## Addressing Uncertainty and Managing Risk at Contaminated Sediment Sites
## USACE/USEPA/SMWG Joint Sediment Conference
## October 26-28, 2004

## Panel 1: Remedial Activities
## An Overview of Monitored Natural Recovery
## Pros & Cons

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# Discussion Outline

1. *What is MNR and where will it be relevant?*
   - *RTDF evaluation framework*
   - *Lessons learned from prior case histories*
2. *Key environmental processes*
   - *Physical*
   - *Chemical*
   - *Biological*
3. *Issues requiring attention*

## Monitored Natural Recovery (MNR) Defined

- *Current working definition (EPA and RTDF)*
- *"Remedial technology that relies on natural sediment burial processes and contaminant weathering to reduce risk of resuspension of contaminated sediments and potential for contaminant transport"*

RTDF

## Framework for MNR Evaluation

- *Remediation Technologies Development Forum (RTDF)*
- *Provide guidance on the technical confirmation of MNR for contaminated sediment*
  - *Framework for Evaluation (5 elements)*
  - *Case History Examples*
- *Apply the framework to assess the effectiveness of sediment MNR as a risk management alternative*

RTDF

## Sediment MNR: Five Assessment Elements

1. *Characterize historical contaminant sources/controls*
2. *Characterize sediment stability and key fate/transport processes*
3. *Compile sufficient historical record to characterize temporal trends in chemistry*
4. *Compile historical trends in relevant biological endpoints to corroborate chemical data*
5. *Develop acceptable and defensible modeling tools to allow prediction of future MNR*

RTDF

## Sediment MNR: Lessons Learned from Case Histories

*MNR has been shown to be an effective cleanup method at those sites where:*

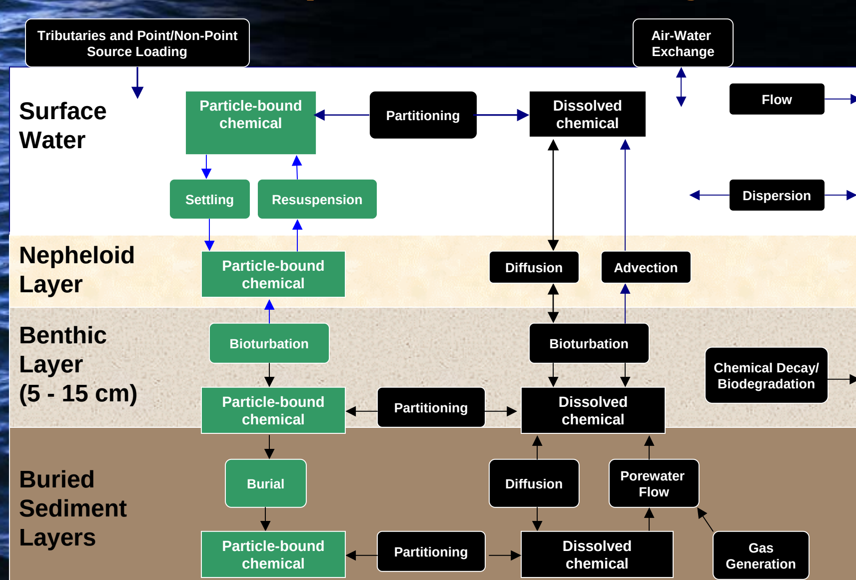
1. *Sources (external and internal) have been adequately controlled*
2. *The sediment bed is largely stable*
3. *Sufficient sediment deposition occurs at a site*
4. *Part of blended remedy*

RTDF

# Sediment MNR: Comprehensive Case Histories

1. *Bellingham Bay, WA – effective MNR due to source control/hotspot remediation*
2. *Commencement Bay, WA – enhanced MNR from dredging surrounding areas*
3. *Lake Hartwell, SC – MNR evaluations of bioaccumulative chemicals*

# MNR Site Conceptual Model – Key Processes

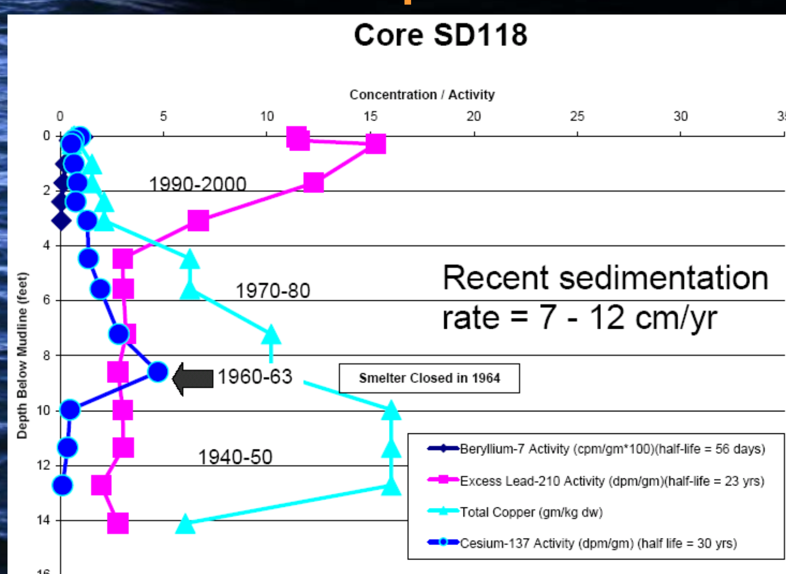


## Physical Processes of Relevance

- *Sedimentation rates (gross & net)*
- *Sediment stability assessments (past & future)*
- *Assessment tools & monitoring design:*
  - *Radioisotope profiles (esp., $^{210}$Pb and $^{137}$Cs)*
  - *Sediment trap deployments (gross sedimentation)*
  - *Shear stress testing (e.g., Sedflume)*
  - *Hydrodynamic & sediment transport modeling*

RTDF

## Radioisotope Profiles

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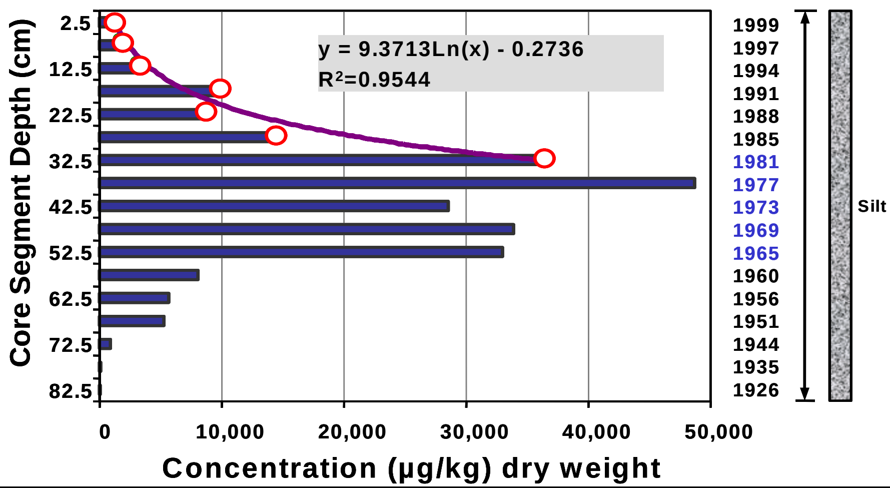
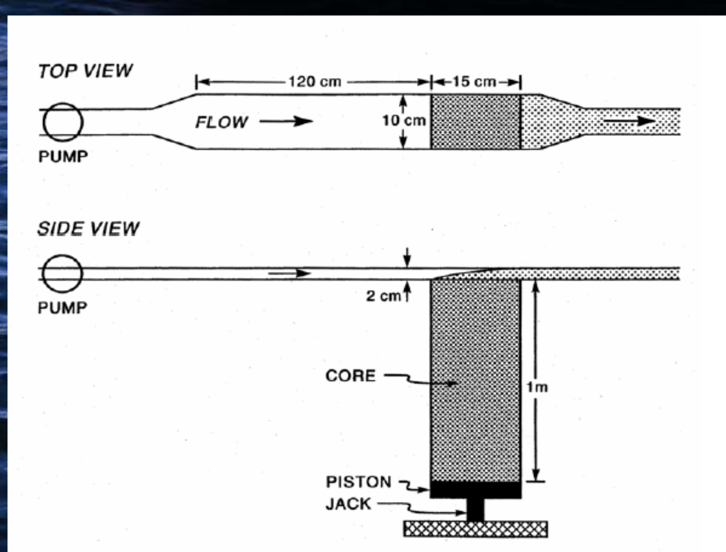
## Representative Core Sample
## Lake Hartwell, SC MNR Remedy




## Shear Stress Testing (e.g., Sedflume)

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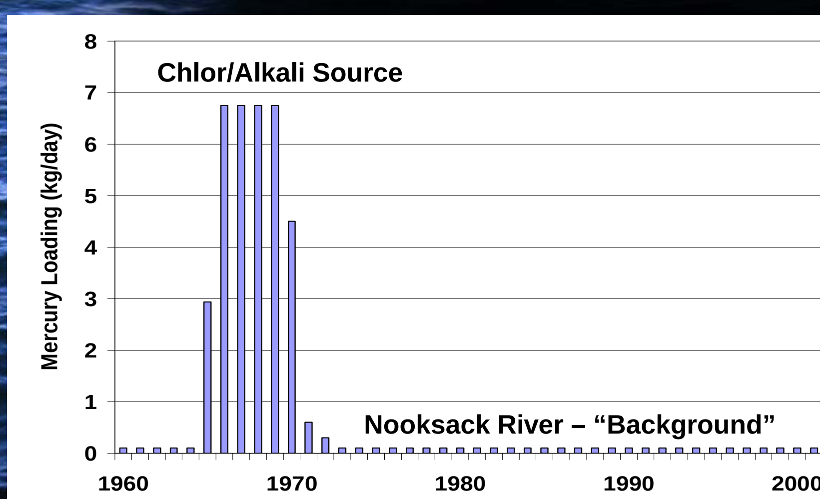
## Chemical Processes of Relevance

- *Source loading (external and internal/"hotspot")*
- *Sequestering and degradation/dechlorination*
- *Assessment tools& monitoring design:*
  - *Historical record of sediment concentration declines*
  - *Fine-scale chemical profiles with depth*
  - *Sediment trap deployments*
  - *Detailed chemical analyses*

RTDF

## Mercury Release and Source Control: Bellingham Bay

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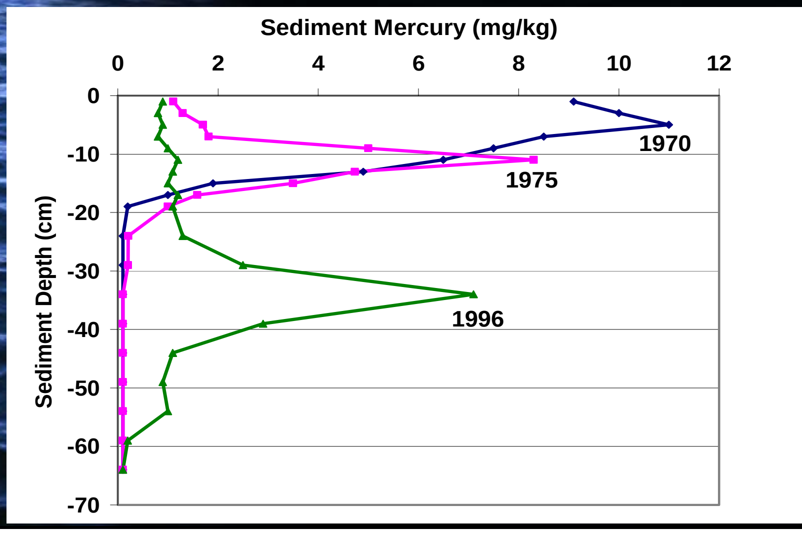
# Temporal Change in Core Profiles: Inner Bellingham Bay (and sediment stability verification)

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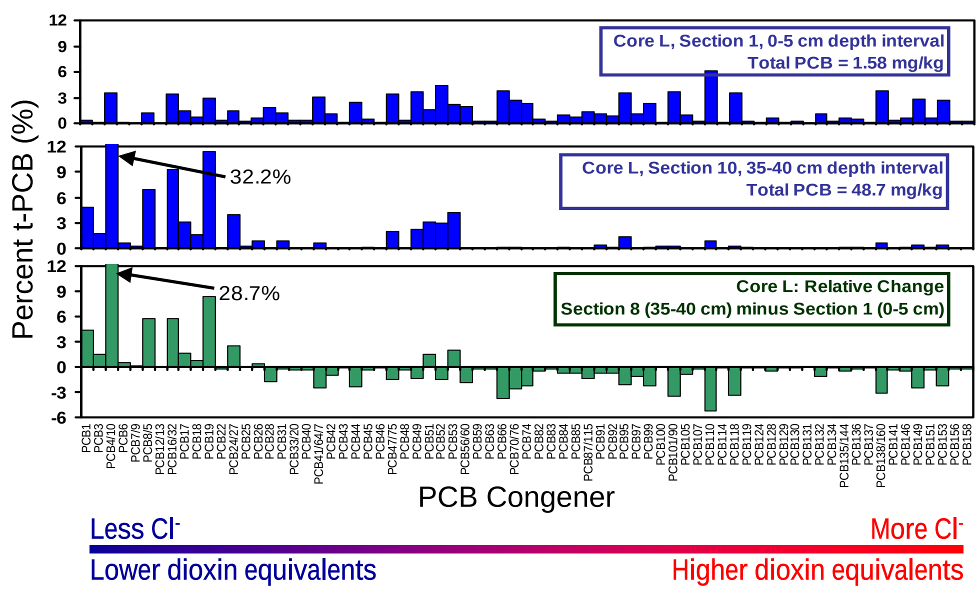
# Lake Hartwell PCB Dechlorination



## Biological Processes of Relevance

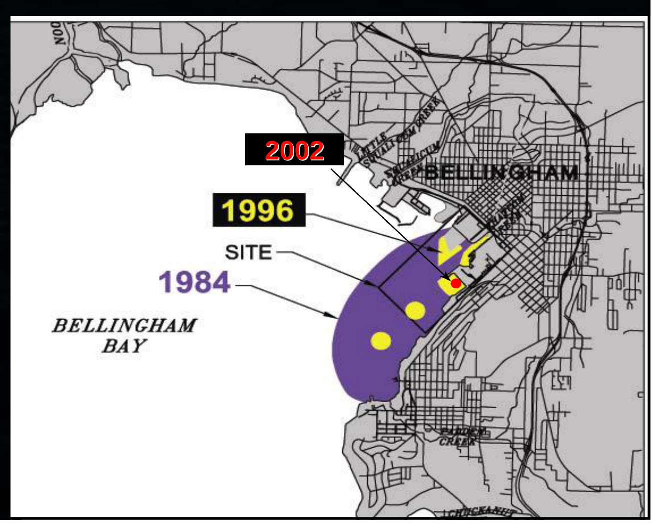
- *Surface sediment mixing/bioturbation rates*
- *Depth of biologically active zone (site-specific)*
- *Assessment tools & monitoring design:*
  - *Historical record of risk endpoints (site-specific)*
  - *Fine-scale radioisotope profiles (esp., $^{7}$Be)*
  - *Detailed chemical analyses*
  - *Laboratory biodegradation tests*

RTDF

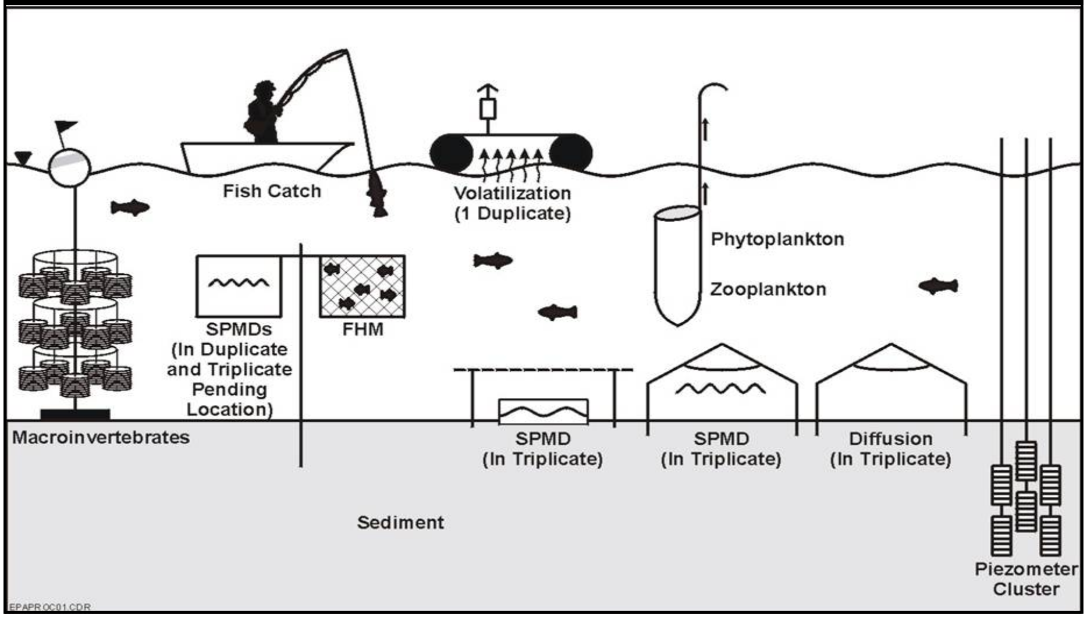
## Biological Endpoint Recovery: Reduction in Bellingham Bay Surface Sediment Toxicity

**Sediment toxicity tests:**

- **Amphipod: acute toxicity**
- **Larval: acute toxicity & abnormality**
- **Polychaete: chronic toxicity & growth**



## Lake Hartwell Conceptual Site Model




## Issues Requiring Attention

- *Accurate characterization of source loadings*
- *Appropriate balancing between different lines of evidence (e.g., modeling vs. empirical)*
- *Attention to quality control on long-term chemical and biological monitoring records*
- *Optimizing statistical evaluations – robustness vs. cost efficiency*
- *Bioaccumulation monitoring complexities (e.g., PCB food web transfer)*