Panel 3 Synthesis – Processes of Relevance to Selecting Remedies

October 28, 2004

Presentations

• Contaminant Releases During Dredging
• Evaluating Post-Dredging Residuals
• Physical and Chemical Processes Affecting CAP Design and Performance
• Biological Processes Affecting Remedial Design and Performance
• Physical and Chemical Stability of Contaminants in Sediments
Dredging Releases

- Primary Releases: Suspended Particulate and Releases to Water Column
- What we know:
  - Production dredging for “aquatic superhighway” different than environmental dredging
  - Need good design specs and experienced dredging contractor
  - Solid and contaminant releases (within an order-of-magnitude)
  - Dredging models available but, unlike disposal models, not validated
    - Data collection not authorized by Congress – Some data from Corps suggests little impact to water column
    - Data difficult to collect – need more
  - International Group (“ACCORD”) formed and developing monitoring protocols – Relevant data may become available within next two years

Questions/Comments

- Corps has studied effects of dredging on water quality using clam shells and hydraulic dredging
  - Never saw water quality exceedances
- Environmental dredging different than navigational dredging – especially in areas of elevated impacts
- Need to interpret impacts in terms of changes in exposure to receptors: short- and long-term
- Have calibrated, but few validated, models
Post-Dredge Residuals

- Fluidized mud flows (nepheloid layer) can be primary mode of transport
- Characteristics:
  - Dry weight solids concentration: Similar to what has been dredged
  - Depth-averaged constituent concentration of dredged sediment during single pass is reasonable estimate of constituent concentration in residual sediment resulting from that dredge pass
  - Thickness: Inches
  - Volume: 10% to 20% of dredge volume

Post-Dredge Residuals

- Case Studies
  - 70,000 to 700,000 cubic yards removed
  - Sandy silt, soft silt/clay, soft silt over dense sand or gravel/cobbles
  - Cable arm/clam shell buckets with BMPs and digging and closed bucket with BMPs
  - Results:
    - 85% to 90% clean after first pass; Natural recovery for residuals in 6 months based on biological testing
    - Assuming second pass required, dredge one foot and place 6-inch cap (adaptive decision matrix)
    - Required 50% re-dredging of cells
- Need: Post-Dredge Monitoring Data
Questions/Comments

• Natural recovery – Should include subaquatic vegetation as well as benthic community
• Details regarding limitations of use of environmental bucket available in literature
• Need for definition of critical specifications for dredge operations – Corps conference planned
• If capping required after dredging, why not cap in the first place?
• Some field data (Canada) suggest that marginal benefit associated with multiple passes

CAP Design and Performance

• Definition of CAPs
  – EPA: Isolation Only
  – Thin Layer CAPS not CAPS
• “Emerging Technology”?  
  – Sand CAPS: No
  – Active CAPs: Yes? Anacostia River Study in Progress
• Niche applications for hydrophobic chemicals – Primary transport mechanisms becomes pore water migration following placement of CAP
• Models and guidance documents available
CAP Design and Performance

• Anacostia River Study – Active CAPs
  – Sand
  – Apatite
  – Aqua Block
  – Coke
• Observations:
  – Can place material in thin layers
  – Gas evolution can be significant
  – Groundwater upwelling/seepage modified by CAP
  – DNAPL migration possible through voids

CAP Design and Performance

• Case Study: Dredged Material Disposal in San Juan Bay
  – Examine “Contained Aquatic Disposal”
  – Chemical of Interest: Selenium
• Conclusions:
  – Thin CAPs work – Question: How thin can they be?
  – Thickness of bioturbation is important
### Questions/Comments

- Sand and Aquablock were not mixed during testing in Anacostia River
- Addition of carbon to sand can help slow down contaminant flux but will not eliminate it, at least at steady state conditions

### Biological Processes: Biodegradation and Bioturbation

- Limiting processes for biodegradation: Kinetics of desorption and/or dissolution or lack of substrate (energy source) for growth of microbial population?
- Sediment as Source or Sink? Effects of CAP on biological processes and contaminant transport?
- Role of bioturbation?
  - Mixing
  - Transport
  - Biodegradation
- Laboratory characterization protocol or determining bioturbation coefficients: Importance based on time-scale and spatial scale of interest
- Plants not considered important contributor to biological action, i.e., rhizosphere; help stabilization
Questions/Comments

• Literature suggests that presence of soot carbon dramatically affects partitioning of contaminants to water column – Likely to affect biodegradation?
  – Microbes can attach directly to contaminants and achieve degradation
  – Typically will do best in transition zones – more mixing and more oxygen
• Large spatial variability re: density of organisms
• Information regarding fluxes of PAHs into water column available from Thibodeaux study on contaminant fluxes from turbated sediments
• Few examples of scaling bioturbation to large scales – Are these data of great value? Hard to get.
  – Particle mixing has been addressed
  – Little regarding solute transport from sediment to pore water

Physical and Chemical Stability – Multiple Lines of Evidence

• Important for in-place Sediment Management Options: MNR, Capping, and Residuals
• Physical Stability
  – Extreme event analysis
  – Focus on potential for elevated risk; Movement of sediments will not necessarily result in an elevated level of risk
• Chemical stability
  – Need end state assessments to account for changes in chemical concentration, partitioning, and bioavailability
  – Assumed constant during extreme events
Reducing Uncertainty

• Options to Reduce Uncertainty
  – Improve Science
  – Collect Additional Data (As Appropriate)
  – Use Multiple Lines of Evidence

• Incorporate Multiple Lines of Evidence in an Iterative Assessment

Key Questions/Comments: Panel Discussion

• Dredging Decreases Uncertainty Associated with Sediment Management
  – Can point to impacted sediment and say it’s been removed from the waterway
  – How much risk reduction has really been achieved?
  – Evidence that greater uncertainty drives more aggressive solutions?

• Sediments: Sources or Sinks?
  – Significant anthropogenic carbon content acts as strong sorbent for hydrophobic organics
  – Capping: Influence (reduce) biodegradation and result in contaminant movement?
Key Questions/Comments: Panel Discussion

• Don’t forget iron chemistry and importance as contaminant scavenger
• Importance of transient Nepheloid layer over long periods of dredging?
• How do we integrate current state of knowledge to make informed decisions regarding remedies?
  – Define future use (Consider expansion of ecological habitat)
  – Use CSM to define plausible pathways to achieve desired end state: Be honest about what is known or unknown
  – Eliminate options based on ability to achieve future end use conditions and associated risk to get there

Key Questions/Comments: Panel Discussion

• Try to avoid using quantitative limits for criteria such as resuspension as basis for making remedial decisions – Too much uncertainty
• Need good contractors who are part of the process from the beginning and who have been given proper incentives
  – Example provided: One pass dredge meeting criteria using four different buckets to address different conditions and with an incentivized contractor