# Mechanical Placement of Granular Activated Carbon Amended ENR Material in the Lower Duwamish Waterway: Design to Construction

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WEDA PACIFIC CHAPTER
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PORTLAND, OR

# Lower Duwamish Waterway Superfund Site




Pilot Project

Required by EPA

Project performed by:

- Lower Duwamish Waterway Group (LDWG)
  - Boeing, City of Seattle, King County, Port of Seattle

Contracted by: King County

Contractor: Pacific Pile & Marine (PPM)

Consultant Team: AMECFW, DOF, Floyd Snider, GeoSyntec, Ramboll Environ

# Activated Carbon Pilot Project

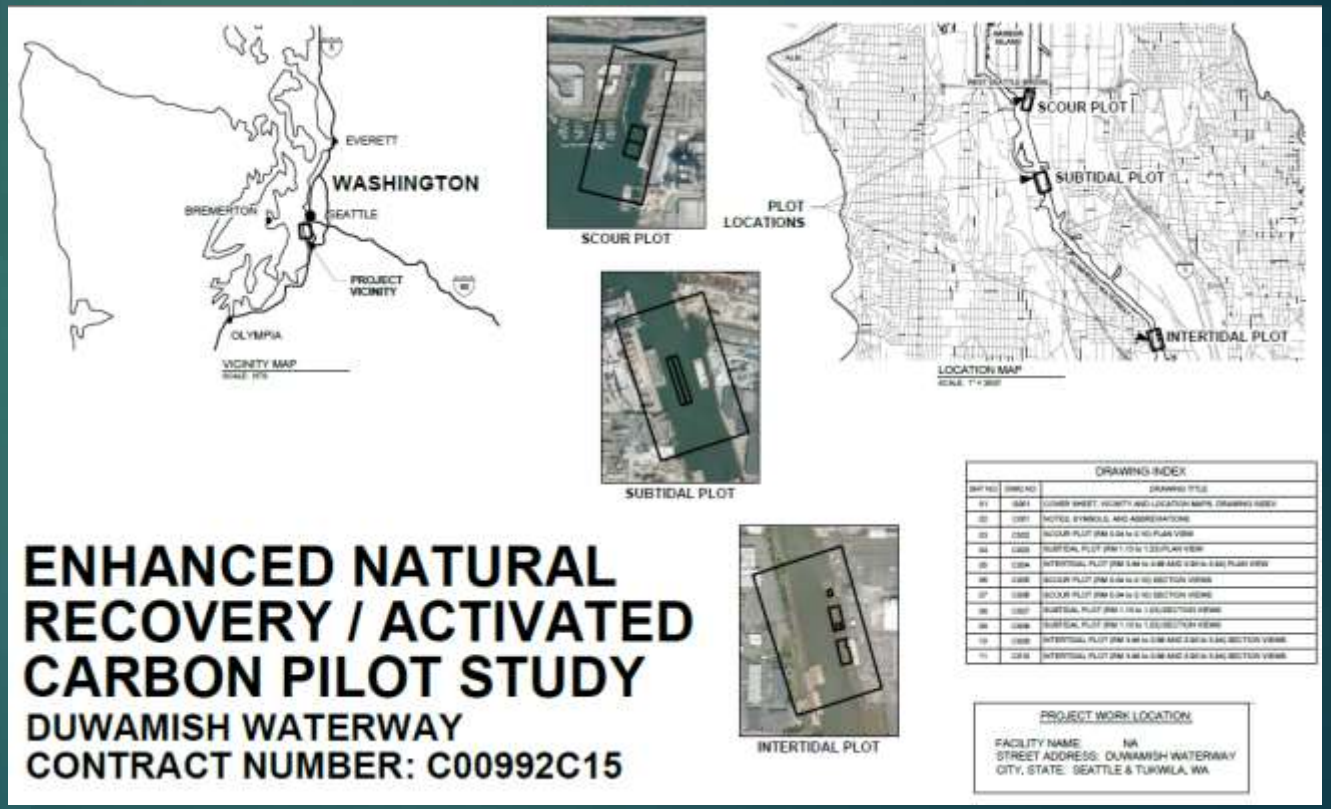


Ongoing Project

Placement Started Nov 28, 2016

Completed Feb 2017

3 Year Monitoring
- Y0 – Completed
- Y1 – 2018
- Y2 - 2019
- Y3 - 2020



# Pilot Study Goals



- Verify that ENR amended with AC can be successfully applied in the LDW by monitoring physical placement success (uniformity of coverage and percent of carbon in a placed layer);

**Construction & Y0 This Presentation**

- Evaluate performance of ENR/AC compared to ENR alone in locations with a range of polychlorinated biphenyl (PCB) concentrations;
- Assess potential impacts to the benthic community in ENR/AC compared to ENR alone; and
- Assess changes in bioavailability in ENR/AC compared to ENR alone.

**Next 3 Years**

# ENR Materials Used



Grain sizes selected to balance stakeholder concerns, habitat considerations and technical issues.

Subtidal Plot:
Sand

Scour & Intertidal Plots:
Gravelly Sand

| SAND ENR MATERIAL | |
|---|---|
| U.S. Standard Sieve Size | Percent Passing by Dry Weight |
| 3/8" | 100 |
| U.S. No. 4 | 95-100 |
| U.S. No. 16 | 45-80 |
| U.S. No. 50 | 10-30 |
| U.S. No. 100 | 2-10 |
| U.S. No. 200 | 0-2 |

| GRAVELLY SAND ENR MATERIAL | |
|---|---|
| U.S. Standard Sieve Size | Percent Passing by Dry Weight |
| 1-1/2" | 100 |
| ¾" | 80-90 |
| 3/8" | 50-80 |
| U.S. No. 4 | 50% min |
| U.S. No. 16 | 10-30 |
| U.S. No. 200 | 0-2 |

# Activated Carbon Selection

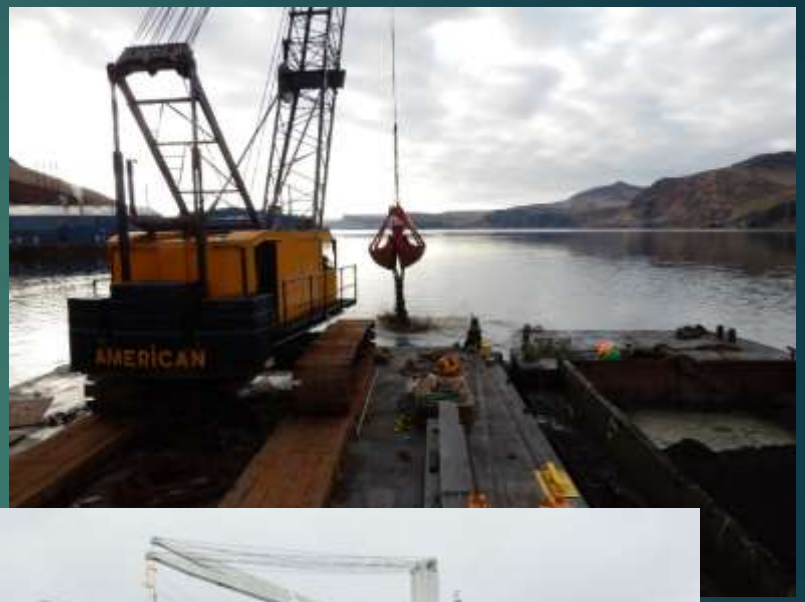


- Material Selection
  - Cannot alter target ENR grain size
  - Available in Pilot Project and potential full scale project quantities
  - Use Bulk Activated Carbon
- Grain Size Selection – finer or coarser
  - Ability to handle and place
  - Stability once placed
  - Effectiveness – Short & Long Term
  - Adverse benthic effects
- Selected Size range – 200 to 1000 Microns (~#70 to #18 Sieve, Fine to Coarse sand)

# ENR/AC Placement Considerations



- Mixing/entrainment of underlying sediment
- ENR layer thickness
- Uniformity of AC in ENR layer
  - Segregation
  - Winnowing
- Surface release not practicable




# Placement Method



Considerations

- Pilot Project
  - Use readily available equipment
  - Methods that can be adapted for full scale
  - Precision to reduce study variables – more than necessary for full scale
- Bulk AC
  - Losses thru water column
  - Water Quality Impacts

# Placement Method

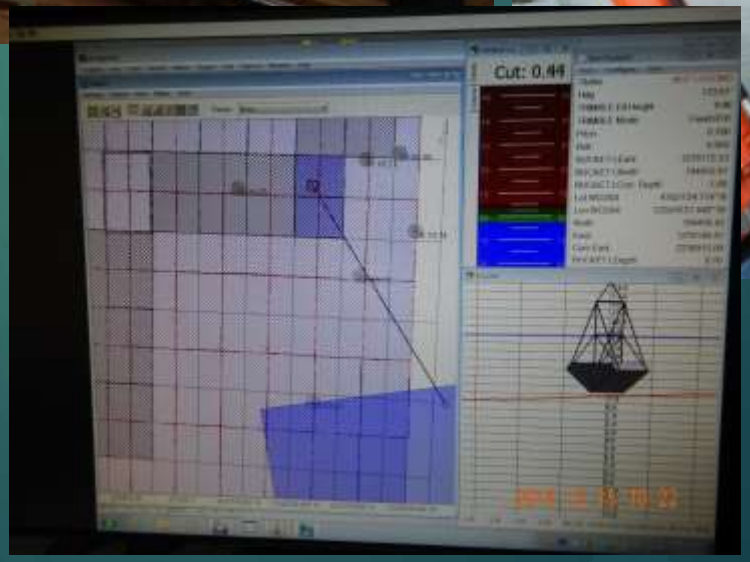


Resulting Approach:

- Mechanical Placement
- Saturate Material
- Release material within 2' of bed

# Navigation System






Each Bucket Placement Pre-Mapped

# Bucket Modifications



5 CY Youngs Bucket modified to limit fill factor

# GAC Blending with ENR Material & Barge Loading



# AC Amended ENR Materials (4% AC)

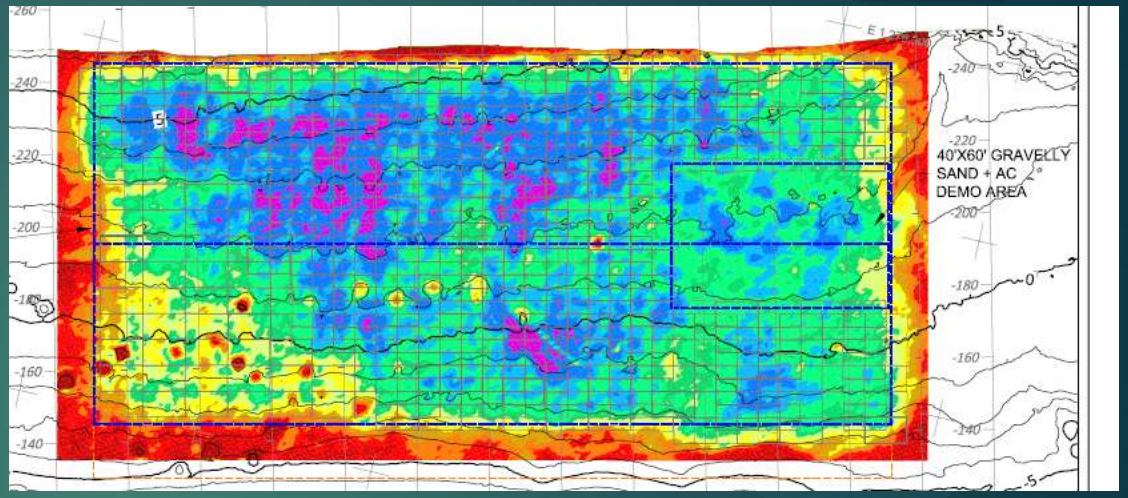


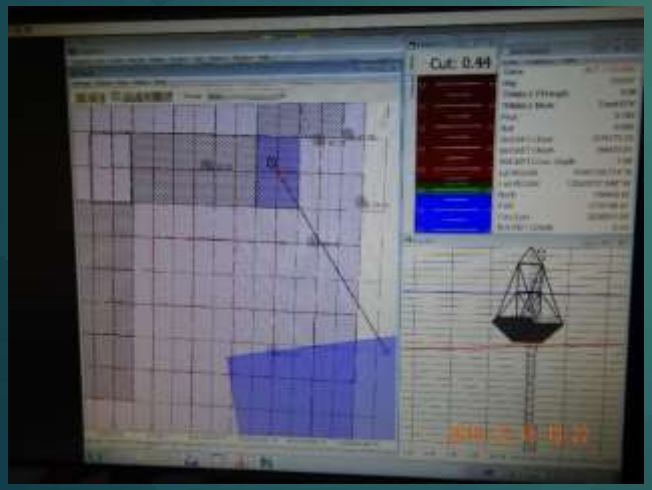
QA/QC
- Grain Size
- Observations
- AC %

# Confirmation Methods



- Real time tracking during Placement
- Multibeam Surveys
- Grade Stakes



# Test Plot Placement



2 - 60'x40' Test Plots
Grade Stake every 100 SF
24 Stakes per Test Plot
Placed during high tide
Visual low tide assessment


Target Thickness: 6" to 9", No Areas less than 4", limit placement over 12"

| SAND ENR + AC | |
|---|---|
| **Placed Thickness** | **Inches** |
| **AVERAGE** | **7** |
| **MINIMUM** | **3** |
| **MAXIMUM** | **12** |

| GRAVELLY SAND ENR + AC | |
|---|---|
| **Placed Thickness** | **Inches** |
| **AVERAGE** | **8** |
| **MINIMUM** | **5** |
| **MAXIMUM** | **11** |

# Field Observations



**GAC visible after placement**

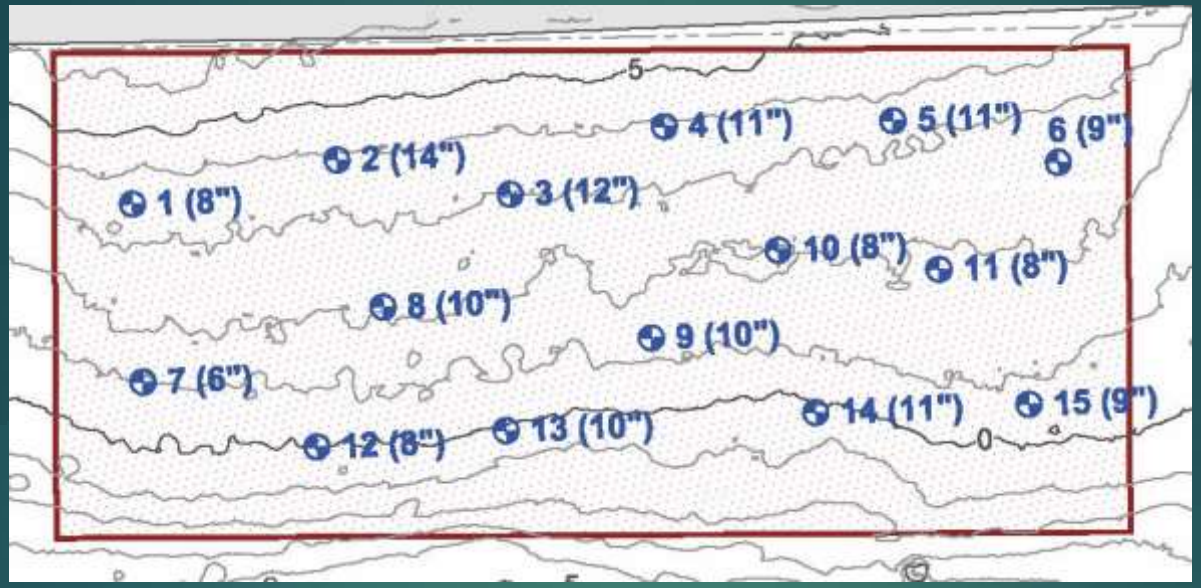
- GAC observed on surface
- Moves with currents, waves


**Spud hole and visible GAC**

- Typical during marine construction
- Spud prior to ENR placement.
- GAC from adjacent placement
- Locations mapped.
- Avoid during monitoring

# Post Placement (Y0) Monitoring Intertidal Plot






- 15 Grade stakes located in the plot.
- ENR+AC Placed during high tide.
- Visual assessment and measurement during the low tide.

| GRAVELLY SAND ENR + AC | |
|---|---|
| Placed Thickness | Inches |
| AVERAGE | 10 |
| MINIMUM | 6 |
| MAXIMUM | 14 |

# Post Placement (Y0) Monitoring Intertidal Plot



Plan View

- Small AC particles observed on the surface and a band of AC material .

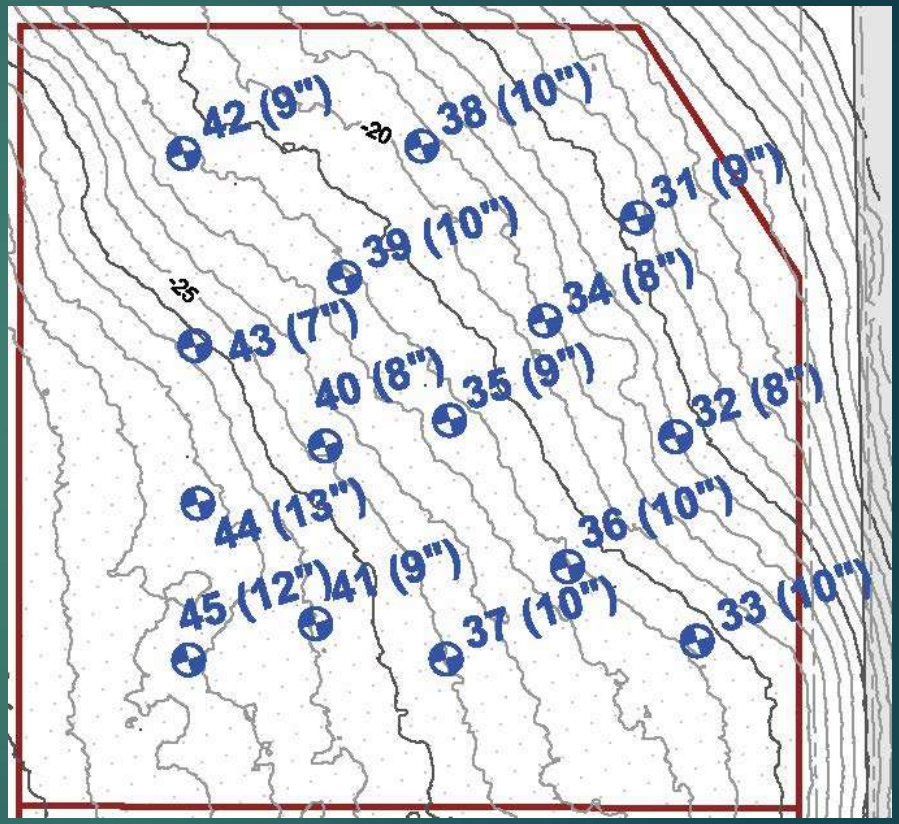
SPI View

- AC is present as small, sand sized, black particles and is mixed throughout the sediment column.

# Post Placement (Y0) Monitoring Scour Plot



- 15 Grade stakes located in the plot.
- Visual assessment and measurement by divers.




| GRAVELLY SAND ENR + AC | |
|---|---|
| Placed Thickness | Inches |
| AVERAGE | 10 |
| MINIMUM | 7 |
| MAXIMUM | 13 |

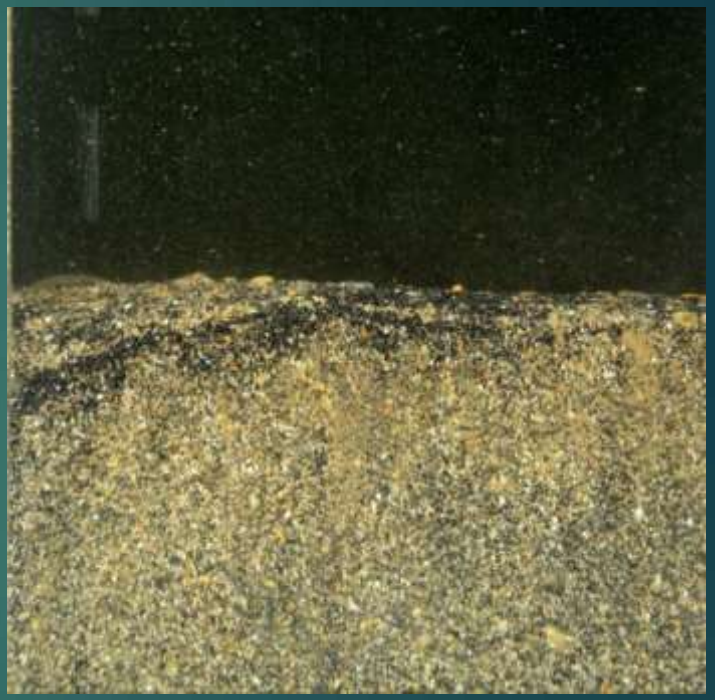
# Post Placement (Y0) Monitoring Scour Plot



Plan View

- Small AC particles observed on the surface and a band of AC material.
- A crab, 2 fish and a bivalve siphon can be seen in this image.

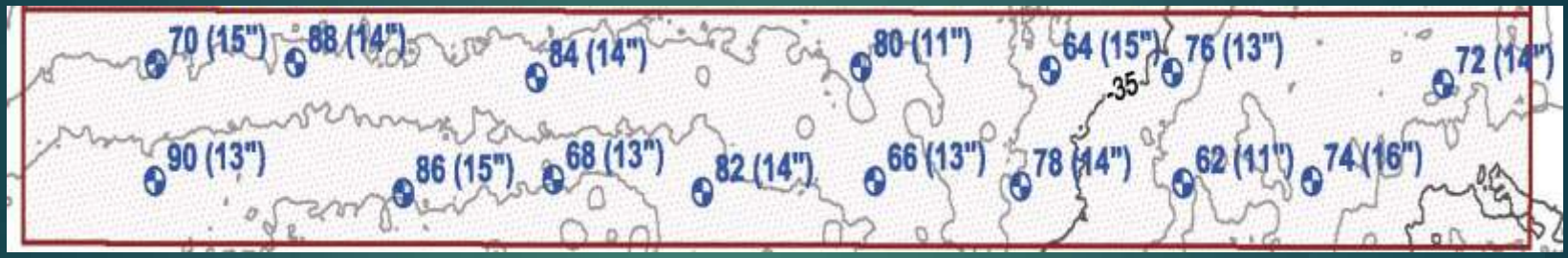
SPI View



- AC is mixed throughout the sediment column with a band of AC on the surface.

# Post Placement (Y0) Monitoring Subtidal Plot





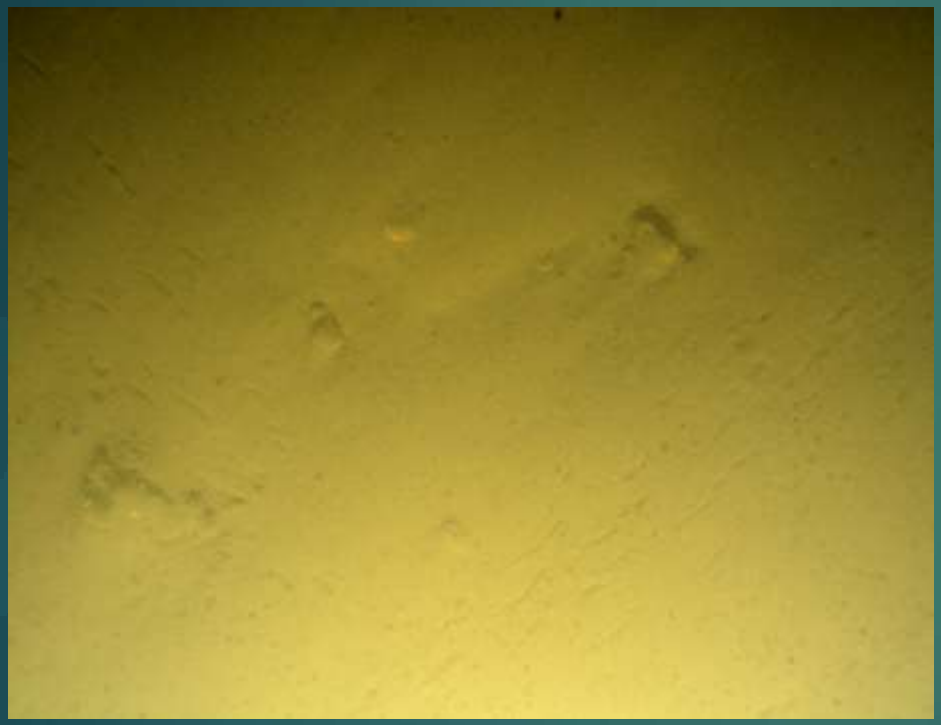

- 15 Measurement locations in the plot.
- Visual assessment and measurement by divers using stainless push probes.

| SAND ENR + AC | |
|---|---|
| Placed Thickness | Inches |
| AVERAGE | 14 |
| MINIMUM | 11 |
| MAXIMUM | 16 |

# Post Placement (Y0) Monitoring Subtidal Plot



Plan View



- Soft, fine grained recently deposited sediment over and obscuring ENR+AC material.

SPI View

- AC is present as small, sand sized, black particles mixed throughout the sediment column.
- Thin layer of recent deposition on the surface.

# Conclusions



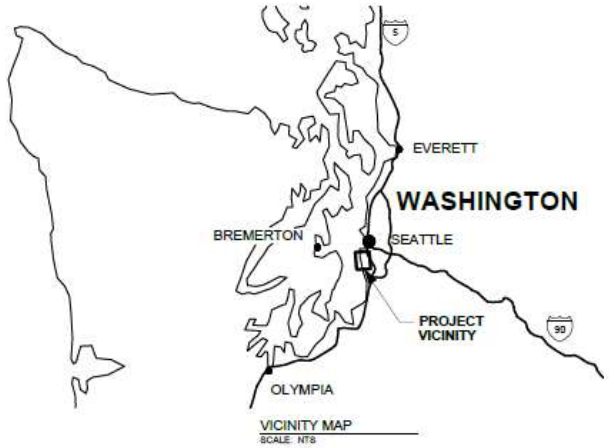
- Bulk GAC can be successfully handled and blended uniformly prior to placement
- Saturated GAC and ENR materials do not separate in barge
- Materials can be placed at target thickness
  - Bucket modifications successful
- GAC amended ENR appears to "flow" better
- Some winnowing and potential loss of GAC observed

## Next Steps

- Effectiveness to be evaluated over next three years

# Questions?



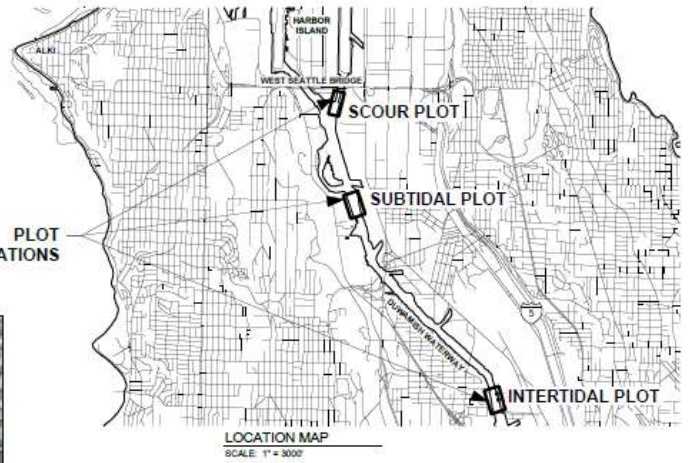




SCOUR PLOT


SUBTIDAL PLOT


INTERTIDAL PLOT




# ENHANCED NATURAL RECOVERY / ACTIVATED CARBON PILOT STUDY

## DUWAMISH WATERWAY

## CONTRACT NUMBER: C00992C15

DRAWING INDEX

| SHT NO | DWG NO | DRAWING TITLE |
|---|---|---|
| 01 | G001 | COVER SHEET, VICINITY AND LOCATION MAPS, DRAWING INDEX |
| 02 | C001 | NOTES, SYMBOLS, AND ABBREVIATIONS |
| 03 | C002 | SCOUR PLOT (RM 0.04 to 0.10) PLAN VIEW |
| 04 | C003 | SUBTIDAL PLOT (RM 1.13 to 1.23) PLAN VIEW |
| 05 | C004 | INTERTIDAL PLOT (RM 3.84 to 3.88 AND 3.90 to 3.94) PLAN VIEW |
| 06 | C005 | SCOUR PLOT (RM 0.04 to 0.10) SECTION VIEWS |
| 07 | C006 | SCOUR PLOT (RM 0.04 to 0.10) SECTION VIEWS |
| 08 | C007 | SUBTIDAL PLOT (RM 1.13 to 1.23) SECTION VIEWS |
| 09 | C008 | SUBTIDAL PLOT (RM 1.13 to 1.23) SECTION VIEWS |
| 10 | C009 | INTERTIDAL PLOT (RM 3.84 to 3.88 AND 3.90 to 3.94) SECTION VIEWS |
| 11 | C010 | INTERTIDAL PLOT (RM 3.84 to 3.88 AND 3.90 to 3.94) SECTION VIEWS |

PROJECT WORK LOCATION:

FACILITY NAME: NA
STREET ADDRESS: DUWAMISH WATERWAY
CITY, STATE: SEATTLE & TUKWILA, WA

DOF DALTON OLMSTED FUGLEVAND