Sankofa Wetland Park
2023 Annual Report

by
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Sampling Design

A monitoring sampling design was developed, shown below, consisting of five monitoring sites (S1 through S5) set approximately equidistant and in the linear pond of the Sankofa Wetland Park. The St. Bernard drainage ditch at the bridge to the Viola Water treatment plant is also being monitored (site SB), as well as a site in the Bayou Bienvenue Wetland Triangle (site T1).

Figure 1. Location of sampling sites at the Sankofa Wetland Park (S1-S5), the Bridge (SB) and Bayou Bienville Wetland Triangle (T1).

Water Quality – DO, Cond., Temp., Salinity & pH

Comite Resources field technicians have been carrying out monthly monitoring of the Sankofa Wetland Park since January 2022. Dissolved oxygen, conductivity, temperature, salinity and pH were measured at monitoring described above using a handheld probe (Figure 2). Data from the 2022 monitoring effort have been added to the 2023 measurements. Sites S3-S5, as well as SB, were added as the wetland park was expanded in 2023.

Figure 2. Taking discrete probe measurements at site S1 on March 1, 2023.

Water temperatures fluctuated throughout the years, with a low during the winter of ~10°C (50.0°F) during the winter to ~33°C (91.4°F) during the summer (Figure 3), with very little variation between sites. Water temperature plays a crucial role in the ecology of aquatic ecosystems, influencing various biological, chemical, and physical processes. For example, Water temperature influences the rates of nutrient cycling in aquatic ecosystems. Biological and chemical processes that contribute to nutrient cycling, such as decomposition and nutrient uptake by plants, are temperature-sensitive. Understanding and monitoring water temperature are essential for assessing the health and resilience of aquatic ecosystems.

Human activities, such as the discharge of heated water from industrial processes or alterations in land use, can also influence water temperature, highlighting the importance of responsible environmental management.

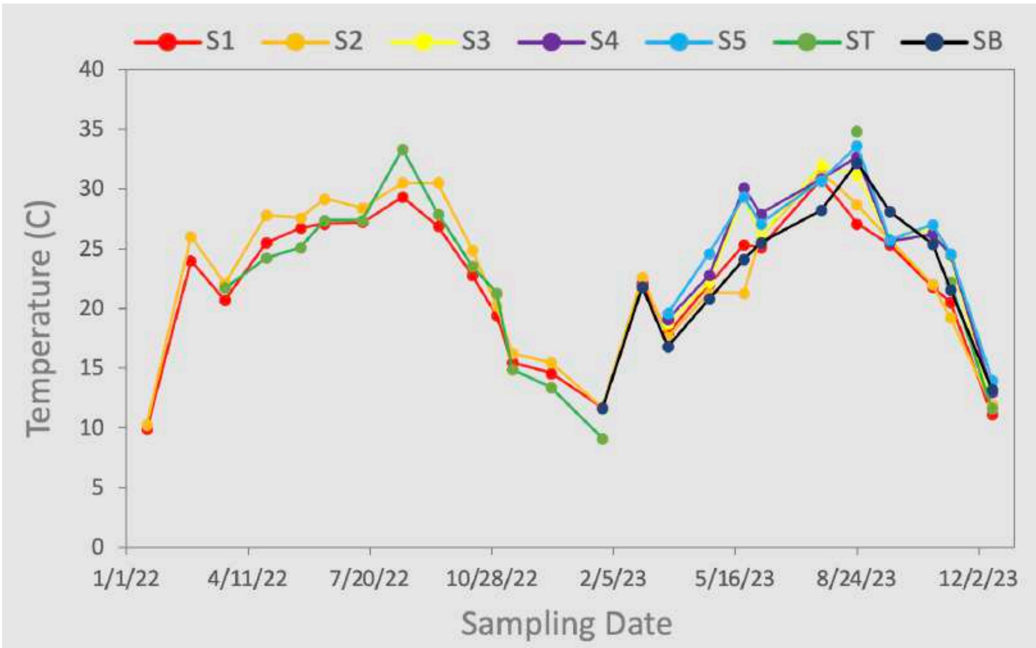


Figure 3. Water temperature data over the 2022 and 2023 calendar years.

Salinity concentrations ranged from 0.2 to 1.4 ppt (Figure 4), with the highest concentrations occurring at site T1. In the wetland park, salinity never rose above 1 ppt. Salinity, or the concentration of dissolved salts in water, is a critical environmental factor that significantly influences the ecology of aquatic systems. Aquatic organisms have varying degrees of tolerance to salinity levels. The salinity range of a particular environment determines which species can thrive there. Salinity affects the solubility of nutrients in water like nitrogen and phosphorus, which can impact primary productivity and the overall health of the ecosystem. Human activities, climate change, and alterations in land use can affect salinity levels, emphasizing the need for responsible environmental stewardship to maintain the health and balance of aquatic systems.

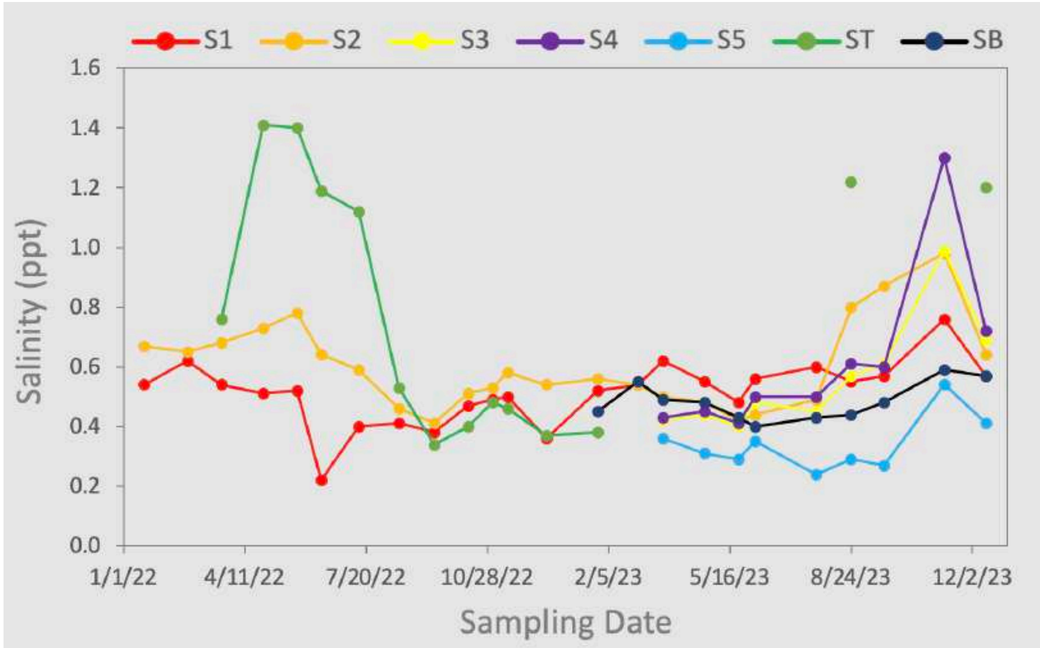


Figure 4. Salinity data over the 2022 and 2023 calendar years.

Conductivity concentrations ranged from 25 to 2664 mS, with the highest concentrations at site T1 (Figure 5). In the wetland park, conductivity never rose above 1900 mS. The very low concentration at site S4 during the November 2023 sampling effort is very anomalous and possibly in error. Conductivity is a measure of the ability of water to conduct an electric current, and it is closely related to salinity. The concentration of dissolved ions, such as sodium, chloride, and sulfate, contributes to the conductivity of water. Monitoring conductivity provides valuable information about the overall salinity of the water, which is crucial for understanding the ecology of the system. Regular monitoring of conductivity levels, along with other water quality parameters, helps scientists, researchers, and resource managers make informed decisions to protect and sustain aquatic environments. Large changes in conductivity beyond the baseline can indicate that a discharge or some other source of pollution has entered the water.

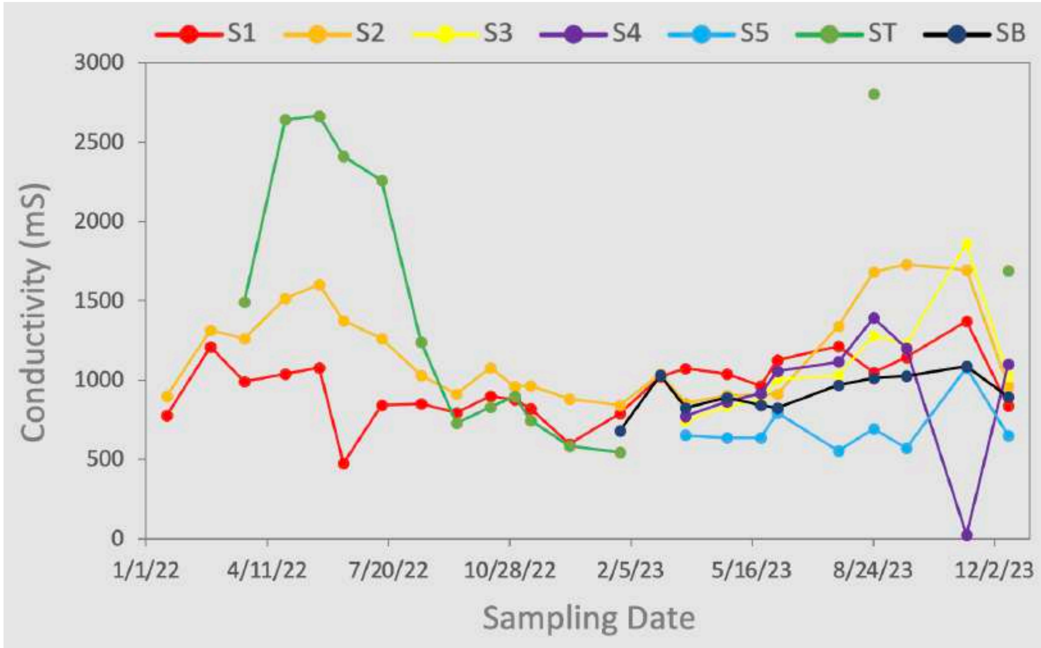


Figure 5. Conductivity data over the 2022 and 2023 calendar years.

Dissolved oxygen concentrations ranged from 0.1 to 17.3 mg/L (Figure 6). Sites S3-S5 had higher concentrations than the rest of the sites during the summer and fall of 2023. Dissolved oxygen (DO) is of paramount ecological importance in aquatic systems as it serves as a life-sustaining factor for a diverse array of organisms. Essential for aerobic respiration, DO directly influences the health and behavior of fish, invertebrates, and microorganisms in aquatic ecosystems. Adequate DO levels are crucial for maintaining optimal conditions for the aerobic decomposition of organic matter, a process vital to nutrient cycling. Low levels of oxygen (hypoxia) or no oxygen levels (anoxia) can occur when excess organic materials, such dead aquatic vegetation, are decomposed by microorganisms. During this decomposition process, dissolved oxygen in the water is consumed. Low oxygen levels often occur in the bottom of the water column and affect organisms that live in the sediments (benthos). As dissolved oxygen levels drop, some sensitive animals may move away, decline in health or even die. The distribution and abundance of aquatic species are intricately linked to dissolved oxygen, shaping habitat selection and community structure. Dissolved oxygen levels also serve as a critical indicator of water quality, with deviations signaling potential pollution events or environmental stress. Consequently, maintaining appropriate DO concentrations is pivotal in preserving the ecological integrity, biodiversity, and overall health of aquatic environments, safeguarding against the onset of hypoxia or anoxia that can lead to deleterious consequences for aquatic life. It is for these reasons that a bubbler was installed at the Sankofa wetland park to introduce additional DO into the water column.

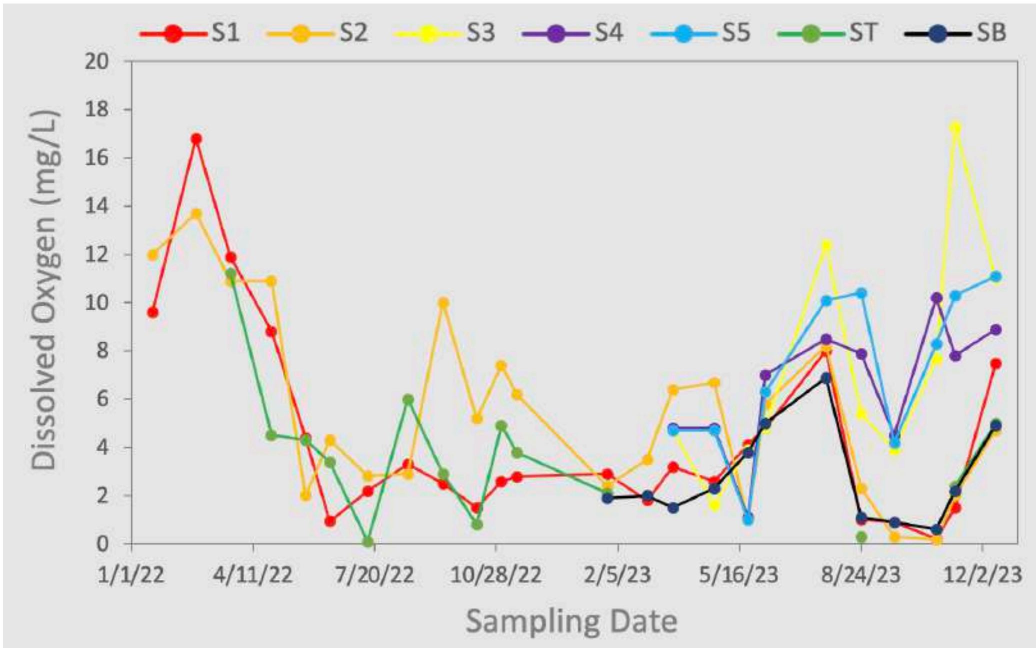


Figure 6. Dissolved oxygen data over the 2022 and 2023 calendar years.

Total dissolved solids concentrations ranged from 0.29 to 1.75 mg/L (Figure 7). Total Dissolved Solids (TDS) play a significant role in the ecological dynamics of aquatic systems. TDS represents the sum of inorganic and organic substances dissolved in water, encompassing ions, minerals, and dissolved organic matter. While elevated TDS levels can result from natural geological processes, anthropogenic activities such as agriculture and urban runoff can contribute to increased TDS concentrations. The ecological importance lies in its impact on water quality, influencing the osmoregulation of aquatic organisms, particularly those adapted to specific salinity ranges. Changes in TDS can alter nutrient availability, affecting primary productivity and nutrient cycling. Additionally, TDS levels are indicative of overall water quality, with excessive concentrations potentially signaling pollution or degradation. Monitoring and managing TDS in aquatic ecosystems are essential for understanding and mitigating the ecological consequences associated with alterations in water chemistry and ensuring the health and sustainability of these environments.

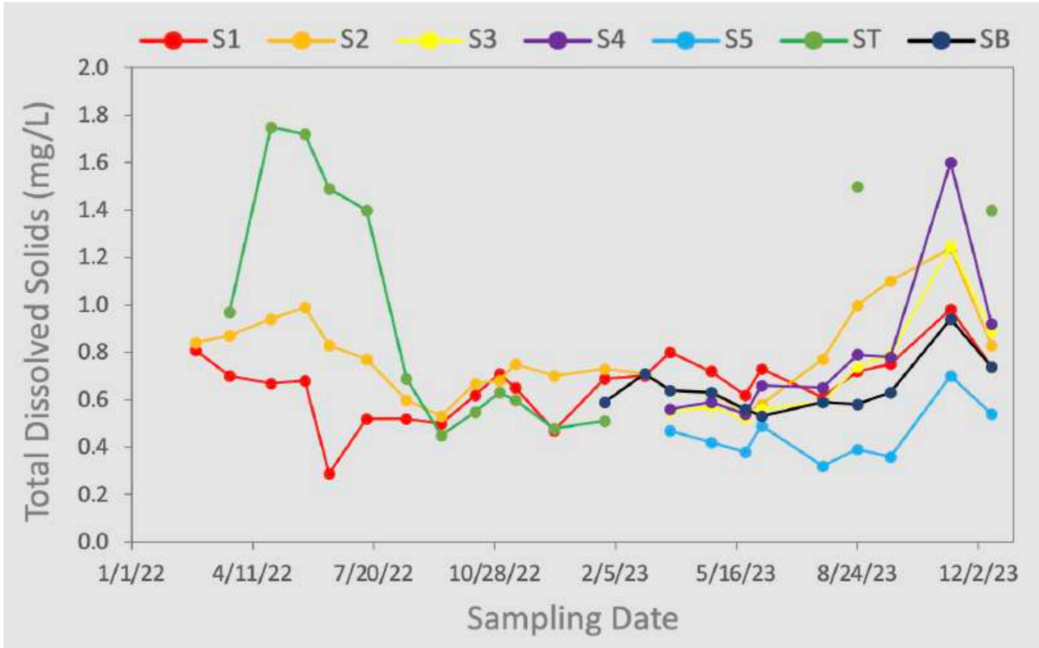


Figure 7. Total dissolved solids data over the 2022 and 2023 calendar years.

pH ranged from 6.3 to 9.0, with most values being above 7.0 at most sites (Figure 8). pH, a measure of the acidity or alkalinity of water, holds critical ecological importance in aquatic systems. It profoundly influences various biological, chemical, and physical processes that dictate the health and functionality of aquatic ecosystems. The pH of water affects the solubility and availability of essential nutrients, influencing the growth and development of aquatic plants and algae. Aquatic organisms, particularly fish and invertebrates, exhibit specific pH tolerance ranges, and deviations outside these ranges can lead to stress, reduced reproduction, or even mortality. pH also influences the bioavailability of toxic substances; for instance, heavy metals can become more or less toxic depending on pH levels. Furthermore, microbial activities responsible for nutrient cycling and decomposition are pH-sensitive. Therefore, maintaining a suitable pH range is crucial for preserving biodiversity, supporting key ecological processes, and ensuring the overall resilience and sustainability of aquatic environments. Regular monitoring of pH is fundamental in assessing and managing water quality in both freshwater and marine ecosystems.

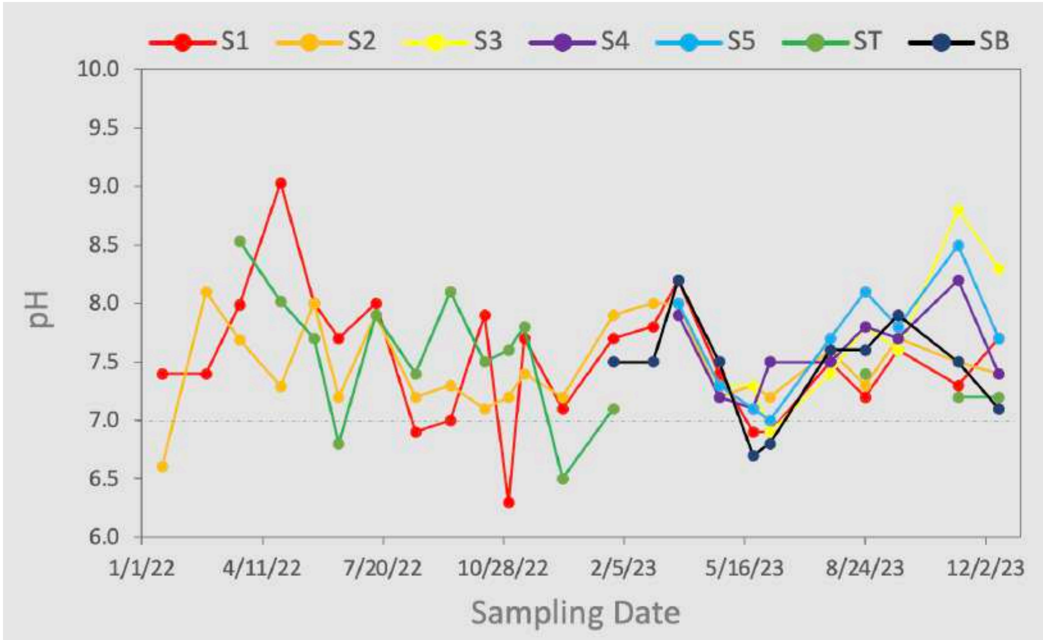


Figure 8. Water pH data over the 2022 and 2023 calendar years.

Water Quality – Nutrients

Comite Resources field technicians visited the Sankofa Wetland Park approximately quarterly to collect samples for nutrient analysis (Figure 9). Water samples for nutrient (NOx, NH3, TN, PO4, TP), BOD_5 and sediment (TSS) analysis were collected and put on ice for transport to Pace Analytical Services in Baton Rouge for analysis. Monitoring nutrient concentrations in natural aquatic habitats is essential for assessing ecosystem health and water quality, serving as a key indicator of potential issues such as eutrophication. This monitoring provides valuable data for the early detection and prevention of nutrient-related problems, safeguarding both the environment and human health. By helping to identify and manage nutrient pollution, it supports regulatory compliance, biodiversity conservation, and sustainable resource management. Additionally, continuous monitoring serves as an early warning system for environmental disturbances, contributes to scientific research, and aids in understanding the impacts of climate change on aquatic ecosystems, emphasizing the importance of proactive measures to ensure the resilience and long-term sustainability of these vital habitats.

Figure 9. Water quality samples for nutrient analysis on August 24th, 2023.

Nitrate+nitrite concentrations were below detection (<0.05 mg/L) at most sites, but there were some detectable concentrations at site S1 and S2, as well as at site SB (Figure 10). Nitrate, which composes generally >95% of nitrate+nitrite, plays a vital role in aquatic ecosystems and influencing various ecological processes. Nitrate serves as a crucial nutrient for aquatic plants and algae, promoting primary productivity and supporting the base of the aquatic food web. However, excessive nitrate levels, often resulting from agricultural runoff and wastewater discharge, can lead to eutrophication - accelerated algal growth that depletes oxygen when the algae decompose. This can create "dead zones" where oxygen levels are insufficient to support most aquatic life. Nitrate levels also impact the health of fish and invertebrates, affecting their growth, reproduction, and overall fitness. Moreover, nitrate contamination poses risks to human health when it enters drinking water sources. Balancing nitrate concentrations is essential for maintaining a healthy nutrient balance, preventing eutrophication, and sustaining the ecological integrity of aquatic systems.

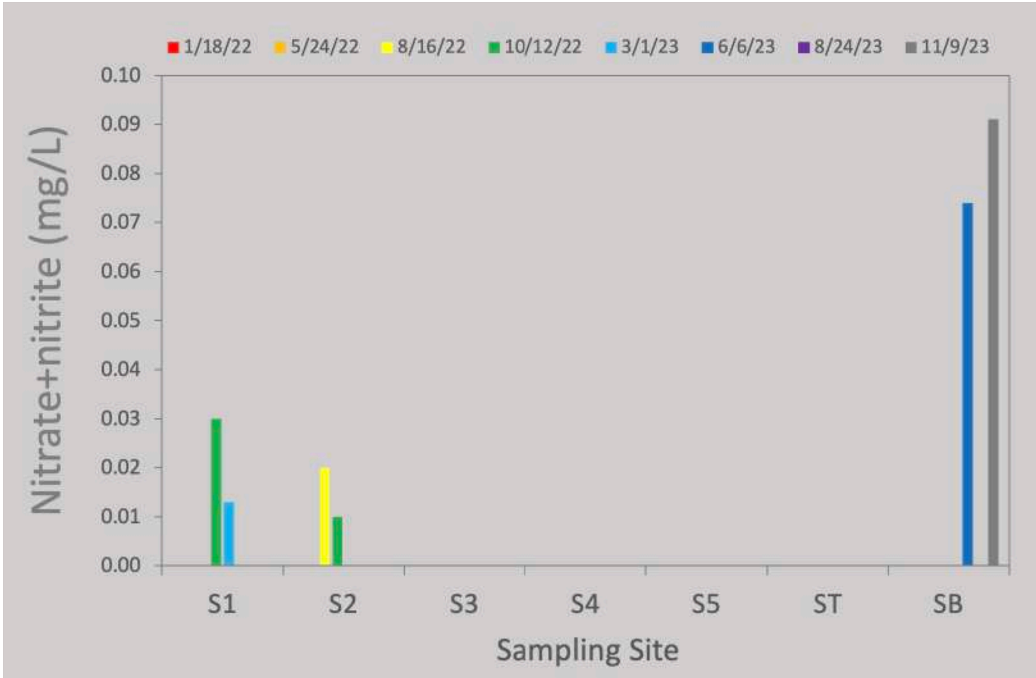


Figure 10. Nitrate+nitrite data over the 2022 and 2023 calendar years.

Ammonia concentrations were generally very low or below detection (0.50 mg/L) at most sites (Figure 11). The BS site, however, had concentrations greater than 7 mg/L, and site S1, which is directly hydrologically connected to site SB, had concentrations at or below 4 mg/L. Ammonia is a critical component in aquatic ecosystems, playing a pivotal role in the nitrogen cycle. It is a byproduct of organic matter decomposition and the excretion of waste by aquatic organisms. Ammonia exists in two forms - ionized (NH_4^+) and unionized (NH_3) - with the latter being more toxic. While low levels of ammonia are essential for supporting the growth of phytoplankton and other microorganisms, elevated concentrations can be detrimental. Ammonia toxicity negatively affects fish and invertebrates, impairing their respiratory and reproductive functions and potentially leading to mortality. In addition, excessive ammonia can contribute to eutrophication by fueling algal blooms, further stressing aquatic ecosystems. Effective management of ammonia levels is crucial for maintaining water quality, preventing harmful ecological imbalances, and safeguarding the health of aquatic organisms and their habitats.

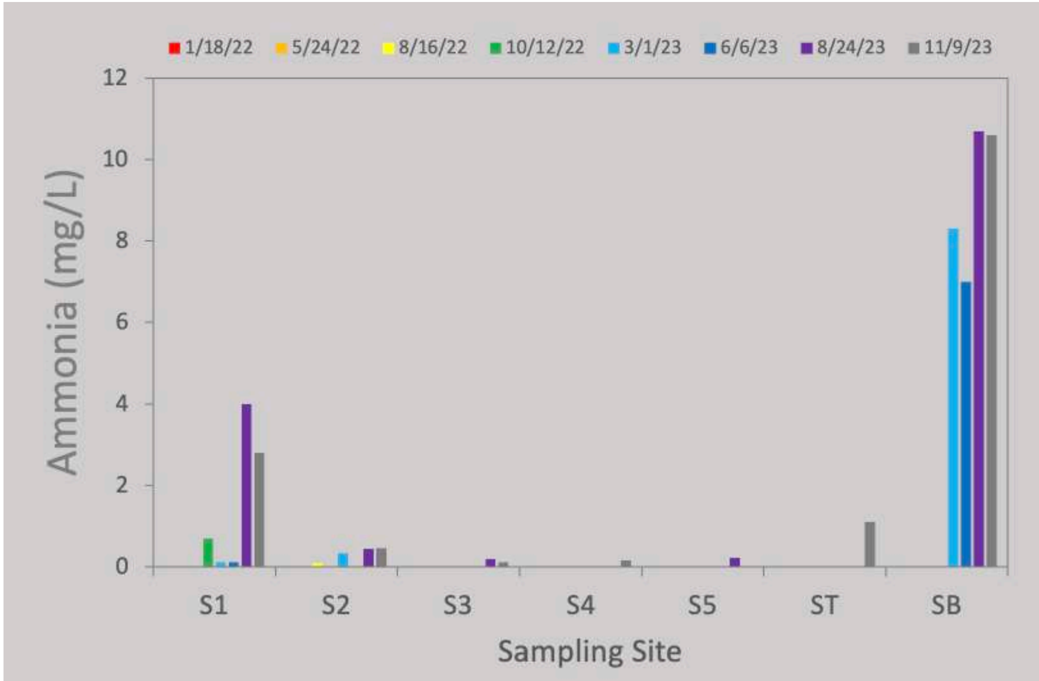


Figure 11. Ammonia data over the 2022 and 2023 calendar years.

Total nitrogen concentrations ranged from below detection (<0.16 mg/L) to 12.3 mg/L, with the highest concentrations at site SB (Figure 12). The SB site (at the bridge) was generally a source of nitrogen pollution to the wetland park. Total nitrogen is the sum of nitrate, nitrite, ammonia and organically bonded nitrogen, such as contained in plants and animals. Total nitrogen in aquatic systems is a key determinant of ecosystem health, playing a central role in nutrient cycling and influencing various ecological processes. While nitrogen is crucial for supporting primary productivity, excessive levels can contribute to eutrophication. This process accelerates algal growth, leading to oxygen depletion when the algae decompose, which can harm aquatic organisms and disrupt entire ecosystems. Balancing total nitrogen levels is essential for maintaining a healthy nutrient cycle, preventing the negative impacts of eutrophication, and sustaining the biodiversity and ecological integrity of aquatic environments. Nitrogen is of particular importance because humans have doubled the amount of biological available nitrogen (i.e., nitrate and ammonia) on planet earth, mostly by the industrial farming and livestock industries, but also through the combustion of fossil fuels, which releases significant amounts of nitrogen that has been stored in the earth for hundreds of millions of years. This has caused rainfall worldwide to have high levels of biological available nitrogen, impacting plant distributions and species diversity worldwide. Monitoring and managing total nitrogen concentrations are critical components of effective water quality management strategies.

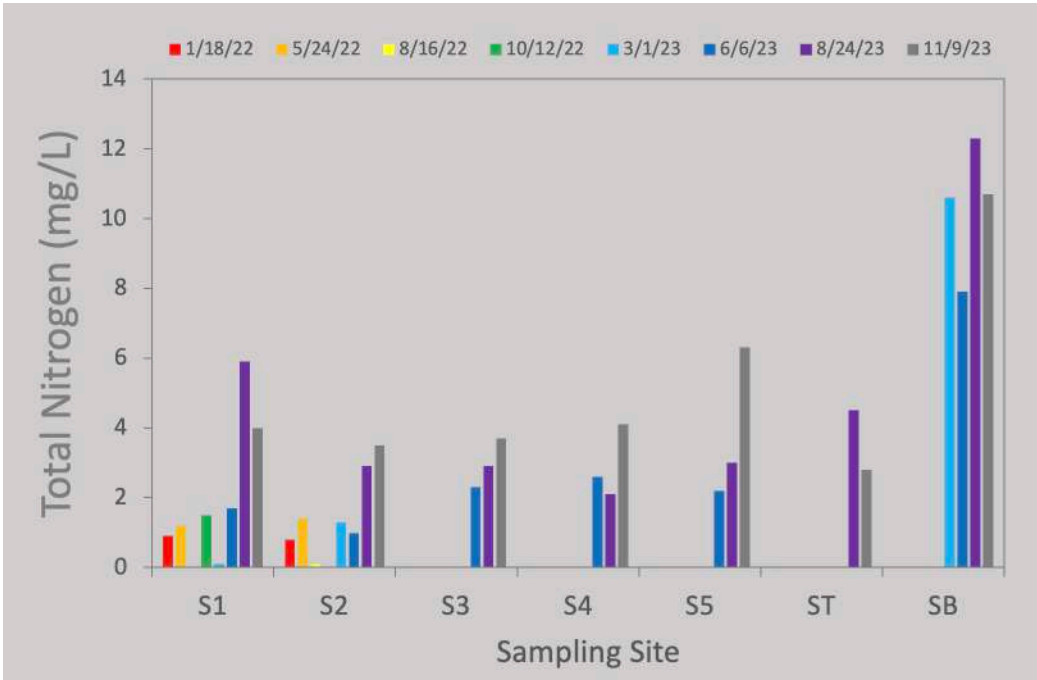


Figure 12. Total nitrogen data over the 2022 and 2023 calendar years.

Phosphate concentrations were below detection (<0.01 mg/L) at sites S3-S5, and were as high as 2.09 mg/L at site SB, which is directly hydrologically connected to sites S1 and S2 that had concentrations as high as 1.5 mg/L (Figure 13). Phosphate is a crucial nutrient in aquatic ecosystems, playing a vital role in supporting the growth and development of aquatic plants and algae. Excessive phosphate fuels algal blooms, leading to oxygen depletion during decomposition and negatively impacting the health of aquatic organisms. Like nitrate and ammonia, phosphate availability has greatly increased on the planet, mostly through the mining of ancient deposits, a finite resource formed over millions of years. Effective management of phosphate levels is essential for maintaining water quality, preventing the detrimental effects of eutrophication, and sustaining the ecological balance of aquatic ecosystems. Monitoring and controlling phosphate concentrations are critical aspects of responsible environmental stewardship and the preservation of biodiversity in aquatic systems.

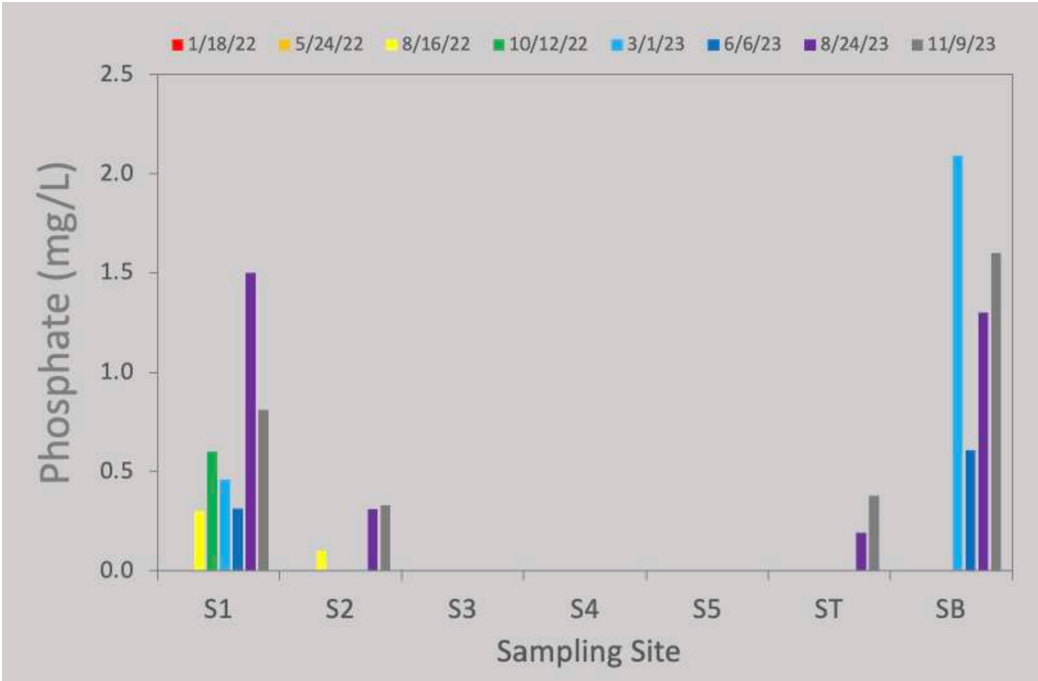


Figure 13. Phosphate data over the 2022 and 2023 calendar years.

Total phosphorus concentrations ranged from below detection (<0.04 mg/L) to 2.6 mg/L, with (like phosphate) the highest concentrations at site SB followed by site S1 and generally decreasing going west into the wetland park (Figure 14). Total phosphorus is the sum of phosphate and organically bonded phosphorus, or organic phosphorus. Total phosphorus in aquatic systems is a critical factor influencing nutrient dynamics and ecological processes. As a component of DNA, RNA, and ATP, phosphorus is essential for the formation of biological molecules and energy transfer processes. While phosphorus is a natural component of aquatic ecosystems, human activities, such as agricultural runoff and wastewater discharge, can contribute to elevated levels. Total phosphorus is a better way to measure phosphorus in natural water bodies because it includes both phosphate and the phosphorus in plant and animal fragments suspended in the water, which will soon decay and release their molecular phosphorus as phosphate. Effective management of total phosphorus is crucial for preventing eutrophication, maintaining water quality, and sustaining the health and biodiversity of aquatic ecosystems. Monitoring and controlling total phosphorus levels are integral components of responsible environmental stewardship and the preservation of the ecological integrity of aquatic habitats.

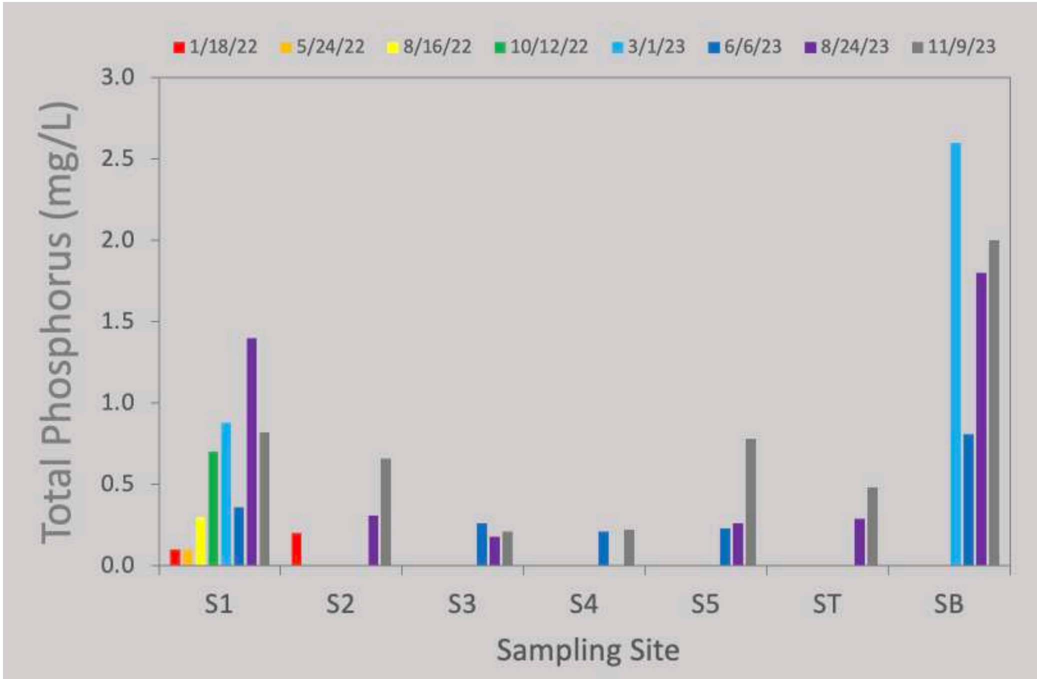


Figure 14. Total phosphorus data over the 2022 and 2023 calendar years.

Total suspended solids (TSS) concentrations ranged from below detection (4 mg/L) to 288 mg/L (Figure 15). The highest concentrations were found at site S3-S5 in June, August and November 2023, presumably due to construction activities that stirred up sediments. TSS in aquatic systems play a multifaceted role in shaping ecological dynamics. Suspended particles, including sediments, organic matter, and other debris, impact water clarity and light penetration, influencing the photosynthetic activity of aquatic plants. Suspended sediments also serve as carriers for nutrients and contaminants, affecting nutrient cycling and water quality. Sediments play a crucial role in habitat formation for benthic organisms, providing substrate for attachment, shelter, and feeding. However, excessive TSS resulting from activities such as urban runoff or erosion can lead to sedimentation, altering bottom habitats, and degrading water quality. Fine sediment particles may smother benthic habitats, impacting macroinvertebrates and fish. Effective management of total suspended solids is essential for preserving water clarity, maintaining healthy benthic ecosystems, and sustaining the overall ecological balance of aquatic environments. Regular monitoring and mitigation measures are critical for preventing sediment-related impacts on aquatic ecosystems.

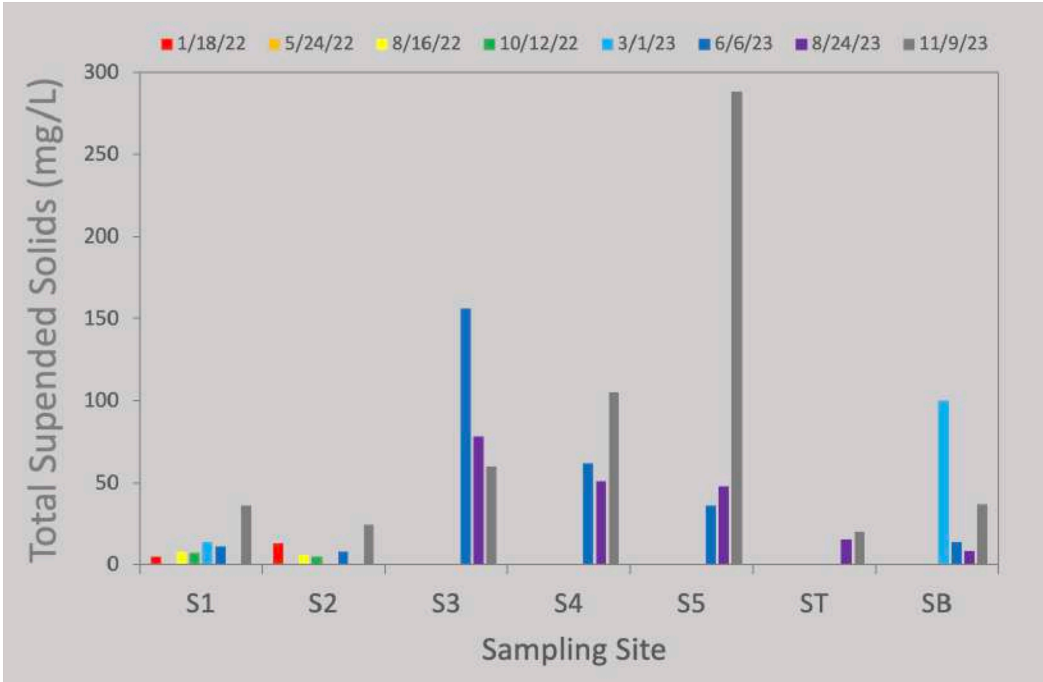


Figure 15. Total suspended solids data over the 2022 and 2023 calendar years.

Biological Oxygen Demand (BOD_5) concentrations ranged from below detection (<3 mg/L) to 18 mg/L, with the highest concentrations at site S2-S4, most likely due to the same construction activities that increased TSS (Figure 16). BOD_5 is a key indicator of the level of organic pollution and the potential impact on aquatic ecosystems. BOD_5 measures the amount of dissolved oxygen consumed by microorganisms during the aerobic decomposition of organic matter over a five-day period. Elevated BOD_5 levels indicate a higher concentration of biodegradable organic pollutants in the water, which can lead to oxygen depletion as microorganisms break down the organic material. The ecological importance of BOD_5 lies in its ability to reveal the biological oxygen demand imposed by organic pollutants, influencing the overall health and balance of aquatic ecosystems. Excessive BOD_5 can lead to hypoxic or anoxic conditions, negatively impacting fish, invertebrates, and other aquatic organisms. Managing BOD_5 levels is crucial for preventing the degradation of water quality, maintaining oxygen levels, and preserving the ecological integrity of aquatic environments. Regular monitoring and effective wastewater treatment practices are essential for mitigating the potential adverse effects of elevated BOD_5 in aquatic systems.

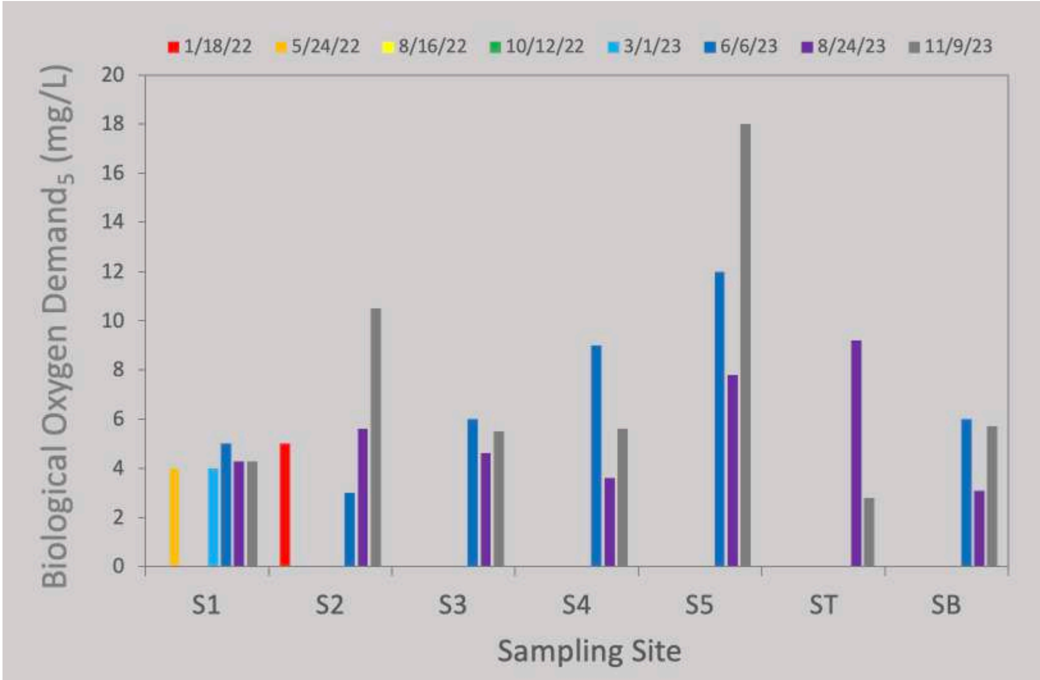


Figure 16. 5-Day Biological Oxygen Demand (BOD_5) data over the 2022 and 2023 calendar years.

Water Level

A water level probe and a barometric compensation probe were installed on February 23rd, 2022 in the wetland park between sites #1 and #2. A staff gauge was also installed and has been read monthly (Table1). Comite Resources personnel carried out an elevation survey at key locations on the eastern end of the Sankofa Wetland Park in December 2022 that facilitated the calculation of the water level gauge data to be in NAVD 88. Data from January through November 2023 indicate that water level fluctuated from a low of nearly -8.0 ft to a high of nearly -6.8 ft (Figure 17). Interestingly, water levels during the summer drought of 2023 were higher than the wet spring, exemplifying how water levels in the wetland park are controlled by the St. Bernard drainage district, which most likely kept water levels lower during the rainy period to prevent flooding, but allowed levels to rise during the drought.

Table 1. Staff gauge readings taken in 2022 and 20223.

Date	Time	Gauge (cm)	Date	Time	Gauge (cm)
2/23/22	16:23	32	1/27/23	10:00	41
3/23/22	15:10	37	3/22/23	11:15	34
4/26/22	13:10	35	4/25/23	12:35	30
5/24/22	11:05	28	5/23/23	11:12	39
6/13/22	9:45	37	6/06/24	10:30	27
7/14/22	9:35	37	7/26/23	11:20	40
8/16/22	13:20	36	8/24/23	10:00	43
9/16/22	15:20	35	9/20/23	11:15	43
10/12/22	10:15	30	10/25/23	12:30	37
11/01/22	11:45	32	11/09/23	12:00	33
11/14/22	15:45	41	12/13/23	9:16	42
12/16/22	10:25	44			

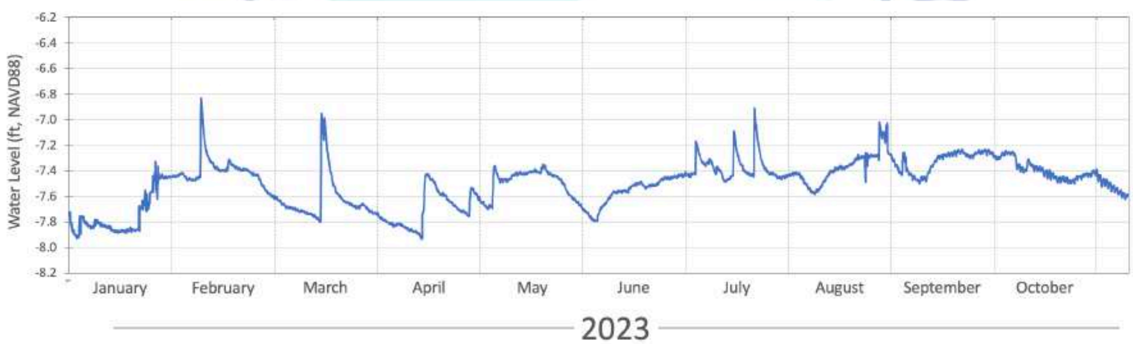


Figure 17. Water level in the Sankofa Wetland Park in 2023.

Avian Survey

Comite Resources has an ornithologist on staff that has been identifying all birds seen and heard in the Sankofa wetland park during monthly monitoring visits. A total of 70 species of birds were observed in the Sankofa Wetland Park in 2023 (Table 2).

Table 2. Bird species seen or heard occupying the Sankofa Wetland Park in 2023.

Common Name	Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12
American Coot	*Fulica americana*	X		X					X	X			X
American Crow	*Corvus brachyrhynchos*	X	X	X		X	X	X	X	X	X	X	X
Anhinga	*Anhinga anhinga*	X	X		X	X		X	X	X		X	X
Bald Eagle	*Haliaeetus leucocephalus*	X			X								X
Belted Kingfisher	*Megaceryle alcyon*											X	
Black Vulture	*Coragyps atratus*		X	X		X	X		X	X	X	X	X
Black-Bellied Whistling-Duck	*Dendrocygna autumnalis*		X				X	X	X	X		X	
Black-Crowned Night Heron	*Nycticorax nycticorax*								X				
Black-Winged Stilt	*Himantopus himantopus*				X	X	X					X	
Blue Grosbeak	*Passerina caerulea*				X								
Blue Jay	*Cyanocitta cristata*	X	X	X	X	X	X	X	X	X	X	X	X
Blue-Grey Gnatcatcher	*Polioptila caerulea*										X		X
Brown Pelican	*Pelecanus occidentalis*												X
Carolina Chicadee	*Poecile carolinensis*	X	X	X	X	X	X		X	X	X	X	X
Carolina Wren	*Thryothorus ludovicianus*		X		X						X	X	X
Cattle Egret	*Bubulcus ibis*							X					
Cedar Waxwing	*Bombycilla cerorum*		X										
Common Grackel	*Quiscalus quiscula*					X			X	X			X
Common Moorhen	*Gallinula chloropus*	X	X	X	X			X	X	X		X	X
Common Tern	*Sterna hirundo*				X								
Common Yellowthroat	*Geothlypis trichas*	X	X										
Coopers Hawk	*Accipiter cooperii*							X					X
Double Crested Cormorant	*Phalacrocorax auritus*									X			
Downy Woodpecker	*Dryobates pubescens*										X	X	
Eastern Phoebe	*Sayornis phoebe*		X		X			X	X		X	X	X
Eurasian Collared Dove	*Streptopelia decaocto*		X	X					X	X			
European Starling	*Sturnus Vulgaris*	X	X	X	X	X	X	X	X	X		X	X
Fish Crow	*Corvus ossifragus*	X		X	X					X			X
Glossy Ibis	*Plegadis falcinellus*								X				
Great Blue Heron	*Ardea herodias*				X					X	X	X	X
Great Crested Flycatcher	*Myiarchus crinitus*		X										
Great Erget	*Ardea alba*	X	X	X	X	X	X	X	X	X		X	X
Green Heron	*Butorides virescens*			X	X	X	X	X	X	X	X		X
Hairy Woodpecker	*Picoides pubescens*		X										
House Finch	*Haemorhous mexicanus*										X		
Killdeer	*Charadrius vociferus*				X	X	X			X	X	X	X
Laughing Gull	*Larus atricilla*	X		X	X			X	X	X			X
Limpkin	*Aramus guarauna*		X	X	X	X	X		X	X		X	X
Little Blue Heron	*Egretta caerlea*		X	X	X			X	X	X			
Mississippi Kite	*Ictinia mississippiensis*					X	X	X	X				
Mockingbird	*Mimus polyglottos*	X	X	X	X	X	X	X	X	X	X	X	X
Mourning Dove	*Zenaida macroura*				X	X	X	X	X	X		X	X
Northern Cardinal	*Cardinalis cardinalis*		X	X	X	X	X	X		X	X	X	X
Northern Parula Warbler	*Setophaga americana*			X									
Osprey	*Pandion Haliaetus*	X		X									
Palm Warbler	*Setophaga palmarum*										X	X	
Pied-billed Grebe	*Podilymbus podiceps*	X											
Prothonotary Warbler	*Protonotaria citrea*						X						
Red Shouldered Hawk	*Buteo lineatus*					X					X	X	X
Red Tailed Hawk	*Buteo jamaicensis*					X							X
Red Winged Blackbird	*Agelaius phoeniceus*		X		X	X	X				X	X	X
Red-BelliedWoodpecker	*Melanerpes carolinus*				X			X		X			
Ruby-Crowned Kinglet	*Corthylio calendula*												X
Semipalmated Plover	*Charadrius semipalmatus*												X
Snowy Egret	*Egretta thula*			X		X	X	X	X	X			
Song Sparrow	*Melospiza melodia*		X										X
Swamp Sparrow	*Melospiza georgiana*	X									X	X	
Tree Swallow	*Tachycineta bicolor*			X	X							X	
Tricolor Egret	*Egretta tricolor*								X		X		
Tuffted Titmouse	*Baeolophus bicolor*		X	X	X						X		
Turkey Vulture	*Cathartes aura*		X							X	X		X
White Ibis	*Eudocimus albus*		X		X	X	X	X	X	X	X	X	X
White Pelican	*Pelecanus erythrorhynchos*												X
White-Eyed Vireo	*Vireo griseus*										X		
Winter Wren	*Troglodytes hiemalis*		x										
Wood Duck	*Aix sponsa*										X		X
Yellow-Billed Cuckoo	*Coccyzus americanus*					X	X						
Yellow-Breasted Chat	*Icteria virens*								X				
Yellow-Crowned Night-Heron	*Nyctanassa violacea*						X						
Yellow-Rumped Warbler	*Setophaga coronata*	X	X	X	X							X	X

Delgado Community College

Students from Delgado Community College came to the Sankofa Wetland Park to attend a three-day workshop where classes were taught by several organizations including staff from Comite Resources. Classes occurred the weeks of May 23, July 26, September 20 and December 13, 2023. Dr. Rob Lane gave lectures on wetlands and water quality monitoring. He prepared a new curriculum for the December 13, 2023 class, which was given as handouts. Below is what was provided.

Class Outline: Sankofa/Delgado Workforce Development Program
Topic: Wetland Habitats

Overview of wetland habitats
Can anyone name the types of wetlands in Louisiana?
Swamps:
Cypress-Tupelo Swamps: Characterized by the presence of bald cypress and water tupelo trees, these swamps are common in the lower reaches of bayous and estuaries.
Bottomland Hardwood Swamps: These swamps are dominated by hardwood trees and are often found along rivers and streams.
Marshes:
Freshwater Marshes: Found in areas with freshwater input, these marshes support diverse vegetation and wildlife.
Brackish Marshes: Found in areas where saltwater and freshwater mix, these marshes are home to species adapted to variable salinity.
Saltwater Marshes: Dominated by salt-tolerant plants, these marshes are typically found in coastal areas with exposure to tidal influences.
Bogs:
Cypress-Tupelo Bogs: Similar to swamps, these wetlands are characterized by the presence of cypress and tupelo trees without direct connection to rivers, usually in depressions.
Sphagnum Moss Bogs: These acidic bogs are characterized by the growth of sphagnum moss and are typically found in northern parts of the state.

What is causing these different types of wetlands?
An interaction of hydrological, geological and ecological factors.
Hydrology:
Salinity: Tidal fluctuations bring a mix of saltwater and freshwater, influencing the types of plants and animals that can survive in these environments.
Geography and Topography:
The elevation of the land influences hydrology and flooding.
Proximity to Coastline: Interactions between freshwater and saltwater.
Vegetation:
The presence of specific plant species, such as cypress and tupelo trees in swamps or marsh grass in saltmarshes, contributes to the classification of wetland types.

Has anybody been down to Grand Isle?
Used to be saltmarsh, but now has mangroves through much of the area.
South of Louisiana, coastal wetlands are mostly mangroves (Florida, Mexico), north of LA they are all mostly saltmarsh.

What is causing saltmarshes to form to the north and mangroves to the south?
Temperature Gradient:
Cold Tolerance: Salt marsh plants are generally more cold-tolerant than mangroves and are found in areas where winter temperatures may drop below freezing.
Warmer Temperatures to the South: Mangroves are adapted to tropical and subtropical climates with consistently warmer temperatures.

Estuaries
Has anyone heard of an estuary?
An estuary is a partially enclosed coastal body of water where freshwater from rivers and streams meets and mixes with saltwater from the ocean. Estuaries are unique and dynamic environments that serve as transition zones between terrestrial and marine ecosystems. '

Mixing of Waters:
Estuaries are areas where freshwater flowing from the land mixes with saltwater from the ocean. This mixing creates brackish water, which has a salinity intermediate between freshwater and seawater.
Tidal Influence:
Estuaries are strongly influenced by tides. The rise and fall of tides bring in seawater, and the ebb and flow of tides contribute to the flushing of estuarine waters.
Biodiversity:
Estuaries are among the most productive ecosystems on Earth. The mixing of nutrients from both freshwater and marine sources creates a nutrient-rich environment that supports diverse and abundant life, including various species of fish, shellfish, birds, and plant life.
Nursery Habitats:
Estuaries serve as important nursery habitats for many marine and bird species and provide abundant food and protection from predators.
Buffer Against Storms:
Estuarine ecosystems provide a natural buffer against storm surges and flooding by absorbing wave energy and decreasing surge height.
Human Interaction:
Almost all human civilizations began near estuaries due to the abundance of food. Indians used to thrive throughout the Mississippi Delta

Can anyone name some Indian tribes that live in the delta?
Choctaw, Chitimacha, Houma tribes   Others: Apalachee, Caddo, Tunica-Biloxi, Coushatta

The Mississippi River delta is made up of six estuaries, from east to west:
Biloxi estuary (Hopedale, Shell Beach) to the east
Breton Sound estuary (Chalmette, Delacroix) to the southeast
Barataria estuary (Grand Isle, Lafitte) to the southwest
Mississippi River runs between those two – to the Bird-foot Delta (Venice)
Further west Terrebonne estuary (Houma, Chuavin, Dulac)
Atchafalaya delta estuary (Morgan City) – Atchafalaya River

Has anyone heard of the Atchafalaya River?

If not for human intervention, the Mississippi River would have started flowing down the Atch.
Beginning of the century (1920 or so), increasing flows to Atch. measured
Old river control structure completed in 1963
Now 1/3rd of Miss. R. discharge goes down Atchafalaya
Atchafalaya only growing estuary in Louisiana, all others are eroding.
75 square miles of wetlands lost annually

Does anyone know why Louisiana wetlands are being lost?

Louisiana's wetlands are facing significant loss due to a combination of natural and human-induced factors. Some of the key reasons for the ongoing loss of wetlands in Louisiana include:

Subsidence:
Subsidence is the settling and sinking of the wetland surface. Natural wetland subsidence is exacerbated by factors such as the withdrawal of groundwater and oil and gas.

Sea Level Rise:
Rising sea levels associated with global climate change contribute to the loss of wetlands. Higher sea levels increase saltwater intrusion into freshwater areas, leading to changes in vegetation and habitat loss.

Hurricane Impact:
Hurricanes and tropical storms can cause storm surges that inundate wetlands and erode shorelines. The frequency and intensity of storms in the Gulf of Mexico is increasing and are exacerbating wetland loss.

Human Activities:
Canal Construction: The construction of navigation canals for oil and gas exploration has altered water flow patterns, allowing saltwater intrusion and accelerating land loss.
Oil and Gas Extraction: The extraction of oil and gas has contributed to subsidence and activation of geologic faults.
Levee Construction: Levees built along the Mississippi River for flood control prevents the natural replenishment of sediment in wetland areas during annual flooding. Without sediment, wetlands cannot build and maintain elevation, making them more vulnerable to erosion and subsidence.

Ecology of wetland habitats

Does anyone know what ecology means?

Ecology is the study of the interactions among organisms and their environment. It is a branch of biology that focuses on understanding the relationships, distribution, abundance, and dynamics of living organisms in their natural environments.

Food Webs

Represents the complex network of feeding relationships within an ecosystem. Different species are interconnected through the transfer of energy and nutrients as they consume and are consumed by one another. Unlike a food chain, a food web is more realistic, reflecting the multiple and often overlapping interactions that occur in natural ecosystems.

Predator-Prey Relationships: Predators hunt and consume prey, and this dynamic is crucial for regulating population sizes within an ecosystem.

Interconnectedness: The loss or introduction of one species can have cascading effects on the entire ecosystem. Human activities, such as exotic species introductions, can disrupt food webs, leading to ecological imbalances.

Trophic Levels:
Primary Producers: Typically, plants and algae that produce their own food through photosynthesis. They form the base of the food web by converting sunlight into energy.
Consumers: Organisms that consume other organisms for energy. Consumers are further classified into different trophic levels:
Herbivores: Eat primary producers.
Carnivores: Eat the herbivores or other carnivores.

Energy Transfer: Energy flows through the food web as organisms are consumed. However, most energy (90%) is not transferred and is lost at each trophic level.

An interesting characteristic of estuarine food webs is the importance of the bottom

Can anyone tell me why the bottom of the estuary is important?

The bottom of an estuary, often referred to as the benthic zone, is of critical importance for various ecological processes and the overall health of the estuarine ecosystem.

Benthos:
The estuarine bottom provides a habitat for a diverse community of benthic organisms, such as worms, clams, crustaceans, and various larvae.

Decomposition:
Decomposition of organic matter, including dead plants and animals, occurs at the estuarine bottom. This decomposition process releases nutrients back into the water, supporting the nutrient cycling essential for the overall productivity of the estuary.

Filter-Feeding:
Many benthic organisms are filter feeders, actively filtering organic particles and detritus from the water column. This process helps maintain water clarity and nutrient cycling.

Carbon Sequestration:
The estuarine bottom can sequester and store significant amounts of carbon. Organic material that accumulates and is buried in sediments contributes to long-term carbon storage, helping to mitigate the impacts of climate change.

Indicator of Environmental Health:
The condition and diversity of benthic communities at the estuarine bottom can serve as indicators of the overall environmental health of the estuary.

Benefits of wetland habitats (humans and wildlife)

Wetland habitats play crucial roles in supporting biodiversity, maintaining water quality, and providing valuable ecosystem services, such as flood control, to surrounding communities.

Wetland Benefits for Wildlife

Habitat and Biodiversity:
Wetlands support a diverse array of plant and animal species, many of which are specially adapted to the unique conditions of wetlands.

Birds:
Many bird species, including waterfowl, shorebirds, and wading birds, use wetlands as nesting and breeding grounds. The sheltered and nutrient-rich conditions of wetlands provide essential resources for raising young.
Wetlands play a crucial role in the migration routes of many bird species. They provide important stopover points where migratory birds can rest and refuel during their long journeys.

Fish:
Juvenile fish use wetland areas as nurseries, finding abundant food and shelter.

Wetland Benefits for Humans

Flood Control:
Wetlands act as natural buffers against flooding by absorbing and storing excess water during heavy rainfall or storm events. They help reduce the risk of downstream flooding and protect nearby communities.

Filtering & Purification:
Wetlands act as natural filters, trapping sediments and filtering pollutants from water. They help improve water quality by removing excess nutrients and sediments before water enters rivers, lakes, or oceans.

Carbon Sequestration:
Wetlands store large amounts of carbon in their soils and vegetation. Subsidence makes this storage permanent.

Erosion Control:
Vegetation in wetlands helps stabilize shorelines and prevent erosion. The root systems of wetland plants bind soil together, reducing the impact of waves and currents.

Conserving wetland habitats is critical for maintaining these benefits and ensuring the health of both ecosystems and human communities. Wetland preservation and restoration efforts are important for sustaining biodiversity, ecosystem services, and the well-being of people around the world.

Topic: Water Quality Testing

Can anybody tell me what inorganic nutrients are?

Inorganic nutrients are chemical elements that are essential for the growth and development of living organisms. They are the building blocks of life.
Unlike organic nutrients, which are derived from living or once-living organisms, inorganic nutrients come from non-living sources such as rocks, minerals, water, and gases in the atmosphere.

Macronutrients: These are required by organisms in relatively large quantities.
Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg) & Sulfur (S)

Micronutrients: These are needed in smaller amounts but are equally essential.
Iron (Fe), Zinc (Zn), Copper (Cu), Manganese (Mn), Boron (B), Chlorine (Cl), Nickel (Ni)

Nitrogen and phosphorus - known as growth limiting nutrients - control algae & plant growth

What happens when there are too much nitrogen and phosphorus in the water?

When there is an excess of nitrogen and phosphorus in water, it can lead to a phenomenon known as nutrient pollution. This type of pollution can have detrimental effects on aquatic ecosystems, water quality, and overall environmental health.

Algal Blooms:
The rapid growth of algae, which are primary producers that use nutrients for photosynthesis.

Harmful Algal Blooms (HABs):
Some algal species, particularly certain types of cyanobacteria (blue-green algae), can produce toxins during blooms. These harmful algal blooms (HABs) can pose serious risks to aquatic life, animals and humans through the contamination of drinking water and recreational waters.

Oxygen Depletion:
The decomposition of algae by benthic organisms consumes dissolved oxygen in the water. This can lead to oxygen depletion, creating "dead zones" where oxygen levels are too low to support most aquatic life.

Fish Kills:
Fish and other aquatic organisms may die due to the lack of oxygen or exposure to algal toxins.

Changes in Water Chemistry:
Elevated nutrient levels can alter the chemical composition of water, leading to changes in pH, nutrient ratios, and the availability of other essential compounds and heavy meatals.

Loss of Biodiversity:
Changes in water quality and oxygen levels can adversely affect the diversity of aquatic plants and animals. Species adapted to lower nutrient conditions may decline, while species that thrive in nutrient-rich environments may dominate, leading to shifts in community composition.

Water quality monitoring and testing

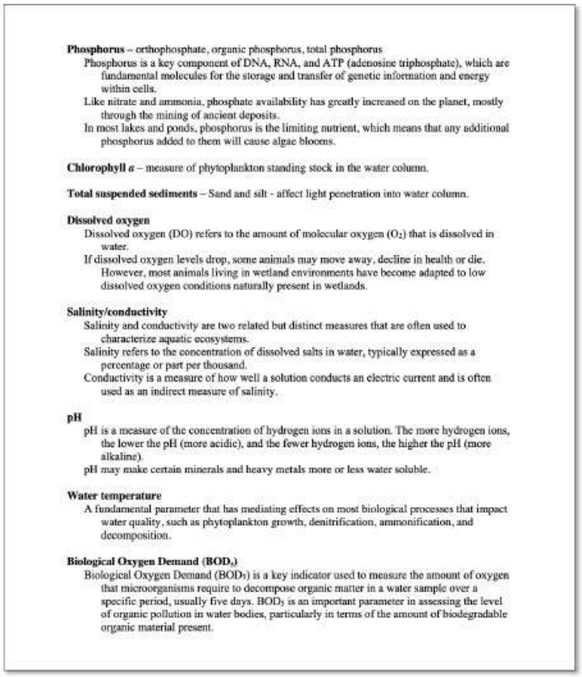
Water quality monitoring is crucial for identifying potential contaminants, tracking changes over time, and making informed decisions about water management and protection.

Nitrogen is of particular importance because humans have doubled the amount of biological available nitrogen on planet earth, mostly by the use of artificial fertilizers, but also through the combustion of fossil fuels.
This has caused rainfall worldwide to have high levels of biological available nitrogen, impacting plant distributions and species diversity worldwide.

Can anyone tell me how increased nitrogen can change plant distributions?

Some plants use nitrogen better than other – out competing (overgrowing) other plants

Nitrogen – nitrate, ammonia, organic nitrogen and total nitrogen
Nitrogen is an essential element for living organisms. It is a key component of amino acids, which are the building blocks of proteins. Nitrogen is also present in nucleic acids (DNA and RNA), chlorophyll, and many other biological molecules.



Phosphorus – orthophosphate, organic phosphorus, total phosphorus

Phosphorus is a key component of DNA, RNA, and ATP (adenosine triphosphate), which are fundamental molecules for the storage and transfer of genetic information and energy within cells.

Like nitrate and ammonia, phosphate availability has greatly increased on the planet, mostly through the mining of ancient deposits.

In most lakes and ponds, phosphorus is the limiting nutrient, which means that any additional phosphorus added to them will cause algae blooms.

Chlorophyll *a* – measure of phytoplankton standing stock in the water column.

Total suspended sediments – Sand and silt - affect light penetration into water column.

Dissolved oxygen

Dissolved oxygen (DO) refers to the amount of molecular oxygen (O_2) that is dissolved in water.

If dissolved oxygen levels drop, some animals may move away, decline in health or die. However, most animals living in wetland environments have become adapted to low dissolved oxygen conditions naturally present in wetlands.

Salinity/conductivity

Salinity and conductivity are two related but distinct measures that are often used to characterize aquatic ecosystems.

Salinity refers to the concentration of dissolved salts in water, typically expressed as a percentage or part per thousand.

Conductivity is a measure of how well a solution conducts an electric current and is often used as an indirect measure of salinity.

pH

pH is a measure of the concentration of hydrogen ions in a solution. The more hydrogen ions, the lower the pH (more acidic), and the fewer hydrogen ions, the higher the pH (more alkaline).

pH may make certain minerals and heavy metals more or less water soluble.

Water temperature

A fundamental parameter that has mediating effects on most biological processes that impact water quality, such as phytoplankton growth, denitrification, ammonification, and decomposition.

Biological Oxygen Demand (BOD_5)

Biological Oxygen Demand (BOD_5) is a key indicator used to measure the amount of oxygen that microorganisms require to decompose organic matter in a water sample over a specific period, usually five days. BOD_5 is an important parameter in assessing the level of organic pollution in water bodies, particularly in terms of the amount of biodegradable organic material present.

Delgado students observing Jason Day take probe measurements on December 13, 2023

Jason Day lecturing to students on July 26th (left) September 20 (right), 2023.

Miscellaneous Activities

February 7, 2023: Rob Lane met virtually with Rashida Ferdinand and Scott Tabary to discuss connecting the two ponds currently at the project site by a shallow area with -8.0 ft elevation. The shallow area is mandated by the City due to a sand deposit located near the railroad. They asked Rob Lane if a shallow area at -8.0 would be acceptable. Dr. Lane replied that the pond water elevation rarely went below -8.0 ft and that a shallow area would simply colonize with wetland vegetation and would be an asset to the park by providing additional varied habitat.

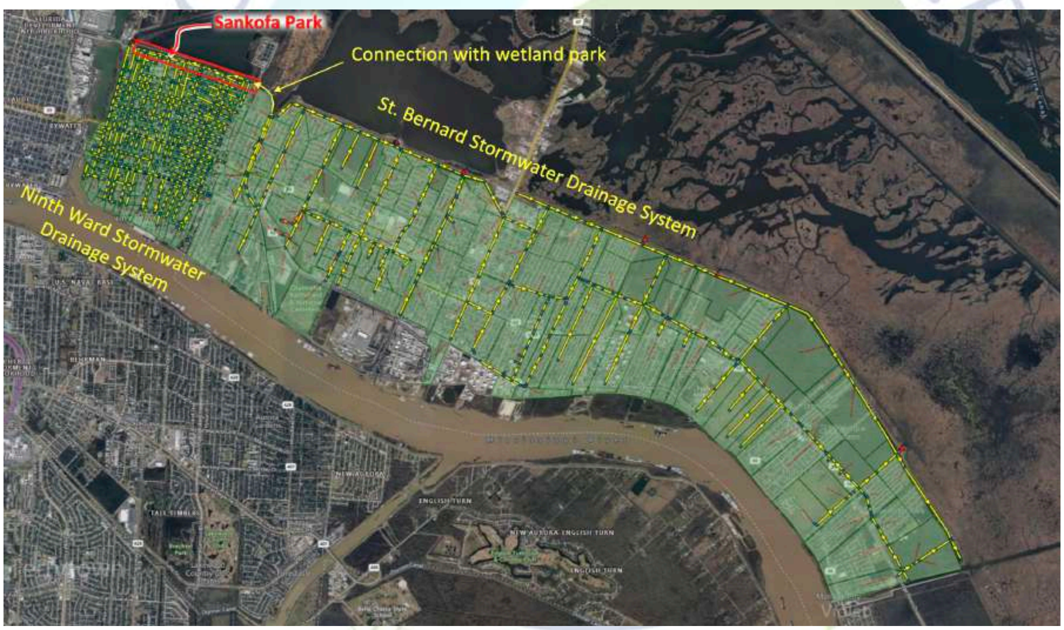
It appears that the water level in the newly constructed ponds in about 2 ft higher than the water in the park (see photo below). Where is this water coming from? This may be a good question for Tom Willis, an engineer who is working with Dr. Lane to create a hydrologic model of the park and surrounding water ways.

The newly constructed pond (left) and the Sankofa Park (right) on March 1, 2023. Notice the difference in water level of about 2 ft.

May 9, 2023: Rob Lane met with Scott Tabary, Gary Shaffer and Rashida F. at the wetland park to meet with Huy Tran. Unfortunately, Huy Tran did not make the meeting. Nonetheless, the rest of the team met and it was decided that Dr. Lane would make the first draft of a white paper discussing the need for additional water input at the park – below is what was sent to the group for review.

Water Level Control in the Sankofa Wetland Park

Currently, water levels in the Sankofa wetland pond are directly tied to the St. Bernard stormwater drainage canal system, which is connected at the east end of the wetland park. This has resulted in water levels in the wetland park being controlled by water levels in the St. Bernard drainage system (i.e., they are at the same level). Since the wetland park is directly connected to the St. Bernard stormwater drainage canal system, during large storms when water levels are elevated in the St. Bernard storm drainage canal system, the wetland park acts as a retention pond, holding water during peak storm discharge and then releasing it back into the drainage system. The St. Bernard and the Lower Ninth Ward storm drainage canal systems intersect near the park. The Lower Ninth Ward canal system water level, however, is maintained at -15 ft, while the St. Bernard system is kept above -7ft. The connection is at a culvert on Florida Ave. where water can be heard falling from the St. Bernard canal at around -7ft to the Ninth Ward system at -15 ft. Thus during large storms water flows into the wetland park from the St. Bernard canal system and flows out of the park partially (or mostly) through the Lower Ninth Ward canal system.



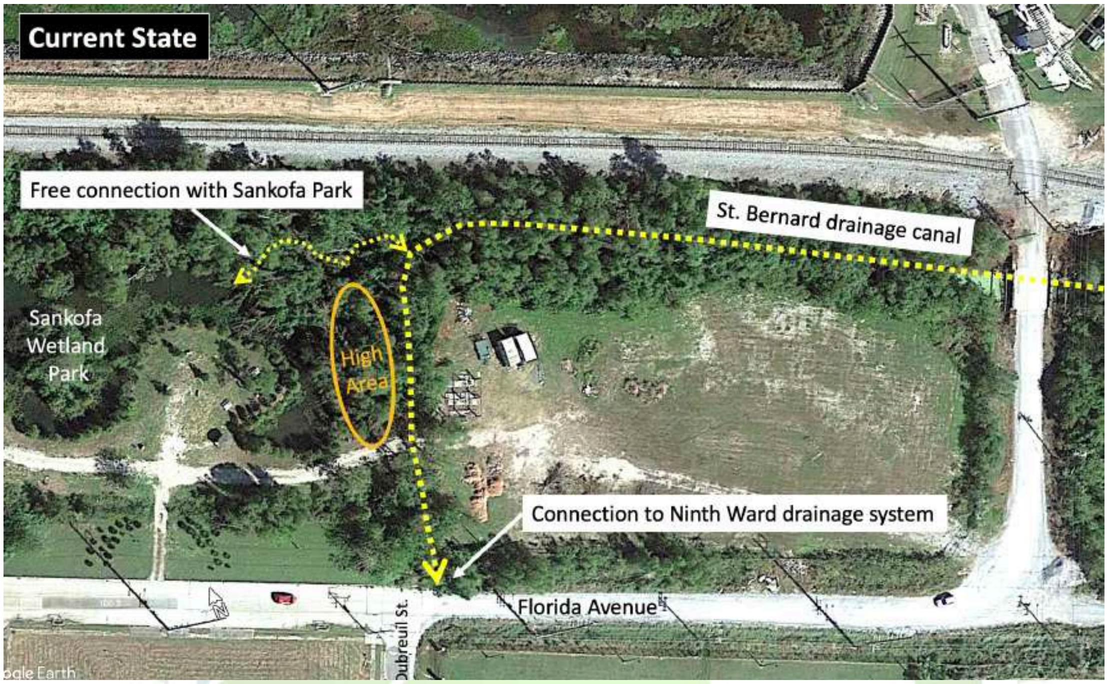
There are two main issues with the current configuration: (1) If St. Bernard Parish decides to lower water levels in their drainage canals then water levels in the wetland pond will be lowered accordingly; and (2) water levels in the park need to be raised about a foot, from about -7 ft to -6ft, due to high sections of the wetland pond bottom that are currently above water or with just a few inches of water. In order to partially solve these issues we intend to install two culverts with flap gates at the east end of the wetland park where it connects with the St. Bernard drainage canal so that water can only flow into the wetland park but not out, thus impeding drainage of the pond if water levels are lowered in the drainage canals.

There is, however, a need for additional water input into the wetland park in order to raise the water level above the high bottom elevations in the middle third of the park. Possible sources identified thus far include: (1) pumping water up from the box culvert near Tupelo St.; (2) pumping water up from the input pond of the pumping station to the west of the wetland park; and (3) diverting water from the outfall pipe of the pumping station to the west of the wetland park. Option 3 has been determined to not be feasible due to complications with the railroad that passes in between the outfall pipe and the park.

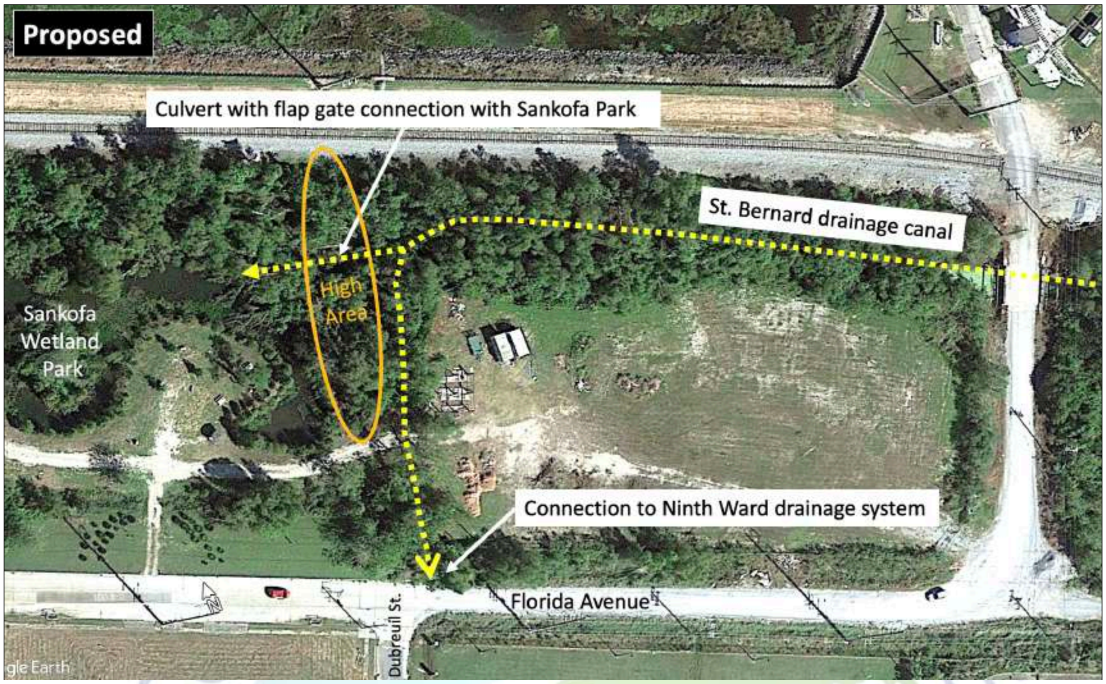
It should be noted that the very low water levels in the Lower Ninth Ward storm drainage canal system is detrimental to the Lower Ninth Ward as a whole. The soils of the Lower Ninth Ward are highly organic and formed under hydric and mostly anoxic conditions. When such soils are exposed to oxygen they rapidly breakdown, resulting in subsidence. It is for this reason that most land in the greater New Orleans metropolitan area is below sea level, with the ninth ward being at around -6ft elevation.

A river otter (Lontra canadensis) in the new part of the pond on May 23rd, 2023.

June 5, 2023: Rob Lane met virtually with Tom Willis, Gary Shaffer and Rashida F. concerning the instillation of flap gates at the Sankofa park. Dr. Lane agreed to provide a schematic of the proposed changes to the park, shown below.



We propose to install two culverts with flap gates at the east end of the wetland park where it connects with the St. Bernard drainage canal so that water can only flow into the wetland park but not out, thus impeding drainage of the pond if water levels are lowered in the drainage canals. This configuration will also increase the residence time of stormwater in the wetland park, allowing for further processing of the water by the wetland system.



August 18, 2023: Dr. Rob Lane looked into the macroalgae issue at the Sankofa ponds and found a product that is safe to use:

https://www.lakerestoration.com/product/cape-furl/

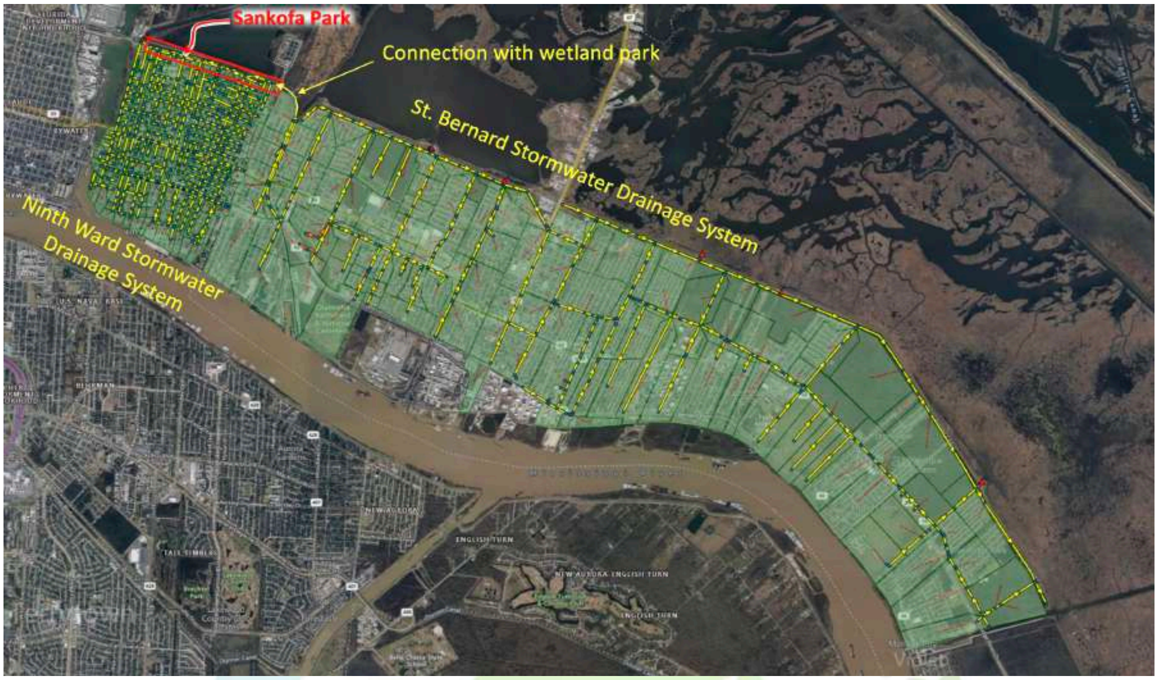
It is an oxidizer that kills macroalgae on contact with byproducts being water and oxygen. It is relatively cheap as well. A permit may be needed if this product is used - we can find out about permitting.

Dr. Lane also found an interesting manual from Texas (http://fisheries.tamu.edu/files/2013/09/Managing-and-Controlling-Algae-in-Ponds-Manual-format.pdf) that suggests using sterile triploid grass carp, which are also available in Louisiana, though permitting may be an issue (again, we can find out if requested).

August 18, 2023: Dr. Lane was asked to prepare a document about the importance of the Sankofa Wetland Park. Below is what was submitted.

The Importance of the Sankofa Wetland Park to Surrounding Environs
The Sankofa Wetland Park is important to the surrounding environment in a variety of ways. The hydrological design of the park allows it act as a stormwater retention pond during major storms. The water in the Sankofa wetland pond is directly connected to the St. Bernard stormwater drainage canal system at the east end of the wetland park. This has resulted in water levels in the wetland park being controlled by water levels in the St. Bernard drainage system (i.e., they are at the same level). Since the wetland park is directly connected to the St. Bernard stormwater drainage canal system, during large storms when water levels are elevated in the St. Bernard storm drainage canal system, the wetland park acts as a retention

pond, holding water during peak storm discharge and then slowly releasing it back into the drainage system as water levels subside.



Wetlands can act as natural filters that purify water by trapping pollutants such as phosphorus and heavy metals in their soils and transform nitrogen into a gas that is released into the air, and wetlands physically and chemically break down dangerous bacteria and other materials. These processes are occurring in the wetland park as it retains stormwater, especially in between storm events when there are long water residence times. During droughts and heatwaves, both of which we are experiencing now, the wetland pond is a source of water and relatively cool habitat for birds and animals in an otherwise dry and hot urban landscape.

The Sankofa Wetland Park provides habitat for a wide range of birds and animals. Over 100 species of birds were observed using the park in 2022. The park has been home to a family of otters since last winter, and a beaver has also been observed in the area, along with alligators and many species of fish.

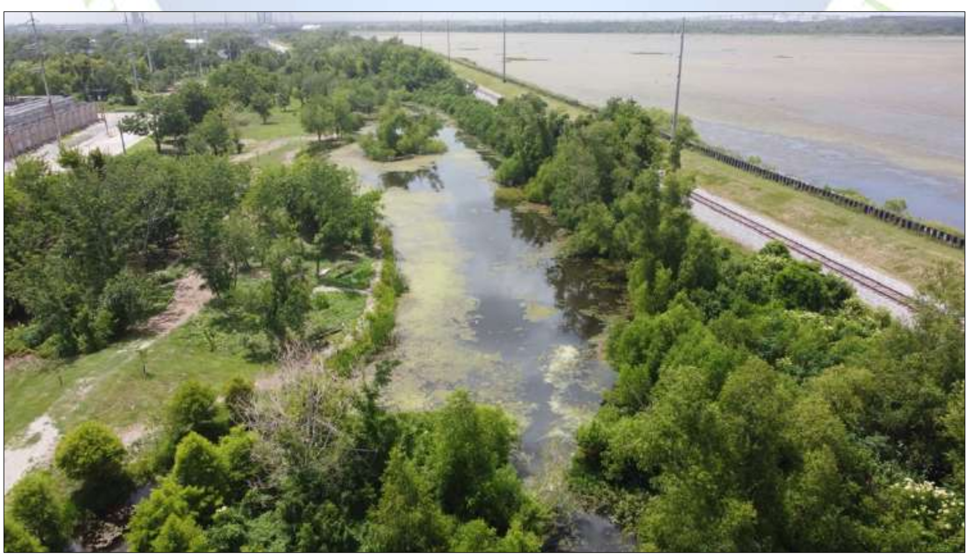
The Bayou Bienvenue Wetland Triangle is located directly to the north of the Sankofa Wetland Park and used to be directly connected before the flood control levee and railroad was constructed. It was once a thriving baldcypress swamp that was used extensively by ninth ward residents for hunting, fishing and lumber, but was killed by saltwater intrusion resulting from the construction of the Mississippi River Gulf Outlet (MRGO) in 1963, which increased regional salinities and coincided with the death of much of the forested wetlands in the region.

Historical imagery of the Bayou Bienvenue Wetlands Triangle.

With the closure of the MRGO in 2009, however, salinities in the Bayou Bienvenue Wetland Triangle have decreased to levels that are conducive to baldcypress and water tupelo survival. Sankofa has a wetland restoration plan for the area, and is advocating for the creation of 103 acres of wetlands in the 400-acre wetland triangle. Forty 1-to-11-acre islands could be created using clean sediment from either a land source, such as the Bonnet Carré Spillway, or from dredged sediments from the Mississippi River. The islands would be planted with baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) seedlings and interspersed with giant bullwhip (*Schoenoplectus californicus*).

Conceptual design of the proposed wetland islands in the Bayou Bienvenue Wetland Triangle.

Restoration of the Bayou Bienvenue Wetland Triangle would provide protection to the surrounding levees from wind generated waves (i.e., fetch) during major storms. In addition, with less water holding capacity due to displacement from the restored wetlands, there would be less continual water pressure on the levees. Both of these factors will greatly improve the integrity and sustainability of the surrounding levees. Restoration of the Bayou Bienvenue Wetland Triangle would also provide habitat for birds, fish and other wildlife, and would greatly compliment the adjacent Sankofa Wetland Park.

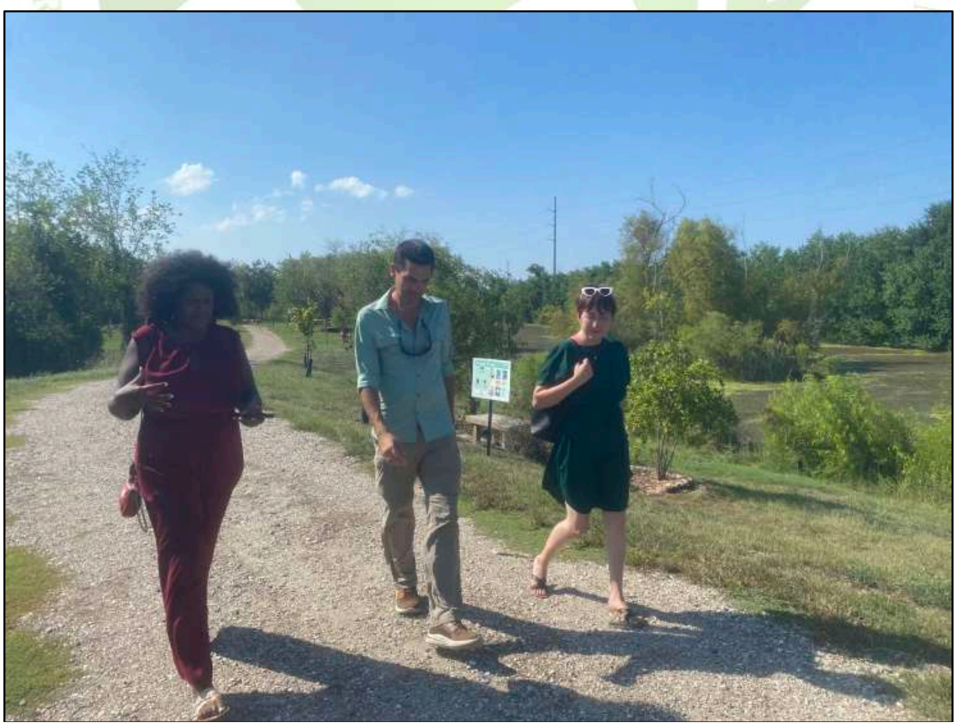


Aerial image showing the Sankofa Wetland Park (left) and the Bayou Bienvenue Wetland Triangle (right) separated by the railroad and flood control levee.

August 24, 2023: A meeting was held with Veolia Water that allowed us establish a new site designated at 'T1'.

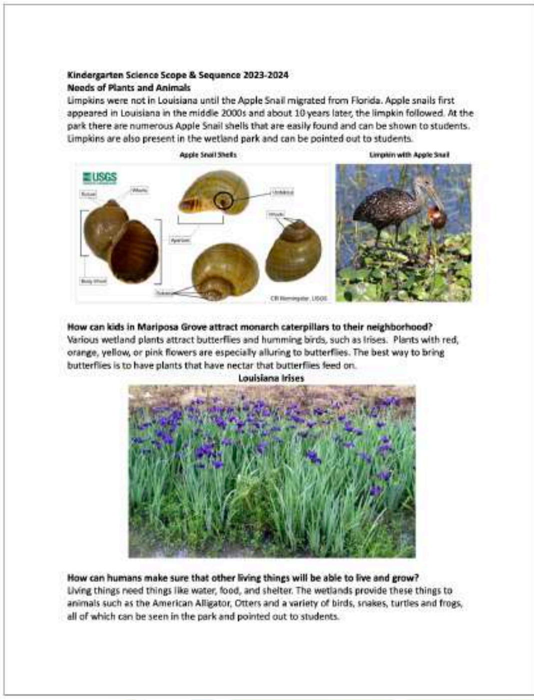
Jason Day walking to collect a water sample at new site T1 on August 24th, 2023.

September 20, 2023: Rashida Ferdinand and Rob Lane met with Dr. Antal Borcsok of Tela Marine in Honduras and Laila Bondi of Global New Orleans. They toured the park and discussed sustainability issues facing the greater New Orleans area and the world.



Rashida Ferdinand, Dr. Antal Borcsok and Laila Bondi on September 20, 2023.

October 11-13, 2023: Dr. Rob Lane and Jason Day were tasked with developing a companion curriculum for teachers of K-2 students for their visits to the wetland park. Below is what was delivered.



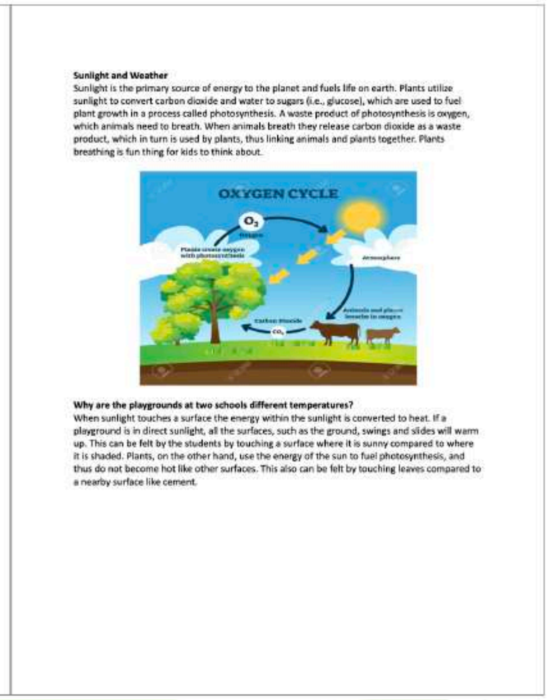
Kindergarten Science Scope & Sequence 2023-2024
Needs of Plants and Animals
Limpkins were not in Louisiana until the Apple Snail migrated from Florida. Apple snails first appeared in Louisiana in the middle 2000s and about 10 years later, the limpkin followed. At the park there are numerous Apple Snail shells that are easily found and can be shown to students. Limpkins are also present in the wetland park and can be pointed out to students.

Apple Snail Shells **Limpkin with Apple Snail**

How can kids in Mariposa Grove attract monarch caterpillars to their neighborhood?
Various wetland plants attract butterflies and humming birds, such as Irises. Plants with red, orange, yellow, or pink flowers are especially alluring to butterflies. The best way to bring butterflies is to have plants that have nectar that butterflies feed on.

Louisiana Irises

How can humans make sure that other living things will be able to live and grow?
Living things need things like water, food, and shelter. The wetlands provide these things to animals such as the American Alligator, Otters and a variety of birds, snakes, turtles and frogs, all of which can be seen in the park and pointed out to students.



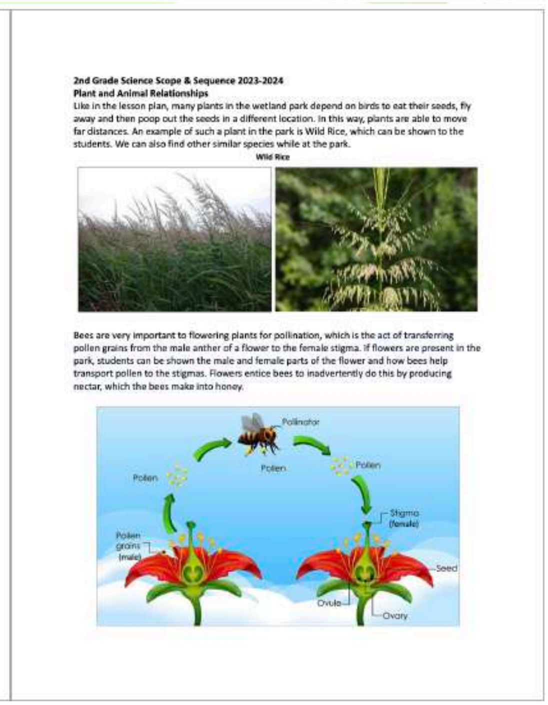
Sunlight and Weather
Sunlight is the primary source of energy to the planet and fuels life on earth. Plants utilize sunlight to convert carbon dioxide and water to sugars (i.e., glucose), which are used to fuel plant growth in a process called photosynthesis. A waste product of photosynthesis is oxygen, which animals need to breath. When animals breath they release carbon dioxide as a waste product, which in turn is used by plants, thus linking animals and plants together. Plants breathing is fun thing for kids to think about.

Why are the playgrounds at two schools different temperatures?
When sunlight touches a surface the energy within the sunlight is converted to heat. If a playground is in direct sunlight, all the surfaces, such as the ground, swings and slides will warm up. This can be felt by the students by touching a surface where it is sunny compared to where it is shaded. Plants, on the other hand, use the energy of the sun to fuel photosynthesis, and thus do not become hot like other surfaces. This also can be felt by touching leaves compared to a nearby surface like cement.

1st Grade Science Scope & Sequence 2023-2024
Animal and Plant Defenses
Like in the class lesson, there are turtles living in the Sankofa wetland. If possible, show the students some turtle shells of species that live in wetland. The wetland park provides food (they eat vegetation and some animals such as worms), shelter and protection from predators by burrowing in the mud or dense vegetation. Also, turtles have many offspring (i.e., babies) that are relatively on their own with the anticipation that many will be eaten by predators, whereas other animals, such as birds and mammals, only have a few offspring that are fed and sheltered for several months by their parents before they go off on their own. Other species that have many young include Apple Snails and fish.

Red-eared Slider **Snapping Turtle**
Box Turtle **Spiny Softshell**

Spinning Earth
As described in the lesson plan, the earth is a globe that is spinning in space whereas the sun is relatively stationary. This can been seen by the movement of the sun across the sky and also by how shadows move throughout the day. This can be demonstrated by marking the edge of a shadow formed by the gazebo at the park when students first enter the park and then seeing the difference in the shadow edge location while they are leaving. Or use a post placed in the ground and marked like a solar clock.



2nd Grade Science Scope & Sequence 2023-2024
Plant and Animal Relationships
Like in the lesson plan, many plants in the wetland park depend on birds to eat their seeds, fly away and then poop out the seeds in a different location. In this way, plants are able to move far distances. An example of such a plant in the park is Wild Rice, which can be shown to the students. We can also find other similar species while at the park.

Wild Rice

Bees are very important to flowering plants for pollination, which is the act of transferring pollen grains from the male anther of a flower to the female stigma. If flowers are present in the park, students can be shown the male and female parts of the flower and how bees help transport pollen to the stigmas. Flowers entice bees to inadvertently do this by producing nectar, which the bees make into honey.

Changing Landforms

The earth is constantly changing due to the processes of erosion (i.e., soil loss) and accretion (i.e., soil gain). Examples of both can be found in the wetland park to show the students. Erosion can be found along the edges of the pond where there are areas that have sloughed off into the water. This is occurring when water levels rise and fall in the pond during storms, and when there are winds that cause small waves to strike the edge. Accretion can be found in the drainage ditches near Florida Avenue that have been filling in with sediment during rain storms. The sediment is pickup by running water as it passes over the ground and is deposited in the drainage ditches when the water becomes still. Accretion is also occurring in the wetland pond through the same process as well as from the sinking of the algal mat that can be seen in the wetland pond. Could also show leaf litter on the ground in different stages of decomposition, demonstrating how soil is formed.

October 24, 2023: Dr. Lane was tasked with determining the carbon sequestered by 3000 trees planted at the park. Below is what he submitted.

The Sankofa Wetland Park will have planted 3000 cypress and tupelo trees in the park by the time it is complete. In order to calculate the carbon sequestered, aboveground tree carbon sequestration was derived from FVS modeling (https://www.fs.usda.gov/fvs/). Results indicate that in the first ten years, 51.0 metric tons of carbon dioxide equivalents (tCO2e) will be sequestered. A carbon dioxide equivalent, abbreviated as CO2e, is a metric measure used to convert the amount of carbon to the equivalent amount of carbon dioxide. In 50 years, 967 tCO2e will be sequestered, and in 100 years a total of 1922 tCO2e will be sequestered. To put this into perspective, an average size car burns a half a ton of CO2e per year. Thus, in the first ten years of growth, the trees in the Sankofa wetland park will sequester the equivalent of what 10 cars burn during that time. Over 50 years, this will increase to 38 cars due to increased sequestration capacity of larger trees.

Aboveground (AGB) biomass, and belowground (BGB) of trees over 100 years as modeled in FVS.

Year	Tree AGB C (tCO2e)	3000 trees AGB (tCO2e)	3000 trees BGB (tCO2e)	3000 trees Total (tCO2e)
0	0.0000	0.0	0.0	0.0
10	0.0137	41.1	9.9	51.0
20	0.0793	237.9	57.1	295.0
30	0.1351	405.2	97.3	502.5
40	0.1836	550.9	132.2	683.1
50	0.2600	780.0	187.2	967.2
60	0.2830	849.0	203.8	1052.7
70	0.3135	940.5	225.7	1166.2
80	0.4888	1466.3	351.9	1818.2
90	0.5012	1503.6	360.9	1864.4
100	0.5169	1550.6	372.1	1922.7

November 7, 2023: Rob Lane met virtually with Nikolaus Richard of the Corps of Engineers, Rashida F., Tom Willis and others for a kickoff meeting of Phase II of the Silver Jackets program.

November 9, 2023: Jason Day traveled to the Sankofa Wetland Park to oversee stocking of the pond with 70 triploid grass carp. The grass carp will help keep the pond from covering with algae, which occurred during the summer but now seems to have dissipated. The carp should live up to ten years, but are sterile and thus will not reproduce.

Triploid grass carp being released into the Sankofa Wetland Park.

November 9, 2023: Rob Lane and Jason Day traveled to the Sankofa Wetland Park to assist with a visit by sixty or so 1st grade students. They brought several turtle shells for the students to observe. Dr. Lane gave a brief talk about the marsh fire near New Orleans East.

First grade students at the Sankofa Wetland Park.

After the class, Rob Lane and Jason Day went to the Sankofa office for a virtual meeting with Kiarra Keith to discuss signage. After the meeting, Rob and Jason returned to the park and downloaded the water level recorder, then went to the Veolia WTP and installed a new water level recorder in the wetland triangle. The T1 staff gauge was 51 cm at 1:15 pm.

Water level recorder in the wetland triangle.

Appendix: Raw Data

Dissolved Oxygen Data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	9.6	12.0	.	.	.	.	.
2/23/22	16.8	13.7	.	.	.	.	.
3/23/22	11.9	10.9	.	.	.	11.2	.
4/26/22	8.8	10.9	.	.	.	4.5	.
5/24/22	4.4	2.0	.	.	.	4.3	.
6/13/22	0.9	4.3	.	.	.	3.4	.
7/14/22	2.2	2.8	.	.	.	0.1	.
8/16/22	3.3	2.9	.	.	.	6.0	.
9/14/22	2.5	10.0	.	.	.	2.9	.
10/12/22	1.5	5.2	.	.	.	0.8	.
11/1/22	2.6	7.4	.	.	.	4.9	.
11/14/22	2.8	6.2	.	.	.	3.8	.
1/27/23	2.9	2.4	.	.	.	2.1	1.9
3/1/23	1.8	3.5	.	.	.	.	2.0
3/22/23	3.2	6.4	4.7	4.8	4.7	.	1.5
4/25/23	2.6	6.7	1.6	4.8	4.7	.	2.3
5/23/23	4.1	1.0	3.9	1.1	1.0	.	3.8
6/6/23	4.8	5.8	4.8	7.0	6.3	.	5.0
7/26/23	8.0	8.2	12.4	8.5	10.1	.	6.9
8/24/23	1.0	2.3	5.4	7.9	10.4	0.3	1.1
9/20/23	0.9	0.3	3.9	4.5	4.2	.	0.9
10/25/23	0.2	0.2	7.7	10.2	8.3	.	0.6
11/9/23	1.5	2.0	17.3	7.8	10.3	2.4	2.2
12/13/23	7.5	4.7	11.0	8.9	11.1	5.0	4.9

Conductivity Data (mS)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	776.5	897.1	.	.	.	.	.
2/23/22	1211.0	1314.7	.	.	.	.	.
3/23/22	988.7	1263.2	.	.	.	1493.1	.
4/26/22	1036.5	1515.2	.	.	.	2643.7	.
5/24/22	1078.3	1604.2	.	.	.	2664.0	.
6/13/22	472.9	1373.9	.	.	.	2408.9	.
7/14/22	842.5	1261.8	.	.	.	2256.6	.
8/16/22	852.3	1030.1	.	.	.	1239.3	.
9/14/22	794.1	913.2	.	.	.	726.9	.
10/12/22	899.7	1079.7	.	.	.	829.6	.
11/1/22	876.6	958.2	.	.	.	896.6	.
11/14/22	819.4	964.0	.	.	.	744.6	.
12/16/22	596.1	880.2	.	.	.	581.9	.
1/27/23	788.6	843.7	.	.	.	543.5	681.7
3/1/23	1020.2	1037.9	.	.	.	.	1029.8
3/22/23	1072.6	854.4	742.1	770.0	651.7	.	822.8
4/25/23	1039.8	902.3	833.0	865.6	635.1	.	888.5
5/23/23	965.6	906.4	872.0	914.2	636.5	.	841.7
6/6/23	1126.5	911.3	1001.6	1054.1	794.1	.	823.3
7/26/23	1211.3	1342.0	1031.1	1114.9	553.1	.	968.0
8/24/23	1045.2	1682.7	1279.7	1393.8	691.7	2805.1	1014.0
9/20/23	1143.0	1730.3	1228.1	1201.5	568.8	.	1025.3
11/9/23	1369.5	1692.7	1862.1	25.0	1079.4	.	1087.6
12/13/23	836.4	957.8	1027.4	1098.8	649.5	1691.2	895.7

Salinity Data (ppt)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	0.54	0.67	.	.	.	.	.
2/23/22	0.62	0.65	.	.	.	.	.
3/23/22	0.54	0.68	.	.	.	0.76	.
4/26/22	0.51	0.73	.	.	.	1.41	.
5/24/22	0.52	0.78	.	.	.	1.40	.
6/13/22	0.22	0.64	.	.	.	1.19	.
7/14/22	0.40	0.59	.	.	.	1.12	.
8/16/22	0.41	0.46	.	.	.	0.53	.
9/14/22	0.38	0.41	.	.	.	0.34	.
10/12/22	0.47	0.51	.	.	.	0.40	.
11/1/22	0.49	0.53	.	.	.	0.48	.
11/14/22	0.50	0.58	.	.	.	0.46	.
12/16/22	0.36	0.54	.	.	.	0.37	.
1/27/23	0.52	0.56	.	.	.	0.38	0.45
3/1/23	0.54	0.54	.	.	.	.	0.55
3/22/23	0.62	0.50	0.42	0.43	0.36	.	0.49
4/25/23	0.55	0.48	0.44	0.45	0.31	.	0.48
5/23/23	0.48	0.42	0.40	0.41	0.29	.	0.43
6/6/23	0.56	0.44	0.48	0.50	0.35	.	0.40
7/26/23	0.60	0.49	0.45	0.50	0.24	.	0.43
8/24/23	0.55	0.80	0.57	0.61	0.29	1.22	0.44
9/20/23	0.57	0.87	0.61	0.60	0.27	.	0.48
11/9/23	0.76	0.98	0.99	1.30	0.54	.	0.59
12/13/23	0.57	0.64	0.69	0.72	0.41	1.20	0.57

Temperature Data (°C)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	9.9	10.3	.	.	.	.	.
2/23/22	24.0	26.0	.	.	.	.	.
3/23/22	20.7	22.1	.	.	.	21.7	.
4/26/22	25.5	27.8	.	.	.	24.2	.
5/24/22	26.7	27.6	.	.	.	25.1	.
6/13/22	27.1	29.2	.	.	.	27.4	.
7/14/22	27.2	28.4	.	.	.	27.4	.
8/16/22	29.3	30.5	.	.	.	33.3	.
9/14/22	26.9	30.5	.	.	.	27.9	.
10/12/22	22.8	24.9	.	.	.	23.5	.
11/1/22	19.4	20.2	.	.	.	21.3	.
11/14/22	15.5	16.2	.	.	.	14.9	.
12/16/22	14.6	15.5	.	.	.	13.4	.
1/27/23	11.7	11.7	.	.	.	9.1	11.6
3/1/23	22.1	22.6	.	.	.	.	21.8
3/22/23	17.9	17.6	18.7	19.1	19.6	.	16.8
4/25/23	22.0	21.3	22.2	22.8	24.6	.	20.8
5/23/23	25.3	21.3	29.5	30.1	29.3	.	24.1
6/6/23	25.1	26.0	26.0	27.9	27.1	.	25.5
7/26/23	30.8	31.4	32.0	30.8	30.7	.	28.2
8/24/23	27.1	28.7	31.2	32.7	33.6	34.8	32.2
9/20/23	25.3	25.7	25.8	25.6	25.7	.	28.1
10/25/23	21.8	22.0	26.7	26.2	27.0	.	25.4
11/9/23	20.5	19.2	24.4	24.5	24.6	22.2	21.6
12/13/23	11.1	11.9	11.6	13.0	14.0	11.6	13.2

pH data

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	7.4	6.6	.	.	.	.	.
2/23/22	7.4	8.1	.	.	.	.	.
3/23/22	8.0	7.7	.	.	.	8.5	.
4/26/22	9.0	7.3	.	.	.	8.0	.
5/24/22	8.0	8.0	.	.	.	7.7	.
6/13/22	7.7	7.2	.	.	.	6.8	.
7/14/22	8.0	7.9	.	.	.	7.9	.
8/16/22	6.9	7.2	.	.	.	7.4	.
9/14/22	7.0	7.3	.	.	.	8.1	.
10/12/22	7.9	7.1	.	.	.	7.5	.
11/1/22	6.3	7.2	.	.	.	7.6	.
11/14/22	7.7	7.4	.	.	.	7.8	.
12/16/22	7.1	7.2	.	.	.	6.5	.
1/27/23	7.7	7.9	.	.	.	7.1	7.5
3/1/23	7.8	8.0	.	.	.	.	7.5
3/22/23	8.2	8.0	8.0	7.9	8.0	.	8.2
4/25/23	7.4	7.2	7.3	7.2	7.3	.	7.5
5/23/23	6.9	7.3	7.3	7.1	7.1	.	6.7
6/6/23	6.9	7.2	6.9	7.5	7.0	.	6.8
7/26/23	7.5	7.6	7.4	7.5	7.7	.	7.6
8/24/23	7.2	7.3	7.8	7.8	8.1	7.4	7.6
9/20/23	7.6	7.7	7.6	7.7	7.8	.	7.9
11/9/23	7.3	7.5	8.8	8.2	8.5	7.2	7.5
12/13/23	7.7	7.4	8.3	7.4	7.7	7.2	7.1

Total Dissolved Solids data (TDS; mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	.	.	.	.	.	.	.
2/23/22	0.8	0.8	.	.	.	.	.
3/23/22	0.7	0.9	.	.	.	1.0	.
4/26/22	0.7	0.9	.	.	.	1.8	.
5/24/22	0.7	1.0	.	.	.	1.7	.
6/13/22	0.3	0.8	.	.	.	1.5	.
7/14/22	0.5	0.8	.	.	.	1.4	.
8/16/22	0.5	0.6	.	.	.	0.7	.
9/14/22	0.5	0.5	.	.	.	0.5	.
10/12/22	0.6	0.7	.	.	.	0.6	.
11/1/22	0.7	0.7	.	.	.	0.6	.
11/14/22	0.7	0.8	.	.	.	0.6	.
12/16/22	0.5	0.7	.	.	.	0.5	.
1/27/23	0.7	0.7	.	.	.	0.5	0.6
3/1/23	0.7	0.7	.	.	.	.	0.7
3/22/23	0.8	0.6	0.6	0.6	0.5	.	0.6
4/25/23	0.7	0.6	0.6	0.6	0.4	.	0.6
5/23/23	0.6	0.6	0.5	0.5	0.4	.	0.6
6/6/23	0.7	0.6	0.6	0.7	0.5	.	0.5
7/26/23	0.6	0.8	0.6	0.7	0.3	.	0.6
8/24/23	0.7	1.0	0.7	0.8	0.4	1.5	0.6
9/20/23	0.8	1.1	0.8	0.8	0.4	.	0.6
11/9/23	1.0	1.2	1.3	1.6	0.7	.	0.9
12/13/23	0.7	0.8	0.9	0.9	0.5	1.4	0.7

Nitrate+Nitrite data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	<0.05	<0.05	.	.	.	.	.
5/24/22	<0.05	<0.05	.	.	.	.	.
8/16/22	<0.05	0.020	.	.	.	.	.
10/12/22	0.030	0.010	.	.	.	.	.
3/1/23	0.013	<0.05	.	.	.	.	<0.05
6/6/23	<0.05	<0.05	<0.05	<0.05	<0.05	.	0.074
8/24/23	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
11/9/23	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.091

Ammonia data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	<0.50	<0.50	.	.	.	.	.
5/24/22	<0.50	<0.50	.	.	.	.	.
8/16/22	<0.50	0.10	.	.	.	.	.
10/12/22	0.70	<0.50	.	.	.	.	.
3/1/23	0.12	0.33	.	.	.	.	8.3
6/6/23	0.12	<0.50	<0.50	<0.50	<0.50	.	7.0
8/24/23	4.0	0.44	0.19	<0.50	0.22	<0.50	10.7
11/9/23	2.8	0.46	0.11	0.16	<0.50	1.10	10.6

Total Nitrogen data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	0.9	0.8	.	.	.	.	.
5/24/22	1.2	1.4	.	.	.	.	.
8/16/22	<0.16	0.1	.	.	.	.	.
10/12/22	1.5	<0.16	.	.	.	.	.
3/1/23	0.093	1.3	.	.	.	.	10.6
6/6/23	1.7	0.98	2.3	2.6	2.2	.	7.9
8/24/23	5.9	2.9	2.9	2.1	3.0	4.5	12.3
11/9/23	4.0	3.5	3.7	4.1	6.3	2.8	10.7

Phosphate data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	<0.01	<0.01	.	.	.	.	.
5/24/22	<0.01	<0.01	.	.	.	.	.
8/16/22	0.3	0.1	.	.	.	.	.
10/12/22	0.6	<0.01	.	.	.	.	.
3/1/23	0.461	<0.01	.	.	.	.	2.09
6/6/23	0.313	<0.01	<0.01	<0.01	<0.01	.	0.607
8/24/23	1.5	0.31	<0.01	<0.01	<0.01	0.19	1.3
11/9/23	0.81	0.33	<0.01	<0.01	<0.01	0.38	1.6

Total Phosphorus data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	0.1	0.2	.	.	.	.	.
5/24/22	0.1	<0.04	.	.	.	.	.
8/16/22	0.3	<0.04	.	.	.	.	.
10/12/22	0.7	<0.04	.	.	.	.	.
3/1/23	0.88	<0.04	.	.	.	.	2.6
6/6/23	0.36	<0.04	0.26	0.21	0.23	.	0.81
8/24/23	1.4	0.31	0.18	<0.04	0.26	0.29	1.8
11/9/23	0.82	0.66	0.21	0.22	0.78	0.48	2.0

Total Suspended Solids data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	5	13	.	.	.	.	.
5/24/22	<4	<4	.	.	.	.	.
8/16/22	8	6	.	.	.	.	.
10/12/22	7	5	.	.	.	.	.
3/1/23	14	<4	.	.	.	.	100
6/6/23	11	8	156	62	36	.	14
8/24/23	<4	<4	78	51	48	15.5	8.4
11/9/23	36	24.5	60	105	288	20	37

Biological Oxygen Demand (BOD_5) data (mg/L)

Date	S1	S2	S3	S4	S5	ST	SB
1/18/22	<3.0	5.0	.	.	.	.	.
5/24/22	4.0	<3.0	.	.	.	.	.
8/16/22	<3.0	<3.0	.	.	.	.	.
10/12/22	<3.0	<3.0	.	.	.	.	.
3/1/23	4.0	<3.0	.	.	.	.	0.0
6/6/23	5.0	3.0	6.0	9.0	12.0	.	6.0
8/24/23	4.3	5.6	4.6	3.6	7.8	9.2	3.1
11/9/23	4.3	10.5	5.5	5.6	18	2.8	5.7