Soil Health Monitoring at Nahant Marsh

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Summary

Soil health is a key aspect of understanding how well an ecosystem is functioning. Clean air and water, healthy crops, diverse wildlife, and ecosystem resilience are all tied to soil. Over the summer, soil samples were collected throughout Nahant Marsh to investigate its health. In the past, soil health and conditions have not been fully investigated or tested. Therefore, this research aimed to establish baseline data on the current soil conditions to inform ongoing conservation and restoration efforts.

Introduction

Nahant Marsh is a 382-acre preserve in SW Davenport. It is known as one of the largest urban wetlands on the Upper Mississippi River. The wetland contains marshy areas, mesic, wet, and sand prairie, sedge meadows, and bottomland forest. Before preservation, these habitats were exposed to high levels of contaminants. Between 1969 and 1995, the marsh was used as a private gun club for trap and skeet shooting range. As a result, 243 tons of lead shot were deposited in the marsh substrate and on upland soils. In 1996, the EPA designated Nahant as a Superfund site and 60,000 cubic yards of contaminated marsh sediment and surface upland soil were removed. Since then, Nahant has been preserved and restored as removal actions resulted in loss of vital plants such as cattails, shoreline plants, and open grassy fields.[1] A major aspect of restoration was ensuring that the soil was no longer contaminated and able to support plant life. While replanting and seeding were a priority, there was little focus on soil health. Wetland soils are a critical component of overall wetland health. Wetland soils retain water to mitigate urban flooding, filter out lingering pollutants, and sequester carbon from decaying organic matter. Furthermore, these soils act as a vital nutrient bank, storing and transferring key nutrients like nitrogen and phosphorus that are essential for the recovery and growth of plants and wildlife. Understanding the current state of Nahant's soil health is therefore critical to ensuring the long-term success of its ongoing ecological restoration. This project aims to investigate the soil health and conditions throughout Nahant Marsh.

Methodology

Fourteen sites were assessed and used for sampling. Site choice was based on previous and current projects that give a comprehensive look at Nahant. The sites chosen included: Carp Lake, Catwalk, Culvert, CRP 1, Beaver Complex, Stream Bank, Stream Bank Prairie, East Side Trail Railside, and Main Marsh. At each site, a soil sample was taken with a 0.4 m AMS soil recovery probe. Field observations such as soil texture, color, and habitat type were taken at each site. Soil texture was determined using the USDA Soil Texture Field Flow Chart. Soil color was determined using the Munsell Soil Color Book. Habitat types were finalized using the USDA Web Soil Survey. Sediment coring samples were all taken in the Main Marsh. Sites included: Dock, East Dock, Drainage Ditch, West Dock, and Bird Blind. These sites attempted to mimic previous sediment coring sites taken by the Army Corps of Engineers. For Main Marsh samples, a 1.2 m Ogeechee hand push core was used. After extraction of cores, texture and composition were determined from field observations. For parameters such as pH, nitrate, potassium, calcium, magnesium, and phosphorus, the LaMotte Soil Kit was used. After collection, these samples were transferred into bags and then air-dried for 1 day before being tested.

References

[1]U.S. Department of the Interior, Fish and Wildlife Service. (2001, September). Natural resource restoration plan for the Nahant Marsh Superfund Site, Iowa (Report No. Final). Rock Island Ecological Services Field Office.

Results

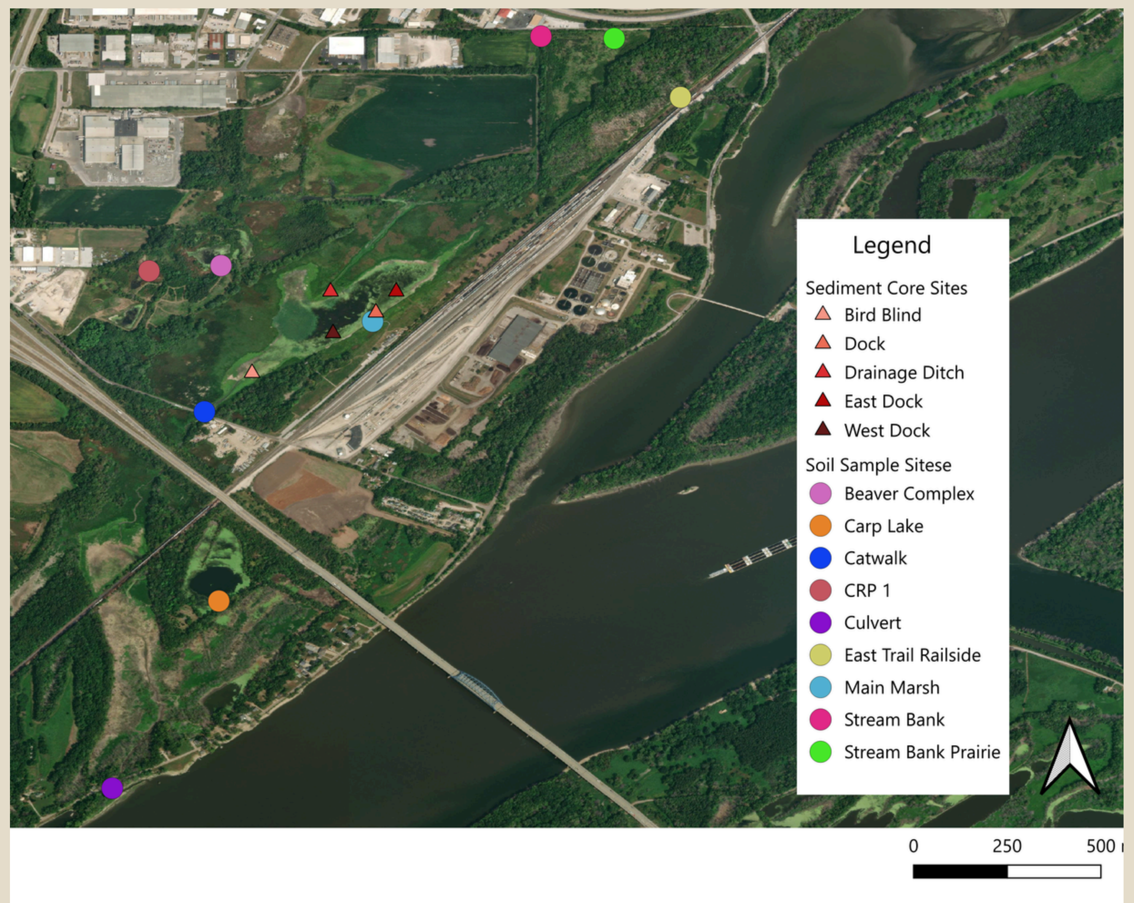

Figure 1: All soil sample location at Nahant Marsh.

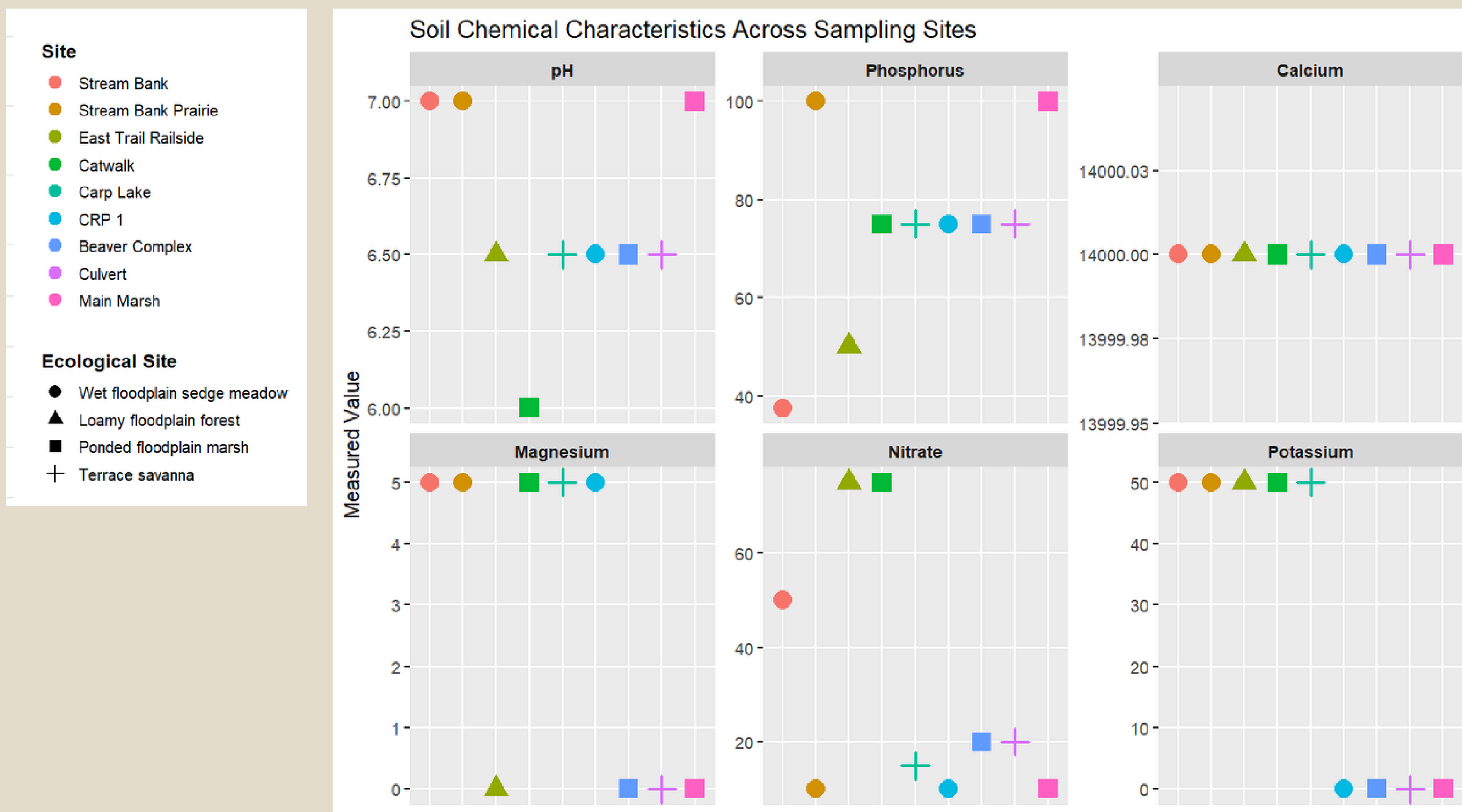

Figure 2: Chemical concentrations of all soil samples.

Site	Length	Water Depth	Composition	Stratigraphic Column
Dock	5ft	42 cm	Dark, black silty organic clay	Supersaturated → sludge → super organic material
East Dock	2ft	42.3 cm		
Drainage Ditch	3.5ft	30.6 cm		
West Dock	1.5ft	49.3 cm		
Bird Blind	3ft	36.3 cm		

Figure 3: Sediment core sample data. Including: length of sediment core, water depth at extraction site, composition, and stratigraphic column top-to-bottom depth.

Site	Color	Texture
Stream Bank	2.5YR: 2.5/1	Sand
Stream Bank Prairie	10YR: 2/1	Clay loam
East Trail Railside	10YR: 2/1	Clay loam
Catwalk	10YR: 2/1	Clay loam
Carp Lake	7.5YR: 2.5/1	Sandy loam
CRP 1	10YR: 2/1	Clay loam
Beaver Complex	10YR: 2/1	Clay loam
Culvert	7.5YR: 2.5/1	Clay loam
Main Marsh	10YR: 2/1	Clay loam

Figure 4: Soil sample physical characteristics. The Munsell Soil Color Book determined soil color. The USDA Soil Texture Field Flow Chart determined soil texture.

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Dicussion

All nine sites were below toxicity thresholds for heavy metal concentrations, indicating the soil has remained safe since the 1996 remediation. Nutrient levels varied across sites and reflected several soil health functions. pH was consistent and near-neutral at every site (6.0–7.0), a range in which most plant nutrients remain readily available, suggesting chemical conditions are supportive of plant uptake marsh-wide. Phosphorus and nitrate are the primary drivers of plant productivity and are central to wetlands' role as nutrient banks, trapping and cycling nutrients from moving water. Phosphorus ranged from 37.5 ppm (Stream Bank) to 100 ppm (Stream Bank Prairie, Main Marsh), and nitrate ranged from 10 ppm (several sites) to 75 ppm (East Trail Railside, Catwalk). Variation among sites may reflect differences in hydrology, vegetation, or proximity to runoff pathways across the marsh. Calcium was uniformly high (14,000 ppm) at all nine sites; calcium supports soil structure and cell wall development; elevated levels are typical of the calcium carbonate–rich parent material in the region. Magnesium and potassium, which support chlorophyll production, plant water regulation, and stress tolerance, were lower at three common sites (Beaver Complex, Culvert, Main Marsh). CRP 1 was low only in potassium, and East Trail Railside only in magnesium. These lower readings are worth future monitoring, since deficiencies in either nutrient could affect how well vegetation establishes during ongoing restoration. Sites spanned four ecological site types (sedge meadow, floodplain forest, floodplain marsh, terrace savanna) and two soil textures beyond the dominant clay loam (sand at Stream Bank, sandy loam at Carp Lake). With only 1–3 sites per ecological category and just two non-clay-loam sites, this dataset is too small to attribute the nutrient patterns above to ecological site type or texture specifically; local hydrology, organic matter content, and plant community composition likely all contribute and would need a larger sample to make conclusions. Sediment cores from five additional sites (Dock, East Dock, Drainage Ditch, West Dock, Bird Blind) showed the same composition (dark, silty organic clay) and stratigraphy at every location despite differing water depths (30.6–49.3 cm) and core lengths (1.5–5 ft), pointing to a shared depositional history across the Main Marsh.

Conclusion

This project provides a baseline dataset of soil chemistry, heavy metals, and sediment characteristics at Nahant Marsh since its restoration. Heavy metal levels remain safe at all sites, supporting the long-term success of the 1996 remediation. Nutrient availability, a key part of the soil's role as a nutrient bank for recovering plant and wildlife communities, varied across sites in ways not yet explained by ecological site type or texture alone, while sediment composition was consistent despite differing water depths. As restoration efforts have prioritized replanting over soil monitoring, this baseline fills an important gap and offers a foundation for future studies, with more sites per ecological category and texture type, to identify what drives these patterns.