# SINCLAIR INLET
# WA

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(US NAVY SPAWAR, RETIRED)

# Sinclair Inlet Site Overview

# Objectives of Remediation

- Reduce surface sediment PCB concentrations in biological active zone to below 3 mg/Kg OC as measure to reduce PCB concentrations in fish tissue
- Control shoreline erosion of contaminated fill at Site 1
- Selectively remove sediment with high Hg concentrations collocated with PCB
- Concurrent Puget Sound Naval Shipyard navigation improvements

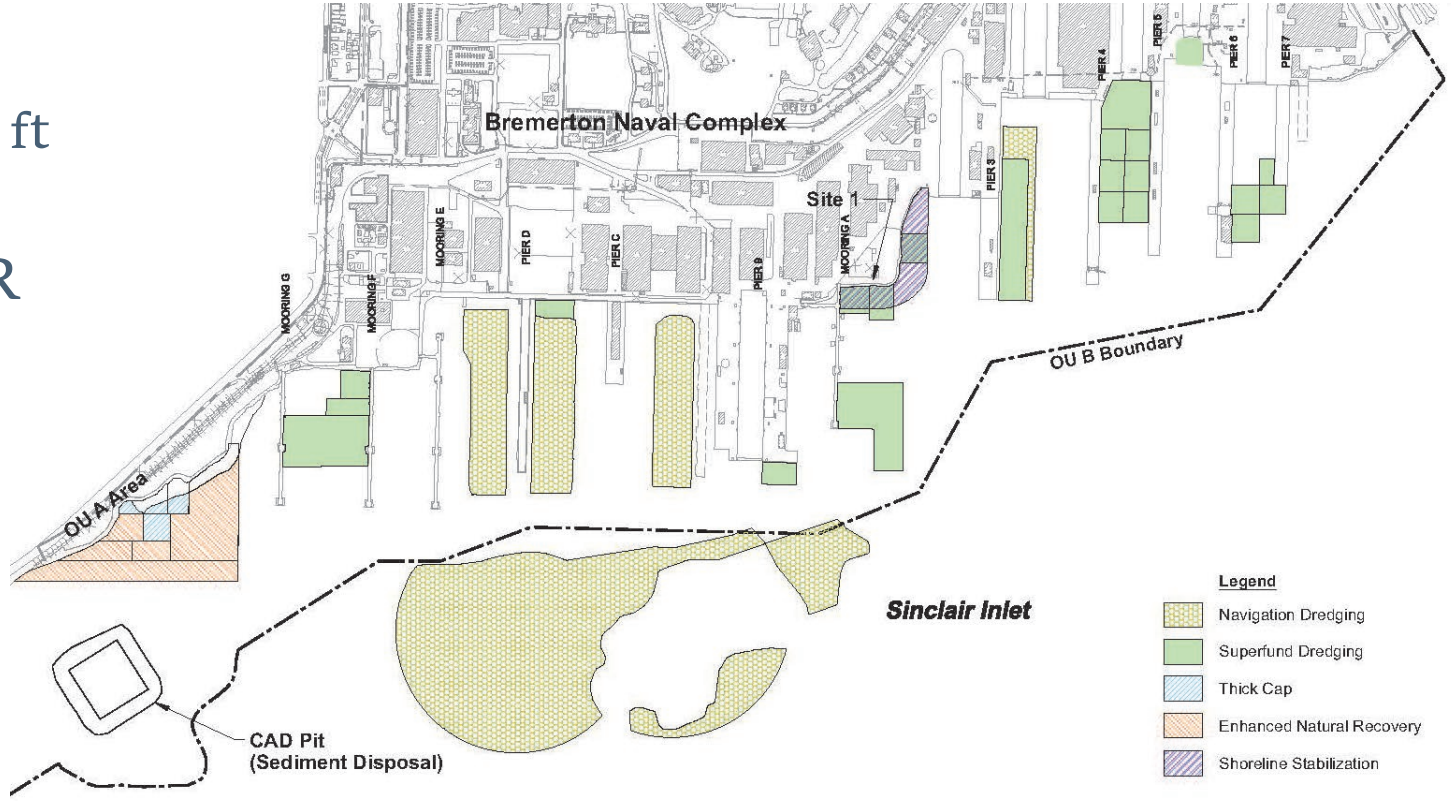
# Remedial Action Levels for Marine Sediments

| COC | Response Action | Action Level |
|---|---|---|
| PCBs | Dredge or cap | >12 mg/kg OC |
| PCBs | Enhanced Natural Recovery | >6 mg/kg OC |
| Mercury and PCBs | Dredge | Hg >3 mg/kg and PCB >6 mg/kg OC |

Data source: US Navy 2002; USEPA 2002

# Summary of Remedy (2000 to 2001)

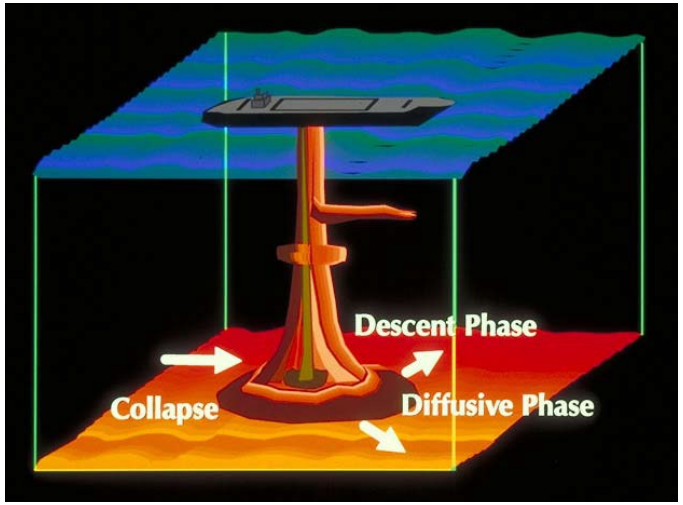
- 200,000 cubic yards dredged (32 acres)
  - Confined Aquatic Disposal Pit (2 ft cap)
- 13 acres capped (3 ft) or ENR (20 cm)
- Shoreline stabilization
- Institutional Controls
- Monitored Natural Recovery

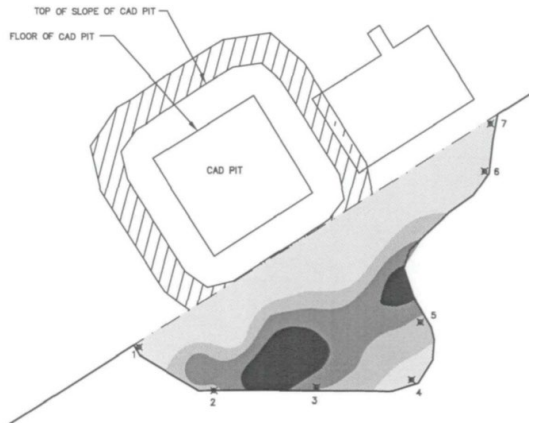



Source: US Navy NAVFAC 2012, 2017

# Significant Remedy Scope or Schedule Deviations

- Unplanned release of contaminated dredged material during CAD placement
  - Unanticipated consequence from bottom-dump barge placement and momentum in CAD cell
  - Follow-on thin-layer cover (ENR) placement to contain release
- Source control
  - Continuous Process Improvement of Shipyard Operations



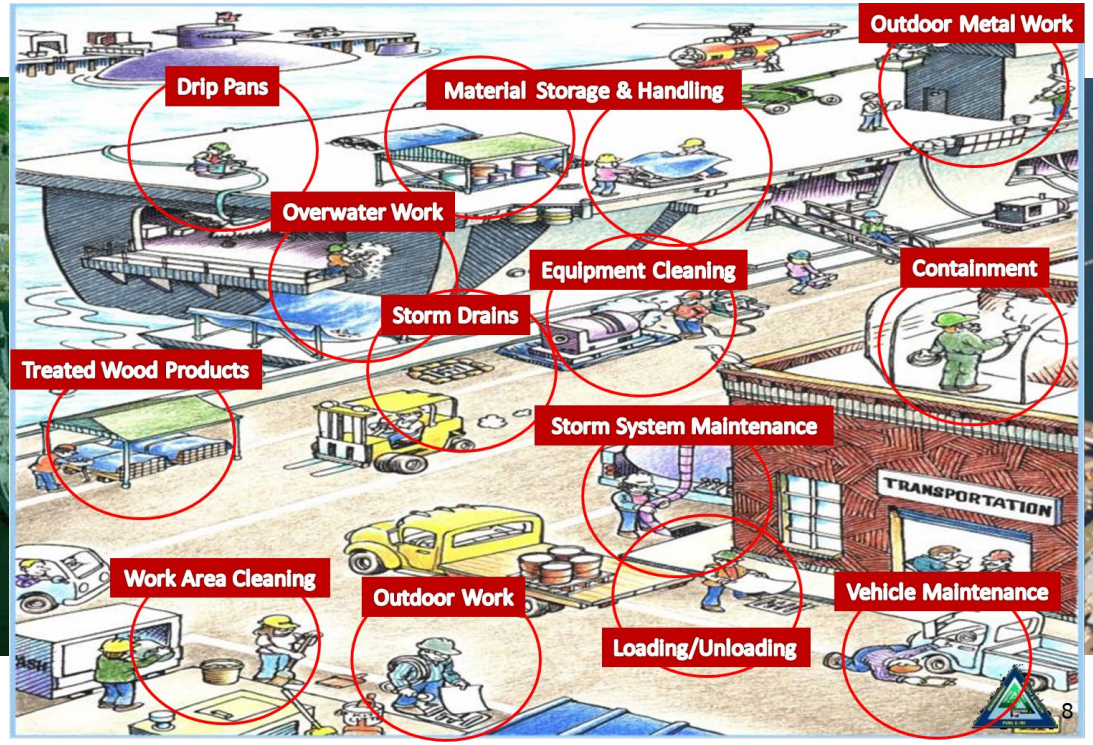

Source: USEPA 2002

# When Were External Sources Characterized and Addressed?

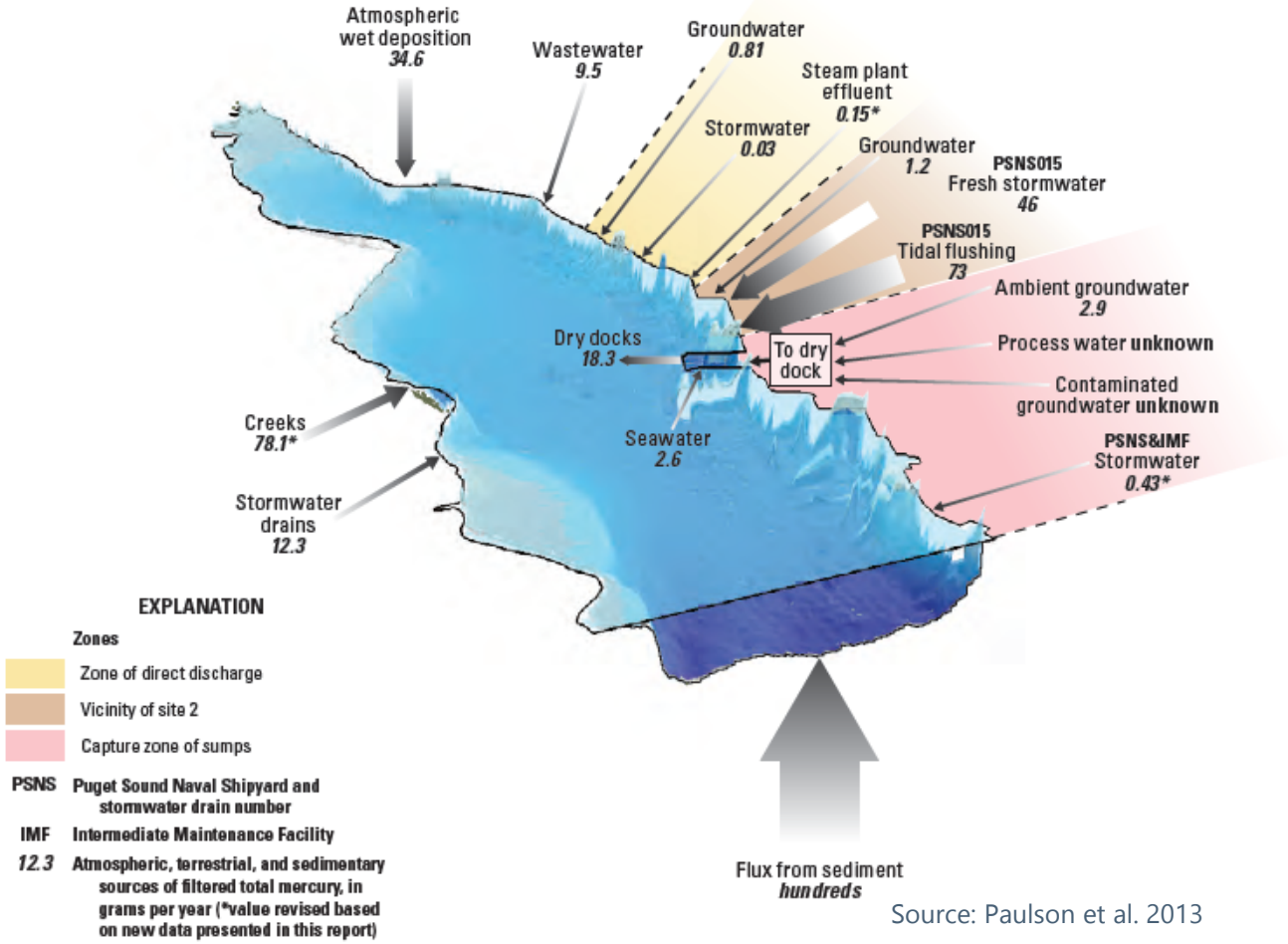
## Water Pollution Prevention BMPs

Continuous Process Improvement is Working!


Source: WA State Depart. of Ecology




# Watershed Loading of Filtered Total Mercury



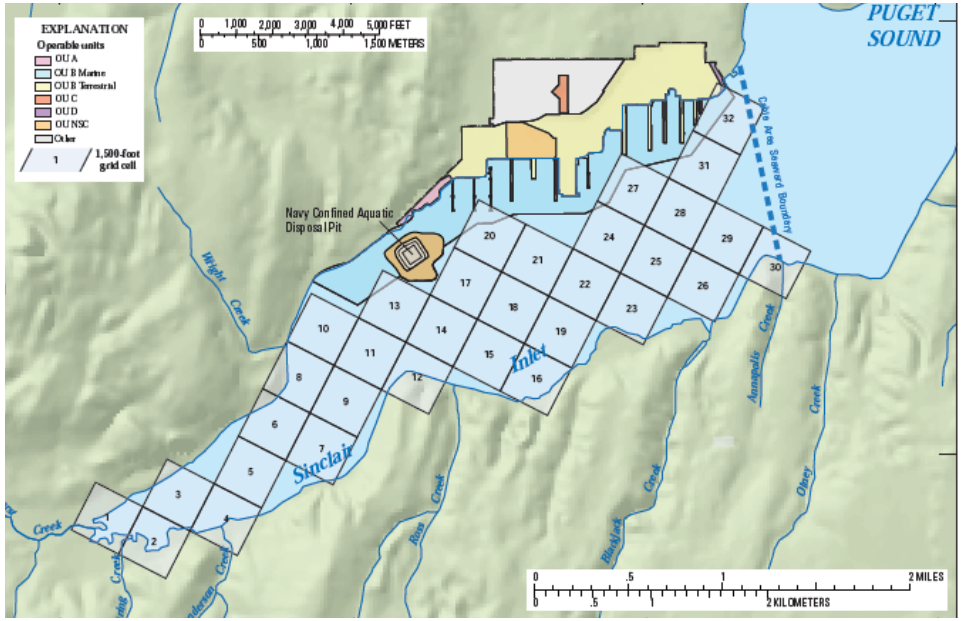

Source: Paulson et al. 2013

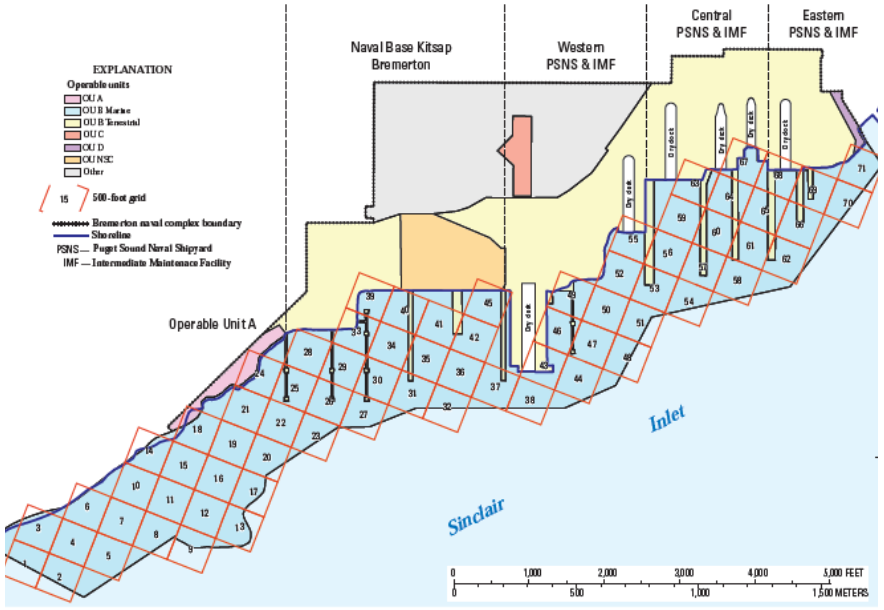
Sediment Remedy

**Figure 7.** Revision of loadings of filtered total mercury from freshwater sources, from seawater recycled in and out of Bremerton naval complex, and from net advective transfers between Sinclair Inlet and Puget Sound (Paulson and others, 2012), Kitsap County, Washington.

# Primary Pre- and Post-Remedy Effectiveness Monitoring Elements

- Surface sediment SWAC (0 to 10 cm) PCB concentration changes
- English sole PCB tissue monitoring: 1991 to 2017 (PSEMP and Navy)

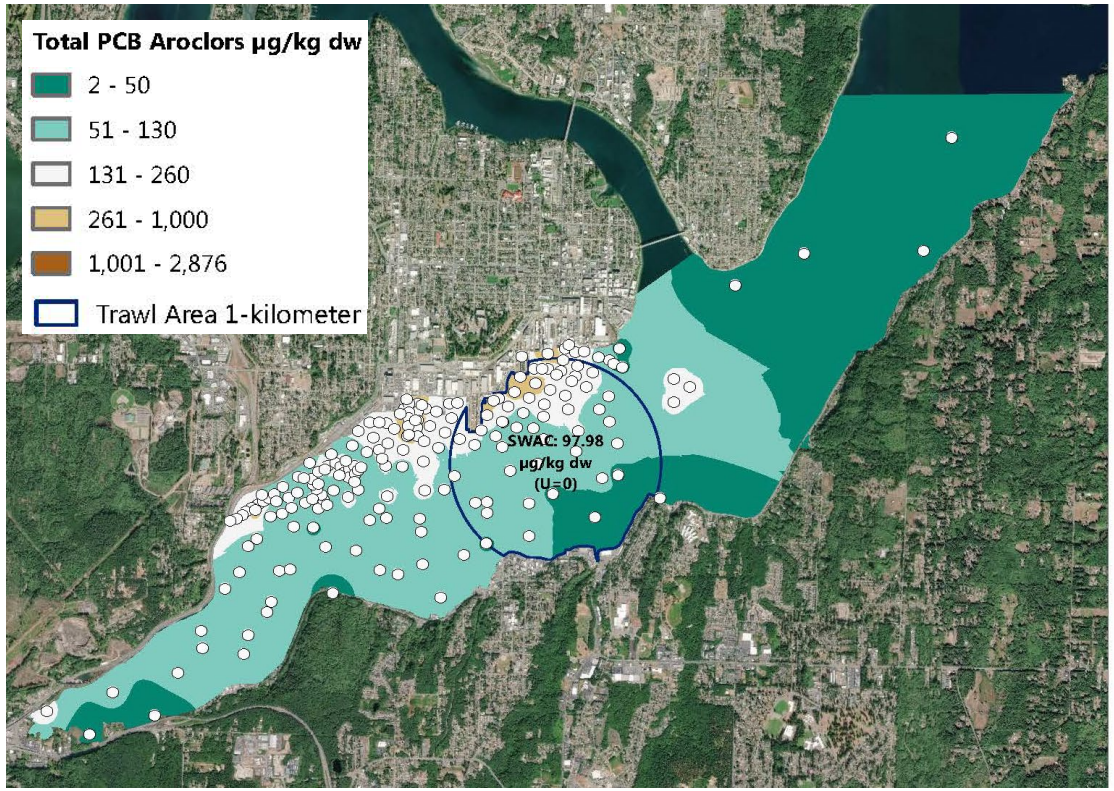


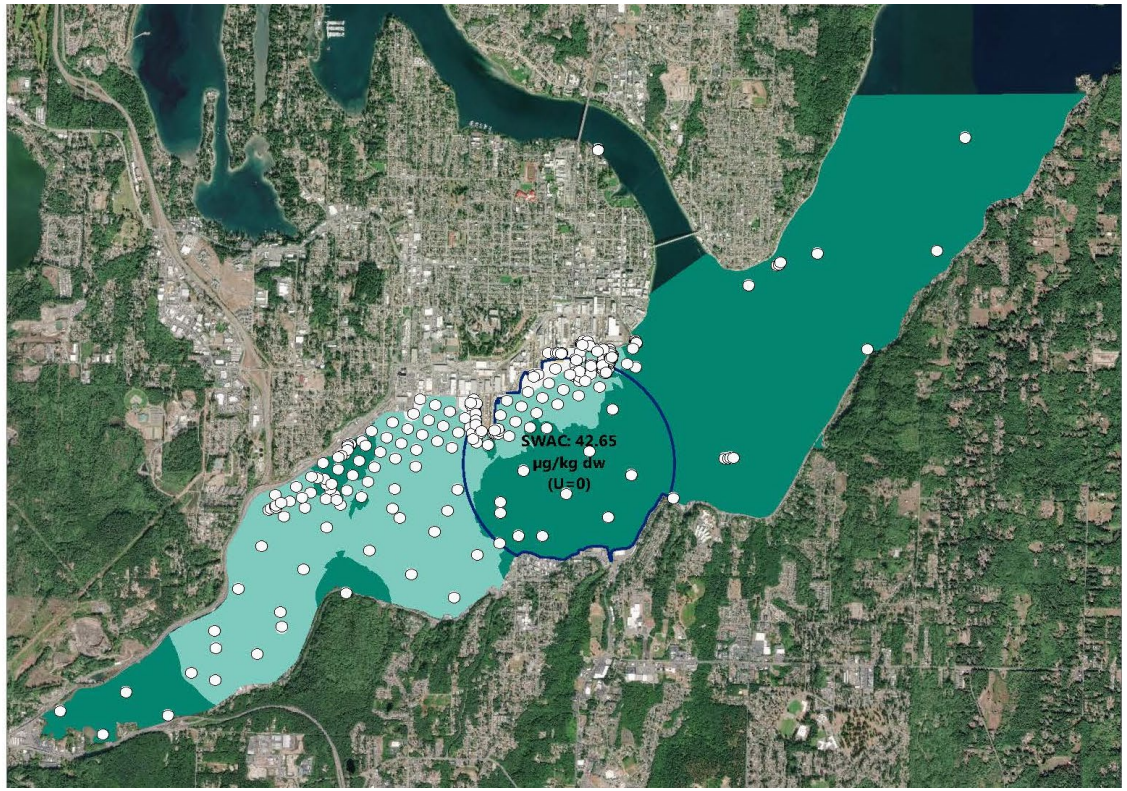

Source: Paulson et al. 2010

# PCB SWAC in Bottom Fish Trawl Area Reduced Two-Fold

## 1994 to 2004 (98 µg/kg)

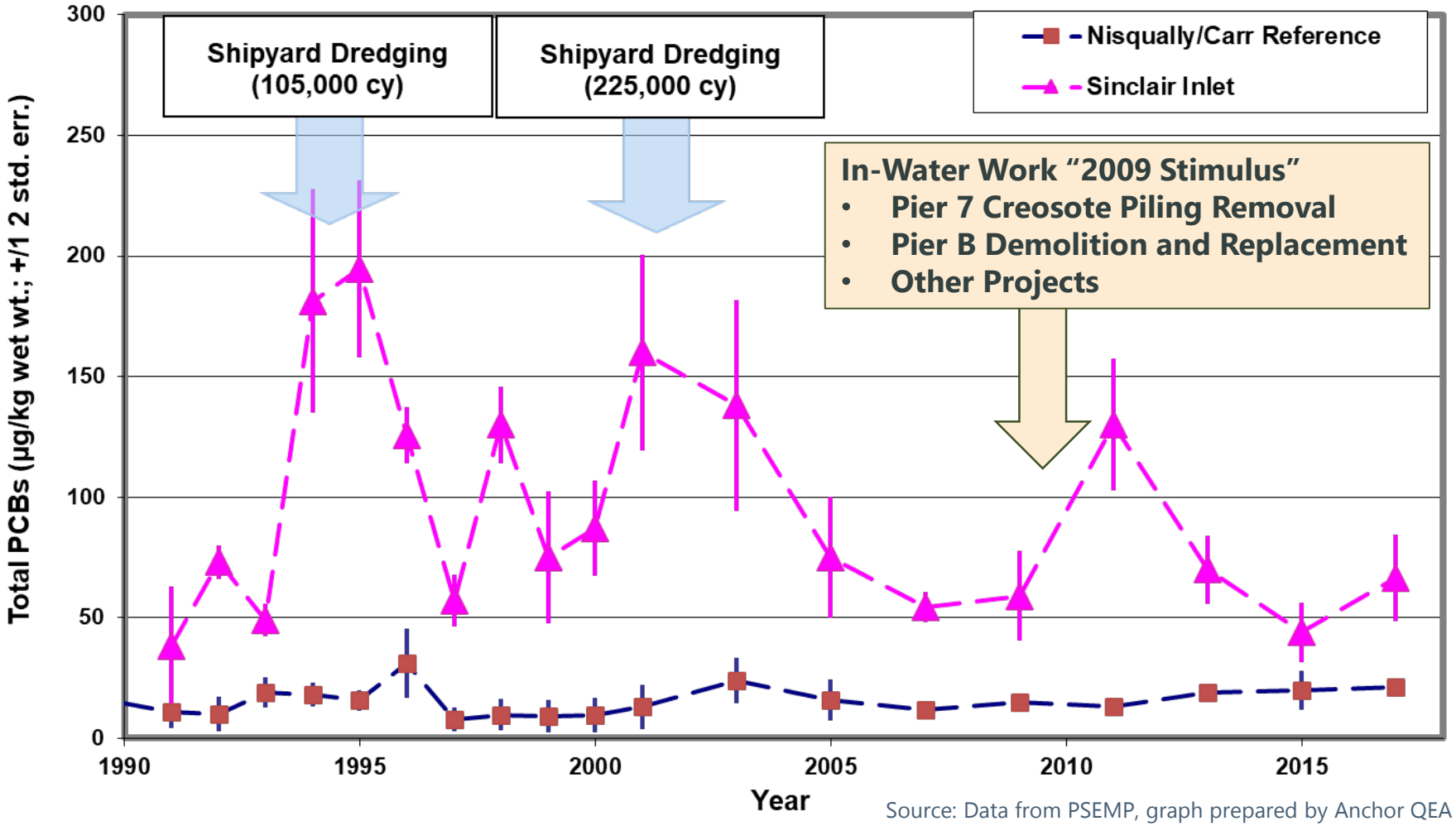



## 2008 to 2018 (43 µg/kg)




Source: Data from EIM, maps prepared by Anchor QEA

# English Sole Muscle Tissue PCB Concentration Trends




Source: Data from PSEMP, graph prepared by Anchor QEA

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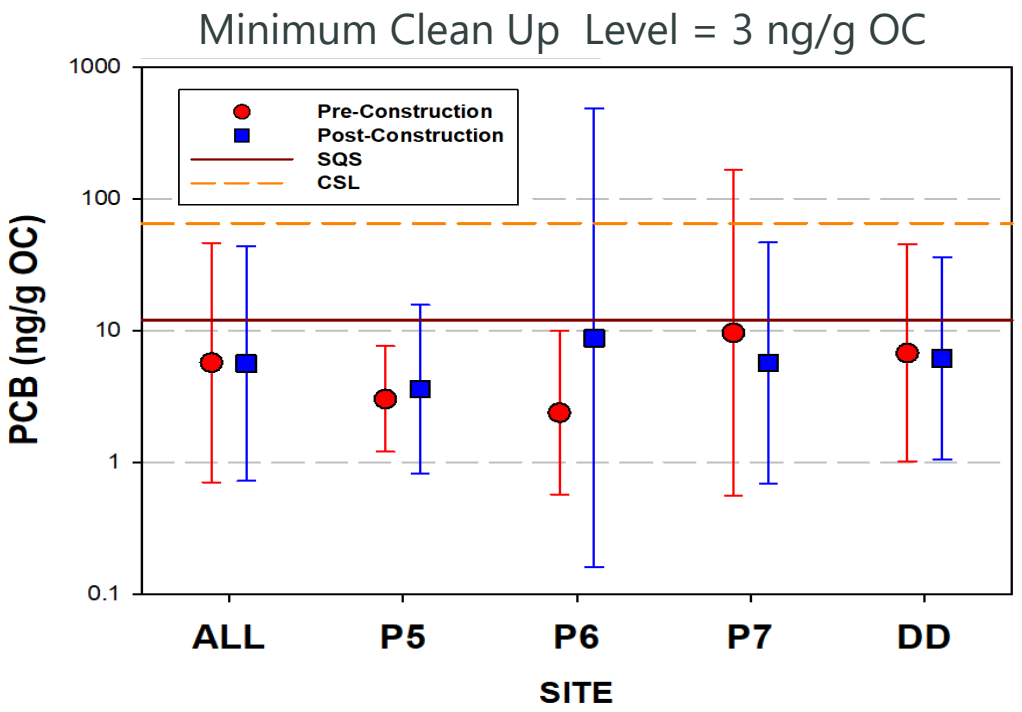
# Did the Remedy Achieve Short- and/or Long-Term Remediation Objectives for Surface Sediment?

- What to do about "pockets of elevated contamination"




**Demonstration of In Situ Treatment with Reactive Amendments for Contaminated Sediments in Active DoD Harbors**

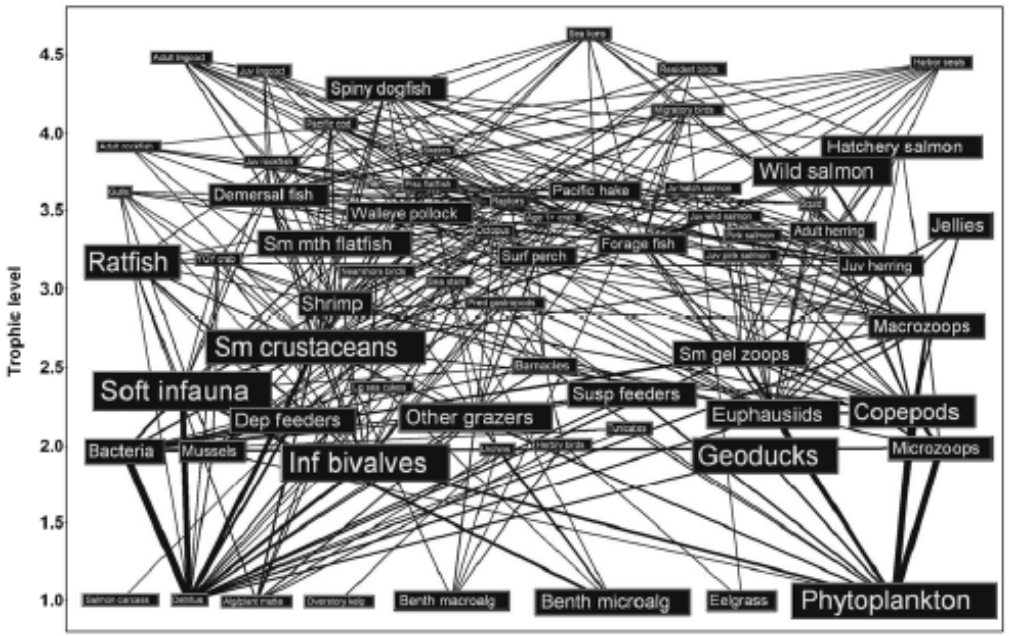

**ESTCP 2016 Project-of-the-Year (Environmental Restoration)**

Source: http://mesodat.org/Public/Pier7/Index.htm, Kirtay et al. 2016

# Is the Remedy on Track to Achieve Long-Term Remediation Objectives for Water and/or Biota?

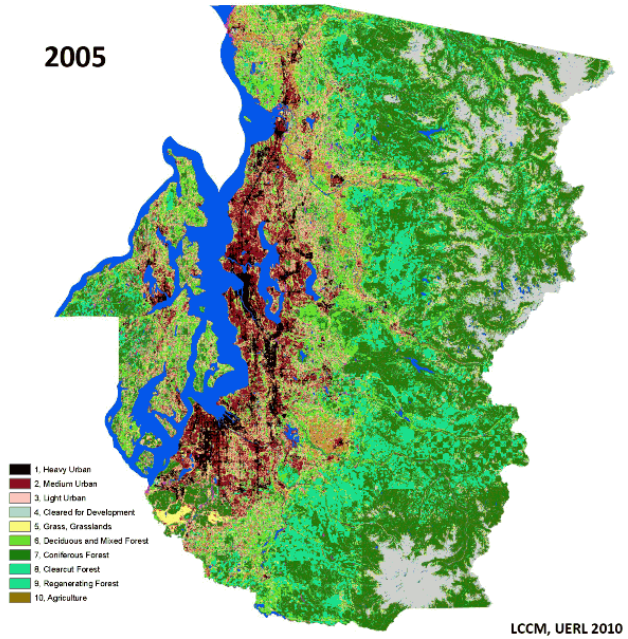
- The remediated environment is more complicated than we think

## "Simplified" Food Web Model




Source: Harvey et al. 2010

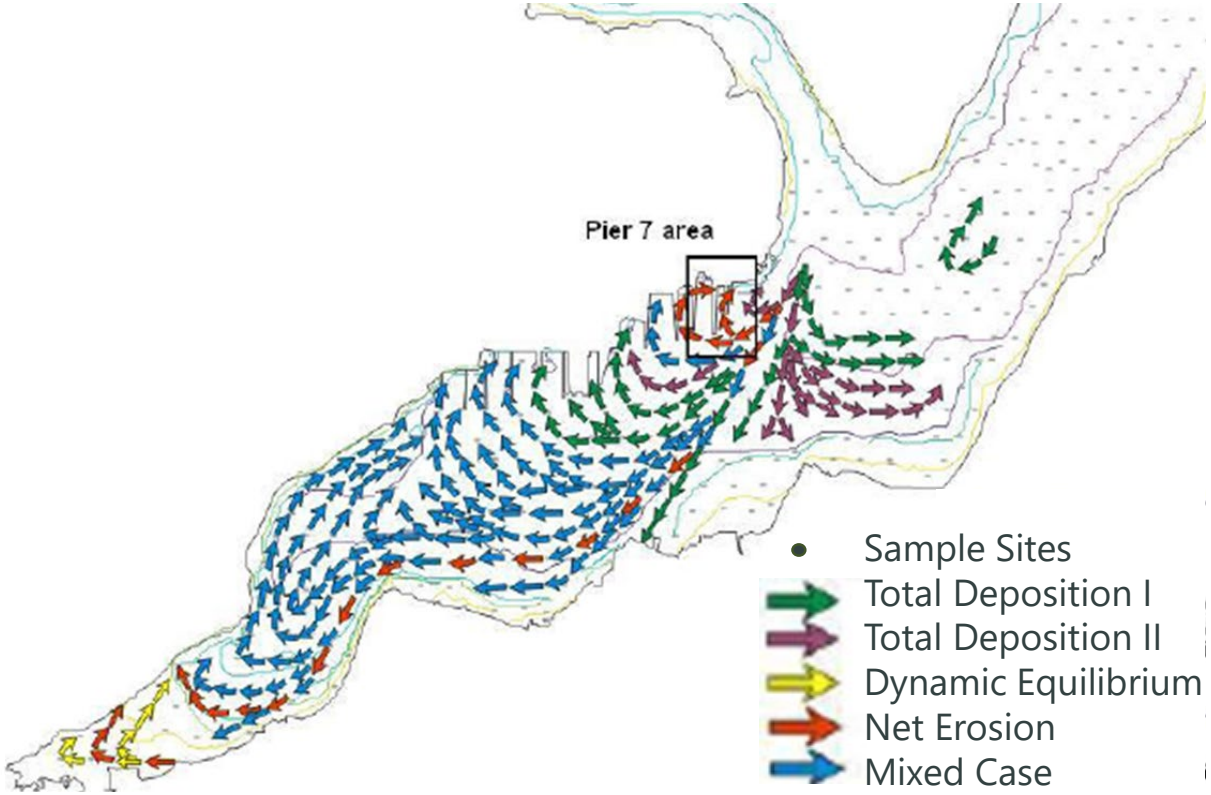
## Simulated Land Use Change 2005-2050




Source: Alberti et al. 2010

# Is the Remedy on Track to Achieve Long-Term Remediation Objectives for Water and/or Biota?

- Design remedies that work with nature
- Enhanced natural recovery
- Prevent contaminated silt from entering dry dock dewatering system
- Improve performance
- Achieve cleanup and water quality goals and advance recovery



# Key Take-Home Messages

- Be a life-long learner
- Source control
- MNR is not as easy as it seems
- The remediated environment is not static
- The remediated environment is more complex than we think
- Design remedies that work with nature

Source: Eyes Over Puget Sound, July 2017, WA State Dept. of Ecology