SUSTAINABLE SEDIMENT MANAGEMENT AND DREDGING SEMINAR
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GALVESTON, TX

Engineering and Operational Controls
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Overview

• Approach and Concepts
• Aquatic Placement Controls
• Upland/Nearshore Placement Controls
Risk

If it is determined that unacceptable risk(s) exist, Engineering and/or operational controls must be evaluated for effectiveness for the site and sediment conditions.
Concepts

Risk is managed by controlling the exposure -- concentration and duration.

Exposure can be reduced by reducing the source concentration, the total mass released, or the rate of release and by altering the release locations.
Engineering Control

Definition: Requires a physical technology or modification of the placement site or design to cause the desired change in conditions.

Source: Geotechnical Supply Inc
Operational Control

**Definition:** Action that can be undertaken by dredge operator to reduce unacceptable risks of the dredging operations using existing equipment.
Control Applications

Changes in dredging equipment and/or operations can modify:

the total mass released, the rate of release and the release locations

But changes in dredging equipment and/or operations involves tradeoffs:

- dredge production rates,
- project duration,
- costs,
- etc.
Engineering Controls -- Size Matters

- As size increases:
  - Production rate increases,
  - Concentration of resuspended sediment increases, and
  - Availability dilution decreases.
Aquatic Placement Controls
Aquatic Control Measures

- **Water Column Management**
  - Submerged discharge
  - Silt curtains
  - Geocontainers
  - Treatment (polymer addition, sequestration)
  - Reduce discharge rate
  - Promote mixing (discharge while under tow)

- **Benthic Management**
  - Treatment
  - Lateral confinement or CAD
  - Capping with cleaner dredged material or armor
  - Geocontainers
Engineering Modifications

- Select different equipment type
- Select different equipment size
- Control placement operation
  - Location
  - Rate
  - Method
STFATE Evaluation of Alternatives

3000 CY Barge – Single Dump

Peak Lead Concentrations

Violation of WQS outside the mixing zone

WQS = 0.032 mg/L
STFATE Evaluation of Alternatives
1500 CY Barge – Single Dump
Peak Lead Concentrations

No violation of WQS outside the mixing zone

WQS = 0.032 mg/L
STFATE Evaluation of Alternatives
3000 CY Barge – Spreading Discharge

Peak Lead Concentrations

No violation of WQS outside the mixing zone

WQS = 0.032 mg/L
Submerged Discharge

- Can reduce water column dispersion
- Can improve accuracy of placement
- Pipeline configurations
- Diffuser design available
- Tremie technology
Silt Curtains

- **Purpose**
  - To control SS/turbidity in the water column (mainly at dredging site)

- **Advantages**
  - Can be used to protect sensitive environments
  - Can allow particles to settle out of the upper water column
  - Commercially available

- **Limitations**
  - Strong currents (> 1 knot/1.5 fps)
  - High winds
  - Debris/ice
  - Excessive wave heights
  - Fluctuating water levels
  - Must allow traffic in/out (such as bubble curtains)

Silt Curtains
Geo-containers

- Geotextiles used for solids containment
- Reduce water column entrainment
- Reduce water release rate
- Reduce water column dispersion
- Reduce capping requirements
- Engineering design approaches available
GEOTUBE DISPOSAL PHASES
CAD/Capping/Treatment

Purpose - Manage contaminant risks by:

- Physical isolation of contaminants
- Reduction of contaminant flux
- Physical stabilization
  - Limiting losses during placement
  - Reducing mobilization and erosion
- Reduction of bioavailability/bioaccumulation
CAD Approaches

- Existing Pits/Fills or Excavated Pits – (most stable)
- Lateral Confinement
- Mounds
- In Situ Capping

![Level Bottom Capping (LBC)](image1)

![Confined Aquatic Disposal](image2)
Capping/Treatment Considerations

- Placement and design of constructed cells
- Placement techniques for unsuitable material
  - Controlled, accurate
- Placement techniques for cap/treatment material
  - Even coverage or incorporation of adsorbents or reactants
  - Avoid displacing unsuitable material
- Cap/Treatment design – account for:
  - Bioturbation
  - Bioaccumulation
  - Recolonization
  - Consolidation
  - Contaminant transport
  - Erosion
Upland/Nearshore Placement Controls
Contaminant Pathways - Upland CDF

- Plant / Animal Uptake
- Volatilization
- Precipitation
- Surface Runoff
- Unsaturated
- Saturated
- Seepage
- Infiltration
- Leachate
- Weir
- Effluent
- Dike
- Contaminant Pathways - Upland CDF
Contaminant Pathways - Nearshore CDF
Upland/Nearshore Pathways Controls

- **Operational (During filling)**
  - Surface water management, production rates, sequencing placement, self-sealing

- **Treatment of Discharges**
  - Filtration, flocculation, treatment of dissolved constituents

- **Engineered Controls (Containment)**
  - Surface covers, liners, lateral containment

- **Site Management (After Filling)**
  - Surface water management, vegetation, dewatering, surface treatments
Effluent and Runoff Controls

- **TSS & Particulate Associated Contaminants**
  - Design & Operational modifications – increase retention time
    - Increase ponding
    - Reduce short-circuiting – baffles, spur dikes, inlets
    - Improve weir operation, locations and design
    - Limit fetch to reduce wind induced resuspension
  - **Filtration** – cells, permeable dikes and barriers
  - **Chemical flocculants**
  - **Engineered controls** – vegetation, capping
Filter Cell
Flocculant Addition
Runoff SS Controls

![Graph showing suspended solids (mg/l) over time (minutes) for different conditions: Veg, Detritus, Bare.](image-url)
Michigan City, MI
Effluent and Runoff Controls

- **Dissolved Contaminants**
  - **Treatment**
    - Carbon adsorption
    - Ion exchange
    - Chemical or UV oxidation
    - Biological – wetlands
  - **Dispersion**
    - Reduced discharge rate and controlled release
    - Dispersed discharge and extension into flow field
Calumet Harbor, Chicago, Illinois
Leachate Controls

- **Liners and Drains**
  - Geomembranes
  - Clay for coarse-grained materials
  - Collection and dispersion

- **Amendments**
  - Stabilizing agents
  - Adsorbing or precipitating agents such as activated carbon to control organics or apatite to control certain metals
Cut Off Walls
Waukegan Harbor, Illinois
Parrot Beak,
Rotterdam, The Netherlands
Volatilization Controls

- **Activated Carbon Applications**
  - CDF pond
  - Slurry
  - Provides control during active placement

- **Capping** (long-term control)
  - Prevent exposed condition by maintaining pond
  - Cover dredged material with clean material
  - Provides post-placement control
Contaminant Uptake Management & Controls

- Manage vegetative cover
- Amendments/treatments to reduce bioavailability
- Cap to reduce exposure
- Others more site specific depending on target species
Questions?