



U.S. ARMY

SUSTAINABLE SEDIMENT MANAGEMENT AND DREDGING SEMINAR

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Monitoring & Adaptive Management

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Key Points

- ☐ Potential improvements involve uncertainty about the outcome
- ☐ Adaptive Management can effectively manage uncertainty
- ☐ Strategic monitoring is essential to adaptive management
- ☐ We routinely apply the principles of Adaptive Management



Innovation Involves Uncertainty

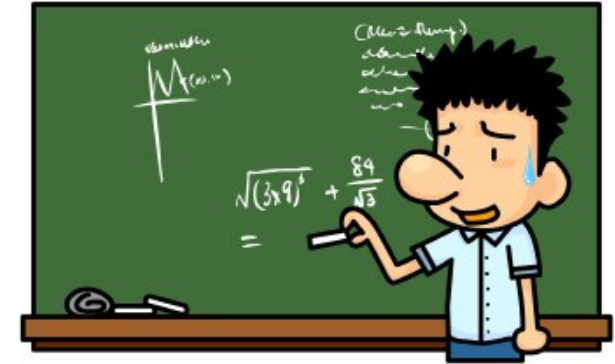
- ❑ Implementing new or modified sediment management practices results in an increased uncertainty of the outcome
- ❑ These uncertainties may yield:
 - Results better than historical practices or with benefits beyond those practices
 - Results similar to historical practices or no real benefits beyond those practices
 - Results inferior to historical practices or consequences not associated with those practices



Bottom Line: Uncertainty is a necessary ingredient of progress.

Managing Uncertainty

- ❑ Uncertainty makes us nervous
- ❑ Fear of failure is a powerful force
- ❑ 4 steps to managing uncertainty*
 - Acknowledge the uncertainty
 - Have a plan
 - Break down the process
 - Teamwork



*Ekekwe, N. "How engineers manage uncertainty," *Harvard Business Review*, 2010.

Managing Uncertainty

- ❑ Every project involves uncertainty, even those using “tried and true” approaches. A successful project requires:
 - Anticipating the range of potential scenarios
 - Predicting outcomes from these scenarios
 - Gathering data for “early detection” of concerns
 - Evaluating available data and determining if mid-course corrections are needed
- ❑ These are the components of an effective Adaptive Management Plan.



What is Adaptive Management (AM)?

□ Definitions

- “a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring.” (Wikipedia)
- “an intentional approach to making decisions and adjustments in response to new information and changes in context.” (USAID)



Adaptive Management Promotes Innovation

- ❑ A foundational premise of adaptive management is that *our knowledge is incomplete, but sufficient to develop new approaches that are likely to provide benefits beyond historical practices.*
- ❑ Expanding knowledge through traditional scientific inquiry is always limited by resources and time, thus solutions will be delayed. Moreover, *solutions developed solely through traditional scientific inquiry will not be accepted until they are proven in the field.*
- ❑ When these limiting factors are combined with resource scarcity, potential irreversibility, and requirements to meet ever-expanding demands, the *necessity to develop new ways to increase understanding, expedite the learning process, and directly inform decision-making and policy processes* becomes apparent.
- ❑ Adaptive Management offers a *scientifically sound course to enhance our knowledge* using a systematic evaluation of actions.

Modified from “Adaptive Management of Natural Resources: Theory, Concepts, and Management Institutions,” by George H. Stankey, Roger N. Clark, Bernard T. Bormann; USDA PNW-GTR-654, Aug. 2005.

Adaptive Management Leads To

- ☐ Learning/increase in knowledge
- ☐ Better understanding of the system
- ☐ Lower costs
- ☐ Better decisions
- ☐ Increased certainty in future efforts

Implementing Adaptive Management

- ❑ An formal Adaptive Management Plan is essential
- ❑ Scale is important, but not mutually exclusive
- ❑ Project-based adaptive management
 - Allows innovation on a narrow scale
 - Can provide valuable learning experiences
 - Limits exposure
 - Limits potential benefits
- ❑ Program-based adaptive management
 - Allows inter-project tradeoffs
 - Broader range of opportunities
 - Increased benefits
 - Increased exposure

Key Elements of an Effective Adaptive Management Plan

- ☐ Clearly stated objectives
- ☐ Description of potential benefits
- ☐ Identify areas of uncertain outcomes
- ☐ Monitoring strategy to provide data at critical points
- ☐ Clear structure to analyze data in a timely manner
- ☐ Decision strategy/criteria at critical points in the project
- ☐ Action triggers
- ☐ Budget to respond to unexpected outcomes

Monitoring to Support Adaptive Management

❑ Different from Compliance Monitoring

- Designed to assure compliance with regulatory requirements
- Locations, frequency, and analysis based upon standards

❑ Adaptive Management Monitoring

- Focused on areas of uncertainty
- Data collection and analysis must be timely
- Completeness and accuracy must be
 - ▶ Adequate to support decisions
 - ▶ Provide information for the current project
 - ▶ Provide data for future assessments
 - ▶ Support evaluation of adaptive management alternatives

Developing an AM Monitoring Plan

A comprehensive monitoring plan must address:

- ☐ Parameters to be monitored
- ☐ Monitoring Locations
- ☐ Monitoring Frequency
- ☐ Monitoring Techniques
- ☐ Required Resources:
 - Budget
 - Equipment
 - Personnel (time and skills)
- ☐ Instrument Calibration
- ☐ Data Processing, Analysis, and Reporting

Monitoring with a Purpose

- ❑ What do we monitor?
 - Fundamental parameters to confirm project assumptions (Non-decisionable)
 - Measurable project outcomes
- ❑ When do we monitor?
 - Fundamental parameters – usually set frequencies to minimize bias
 - Project outcomes – times that assist with adaptive decision making
- ❑ How do we monitor?
 - Approach to monitoring must be intentional
 - Temporally and spatially varying sources (many dredging related facets) particularly difficult; e.g. resuspension
 - Single-sample vs. continuous measurement
- ❑ Monitoring equipment – Availability, Security, Calibration

Data Synthesis and Analysis

- ❑ Data has value only if it is used!
- ❑ Adaptive Management plan must
 - Identify specific decision points
 - Specify data required to support decisions
 - ▶ Type
 - ▶ Quality
 - ▶ Frequency
 - Assign responsibilities
 - ▶ Synthesize data
 - ▶ Review data
 - ▶ Make decision on the data

Adaptive Management Example – Project Level

- ❑ Ship channel dredging project, routine maintenance
- ❑ Typical dredge is 16 to 18" cutterhead
- ❑ Direct discharge into Placement Area 14B; history shows no water quality concerns with typical 2' pond at weir.
- ❑ Low bid contractor plans to use 24" dredge; flow about double historical discharges
- ❑ State Environmental Quality raises concerns about meeting effluent WQ requirements



Adaptive Management Example – Project Level

- ❑ Example Adaptive Management Plan
- ❑ Implement WQ monitoring program at the beginning of the project to provide data
- ❑ Plan daily reviews of the data, with a range of potential responses if the data suggest effluent WQ may be an issue
- ❑ Potential responses:
 - Increase ponded water depth
 - Change the location and direction of inflow relative to the weir
 - Limit operating hours of the dredge; slow production
 - Add silt curtain to reduce wind impacts
 - Add flocculants



