BATTELLE 2023 SEDIMENTS CONFERENCE

Scanlon Reservoir Remediation An R&D Pilot Study for In Situ Remediation of Dioxins/Furans in an Operating Hydroelectric Reservoir

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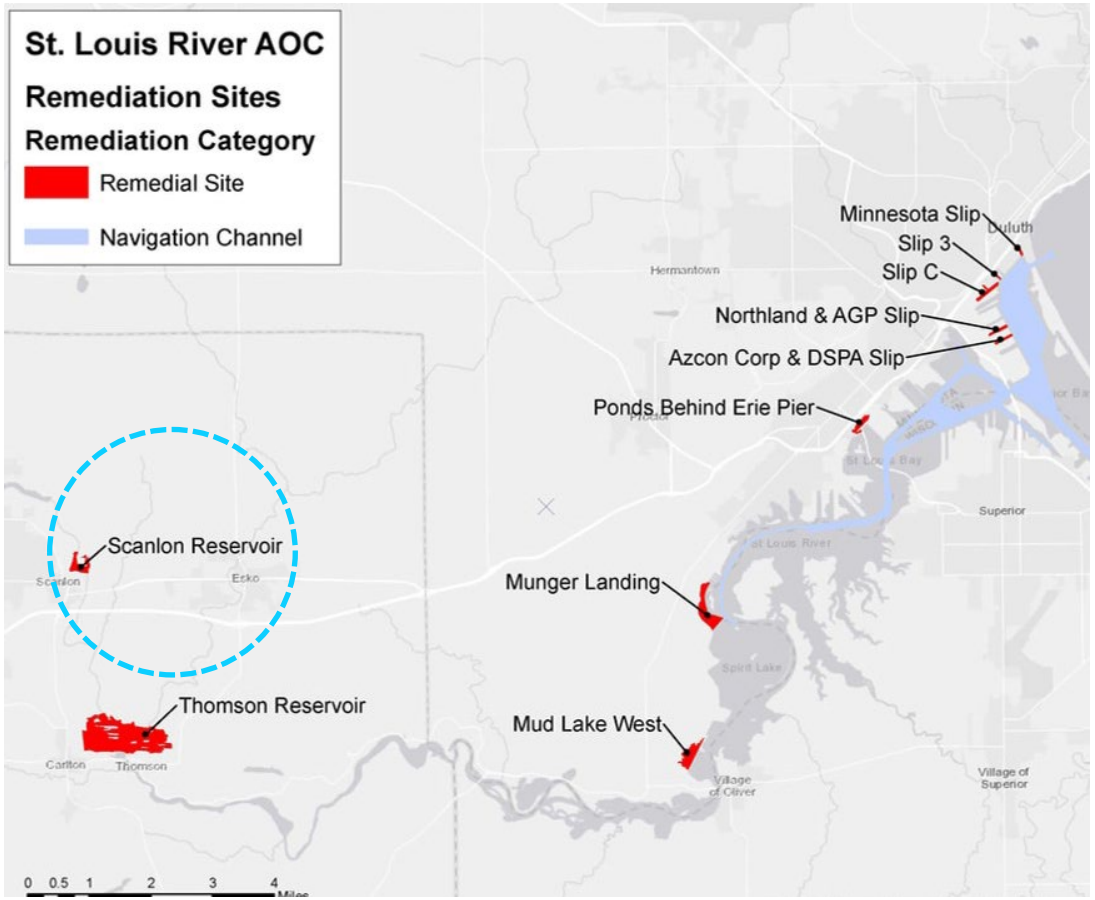
MINNESOTA POLLUTION CONTROL AGENCY

ANCHOR QEA

Baird.

Sevenson Environmental Services, Inc.

Project Location

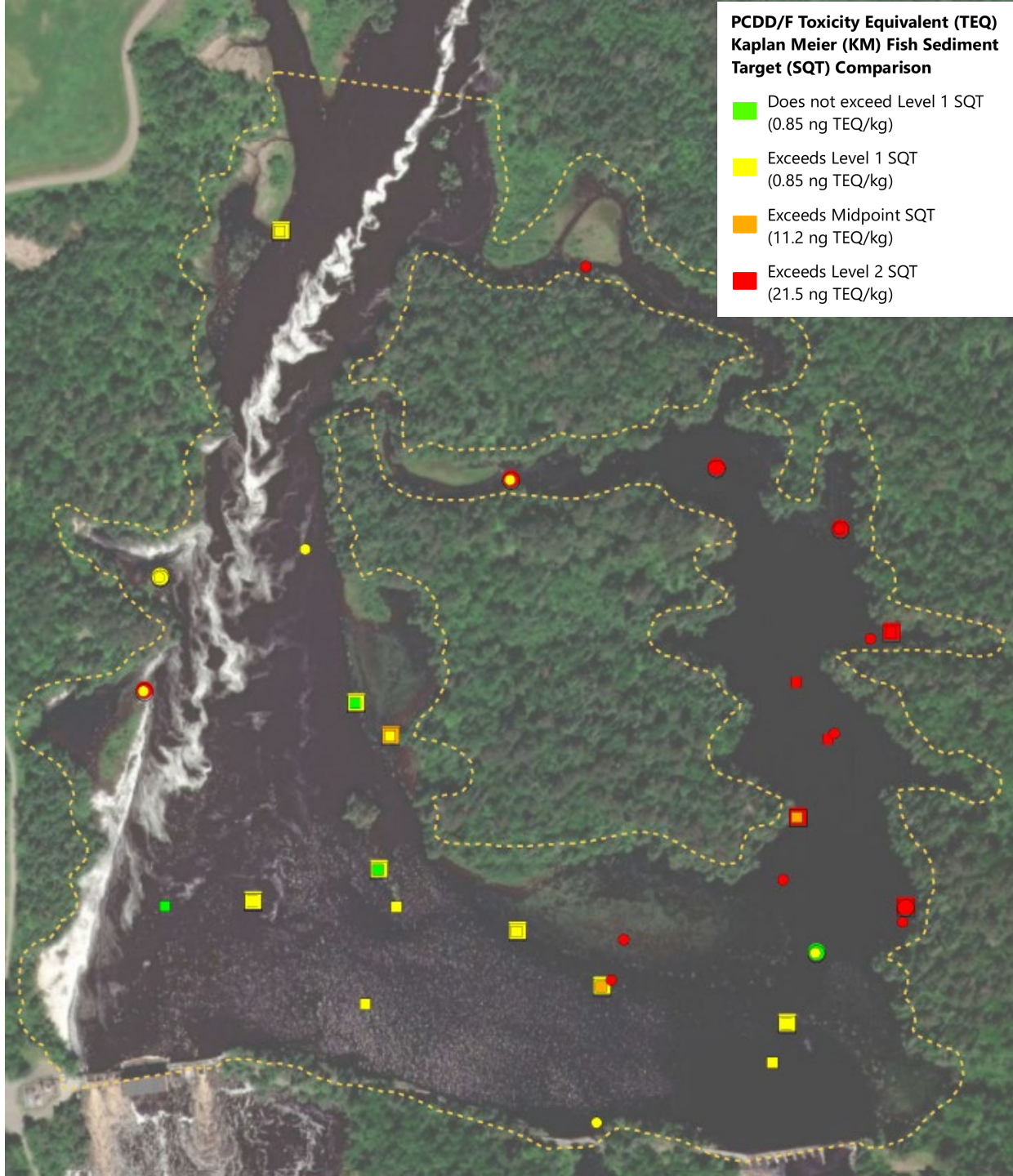


Saint Louis River Area of Concern (AOC)

Scanlon Reservoir remedial areas

Project Background

- 50-plus years of pulp mill industrial wastewater discharge to river
  - Elevated concentrations of dioxins/furans (D/F) in sediments and biota in sheltered areas
  - 55,000 cubic yards of contaminated sediment within 13.5-acre area
- Activated carbon direct amendment remedy selected during feasibility study
- Remedy objectives
  - Improve benthic environment and reduce fish tissue concentrations, while limiting impacts to storage capacity



CHALLENGE

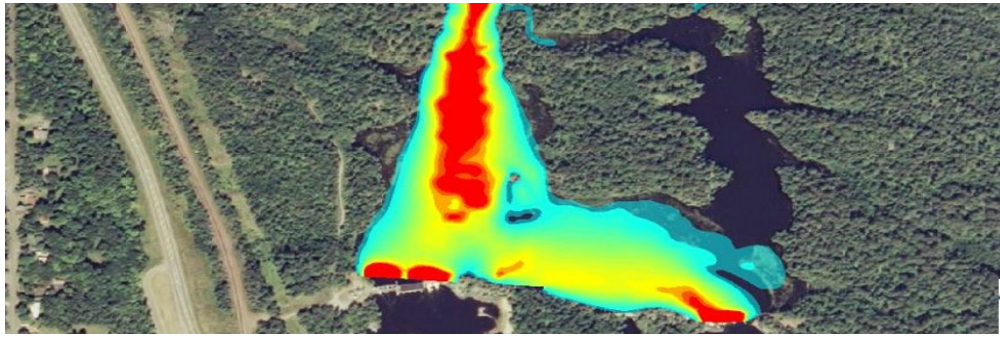
Design and implement a direct amendment remedy to inform in situ management practices for Great Lakes AOC Projects

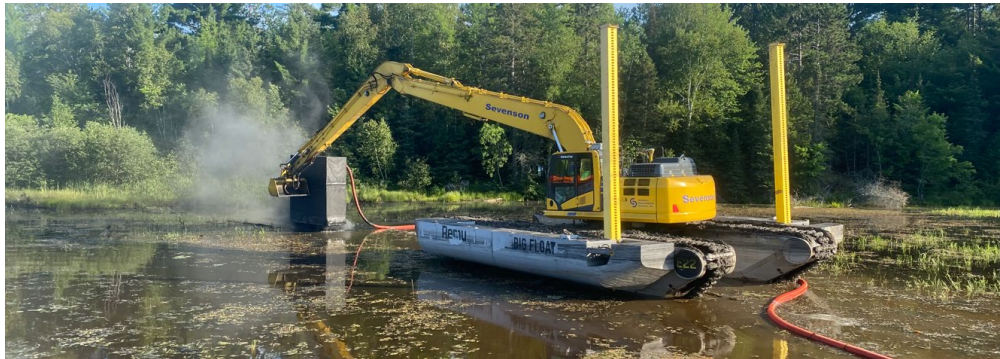
Project Challenges

- Active power-generating facility
- Sensitive wetland habitats
- High erosional areas
- Amendment selection considerations
- Placement verification for fine-grained activated carbon material

Project Approach

- Bench-scale treatability testing to estimate amendment performance
- Hydrodynamic modeling to evaluate amendment stability
- Amendment delivery selection to address site-specific conditions
- Utilize multiple placement verification methodologies





Bench-Scale Treatability Study Design

- Assessed two grain sizes of activated carbon (AC)
  - Silt-sized PAC: <325 mesh
  - Fine sand-sized granular activated carbon (GAC): 80 X 325 mesh
- Conservatively selected sediment samples with highest measured D/F concentrations
- Polyethylene passive samplers used to assess bioavailability of D/F

Bench-scale treatability study mesocosms

Bench-Scale Treatability Study Design

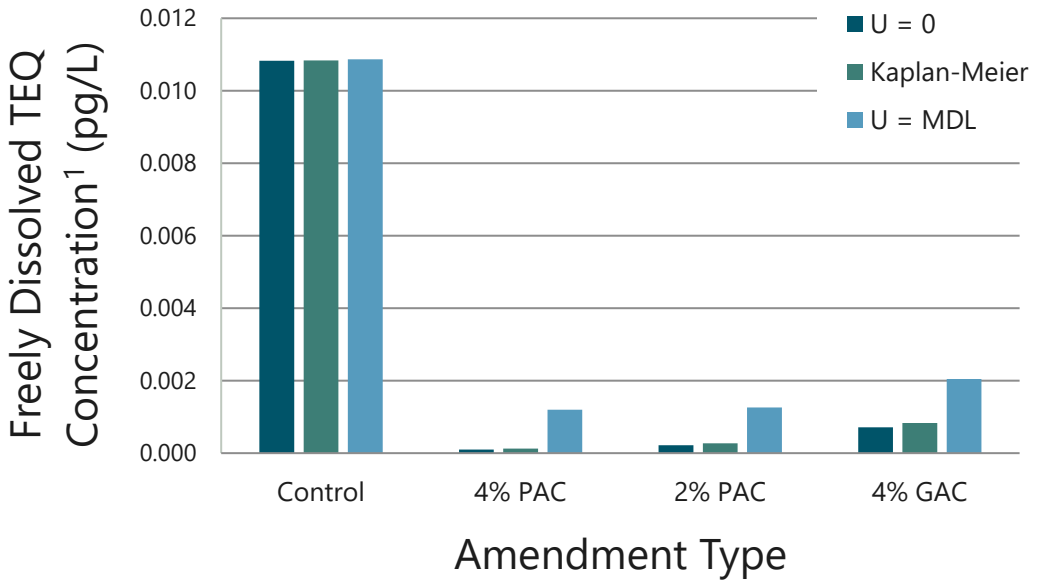
- Four test conditions evaluated
  - Untreated control
  - 4%[1] PAC
  - 2%[1] PAC
  - 4%[1] GAC
- Sediment mixed with AC for 30 days on orbital shaker table
- Test conditions sampled with passive sampler at 60 and 97 days

Note:
1. All treatment percentages represent dry weight dosages relative to surface sediments (top 10 centimeters)

Bench-Scale Treatability Study Findings

- Freely dissolved D/F concentrations[1] in porewater substantially reduced for all amendments
- 4% PAC was most effective amendment (2 to 9 times more effective than 4% GAC)
- 2% PAC ultimately selected following value engineering study evaluation due to comparable performance and cost benefits

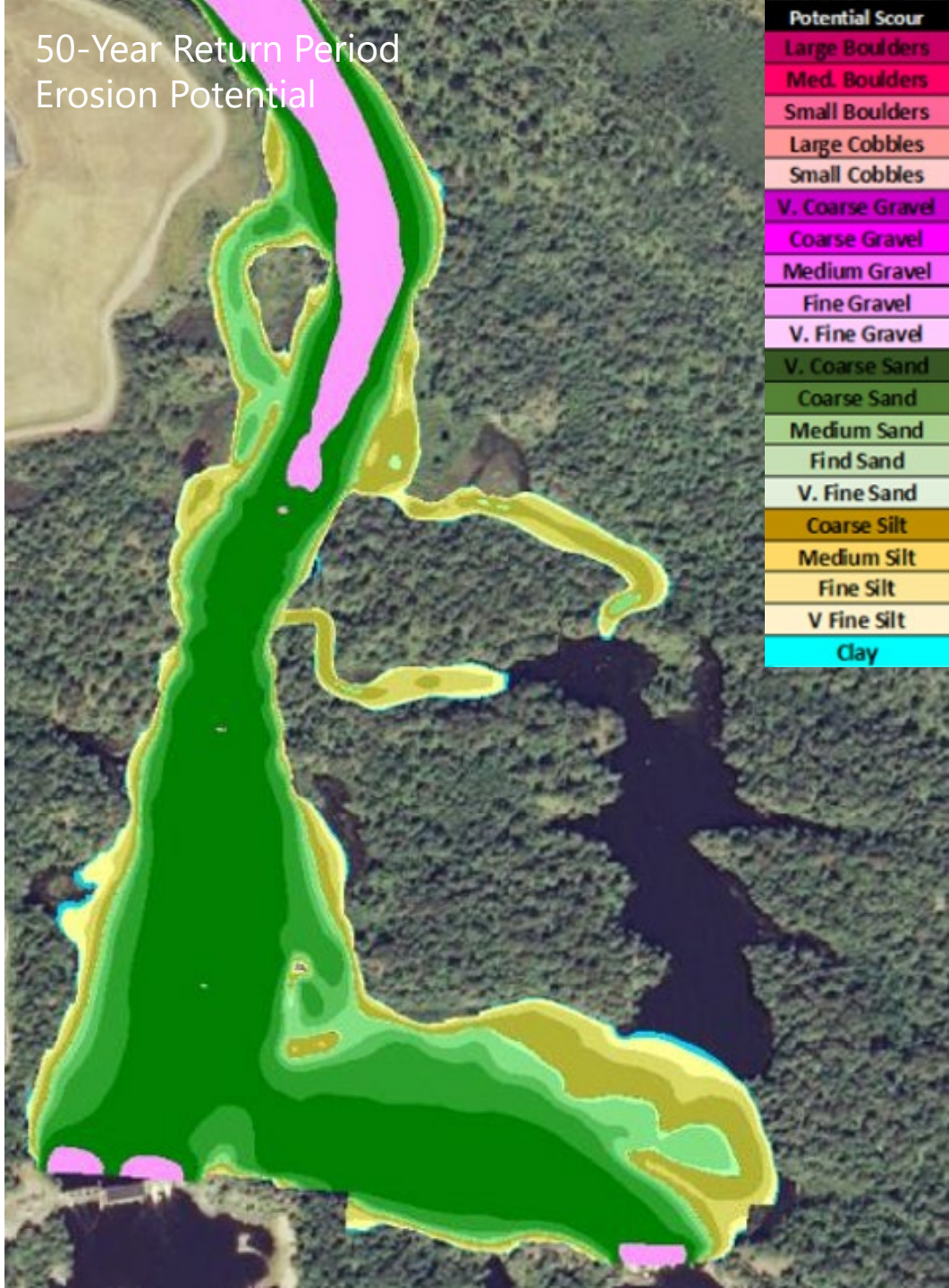
Amendment	D/F Reductions (%)
4% PAC	86 to 100
2% PAC	**81 to 98**
4% GAC	74 to 93



Note:
1. Concentrations calculated via multiple methodologies for addressing non-detect (U) values

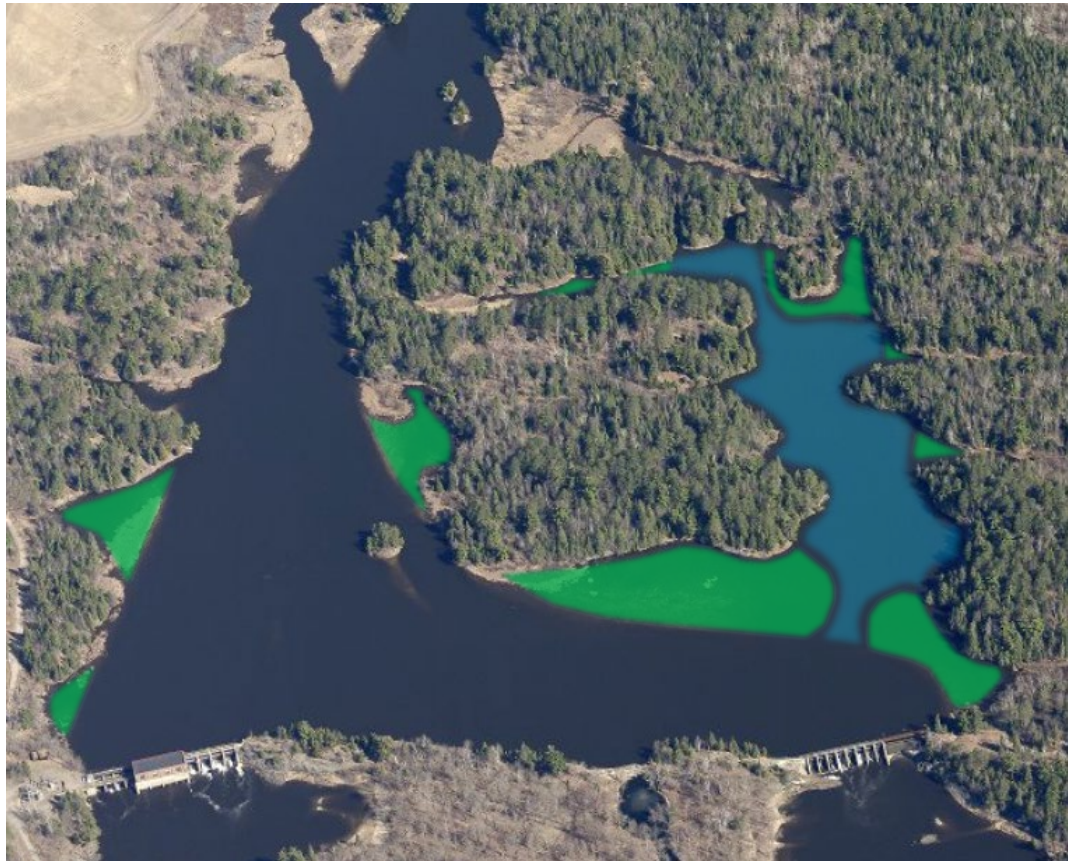
Sediment Stability Modeling

- Evaluated peak discharges through 100-year return period
- Predicted high erosion potential in main channel and low erosion potential in wetland areas and side channels
- Results generally indicated stability of fine-grained sediments or placed amendments in remedial areas



Amendment Design

- Hybrid approach
  - Direct amendment via SediMite™ in shallow, wetland areas (7.4 acres)
  - "Blended cover" of SediMite™ overlain by a 4-inch sand layer in areas >4 feet in water depth (6.1 acres)
- Limits impact to wetlands, while providing additional amendment stability and accelerated reductions to D/F bioavailability where possible
- Approximately 0.5 pound per square foot (lb/sf) SediMite™ dose



Direct amendment areas

Blended cover areas

Remedy Implementation

General contractor: Kemron-Arrowhead JV
Key subcontractor: Sevenson Environmental

SediMite™ pneumatic placement operations

SediMite™ pneumatic placement operations

Blended cover sand layer placement operations

Placement Confirmation

- Amendment certification units
  - Volumetric tracking by area
  - GPS-based coverage mapping
  - Submerged pans to assess hydrated volume
  - Floating pans to correlate with volumetric tracking (target: 1 lb/sf)
- SediMite™ bid quantity assumed up to 100% loss/overplacement to achieve design dose

Hydrated SediMite™ after draining water

Settling in graduated cylinders

Floating catch pan in swing path

Recovered floating pan

Summary

- Site-specific bench-scale testing and sediment stability modeling are critical evaluations for informing direct amendment-based project design
- Direct amendment design must plan for material losses during placement and include reasonable loss estimates, in situ confirmation, or appropriate combination
- Direct amendment with PAC-based products can be effectively implemented as a remedial approach for enhanced natural recovery in Great Lakes AOC projects

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THANK YOU

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