Cost and Feasibility of Conventional and Active Sediment Capping

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South and Southwest

LSU

Rice   Texas A&M   Georgia Tech

- Research and Technology Transfer supported by EPA
  - Contaminated sediments and dredged material
  - Historically focused on in-situ processes and risk management
  - Unique regional (4&6) hazardous substance problems
- Outreach
  - Primarily regional in scope
  - Driven by community interests and problems

Cap Functions/ Design Objectives

- Physical isolation of sediments
- Stabilization of sediments
- Improve aquatic habitat
- Reductions in flux (elimination of direct bioturbation of contaminated sediments) to improve water quality and/or to maintain desired sediment concentrations
- Control of residuals (remaining inventory and dredging residual)

Potential of Active Caps

- Sand caps easy to place and effective
  - Contain sediment
  - Retard contaminant migration
  - Physically separate organisms from contamination
- Greater effectiveness possible with “active” caps
  - Encourage fate processes such as sequestration or degradation of contaminants beneath cap
  - Discourage recontamination of cap
  - Encourage degradation to eliminate negative consequences of subsequent cap loss

Active Capping Demonstration

The comparative effectiveness of traditional and innovative capping methods relative to control areas needs to be demonstrated and validated under realistic, well documented, in-situ, conditions at contaminated sediment sites

- Better technical understanding of controlling parameters
- Technical guidance for proper remedy selection and approaches
- Broader scientific, regulatory and public acceptance of innovative approaches

Anacostia River, Washington DC

Project Participants

- PI – Danny Reible, LSU & HSRC/S&SW
- Anacostia Watershed Toxics Alliance
- EPA SITE program/Batelle
- Sediment RTDF
- Laboratory Demonstration Studies
  - Carnegie Mellon University
  - Hart-Crowser
  - Rice University
  - University of New Hampshire
  - Hull and Associates
  - LSU
- Field Program
  - Horne Engineering
  - Sevenson Marine Contractors
  - EA Environmental Consultants
  - Electric Power Research Institute/PEPCO
  - University of Michigan
  - Cornell University
  - Ocean Survey
  - HydroQual
  - LSU

Active Caps Preliminary or Lab Assessment

- Seepage control
  - Aquablok
- Sequestration of hydrophobic organic compounds
  - Activated Carbon
  - Coke
  - Ambersorb
  - XAD-2
  - Organo modified clay
- Sequestration of metals
  - Apatite
- Encourage degradation
  - Bion Soil
  - Zero valent iron

Selected Active Caps and Goals of Field Program

- AquaBlokTM – w/EPA SITE program
  - Evaluate tidal seepage control
  - Evaluate potential for uplift during tidal range
- Coke
  - Evaluate PAH sequestration/retardation
  - Evaluate placement in laminated mat designed and built by CETCO
- Apatite
  - Evaluate metal sequestration/retardation
  - Evaluate effectiveness of direct placement
- Sand (for comparison)

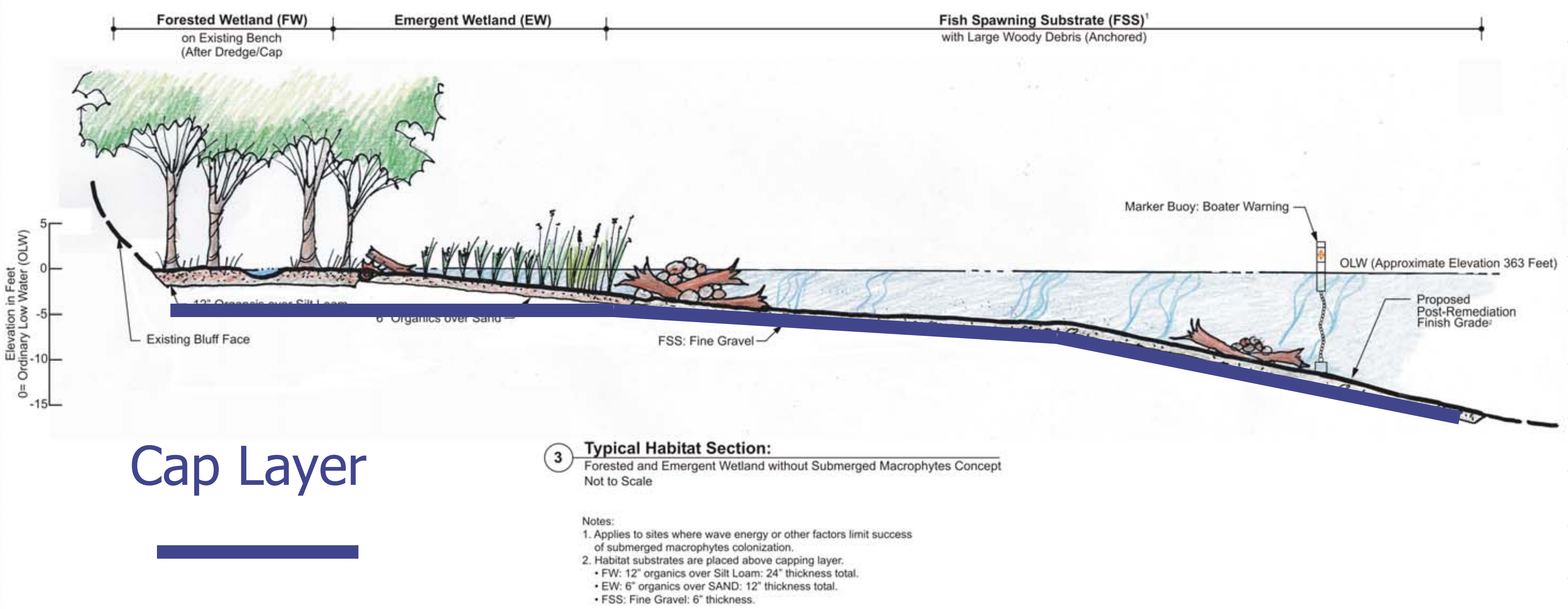
Scale up - Conventional

- Laboratory experiments to define key processes and parameters
- Modeling to project to field time and distance scales
- Demonstration
  - Evaluation of adequacy of scale up
  - Influence of complicating factors

Capping
Issues and Complications

- Long term containment of contaminants
- Erosion due to wind-driven waves or stream flow
- Influence of habitat on cap performance
- Ground water upwelling
- Mobilization of NAPL
- Gas ebullition
- Ice scour
- Sediment slope stability
- Cap placement limitations

Potential Habitat with Cap

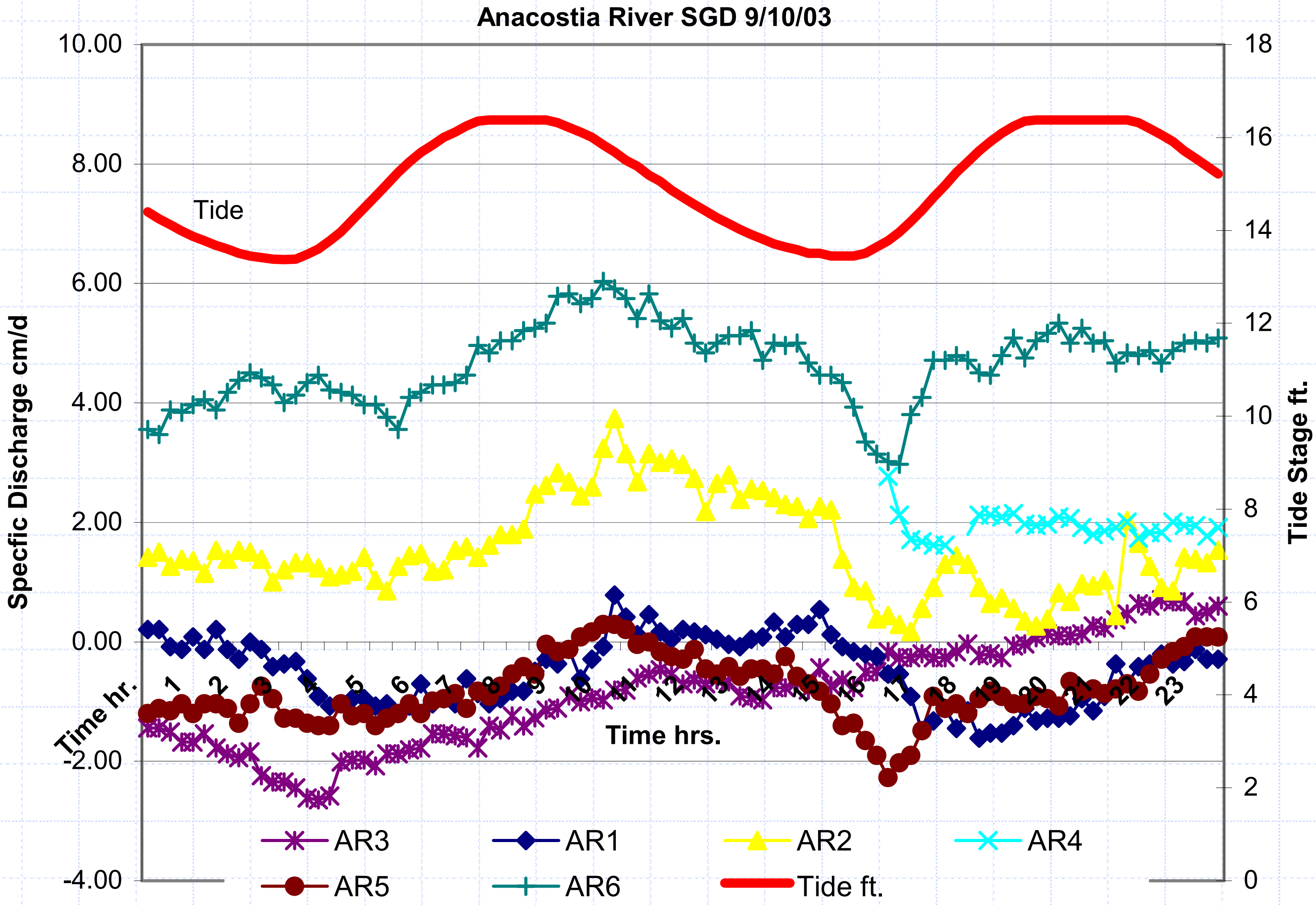


Cap Layer

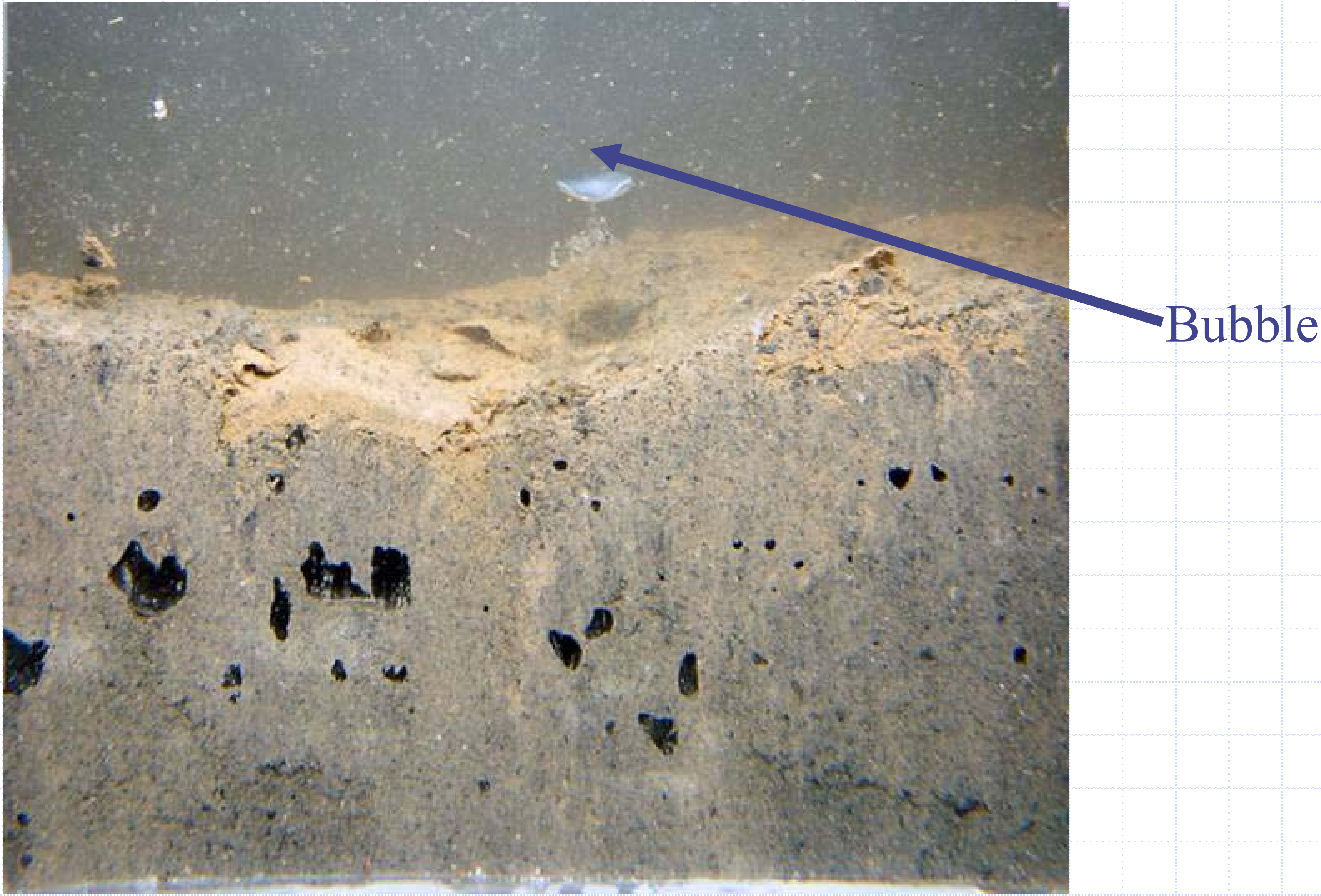
e.g.<5 ft below MWD

R.Davis

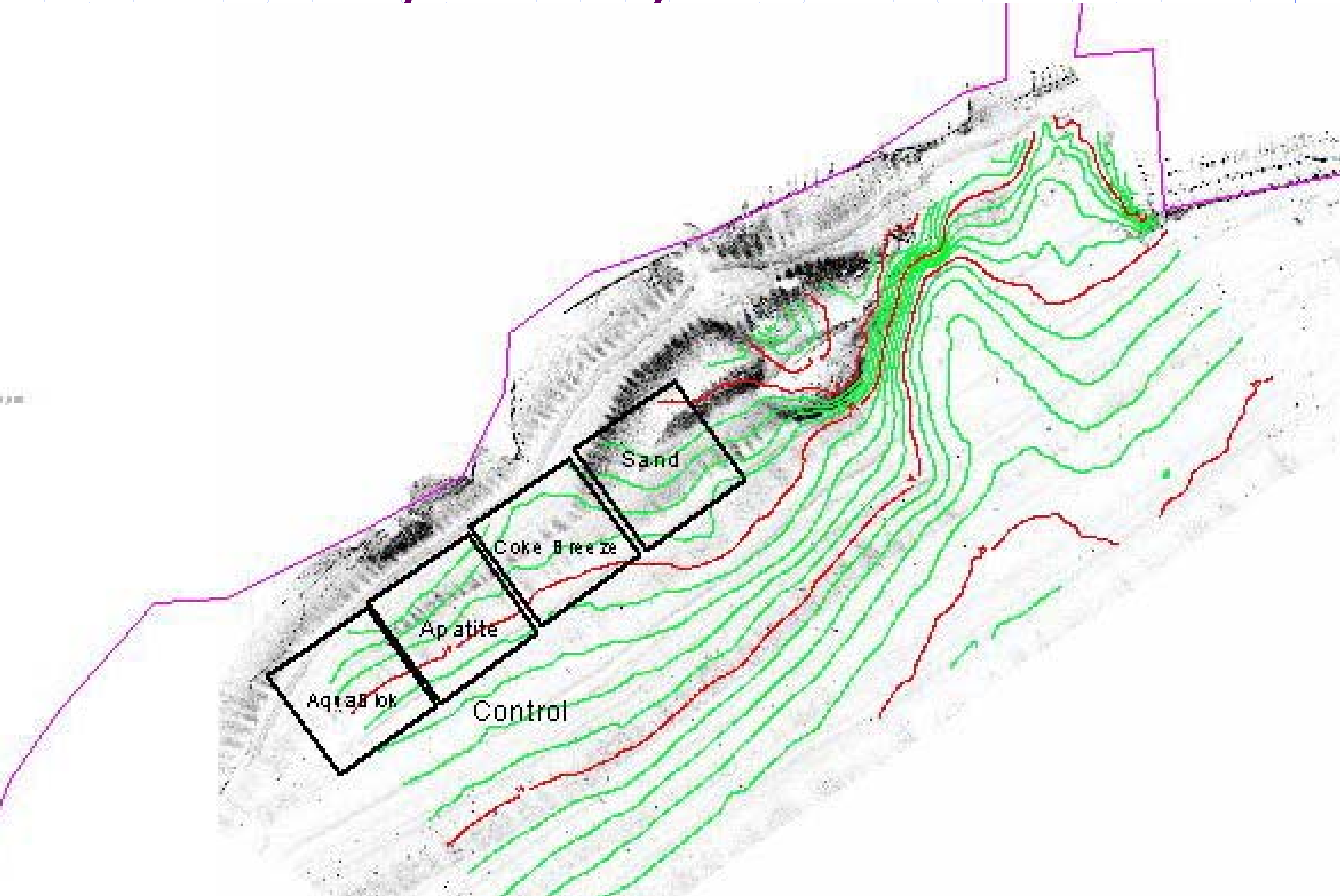
Seepage rates in Anacostia



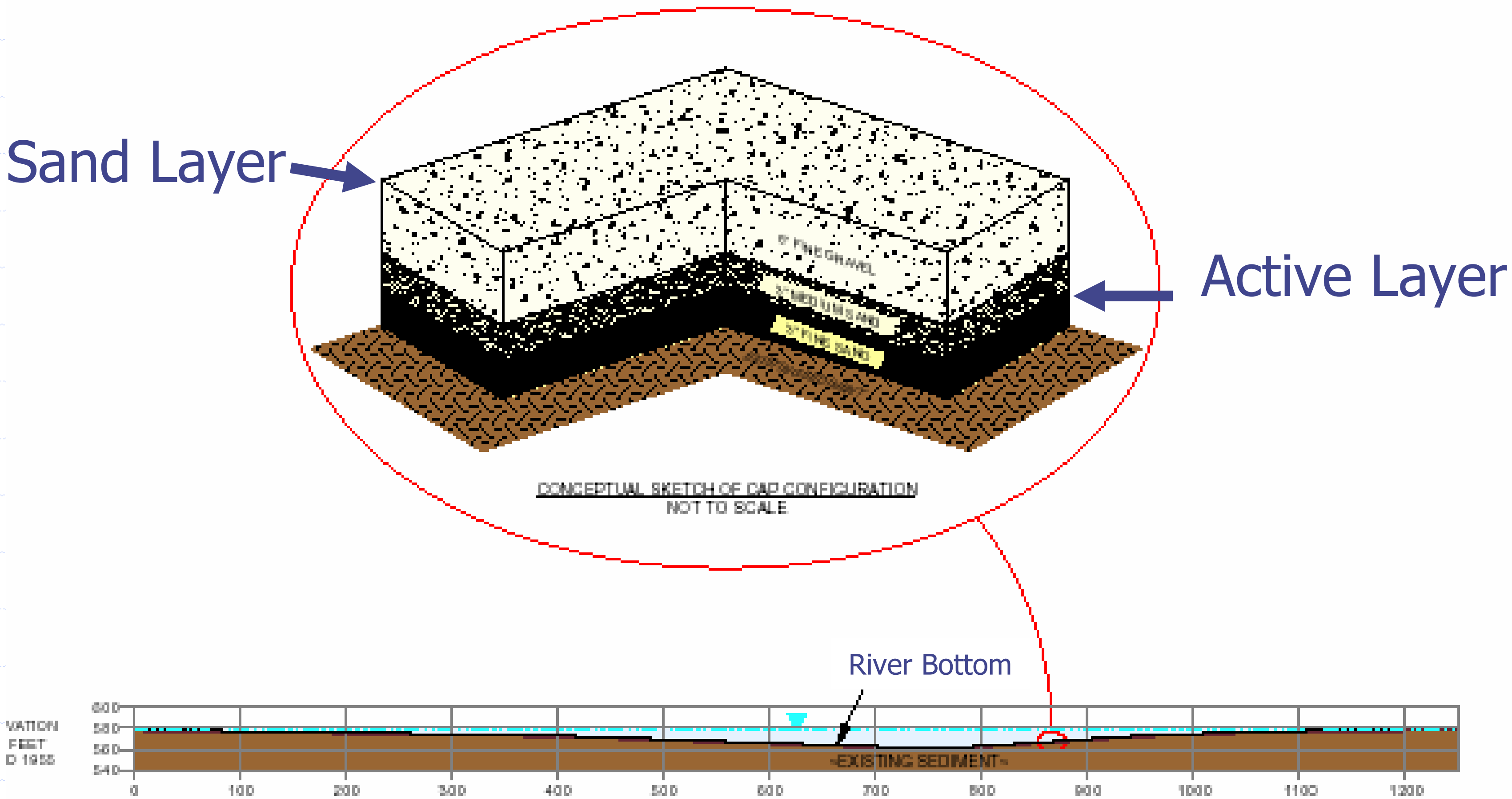
Sediment Camera Image – Anacostia



Pilot Study Cell Layout



Composite Cap Design




JLG


Position
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TP Y: 438835.8
COG: 35.9 SOG: 0.0
HDG: Aux-Main 057
Dpth: 0.0
Mode: RTK (Float)
HDOP: 1.0 Sats: 8
AT: Nav ON
Log Rec: 1527
Log File: jed08304.log
Auxiliary
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Lon: W77 00 16.47
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Y: 438782.6
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XY Planar Graphics
Scale (US ft) 208
Nav Mode: Real Time
1310993,438915
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Q50
start
WinOPS Dredge Posit...
90%
11:38 AM

Observations on Placement (Tentative)

- Intermixing
  - 3-4" in softest sediment areas for sand cap and near-surface bucket release
    - Areas where undrained shear strength 10-25 lb/ft^2
    - Minimal in other areas where undrained shear strength >40 lb/ft^2
- Uniformity
  - Influenced most by intermixing in sand area
  - 3-6" likely minimum by surface bucket release
  - Winops system and operator experience critical for control of thin lifts

Selected Active Caps Material Costs

- AquaBlok
  - \$170/ton material cost
  - \$2.30/ft^2 material cost (2-4″ layer)
  - ~\$3.00/ft^2 material cost (3-6″ layer- minimum achievable)
- Coke
  - \$145/ton material cost
  - \$0.11-\$0.14/ft^2 material cost (~1/2″ active layer thickness)
  - \$1/ft^2 mat construction cost
- Apatite
  - \$135/ton
  - \$4.20 /ft^2 (6″ layer)
- Sand (for comparison)
  - \$13.50/ton
  - \$0.68 ft^2 (6″ layer)

Selected Active Caps Total Material Costs

- AquaBlok (3-6" + 6" sand)
  - $3.70/ft^2$
  - $33/yd^2$
- Coke (mat + 6" sand)
  - $1.80/ft^2$
  - $16/yd^2$
- Apatite (6" + 6" sand)
  - $4.90 /ft^2$
  - $44/yd^2$
- Sand (12" layer)
  - $1.40/ ft^2$
  - $ 13/yd^2$

Cap Placement Costs

- Demonstration approaches $\$200/yd^2$
- Large scale site (~1000 acre)
  - $\$25/yd^2$ + materials
  - Mobilization/demobilization ~$\$1 /yd^2$
  - Cap placement ~$\$10/yd^2$
  - Project Management ~$\$2/yd^2$
  - Monitoring ~ $\$10/yd^2$
  - Miscellaneous ~$2/yd^2$
    - Site Preparation
    - Construction Management
    - Design and Permits
- Sand capping cost ~ Navigational dredging