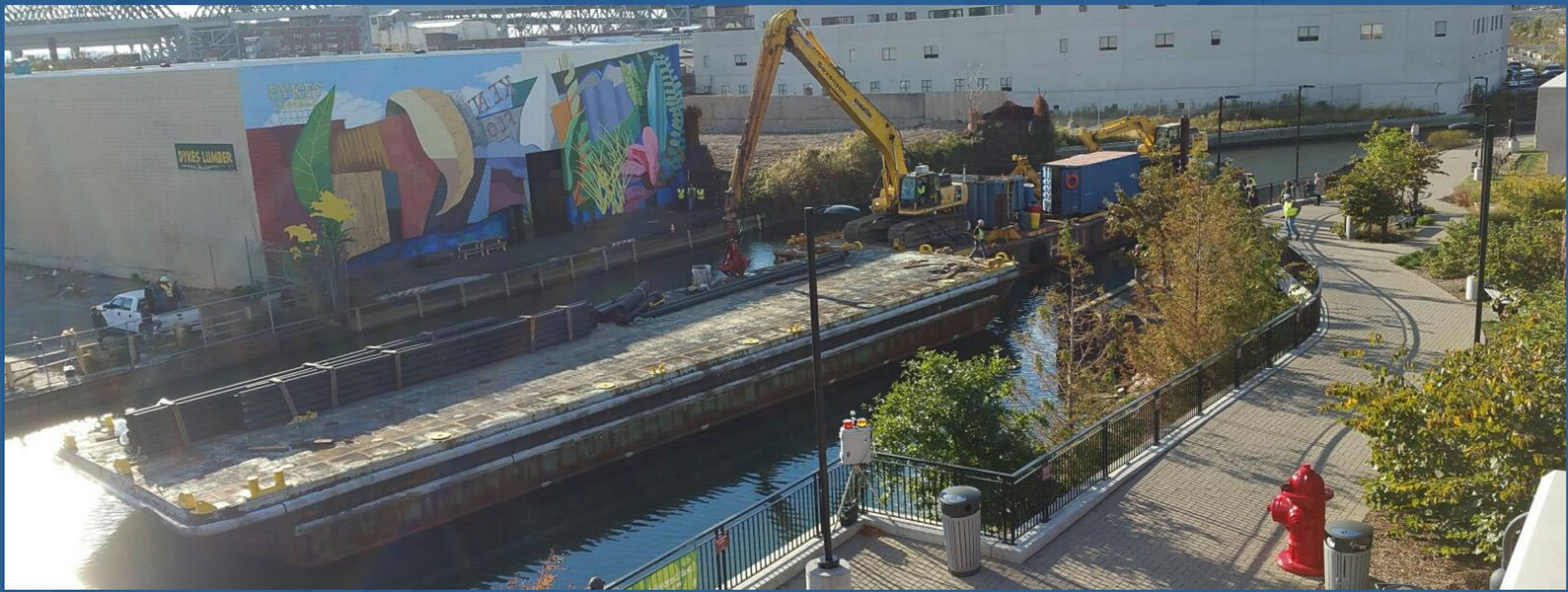

Multi-Objective Cap Design for Ecological and Armor Layers at Gowanus Canal Superfund Site

Geosyntec consultants

M. Schillinger, J. Beech, S. Sood, D. Nicholas, and D. Himmelheber

2019 Battelle Sediments Conference – New Orleans, LA

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(1) Licensed in GA, SC, NC, and TN

Presentation Preview

- Gowanus Canal Brief History and Background
- Major Remedial Design Components
- Capping Design: Armor and Ecological Habitat Layers
- Pilot Study Construction
- Future Design Considerations

Gowanus Canal – Brooklyn, NY

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1.8 mile (2.9 km)
man-made canal

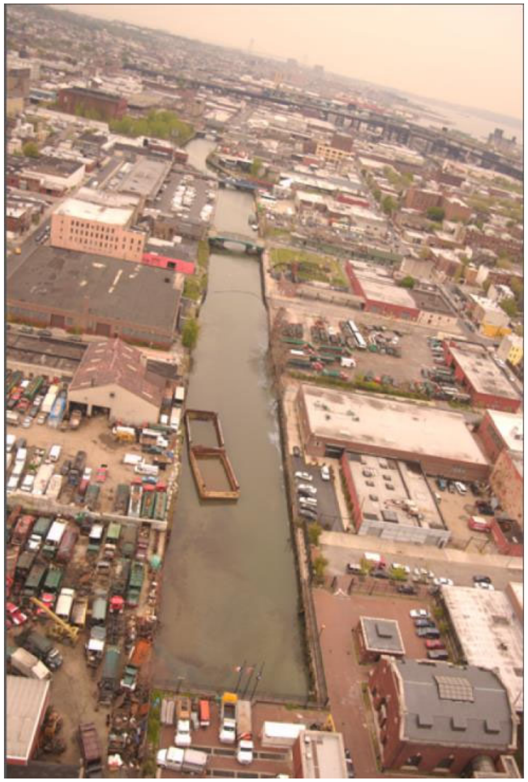
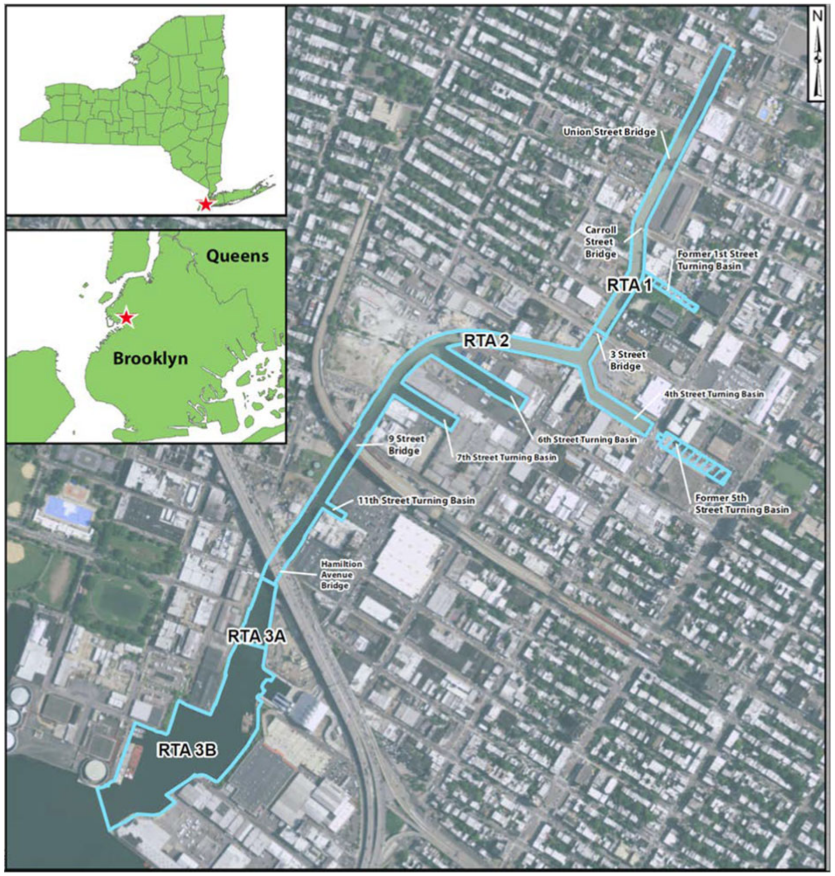


Photo: Looking South from Head of Canal



Gowanus Canal History

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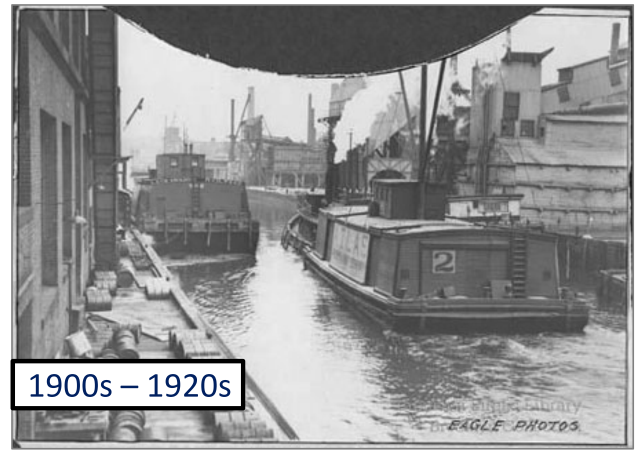
- Authorized: 1848
- Constructed: 1853 – 1869
- Peak operation: 1915-1950
  – 25,000 vessel trips/year and 60 dock facilities
- By 2000
  – 500 vessel trips/year and 5 dock facilities



1900s – 1920s

Gowanus Canal – 1935 photograph by Seymour "Zee" Zolotorofe.

Gowanus Canal Design Overview

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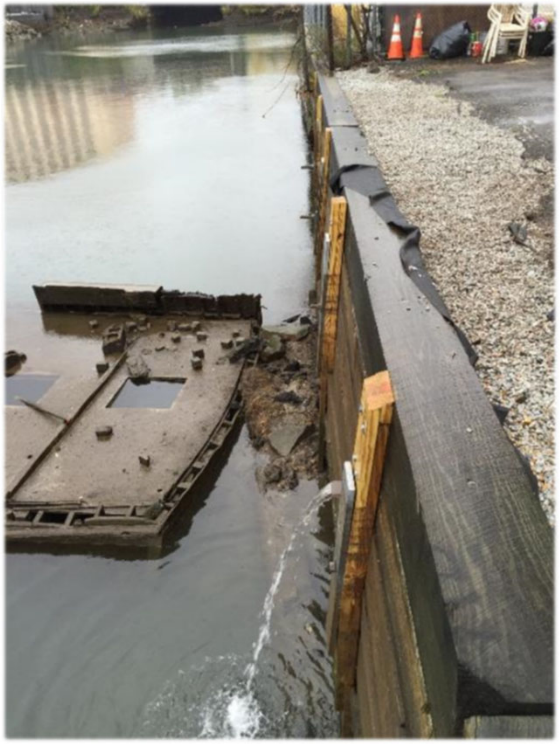
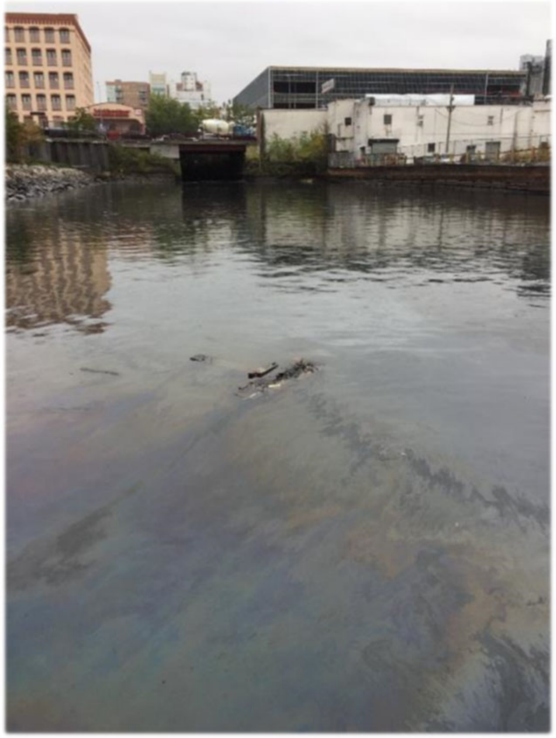
Major Components

1. Staging Site Preparation
2. Dredging
3. Marine Shoring
4. Sediment & Debris Mgmt.
5. Water Treatment
6. In-Situ Stabilization
7. Capping





Design Criteria and Challenges

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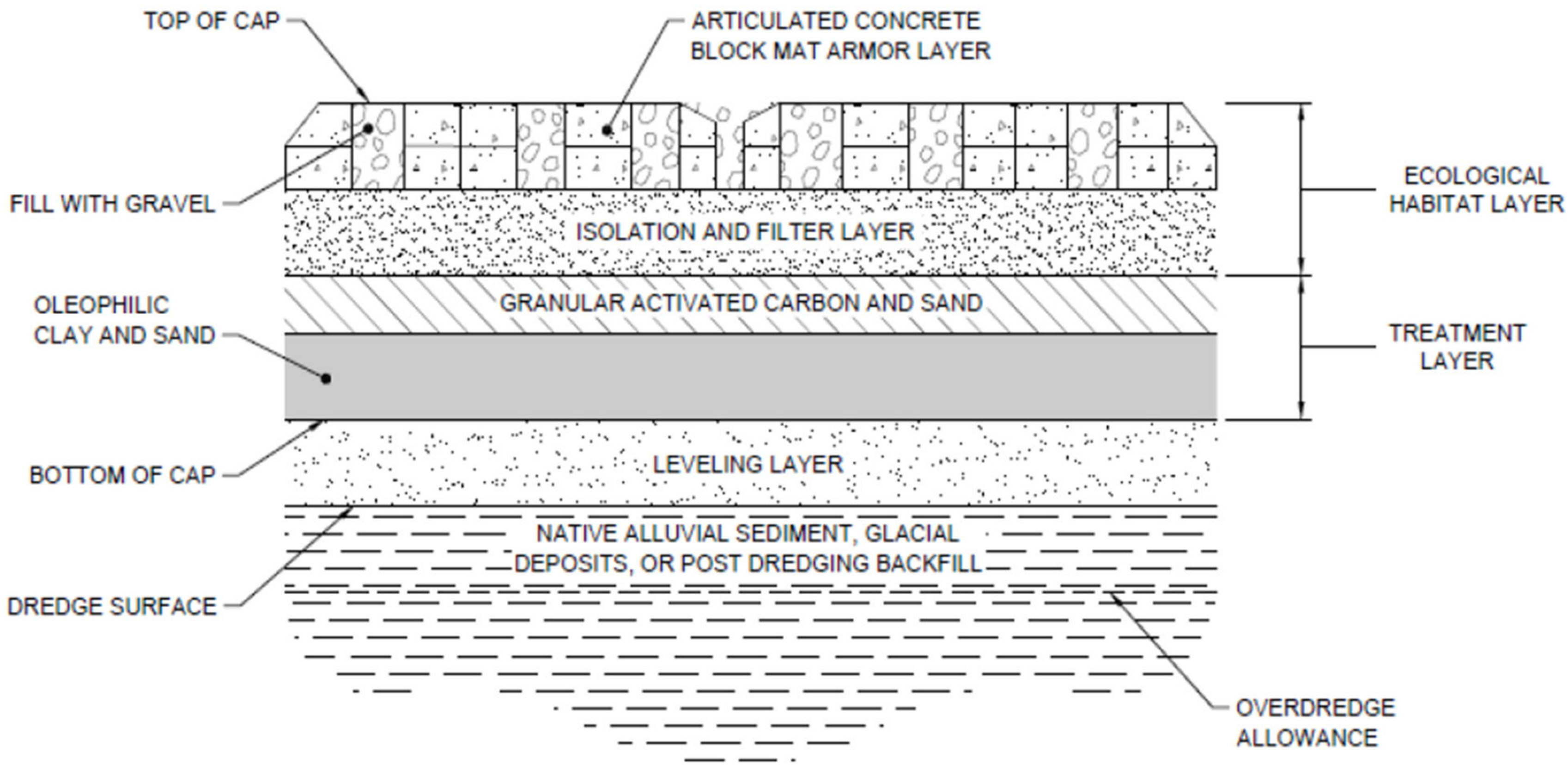
1. Protect Cap from Erosion
2. Benthic Recolonization
3. Navigation
4. Constructability
5. Environmental/Groundwater Impacts
6. Cost Efficiency

Cap Design


TOP OF CAP
ARTICULATED CONCRETE
BLOCK MAT ARMOR LAYER
FILL WITH GRAVEL
ISOLATION AND FILTER LAYER
ECOLOGICAL
HABITAT LAYER
OLEOPHILIC
CLAY AND SAND
GRANULAR ACTIVATED CARBON AND SAND
TREATMENT
LAYER
BOTTOM OF CAP
LEVELING LAYER
NATIVE ALLUVIAL SEDIMENT, GLACIAL
DEPOSITS, OR POST DREDGING BACKFILL
DREDGE SURFACE
OVERDREDGE
ALLOWANCE

Cap Design

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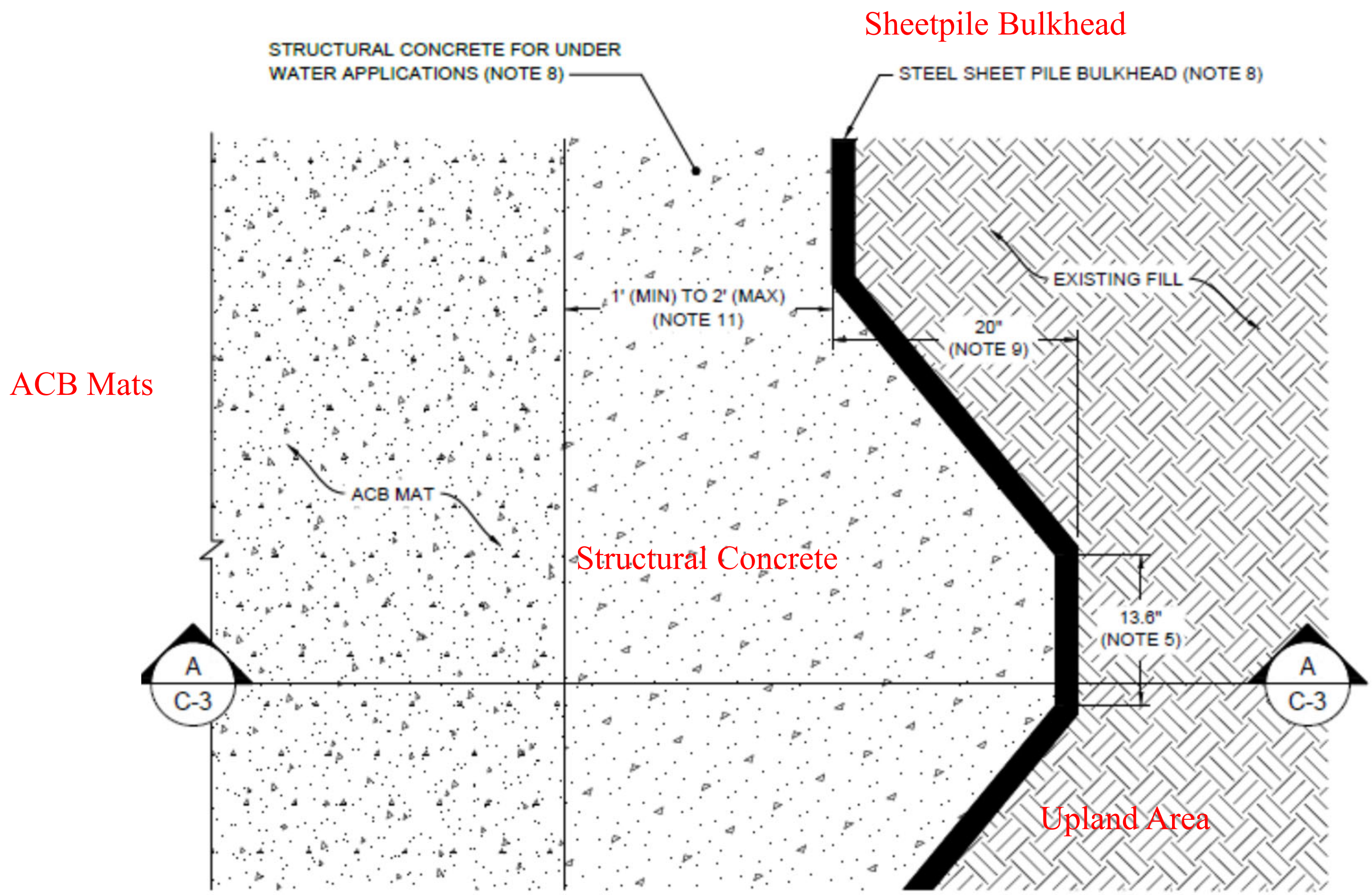

PLAN

TB4 Pilot Study

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Hydrodynamics

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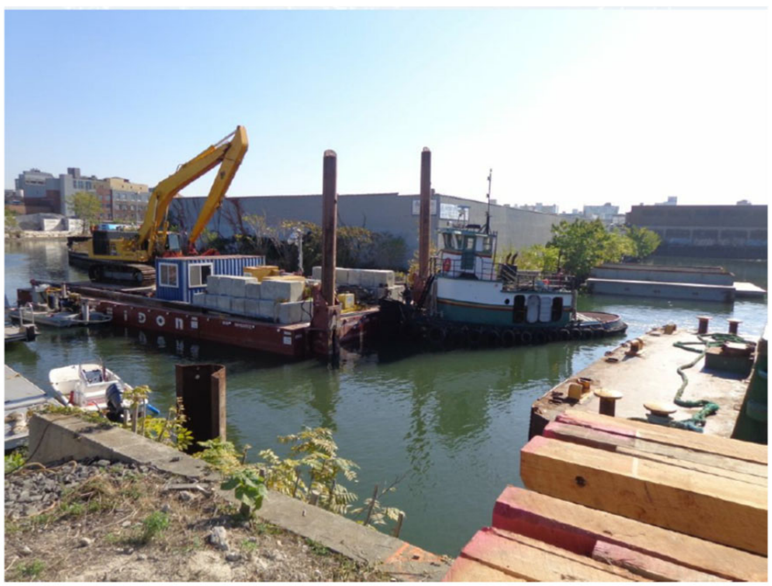
- Hydrodynamic Forces
  - Combined Sewer Overflows (CSOs)
  - Flushing Tunnel (12-ft diameter)
  - Tidal Effects (5-ft a day)
  - Storm Surge



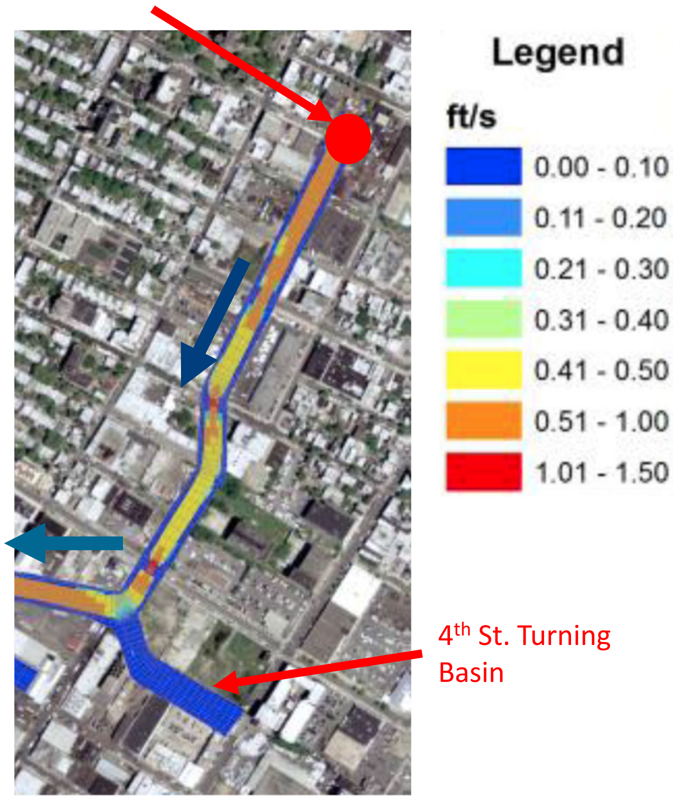
Tug pushing dredge equipment into Canal

4th St. Turning Basin (looking South)

- Ice Scour
- Vessel Impacts
  - Current/Future Vessel Use
  - Propeller Wash Velocity/Shear Stress Estimates

Hydrodynamics

Flushing Tunnel and CSO RH-034



4th St. Turning Basin

Bed Velocities during Flushing Tunnel Operations at Low Tide (Baird, 2017)

- Hydrodynamic Modeling
  - Storm Surge
  - Flushing Tunnel
  - CSO flows
  - Tidal effects
- Ice scour

Flushing Tunnel CSO RH-034

Vessel Impacts – Design Driver

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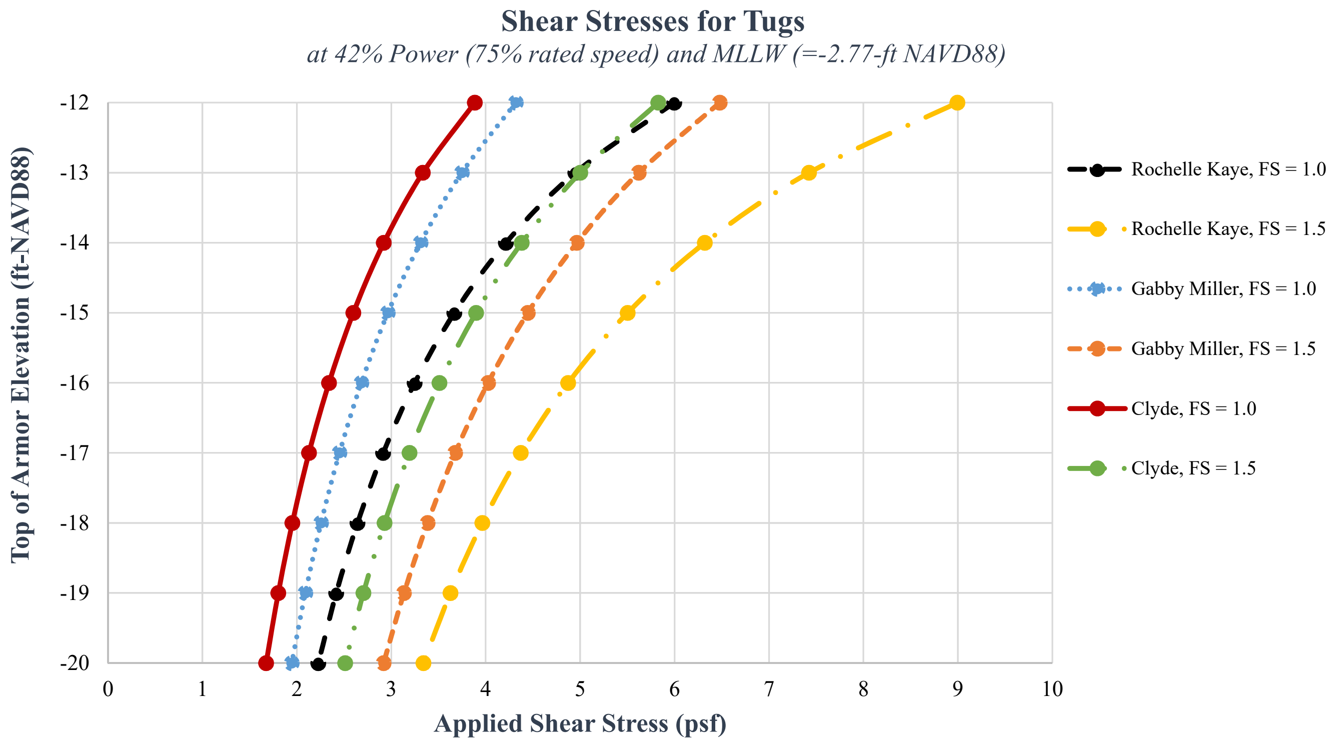
- Study of Vessels Using Canal
- EAU and methodology for dual propellers – velocities
- FHWA methodology – shear stress conversion
  - Vessel characteristics; geometry; depths
  - Velocities > 10 fps, **high shear stresses**



Armor Design Evaluation

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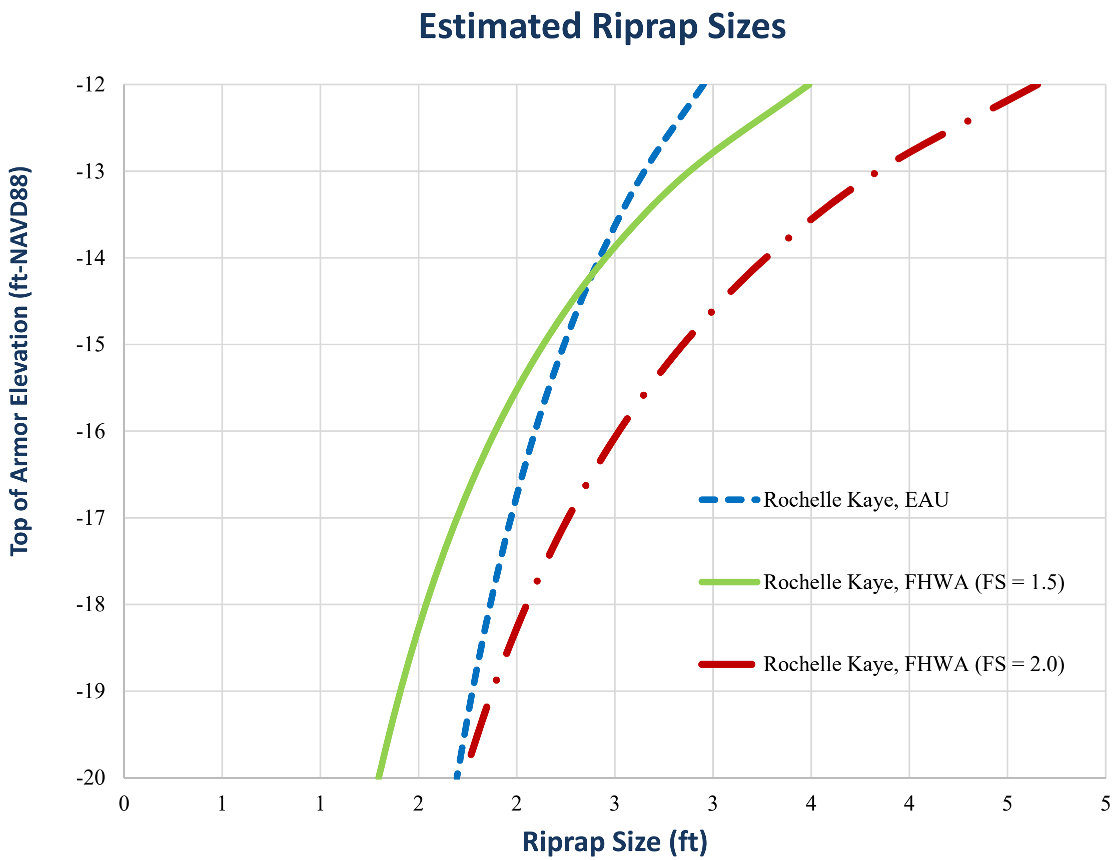

Marine Mattresses

Mattress Thickness		Permissible Shear Stress
inches	feet	psf
6	0.5	3.6
12	1	4.0
18	1.5	4.4
24	2	4.8

Armor Layer Selection – ACB Mats

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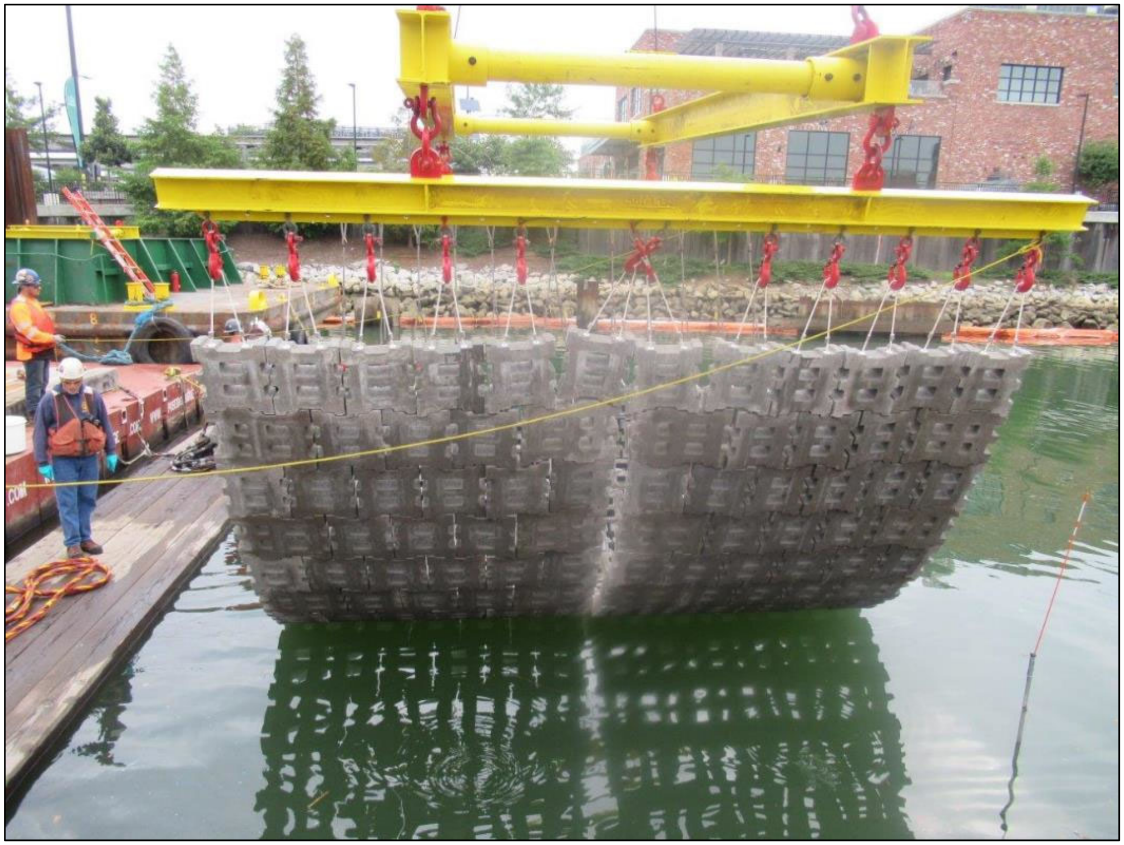
Selection:

ACB Mats filled with gravel

- 20% Open Area
- High Allowable Shear Stress

Design Criteria:

✓ Cap Protection
✓ Benthic Recolonization
✓ Navigation
✓ Cost Efficiency
✓ Maintenance
✓ Constructability
✓ Groundwater/Environmental



Mat Placement

Isolation/Filter and Ecological Habitat

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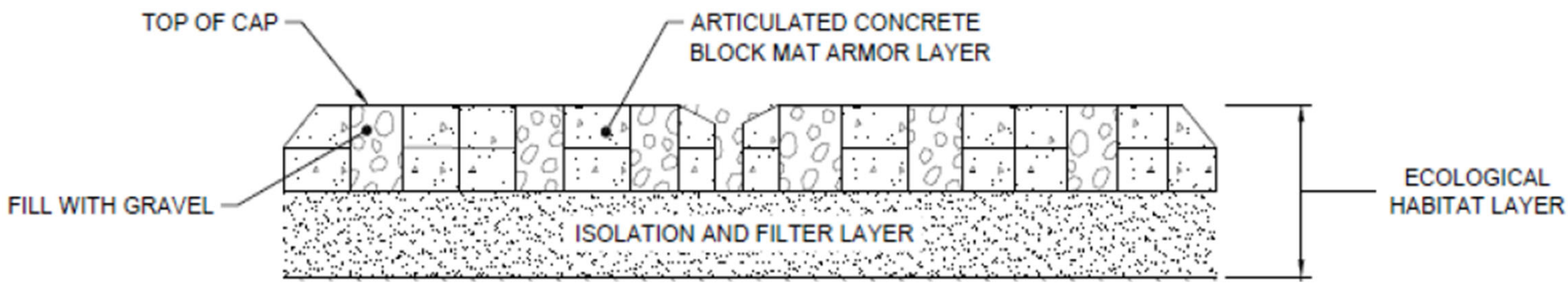
- Bioturbation Depth
- Promotes Benthic Recolonization
- Mat Placement Protection



Groundwater

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- 3D Numerical Groundwater Modeling
  - Multiple Scenarios, Sensitivity Analyses
  - Steady State and Transient Modeling
- Large Scale Field Investigation

Fiber Optic Cable Installation - Temperatures

Seepage Meter Installation

TB4 Cap Construction

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Gravel Placement

Placement:

- Sand/gravel - hydraulic
- Mats placed via crane
    - Up to 16,000 lbs at a time
    - Safety
    - Property Access

Field Modification:

- Use of Controlled Low Strength Material (CLSM)
- Sand Buttress

TB4 QA/QC

- Divers
  - Confirmed mat tolerances
  - Guided CLSM/structural concrete
- Submersible camera
- Additional gravel placement
- Hydrographic Surveys

Hydrographic Surveying

Future Design Challenges

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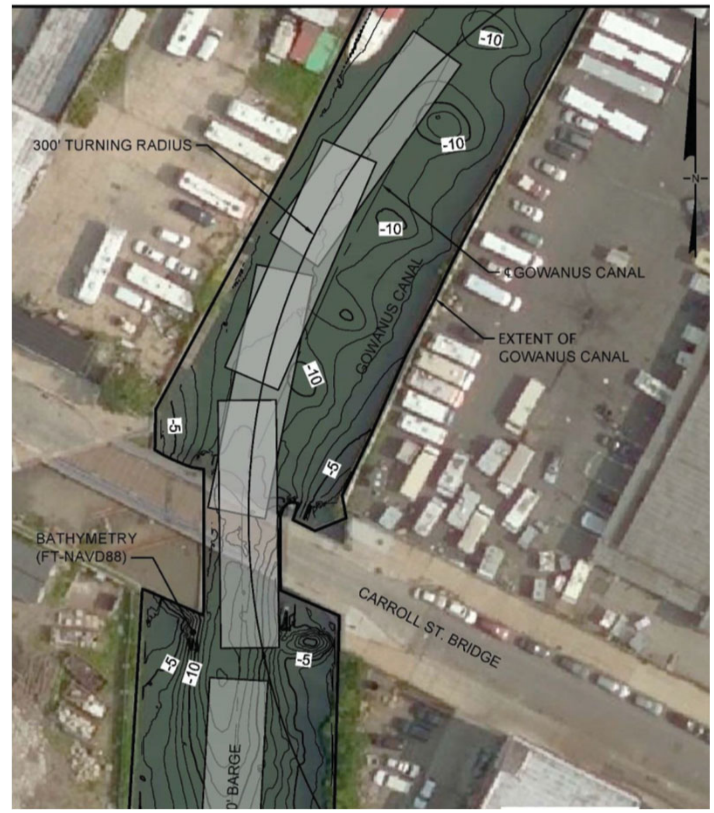
- Hydrodynamic forces
- Larger vessels
- Design optimization
- Placement near bridges
- Construction Phasing



36-ft Wide Carroll St. Bridge

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Questions?

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