Monitoring and Adaptive Management

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RISK ASSESSMENT PARADIGM

- Exposure Assessment
- Problem Formulation
- Effects Assessment
- Risk Characterization

Risk = 1 / (Exposure + Effect)

Economic Analysis, Socio-Political, Engineering Feasibility

Risk Management

Dredged Material Assessment and Management Seminar
15-17 September 2009, Detroit, MI
Topics

- Uncertainty and the Role of Monitoring
- Compliance Monitoring and Adaptive Management
- Development of a Monitoring Plan
- Monitoring Considerations
- Monitoring Components
- Adaptive Management
- Adaptive Management Components
- Example Case Study
Roles of Monitoring

- Traditionally
  - To assure compliance with regulatory requirements
  - Water and air sampling at points of compliance for comparison with water and air quality standards

- Adaptively
  - To support the risk paradigm
  - To address uncertainties in exposure data and source strength
  - To address uncertainties in effects data
  - To learn from the project and provide data for future assessments
  - To support adaptive risk management alternatives
  - To assure effectiveness of control measures
  - To assure compliance with risk goals and regulatory requirements
Development of a Monitoring Plan

• What? Parameters to be Monitored
• Where? Locations
• When? Frequency
• How? Techniques
• Who? Resources: budget, equipment, time and skills
• Why? Data Calibration, Processing and Analysis and Reporting
• OK? Does it satisfy the objectives?
Monitoring Considerations

- **Unsteady Source**
  - Dredging is intermittent, processes are cyclic

- **Moving Source**
  - Hopper dredge travels more than 5 miles in a 60-minute cycle
  - Cutterhead swings over a width of 22 - 250 ft at a rate of 0.5 - 1 ft/sec
  - Auger dredges advances about 500 ft/hr

- **Multiple Sources**
  - Dredgehead, overflow, props, anchors, etc.
  - Bottom and surface

- **Unsteady Flow**
  - Tides
  - Wind

- **Exposure Pathway for Receptors of Concern**
Stressors and Components

- **Turbidity and TSS**
  - Discrete samples from multiple depths and locations
  - Continuous discrete locations – OBS grid
  - Periodic transects – ADCP
  - Calibration samples to estimate TSS from OBS and ADCP

- **Total Mass Loss and Loss Rate**
  - TSS (requires background sampling as well)
  - Flow
    - ADCP
    - Gages
    - Current meter transects
    - Models
Stressors and Components

- **Deposition**
  - TSS
  - Settling characteristics
  - Shear stress characteristics
  - Sediment traps
  - Modeling

- **Total Contaminant Mass Loss and Loss Rate**
  - Discrete samples from multiple depths and locations analyzed for TSS, dissolved and total contaminant concentration
  - TSS
  - Flow
  - Sediment density, volume and bulk sediment contaminant concentrations
Adaptive Management

- **Traditional Approach**
  - Implement controls
  - Monitor to ensure risk goals are being attained

- **Adaptive approach**
  - Implement initial controls
  - Monitor
  - Assess impact/efficiency of controls
  - Adapt controls and possibly increase or reduce controls
Adaptive Management

• Adaptive management should be used when:
  ➢ High degree of uncertainty in the risk characterization
  ➢ High degree of uncertainty in the effectiveness risk management controls
  ➢ High costs of risk management

• Adaptive management leads to:
  ➢ Learning and a better explanation/understanding of the system
  ➢ Increase effectiveness of risk management
  ➢ Lower costs
  ➢ Better decisions
Adaptive Management Approach

- Develop short-term and long-term control alternatives
  - Turbidity and TSS concentrations
  - Contaminants concentrations
  - Flux (flow augmentation)
  - Total loss
- Establish action triggers for the risk management
  - Effects-based criteria
  - Exposure modeling
  - Risk characterization
- Develop a control plan and implement
- Establish an active compliance monitoring plan and implement
Adaptive Management Approach

- **Establish a response plan for triggers**
  - Implement short-term control measures (such as stop overflowing or pause dredging)
  - Assess impacts
  - Analyze event data – cause and effect -- learn
  - Determine need for long-term controls
  - Implement long-term controls (such as slow production, install silt curtain, restrict overflow or seasonal restriction)
  - Assess impacts

- **Update control, monitoring and response plans**
- **Perform ecological response monitoring of environmental resources to ensure that effects-based triggers are effective at achieving risk goals**
Toddaho Adaptive Management

- **Risk Characterization Results**
  - Minor to moderate effects on juvenile salmonids
  - Potential burial of fish eggs; particularly from open water placement by hopper dredge
  - No exposure pathway to mussel bed

- **Risk Management Control Options**
  - Environmental bucket instead of open bucket
  - Silt curtains for clamshell dredging
  - Managed placement (spread placement along upstream side of open water placement site)
  - Seasonal restriction / environmental window

- **Action Triggers**
  - Turbidity greater than 10 NTU above background midway between channel and spawning habitat
  - Turbidity greater than 100 NTU in upper 15 ft of channel bottleneck
Toddaho Adaptive Management

- **Initial Controls**
  - Environmental bucket

- **Monitoring plan**
  - Three ADCP transects daily midway between channel and spawning habitat and midway between placement site and spawning habitat for first 3 days
  - TSS calibration sampling
  - Three transects twice a week thereafter
  - Additional transects if change in currents and wind
  - Surficial turbidity/TSS sampling in channel bottleneck
**Toddaho Adaptive Management**

- **Response Plan**
  - If turbidity transport is greater than trigger at dredging site, install silt curtain in adjacent reaches.
  - If turbidity transport is greater than trigger at placement site, dispose from stationary position under favorable currents.
  - If turbidity in fish passage is greater than trigger, install silt curtain or decrease bucket speed.
  - If turbidity is greater than 300% of triggers on three consecutive monitoring passes, stop dredging and impose environmental window.

- **Update controls, monitoring and response plan**
  - If turbidity is still greater than triggers with controls, stop dredging and impose environmental window.
  - If turbidity transport is still greater than trigger at placement site, dispose into CDF.
Questions?