

US EPA ARCHIVE DOCUMENT



# Release, Bioavailability and Effects of Contaminants Associated with Resuspended Sediments at Superfund Sites (Contaminated Sites MYP)

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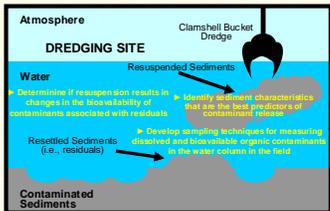
## Agency Problem

Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation, is facing remediation contaminated sites around the country. The most common and expensive remediation technique is dredging. However, there is a great deal of uncertainty exists around the ecological risks of dredging; specifically, the associated resuspension of sediment including the possible increase in bioavailability of contaminants associated with resuspended residual sediments. Release of dissolved and bioavailable contaminants into the water column.

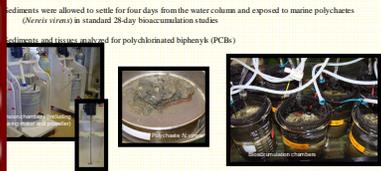
## Research Goals

Which will produce the underlying science needed by the Office of Superfund Remediation and Technology Innovation to reduce uncertainty around the effects of resuspension at Superfund sites undergoing dredging, specifically: Determine if resuspension results in changes in the bioavailability of organic contaminants associated with residuals (i.e., contaminated sediments remaining after the dredging operation). Identify sediment characteristics that are the best predictors of organic and inorganic contaminant release during resuspension. Develop sampling techniques for measuring dissolved and bioavailable organic contaminants in the water column released during resuspension in the field.

## Approach

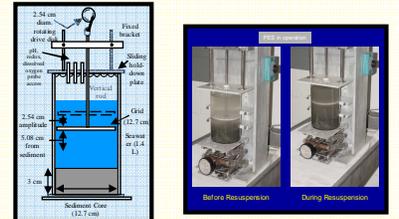


Determine if resuspension results in changes in the bioavailability of organic contaminants associated with residuals. Under laboratory conditions, estuarine sediments from the Region 1 New Bedford Harbor (MA) Superfund site were resuspended over three days to emulate dredging. Water column conditions were varied to determine the effects of mixing and oxidation on contaminant bioavailability. Treatments included: mixing, mixing with air added, mixing with helium added, and no mixing.

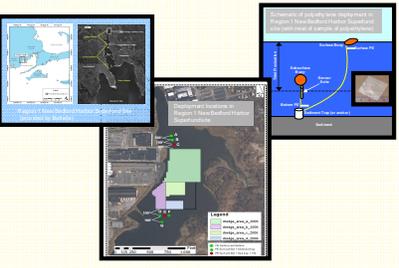


## Approach (cont.)

- Identify sediment characteristics that are the best predictors of contaminant release during resuspension
  - Under laboratory conditions, estuarine sediments from several contaminated sites were investigated including the following Superfund sites:
    - Region 1 New Bedford Harbor, MA (NBH)
    - Region 2 Hudson River, NY (HR) and Passaic River, NJ (PR)
    - Region 9 Palos Verdes, CA (PV)
  - Sediments were resuspended with the particle entrainment simulator (PES) in six hour resuspension sessions at 5 dynes/cm<sup>2</sup> (energy equivalent to a storm event)
  - Water column measurements of metals (cadmium, nickel, zinc) and PCBs (chlorinated biphenyl (CB), CB28 and CB52) were performed periodically during the resuspension sessions
  - Particulate organic carbon (POC), acid volatile sulfide (AVS) and grain size were used to predict metal and PCB release into the water column

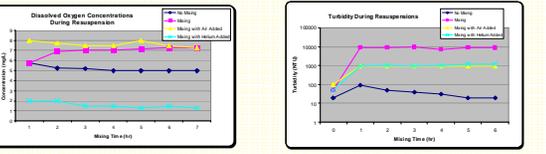


- Develop sampling techniques for measuring dissolved and bioavailable organic contaminants in the water column released during resuspension in the field
  - In collaboration with U.S. EPA Region 1, the Army Corps of Engineers (Division 1), Battelle, and the University of Rhode Island, a two year study (2006 - 2007) is underway comparing passive samplers deployed in the Region 1 Superfund site at New Bedford Harbor during periods of remedial dredging and non-dredging activity
  - Passive samplers being compared include polyethylene devices (PEDs), semi-permeable membrane devices (SPMDs) and solid phase microextraction (SPME)
  - Contaminant accumulation by the passive samplers is being compared to bioaccumulation by blue mussel (*Mytilus edulis*) also deployed at the site
  - Concentrations of PCBs are quantified in the samplers and mussels. Sediment deposition and turbidity are also being monitored
  - In 2006, PEDs were compared to mussel; in 2007, the plan is to include SPMDs and SPME

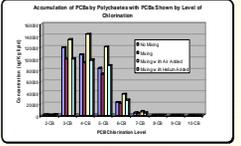


## Results

- Determine if resuspension results in changes in the bioavailability of organic contaminants associated with residuals
  - During the three day resuspension period, water column oxidation conditions were maintained at desired levels; for example dissolved oxygen and turbidity:

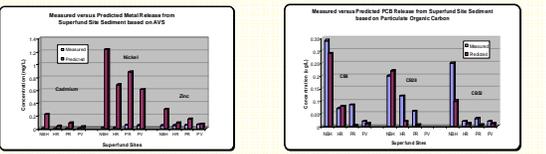


- Changing the oxidation conditions of the sediments during the resuspension resulted in a trend of increased bioaccumulation of PCBs in the treatment in which sediments were mixed with air added:



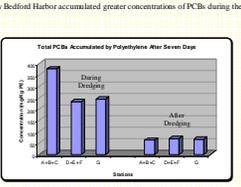
- Polychaetes in the aerated treatment showed about 30% greater bioaccumulation of PCBs than worms in the other treatments

- Identify sediment characteristics that are the best predictors of contaminant release during resuspension
  - Effectiveness of predicting metal and PCB release based on acid volatile sulfide (AVS) and particulate organic carbon, respectively, varied by Superfund site:



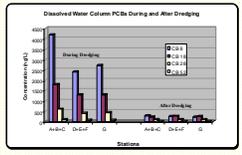
- AVS consistently over-predicted metal release while particulate organic carbon tended to under-predict PCB release

- Develop sampling techniques for measuring dissolved and bioavailable organic contaminants in the water column released during resuspension in the field
  - Polyethylene samplers deployed in New Bedford Harbor accumulated greater concentrations of PCBs during the dredging events as compared to after the dredging activity:

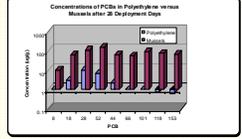


## Results (cont.)

- Dissolved PCBs calculated based on PCB concentrations accumulated on the PEDs show concentrations approaching 5 pg/L



- PCBs accumulated by the PEDs were much less than mussel bioaccumulation:



- Mussels maybe exposed via the dissolved and particulate phases while PEDs only exposed via the dissolved phase

## Conclusions

- Resuspension of PCB contaminated sediments into an aerated water column resulted in elevated bioavailability of PCBs as compared to non-resuspended sediments or sediments that are resuspended into a reduced water column.
- Attempts to use simple sediment characteristics like AVS and particulate organic carbon in some instances proved to be useful for predicting metal and PCB release into the water column; however, in many instances they were not effective.
- Using polyethylene devices to sample dissolved phase PCB demonstrated increased concentrations during dredging events as compared to non-dredging conditions.

## Impacts, Outcomes and Future Directions

Information generated from these investigations will assist the Office of Superfund Remediation and Technology Innovation to better understand the uncertainty around the effects of dredging at contaminated sites. This information will be critical to remedial project managers around the country trying to monitor the effects of resuspension and decide the best ways to remediate their Superfund sites. All of the work described requires further field verification in future investigations.

## References

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