# Importance Of Source Control: Recontamination Of Completed Sediment Remedial Projects

24th Annual International Conference On Soils, Sediments And Water
Amherst, MA
October 22, 2008

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## Magnitude of the Contaminated Sediment Problem

- In its 1998 Contaminated Sediment Management Strategy document, U.S. EPA estimated that 1.2 billion cubic yards of sediment is contaminated, using only the top 5 cm of the areas identified.
- Assuming an average sediment thickness of 2 to 3 feet, an estimated 20 billion cubic yards of sediment is likely to require some form of management.

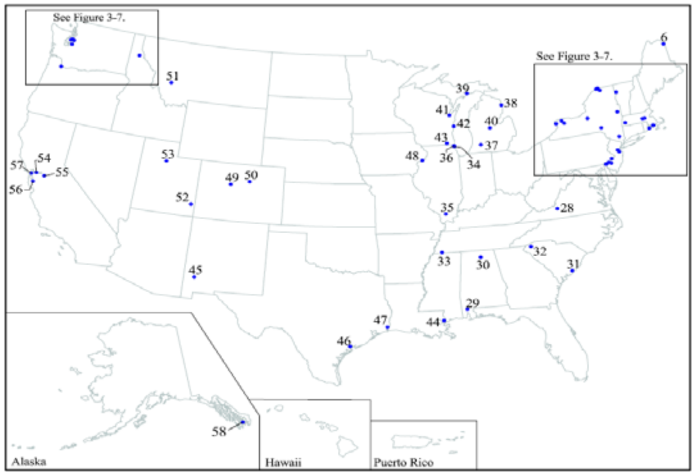
## Magnitude of the Contaminated Sediment Problem

- To put this in perspective, 20 billion cubic yards of contaminated sediment equates to:
  - 24 years of our entire national household trash volume
  - 12,000 years of our entire national RCRA landfill trash volume

## CURRENT STATISTICS

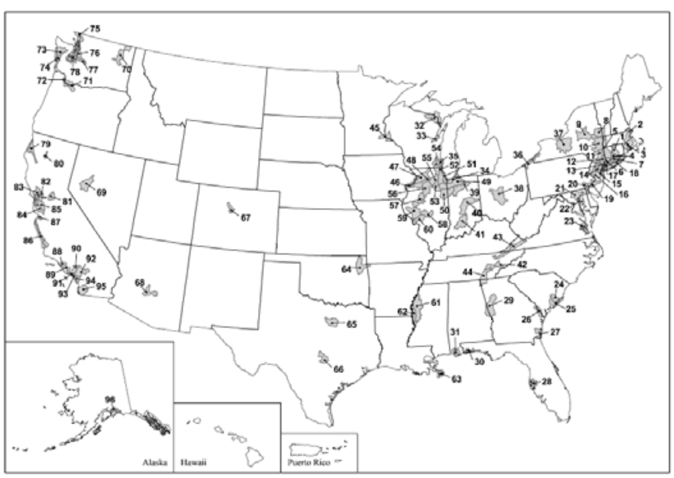
- The 2004 U.S. EPA *Updated Report on the Incidence and Severity of Sediment Contamination in Surface Waters of the United States* notes that in the 2800 waterbodies with fish advisories include:
  - 33% of the nation's total lake acreage
  - 15% of the total river miles
  - 100% of the Great Lakes
- The Superfund Program has decided to address sediment issues at over 150 sites
- Over 65 of these sites are large enough that they are being tracked at the national level
- 96 watersheds were identified as being areas of probable concern for sediment contamination

# Nationally Tracked CERCLA Sites




***From U.S. Environmental Protection Agency. 2004. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States.***

# Areas of Probable Concern




***From U.S. Environmental Protection Agency. 2004. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States.***

## EPA's Emphasis on Source Control

- *Contaminated Sediment Management Strategy* (1998):
  - "Before initiating any remediation, active or natural, it is important that point and nonpoint sources of contamination be identified and controlled." (p. 55)

## EPA's Emphasis on Source Control

- *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (2002):
  - Principle #1: CONTROL SOURCES EARLY

## EPA’s Emphasis on Source Control

- *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (2005):
  - “Identifying and controlling contaminant sources typically is critical to the effectiveness of any Superfund sediment cleanup.” (p. 2-20)
  - “In most cases, before any sediment action is taken, project managers should consider the potential for recontamination and factor that potential into the remedy selection process.” (p. 2-21)

## Recontamination Following Remediation

- Survey of recently completed projects identified 19 sites where recontamination occurred.
- Sites varied widely in geomorphic and geographic settings.
- Included freshwater and estuarine locations.

## Recontamination Following Remediation

- Initial remedial actions included dredging, capping, and combinations of dredging and capping.
  - 8 capping sites
  - 6 dredging sites
  - 5 combination capping & dredging sites

## Recontaminated Sites

| Site | Response Measure(s) | Recontamination Information |
|---|---|---|
| Anacostia River, DC | 2004 cap | 2006 urban sources, upstream sources |
| Bloomington, IN (3 creeks) | 1987 sediment removal | 1992 all sources unclear – point source discharge included |
| Convair Lagoon, CA | 1998 cap | 2002 public storm drain discharges |
| Denny Way Site, WA | 1990 cap | 1993 CSO point source discharges |
| Duwamish Norfolk CSO, WA | 1999 dredge-cap | 2001 CSO point source discharges; unremediated adjacent contaminated sediment |
| Duwamish River Diagonal, WA | 2004 dredge | 2005 sewage system discharges |
| Eagle Harbor Site, WA | 1994 cap | 1999 “surface sources,” “offsite sources” |
| Ford Outfall/River Raisin, MI | 1997 dredge | 2001 unremediated upstream sediments and/or upland sources; sediments sloughed from adjacent navigational channel |
| Fox River SMU 56/57, WI | 2000 dredge-cap | 2005 1.2-1.5 m of new impacted sediment deposited in 5 years |
| Housatonic River, MA | 2002 dredge-cap | 2005 upstream sources, CSO and SSO point source discharges |

# Recontaminated Sites

| Site | Response Measure(s) | Recontamination Information |
|---|---|---|
| Lauritzen Canal, CA | 1996 dredge-cap | 1998 undetected point source(s); incomplete remediation near margins of site |
| Long Beach North Energy Island Borrow Pit (NEIBP), CA | 2001 cap | 2004 "deposition from the surrounding harbor" |
| Pier 51 Ferry Terminal, WA | 1989 cap | 1990 PAHs due to pile pulling; metals from "new sediment deposition" |
| Pier 53-55, WA | 1992 cap | 2002 prop wash resuspension near edges; PAHs due to pile removal |
| Pier 64-65, WA | 1994 cap | 2002 piling repair work released creosote |
| Puget Sound Naval Shipyard Pier D, WA | 1994 dredge | 1998 suspected resuspension of sediments from outside response area |
| Sitcum Waterway/Nearshore Tideflats, WA | 1993 dredge | 2002 "continued source input from recent sediment deposition or off-loading activities" |
| St. Clair Shores, MI | 2002 dredge | 2003 sewer pipe discharges |
| Thea Foss Waterway, WA | 2002 dredge-cap | 2006 city storm drain discharges |

# Common Sources of Recontamination

- Point sources:
  - combined sewer overflows (CSOs)
  - storm sewer outfalls (SSOs)
  - municipal sewage treatment plants
- Sediment sources:
  - upstream sources
  - unremediated nearby sediments

## Common Sources of Recontamination

- Runoff sources:
  - industrial manufacturing and storage sites
  - erosion of streambank and/or adjacent upland soils
  - mining sites
  - agricultural runoff
- Other sources:
  - atmospheric deposition
  - contaminated groundwater advection
  - spills

## Sources of Recontamination for the 19 Sites

- Point sources (10 of 19 sites - 53%):
  - Most frequent source: CSO and other public storm water discharges
  - Absent: industrial sources (but could be unidentified upstream contributors to CSOs)
- All 10 sites located in urban areas
  - Many of the 96 APCs identified in U.S. EPA's 2004 sediment inventory are in urban areas
  - 9 of these 10 sites are located in APCs

## Sources of Recontamination for the 19 Sites

- Sediment sources (7 of 19 sites - 37%):
  - Relocation of unremediated nearby sediments into the response area
- Runoff sources (8 of 19 sites - 42%)
  - Recent sediment deposition
  - From surrounding harbor
  - Upland/upstream sources

## Sources of Recontamination for the 19 Sites

- Other processes (3 of 19 - 16%):
  - Processes other than those already described as "other sources" (E.g., associated with pile pulling and/or pile repair along piers)
- Other sources (0 of 19 – 0%):
  - No reported recontamination due to contaminated groundwater advection, mining site impact, or agricultural runoff

## Case Study: Anacostia River

- Site characteristics:
  - Freshwater Tidal System
- COCs:
  - PAHs, PCBs, metals, other
- Remedy:
  - Innovative “active” cap (2004)
  - Successfully contained  targeted contaminated sediment
- Recontamination:
  - Deposition of contaminated sediments on top of the cap from urban sources in the area and relocation of unremediated sediments present elsewhere in the waterway (2006).

## Case Study: Ford Outfall

- Site characteristics:
  - River
- COCs:
  - PCB Aroclor 1248
- Remedy:
  - Dredged 20,600 $m^3$ (1997)
  - Post-dredging sampling confirmed that cleanup level was achieved
- Recontamination:
  - Deposition of sediment contaminated with a different PCB Aroclor -- 1242 -- likely from unremediated sediment and land soil sources (such as the former paper mill) upstream of the dredged area.

## Case Study: Convair Lagoon

- Site characteristics:
  - 4 hectare embayment in North San Diego Bay
- COCs:
  - PCBs
- Remedy:
  - 2.3 hectare area remediated by placement of a cap (1998)
- Recontamination:
  - Deposition of contaminated sediments on top of the cap from adjacent public storm drain systems (2002).

## Case Study: St. Clair Shores

- Site characteristics:
  - Lange and Revere Canals, which connect to Lake St. Clair
- COCs:
  - PCBs
- Remedy:
  - Dredging (2002-2003)
- Recontamination:
  - Recurrence of elevated concentrations of PCBs due to an adjacent public storm water sewer. After source controls were implemented, waterways were redredged (2006).

## Case Study: Lauritzen Canal

- Site characteristics:
  - Tidally influenced marine site off San Francisco Bay
- COCs:
  - DDT and dieldrin
- Remedy:
  - 82,000 $m^3$ dredged, followed by placement of 30 cm thick cap (1996-1997)
- Recontamination:
  - Sampling in 1998 & 1999 showed recontamination with DDT. One source thought to be from slumping and erosion from undredged areas but capped beneath docks and around pilings.
  - Second source later discovered to be waters discharged from embankment outfall.

## Case Study: Thea Foss Waterway

- Site characteristics:
  - 2,440 m long tidal marine waterway
- COCs:
  - PAHs, PCBs, DDE, DDD, bis(2-ethylhexyl) phthalate
- Remedy:
  - 400,000 $m^3$ dredged, plus application of 8.5 hectare cap (Response actions began in 2002)
- Recontamination:
  - Sampling in 2005 showed recontamination by di(2-ethylhexyl) phthalate, which was attributed to waters discharged from 2 city storm drains.

## Rapid Recontamination

- All 19 sites became recontaminated relatively quickly following remediation.
- Not a failure of the initial remedial action.
- Reasons for recontamination:
  - No assessment of source control made prior to remedy selection
  - Incomplete assessment of source control made prior to remedy selection
  - Remediation conducted at locations where source control known to be incomplete

## Conclusions

- Survey identified 19 sites that were recontaminated.
- U.S. EPA's sediment strategy, policies, and guidance have consistently focused on avoiding this problem.

## Conclusions

- Recontamination most likely to arise from uncontrolled Point Sources and/or incomplete remediation in adjacent/upstream areas.
  - 10 of the sites were recontaminated from public discharge systems such as CSOs and SSOs
- Careful study of potential Point Sources is necessary.
- Control of Point Sources must be as great or greater a priority as the sediment response action.

## Conclusions

- 7 sites recontaminated due to incomplete remediation – contaminated sediment from outside the response area entered via resuspension, etc.
- Lesson: Avoid remediating single or discrete locations (especially downstream) out of a larger area until a thorough understanding is developed of how the unremediated area may affect the long-term effectiveness of the remediation.

## Bottom Line

CONTROL SOURCES EARLY

## For Further Info ...

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