Recoverable Trace Metals in Sediment from Maple Leaf Golf and Country Club Rampart Pond.

Maple Leaf Golf and Country Club Natural Resources Committee, 2017.

Summary

The principal source of water to Maple Leaf Golf and Country Club (MLG&CC) ponds is from storm water runoff. The major water input to ponds comes through the inflow located on the northern property line adjacent to Rampart Avenue. Sediments from the receiving pond (Rampart Pond) were analyzed for trace metals as a Natural Resources Committee project and as one of the Committees' Audubon International Green Neighborhood initiatives. Trace metal testing is part of an ongoing program to characterize surface water impact on park pond water quality and our need to establish a set of baseline data for future assessments. MLG&CC has a history of water quality complaints (*Simms, 2005; Letter to the Board, 2014, Comba, 2015*) with Charlotte County and Southwest Florida Water Management District over the impairment of stormwater discharged into park ponds. Such data collection is needed to differentiate between external and internal inputs.

Sample collection

Samples were taken on June 15, 2016, from Rampart pond near the pond inflow (site 3) the central basin (site 2) and the southern end (site 1) near the Queensway. See Figure 1 for locations. Sediment was collected during dredging of the pond with a suction pump, and are thought to represent a well-mixed portion of the top six inches of settled material.

The sediment was collected in 5-gallon plastic containers and allowed to air dry. Sub samples of mixed dried soil were screened through 1/8" plastic mesh to remove shells, twigs and other coarse materials.

Smaller sub samples were taken for trace metal analyses.

Analysis

Recoverable Metals in Sediment, Method EC 2404.

The method recovers metals adsorbed on sediment particles and metals in the form of insoluble salts and organic complexes. There may be some leaching of metals from the surfaces of the mineral portion of the sediment, however, metals trapped within the silicate matrix are not extracted. Recovery of metals may vary depending on the type and proportion of minerals present in the sediment. Metals extracted by this procedure are considered as "environmentally available". A half gram of homogeneous freeze-dried sediment is digested with nitric and hydrochloric acids. The sediment is analyzed by inductively coupled argon plasma-collision/reaction cell mass spectrometry (CRC-ICP-MS). Each element is measured at a specific mass to charge ratio (m/z value expressed in atomic mass units). Concentrations are reported on a dry weight basis.

Mercury in Sediment by Combustion, EPA method 7473.

Fifty milligrams of homogenized freeze-dried sediment are thermally and chemically decomposed at 750 ^{o}C in an oxygen rich environment. Released mercury vapor is measured through a set of two absorbance cells with a flameless atomic absorption spectrometer set at an absorbance of 253.7 nm.

Results

Samples were collected using a non-standard analytical procedure. Element measurements were provided at no charge by a certified analytical laboratory in June 2017. Although the data is considered highly reliable, for these reasons their use here is for informative purposes only.

Trace element concentrations as ppm (ug/g) dry weight sediment are provided in Table 2. There were no concentrations of a "hazardous" element that would cause any environmental concern. Five elements had concentrations that exceeded 1000 ppm. These were iron, calcium, aluminum, sulphur and phosphorous. Four elements had concentrations greater than 100 ppm (magnesium, strontium, potassium and sodium). Ten elements had concentrations greater than 10 ppm (zinc, barium, vanadium, chromium, cerium, titanium, manganese, copper and lanthanum). The above chemicals are listed in order of descending concentration. For comparison, the concentration range of elements reported in Charlotte Harbor sediments by McPherson and others, 1996, are shown in Table 1. Except for iron, the values in the MLG&CC pond are in the same order of magnitude as those reported for the harbor.

The Rampart Avenue storm sewer system was re-constructed in 2013 and anticipated to improve water quality. Since then we have had two summers (2015-16) with exceptionally high rainfall events. The observed concentration gradient is therefore important. The concentrations closest to the inflow (site 3) are 5 times higher than the central location (site 2) and 10 times higher than concentrations closer to the outflow (site 1). The large gradient is a surprise as the ponds are very shallow and should have experienced flushing, and in conjunction with the highly colloidal nature of the suspended sediment, any deposition should be minimal. The magnitude of the gradient suggests the pond's inflow is still an active source of these chemicals.

Since the sample collection did not specifically isolate only surficial sediment the data may represent historical deposits. However, given our current and past knowledge of the pond's history we expected pond sediment concentrations to be more homogeneous. Without radio dating and a sedimentation rate no definitive conclusion can be made. Analyses of sediment samples from other park ponds would be beneficial to determine if the Rampart pond retains contaminants or whether they are transported throughout the watershed. The Rampart inflow was shown to be the source of suspended solids (Comba, 2015) which were reduced by a factor of 5 after passage through the park's watercourse.

References

McPherson, B.F., Miller, R.L. and Stoker, Y.E. 1996. Physical, Chemical, and Biological Characteristics of the Charlotte Harbor Basin and Estuarine System in Southwestern Florida-A Summary of the 1982-89 U.S. Geological Survey Charlotte Harbor Assessment and Other Studies. U. S. Geological Survey Water Supply Paper 2486, 32p.

Simmons, R., 2004. Maple Leaf Irrigation Water Storage and Storm Water Storage System. Assessment Committee Report February 5, 2004. 10 p.

Committee for Improvement of Stormwater Quality 2014. Letter to the Maple Leaf Golf and Country Club Board of Directors, January 2014., 3 p.

Comba, M.E., 2015. Maple Leaf Golf and Country Club Inflow Water Sampling Project 2015. Committee for Improvement of Stormwater Report. 4 p.

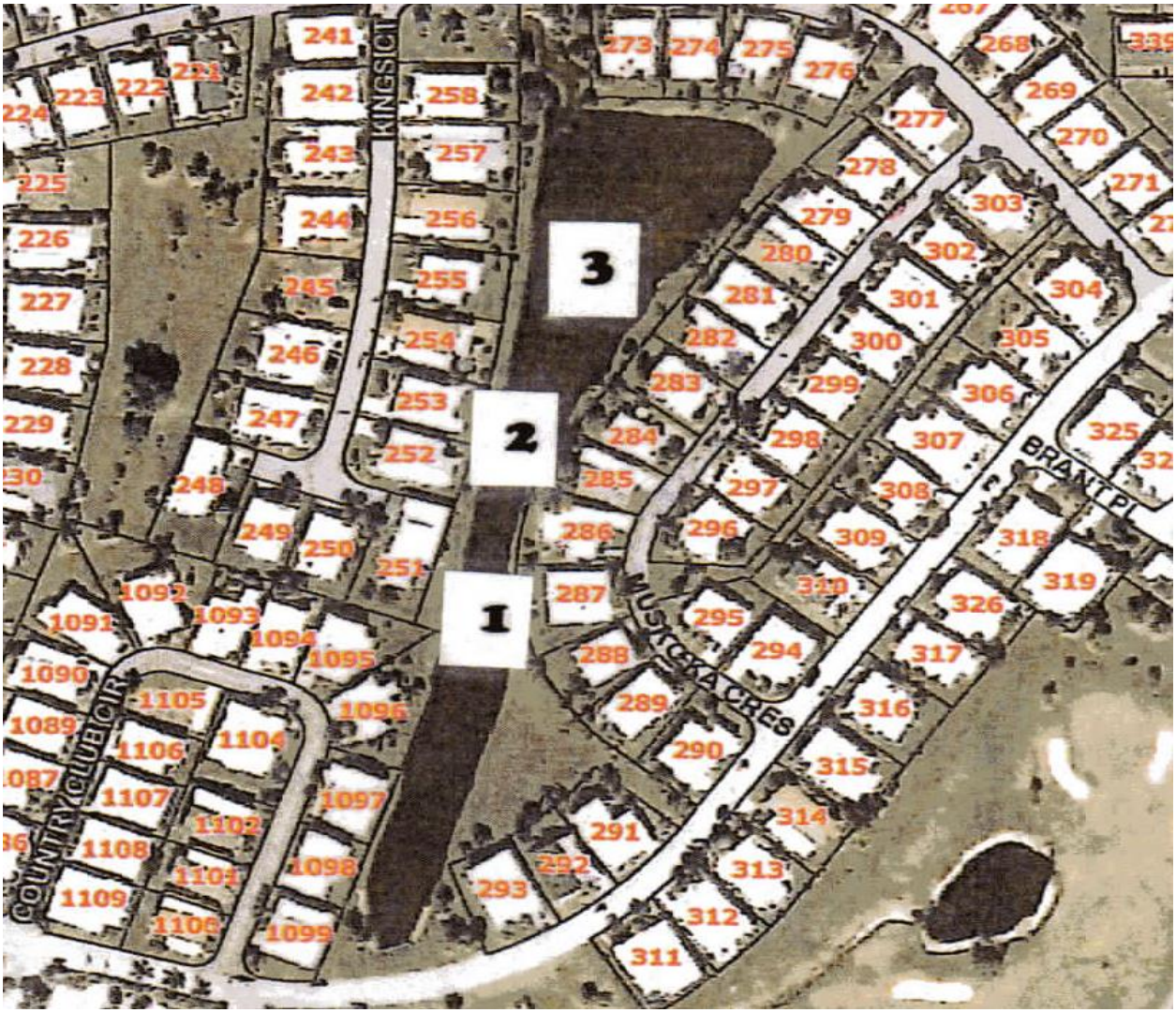

Figure 1. Rampart Pond 2016 Sampling Sites for Recoverable Trace Metals.

Table 1. Percent Organic Matter in Rampart Pond Sediment Samples.

Site number	% carbon	% nitrogen	% organic matter
1	0.1	0.0	0.5
2	1.1	0.06	4.8
3	1.5	0.04	3.7

Table 2. Concentration of Trace Elements in Rampart Pond Bottom Sediments 2016.

Method Detection Limit			***Concentration*** **µg/g (ppm) dry weight**			**Charlotte Harbor Data 1982-89 µg/g (ppm) dry weight**
MDL (µg/g)	Atomic Symbol	Chemical Name	Site 1	Site 2	Site 3	
0.005	Ag	silver	0.00	0.004	0.042	
20	Al	aluminum	717	1500	9100	430-7100
0.02	As	arsenic	0.28	0.11	5.49	<1
0.05	Au	gold	0.00	0.00	0.00	
5	B	boron	0	0	2	
0.5	Ba	barium	2.5	3.3	32.6	
0.005	Be	beryllium	0.019	0.069	0.251	
0.005	Bi	bismuth	0.007	0.015	0.064	
50	Ca	calcium	1560	2231	13000	
0.01	Cd	cadmium	0.01	0.00	0.08	1-2
0.02	Ce	cerium	1.76	2.98	19.7	
0.01	Co	cobalt	0.08	0.04	0.79	<10
0.05	Cr	chromium	1.86	2.46	22.4	3-20
0.005	Cs	caesium	0.028	0.024	0.15	
0.2	Cu	copper	1.6	0.4	12.0	1-3
5	Fe	iron	1350	964	36000	1400-4000
0.01	Ga	gallium	0.20	0.51	2.25	
0.1	Gd	gadolinium	0.2	0.2	2.2	
0.02	Ge	geranium	0.01	0.01	0.11	
0.001	Hg	mercury	0.002	0.024	0.017	0.18-0.56
20	K	potassium	19	7	137	
0.01	La	lanthanum	0.93	1.60	10.1	
0.05	Li	lithium	0.55	0.25	4.52	
10	Mg	magnesium	47	55	515	
0.5	Mn	manganese	1.0	0.6	12.5	7-17
0.02	Mo	molybdenum	0.15	0.31	0.97	<0.1-4
5	Na	sodium	50	24	189	
0.05	Nb	niobium	0.02	0.04	0.09	

Table 2 cont'd. Concentration of Trace Elements in Rampart Pond Bottom Sediments 2016.

Method Detection Limit			*Concentration* µg/g (ppm) dry weight			Charlotte Harbor Data 1982-89 µg/g (ppm) dry weight
MDL (µg/g)	Atomic Symbol	Chemical Name	Site 1	Site 2	Site 3	
0.2	Ni	nickel	0.3	0.3	3.3	<10
20	P	phosporous	93	61	1160	
0.02	Pb	lead	0.66	0.96	6.39	
0.02	Pd	palladium	0.00	0.00	0.01	
0.01	Pt	platinum	0.00	0.00	0.00	
0.05	Rb	rubidium	0.13	0.09	1.12	
0.002	Rh	rhodium	0.000	0.002	0.002	
20	S	sulphur	415	138	1810	
0.01	Sb	antimony	0.03	0.05	0.29	
0.02	Sc	scandium	0.17	0.18	1.75	
0.02	Se	selinium	0.05	0.26	0.67	<1
0.1	Sn	tin	0.0	0.0	0.2	
0.05	Sr	strontium	13.9	14.0	139	
0.02	Te	tellurium	0.03	0.01	0.02	
1	Ti	titanium	5	16	13	
0.005	Tl	thallium	0.006	0.005	0.049	
0.002	U	uranium	0.47	0.71	2.64	
0.1	V	vanadium	3.1	2.6	27.6	
0.02	W	tungsten	0.00	0.00	0.00	
0.01	Y	yttrium	1.23	0.69	8.30	
0.5	Zn	zinc	3.0	0.0	34.3	4-10
0.2	Zr	zirconium	0.2	0.1	1.4	