

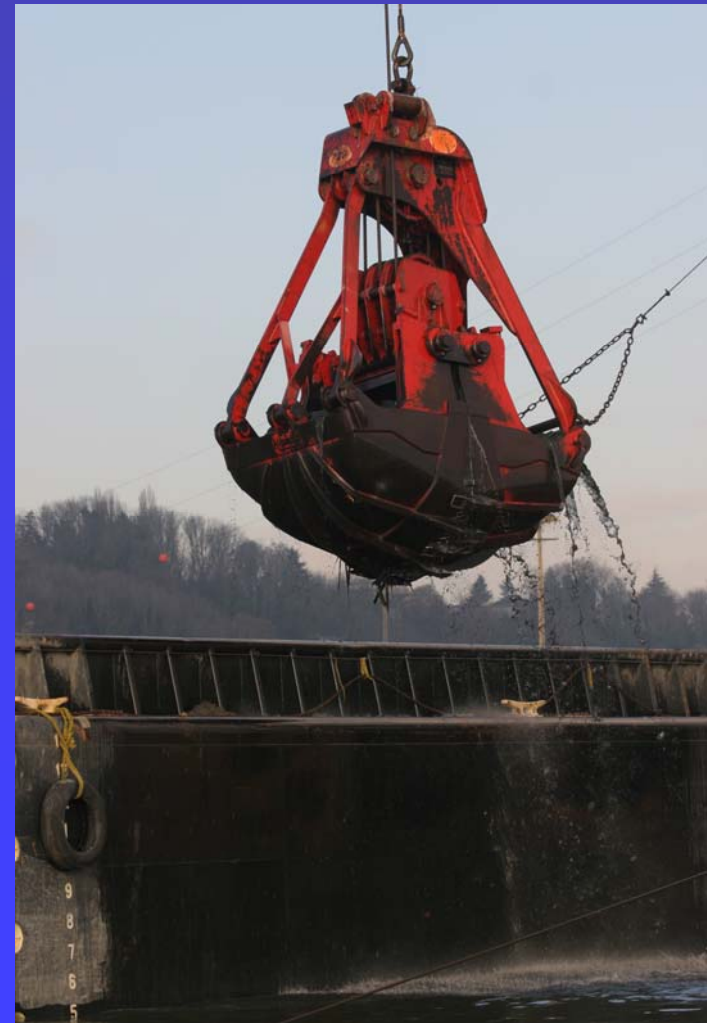
# Addressing Dredge Residuals in the Diagonal / Duwamish Sediment Cleanup

Elliott Bay / Duwamish River  
Restoration Program

Jeff Stern

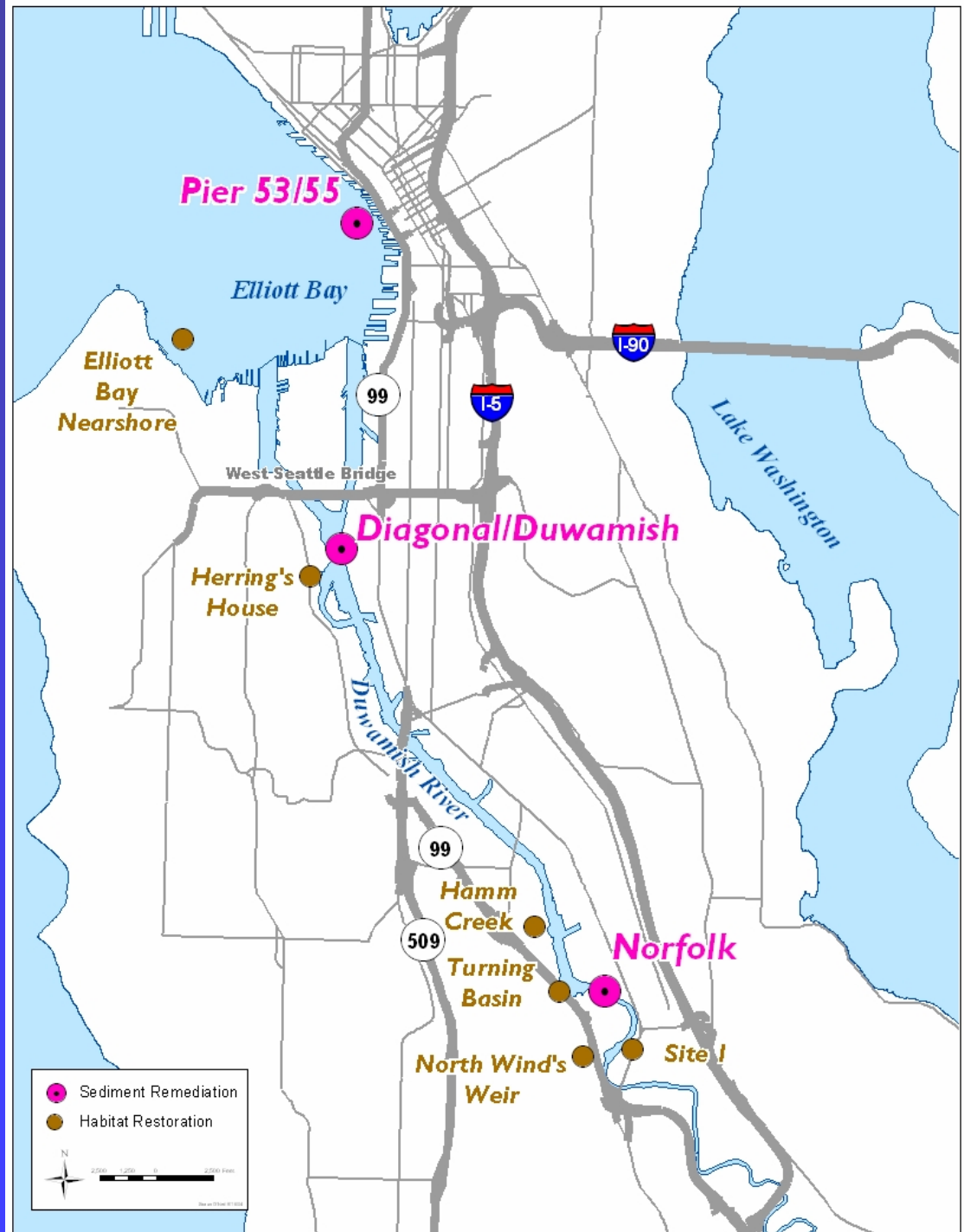
Dept. Natural Resources and Parks

Pat Romberg and Scott Mickelson, DNRP  
Anchor Environmental, LTD; Ecochem, Inc.



# Elliott Bay Duwamish Restoration Program (EBDRP) Project Sites

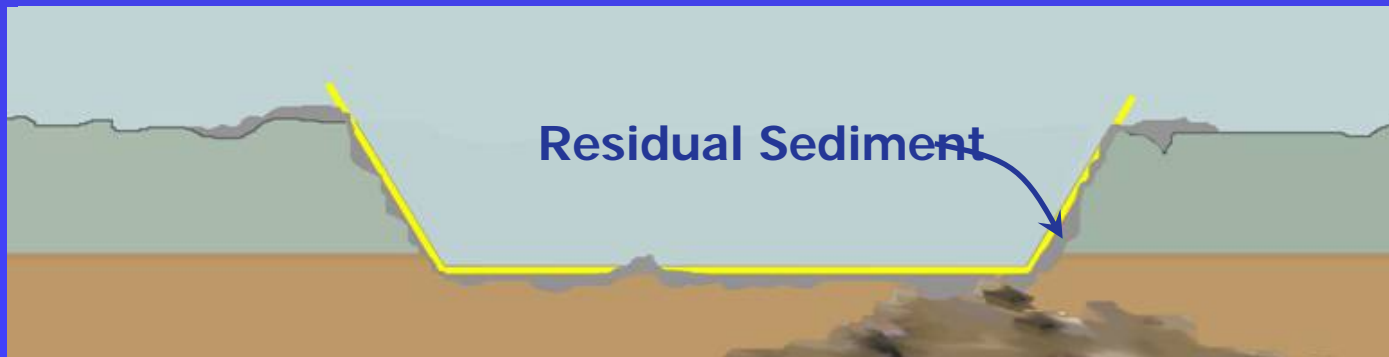
- Members:
  - NOAA
  - USF&W
  - State of WA
  - Suquamish Tribe
  - Muckleshoot Tribe
  - City of Seattle
  - King County



# Sediment Residuals Defined

Contaminated sediments that either:

- 1) Remain within the dredge prism after dredging; or
- 2) Have been spread to non-cleanup areas as a result of dredging



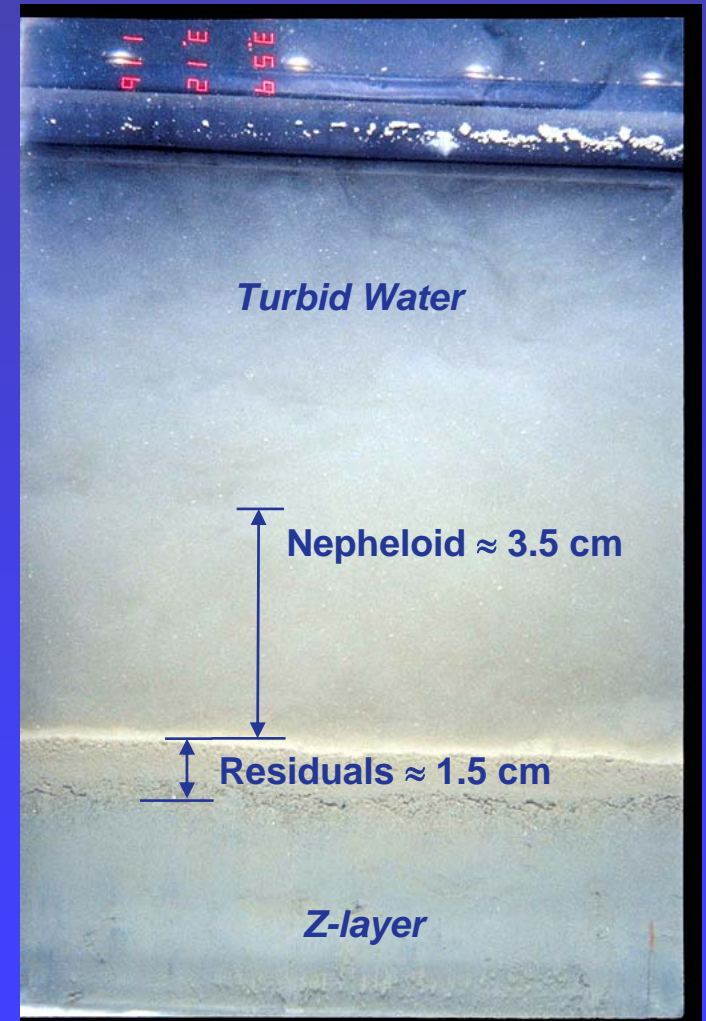
# Residual Sediment Characteristics

## *Typical physical properties*

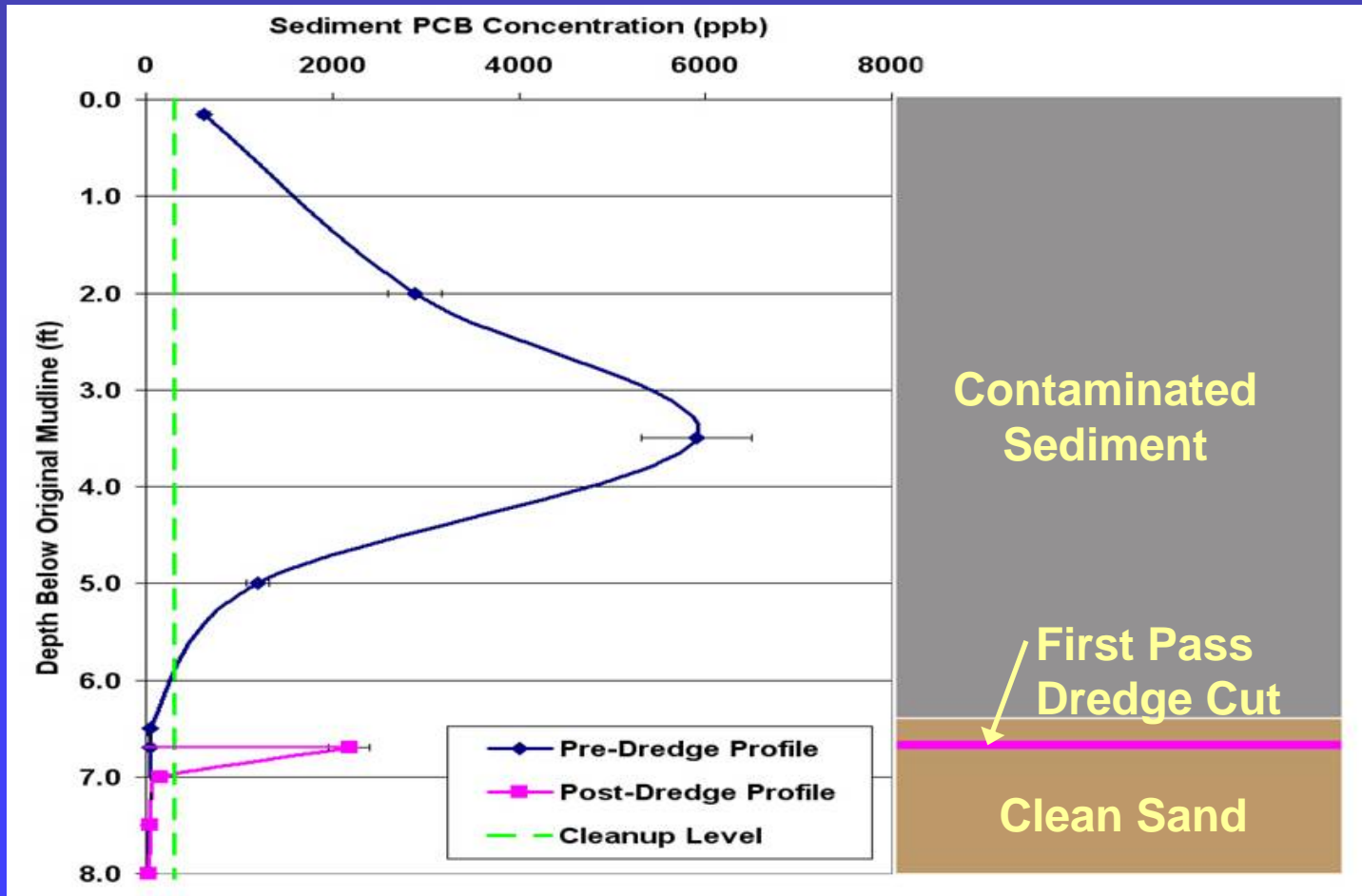
- Fine Grained
- Unconsolidated
- High moisture content
- May exist as a “fluid mud” layer

## *Typical chemical properties*

- Constituent concentrations typically equal the average dredge prism concentration



# Pre- and Post-Dredge Sampling Data Hylebos Waterway Middle – PCB Deposit



Mass-Balance Approach

$$10 \text{ cm (C)} = t \text{ (B)} + (10 - t)(A)$$

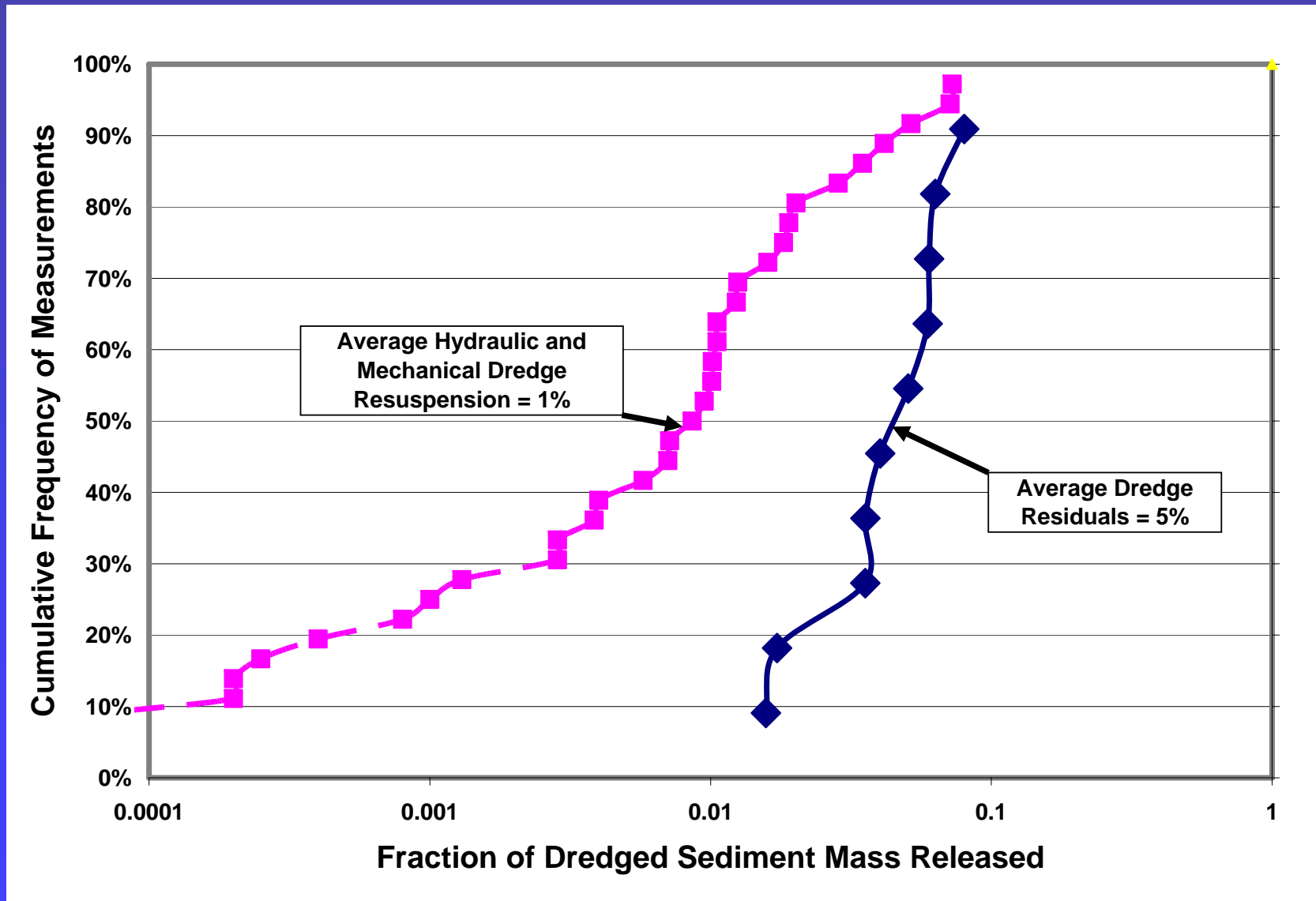
calculated residual thickness  $\approx t \text{ cm}$

Average PCB Concentrations (ppb)	
Dredge Prism Average	A
Z-layer	B
Post-Dredge Grab Sample	C

# Primary Sources of Sediment Residuals

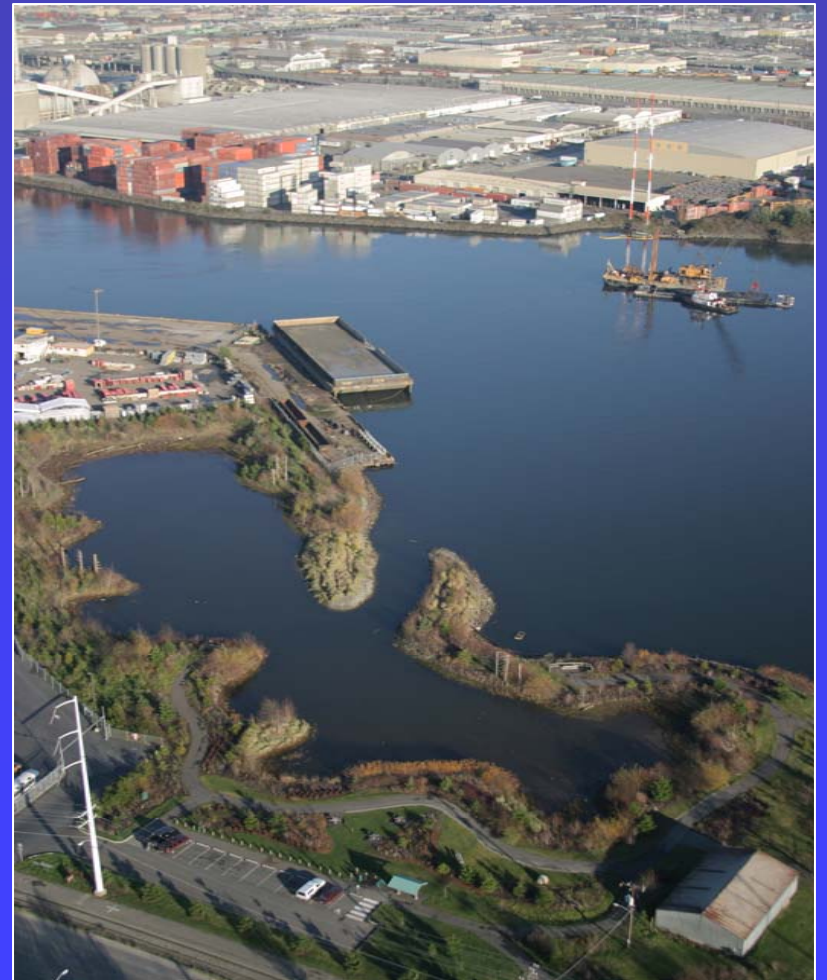
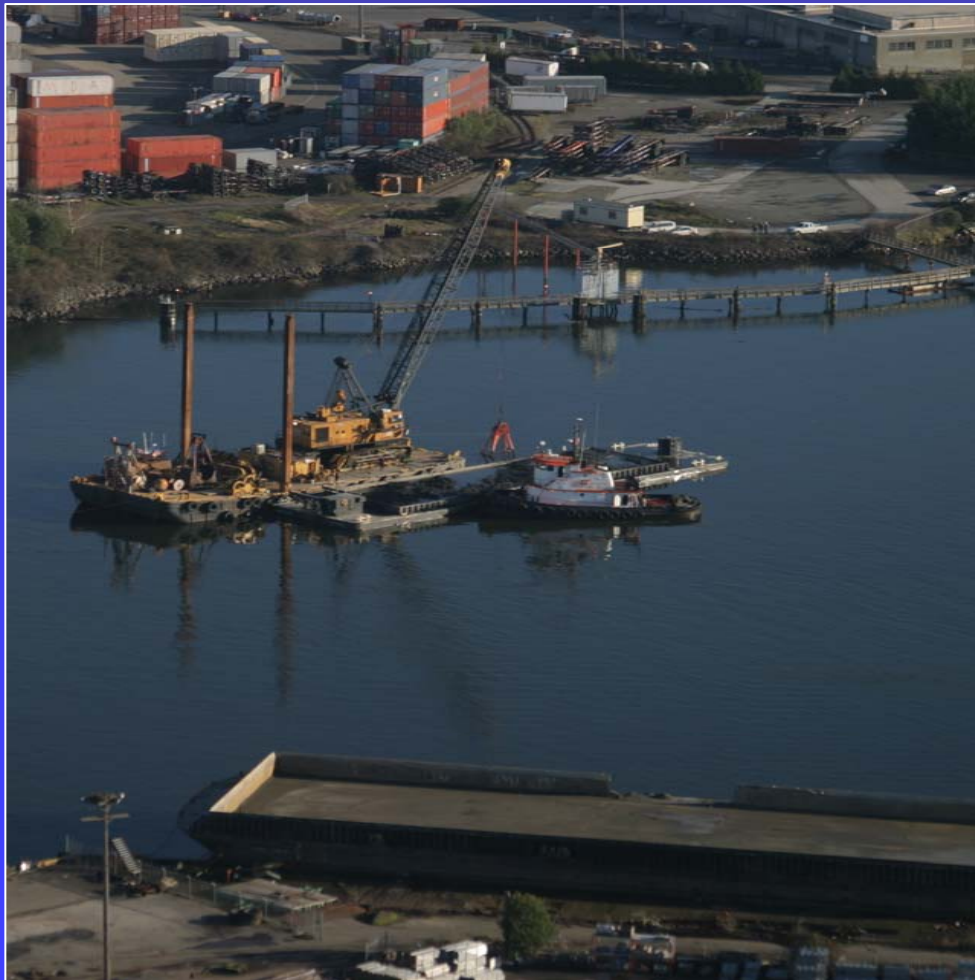


# Residuals vs. Resuspension Measurements



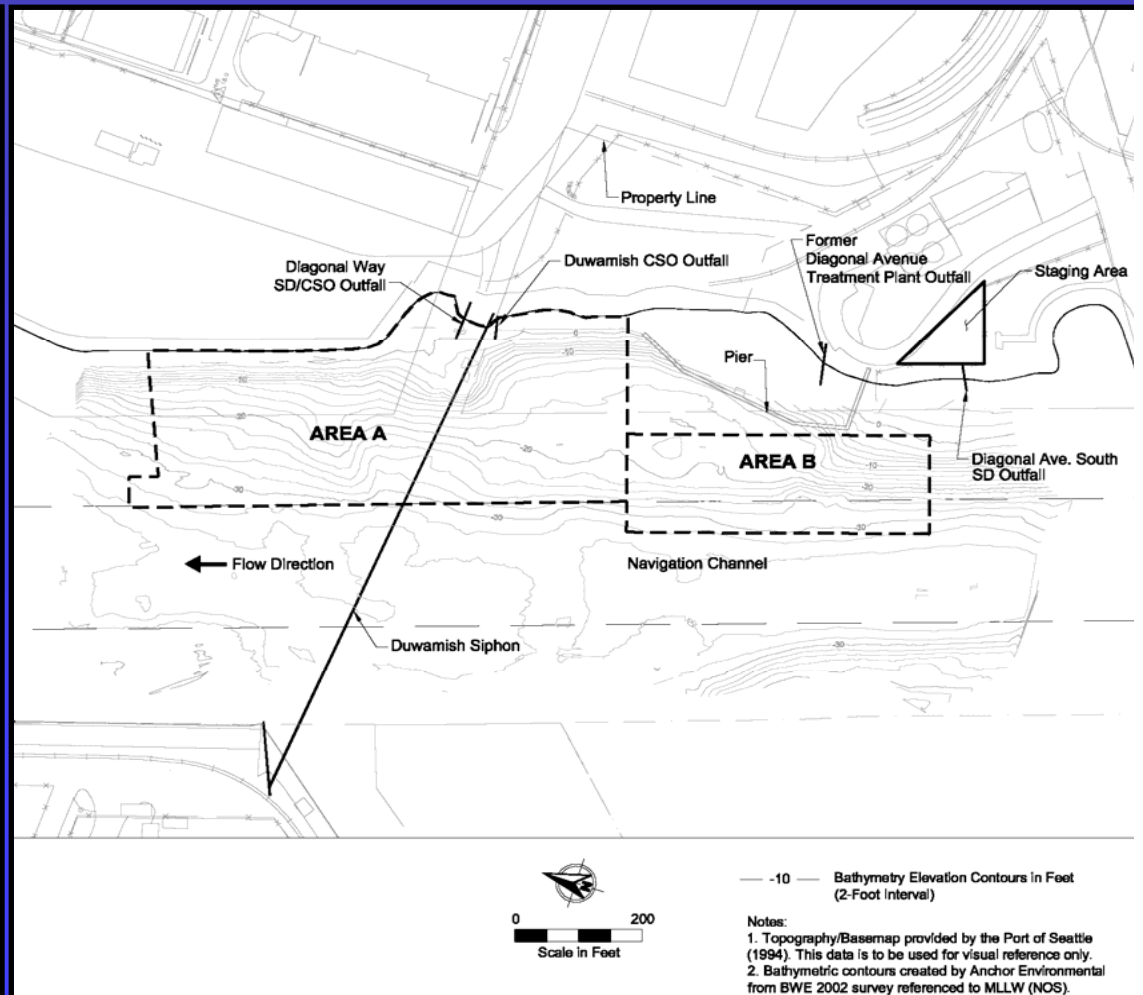
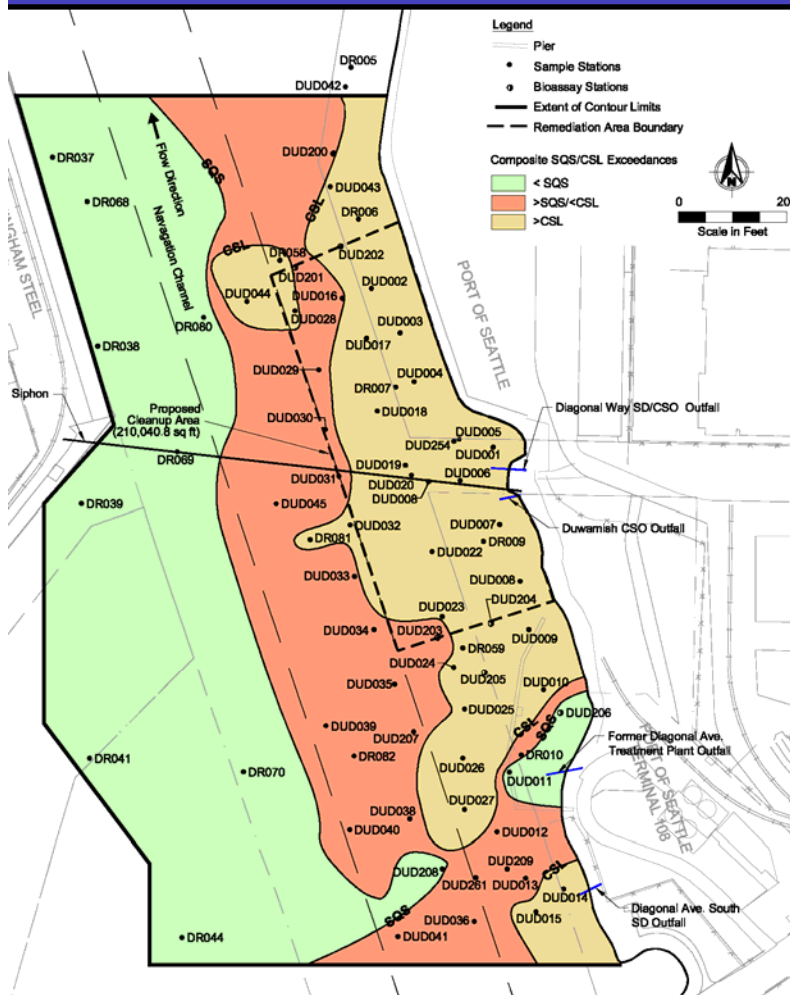


# Diagonal/Duwamish Combined Sewer Overflow (CSO) & Storm Drain Outfall, Duwamish River - 2004





# Final Cleanup Area Boundary Area B Added

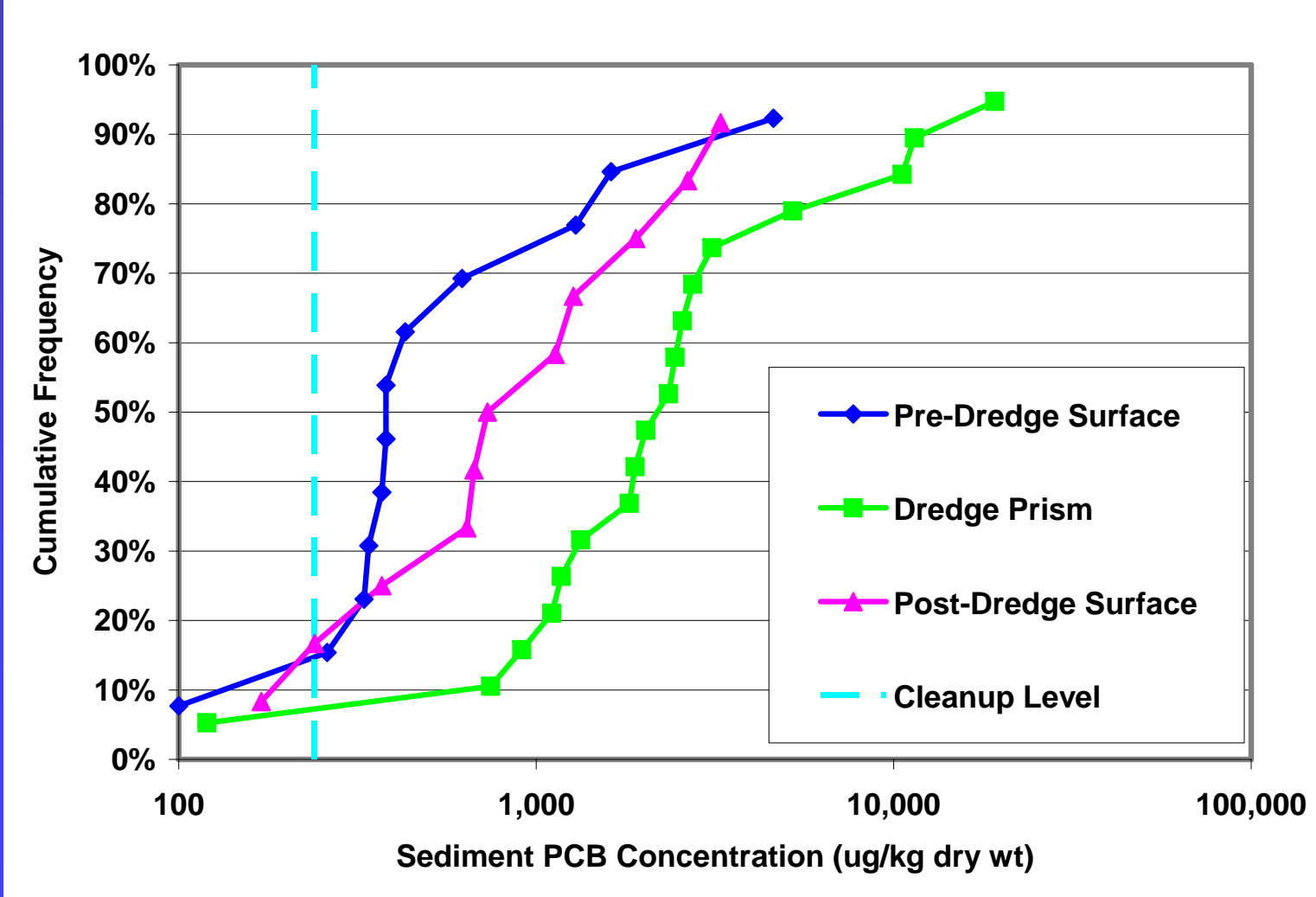


Notes:

1. Topography/Basemap provided by the Port of Seattle (1994). This data is to be used for visual reference only.
2. Bathymetric contours created by Anchor Environmental from BWE 2002 survey referenced to MLLW (NOS).

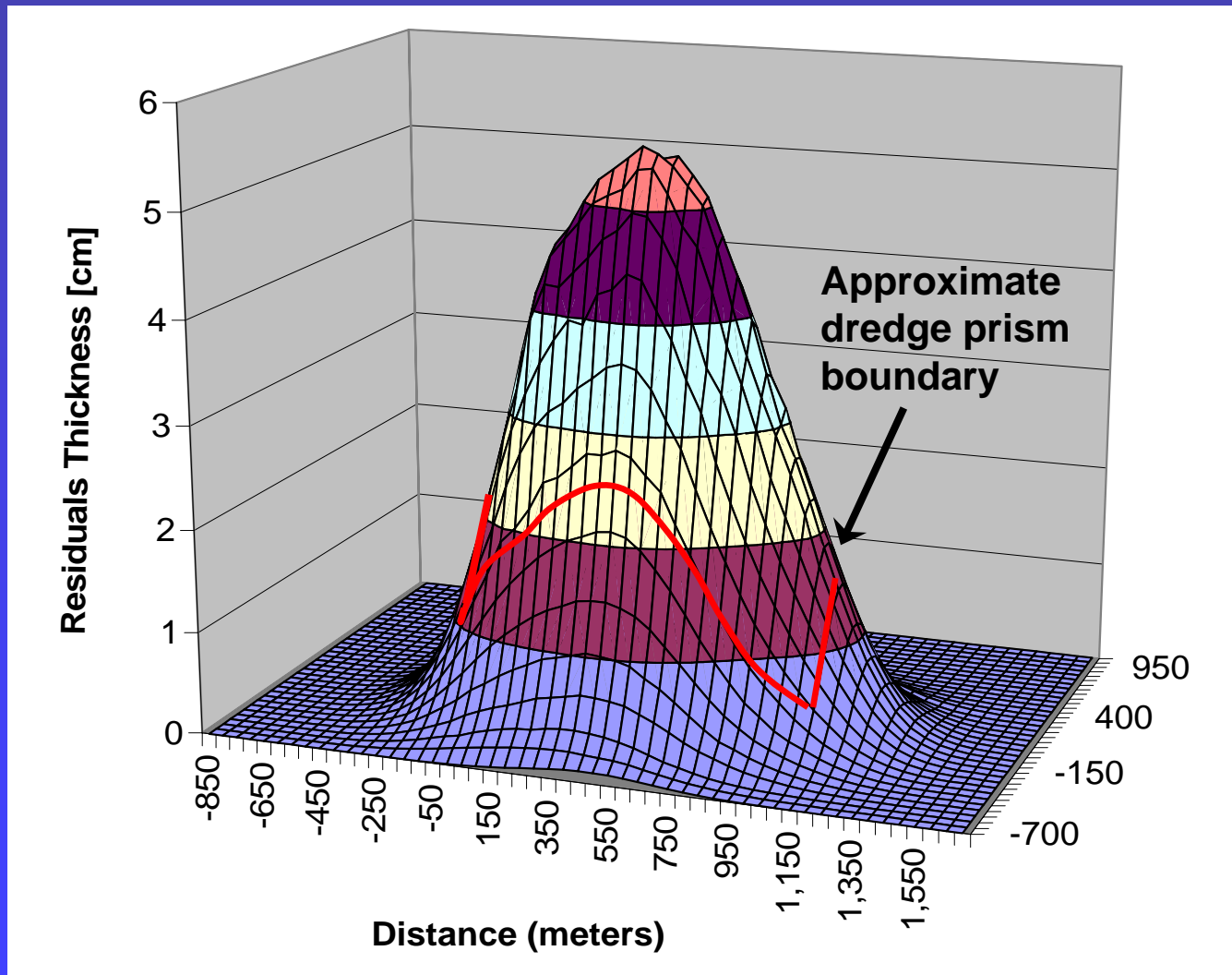
# Pre- and Post-Dredge Sampling Data

## *Duwamish/Diagonal*



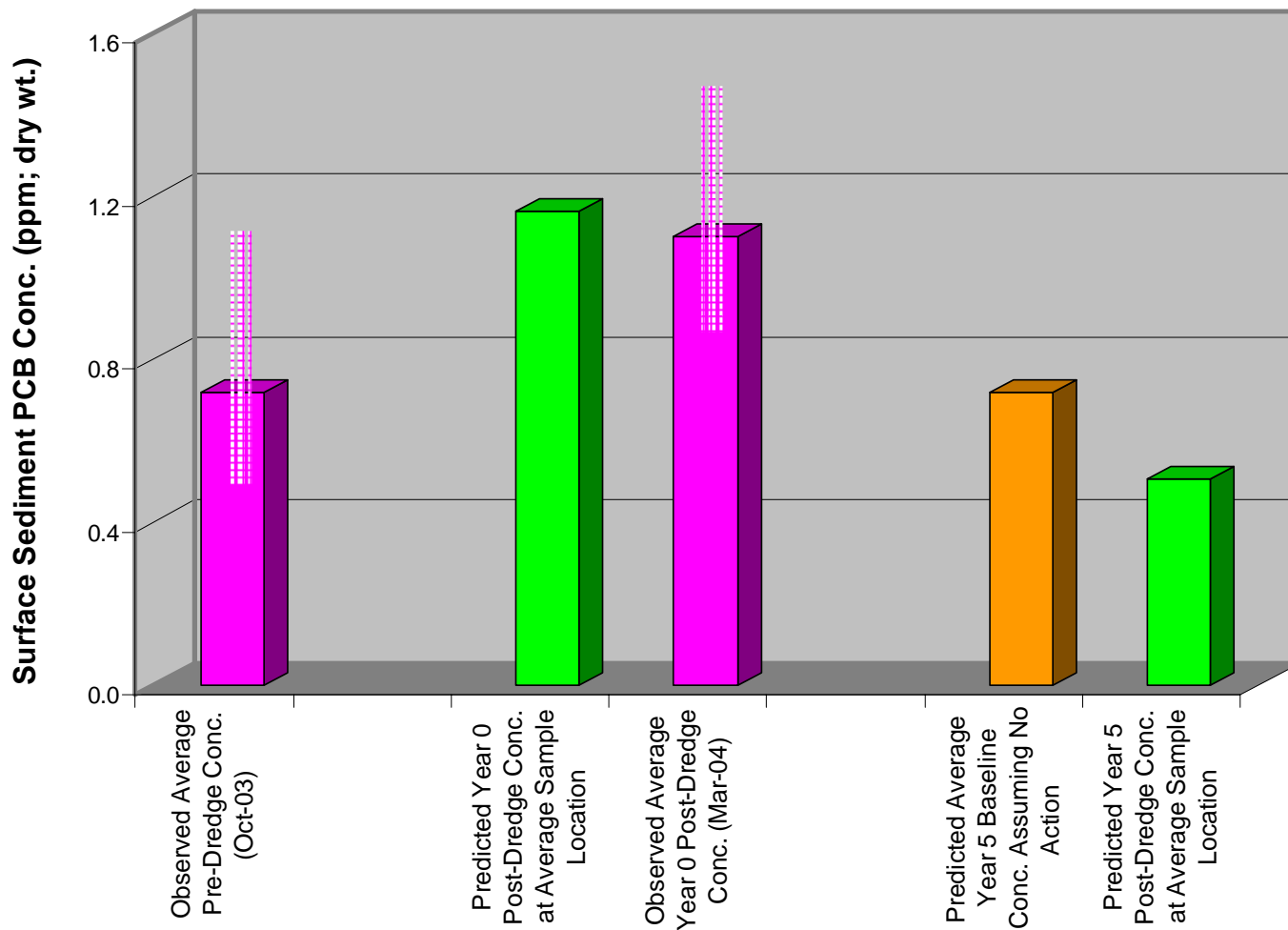
# Lateral Spreading of Dredge Residuals

## *STFATE Model Predictions – Duwamish/Diagonal*



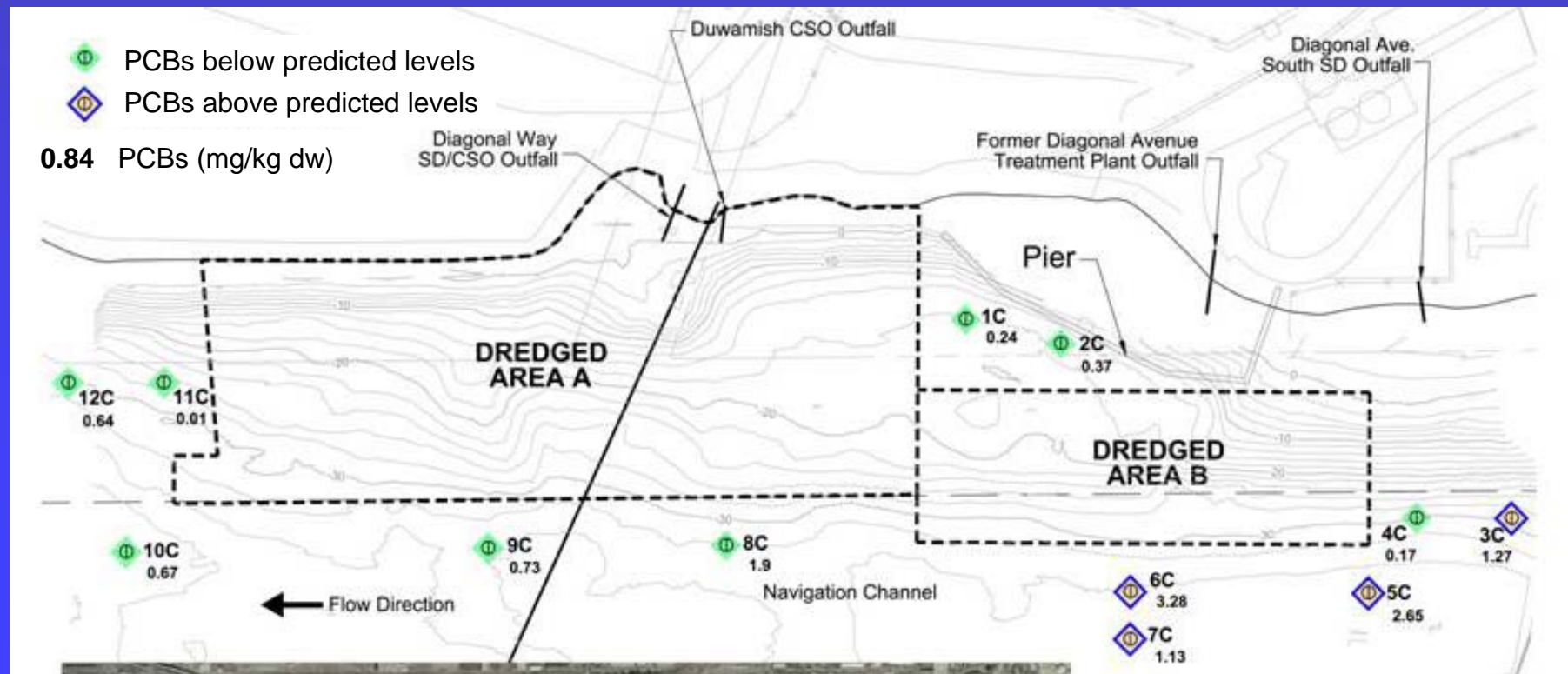
# Observed vs. Predicted Post-Dredge Sediment PCB Concentrations

*Duwamish/Diagonal Boundary Area Sampling Stations*



# Post-Dredge PCB Sediment Concentrations at Monitoring Stations

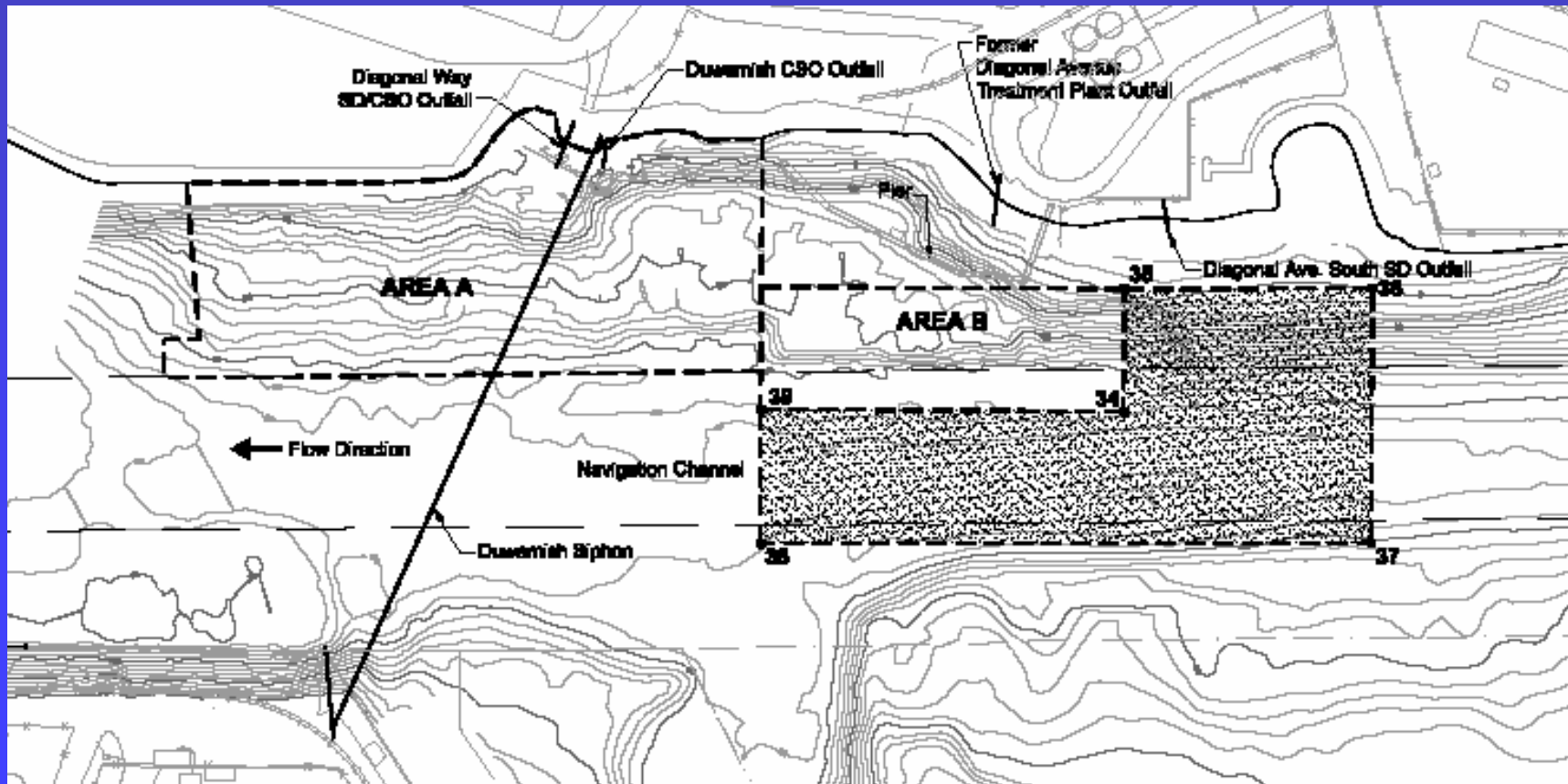
## Comparisons to model predictions



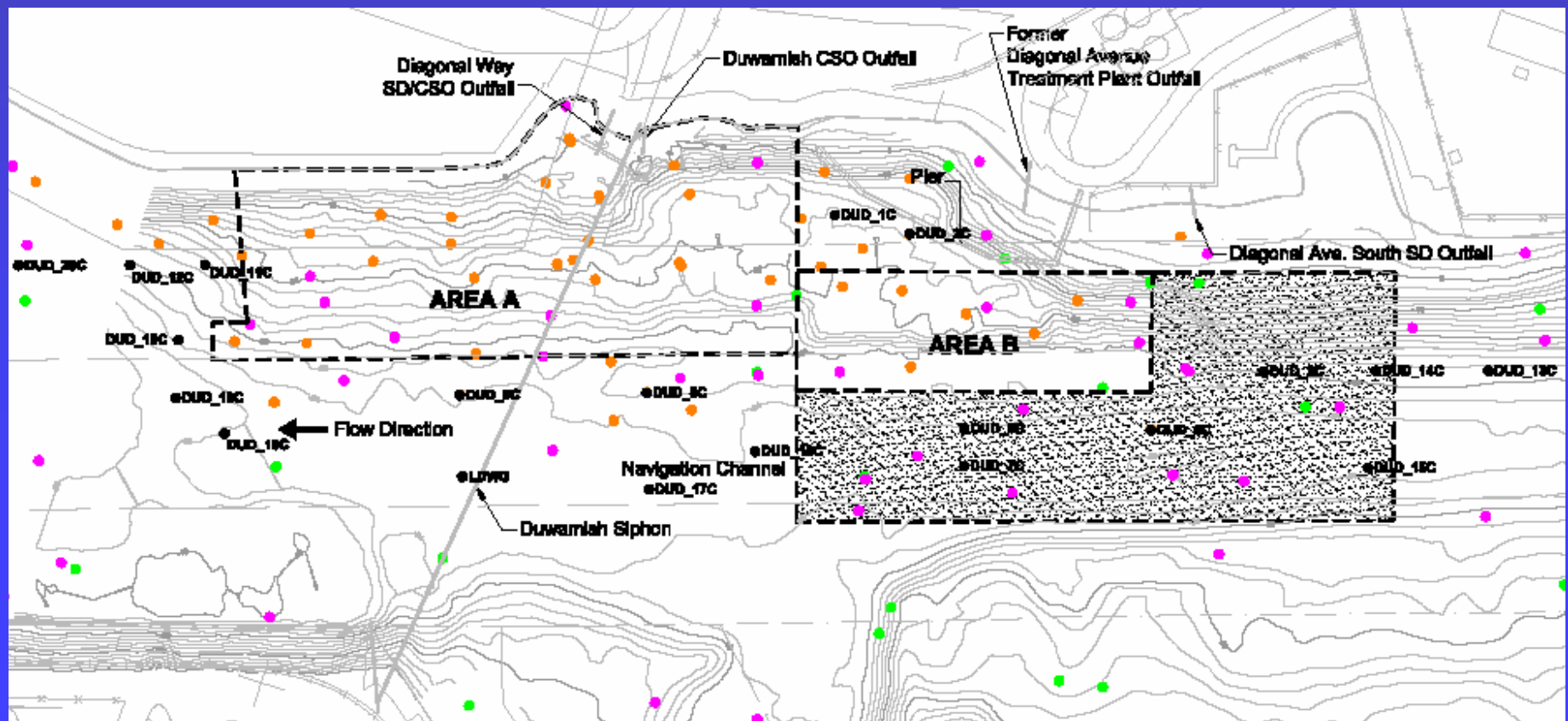


# Proposed Thin-Layer Placement

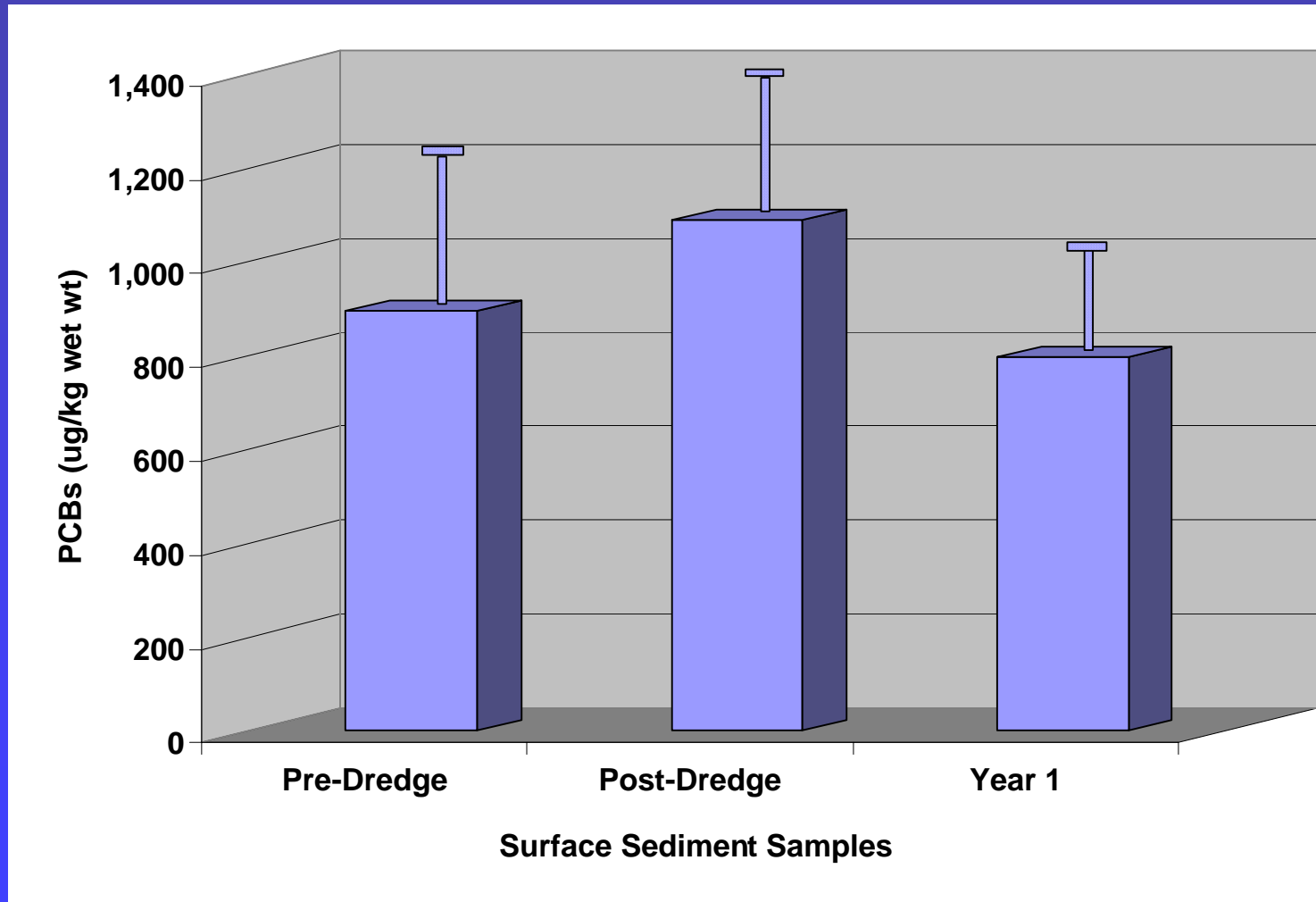
Remediate Area of Highest Residuals



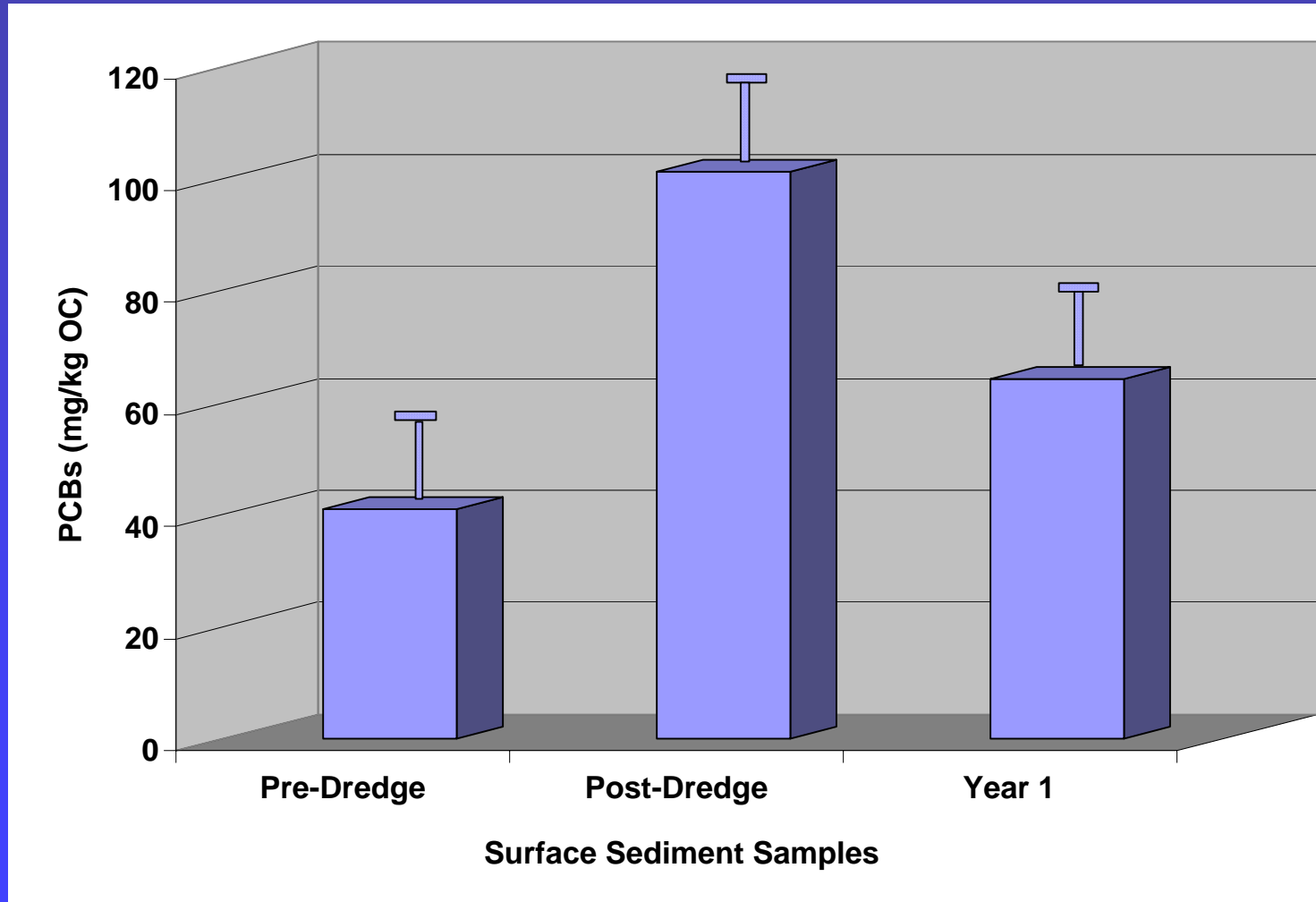
# Monitoring to Track Both Enhanced and Natural Recovery Areas



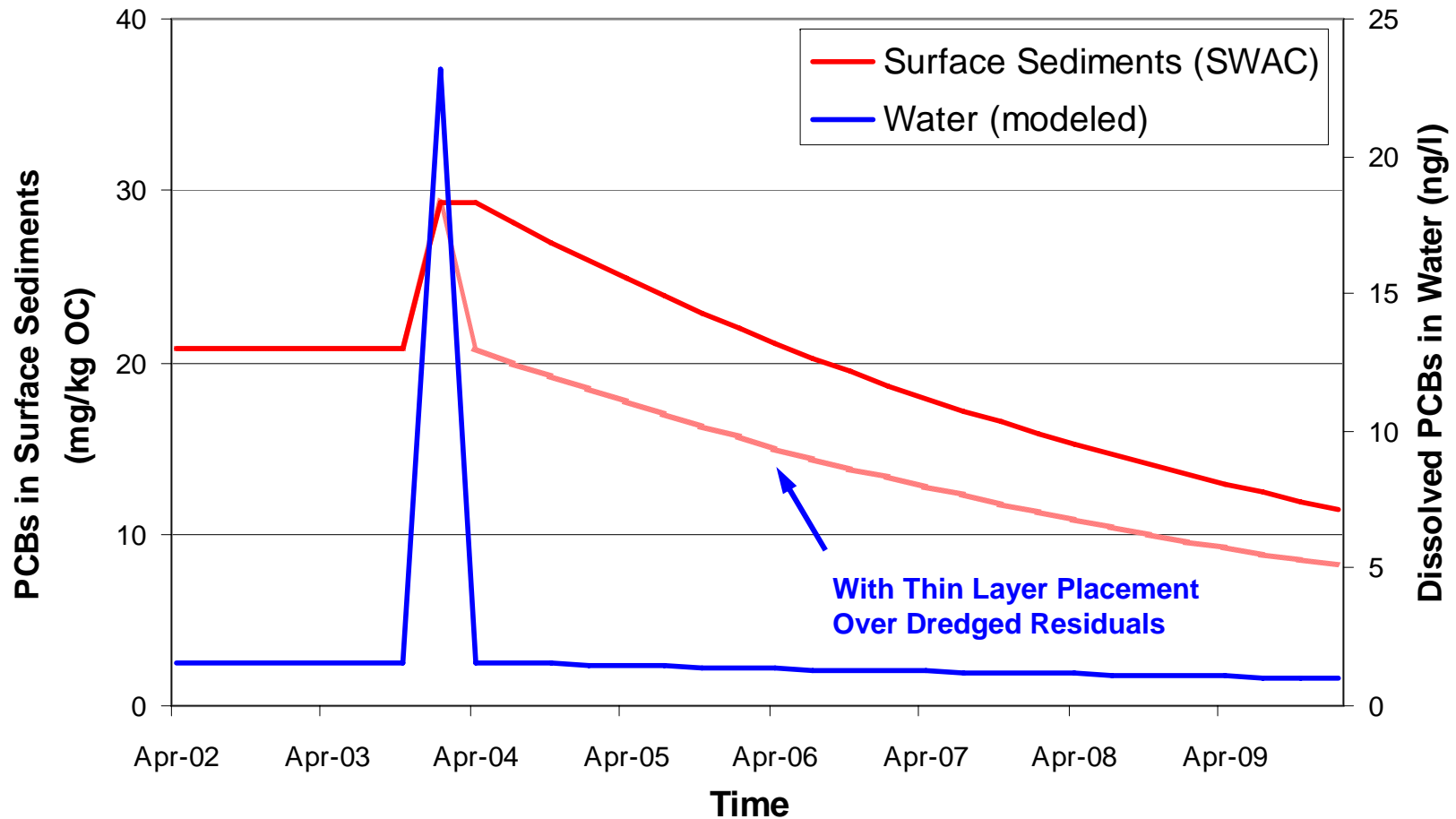
# Duwamish/Diagonal Natural Recovery



# Duwamish/Diagonal Natural Recovery



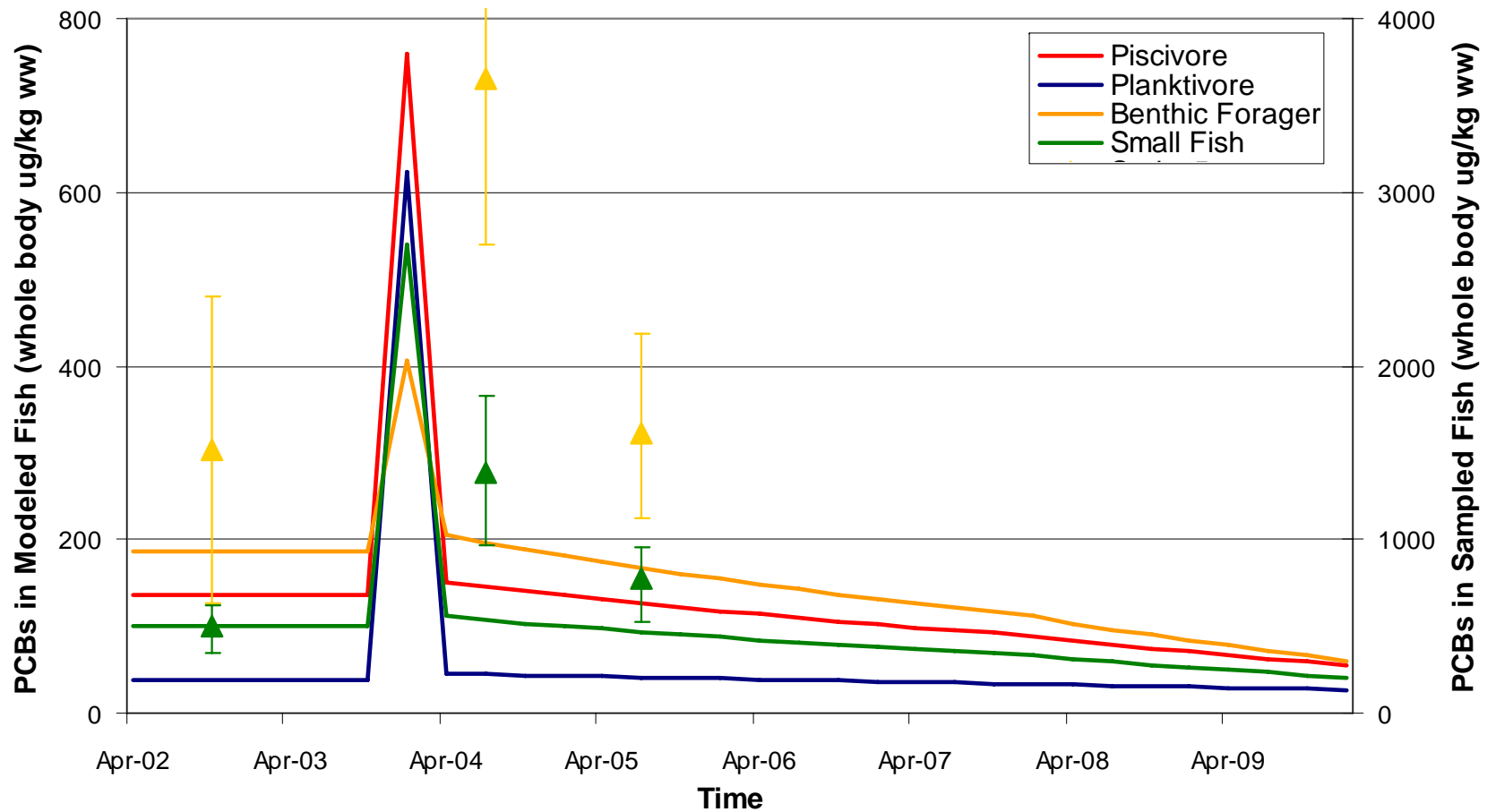
# Water and Sediment PCB Concentrations Throughout a Dredging Project



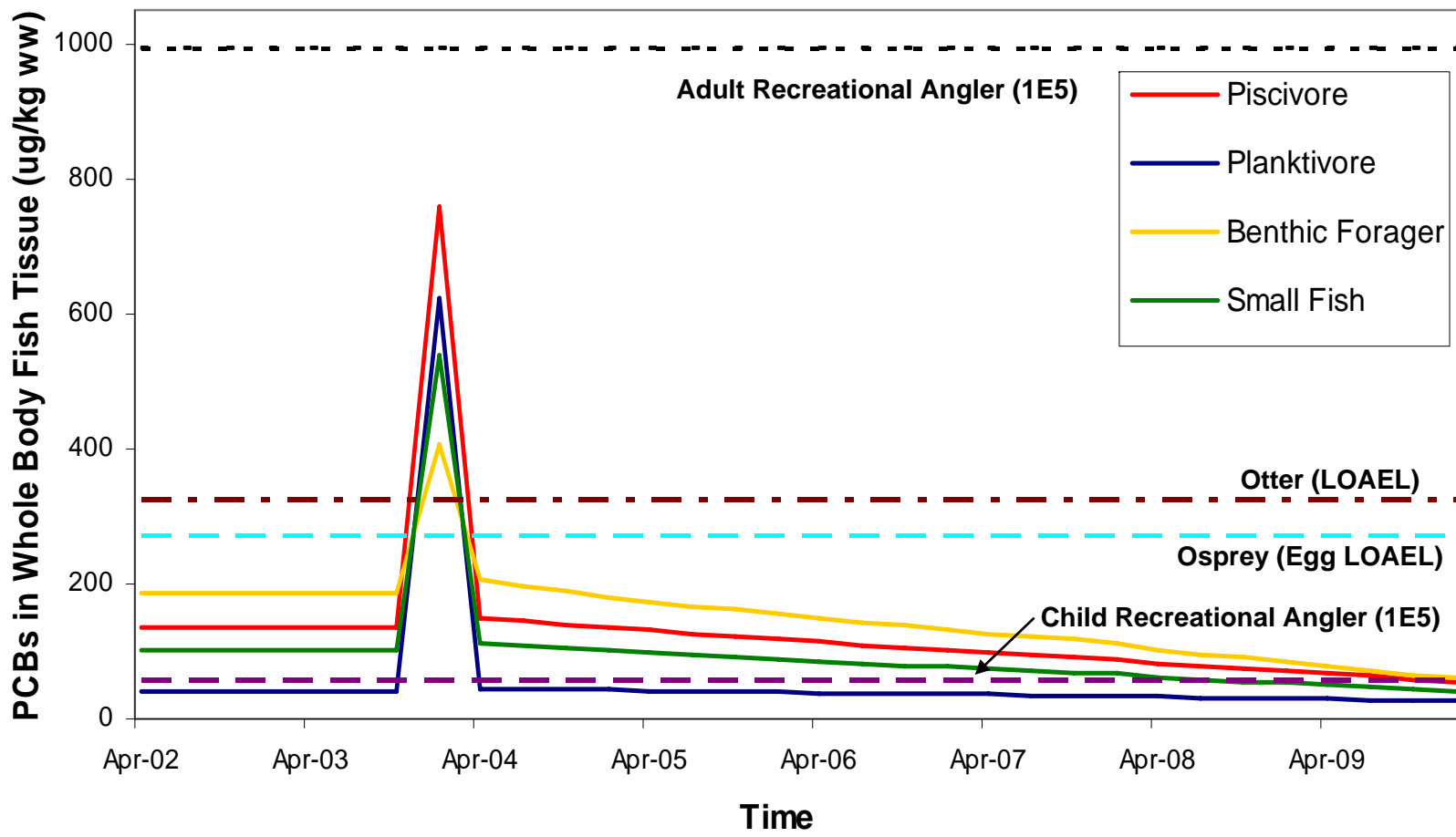
4% Residuals ~ 11 mg/kg TSS Average in the water column    Average measured over dredging period = 15mg/kg TSS



# Predicted Tissue Concentration Change Over Time



# Tissue Concentration Change Over Time Compared to Effects Levels



# Implications of Residuals on Meeting Remediation Goals

- Dredging can produce spikes in contaminant concentrations
  - Water: 10-30 times (during construction)
  - SWAC: 1 to 5 times (after construction)
  - Tissue: Greater during; lesser after
- Risk to receptors can increase significantly over short term
- Active management of residuals can reduce long-term exposure
  - Protect receptors of concern with longer life spans or needing longer-term exposures
  - Receptors affected by short exposures can be at risk (children; some birds and mammals; most fish)

# Conclusions

## ➤ Residuals happen

- Post-dredge surface often higher than pre-dredge
- Dredging can raise on- & off-site levels above sediment and risk reduction goals

## ➤ Plan accordingly

- Estimate and design for residuals
- Post dredge data to determine appropriate action
- Simple tissue modeling to determine if receptors at risk



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