Sankofa Wetland Park
2022 Monitoring Report

by
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Sampling Design

An experimental sampling design was developed, shown below, consisting of five monitoring sites (S1 through S5) set approximately equidistant and in the planned path of the linear pond of the Sankofa Wetland Park (Figure 1). The park currently encompasses sites S1 and S2. In previous reports, these sites were labeled S5 and S4, respectively, but will go by the new designations from this time forward. A site in the Bayou Bienville Wetland Triangle (BBWT) was also monitored.

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

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

Comite Resources field technicians visited the Sankofa Wetland Park monthly to carry out monitoring. Dissolved oxygen, conductivity, temperature, salinity and pH were measured at monitoring sites #1, #2 and the Bayou Bienville Wetland Triangle site using a handheld probe (Figure 2).

Figure 2. Taking discrete probe measurements on February 23, 2022.

Statistical analyses were carried out using JMP IN (Version 12) produced by SAS Institute, Inc (Sall et al. 2017). Analysis of Variance (ANOVA) was used to detect differences between means, and post hoc comparison of means with significant ANOVA tests were made using the Tukey-Kramer Honestly Significant Difference (HSD) test. All analyses were conducted using a p-value of 0.05 to determine significance.

Water temperatures ranged from 9.9°C (49.8°F) to 33.3°C (91.9°F), with a mean temperature of 23.2°C (73.8°F; Figure 3). There was not a statistically significant difference between sites ($p=0.7881$). Water temperature is a fundamental parameter that has mediating effects on most biological processes that impact water quality, such as phytoplankton growth, denitrification, ammonification, and decomposition.

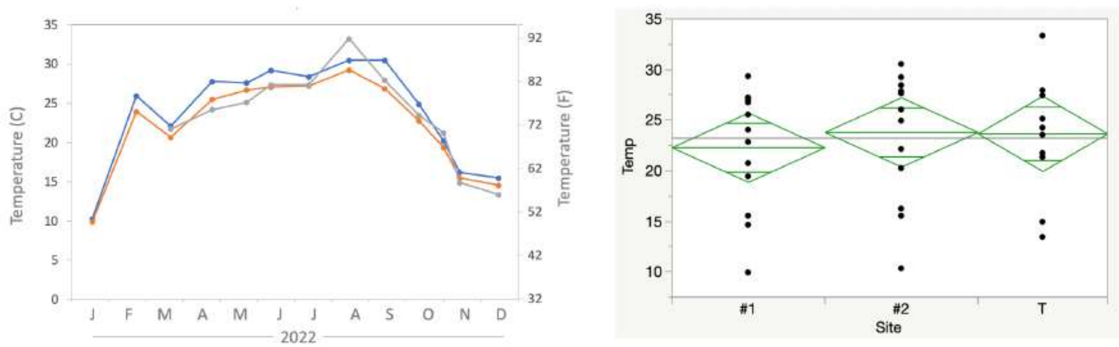


Figure 3. Water temperature data from monitoring sites S1 (orange), S2 (blue) and the BBWT (gray) over the 2022 calendar year (left). Results of statistical analysis (right).

Salinity concentrations ranged from 0.2 to 1.4 ppt (Figure 4). Statistical analysis found a significant difference between sites (p=0.0128), with post hoc analysis indicating significantly higher concentrations at the BBWT site (mean 0.77 ppt) compared to site S1 (mean 0.45 ppt), with neither site being significantly different than site S2 (mean 0.60 ppt).

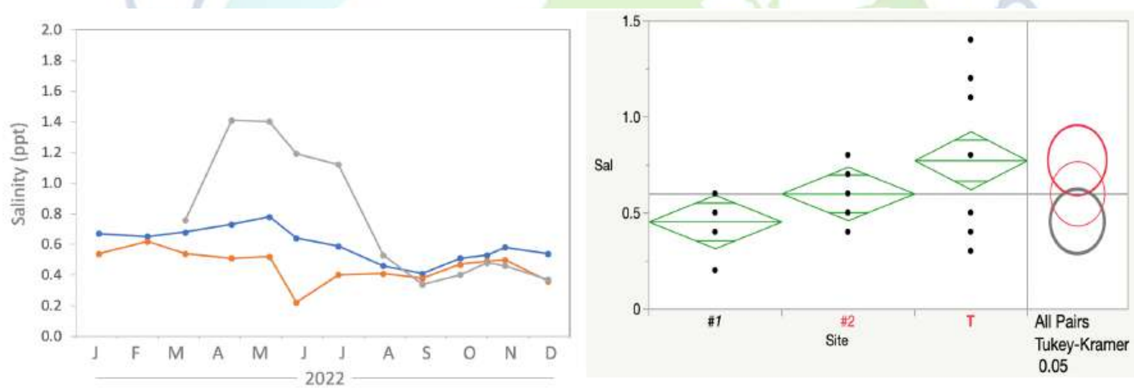


Figure 4. Salinity data from monitoring sites S1 (orange), S2 (blue) and the BBWT (gray) over the 2022 calendar year (left). Results of statistical analysis (right).

Salt in natural water bodies is generally derived from three sources: (1) small amounts of salt (primarily sodium chloride) are evaporated from ocean water and are carried in rainclouds and deposited across the landscape with rainfall, with higher concentrations near the coast and decreasing inland; (2) some landscapes may also contain salt that has been released from rocks during weathering (gradual breakdown), and (3) salt may remain in sediments left behind by retreating seas after periods where ocean levels were much higher.

Conductivity concentrations ranged from 472 to 2664 mS (Figure 5). Statistical analysis found a significant difference between sites (p=0.0125), with post hoc analysis indicating significantly higher concentrations at the

BBWT site (mean 1498 mS) compared to site S1 (mean 865 mS), with neither site being significantly different than site S2 (mean 1158 mS).

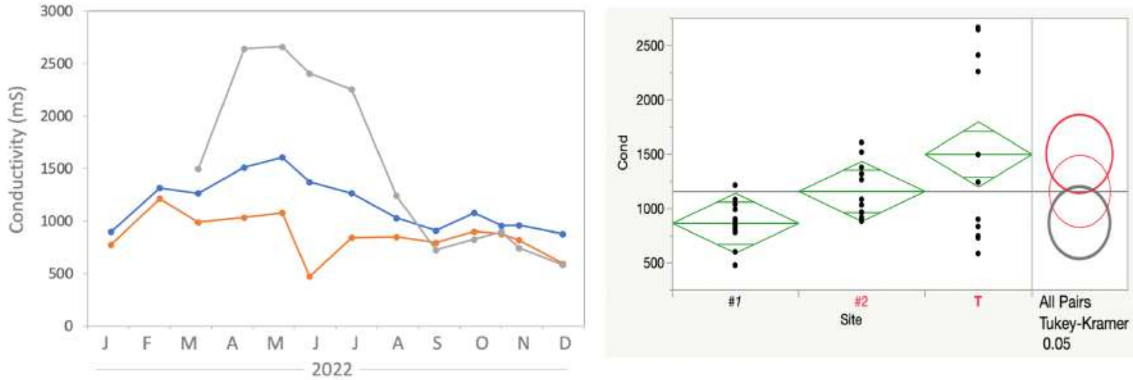


Figure 5. Conductivity data from monitoring sites S1 (orange), S2 (blue) and the BBWT (gray) over the 2022 calendar year (left). Results of statistical analysis (right).

Conductivity is a measure of the ability of water to pass an electrical current. Because dissolved salts conduct electrical current, conductivity increases when there are more ions dissolved in the water. Conductivity measurements are made over time so that a baseline value can be established. Large changes in conductivity beyond the baseline can indicate that a discharge or some other source of pollution has entered the water.

Dissolved oxygen concentrations ranged from 0.1 to 16.8 mg/L (Figure 6), with concentrations at all sites being above 4 mg/L during the first quarter of the year, followed decreased and highly variable levels for the duration of the year. There was not a statistically significant difference between sites (p=0.2179) due to high within site variability, however, mean concentrations were highest at site S2 (mean 7.4 mg/L), followed by site S1 (mean 5.6 mg/L) and the Bayou Bienville Wetland Triangle site (mean 4.2 mg/L).

Dissolved oxygen is the amount of oxygen that is present in water. Water bodies receive oxygen from the atmosphere by diffusion and from aquatic plants during respiration. All aquatic animals need dissolved oxygen to breathe. 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). In some water bodies, dissolved oxygen levels fluctuate periodically, seasonally and even as part of the natural daily ecology of the aquatic resource. As dissolved oxygen levels drop, some sensitive animals may move away, decline in health or even die. However, most animals living in wetland environments have become adapted to low dissolved oxygen conditions naturally present in wetlands.

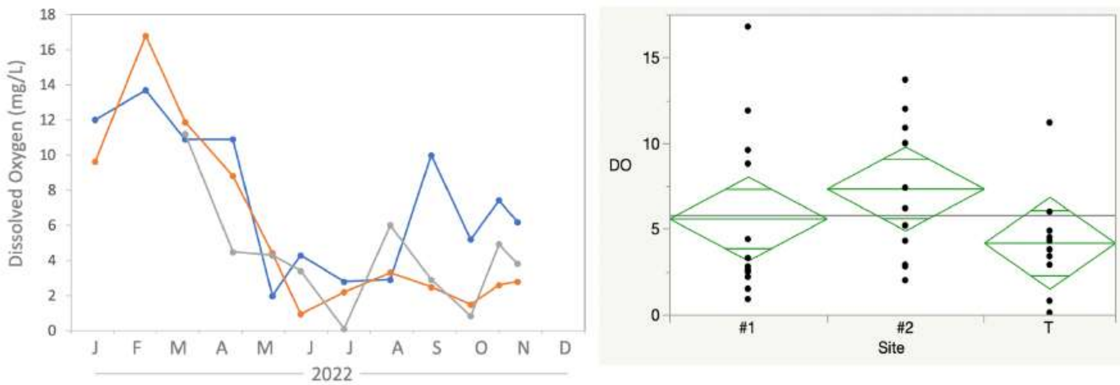


Figure 6. Dissolved oxygen data from monitoring sites S1 (orange), S2 (blue) and the BBWT (gray) over the 2022 calendar year (left). Results of statistical analysis (right).

Total dissolved solids concentrations ranged from 0.29 to 1.75 mg/L (Figure 7). Statistical analysis found a significant difference between sites (p=0.0124), with post hoc analysis indicating significantly higher concentrations at the BBWT site (mean 0.99 mg/L) compared to site S1 (mean 0.60 mg/L), with neither site being significantly different than site S2 (mean 0.76 mg/L).

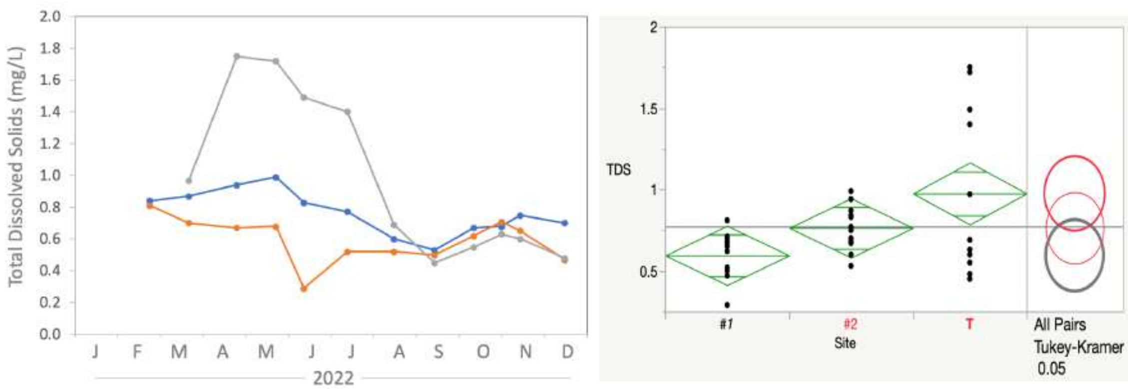


Figure 7. Total dissolved solids data from monitoring sites S1 (orange), S2 (blue) and the BBWT (gray) over the 2022 calendar year (left). Results of statistical analysis (right).

Total dissolved solids is made up of inorganic salts, as well as a small amount of organic matter. Common inorganic salts that can be found in water include calcium, magnesium, potassium and sodium, which are all cations, and carbonates, nitrates, bicarbonates, chlorides and sulfates, which are all anions. Cations are positively charged ions and anions are negatively charged ions. These minerals can originate from a number of sources, both natural and as a result of human activities, such as from agricultural and urban runoff. High concentration of total dissolved solids is an indicator that harmful contaminants, such as iron, manganese, sulfate, bromide and arsenic, may be present in the water.

pH ranged from 6.3 to 9.0 (Figure 8). There was not a statistically significant difference between sites (p=0.6040), and though there is apparent high within site and temporal variability, the sites for the most part were correlated and tracked each other. Mean concentrations were very similar, with a mean of 7.6 at sites S1 and BBWT, and a mean of 7.4 at site S2.

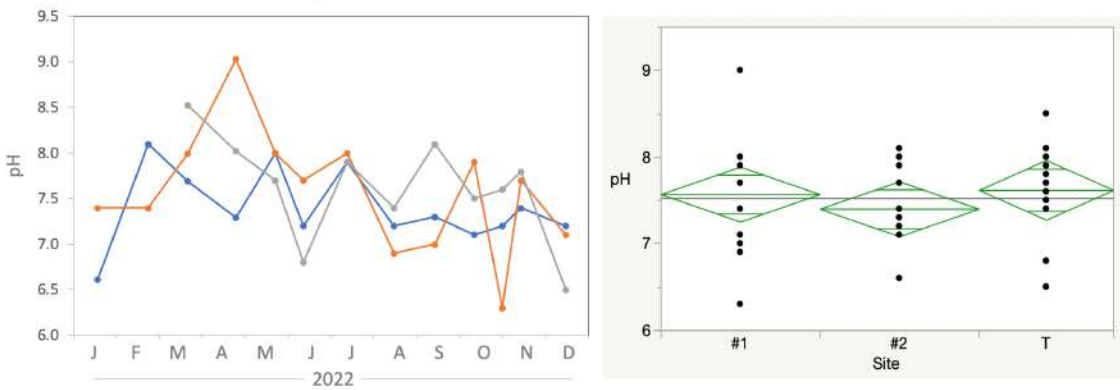


Figure 8. Water pH data from monitoring sites S1 (orange), S2 (blue) and the BBWT (gray) over the 2022 calendar year (left). Results of statistical analysis (right).

pH is a measurement of the concentration of hydrogen ions in water and plays an important role in water quality. For instance, the pH of water may make certain minerals and heavy metals more or less water soluble. Heavy metals in water with low pH tend to be more toxic, as the metals dissolve in the water and thus are more bioavailable, while at high pH the same heavy metals are less water soluble, and, therefore, less toxic. Large changes in pH may also be a sign of other chemical contaminants being released into the water.

Water Quality – Nutrients

Comite Resources field technicians visited the Sankofa Wetland Park approximately quarterly to collect samples for nutrient analysis from monitoring sites #1 and #2 (Figure 9). Sample collection occurred on January 18th, May 24th, August 16th and October 12th, 2022. Water samples for nutrient (NOx, NH_3, TN, PO4, TP), BOD_5 and sediment analysis were collected and put on ice for transport to Pace Analytical in Baton Rouge for analysis.

Nitrate+nitrate concentrations were below detection (<0.05 mg/L) in January and May, as well as at site S1 in August (Figure 10). Site S2 had a concentration of 0.03 mg/L in August and 0.01 mg/L in October, while site S1 had a concentration of 0.01 mg/L in October. Both sites had the same mean concentration of 0.0075 mg/L (assuming zero for non-detectable concentrations).

Figure 9. Taking water quality samples on May 24, 2022.

Nitrate and nitrite are two nitrogen compounds that are needed by plants and animals to live and grow. Nitrate and nitrite are naturally present in soils, water, air, and plants. The use of fertilizers for farming and effluents from industrial livestock production have greatly added to the amount of nitrate in the environment. Nitrate and nitrite dissolve easily in water and will therefore move quickly through the soil into surface water and groundwater. In the soil and water, these chemicals will usually remain until taken up by plants or changed into another chemical (such as ammonia) by microorganisms.

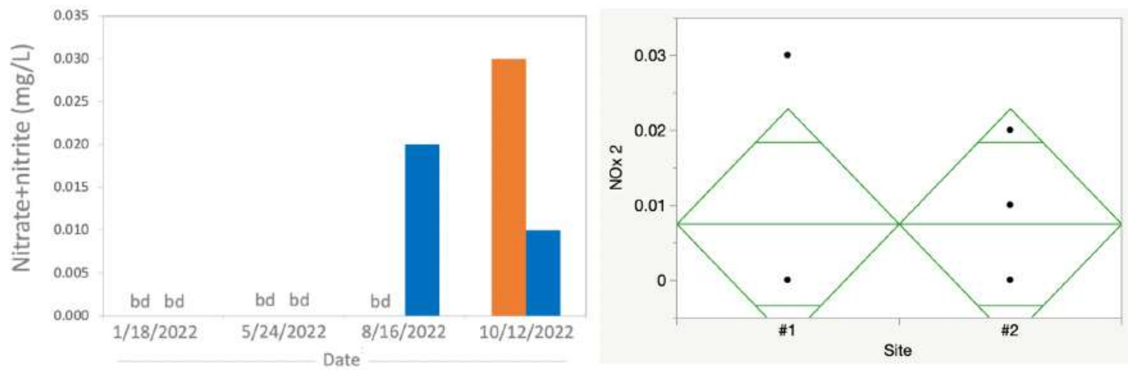


Figure 10. Nitrate+nitrite concentrations from monitoring sites S1 (orange) and S2 (blue; left). Results of statistical analysis (right).

Ammonia concentrations were 0.68 mg/L at site S1 in October and 0.13 mg/L at site S2 in August. Otherwise, ammonia concentrations were below detection (<0.10 mg/L; Figure 11). Assuming zero for non-detectable concentrations, site S1 had a mean concentration of 0.17 mg/L, while site S2 had a mean concentration of 0.03 mg/L, however, they were not significantly different from each other (p=0.4572).

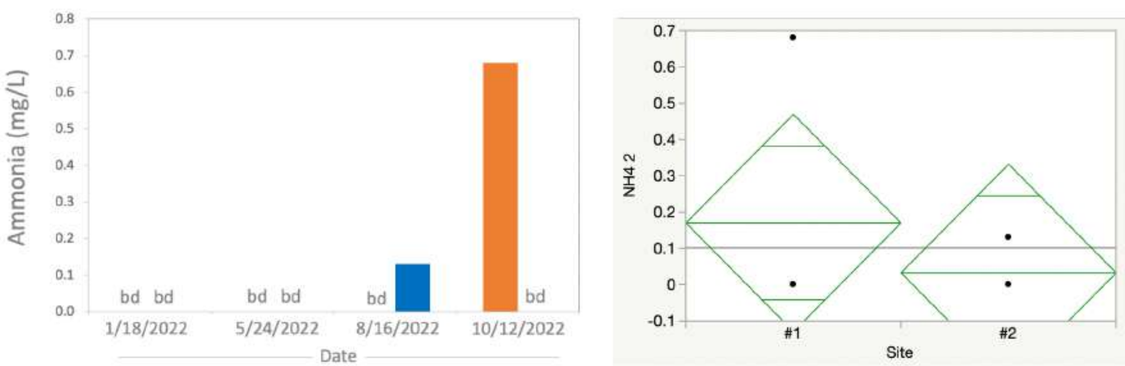


Figure 11. Ammonia concentrations from monitoring sites S1 (orange) and S2 (blue; left). Results of statistical analysis (right).

Ammonia is both a metabolic waste and a metabolic input throughout the living world, and is an important source of nitrogen for living systems. Ammonia occurs naturally in the environment, with a small amount generated when lightning strikes and reaches earth in rainfall, but most ammonia is produced by bacteria in water and soil as an end product of plant and animal waste decomposition. Water reacts with ammonia to form ammonium and hydroxide ions. Ammonia is toxic to aquatic organisms but ammonium is non-toxic. There exists an equilibrium in water between the toxic ammonia and the non-toxic ammonium, which is affected by water temperature and pH. At a pH of 6 the ratio of ammonia to ammonium is 1 to 3000 but decreases to 1 to 30 when the pH rises to 8. Warm water can contain more toxic ammonia then cooler water, thus issues with ammonia are most acute during summer.

Total nitrogen concentrations ranged from below detection (<0.16 mg/L) to 1.40 mg/L (Figure 12). Mean concentrations were 0.92 mg/L at site S1 and 0.58 mg/L at site S2, however, a significant difference between sites was not detected (p=0.4884).

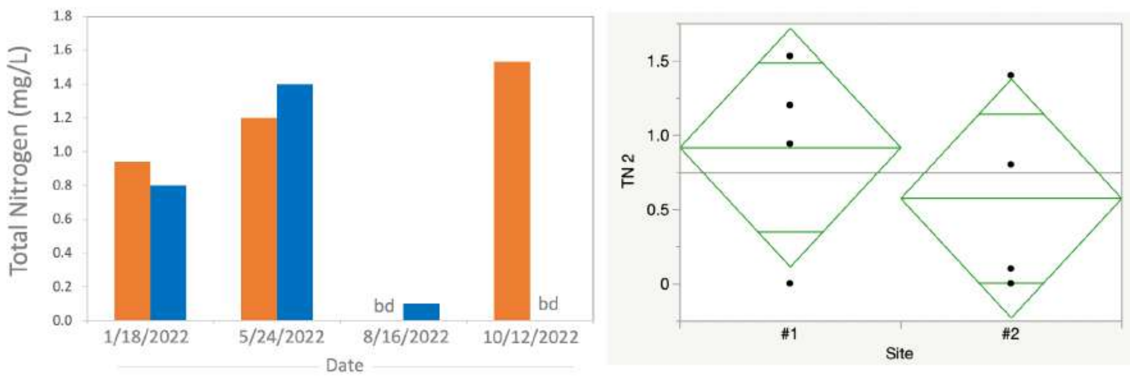


Figure 12. Total nitrogen concentrations from monitoring sites S1 (orange) and S2 (blue; left). Results of statistical analysis (right).

Total nitrogen is the sum of nitrate, nitrite, ammonia and organically bonded nitrogen, such as contained in plants and animals. Nitrate, nitrite, and ammonia dissolve readily in water and thus are immediately biologically available to plants and other organisms. Organically bonded nitrogen, known as organic nitrogen, however, is molecularly bonded to other elements, mostly carbon, in living organic molecules (i.e., the cells of phytoplankton, zooplankton and bacteria in water, for example). This nitrogen remains stable until the organism dies, after which decomposition slowly releases the bound nitrogen through several different pathways, such as denitrification, in what is known as the nitrogen cycle. 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 millions of years. This has caused rainfall worldwide to have high levels of biological available nitrogen, impacting plant distributions and species diversity worldwide.

Phosphate concentrations were below detection (<0.01 mg/L) in January and May, as well as at site S2 in October (Figure 13). Measurable concentrations were 0.25 and 0.59 mg/L at site S1 during August and October, respectively, and 0.06 mg/L at site S2 in August. Mean concentrations when non-detectable measurements were set to zero, were 0.21 and 0.02 mg/L for site S1 and S2, respectively, but were not significantly different (p=0.2145).

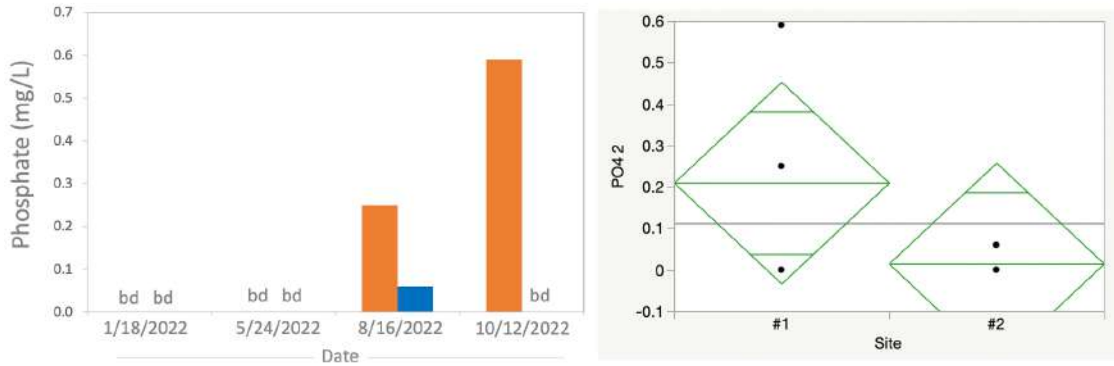


Figure 13. Phosphate concentrations from monitoring sites S1 (orange) and S2 (blue; left). Results of statistical analysis (right).

Phosphate is a water-soluble form of phosphorus that is biologically available to plants and other organisms, such as bacteria and fungi. It naturally occurs through decomposition and is a part of the molecular structure of all living 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. Too much phosphate in natural waters can cause an increased the growth of algae and large aquatic plants, which can result in decreased dissolved oxygen levels and stress to aquatic organisms.

Total phosphorus concentrations ranged from below detection (<0.04 mg/L) to 0.65 mg/L (Figure 14). Site S1 had a mean concentration of 0.31 mg/L, while site S2 had only one detectable measurement (0.20 mg/L) in January and a mean of 0.05 mg/L. Nonetheless, these means were not statistically different from each other (p=0.0951).

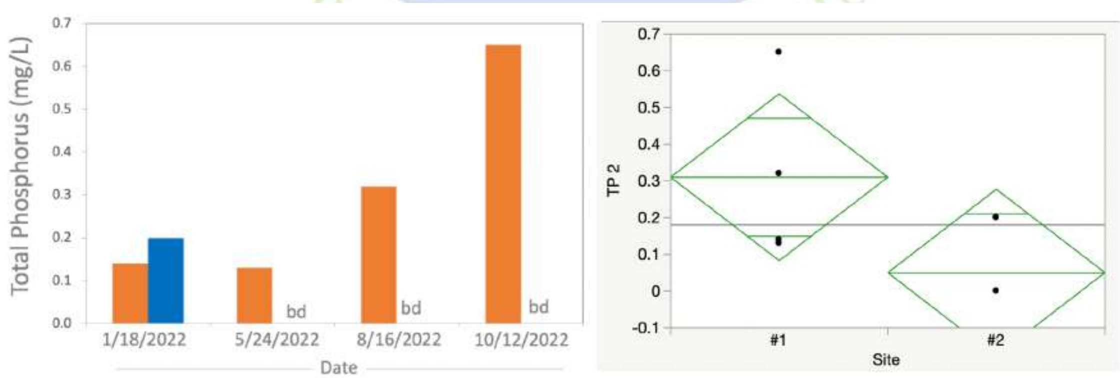


Figure 14. Total phosphorus concentrations from monitoring sites S1 (orange) and S2 (blue; left). Results of statistical analysis (right).

Total phosphorus is the sum of phosphate and organically bonded phosphorus, or organic phosphorus. Phosphorus is an essential macronutrient for life on earth. In most lakes and ponds, phosphorus is the limiting nutrient, which means that any additional phosphorus added to them will cause algae blooms. 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.

Total suspended solids concentrations ranged from below detection (4 mg/L) during May at both sites to 13 mg/L at site S1 in January (Figure 15). Mean concentrations were 5.0 and 6.0 mg/L for sites S1 and S2, respectively, and were not significantly different from each other (p=0.0968).

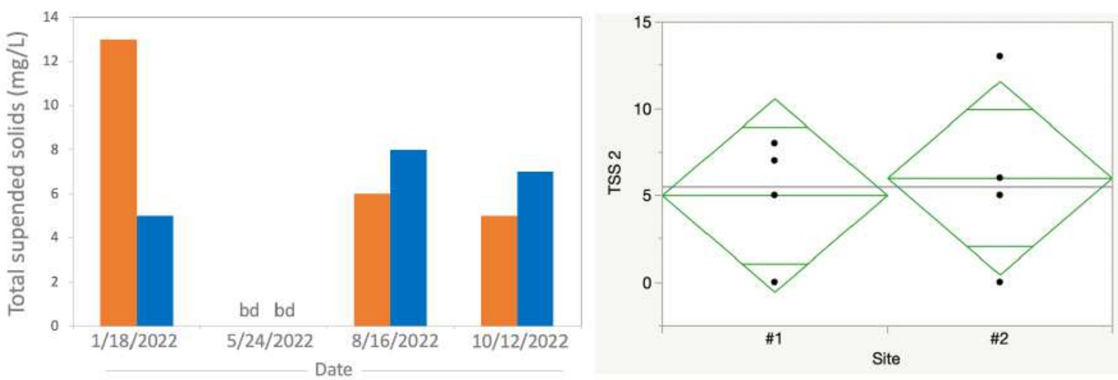


Figure 15. Total suspended solids concentrations from monitoring sites S1 (orange) and S2 (blue; left). Results of statistical analysis (right).

Total suspended solids (or sediments) is defined as the suspended particulates in stormwater with a diameter greater than 1.5 microns that will not pass through a glass fiber filter. These suspended particulates include both organic (e.g., algae and plant fragments) and inorganic (e.g., clay and sand) constituents. Sources of total suspended solids in stormwater include pavement (from wear), vehicle exhaust emissions, building and construction material, road paint, pedestrian and pet debris, soil material, plant and leaf litter, and atmospheric deposition of particles.

Biological Oxygen Demand (BOD_5) concentrations were below detection (<3 mg/L) at all sites and dates except for site S1 in May (4 mg/L) and site S2 in January (5 mg/L; Figure 16). Mean concentrations were 1.0 mg/L at site S1 and 1.3 mg/L at site S2, but were not statistically different from each other (p=0.8810).

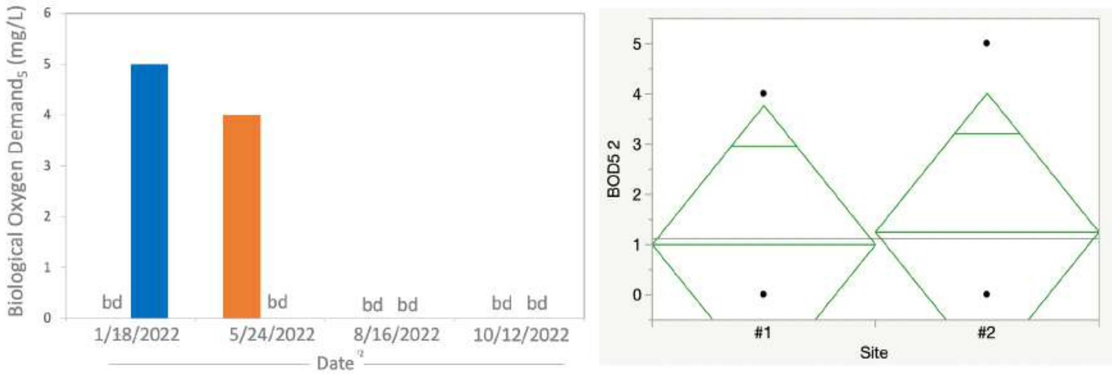


Figure 16. 5-Day Biological Oxygen Demand (BOD_5) concentrations from monitoring sites S1 (orange) and S2 (blue; left). Results of statistical analysis (right).

Biological Oxygen Demand (BOD_5) indicates the amount of oxygen that bacteria and other micro-organisms consume in a water sample during the period of 5 days at a temperature of 20 °C (68 °F) to degrade the water contents aerobically. BOD_5 is thus an indirect measure of the sum of all biodegradable organic substances in the water. BOD_5 indicates how much dissolved oxygen is needed in a given time for the biological degradation of the organic constituents in the water column. This value is an important parameter for the assessment of the degree of pollution in a body of water.

Water Level

A water level probe and a barometric compensation probe were installed on February 23rd, 2022 in the pond located between station #1 and #2 (Figure 17). A staff gauge was also installed. Discrete water level measurements were also taken at several locations immediately surrounding the water level probe. Initial staff gauge measurement was 32 cm at 4:23 pm. Below are all of the staff gauge measurements taken in 2022 (Table 1). The 2022 water level data will be analyzed in Q1 of 2023 and presented in future monitoring reports.

Figure 17. Water level probe and staff gauge in Sankofa wetland.

Table 1. Staff gauge readings taken in 2022.

Date	Time	Gauge (cm)	Date	Time	Gauge (cm)
2/23/22	16:23	32	8/16/22	13:20	36
3/23/22	15:10	37	9/16/22	15:20	35
4/26/22	13:10	35	10/12/22	10:15	30
5/24/22	11:05	28	11/1/22	11:45	32
6/13/22	9:45	37	11/14/22	15:45	41
7/14/22	9:35	37	12/16/22	10:25	44

Comite Resources personnel carried out an elevation survey at key locations on the eastern end of the Sankofa Wetland Park (Figure 18). The manhole cover on Florida Ave. was used as a benchmark (elevation -6.74 ft). These measurements will allow the water level gauge data to be in NAVD 88. The main ditch connects to the ponds in the back via a meandering 25-40 cm deep ditch (depth measured twice with those two values; Figure 19). This is an important detail that was missing from the model that Tom Willis of the Corps of Engineers Silver Jacket program is developing.

Figure 18. Results of elevation survey from December 16, 2022.


Figure 19. The meandering swale connecting the drainage canal and the wetland park.

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 57 species of birds were observed in the Sankofa Wetland Park since June (Table 2). A species of note are Limpkins, which are growing in population in Louisiana in response to the invasion of Apple Snails, which are present in the park, and that Limpkins eat.

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

Common Name	Scientific Name	6/13/22	7/14/22	8/16/22	9/14/22	10/12/22	11/1/22	12/16/22
American Coot	*Fulica americana*						X	X
American Crow	*Corvus brachyrhynchos*	X		X	X		X	X
American Kestrel	*Falco sparverius*					X		X
Anhinga	*Anhinga anhinga*	X	X	X	X	X	X	X
Bald Eagle	*Haliaeetus leucocephalus*					X	x	X
Barn Swallow	*Hirundo rustica*			X				
Black Vulture	*Coragyps atratus*				X	X	X	
Black-Bellied Whistling-Duck	*Dendrocygna autumnalis*	X	X	X				
Blue Jay	*Cyanocitta cristata*	X	X	X	X	X		
Brown Pelican	*Pelecanus occidentalis*							X
Carolina Chicadee	*Poecile carolinensis*	X		X		X	X	X
Carolina Wren	*Thryothorus ludovicianus*	X	X					
Cattle Egret	*Bubulcus ibis*				X			
Chimney Swift	*Chaetura pelagica*	X	X	X				
Common Grackel	*Quiscalus quiscula*	X				X	X	
Common Moorhen	*Gallinula chloropus*		X	X	X	X	X	X
Common Tern	*Sterna hirundo*	X						
Common Yellowthroat	*Geothlypis trichas*	X	X					
Double Crested Cormorant	*Phalacrocorax auritus*		X			X		X
Eastern Kingbird	*Tyrannus tyrannus*	X	X	X	X			
Eastern Phoebe	*Sayornis phoebe*					X	X	X
Eurasian Collared Dove	*Streptopelia decaocto*						X	
European Starling	*Sturnus Vulgaris*					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	X
Great Erget	*Ardea alba*	X		X	X	X	X	X
Green Heron	*Butorides virescens*	X		X				X
Grey Catbird	*Dumetella carolinensis*							X
Gull-Billed Tern	*Gelochelidon nilotica*				X			
Hairy Woodpecker	*Picoides pubescens*			X				
Laughing Gull	*Larus atricilla*			X				X
Least Tern	*Sterna antillarum*		X					
Lesser Scaup	*Aythya affinis*							X
Limpkin	*Aramus guarauna*	X	X	X			X	
Little Blue Heron	*Egretta caerlea*		X		X		X	X
Mississippi Kite	*Ictinia mississippiensis*	X		X				
Mockingbird	*Mimus polyglottos*	X	X			X	X	X
Mourning Dove	*Zenaida macroura*			X		X	X	X
Northern Cardinal	*Cardinalis cardinalis*	X	X	X		X	X	X
Osprey	*Pandion Haliaetus*					X	X	X
Pied-billed Grebe	*Podilymbus podiceps*				X	X	X	X
Purple Gallinule	*Porphyrio martinicus*				X			
Red Shouldered Hawk	*Buteo lineatus*	X	X			X		X
Red Winged Blackbird	*Agelaius phoeniceus*						X	X
Ruby-throated Hummingbird	*Archilochus colubris*					X		
Snowy Egret	*Egretta thula*			X	X	X	X	X
Song Sparrow	*Melospiza melodia*							X
Swamp Sparrow	*Melospiza georgiana*						X	X
Tricolor Egret	*Egretta tricolor*				X	X	x	X
Tuffted Titmouse	*Baeolophus bicolor*	X		X				
Turkey Vulture	*Cathartes aura*						X	X
White Ibis	*Eudocimus albus*	X		X	X	X	X	X
Yellow-Bellied Sapsucker	*Sphyrapicus varius*							X
Yellow-Crowned Night-Heron	*Nyctanassa violacea*	X						
Yellow-Rumped Warbler	*Setophaga coronata*							X
Yellow-Throated Vireo	*Vireo flavifrons*			X				

Meetings with Tom Willis, PE

Mr. Thomas M. Willis of MSMM Engineering contacted Dr. Rob Lane regarding the Silver Jackets program by the Corps of Engineers. He is tasked with assisting with hydrological modeling of the Sankofa wetland using variations of the EPA Storm Water Management Model (SWMM). Drs. John Day and Robert Lane had a zoom call with Mr. Willis on May 16th, 2022, that lasted over an hour. During the discussion Mr. Willis asked that we set the water level recorder to 5-minute intervals as well as determine locations for measuring flow going into and out of the Sankofa Wetland Park. Another topic of discussion was the instillation of rain gauges.

Another phone meeting was had between Dr. Rob Lane and Mr. Willis on May 19th, 2022. Mr. Willis showed the SWMM model he received from the City (Figure 20) and expressed a concern that there may not be sufficient water to fill the Sankofa wetland once it is complete if the stormwater culvert at the eastern end of the project is the sole source of water. He will be modeling this to find out. If there isn't, it would be possible to tie into the drainage system at Fats Domino Ave. Mr. Willis asked that we investigate the stormwater culvert that runs along Florida Ave. His model indicates that it is a 16'x11' culvert, which is rather large.

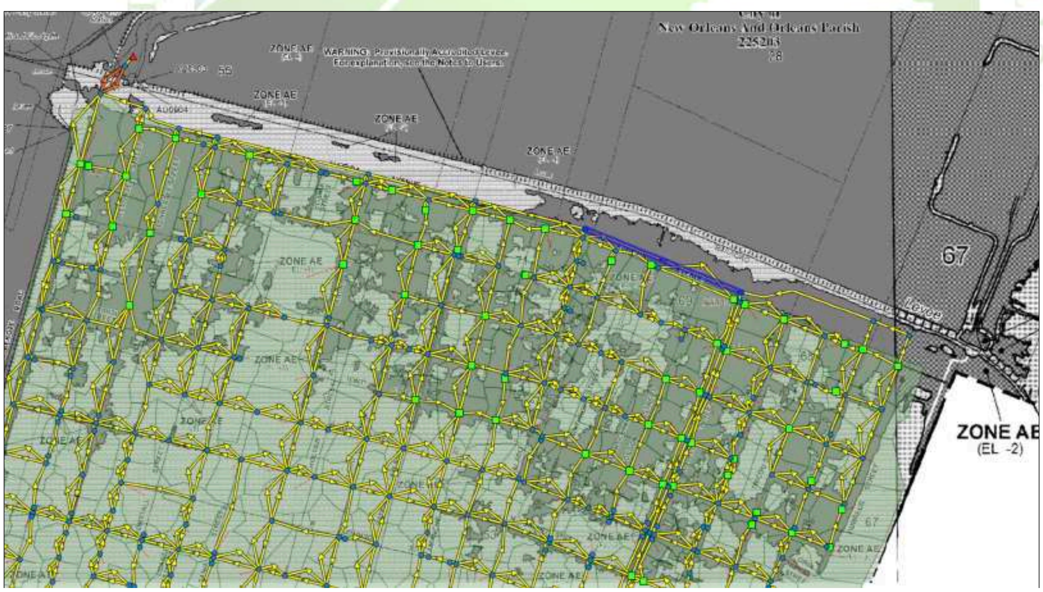


Figure 20. The SWMM model of the region south of the Sankofa wetland park.

A third phone meeting between Dr. Rob Lane and Mr. Willis was had on May 23rd, 2022. The meeting focused on the current drainage system layout and tasks for a field excursion planed for the next day. A follow-up call was made on May 25th between Dr. Rob Lane and Mr. Willis to discuss findings from the field trip the previous day. Key findings concerned the canal to the west and its stormwater contribution to the wetlands park, as well as the presence and location of the 16'x11' culvert that starts at Tupelo Street (Figure 21).

Figure 21. The trench that allows stormwater input (left), and the 16'x11' culvert at Tupelo St. (right).

Contrary to what Dr. Shaffer has been claiming, Mr. Willis believes ground water at the Sankofa Park project area is much lower than 3 ft. If ground water was at -3 ft, the 7 x 11 ft culvert running along Florida Ave. would be flooded, which it is not. Mr. Willis thinks that the pump station to the east lowers water to around -10 ft while the one to the west lowers it to around -2 ft, which is the height of the Sankofa Park pond. Mr. Willis thinks that the pond is being filled by water from the drainage ditch to the west and thus water level is controlled by the pumping station to the west.

Mr. Willis also found that drainage has been interrupted on Delery and Tricou Streets due to filling of the ditch on the southern edge of the wetland park. This could cause flooding and poor public perception if not corrected.

September 15, 2022: Tom Willis called Rob Lane to discuss the geotechnical report and hydrology at the Sankofa Wetland Park. Mr. Willis is almost complete with his hydrological model. One of the outputs will be storage volume with water depth. The model itself, which is a SWMM (Stormwater Management Model), will be provided to Dr. Lane so that he can carry out any additional scenario runs if needed (Figure 22). Mr. Willis requested that the following be conveyed to Rashida and Tricia:

- A path should be cleared to the bottom of the 12 x 16 ft culvert at Tupelo St to allow access for hydrological measurements.

- Curb cuts should not be made to allow infiltration of water to the wetland because curb culverts already exist that direct stormwater runoff to the culvert at Tupelo St.

Mr. Willis also spoke about the possibility of installing a sub-pump at the culvert connecting to the pumphouse at the west end of the park. This would allow water to be pumped into the wetlands during dry conditions.

Figure 22. A hydrologic model of the Sankofa Wetland Park developed by Tom Willis.

November 1, 2022: Tom Willis called Rob Lane to discuss geology and hydrology at the Sankofa Wetland Park in regard to the SWMM model. Mr. Willis once again expressed his concern that there would not be sufficient runoff entering the park to keep water levels high.

There appears to be a linear sand body running parallel with the park with its northern most extent at the railroad tracks and some parts of the southern extent running into the planned wetland park, including the section already constructed. This sand body acts as a reservoir, releasing water into the park if pond water level is low and taking in water when pond water heights are increased.

Dr. Lane informed Mr. Willis about concerns that the wetland would flood homes, and that he assured the public that the wetland would store water during a storm, thereby lowering water levels. Mr. Willis said he we model that and provide proof that this was true.

One of the outputs will be storage volume with water depth. The model itself, which is a SWMM (Stormwater Management Model), will be provided to Dr. Lane so that he can carry out any additional scenario runs if needed. Mr. Willis requested that Dr. Lane obtain water level data from the recorder deployed in the ponds, along with precipitation data from the New Orleans airport.

November 2, 2022: Tom Willis called Rob Lane to discuss some other aspects of the Sankofa park and SWMM model. He displayed a cross-sectional image of the pipe that runs from the eastern corner of the park southward into the neighborhood and then wraps around to drain into the main culvert along Florida Ave (Figure 23). It appears that this culvert is currently clogged and thus does not connect to the wetland park, however, if the City unclogs the culvert it is possible that water will drain from the wetland park to the level of the culvert, which is about two feet below the current pond water level. Dr. Lane will search for the culvert during the next field visit to confirm its existence.

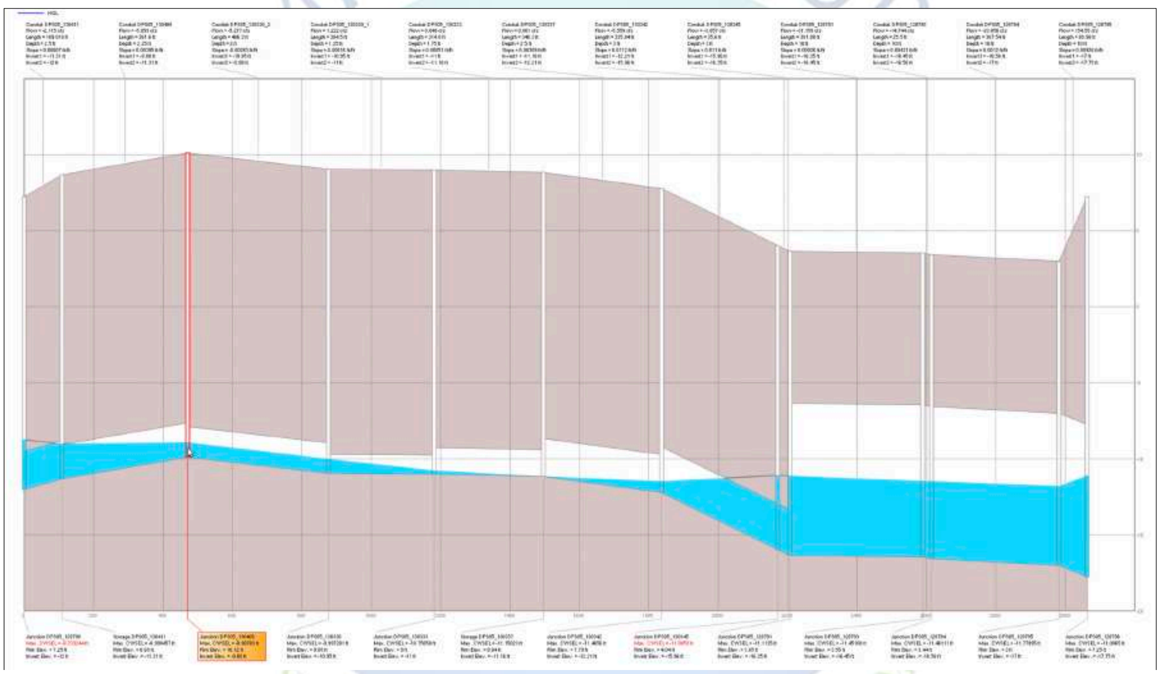


Figure 23. Cross-section of the culvert system that runs from the wetland park (left) to the main culvert on Florida Ave. (right).

Mr. Willis had an interesting solution to this problem: install a flap gate at the wetland park side of the culvert that would prevent water from draining from the wetland park but would allow water to enter during severe high water. This would provide a direct stormwater storage mechanism for the wetland park, which is currently lacking.

Another issue of discussion was the timeline for drainage alterations to the site, which occurred sometime between 1965 and the early 1990's. Mr. Willis also displayed spatial extent of flooding at various water levels (Figure 24).

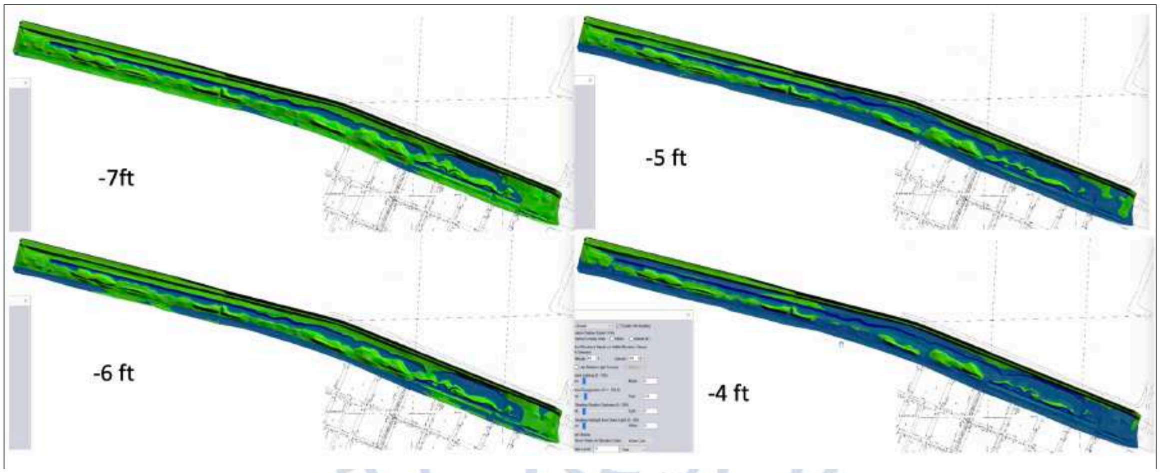


Figure 24. Spatial extent of flooding at various pond water levels. The pond water level is currently at -7.5 ft.

In addition to the sand body discussed above, there is a reservoir of water in the drainage channels and culverts that extend from the channel that connects to the current wetland pond to the east (Figure 25).

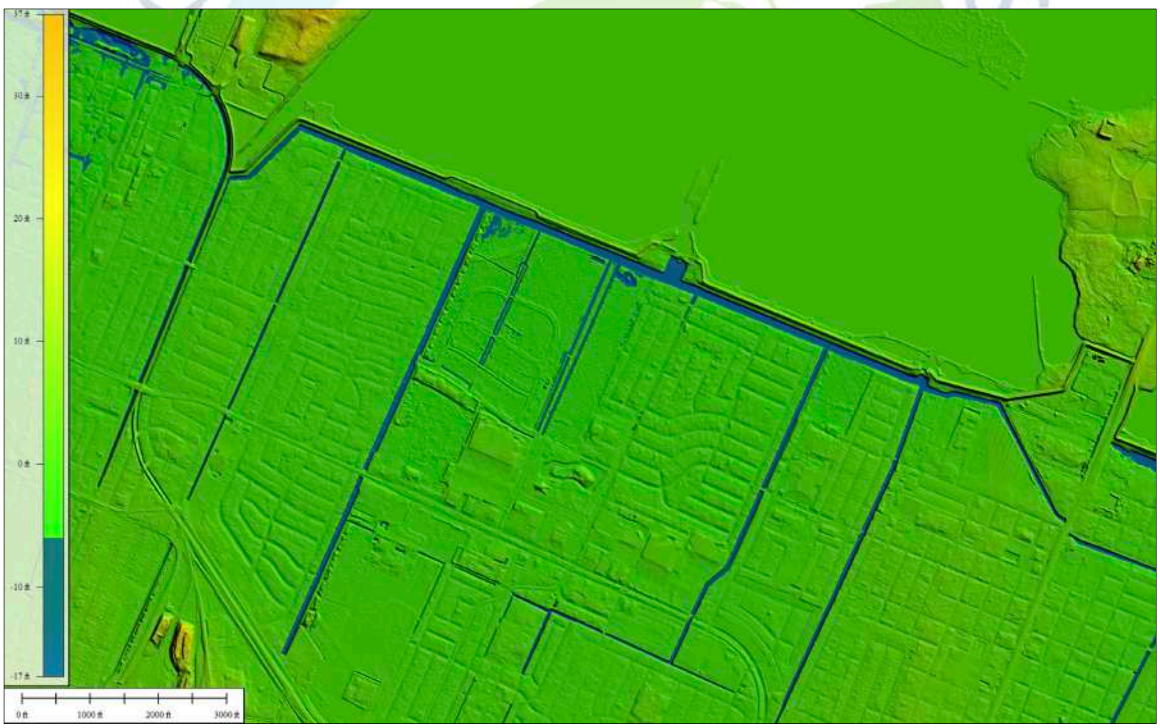


Figure 25. The drainage network that acts a reservoir for the Sankofa Wetland Park.

November 3, 2022: Tom Willis called Rob Lane to discuss some additional aspects of the Sankofa park and SWMM model. Contrary to what he thought earlier, Mr. Willis not believes that water level is limited by the culvert that runs north south between the Dubreuil St. culvert and the eastern most extension of the Sankofa wetland. Unfortunately, the Batture

Engineering land survey did not adequately survey the land mass to the east of the pond. Mr. Willis requested that this area be resurveyed (Figure 26).

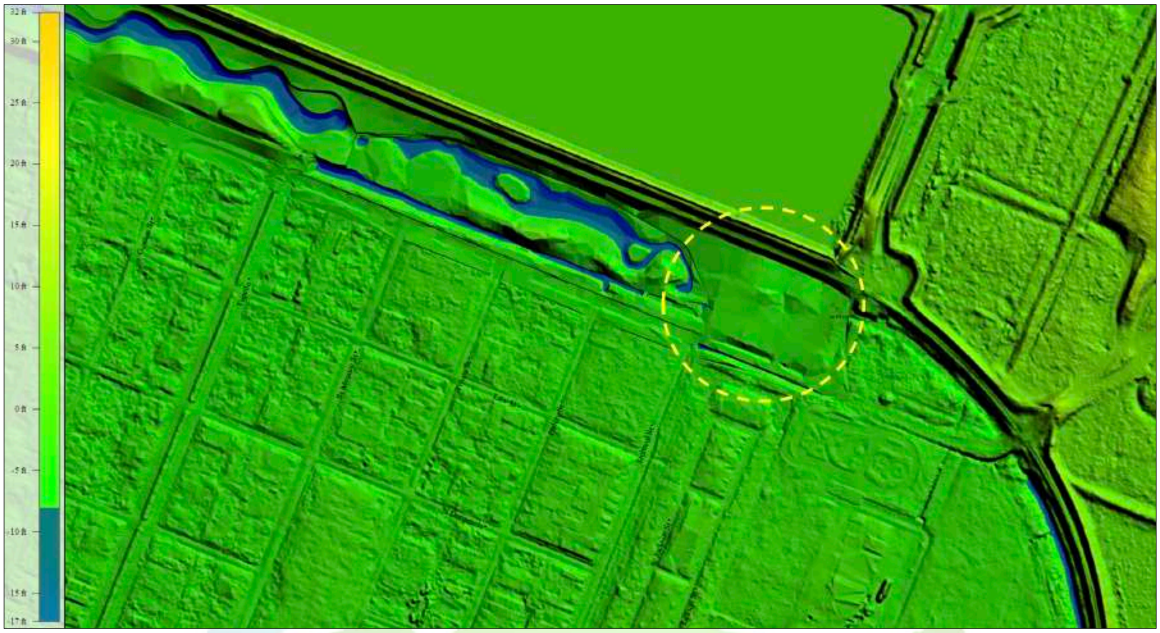


Figure 26. The Batture Engineering land survey of the Sankofa Wetland Park overlayed onto a lidar map. The dashed circle indicates where additional surveying is needed.

Tom Willis sent some materials to Rashida for her COP27 presentation. These included some photographs taken by drone (Figure 27) and an image of the SWMM model, which encompasses most of the ninth ward (Figure 28).

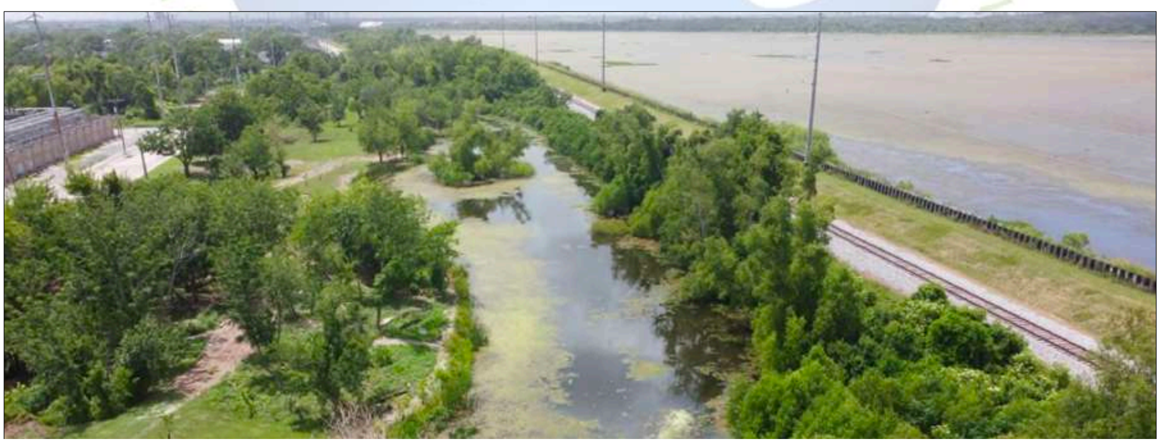


Figure 27. An aerial photo Tom Willis took of the Sankofa Wetland Park on June 13, 2022.

Figure 28. An image of the SWMM model connections. Provided by Tom Willis on November 3, 2022.

November 15, 2022: Tom Willis called Rob Lane to discuss some additional aspects of the Sankofa park and SWMM model. Below is a map with red dashed ovals indicating the sections that need to be surveyed. The oval to the left (west) indicates the need for an accurate survey of the current ditch, some of which has been disrupted with earth works. This includes the invert elevations of the culvert going under the access road between Dubreuil St. and Delery St., and the elevation of the access road itself. The middle oval shows the need for detailed information of the connections between the culvert connecting from the ninth ward, the channel running east bending to the south, and the wetland park. The oval to the right (east) shows the need for an accurate survey of the channel running east bending to the south, including the bridges, all the way until open water can be seen. The channel also needs to be checked for blockages along the path to the wetland park. How these all connect and the elevations of key points, such as the ditch connecting the channel running east to the wetland park, need to known (Figure 29). This was carried out by Dr. Lane on December 16, 2022.

Figure 29. Locations of interest for topographic survey.

Bayou Bienvenue Wetlands Triangle

Figure 30. Location of sampling sites at the Sankofa Wetland Park (S1-S5)and Bayou Bienville Wetland Triangle (Tr1-Tr4).

There is interest in the triangular wetland/pond to the north of the project site by Rob Lane and Rashida Ferdinand, who spoke about it on January 24th, 2022 (Figures 30 & 31). The wetland, known as the 'Bayou Bienvenue Wetlands Triangle', is currently in a very degraded state but would be a great asset to the park if it were restored.

Figure 31. The Bayou Bienvenue Wetlands Triangle to the north of the project site.

A bridge could be constructed to allow safe passage of people from the park over the railroad to the edge of the wetland, as shown below (Figure 32).

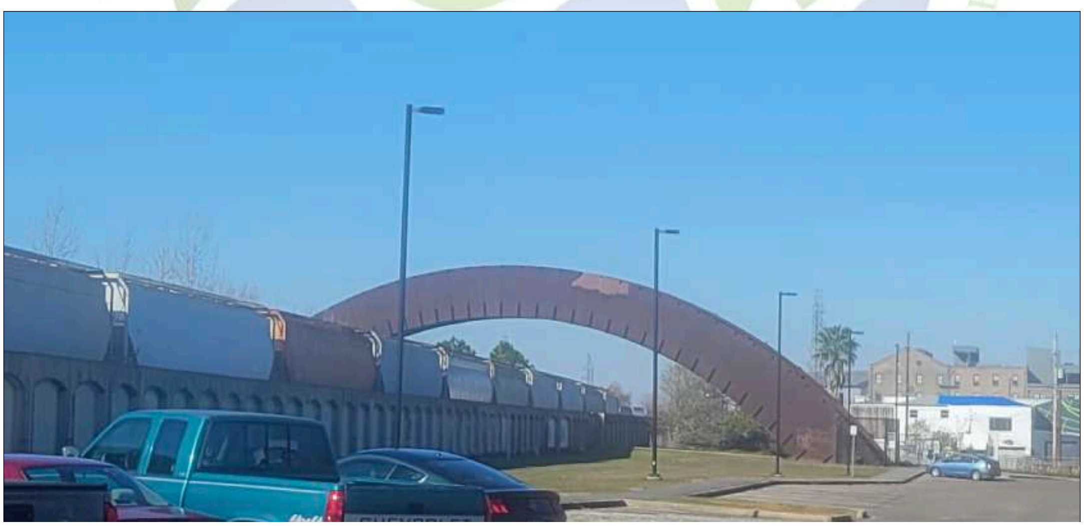


Figure 32. Bridge constructed to allow safe passage of people over the railroad.

In order to attain background data on the Bayou Bienvenue Wetlands Triangle, which could aid in our understanding of its degraded condition as well as be used for future proposals, Comite Resources started taking probe measurements in March, and will collect a water quality sample whenever it is done so for monitoring at the Sankofa Wetland Park. Details and results will be provided in future monitoring reports.

Dr. Rob Lane spoke with Dr. Sarah Mack of Tierra Resources concerning the Bayou Bienvenue Wetlands Triangle (BBWT). Dr. Mack managed the Veolia wastewater treatment plant located directly to the east of the BBWT during Katrina. She said that she had pursued a restoration project for the BBWT but had to abandon the effort due to multiple paper developments in the region with multiple landowners. She provided several maps that illustrate the issue (Figure 33).

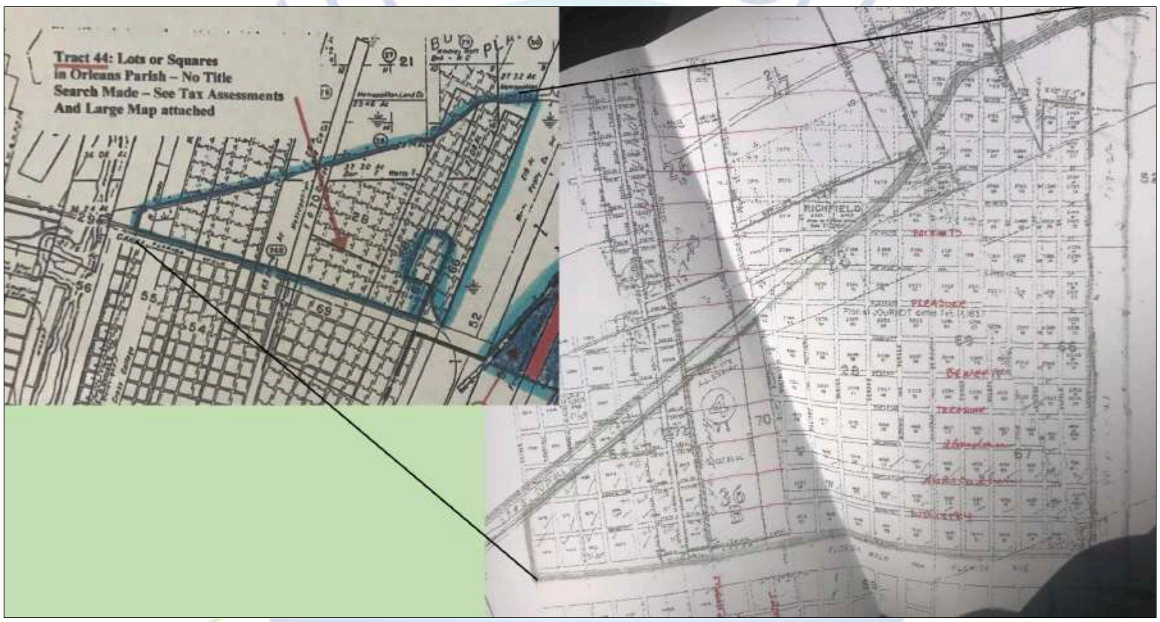


Figure 33. Landowner map of the Bayou Bienvenue Wetlands Triangle directly north of the Sankofa Wetland Park.

The Lake Pontchartrain Basin Foundation (LPBF) carried out a study of the Central Wetland Unit where they measured soil salinities (Figure 34). They found soil salinities consistently over 2 ppt, which are deleterious to the survival of Baldcypress and even more so for Water Tupelo.

Figure 34. Soil salinities in the Bayou Bienvenue Wetland Triangle (from LPBF 2015).

In the same report, however, they present surface water salinities showing greatly reduced salinities in the wetland triangle during the same time period that soil salinity data was gathered (Figure 35).

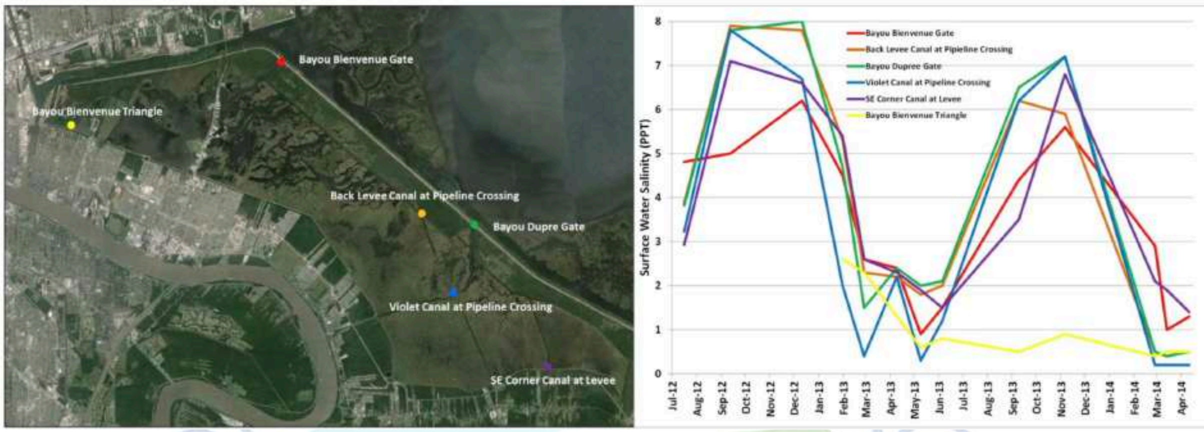


Figure 35. Surface water salinity data from six locations in the CWU (from LPBF 2015).

Below is an excerpt from the LPBF (2015) report where they explain reasons for the difference:

Previous research has shown that sediment soil salinity is influenced by rainfall (Adams 1963), marsh elevation, evaporation rates and proximity to saline water (Penfound and Hathaway 1938; Purer 1942). Salt marsh plant species can change marsh hydrology and increase the salt content of sediment pore water through evaporation (Sutcliffe 1962; Smart and Barko 1978). The difference between surface water and soil salinity is also partly explained by several other factors; channelization of water bodies, marsh impoundments and a lag time between fresh water inundation and a freshening effect.

Comite Resources installed four soil porewater sampling wells in the Bayou Bienville Wetland Triangle on July 14, 2022. These wells consisted of 5 ft long 2" wide PVC pipes with slits on the bottom foot. The wells were blocked on the down-end so that soil could not enter and pointed in order to break through the layer of tree roots that underlies the entire wetland triangle. Once installed (Figure 36), the wells were pumped dry of water and allowed to sit for a few minutes before pumping out newly formed water and measuring salinity with a handheld probe.

Table 3. Location, depth and salinity data for the BBWT on July 14, 2022.

Site	Latitude	Longitude	Water Depth (cm)	Surface Salinity (ppt)	Soil salinity (ppt)
Tr1	29° 59.107'	89° 59.717'	60	1.12	0.64
Tr2	29° 58.749'	90° 00.097'	78	1.25	2.39
Tr3	29° 58.830'	90° 00.655'	68	1.00	1.18
Tr4	29° 58.998'	90° 00.221'	76	0.76	0.43

Figure 36. A soil porewater sampling well in the Bayou Bienville Wetland Triangle.

Water depth in the BBWT ranged from 60 to 78 cm. Surface water salinity ranged from 0.76 to 1.25 ppt, with the lowest salinity near Bayou Bienville. Soil porewater salinity was highest (2.39 ppt) in the southeast corner site (Tr2), followed by 1.18 ppt at the southwest corner (Tr3), with the other two sites having <1 ppt (Figure 30; Table 3).

Bayou Bienvenue Wetland Triangle Restoration Project

The Bayou Bienvenue Wetland Triangle was once a thriving baldcypress swamp. The swamp 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.

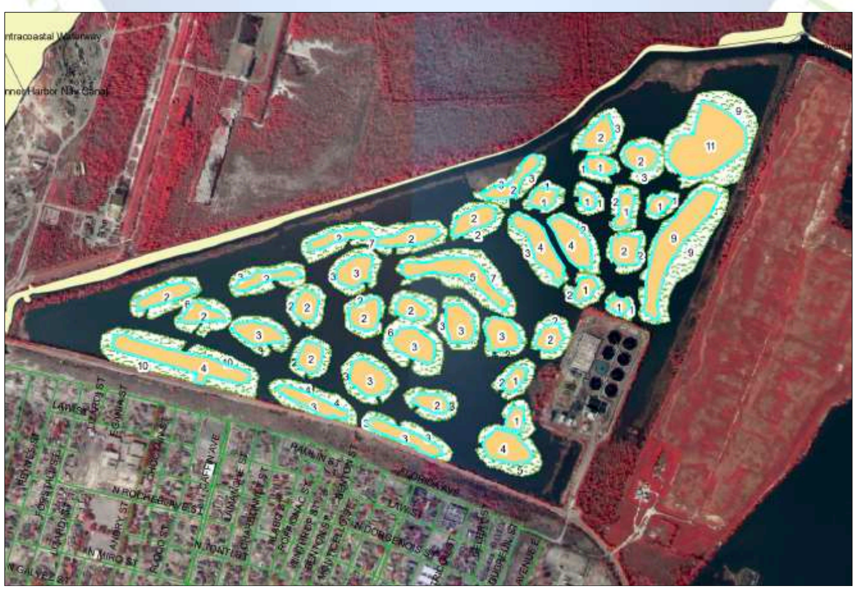
Historical imagery of the Bayou Bienvenue Wetlands Triangle

With the closure of the MRGO in 2009, salinities in the Bayou Bienvenue Wetland Triangle have decreased to levels that are conducive to baldcypress and water tupelo survival and growth.

We propose to create forty 1 to 11 acre islands using clean sediment from either a land source, such as the Bonnet Carré Spillway, or from dredged sediments from the Mississippi River.

A total of 103 acres of wetlands will be created in the 400-acre Wetland Triangle. The average depth of the Wetland Triangle is 3 ft. Thus, the total amount of fill needed will be approximately 500,000 cubic yards : 103 acres = 4,486,680 ft^2 x 3 ft depth = 13,460,040 ft^3 = 498,520 $yards^3$

Islands will 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.

Fun Facts about the Sankofa Wetland Park

Tricia LeBlanc requested assistance with developing 'fun facts' about the Sankofa Park. Below is what was submitted on September 16, 2022:

• The park is located at the lowest elevation in the ninth ward, so all water flows towards the park during storms

• The park will decrease flooding in the ninth ward by providing storage for flood waters. Wetlands act like a sponge, soaking and storing water, thus reducing the risk of flooding. One acre of wetland can store over 1 million gallons of floodwater.

• Wetlands can act as natural filters that purify water. Wetlands trap 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.

• Wetlands are considered to be one of the most diverse biomes in the world. Globally, it is estimated that 40% of all wildlife rely on wetlands.

• The species found in wetlands are some of the most unique in the world because they've evolved specifically to survive in these hydrologically changing ecosystems. Alligators, crocodiles, muskrats, nutria, fish species and hundreds of birds, including mallards, geese and herons are all found in wetlands.

• The National Wildlife Federation estimates that around ⅓ of endangered species that call the United States home depends on wetlands either directly or indirectly for survival

• The park draws in migratory birds as they fly over, with over 100 species identified so far. Up to 80% of all the birds breeding in America require wetlands.

• Wetlands have a great capacity for storing carbon, reducing carbon dioxide (CO_2) levels that cause the greenhouse effect, thus fighting climate change.

• Wetlands cover between 5-10% of the Earth's land area. It is estimated that more than half of the world's original wetlands have disappeared and they are being lost and degraded more quickly than any other ecosystem type. Over the past century, the world has lost half of its wetlands due to drainage for agricultural and infrastructural development.

Carbon Sequestration by the Sankofa Wetland Park

Carbon sequestration refers to the removal of atmospheric carbon by plants and soils or other storage mechanisms, which can mitigate greenhouse gases released as a result of changes in land use and the burning of fossil fuels (Lal 2004; Euliss et al. 2006; Kayranli et al. 2010). Traditionally, the carbon sequestered in vegetated coastal ecosystems, specifically mangrove forests, seagrass beds, and salt marshes (Nellemann et al. 2009; Mcleod et al. 2011), as well as bald cypress forests (Lane et al. 2017), has been termed 'blue carbon'. Wetland restoration is an effective climate change mitigation strategy because it enhances carbon sequestration and avoids carbon releases that would occur in the absence of restoration activities (Pendleton et al. 2012; Lane et al. 2016; Sapkota and White 2019). Belowground carbon accumulation in wetlands is a balance between belowground production and organic matter decomposition that are in turn dependent on a variety of factors such as nutrient availability, flooding status, elevation, and soil redox (Mitsch and Gosselink 2015). Projects that increase vegetative productivity result in enhanced organic soil deposition, and geological subsidence of this organic soil results in carbon burial (Bridgham et al. 2006; Hansen and Nestlerode 2014). Peat soils of wetland environments have the highest carbon content of all the soil orders (Bridgham et al. 2006) due to very high net primary production coupled with slow organic matter decomposition (Mitsch and Gosselink 2015; Reddy and DeLaune 2008). This makes wetland soils an important sink for atmospheric CO_2 (Bridgham et al. 2006; Hansen and Nestlerode 2014), especially in areas with high rates of subsidence that leads to carbon burial (Lane et al. 2016, 2017). Successful wetland restoration creates conditions for healthy, thriving wetland systems that are optimal for the sequestration and burial of carbon, preventing the release of carbon to the atmosphere.

The Sankofa wetland park began to sequester carbon as soon as trees that were planted started growing and groundcover became established. As the park matures, its potential to store carbon in the soils will become realized. Given the finished area of the park will be approximately 40 acres, and that freshwater wetlands generally sequester approximately 176 g $C/m^2/yr$ (Villa and Bernal 2018), we can expect a sequestration rate of approximately 28 tons of carbon per year.

Literature Cited

Bridgham, S.D., J.P. Megonigal, J.K. Keller, N.P. Bliss, and C. Trettin. 2006. The carbon balance of North American wetlands. Wetlands 26: 889-916.

Euliss, N.H.J., R.A. Gleason, A. Olness, R.L. McDougal, H.R. Murkin, R.D. Roberts, R.A. Bourbonniere, and B.G. Warner. 2006. North American prairie wetlands are important nonforested land-based carbon storage sites. Science of the Total Environment 361: 179-188.

Hansen, V.D., and J.A. Nestlerode. 2014. Carbon sequestration in wetland soils of the northern Gulf of Mexico coastal region. Wetlands Ecology & Management 22: 289-303.

Kayranli, B., M. Scholz, A. Mustafa, and Å. Hedmark. 2010. Carbon storage and fluxes within freshwater wetlands: a critical review. Wetlands 30(1): 111-124.

Lal, R. 2004. Soil carbon sequestration to mitigate climate change. Geoderma 123: 1-22.

Lane, R.R., S. Mack, J.W. Day, R.D. DeLaune, M.J. Madison, P.R. Precht. 2016. Fate of soil organic carbon during wetland loss. Wetlands 36(6): 1167-1181.

Lane, R.R., S.K. Mack, J.W. Day, R. Kempka, L.J. Brady. 2017. Carbon sequestration at a forested wetland receiving treated municipal effluent. Wetlands 37(5): 861-873.

Mcleod, E., G.L. Chmura, S. Bouillon, R. Salm, M. Björk, C.M. Duarte, C.E. Lovelock, W.H. Schlesinger, and B.R. Silliman. 2011. A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2. Frontiers in Ecology & the Environment 9: 552-560.

Mitsch, W.J., and J.G. Gosselink. 2015. Wetlands. John Wiley & Sons: Hoboken, N.J.

Nellemann, C., E. Corcoran, C.M. Duarte, L. Valdés, C. De Young, L. Fonseca, and G. Grimsditch (Eds). 2009. Blue Carbon. A Rapid Response Assessment. United Nations Environment Programme, GRID-Arendal, www.grida.no

Pendleton, L., D.C. Donato, B.C. Murray, S. Crooks, W.A. Jenkins, S. Sifleet, C. Craft, W. Fourqurean, J.B. Kauffman, N. Marbà, P.K. Megonigal, E. Pidgeon, D. Herr, D. Gordon, and A. Baldera. 2012. Estimating global "blue carbon" emissions from conversion and degradation of vegetated coastal ecosystems. PLoS One 7(9): e43542.

Reddy, K.R., and R.D. DeLaune. 2008. Biogeochemistry of Wetlands: Science and Applications. CRC Press, Boca Raton, FL.

Sapkota, Y., and J.R. White. 2019. Marsh edge erosion and associated carbon dynamics in coastal Louisiana: a proxy for future wetland-dominated coastlines world-wide. Estuarine, Coastal & Shelf Science 106289.

Villa, J.A., and B. Bernal. 2018. Carbon sequestration in wetlands, from science to practice: An overview of the biogeochemical process, measurement methods, and policy framework. Ecological Engineering 114: 115-128.

Table S1. Raw probe data.

Site	Date	Dissolved Oxygen (mg/L)	Conductivity (mS)	Temperature (°C)	Salinity (ppt)	pH	TDS (mg/L)
#1	1/18/22	9.6	776.5	9.9	0.5	7.4	.
#1	2/23/22	16.8	1211.0	24.0	0.6	7.4	0.81
#1	3/23/22	11.9	988.7	20.7	0.5	8.0	0.70
#1	4/26/22	8.8	1036.5	25.5	0.5	9.0	0.67
#1	5/24/22	4.4	1078.3	26.7	0.5	8.0	0.68
#1	6/13/22	0.9	472.9	27.1	0.2	7.7	0.29
#1	7/14/22	2.2	842.5	27.2	0.4	8.0	0.52
#1	8/16/22	3.3	852.3	29.3	0.4	6.9	0.52
#1	9/14/22	2.5	794.1	26.9	0.4	7.0	0.50
#1	10/12/22	1.5	899.7	22.8	0.5	7.9	0.62
#1	11/1/22	2.6	876.6	19.4	0.5	6.3	0.71
#1	11/14/22	2.8	819.4	15.5	0.5	7.7	0.65
#1	12/16/22	.	596.1	14.6	0.4	7.1	0.47
#2	1/18/22	12.0	897.1	10.3	0.7	6.6	.
#2	2/23/22	13.7	1314.7	26.0	0.7	8.1	0.84
#2	3/23/22	10.9	1263.2	22.1	0.7	7.7	0.87
#2	4/26/22	10.9	1515.2	27.8	0.7	7.3	0.94
#2	5/24/22	2.0	1604.2	27.6	0.8	8.0	0.99
#2	6/13/22	4.3	1373.9	29.2	0.6	7.2	0.83
#2	7/14/22	2.8	1261.8	28.4	0.6	7.9	0.77
#2	8/16/22	2.9	1030.1	30.5	0.5	7.2	0.60
#2	9/14/22	10.0	913.2	30.5	0.4	7.3	0.53
#2	10/12/22	5.2	1079.7	24.9	0.5	7.1	0.67
#2	11/1/22	7.4	958.2	20.2	0.5	7.2	0.68
#2	11/14/22	6.2	964.0	16.2	0.6	7.4	0.75
#2	12/16/22	.	880.2	15.5	0.5	7.2	0.70
T	3/23/22	11.2	1493.1	21.7	0.8	8.5	0.97
T	4/26/22	4.5	2643.7	24.2	1.4	8.0	1.75
T	5/24/22	4.3	2664.0	25.1	1.4	7.7	1.72
T	6/13/22	3.4	2408.9	27.4	1.2	6.8	1.49
T	7/14/22	0.1	2256.6	27.4	1.1	7.9	1.40
T	8/16/22	6.0	1239.3	33.3	0.5	7.4	0.69
T	9/14/22	2.9	726.9	27.9	0.3	8.1	0.45
T	10/12/22	0.8	829.6	23.5	0.4	7.5	0.55
T	11/1/22	4.9	896.6	21.3	0.5	7.6	0.63
T	11/14/22	3.8	744.6	14.9	0.5	7.8	0.60
T	12/16/22	.	581.9	13.4	0.4	6.5	0.48

Table S2. Raw nutrient data.

Site	Date	NO_3+NO_2 (mg/L)	NH_3 (mg/L)	TN (mg/L)	PO_4 (mg/L)	TP (mg/L)	TSS (mg/L)	BOD_5 (mg/L)
#1	1/18/22	<0.05	<0.10	0.94	<0.01	0.14	5.00	<3.0
#1	5/24/22	<0.05	<0.10	1.20	<0.01	0.13	<4.0	4.00
#1	8/16/22	<0.01	<0.10	<0.16	0.25	0.32	8.00	<3.0
#1	10/12/22	0.03	0.68	1.53	0.59	0.65	7.00	<3.0
#2	1/18/22	<0.05	<0.10	0.80	<0.01	0.20	13.00	5.00
#2	5/24/22	<0.05	<0.10	1.40	<0.01	<0.04	<4.0	<3.0
#2	8/16/22	0.02	0.13	0.10	0.06	<0.04	6.00	<3.0
#2	10/12/22	0.01	<0.10	<0.16	<0.01	<0.04	5.00	<3.0