SPAWAR
Systems Center
San Diego

In Place Contaminated Sediment Management:

Support of Feasibility Studies

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2. Introduction

- Problem
  - Most Navy FS studies focus on presumptive remedy (ie dredging), and do not collect data to support inplace options
- Solution
  - Develop framework to adapt EPA "Sediment Remedial Guidance" to support inplace sediment management
- EQ Requirements
  - High Priority Cleanup 1.III.02.n Improved Site Characterization and Monitoring for Sediments
  - Med. Priority Compliance 2.II.02.b Improved Field Analytical Sensors, Toxicity Assay Methods, and Protocols to Supplement Traditional Sampling and Lab Analysis

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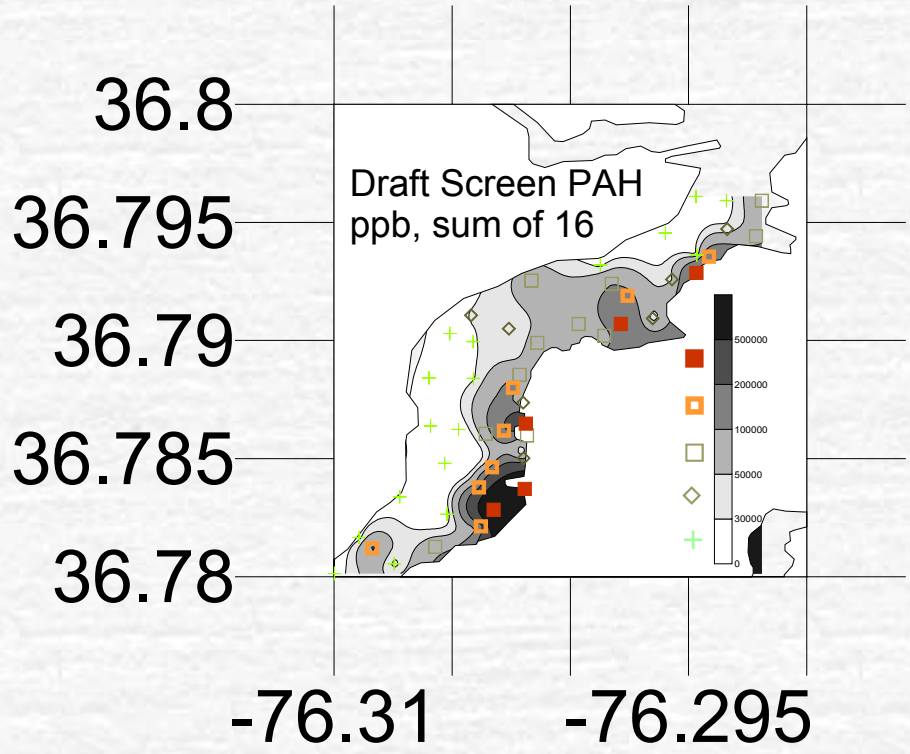
2a.Objective: Build Modeling Prediction and Monitoring Validation into Feasibility Studies

- Modeling will predict future conditions to evaluate remedial options under:
  - No Action scenarios
  - Monitored Recovery scenarios
  - Capping scenarios
  - *In situ* treatment scenarios
  - Dredge scenarios
- Monitoring (with exit strategy) is designed to validate modeling predictions and confirm remedial scenarios

Current sediment concentrations



How will source removal impact downriver sediments?

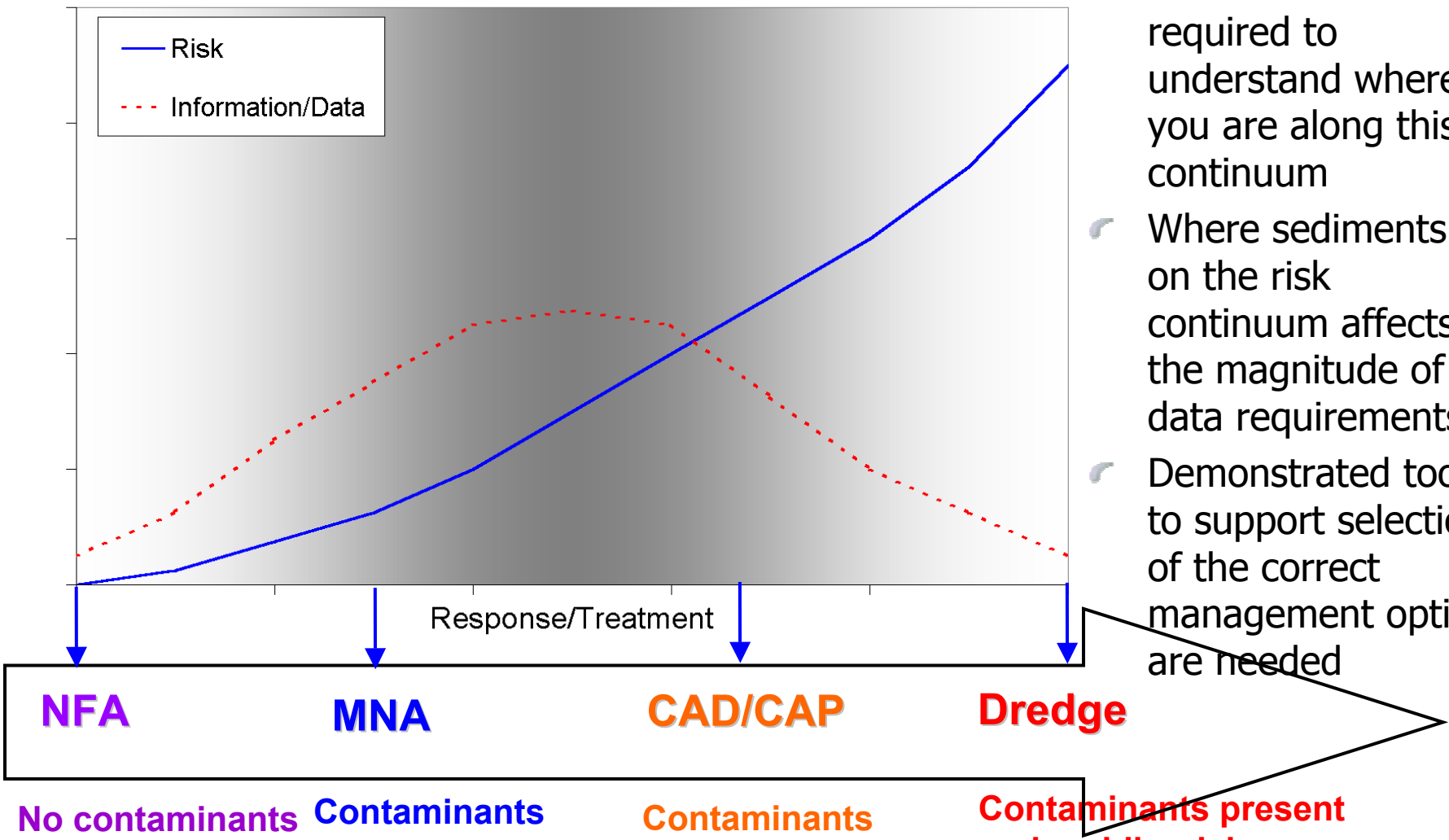
3. Problem Statement/Regulatory Drivers

- Original draft 1998 Feasibility Study at Hunters Pt Shipyard had 9 preliminary and 5 final remedial alternatives, mostly based on dredging components. High proposed costs led Navy to conduct Validation Study and current Feasibility Study which will include more inplace sediment management options
- Demonstration is needed to show inplace management options, including any long term monitoring requirements, can be more cost effective than presumptive dredging remedies

3. Why Model and Monitor?

- Most Navy FS reports are engineering efforts that validate the presumptive remedy (usually dredging), not a true comparison of remedial option effectiveness and relative risk reduction
- Risk reduction should drive remedial decisions
- Models help predict future effectiveness of various remedial options alone and in tandem
- Monitoring validates modeling predictions, and helps refine conceptual model (confirms our understanding of the site processes)
- Modeling and Monitoring will focus the FS, and help Navy in selection of needed measurements

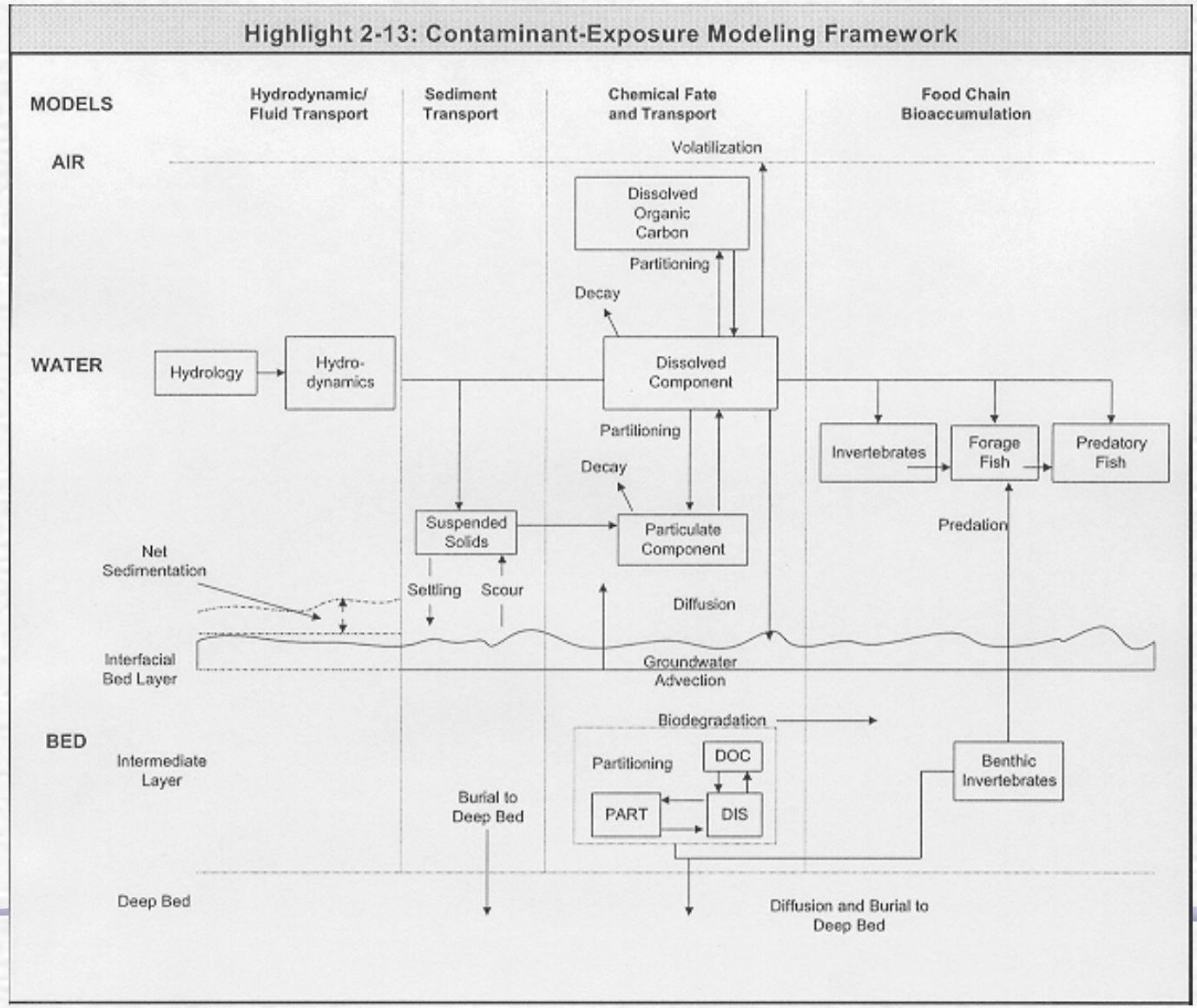
Sediment Management Framework



- Data collection is required to understand where you are along this continuum
- Where sediments are on the risk continuum affects the magnitude of data requirements
- Demonstrated tools to support selection of the correct management option are needed

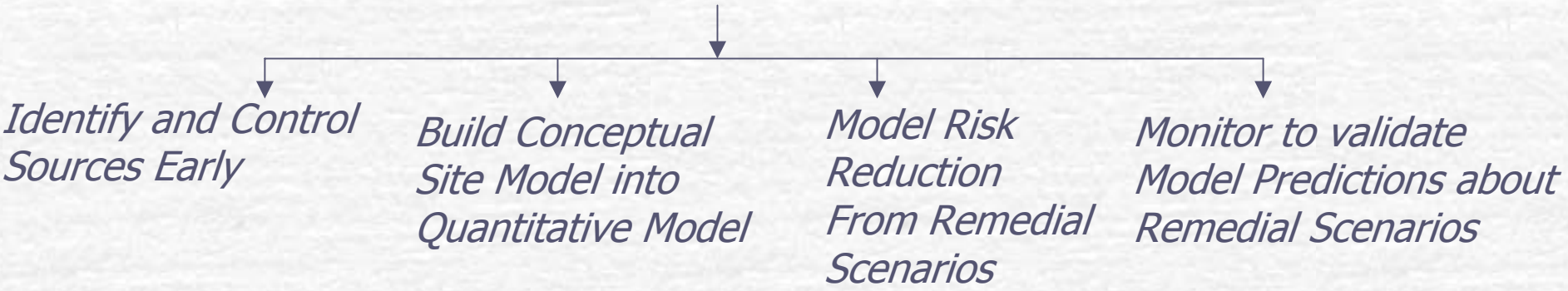
4. Proposed Solution from EPA Draft Remedial Guidance

- EPA draft guidance proposes modeling and monitoring approach
- Need only be complex enough to answer remedial questions



5. Project Description

In place Sediment Management Options require additional components during FS

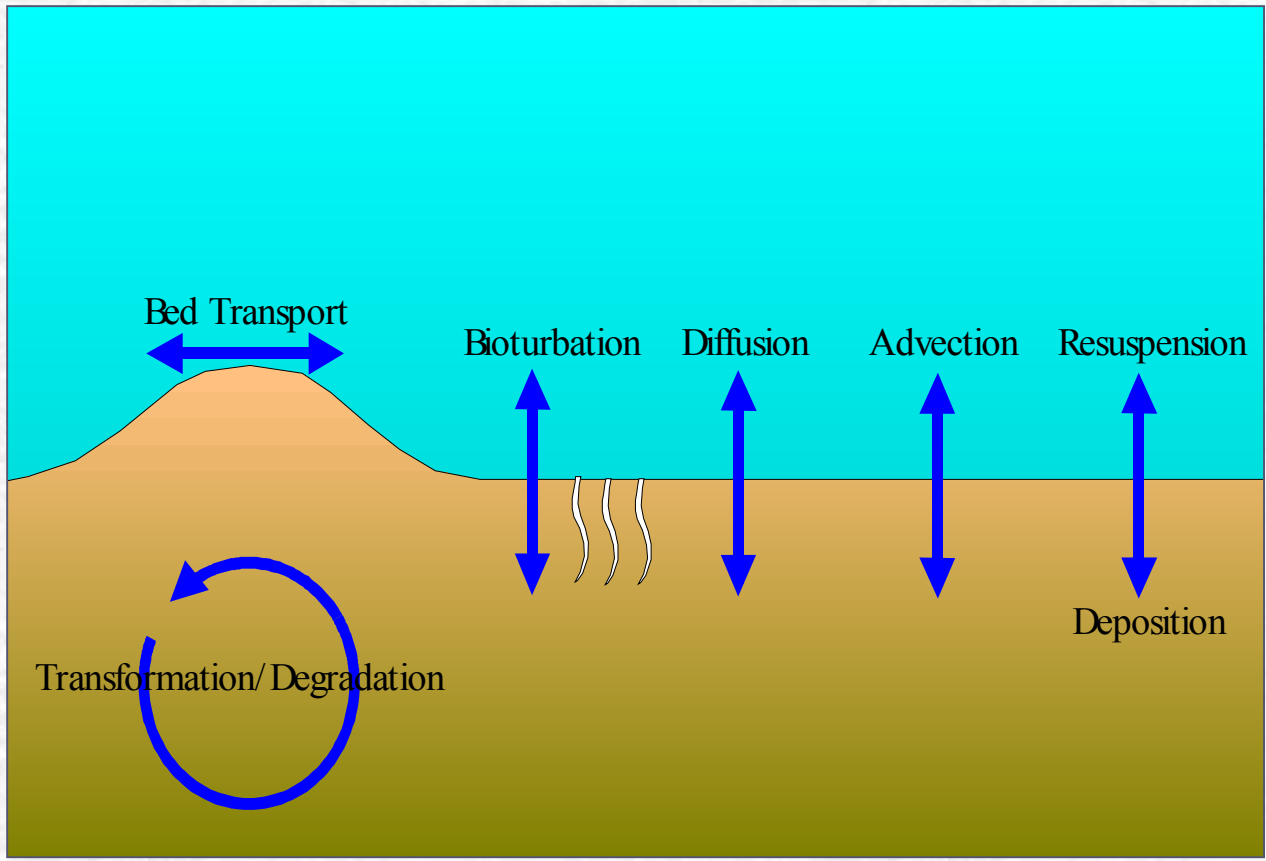


Input data from: forensics, source loading, sediment transport, contaminant fate and transport, food chain bioaccumulation

5.Technologies for Fate and Transport (F/T)

Critical risk or recovery pathways from SERDP PRISM

- A number of dynamic pathways may contribute to transport and exposure at contaminated sediment sites.
- The PRISM project can prioritize which pathways and tools are most important to measure F/T



after Reible, D and Thibideaux, L (1999) "Using Natural Processes to Define Exposure From Sediments" in Sediment Management Work Group; Contaminated Sediment Management Technical Papers, Sediment Management Work Group, http://www.smwg.org/index.htm.

6. Benefits/Payback

- The Navy has ~ 223 contaminated sediment sites with an estimated cost for remediation of $1.3 billion
  - Using current remedial technologies (assume presumptive remedy is dredging): 100 acres contaminated sediment = $2.2 – $6.2 million
- Improved knowledge of sites can lead to selection of more appropriate and potentially more cost-effective management strategies (MNR vs. Dredge) and substantial cost avoidance (several million $/site)

7. Milestones

Milestone	Planned	Actual
Mid-year Funding Received	---	04/02
Site 1 (Elizabeth River): Data Review, CSM	05/02	05/02
Site 1 (Elizabeth River): Sample Collections	06/02 - 09/02	06/02 - 09/02
Site 1 (Elizabeth River): Report	09/02	06/03
Site 2 (Hunters Pt Shipyard): Data Review, Lab, Field Analyses*	09/03 – 06/04	
Site 2 (Hunters Pt Shipyard): Report	09/04	
Final Report, Guidance Document	12/04	

* In coordination with ongoing regulatory project and Y0187 Sediment Transport

8. Coordination

- Worked with Y0817 Fingerprinting and ONR Biodegradation projects for sampling on the Elizabeth River
- Continued implementation on Elizabeth River with the ERP/AWTA group
- At HPS, working with ongoing regulatory and Y0817 Sediment Transport projects

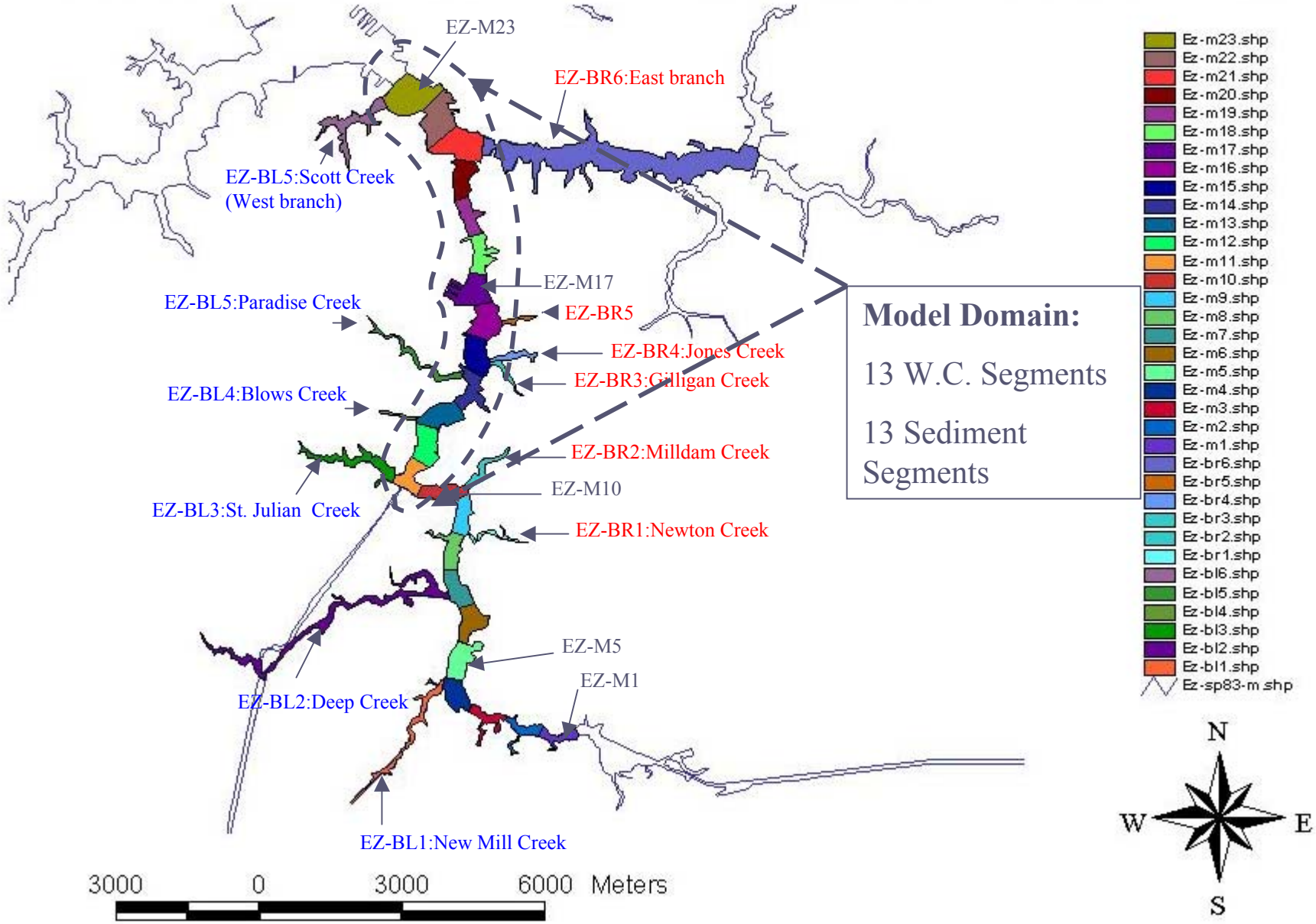
9. Technical section: How do we evaluate remedial option success?

- We need methods to:
  - Estimate risk reduction
  - Compare remedial options alone and in combination
  - Make these comparisons realistic, especially concerning releases, residuals, and recontamination

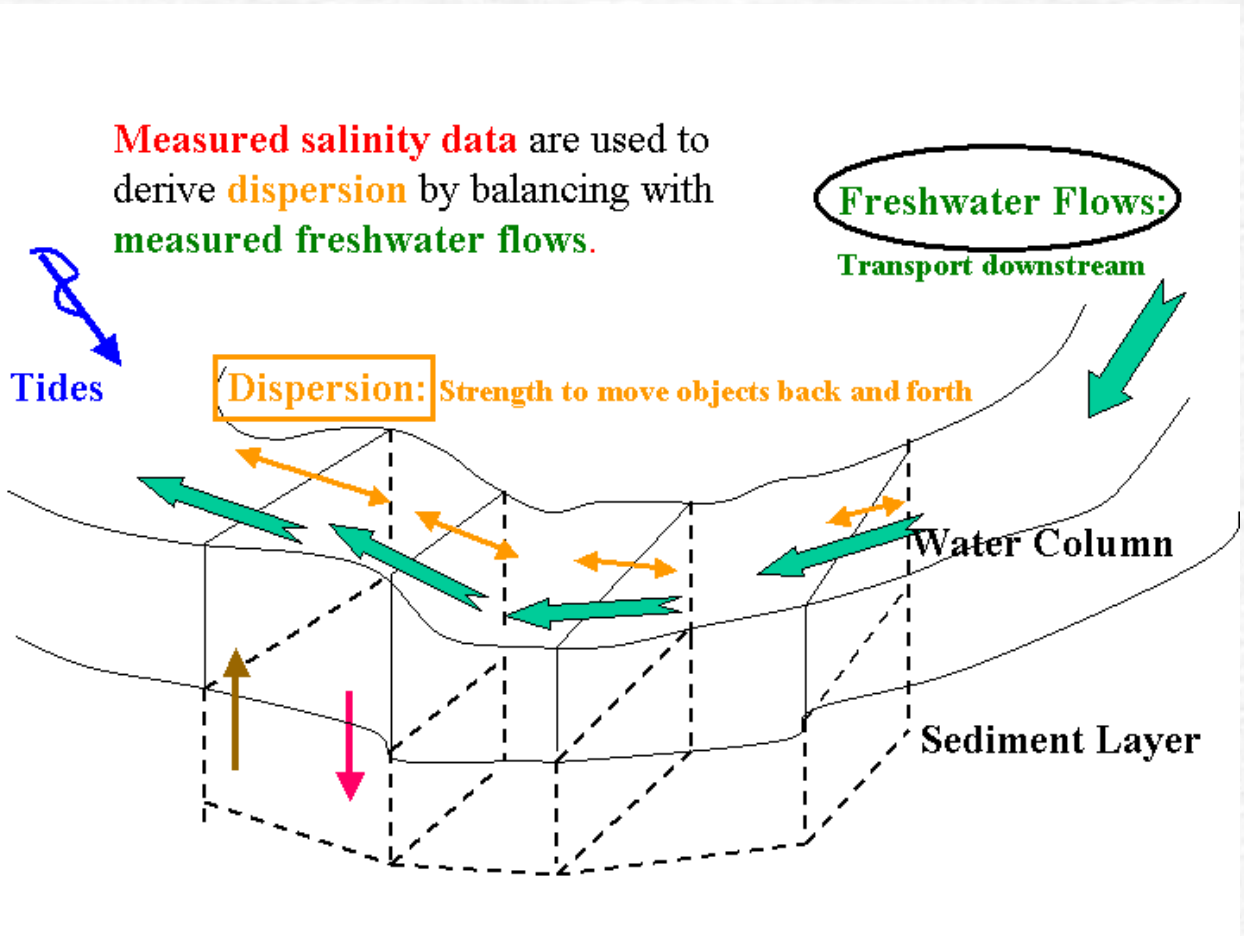
Case Studies

- Elizabeth River near Norfolk Naval Shipyard
- South Basin (Area X) off Hunters Pt Shipyard

Box Model for Elizabeth River



Conceptual 1-D Model for Sediment (and conservative contaminant) Transport



Transport processes in water column: Freshwater flows (measured, net flow) and dispersion (derived from salinity data)

Processes at water-sediment interface: Resuspension and Deposition. Usually, only the net deposition, defined as:

NET=DEP-RES

is measured. We treat **ONE** of DEP or RES as the calibration parameter. Sediment layer is treated as one fully mixed layer

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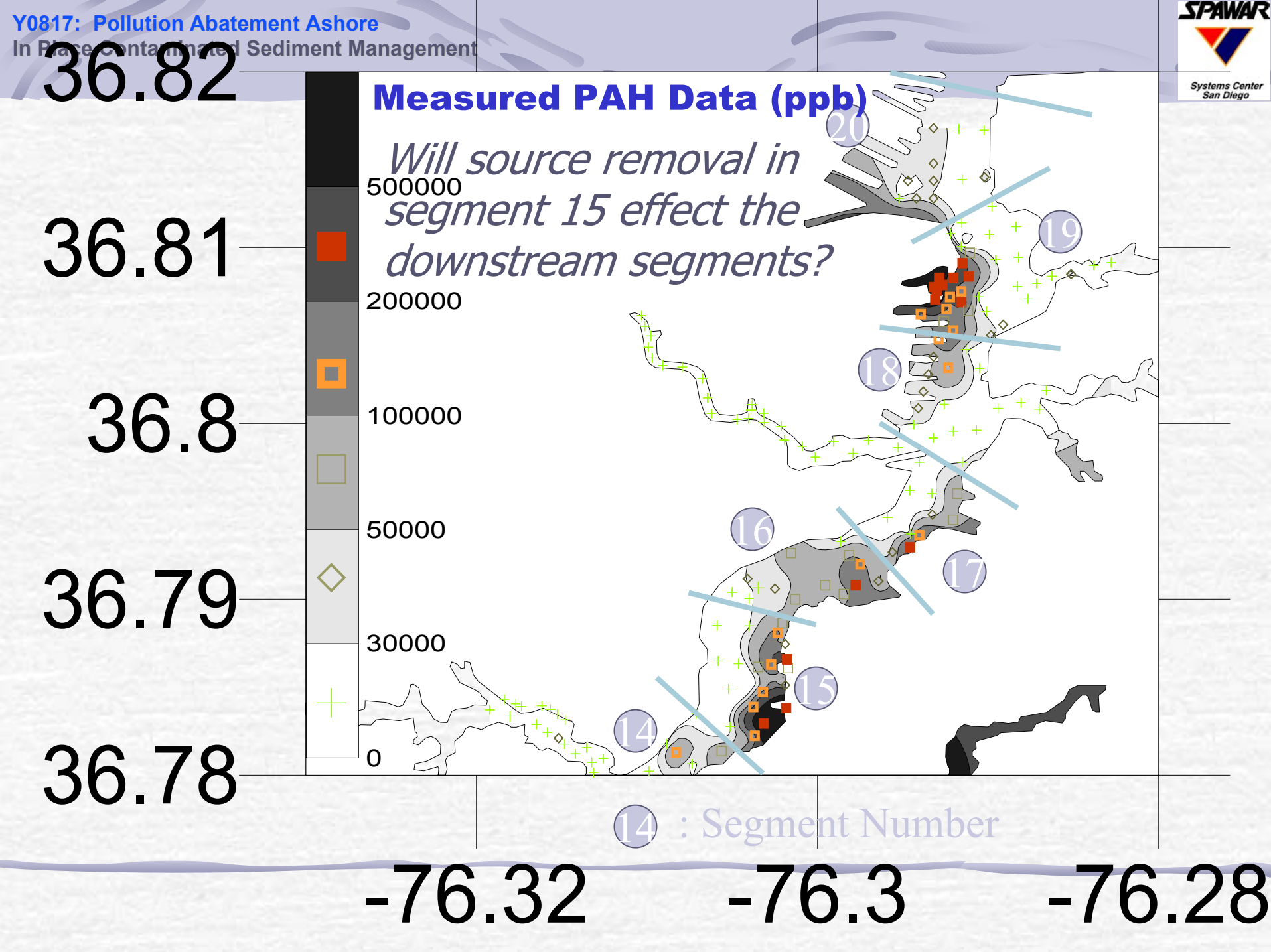
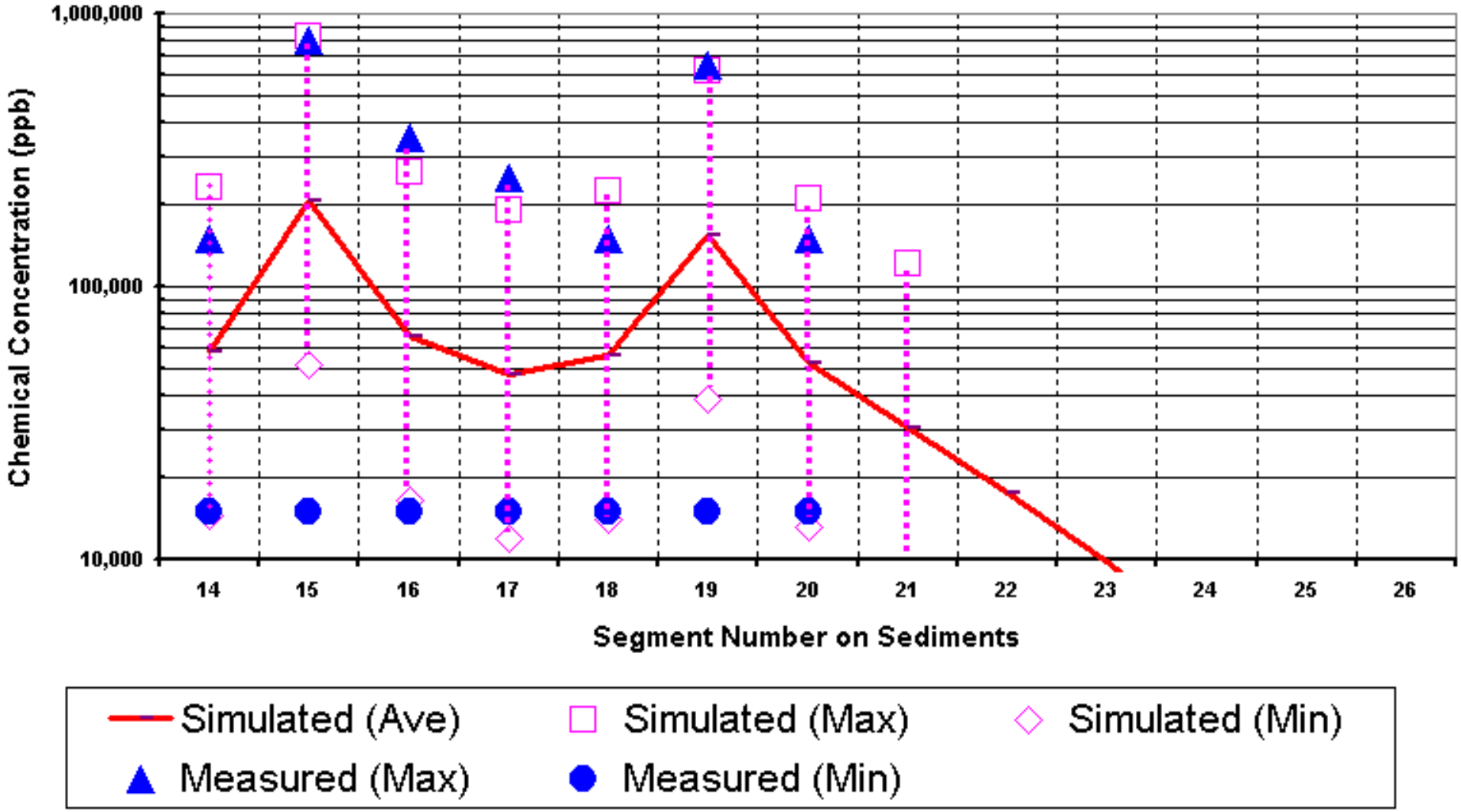


Model/Data Comparison (2002)

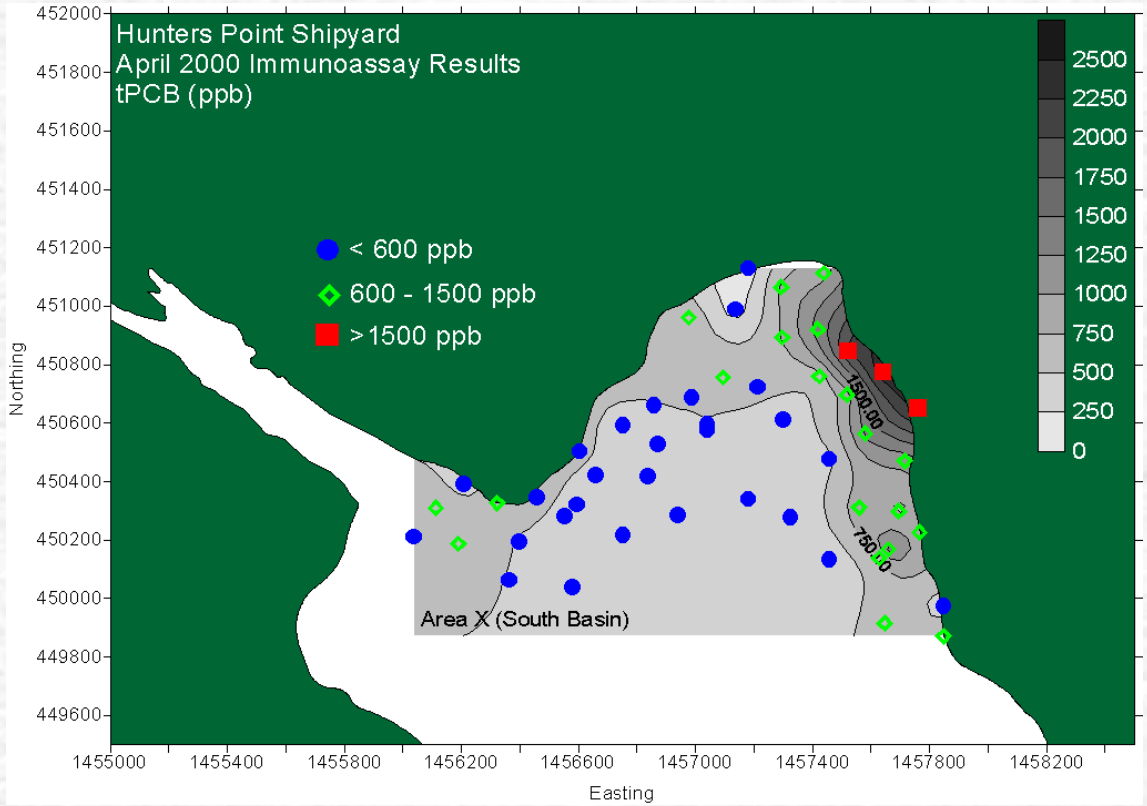


For Hunters Pt Area X site:

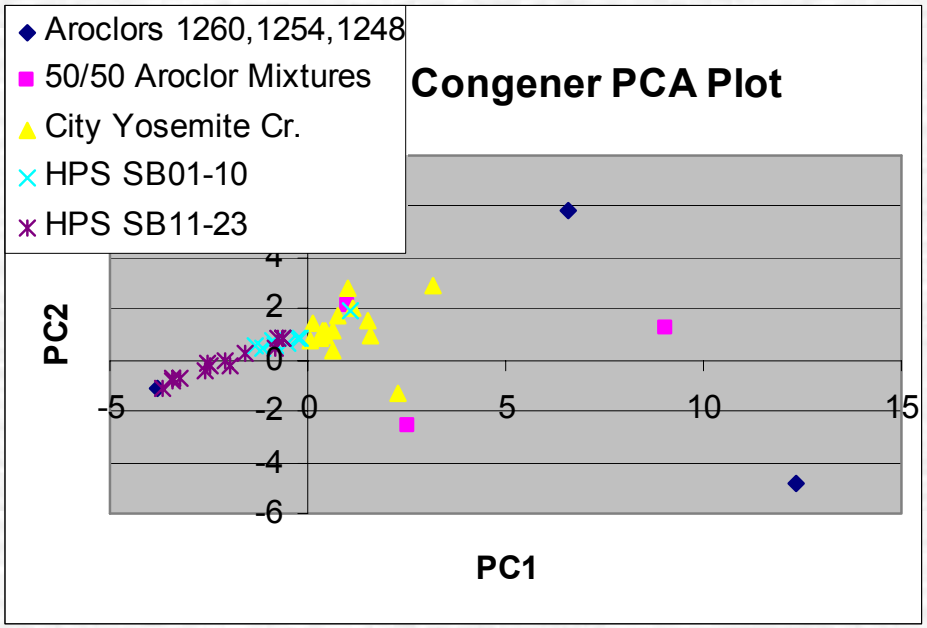
- Sediment Transport and Inplace Sediment Management (ISM) projects are being leveraged with regulatory project to provide:
  - Initial measurements needed for sediment and chemical transport modeling and baseline monitoring requirements
  - Long-term monitoring plan will be developed to confirm these modeling predictions with defined exit criteria

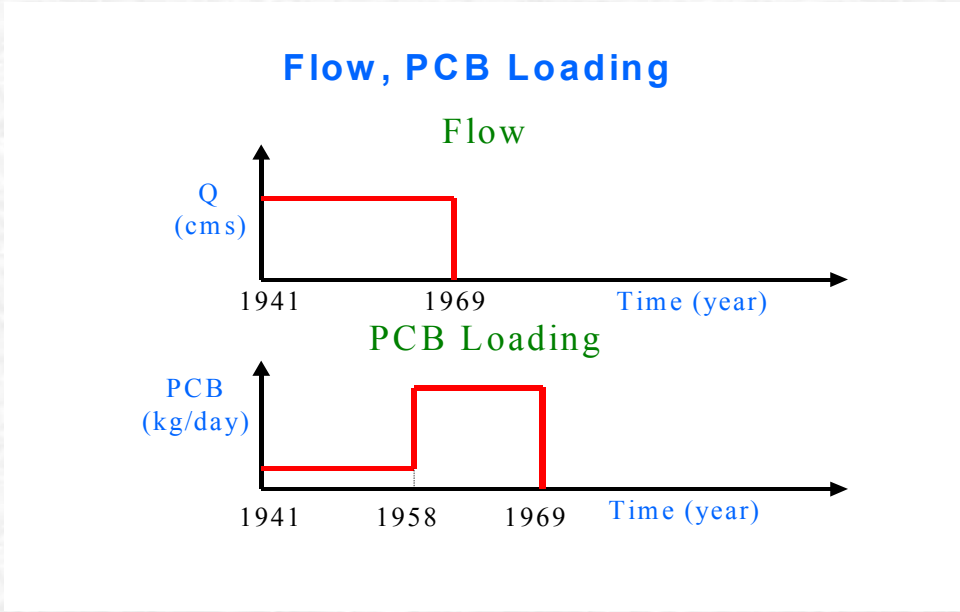
Remedial Option Comparisons

- For Area X at HPS, available data for baseline sediment chemistry
- Validation Study divided area into 3 strata with high, medium, and low chemistry levels
- Surface, Core, and onshore source data



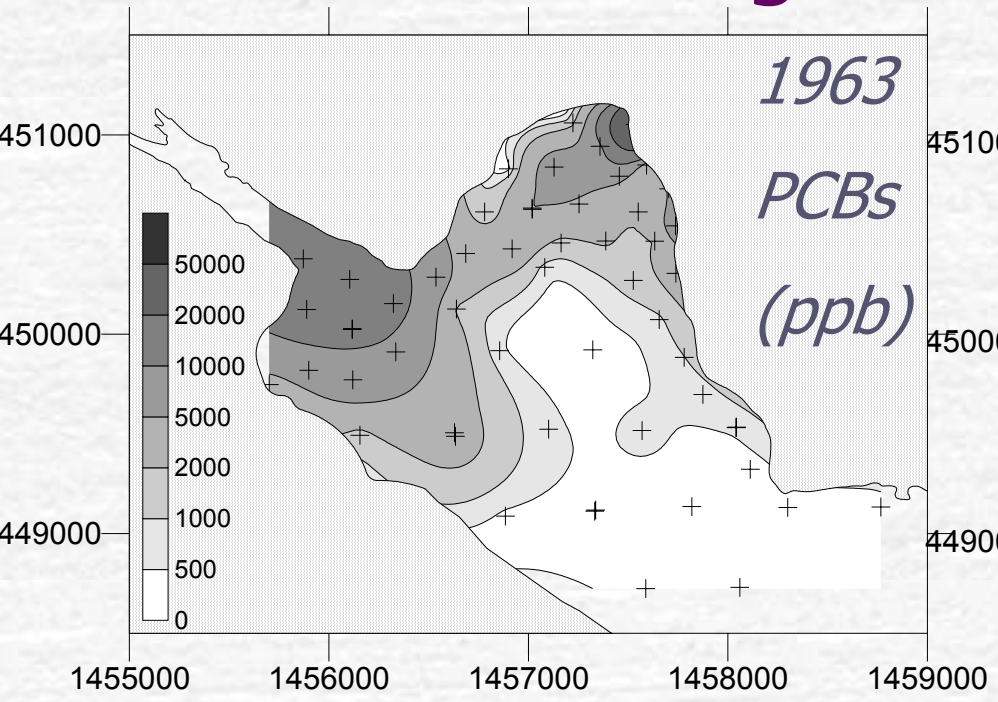
PCB Sources and Loading

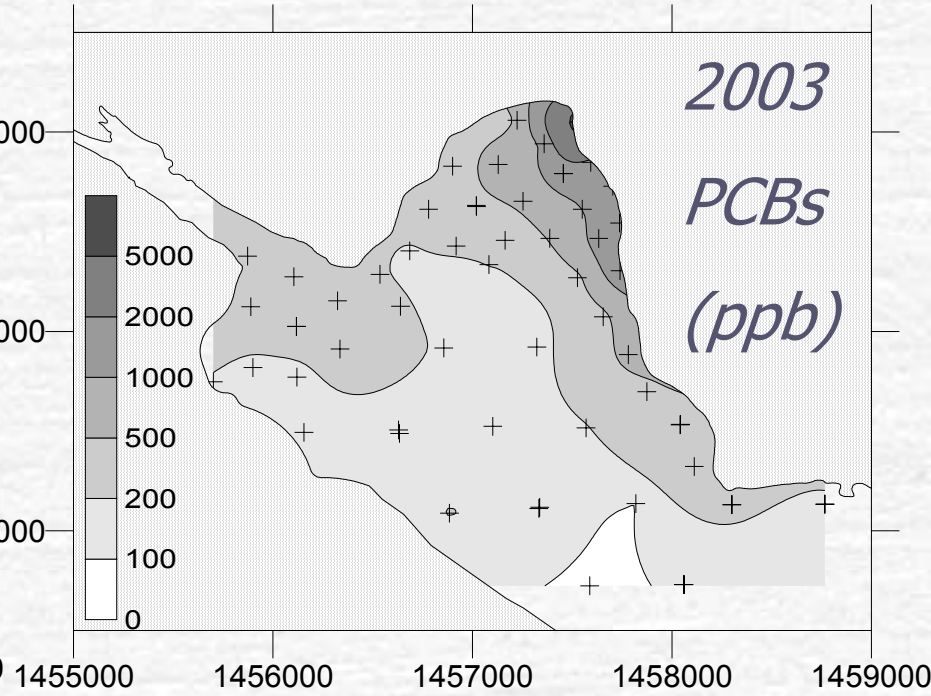




- Initial efforts to identify sources and define loadings

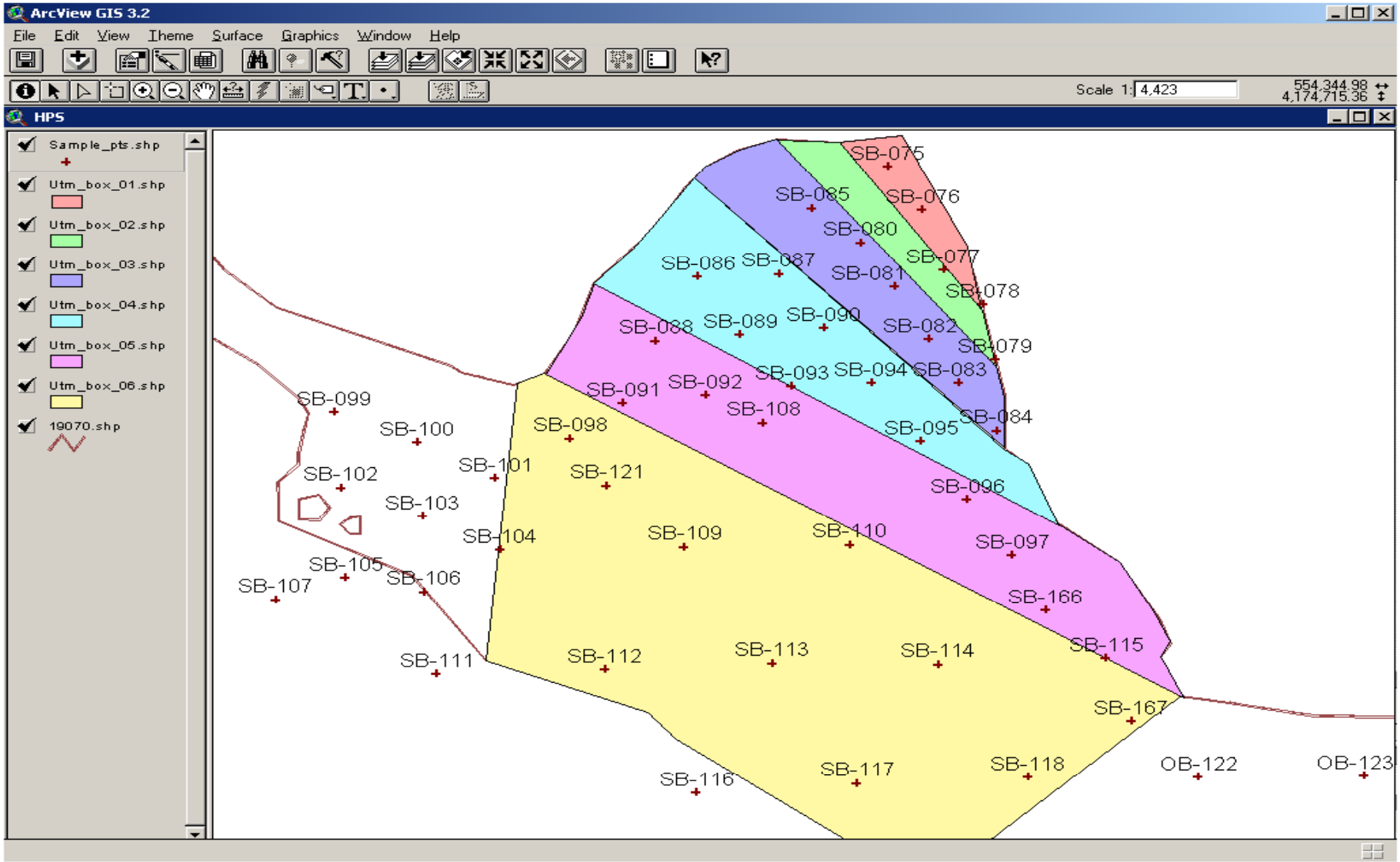
PCB Core Data provide time horizons for Source loading and MNR comparisons





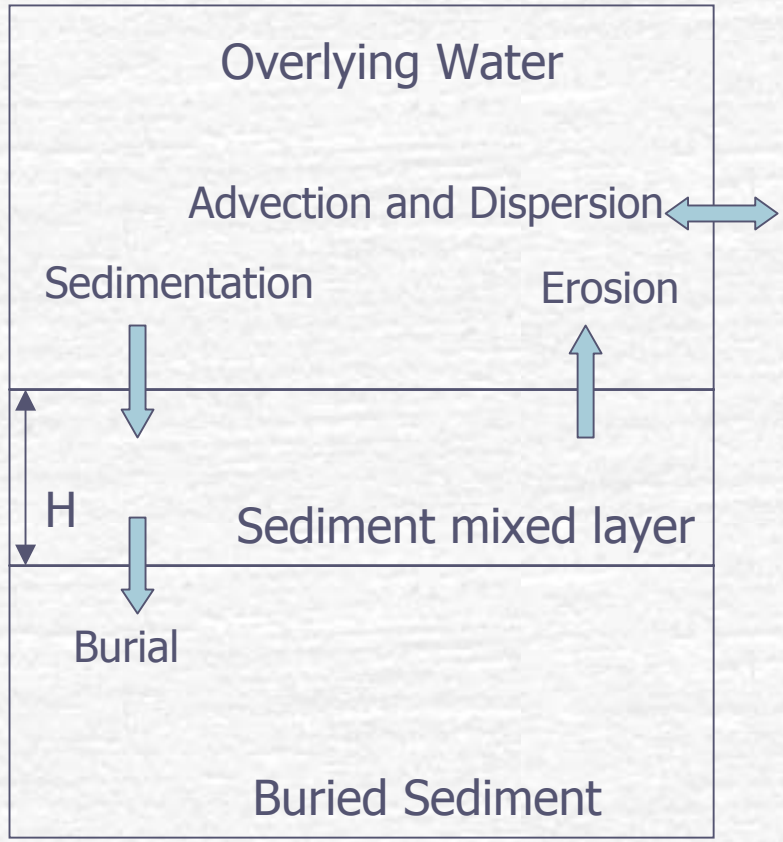
- Sedimentation rates and core profiles used to define time horizons and demonstrate continuing recovery

Model "Boxes" set up in ArcView



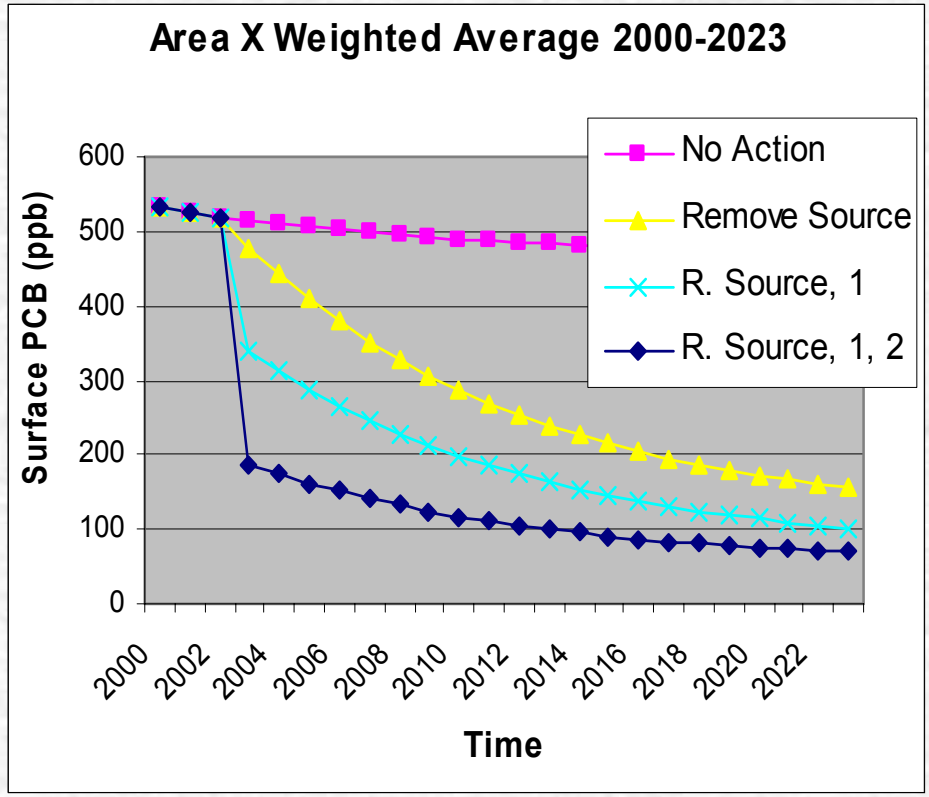
Chemical Transport and Fate

- Start with a simple screening level to show concept:
- H(dC/dt)=Cr(r+s)-C(s+b)
  - H=Height of mixed layer sediment box
  - C=Conc. in mixed layer of surface sediment
  - Cr=Conc. in incoming sediment material
  - r=sedimentation rate
  - s=erosion (resuspension loss) rate
  - b=burial rate
- Add complexity as needed depending on questions and data availability. PF Wang has been working with an EPA fate and transport model called WASP5 (Water Quality Analysis Simulation Program). This model is one of several reviewed and recommended for sediment use by ongoing EPA review panel.



Remedial Option Comparisons

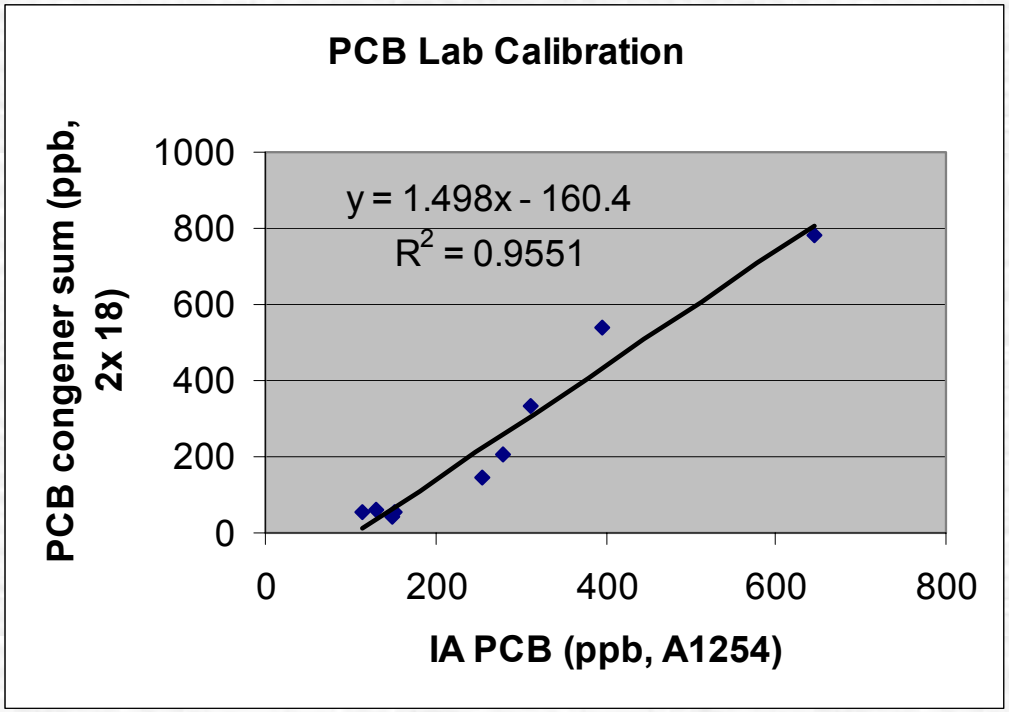
- For Area X, area weighted average is 65% Area 3, 25% Area 2, and 10% Area 1
- For No action, level is 500ppb
- Turn off sources and sediment reaches recovery level of 200ppb in 14 years
- Add removal of sediment above 1 ppm(area 1) and time to 200ppb is cut to 7 years
- Removal of sediment in area 1 and 2 (above 700ppb) brings average level below 200ppb immediately if you can't wait

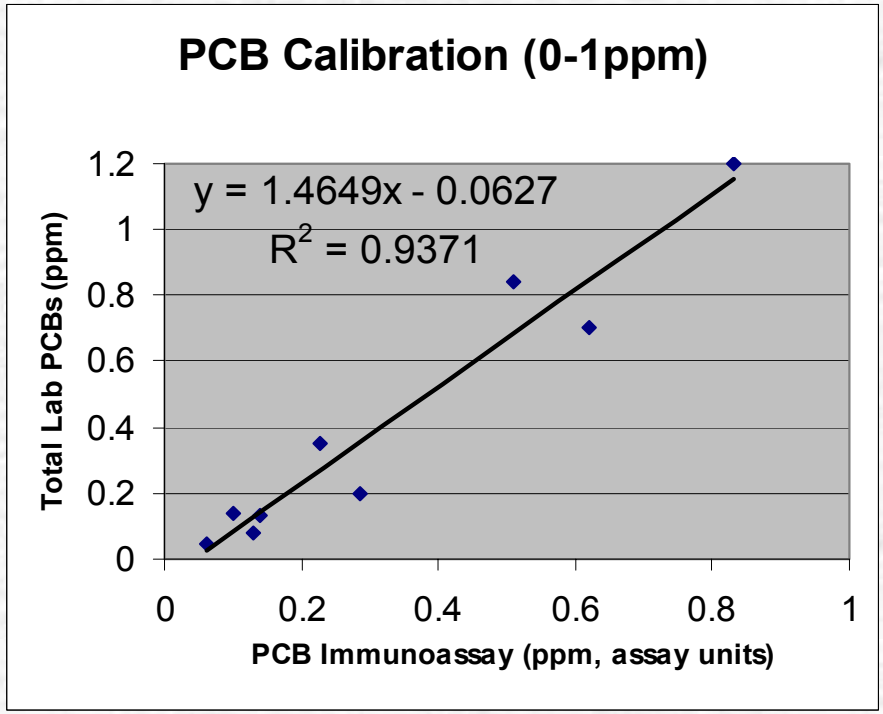


Monitoring Considerations

- Modeling results point to monitoring requirements to validate predictions
- Large amount of sediment baseline data available, but some data gaps in tissues
- For post-remedial monitoring, combine screening (for spatial and temporal coverage) and laboratory chemical analyses
- For biological data, large variability leads to unreasonable sample size requirements

Immunoassay(IA) Lab Calibration

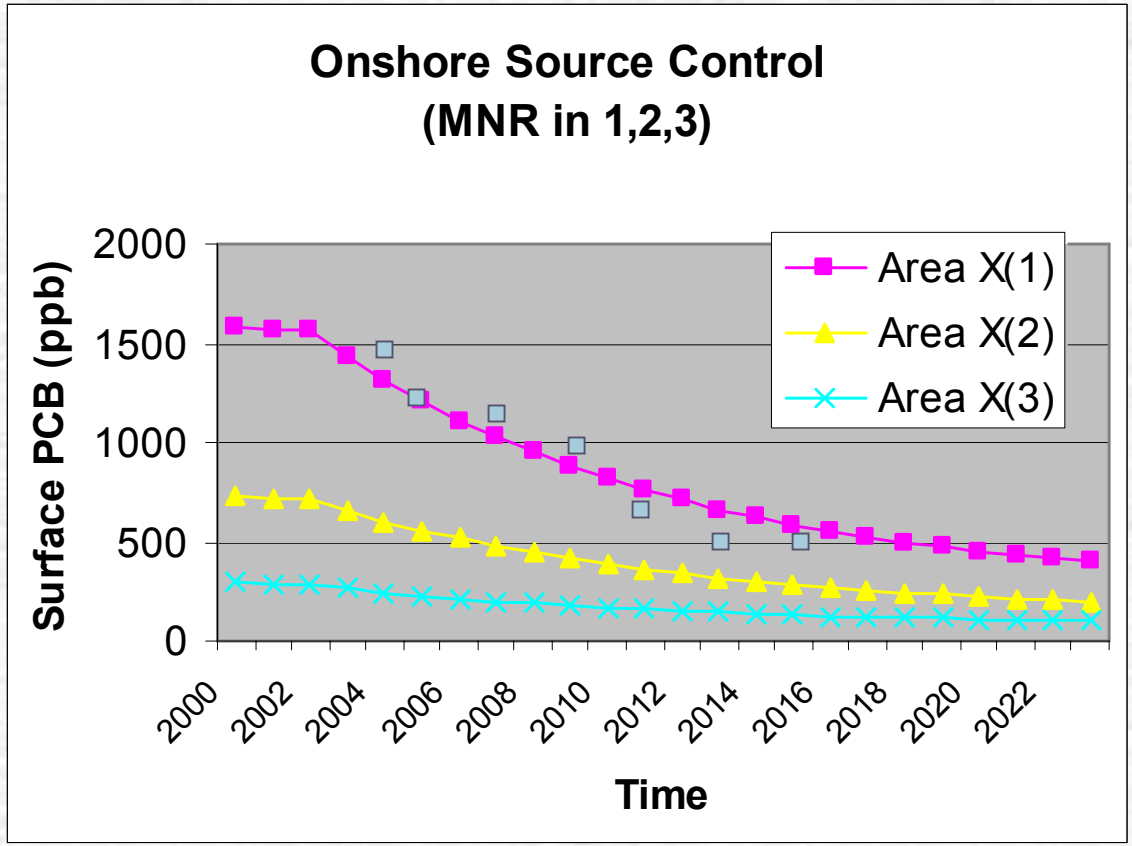




- Validation and Shoreline Core Studies have calibrated to both TTEMI and Battelle lab data, with an additional 10x as many screening samples to provide spatial and temporal coverage

Monitoring Example - Source Control

- For Sediment, rate of change and size of difference that is to be detected will affect monitoring frequency
- For Tissue, start with simple BSAF model and consider more complicated models as needed



- Proposed monitoring data tracks model data

10. Implementation

- Work will be carried out at sites undergoing remedial investigation or FS management, in direct collaboration with RPMs, regulators and stakeholders.
- An evaluation of the results from the implementation of the tools at sites will be performed
  - Based on a selection of the tools that were demonstrated to provide useful information, a guidance document will be developed that instructs users on which tools should be used to answer site-specific questions
- Dissemination of information via
  - Peer-reviewed journals, professional scientific and technical meetings, reports, RITS
- Barriers to Implementation
  - Regulatory framework still in flux

10. Implementation

- For FY04:
  - Demo site at HPS for Michael Pound (SWDIV)
  - Implementation to be leveraged with Regulatory and Sed. Transport projects

14. Logic Model for Inplace Sediment Management

Navy Benefits	Modeling and Monitoring approaches should result in more cost effective implementation of inplace sediment management options at sediment remedial sites.
Customer Capability	Better selection of appropriate risk reduction and cost-effective remedial options.
Products	Guidance document to implement sediment feasibility studies.
Project Milestones	1.Joint Field work with Fingerprinting and NRL projects (FY03) 2.Interim Model Report for Elizabeth River (FY03) 3.Joint Field work with regulatory project at Hunters Pt(HP) (FY04) 4.Interim Model and monitoring report at HP (Q4, FY04) 5.Final Guidance Document (Q1, FY05)

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15.Summary: Build Modeling Prediction and Monitoring Validation into Feasibility Studies

- Modeling will predict future conditions to evaluate remedial options under:
  - No Action scenarios
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  - *In situ* treatment scenarios
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- Monitoring (with exit strategy) is designed to validate modeling predictions and confirm remedial scenarios

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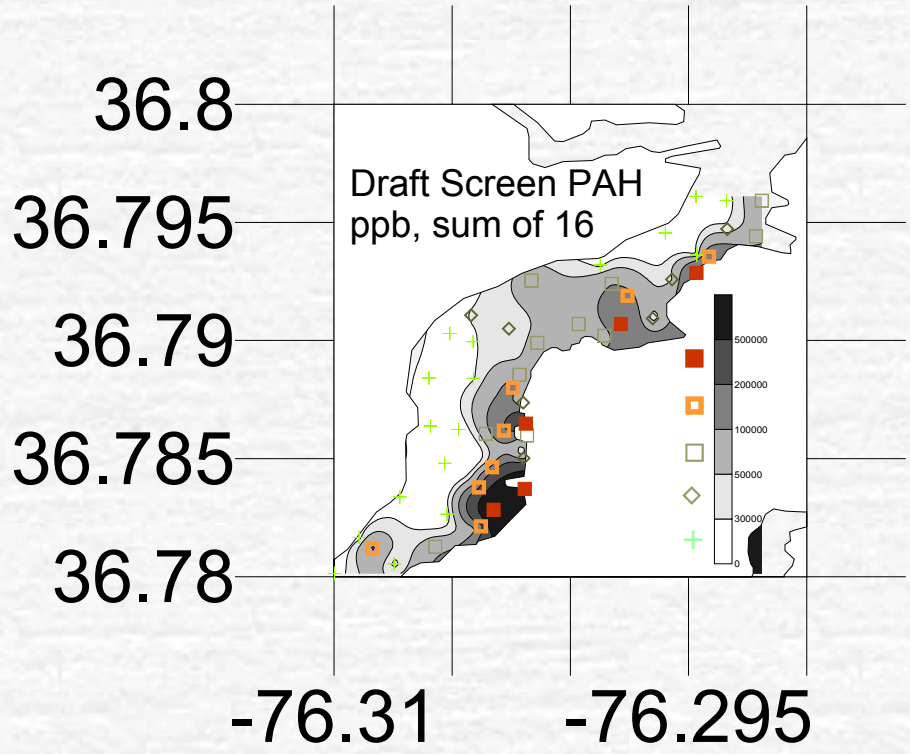

How will source removal impact downriver sediments?

15. Summary (con't)

- FS remedial option selection process should include metrics for relative risk reduction
- Modeling and Monitoring are important techniques to evaluate long term trends and remediation effectiveness
- Fair representation of risk reduction among remedial options requires consideration of actual (not best case) remedial practices and consideration of any continuing sources
- Site specific data are needed for modeling and monitoring applications, with multiple techniques available to obtain both types of these data