

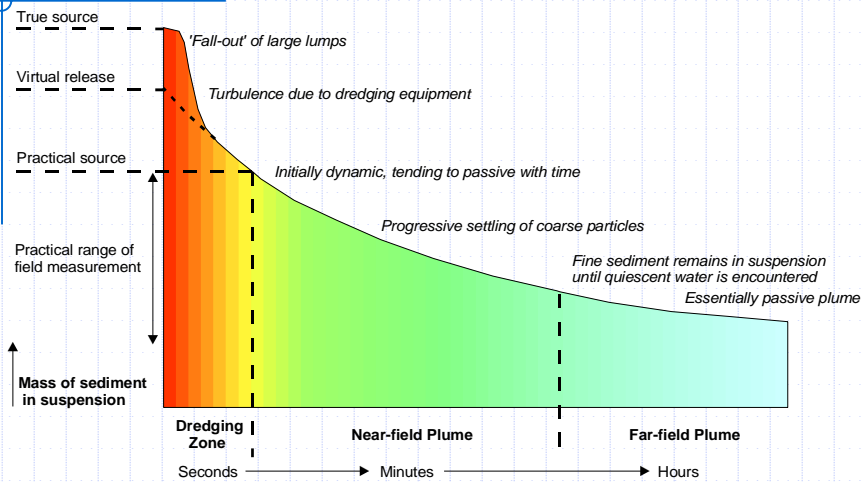
Understanding, Predicting and Monitoring Contaminant Releases During Dredging

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What Are Dredging Releases?



Primary Concerns With Dredging Releases

- Main concerns are effects due to:
 - Water column releases during operations
 - Bed contamination outside of the dredging zone

- Concerns about re-deposition within the dredging zone are related to evaluating residual impacts
 - Not a focus of this presentation



Factors Affecting Contaminant Releases

- Suspended particulate
 - Equipment
 - Operation
 - Physical properties of sediment and debris

- Dissolved
 - Porewater releases
 - Dissolution/partitioning from suspended solids
 - ◆ Dredging Elutriate Test (DRET)



Mechanical Dredge Operation

➤ Release processes

- Bottom wake
- Expulsion during closing
- Stripping during raising
- Draining during slewing
- Washing during descent
- Lost loads from debris



➤ Operator controls

- Cycle time
- Depth of cut
- Debris removal

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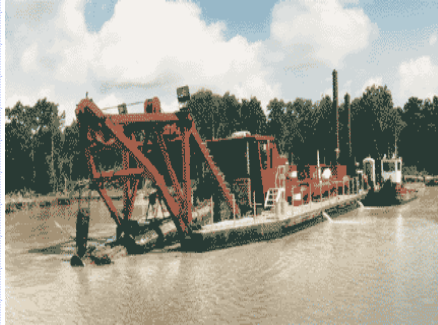
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Hydraulic Dredge Operation

➤ Factors affecting release rate:

- Pump rate
- Cutterhead speed
- Swing speed
- Depth of cut
- Direction of cut
- Debris
- Banks



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Solids Releases

➤ Equipment

- Mechanical dredges
 - ◆ Open → 0.5 to 10% loss rate
 - ◆ Closed /Sealed → 0.2 to 3% loss rate
- Hydraulic dredges → 0.2 to 3% loss rate

➤ Production versus turbidity control

- Operator feedback

➤ Erosion

- Weakening of sediment structure
- Entrainment of water in residuals



Dissolved Contaminant Releases

➤ Entrainment of porewater

- 0.5 to 10% loss rate

➤ Dispersion of particulate and dissolution/partitioning of particulate-associated contaminants

- Function of variable contaminant properties, availability and kinetics

➤ Advection and diffusion from residuals and face of dredge cut



Controlling Releases: **Silt Curtains**

- **Solids controls**
 - Limit dispersion and advection
 - Promote sedimentation
 - Restrict releases to bottom of water column, reducing spreading

- **Dissolved contaminant controls**
 - Reduce flow through area, thereby decreasing dissolved mass loss



Predicting Impacts: **Near-Field Models**

- **Two primary purposes**
 - Evaluate source strength
 - Evaluate acute impacts in vicinity of dredge-head during operations

- **Spatial scale is restricted to ~10 m from dredge-head**

- **Examples of available models**
 - DREDGE (USACE)
 - TASS (Wallingford)



Predicting Impacts: **Far-Field Models**

- Primary purpose
 - Evaluate impacts during operational and post-dredge periods
- Spatial scale ranges from ~ 10 m to > 1,000 m from dredge-head
- Examples of available models
 - Particle tracking models
 - ♦ **SSFATE (USACE)**
 - Plume models
 - ♦ **DREDGE (USACE)**
 - Sophisticated models
 - ♦ **Coupled hydrodynamic-sediment transport-contaminant transport models**



Predicting Impacts: **Sources of Uncertainty**

- Loss rates of solids and COC during dredging
- Assumptions and approximations in model structure
- Site-specific data
 - Spatial heterogeneity
 - Specification of model parameters
 - Model calibration and validation



Predicting Impacts: **Stochastic Approach**

- Consider distributions of
 - Releases
 - Contaminant concentrations
 - Partitioning/availability
 - Flow
 - Production
 - Control efficiency

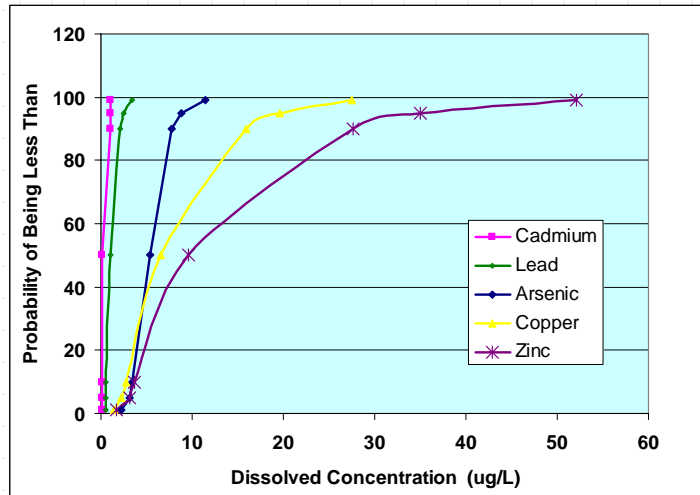


Predicting Impacts: **Milltown Reservoir**

- Metals contaminated Clark Fork River above Missoula, MT
- Hydraulic dredging
- Monte Carlo simulation
 - Used 10 levels of flow, background, solids resuspension: 5th to 95th percentiles
 - Used 27 paired metals concentrations and distribution coefficients
- Sensitivity of silt curtain performance
 - Velocity reduction
 - Width of silt curtain



Predictions Without Silt Curtains



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Monitoring of Dredging Operations

➤ Difficulties

- Selecting proper spatial and temporal scales
- Working near the source
- Distinguishing suspended solids from residuals
- Unsteady source
- Variable flow field
- Variable background conditions



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New Sampling Protocols for Monitoring

- **Developed by ACCORD to quantify solids releases**
- **ACDP and solids sampling**
- **Multiple locations and times**