Will Sediment Caps Last Forever? And How Should We Address the Possibility that They Don't?

Moderators

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Main Topics Today

- If you design it, we will build it, maybe…
- Monitoring remedy performance versus monitoring cap integrity
- Seismic risk and long-term cap integrity
- Financial assurance and regulatory acceptance
- Probabilistic modeling of long term monitoring cost

In-Place Capping of Contaminated Sediment…

- Caps can offer a sustainable solution, but questions about performance remain
- Capping is generally perceived to be lower cost than removal, but these cost may be converging
- What are the PRP exit criteria for capping? How do we gain confidence that caps will last, in some cases forever?
- How do we evaluate questions about long-term liability and use impairment for land owners
- When is capping a beneficial use

You design it, we will build it, maybe…

- Several factors effect the performance and longevity of a cap
- Design is where it starts
- Constructability issues can effect the final cap durability
- Contractor is building what is designed

You design it, we will build it, maybe…

- Factors to consider for a Bullet Proof Cap Materials
  - What's in the design vs. what's available
  - Exotic materials
  - Amendments and placement
  - Organic content, if there are fines, they will be gone
  - Just because its available does not mean there is enough
- Construction can have challenges
  - Caps don't do well on steep slopes
    - Hard to place and maintain a cap on a 2:1 slope
    - "Build the wedge."
  - High flows
  - Soft sediment
- Where are you building it?
- What are you building it with?
- Acceptance tolerances can become difficult
- Amendments

You design it, we will build it, maybe…

- Amendments and Design
  - Mixing and placement problematic
  - Validation of material placed
    - Samples based on average
- Placement tolerances
  - Needs to be on an average
  - Cores VS. Survey
  - Armoring
    - Average tolerance
    - Hard to meet a 6” tolerance placing 12” stone
- How do you fix it if it breaks? That’s the big question.
  - What’s broken?
  - Why is it broken?
  - Big break or small

Distinguishing remedy and cap performance

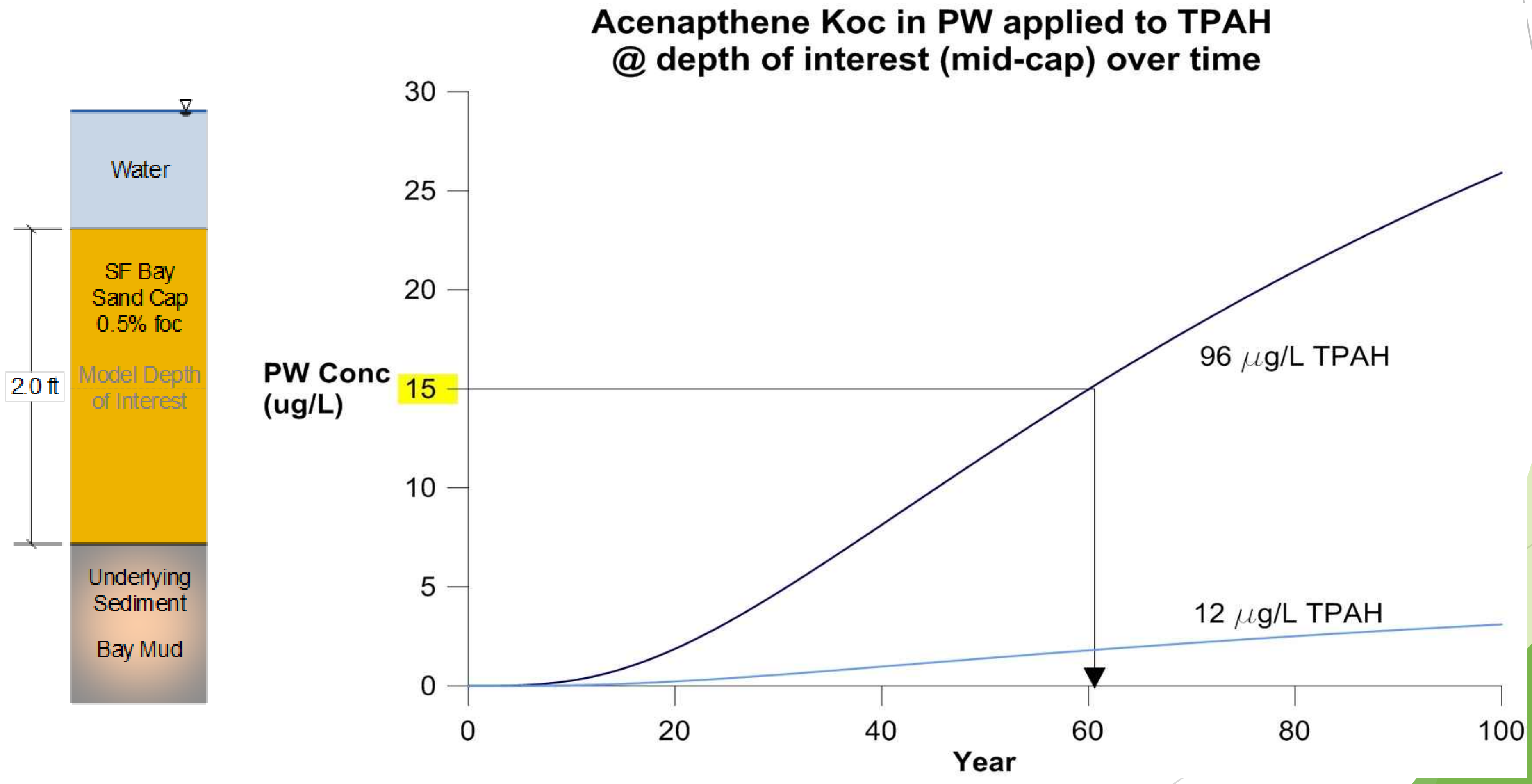
- Monitoring remedy success typically focuses on attainment of Remedial Action Objectives (RAOs), e.g.:
  - Monitor PCB levels in fish to evaluate human health risk reduction
  - Monitor PAH concentrations in sediment to evaluate infauna exposure reduction
- Sediment caps are typically ONE element of a remedy; other elements:
  - Source control
  - Potential recontamination from cleanup levels < “background”
- Remedies may not meet RAOs even when caps perform as designed
  - Inadequate identification of sources, exposure pathways, receptors
  - Uncertainty in risk modeling that establishes chemical isolation specs for COC breakthrough

Cap performance – basis of design

- Capping objective: physical and chemical isolation to prevent exposure of receptors to chemicals of concern (COCs)
  - Physical isolation design elements: thickness of cap, armoring needs, habitat features (loss vs restoration, soft-bottom vs hardscape)
  - Chemical isolation design elements: retarding COC breakthrough (advection, diffusion) in pore water (PW) above the reactive cap layer
- Monitoring cap overall performance
  - Cap Integrity: does it maintain adequate physical isolation?
  - Cap Performance: does it maintain isolation of COCs from receptors?

CapSIM models COC breakthrough

- Evaluate chemical isolation by monitoring breakthrough in PW



What Does Failure of a Sediment Cap Look Like?

- Force based design or deformation-based design?
- Limit Equilibrium Factors of Safety can yield deformations of several feet
- How to limit deformations to acceptable values
- How to replace deformation limits with allowance for repair and maintenance?

Seismic Resiliency of Sediment Caps

- Design standards (or lack thereof)
- Performance criteria (i.e., What constitutes Failure)
- Design life
- Facility (cap) importance

- “Caps will also factor in appropriate earthquake design elements for contingency level events.”
- “Engineering Considerations must include the currents, storm surges, and earthquakes. Installation of structures must allow for limited deformation in the event of an earthquake.”
- “Appropriate testing and analysis shall be conducted to evaluate the stability of the waste structure under seismic loads.”

Long-Term Financial Assurance for Caps

What circumstances may require financial assurance?

- Future event-based failures of engineering control
- Future removal of impediments (i.e., bridge footings, dams) after investigation/remediation
- Monitoring and maintenance
- Third-party damages to cap

What response action costs to consider?

- Assessment of extent of "failure"
- Design, permitting, procurement
- Mobilization and repair
- Maintenance

Long-Term Financial Assurance for Caps

Approaches for estimating costs

- Percentage of installation costs
- Cost to dredge all
- Flat rate based on small versus large site
- Probabilistic modeling
- Depends on the responsible party and net worth test

Factors that might affect financial assurance requirements

- Bio-accumulative versus non-bioaccumulative contaminant
- Do consumption advisories affect financial assurance
- Discharges on to the cap
- Conservatism of cleanup goals
- Navigational versus non-navigational
- Enhanced cap design parameters i.e., betterment

Need for Greater Regulatory Advocacy

Lower Environmental Footprint

- Less energy use
- Lower construction impacts on nearby communities
- Opportunity to beneficially use capped resource (new habitat)
- Opportunity to integrate caps into upland infrastructure

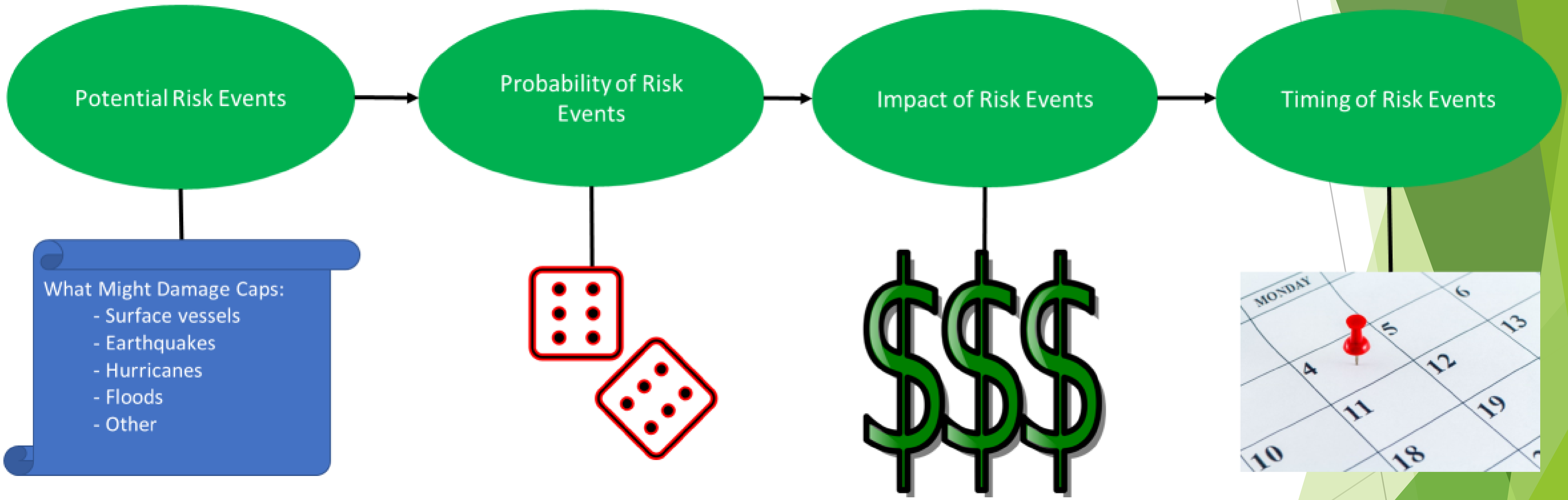
Reduce Long-Term Cap Risks

- Work with designers to ensure long-term cap integrity
- Understand the range of potential flow conditions and include adequate factor of safety
- Consider management and repair requirements, as opposed to a need for replacement

Probabilistic Financial Modeling – Cap Maintenance and Repair

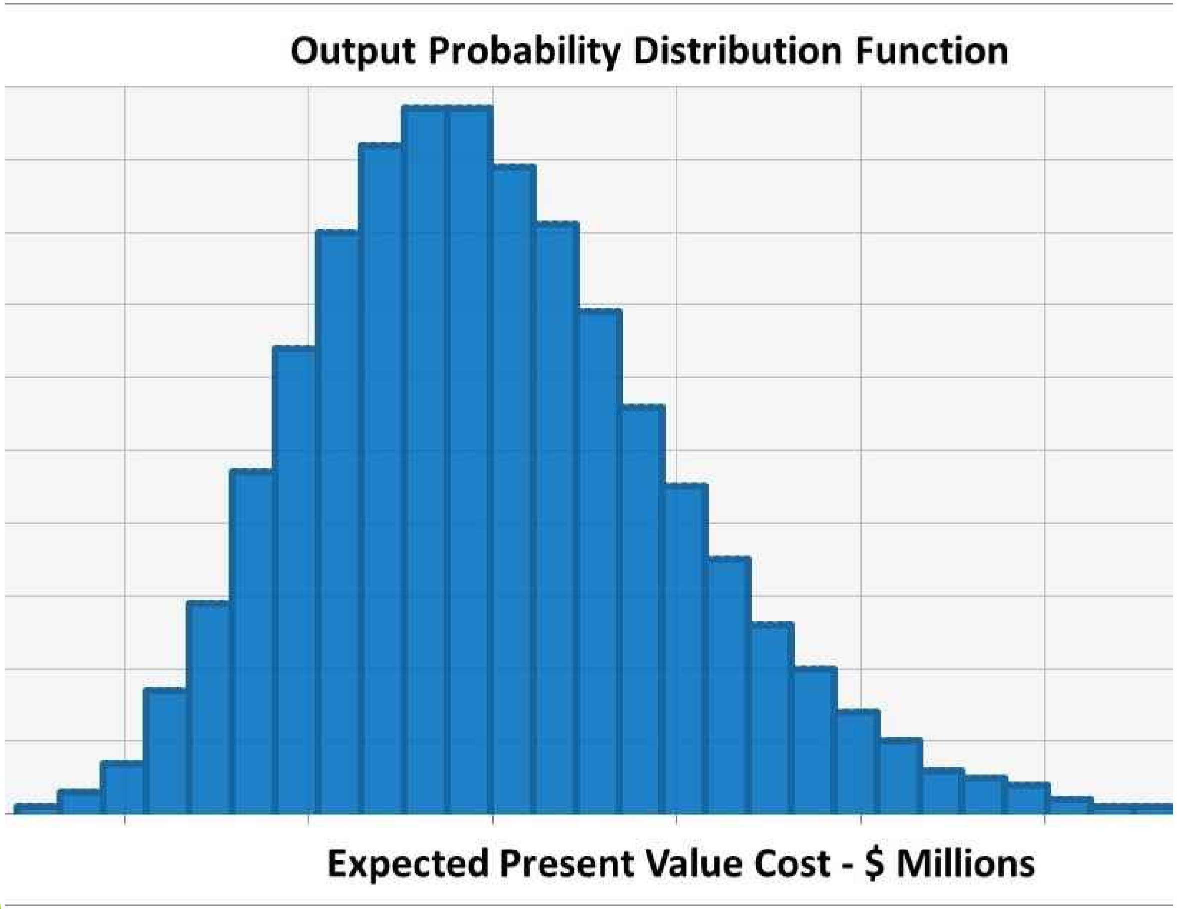
- Purpose: Quantify the long-term financial risk associated with cap maintenance and repair.
- Primary Challenge: Gaining regulatory/industry understanding that representative models can be developed
- Provides Basis: For establishing financial assurance
- Representative Models: Should be location and site-specific using inputs from qualified and calibrated subject matter experts
- Financial Assurance Considerations: State requirements, ASTM Guidance, Others

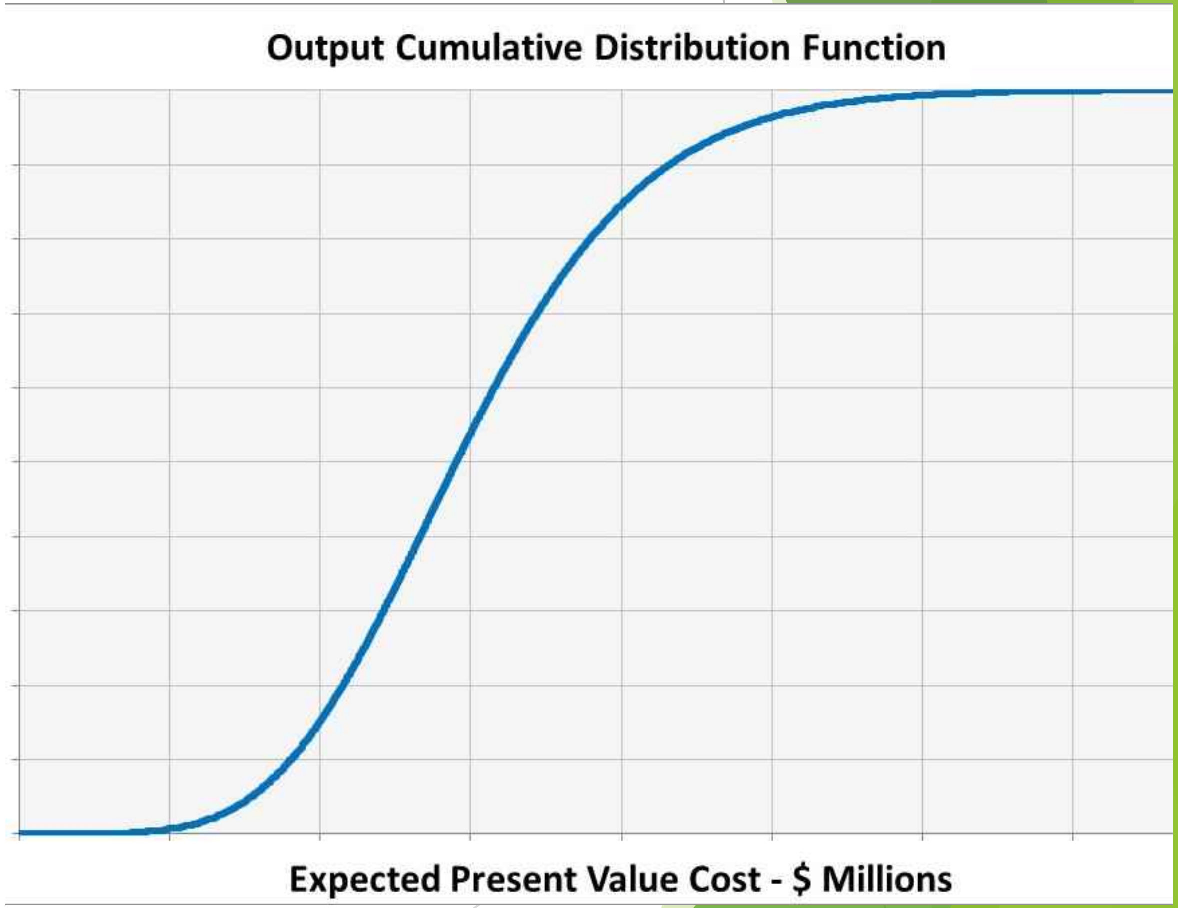
Probabilistic Financial Model Elements



Financial Model Output Results

Basis for Establishing Financial Assurance





Thank you