Presentation Overview

- Background
- Feasibility Study overview
- Next steps
Background
Site Location

Gowanus Canal Project Area

Note: The Gowanus Creek Channel referenced in text extends from between Bryant and Halseck Streets to 28th Street. Approximate extent shown by two small hatched lines on map within Gowanus Bay
Project History & Schedule

✓ Gowanus Canal placed on the National Priorities List – March 2010
✓ Remedial Investigation Report – January 2011
✓ Feasibility Study – December 2011

◆ Proposed Plan – 6 to 8 months after Feasibility Study completion
◆ Selection of Remedy – end of 2012
Gowanus Canal Sediment Layers

- Native Sediment
- Soft Sediment
- Surface Sediment (top 6 inches of soft sediment)
Contaminants of Concern

◆ **Soft Sediment**
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Polychlorinated biphenyls (PCBs)
  - Metals (barium, cadmium, copper, lead, mercury, nickel, silver)
  - Non-aqueous phase liquid (NAPL)

◆ **Native Sediment**
  - PAHs
  - Non-aqueous phase liquid (NAPL)
Soft and Native Sediment Layers

Soft Sediment

Native Sediment

NAPL
Conceptual Site Model

- Discharges from upland contaminated sites
- Historical and on-going non-CSO discharges
- Ecological receptors potentially at risk
- Oil sheen migration
- Oil seep migration
- Historical spills
- Sediment resuspension from propeller wash and flushing tunnel currents
- Ebullition
- Bioturbation
- Not to Scale

LEGEND
- Fill
- Soft sediment (deposited after canal was created)
- Gowanus Creek native sediments
- NAPL impacted sediment/soil
- Groundwater Flow Direction
- Groundwater seepage through bulkhead
- NAPL-saturated sediment/soil

Watershed Inputs
- Combined Sewers 52%
- Storm Sewers 2%
- Surface runoff 6%

NOTE
- Potential human health risks from recreational use of canal, and ingestion of fish and crabs
- Benthic organisms potentially at risk

FIGURE 1-8
Conceptual Site Model
Gowanus Canal Feasibility Study
Brooklyn, New York
Feasibility Study (FS) Overview
Key FS Considerations

◆ Recontamination concerns
  - Source control
  - NAPL in sediment is deeper than the practical depth of removal

◆ A large portion of the bulkheads are in poor condition
Source Control

- Source control required for any alternative to be effective

- Sources include:
  - CSO and stormwater discharges
  - Discharges from former MGP sites
  - Contaminated groundwater discharge
  - Street runoff
  - Discharges from unpermitted pipes
Concentrations of PAHs and metals in surface sediment are similar to estimated concentrations in CSO solids discharged during wet weather.
Contaminated Groundwater Discharge

PAH Toxic Unit indicates potential for groundwater to recontaminate the canal
Feasibility Study Process

◆ Six Main Steps

1. Develop Remedial Action Objectives
2. Develop Preliminary Remediation Goals
3. Define Remediation Target Areas
4. Identify and Screen Remedial Technologies
5. Develop and Screen Remedial Alternatives
6. Evaluate Remedial Alternatives in Detail
Step 1
Develop Remedial Action Objectives
Step 1 - Remedial Action Objectives

◆ Ecological

- Reduce toxicity to benthic (bottom-dwelling) organisms from direct contact with PAHs, PCBs, and metals in sediment
- Reduce risk to herbivorous (plant-eating) birds from dietary exposure to PAHs
Step 1 - Remedial Action Objectives (continued)

◆ Human Health

- Reduce risk from exposure to PAHs in sediment and surface water during recreational use of the canal or from exposure to canal overflow

- Reduce risk from ingestion of PCB-contaminated fish and shellfish collected from the canal
Step 1 - Remedial Action Objectives (continued)

◆ NAPL Mitigation

- Prevent migration of NAPL into the canal after the remedial action is completed
- Prevent NAPL from acting as source of contaminants to groundwater discharging to canal
Step 2
Develop Preliminary Remediation Goals
Step 2 – Preliminary Remediation Goals (PRGs)

◆ Ecological Protection
  - PRGs for Total PAHs range from 7.8 to 290 mg/kg
  - Cleanup based on total PAHs will also address PCBs and metals

◆ Human Health Protection
  - PRGs were developed for six individual PAHs
  - For fish/shellfish ingestion, cleanup based on PAHs will also address PCBs in the canal
Step 3
Define Remediation Target Areas
Step 3 – Define Remediation Target Areas: Soft Sediment

Total PAHs in Soft Sediment

Distance from Head of Canal (feet)
0 2000 4000 6000 8000

Total PAH (mg/kg)
0.1 1 10 100 1000 10000

Most protective preliminary remediation goal
Highest preliminary remediation goal
Deeper soft sediment sample
Surface sediment sample

Gowanus Expy 3rd St. 9th St.
Step 3 – Define Remediation Target Areas: Native Sediment

Total PAHs in Native Sediment

- Most protective preliminary remediation goal
- Highest preliminary remediation goal
- Native sediment sample
Step 3 – Define Remediation Target Areas (RTAs)

**RTA 1**
Upper Canal
*Intermediate level of contamination*

**RTA 2**
Middle Canal
*Highest level of contamination*

**RTA 3a**
Lower Canal
*Lowest level of contamination, shallower*

**RTA 3b**
Lower Canal
*Lowest level of contamination, deeper*
Step 4

Identify and Screen Remedial Technologies
Step 4 - Technology Identification and Screening

- Identified potential sediment cleanup technologies
  - Dredging (removal)
  - Containment (capping)
  - In situ (in place) Treatment
  - Monitored Natural Recovery
  - Dredged Sediment Treatment, Beneficial Use, or Disposal
    - Treatment (e.g. thermal treatment, stabilization)
    - Beneficial use (e.g. construction fill, landfill cover)
    - Disposal (e.g., landfill, confined disposal facility [CDF])
Step 4 - Technology Identification and Screening

Potential technologies screened based on:
- Effectiveness
- Implementability
- Cost

Technologies that were retained were combined into seven remedial alternatives
Step 5
Develop and Screen Remedial Alternatives
Step 5 – Sediment Dredging and Capping Alternatives

1. No Action

2. Dredge some soft sediment
   Two-layer cap (isolation and armor layers)

3. Dredge some soft sediment
   Three-layer cap (treatment, isolation, and armor layers)

4. Dredge all soft sediment
   Two-layer cap (isolation and armor layers)

5. Dredge all soft sediment
   Three-layer cap (treatment, isolation, and armor layers)

6. Dredge all soft sediment
   Solidify top of native sediment
   Two-layer cap (isolation and armor layers)

7. Dredge all soft sediment
   Solidify top of native sediment
   Three-layer cap (treatment, isolation, and armor layers)
Conceptual Three-Layer Cap

Gravel armor layer
Sand and Gravel Isolation Layer
Organoclay Treatment Layer
Contaminated Native Sediment
Conceptual Three-Layer Cap with In situ Stabilization

- Gravel armor layer
- Sand and Gravel Isolation Layer
- Organoclay Treatment Layer
- Stabilized Native Sediment
- Contaminated Native Sediment
Step 5 - Sediment Treatment and Disposal Alternatives

A  Offsite thermal desorption, beneficial use
B  Offsite disposal (landfill)
C  Offsite cogeneration, beneficial use
D  Offsite stabilization, beneficial use
E  Onsite stabilization, beneficial use
F  Offsite stabilization and disposal in onsite constructed Confined Disposal Facility (CDF)
G  Onsite stabilization and disposal in onsite constructed CDF
Aerial Photograph of Confined Disposal Facility (CDF) - Waukegan Harbor

Confined Disposal Facility
Photographs of Deep Mixing for Stabilization
Cogeneration Process

Fuel
- Coal
- NAPL-contaminated sediment
- Heating oil
- Biogas
- Municipal waste
- Biomass
- Vegetable oils

Cogeneration Plant (Steam Turbine)

Heat

Electricity

Beneficial Use of Residuals
Step 5 - Alternative Screening

- Alternatives screened for each RTA based on:
  - Technical Effectiveness
  - Implementability
  - Cost
    - Cost was not used to screen out alternatives
Step 5 – Alternative Screening Results

1. No Action
2. Dredge some soft sediment
   Two-layer cap (isolation and armor layers)
3. Dredge some soft sediment
   Three-layer cap (treatment, isolation, and armor layers)
4. Dredge all soft sediment
   Two-layer cap (isolation and armor layers)
5. **Dredge all soft sediment**
   Three-layer cap (treatment, isolation, and armor layers)
6. Dredge all soft sediment
   Solidify top of native sediment
   Two-layer cap (isolation and armor layers)
7. **Dredge all soft sediment**
   Solidify top of native sediment
   Three-layer cap (treatment, isolation, and armor layers)

Alternatives 5 and 7 retained for detailed evaluation.
## Step 5 - Screening - Sediment Treatment and Disposal Alternatives

<table>
<thead>
<tr>
<th>Option</th>
<th>RTA1</th>
<th>RTA 2</th>
<th>RTA 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> Offsite thermal desorption, beneficial use</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>B</strong> Offsite disposal (landfill)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>C</strong> Offsite cogeneration, beneficial use</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>D</strong> Offsite stabilization, beneficial use</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>E</strong> Onsite stabilization, beneficial use</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>F</strong> Offsite stabilization and disposal in onsite CDF</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>G</strong> Onsite stabilization and disposal in onsite CDF</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Y** – yes (retained)  
**N** – no (screened out)
Step 6
Evaluate Remedial Alternatives in Detail
Example - Alternative 5 for RTA 1

RTA 1 Cap Configuration – Alternative 5

Elevation (feet NAVD88 Approximate)

100'-0"

Isolation Layer
Armor Layer
Treatment Layer (clay)

Native Sediment
Example – Alternative 7 for RTA 1

RTA 1 Cap Configuration – Alternative 7

- Native Sediment
- Stabilized Sediments
- Isolation Layer
- Armor Layer
- Treatment Layer (clay)
- Augers

Elevation (feet NAVD88 Approximate)

100'-0”
Proposed In situ Stabilization Areas

Areas proposed for in situ stabilization show potential for active upward migration of NAPL from native sediment.
Step 6 - Detailed Evaluation of Alternatives

- Evaluated alternatives using criteria established by the National Contingency Plan

  - Threshold Criteria
    - Overall Protection of Human Health and the Environment
    - Compliance with “applicable or relevant and appropriate requirements” (ARARs)

  - Balancing Criteria
    - Long-term Effectiveness and Permanence
    - Reduction of Toxicity, Mobility or Volume through Treatment
    - Short-term Effectiveness
    - Implementability
    - Cost

  - Modifying Criteria
    - State and Community Acceptance - considered after State and public comments are received on the Proposed Plan

- Sustainability
## Step 6 - Evaluation of Sediment Dredging and Capping Alternatives

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternative 1 No Action</th>
<th>Alternative 5 Dredge all Soft Sediment Three-layer Cap</th>
<th>Alternative 7 Dredge all Soft Sediment Stabilize Three-layer Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Protection of Human Health and Environment</td>
<td>Does not meet</td>
<td>Meets</td>
<td>Meets</td>
</tr>
<tr>
<td>Compliance with ARARs</td>
<td>Does not meet</td>
<td>Meets</td>
<td>Meets</td>
</tr>
<tr>
<td>Long-Term Effectiveness</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Reduction of Toxicity, Mobility, or Volume Through Treatment</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Short-Term Effectiveness</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Implementability</td>
<td>High</td>
<td>Moderate</td>
<td>Low to Moderate</td>
</tr>
</tbody>
</table>
### Step 6 - Evaluation of Sediment Treatment and Disposal Options

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Protection of Human Health and Environment</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
</tr>
<tr>
<td>Compliance with ARARs</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
<td>Meets</td>
</tr>
<tr>
<td>Long-Term Effectiveness</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low to Moderate</td>
<td>Low to Moderate</td>
<td>Moderate to High</td>
<td>Moderate to High</td>
</tr>
<tr>
<td>Reduction of Toxicity, Mobility, or Volume Through Treatment</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Short-Term Effectiveness</td>
<td>Moderate to High</td>
<td>Moderate to High</td>
<td>Moderate to High</td>
<td>Moderate to High</td>
<td>Moderate to High</td>
<td>Moderate to High</td>
<td>Moderate to High</td>
</tr>
<tr>
<td>Implementability</td>
<td>Moderate</td>
<td>Moderate to High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
### Step 6 – Sustainability Evaluation

<table>
<thead>
<tr>
<th>Sustainability Impacts</th>
<th>Option A Offsite Thermal Desorption, Offsite Beneficial Use</th>
<th>Option B Offsite Landfill Disposal</th>
<th>Option C Offsite Cogeneration, Offsite Beneficial Use</th>
<th>Option D Offsite Stabilization, Offsite Beneficial Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumed/Fossil Fuel Depletion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green House Gas and Other Air Emissions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation Impacts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste Reduction, Reuse, and Recycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall sustainability impacts</td>
<td>High</td>
<td>Moderate to high</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sustainability Impacts</th>
<th>Option E Onsite Stabilization, Onsite Beneficial Use</th>
<th>Option F Offsite Stabilization and Onsite Disposal in Constructed CDF</th>
<th>Option G Offsite Stabilization and Onsite Disposal in Constructed CDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumed/Fossil Fuel Depletion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green House Gas and Other Air Emissions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation Impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste Reduction, Reuse, and Recycling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall sustainability impacts</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Lower negative impacts
Moderate negative impacts
Higher negative impacts
## Step 6 - Summary of Estimated Costs

<table>
<thead>
<tr>
<th>Alternative 5</th>
<th>Lowest Cost Disposal Option ¹</th>
<th>Highest Cost Disposal Option ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredge all soft sediment</td>
<td>$351 M</td>
<td>$439 M</td>
</tr>
<tr>
<td>Three-layer cap</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative 7</th>
<th>Lowest Cost Disposal Option ¹</th>
<th>Highest Cost Disposal Option ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredge all soft sediment</td>
<td>$369 M</td>
<td>$456 M</td>
</tr>
<tr>
<td>Solidify top of native sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three-layer cap</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cost of No Action alternative is $0

¹ Offsite thermal desorption and beneficial use for RTAs 1 and 2
   Onsite stabilization and disposal in onsite CDF for RTA 3

² Offsite cogeneration for RTAs 1, 2, and 3
Next Steps
Next Steps

- Treatability Studies / Pilot Testing
- Ongoing coordination with NYCDEP, NYSDEC, National Grid, and others
- Proposed Plan
- Selection of Remedy
Questions?