

In Situ Stabilization/Solidification (ISS), Another Tool for Remediation of Contaminated Sediments

Christopher A. Robb, PE

Thomas J. deGrood

Richard H. Weber, PE

Natural Resource Technology, Inc.

March 13, 2015



Presented at the Western Dredging Association, Midwest Chapter Meeting
March 11-13, 2015, Milwaukee, Wisconsin

Sediment ISS

- Another tool in the sediment remediation tool box:
 - Monitored natural recovery
 - Enhanced natural recovery
(e.g., sand cover, sediment amendments)
 - Dredging
 - Capping
 - **ISS**
 - Combination remedy



Sediment ISS:

State of the Practice

- Work from floating platform through water column, for example using backhoe or auger mixing
- Examples:
 - Pilot Test for Manitowoc Former MGP (1992/93)
 - Rutgers University Pilot Test for NJDOT (2005)
 - EPRI Development Needs Report (2010) and Pilot Test (December 2013)
 - Gowanus Canal Record of Decision (2013)

Gowanus Canal ROD (2013)

- *RTAs 1 and 2:* Alternative 7 (dredge entire soft sediment column, **targeted ISS of native sediment in areas with potential for active upward NAPL migration from the native sediment** and cap with treatment, isolation and armor layers).
- Perform ISS in top 3-5 ft of underlying native sediment in NAPL-impacted areas with barge-mounted auger rig

Construction Techniques for Sediment ISS

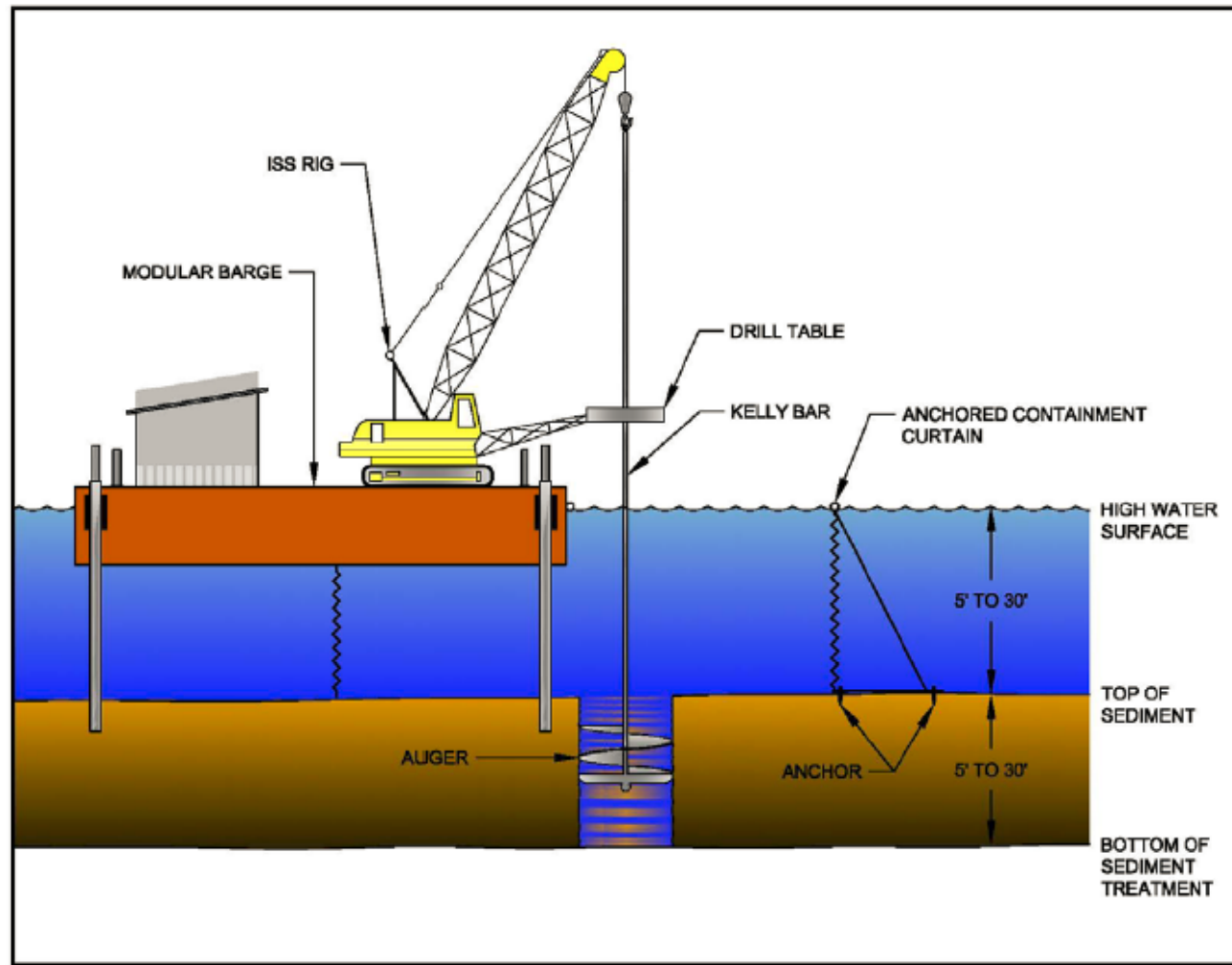
- Rake Injection
- Backhoe Mixing
- Vertical Rotary Mixed ISS – Crane Mounted Drill Table
- Hydraulic Auger Mixed ISS – Delmag
- Hydraulic Mixing Tool ISS - Allu/Lang Tool

All of this equipment can be deployed from a barge or floating platform

Sediment ISS “in the wet”

- Work from floating platform through water column to solidify/stabilize the sediments in situ
- Very few examples of full scale ISS remediation for contaminated sediments
- Full scale ISS remediation for contaminated sediments “in the wet” not yet performed at an MGP site

EPRI ISS Field Pilot (2013)



Ashley River, SC (2002)



Source: 2002 Work by Thomas deGrood, in conjunction with Williams Environmental

Sediment ISS “in the dry”

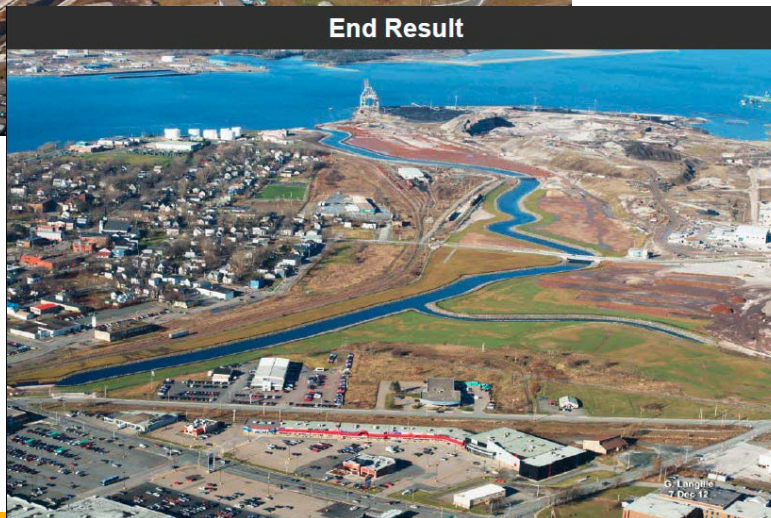
- Isolate area and pump off surface water, follow with backhoe mixing from shore or stabilized surface
- A couple examples:
 - NRT – Appleton Former MGP (2003)
 - AECOM – Sydney Tar Ponds (2008-2013)

NRT - Appleton Former MGP (2003-2004)



ISS: River Canal (2003)
Area: 630 lineal feet of shoreline
Depth: 7 feet
Quantity: 1,600 cy
Strength: ≥ 150 psi (constructed)
Permeability: $\leq 1.0 \times 10^{-6}$ cm/s (constructed)

AECOM – Sydney Tar Ponds (2008-2013)



Source: Battelle Seventh International Conference on Remediation of Contaminated Sediments,
Dallas Texas, February 2013

Remedy Evaluation/Selection for Sediment ISS

- Data Collection – **Evaluate during RI/FS**
- Field Sample Collection
 - Methods – VPCs, split spoons, shelby tubes, hydraulic piston sampler, etc.
 - Composite and undisturbed samples
 - Geotechnical parameters
 - Particle size analysis, moisture content, dry unit weight, shear strength, organic content, atterberg limits, specific gravity, one-dimensional consolidation
 - Analyze for COCs
 - Test samples from the target ISS zone
 - Test samples from below the target ISS zone
- Sample selection for bench testing

Technical Considerations for ISS in Sediment

- Type of contaminant and concentration
 - Leach performance for COCs
- Treatment performance criteria (UCS, hydraulic conductivity)
- Reagent mix design - Prevention of reagent dispersal
- Surface water hydraulics and subsurface flow conditions
- Ebullition?
- Depth of water/depth to sediment/depth of treatment
- Treatment in saltwater vs. freshwater

Technical Considerations for ISS in Sediment (cont.)

- Permanence of ISS monolith and waterway use
 - Maintenance dredging, recreation, etc.
- Benthos and biota
 - e.g., Integration of sand cap for benthic invertebrates
- Control of NAPL/sheen and TSS releases during mixing
- ISS Bulking/swell factors and post-mixing ISS surface conditions
- Positional control and survey documentation and CQC/CQA techniques

Creative/Beneficial Uses for Sediment ISS

- Full depth treatment
- Partial depth treatment
- ISS cap to supplement or replace dredging or capping components
- Constructed land
- Underwater habitat enhancement (e.g., artificial reefs)
- Integrate with civil projects (e.g., constructed reefs for storm surge protection)
- Recreation enhancement

Sustainable Benefits for Sediment ISS vs. Dredging

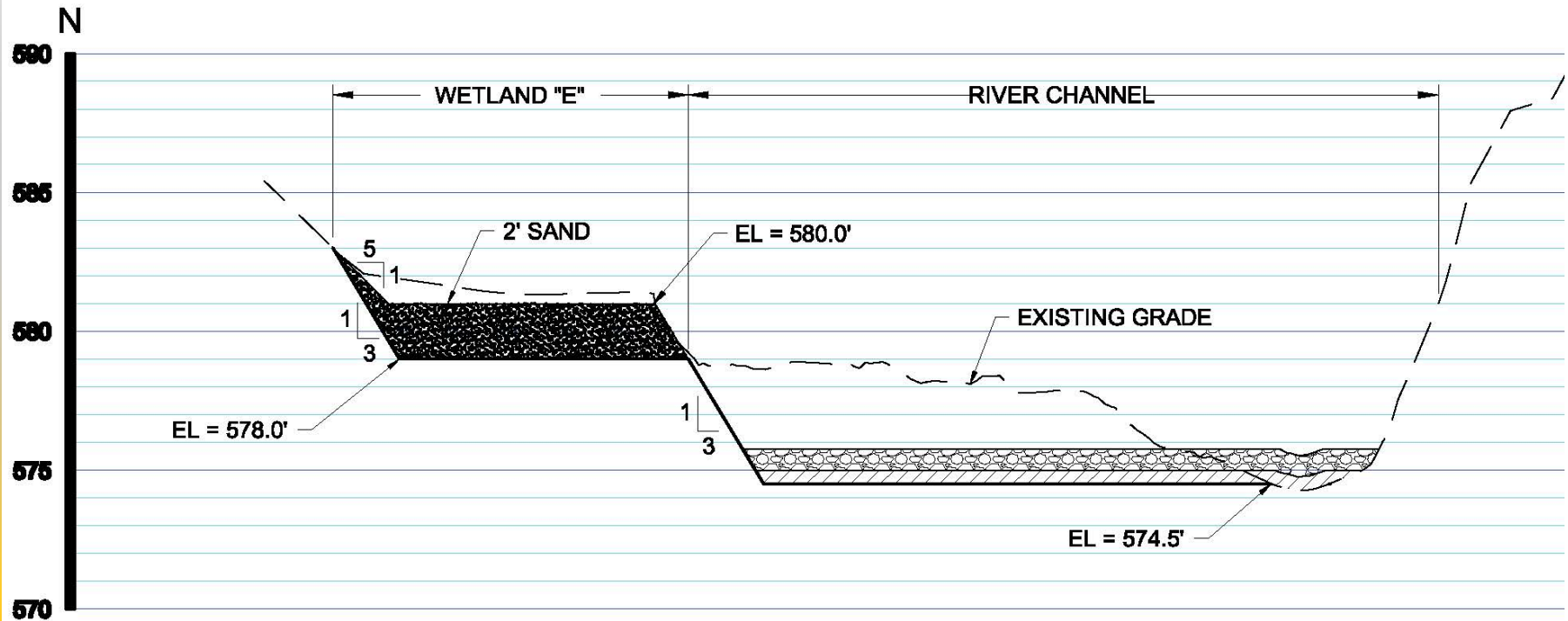
- Achieve USEPA's preference for treatment rather than relocation of the contaminant mass
- Increasing public safety by eliminating a significant number of highway truck trips
- Green remediation
 - Less fuel consumption and air emissions for truck trips
 - Nearly eliminates the need for water treatment and associated energy expenditure

Case Study: Dredge/Reactive Cap vs. Sediment ISS

Original Project Design:

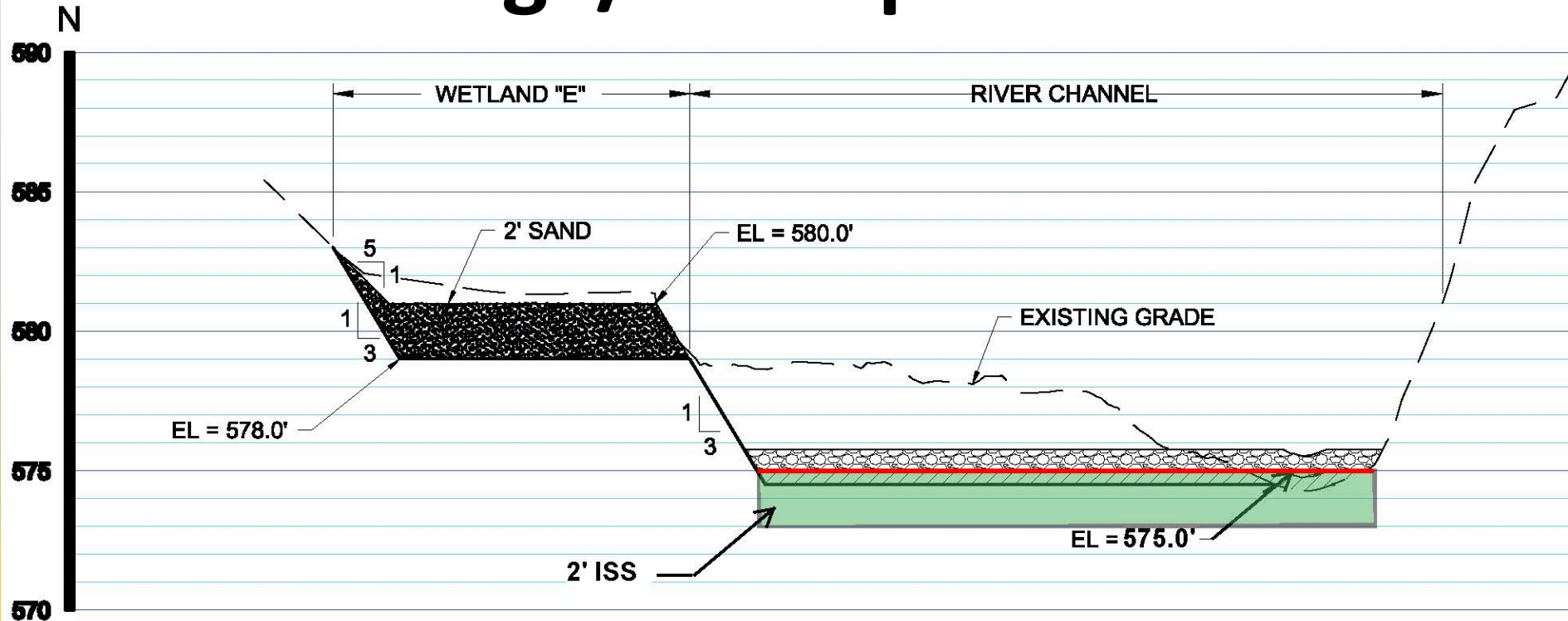
- Dredge and Reactive Cap Cost: \$31,900,000
- CY remediated: 36,400 CY [landfill disposal]
- Cost/CY: \$880 Cost/Acre: \$1.8M

Dredge/Reactive Cap Section



SECTION @ STA 40+00

Dredge/ISS Cap Section



SECTION @ STA 40+00

Key Assumptions for Comparison

- Differences for Dredge/ISS layer comparison:
 - Alter dredge depth selected to provide adequate water depth and room for reactive cap [reduce dredge cut 6"]
 - Construct 2' ISS layer in lieu of 6" reactive cap
- Keep 9" sand layer for dredge/reactive cap and dredge/ISS evaluation
- ISS V = Capping area [17.8 acres] *
2' treatment depth ~ 57,000 CY Treatment
- Dredge reduction ~ 13,500 CY

Dredge/ISS Cap Design

- Comparison Cost: \$10,800,000
- CY remediated: 22,900 CY [landfill disposal]
57,000 CY [ISS treated]
79,900 CY total
- Total Cost/CY: \$135 Cost/Acre: \$613,000
- How much ISS could be performed using this cost model?
 - ~ 230,000 CY @ \$32,000,000

NEAR FULL DEPTH TREATMENT!

Next Steps for Advancing Sediment Solidification/Stabilization

- Overcome agency skepticism
- For serious consideration, gather related data during the RI/FS phase
- Post remediation bed conditions – show equivalent to dredging or capping
- Cost benefits / sustainable benefits
- Engage stakeholders with demonstrations of partial and/or full sediment profile applications