Biological Assessment of
Cellon Creek
at
Moltech Power Systems, Inc.

Alachua County, Florida

Sampled
July 24, 2003,
May 5, 2003,and
November 17, 2003

Environmental Assessment Section
FDEP Bureau of Laboratories

Executive Summary

The FDEP Resource Conversation and Recovery Act (RCRA) Program requested technical assistance from the FDEP Bureau of Laboratories for assessment of stream health of Cellon Creek at the Moltech Power Systems, Inc. (a.k.a. Battery Park Industries, Inc.) property in Alachua, Florida. DEP RCRA staff requested a biological assessment of Cellon Creek within the property boundaries of the facility.

DEP laboratory staff performed biological and surface water sampling of Cellon Creek in July of 2002 and May of 2003. Laboratory staff sampled for sediment quality in May of 2003. WRS Infrastructure and Environment, Inc., performed follow up sampling for metals in sediment and water in November, 2003.

In the July 2002 sampling, the benthic organism community at the Cellon Creek Test Site was degraded compared with the upstream Control Site, with a slight exceedance of surface water quality standards for cadmium at the Test Site sampling location. Sediment samples were not collected during this sampling event.

In May 2003, the benthic organism community at the Test Site location no longer showed degradation, and all water column metals complied with Class III water quality standards. Chronic toxicity tests on surface water from the Effluent Site showed reduced body weight in fish and reduced reproduction in water fleas as compared to controls, both of which are typically indicators of chronic toxicity. Cadmium and nickel in the Test Site sediments exceeded their respective Threshold Effect Levels (TEL), and sediment cadmium there exceeded the Probable Effect Concentration (PEC).

In November 2003, water samples collected by WRS in the Moltech discharge ditch and in Cellon Creek complied with water quality standards for cadmium and nickel. Sediments in both the discharge ditch and in Cellon Creek, extending from the facility to approximately 400 m south of US 441, exceeded the Threshold Effect Level for cadmium. Sediment cadmium exceeded the Probable Effect Level in Cellon Creek immediately downstream of the Moltech discharge ditch. Sediment nickel at this site exceeded the TEL. Effluent samples collected in November, 2003, were not chronically toxic to fish or water fleas in chronic toxicity tests conducted by the Bureau of Laboratories.

Introduction

History of Operations

In 1963, General Electric (GE) Company began operating a rechargeable battery manufacturing facility near Hague, Florida. Gates Energy Products purchased the facility from GE in 1987, and continued to manufacture rechargeable nickel-cadmium batteries. Eveready Battery Company, Inc. purchased the facility in August 1993, and operated as Energizer Power Systems Division (Energizer). MPS, Inc. purchased the facility in November 1999. In May of 2001, MPS filed for bankruptcy. In October of 2002, MPS reorganized and sold the bulk of the manufacturing technology and equipment to HUAYI Group based in Shanghai, China. In April of 2003, HUAYI began shipping the manufacturing equipment to China.

History of Environmental Permits

In September of 1990, Florida DEP issued the first Resource Conversation and Recovery Act (RCRA) Closure Permit for the facility. This RCRA Closure Permit addressed physical closure of regulated units known as Hazardous Waste Management Area I and II (see Attachment I). This Permit also addressed contamination assessment and remediation facility wide.

In September of 1987, US Environmental Protection Agency (EPA) issued the first Hazardous & Solid Waste Amendment (HSWA) permit for assessment and remediation of solid waste management units known as SWMU I and II (see Attachment I). In October of 1997, this permit was renewed by EPA. In May of 2002, FDEP issued a joint RCRA/HSWA permit for site-wide corrective action. The state assumed full responsibility for site-wide corrective action in May of 2002.

Facility Property

The facility currently owns 146 acres of land. The facility is bordered on the north by the Seaboard Coastline Railroad and on the south by State Road 441. Along the northern property boundary beyond the Seaboard Coastline Railroad and south of State Road 441 are residential developments. Cellon Creek parallels the eastern and southeastern property boundaries. Beyond Cellon Creek towards the east is undeveloped land, while towards the southeast is the community of Hague, with low density housing. The western and northeastern portion of the facility is bordered by undeveloped land.

Biological Sampling Events

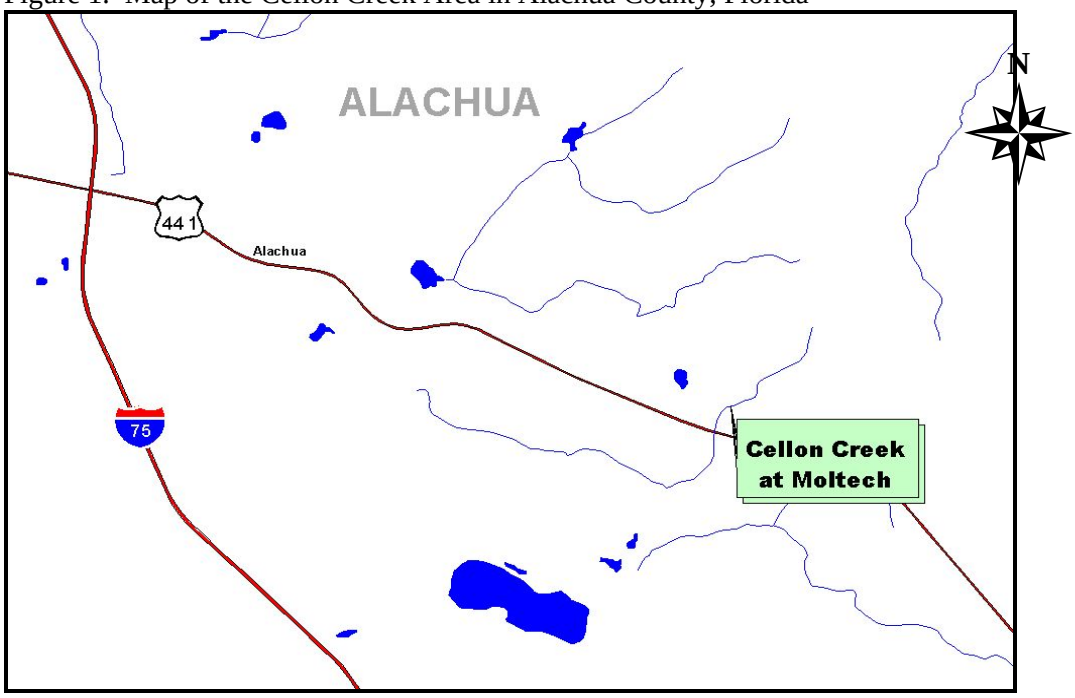
Cellon Creek flows along the eastern edge of the Moltech property in Alachua County. Cellon Creek, northeast and upstream of the MPS property is fed primarily by surface water and groundwater. Cellon Creek, on-site of the MPS property, is fed primarily by a drainage ditch that currently contributes 200,000 gallons per day of non-contact cooling tower waters from the MPS facility. The non-contact cooling waters originate in the Floridan aquifer system via the two on-site production wells and pass through the manufacturing system boiler pipes as a coolant for the system. The non-contact cooling waters never come in contact with external manufacturing operations. In July 2002, the FDEP RCRA Program requested that the FDEP Bureau of Laboratories conduct a biological assessment study of Cellon Creek to determine if there were any surface water quality or biological effects from MPS or former owner manufacturing activities.

Bureau of Laboratories staff (Amy Wheeler, Russ Frydenborg, Tom Frick, and Mike Heyn) conducted a biological assessment of Cellon Creek on July 24, 2002. Two sampling locations were established for the study: the Test Site was in Cellon Creek downstream of the confluence with the drainage ditch, and the Control Site was in Cellon Creek upstream of the confluence with the drainage ditch (Figure 1). The study consisted of stream condition index (SCI) and chemical sampling, habitat assessment, and meter readings of physical-chemical parameters

RCRA staff requested that additional confirmatory sampling be performed in May of 2003. Bureau of Laboratories staff conducted another biological assessment of Cellon Creek on May 5, 2003. In the second event, the Test Site and Control Site were essentially the same as in the July 2002 event. A third sampling point in the drainage ditch, prior to its confluence with Cellon Creek, was added for water and sediment chemistry samples, toxicity tests, and physical/chemical

parameters; this site is referred to as the Effluent Site. All sampling activities were conducted according to the FDEP Standard Operating Procedures for Field Activities (DEP-SOP-001/01).

Figure 1. Map of the Cellon Creek Area in Alachua County, Florida



Results

July 2002 Results

In July 2002, the stream condition index (SCI) score for the Control Site (31) in Cellon Creek was in the "excellent" range for the Florida peninsula; the SCI score for the Test Site (19) was in the "poor" range (Table 1). The habitat assessment total scores for the Control Site and the Test Site were both in the "optimal" range, with the Test Site score slightly higher than the Control Site score. Thus, habitat condition was not a limiting factor for benthic macroinvertebrates during the sampling and was not expected to have contributed to the difference in SCI scores between the two locations.

Nitrate concentrations at both the Control Site and Test Site were above the natural background range for Florida streams, although the concentrations at the two sites were similar to each other (Table 2). Cadmium and zinc in Cellon Creek were elevated at the Test Site compared with the Control Site concentrations. The Class III water quality standards for cadmium and zinc were calculated based on the hardness of the water; hardness was calculated using calcium and magnesium concentrations (see Table 3).

The cadmium concentration at the Test Site was 2.5 ug/L, slightly exceeded Class III water quality standard for cadmium (2.37 ug/L) based on the hardness. The Test Site zinc concentration was 84.9 ug/L. This complied with the Class III water quality standard of 234.43 ug/L.

May 2003 Results

In May 2003, the Stream Condition Index (SCI) score for the Control Site (25) in Cellon Creek was in the "good" range for the Florida peninsula, while the SCI score for the Test Site (27) was in the "excellent" range (Table 4). The habitat assessment total scores for the Control Site and the Test Site (120 and 121, respectively) were both in the low "optimal" category.

Nitrate-nitrite concentrations at the Control Site, Test Site, and Effluent Site were above the natural background range for Florida streams, although the concentrations at the three sites were in the same range, indicating no enrichment attributable to the facility (Table 5).

For the May 2003 sampling event, cadmium and zinc concentrations for surface water quality at the Test Site were again slightly elevated compared with the Control Site. The Test Site cadmium concentration (1.9 ug/L) did not exceed the hardness-based Class III water quality standard (2.49 ug/L). Similarly, the zinc concentration at the Test Site complied with the Class III water quality standard.

Sediment samples were collected from the Control Site, Test Site, and Effluent site in May 2003 (Table 6). At the Test Site, the concentrations for cadmium and nickel were 8.7 mg/kg and 30.3 mg/kg, respectively. At the Effluent Site, the concentrations for cadmium and nickel were 1.9 mg/kg and 7.03 mg/kg, respectively

Chronic toxicity screening tests were done with both freshwater fish and freshwater invertebrates on Effluent Site water for the May 2003 sampling event. In the freshwater fish tests, there was no significant difference between the survival in the controls and survival in the 100% Effluent Site water concentration. The biomass (mean dry weight 0.696 mg/organism) in the 100% Effluent Site concentration was significantly less than the biomass in the controls (mean dry weight 0.792 mg/organism). In the freshwater invertebrate tests, there was no significant difference in survival between the control organisms and the organisms in the 100% Effluent Site water sample. There was a significant difference in reproduction between the controls (mean 22.1 neonates/adult) and the 100% Effluent Site sample (mean 9 neonates/adult).

November 2003 Results

At the request of the DEP RCRA Section, Moltech contracted with WRS Infrastructure and Environment, Inc., to collect water and sediment from the Moltech discharge ditch and in Cellon Creek in November, 2003. The sediment stations sampled were as follows ("A" samples at each station were taken at the sediment surface, "B" samples were collected 5 cm below the sediment surface):
CSS-1: Cellon Creek, approximately 400 m south of us 441.
CSS-2: Cellon Creek, approximately 40 m south of us 441.
CSS-3: Cellon Creek, approximately 150 m south of the confluence of the Moltech discharge ditch and Cellon Creek
CSS-4: Moltech discharge ditch, immediately upstream of the confluence of the Moltech discharge ditch and Cellon Creek.

CSS-5: Cellon Creek, immediately downstream of the confluence of the Moltech discharge ditch and Cellon Creek.
CSS-6: Moltech discharge ditch, approximately 50 m downstream of weir.

Surface water was sampled by WRS at the discharge weir and the Effluent Site, the Moltech discharge ditch immediately upstream from the confluence with Cellon.
In November, 2003, sediments at CSS-1 through CSS-5, exceeded the Threshold Effect Level for cadmium (Figure 2). Sediment cadmium exceeded the Probable Effect Level in Cellon Creek immediately downstream of the Moltech discharge ditch (CSS-5). Sediment nickel at this site also exceeded the TEL. Effluent samples collected in November, 2003, were not chronically toxic to fish or water fleas in chronic toxicity tests conducted by the Bureau of Laboratories. Water column cadmium was measured at the weir (1.6 ug/L) and the Effluent Site (1.7 ug/L). Assuming a hardness of 271.9 mg $CaCO_3$/L, which was the hardness found at the Effluent Site in May, 2003, the resulting cadmium water quality standard would be 2.48 ug/L). If the assumed hardness is indeed correct, then the Class III water quality standards for cadmium were not exceeded in the November sampling.

Analysis of Results and Conclusions

In July 2002, the invertebrate community at the Cellon Creek Test Site was degraded compared with the upstream Control Site, potentially caused by an exceedance of Class III water quality standards for cadmium. Data collected later suggests that this water quality exceedance may be due in part to releases of cadmium from the sediments at the Test Site

In May 2003, the biological community downstream of the MPS discharge no longer showed this degradation, and all water column metals complied with Class III water quality standards.

Chronic toxicity tests on water from the Effluent Site showed reduced body weight in fish and reduced reproduction in invertebrates as compared to controls, both indicators of chronic toxicity. The May 2003 Effluent Chronic Toxicity test results suggest that the effluent, although not acutely toxic, the facility is in non-compliance with Class III water quality standards for chronic toxicity. Follow up toxicity tests in November, 2003, indicated that the Moltech effluent was not acutely or chronically toxic.

In May, 2003, the FDEP Sediment Guidance concentration Probable Effect Level (PEL) for cadmium (4.98 mg/kg) was exceeded at the Test Site, where the concentration was 8.7 mg/kg. In November, 2003, sampling by WRS indicated that sediment cadmium at CCS-5, located at the same location as DEP's Test Site, was 6.6 mg/kg, again exceeding the PEL. This suggests the sediments at the Test Site location may be chronically toxic to infaunal organisms. Additionally, when sediments are re-suspended (during floods for example), it is possible that epi-faunal invertebrates living on snags, roots, and leaf packs would be exposed to potentially toxic concentrations of cadmium.

In May, 2003, the FDEP Sediment Guidance consensus-based Threshold Effect Level (TEL) for cadmium (0.99 mg/kg) and nickel (22.7 mg/kg) were exceeded at the Test Site. While non-problematic at the Control Site, cadmium, zinc, and nickel levels at the Test Site and the Effluent Site indicated anthropogenic enrichment (above the 95% prediction levels when normalized to

aluminum) (see methodology in Alexandra *et al.* 2002). This means that the proportions of those three metals in the sediment exceeded expected natural concentrations. For all three metals, concentrations in the Test Sites sediment exceeded the Effluent Site concentrations. In November, WRS data indicated that sediment cadmium was elevated above the TEL in the Moltech discharge ditch and in four Cellon Creek stations, as far as 400 m south of US 441. Sediment nickel also exceeded the TEL in Cellon Creek downstream of the discharge ditch in the November, 2003 sampling.

These data indicate accumulation of cadmium, zinc, and nickel in Cellon Creek sediments downstream of the drainage ditch from Moltech.

Table 1. July 2002 Biology, Habitat, and Meter Data from Cellon Creek

Cellon Creek at Moltech		
Biological Community and Physical Data		
	Control Site	**Test Site**
Sampling Date	7/24/2002	
WBID	3678	
Dissolved Oxygen (mg/L)	7.4	7.3
pH	7.7	7.5
Specific Conductance (umhos/cm)	415	522
Temperature (deg. C)	23.1	25.3
Total Habitat Score	130	135
SCI Score	31	19
Peninsula Evaluation	Excellent	Poor
Number of Taxa	26	15
EPT Index	4	0
% Contribution Dominant Taxon	23.36	38.78
Florida Index	11	13
% Diptera	25.23	25.51
Total Number of Chironomidae Taxa	12	6
% Filter-Feeders	17.76	1.02

Table 2. July 2002 Chemistry Data from Cellon Creek

Cellon Creek at Moltech Chemistry Data		
	Control Site	Test Site
Sampling Date	7/24/2002	
WBID	3678	
Ammonia (mg N/L)	0.027 Y	0.017 I,Y
Nitrite (mg N/L)	0.021 Q	0.009 I,Q
Nitrate (mg N/L)	1 Q	0.96 Q
TKN (mg N/L)	0.37 A,Y	0.22 Y
Total Phosphorus (mg P/L)	0.32 A,Y	0.23 Y
Sulfate (mg SO4/L)	16	88
TDS (mg/L)	244	336 A
TSS (mg/L)	4 U	4 U
Turbidity (NTU)	1.8	1.2
TOC (mg C/L)	5.6 Y	3.6 I,Y
Alkalinity (mg CaCO3/L)	160	169
Chloride (mg Cl/L)	28	17
Arsenic (ug/L)	1.1 U	1.3 I
Cadmium (ug/L)	0.027 I	2.5
Lead (ug/L)	0.13 I	0.21 I
Aluminum (ug/L)	105	80
Barium (ug/L)	10	10.3
Calcium (mg/L)	43	68.9
Copper (ug/L)	2 U	6 I
Iron (ug/L)	106	80
Magnesium (mg/L)	19.8	20.2
Manganese (ug/L)	13.5	10.8
Nickel (ug/L)	1.5 U	3.4 I
Potassium (mg/L)	13.3	5.6
Sodium (mg/L)	10.3	16.8
Vanadium (ug/L)	6	10.3
Zinc (ug/L)	2 U	84.9

Table 3. Calculated Class III Surface Water Standards for Metals in ug/L for Cellon Creek

Label:	Hardness*	Cd Standard	Cu Standa	Pb Standard	Zn Standard	Ni Standard
Control - July 2002	188.9074	1.869058738	16.06518	7.150055327	205.3913147	89.34483003
Test - July 2002	255.2269	2.367177931	26.3316	10.48725499	234.4555921	348.3338638
Control - May 2003	182.1917	1.816683642	19.74151	6.82806042	176.2047823	261.90459
Test - May 2003	272.1099	2.48927866	27.81299	11.37821173	247.5316291	367.730488
Effluent - May 2003	271.9478	2.488114212	27.79883	11.36958381	247.406682	367.5451525

Table 4. May 2003 Biology, Habitat, and Meter Data from Cellon Creek

Cellon Creek at Moltech Biological Community and Physical Data			
	Control Site	**Test Site**	**Effluent**
Sampling Date	5/5/2003		
WBID	3678		
Dissolved Oxygen (mg/L)	7.6	7.6	7.5
pH	7.7	7.2	7.7
Specific Conductance (umhos/cm)	390	539	561
Temperature (deg. C)	20.8	25.6	26.3
Total Habitat Score	120	121	
SCI Score	25	27	
Peninsula Evaluation	Good	Excellent	
Number of Taxa	25	39	
EPT Index	2	3	
% Contribution of Dominant Taxon	20.91	9.80	
Florida Index	14	19	
% Diptera	58.18	51.96	
Total Number of Chironomidae Taxa	12	15	
% Filter-Feeders	26.36	6.86	

Table 5. May 2003 Water Chemistry Data from Cellon Creek

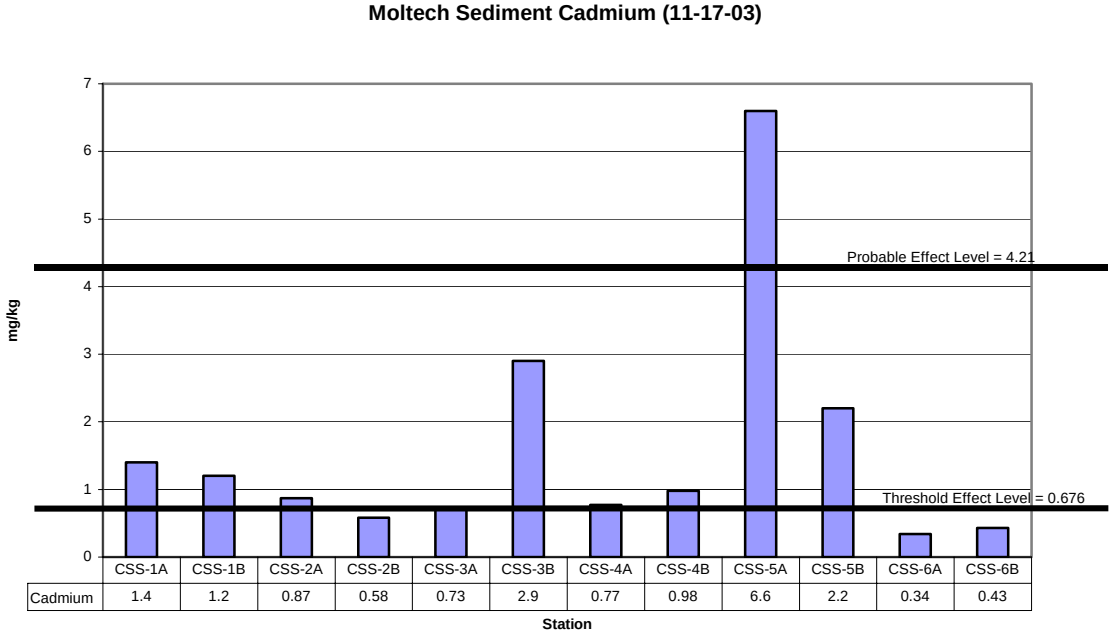
Cellon Creek at Moltech Water Chemistry Data			
	Control Site	**Test Site**	**Effluent**
Sampling Date	5/5/2003		
WBID	3678		
Ammonia (mg N/L)	0.052	0.019 I	0.042
Nitrate + Nitrite (mg N/L)	0.78	0.91	0.87
TKN (mg N/L)	0.3	0.12 I	0.15 I
Total Phosphorus (mg P/L)	0.23	0.26 A	0.23
Hardness (mg CaCO3/L) - calculated	182.2	272.1	271.9
Arsenic (ug/L)	1 U	1 U	1 U
Cadmium (ug/L)	0.025 U	1.9	1.7 A
Lead (ug/L)	0.14 I	0.1 U	0.1 U
Aluminum (ug/L)	186	40 I	23 I
Barium (ug/L)	9.9	10.3	10 A
Calcium (mg/L)	41.3	78.3	78.4 A
Copper (ug/L)	3 U	6.5 I	6.7 I
Iron (ug/L)	220	54	48 A
Magnesium (mg/L)	19.2	18.6	18.5 A
Manganese (ug/L)	23.5	6.6	4.7 A
Nickel (ug/L)	2 U	3.5 I	3.6 I
Potassium (mg/L)	7.5	0.87	0.87 A
Sodium (mg/L)	10.4	19.6	19.1 A
Vanadium (ug/L)	4.9	5.6	4.5 A
Zinc (ug/L)	3 U	12 I	11 I

Table 6. May 2003 Sediment Chemistry Data from Cellon Creek

Cellon Creek at Moltech Sediment Chemistry Data			
	Control Site	Test Site	Effluent
Sampling Date	5/5/2003		
WBID	3678		
Arsenic (mg/kg)	0.99 U	1 U	0.94 U
Cadmium (mg/kg)	0.48	8.7 A	1.9
Lead (mg/kg)	2.4 I	2.9 I	1.1 I
Aluminum (mg/kg)	3750	2820 A	1030
Barium (mg/kg)	23.1	19.4 A	7.09
Calcium (mg/kg)	7080 J	5910 A,J	4310 J
Copper (mg/kg)	1.3 I	7.2 A	4.2
Iron (mg/kg)	2390	1160 A	303
Magnesium (mg/kg)	525 J	399 A,J	118 J
Manganese (mg/kg)	94.6	40.3 A	13.9
Nickel (mg/kg)	2.12	30.3 A	7.03
Potassium (mg/kg)	108 J	69 A,J	30 J
Sodium (mg/kg)	73 I	57 I	58 I
Vanadium (mg/kg)	8.78	9.58 A	4.27
Zinc (mg/kg)	6.9	44.3 A	17.3

Figure 2. Sediment cadmium data collected on 11-17-03 by WRS in the Moltech discharge ditch and in Cellon Creek ("A" samples at each station were taken at the sediment surface, "B" samples were collected 5 cm below the sediment surface).

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Literature Cited

Alexandra, C, S. J. Schrop, G. M. Sloane, T. P. Biernacki, and T. L. Seal. 2002. Development of an interpretive tool for assessment of metal enrichment in freshwater sediments. FDEP. 61 pp.