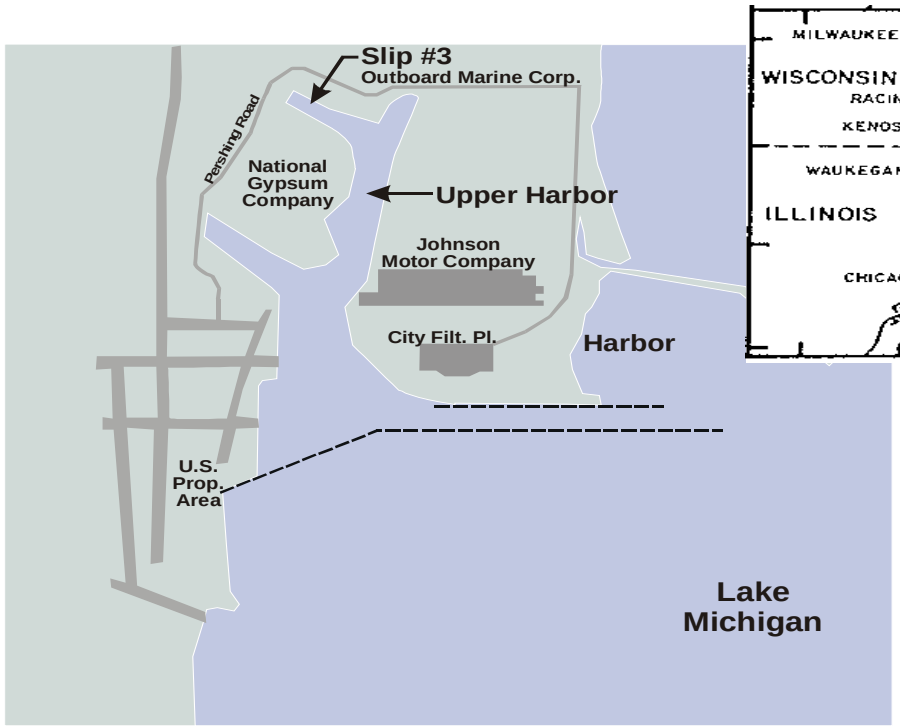
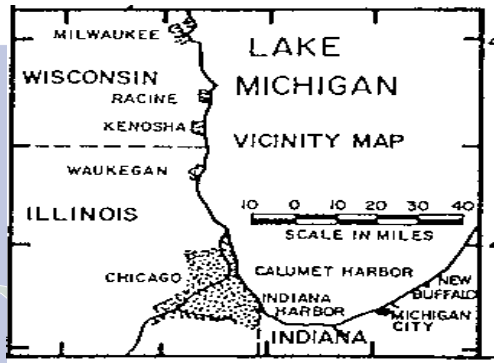
St. Lawrence River, GM Massena – Hydraulic Dredging

- 11-acre area of nearshore sediments dredged in 1995 (General Motors)
- Goal → 1 ppm PCB (sediment)
- Mechanical debris removal and hydraulic dredging (horizontal auger)
- Silt containment -- steel sheeting
- Removed 13,250 cy; stockpiled at the GM site in a lined and covered area and then disposed off-site in summer 1999
- Project cost = $11.5M ($870/cy)

Waukegan Harbor – Hydraulic Dredging

- Slip #3 (max. 17,000 ppm PCBs) first remediated by dredging, then used as a CDF
- 10-acres of Upper Harbor dredged in early 1992 with disposal into the CDF





Waukegan Harbor

- Target sediment PCB cleanup 50 ppm : no PCB verification
- 1996 sediment data: 3 - 9 ppm PCBs (from 17 surface locations within the Upper Harbor)