Final Report for Sediment Sampling and Chemical Analysis at the Union Ship Canal in Buffalo, New York Volume I - Technical Report

JANUARY, 2000 (FINAL REVISION, NOVEMBER, 2000)

Contract No. DACW49-97-D-0006
Delivery Order No. 0026

Prepared for:
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3119

by
PADIA Environmental Inc.
65 East Wilson Bridge Road
Suite A
Worthington, [illegible]

PADIA Environmental

January 6, 2000

Mr. David Melfi
Project Manager
Environmental Section
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207-3199

RE: TRANSMITTAL OF FINAL REPORT FOR THE UNION SHIP CANAL SAMPLING PROJECT

Dear Mr. Melfi:
Please find enclosed two (2) copies of the Final Technical Report Volume I on Sediment Sampling and Chemical Analysis Report, one (1) copy of Volume II Laboratory Analysis Report, and one (1) electronic file diskette for the Union Ship Canal sampling project in Buffalo, New York. We have included revisions to the draft report as per your comments. These copies are submitted as the final report. If you have any question(s) please do not hesitate to contact me at 614-885-9955. Thank you for giving PADIA the opportunity to assist the Buffalo District of the U.S. Army Corps of Engineers in conducting this investigation.

Sincerely,

Mikail Suleiman
Field Engineer

Enclosures (3)

65 E Wilson Bridge Rd Suite A / Worthington, OH 43085
614-885-9955 / FAX 614-848-4438
padiaenvironment@mindspring.com
www.padiaenvironmental.com

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1.0 INTRODUCTION

PADIA Environmental Inc. (PADIA) has prepared this report to document field activities associated with sediment sample collection and present the results of laboratory analyses for sampling performed at locations at the Union Ship Canal in Buffalo, New York. (Figure 1, Site Location Map). This effort was conducted by a sampling team from the U.S. Army Corps of Engineers (USACE), Buffalo District Office, according to the work statement provided by the USACE Buffalo District Office as part of Delivery Order No.0026 of Contract DACW49-97-D-0006.

PADIA's responsibilities for this task included coordinating laboratory analyses of sediment sample collected and report preparation. Field activities were coordinated by Mr. David Melfi, the Project Manager for the USACE, Buffalo District Office. Laboratory analyses and Quality Assurance issues raised by Mr. Fred Kozminski, the Project Chemist for USACE, Buffalo District Office were addressed by Severn Trent Laboratories Inc, formerly known as CORE Laboratory Inc. The USACE, Buffalo District Office provided the sampling personnel, boat and sampling equipment needed to perform sample collection on November 15, 1999.

2.0 FIELD PROCEDURES

2.1 Sample Locations

Samples were collected at locations specified by the USACE Buffalo District Project Manager. The latitude and longitude of sample locations were not recorded due to a problem encountered with the Global Positioning Satellite System (GPSS) instrument on board the sampling boat. Provided in Table A, is summary of Field Notes for the Union Ship Canal sampling activities. Sample location points recorded in field note book are shown in Figure 2. All samples were collected as close to the designated sample location point as possible.

2.2 Water Sample Collection

No water samples were collected from the sample location at the Union Ship Canal area because it was not a requirement in the work statement provided by the USACE, Buffalo District Office for this task.

FIGURE 1 - Location of the Union Ship Canal

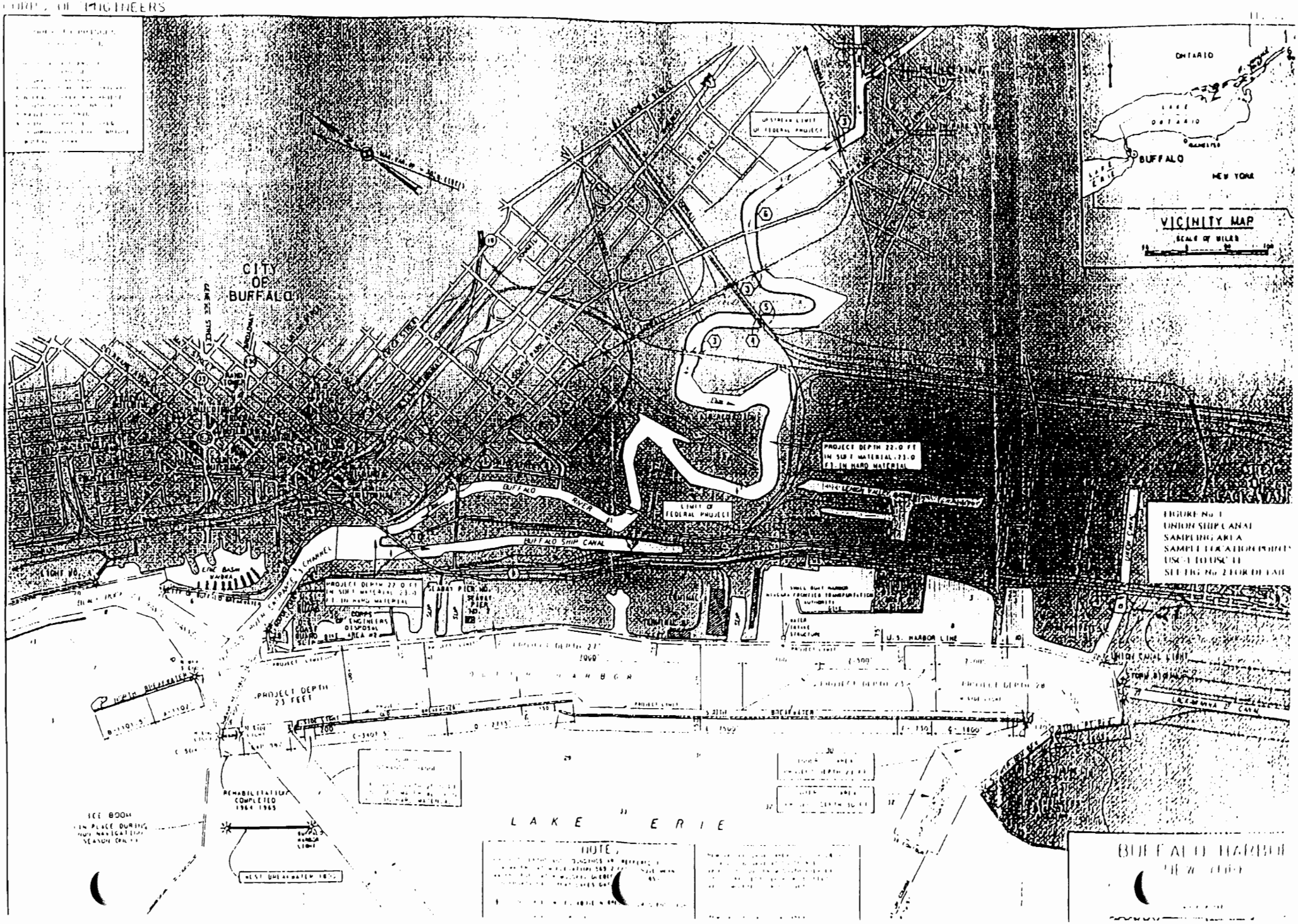
CITY OF BUFFALO
BUFFALO RIVER
BUFFALO SHIP CANAL
LIMIT OF FEDERAL PROJECT
PROJECT DEPTH 22.0 FT IN SOFT MATERIAL, 23.0 FT IN HARD MATERIAL
PROJECT DEPTH 23 FEET
LAKE ERIE
ONTARIO
BUFFALO
NEW YORK
VICINITY MAP
SCALE OF MILES
FIGURE No. 1
UNION SHIP CANAL
SAMPLING AREA
SAMPLE LOCATION SITES
USGS TO USCE
SEE FIG No. 2 FOR DETAIL
NOTE:

FIGURE 2 - Union Ship Canal Sample Location

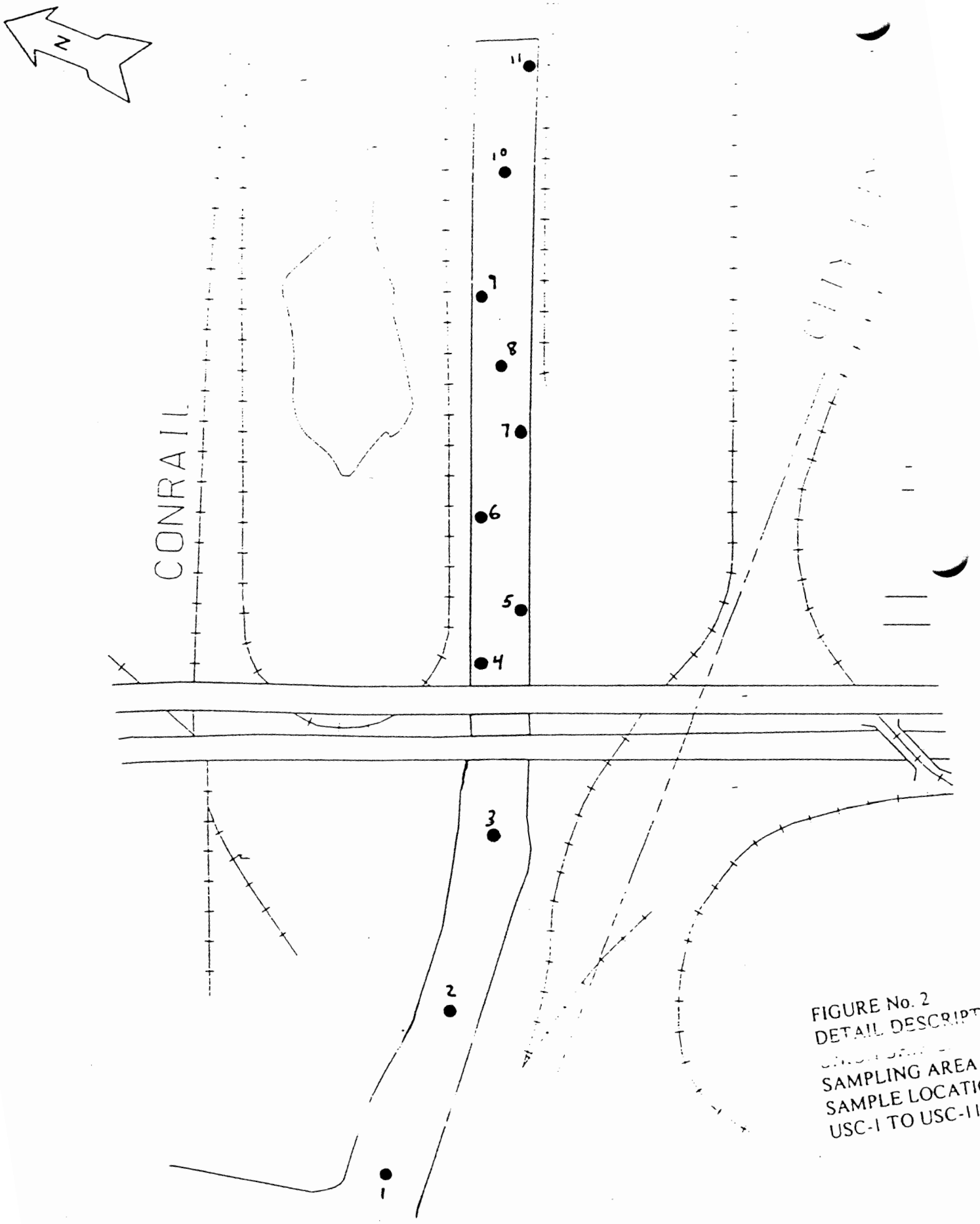

FIGURE No. 2
DETAIL DESCRIPTION

SAMPLING AREA
SAMPLE LOCATION
USC-I TO USC-II

TABLE A - Summary of Field Notes for Union Ship Canal Sediment Sample Collection

SAMPLE NO.	DEPTH (FEET)	DATE	NOTES
USC-1	26.0	11/15/99	Light brown / gray clay. At channel opening.
USC-2	23.0	11/15/99	Light brown / gray clay. Outfall on north side of channel. Zebra mussels with oil sheen.
USC-3	22.0	11/15/99	Light brown / gray clay. 5th Ballard west of Route 5. Zebra mussels was observed.
USC-4	22.0	11/15/99	Brownish clay mixed w / vegetation and zebra mussels. 30th Ballard.
USC-5	20.0	11/15/99	Soft light gray clay. less dense. 26th Ballard.
USC-6	23.0	11/15/99	Brown gray silty clay w/some sand. Sediment has petroleum sheen odor. 21st Ballard.
USC-7	23.0	11/15/99	Brown gray silty clay w/some sand. Sediment has petroleum sheen odor. 17th Ballard.
USC-8	22.0	11/15/99	Brown gray silty clay w/some sand. Sediment has petroleum sheen odor. 13th Ballard.
USC-9	17.0	11/15/99	Dark gray w/ some brown sandy silt clay, has petroleum sheen odor. 11th Ballard from east Side.
USC-10	23.0	11/15/99	Dark gray silty clay w/ petroleum odor. 8th Ballard from east side of channel.
USC-11	18.0	11/15/99	Dark gray silty sand w/ some vegetation oil sheen odor, rotten vegetation odor. 4th Ballard from east side of channel.

NOTES

1. Weather: Cool and windy

2.3 Sediment Sample Collection

Sediment samples were obtained using a Petite Ponar Dredge to collect sample at all sample locations. At each sample location, grab samples were collected and homogenized in a stainless steel bowl with a stainless steel sp then placed in sample jars and sealed with a lid. A final check was made on the labels and the samples arranged and stored in a cooler box. Each sample was identified by sample location number. Each soil sample comprised of the following jars:

1 - 8 oz. soil jar for metals and inorganic analyses.
1 - 8 oz. soil jar for organic analysis.

2.4 Equipment Decontamination

Equipment decontamination was performed to ensure that sediment sampling equipment was rinsed clean of residual sediment prior to subsequent sampling at each sampling location. This involved rinsing the stainless st bowl, spoon, and the Petite Ponar Dredge with site water at the completion of sampling at each sample location

2.5 Sample Custody and Shipment

Sample bottles had the appropriate labels and were pre-labeled to indicate analysis to be performed. When the sample jar was filled the following information was noted on the label in indelible ink:

Sample Location
Sample Identification Number
Sample Collection Date
Analytical Parameters
Samplers Initials

Sample bottles were returned to the storage cooler and kept cool with ice until final preparation for shipping. Samples were prepared and shipped to Severn Trent Laboratory in Houston,Texas, following the guidelines provided in the Buffalo COE HTRW Standard Operating Procedure (SOP)and included the following steps:

- Sample label information checked for completeness
- Sample bottle label covered with clear tape
- Tag fastened to bottle indicating Sample ID & analysis type
- Bottle placed in ZipLoc™ bag or sealed in bubble wrap bag
- Sample bottles placed in coolers to distribute the weight evenly and reduce the potential for breakage
- Sample bottles in each cooler noted on Chain-of-Custody (CoC) indicating the analysis required
- CoC release signed and dated, pink copy removed, and CoC and completed cooler inspection form sealed in in top of cooler
- Fresh ice contained in ZipLoc™ bags placed in coolers
- Coolers closed and sealed with signed and dated Custody Seals placed as per the SOP
- Coolers labeled for shipment, label attached, and cooler taped shut with strapping tape
- Cooler drain taped shut with strapping tape

2.6 Sample Identification Numbers

Samples were identified in the field based on the prescribed location numbers selected by the Project Manager, and as provided in the Work Statement provided by the USACE, Buffalo District Office. The basic sample identification abbreviation relates to the facility being sampled - Union Ship Canal - USC. The number following the abbreviation for Union Ship Canal, USC is the numeric designator for the sample location assigned by the Project Manager.

For Example:

USC- 4 = Soil sample location number four (4) at the Union Ship Canal

3.0 SOIL SAMPLE CHARACTERIZATION

3.1 Chemical Analyses

Sediment samples collected with the Petite Ponar Dredge and observed in stainless steel bowl were predominantly dark gray silty clay to brown silty clay mixed with some sand and decayed vegetation. Sediment sample depths and physical characteristics are noted in Table A.

Soil samples were analyzed by Severn Trent Laboratory in accordance with the analyses listed in the Work Statement or as directed by Mr. Fred Kozminski, the Buffalo COE Project chemist. The analyses and methods for sediment samples included:

ANALYTE	PREP. METHODS	ANALYSIS METHOD
Pesticides and Polychlorinated Biphenols (PCBs)	3510(water)/ 3550(solids)	8081/ 8082
Polynuclear Aromatic Hydrocarbons (PAHs)	3510(water)/ 3550(solids)	8310/8270
TAL Metals	3010 (ICP), 3020 (GFAA), 3050 (solids)	6010/7000
Oil and Grease	none	413.2
Ammonia	none	350.1

Results of the soil sample analyses are summarized in tables and are included in Appendix B. The actual Severn Trent Laboratory Analytical Data Package are contained in Volume II of this report . The following paragraphs describe the chemical characteristics of the sediment as determined from the sample analyses:

3.2 PCBs in Sediment

Chemical analyses were performed on sediment samples collected from the Union Ship Canal Area at sample locations (USC-1 to USC-11). Based on the analyses performed, sediment samples indicated the presence of Aroclor 1254 and Aroclor 1260 in several samples. The following table summarize the PCB occurrences in the sediment samples. Actual sample results are provided in Appendix B.

TABLE B: Sediment Samples with Detected PCB Concentrations
All results in table are provided in parts per billion (ppb)

SAMPLE	USC-2	USC-3	USC-5	USC-6	USC-7	USC-8	USC-9	USC-10	USC-11
Aroclor 1254	79	79				781			
Aroclor 1260		56	102	247	168	559	305	331	126

TABLE B (1): Duplicate Sediment Samples with Detected PCB Concentrations
Results in table are provided in parts per billion (ppb)

SAMPLE	USC-9D
Aroclor 1254	
Aroclor 1260	290

3.3 PAHs in Sediment

PAHs concentrations in sediment samples analyzed are dispersed across the sample area. PAHs were detected at all sample locations. Total PAHs concentrations at some location are quite high. Sediment sample analyses are summarized and attached in Appendix B.

3.4 Metals in Sediment

Most of the TAL metals were detected in the sediment samples collected. Please refer to the summary tables of the metals analyses in Appendix B for information on the concentrations of the various TAL metals. Beryllium, Mercury, Selenium, Silver, Thallium and Sodium were the only metals not detected above the detection limit in the sediment sample. Please refer to the summary tables in Appendix B of the metal analyses for sediment sample.

3.5 Inorganic Analyses of Sediment

All of the sediment samples analyzed reported detectable concentrations for Ammonia - N, and Oil and Grease. As per the work statement, analysis for oil and grease was not performed on the collected duplicate sample at sample location number USC-9D. Please refer to the summary table of the inorganic analyses for the sediment samples in Appendix B for details on the inorganic characteristics.

TABLE C - Metal Concentrations in Union Ship Canal Area

METALS	UNITS	USC-1	USC-2	USC-3	USC-4	USC-5	USC-6	Mean	Average
Al	mg/kg	13300	13300	12300	8420	14900	16400	12800	13000
Sb	mg/kg	U 0.64	U 0.61	B 0.46	B 0.35	B 0.41	B 1.0	0.51	.55
As	mg/kg	10.3	13.1	12.5	10.4	14.9	26.7	13.8	14.6
Ba	mg/kg	76.6	79.9	72.6	66.2	89.2	95.1	79.3	80.0
Be	mg/kg	0.27	0.42	0.33	0.14	0.36	1.1	0.36	0.44
Cd	mg/kg	1.4	0.97	0.77	1.5	2.1	4.1	1.5	1.8
Ca	mg/kg	29000	45200	37600	54400	47000	56900	43900	45000
Cr	mg/kg	41.6	51.2	43.8	22.2	28.5	70.1	40.1	42.9
Co	mg/kg	10.5	11.7	9.8	6.4	10.0	12.8	10.0	10.2
Cu	mg/kg	36.3	59.5	53.5	41.8	64.7	122	58.0	63.0
Fe	mg/kg	39100	47300	55100	31500	45900	92500	48900	51900
Pb	mg/kg	35.6	105	113	92.7	119	857	126	220
Mg	mg/kg	7150	7920	7050	5940	7970	9430	7500	7580
Mn	mg/kg	1070	1190	961	1050	1130	1920	1190	1220
Hg	µg/kg	B 144	B 371	B 224	B 123	B 217	B 329	217	235
Ni	mg/kg	31.0	35.1	31.1	21.8	31.5	47.4	32.1	33.0
K	mg/kg	2770	1880	2180	2130	1510	1920	2030	2060
Se	mg/kg	1.0	0.76	0.98	1.4	1.8	1.7	1.2	1.3
Ag	mg/kg	B 0.41	1.1	0.86	1.1	0.69	3.0	0.98	1.2
Na	mg/kg	254	251	243	432	433	310	311	321
Th	mg/kg	0.51	U 0.16	U 0.17	U 0.17	U 0.19	0.80	0.64	0.66
V	mg/kg	32.5	36.9	33.2	22.2	36.0	50.8	34.3	35.3
Zn	mg/kg	228	547	599	391	400	753	454	486

TABLE C - Metal Concentrations in Union Ship Canal Area, (Continued)

METALS	UNITS	USC-7	USC-8	USC-9	USC-9D	USC-10	USC-11	Mean	Average
Al	mg/kg	14900	6830	10700	14200	15500	8660	11300	11800
Sb	mg/kg	B 0.32	U 0.64	U 0.68	U 0.81	B 0.50	U 0.60	0.40	0.41
As	mg/kg	18.2	13.9	15.0	20.3	15.9	13.2	15.9	16.1
Ba	mg/kg	87.3	52.2	84.7	111	96.3	77.3	82.7	84.8
Be	mg/kg	0.45	0.49	0.66	0.82	0.64	0.48	0.58	0.59
Cd	mg/kg	1.1	3.0	2.0	2.4	2.1	2.0	2.0	2.1
Ca	mg/kg	34000	33900	42400	51800	44300	42400	41000	41500
Cr	mg/kg	28.6	33.8	34.8	44.0	41.8	32.8	35.6	36.0
Co	mg/kg	12.2	5.4	8.7	10.9	11.6	7.5	9.0	9.4
Cu	mg/kg	82.8	71.4	82.7	128	90.4	73.8	86.5	88.2
Fe	mg/kg	44800	107000	64400	84600	57200	64600	67700	70400
Pb	mg/kg	161	9.9	369	418	308	232	161	250
Mg	mg/kg	7930	5190	7630	9250	8490	5420	7150	7320
Mn	mg/kg	920	1480	1230	1490	1090	1330	1240	1260
Hg	µg/kg	B 241	B 409	B 396	B 448	B 318	B 251	334	344
Ni	mg/kg	37.0	19.8	29.9	37.3	39.4	28.2	31.1	31.9
K	mg/kg	2660	1940	1930	2700	2430	1370	2110	2170
Se	mg/kg	1.6	2.3	1.6	2.2	2.2	1.6	1.9	1.9
Ag	mg/kg	B 0.41	2.3	1.1	1.6	1.1	1.3	1.2	1.3
Na	mg/kg	354	305	276	350	336	309	320	322
Ti	mg/kg	U 0.18	1.7	1.1	0.99	0.96	0.60	1.0	1.1
V	mg/kg	2435.0	25.1	33.8	43.0	40.0	29.6	68.7	434
Zn	mg/kg	542	2480	1030	1240	993	741	1040	1170

4.0 QUALITY CONTROL SUMMARY

This section describes the quality control checks performed for the Union Ship Canal sediment sample analyses in conjunction with PADIA Environmental and the U.S. Army Corps of Engineers. The summary of the laboratory analytical process is broken down into the following five discussions: (1) Accuracy, (2) Precision, (3) Laboratory Contaminants, (4) Field Contamination, and (5) Holding Times. Note that for these sediment samples, the detection limits have been adjusted to reflect the dry weight values based upon the MDL studies.

4.1 Accuracy

In order to assess analytical accuracy of the various procedures used in the laboratory, a number of quality control checks were analyzed including matrix spikes, matrix spikes duplicates, surrogate and laboratory control samples.

Surrogate Recoveries

1) **PCBs (Method 8082):** All surrogate recoveries were within range.

3) **PAHs** (Method 8270): All surrogate recoveries were within range.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

All batch MS/MSD samples were analyzed in accordance with the methodologies.

Laboratory Control Samples (LCSs)

1) **PCBs (Method 8082):** All parameters within acceptable range.

2)**PAHs (Method 8270):** All parameters within acceptable range.

3)**Metals:** All parameters within acceptable range.

4)**Inorganic:** All parameters within acceptable range.

4.2 Precision

Matrix Spike/Matrix Spike Duplicates

During analysis, the laboratory designated MS/MSD for samples collected. All batch MS/MSD samples were analyzed in accordance with the methodologies. The PCB results failed in accuracy. The control sample verified matrix interference.

Laboratory Duplicates

During laboratory analysis, the laboratory designated MS/MSD for samples collected. All batch MS/MSD samples were analyzed in accordance with the methodologies.

4.3 Laboratory Contaminants

1)**PCBs (Method 8082):** All results for laboratory reagent blanks were below reporting limits

2)**PAHs (Method 8270):** All results for laboratory reagent blanks were below reporting limits.

3)**Metals:** All results for laboratory reagent blanks were below reporting limits.

4)**Inorganics:** All results for laboratory reagent blanks were below reporting limits.

4.4 Field Contamination

No problems to report.

4.5 Holding Times

All holding times for sample extractions /analysis were met for the project.

APPENDIX A - Field Notes

S 11 - DARK GRAY SILTY SAND; SOME LESS DENSE
OIL SHEEN/ODOR; NONE VEGETATION SMELL
15th & 11th BALLARD FROM EAST SIDE OF CHANNEL

S-10 - 23' DEEP DARK GREY SILTY CLAY
PETROLEUM SCENT + SHEEN
5TH BALLARD FROM EAST SIDE OF CHANNEL

S-9 - 11TH BALLARD FROM EAST SIDE
DARK GREY WITH SOME BROWN SANDY SILT CLAY
17' DEEP, PETROLEUM SHEEN/ODOR

S-8 13TH BALLARD FROM EAST SIDE - 22' DEEP
BROWN TO GREY SILTY CLAY W/SOME SAND
PETROLEUM SHEEN/ODOR

S-7 23' - 17TH BALLARD
SEDIMENTS SAME

S-6 23' 21ST BALLARD
SEDIMENTS SAME

S-5 22' DEEP 26TH BALLARD
LIGHT GRAY CLAY - LESS DENSE MORE LIQUID

S-4 30TH BALLARD - 22' DEEP
VEGETATION - ZEBRA MUSSELS
BROWN SILT

S-3 LIGHT BROWN/GRAY SAND 23 FEET
5TH BALL AND WEST OF RT 5
ZEBRA MUSSELS

S-2 - OUTFALL ON N SIDE OF CHANNEL 13 FEET
SAME AS S-3 - MUSSELS
OIL SHEEN

S-1 - AT CHANNEL OPENING - 26 FEET DEEP
SAME SEDIMENTS

APPENDIX B - Sediment Sample Analytical Results

Summary Table for Analytical Data for Inorganic Material from the Union Ship Canal

INORGANIC MATERIAL	SAMPLE #	USC-1	USC-2	USC-3	USC-4	USC-5	USC-6
	UNITS						
AMMONIA N	mg/kg	35.9	54.8 [f]	43.4 [e]	46.8 [e]	52.0 [f]	36.8 [g]
OIL & GREASE	mg/kg	516	1400 [a]	1600 [a]	910	839	2560 [g]

INORGANIC MATERIAL	SAMPLE #	USC-7	USC-8	USC-9	USC-9D	USC-10	USC-11
	UNITS						
AMMONIA N	mg/kg	30.2 [f]	41.4 [d]	68.4 [d]	78.9 [f]	45.4 [g]	44.1 [d]
OIL & GREASE	mg/kg	1000 [c]	11700 [b]	5030 [g]	N/A	2970 [c]	1550 [e]

[a] Denotes a Dilution Factor of 2.0 to 1

[b] Denotes a Dilution Factor of 25.0 to 1

[c] Denotes a Dilution Factor of 5.0 to 1

[d] Denotes a Dilution Factor of 9.60 to 1

[e] Denotes a Dilution Factor of 9.70 to 1

[f] Denotes a Dilution Factor of 9.90 to 1

[g] Denotes a Dilution Factor of 10.0 to 1

N/A – Analyte was not tested.

Summary Table of Analytical Data for Polychlorinated Bi-phenols from the Union Ship Canal

PCBs	SAMPLE #	USC-1	USC-2	USC-3	USC-4	USC-5	USC-6
	UNITS						
Aroclor 1016	ug/kg	U 2.7	U 2.5	U 2.8	U 2.7	U 3.1	U 2.8
Aroclor 1221	ug/kg	U 46.7	U 44.2	U 48.2	U 47.2	U 53.6	U 49.0
Aroclor 1232	ug/kg	U 16.2	U 15.3	U 16.7	U 16.4	U 18.6	U 17.0
Aroclor 1242	ug/kg	U 3.2	U 3.0	U 3.3	U 3.2	U 3.6	U 3.3
Aroclor 1248	ug/kg	U 28.5	U 27.0	U 29.5	U 28.8	U 32.7	U 30.0
Aroclor 1254	ug/kg	U 6.8	78.7	78.8	U 6.9	U 7.8	U 7.2
Aroclor 1260	ug/kg	U 6.6	U 6.3	56.3	U 6.7	102	247

PCBs	SAMPLE #	USC-7	USC-8	USC-9	USC-9D	USC-10	USC-11
	UNITS						
Aroclor 1016	ug/kg	U 3.1	U 2.6	U 2.8	U 3.4	U 3.4	U 2.5
Aroclor 1221	ug/kg	U 53.6	U 46.1	U 49.6	U 59.2	U 59.2	U 43.2
Aroclor 1232	ug/kg	U 18.6	U 16.0	U 17.2	U 20.5	U 20.5	U 15.0
Aroclor 1242	ug/kg	U 3.6	U 3.1	U 3.4	U 4.0	U 4.0	U 2.9
Aroclor 1248	ug/kg	U 32.7	U 28.2	U 30.3	U 36.1	U 36.2	U 26.4
Aroclor 1254	ug/kg	U 7.8	782 *	U 7.3	U 8.7	U 8.7	U 6.3
Aroclor 1260	ug/kg	168	559 *	305	290	332	126

U = Indicates the value was analyzed for but not detected. The sample Reporting Limit has been corrected for dilution and for percentage moisture as set forth in EPA SW-846.

* Denotes a Dilution Factor of 10 to 1.

Summary Table of Analytical Data for Polynuclear Aromatic Hydrocarbons (PAH) from the Union Ship Canal

PAH	SAMPLE #	USC-1	USC-2	USC-3	USC-4	USC-5	USC-6
	UNITS						
Acenaphthene	ug/kg	U 69.0 *	1320	U 71.4 *	U 70.0 *	U 79.2 *	U 72.5 *
Acenaphthylene	ug/kg	U 55.2 *	972	193	U 55.8 *	U 63.3 *	244
Anthracene	ug/kg	J 239	2700	579	J 244	J 179	416
Benzo (a) Anthracene	ug/kg	471	4640	1130	763	615	1340
Benzo (a) Pyrene	ug/kg	554	4680	1600	950	739	1840
Benzo (b) Fluoranthene	ug/kg	471	4490	1490	1100	778	1860
Benzo (ghi) Perylene	ug/kg	J 338	2090	938	589	504	934
Benzo (k) Fluoranthene	ug/kg	540	4090	1330	915	794	1670
Chrysene	ug/kg	U 87.4 *	4600	1620	1040	794	1800
DiBenzo (a,h) Anthracene	ug/kg	U 92.0 *	457	J 195	J 161	U 106 *	179
Fluoranthene	ug/kg	1020	8000	2330	1170	1020	2400
Fluorene	ug/kg	U 96.6 *	2340	401	J 183	U 111 *	401
Indeno (1,2,3-cd) Pyrene	ug/kg	J 386	2650	1030	696	541	965
1-Methylnaphthalene ✓	ug/kg	U 82.8 *	289	U 85.7 *	U 83.7 *	U 95.0 *	U 87.0 *
2-Methylnaphthalene ✓	ug/kg	U 124 *	616	411	U 126 *	U 142 *	J 365
Naphthalene	ug/kg	U 73.6 *	1730	1240	279	U 84.4 *	837
Phenanthrene	ug/kg	616	6580	1400	815	610	1200
Pyrene	ug/kg	970	8290	2380	1380	1230	2680

U = Indicates the value was analyzed for but not detected. The sample Reporting Limit has been corrected for dilution and for percentage moisture. The preparatory factor of 3 which used by the analytical laboratory to correct for matrix and preparation effects has not been used by PADIA in calculating the final Reporting Limit for undetected analytes (U) as set forth in EPA SW-846.

J = Indicates an estimated value. The mass spectral and retention time data indicate the presence of a compound that meets the volatile and semi-volatile GC/MS identification criteria, and the result is less than the Reporting Limit but greater than zero.

All results have a 2 to 1 Dilution Factor

Summary Table of Analytical Data for Polynuclear Aromatic Hydrocarbons(PAH) from the Union Ship Canal (cont.)

PAH	SAMPLE #	USC-7	USC-8	USC-9	USC-9D	USC-10	USC-11
	UNITS						
Acenaphthene	ug/kg	U 77.3 *	J 167	U 73.4 *	U 87.5 *	U 87.5 *	U 64.0 *
Acenaphthylene	ug/kg	U 61.9 *	402	U 58.7 *	U 70.0 *	U 70.0 *	U 51.2 *
Anthracene	ug/kg	J 284.	580	4840	643	J 364 *	326
Benzo (a) Anthracene	ug/kg	688	2460	1270	1690	1480	1100
Benzo (a) Pyrene	ug/kg	828	2240	1540	2160	1590	1200
Benzo (b) Fluoranthene	ug/kg	887	2720	1640	2240	2120	1300
Benzo (ghi) Perylene	ug/kg	523	1180	828	1150	1400	863
Benzo (k) Fluoranthene	ug/kg	918	2440	1520	1840	1230	1250
Chrysene	ug/kg	874	3180	1910	2460	1520	1410
DiBenzo (a,h) Anthracene	ug/kg	U 103 *	J 234	J 252	U 117 *	U 117 *	J 228
Fluoranthene	ug/kg	962	4570	1520	2220	2320	2150
Fluorene	ug/kg	U 108 *	618	567	J 287	U 122 *	J 158
Indeno (1,2,3-cd) Pyrene	ug/kg	575	1130	984	1360	1340	824
1-Methylnaphthalene	ug/kg	U 92.8 *	U 81.8 *	U 88.0 *	U 105 *	U 105 *	U 76.8 *
2-Methylnaphthalene	ug/kg	U 139 *	409	J 293 *	J 280	U 157 *	U 1[illegible]
Naphthalene	ug/kg	J 242	857	452	521	414	U 6[illegible]
Phenanthrene	ug/kg	725	1740	1780	1240	1060	1080
Pyrene	ug/kg	1440	4090	2160	3200	2320	2240

U = Indicates the value was analyzed for but not detected. The sample Reporting Limit has been corrected for dilution and for percentage moisture. The preparatory factor of 3 which used by the analytical laboratory to correct for matrix and preparation effects has not been used by PADIA in calculating the final Reporting Limit for undetected analytes (U) as set forth in EPA SW-846.

J = Indicates an estimated value. The mass spectral and retention time data indicate the presence of a compound that meets the volatile and semi-volatile GC/MS identification criteria, and the result is less than the Reporting Limit but greater than zero.

All results have a 2 to 1 Dilution Factor

Summary Table of Analytical Data for Metals from the Union Ship Canal

METALS	SAMPLE #	USC-1	USC-2	USC-3	USC-4	USC-5	USC-6
	UNITS						
Aluminum	mg/kg	13300	13300	12300	8420	14900	16400
Antimony	mg/kg	U 0.64	U 0.61	B 0.46	B 0.35	B 0.41	B 1.0
Arsenic	mg/kg	10.3	13.1	12.5	10.4	14.9	26.7
Barium	mg/kg	76.6	79.9	72.6	66.2	89.2	95.1
Beryllium	mg/kg	0.27	0.42	0.33	0.14	0.36	1.1
Cadmium	mg/kg	1.4	0.97	0.77	1.5	2.1	4.1
Calcium	mg/kg	29000	45200	37600	54400	47000	56900
Chromium	mg/kg	41.6	51.2	43.8	22.2	28.5	70.1
Cobalt	mg/kg	10.5	11.7	9.8	6.4	10.0	12.8
Copper	mg/kg	36.3	59.5	53.5	41.8	64.7	122
Iron	mg/kg	39100*	47300*	55100*	31500*	45900*	92500*
Lead	mg/kg	35.6	105	113	92.7	119	857
Magnesium	mg/kg	7150	7920	7050	5940	7970	9430
Manganese	mg/kg	1070	1190	961	1050	1130	1920
Mercury	ug/kg	B 144	B 371	B 224	B 123	B 217	B 329
Nickel	mg/kg	31.0	35.1	31.1	21.8	31.5	47.4
Potassium	mg/kg	2770	1880	2180	2130	1510	1920
Selenium [x]	mg/kg	1.0	0.76	0.98	1.4	1.8	1.7
Silver	mg/kg	B 0.41	1.1	0.86	1.1	0.69	3.0
Sodium	mg/kg	254	251	243	432	433	310
Thallium [x]	mgkg	0.51	U 0.15	U 0.16	U 0.16	U 0.18	0.80
Vanadium	mg/kg	32.5	36.9	33.2	22.2	36.0	50.8
Zinc	mg/kg	228	547	599	391	400	753

U = Indicates the value was analyzed for but not detected. The sample Reporting Limit has been corrected for dilution and for percentage moisture as set forth in EPA SW-846.

B = Indicates an estimated value. The result is less than the Reporting Limit but greater than zero.

* Denotes a Dilution Factor of 20 to 1.

[x] Denotes Graphite Furnace AA Method

[z] Denotes value was determined by the Method of Standard Additions.

Summary Table of Analytical Data for Metals from the Union Ship Canal

METALS	SAMPLE #	USC-7	USC-8	USC-9	USC-9D	USC-10	USC-11
	UNITS						
Aluminum	mg/kg	14900	6830	10700	14200	15500	8660
Antimony	mg/kg	B 0.32	U 0.64	U 0.68	U 0.81	B 0.50	U 0.60
Arsenic	mg/kg	18.2	13.9	15.0	20.3	15.9	13.2
Barium	mg/kg	87.3	52.2	84.7	111	96.3	77.3
Beryllium	mg/kg	0.45	0.49	0.66	0.82	0.64	0.48
Cadmium	mg/kg	1.1	3.0	2.0	2.4	2.1	2.0
Calcium	mg/kg	34000	33900	42400	51800	44300	42400
Chromium	mg/kg	28.6	33.8	34.8	44.0	41.8	32.8
Cobalt	mg/kg	12.2	5.4	8.7	10.9	11.6	7.5
Copper	mg/kg	82.8	71.4	82.7	128	90.4	73.8
Iron	mg/kg	44800	107000*	64400*	84600*	57200*	64600*
Lead	mg/kg	161	9.9	369	418	308	232
Magnesium	mg/kg	7930	5190	7630	9250	8490	5420
Manganese	mg/kg	920	1480	1230	1490	1090	1330
Mercury	ug/kg	B 241	B 409	B 396	B 448	B 318	B 251
Nickel	mg/kg	37.0	19.8	29.9	37.3	39.4	28.2
Potassium	mg/kg	2660	1940	1930	2700	2430	1370
Selenium [x]	mg/kg	1.6	2.3	1.6	2.2	2.2	1.6
Silver	mg/kg	B 0.41	2.3	1.1	1.6	1.1	1.3
Sodium	mg/kg	354	305	276	350	336	309
Thallium [x]	mg/kg	U 0.17	1.7	1.1	0.99	0.96	0.60
Vanadium	mg/kg	35.0	25.1	33.8	43.0	40.0	29.6
Zinc	mg/kg	542	2480	1030	1240	993	741

U = Indicates the value was analyzed for but not detected. The sample Reporting Limit has been corrected for dilution and for percentage moisture as set forth in EPA SW-846.

B = Indicates an estimated value. The result is less than the Reporting Limit but greater than zero.

* Denotes a Dilution Factor of 20 to 1.

[x] Denotes Graphite Furnace AA Method

[z] Denotes value was determined by the Method of Standard Additions.