Contained Aquatic Disposal (CAD)/Capping

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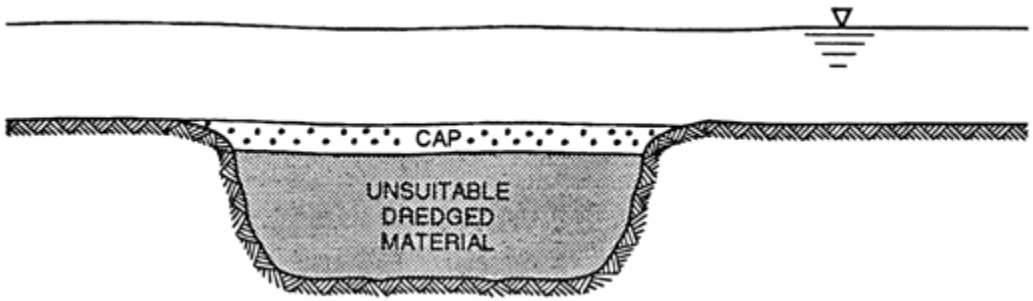
Purpose

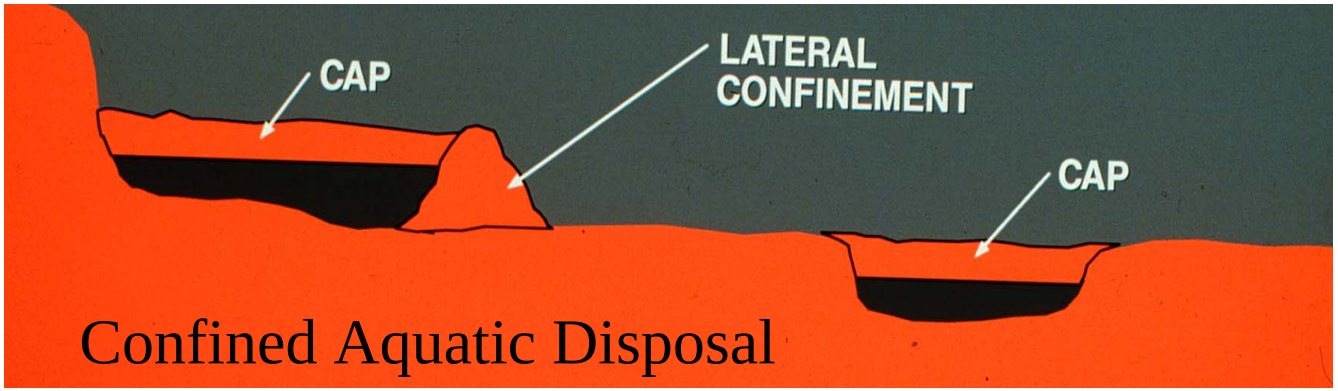
Manage risks from contaminated material by:

- **Physical isolation of contaminants**
- **Reduction of contaminant flux**
- **Physical stabilization**
  - Limiting losses during placement
  - Reducing mobilization and erosion



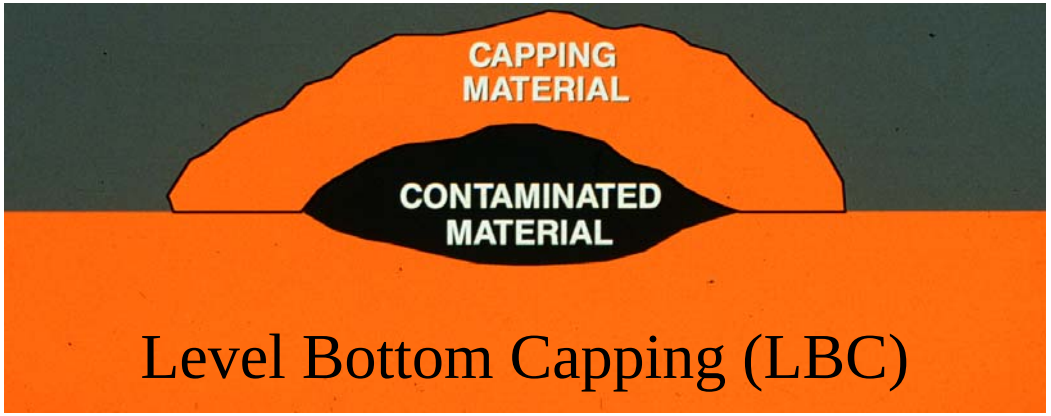
CAD Approaches

- **Existing Pits/Fills or Excavated Pits – (most stable)**
- **Lateral Confinement**



Confined Aquatic Disposal

- **Mounds**



Level Bottom Capping (LBC)

Where has CAD been done?

- New York
- Boston
- Los Angeles
- Netherlands
- Belgium
- Hong Kong
- Brazil
- New Bedford, MA
- Portland, OR
- Puget Sound, WA
- Duwamish, WA Demo
- Puerto Rico

Considerations

- Site Conditions and Sediment Characteristics
- Design and Disposal Objectives
- Design and Construction
- Placement Methods
- Placement Losses
- Dredged Material Strength and Consolidation
- Cap Stability and Design
- Cap Placement
- Habitat Restoration
- Monitoring and Maintenance

Site Characterization for Selection

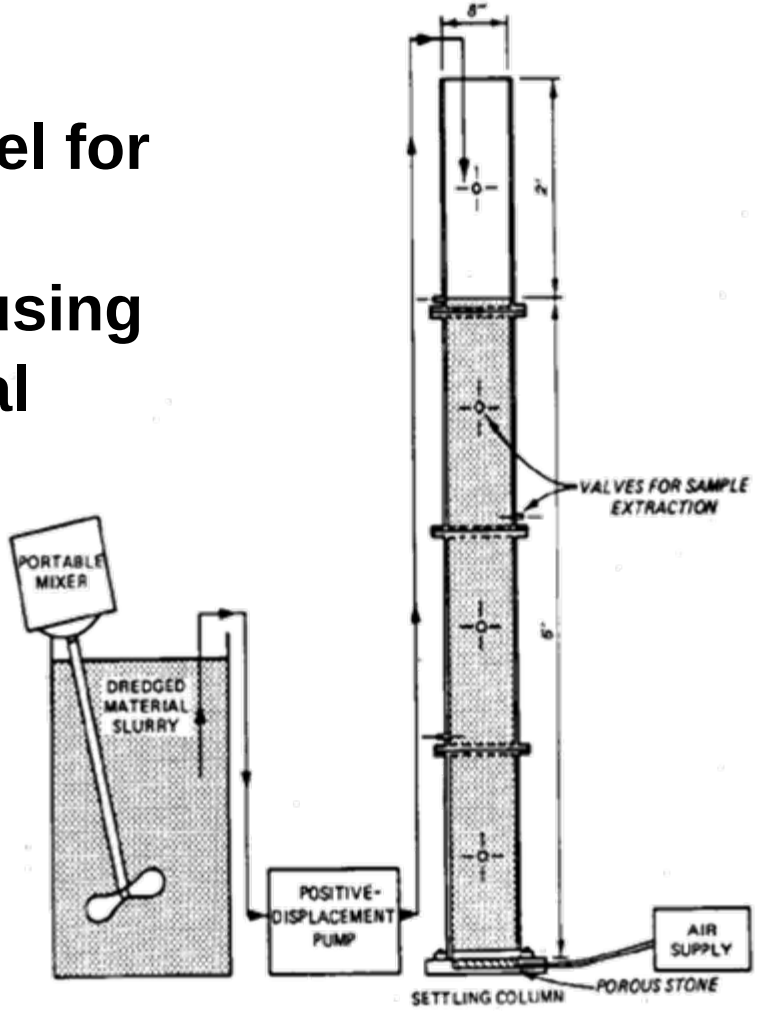
- Physical environment
- Environmental setting
- Hydrodynamic conditions
- Access
- Geotechnical/Geological conditions
- Hydrogeological conditions
- Sediment characterization and stability
- Waterway uses

CAD Design Objectives

- **Accommodate projected volume of dredged material**
- **Control releases of dredged material or associated contaminants to the water column within acceptable limits**
- **Control bioavailability of contaminants in surficial sediment biozone**
- **Maintain stability in response to physical, chemical and biological processes**
- **Consider habitat restoration/creation**
  - Recolonization: Biodensity and Biodiversity
  - Substrate: Grain Size and Nutrients
  - Vegetation: Elevation and Turbidity Control

CAD Sizing for Storage Capacity

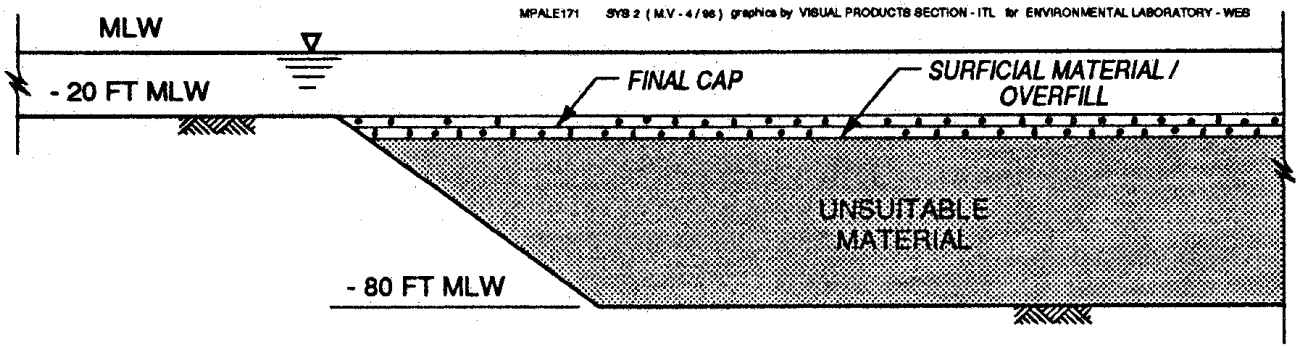
- Compression settling test analysis using SETTLE model for hydraulic placement or consolidation test analysis using PSDDF model for mechanical placement
- Examine range of dredging rate and conditions
- Analyze range of parameters



CAD Design and Construction

- Site selection: existing pits or excavation
- Access and exposure
- Ocean disposal of excavated materials or use for capping material
- Excavation depth
- Side slopes

- Fill limitations
- Surface Area
- Shape/ L:W ratio
- Number of cells
- Orientation
- Volume changes

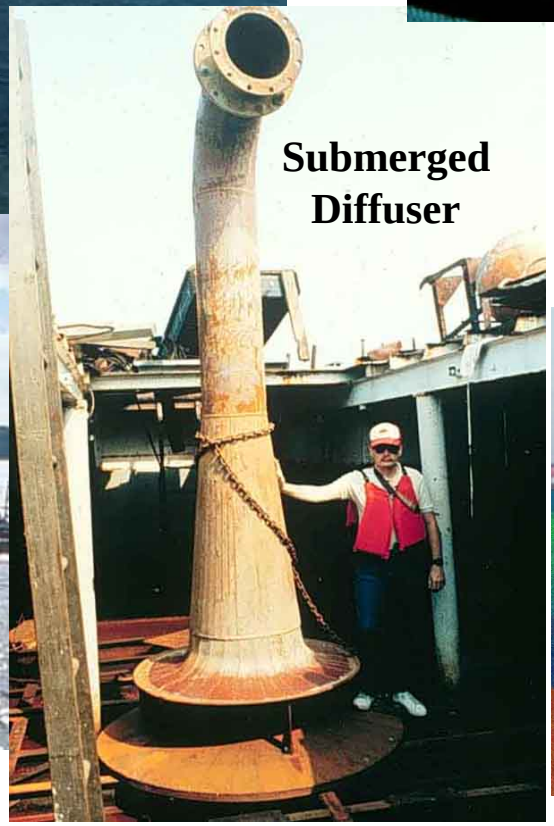


MAXIMUM ANTICIPATED EXCAVATION

Placement Methods

Hopper, NY Mud Dump

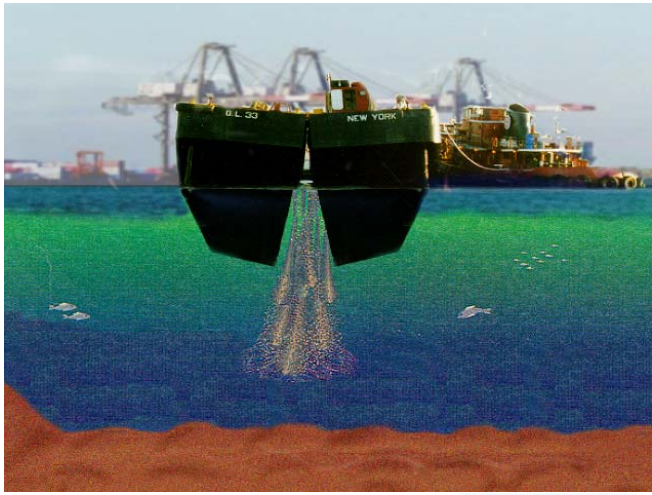
One Tree Island Marina



Submerged Diffuser

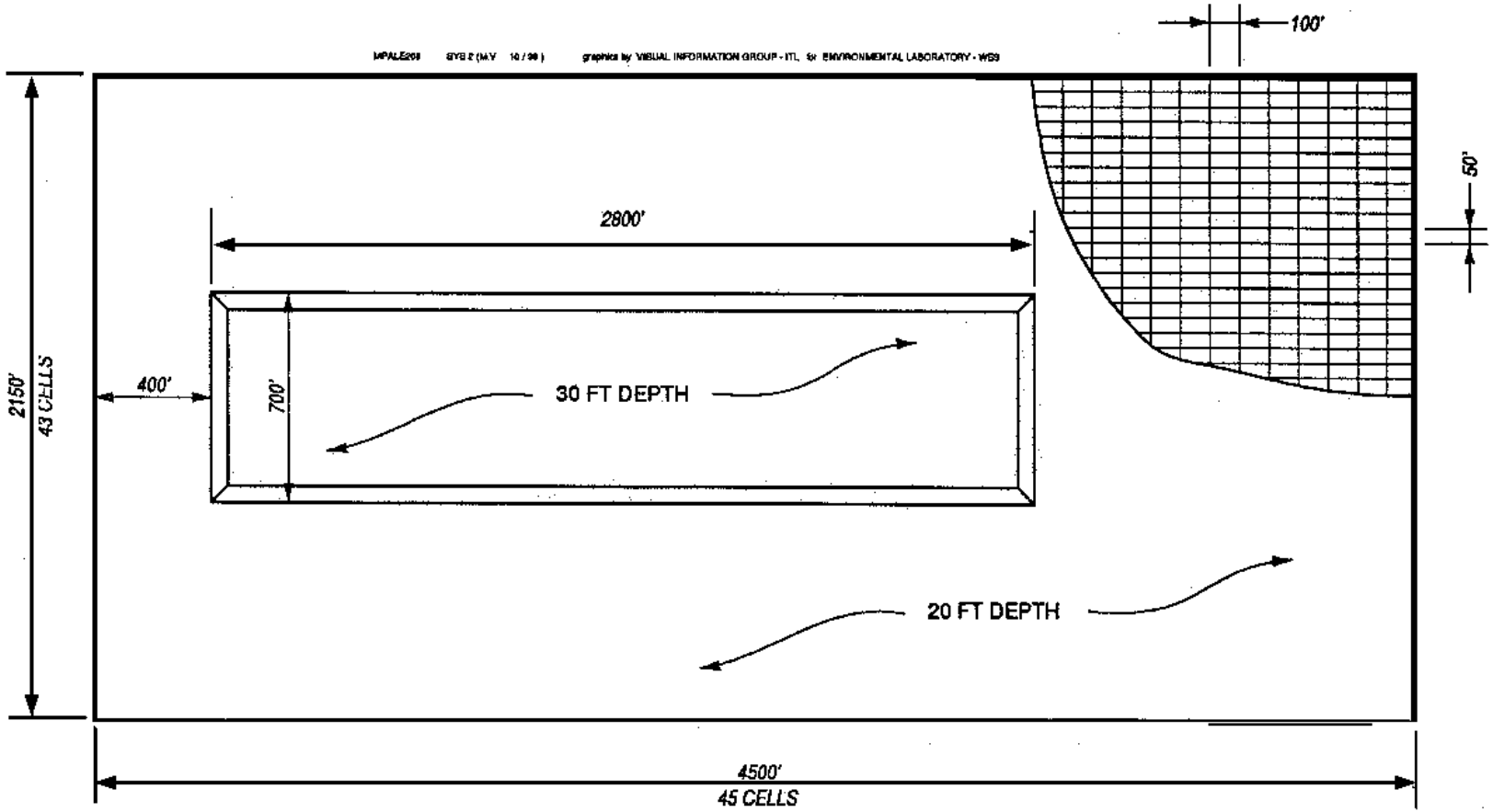
See TN at:
http://el.erdc.usace.army.mil/elpubs/pdf/doerr9.pdf

Denny Way CSO



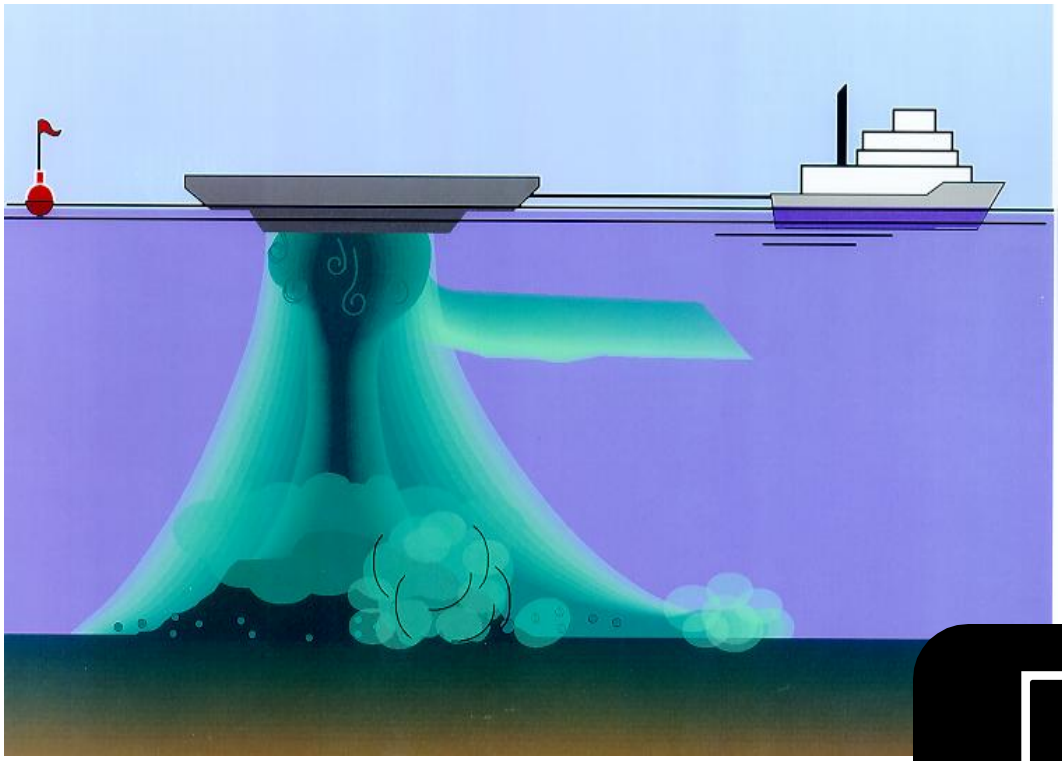
In-Pit Retention of Material

Illustration of STFATE grid for pit retention efficiency simulations

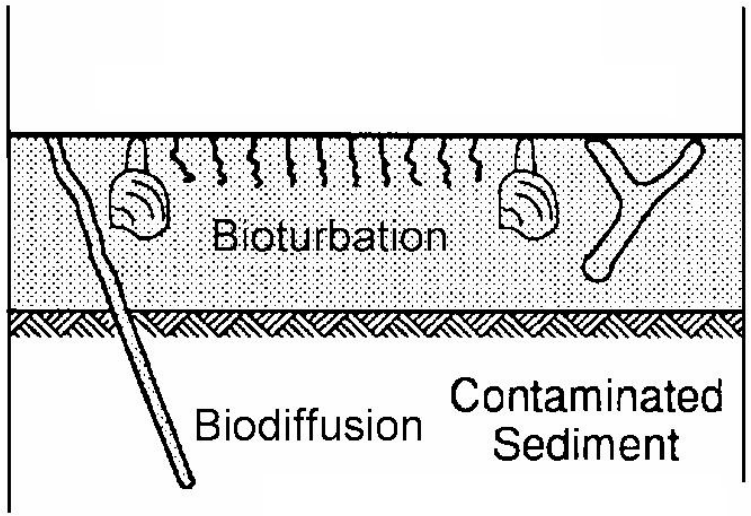


FATE Models

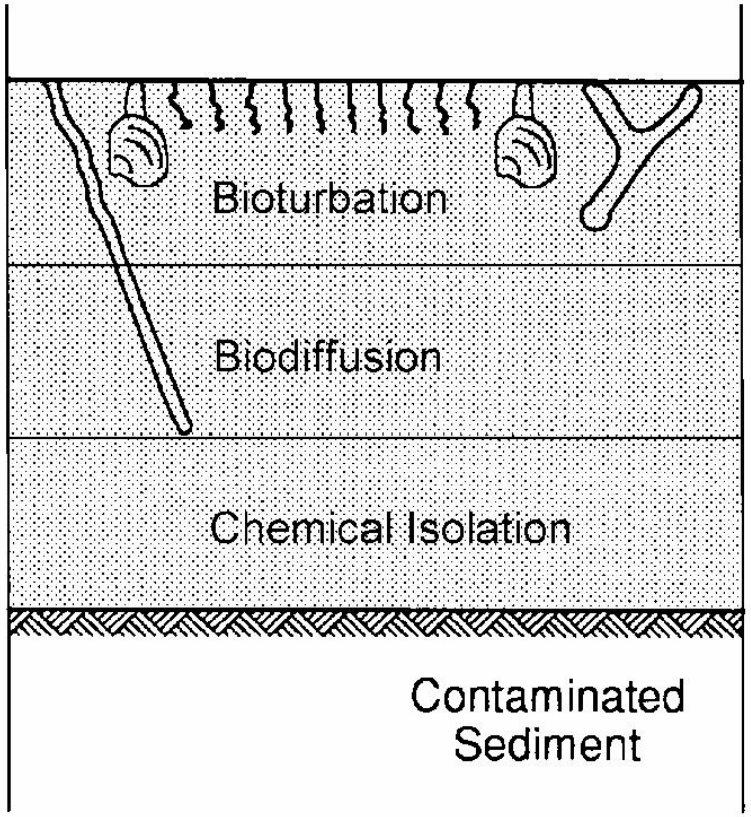
- STFATE
- MDFATE
- LTFATE
- CDFATE
- SSFATE
- DREDGE



Cap Designs

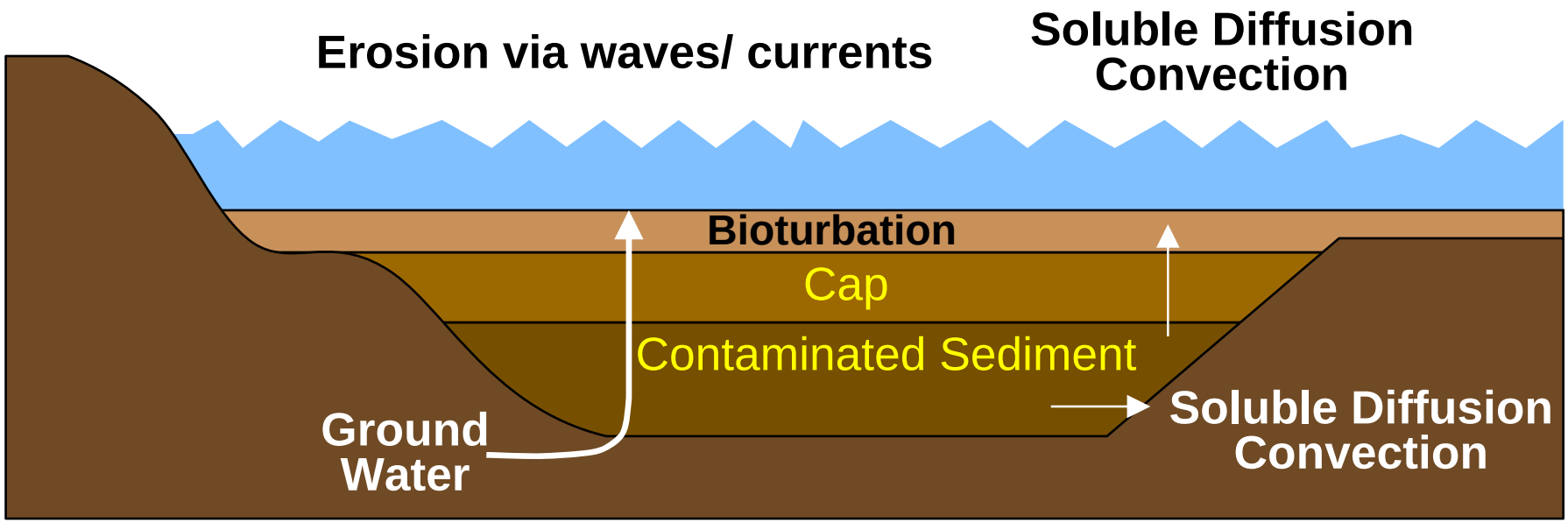


Minimal Isolation Capping

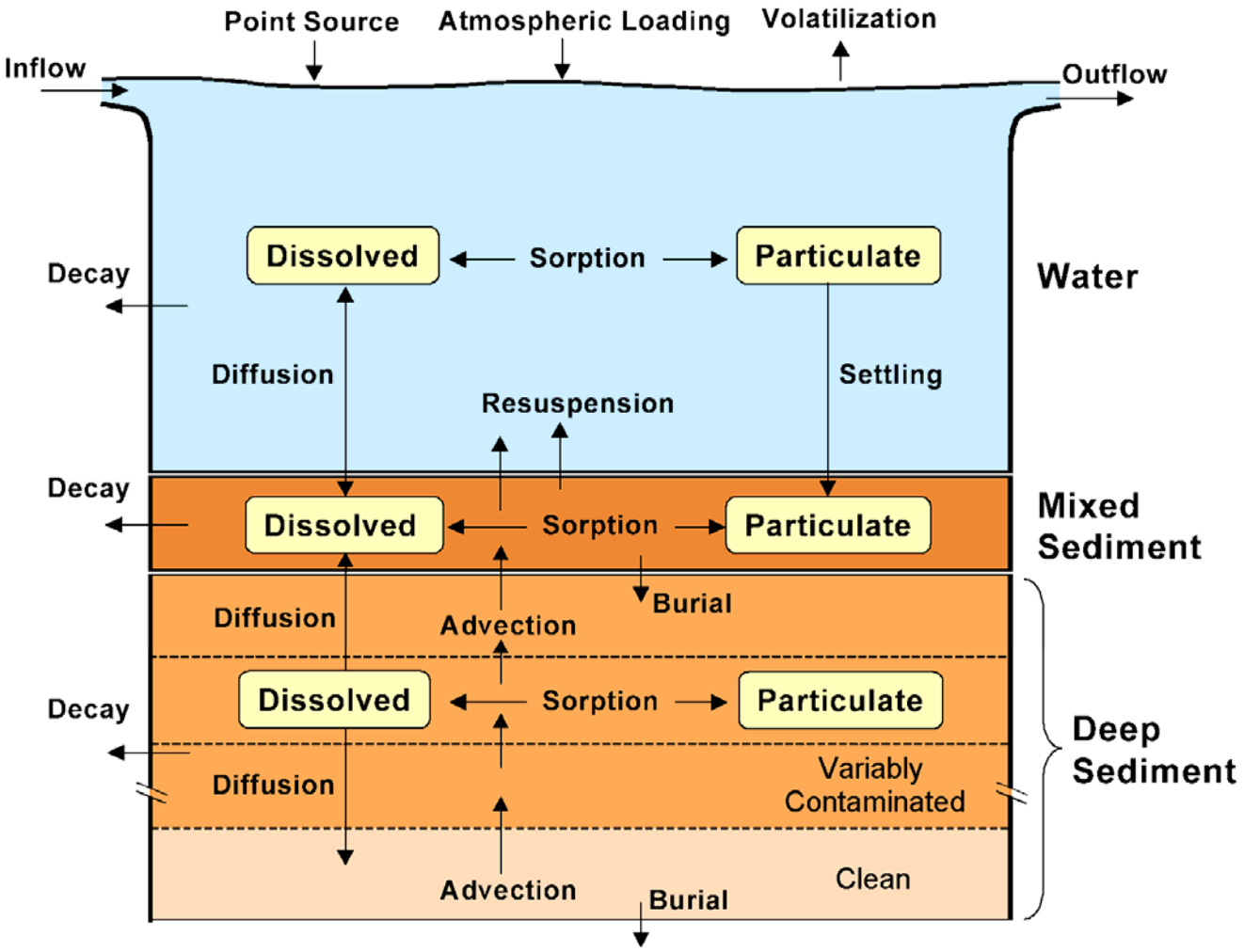


Isolation Capping

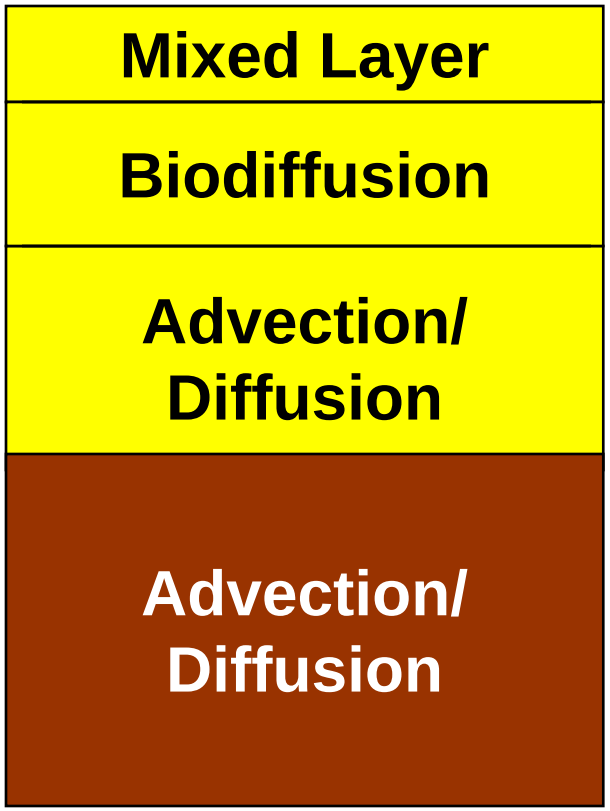
Migration Pathways for Contained Aquatic Disposal (CAD)



Models are needed for long term effectiveness evaluations



Cap Design

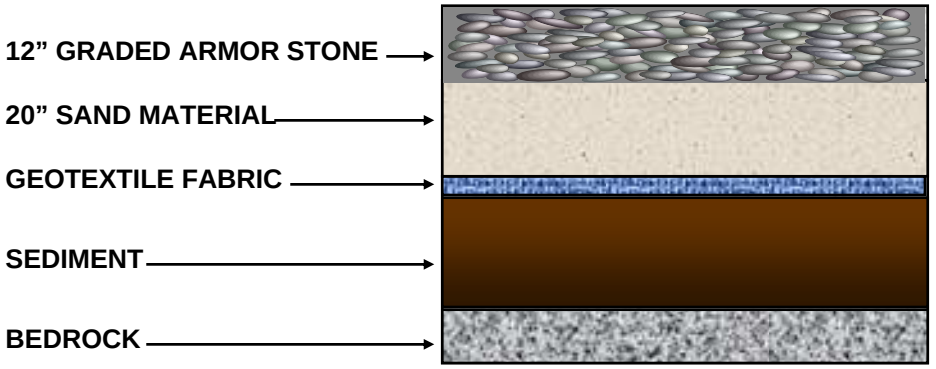


Designed to accommodate:

- **Advection/ Diffusion**
- **Bioturbation**
- **Erosion**
- **Consolidation**
- **Operational factors**

CAP Design Specifications

- **Cap thickness designed to prevent breach from:**
  - Props
  - Anchors
  - Fishing trawlers/nets
  - Storm waves
  - Flood currents
- **Materials**
  - Erosion control – armor, cohesive
  - Contaminant control
  - Habitat



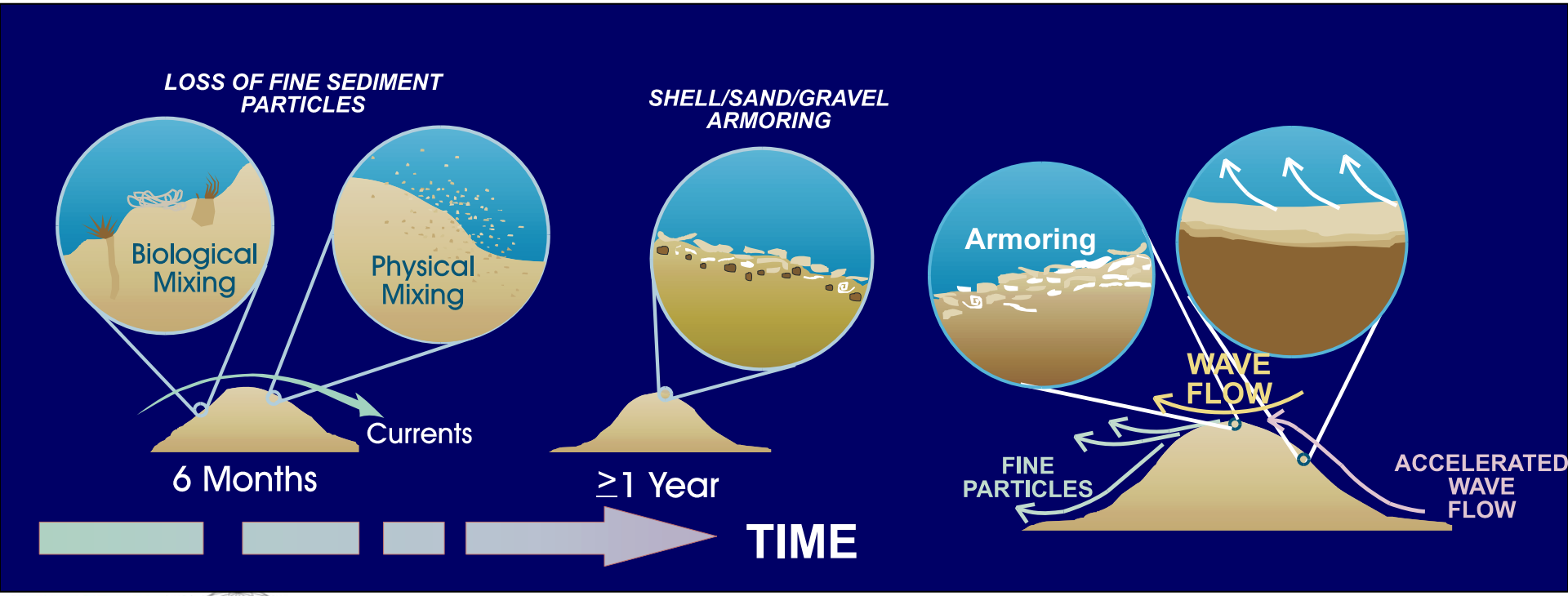
Example Cap Design

Capping Materials

- **Granular Materials**
  - Sediments
  - Soils
  - Quarry run materials
- **Amendments**
  - Adsorbents
  - Reactants
- **Fabrics, Membranes and Specialty Materials**
- **Armor Stone**

Physical Cap Processes

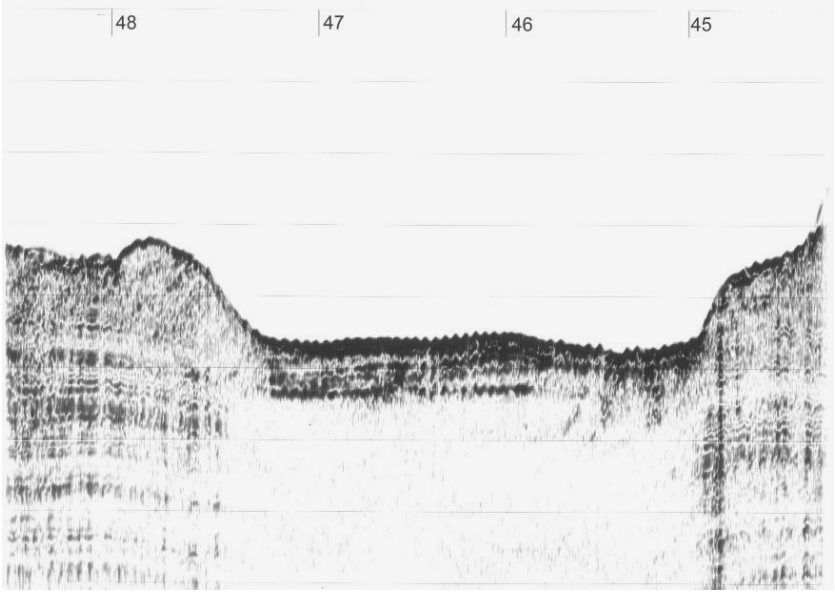
- **Erosion and Armoring/Winnowing/Bed Load**
  - Cap Elevation or Cap Thickness Distribution
  - Grain Size Distribution Profile throughout Cap Depth



Physical Cap Processes

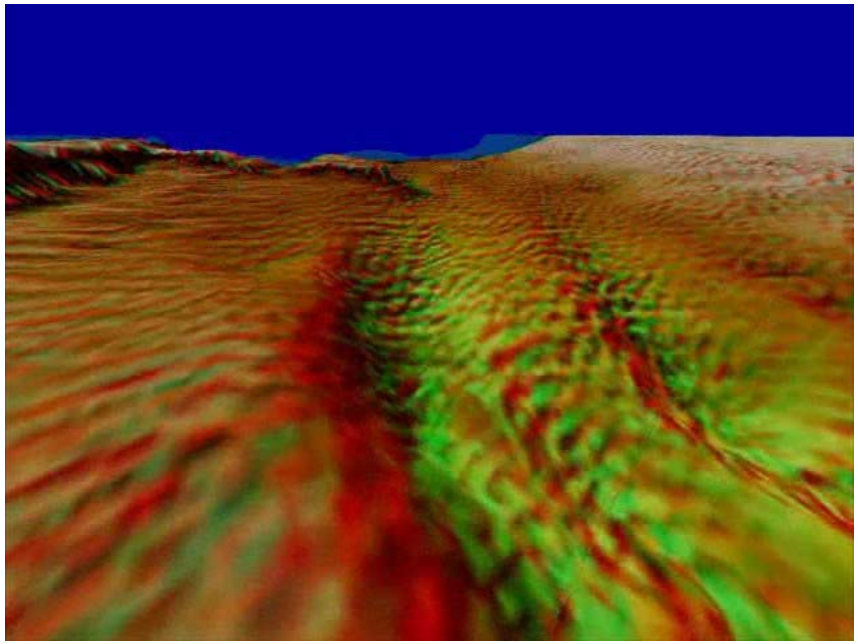
- **Deposition**
  - Cap Elevation or Cap Thickness
  - Contaminant Concentration, Organic Content, and Grain Size Distribution Profiles
- **Consolidation and Differential Settlement**
  - Cap Elevation or Cap Thickness or Settlement
  - Dry Bulk Density Profile throughout Cap Depth
  - Shear Strength/ Cap Support

Cap Thickness



Physical Cap Processes

- **Mixing and Disruption**
  - Visual Inspection
  - Geophysical Surveys



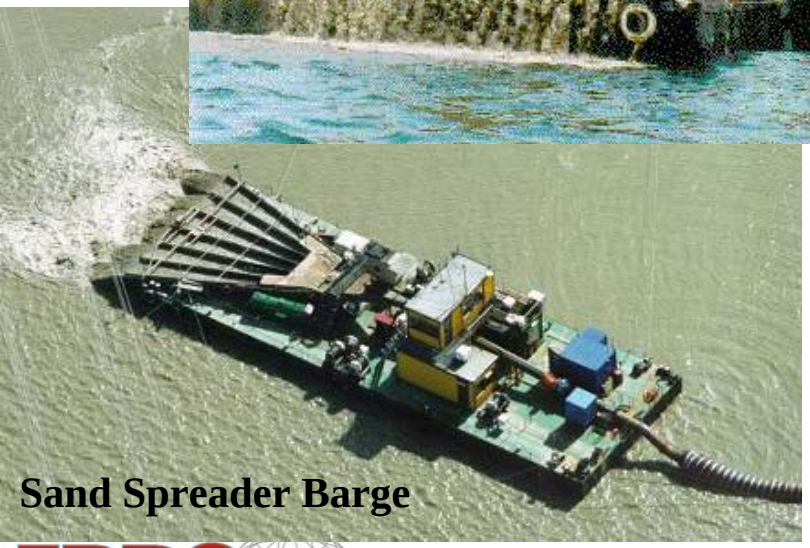
Cap Placement Methods


Baffle Plate on MS River


Eagle Harbor


Eagle Harbor

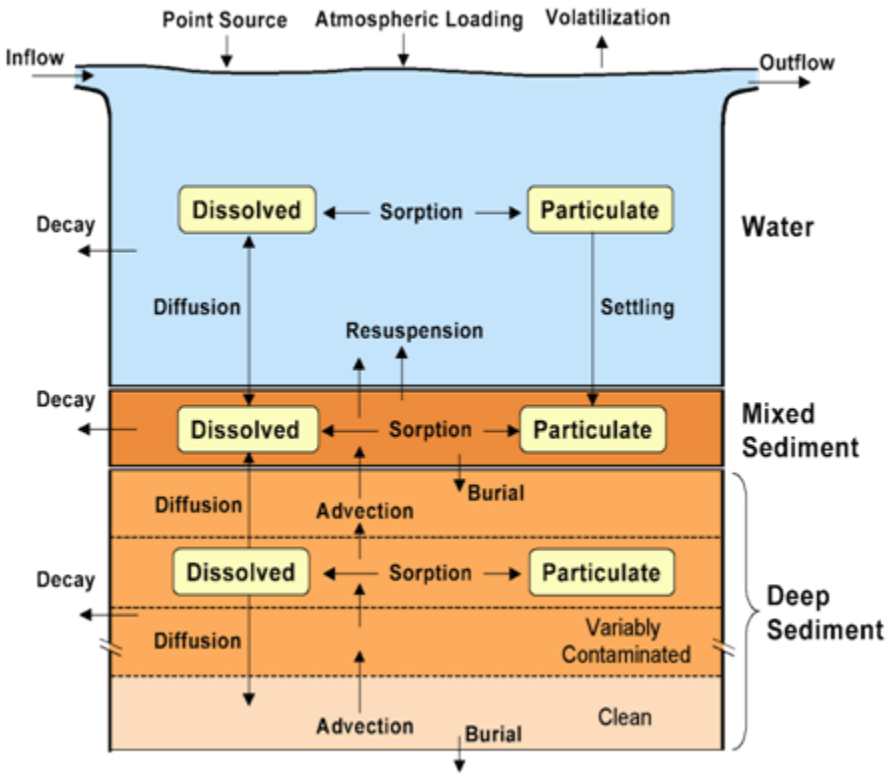

Sprayed slurry system placing sand at Soda Lake, WY


Sand Spreader Barge


Simpson-Kraft Sand Box

Chemical Cap Processes

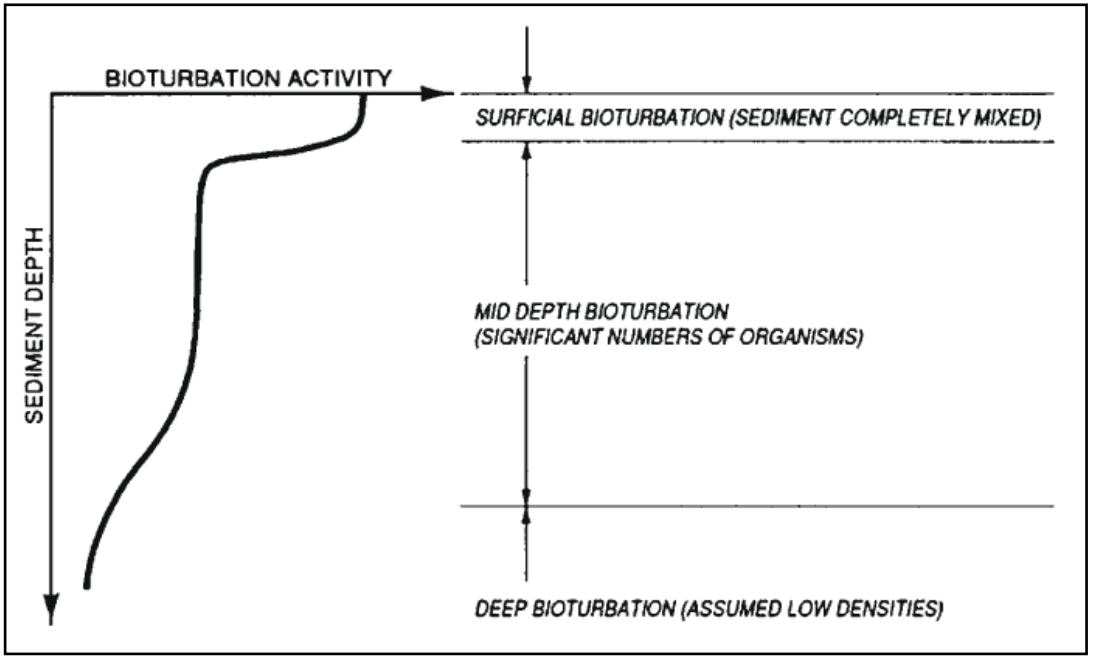
- Diffusion
- Advection/Convection
- Biotic Degradation
- Abiotic Degradation
- Adsorption/Retardation
- Volatilization/Stripping by Gas Transport



Biological Cap Processes

- **Recolonization**
  - Benthic Population and Diversity
- **Bioturbation**
  - Total Concentration Profile
  - Porosity, TOC and Grain Size Profile
- **Biouptake/ Bioaccumulation**
  - Benthic
  - Water Column
- **Toxicity**

Conceptual Illustration of Bioturbation Activity vs. Sediment Depth



Monitoring

- Define Objectives
- Tiered Approach
- Equipment and Methods
- Construction Monitoring
- Cap Performance Monitoring
- Monitoring Plan

Sediment Profiling Camera (SPC)

Maintenance and Rehabilitation

- **Assess findings to establish needs by comparing with performance predictions, considering natural processes**
  - If in agreement or better, adapt monitoring plan to findings
  - If contradicts predictions, determine processes of interest
  - Perform process-based confirmation monitoring
  - Determine maintenance and rehabilitation needs
- **Maintenance: Restores performance in response to extreme events**
- **Rehabilitation: Upgrades performance to achieve long-term performance goals**

QUESTIONS?

- **USACE guidance for DM capping**
  - http://www.wes.army.mil/el/dots/doer/pdf/trdoer1.pdf
- **EPA (ARCS) guidance for ISC**
  - http://www.epa.gov/glnpo/sediment/iscmain/index.html