PRECONSTRUCTION CHEMISTRY REPORT OF THE HAMMOND'S FERRY CONSTRUCTED WETLAND RESTORATION SITE IN NORTH AUGUSTA, SC

Conducted for the City of North Augusta, SC

by

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INTRODUCTION

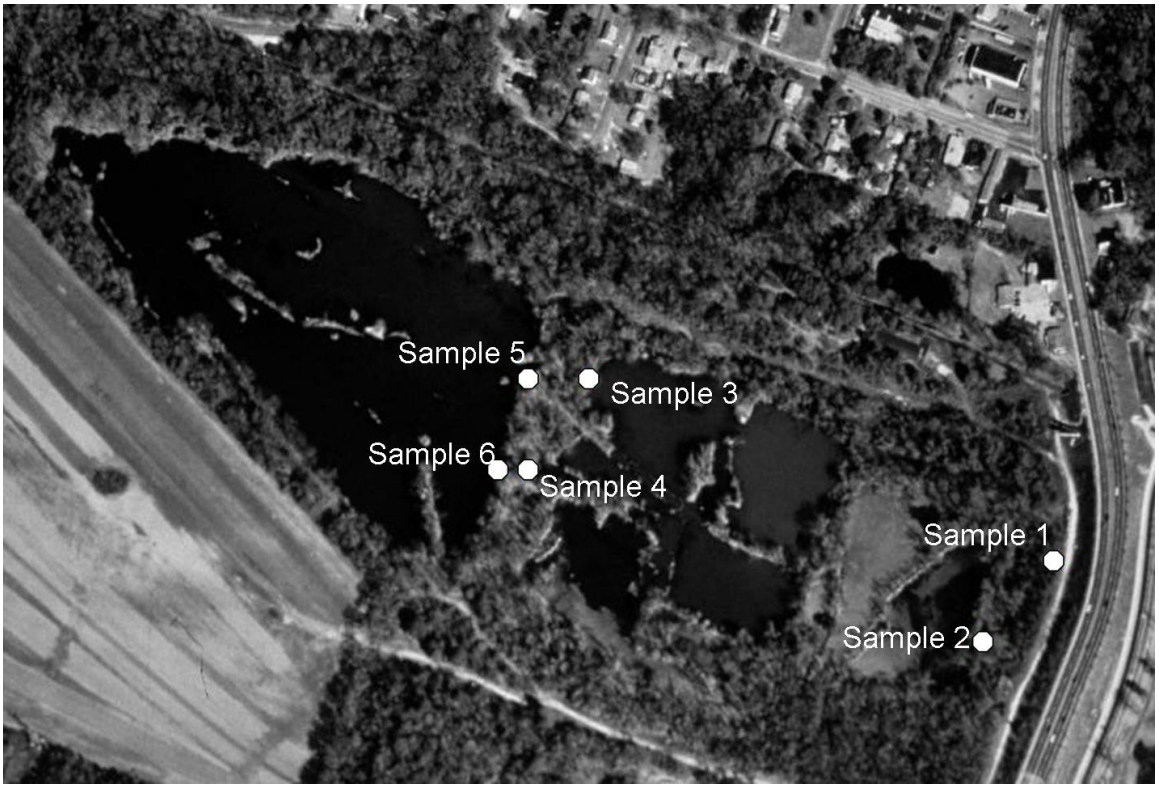
The purpose of this report was to present a baseline of water quality and overall conditions in the area proposed for restoration through a conservation grant from the National Fish and Wildlife Foundation. Two sampling events occurred prior to construction: an initial waster and sediment sample taken in December 2006, and a more comprehensive water sample set taken in April 2007.

The area slated for restoration encompasses approximately 30 acres and is a former industrial site used for mining of clay and production of bricks. Clay mining activities left behind a series of small pools and quarry ponds that filled with water shortly after mining was complete in the 1930s and remain filled to this day. This site is located within the city limits of North Augusta, SC, in the floodplain adjacent to the Savannah River. The area immediately surrounding this site is being developed for mixed commercial and residential purposes. The former brick quarry that is to be restored is featured in Figure 1 along with some of the dominant features of this property.

Figure 1. Aerial photograph of the area to be restored. The December 2006 chemistry sampling was conducted in the area labeled "Future Constructed Wetland."

METHODS

The initial sample set was taken in December 2006 from the area labeled "Future Constructed Wetland" featured in Figure 1 above. This sampling consisted of one aquatic grab sample and one sediment sample. The second series of preconstuction samples were taken April 2, 2007, from sampling locations noted in Figure 2. The April samples consisted of aquatic grab samples from each location. Both December 2006 and April 2007 sampling was conducted during clear weather. Sample containers with appropriate preservatives were provided by Shealy Environmental Services, Inc., Columbia, SC.



Water quality parameters (dissolved oxygen, pH, and temperature) were recorded at the time of sampling in April 2007. Dissolved oxygen and temperature were measured with a YSI Ecosense DO200 meter (Yellow Springs Instrument Company, Yellow Springs, OH); pH was measured with an Oakton Model 30 pH tester (Oakton Instruments, Vernon Hills, IL).

Analytical samples were preserved and shipped on ice to Shealy Environmental Services, Inc., Columbia, SC. All samples were analyzed within acceptable holding times. Standard trip and temperature blanks were included. A complete list of analytical methods is presented in Appendix 1.

RESULTS

Water Quality

The December 2006 sample included all basic inorganic water quality parameters listed in Table 1. Samples collected in April 2007 included only ammonia, 5-day BOD, phosphorus, and TKN. Dissolved oxygen ranged from 1.0 to 7.8 mg/L. Samples from locations 1-4 were below the standard 4.0 mg/L recommended by the state of South Carolina for freshwater (SC DHEC 2004). Biological oxygen demand (BOD) ranged from 2.2 to 13 mg/L. While there are no specific water quality criteria that pertain to BOD, values greater than 6 are usually indicative of a high organic load. Field-measured pH values ranged from 6.06 to 7.16, and all were within acceptable SC DHEC guidelines for a healthy freshwater system.

Table 1. Summary of water quality analyses conducted during December 2006 and April 2007. Blank spaces indicate that analyses were not conducted on a particular sample.

Parameter (mg/L)	December 2006	April 2007 Sample 1	April 2007 Sample 2	April 2007 Sample 3	April 2007 Sample 4	April 2007 Sample 5	April 2007 Sample 6
Alkalinity	17						
5-day BOD	2.2	6.2	2.6	13	4.1	2.9	2.2
5-day Carbonaceous BOD	2.0						
Chloride	3.7						
COD	46						
Dissolved chloride	4.8						
Dissolved ammonia N	<0.10	0.59	0.33	0.47	0.25	0.29	0.11
Dissolved nitrate-nitrite N	0.10						
Dissolved nitrite N	0.0076						
Dissolved oxygen[1]		3.5	1.0	1.5	1.5	5.8	7.8
Dissolved sulfate	1.2						
DOC	10						
Ortho-phosphorus	0.010						
Phosphorus	0.054	0.27	0.10	0.19	0.11	0.041	0.036
Sulfate	1.8						
TDS	31						
TIC	2.8						
TKN	0.49	2.6	1.2	2.6	1.3	0.69	0.98
TOC	7.6						
TSS	7.2						
TVSS	5.9						
pH[1] (no unit)		6.46	6.06	6.43	6.28	6.85	7.16

[1]Parameters measured in the field at the time of sample collection. Field temperatures for the April 2007 samples ranged from 17.8°C -23.1°C.

Water samples from December 2006 and April 2007 were also analyzed for metals and a number of organic contaminants including herbicides, PCBs, organochloine pesticides and volatile organic compounds (Table 2 and Appendix 2). Metals of concern that were detected in at least one sample over the two sampling periods included chromium, copper, lead, and zinc. While they were detected, all of these potential aquatic contaminants were at concentrations well below water quality limits set by the USEPA for freshwater (USEPA 2002). Other metals, such as iron, manganese, or sodium, were above detection, but are of no environmental concern because they are generally considered essential metals that are nontoxic in the environment at these concentrations. For organic compounds, there were only two positive detections: chloroform was detected at sample location 2, and toluene was detected at sample location 3. There are no water quality limits for either of these volatile organic compounds; however, both were detected in concentrations well below US EPA standards set for the protection of human health. Aqueous samples were analyzed for a number of organic contaminants that were below the detection limit and, therefore, not listed in Table 2. These include herbicides, organochlorine pesticides, and PCBs. Please refer to Appendix 2 for a comprehensive list of analytes that were below detection.

Table 2. Metals and organics measured in water samples during December 2006 and April 2007. Blank spaces indicate that analyses were not conducted on a particular sample.

	December 2006	April 2007 Sample 1	April 2007 Sample 2	April 2007 Sample 3	April 2007 Sample 4	April 2007 Sample 5	April 2007 Sample 6
Metals (µg/L)							
Arsenic	<1.0						
Cadmium	<0.10						
Calcium	4300						
Chromium	0.50						
Copper	1.1	8.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Iron	1200	3700	4200	3700	2800	560	480
Lead	0.44	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Magnesium	1400						
Manganese	74	300	190	1700	550	62	52
Mercury	<0.10						
Nickel	0.48						
Potassium	2200						
Selenium	<1.0						
Silicon	660						
Sodium	2200						
Zinc	8.4	92	<20	<20	<20	<20	<20
Organics (µg/L)[1]							
Chloroform		2.7	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene		<1.0	<1.0	1.4	<1.0	<1.0	<1.0

[1]Aqueous samples were analyzed for a number of organic contaminants that were below the detection limit for all samples and, therefore, not listed in this table. These include herbicides, organochlorine pesticides, and PCBs. Refer to Appendix 2 for a comprehensive list.

Sediment

A composite sediment sample from the proposed constructed wetland location was analyzed for metals and various organic contaminants in December 2006; results are summarized in Table 3. While South Carolina has no regulatory limits for sediment contamination, typical screening guidelines used by the USEPA and other federal agencies include the threshold effect concentration (TEC) and the probable effect concentration (PEC) in freshwater sediments (Jones et al. 1997). The TEC value is typically considered the value at which harmful effects on aquatic communities are rarely observed. The PEC concentrations are those at which harmful effects would frequently occur. Two metals, copper and zinc, exceeded the TEC but not the PEC values (Table 3). Other analytes listed in Table 3 (calcium, iron, magnesium, manganese, potassium, and selenium) are considered nontoxic at these concentrations.

Dalapon was the only organic contaminant detected. It is a herbicide used for used to control grasses in crops, lawns, drainage ditches, along railroad tracks, and in industrial areas (US EPA 2006). In the environment, Dalapon completely degrades to inorganic compounds through bacterial activity (Sternersen 2004).

Table 3. Summary of sediment analyses conducted in December 2006 in the location of the proposed constructed wetland.

	December 2006	TEC[1]	PEC[1]
Metals (mg/kg)[2]			
Arsenic	5.1	12.1	57
Cadmium	0.24	0.59	11.7
Calcium	2000		
Chromium	40	56	159
Copper	32	28	77.7
Iron	20,000		
Lead	43	34.2	396
Magnesium	2700		
Manganese	300		
Mercury	<0.47		
Nickel	22	39.6	38.5
Potassium	1800		
Selenium	1.2		
Zinc	210	159	1532
Herbicides (µg/kg)			
Dalapon	57		

[1]TEC= threshold effect concentration. PEC=probable effect concentration.
[2]Sediment samples were analyzed for a number of contaminants that were below the detection limit for all samples and, therefore, not listed in this table. These include sodium, herbicides, organochlorine pesticides, and PCBs. Refer to Appendix 2 for a comprehensive list.

Summary

Preconstruction chemical analyses indicated a moderately impaired system with low dissolved oxygen. This was probably due to the low-flow and high BOD conditions of this system prior to wetland construction. All other basic water quality parameters indicated the potential for a healthy system once restoration is complete and the wetland is given time to mature. Several potential contaminants were detected, but all were at concentrations that will not weaken the restoration effort nor present a risk to future ecological receptors in this constructed wetland.

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APPENDIX 1: METHODS FOR ANALYSES

Parameter	Sample Date	Matrix	Method
Alkalinity	Dec. 2006	Aqueous	Titration US EPA Method 310.1[1]
Ammonia	Apr. 2007	Aqueous	Colorimetry US EPA Method 350.1[2]
BOD (5-day)	Dec. 2006 Apr. 2007	Aqueous	Probe Method at 20ºC US EPA Method 405.1[3]
Chloride	Dec. 2006	Aqueous	Ion Chromatography US EPA Method 300.0[4]
COD (low-level)	Dec. 2006	Aqueous	Colorimetry US EPA Method 410.4[5]
Herbicides[a]	Dec. 2006	Aqueous Sediment	Capillary GC-ECD US EPA Method 8151A[6]
Mercury	Dec. 2006	Aqueous	Manual CVAA US EPA Method 245.1[7]
Mercury	Dec. 2006	Sediment	CVAA US EPA Method 7471A[8]
Metals (As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Na, Zn)	Dec. 2006	Sediment	ICP-AES US EPA Method 6010B[9]
Metals (As, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Si, Na, Zn)	Dec. 2006	Aqueous	ICP-MS US EPA Method 200.8[10]
Metals (Cu, Fe, Pb, Mn, Zn)	Apr. 2007	Aqueous	ICP-AES USEPA Method 200.7[11]
Nitrate	Dec. 2006	Aqueous	Colorimetry US EPA Method 353.2[12]
Nitrite	Dec. 2006	Aqueous	Spectrophotometry US EPA Method 354.1[13]
Organochlorine Pesticides[a]	Dec. 2006	Aqueous Sediment	GC US EPA Method 8081A[14]
PCBs[a]	Dec. 2006	Aqueous Sediment	GC US EPA Method 8082[15]
pH	Dec. 2006	Aqueous	US EPA Method 150.1[16]
Phosphorus	Apr. 2007	Aqueous	Colorimetry US EPA Method 365.11[17]
Sulfate	Dec. 2006	Aqueous	Ion Chromatography US EPA Method 300.0[4]
TIC	Dec. 2006	Aqueous	US EPA Method 415.1[18]
TKN	Apr. 2007 Dec. 2006	Aqueous	Colorimetry US EPA Method 351.2[19]
TOC / DOC	Dec. 2006	Aqueous	US EPA Method 415.1[18]

Parameter	Sample Date	Matrix	Method
TSS / TDS	Dec. 2006	Aqueous	Filterable Residue US EPA Method 160.1[20]
Volatile Organic Compounds[a]	Apr. 2007	Aqueous	Purge and Trap GC/MS US EPA Method 8260B[21]

[a]See Appendix A for a complete list of individual constituents and/or congeners that were included in the analysis

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APPENDIX 2: COMPLETE ANALYTE LIST

December 2006 sediment and water samples were analyzed for all of the following contaminants, with results of less than detection:

Herbicides
2,4,5-T; 2,4-D; dalapon; 2,4-DB; dicamba; dichloroprop; dinoseb; MCPA; MCPP; 2,4,5-TP (Silvex).

PCBs
arochlor 1016, arochlor 1221, arochlor 1232, arochlor 1242, arochlor 1248, arochlor 1254, arochlor 1260

Oganochlorine Pesticides
aldrin; alpha-BHC; beta-BHC; delta-BHC; gamma-BHC (lindane); alpha-chlordane; gamma-chlordane; 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; dieldrin; endosulfan I; endosulfan II; endosulfan sulfate, endrin, endrin aldehyde; endrin ketone; heptachlor; heptachlor epoxide; methoxychlor; toxaphene

April 2007 water samples were analyzed for all of the following contaminants, with results of less than detection:

Volatile Organic Compounds
acrolein; acrylonitrile; benzene; bromodichloromethane; bromoform; bromomethane; carbon disulfide; carbon tetrachloride; chlorobenzene; chloroethane; 2-chloroethylvinylether; chloromethane; dibromochloromethane; 1,2-dichlorobenzene; 1,3-dichlorobenzene; 1,4-dichlorobenzene; dichlorodifluoromethane; 1,1-dichloroethane; 1,1-dichloroethene; 1,2-dichloroethane; trans-1,2-dichloroethene; 1,2-dichloropropane; cis-1,3-dichloropropene; trans-1,3-dichloropropene; ethylbenzene; methylene chloride; 1,1,2,2-tetrachloroethane; tetrachloroethene; 1,2,4-trichlorobenzene; 1,1,1-trichloroethane; 1,1,2-trichloroethane; trichloroethene; trichlorofluoromethane; vinyl chloride