Can Restored Urban Wetlands Avoid Recontamination? An Overview of Biota/Sediment Monitoring in NYC

WSP USA- Peg McBrien (peg.mcbrien@wsp.com; Morristown, NJ) | Xiulan Wang | Tara Stewart | Tom Shinskey | Robert F. Wachter III
NYCEDC - Max Taffet | Sarah Murphy

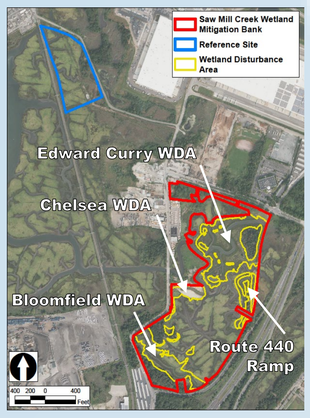
Background and Objectives

New York City (NYC) is facilitating the restoration of critical coastal resources by establishing the Saw Mill Creek Wetland Mitigation Bank (see Figure 1). This publicly operated wetland bank in Staten Island is near industrially developed land. Extensive dumping of trash and historic fill had occurred throughout the Site for decades. Sediment samples indicated that prior to restoration, the Site posed an ecological risk to wildlife due to metals, pesticides, and PCBs.

Restoration actions removed over 40,000 cubic yards of contaminated soils and 40 truckloads of tires and debris from the 54-acre site to create tidal creeks and marshes planted with native vegetation.

The restored wetland is meeting success criteria developed in collaboration with state and federal agencies, including permit-required sediment and biota baseline sampling (conducted immediately after construction/planting of the restored wetland) and post-construction annual monitoring.

The requirement for post-construction sediment and biota sampling is based on agency concerns that wildlife are attracted to the newly established marshes and could be exposed to contaminants that may accumulate at the site over time from other sources within the estuary – an estuary that includes multiple Superfund sites.



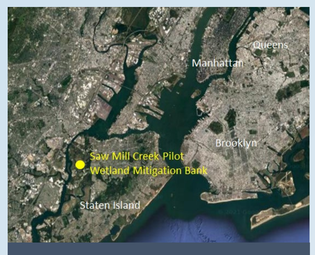


Figure 1. Map of Saw Mill Creek Wetland Mitigation Bank Study Area.

Approach

Sediment and biota samples were collected from the Bank and the Reference Area (see Figure 1). Specific sample areas where earth work construction occurred in 2018 as part of the creation of the wetland mitigation bank, also known as Wetland Disturbance Areas (WDA), were named according to their nearby roadways: Edward Curry WDA, Chelsea WDA, and Bloomfield WDA.

The baseline and post construction sediment monitoring program (see Figure 2) was designed using incremental sampling methodology (ISM) to collect spatially representative sediment samples across the wetland (see Figures 3 and 4).

Baseline and post-conduction biota tissue sampling included ribbed mussels, mummichogs, fiddler crabs, amphipods, wolf spiders, and long-jawed spiders as key receptors in the wetlands (see Figure 5). Due to the limited biota mass of some species, a compositing scheme/analytical hierarchy was developed with low-level laboratory methods to complete the analysis (see Figure 6).

Saw Mill Creek Pilot Wetland Mitigation Bank Overview

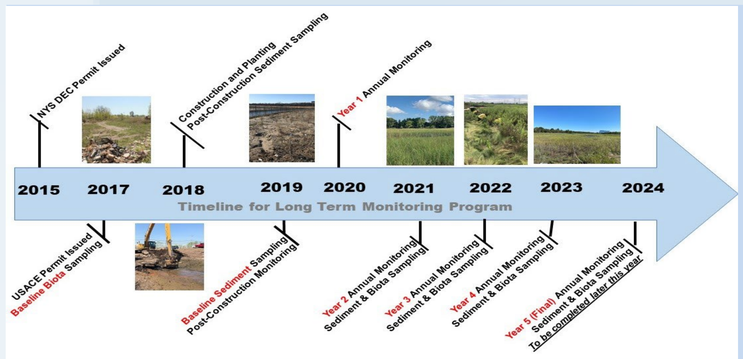


Figure 2. Timeline for Long-Term Monitoring Program at Saw Mill Creek

Sediment – Incremental Sampling Methodology

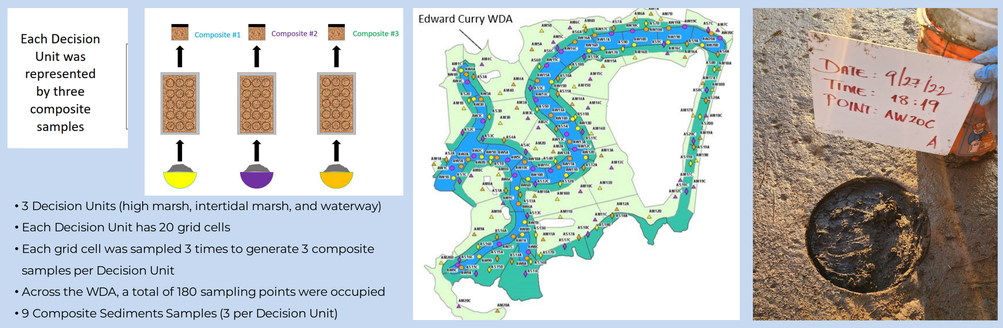


Figure 3. Implementation of Incremental Sampling Methodology (ISM) in the field with Decision Units and Creating Composite Samples

The Incremental Sampling Methodology is designed to collect a representative sample by dividing a decision unit into grid cells and generating a composite sample across the grid following a specific procedure for filling jars, so that the composite sample is representative of the collected material (see Figure 3).

Mercury and Total PCB Concentrations and Trends in Sediment

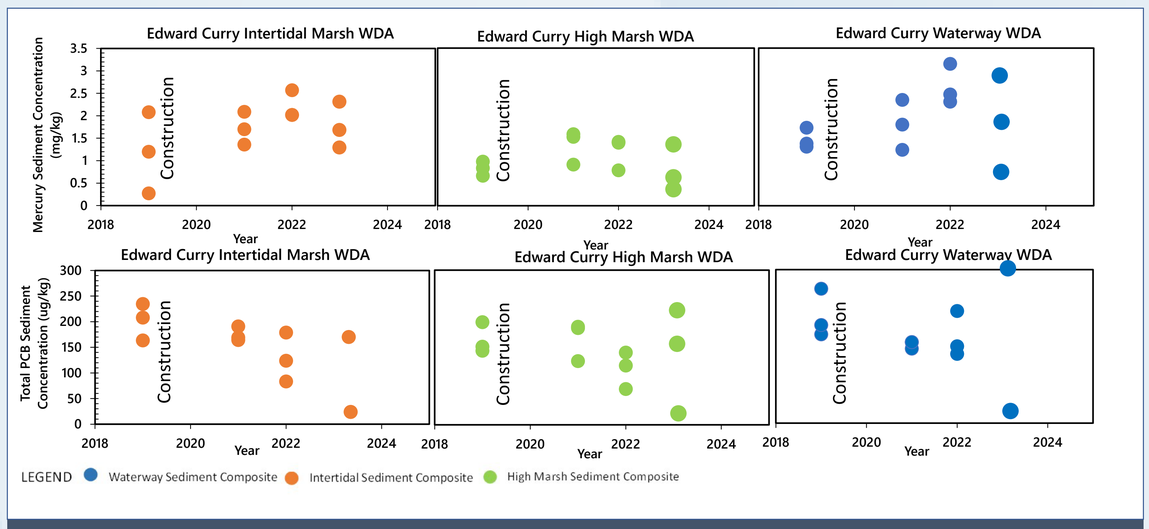


Figure 4. Mercury and Total PCB Concentrations in Composite Sediment Samples

In general, the sediment composite samples collected in 2021, 2022 and 2023 (Years 2, 3 and 4 monitoring events) are comparable to the range of sediment concentrations from the 2019 baseline event for Mercury and Total PCB (see Figure 4).

Mercury Concentrations and Trends in Biota Mass

<u>Comparison of tissue concentrations per species in the WDA relative to the Reference Area</u>

- Assumption that Reference Area conditions will not change over time, so Reference area tissue samples from 2017, 2021, 2022 & 2023 represent one population (per species)
- 2017 tissue samples collected on the east side of the Study Area (from the Route 440 Ramp) are included in the Reference Area population since no construction occurred in this area

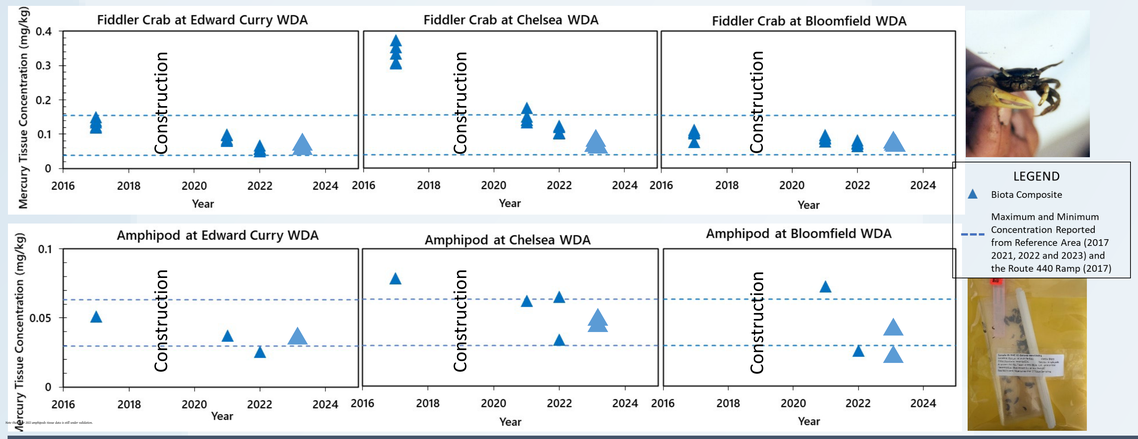
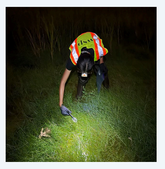
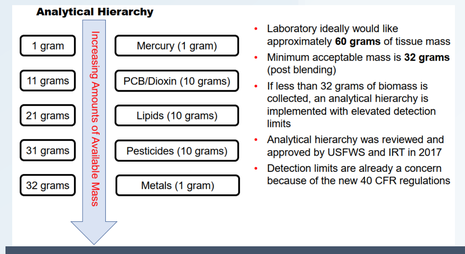


Figure 5. Mercury Concentrations in Composite Biota Samples

- USACE Permit does not require corrective action for any observed bioaccumulation
- In general, the Years 2, 3 and 4 (2021, 2022 and 2023) Mercury tissue concentrations in mummichogs, fiddler crabs, wolf spiders, long jawed spiders, and amphipods were (1) comparable to the range of Mercury tissue concentrations reported in the Reference Area and Route 440 Ramp work area, and (2) comparable or less than the 2017 Mercury tissue concentrations.



Limited Biota Mass and Analytical Challenges



Species	Year 2		Year 3	
	Number of Individuals	Total Biomass after Blending	Number of Individuals	Total Biomass after Blending
Amphipods	57	1.58 grams	164	17.56 grams
Long Jawed Spiders	38	0.72 grams	81	2.68 grams
Wolf Spiders	84	12.91 grams	206	37.83 grams

Figure 6. Laboratory Analytical Methods Hierarchy and Biota Mass Requirement Example from Year 3

- Mummichogs: Successfully collected with minnow traps from all areas (100% complete)
- Fiddler crabs: Successfully collected from all areas in intertidal marshes (100% complete)
- Amphipods: Collected in the high marsh grasses. 30% complete and limited biomass on all Year 3 samples
- Long Jawed Spiders: Collected at nighttime on cordgrass overhanging channel. 35% complete and limited biomass on all Year 3 samples
- Wolf Spiders: Collected in the high marsh grasses. 45% complete and limited biomass on all Year 3 samples
- Analytical hierarchy was needed to accommodate samples with limited mass

Results/Lessons Learned

- Years 2, 3 and 4 post-construction sediment and biota tissue results are comparable to baseline restoration conditions, suggesting the wetland has not been re-contaminated.
- Monitoring indicates that contaminants from off-site sources within the urban estuary are not accumulating within the restored wetland.
- Sediment and biota samples demonstrated that wildlife utilizing the restored site are not exposed to increased ecological risk.
- Information from this monitoring program may be transferred for use in habitat restoration in other urban areas by eliminating uncertainty regarding recontamination.