

# An Updated Site Conceptual Model for Oleophilic Bio-Barriers

Battelle Sediments Conference



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# Agenda

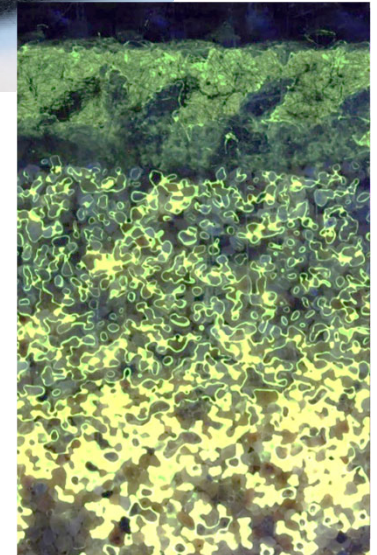
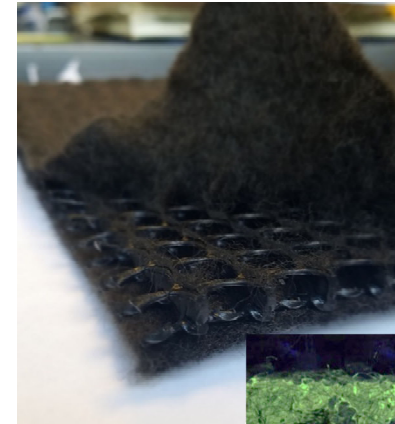
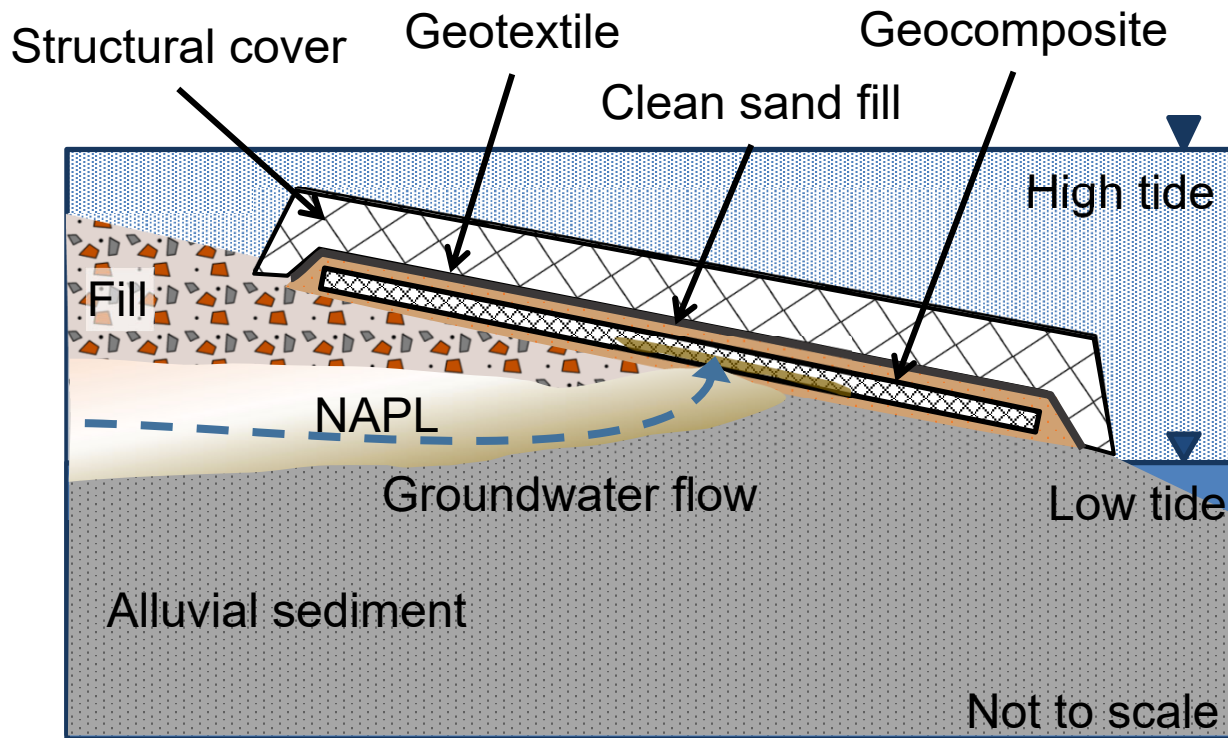
1. Problem statement
2. OBB overview
3. Site history
4. Site sampling
5. Sampling results
6. Conclusions and future work

## The Problem: Sheens

- Sheens form at Groundwater/Surface water Interfaces (GSIs) due to seeps, ebullition, and erosion/scour
- Challenges include permitting and access
- Current remedies have limitations
- OBB is designed to be a low-cost, sustainable sheen solution

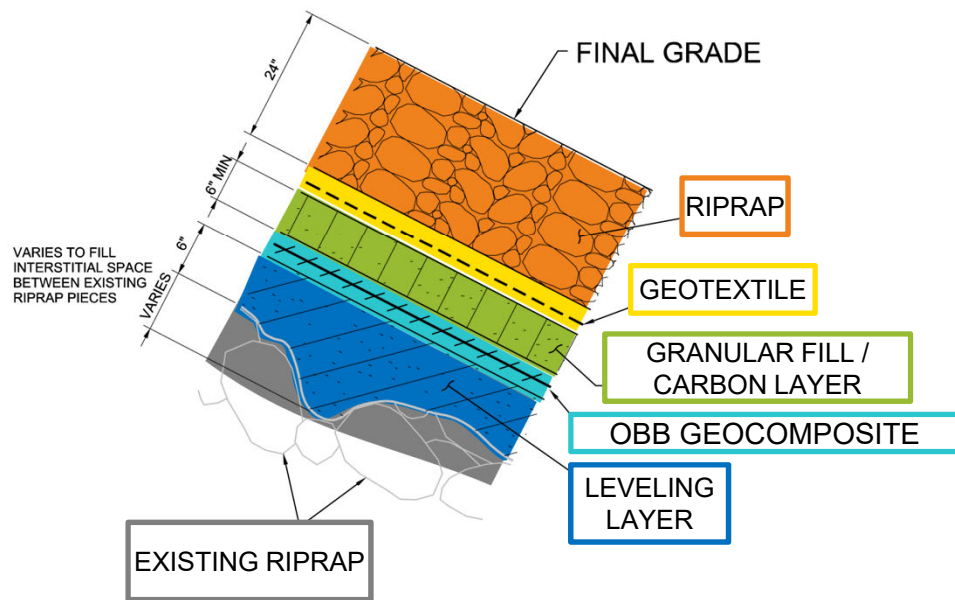


# OBB Utilizes Multiple Layers

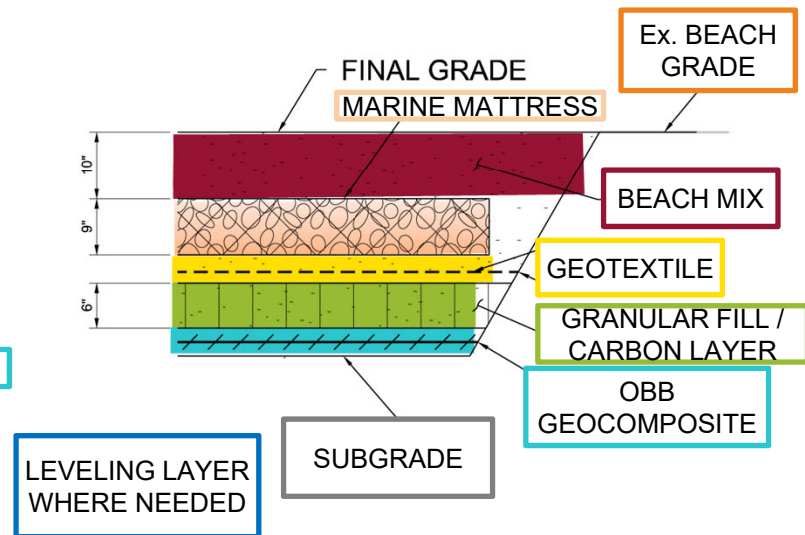


# Customize Layers for Site

## Typical Cap Section 1



## Typical Cap Section 3



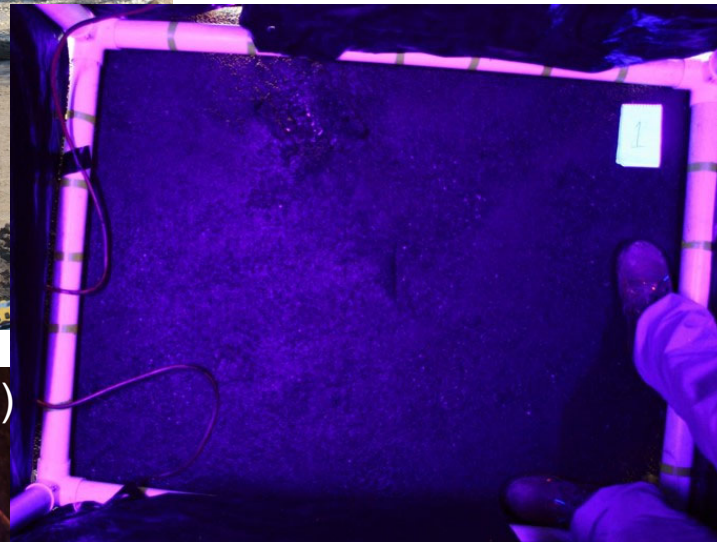


## Site History

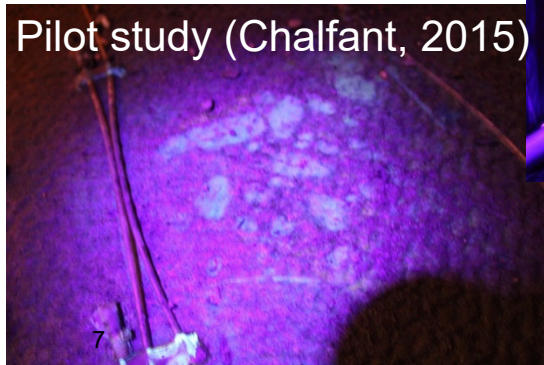
- Former petroleum storage facility on tidal river in the northeast US
- OBB installed November 2013
- No sheens observed
- Expanded/sampled October 2017



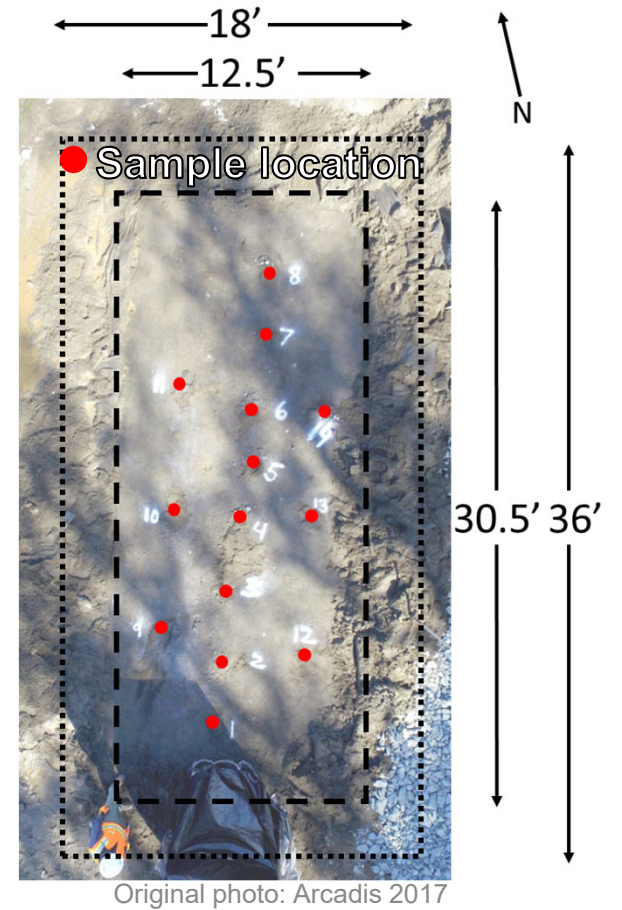
# Sample Locations



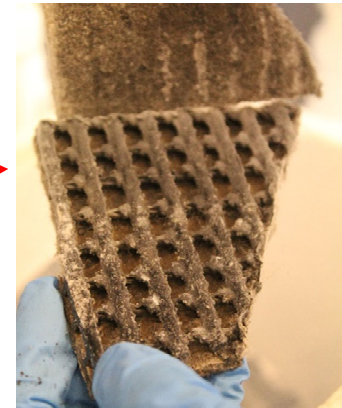
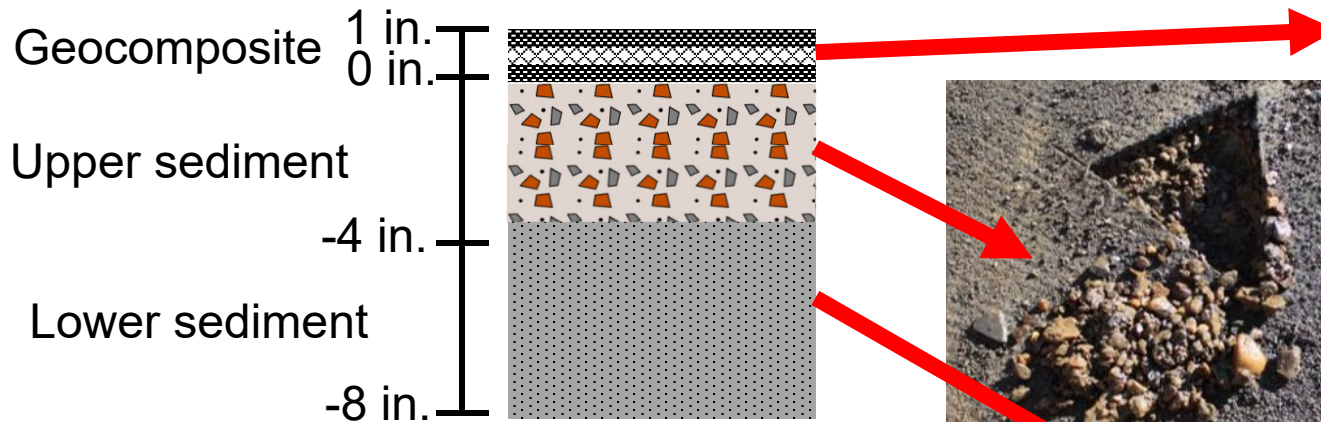
Pilot study (Chalfant, 2015)



No fluorescence found on geocomposite surface



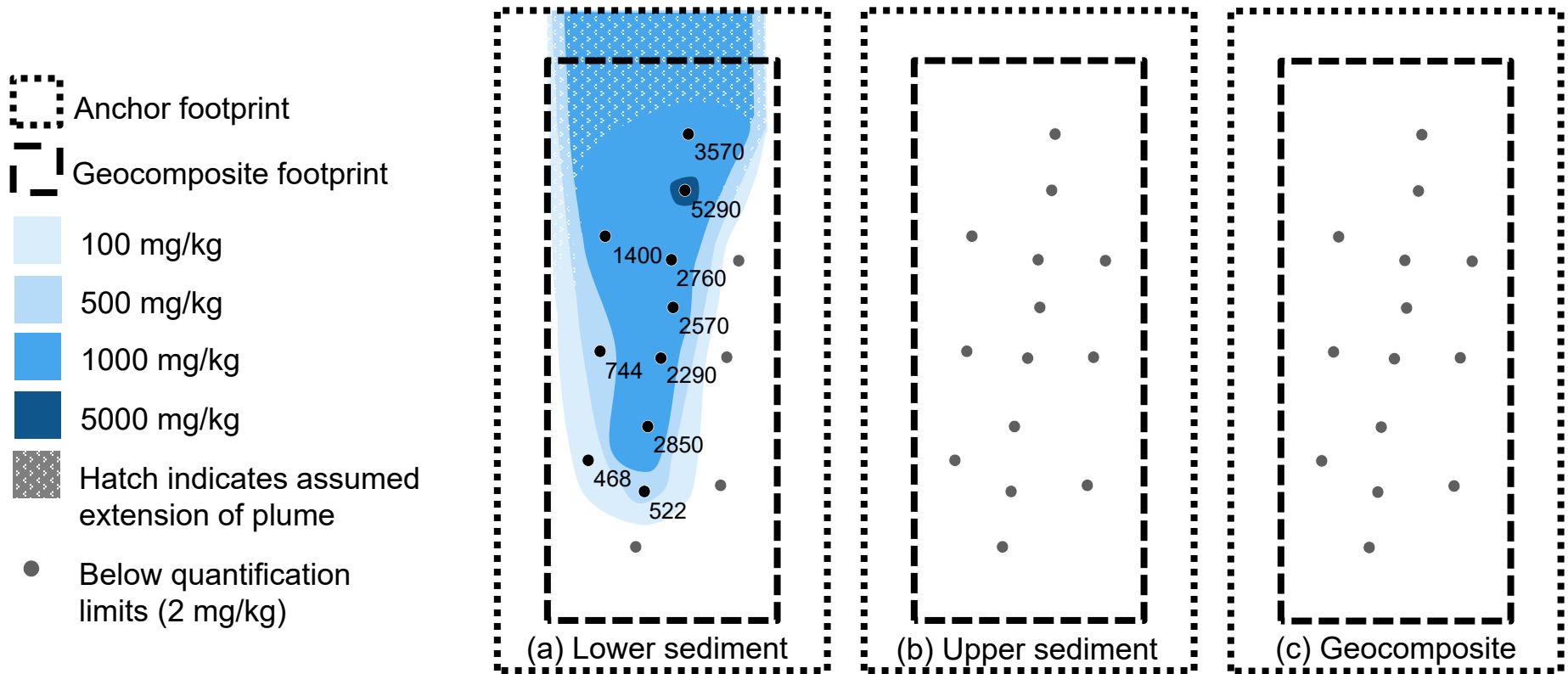
# Sampled 3 Layers at each Location



Analysis included:  
Diesel Range Organics (DRO) toluene extractions  
GC-FID quantifications  
GC-MS composition  
Microbial RNA



# Orders of Magnitude Reduction in DRO Concentrations Across Layers









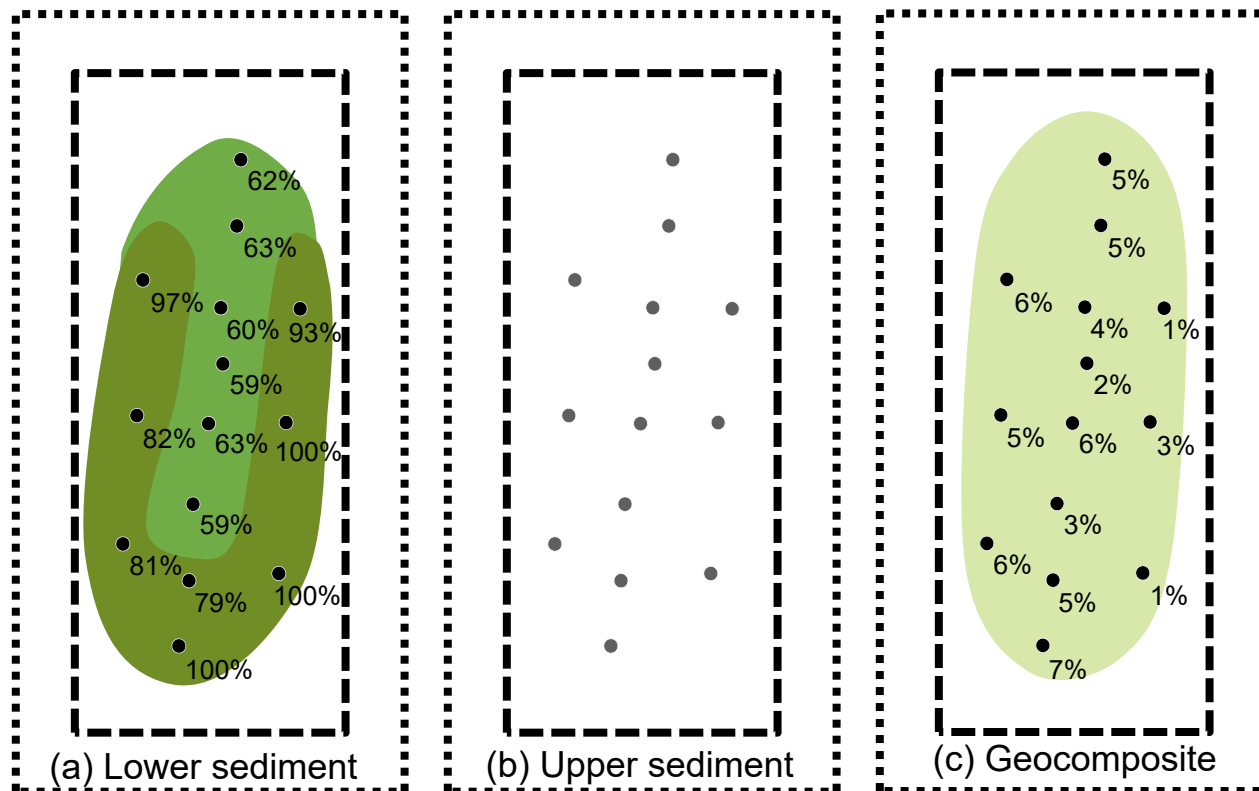
Units: mg DRO / kg dry weight sample  
 GC/FID quantification limits: 2 mg/kg

## Sheens and Odor in the Lower Sediment





# Oxygenated Compounds Present in Lower Sediment

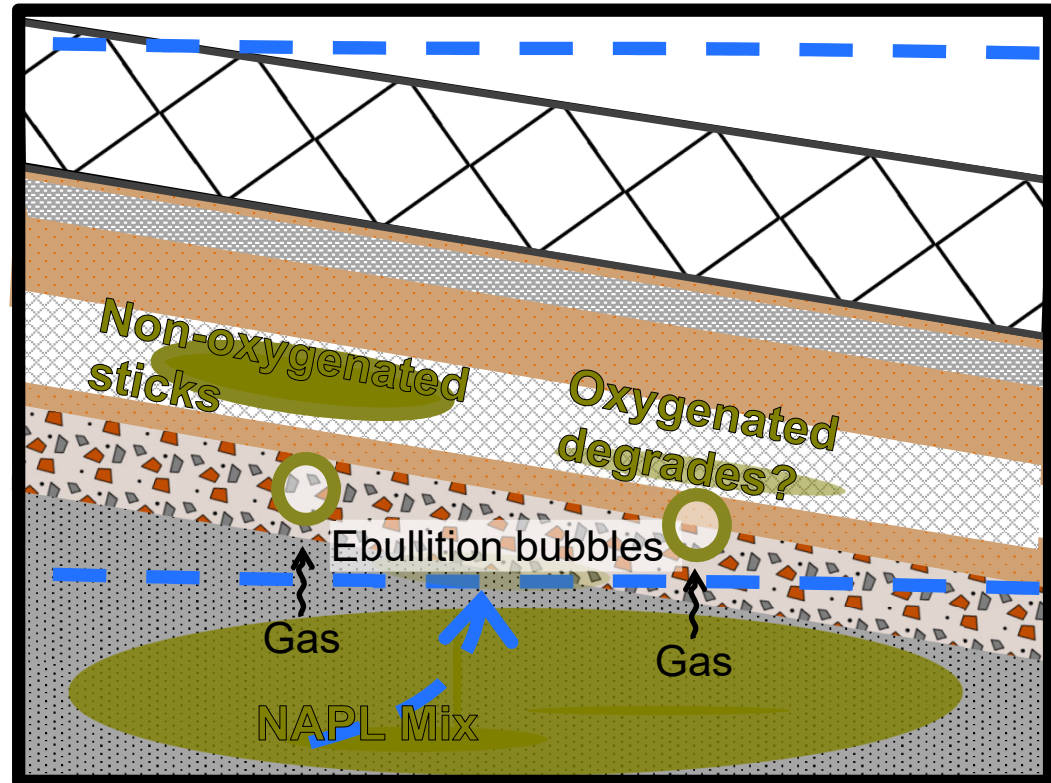
-  Anchor footprint
-  Geocomposite footprint
-  <25% Oxygenated
-  25 – 75% Oxygenated
-  >75% Oxygenated
-  Below quantification limits (6 mg/kg)



% Oxygenated = Area of oxygenated peaks / Total area  
 GC/MS quantification limit: 6 mg/kg

# Hypothesis 1: Oxygenated Compounds Degrade








-  Structural cover
-  Clean sand fill
-  OBB Geocomposite
-  Geotextile
-  Coarse sediment
-  Fine sediment
-  Petroleum

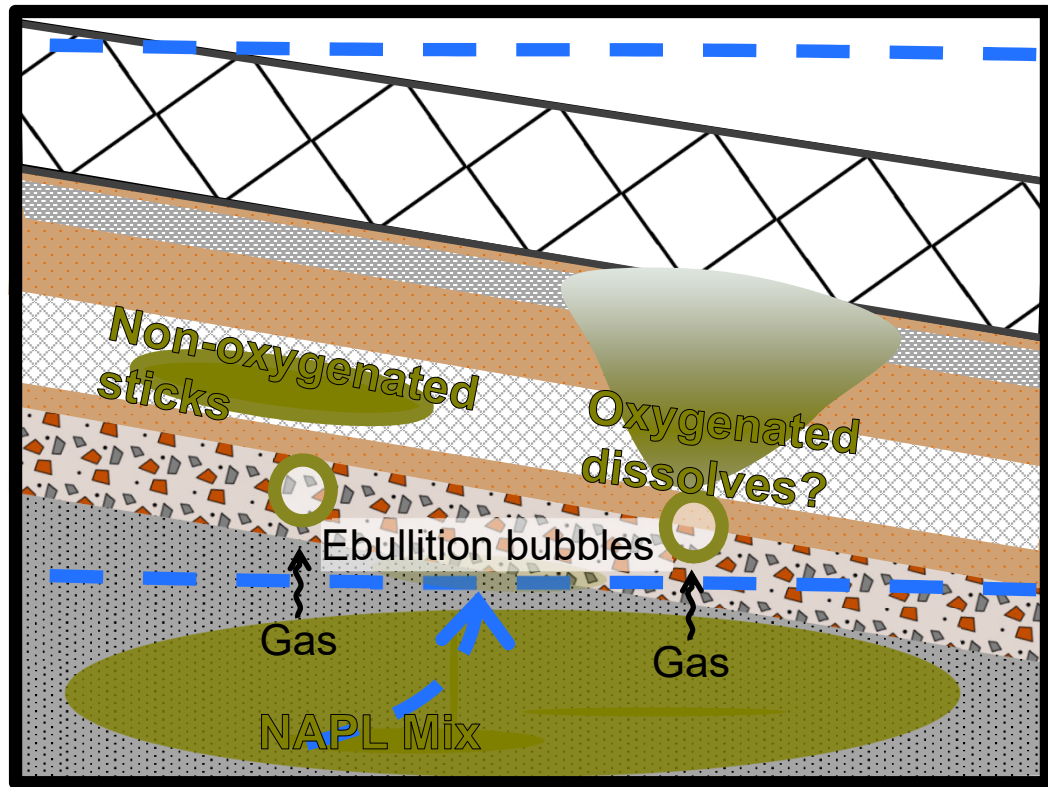


Not to scale



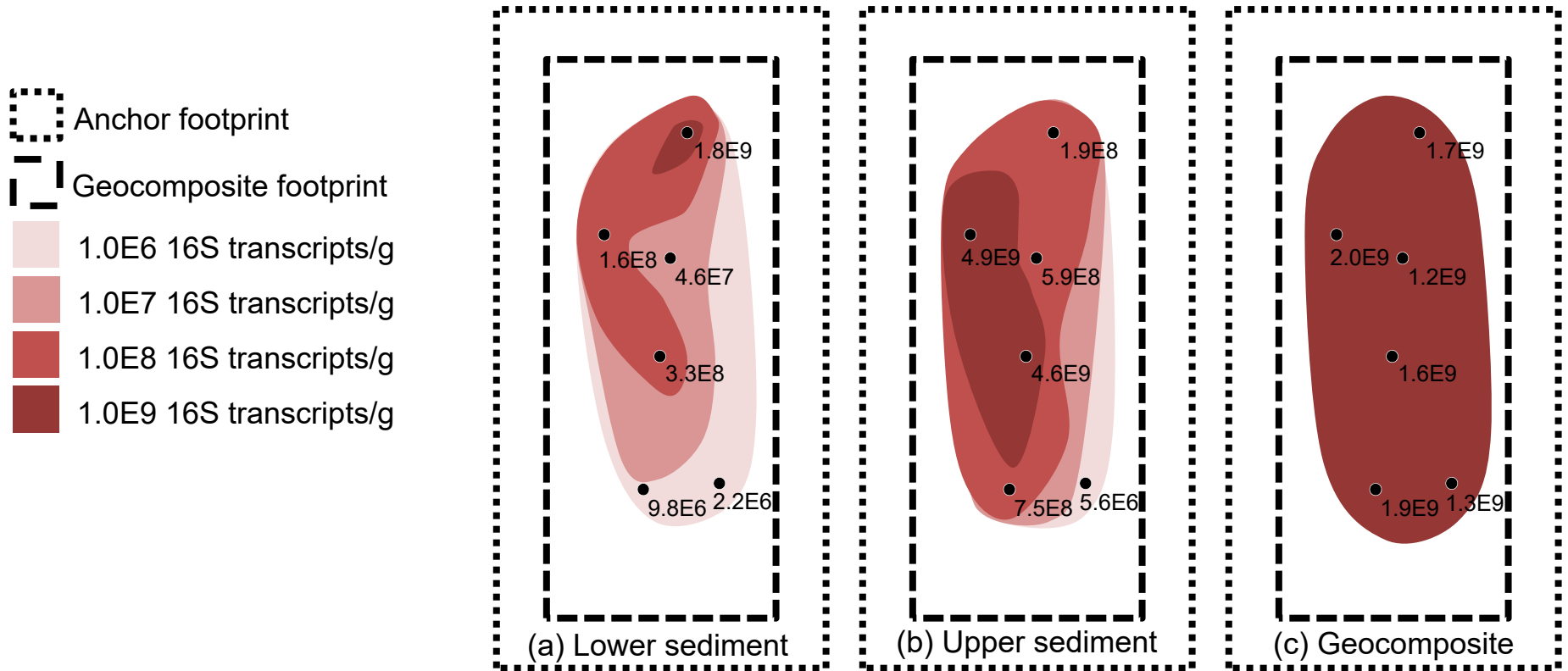
# Hypothesis 2: Oxygenated Compounds Dissolve

-  Structural cover
-  Clean sand fill
-  OBB Geocomposite
-  Geotextile
-  Coarse sediment
-  Fine sediment
-  Petroleum



Not to scale

# High Number of Bacteria on Geocomposite



Units: number of bacterial 16S transcripts / g sample wet weight

## Detailed Microbial Analysis

- Geocomposite and Upper Sediment showed similar levels of aerobes and nitrate reducers
- Lower Sediment showed less aerobes and nitrate reducers and more sulfate reducers and fermenters

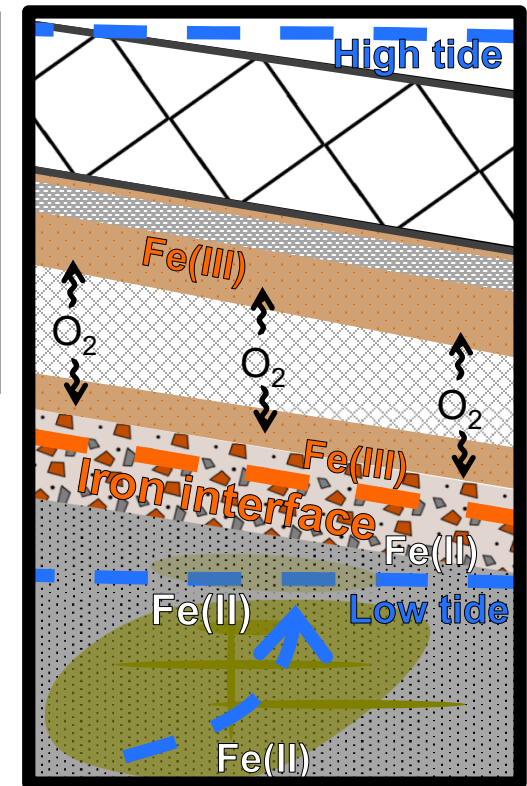
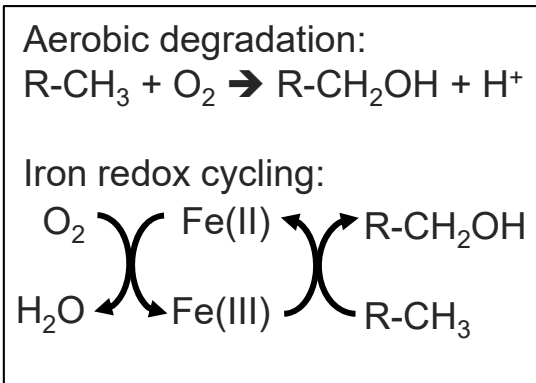
## Conclusions

- Natural systems have large assimilation capacity
- Treatment should focus on enhancing, versus compromising, natural attenuation processes at GSIs
- OBB layers provide a complementary contingency for periods of high loading and/or low degradation



## Future Work

- Adapt OBB for wider-range of conditions including non-tidal
- Explore role of iron at sites with petroleum sheens
- Develop internet-connected monitoring systems to track parameters such as ORP, temperature, and water levels



## Acknowledgements



March 4, 2019

# Thank you! Questions?

**OBB poster C6.44 Shoreline Remediation of  
Petroleum Hydrocarbons Using Oleophilic  
Biobarrier for Sheen Control on the Portland  
Harbor Superfund Site**



March 4, 2019