SUPPLEMENTAL INVESTIGATION REPORT

HANNA FURNACE SITE
THE FORMER RAILROAD YARD AREA (SUBPARCEL 1)

BUFFALO ECONOMIC RENAISSANCE CORPORATION
BUFFALO, NEW YORK

JULY 2000
REVISED JANUARY 2001

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BUFFALO ECONOMIC RENAISSANCE CORPORATION
HANNA FURNACE SUPPLEMENTAL INVESTIGATION

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1.0 INTRODUCTION

1.1 BACKGROUND

As part of the South Buffalo Redevelopment Project, Malcolm Pirnie, Inc. (Malcolm Pirnie) has prepared this Supplemental Investigation Report for the Former Railroad Yard Area at the Hanna Furnace Site in South Buffalo, New York. The approximately 43-acre Former Railroad Yard Area is part of the 113-acre, Hanna Furnace Site in Buffalo, New York, owned by the City of Buffalo (the City). After pig iron manufacturing operations ceased in 1982, the Hanna Furnace Site was used briefly by a salvaging firm, and is currently vacant. The location of the Hanna Furnace Site is shown on Figure 1-1.

The City is currently seeking to develop the Hanna Furnace Site as one element of the initiative to redevelop South Buffalo. Information previously collected to characterize the Hanna Furnace Site was summarized in the Hanna Furnace Site - Characterization of the Former Railroad Yard Report (Malcolm Pirnie, October 1999). The report concluded that the Former Railroad Yard Area is suitable for redevelopment, contingent upon the establishment of site-specific health and safety criteria and due diligence site development.

1.2 PURPOSE AND SCOPE

Since the cessation of pig iron manufacturing at the Hanna Furnace Site, several environmental investigations have been performed at the site. However, little characterization had occurred on the Former Railroad Yard Area of the Hanna Furnace Site. For this reason, Malcolm Pirnie performed an initial Site Characterization in January 1999 for the Buffalo Economic Renaissance Corporation (BERC). The characterization effort included the completion of a subsurface drilling and sampling program to collect surface and subsurface soil/fill samples at the 43-acre parcel. A report summarizing the procedures and results of that investigation was submitted to the New York State Department of Environmental Conservation (NYSDEC) in October 1999.

Based on the results of that investigation and comments by the NYSDEC, Malcolm Pirnie submitted the Work Plan for the Hanna Furnace Site - Supplemental Investigation of the Former Railroad Yard to the NYSDEC in January 2000. The NYSDEC approved the Supplemental Investigation Work Plan in a letter dated February 2, 2000. The Supplemental Investigation field program was implemented in January and February 2000.

The Supplemental Investigation was designed to provide the additional information necessary to complete the characterization of the Former Railroad Yard Area, and the characterization will serve as the basis for a voluntary cleanup agreement. The investigatory program was completed to address five outstanding issues:

- Because the grid of soil borings sampled in January 1999 did not extend to the eastern site perimeter, the NYSDEC requested the drilling and sampling of one additional soil boring in the eastern portion of the Former Railroad Yard Area.

- The NYSDEC requested additional characterization of the blue-colored material present in the subsurface throughout the Former Railroad Yard Area.

- Although two monitoring wells were previously installed in the Former Railroad Yard Area and sampled, the NYSDEC requested additional groundwater characterization information.

- The NYSDEC requested a thorough inventory and characterization of the debris piles located on the Former Railroad Yard Area.

- A complete site survey is required as part of the voluntary cleanup agreement.

To address these issues, the following tasks were performed as part of the Supplemental Investigation:

- Completion of seven shallow overburden borings.
- Installation of three shallow groundwater monitoring wells.
- Collection of subsurface soil and groundwater samples for chemical analyses.
- Characterization of on-site debris piles.
- Completion of a Site Boundary Survey.

A description of program methodologies and results of the investigation are discussed in Sections 2.0 and 3.0, respectively.

2.0 SUPPLEMENTAL INVESTIGATION APPROACH

2.1 DRILLING PROGRAM

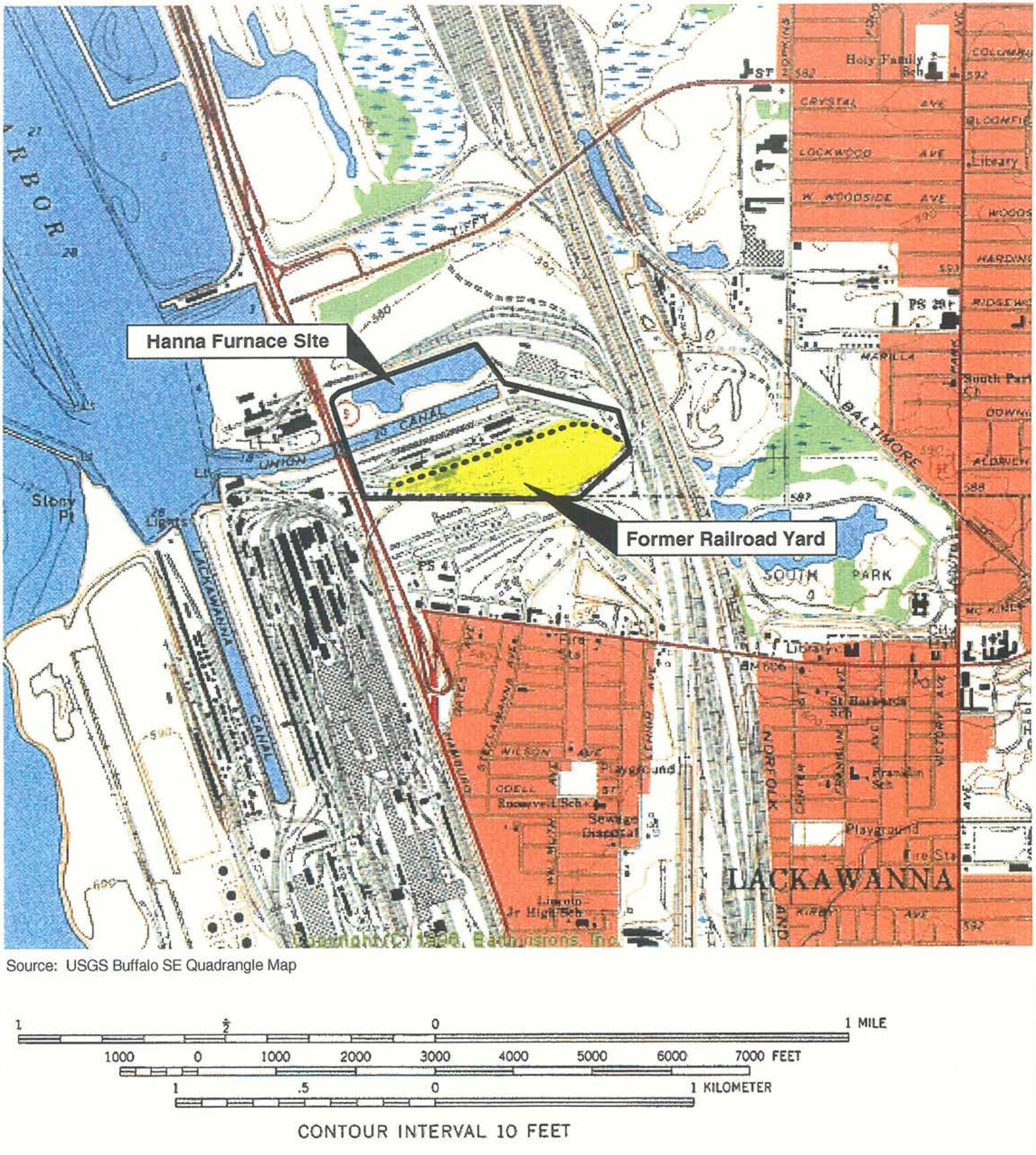
Drilling activities were conducted from January 24 through January 26, 2000 and included the advancement of seven borings and the installation of shallow groundwater monitoring wells in three of those borings. The borings in which monitoring wells were installed were designated MW-001 through MW-003. The remaining four borings were designated B-37 through B-40. Locations of these new borings and monitoring wells, as well as sampling locations from previous investigations, are shown on Figure 2-1. Well installation and sampling activities were completed in accordance with approved methods detailed in the Supplemental Work Plan and modifications developed during the investigation.

All borings were advanced through the fill material to the underlying native sediments using 4 ¼-inch hollow-stem augers for characterization purposes. Split-spoon samples were continuously collected during drilling and described by an on-site geologist. Detailed overburden soil sample descriptions are presented on the stratigraphic borehole logs in Appendix A. Select samples were placed in pre-cleaned sampling jars provided by the laboratory for soil analyses identified in the Work Plan. Samples were placed in coolers and chilled with ice in the field, and shipped to Upstate Laboratory, Inc., in Syracuse, New York.

2.1.1 Additional Characterization of Blue-Colored Fill Material

During the January 1999 characterization, a blue-colored layer of fill material was encountered beneath the majority of the Former Railyard. This blue material was included in composite samples of the overall subsurface fill material. Additionally, one discrete sample of this blue material was collected from the 7 to 10 feet depth interval in boring SB-20 and analyzed for total and reactive cyanide because blue color is often an indicator of cyanide contamination. The analytical results of that sample indicated the cyanide concentrations were very low in the blue material. To further characterize the

FIGURE 1-1



Source: USGS Buffalo SE Quadrangle Map

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HANNA FURNACE SITE - FORMER RAILROAD YARD
SUPPLEMENTAL INVESTIGATION

SITE LOCATION MAP

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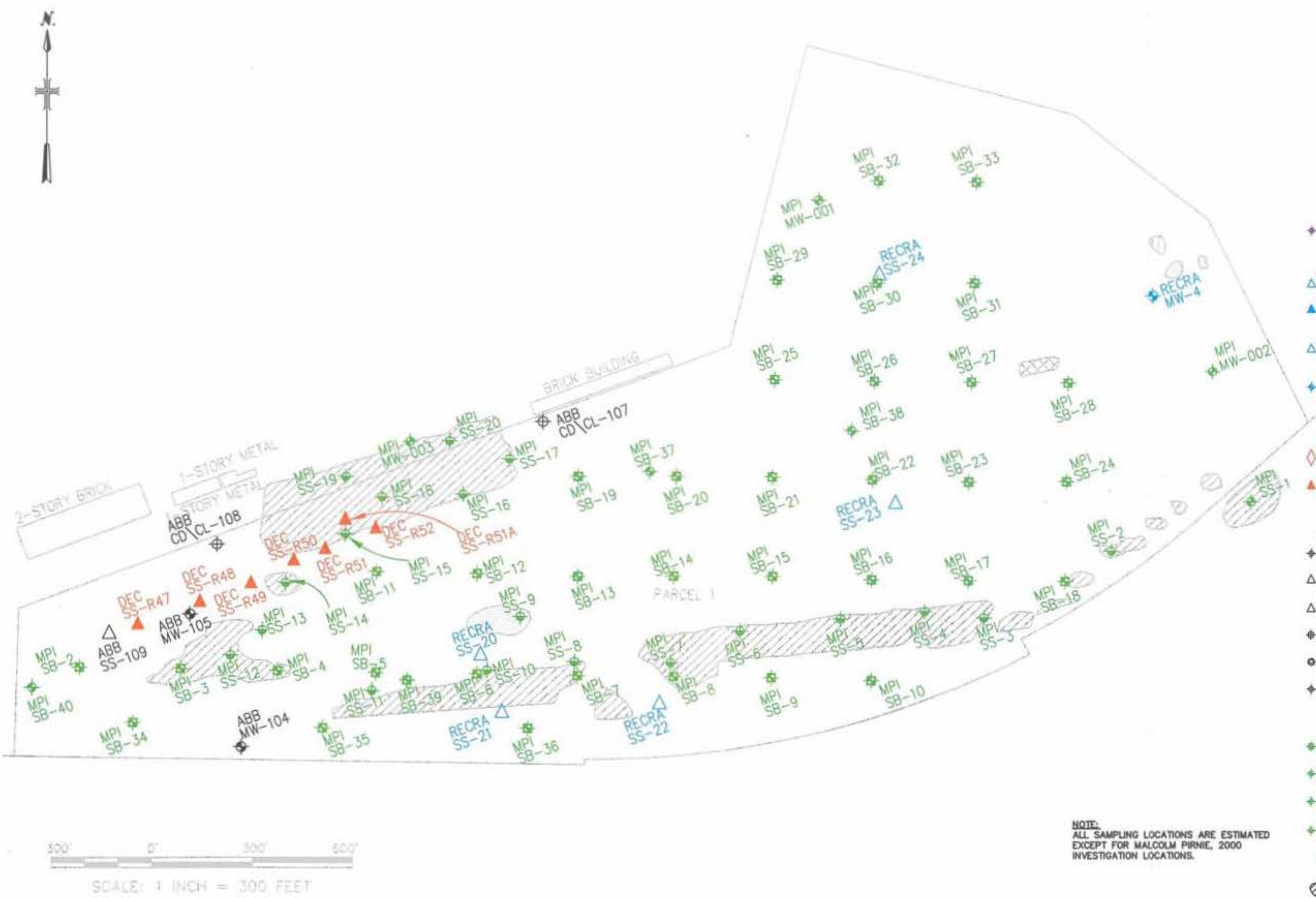
APRIL 2000



LEGEND

US GEOLOGICAL SURVEY

USGS TB- = SOIL BORING, 1982

RECRA ENVIRONMENTAL, INC.

△ RECRA SS- = SURFACE SOIL SAMPLE, 1988
▲ RECRA SW/SD- = SURFACE WATER/SEDEMENT SAMPLE PAIR, 1988
△ RECRA P- = POND WATER/SEDEMENT SAMPLE PAIR, 1988
RECRA MW- = MONITORING WELL (DESTROYED), 1988

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

◇ DEC SS- = SURFACE SOIL SAMPLE, 1990
▲ DEC SS- = SURFACE SOIL SAMPLE, 1994

ABB ENVIRONMENTAL SERVICES, INC.

ABB MW- = MONITORING WELL LOCATION, 1995
△ ABB SS- = SURFACE SOIL SAMPLE LOCATION, 1995
△ ABB SW/SD- = SURFACE WATER/SEDEMENT SAMPLE LOCATION, 1995
⊕ ABB TP- = TEST PIT LOCATION, 1995
● ABB WT- = DRUM SAMPLE LOCATION, 1995
ABB CD/CL = STRUCTURE SEDEMENT/ LIQUID SAMPLE, 1995

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MPI SB- = SOIL BORING LOCATION, 1999
MPI SB- = SHALLOW BORING, 2000
MPI MW- = MONITORING WELL, 2000
MPI SS- = DEBRIS PILE SAMPLE, 2000
= PROPOSED BORING
▨ = SOIL/FILL PILE

NOTE:
ALL SAMPLING LOCATIONS ARE ESTIMATED EXCEPT FOR MALCOLM PIRNIE, 2000 INVESTIGATION LOCATIONS.

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HANNA FURNACE SITE
BUFFALO, NEW YORK
SOUTH BUFFALO REDEVELOPMENT PLAN
DOWNTOWN DEVELOPMENT, INC.

FIGURE 2–1
SITE SAMPLING
LOCATIONS BY INVESTIGATION

chemical composition of the blue material, discrete samples of this material were collected during the Supplemental Investigation.

Four soil borings (B-37 through B-40) were drilled and sampled at locations known to contain the blue fill material. The boring locations were selected also for spatial distribution across the Former Railroad Yard Area to best represent the entire area. One discrete sample of the blue fill material was collected at each borehole location and analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated benzenes (PCBs) and pesticides and Target Analyte List (TAL) metals and cyanide

2.1.2 Characterization of Eastern Portion of Former Railroad Yard Area

At the request of the NYSDEC, one additional soil boring was drilled to characterize the fill material in the extreme eastern portion of the Former Railroad Yard Area. Additionally, one boring was completed in the northeastern portion of the Former Railroad Yard Area because that portion of the area was not characterized in previous investigations. Because two of the proposed groundwater monitoring wells (MW-001 and MW-002) were to be installed in these portions of the Former Railroad Yard Area, the NYSDEC agreed that the locations of the proposed groundwater monitoring wells were sufficient to collect the desired fill samples. The well boring locations are shown on Figure 2-1.

The well borings were sampled during advancement using the same sampling techniques employed during the January 1999 investigation. The subsurface soil sample interval with the highest recorded PID measurement in each boring was submitted to the laboratory for analysis of TCL VOCs. The composite samples were created by mixing the entire vertical column of fill material from the well boring and the resulting composite samples were analyzed for TCL SVOCs, pesticides, PCBs, and TAL metals plus cyanide.

2.1.3 Shallow Overburden Well Installation

Groundwater has been characterized over the Hanna Furnace Site during previous investigations but only two groundwater monitoring wells (MW-104 and MW-105) were located on the Former Railroad Yard Area. Three shallow overburden wells were installed at locations designated MW-001, MW-002 and MW-003 to more completely characterize the groundwater quality and horizontal flow directions at the Former Railroad Yard Area. The screens of the shallow wells were installed from 4 to 14 feet below ground surface with the intent of straddling the water table.

The overburden monitoring wells were constructed using 2-inch diameter, Schedule 40 PVC screen and riser materials with #1 silica sand used as a filter pack. The screens were installed as 10-foot lengths with a 0.010-inch slot size. Approximately one foot of sand was placed on the bottom of each boring below the well screen, and the sandpack extended to approximately 0.2 feet above the top of the screen. A bentonite pellet seal approximately one foot thick was placed above the sandpack and potable water was added to hydrate the pellets. A cement bentonite grout was installed to fill the remainder of the borehole annulus to the ground surface. A lockable 4-inch diameter steel protective casing was placed over the PVC well riser to complete the installation. Table 2-1 summarizes the construction details of the newly installed wells. Monitoring well construction details for all new and existing monitoring wells on the Former Railroad Yard Area are presented in Appendix B.

2.2 MONITORING WELL DEVELOPMENT AND SAMPLING

2.2.1 *Monitoring Well Development*

In accordance with the approved Work Plan, the newly installed monitoring wells were developed no sooner than 48 hours after well installation. Additionally, two existing monitoring wells designated MW-104 and MW-105 were redeveloped. Well development and redevelopment were performed using a centrifugal pump for monitoring wells MW-001, MW-003, MW-104, and MW-105. Due to the low yield of monitoring well MW-002, a dedicated disposable bailer was used to develop the well by

TABLE 2-1

WELL CONSTRUCTION SUMMARY

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILYARD SITE

Well ID No.	Surveyed Ground Elev.(1)	PVC Riser Elev.(1)	Borehole Dia./Well Dia. (in.)	Total Borehole Depth (2)	Top of Seal (2)	Top of (2) Sandpack	Screened Interval (2)	Base (2) of Sandpack	Type of Sandpack	Screen Slot Size	Installation Date
Existing Monitoring Wells											
MW - 104	583.96	586.38	8.25/2.0	15.0	3.0	4.0	5.0 - 15.0	15.0	# 00	0.006	10/94
MW - 105	583.74	585.59	8.25/2.0	15.0	3.0	4.0	5.0 - 15.0	15.0	# 00	0.006	10/94
Newly Installed Monitoring Wells											
MW - 001	582.24	583.96	8.5/2.0	14.0	3.0	3.8	4.0 - 14.0	14.0	# 1	0.010	1/00
MW - 002	584.27	586.01	8.5/2.0	14.0	3.0	3.8	4.0 - 14.0	14.0	# 1	0.010	1/00
MW - 003	580.84	582.79	8.5/2.0	15.0	3.0	3.8	4.0 - 14.0	15.0	# 1	0.010	1/00

Notes:

(1) Elevations in feet above mean sea level.
(2) Depths are feet below grade.

repeatedly purging the well to a "dry" condition. Groundwater purged from each well location during the development process was monitored for development parameters that included pH, specific conductivity, temperature and turbidity. Table 2-2 summarizes the development measurements. Where possible, development was continued until turbidity values were less than 50 NTU, or until pH, temperature and conductivity values had stabilized. The slow recovery of monitoring well MW-002 allowed for the removal of more than 10 well volumes over a period of approximately two days. Field data sheets completed during the well development are included in Appendix C.

2.2.2 Groundwater Sampling Procedures

Prior to purging, static water level elevations were measured in all the on-site monitoring wells. The monitoring wells were then purged in accordance with the procedures specified in the approved Work Plan. All wells except MW-002 exhibited rapid or continuous recovery after purging and were allowed to recharge prior to sampling. Measurements for the field samples collected from all monitoring locations during purging or sampling operations were immediately analyzed for pH, specific conductivity, temperature and turbidity field parameters. A summary of field measurements recorded during the February 2, 2000 sampling event is presented in Table 2-3. The field data sheets are presented in Attachment C.

Groundwater samples were collected using disposable polyethylene bailers in accordance with the protocols identified the Work Plan. Samples for laboratory analysis were stored in the appropriate pre-preserved, plastic or glass sample bottles, placed in a cooler and chilled with ice in the field, and shipped to Upstate Laboratory, Inc. located in Syracuse, New York. The groundwater samples were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs, and TAL metals plus cyanide.

2.3 DEBRIS PILE CHARACTERIZATION

Numerous debris piles of admixed soil and construction debris have been documented and were observed in the Former Railroad Yard Area during the January

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TABLE 2-2

SUMMARY OF WELL DEVELOPMENT FIELD MEASUREMENTS(1)

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

LOCATION	DEVELOPMENT DATE	TURBIDITY(3) (NTU)	TEMP (°C)	pH (units)	CONDUCTANCE (umhos/cm) (2)	GALLONS PURGED	SAMPLE APPEARANCE(3)
Existing Monitoring Wells							
MW-104	01/27/00	38	10	12.25	745	50	Clear
MW-105	01/27/00	18	9	10.20	600	50	Clear
Newly Installed Monitoring Wells							
MW-001	01/27/00	39	9	8.79	850	100	Clear
MW-002	01/27-01/28	> 100	9	7.03	1377	28	Cloudy
MW-003	01/28/00	92	9	7.76	1393	150	Cloudy

Notes :

(1) Except where noted, all measurEments are averages of readings obtained during well development.

(2) Conductance corrected to 25°C.

(3) Turbidity and Sample Appearance are based on last bailer measurements.

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TABLE 2-3

SUMMARY OF WELL SAMPLING FIELD MEASUREMENTS(1)

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

LOCATION	SAMPLING DATE	TURBIDITY(3) (NTU)	TEMP (°C)	pH (units)	CONDUCTANCE (umhos/cm) (2)	GALLONS PURGED	SAMPLE APPEARANCE(3)
Existing Monitoring Wells							
MW-104	02/02/00	30	9.5	11.19	864	15	Clear
MW-105	02/02/00	31	9.0	8.99	603	15	Clear
Newly Installed Monitoring Wells							
MW-001	02/02/00	33	7.0	7.99	780	15	Clear
MW-002	02/02/00	46	7.5	6.56	1335	6	Clear
MW-003	02/02/00	45	6.0	7.40	1315	15	Clear

Notes :

(1) Except where noted, all measurments are averages of readings obtained during sampling from first and last bailers of water.

(2) Conductance corrected to 25°C.

(3) Turbidity and Sample Appearance are based on first bailer measurements.

1999 site characterization effort. The debris piles are generally located along the southern and southeastern perimeters of the Former Railroad Yard Area and are shown on Figure 2-1.

Since these piles had not yet been characterized analytically, a thorough inventory and sampling program was implemented during the Supplemental Investigation to characterize the contents of the debris piles. Malcolm Pirnie verified and updated the inventory to provide an accurate estimate of the number, location, volume, and apparent contents of all on-site debris piles and collected samples during a test pit program.

2.3.1 Debis Pile Inventory

In 1997, Ecology and Environment, Inc. inventoried the debris piles on the Former Railroad Yard Area as part of an Environmental Site Assessment. All debris piles were measured and mapped and estimates of volumes and contents of the piles were made. The total estimated volume of piled debris on the Former Railroad Yard Area was approximately 20,000 cubic yards. As part of the Supplemental Investigation, Malcolm Pirnie verified and amended the inventory to include the contents of the debris piles. Malcolm Pirnie's revised estimate of the volume of all above grade debris in the piles was approximately 24,000 cubic yards.

The materials observed in the debris piles during the investigation were generally categorized as construction and demolition debris mixed with sand and gravel with occasional railroad ties, slag, and metal refuse. A summary of debris pile characteristics is presented in Table 2-4.

2.3.2 Debris Pile Screening and Sampling

Subsequent to an inventory of all debris piles, sampling of the debris was performed. A backhoe was used to breach select debris piles to ascertain the contents and provide access to non-weathered debris for sampling. Samples were visually characterized and screened for VOCs using a PID equipped with a 10.2 eV lamp and the observations were recorded on the test pit logs. Samples were collected at an approximate frequency of one sample per estimated 1000 cubic yards for all soil-like

TABLE 2-4

SUMMARY OF DEBRIS PILE CHARACTERISTICS

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

Depris Pile ID No.	Sample ID	Debris Pile Contents	PID Screening Results	Sampled Depth (ft bgs)	Estimated Area (ft^2)	Estimated Depth	Estimated Volume (yd^3)
DP-1	SS-12	C & D debris, concrete rubble, rebar,	0.2	3-5	20,394	2	1,510
	SS-13	sand and gravel	0.2	2-4			
DP-2		C & D debris, sand and gravel			154	2	11+
DP-3	SS-8 (2)	C & D debris, concrete, sand and gravel	0.2	3-5	28,680	3.5	3,717
	SS-10		0.2	3-5			
	SS-11		0.2	3-5			
DP-4	SS-9	Stone, gravel	0.2	4-6	6,790	2	503
DP-5		C & D debris, concrete, sand and gravel, silt			3,416	3	316
DP-6	SS-3	C & D debris, sand, gravel, silt,	0.2	3-5	56,502	3	6,278
	SS-4		0.2	2-4			
	SS-5		0.2	2-4			
	SS-6		0.2	3-5			
	SS-7		0.2	2-4			
DP-7		Lime flux, slag			2,575	2.5	238
DP-8		Trash, tires			400	2	30

TABLE 2-4

SUMMARY OF DEBRIS PILE CHARACTERISTICS

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

Depris Pile ID No.	Sample ID	Debris Pile Contents	PID Screening Results	Sampled Depth (ft bgs)	Estimated Area (ft ^{2})	Estimated Depth	Estimated Volume (yd ^{3})
DP-9		C & D debris, wood, concrete, sand, misc. metal			1,295	2	96
DP-10	SS-2	C & D debris, concrete, rebar, brick, asphalt	0.5	2-4	2,311	2	171
DP-11		C & D debris, concrete, sand and gravel			862	2	64
DP-12		C & D debris, concrete, sand and gravel			646	2	48
DP-13		C & D debris, concrete, sand and gravel			1,233	2	91
DP-15		Slag, railroad ties			2,194	3	244
DP-16		Wood, metal, debris,			433	2	32
DP-17		Sand			909	4.5	9
DP-18		Sinter,			884	5	164
DP-23	SS-15	C & D debris, concrete, sand and gravel	0.4	3-5	81,100	3	9,011
	SS-16		0.2	2-4			
	SS-17		1.6 / 0.2 (3)	3-5			
	SS-18		0.2	4-6			
	SS-19		0.2	3-5			
	SS-20		0.2	3-5			

TABLE 2-4

SUMMARY OF DEBRIS PILE CHARACTERISTICS

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

Depris Pile ID No.	Sample ID	Debris Pile Contents	PID Screening Results	Sampled Depth (ft bgs)	Estimated Area (ft ^{2})	Estimated Depth	Estimated Volume (yd ^{3})
DP- A	SS-1	Fill as slag, gravel, RR ties, tires, metal	0.2	2-4	7,500	4.5	1,250
DP - B	SS-14	Fill as sand, gravel, brick, misc. metal	0.2	0-3	150	2	11

NOTES:

Sampled debris piles indicated by shaded / stipple pattern.

(1) All debris piles sampled above grade unless noted.

(2) White fill material sampled below grade surface at SS-8 per NYSDEC request.

(3) Elevated PID reading measured in proximity to RR tie within excavation.

(soil, sand, gravel) debris. Other, non-soil-like, debris was sampled at a lesser frequency as determined in the field and approved by the NYSDEC.

A total of 20 debris pile test pits designated SS-1 through SS-20 were excavated at the Hanna Furnace Site on January 23 and 24, 2000, and one sample was collected from each test pit. Approved sampling locations were determined based on a site reconnaissance and discussions with the NYSDEC prior to initiating the characterization effort. Sampled debris pile locations are illustrated on Figure 2-1. A descriptive log for each sampled excavation is presented in Appendix D and is summarized in Table 2-4. The 20 debris pile samples were submitted to the laboratory for analysis of TCL VOCs, SVOCs, pesticides, and PCBs, and TAL metals plus cyanide.

2.3.3 Site Boundary Survey

To formally establish the site boundary of the Former Railroad Yard Area as required as part of the voluntary cleanup agreement, Parsons Engineering Science prepared a boundary site map. Seneca Design, P.C. performed the site survey to establish and provide field verification of a horizontal and vertical control survey for preparation of the map. Horizontal control was established based on the New York State Plane Coordinate System and vertical control was established using the Nation Geodetic Vertical Datum (1929). In addition to the map, Seneca Design, P.C. surveyed all new and existing monitoring wells and borings to determine horizontal and vertical components. Malcolm Pirnie estimated the debris pile sampling locations using mapped site features.

2.4 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

2.4.1 Field Quality Assurance/Quality Control Procedures

Quality Assurance and Quality Control (QA/QC) measures were taken to verify the reliability of the data generated during the Supplemental Investigation. The field program was conducted in accordance with the NYSDEC-approved Work Plan. Additional QA/QC measures included the collection of blind duplicates, matrix spike samples, and matrix spike duplicates. Trip blanks were also submitted for analysis on each day that samples were collected for analysis of TCL VOCs. The analytical results for the blind duplicates and the trip blanks have been included in the analytical results summary tables. These QA/QC samples were used during data validation to assess the accuracy of the analytical results.

2.4.2 Analysis/Data Usability

The laboratory analytical packages prepared by Upstate Laboratories were reviewed and evaluated by an independent subcontractor, Chemworld Environmental, Inc. (Chemworld) of Rockville, Maryland, to assess compliance with the analytical method protocols as described by the NYSDEC Analytical Services Protocol (ASP). The evaluation of the analytical results was based on information supplied by the laboratory data sheets and chain-of-custody forms. The evaluation included the examination of sample holding times and the analytical results for the method blanks, trip blanks, matrix spike samples, and field duplicates.

Chemworld prepared a Data Usability Summary Report (DUSR) that compares the quality of the performance of the laboratory analyses to that described in the ASP. The DUSRs have been included in Attachment A with the laboratory results. All analytical results summary tables included in this report include the validated analytical results.

The evaluation of the analytical results of samples collected from the Former Railroad Yard Area indicated that Upstate Laboratories generally performed the analyses within the ASP. Although the analysis of duplicate samples indicated that precision was generally acceptable, a number of the analytical results were qualified during validation.

The reasons for qualifications of VOC results include high surrogate recoveries, elevated percent differences in continuing calibrations, and compounds (acetone, methylene chloride, and 2-butanone) detected in associated blanks. Non-detectable results for 2-butanone were rejected for some of the samples due to poor average relative response factors. 2-Butanone is not considered to be a concern at the Former Railroad Yard.

The qualification of the SVOC results were due to low reported area counts for internal standards, elevated percent differences in continuing calibrations, and one compound (bis-2-ethylhexylphthalate) detected in associated blanks. Very low surrogate recoveries were detected for sample MW-002T, and therefore the positive results were qualified as estimated and the non-detect results were rejected for that sample.

The pesticide and PCB results were qualified due to elevated percent differences in continuing calibrations or in different columns and the results were qualified as estimated. Although the surrogate recovery for seven samples was very poor and the non-detect results were rejected, reanalysis of the samples generated usable results.

No analytical results for inorganic analytes were rejected. The Contract Required Detection Limit (CRDL) for mercury was generated at 0% for the samples and it appears that the standard for mercury may not have been functioning properly. Therefore, non-detect results for mercury were qualified as estimated (UJ). Other reasons for qualification included poor precision of the laboratory duplicate samples for zinc, selenium, and nickel, elevated percent differences for serial dilutions, and recoveries of CRDL standards outside the 80 to 120 percent limits. Analytical results with these issues were qualified as estimated.

3.0 SUPPLEMENTAL INVESTIGATION RESULTS

The groundwater analytical results were compared to the NYSDEC June 1998 Ambient Water Quality Standards and Guidance Values for Class GA waters to determine impacts to groundwater quality. The soil sample analytical results were compared to the Recommended Soil Cleanup Guidelines in the NYSDEC January 1994 Technical Administrative Guideline Memorandum (TAGM) 4046. Where no cleanup guideline for an inorganic analyte is included in TAGM 4046, the highest value of the Eastern United States of America Background Concentrations listed in TAGM 4046 was used for comparison for that analyte. Additionally, the cadmium, chromium, and lead concentrations were compared to the guidelines of 10, 50 and 1000 milligrams/kilogram (mg/kg), respectively, suggested by the NYSDEC in a March 28, 2000 telephone conversation. The suggested lead soil cleanup guideline of 1000 mg/kg is for non-residential soils. Because the NYSDEC does not have soil cleanup guidelines for cyanide, the USEPA Region III Soil Screening Level of 1,600 mg/kg was used for comparison.

3.1 ADDITIONAL CHARACTERIZATION OF BLUE-COLORED FILL MATERIAL

The analytical results of the samples collected from the blue-colored material (B-37, B-38, B-39, and B-40) are summarized in Table 3-1. The analysis of the samples indicated that VOCs were detected at concentrations below the soil cleanup guidelines, and pesticides and PCBs were not detected. Two SVOCs (benzo(a)anthracene and benzo(a)pyrene) were detected at concentrations above the soil cleanup guidelines in at least one sample collected from the blue-colored material. Eight metals (aluminum, barium, beryllium, calcium, iron, magnesium, selenium, and zinc) were detected in at least one of the blue-colored soil samples at concentrations above the soil cleanup guidelines.

Although the exact source of the fill at the site is not known, it is possible that portions of the material was derived from some off-site steel manufacturing operations or

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TABLE 3-1

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL/FILL

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILYARD SITE

PARAMETER[1]	SAMPLE LOCATION										NYSDEC TAGM VALUES[2]	EASTERN U.S. BACK-GROUND RANGE[2]
	B-37		B-38	B-39		B-40	Duplicate	MW-001	MW-002			
	1/25/00	1/25/00	1/25/00	1/25/00	1/25/00	1/26/00	1/26/00	1/26/00	1/25/00	1/25/00		
	6-8'	8-10'	6-8'	8-10'	6.5-10.4'	6-8'	(B-40)	2-4'	0-2'	0-4'		
VOLATILE ORGANIC COMPOUNDS (ug/kg)												
Carbon Disulfide	12 J	NA	4 J		NA	6 J	6 J	9 J	5 J	NA	2,700	-
Chloroform		NA			NA				3 J	NA	300	-
2-Butanone		NA	4 J		NA				27 J	NA	300	-
Benzene		NA			NA				2 J	NA	60	-
2-Hexanone		NA			NA				14 J	NA	-	-
1,1,2,2-Tetrachloroethane		NA			NA				3 J	NA	600	-
Toluene	4 J	NA			NA			6J	8 J	NA	1,500	-
Ethylbenzene		NA			NA				2 J	NA	5,500	-
m-Xylene and p-Xylene		NA			NA				6 J	NA	1200[3]	-
o-Xylene		NA			NA				3 J	NA		-
SEMIVOLATILE ORGANIC COMPOUNDS (ug/kg)												
Phenanthrene	NA			NA		890	850		NA	380 J	50,000	-
Fluoranthene	NA			NA		990	1,100		NA	410 J	50,000	-
Pyrene	NA			NA		860	860		NA	600 J	50,000	-
Chrysene	NA			NA		320 J	340 J		NA	**480 J**	400	-
Benzo (b) fluoranthene	NA			NA		490 J	450 J		NA	490 J	1,100	-
Benzo (k) fluoranthene	NA			NA		160 J	170 J		NA	R	1,100	-
Bis(2-ethylhexyl)phthalate	NA	160 J	110 J	NA	210 J	170 J	180 J	250 J	NA	R	50,000	-
Benzo (a) pyrene	NA			NA		**310 J**	**300 J**		NA	R	61	-
Acenaphthene	NA			NA		65 J	62 J		NA	R	50,000	-
Dibenzofuran	NA			NA		110 J	92 J		NA	R	6,200	-
Fluorene	NA			NA		89 J	94 J		NA	R	50,000	-
Anthracene	NA			NA		180 J	190 J		NA	R	50,000	-
Carbazole	NA			NA		60 J			NA	R	-	-
Ideno (1,2,3-cd) pyrene	NA			NA		110 J	100 J		NA	R	3,200	-
Benzo (ghi) perylene	NA			NA		110 J			NA	R	50,000	-
Benzo (a) anthracene	NA			NA		**370 J**	**370 J**		NA	R	224	-

Notes:

(1) Only those parameters having a value above the laboratory detection limit, and found at a minimum of one location are shown.

(2) Soil Cleanup Guidelines from NYSDEC TAGM 4046 (1/24/94).

(3) Soil cleanup guideline for total xylenes is 1200 ug/kg

R - Non-detect result rejected during validation.

J - Indicates an estimate value. Result is below quantitation limit but above zero.

NA - Not Analyzed

Blank space indicates analyte was not detected.

Shaded/bold text indicates guidance criteria was exceeded.

\- Soil cleanup guideline or background range not available.

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TABLE 3-1

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL/FILL

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILYARD SITE

	SAMPLE LOCATION											EASTERN U.S. BACK-GROUND RANGE(2)
	B-37		B-38	B-39		B-40	Duplicate	MW-001	MW-002		NYSDEC TAGM VALUES(2)	
	1/25/00	1/25/00	1/25/00	1/25/00	1/25/00	1/26/00	1/26/00	1/26/00	1/25/00	1/25/00		
PARAMETER(1)	6-8'	8-10'	6-8'	8-10'	6.5-10.4'	6-8'	(B-40)	2-4'	0-2'	0-4'		
PESTICIDES/PCB (ug/kg)												
Pesticides/PCBs	NA			NA					NA			
METALS (mg/kg)												
Aluminum	NA	29,200 J	29,600 J	NA	26,100 J	**33,200 J**	32,500 J	**45,700 J**	NA	9,690 J	SB	33000
Arsenic	NA			NA					NA	**10**	7.5 or SB	3 - 12
Barium	NA	**428 J**	**319 J**	NA	269 J	210 J	214 J	201 J	NA	109 J	300 or SB	15 - 600
Beryllium	NA	**5.7**	**5.9**	NA	**5.5**	**5.9**	**5.8**	**8.2**	NA	**2.1**	.016 or SB	0 - 1.75
Cadmium	NA			NA				2.1	NA	6.2	(10)	0.1-1
Calcium	NA	**134000**	**138000**	NA	**192000**	**165000**	**164000**	**259000**	NA	**55800**	SB	130-35000
Chromium	NA	8.2	13.5	NA	4.9	8.6	10.7	6.8	NA	19.5	(50)	1.5 - 40
Cobalt	NA			NA					NA	5.8 B	30 or SB	2.5 - 60
Copper	NA	5.0 B		NA		13.3	20.9		NA	**44.1**	25 or SB	1 - 50
Iron	NA	**13,700 J**	**3,860 J**	NA	**3,250 J**	**11,600 J**	**19,600 J**	**27,400 J**	NA	**89,400 J**	2000 or SB	2000 - 550000
Lead	NA	5.4		NA				2.2	NA	54.6	(1000)	4 - 500
Magnesium	NA	**10,000 J**	**9,540 J**	NA	**10,700 J**	**12,200 J**	**12,300 J**	**13,500 J**	NA	**8,800 J**	SB	100 - 5000
Manganese	NA	1,200 J	960 J	NA	1,150 J	1,980 J	2,190 J	1,290 J	NA	1,530 J	SB	50 - 5000
Potassium	NA	3,250 J	2,630 J	NA	2,950 J	4,610 J	4,460 J	6,120 J	NA	1,910 J	SB	8500 - 43000
Selenium	NA	17.4 J	**23.1 J**	NA	**28.3 J**	**25.8 J**	**25.2 J**	**27.1 J**	NA		2 or SB	0.1 - 3.9
Vanadium	NA			NA				12.5 B	NA	12.9	150 or SB	1 - 300
Zinc	NA	**34 J**	6.4 J	NA	7.8 J	6.8B J	15.2 J	**114 J**	NA	**166 J**	20 or SB	9 - 50
Cyanide	NA	3.1	23.4	NA	43	5.8	4.3	19.5	NA		-	-

Notes:

(1) Only those parameters having a value above the laboratory detection limit, and found at a minimum of one location are shown.

(2) Soil Cleanup Guidelines and Eastern U.S. Background Range from NYSDEC TAGM 4046 (1/24/94). Value in parentheses are NYSDEC revised values for nonresidential sites but have not yet been incorporated into TAGM 4046.

- Soil cleanup guideline or background range not available.

B - Result is between Instrument Detection Limit and Contract Required Detection Limit.

J - Indicates an estimate value. Result is below quantitation limit but above zero.

NA - Not Analyzed

Blank space indicates analyte was not detected.

Shaded/bolded text indicates guidance criteria or background range was exceeded.

historical pig iron manufacturing operations at the site. This might explain the elevated iron and calcium concentrations. Additionally, it should be noted that the highest iron concentration in the blue-colored fill material was 19,600 mg/kg, which is below the highest concentration in the Eastern U.S. Background Range of 550,000 mg/kg.

The elevated calcium concentrations detected in the blue-colored material might indicate that the material is a type of slag. Because the blue-colored material appears to be similar in size and shape to the chalk-white to gray material encountered just above it in many borings throughout the site, it is possible that these two layers of material are both comprised of a type of slag material. The different colors of the two layers might indicate differential weathering above and below the water table due to oxidation-reduction reactions or variations in pH. Based on the low concentrations of cyanide, the blue color of the material is not due to the presence cyanide.

The elevated selenium concentrations were detected during the analysis of the samples using inductively coupled plasma (ICP) methods. The limitation of this method is that elevated calcium concentrations, as detected in these samples, can interfere with the analysis for selenium and yield artificially high selenium concentrations as a result. The selenium concentrations using ICP analysis ranged from 17.4 to 28.3 mg/kg. Two of the samples (B-39 and B-40) were also analyzed for selenium using graphite furnace methods because calcium generally does not interfere with selenium analysis in the graphite furnace method. These results indicated that selenium concentrations in B-39 and B-40 decreased from 28.3 and 25.8 mg/kg, respectively, with the ICP method to 0.30 and 0.68 mg/kg, respectively, with the graphite furnace method. These concentrations are below the soil cleanup guideline for selenium (2 mg/kg).

3.2 SUBSURFACE SOIL CHARACTERIZATION RESULTS

Subsurface soil samples were collected from the monitoring well borings MW-001 and MW-002 to characterize soil/fill material in the eastern and northeastern portions of the Former Railroad Yard Area not previously characterized. The material encountered during the drilling of the monitoring wells was similar to that encountered in the borings throughout the site. The analytical results of the soil samples collected from the two borings indicated that VOCs were detected at concentrations below the soil cleanup guidelines, and pesticides and PCBs were not detected. Only one SVOC (chrysene) was detected at concentrations above the soil cleanup guidelines. Chrysene was detected in the sample collected from boring MW-002 at a concentration of 480 μg/kg, slightly above the soil cleanup guideline of 400 μg/kg. The elevated concentrations of PAHs detected in other samples collected from the Former Railroad Yard Area were not detected in these samples. Nine metals (aluminum, arsenic, beryllium, calcium, copper, iron, magnesium, selenium, and zinc) were detected in at least one of the soil samples at concentrations above the soil cleanup guidelines.

As discussed in Section 3.1, the elevated iron and calcium concentrations are likely due to the type of fill material and historical pig iron manufacturing operations at the site. Additionally, it should be noted that the highest iron concentration in the samples was 89,400 mg/kg, which is well below the highest concentration in the Eastern U.S. Background Range (550,000 mg/kg). The elevated calcium concentrations detected in the samples indicate that some of the fill material may be a calcium-rich type of slag. Slag was observed in the sample interval in sample MW-002, and the blue-colored material, which might be slag, was observed in the sampling interval in sample MW-001.

Similar to the samples discussed in Section 3.1, elevated selenium concentrations were detected during the analysis of the soil samples using ICP methods. The selenium concentrations using ICP analysis were 27.1 mg/kg in sample MW-001, and selenium was not detected in sample MW-002. Sample MW-001 was also analyzed for selenium using graphite furnace methods and the detected concentration was 0.88 mg/kg, which is below the soil cleanup guideline of 2 mg/kg.

3.3 DEBRIS PILE CHARACTERIZATION RESULTS

The results of the analysis of the debris pile samples are summarized in Table 3-2. The analytical results of the debris pile sampling indicated that no VOCs were detected at concentrations above the soil cleanup guidelines. One pesticide (i.e., Aldrin) was

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TABLE 3-2

SUMMARY OF ANALYTICAL RESULTS - FILL PILES

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

PARAMETER$^{(1)}$	SAMPLE LOCATION																						NYSDEC TAGM VALUES$^{(2)}$	EASTERN U.S. BACKGROUND RANGE$^{(2)}$
	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS-10	SS-11	SS-12	Duplicate	SS-13	SS-14	SS-15	SS-16	SS-17	SS-18	SS-19	SS-20	TRIP BLANK		
	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/24/00	(SS-12)	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/25/00		
VOLATILE ORGANIC COMPOUNDS (ug/kg)																								
Chloromethane				16																			-	-
Carbon Disulfide			2 J																				2,700	-
cis-1,2-Dichloroethene				5 J																			-	-
Chloroform	2 J	2 J		2 J					7 J	2 J	2 J					2 J		4 J	4 J	2 J	6 J		300	-
2-Butanone				19 J								12											300	-
Trichloroethene				220 J																			700	-
Benzene									11 J														-	-
4-Methyl-2-pentanone	4 J			4 J	2 J																		1000	-
Tetrachloroethene	1 J			2 J																			1400	-
1,1,2,2-Tetrachloroethane									59 J														600	-
Toluene	3	8 J	3 J	13 J	5 J	2 J	4 J	4 J	60 J	6 J	19 J	2 J	1 J	2 J	2 J	5 J	3 J	14 J	5 J		6 J		1,500	-
Ethylbenzene									33 J														5,500	-
Styrene									20 J														-	-
m-Xylene and p-Xylene	2 J								28 J														1,200	-
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/kg)																								
4-Methylphenol						120 J																NA	900	-
Naphthalene			170 J	71 J	240 J	720										54 J		320 J	42 J		67 J	NA	13000	-
2-Methylnaphthalene			92 J	83 J	170 J	430												210 J				NA	36400	-
Acenaphthylene			130 J		95 J	210 J		66 J										150 J			170 J	NA	41000	-
2,6-Dinitrotoluene																		120 J				NA	1000	-
Acenaphthene			220 J	140 J	320 J	690	91 J								74 J	260 J		260 J	120 J		47 J	NA	50000	-
Dibenzofuran			210 J	69 J	340 J	670	47 J									87 J		200 J	48 J		57 J	NA	6,200	-
Fluorene			310 J	120 J	430	900	74 J								69 J	150 J		210 J	83 J			NA	50000	-
Phenanthrene	290 J	74 J	2,300	1,400 J	4,200	6,000	1,200	43 J		230 J	150 J	61 J	230 J	670	740	1,700	230 J	2,000	720	98 J	1,100	NA	50,000	-
Anthracene	74 J	62 J	640	320 J	1,000	2,500	200 J						57 J	190 J	220 J	420	64 J	510	190 J		340 J	NA	50,000	-
Carbazole			160 J	90 J	290 J	570	210 J							40 J		99 J		170 J	52 J		47 J	NA	-	-
Di-n-butylphthalate				120 J	56 J													47 J	64 J			NA	8100	-
Fluoranthene	470	120 J	1,700	1,600 J	2,400	8,500	4,100 J	53 J		520 J	280 J	120 J	450 J	1,900	1,000	1,800	750	1,800	730	260 J	2,300	NA	50,000	-
Pyrene	460	140 J	6,700	1,700 J	9,700 J	8,500 J	3,400 J	78 J		530 J	250 J	110 J	600 J	2,100 J	1,100 J	4,300 J	920 J	4,100 J	810	410 J	3,200 J	NA	50,000	-
Butylbenzylphthalate				540 J										790 J		130 J						NA	50000	-
Benzo(a)anthracene	**340 J**	86 J	**2,000 J**	**900 J**	**3,300 J**	**3,700 J**	**1,100 J**	51 J		**310 J**	86 J	64 J	**460 J**	**1,000 J**	**540 J**	**1,400 J**	**390 J**	**2,000 J**	**440**		**1,400 J**	NA	225	-
Chrysene	340 J	110 J	**2,000 J**	**940 J**	**3,200 J**	**3,800 J**	**1,300 J**	68 J		350 J	97 J	66 J	**510 J**	**1,200 J**	**520 J**	**1,600 J**	370 J	**2,200 J**	**410**	150 J	**1,400 J**	NA	400	-
Bis(2-Ethylhexyl)phthalate	56 J	52 J	150 J	440 J	650 J	320 J	220 J	50 J	51 J	200 J	57 J	41 J		210 J	47 J	200 J	190 J	350 J	73 J	84 J	64 J	NA	50,000	-
Benzo(b)fluoranthene	410	220 J	**1,900 J**	**1,300 J**	**5,400 J**	**5,300 J**	**2,300 J**	160 J		510 J	110 J	89 J	920 J	**1,200 J**	570 J	**1,600 J**	620 J	**2,200 J**	510		**2,000 J**	NA	1,100	-
Benzo(k)fluoranthene	170 J	55 J	700 J	480 J	**1,600 J**	**1,500 J**	750 J	52 J		150 J	39 J		350 J	490 J	260 J	700 J	240 J	860 J	210 J		780 J	NA	1,100	-
Benzo(a)pyrene	**280 J**	**130 J**	**1,400 J**	**980 J**	**4,200 J**	**4,000 J**	**1,600 J**	**120 J**		**370 J**	**64 J**	57 J	**800 J**	**820 J**	**490 J**	**1,300 J**	**460 J**	**1,500 J**	**410**	**200 J**	**1,500 J**	NA	61	-
Ideno(1,2,3-cd)pyrene		250 J	1,000 J	630 J	2,700 J	2,300 J	1,000 J	170 J		210 J			520 J	410 J	280 J	1,300 J	290 J	1,200 J	240 J		790 J	NA	3,200	-
Dibenzo(a,h)anthracene					**780 J**	**950 J**										**110 J**					**270 J**	NA	14	-
Benzo(ghi)perylene	89 J	600 J	1,000 J	670 J	3,000 J	2,700 J	1,200 J	250 J		230 J			640 J	540 J	320 J		390 J	1,300 J	240 J		950 J	NA	50,000	-

Notes:

(1) Only those parameters having a value above the laboratory detection limit, and found at a minimum of one location are shown.

(2) Soil Cleanup Guidelines and Easter U.S. Background Range from NYSDEC TAGM 4046 (1/24/94). Value in parentheses are NYSDEC revised values for nonresidential sites but have not yet been incorporated into TAGM 4046.

\- Soil cleanup guideline or background range not available.

J - Indicates an estimate value. Result is below quantitation limit but above zero.

NA - Not Analyzed

Blank space indicates analyte was not detected.

Shaded/bold text indicates guidance criteria or background range was exceeded.

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TABLE 3-2

SUMMARY OF ANALYTICAL RESULTS - FILL PILES

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

PARAMETER$^{(1)}$	SAMPLE LOCATION																						NYSDEC TAGM VALUES$^{(2)}$	EASTERN U.S. BACKGROUND RANGE$^{(2)}$
	SS-1	**SS-2**	**SS-3**	**SS-4**	**SS-5**	**SS-6**	**SS-7**	**SS-8**	**SS-9**	**SS-10**	**SS-11**	**SS-12**	**Duplicate**	**SS-13**	**SS-14**	**SS-15**	**SS-16**	**SS-17**	**SS-18**	**SS-19**	**SS-20**	**TRIP BLANK**		
	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/23/00	2/24/00	(SS-12)	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/24/00	2/25/00		
PESTICIDES / PCBs (ug/kg)																								
Aldrin				**500 J**		2.9 J										2.6 J						NA	41	-
4,4'-DDE										7.9 J				3.9 J		10.9 J	3.9 J				13.8 J	NA	2100	-
4,4'-DDT			8.0 J							10.9 J					4.7 J	10.8 J		32 J			15 J	NA	2100	-
alpha-Chlordane				500		29.3																NA	540	-
gamma-Chlordane																	2.1 J					NA	540	-
Heptachlor				3.2 J																		NA	20	-
Aroclor 1254						**1200**																NA	1000	-
Aroclor 1260				**3820**																		NA	1000	-
METALS (mg/kg)																								
Aluminum	5,810	28,600	21,000	10,500	11,600	2,950	7,350	25,500	8,140	4,950	4,010	5,230	7,250	7,700	7,670	7,300	4,830	4,680	6,600	5,460	6,480	NA	SB	33,000
Antimony																		7.2 J				NA	SB	-
Arsenic	6.31	4.8		5.5	6.3	**10.6**	5.3		**17.9**	4.6	6.3			5.4		3.7	3.6	**22.9**	3.0		**11.7**	NA	7.5 or SB	3 - 12
Barium	75.4 J	**316 J**	248 J	**327 J**	175 J	53.1 J	55.5 J	150 J	83.7 J	65.7 J	40.2 J	49.5 J	83.5 J	96.1 J	71.3	80.3 J	60.4 J	298 J	87.8 J	55.0 J	86.6 J	NA	300 or SB	15 - 600
Beryllium		**5**	**5.3**	**0.74 B**				**4.5**	**1.4**				**1.2**			**0.73 B**			**0.92**			NA	.016 or SB	0 - 1.75
Cadmium	4.6 J	2.3 J	4.5 J	5.3 J	4.6 J	**19.9 J**	1.7 J	2.6 J	2.0 J	2.5 J		2.2 J	1.4 J	3.3 J	1.4 J	1.9 J	3.1 J	**19.9 J**	1.5 J	1.4 J	3.7 J	NA	(10)	0.1 - 1
Calcium	27,500	**209,000**	**124,000**	22,600	29,400	14,200	**65,700**	**157,000**	24,500	23,800	**52,900**	**64,100**	**67,000**	**55,600**	**65,100**	**62,100**	**56,300**	32,900	**52,100**	**52,700**	**36,200**	NA	SB	130 - 35,000
Chromium	11.7 J	17.3 J	45.4 J	28.9 J	81.1 J	193 J	11.5 J	10.2 J	20.7 J	10.1 J	8.2	31.3 J	32.8 J	22.0 J	13.2 J	13.3 J	13.0 J	38.4 J	17.6 J	9.53	42.9 J	NA	(50)	1.5 - 40
Cobalt	9.6 B		5.0 B	13.5	11.2 B	15.9	8.6		7.7 B	5.6				6.4 B	6.7 B	4.5 B	6.5 B	13.1	5.2 B	5.0 B	6.7 B	NA	30 or SB	2.5 - 60
Copper	**46.1 J**	13.2	20.9 J	**504 J**	**40.2 J**	**58.3 J**	19.5 J	9.4	15.3	22.9 J	11.0	19.9 J	11.5	**70.2 J**	14.7	**39.0 J**	**62.5 J**	**501 J**	**49.1 J**	21.6 J	**69.4 J**	NA	25 or SB	1 - 50
Iron	**56,900**	**18,500**	**58,000**	**27,400**	**47,800**	**244,000**	**17,200**	**25,400**	**20,100**	**16,700**	**7,910**	**21,000**	**10,900**	**20,300**	**14,300**	**13,700**	**20,200**	**108,000**	**13,300**	**13,100**	**27,800**	NA	2,000 or SB	2,000 - 550,000
Lead	80.2 J	38.1 J	93.4 J	89.0 J	571 J	89.4 J	20.5 J	29.3 J	46.8 J	85.6 J	15.2 J	49.0 J	61.8 J	121 J	22.4 J	188 J	136 J	766 J	117 J	46.1 J	208 J	NA	(1000)	4 - 500
Magnesium	4,830	**18,500**	**23,600**	**6,000**	**8,660**	3,070	**12,400**	**11,400**	4,740	**6,620**	**17,700**	**13,900**	**15,000**	**13,400**	**19,200**	**9,470**	**13,600**	**7,200**	**11,500**	**17,100**	**11,300**	NA	SB	100 - 5,000
Manganese	1,240	3,320	1,770	426	777	2,410	413	1,300	194	303	230	741	1,470	419	422	510	395	1,310	610	304	384	NA	SB	50 - 5,000
Mercury	**0.49 J**		**0.12 J**	**0.54 J**	**0.15 J**									**0.18 J**	**0.12 J**	**0.30 J**		**0.67 J**	**0.48 J**	**0.17 J**	**0.19 J**	NA	0.1	0.001 - 0.2
Nickel	**29.0 J**		**13.9 J**	**41.7 J**	**29.3 J**	**84.8 J**	**21.4 J**		**17.8 J**	**15.4 J**	7.7 J	9.2 J	6.9 J	**24.7 J**	**15.6 J**	**13.5 J**	**14.3 J**	**38.9 J**	**18.1 J**	12.1 J	**19.0 J**	NA	13 or SB	0.5 - 25
Potassium	1,110 B	4,970	3,270	2,170	2,510	657 B	1,050 B	3,120	2,100	696 B	1,100 B	872 B	1,430	1,910	1,870	1,470	1,410	1,360	1,270	1,500	1,450	NA	SB	8,500 - 43,000
Selenium	**2.3**	**35.2 J**	**35.9 J**	**11.5 J**	**12.3 J**		**23.7 J**	**28.0 J**	**10.9 J**	**15.3 J**	**33.1 J**	**25.6 J**	**29.2 J**	**23.5 J**	**33.2 J**	**21.4 J**	**25.2 J**		**24.0 J**	**29.7 J**	**22.6 J**	NA	2 or SB	0.1 - 3.9
Sodium		675 B	532 B							291 B			301 B		230 B							NA	SB	6,000 - 8,000
Thallium							2.4 J	4.8 J								2.7 J						NA	SB	-
Vanadium	27.0		8.7 B	22.6	25.3	9.0 B	14.9	9.9 B	44.2	12.7	16.4	15.9	15.0	17.2	15.9	13.4	18.6	17.6	13.3	14.6	22.9	NA	150 or SB	1 - 300
Zinc	**64.3 J**	**133 J**	**261 J**	**264 J**	**299 J**	**86.4 J**	**64.8 J**	**101 J**	**73.5 J**	**462 J**	**63.8 J**	**113 J**	**140 J**	**239 J**	**66.5 J**	**192 J**	**315 J**	**2,380 J**	**108 J**	**77.5 J**	**254 J**	NA	20 or SB	9 - 50
Cyanide		3.5	12.0			3.6		12.7					1.7	3.0								NA	-	-

Notes:

(1) Only those parameters having a value above the laboratory detection limit, and found at a minimum of one location are shown.

(2) Soil Cleanup Guidelines and Easter U.S. Background Range from NYSDEC TAGM 4046 (1/24/94). Value in parentheses are NYSDEC revised values for nonresidential sites but have not yet been incorporated into TAGM 4046.

\- Soil cleanup guideline or background range not available.

B - Result is between Instrument Detection Limit and Contact Required Detection Limit.

J - Indicates an estimate value. Result is below quantitation limit but above zero.

NA - Not Analyzed

Blank space indicates analyte was not detected.

Shaded/bold text indicates guidance criteria or background range was exceeded.

detected in one sample (SS-4) above the soil cleanup guideline. The PCBs Aroclor 1254 and Aroclor 1260 were each detected in one sample, and were detected at concentrations above the soil cleanup guidelines.

Only six SVOCs were detected at concentrations exceeding the soil cleanup guidelines. The six compounds are polycyclic aromatic hydrocarbons (PAHs), which were also detected in the samples collected during the 1999 Site Characterization. These PAHs and the associated concentrations are consistent with those detected in the soil samples collected during previous investigations. The concentrations of these compounds detected in the soil/fill material at this site are primarily within the range typically found in urban soils. Because PAHs are formed through anthropogenic combustion processes such as the burning of coal, oil and gasoline, they are generally ubiquitous in soils, especially urban soils. The presence of PAHs at this site is consistent with its urban location and past use as a railyard.

Twelve metals were detected in at least one debris pile sample at concentrations above the soil cleanup guidelines. These metals included arsenic, barium, beryllium, cadmium, calcium, copper, iron, magnesium, mercury, nickel, selenium and zinc. Although the source of the debris piles is not known, it should be noted that the highest iron concentration in the debris pile samples was 244,000 mg/kg, which is below the highest concentration in the Eastern U.S. Background Range (550,000 mg/kg). Similar to the samples discussed in Sections 3.1 and 3.2, the elevated selenium concentrations were detected during the analysis of the soil samples using ICP methods. The selenium concentrations using ICP analysis ranged from 2.29 to 35.9 mg/kg in the debris pile samples, but selenium was not detected when the three samples with the highest concentrations were re-analyzed using graphite furnace methods. Therefore, interference due to elevated calcium concentrations during the ICP analysis likely caused the artificially inflated concentrations of selenium detected in the samples.

3.4 GROUNDWATER CHARACTERIZATION RESULTS

The results of the analysis of the groundwater samples are summarized in Table 3-3. The groundwater analytical results indicated that only two VOCs (4-methyl-2-pentanone and 2-hexanone) and one SVOC (di-n-butylphthalate) were detected in the groundwater samples. These compounds were detected at concentrations below the Class "GA" Groundwater Quality Standards. Pesticides and PCBs were not detected in the groundwater samples.

Six metals (iron, magnesium, manganese, selenium, sodium, and thallium) were detected at concentrations exceeding the Class "GA" Groundwater Quality Standards in at least one groundwater sample. As discussed previously, the elevated iron concentrations in the Former Railroad Yard Area may be due to historical operations at the site and/or the fact that 8 to 12 feet of fill material cover the site. The elevated selenium concentrations are likely due to interference of elevated calcium concentrations in the ICP analytical methods, as discussed previously. Thallium was detected in only one groundwater sample (MW-104), and was not detected in previous sampling at this location. Additionally, thallium was not previously detected in any soil samples collected in the Former Railyard.

These groundwater characterization results are useful in assessing the "oil-like sheen" observed at a depth of approximately 7.3 feet below grade in MW-003, as described on the boring log for the well (included in Appendix A). No soil samples were collected for analysis from this well boring. However, the depth of the interval with the sheen is located within the screened interval of the well, and was below the water table during the groundwater sampling event. No volatile organic compounds, pesticides, or PCBs were detected in the groundwater sample from MW-003, and only one semivolatile organic compound (di-n-butylphthalate) was detected in the sample. Di-n-butylphthalate was detected at a concentration of 4 μg/L. Based on the groundwater sampling results, the oil-like sheen does not appear to be due to contamination by organic compounds.

TABLE 3-3

SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER SAMPLES

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

PARAMETER$^{(1)}$	SAMPLE LOCATION								NYSDEC
	MW-001	Duplicate	MW-002	MW-003	Duplicate	MW-104	MW-105	TRIP BLANK	Class GA
	2/2/00	(MW-001)	2/2/00	2/2/00	(MW-003)	2/2/00	2/2/00	2/2/00	Standards$^{(2)}$
VOLATILE ORGANIC COMPOUNDS (ug/L)									
4-Methyl-2-pentanone	4 J							NA	-
2-Hexanone	9 J							NA	50
Toluene								27	-
SEMI-VOLATILE ORGANIC COMPOUNDS (ug/L)									
Di-n-butylphthalate			3 J	4 J		3 J		NA	50
PESTICIDES / PCBs (ug/L)									
None Detected								NA	
METALS (ug/L)									
Cyanide	39.0	36.0		20.0	10.0	90.0	20.0	NA	1000
Aluminum	162B	653	902	402	277	1630		NA	-
Barium			140 B	65.1 B	59.5 B			NA	1000
Calcium	57,100	60,300	171,000	159,000	141,000	101,000	75,100	NA	-
Copper			10.9 B					NA	200
Iron	**340 J**	**1230 J**	**11,700 J**	**2,960 J**	**2,340 J**	231 J	**304 J**	NA	300
Lead			5.1 J	4.3 J	4.1 J		3.8 J	NA	25
Magnesium	6,940	7,610	**55,700**	32,100	28,900		7,750	NA	35000
Manganese	40.7	62.5	**658**	**846**	**757**		25.0	NA	300
Potassium	38,600 J	40,800 J	1,080 J	61,000 J	53,200 J	12,400 J	14,100 J	NA	-
Selenium	**25.0 J**	**20.6 J**	**114 J**	**84.5J**	**63.2 J**	**13.6 J**	**29.3 J**	NA	10
Silver			35.9					NA	50
Sodium	**61,400**	**64,600**	**36,600**	**44,000**	**39,000**	14,700	**23,100**	NA	20000
Thallium						**16.6**		NA	0.5
Zinc		11.3 B	14.0 B	86.2	39.5	16.5 B	10.0 B	NA	2000

Notes:

(1) Only those parameters having a value above the laboratory detection limit, and found at a minimum of one location are shown.

(2) NYSDEC Water Quality Guidance Values for Class GA Waters from NYS Ambient Water Quality Standards and Guidelines (June 1998).

- Water Quality Standard or Guideline not available.

B - Result is between Instrument Detection Limit and Contact Required Detection Limit.

J - Indicates an estimate value. Result is below quantitation limit but above zero.

NA - Not Analyzed

Blank space indicates analyte was not detected.

Shaded/bolded text indicates guidance criteria was exceeded.

Table 3-4 shows the groundwater elevations measured on February 2, 2000. As shown in Figure 3-1, the groundwater flow direction at the Former Railroad Yard Area is north and west, toward the canal. This groundwater flow direction is consistent with that described during previous investigations at the site.

TABLE 3-4

MALCOLM PIRNIE

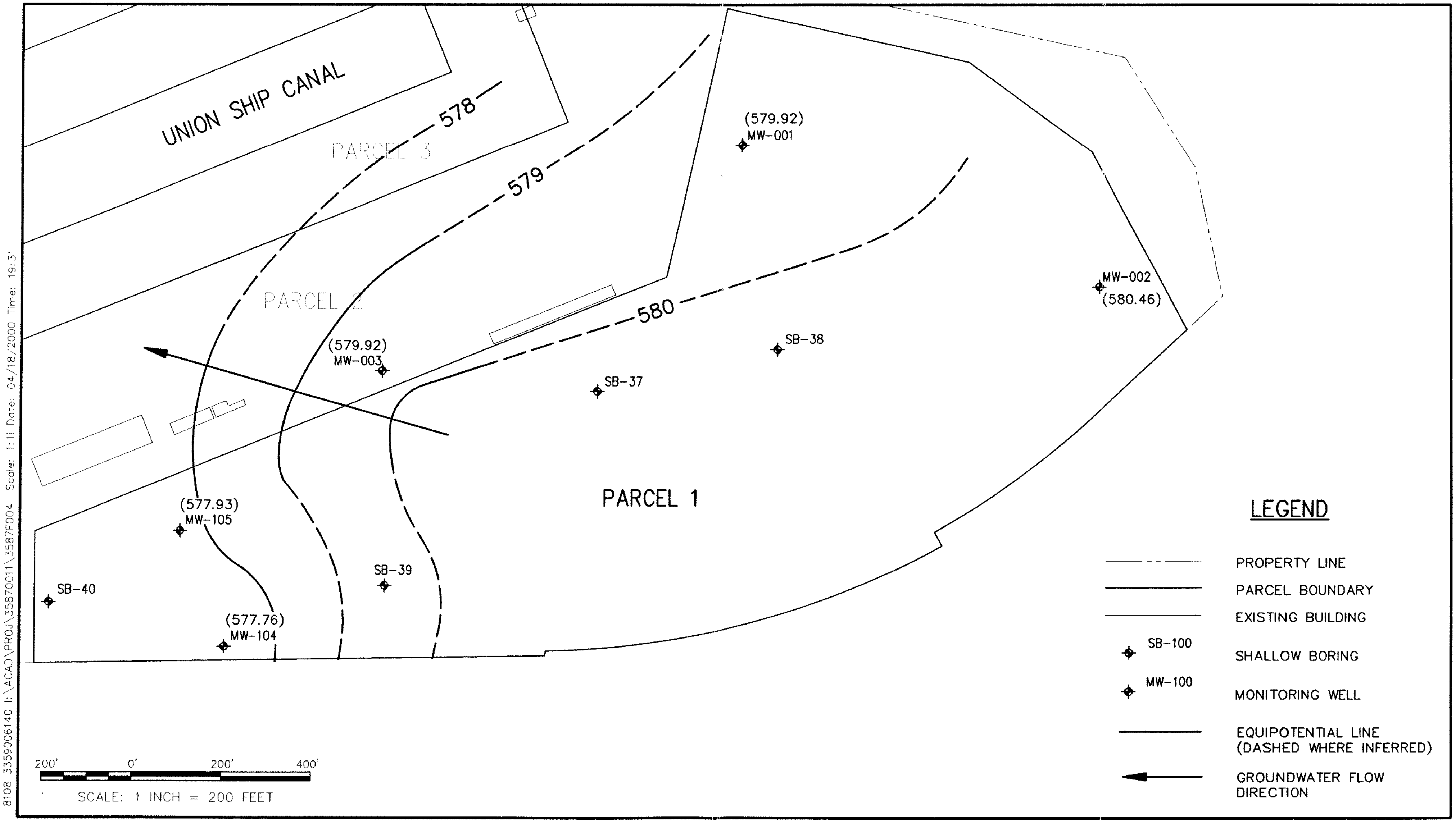
GROUNDWATER ELEVATION MEASUREMENTS

SUPPLEMENTAL INVESTIGATION
HANNA FURNACE - FORMER RAILROAD YARD AREA

WELL NUMBER	RISER ELEVATION$^{(1)}$	BOTTOM DEPTH $^{(2)}$	MEASUREMENT	
			STATIC LEVEL $^{(2)}$	ELEVATION
Existing Monitoring Wells				
MW-104	586.38	17.78	8.62	577.76
MW-105	585.59	17.60	7.66	577.93
Newly Installed Monitoring Wells				
MW-001	583.96	15.60	4.18	579.78
MW-002	586.01	15.60	5.55	580.46
MW-003	582.79	16.05	2.87	579.92

Notes:
(1) Measured in feet above mean sea level.
(2) Feet below top of riser.

FIGURE 3-1



8108 3359006140 I:\ACAD\PROJ\35870011\3587F004 Scale: 1:1; Date: 04/18/2000 Time: 19:31

MALCOLM PIRNIE

3587F004

HANNA FURNACE–FORMER RAILYARD SITE
SUPPLEMENTAL INVESTIGATION

WATER TABLE MAP–FEBRUARY 2, 2000

HANNA FURNACE APRIL 2000

4.0 QUALITATIVE RISK ASSESSMENT

As part of the Supplemental Investigation, Malcolm Pirnie completed a qualitative risk assessment that examines the risk that contaminants at the site pose to human health and the environment. The Qualitative Risk Assessment is included in Appendix E.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The results of the Supplemental Investigation of the Former Railroad Yard Area at the Hanna Furnace Site were consistent with previous investigations performed at the area. The media characterized during the Supplemental Investigation are separately discussed below.

5.1 SUBSURFACE SOIL/FILL MATERIAL

Consistent with the samples collected during the 1999 Site Characterization, the analytical results indicate that VOCs and PCBs were not detected in the samples collected in the eastern portion the Former Railyard. Additionally, cyanide concentrations were well below the USEPA soil screening levels. A number of metals and PAHs were detected at concentrations above the NYSDEC soil cleanup guidelines, and the concentrations were similar to those encountered in the 1999 Site Characterization.

5.2 DEBRIS PILES

The debris pile inventory indicated that the majority of the debris piles are composed of construction and demolition debris. Malcolm Pirnie's estimate of the volume of all above grade debris in the piles is approximately 24,000 cubic yards. The analysis of 20 samples collected from the debris piles generally indicated that some PAHs and metals were detected at concentrations above the soil cleanup guidelines. These constituents and concentrations are generally similar to those encountered in the 1999 Site Characterization.

5.3 GROUNDWATER

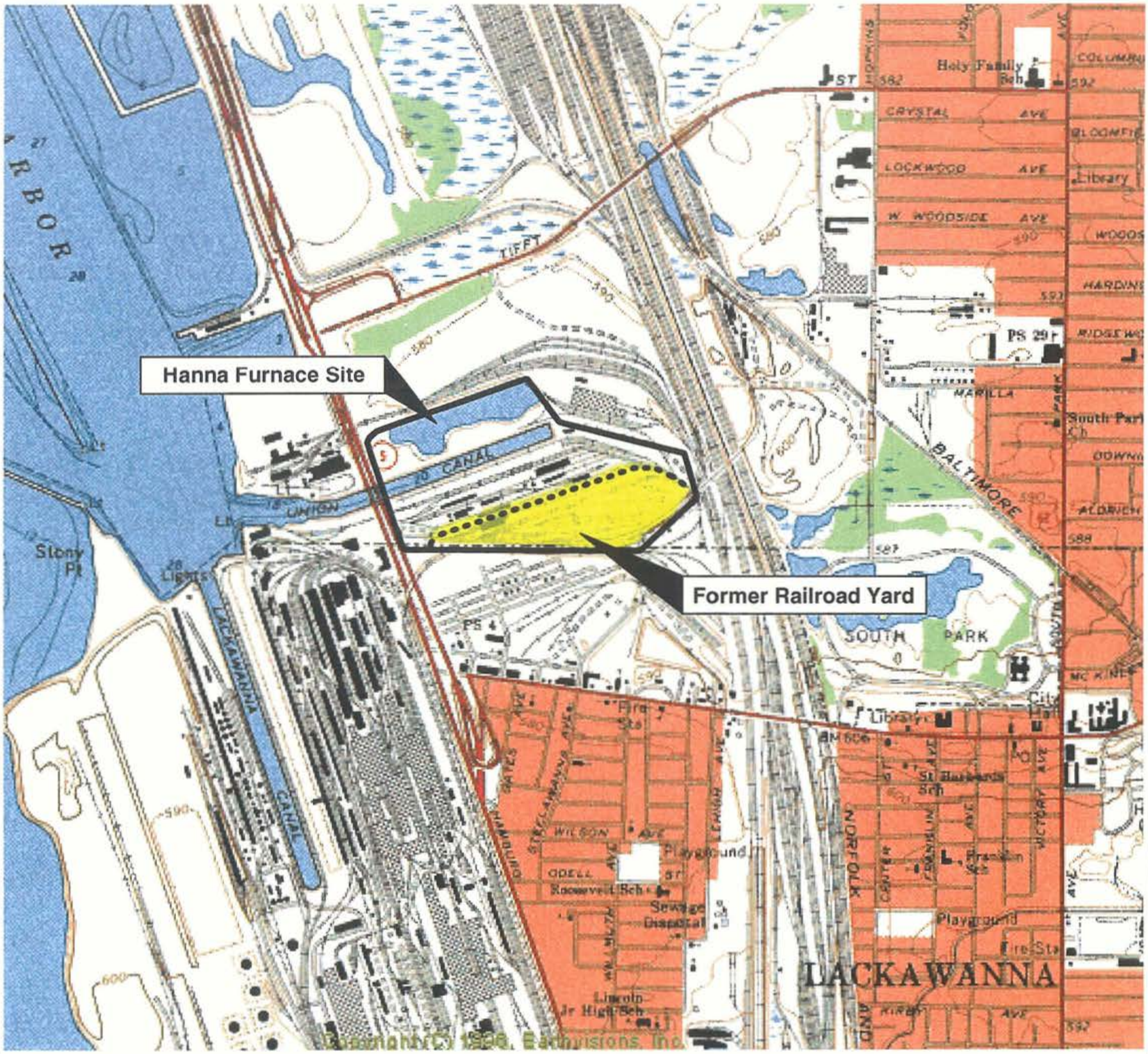
Analysis of the groundwater from five monitoring wells in and downgradient of the Former Railroad Yard Area indicated that only two VOCs and one SVOC were detected in the groundwater samples. Pesticides and PCBs were not detected. Six metals were detected at concentrations above the applicable groundwater standards. The elevated concentrations of these metals are most likely due to the presence of fill material and/or historical uses of the Former Railroad Yard Area rather than the presence of significant concentrations of contaminants in the subsurface.

5.4 RECOMMENDATIONS

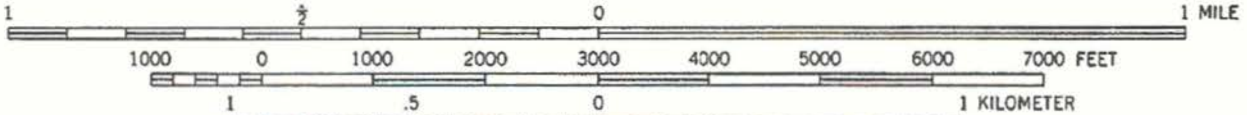
As described in the 1999 Site Characterization Report and confirmed by the results of the Supplemental Investigation, the Former Railroad Yard Area is suitable for re-development as a commercial/light industrial park provided that certain precautions are taken to limit exposure to the metals and PAHs present in the on-site fill material. Minimum precautions should include:

- Establishment of health and safety protocols for specific re-development activities to minimize exposure potential.
- Development of a protocol for dealing with excavated fill material
- Placement of a minimum of 1-foot of clean soil over the surface following or during development to minimize the potential for exposure following site re-development. Due to the similarities in chemical constituents of the debris piles and the surface and subsurface soil/fill, the debris piles should be spread across the site (with removal and off-site disposal of large debris such as tires, railroad ties etc.), graded, and covered in the same manner planned for the surface soil/fill material. As discussed in the qualitative risk assessment, these actions will be sufficient to protect human health and the environment.
- Establishment of a protocol for digging required to maintain or enhance utilities following completion of site redevelopment including health and safety requirements and excavated soil handling/disposal requirements.

FIGURE 1



Source: USGS Buffalo SE Quadrangle Map



CONTOUR INTERVAL 10 FEET

3587-001-200

MALCOLM PIRNIE

HANNA FURNACE SITE - FORMER RAILROAD YARD
SUPPLEMENTAL INVESTIGATION

SITE LOCATION MAP

APRIL 2000

MALCOLM
PIRNIE

APPENDIX A

BORING LOGS

CLIENT So. Bhlc Redevelopment

PROJECT HANNA Furnace

LOCATION " "

CONTRACTOR Maxim Tech

METHOD OF BORING: SOIL 4¼" HSA

ROCK

JOB NO. 3587-001

LOGGED BY J. P. Hilton

CORE DIA.

FIELD BOREHOLE LO

BOREHOLE NO. MW-001

STARTED 13.15 PM 1/24 19 200

FINISHED 15 45 PM 1/24 19 200

ELEVATIONS: DATUM

Fill

blue-grn 2-6'

±6.0'

SAND w/ Silt & Clay

SAMPLE NO.	HNu TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
1		0	2	1.3/		1.3 Fill black brown Silt AND Med Crs SAND	WeT - Moist
			7			w/little-Some F-Crs Gravel, Slag & brick	
		1	18				
			14	2.0		(med)	
2		2	3	1.8/		.5 Fill SAND, Red-brown, trace fine Gravel	Moist
			14			sharp contact w/	
		3	47			1.3 Fill, dark blue-green Crs SAND, slag-like	
			50	1.8			
3		4	8	1.4/		.4 Fill, SAND, fine, dark brown-red,	WET - SAT
			13			1.0 Fill SAND, Crs blue-green	
		5	50				50 cnt / .4'
			—	1.5			
4		6	14	1.3/		1.3 SAND fine-Med, black w/trace-little	SAT
			25			fine Gravel	
		7	13				
			12	2.0			
5		8	5	0.0/		No Recovery	
			3				
		9	2				
			2	2.0			
6		10	3	1.2/		.2 SAND fine black w/some Silt	SAT
			4			1.0 Silt AND Clay, med brown yellow,	WET
		11	5			grading downward to gray, stiff	
			5	2.0			
7		12	6	1.6/		.4 Silt AND Clay A/A	
			3			1.2 Clay, brown-gray w/trace-little	Moist
		13	10			Silt as laminae	
			14	2.0			
		14					

Sheet No. 1 of 1

MALCOLM

FIELD BOREHOLE LO

CLIENT So. Blvd Redevelopment
JOB NO. 3587-001
PROJECT HANNA FURNACE
LOCATION " "
BOREHOLE NO. MW-002
CONTRACTOR Maxim
LOGGED BY JPH
STARTED 10:00 AM 1/24 19 2000
METHOD OF BORING: SOIL 4 1/4" HSA
FINISHED 11:50 AM 1/24 19 2000
ROCK
CORE DIA.
ELEVATIONS: DATUM

SAMPLE NO.	HNU TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
1	1.2	0 1	2 4 5 6	1.0/2.0		1.0 Fill SAND and Silt black-brown fine, w/ little F-Crs Gravel as cinders, and Slag	0.0-0.8 Frozen DRY-Moist took VOC sample 0-2'
2	0.4	2 3	6 4 4 7	0.2/2.0		0.2 Fill as above (A/A) poor recovery	Moist Composite SVOC, MET, CN Pest/PCB 0-4'
3	0.3	4 5	1 2 4 5	.9/2.0		0.9 Clay, gray-red mottled w/ Lt brown Silt interbed, soft, plastic	WET
4	0.2	6 7	2 3 4 4	1.4/2.0		1.4 Clay and Silt medium gray, trace fine, sub-rnd GRVL	SAT
5	0.2	8 9	2 4 3 7	1.5/2.0		1.5 Clay dark-med gray w/ Silt and fine Sand interbed @ 8.7-9.0	WET
6	0.2	10 11	1 1 4 9	1.7/2.0		1.7 Clay, soft, plastic, gray-black w/ peat interbed @ 10.9-11.0	WET
7	0.2	12 13	1 3 6 9	2.0/2.0		2.0 Clay Lt gray-brown, stiff moderate plasticity w/ trace-little Silt	WET
		14					

Fill
SAND
w/slag
cinders
4.0'
Clay
w/
Silt

Sl... No. ____ of ____

MAXIM

FIELD BOREHOLE LO

CLIENT So Bflo Redevelopment

JOB NO. 3587-001

PROJECT HANNA FurNACE

LOCATION " "

BOREHOLE NO. MW-003

CONTRACTOR Maxim Tech

LOGGED BY J P. Hilton

STARTED 10:30 AM 1/26 19 2000

METHOD OF BORING: SOIL 4¼" HSA

FINISHED 12:00 PM 1/26 19 2000

ROCK

CORE DIA.

ELEVATIONS: DATUM

Fill
Red-brown SAND

7.3'

Peat w/Organic Silt

SAMPLE NO.	TYPE	DEPTH	BLOWS 'N'	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
1		0 1	8 3 8 13	1.2/2.0		1.2 Fill SAND, dark red-brown, F-MED grain	WET Overburden As iron oxide dust
2		2 3	4 4 5 3	1.7/2.0		1.7 Fill SAND As above (A/A) red-brown w/some black Silt (Ash)	SATURATED
3		4 5	3 4 4 7	1.4/2.0		1.4 Fill SAND A/A w/ Silt	SAT
4		6 7	8 7 4 2	1.5/2.0		1.3 Fill SAND, A/A w/ black Silt sharp contact w/ .2 Peat AND Organic Silt, black-brown	w/ oil-like sheen @ contact
5		8 9	3 2 3 5	.5/2.0		.5 Peat AND Organic Silt A/A	MoisT
6		10 11	2 2 1 2	.3/2.0		.3 SAND brown-black, fine grain	SAT
7		12 13	1 2 1 3	.8/2.0		.3 SAND w/ Peat dark brown .5 Silt gray-brown	MoisT WET
		14					

Sheet No. 1 of 1

CLIENT So. Bflo Redevelopment

JOB NO. 3587-001

FIELD BOREHOLE LO

PROJECT HANNA Furnace

LOCATION " "

BOREHOLE NO. B-37

CONTRACTOR Maxim Tech

LOGGED BY J. P. Hilton

STARTED 10:00 A M 1/25 19 2000

METHOD OF BORING : SOIL 4¼" HSA

FINISHED 12:45 P M 1/25 19 2000

ROCK

CORE DIA.

ELEVATIONS: DATUM

Fill

6.0 Bl-Grn Fill

9.2' Peat

SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
1		0 1	2 3 2 4	.3/2.0		.3 Fill, silt dark brown AND slag w/ brick, Nails	Wet - Frozen
2		2 3	23 43 35 22	1.6/2.0		1.1 Fill, crs Gravel as slag & crushed stone w/ dark brown silt, sharp contact w/ .5 Fill Chalk-White SAND f-crs w/ fine Gravel as ballast	Wet - SAT
3		4 5	13 14 24 22	0.0/2.0	11:50	No Recovery presumed RR ballast & crushed stone	
4		6 7	19 28 24 27	.6/2.0	12:10	.6 Fill blue-green, crs SAND/Slag	SAT VOC smpl @ 12:10
5		8 9	30 32 14 16	1.4/2.0	12:20	1.2 Fill SAND/slag, blue-green as above sharp contact w/ .2 Peat, dark brown silt, woody tissue	SAT SVOC, MT/CN
6		10 11		/			
7		12 13		/			

Sheet No. 1 of 1

CLIENT So. Bflo Redevelopment

JOB NO. 3597-001

FIELD BOREHOLE LO

PROJECT HANNA FURNACE

LOCATION " "

BOREHOLE NO. B-38

CONTRACTOR MAXIM Tech

LOGGED BY J P Hilton

STARTED 12:55 PM 1/25 19 200

METHOD OF BORING: SOIL 4¼" HSA

FINISHED 13:30 PM 1/25 19 200

ROCK

CORE DIA.

ELEVATIONS: DATUM

	SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
Fill	1		0 1	2 4 5 4	1.0' 2.0	12:55	1.0 Fill (.6) Silt AND SAND dark brown, fine sharp contact w/ (.4) SAND Lt brown, Crs w/ Fine Gravel	WET
	2		2 3	3 3 5 11	1.4' 2.0	13:00	1.4 Fill, SAND white-Lt brown, Crs w/ Trace Fine Gravel	SAT
5.7' Bl-Grn Fill	3		4 5	4 4 4 30	2.0 2.0	13:05	2.0 (1.3) SAND white-gray-blue, Crs (.4) SAND brown-black, Fine-Med (.3) SAND green-blue, MED-Crs	SAT
8.0' Peat	4		6 7	6 13 24 8	1.3 2.0	13:15	1.3 Fill SAND/Slag Lt blue-green, Crs	SAT VOC/SVOC @ 13:15 6-8'
	5		8 9	3 4 3 3	.1 2.0		.1 Peat, dark brown-black Silty, woody plant tissue	WET
	6		10 11		/			
	7		12 13		/			
	8		14 15		/			

Sheet No. 1 of

MALCOLM

FIELD BOREHOLE LO

CLIENT So. Bflo Redevelopment
JOB NO. 3587-001
PROJECT HANNA FURNACE
LOCATION " "
BOREHOLE NO. B-39
CONTRACTOR Maxim Tech
LOGGED BY J. P. Hilton
STARTED 15:30 PM 1/25 19 2000
METHOD OF BORING: SOIL 4 1/4" HSA
FINISHED 16:20 PM 1/25 19 2000
ROCK
CORE DIA.
ELEVATIONS: DATUM

Fill

SAND w/Gravel

8.0

Blue-Grn Fill

≈10.5'

SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
1		0 1	10 19 50 –	1.1/1.2		1.1 Fill SAND AND Gravel, dark brown, MED-Crs w/ f-Crs crushed stone	DRY-FROZEN 50 cnt/.2
2		2 3	16 16 12 11	1.3/2.0		1.3 Fill SAND AND Gravel as above (A/A) w/slag and white chalk-like material @ 3.0-3.3' bgs	SAT
3		4 5	3 5 4 4	1.7/2.0		1.7 Fill SAND white-gray, Crs w/ trace fine Gravel	SAT
4		6 7	6 5 4 6	1.8/2.0		1.4 Fill SAND A/A w/ fine Gravel .4 Fill SAND blue-white, MED-Crs	SAT
5		8 9	4 8 11 16	1.8/2.0	16:00	1.8 Fill SAND blue-green, MED-Crs w/ trace fine Gravel	SAT
6		10 11	5 5 5 8	1.1/2.0		.4 Fill SAND A/A w/ sharp contact @ ≈10.5 .7 PEAT brown-black, w/silt grading downward to Clay	SAT Moist
		12					

Sheet No. 1 of 1

MAXIM

FIELD BOREHOLE LO

CLIENT So Bflo Redevelopment
PROJECT HANNA FurNACE
LOCATION " "
CONTRACTOR MAXim Tech
METHOD OF BORING: SOIL 4¼" HSA
ROCK
JOB NO. 3587-001
LOGGED BY J.P. Hilton
CORE DIA.
BOREHOLE NO. B-40
STARTED 9:00 AM 1/26 19 200
FINISHED 10:00 AM 1/26 19 200
ELEVATIONS: DATUM

	SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
	1		0	3	1.8/		1.0 Fill Silt AND SAND dark brown-black,	Moist
Fill				32			f-MED w/Slag & metal sharp contact w/	
			1	14	/2.0		0.8 SAND yellow brown, MED-Crs, trace	
SAND				15			fine Gravel	
w/Grvl	2		2	9	1.6/		1.6 SAND yellow-orange, MED-crs w/ trace	Moist-Wet
				7			fine Gravel as crushed stone	
			3	5	/2.0	8:40		
				4				
	3		4	11	1.6/		1.4 SAND w/ F-Crs Gravel A/A	SAT
5.5'				32			.2 SAND MED-Crs, blue-gray	
			5	31				
SAND				50	/1.8			
Bl-Grn	4		6	9	1.4/		1.4 SAND blue-green MED-crs A/A	SAT
				15		9:05	w/ fine angular gravel	
			7	16	/2.0			
				10				
8.1	5		8	1	1.2/		.1 SAND blue-green A/A, sharp contact w/	SAT
Peat				2				
			9	1	/2.0		.3 Peat brown-black	Moist
w/silt				5			.8 Silt AND Clay dark gray-brown, soft, weak plasticity	
+			10					
Clay								

Sheet No. 1 of 1

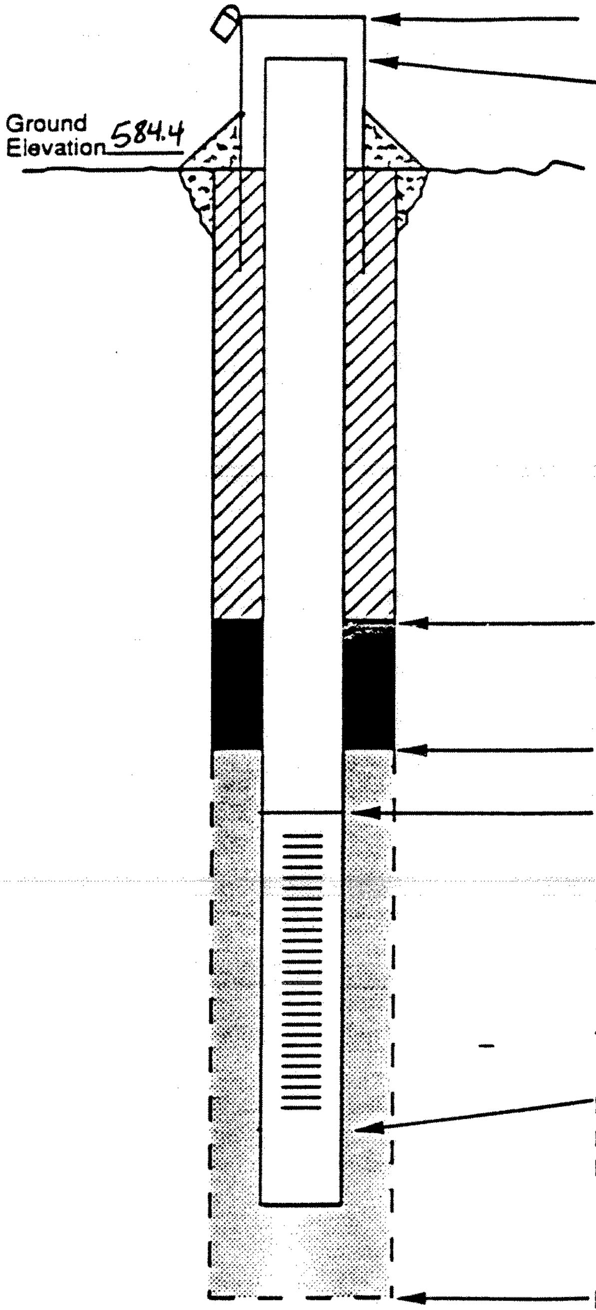
MALCOLM

APPENDIX B

MONITORING WELL CONSTRUCTION DETAILS

OVERBURDEN MONITORING WELL CONSTRUCTION DIAGRAM

Project Hanna Furnace
Study Area South UPG
Driller B. Lambert
Project No. 7169-40
Boring No. MW-104
Drilling Method 4.25" ID HSA
Date Installed 10/21/94
Development Method PUMP & SURGE
Field Geologist BK Butl



Elevation of Top of Surface Casing: 587.19
Stick-up of Casing Above Ground Surface: +2.5'
Elevation of Top of Riser Pipe: 586.90
Type of Surface Seal: Cement/Bent Grout
Type of Surface Casing: Steel

ID of Surface Casing: 6"

Diameter of Borehole: 8.25"

Riser Pipe ID: 2"
Type of Riser Pipe: PVC

Type of Backfill: 95% ~~ø~~ Cement, 5% Bentonite

Elevation of Top of Seal: 581.4
Depth of Top of Seal: 3' bgs
Type of Seal: Bentonite Chips

Elevation of Top of Sand: 580.4
Depth of Top of Sand: 4'
Elevation of Top of Screen: 579.4
Depth of Top of Screen: 5'

Type of Screen: PVC
Slot Size x Length: #6 x 10'
ID of Screen: 2"

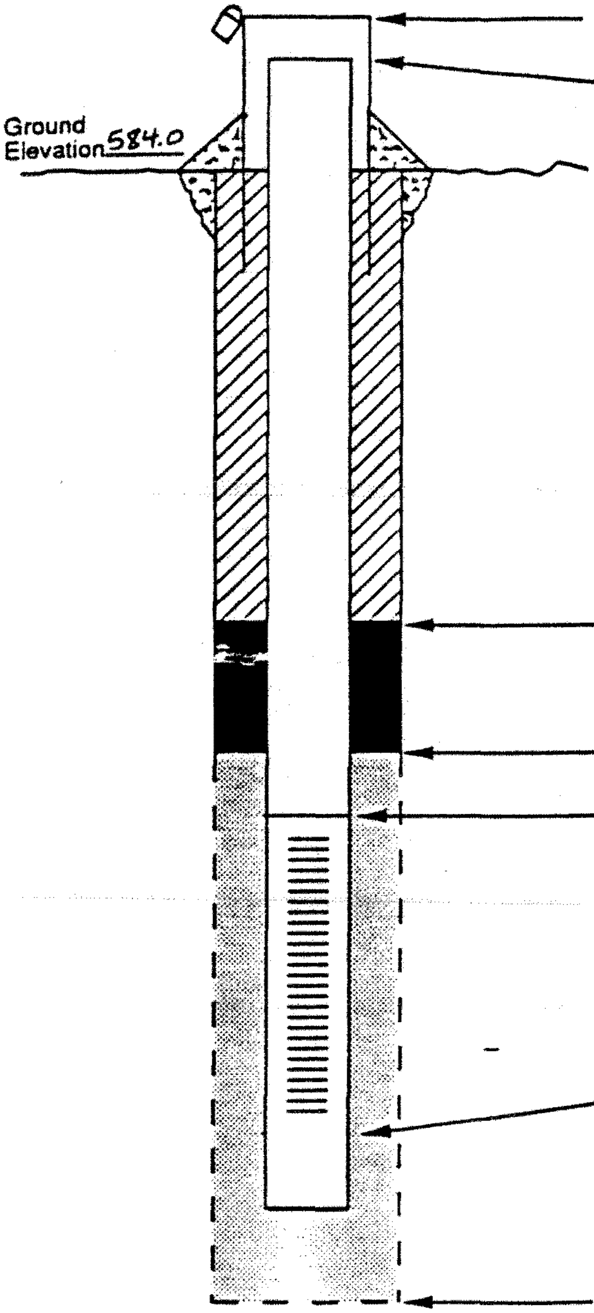
Type of Sandpack: #00 Morie

Elevation of Bottom of Screen:
Depth of Bottom of Screen: 15'
Depth of Sediment Sump with Plug: N/A

Elevation of Bottom of Borehole: 569.4
Depth of Bottom of Borehole: 15'

OVERBURDEN MONITORING WELL CONSTRUCTION DIAGRAM

Project Hanna Furnace
Study Area Boiler House
Driller B. Lambert
Project No. 7169-40
Boring No. MW-105
Drilling Method 4.25" HSA
Date Installed 10/21/94
Development Method PUMP & SURGE
Field Geologist BK Butler



Ground Elevation 584.0

Elevation of Top of Surface Casing: 586.22
Stick-up of Casing Above Ground Surface: +2.5
Elevation of Top of Riser Pipe: 586.03
Type of Surface Seal: Cement/Bent Grout
Type of Surface Casing: Steel

ID of Surface Casing: 6"

Diameter of Borehole: 8.25"

Riser Pipe ID: 2"
Type of Riser Pipe: PVC, Sch 40

Type of Backfill: 95% Portland Cement, 5% bentonite

Elevation of Top of Seal: 581
Depth of Top of Seal: 3' bgs
Type of Seal: Bent. Chips

Elevation of Top of Sand: 580
Depth of Top of Sand: 4' bgs
Elevation of Top of Screen: 579
Depth of Top of Screen: 5' bgs

Type of Screen: PVC Sch 40
Slot Size x Length: #6 x 10'
ID of Screen: 2"

Type of Sandpack: #00 Morie Silica

Elevation of Bottom of Screen:
Depth of Bottom of Screen: 15' bgs
Depth of Sediment Sump with Plug: N/A

Elevation of Bottom of Borehole: 569
Depth of Bottom of Borehole: 15' bgs

ABB Environmental Services

MALCOLM PIRNIE

MONITORING WELL SHEET

WELL NO. MW-

PROJECT So. Bflo Redevelopment

START DATE 1/24/00

END DATE 1/24/00

PROJECT NO. 3587-001

FIELD GEOLOGIST J P Hilton

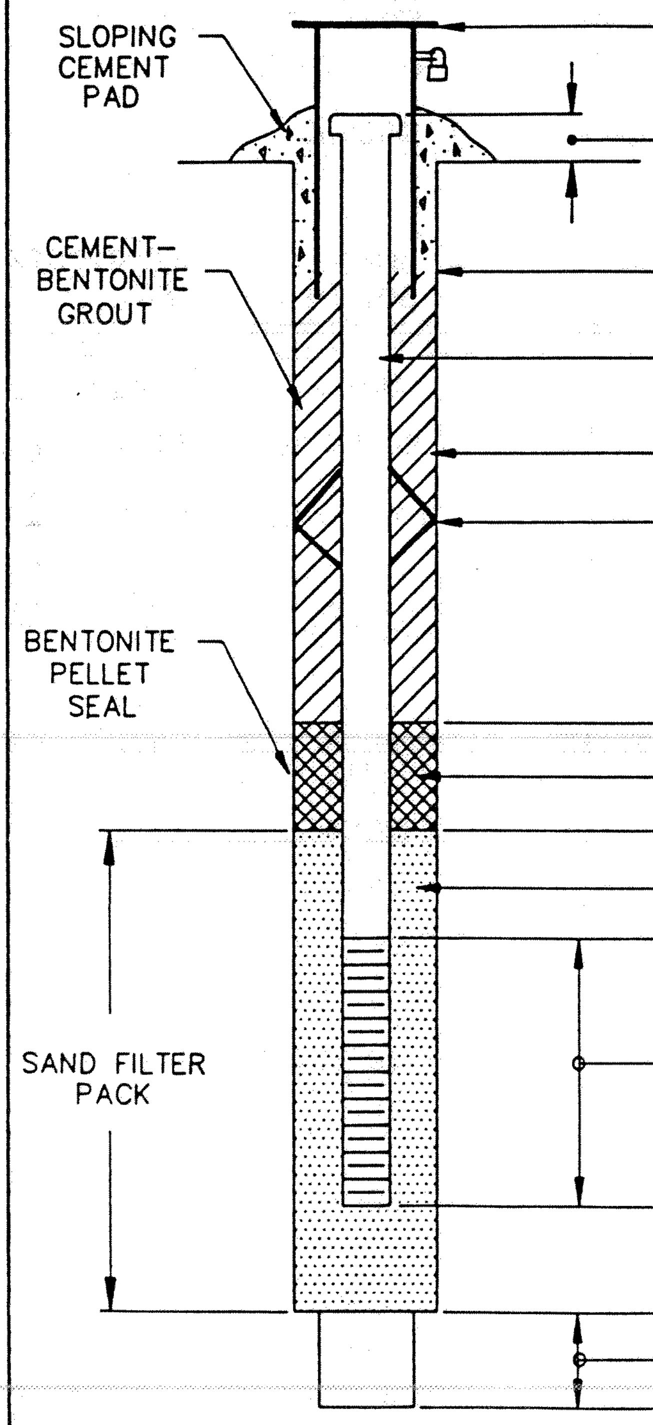
LOCATION Hanna Furnace

DRILLING CO. MAXIM

DRILLER(S) R. Brown

DRILLING METHOD(S) 4¼" HSA

DEVELOPMENT METHOD(S)



SIZE AND LENGTH OF LOCKABLE PROTECTIVE STEEL CASING 4"x5'

LOCKED? [✓ YES] NO

STICK-UP

DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT @ Grade

RISER DIAMETER AND MATERIAL 2" Sch 40 PVC

BOREHOLE DIAMETER 8¼"

DEPTH TO CENTRALIZERS NA

DEPTH 3.0'

PELLET SIZE Med Chips

DEPTH 3.8

SAND SIZE #1

DEPTH 4.0'

SCREEN DIAMETER, SLOT SIZE, AND MATERIAL 2" 0.010" Sch 40 PVC

DEPTH 14.0'

DEPTH 14.0'

BACKFILL MATERIAL NA

BOTTOM OF BOREHOLE 14.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

OMWSHEET.DWG 9-20-90

MALCOLM PIRNIE

MONITORING WELL SHEET

WELL NO.

PROJECT So Bflo Redevelopment START DATE 1/24/00 END DATE 1/24/00

PROJECT NO. 3587-001 FIELD GEOLOGIST J.P. Hilton

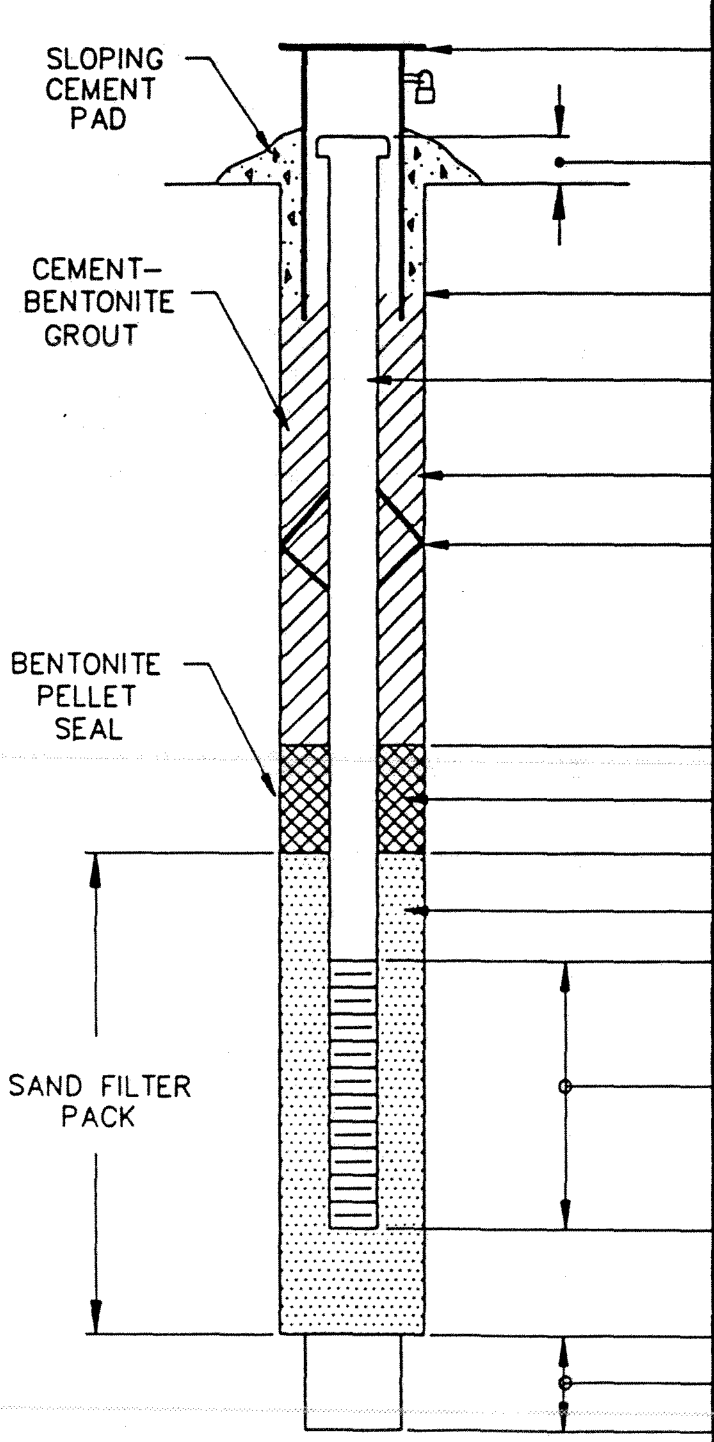
LOCATION Hanna Furnace

DRILLING CO. MAXIM

DRILLER(S) R. Brown

DRILLING METHOD(S) 4¼" HSA

DEVELOPMENT METHOD(S)



SIZE AND LENGTH OF LOCKABLE PROTECTIVE, STEEL CASING 4" x 5'

LOCKED? X YES ___ NO

STICK-UP ________

DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT @ grade

RISER DIAMETER AND MATERIAL 2" Sch 40 PVC

BOREHOLE DIAMETER 8½"

DEPTH TO CENTRALIZERS NA

DEPTH 3.0

PELLET SIZE Med

DEPTH 3.8

SAND SIZE #1

DEPTH 4.0

SCREEN DIAMETER, SLOT SIZE, AND MATERIAL 2" .010 Sch 40 PVC

DEPTH 14.0

DEPTH 14.0

BACKFILL MATERIAL NA

BOTTOM OF BOREHOLE 14

NOTE: DEPTHS ARE FEET BELOW GRADE

OMWSHEET.DWG 9-20-90

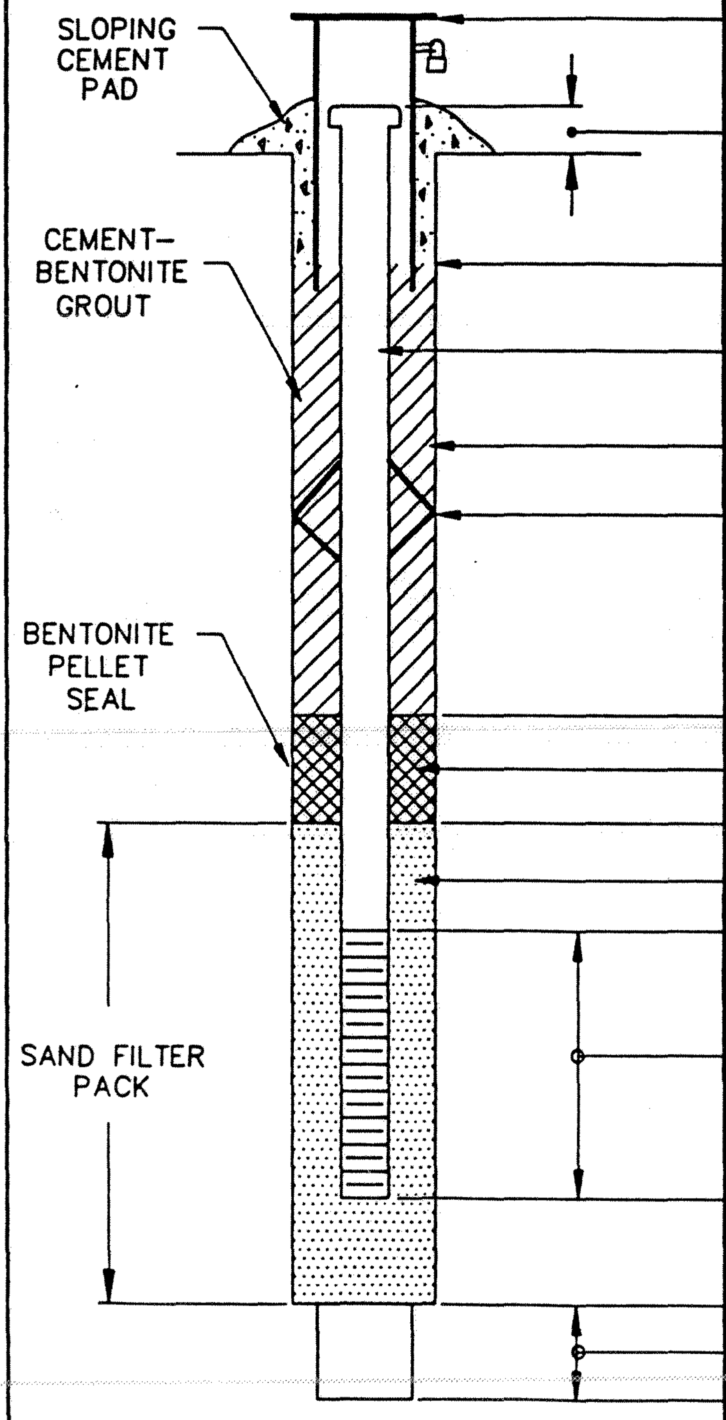
MALCOLM PIRNIE

MONITORING WELL SHEET

WELL NO. MW-

PROJECT So Bflo Redevelopment
START DATE 1/26/00
END DATE 1/26/00
PROJECT NO. 3587-001
FIELD GEOLOGIST J.P. Hilton
LOCATION Hanna Furnace

DRILLING CO. Maxim
DRILLER(S) R. Brown
DRILLING METHOD(S) 4¼" HSA
DEVELOPMENT METHOD(S)



SIZE AND LENGTH OF LOCKABLE PROTECTIVE STEEL CASING 4" x 5'
LOCKED? X YES ___ NO
STICK-UP 2.0'
DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT @ grade
RISER DIAMETER AND MATERIAL 2" Sch 40 PVC
BOREHOLE DIAMETER 8½"
DEPTH TO CENTRALIZERS NA
DEPTH 3.0
PELLET SIZE Med Chips
DEPTH 3.8
SAND SIZE #1
DEPTH 4.0'
SCREEN DIAMETER, SLOT SIZE, AND MATERIAL 2" 0.010" Sch 40 PVC
DEPTH 14.0'
DEPTH 15.0'
BACKFILL MATERIAL NA
BOTTOM OF BOREHOLE 15.0

NOTE: DEPTHS ARE FEET BELOW GRADE

OMWSHEET.DWG 9-20-90

APPENDIX C

WELL DEVELOPMENT AND SAMPLING LOGS

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace
PROJECT NO. : 3587-001
STAFF: JPH
DATE: 1/27/00

WELL NO.: **MW-001**

(1) TOTAL CASING AND SCREEN LENGTH (ft.): 16.22
(2) CASING INTERNAL DIAMETER (in.): 2"
(3) WATER LEVEL BELOW TOP OF CASING (ft.): 4.2
(4) VOLUME OF WATER IN CASING (gal.): 2.0

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$V = 0.0408 [(2)^2 \times \{ (1) - (3) \}] =$ ______ GAL.

Time	10:15	10:21	10:25	10:32	10:40						
PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS)										
	20	40	60	80	100						
pH	8.93	8.75	8.72	8.82	8.73						
CONDUCTIVITY	856	874	852	840	830						
TEMPERATURE	9°C	9°	9	9	9						
TURBIDITY	>100	47	>100	>100	39						
APPEARANCE	gray silty	gray silty	Milky	Milky	Clear						

COMMENTS: - Initially purged 10 gal with 1¼" disposable bailer 1/26/00
- Note strong sulfur odor during purge & development process
- Continued development w/centrifugal pump, well recharges readily
- Unable to pump well to "dry" condition

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace
PROJECT NO. : 3587-001
STAFF: JPH / SRD
DATE: 2/2/00

WELL NO.: **MW-001**

(1) TOTAL CASING AND SCREEN LENGTH (ft.): 16.22
(2) CASING INTERNAL DIAMETER (in.): 2"
(3) WATER LEVEL BELOW TOP OF CASING (ft.): 4.18
(4) VOLUME OF WATER IN CASING (gal.): 2.1

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

V = 0.0408 [$(2)^2$ x { (1) - (3) }] = ______ GAL.

Time 9:20 9:24 9:27

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS)										
	5	10	15								
pH	8.2	8.02	7.97								
CONDUCTIVITY	777	815	832								
TEMPERATURE	9.2	8.9	9.2								
TURBIDITY	39	35	39								
APPEARANCE	clear	clear									

COMMENTS: - purged w/ centrifugal pump   start @ 9:16
- strong sulfur odor

MALCOLM PIRNIE

WATER SAMPLING FIELD DATA SHEETS

PROJECT So. Buffalo Redevelopment
TYPE OF SAMPLE: Water
CLIENT: BERC
LOCATION NO.: MW - 001
JOB NO.: 3587-001
LAB SAMPLE NO.:

WELL DATA: **DATE:** 2/2 **TIME:** 9:15
Casing Diameter (inches): 2 inches
Casing Material: SCH 40 PVC
Screened interval (ft. BGS): 4.0 - 14.0
Screen Material: SCH 40 PVC
Static Water Level Below TOR (ft.): 4.18
Bottom Depth (ft.): 14.0
Elevation Top of Well Riser:
Datum Ground Surface:
Elevation Top of Screen:

PURGING DATA: **DATE:** 2/2/00
Method: Centrifugal Pump
TIME: Start: 9:16 Finish: 9:28
Well Volumes Purged:
Pumping Rate (gal/min):
Standing Volume (Gal.) 2.1
Was well purged dry? Yes___ No X
Volume Purged (Gal.) 15 gal
Was well purged below sand pack? Yes___ No X

Is purging equipment dedicated to sample location?
YES___ **NO** X

Field Personnel: JFH/SRD

Well I.D. (inches)	Volume (gal/ft)
2	0.17
4	0.66
6	1.50

SAMPLING DATA: **DATE:** 2/2/00 **TIME:** Start: 11:45 Finish: 11:55
Method: Disposable Plastic Bailer
Sampler: JFH/SRD
Present Water Level (ft.): 4.16
Air Temperature (°F): 20°
Depth of Sample (ft.): 4.18
Weather Conditions: Clear
Is sampling equipment dedicated to sample location? : Yes X No___
Source and type of water used in field for QC purposes: NA

PHYSICAL AND CHEMICAL DATA:
Appearance: Clear ✓ Turbid___ **Color:**___
Contains Sediment___ **Odor:** ✓ **Other:**___

PARAMETER	Measurement	
pH	7.84	8.11
Specific Conductivity (umhos/cm)	780	779
Temperature (°C)	6°	8
Turbidity (NTU)	33	39
Eh (mV)		

REMARKS: Sulfur odor

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace

PROJECT NO. : 3587-001

STAFF: JPH

DATE: ~~2/-/00~~ 1/27/00, 1/28/00

WELL NO.: **MW-002**

(1) **TOTAL CASING AND SCREEN LENGTH (ft.):** 15.6

(2) **CASING INTERNAL DIAMETER (in.):** 2"

(3) **WATER LEVEL BELOW TOP OF CASING (ft.):** 5.34

(4) **VOLUME OF WATER IN CASING (gal.):** 1.8

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$V = 0.0408\ [\ (2)^2\ x\ \{\ (1) - (3)\ \}\ ]$ = _______ GAL.

Time	9:31	9:43	11:00	11:10	13:35	1/28 9:30	9:39	11:15			
PARAMETERS	**ACCUMULATED VOLUME PURGED (GALLONS)**										
	7	9	12	14	18	20	24	28			
pH	7.06	7.12	7.21	7.37	7.42	6.61	6.66	6.79			
CONDUCTIVITY	1336	1331	1367	1357	1362	1369	1376	1514			
TEMPERATURE	10°C	10	9	9	9	9	9	9			
TURBIDITY	>100	>100	>100	>100	>100	>100	>100	>100			
APPEARANCE	gray silty	gray silty	lt gray brown silty	brown muddy	brown muddy	cloudy	cloudy	cloudy			

COMMENTS: - Initially purged 5 gal with disposable bailer on 1/26
- Well recharges slowly, capable of purging to "dry" condition

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace

PROJECT NO. : 3587-001

STAFF: -PH / SRD

DATE: 2/2/00

WELL NO.: **MW-002**

(1) **TOTAL CASING AND SCREEN LENGTH (ft.):** 15.6

(2) **CASING INTERNAL DIAMETER (in.):** 2"

(3) **WATER LEVEL BELOW TOP OF CASING (ft.):** 5.55

(4) **VOLUME OF WATER IN CASING (gal.):** 1.7

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$$V = 0.0408\ [\ (2)^2\ x\ \{\ (1) - (3)\ \}\ ]\ = \_\_\_\_\_\_\ \text{GAL.}$$

Time 9:42 9:47 8:51

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS)										
	2	4	6								
pH	6.61	6.59	6.64								
CONDUCTIVITY	1390	1367	1330								
TEMPERATURE	8 C	9.5	10								
TURBIDITY	>100	>100	>100								
APPEARANCE	cloudy	cloudy	Brown								

COMMENTS: - Purged w/ 1¼" disposable bailer start @ 8:39

MALCOLM PIRNIE

WATER SAMPLING FIELD DATA SHEETS

PROJECT So. Buffalo Redevelopment
CLIENT: BERC
JOB NO.: 3587-001
TYPE OF SAMPLE: Water
LOCATION NO.: MW - 002
LAB SAMPLE NO.:

WELL DATA: **DATE:** **TIME:**
Casing Diameter (inches): 2 inches
Casing Material: SCH 40 PVC
Screened interval (ft. BGS): 4.0 - 14.0
Screen Material: SCH 40 PVC
Static Water Level Below TOR (ft.): 5.55
Bottom Depth (ft.): 14.0
Elevation Top of Well Riser:
Datum Ground Surface:
Elevation Top of Screen:

PURGING DATA: **DATE:** 2/2
Method: Disposable Bailer
TIME: Start: 8:39 **Finish:** 8:51
Well Volumes Purged:
Pumping Rate (gal/min):
Standing Volume (Gal.) 1.7
Was well purged dry? Yes X **No**
Volume Purged (Gal.) 6
Was well purged below sand pack? Yes X **No**

Is purging equipment dedicated to sample location?
YES X **NO**

Field Personnel: JPH / SRD

Well I.D. (inches)	Volume (gal/ft)
2	0.17
4	0.66
6	1.50

SAMPLING DATA: **DATE:**
TIME: Start: 12:10 **Finish:** 12:15
Method: Disposable Plastic Bailer
Sampler: JPH / SRD
Present Water Level (ft.): 5.98
Air Temperature (°F): 20
Depth of Sample (ft.): 5.99
Weather Conditions: SUNNY
Is sampling equipment dedicated to sample location? : Yes X **No**
Source and type of water used in field for QC purposes: NA

PHYSICAL AND CHEMICAL DATA:
Appearance: Clear X **Turbid**
Contains Sediment
Color:
Odor:
Other:

PARAMETER	Measurement	
pH	6.56	6.55
Specific Conductivity (umhos/cm)	1298	1372
Temperature (°C)	7	8
Turbidity (NTU)	46	215
Eh (mV)		

REMARKS:

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace
PROJECT NO. : 3587-001
STAFF: JPH
DATE: ~~2/ /00~~ 1/28/00

WELL NO.: **MW-003**

(1) TOTAL CASING AND SCREEN LENGTH (ft.): 16.05
(2) CASING INTERNAL DIAMETER (in.): 2"
(3) WATER LEVEL BELOW TOP OF CASING (ft.): 2.76
(4) VOLUME OF WATER IN CASING (gal.): 2.3

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$$V = 0.0408\ [\ (2)^2\ \ x\ \{\ (1) - (3)\ \}\ ]\ \ = \_\_\_\_\_\_\ \text{GAL.}$$

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS)										
Time	15:10	15:20	15:37	1/28 10:09	10:19	10:35					
	20	40	60	80	100	150					
pH	8.18	7.97	8.04	7.37	7.49	7.52					
CONDUCTIVITY	1426	1416	1419	1379	1352	1367					
TEMPERATURE	9°C	9	9	9	9	9					
TURBIDITY	>100	>100	>100	>100	>100	92					
APPEARANCE	black silty	black	black	cloudy	black	cloudy					

COMMENTS: - Initially purged 60 gal on 1/27, completed development 1/28
- Oil sheen (blebs) noted on surface of initial 20 gal purged from well
- Significant volume of black, ash-like sediment Removed during development process
- Unable to purge well to dry condition, quick recharge

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace

PROJECT NO. : 3587-001

STAFF: JPH / SRD

DATE: 2/2/00

WELL NO.: MW-003

(1) **TOTAL CASING AND SCREEN LENGTH (ft.):** 16.05

(2) **CASING INTERNAL DIAMETER (in.):** 2"

(3) **WATER LEVEL BELOW TOP OF CASING (ft.):** 2.87

(4) **VOLUME OF WATER IN CASING (gal.):** 2.4

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$V = 0.0408 [(2)^2 \times \{ (1) - (3) \}]$ = ______ GAL.

Time 9:00 9:04 9:07

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS)										
	5	10	15								
pH	7.41	7.55	7.6								
CONDUCTIVITY	1295	1343	1369								
TEMPERATURE	7°C	7°	7°								
TURBIDITY	32	30	32								
APPEARANCE	clear	clear	clear								

COMMENTS: – purged w/ centrifugal pump

MALCOLM PIRNIE

WATER SAMPLING FIELD DATA SHEETS

PROJECT So. Buffalo Redevelopment
CLIENT: BERC
JOB NO.: 3587-001
TYPE OF SAMPLE: Water
LOCATION NO.: MW - 003
LAB SAMPLE NO.:

WELL DATA: **DATE:** 2/2/00 **TIME:**
Casing Diameter (inches): 2 inches
Casing Material: SCH 40 PVC
Screened interval (ft. BGS): 4.0- 14.0
Screen Material: SCH 40 PVC
Static Water Level Below TOR (ft.): 2.87
Bottom Depth (ft.): 14.0
Elevation Top of Well Riser:
Datum Ground Surface:
Elevation Top of Screen:

PURGING DATA: **DATE:** 2/2/00
Method: Centrifugal Pump
TIME: Start: 8:55 **Finish:** 9:07
Well Volumes Purged: 15
Pumping Rate (gal/min):
Standing Volume (Gal.) 2.4
Was well purged dry? Yes ___ **No** X
Volume Purged (Gal.)
Was well purged below sand pack? Yes ___ **No** X

Is purging equipment dedicated to sample location?
YES ___ **NO** X

Well I.D. (inches)	Volume (gal/ft)
2	0.17
4	0.66
6	1.50

Field Personnel: JPH /SRD

SAMPLING DATA: **DATE:** 2/2/00
TIME: Start: 12:30 **Finish:** 12:39
Method: Disposable Plastic Bailer
Sampler: JPH /SRD
Present Water Level (ft.): 2.87
Air Temperature (°F): 20°
Depth of Sample (ft.): 2.87
Weather Conditions: Sunny
Is sampling equipment dedicated to sample location? : Yes X **No** ___
Source and type of water used in field for QC purposes: N/A

PHYSICAL AND CHEMICAL DATA:
Appearance: Clear X **Turbid** ___ **Color:**
Contains Sediment ___ **Odor:** **Other:**

PARAMETER	Measurement	
pH	7.30	7.44
Specific Conductivity (umhos/cm)	1320	1309
Temperature (°C)	5	7
Turbidity (NTU)	45	45
Eh (mV)		

REMARKS: Blind Dupl #1 taken!

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace
PROJECT NO. : 3587-001
STAFF: JPH
DATE: ~~2/ /00~~ 1/27

WELL NO.: **MW-104**

(1) **TOTAL CASING AND SCREEN LENGTH (ft.):** 17.78

(2) **CASING INTERNAL DIAMETER (in.):** 2"

(3) **WATER LEVEL BELOW TOP OF CASING (ft.):** 8.48

(4) **VOLUME OF WATER IN CASING (gal.):** 1.6

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$V = 0.0408 [(2)^2 \times \{ (1) - (3) \}] =$ ______ GAL.

Time	14:20	14:35	14:45								
	ACCUMULATED VOLUME PURGED (GALLONS)										
PARAMETERS	20	40	50								
pH	12.73	11.96	12.06								
CONDUCTIVITY	889	610	735								
TEMPERATURE	10°c	10	10								
TURBIDITY	16	14	38								
APPEARANCE	Clear	Clear	Clear								

COMMENTS: - Purged w/ Centrifugal pump
- Well recharges quickly

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace
PROJECT NO. : 3587-001
STAFF: JPH SRD
DATE: 2/2/00

WELL NO.: **MW-104**

(1) TOTAL CASING AND SCREEN LENGTH (ft.): 17.78
(2) CASING INTERNAL DIAMETER (in.): 2"
(3) WATER LEVEL BELOW TOP OF CASING (ft.): 8.62
(4) VOLUME OF WATER IN CASING (gal.): 1.6

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

V = 0.0408 [(2)^2 x { (1) - (3) }] = ______ GAL.

Time 10:17 10:21 10:25

PARAMETERS	**ACCUMULATED VOLUME PURGED (GALLONS)**									
	5	10	15							
pH	11.26	11.21	11.2							
CONDUCTIVITY	810	870	909							
TEMPERATURE	11.2	12°	12							
TURBIDITY	45	32	36							
APPEARANCE	cloudy	clear	clear							

COMMENTS: - purged w/ centrifugal pump   Start 10.14

MALCOLM PIRNIE

WATER SAMPLING FIELD DATA SHEETS

PROJECT So. Buffalo Redevelopment
TYPE OF SAMPLE: Water
CLIENT: BERC
LOCATION NO.: MW - 104
JOB NO.: 3587-001
LAB SAMPLE NO.:

WELL DATA:

DATE: 2/2
TIME:
Casing Diameter (inches): 2 inches
Casing Material: SCH 40 PVC
Screened interval (ft. BGS):
Screen Material: SCH 40 PVC
Static Water Level Below TOR (ft.): 8.62
Bottom Depth (ft.):
Elevation Top of Well Riser:
Datum Ground Surface:
Elevation Top of Screen:

PURGING DATA:

DATE: 2/2/00
Method: Centrifugal Pump
TIME: Start: 10:14 Finish: 10:24
Well Volumes Purged:
Pumping Rate (gal/min):
Standing Volume (Gal.) 1.6
Was well purged dry? Yes ___ No X
Volume Purged (Gal.) 15
Was well purged below sand pack? Yes ___ No X

Is purging equipment dedicated to sample location?
YES ___ NO X

Well I.D. (inches)	Volume (gal/ft)
2	0.17
4	0.66
6	1.50

Field Personnel: JPH/SRD

SAMPLING DATA:

DATE: 2/2/00
TIME: Start: 13:15 Finish: 13:20
Method: Disposable Plastic Bailer
Sampler:
Present Water Level (ft.): 8.6
Air Temperature (°F): 20°
Depth of Sample (ft.): 8.6
Weather Conditions: Sunny
Is sampling equipment dedicated to sample location? : Yes X No ___
Source and type of water used in field for QC purposes: NA

PHYSICAL AND CHEMICAL DATA:

Appearance: Clear X Turbid ___
Color:
Contains Sediment
Odor:
Other:

PARAMETER	Measurement	
pH	11.23	11.14
Specific Conductivity (umhos/cm)	807	920
Temperature (°C)	9	10
Turbidity (NTU)	36	24
Eh (mV)		

REMARKS:

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace

PROJECT NO. : 3587-001

STAFF: JPH

DATE: ~~2/ /00~~ 1/27/00

WELL NO.: **MW-105**

(1) **TOTAL CASING AND SCREEN LENGTH (ft.):** 17.6

(2) **CASING INTERNAL DIAMETER (in.):** 2"

(3) **WATER LEVEL BELOW TOP OF CASING (ft.):** 7.51

(4) **VOLUME OF WATER IN CASING (gal.):** 1.7

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$V = 0.0408\ [\ (2)^2\ \times \{\ (1) - (3)\ \}\ ]$ = ______ GAL.

Time 12:13 12:21 12:25

PARAMETERS	ACCUMULATED VOLUME PURGED (GALLONS)										
	20	40	50								
pH	9.5	10.32	10.77								
CONDUCTIVITY	601	600	600								
TEMPERATURE	9°C	9	9								
TURBIDITY	33	32	18								
APPEARANCE	clear	clear	Clear								

COMMENTS: - Purged w/ Centrifugal pump

- Well recharges readily

MALCOLM PIRNIE

WELL DEVELOPMENT / PURGING LOG

PROJECT TITLE: So. Buffalo Redevelopment @ Hanna Furnace
PROJECT NO. : 3587-001
STAFF: JTH/SRD
DATE: 2/2/00

WELL NO.: **MW-105**

(1) **TOTAL CASING AND SCREEN LENGTH (ft.):** 17.6
(2) **CASING INTERNAL DIAMETER (in.):** 2"
(3) **WATER LEVEL BELOW TOP OF CASING (ft.):** 7.66
(4) **VOLUME OF WATER IN CASING (gal.):** 1.7

WELL I.D.	VOL. GAL/Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$V = 0.0408\ [\ (2)^2\ x\ \{\ (1) - (3)\ \}\ ]\ =$ ______ GAL.

Time	9:46	9:48	9:50								
PARAMETERS	**ACCUMULATED VOLUME PURGED (GALLONS)**										
	5	10	15								
pH	7.6	8.3	8.8								
CONDUCTIVITY	626	601	595								
TEMPERATURE	9.0°	9°	9.2								
TURBIDITY	35	33	35								
APPEARANCE	clear	clear	clear								

COMMENTS: - purged w/centrifugal pump   Start @ 9:43

MALCOLM PIRNIE

WATER SAMPLING FIELD DATA SHEETS

PROJECT So. Buffalo Redevelopment
CLIENT: BERC
JOB NO.: 3587-001
TYPE OF SAMPLE: Water
LOCATION NO.: MW - 105
LAB SAMPLE NO.:

WELL DATA:

DATE: 2/2
TIME:
Casing Diameter (inches): 2 inches
Casing Material: SCH 40 PVC
Screened interval (ft. BGS):
Screen Material: SCH 40 PVC
Static Water Level Below TOR (ft.): 7.66
Bottom Depth (ft.):
Elevation Top of Well Riser:
Datum Ground Surface:
Elevation Top of Screen:

PURGING DATA:

DATE: 2/2/00
Method: Centrifugal Pump
TIME: Start: 9:43 **Finish:** 9:50
Well Volumes Purged:
Pumping Rate (gal/min):
Standing Volume (Gal.) 1.7
Was well purged dry? Yes ___ **No** X
Volume Purged (Gal.) 15
Was well purged below sand pack? Yes ___ **No** X

Is purging equipment dedicated to sample location?
YES ___ **NO** X

Well I.D. (inches)	Volume (gal/ft)
2	0.17
4	0.66
6	1.50

Field Personnel: JPH /SRD

SAMPLING DATA:

DATE: 2/2/00
TIME: Start: 13:00 **Finish:** 13 07
Method: Disposable Plastic Bailer
Sampler: JPH / SRD
Present Water Level (ft.): 7.65
Air Temperature (°F): 20°
Depth of Sample (ft.): 7.65
Weather Conditions: SUNNY
Is sampling equipment dedicated to sample location? : Yes X **No** ___
Source and type of water used in field for QC purposes:

PHYSICAL AND CHEMICAL DATA:

Appearance: Clear X **Turbid** ___
Contains Sediment ___
Color: ___
Odor: ___
Other: ___

PARAMETER	Measurement	
pH	8.80	9.18
Specific Conductivity (umhos/cm)	606	598
Temperature (°C)	8°	10
Turbidity (NTU)	30	32
Eh (mV)		

REMARKS:

APPENDIX D

DEBRIS PILE SAMPLING LOGS

CLIENT So. Buffalo Redevelopment

PROJECT Hanna Furnace

LOCATION " "

CONTRACTOR Maxim Technologies

METHOD OF BORING: SOIL backhoe

ROCK

JOB NO. 3597-001

LOGGED BY J.P. Hilton

CORE DIA.

FIELD BOREHOLE LO

BOREHOLE NO. SS-1

STARTED 11:30 AM 2/23 19 00

FINISHED 12:00 PM 2/23 19 00

ELEVATIONS: DATUM

SAMPLE NO.	HNU TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS1	0.2	2 3		11.50		Fill, SAND MED. BRWN f-crs Gravel, w/ Slag, Some Silt	
		4					

Sheet No. 1 of 1

MALCOLM

CLIENT S. Buffalo Redevelopment

PROJECT HANNA FURNACE

LOCATION " "

CONTRACTOR Maxim Technologies

METHOD OF BORING : SOIL backhoe

ROCK

JOB NO. 3587-001

LOGGED BY J. P. Hilton

CORE DIA.

FIELD BOREHOLE LO

BOREHOLE NO. SS-2

STARTED 1210 PM 2/23 19 00

FINISHED 12:30 PM 2/23 19 00

ELEVATIONS: DATUM

SAMPLE NO.	HNU TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS2	0.5	2		12:15		SAND AND Gravel, dark brown-gray fine grain w/ Lt gray fine gravel compacted, cemented	Sampled Adjacent to two RR ties
		3					
		4					slight creosote odor noted in trench

Sh... No. ___ of ___

MAXIM

FIELD BOREHOLE LO

CLIENT S. Buffalo Redevelopment

JOB NO. 3597-001

PROJECT HANNA FURNACE

LOCATION ″ ″

BOREHOLE NO. SS-3

CONTRACTOR Maxim Technologies

LOGGED BY J.P. Hilton

STARTED 12:35 PM 2/23 19 00

METHOD OF BORING : SOIL backhoe

FINISHED 13:00 PM 2/23 19 00

ROCK

CORE DIA.

ELEVATIONS: DATUM

SAMPLE NO.	TYPE HNu	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
S3	0.2	3		12:50		Fill, SAND and Silt, Med Brown-Gray w/ F-Crs Gravel, Asphalt, brick	
		4					
		5					

Sheet No. 1 of 1

MALCOLM

FIELD BOREHOLE LO

CLIENT So. Buffalo Redevelopment

JOB NO. 3587-001

PROJECT HANNA FURNACE

LOCATION " "

BOREHOLE NO. SS-4

CONTRACTOR Maxim Technologies

LOGGED BY J.P. Hilton

STARTED 13:15 PM 2/23 19 00

METHOD OF BORING: SOIL backhoe

FINISHED 13:30 M 4/23 19 OC

ROCK

CORE DIA.

ELEVATIONS: DATUM

SAMPLE NO.	HNu TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-4	0.2	2		13:20		Fill Silt, dark gray-brown, little crs Gravel, trace-little Clay, occasional glass, brick, wood	
		3					
		4					

Sheet No. 1 of 1

CLIENT So. Buffalo Redevelopment

PROJECT Hanna Furnace

LOCATION " "

CONTRACTOR Maxim Technologies

METHOD OF BORING : SOIL backhoe

ROCK

JOB NO. 3597-001

LOGGED BY J. P. Hilton

CORE DIA.

FIELD BOREHOLE LO

BOREHOLE NO. SS-5

STARTED 13:35 PM 2/23 19 00

FINISHED 13:55 PM 2/23 19 00

ELEVATIONS: DATUM

SAMPLE NO.	TYPE HNu	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-5	0.2		2 3 4	13:50		Clay lt gray-red, strong plasticity w/ MED-DARK brown SAND 'ND GRAVEL, brick	

Sheet No. 1 of 1

MALCOLM

CLIENT So. Buffalo Redevelopment

PROJECT Hanna Furnace

LOCATION " "

CONTRACTOR Maxim Technologies

METHOD OF BORING: SOIL backhoe

ROCK

JOB NO. 3587-001

LOGGED BY J.P. Hilton

CORE DIA.

FIELD BOREHOLE LO

BOREHOLE NO. SS-6

STARTED 13:55 PM 2/23 19 00

FINISHED 14:20 M 2/23 19 00

ELEVATIONS: DATUM

SAMPLE NO.	HNA TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-6	0.2		3			Silt, MED gray-red, little fine SAND, w/ black f-MED SAND layered @ approx 3-4' bgs, cobbles, brick, glass	
			4				
			5				

Maxim

FIELD BOREHOLE LO

CLIENT S. Buffalo Redevelopment
JOB NO. 3597-001
PROJECT Hanna Furnace
LOCATION " "
CONTRACTOR Maxim Technologies
LOGGED BY J.P. Hilton
METHOD OF BORING: SOIL backhoe
ROCK
CORE DIA.
BOREHOLE NO. SS-1
STARTED 14:20 P M 2/23 19 00
FINISHED 14:50 M 2/23 19 00
ELEVATIONS: DATUM

SAMPLE NO.	TYPE HNu	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain, Drilling and Testing Equipment, Etc.
SS-1	0.2	2 3		14:40		Fill as Silt and SAND, yellow-brown, fine grain w/ trace-little f-crs Gravel w/ Shale cobbles	
		4					

Sheet No. 1 of 1

MALCOLM

CLIENT S. Buffalo Redevelopment

JOB NO. 3597-001

FIELD BOREHOLE LO

PROJECT Hanna Furnace

LOCATION " "

BOREHOLE NO. SS-8

CONTRACTOR Maxim Technologies

LOGGED BY J.P. Hilton

STARTED 14:30 PM 2/23 19 00

METHOD OF BORING : SOIL backhoe

FINISHED 14:50 PM 2/23 19 00

ROCK

CORE DIA.

ELEVATIONS: DATUM

SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-0	0.2	3		15:00		Fill Olive-brown Silt 0-2	Sampled white lime
						Silt and SAND Red-brown Fine 2-4	material per NYSDEC
		4				White SAND, Crs, hard chalk-like	request
						lime	
		5					

Sheet No. ___ of ___

Maxim

FIELD BOREHOLE LO

CLIENT So. Buffalo Redevelopment

JOB NO. 3597-001

PROJECT Hanna Furnace

LOCATION " "

BOREHOLE NO. SS-9

CONTRACTOR Maxim Technologies

LOGGED BY J. P. Hilton

STARTED 15:05 PM 2/23 19 00

FINISHED 15:20 PM 2/23 19 00

METHOD OF BORING : SOIL backhoe

ROCK

CORE DIA.

ELEVATIONS: DATUM

SAMPLE NO.	HNu TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-9	0.2		4	15:30		Fill as black Ash/Silt 0-5	
						w/ trace Crs Gravel and cobbles	
			5			SAND dark brown-black MED-Crs	
			6				

Sheet No. 1 of 1

MALCOLM

FIELD BOREHOLE LO

CLIENT So. Buffalo Redevelopment
PROJECT HANNA FURNACE
LOCATION " "
CONTRACTOR Maxim Technologies
METHOD OF BORING: **SOIL** backhoe
ROCK

JOB NO. 3587-001
LOGGED BY J.P. Hilton
CORE DIA.

BOREHOLE NO. SS-10
STARTED 15:25 PM 2/23 19 00
FINISHED 15:45 PM 2/23 19 00
ELEVATIONS: DATUM

SAMPLE NO.	HNu TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
			3			Fill as Silt and Clay, olive brown-red	
						w/ little Fine SAND, f-Crs Gravel	
SS10	0.2		4			/ brick, plastic, glass	
			5				

Sheet No. 1 **of** 1

CLIENT So. Buffalo Redevelopment

JOB NO. 3587-001

FIELD BOREHOLE LO

PROJECT HANNA FURNACE

LOCATION " "

BOREHOLE NO. SS-11

CONTRACTOR Maxim Technologies

LOGGED BY J.P. Hilton

STARTED 15:50 PM 2/23 19 00

METHOD OF BORING: SOIL backhoe

FINISHED 16:15 PM 2/23 19 00

ROCK

CORE DIA.

ELEVATIONS: DATUM

SAMPLE NO.	TYPE HNW	DEPTH	BLOWS 'N'	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-11	0-2		3	16:15		SAND lt brown fine, w/ little f-crs Gravel, Shale cobbles, trace clay	
			4				
			5				

Sheet No. 1 of 1

MALCOLM

CLIENT S. Buffalo Redevelopment

JOB NO. 3587-001

FIELD BOREHOLE LO

PROJECT Hanna Furnace

LOCATION " "

CONTRACTOR Maxim Technologies

LOGGED BY J P. Hilton

METHOD OF BORING: **SOIL** backhoe **ROCK**

CORE DIA.

BOREHOLE NO. SS-12

STARTED 08:40 AM 2/24 19 00

FINISHED 08:15 AM 2/24 19 00

ELEVATIONS: DATUM

SAMPLE NO.	TYPE HNU	DEPTH	BLOWS 'N'	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-12	0.2		3			Silt, Lt brown - olive, little fine Gravel, trace Clay, Cobbles	Blind Dupl #1 taken
			4				
			5			RR ballast below 4'	

Sheet No. 1 of 1

Maxim

CLIENT S. Buffalo Redevelopment

JOB NO. 3587-001

FIELD BOREHOLE LO

PROJECT Hanna Furnace

LOCATION " "

BOREHOLE NO. SS-13

CONTRACTOR Maxim Technologies

LOGGED BY J. P. Hilton

STARTED 8:45 AM 2/24 19 80

FINISHED 8:10 M 2/24 19 00

METHOD OF BORING: SOIL backhoe

ROCK

CORE DIA.

ELEVATIONS: DATUM

SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-13	0-2'		2			Fill as Silt and Clay, med gray-red	
						little Fine Sand and f-Crs Gravel	
			3			wood, metal	
						w/ RR ties, ballast w/in trench	
			4				

Sheet No. 1 of 1

MALCOLM

FIELD BOREHOLE LO

CLIENT So. Buffalo Redevelopment

JOB NO. 3597-001

PROJECT Hanna Furnace

LOCATION " "

BOREHOLE NO. SS-14

CONTRACTOR Maxim Technologies

LOGGED BY J.P. Hilton

STARTED 10:00 A M 2/24 19 00

METHOD OF BORING: SOIL backhoe

FINISHED ____ M 2/24 19 00

ROCK ____

CORE DIA. ____

ELEVATIONS: DATUM ____

SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-14	0-2' ✓	0				Clay and Silt red-brown, little-Some f-Crs gravel, sharp contact @ 3' bgs w/ Sand dark brown w/ RR ballast	
		1					
		2					
		3					

Sheet No. ___ of ___

FIELD BOREHOLE LO

CLIENT S. Buffalo Redevelopment

JOB NO. 3587-001

PROJECT Hanna Furnace

LOCATION " "

BOREHOLE NO. SS-15

CONTRACTOR Maxim Technologies

LOGGED BY J. P. Hilton

STARTED 10:15 A M 2/24 19 00

METHOD OF BORING: SOIL backhoe

FINISHED _____ M 2/24 19 00

ROCK _____

CORE DIA. _____

ELEVATIONS: DATUM _____

SAMPLE NO.	HNU TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-15	0.4		3			Fill as SAND and Gravel w/ some Silt	
						and Clay, fine grain w/ occasional	
			4			cobbles > 6" dia, metallic fill below	
						approx 4-5' depth (RR ballast)	
			5				

Sheet No. 1 of 1

MALCOLM

CLIENT So. Buffalo Redevelopment
PROJECT HANNA FURNACE
LOCATION " "
CONTRACTOR Maxim Technologies
METHOD OF BORING: SOIL backhoe
ROCK

JOB NO. 3597-001

LOGGED BY J.P. Hilton

CORE DIA.

FIELD BOREHOLE LO

BOREHOLE NO. SS-16
STARTED 10:30 AM 2/24 19 00
FINISHED 10:50 AM 2/24 19 00
ELEVATIONS: DATUM

SAMPLE NO.	TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-16	0-2		2			Fill as Silt and f-crs Gravel, lt med gray, trace fine Sand w/ black carbonized material, brick /	perched H_2O @ approx 4' bgs
			3				
			4			Dense RR ballast @ approx 4.5' bgs	

Sheet No. 1 of 1

CLIENT So. Buffalo Redevelopment
PROJECT Hanna Furnace
LOCATION " "
CONTRACTOR Maxim Technologies
METHOD OF BORING: SOIL backhoe
ROCK

JOB NO. 3597-001
LOGGED BY J.P. Hilton
CORE DIA.

FIELD BOREHOLE LO

BOREHOLE NO. SS-17
STARTED 11:00 A 2/24 19 00
FINISHED 11:20 A 2/24 19 00
ELEVATIONS: DATUM

SAMPLE NO.	HNu TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Samplin Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-17	1.6/0.2		3 4			Fill as SAND, dark brown, F-Crs w/ some F-Crs Gravel, trace slag, brick, clay, wood	H2O @ approx 5'
			5				HNu reading of 1.6 ppm adjacent to RR tie, 0.2 ppm in other areas of pit.

Sheet No. 1 of 1

MALCOLM

FIELD BOREHOLE LOG

CLIENT ____________________ JOB NO. ____________

PROJECT ____________________

LOCATION ____________________

CONTRACTOR ____________________ LOGGED BY ____________

METHOD OF BORING : SOIL ____________________

ROCK ____________________ CORE DIA. ____________

BOREHOLE NO. SS-18

STARTED 11:30 AM 2/24 19 00

FINISHED 12:00 PM 2/24 19 00

ELEVATIONS: DATUM ____________

SAMPLE NO.	TYPE HNu	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS-18	0.2		4			Fill as 2 Fill layers 0-4 Red-brown Clay w/ Silt and F-Crs Gravel w/ Brick	
			5			4-6 Med-Dark Brown Silt and Sand	
			6				

She. . .o. ____ ____

FIELD BOREHOLE LO

CLIENT
PROJECT
LOCATION
CONTRACTOR
METHOD OF BORING : SOIL
ROCK
JOB NO.
LOGGED BY
CORE DIA.
BOREHOLE NO. SS-19
STARTED 13:30 PM 2/24 19 00
FINISHED 13:50 PM 2/24 19 00
ELEVATIONS: DATUM

SAMPLE NO.	HNu TYPE	DEPTH	BLOWS "N"	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor ,Etc.	NOTES: Boring ,Testing and Sampling Procedures ,Water Loss and Gain Drilling and Testing Equipment ,Etc.
SS-19	0.N		3			Fill AS two (2) LAYERS	
						0-3 CLAY red-brown, stiff w/Some Gravel & Cobbles	
			4			3-5 SAND yellow-brown F-MED, w/ Silt	
			5			5+ SAND Dark brown, MED w/Some Gravel	

Sheet No. ____ of ____

MALCOLM

CLIENT ____________________

PROJECT ____________________

LOCATION ____________________

CONTRACTOR ____________________

METHOD OF BORING : SOIL ____________________

ROCK ____________________

JOB NO. ____________________

LOGGED BY ____________________

CORE DIA. ____________________

FIELD BOREHOLE LO

BOREHOLE NO. SS-20

STARTED 12:55 PM 2/24 19 00

FINISHED 13:20 PM 2/24 19 00

ELEVATIONS: DATUM ____________________

SAMPLE NO.	TYPE HNU	DEPTH	BLOWS 'N'	RECOVERY %	MOISTURE TIN NO.	SAMPLE DESCRIPTION: Color, Texture Classification, Compactness/Consistency, Moisture Condition, Weathering/Fracturing, Inclusions, Odor, Etc.	NOTES: Boring, Testing and Sampling Procedures, Water Loss and Gain Drilling and Testing Equipment, Etc.
SS 20	0.2	3				Fill as Dark gray-brown Silt and Fine SAND, Some C/S Gravel and Cobbles > [illegible]″, concrete, asphalt, RR ties, brick	
		4					
		5					

Sheet No. ____ of ____

APPENDIX E

QUALITATIVE RISK ASSESSMENT

MALCOLM PIRNIE

HANNA FURNACE SITE – FORMER RAILROAD YARD QUALITATIVE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

BUFFALO ECONOMIC RENAISSANCE CORPORATION
BUFFALO, NEW YORK

MAY 2000

MALCOLM PIRNIE, INC.

P.O. Box 1938
Buffalo, New York 14219

3587-001/RA

HANNA FURNACE SITE
FORMER RAILROAD YARD
QUALITATIVE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

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HANNA FURNACE SITE
FORMER RAILROAD YARD
QUALITATIVE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

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LIST OF ATTACMENTS

Attachment No.	Description
I	Essential Nutrient Screen
II	Toxicological Profiles of Chemicals of Potential Concern for Human Health Evaluation
III	Toxicological Profiles for Chemicals of Potential Ecological Concern

1.0 INTRODUCTION

Following are the qualitative human and qualitative ecological health risk assessments for the Hanna Furnace Site, Former Railroad Yard Area. Each assessment seeks to identify relevant environmental media and chemicals of potential concern that may present a health risk to the populations in and around the vicinity of the Former Railroad Yard Area of the Hanna Furnace Site in Buffalo, NY. Consideration is given to the current and potential future conditions within and surrounding the site.

The site is currently zoned industrial/commercial. Some industrial development exists in the vicinity of the Former Railroad Yard Area. On the north side of the site is the Union Ship Canal. There is a Bethlehem Steel facility on the west side of Route 5. The nearest residential populations are approximately one-half mile to the south, and between one-half to one mile to the southeast, east, and northeast.

In each section, data are evaluated, exposure and toxicity are assessed, and risks are characterized. As these risk assessments are of a qualitative nature, quantitative estimates of specific risks to human and ecological health are not made; rather, chemicals of potential concern and potentially exposed populations are identified and considered to determine the extent of possible adverse health effects that may result from exposure under current and future conditions at the Former Railroad Yard Area, in the absence of remediation.

1.1 SITE BACKGROUND

The Former Railroad Yard Area is a 43-acre portion of the 113-acre Hanna Furnace Site (Figure 1). The site was owned by the Hanna Furnace Corporation, and was comprised of the Union Ship Canal, manufacturing buildings, the railroad yard, and a storage area. The site was closed in the early 1980s, and subsequently purchased by a scrap metal company. This company proceeded to remove the rails and demolish the buildings, salvaging scrap metal where feasible. Later, the U.S. Army Reserves removed many of the remaining railroad ties and stockpiled them on-site. Debris piles still remain throughout the site. These piles consist of primarily soil, along with some demolition and construction debris.

The grounds are partially vegetated. The soil consists of fill material to a depth of 8-10 feet. The Union Ship Canal was used for shipping of cargo, and is currently not in use. Otherwise, no other surface water bodies lie in the Former Railroad Yard Area or within the Hanna Furnace Site.

The Hanna Furnace Site is bordered on the west by Route 5. On the west side of Route 5 is a Bethlehem Steel facility. On the north of the Hanna Furnace Site is the Tifft Landfill/Park area. To the east is an operating railroad yard, the Marilla Street Landfill, and South Park. A small industrial park is located to the south of the site, and Ridge Road forms the southern boundary of the industrial park. Bethlehem Park, a residential community, is located to the south of Ridge Road.

Several buildings remain within the Hanna Furnace Site, but not within the Former Railroad Yard Area. The Former Railroad Yard Area is currently abandoned and only partially bordered by a fence. Therefore, the site is accessible to trespassers.

2.0 HUMAN HEALTH EVALUATION

The purpose of this risk assessment is to evaluate potential human health risks associated with the Former Railroad Yard Area. The objectives of the risk assessment are to:

- Identify environmental media and chemicals of potential concern;
- Provide an evaluation of potential human receptors and exposure pathways associated with the groundwater and soil at and around the complex;
- Characterize the potential for adverse effects to human health in the absence of any actions to control or mitigate site contamination.

The human health evaluation is conducted in the typical four-step process:

- Data Evaluation: relevant site data are analyzed, and environmental media and chemicals of potential concern are identified;
- Exposure Assessment: chemical release mechanisms are analyzed, potentially exposed human populations are identified, and potential exposure pathways and routes are identified;
- Toxicity Assessment: qualitative toxicity information is presented for the chemicals of potential concern;
- Risk Characterization: the potential for adverse human health risks (noncarcinogenic and carcinogenic) is evaluated, and the risk information is summarized to determine the baseline risk in the absence of future remediation.

This risk assessment is of a qualitative nature; as such, quantitative estimates of risk from exposure to the chemicals of potential concern will not be derived. By evaluating the analytical data for each environmental medium, possible exposure points, potential human receptors, and reasonable exposure routes, it can be evaluated whether or not human health is or will be subjected to significant chemical risks. The results of the qualitative risk assessment are important in considering the potential for reuse of the Former Railroad Yard Area.

2.1 DATA EVALUATION

Environmental investigations have taken place at the Hanna Furnace Site since 1979. Soil samples and groundwater samples within the Former Railroad Yard Area from historical sampling are used, along with more recent analytical data collected by Malcolm Pirnie from 1999 to 2000 as described below.

2.1.1 Selection of Chemicals of Potential Concern

The following hierarchy is used to select chemicals of potential concern (COPCs) in subsurface soil, surface soil, soil fill piles, and groundwater:

Subsurface Soil, Surface Soil, Soil/Fill Piles - For all soil samples, total organic carbon (TOC) is assumed to be 1%. For volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), phenolic compounds, and pesticides/polychlorinated biphenyls (PCBs), maximum detected chemical concentrations are compared to the NYSDEC TAGM 4046 recommended soil cleanup objectives. Chemicals with maximum detected concentrations exceeding these levels are selected as COPCs. Chemicals that are detected but are not assigned NYSDEC recommended soil cleanup objectives are selected as COPCs.

For inorganic chemicals, the following procedures are used:

- If the inorganic chemical is one of the five essential nutrients (calcium, iron, magnesium, potassium, or sodium), then a derived nutrient screening concentration is used as the screening criterion. If the maximum detected concentration for an essential nutrient exceeds the derived nutrient screening concentration (see Attachment I), then it is selected as a COPC.

- If the NYSDEC recommended soil cleanup objective is listed as "Site Background," then the average value for New York State (Eastern United States, if not available) from Dragun and Chiasson (1991) is used as the "site background" criterion. If the average of detected concentrations for an inorganic chemical exceeds twice the background value, then it is selected as a COPC.

- If the NYSDEC recommended soil cleanup objective for an inorganic is listed as "[numerical concentration] or Site Background", then the given numerical concentration is used as a screening value, since no background samples are available. If the maximum detected concentration for an inorganic chemical exceeds the NYSDEC criterion, then it is selected as a COPC.

- If the NYSDEC recommended soil cleanup objective for an inorganic chemical is given as a numerical value, then the maximum detected concentration is compared to the numerical value. If the maximum detected concentration for an inorganic chemical exceeds the NYSDEC criterion, then it is selected as a COPC.

- If an inorganic chemical is detected but does not have a NYSDEC recommended soil cleanup objective assigned to it, then it is selected as a COPC.

Groundwater - For the essential nutrients (calcium, iron, magnesium, potassium, or sodium), maximum detected concentrations are compared to derived nutrient screening concentrations (Attachment I) to determine inclusion as COPCs. Chemicals with maximum detected concentrations exceeding these levels are selected as COPCs.

For all other chemicals, maximum detected chemical concentrations are compared to the NYSDEC Class GA groundwater quality standards. Chemicals with maximum detected concentrations exceeding these levels are selected as COPCs, while chemicals that are detected but are not assigned NYSDEC standards are selected as COPCs.

2.1.2 Data by Environmental Medium

For all environmental media, chemical-specific analytical data are used. Data with qualifiers (e.g., "J" and "B") are used. If a sample has a duplicate, then the higher value for each detected analyte is used.

Subsurface Soil – Soil boring data are used to characterize subsurface soil conditions at the Former Railroad Yard Area. These samples were taken at depths at 2 feet or more below ground surface. The soil is comprised of fill material to depths of approximately 8-10 feet below ground surface. In 1988, Recra Environmental, Inc., collected two subsurface soil samples (HF-4/SB-2 and HF-4/SB-5) as part of its "Site

Characterization and Environmental Assessment". These samples were analyzed for arsenic, chromium, copper, and lead. As part of a Preliminary Site Assessment, ABB Environmental Services took two subsurface soil samples (BS-104 and BS-105) in 1995. These samples were analyzed for VOCs, SVOCs, pesticides/PCBs, target analyte list (TAL) metals, and cyanide. In 1999, Malcolm Pirnie, Inc. made 36 additional soil borings. Composite samples were made, where two soil borings were combined to make one composite subsurface soil sample; as such, 18 subsurface soil samples were collected. These samples were analyzed for polynuclear aromatic hydrocarbons (PAHs)/phenolics, TAL metals, and cyanide. In 2000, Malcolm Pirnie, Inc. collected six more soil borings from the Former Railroad Yard Area. These samples were analyzed individually for VOCs, SVOCs, pesticides/PCBs, TAL metals, and/or cyanide. The analytical results are presented in Table 1.

Chemicals selected as COPCs in subsurface soil are as follows:

- SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, and chrysene;
- Inorganic chemicals: antimony, arsenic, barium, beryllium, copper, iron, lead, manganese, nickel, and zinc;
- Other chemicals: cyanide.

The maximum detected concentration for iron exceeds the nutrient screening concentration. The average of detected concentrations for antimony, lead, and manganese exceed two times their respective average background concentrations. For all other chemicals, the maximum detected concentrations exceed the respective NYSDEC recommended soil cleanup objectives.

Surface Soil – Soil samples at depths of 0-2 feet below ground surface are used to characterize surface soil conditions at the Former Railroad Yard Area. In 1998, five samples (numbers 20–24) were taken within the Former Railroad Yard Area by Recra Environmental, Inc., as part of its "Site Characterization and Environmental Assessment". These samples were analyzed for phenolic compounds, pesticides/PCBs,

TABLE 1
SUBSURFACE SOIL DATA
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1995 (ABB)		1988 (Recra)		NYSDEC TAGM Recommended Soil Cleanup Objectives
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
VOLATILE ORGANICS (ug/kg)									
2-Butanone	1 / 5	4	NA	NA	1 / 2	18	NA	NA	300
Carbon disulfide	4 / 5	4 - 12	NA	NA	0 / 2	ND	NA	NA	2,700
Toluene	2 / 5	4 - 6	NA	NA	0 / 2	ND	NA	NA	1,500
SEMI-VOLATILE ORGANICS (ug/kg)									
Acenaphthene	1 / 6	65	1 / 18	170	0 / 2	ND	NA	NA	50,000
Anthracene	1 / 6	190	3 / 18	110 - 360	0 / 2	ND	NA	NA	50,000
Benzo(a)anthracene	1 / 6	370	5 / 18	110 - 450	0 / 2	ND	NA	NA	224
Benzo(a)pyrene	1 / 6	310	5 / 18	160 - 470	0 / 2	ND	NA	NA	61
Benzo(b)fluoranthene	2 / 6	450 - 490	5 / 18	220 - 650	0 / 2	ND	NA	NA	224
Benzo(g,h,i)perylene	1 / 6	110	5 / 18	89 - 410	0 / 2	ND	NA	NA	50,000
Benzo(k)fluoranthene	1 / 6	170	1 / 18	150	0 / 2	ND	NA	NA	1,100
bis(2-Ethylhexyl)phthalate	5 / 6	110 - 250	NA	NA	0 / 2	ND	NA	NA	50,000
Carbazole	1 / 6	60	NA	NA	0 / 2	ND	NA	NA	--
Chrysene	2 / 6	340 - 480	5 / 18	160 - 500	0 / 2	ND	NA	NA	400
Dibenzofuran	1 / 6	110	NA	NA	0 / 2	ND	NA	NA	6,200
Fluoranthene	2 / 6	410 - 990	6 / 18	96 - 980	0 / 2	ND	NA	NA	50,000
Fluorene	1 / 6	94	0 / 18	ND	0 / 2	ND	NA	NA	50,000
Indeno(1,2,3-cd)pyrene	1 / 6	110	2 / 18	220 - 330	0 / 2	ND	NA	NA	3,200
2-Methylnaphthalene	0 / 6	ND	3 / 18	96 - 230	0 / 2	ND	NA	NA	36,400
Naphthalene	0 / 6	ND	3 / 18	79 - 150	0 / 2	ND	NA	NA	13,000
Phenanthrene	2 / 6	380 - 890	5 / 18	180 - 1,400	0 / 2	ND	NA	NA	50,000
Pyrene	2 / 6	600 - 860	5 / 18	170 - 1,100	0 / 2	ND	NA	NA	50,000

TABLE 1 (cont'd)
SUBSURFACE SOIL DATA
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1995 (ABB)		1988 (Recra)		NYSDEC TAGM Recommended Soil Cleanup Objectives
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
INORGANICS (mg/kg)									
Aluminum (average = 33,784)	6 / 6	9,690 - 45,700	18 / 18	12,200 - 54,000	2 / 2	35,300 - 43,600	NA	NA	144,000 *
Antimony (average = 12.19)	0 / 6	ND	9 / 18	10.3 - 16.6	0 / 2	ND	NA	NA	2.0 *
Arsenic	1 / 6	10	2 / 18	20.4 - 35.6	0 / 2	ND	2 / 2	11	7.5
Barium	6 / 6	109 - 428	18 / 18	89.3 - 416	2 / 2	188 - 464	NA	NA	300
Beryllium	6 / 6	2.1 - 8.2	18 / 18	0.73 - 9.61	2 / 2	3.8 - 6.3	NA	NA	0.16
Cadmium	2 / 6	2.1 - 6.2	4 / 18	1.05 - 8.1	0 / 2	ND	NA	NA	10
Calcium	6 / 6	55,800 - 259,000	18 / 18	37,400 - 296,000	2 / 2	132,000 - 233,000	NA	NA	1,000,000 **
Chromium	6 / 6	4.9 - 19.5	18 / 18	4.36 - 35.2	1 / 2	9.6	2 / 2	4.2 - 23	50
Cobalt	1 / 6	5.8	16 / 18	3.08 - 14	0 / 2	ND	NA	NA	30
Copper	3 / 6	5 - 44.1	18 / 18	5.53 - 42.2	1 / 2	7.3	2 / 2	17 - 28	25
Iron	6 / 6	3,250 - 89,400	18 / 18	4,250 - 209,000	2 / 2	1,780 - 9,450	NA	NA	200,000 **
Lead (average = 52.63)	3 / 6	2.2 - 54.6	15 / 18	9.78 - 175	2 / 2	1.9 - 113	2 / 2	19 - 22	42 *
Magnesium	6 / 6	8,800 - 13,500	18 / 18	5,320 - 26,800	2 / 2	9,220 - 16,700	NA	NA	1,000,000 **
Manganese (average = 2,392)	6 / 6	960 - 2,190	17 / 18	671 - 5,150	2 / 2	2,690 - 2,710	NA	NA	1,280 *
Mercury	0 / 6	ND	5 / 18	0.022 - 0.097	0 / 2	ND	NA	NA	0.1
Nickel	0 / 6	ND	18 / 18	8.71 - 33.5	0 / 2	ND	NA	NA	13
Potassium	6 / 6	1,910 - 6,120	18 / 18	1,080 - 2,970	2 / 2	655 - 1,230	NA	NA	1,000,000 **
Selenium	5 / 6	17.4 - 28.3	0 / 18	ND	0 / 2	ND	NA	NA	0.6 *
Sodium	0 / 6	ND	18 / 18	189 - 746	2 / 2	522 - 1,400	NA	NA	1,000,000 **
Vanadium	2 / 6	12.5 - 12.9	18 / 18	8.4 - 104	1 / 2	13.8	NA	NA	150
Zinc	6 / 6	6.4 - 166	17 / 18	9.05 - 1,670	2 / 2	5.4 - 74.8	NA	NA	20
OTHER (mg/kg)									
Cyanide, total	5 / 6	3.1 - 43	18 / 18	0.99 - 33.2	2 / 2	3.9 - 32.1	NA	NA	--

NA: Not Analyzed.
ND: Not Detected.
--: Not Available.
*: Two times the New York or Eastern United States average background value, from Dragun and Chiasson (1991).
**: Nutrient screening concentration.

oil & grease, and four heavy metals (arsenic, chromium, iron, and lead). In 1999, Malcolm Pirnie, Inc. made 36 additional soil borings. As described above for subsurface soils, composite samples were made, where two soil borings were combined to make one composite subsurface soil sample; as such, 18 surface soil samples were collected. These samples were analyzed for PAHs/phenolics, TAL metals, and cyanide. In 2000, Malcolm Pirnie, Inc. took one surface soil sample (MW-002). This sample was analyzed for VOCs. The sampling results are presented in Table 2.

Chemicals selected as COPCs in surface soil are as follows:

- VOCs: 2-hexanone;
- SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene;
- Pesticides/PCBs: Aroclor 1254;
- Inorganic chemicals: antimony, arsenic, barium, beryllium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, vanadium, and zinc;
- Other chemicals: cyanide.

The maximum detected concentration of iron exceeds the nutrient screening concentration. The average detected concentrations for antimony, lead, and manganese exceed two times their respective average background concentrations. For all other chemicals, the maximum detected concentrations exceed the respective NYSDEC recommended soil cleanup objectives.

Soil/Fill Piles – In 1999, twenty samples were taken from the soil/fill piles in the Former Railroad Yard Area by Malcolm Pirnie, Inc. These samples were analyzed for VOCs, SVOCs, pesticides/PCBs, TAL metals, and cyanide. These sampling results are presented in Table 3.

The following chemicals are selected as COPCs:

- VOCs: chloromethane, cis-1,2-dichloroethene, and styrene;

TABLE 2
SURFACE SOIL DATA
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1988 (RECRA)		NYSDEC TAGM
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Recommended Soil Cleanup Objectives
VOLATILE ORGANICS (ug/kg)							
Benzene	1 / 1	2	NA	NA	NA	NA	60
2-Butanone	1 / 1	27	NA	NA	NA	NA	300
Carbon Disulfide	1 / 1	5	NA	NA	NA	NA	2,700
Chloroform	1 / 1	3	NA	NA	NA	NA	300
Ethylbenzene	1 / 1	2	NA	NA	NA	NA	5,500
2-Hexanone	1 / 1	14	NA	NA	NA	NA	--
1,1,2,2-Tetrachloroethane	1 / 1	3	NA	NA	NA	NA	600
Toluene	1 / 1	8	NA	NA	NA	NA	1,500
Xylenes (total)	1 / 1	9	NA	NA	NA	NA	1,200
SEMI-VOLATILE ORGANICS (ug/kg)							
Acenaphthene	NA	NA	5 / 18	74 - 400	NA	NA	50,000
Acenaphthylene	NA	NA	2 / 18	130 - 200	NA	NA	41,000
Anthracene	NA	NA	8 / 18	78 - 530	NA	NA	50,000
Benzo(a)anthracene	NA	NA	16 / 18	75 - 3,700	NA	NA	224
Benzo(a)pyrene	NA	NA	17 / 18	73 - 5,100	NA	NA	61
Benzo(b)fluoranthene	NA	NA	17 / 18	120 - 6,400	NA	NA	224
Benzo(g,h,i)perylene	NA	NA	13 / 18	95 - 4,100	NA	NA	50,000
Benzo(k)fluoranthene	NA	NA	8 / 18	250 - 1,900	NA	NA	1,100
Chrysene	NA	NA	17 / 18	82 - 3,300	NA	NA	400
Dibenz(a,h)anthracene	NA	NA	3 / 18	170 - 960	NA	NA	14
Fluoranthene	NA	NA	17 / 18	83 - 2,000	NA	NA	50,000
Indeno(1,2,3-cd)pyrene	NA	NA	8 / 18	430 - 3,700	NA	NA	3,200
2-Methylnaphthalene	NA	NA	6 / 18	65 - 210	NA	NA	36,400
Naphthalene	NA	NA	6 / 18	65 - 130	NA	NA	13,000
Phenanthrene	NA	NA	13 / 18	78 - 1,500	NA	NA	50,000
Pyrene	NA	NA	15 / 18	110 - 5,200	NA	NA	50,000
PHENOLIC COMPOUNDS (mg/kg)	ND	ND	ND	ND	1 / 5	1.5	30
PESTICIDES/PCBs (mg/kg)							
Aroclor 1242	NA	NA	NA	NA	2 / 5	0.15 - 0.37	1
Aroclor 1254	NA	NA	NA	NA	2 / 5	0.35 - 1.3	1
Aroclor 1260	NA	NA	NA	NA	1 / 5	0.074	1

TABLE 2 (cont'd)
SURFACE SOIL DATA
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1988 (RECRA)		NYSDEC TAGM Recommended Soil Cleanup Objectives
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
INORGANICS (mg/kg)							
Aluminum (average = 24,717)	NA	NA	18 / 18	16,300 - 45,700	NA	NA	144,000 *
Antimony (average = 9.43)	NA	NA	12 / 18	6.99 - 15.1	NA	NA	2.0 *
Arsenic	NA	NA	3 / 18	15.4 - 61.7	5 / 5	14 - 32	7.5
Barium	NA	NA	18 / 18	80.7 - 365	NA	NA	300
Beryllium	NA	NA	18 / 18	1.44 - 7.45	NA	NA	0.16
Cadmium	NA	NA	5 / 18	0.707 - 8.00	NA	NA	10
Calcium	NA	NA	18 / 18	48,000 - 212,000	NA	NA	1,000,000 **
Chromium	NA	NA	18 / 18	6.89 - 127	5 / 5	22 - 4,700	50
Cobalt	NA	NA	18 / 18	1.89 - 15.7	NA	NA	30
Copper	NA	NA	18 / 18	20.1 - 181	5 / 5	23 - 640	25
Iron	NA	NA	18 / 18	13,700 - 236,000	NA	NA	200,000 **
Lead (average = 408.2)	NA	NA	18 / 18	22.1 - 1,120	5 / 5	21 - 3,300	42 *
Magnesium	NA	NA	18 / 18	5,890 - 38,200	NA	NA	1,000,000 **
Manganese (average = 3,548)	NA	NA	18 / 18	1,900 - 10,400	NA	NA	1,280 *
Mercury	NA	NA	4 / 18	0.025 - 0.21	NA	NA	0.1
Nickel	NA	NA	18 / 18	11.9 - 96.9	NA	NA	13
Potassium	NA	NA	18 / 18	716 - 2,310	NA	NA	1,000,000 **
Silver	NA	NA	18 / 18	191 - 1,170	NA	NA	--
Sodium	NA	NA	18 / 18	6.26 - 66.3	NA	NA	1,000,000 **
Vanadium	NA	NA	18 / 18	63.7 - 1,150	NA	NA	150
Zinc	NA	NA	18 / 18	64 - 1,200	NA	NA	20
OTHER (mg/kg)							
Cyanide, total	NA	NA	18 / 18	2.17 - 28.8	4 / 5	3.2 - 70	--

--: Not Available.
*: Two times the New York or Eastern United States average background value, from Dragun and Chiasson (1991).
**: Nutrient screening concentration.

TABLE 3
SOIL/FILL PILES DATA
FORMER RAILROAD YARD AREA

ANALYTE	Feb 2000 (MPI)		NYSDEC TAGM Recommended Soil Cleanup Objectives
	Frequency of Detection	Range of Detected Concentrations	
VOLATILE ORGANICS (ug/kg)			
Benzene	1 / 20	11	60
2-Butanone	1 / 20	12 - 19	300
Carbon disulfide	2 / 20	2	2,700
Chloroform	11 / 20	2 - 7	300
Chloromethane	1 / 20	16	--
cis-1,2-Dichloroethene	1 / 20	5	--
Ethylbenzene	1 / 20	33	5,500
4-Methyl-2-pentanone	3 / 20	2 - 4	1,000
Styrene	1 / 20	20	--
1,1,2,2-Tetrachloroethane	1 / 20	59	600
Tetrachloroethene	2 / 20	1 - 2	1,400
Toluene	19 / 20	2 - 60	1,500
Trichloroethene	1 / 20	220	700
Xylenes (total)	2 / 20	2 - 28	1,200
SEMIVOLATILE ORGANICS (ug/kg)			
Acenaphthene	10 / 20	47 - 690	50,000
Acenaphthylene	6 / 20	66 - 210	41,000
Anthracene	14 / 20	62 - 2,500	50,000
Benzo(a)anthracene	18 / 20	51 - 3,700	224
Benzo(a)pyrene	19 / 20	57 - 4,200	61
Benzo(b)fluoranthene	18 / 20	89 - 5,400	224
Benzo(g,h,i)perylene	15 / 20	89 - 3,000	50,000
Benzo(k)fluoranthene	17 / 20	39 - 1,600	1,100
bis(2-Ethylhexyl)phthalate	20 / 20	41 - 650	50,000
Butylbenzylphthalate	3 / 20	130 - 790	50,000
Carbazole	10 / 20	40 - 570	--
Chrysene	19 / 20	66 - 3,800	400
Dibenz(a,h)anthracene	4 / 20	110 - 950	14
Dibenzofuran	9 / 20	47 - 670	6,200
Di-n-butylphthalate	4 / 20	47 - 120	8,100
2,6-Dinitrotoluene	1 / 20	120	1,000
Fluoranthene	19 / 20	53 - 8,500	50,000
Fluorene	9 / 20	69 - 900	50,000
Indeno(1,2,3-cd)pyrene	15 / 20	170 - 2,700	3,200
2-Methylnaphthalene	5 / 20	83 - 430	36,400
4-Methylphenol	1 / 20	120	900
Naphthalene	8 / 20	42 - 720	13,000
Phenanthrene	19 / 20	43 - 6,000	50,000
Pyrene	19 / 20	78 - 9,700	50,000

TABLE 3
SOIL/FILL PILES DATA
FORMER RAILROAD YARD AREA

ANALYTE	Feb 2000 (MPI)		NYSDEC TAGM Recommended Soil Cleanup Objectives
	Frequency of Detection	Range of Detected Concentrations	
PESTICIDES / PCBs (ug/kg)			
Aldrin	3 / 20	2.6 - 500	41
alpha-Chlordane	2 / 20	29.3 - 500	540
gamma-Chlordane	1 / 20	2.1	540
4,4'-DDE	5 / 20	3.9 - 13.8	2,100
4,4'-DDT	6 / 20	4.7 - 32	2,100
Heptachlor	1 / 20	3.2	20
Aroclor 1254	1 / 20	1,200	1,000
Aroclor 1260	1 / 20	3,820	1,000
INORGANICS (mg/kg)			
Aluminum (average = 9,318)	20 / 20	2,950 - 28,600	144,000 *
Antimony (average = 7.16)	1 / 20	7.2	2.0 *
Arsenic	15 / 20	3.0 - 22.9	7.5
Barium	20 / 20	40.2 - 327	300
Beryllium	8 / 20	0.73 - 5.3	0.16
Cadmium	19 / 20	1.4 - 19.9	10
Calcium	20 / 20	14,200 - 209,000	1,000,000 **
Chromium	20 / 20	8.2 - 193	50
Cobalt	15 / 20	5.0 - 15.9	30
Copper	20 / 20	9.4 - 504	25
Iron	20 / 20	7,910 - 244,000	200,000 **
Lead (average = 140.7)	20 / 20	15.2 - 766	42 *
Magnesium	20 / 20	3,070 - 23,600	1,000,000 **
Manganese (average = 882.0)	20 / 20	194 - 3,320	1,280 *
Mercury	11 / 20	0.12 - 0.67	0.1
Nickel	18 / 20	7.74 - 84.8	13
Potassium	20 / 20	657 - 4,970	1,000,000 **
Selenium	19 / 20	2.3 - 35.9	0.6 *
Sodium	5 / 20	230 - 675	1,000,000 **
Thallium	3 / 20	2.4 - 4.8	--
Vanadium	19 / 20	8.7 - 44.2	150
Zinc	20 / 20	63.8 - 2,380	20
OTHER (mg/kg)			
Cyanide, total	6 / 20	1.7 - 12.7	--

--: Not Available.
*: Two times the New York or Eastern United States average background value, from Dragun and Chiasson (1991).
**: Nutrient screening concentration.

- SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, and dibenz(a,h)anthracene;
- Pesticides/PCBs: aldrin, Aroclor 1254, Aroclor 1260;
- Inorganic chemicals: antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, thallium, and zinc;
- Other chemicals: cyanide.

The maximum detected concentration of iron exceeds the screening concentration. The average detected concentrations of antimony, lead, and selenium exceed two times their respective average background concentrations. For all other chemicals, the maximum detected concentrations exceed the respective NYSDEC recommended soil cleanup objectives.

Groundwater – In 1988, one monitoring well (MW-4) was installed in the Former Railroad Yard Area as part of the Recra Environmental, Inc. "Site Characterization and Environmental Assessment". This sample was analyzed for PCBs, phenolics, three heavy metals (arsenic, chromium, and lead), and cyanide. In 1995, ABB installed two monitoring wells in the Former Railroad Yard Area (MW-104 and MW-105) and analyzed a sample from each well for VOCs, SVOCs, pesticides/PCBs, TAL metals, and cyanide. In 2000, Malcolm Pirnie, Inc. installed three more monitoring wells (MW-001, MW-002, and MW-003), and sampled them and the two ABB wells. These samples were analyzed for VOCs, SVOCs, pesticides/PCBs, TAL metals, and cyanide. Because MW-002 (Malcolm Pirnie, Inc., 2000) lies near the location of MW-4 (Recra Environmental, Inc., 1988), and represents more current groundwater conditions at this point, the data from the 1988 sampling event are not used. These results are presented in Table 4.

The following chemicals are selected as COPCs:

- VOCs: 4-methyl-2-pentanone;
- Inorganic chemicals: aluminum, iron, manganese, and thallium;

TABLE 4
GROUNDWATER DATA
FORMER RAILROAD YARD AREA

ANALYTE	Feb 2000 (MPI)		1995 (ABB)		NYSDEC Ambient Water Quality Standards and Guidance Values for Class GA Groundwater
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
VOLATILE ORGANICS (ug/L)					
2-Hexanone	1 / 5	9	0 / 2	ND	50
4-Methyl-2-pentanone	1 / 5	4	0 / 2	ND	--
SEMI-VOLATILE ORGANICS (ug/L)					
Di-n-butylphthalate	3 / 5	3 - 4	0 / 2	ND	50
INORGANICS (ug/L)					
Aluminum	4 / 5	402 - 1,630	2 / 2	150 - 1,600	--
Barium	2 / 5	65.1 - 140	2 / 2	23.2 - 29.4	1,000
Calcium	5 / 5	60,300 - 171,000	2 / 2	45,100 - 98,600	800,000 *
Copper	1 / 5	10.9	0 / 2	ND	200
Iron	5 / 5	231 - 11,700	2 / 2	25.8 - 53.5	10,000 *
Lead	3 / 5	3.8 - 5.1	0 / 2	ND	25
Magnesium	4 / 5	7,610 - 55,700	1 / 2	11,700	80,000 *
Manganese	4 / 5	25.0 - 846	1 / 2	13.6	300
Potassium	5 / 5	1,080 - 61,000	2 / 2	13,500 - 16,200	1,000,000 *
Selenium	5 / 5	13.6 - 114	1 / 2	8.7	10
Silver	1 / 5	35.9	1 / 2	41.2	50
Sodium	5 / 5	14,700 - 64,600	2 / 2	24,600 - 26,300	975,000 *
Thallium	1 / 5	16.6	0 / 2	ND	0.5
Zinc	5 / 5	10.0 - 86.2	0 / 2	ND	2,000
OTHER (ug/L)					
Cyanide, total	4 / 5	20.0 - 90.0	2 / 2	50.0 - 240	200

ND: Not Detected.
NA: Not Analyzed.
*: Nutrient screening concentration.
--: Not Available.

- Other chemicals: cyanide.

The maximum detected concentration of iron exceeds the nutrient screening concentration. For all other chemicals, the maximum detected concentrations exceed the respective NYSDEC Ambient Water Quality Standards for Class GA Groundwater.

Based on this analysis, the chemicals of potential concern for each environmental medium are summarized in Table 5.

2.2 TOXICITY ASSESSMENT

For each COPC, critical oral and inhalation effects are presented in Tables 6 (non-carcinogenic health effects) and 7 (carcinogenic health effects). The critical health effects given are those that are used by the USEPA (2000, 1997) to derive reference doses, reference concentrations, and slope factors. In a quantitative human health risk assessment, reference doses and reference concentrations are used to assess the potential for chronic noncarcinogenic health effects, and slope factors are used to assess carcinogenic risk. The reference doses, reference concentrations, and slope factors are not presented in these tables.

For the VOCs, SVOCs, and pesticides/PCBs selected as COPCs, brief toxicological profiles are provided in Attachment II. For the inorganic chemicals selected as COPCs, a brief composite toxicological profile is provided in Attachment II.

2.3 EXPOSURE ASSESSMENT

2.3.1 Identification of Potential Exposure Pathways

As described above, the site is currently abandoned. The current designation of the grounds is industrial/commercial, and it is expected to remain that way in the future. The City of Buffalo is planning to redevelop the Former Railroad Yard Area as a commercial/light industrial park. The Union Ship Canal, which lies outside the study area, is currently inactive and not fenced off to trespassers. In the future, the City of Buffalo may expand the water area to the north, and make the canal into a boat harbor.

TABLE 5
CHEMICALS OF POTENTIAL CONCERN
FORMER RAILROAD YARD AREA

ANALYTE	SUBSURFACE SOIL	SURFACE SOIL	SOIL/FILL PILES	GROUNDWATER
VOLATILE ORGANICS				
Chloromethane	ND	ND	X	ND
cis-1,2-Dichloroethene	ND	ND	X	ND
2-Hexanone	ND	X	ND	*
4-Methyl-2-pentanone	ND	ND	*	X
Styrene	ND	ND	X	ND
SEMI-VOLATILE ORGANICS				
Benzo(a)anthracene	X	X	X	ND
Benzo(a)pyrene	X	X	X	ND
Benzo(b)fluoranthene	X	X	X	ND
Benzo(k)fluoranthene	*	X	X	ND
Carbazole	X	ND	X	ND
Chrysene	X	X	X	ND
Dibenz(a,h)anthracene	ND	X	X	ND
Indeno(1,2,3-cd)pyrene	*	X	*	ND
PESTICIDES/PCBs				
Aldrin	ND	ND	X	ND
Aroclor 1254	ND	X	X	ND
Aroclor 1260	ND	*	X	ND
INORGANICS				
Aluminum	*	*	*	X
Antimony	X	X	X	ND
Arsenic	X	X	X	ND
Barium	X	X	X	*
Beryllium	X	X	X	ND
Cadmium	*	*	X	ND
Chromium	*	X	X	ND
Copper	X	X	X	*
Iron	X	X	X	X
Lead	X	X	X	*
Manganese	X	X	*	X
Mercury	*	X	ND	ND
Nickel	X	X	X	ND
Selenium	*	ND	*	*
Silver	ND	X	X	*
Thallium	ND	ND	X	X
Vanadium	*	X	*	ND
Zinc	X	X	X	*
OTHER				
Cyanide, total	X	X	X	X

X: Selected as a chemical of potential concern (COPC).
*: Detected, but not selected as a COPC.
ND: Not Detected.
NA: Not Analyzed.

TABLE 6
NON-CARCINOGENIC HEALTH EFFECTS OF CHEMICALS OF POTENTIAL CONCERN
FORMER RAILROAD YARD AREA

CHEMICAL	CAS #	NON-CARCINOGENIC ORAL CRITICAL EFFECT	NON-CARCINOGENIC INHALATION CRITICAL EFFECT
VOLATILE ORGANICS			
Chloromethane	74-87-3	--	Cerebellar degeneration and severe neurological impairment
cis-1,2-Dichloroethene	156-59-2	Decreased hemoglobin and hematocrit	--
2-Hexanone	591-78-6	--	Neurological effects
4-Methyl-2-pentanone	108-10-1	Liver and kidney effects	Liver and kidney effects
Styrene	100-42-5	Red blood cell & liver effects	CNS effects
SEMI-VOLATILE ORGANICS			
Benzo(a)anthracene	56-55-3	--	--
Benzo(a)pyrene	50-32-8	--	--
Benzo(b)fluoranthene	205-99-2	--	--
Benzo(k)fluoranthene	207-08-9	--	--
Carbazole	86-74-8	--	--
Chrysene	218-01-09	--	--
Dibenz(a,h)anthracene	53-70-3	--	--
Indeno(1,2,3-cd)pyrene	193-39-5	--	--
PESTICIDES/PCBs			
Aldrin	309-00-2	Liver	Liver, diet
Aroclor 1254	11097-69-1	Ocular exudate, inflamed Meibomian glands, distorted nail growth, decreased antibody response.	--
Aroclor 1260	11096-82-5	Ocular exudate, inflamed Meibomian glands, distorted nail growth, decreased antibody response.	--
INORGANICS			
Aluminum	7429-90-5	Minimal neurotoxicity	Psychomotor and cognitive impairment
Antimony	7440-36-0	Longevity, blood glucose, and cholesterol	--
Arsenic	7440-38-2	Hyperpigmentation, keratosis and possible vascular complications	--
Barium	7440-39-3	Increased blood pressure	Fetotoxicity
Beryllium	7440-41-7	Small intestine lesions	Sensitization and progression to chronic beryllium disease
Cadmium	7440-43-9	--	Significant proteinuria (cadmium in water)
Chromium III	16065-83-1	No effects observed	--
Copper	7440-50-8	Gastrointestinal irritation	--
Iron	7439-89-6	--	--
Lead	7439-92-1	--	--
Manganese	7439-96-5	CNS effects	Impairment of neurobehavioral function
Mercury (elemental)	7439-97-6	--	Neurotoxicity
Nickel (soluble salts)	7440-02-0	Decreased body and organ weights	--
Silver	7440-22-4	Argyria	Argyrosis
Thallium	7440-28-0	--	--
Vanadium	7440-62-2	--	--
Zinc	7440-66-6	Decrease in erythrocyte superoxide	--
OTHER			
Cyanide	57-12-5	Weight loss, thyroid effects and myelin degeneration.	--

TABLE 7
CARCINOGENIC HEALTH EFFECTS OF CHEMICALS OF POTENTIAL CONCERN
FORMER RAILROAD YARD AREA

Chemical	CAS #	ORAL CARCINOGENIC CANCER TYPE	INHALATION CARCINOGENIC CANCER TYPE	Weight-of-Evidence Classification (*)
VOLATILE ORGANICS				
Carbon disulfide	75-15-0	--	--	--
Chloromethane	74-87-3	Kidney tumors	Kidney tumors	C
cis-1,2-Dichloroethene	156-59-2	--	--	D
2-Hexanone	591-78-6	--	--	--
4-Methyl-2-pentanone	108-10-1	--	--	--
Styrene	100-42-5	--	--	--
SEMI-VOLATILE ORGANICS				
Benzo(a)anthracene	56-55-3	--	--	B2
Benzo(a)pyrene	205-99-2	Forestomach	--	B2
Benzo(b)fluoranthene	207-08-9	--	--	B2
Benzo(k)fluoranthene	50-32-8	--	--	B2
Carbazole	86-74-8	Liver	Liver carcinoma	B2
Chrysene	218-01-09	--	--	B2
Dibenz(a,h)anthracene	53-70-3	--	--	B2
Indeno(1,2,3-cd)pyrene	193-39-5	--	--	B2
PESTICIDES/PCBs				
Aldrin	309-00-2	Liver	Liver carcinoma	B2
Aroclor 1254	11097-69-1	Trabecelar carcinoma/adenocarcinoma (**)	-- (**)	B2 (**)
Aroclor 1260	11096-82-5	Trabecelar carcinoma/adenocarcinoma (**)	-- (**)	B2 (**)
INORGANICS				
Aluminum	7429-90-5	--	--	D
Antimony	7440-36-0	--	--	B1
Arsenic	7440-38-2	Skin	Respiratory	A
Barium	7440-39-3	--	--	D
Beryllium	7440-41-7	--	Lung tumors	B1
Cadmium	7440-43-9	--	Respiratory (cadmium in water)	B1
Chromium III	16065-83-1	--	--	D
Copper	7440-50-8	--	--	D
Iron	7439-89-6	--	--	-
Lead	7439-92-1	--	--	B2
Manganese	7439-96-5	--	--	D
Mercury (elemental)	7439-97-6	--	--	D
Nickel (soluble salts)	7440-02-0	--	--	-
Silver	7440-22-4	--	--	D
Thallium	7440-28-0	--	--	-
Vanadium	7440-62-2	--	--	-
Zinc	7440-66-6	--	--	D
OTHER				
Cyanide	57-12-5	--	--	D

*: Weight of Evidence Classification refers to the known carcinogenicity of the chemical. "A" = Human Carcinogen; "B" = Probable Human Carcinogen; "C" = Possible Human Carcinogen; "D" = Not classifiable as to human carcinogenicity; "-" = Has not been classified.

**: Carcinogenic health effects and weight-of-evidence ratings are for total PCBs.

While boating would be permitted in such a development, swimming and fishing are not likely to be permitted. Also, ground area bordering the canal may be developed by approximately 100-200 feet to the east, west, and south into a recreational park area. There is no expectation of the site being used for residential purposes.

The surrounding community obtains its drinking water from the City of Buffalo, and as such, does not rely on the underlying groundwater for its potable water supply. During the operation of the site's businesses, groundwater is not known to have been drawn from production wells on-site, and the Union Ship Canal was used only for industrial and cargo-related purposes. No water in the investigation area is currently used by residential or commercial entities in the vicinity of the site.

An overview of the site dynamics and the potential human for exposure to the environmental media is presented in Table 8.

2.3.2 Identification of Pathways Considered Complete

The possible means by which people (i.e., construction/utility workers, off-site residents, future on-site workers, and trespassers) could come in contact with the COPCs, either now or in the future, are itemized in Table 9. Each of these possible exposure scenarios has been analyzed to determine whether it is viable and the reason associated with each determination is provided.

Because the Former Railroad Yard Area is currently unoccupied, there are no current site workers included in the analysis. Construction and utility workers are included in the future scenario, as redevelopment of the railroad yard will require their efforts. As a result, these workers may come in contact with soil, ingest soil, and inhale respirable particulates during such activities as excavation, drilling, and removal of the soil/fill piles. Additionally, since the groundwater lies 4 to 8 feet below ground surface, construction activity may infiltrate the water table, leading to dermal contact with contaminated groundwater. Also, future on-site workers are included in the analysis to consider possible exposure pathways in the event of new building construction.

The Former Railroad Yard Area is accessible to trespassers. Trespassers may come in contact with soil contamination via dermal contact, ingestion, and inhalation of

TABLE 8
CHEMICAL RELEASE MECHANISMS IN ABSENCE OF REMEDIAL ACTION
FORMER RAILROAD YARD AREA

RELEASE SOURCE	RELEASE MECHANISM	RECEIVING MEDIUM	SITE CONDITIONS	VIABLE CURRENT RELEASE SCENARIO?	VIABLE FUTURE RELEASE SCENARIO?
Contaminated surface soil, subsurface soil, or soil/fill piles	Fugitive dust generation	AIR	Chemical contamination found in surface soil and soil/fill piles. Surface soil is exposed, as the area is partially vegetated.	Possible - particulate material from surface soil and soil/fill piles may be introduced and spread throughout the vicinity of the site via wind dispersion.	Possible -releases from subsurface soil, surface soil, and/or soil/fill piles may be caused by construction/utility activity, but are not likely to result from wind dispersion, as the soil/fill piles will have been removed, and the entire area will have been covered with clean fill.
Contaminated surface soil, subsurface soil, or soil/fill piles	Volatilization	AIR	Chemical contamination found in subsurface soil, surface soil, and soil/fill piles. Surface soil is exposed, as the area is partially vegetated. However, little VOC contamination was detected.	Possible - chemicals may volatilize from subsurface soil, surface soil, and/or soil/fill piles and into the ambient air.	Possible - the entire area will be covered with clean fill; subsurface and surface soil may release volatile chemicals which may enter the ambient air; soil/fill piles will have been removed; construction activity may cause the release of volatile chemicals upon excavation into native soil/fill. However, little VOC contamination was detected.
Contaminated surface soil, subsurface soil, or groundwater	Volatilization	INDOOR AIR	All existing buildings on the site are vacated. Groundwater flows toward the Union Ship Canal.	No - volatile chemicals may enter buildings via migration through their foundations, but given the vacancy of the buildings, exposure is not currently a concern.	Possible - construction upon contaminated soil may lead to volatilization of chemicals from soil and groundwater into indoor air through cracks in the foundations of new buildings. However, little VOC contamination was detected, and addition of clean fill will reduce the intrusion of volatile chemicals into the indoor air.
Contaminated surface soil, subsurface soil, or soil/fill piles	Fugitive dust generation / deposition	SOIL	Chemical contamination found in surface soil and soil/fill piles. Surface soil is exposed, as the area is partially vegetated.	Yes	No - soil/fill piles will have been removed, and clean fill will have been laid down over the entire site.
Contaminated surface soil, subsurface soil, or soil/fill piles	Tracking	SOIL	Chemical contamination found in surface soil and soil/fill piles. Surface soil is exposed, as the area is partially vegetated.	Yes	Possible - construction activity may relocate contamination from surface soil, subsurface soil, and soil/fill piles to surface soil.
Contaminated surface soil, subsurface soil, or soil/fill piles	Infiltration / Percolation	GROUND-WATER	Groundwater samples did not demonstrate SVOC contamination as found in soil samples. Groundwater flows toward the Union Ship Canal.	Possible, but unlikely - groundwater sampling showed corresponding contamination for inorganic chemicals, but not for other chemicals.	Possible, but unlikely - groundwater sampling showed corresponding contamination for inorganic chemicals, but not for other chemicals.

TABLE 9
IDENTIFICATION OF POTENTIAL RECEPTORS AND ROUTES OF EXPOSURE
FORMER RAILROAD YARD AREA

Exposure Route, Exposure Medium, and Exposure Point	Potentially Exposed Population	Exposure Pathway Complete?	Scenario, and Reason for Selection or Exclusion as Complete Exposure Pathway
Incidental dermal contact with chemicals in groundwater	Construction/utility workers	Possible (future only)	Current: No construction/utility work is currently in progress. Future: Construction/utility workers may come in contact with groundwater in excavation/drilling work due to the depth of the groundwater (4-8 ft below ground surface).
Incidental ingestion of and dermal contact with chemicals in on-site soil	Construction/utility workers	Yes (future only)	Current: No construction/utility work is currently in progress. Future: Construction/utility workers may come in contact with soils during excavation, drilling, and removal of soil/fill piles.
	Off-site residents, on-site workers	No	Current/Future: It is not expected that off-site residents or future on-site workers will come in contact with on-site soil.
	Trespassers	Yes (current only)	Current: Soil and soil/fill piles are accessible, despite fencing. Future: Soil/fill piles will have been removed, and clean fill will have been laid down over the entire site.
Incidental inhalation of volatile chemicals and of chemicals on fugitive dust	Construction/utility workers	Yes (future only)	Current: No construction/utility work is currently in progress. Future: Construction/utility workers may come in contact with fugitive dust during excavation, drilling, and removal of soil/fill piles.
	Off-site residents	Possible (current only)	Current: Particulate matter from soil/fill piles and surface soil may be introduced and spread throughout the vicinity of the site via wind dispersion. Future: Soil/fill piles will have been removed, and clean fill will have been laid down over the entire site.
	On-site workers	No	Current: The site is currently unoccupied. Future: Soil/fill piles will have been removed, and clean fill will have been laid down over the entire site.
	Trespassers	Possible (current only)	Current: Particulate matter from soil/fill piles and surface soil may be introduced and spread throughout the vicinity of the site via wind dispersion. Future: Soil/fill piles will have been removed, and clean fill will have been laid down over the entire site.
Inhalation of volatile chemicals in indoor air from groundwater and/or soil.	On-site workers	Possible (future only), but unlikely	Current: The site is currently unoccupied. Future: Volatile chemicals may be transported into buildings through cracks in the foundation. However, few volatile chemicals are of potential concern, and a layer of clean fill is to be added to the entire site before construction.
Ingestion of, dermal contact with, and inhalation of chemicals in groundwater	Off-site residents, on-site workers	No	Current: City water is used by area residents for potable use. Future: City water is expected to be used for potable purposes; underlying groundwater sources will not be used by the community.

respirable particulates at the railroad yard. Soil contact may occur from exposure to surface soils, as the Former Railroad Yard Area is partially vegetated, and from the soil/fill piles, which may be attractive play areas for trespassers.

Off-site residents are not expected to contact soil on the site. However, a scenario in which winds disperse soil particles from the surface soil and soil/fill piles in the direction of residential areas (primarily to the south, southeast, east, and northeast) in the form of fugitive emissions, is possible, but unlikely.

Off-site residents are not expected to be exposed to groundwater contamination from the site. Currently, potable water is supplied to the site from the City of Buffalo. Under future conditions, water will be provided by either the City of Buffalo or the Erie County Water Authority. Furthermore, groundwater flows from the area of the Former Railroad Yard Area toward the Union Ship Canal. As such, migration of groundwater to the underlying soil of residential homes and subsequent volatilization of chemicals through building foundations and into the indoor air of residences is unlikely.

Future on-site workers are not expected to contact contaminated soil in the area of the Former Railroad Yard Area for the following reasons: (1) soil/fill piles will have been bulldozed, graded, covered with fill, and grassed over; and (2) it is expected that a one-foot (or greater) layer of clean fill material will have been laid over the current ground surface before any new construction (which is expected to be primarily slab-on-grade) takes place.

Future on-site workers are not expected to be exposed to groundwater contamination from the Former Railroad Yard Area. Potable water is expected to be supplied by the City of Buffalo or Eire County Water Authority; as such, groundwater underlying the Former Railroad Yard Area would not be used as a potable water supply.

2.4 RISK CHARACTERIZATION

2.4.1 Current Scenario

The potential for exposure to the COPCs at the Former Railroad Yard Area in the Hanna Furnace Site is very limited, given that the site is vacated. The Former Railroad Yard Area is accessible to trespassers. Surface soil is exposed throughout much of the Former Railroad Yard Area. Also, soil/fill piles, which contain soil, fill, construction debris, and building debris, are a source of exposed soil. As such, dermal contact and ingestion of soil is a viable exposure pathway. Also, for trespassers, the generation and dispersion of windblown dust, and thus, inhalation of such particles, is possible. For the neighboring communities, which lie approximately one-half mile to the south, northeast, and east of the study area, inhalation of respirable particulates generated by wind is possible, although such an event is less likely, given the distance to the study area.

Groundwater is not currently used for potable drinking water by any residential or commercial entities in the area. Current water use is supplied by the City of Buffalo. As such, exposure to groundwater in the current scenario is unlikely.

2.4.2 Future Scenario

The extent of future exposure to the COPCs at the Former Railroad Yard Area depends on the nature of activities and uses of the land. Currently, the Buffalo Economic Renaissance Corporation plans to have the Former Railroad Yard Area redeveloped as a light industrial/commercial area. As part of the redevelopment plan, the soil/fill piles are expected to be bulldozed and graded. The area will then be covered with a one-foot layer of clean fill material (seeded with grass), asphalt, or concrete, depending on the redevelopment plan.

Based on such plans, potential exposure by construction and utility workers and off-site residents is discussed as follows. Subsurface soil and surface soil may be excavated during construction activities. Such action could generate fugitive dust, and could expose workers and off-site residents via inhalation. Furthermore, soil could be dermally contacted and ingested by workers throughout construction activities.

Groundwater may be reached during construction activity and may be contacted by construction and utility workers given its depth (4 to 8 feet below ground surface). As such, dermal contact with groundwater is possible.

Given the redevelopment plans, exposure to the soil fill piles and surface soil would be substantially precluded for future on-site workers.

For the trespasser, potential exposure to contaminated soil is expected to be precluded due to the planned redevelopment activity.

3.0 ECOLOGICAL RISK ASSESSMENT

3.1 INTRODUCTION

A qualitative ecological risk assessment was prepared to characterize the natural resources and potential ecological receptors at the Former Railroad Yard Area. The ecological risk assessment was performed in accordance with applicable New York State and USEPA guidance for ecological assessments at hazardous waste sites, including the NYSDEC guidance, *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites* (FWIA) (NYSDEC, 1994). This evaluation consists of the following six components of an ecological risk assessment:

- Ecological characterization
- Identification of chemicals of potential ecological concern.
- Exposure and effects assessment.
- Ecological risk characterization.
- Assessment of uncertainties and limitations.
- Summary.

3.2 ECOLOGICAL CHARACTERIZATION

Ecological resources within the 2-mile radius were identified from review of site photos, aerial photos, the U.S. Geological Survey (USGS) Buffalo SE, NY topographic quadrangle map, the National Wetlands Inventory (NWI) map and the New York State Freshwater Wetlands map for the site vicinity. Descriptions of the terrestrial and aquatic resources near the Former Railroad Yard Area follow, along with discussions of wildlife resources and the value of ecological resources in the vicinity to both wildlife and humans.

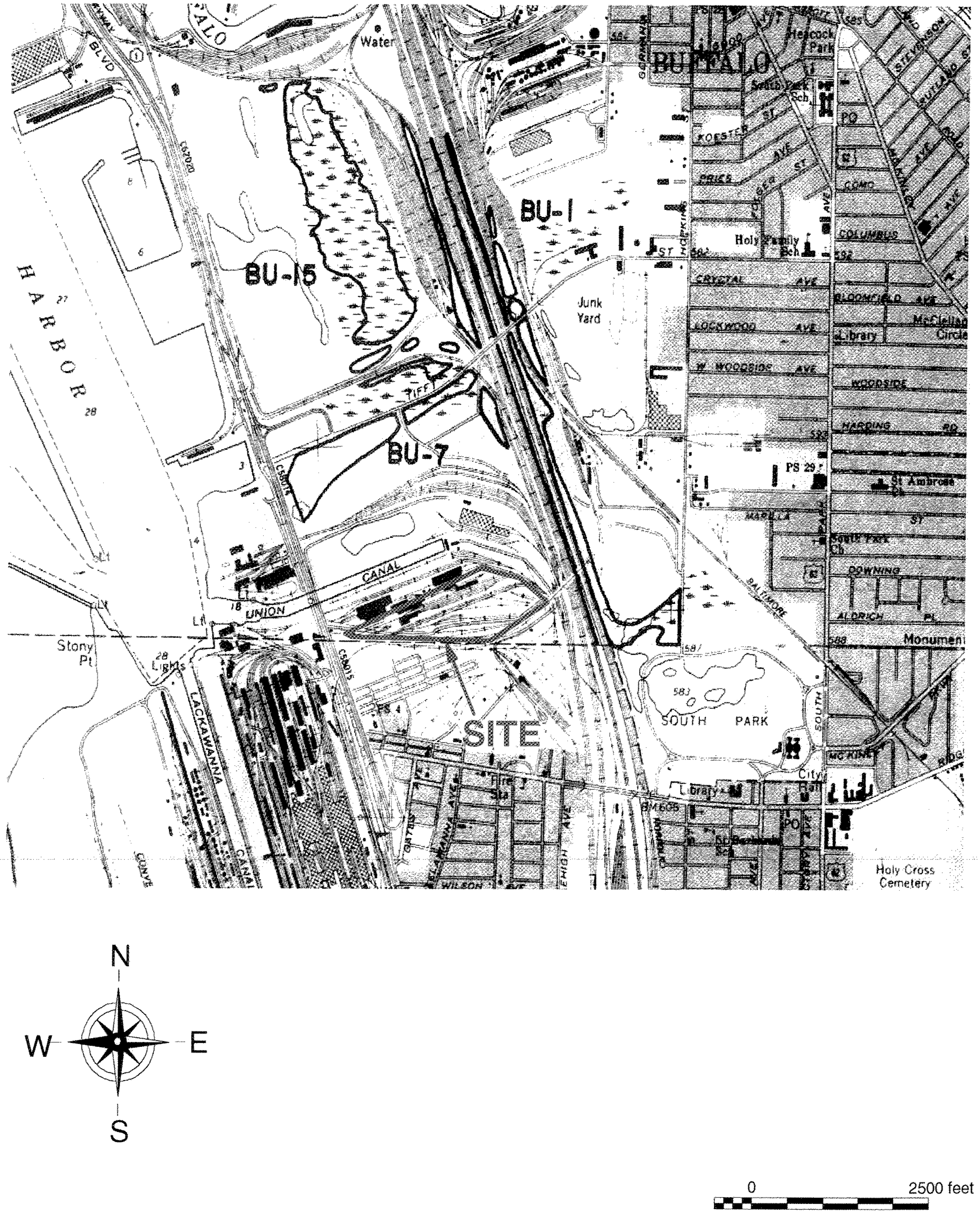
3.2.1 Description of Natural Resources

Lake Erie in the vicinity of the site is classified by the NYSDEC as Class C. The Union Ship Canal and the Lackawanna Canal are also Class C. Class C waters support warm water species. The New York State Freshwater Wetlands Map for the site vicinity (Figure 2) shows that there are several State wetlands in the immediate vicinity of the site, but there are no State wetlands within the Former Railroad Yard Area boundaries. Wetlands BU-7, BU-1 and BU-15 are located to the north of the site.

According to the NYSDEC (personal communication, 1993), Wetland BU-1 is approximately 58 acres in size, and is considered to be a Class I wetland since it exhibits four or more Class II characteristics. It is classified as an emergent marsh with a maximum 66% of the covertype being purple loosestrife and/or phragmites, and it is considered to be one of the three largest wetlands in the city of Buffalo. Also according to NYSDEC (personal communication, 1993), Wetland BU-1 also contains softstem bulrush, various sedges, water plaintain, duckweed, joe-pye weed, soft rush, pondweeds, water milfoil, and American elodea.

Wetland BU-7 is described by the NYSDEC as a combined deciduous woods and emergent marsh which is approximately 20 acres in size (personal communication, 1993). It is a Class II wetland which is a maximum of 66% purple loosestrife and/or phragmites. Tree and shrub species include black willow, eastern cottonwood, and red-osier dogwood. Emergent species include cattail, purple loosestrife, phragmites, and swamp milkweed. Wildlife observed by NYSDEC personnel in 1980 include cottontail rabbit, ring-necked pheasant, and muskrat, and it was believed at the time to be an excellent site for breeding waterfowl and for use by waterfowl during migration periods.

Wetland BU-15 is approximately 95 acres in size and is part of the Tifft Farm Nature Preserve which is owned by the City of Buffalo. It is listed as a Class I wetland since it has four or more Class II characteristics. It is one of the three largest wetlands in the City of Buffalo, and it is within a publicly owned recreation area. Vegetation found to occur within this wetland area includes cattail, purple loosestrife, phragmites, black willow, red-osier dogwood, cottonwood, reed canary grass, rushes, duckweed, water horsetail, and skunk cabbage. Included in this area is a 75-acre cattail wetland. Wildlife



Source: NYS Freshwater Wetlands Map, Erie County, Map 12 of 31

MALCOLM PIRNIE

HANNA FURNACE SITE - FORMER RAILROAD YARD
BUFFALO, NEW YORK

NEW YORK STATE FRESHWATER WETLANDS MAP

MALCOLM PIRNIE, INC.

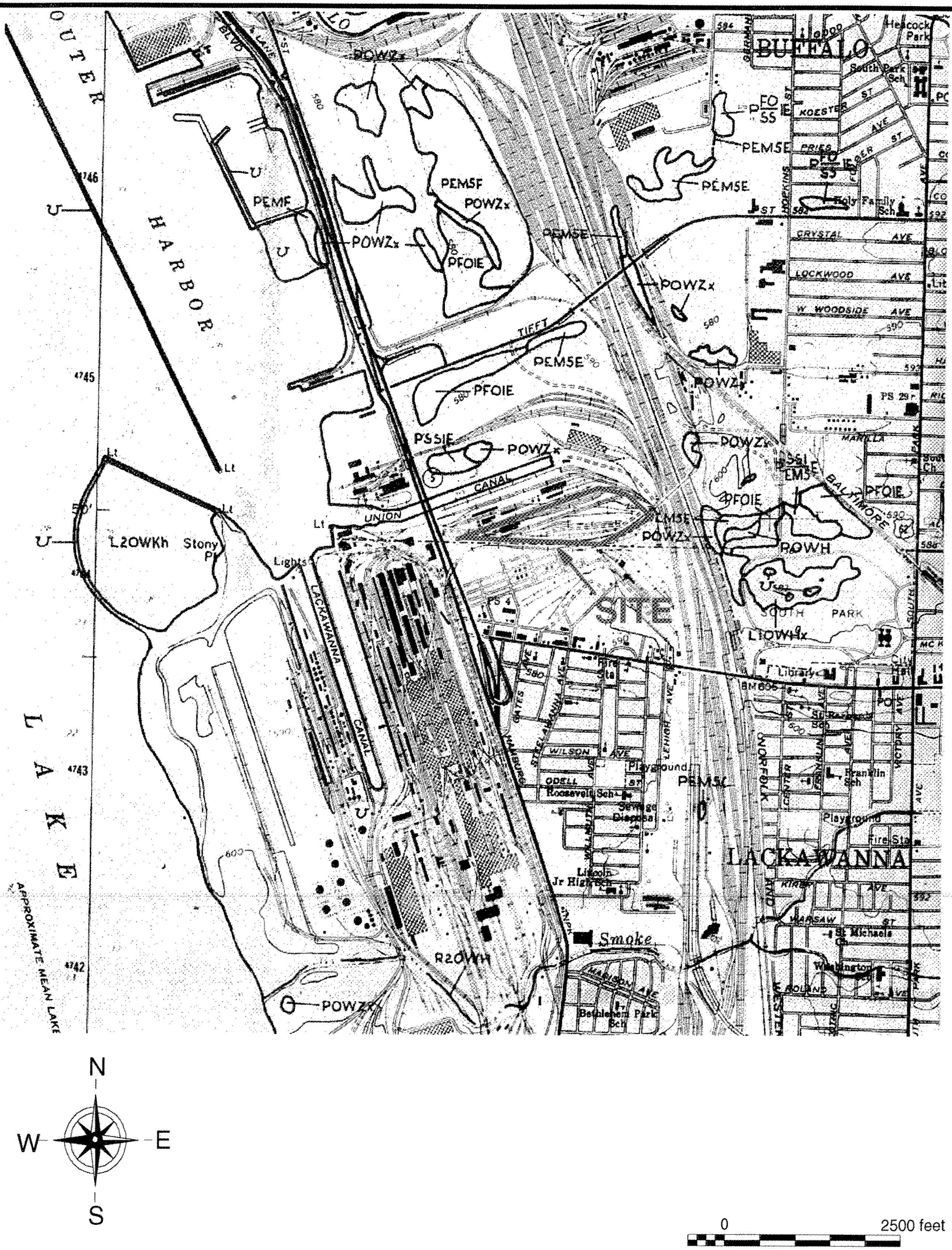
FIGURE 2

observed by the NYSDEC in 1976 include mallard, horned grebe, blue-winged teal, bufflehead, scaup, American widgeon, coot, northern shoveler, ring-necked duck, herring gull, American bittern, red-winged blackbird, killdeer, white-throated sparrow, brown thrasher, cottontail rabbit and muskrat. Other furbearers such as mink, red fox, gray fox, raccoon, and beaver may also be associated with this wetland (personal communication, 1993).

South Park, a public recreation area, is located southeast of the site. South Park is owned by the City of Buffalo, and has a 9-hole golf course, several baseball diamonds, and a picnic area (Buffalo City Parks Commissioner Office, personal communication, 1993). Other activities which take place within the park include walking, jogging, bicycling, rollerskating, and bird watching. An arboretum is also located in the area of the park, which is owned and run by the Erie County Parks Department. There are two ponds within the park which are connected by culverts. The two South Park ponds are classified as L1OWHx on the NWI mapping, which indicates that they are lacustrine (L) limnetic (1) open water (OW) which is a permanent (H) excavation (x). Several upland islands appear within the larger pond. No boating or swimming is permitted within South Park, but fishing is permitted with a license.

The NWI map (Figure 3) also indicates the presence of several wetland areas `in the immediate vicinity of the site, but not within the site boundaries. These wetlands are classified as:

- **POWZx**: Palustrine Open Water, Intermittently Exposed/Permanent
- **PSS1E**: Palustrine Scrub Shrub, Broad-leaved Deciduous, Seasonal Saturated
- **PFO1E**: Palustrine Forested, Broad-leaved Deciduous, Seasonal Saturated
- **PEM5E**: Palustrine Emergent, Narrow-leaved Persistent, Seasonal Saturated
- **PEM5F**: Palustrine Emergent, Narrow-leaved Persistent, Semipermanent
- **POWH**: Palustrine Open Water, Permanent
- **R2OWH**: Riverine, Lower Perennial, Open Water, Permanent
- **PEMF**: Palustrine, Emergent, Semipermanent
- **L2OWKh**: Lacustrine, Littoral, Open Water, Artificial, Diked/Impounded
- **L1OWHx**: Lacustrine, Limnetic, Open Water, Permanent, Excavated



Source: Buffalo SE, NY NWI Quadrangle

MALCOLM PIRNIE

HANNA FURNACE SITE - FORMER RAILROAD YARD
BUFFALO, NEW YORK

NATIONAL WETLANDS INVENTORY MAP

MALCOLM PIRNIE, INC.

FIGURE 3

The area itself comprises a Former Railroad Yard Area, which has not been in active use since 1982. A significant amount of debris is present in mounds, which contain tires, scrap metal, wood and appliances. Railroad ties are present in piles as well as in place in the Former Railroad Yard Area. The area has become overgrown with early successional scrub-shrub and herbaceous vegetation. These species tend to be opportunistic and thrive well in urban locations. Some representative herbaceous species include ragweed, goldenrod, Queen Anne's Lace, common mullein and Yarrow. Tree and shrub species include cottonwood and sumac. Wildlife likely to use the site include small birds and mammals such as robins, sparrows, starlings, voles, mice, rats, rabbits, woodchucks, raccoons and squirrels.

3.2.2 Observations of Stress

Signs of stress to vegetation and wildlife from site-related chemicals have not been observed. Physical stress, however, exists throughout the area since the Hanna Furnace Site contains piles of demolition debris, tires, scrap metal, wood, appliances and railroad ties. The vegetation that exists on the Former Railroad Yard Area consists of opportunistic species that can thrive in urban/industrial settings.

3.2.3 Value of Resources to Wildlife and Humans

As discussed above, the area itself offers little habitat for wildlife. The surrounding area, within the 0.5-mile radius, is mainly industrial/commercial, with some residential areas to the south. It is an urban setting with little wildlife habitat. The only potential habitat within the 0.5-mile radius exists in several open and/or wooded areas associated with municipal parks and wetlands.

The land uses within 2-mile radius surrounding the Former Railroad Yard Area are slightly more varied than the land uses within the 0.5-mile radius. More open space exists, along with residential areas and some commercial/industrial facilities. Wildlife would tend to utilize the open areas within the 2-mile radius of the Former Railroad Yard Area, such as the Tifft Farms Nature Preserve, rather than those areas closer to the railroad yard. Also within the 2-mile radius is Lake Erie, to the west and downstream.

The value of ecological resources to humans, within the 0.5-mile radius of the Former Railroad Yard Area, is expected to be minimal. As discussed above, the immediate vicinity of the site consists of industrial/commercial and residential uses. Little open space exists, with the exception of South Park, the Union Ship Canal and Lackawanna Canal. The value of resources within the 2-mile radius is expected to be higher, since more open space exists in this area. Land uses within the 2-mile radius include residential, commercial, wetlands and wooded areas. Human use of the area within the 2-mile radius includes fishing in the open space areas and Lake Erie.

3.3 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

The Former Railroad Yard Area was constructed on fill that is present to an approximate depth of 8 to 12 feet. Metals and polynuclear aromatic hydrocarbons (PAHs) were detected at concentrations above the NYSDEC-recommended soil cleanup objectives. The highest concentrations of metals and PAHs were generally found in the 0 to 2-foot interval. Soil and groundwater samples within the Former Railroad Yard Area from investigations conducted by Recra Environmental, Inc. in 1988 and ABB Environmental Services in 1995 as well as more recent sampling conducted by Malcolm Pirnie from 1999 to 2000 are summarized here for use in this ecological risk assessment. A discussion of data used and selection of chemicals of potential ecological concern (COPEC) follows, for each medium sampled.

3.3.1 Soil

Although most burrowing animals create dens in the upper 4 feet of soil, all the surface soil and subsurface soil data (up to 10 feet below ground surface) were considered for the ecological evaluation. Soil samples were analyzed for VOCs, SVOCs pesticides/PCBs, inorganic chemicals and cyanide. The soil data, segregated by surface soil (0 to 2 feet) and subsurface soil (2 feet and greater), are summarized and presented in Tables 10 and 11. Samples were also collected from the various debris piles on-site and these data were summarized separately and presented in Table 12. All detected chemicals are considered to be COPEC for this assessment, as follows:

TABLE 10
ECOLOGICAL RISK CHARACTERIZATION: SURFACE SOIL
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1988 (RECRA)		Benchmarks (1)
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
VOLATILE ORGANICS (ug/kg)							
Benzene	1 / 1	2	NA	NA	NA	NA	53,100
2-Butanone	1 / 1	27	NA	NA	NA	NA	6,590,000
Carbon Disulfide	1 / 1	5	NA	NA	NA	NA	--
Chloroform	1 / 1	3	NA	NA	NA	NA	56,000
Ethylbenzene	1 / 1	2	NA	NA	NA	NA	--
2-Hexanone	1 / 1	14	NA	NA	NA	NA	--
1,1,2,2-Tetrachloroethane	1 / 1	3	NA	NA	NA	NA	2820
Toluene	1 / 1	8	NA	NA	NA	NA	52,300
Xylenes (total)	1 / 1	9	NA	NA	NA	NA	4,228
SEMI-VOLATILE ORGANICS (ug/kg)							
Acenaphthene	NA	NA	5 / 18	74 - 400	NA	NA	--
Acenaphthylene	NA	NA	2 / 18	130 - 200	NA	NA	--
Anthracene	NA	NA	8 / 18	78 - 530	NA	NA	--
Benzo(a)anthracene	NA	NA	16 / 18	75 - 3,700	NA	NA	--
Benzo(a)pyrene	NA	NA	17 / 18	73 - 5,100	NA	NA	2010
Benzo(b)fluoranthene	NA	NA	17 / 18	120 - 6,400	NA	NA	--
Benzo(g,h,i)perylene	NA	NA	13 / 18	95 - 4,100	NA	NA	--
Benzo(k)fluoranthene	NA	NA	8 / 18	250 - 1,900	NA	NA	--
Chrysene	NA	NA	17 / 18	82 - 3,300	NA	NA	--
Dibenz(a,h)anthracene	NA	NA	3 / 18	170 - 960	NA	NA	--
Fluoranthene	NA	NA	17 / 18	83 - 2,000	NA	NA	--
Indeno(1,2,3-cd)pyrene	NA	NA	8 / 18	430 - 3,700	NA	NA	--
2-Methylnaphthalene	NA	NA	6 / 18	65 - 210	NA	NA	--
Naphthalene	NA	NA	6 / 18	65 - 130	NA	NA	--
Phenanthrene	NA	NA	13 / 18	78 - 1,500	NA	NA	--
Pyrene	NA	NA	15 / 18	110 - 5,200	NA	NA	--

TABLE 10 (cont'd)
ECOLOGICAL RISK CHARACTERIZATION: SURFACE SOIL
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1988 (RECRA)		Benchmarks (1)
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
PHENOLIC COMPOUNDS (mg/kg)	ND	ND	ND	ND	1 / 5	1.5	--
PESTICIDES/PCBs (mg/kg)							
Aroclor 1242	NA	NA	NA	NA	2 / 5	0.15 - 0.37	334
Aroclor 1254	NA	NA	NA	NA	2 / 5	0.35 - 1.3	113
Aroclor 1260	NA	NA	NA	NA	1 / 5	0.074	--
INORGANICS (mg/kg)							
Aluminum	NA	NA	18 / 18	16,300 - 45,700	NA	NA	3.886
Antimony	NA	NA	12 / 18	6.99 - 15.1	NA	NA	0.252
Arsenic	NA	NA	3 / 18	15.4 - 61.7	5 / 5	14 - 32	0.254
Barium	NA	NA	18 / 18	80.7 - 365	NA	NA	20
Beryllium	NA	NA	18 / 18	1.44 - 7.45	NA	NA	2.46
Cadmium	NA	NA	5 / 18	0.707 - 8.00	NA	NA	3.589
Calcium	NA	NA	18 / 18	48,000 - 212,000	NA	NA	--
Chromium	NA	NA	18 / 18	6.89 - 127	5 / 5	22 - 4,700	10.184
Cobalt	NA	NA	18 / 18	1.89 - 15.7	NA	NA	--
Copper	NA	NA	18 / 18	20.1 - 181	5 / 5	23 - 640	56.6
Iron	NA	NA	18 / 18	13,700 - 236,000	NA	NA	--
Lead	NA	NA	18 / 18	22.1 - 1,120	5 / 5	21 - 3,300	29.77
Magnesium	NA	NA	18 / 18	5,890 - 38,200	NA	NA	--
Manganese	NA	NA	18 / 18	1,900 - 10,400	NA	NA	327
Mercury	NA	NA	4 / 18	0.025 - 0.21	NA	NA	26.58
Nickel	NA	NA	18 / 18	11.9 - 96.9	NA	NA	148.84
Potassium	NA	NA	18 / 18	716 - 2,310	NA	NA	--
Silver	NA	NA	18 / 18	191 - 1,170	NA	NA	--
Sodium	NA	NA	18 / 18	6.26 - 66.3	NA	NA	--
Vanadium	NA	NA	18 / 18	63.7 - 1,150	NA	NA	0.725
Zinc	NA	NA	18 / 18	64 - 1,200	NA	NA	595.4
OTHER (mg/kg)							
Cyanide, total	NA	NA	18 / 18	2.17 - 28.8	4 / 5	3.2 - 70	240.2

--: Not Available.

(1) Toxicological Benchmarks for Wildlife: 1996 Revision (NOAEL-Based Benchmarks for food for cottontail rabbit).
(Sample et al., 1996)

TABLE 11
ECOLOGICAL RISK CHARACTERIZATION: SUBSURFACE SOIL
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1995 (ABB)		1988 (Recra)		Benchmarks (1)
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
VOLATILE ORGANICS (ug/kg)									
2-Butanone	1 / 5	4	NA	NA	1 / 2	18	NA	NA	6,590,000
Carbon disulfide	4 / 5	4 - 12	NA	NA	0 / 2	ND	NA	NA	--
Toluene	2 / 5	4 - 6	NA	NA	0 / 2	ND	NA	NA	52,300
SEMI-VOLATILE ORGANICS (ug/kg)									
Acenaphthene	1 / 6	65	1 / 18	170	0 / 2	ND	NA	NA	--
Anthracene	1 / 6	190	3 / 18	110 - 360	0 / 2	ND	NA	NA	--
Benzo(a)anthracene	1 / 6	370	5 / 18	110 - 450	0 / 2	ND	NA	NA	--
Benzo(a)pyrene	1 / 6	310	5 / 18	160 - 470	0 / 2	ND	NA	NA	2010
Benzo(b)fluoranthene	2 / 6	450 - 490	5 / 18	220 - 650	0 / 2	ND	NA	NA	--
Benzo(g,h,i)perylene	1 / 6	110	5 / 18	89 - 410	0 / 2	ND	NA	NA	--
Benzo(k)fluoranthene	1 / 6	170	1 / 18	150	0 / 2	ND	NA	NA	--
bis(2-Ethylhexyl)phthalate	5 / 6	110 - 250	NA	NA	0 / 2	ND	NA	NA	37,000
Carbazole	1 / 6	60	NA	NA	0 / 2	ND	NA	NA	--
Chrysene	2 / 6	340 - 480	5 / 18	160 - 500	0 / 2	ND	NA	NA	--
Dibenzofuran	1 / 6	110	NA	NA	0 / 2	ND	NA	NA	--
Fluoranthene	2 / 6	410 - 990	6 / 18	96 - 980	0 / 2	ND	NA	NA	--
Fluorene	1 / 6	94	0 / 18	ND	0 / 2	ND	NA	NA	--
Indeno(1,2,3-cd)pyrene	1 / 6	110	2 / 18	220 - 330	0 / 2	ND	NA	NA	--
2-Methylnaphthalene	0 / 6	ND	3 / 18	96 - 230	0 / 2	ND	NA	NA	--
Naphthalene	0 / 6	ND	3 / 18	79 - 150	0 / 2	ND	NA	NA	--
Phenanthrene	2 / 6	380 - 890	5 / 18	180 - 1,400	0 / 2	ND	NA	NA	--
Pyrene	2 / 6	600 - 860	5 / 18	170 - 1,100	0 / 2	ND	NA	NA	--

TABLE 11 (cont'd)
ECOLOGICAL RISK CHARACTERIZATION: SUBSURFACE SOIL
FORMER RAILROAD YARD AREA

ANALYTE	Jan 2000 (MPI)		Jan 1999 (MPI)		1995 (ABB)		1988 (Recra)		Benchmarks [1]
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
INORGANICS (*mg/kg*)									
Aluminum (average = 33,784)	6 / 6	9,690 - 45,700	18 / 18	12,200 - 54,000	2 / 2	35,300 - 43,600	NA	NA	3.886
Antimony (average = 12.19)	0 / 6	ND	9 / 18	10.3 - 16.6	0 / 2	ND	NA	NA	0.252
Arsenic	1 / 6	10	2 / 18	20.4 - 35.6	0 / 2	ND	2 / 2	11	0.254
Barium	6 / 6	109 - 428	18 / 18	89.3 - 416	2 / 2	188 - 464	NA	NA	20
Beryllium	6 / 6	2.1 - 8.2	18 / 18	0.73 - 9.61	2 / 2	3.8 - 6.3	NA	NA	2.46
Cadmium	2 / 6	2.1 - 6.2	4 / 18	1.05 - 8.1	0 / 2	ND	NA	NA	3.589
Calcium	6 / 6	55,800 - 259,000	18 / 18	37,400 - 296,000	2 / 2	132,000 - 233,000	NA	NA	--
Chromium	6 / 6	4.9 - 19.5	18 / 18	4.36 - 35.2	1 / 2	9.6	2 / 2	4.2 - 23	10.184
Cobalt	1 / 6	5.8	16 / 18	3.08 - 14	0 / 2	ND	NA	NA	--
Copper	3 / 6	5 - 44.1	18 / 18	5.53 - 42.2	1 / 2	7.3	2 / 2	17 - 28	56.6
Iron	6 / 6	3,250 - 89,400	18 / 18	4,250 - 209,000	2 / 2	1,780 - 9,450	NA	NA	--
Lead (average = 52.63)	3 / 6	2.2 - 54.6	15 / 18	9.78 - 175	2 / 2	1.9 - 113	2 / 2	19 - 22	29.77
Magnesium	6 / 6	8,800 - 13,500	18 / 18	5,320 - 26,800	2 / 2	9,220 - 16,700	NA	NA	--
Manganese (average = 2,392)	6 / 6	960 - 2,190	17 / 18	671 - 5,150	2 / 2	2,690 - 2,710	NA	NA	327
Mercury	0 / 6	ND	5 / 18	0.022 - 0.097	0 / 2	ND	NA	NA	119
Nickel	0 / 6	ND	18 / 18	8.71 - 33.5	0 / 2	ND	NA	NA	148.84
Potassium	6 / 6	1,910 - 6,120	18 / 18	1,080 - 2,970	2 / 2	655 - 1,230	NA	NA	--
Selenium	5 / 6	17.4 - 28.3	0 / 18	ND	0 / 2	ND	NA	NA	0.744
Sodium	0 / 6	ND	18 / 18	189 - 746	2 / 2	522 - 1,400	NA	NA	--
Vanadium	2 / 6	12.5 - 12.9	18 / 18	8.4 - 104	1 / 2	13.8	NA	NA	0.725
Zinc	6 / 6	6.4 - 166	17 / 18	9.05 - 1,670	2 / 2	5.4 - 74.8	NA	NA	595.4
OTHER (mg/kg)									
Cyanide, total	5 / 6	3.1 - 43	18 / 18	0.99 - 33.2	2 / 2	3.9 - 32.1	NA	NA	240.2

NA: Not Analyzed.
ND: Not Detected.
--: Not Available.

[1] Toxicological Benchmarks for Wildlife: 1996 Revision (NOAEL-based benchmarks for food for cottontail rabbit).
(Sample et al., 1996)

TABLE 12
ECOLOGICAL RISK CHARACATERIZATION: SOIL/FILL PILES
FORMER RAILROAD YARD AREA

ANALYTE	Feb 2000 (MPI)		Benchmarks [(1)]
	Frequency of Detection	Range of Detected Concentrations	
VOLATILE ORGANICS (ug/kg)			
Benzene	1 / 20	11	53100
2-Butanone	2 / 20	12	6,590,000
Carbon disulfide	1 / 20	2	--
Chloroform	11 / 20	2 - 7	56000
Chloromethane	1 / 20	16	--
cis-1,2-Dichloroethene	1 / 20	5	91000
Ethylbenzene	1 / 20	33	--
4-Methyl-2-pentanone	3 / 20	2 - 4	93,000
Styrene	1 / 20	20	--
1,1,2,2-Tetrachloroethane	1 / 20	59	2820
Tetrachloroethene	2 / 20	1 - 2	--
Toluene	19 / 20	2 - 60	52,300
Trichloroethene	1 / 20	220	1409
Xylenes (total)	2 / 20	2 - 28	4,228
SEMIVOLATILE ORGANICS (ug/kg)			
Acenaphthene	10 / 20	47 - 690	--
Acenaphthylene	6 / 20	66 - 210	--
Anthracene	14 / 20	62 - 2,500	--
Benzo(a)anthracene	18 / 20	51 - 3,700	--
Benzo(a)pyrene	19 / 20	57 - 4,200	2010
Benzo(b)fluoranthene	18 / 20	89 - 5,400	--
Benzo(g,h,i)perylene	15 / 20	89 - 3,000	--
Benzo(k)fluoranthene	17 / 20	39 - 1,600	--
bis(2-Ethylhexyl)phthalate	20 / 20	41 - 650	37,000
Butylbenzylphthalate	3 / 20	130 - 790	--
Carbazole	10 / 20	40 - 570	--
Chrysene	19 / 20	66 - 3,800	--
Dibenzo(a,h)anthracene	4 / 20	110 - 950	--
Dibenzofuran	9 / 20	47 - 670	--
Di-n-butylphthalate	4 / 20	47 - 120	1,107,000
2,6-Dinitrotoluene	1 / 20	120	--
Fluoranthene	19 / 20	53 - 8,500	--
Fluorene	9 / 20	69 - 900	--
Indeno(1,2,3-cd)pyrene	15 / 20	170 - 2,700	--
2-Methylnaphthalene	5 / 20	83 - 430	--
4-Methylphenol	1 / 20	120	--
Naphthalene	8 / 20	42 - 720	--
Phenanthrene	19 / 20	43 - 6,000	--
Pyrene	19 / 20	78 - 9,700	--

TABLE 12
ECOLOGICAL RISK CHARACATERIZATION: SOIL/FILL PILES
FORMER RAILROAD YARD AREA

ANALYTE	Feb 2000 (MPI)		Benchmarks [1]
	Frequency of Detection	Range of Detected Concentrations	
PESTICIDES / PCBs (ug/kg)			
Aldrin	3 / 20	2.6 - 500	744
alpha-Chlordane	2 / 20	29.3 - 500	9300
gamma-Chlordane	1 / 20	2.1	9300
4,4'-DDE	5 / 20	3.9 - 13.8	2,980
4,4'-DDT	6 / 20	4.7 - 32	2,980
Heptachlor	1 / 20	3.2	20
Aroclor 1254	1 / 20	1,200	1,000
Aroclor 1260	1 / 20	3,820	1,000
INORGANICS (mg/kg)			
Aluminum	20 / 20	2,950 - 28,600	3.886
Antimony	1 / 20	7.2	0.252
Arsenic	15 / 20	3.0 - 22.9	0.254
Barium	20 / 20	40.2 - 327	20
Beryllium	8 / 20	0.73 - 5.3	2.46
Cadmium	19 / 20	1.4 - 19.9	3.589
Calcium	20 / 20	14,200 - 209,000	--
Chromium	20 / 20	8.2 - 193	10.184
Cobalt	15 / 20	5.0 - 15.9	--
Copper	20 / 20	9.4 - 504	56.6
Iron	20 / 20	7,910 - 244,000	--
Lead	20 / 20	15.2 - 766	29.77
Magnesium	20 / 20	3,070 - 23,600	--
Manganese	20 / 20	194 - 3,320	327
Mercury	11 / 20	0.12 - 0.67	4.84
Nickel	18 / 20	7.74 - 84.8	148.84
Potassium	20 / 20	657 - 4,970	--
Selenium	19 / 20	2.3 - 35.9	0.744
Sodium	5 / 20	230 - 675	--
Thallium	3 / 20	2.4 - 4.8	0.028
Vanadium	19 / 20	8.7 - 44.2	0.725
Zinc	20 / 20	63.8 - 2,380	595.4
OTHER (mg/kg)			
Cyanide, total	12 / 20	1.40 - 13.0	240.2

--: Not Available.

(1) Toxicological Benchmarks for Wildlife: 1996 Revision (NOAEL-Based Benchmarks for food for cottontail rabbit). (Sample et al., 1996)

TABLE 13
ECOLOGICAL RISK CHARACTERIZATION: GROUNDWATER
FORMER RAILROAD YARD AREA

ANALYTE	Feb 2000 (MPI)		1995 (ABB)		NYSDEC Ambient Water Quality Standards and Guidance Values for Fish Propogation (fresh water) [1]		Benchmark Values [2]	
	Frequency of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations				
VOLATILE ORGANICS (ug/L)								
2-Hexanone	1 / 5	9	0 / 2	ND	--		99	b
4-Methyl-2-pentanone	1 / 5	4	0 / 2	ND	--		170	b
SEMI-VOLATILE ORGANICS (ug/L)								
Di-n-butylphthalate	3 / 5	3 - 4	0 / 2	ND	--		35	b
INORGANICS (ug/L)								
Aluminum	4 / 5	402 - 1,630	2 / 2	150 - 1,600	100	*	87	a
Barium	2 / 5	65.1 - 140	2 / 2	23.2 - 29.4	--		4	b
Calcium	5 / 5	60,300 - 171,000	2 / 2	45,100 - 98,600	--		116,000	c
Copper	1 / 5	10.9	0 / 2	ND	0.904	a	12+	a
Iron	5 / 5	231 - 11,700	2 / 2	25.8 - 53.5	300	**	1,000	a
Lead	3 / 5	3.8 - 5.1	0 / 2	ND	0.912	b	3.2+	a
Magnesium	4 / 5	7,610 - 55,700	1 / 2	11,700	--		82,000	c
Manganese	4 / 5	25.0 - 846	1 / 2	13.6	--		120	b
Potassium	5 / 5	1,080 - 61,000	2 / 2	13,500 - 16,200	--		53,000	c
Selenium	5 / 5	13.6 - 114	1 / 2	8.7	4.6	c	5	a
Silver	1 / 5	35.9	1 / 2	41.2	0.1	d	0.36	b
Sodium	5 / 5	14,700 - 64,600	2 / 2	24,600 - 26,300	--		680,000	c
Thallium	1 / 5	16.6	0 / 2	ND	8	*	12	b
Zinc	5 / 5	10.0 - 86.2	0 / 2	ND	121	e	110+	a
OTHER (ug/L)								
Cyanide, total	4 / 5	20.0 - 90.0	2 / 2	50.0 - 240	5.2	f	5.2	a

ND: Not Detected.
--: Not Available.

1 = New York State Department of Environmental Conservation Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, June 1998
* = For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).
** = For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).
a = (0.96)exp(0.8545[ln(ppm hardness)]-1.702), with a default hardness of 100 mg/l
b = {1.46203 - [ln(hardness) * (0.145712]} * exp(1.273[ln(hardness)]-4.297), with a default hardness of 100 mg/l
c = Aquatic Type standard applies to dissolved form.
d = Applies to ionic silver.
e = exp(0.85[ln(ppm hardness)]+0.5), with a default hardness of 100 mg/l
f = As free cyanide: the sum of HCN and CN^- expressed as CN.

2 = Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision
a = Tier II Values, Secondary Chronic Value
b = National Ambient Water Quality Criteria, chronic
c = Lowest Chronic Value for all organisms

- **Surface Soil** – Nine VOCs, 16 SVOCs, total phenolic compounds, PCBs, 21 inorganic chemicals and cyanide were detected in surface soil.
- **Subsurface Soil** – Three VOCs, 18 SVOCs, 21 inorganic chemicals and cyanide were detected in subsurface soil.
- **Soil/Fill Piles** – Fourteen VOCs, 24 SVOCs, five pesticides, 23 inorganic chemicals and cyanide were detected in the soil/fill pile samples.

3.3.2 Groundwater

The depth to groundwater on-site is generally between 4 and 8 feet below ground surface (bgs). This is below the root zone of most herbaceous plants. However, due to the proximity to the Union Ship Canal, which discharges to Lake Erie, groundwater is considered for the potential to discharge to surface water. Groundwater samples were analyzed for volatile chemicals, semi-volatile organic chemicals, pesticides/PCBs, inorganic chemicals and cyanide. The groundwater data are summarized and presented in Table 13. Two VOCs, one SVOC, and 15 inorganic chemicals were detected in groundwater. All of the detected chemicals are considered to be COPEC for this assessment.

3.4 EXPOSURE AND EFFECTS ASSESSMENT

3.4.1 Chemical Migration and Fate

Transformation or losses due to environmental degradation are not considered in this assessment. It is assumed that following uptake, concentrations in soil will equal concentrations in organisms. The approach used in the ecological risk assessment is conservative in that plants readily volatilize the COPEC and wildlife have limited contact with these chemicals in the soil and plants. The approach is also conservative because no dilution or attentuation of the groundwater potentially entering surface water bodies is considered. Information regarding the environmental migration and fate of those chemicals of potential ecological concern that exceed screening levels is presented below by chemical class. General information about the toxicity of these chemicals is included in Attachment III.

3.4.2 Exposure Pathways and Potential Receptors

There are two environmental media (groundwater and surface soils) that can be potential sources of risk for receptors at and in the immediate vicinity of the Former Railroad Yard Area. Surface water runoff and groundwater discharge are two pathways for chemical migration. Several ecologically relevant exposure pathways for chemicals exist. Wildlife near the Former Railroad Yard Area may have incidental contact with or ingest COPEC while foraging, nesting, or engaging in other activities in the terrestrial portion of the area. COPEC can also adversely affect plants and animals in surrounding habitats via the food chain. COPEC in surface water may be taken up by aquatic life as well as semi-aquatic and terrestrial wildlife. Upon their release, some COPEC may be persistent and may be transformed to more bioavailable forms and mobilized in the food chain

Based on the pathways and receptors identified, detrimental effects (i.e., reduced vigor or population decline) in fish and small mammals (e.g., cottontail rabbit) were selected as the endpoints for this screening-level assessment.

3.5 ECOLOGICAL RISK CHARACTERIZATION

3.5.1 Soil

Since there are currently no criteria or guidelines available for protection of ecological resources, screening benchmarks developed by the Oak Ridge National Laboratory (ORNL) for toxicity to wildlife (Sample et al., 1996) were used for comparison with concentrations of the COPEC in surface soil. Benchmark values for the cottontail rabbit are presented in Tables 10, 11 and 12. The cottontail rabbit was selected to represent a herbivorous small mammal. Small mammals are at the base of the food chain and an important food source for higher organisms. The benchmark values for the rabbit are presented in Tables 10, 11 and 12 as dietary concentrations in mg of chemical per kg of diet that correspond to the appropriate no observed adverse effect levels

(NOAELs). For screening purposes, it was assumed that the chemical concentrations in soil would be found in the food items of the receptor. This is a conservative approach that should result in the overestimation of potential exposure and risk.

For surface soil, one PAH (benzo(a)pyrene) and 13 inorganic chemicals exceed the ORNL toxicological benchmarks for the cottontail rabbit. For subsurface soil, 12 inorganic chemicals exceed the ORNL toxicological benchmarks for the cottontail rabbit. For the soil/fill piles, one PAH (benzo(a)pyrene) and 14 inorganic chemicals exceed the ORNL toxicological benchmarks for the cottontail rabbit. Brief toxicological profiles for the COEPC containing further information on toxicity are provided in Attachment III.

3.5.2 Groundwater

Since groundwater at the site may discharge to the surface waters of the Union Ship Canal, groundwater data were compared with NYSDEC and USEPA Ambient Water Quality Criteria (AWQC) for chronic effects in fresh water. As shown in Table 13, concentrations of several COPEC exceeded either or both of the AWQC. In Table 13, additional benchmarks are shown for those chemicals that do not currently have AWQC. These benchmarks were taken from "*Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota*", developed by the Oak Ridge National Laboratory (Suter and Tsao, 1996). Of the detected chemicals, carbon disulfide and 12 inorganic chemicals in groundwater exceed one or both of the NYSDEC AWQC and the ORNL toxicological benchmarks for aquatic biota. It should be noted that this is a conservative screening-level assessment as dilution or attenuation of the groundwater potentially entering surface water bodies are not considered. Brief toxicological profiles for the COEPC containing further information on toxicity are provided in Attachment III.

3.6 UNCERTAINTY ANALYSIS

Uncertainty is inherent in the process of conducting predictive risk assessments. Environmental sampling and analysis are prone to uncertainty, as are the available toxicity data used to characterize risk. Uncertainty associated with environmental sampling is generally related to the limitations of the sampling program in terms of the number and distribution of samples, while uncertainty associated with the analysis of the samples is generally related to systematic or random errors. Aspects of the current exposure assessment methodology can result in overestimation or underestimation of long-term exposure.

The methodologies used in this screening-level ecological risk assessment rely on very conservative assumptions and, therefore, the risk is overestimated. These assumptions include:

- Terrestrial receptors forage exclusively from the Former Railroad Yard Area (however, with the limited habitat on the area, receptors would need to forage outside of the area as well).
- The receptors' entire food source is contaminated at the maximum detected concentrations of each COPEC (however, this is unlikely since the COPEC were not detected across the entire area and some receptors are likely to forage outside of the area as well as on the area).
- The COPEC concentrations in soil represent the concentration of COPEC in the rabbit's food source (vegetation) (however, plants do not readily take up all COPEC in a 1:1 ratio).

Other sources of uncertainty in the ecological risk assessment, which could lead to overestimation of risk, include:

- Screening benchmark values were derived from data for laboratory animals; differences in toxicity may exist between these animals and wild species.
- In most cases, the lowest available benchmark values were used in the assessment; benchmark values can range by orders of magnitude for the same chemical, depending upon the species used and the type of test conducted.
- Other receptor species, which may inhabit the area, may be less sensitive to COPEC than the receptors chosen for this assessment.

4.0 SUMMARY

Soil is the predominant environmental medium of concern and a number of PAHs and inorganic chemicals are the predominant COPC at the Former Railroad Yard Area in the Hanna Furnace Site. However, these COPCs are typical components of fill material.

The potential for human exposure to the COPCs in the current scenario is very limited, given that the Former Railroad Yard is vacated. Surface soil is exposed throughout much of the Former Railroad Yard Area and the soil/fill piles are a source of exposed soil. Thus, dermal contact with and ingestion of soil, and inhalation of respirable particulates generated by wind, are viable exposure routes for trespassers. For the neighboring communities, inhalation of respirable particulates generated by wind is possible, although such an event is less likely, given the distance to the study area. Groundwater is not currently used for potable drinking water by any residential or commercial entities in the area. As such, exposure to groundwater in the current scenario is unlikely.

The extent of future exposure to the COPCs at the Former Railroad Yard Area depends on the nature of activities and uses of the land. As part of the redevelopment plan, the soil/fill piles are expected to be bulldozed, graded and covered with clean soil/fill and grassed over. The remaining area is expected to be covered with a one-foot layer of clean fill material (seeded with grass cover), asphalt, or concrete, depending on the redevelopment plan. Based on such plans, potential exposure for construction and utility workers and off-site residents is discussed as follows. Surface soil and subsurface soil may be excavated during construction activities. Such action could generate respirable particulates, and could expose workers and off-site residents via inhalation. Soil could be dermally contacted and ingested by workers, and groundwater may be reached and contacted by workers, throughout construction activity. Exposures to construction workers could be effectively mitigated through implementation of a site-specific health and safety plan. Given the redevelopment plans, exposure to the soil fill piles and surface soil would be precluded for future on-site workers and trespassers.

Using conservative assumptions that overestimate risk (i.e., receptors foraging exclusively from the Former Railroad Yard Area), a risk to wildlife inhabiting the area and the area vicinity may exist. A comparison of chemical concentrations in soil at the Former Railroad Yard Area with available screening benchmarks indicates that a risk may exist from the presence of benzo(a)pyrene and inorganic chemicals in soil at the Former Railroad Yard Area.

Future use of the area as a light industrial/commercial area will significantly limit wildlife use. As part of the redevelopment plan, the soil/fill piles are expected to be bulldozed, graded and covered with clean soil/fill and grassed over. The entire Former Railroad Yard Area will be covered with a one-foot layer of clean fill (with grass cover), asphalt or concrete, depending on the redevelopment plan. With the combination of limited wildlife use and the one-foot cover of clean fill over the entire area, it is highly unlikely that the redeveloped Former Railroad Yard Area will present a significant risk to wildlife through ingestion of soils.

An evaluation of chemical concentrations in groundwater indicates that a risk may exist for aquatic life in the Union Ship Canal from the presence of carbon disulfide, bis(2-ethylhexyl)phthalate and inorganic chemicals in groundwater. It should be noted, however, that comparing groundwater concentrations to surface water quality criteria requires the conservative assumption that the maximum COPEC concentrations in groundwater are equal to in-stream surface water concentrations. Also, it must be assumed that groundwater will not be diluted upon entering the surface water body. With large bodies of water such as the Union Ship Canal and Lake Erie, these assumptions are overly conservative.

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ATTACHMENT I

ESSENTIAL NUTRIENT SCREEN

ATTACHMENT I – ESSENTIAL NUTRIENT SCREEN

Nutrient screening concentrations to evaluate the concentrations of essential nutrients (i.e., calcium, iron, magnesium, potassium, and sodium) in soil were derived from Recommended Daily Allowances (RDAs) and typical default exposure parameters used by the USEPA. Based on the exposure scenarios considered in the human health evaluation, nutrient screening concentrations for soil were derived for ingestion by a future site worker. Nutrient screening concentrations in groundwater were derived for future residential tap water use by a child. (ESHA Research, 1990).

Nutrient Screening Concentrations for Soil - Adult

$$RC_s = (RDA_a / IR_s) * CF$$

where

RC_s = nutrient screening concentration for soil (μg/kg)
RDA_a = recommended daily allowance for an adult (mg/day)
IR_s = soil ingestion rate (50 mg/day)
CF = conversion factor (10^9 μg/kg)

Essential Nutrient	Recommended Daily Allowance (mg/day; male adult)	Nutrient Screening Concentration for Soil (µg/kg)
Calcium	800	> 1E+09 (*)
Iron	10	2E+08
Magnesium	350	> 1E+09 (*)
Potassium	2000	> 1E+09 (*)
Sodium	2400	> 1E+09 (*)

(*): indicates that the calculated value is greater than 1E+09, but is not applicable, as there is a maximum of 1E+09 µg of substance per kg of soil.

Nutrient Screening Concentrations for Groundwater - Child

$$RC_w = (RDA_c / IR_w) * CF$$

where

RC_w = nutrient screening concentration for water (µg/L)
RDA_a = recommended daily allowance for a child (mg/day)
IR_w = water ingestion rate (1 L/day)
CF = conversion factor (10^3 µg/mg)

Essential Nutrient	Recommended Daily Allowance (mg/day; male child)	Nutrient Screening Concentration for Groundwater (µg /L)
Calcium	800	800,000
Iron	10	10,000
Magnesium	80	80,000
Potassium	1000	1,000,000
Sodium	975	975,000

References

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ATTACHMENT II

TOXICOLOGICAL PROFILES OF CHEMICALS OF POTENTIAL CONCERN FOR HUMAN HEALTH EVALUATION

ATTACHMENT II – TOXICOLOGICAL PROFILES OF CHEMICALS OF POTENTIAL CONCERN FOR HUMAN HEALTH EVALUATION

VOLATILE ORGANIC COMPOUNDS

Chloromethane (ATSDR, 1999c)

Chloromethane is a clear, colorless gas (vapor) that is difficult to smell. It has a faintly sweet, nonirritating odor at high levels in the air. It is a naturally occurring chemical that is made in large amounts in the oceans and is produced by some plants and rotting wood and when materials such as grass, wood, and charcoal burn. Chloromethane is also produced industrially, but most of it is destroyed during use. It is used mainly in the production of other chemicals such as silicones, agricultural chemicals, and butyl rubber.

Chloromethane was used widely in refrigerators over 30 years old, but has generally been replaced by refrigerants such as Freon. Other consumer sources of chloromethane include cigarette smoke, polystyrene insulation, aerosol propellants, home burning of wood, grass, coal, or certain plastics, and the use of chlorinated swimming pools. Chloromethane is continuously released into the atmosphere from oceans and biomass; as such, a very low concentration will always be present. When present in water, chloromethane evaporates rapidly. Chloromethane will evaporate from the soil surface, but if present in a landfill or waste site, it may move downward and contaminate groundwater aquifers.

Brief exposures to very high levels of chloromethane can have serious effects on the nervous system, including convulsions, coma, and death. Health effects from inhalation of high levels of chloromethane include staggering, blurred and double vision, dizziness, fatigue, personality changes, confusion, tremors, uncoordinated movements, nausea, and vomiting. These symptoms can last for several months or more, but complete recovery is possible. Exposure to chloromethane has also had harmful effects on the liver, kidney, heart rate, and blood pressure.

Chloromethane has been classified by the USEPA as a “possible human carcinogen” (weight-of-evidence rating of “C”).

cis-1,2-Dichloroethene (ATSDR, 1997c)

Two forms of 1,2-dichloroethene exist: cis-1,2-dichloroethene, and trans-1,2-dichloroethene. These chemicals are commonly found together in a mixture. 1,2-Dichloroethene is used primarily as a chemical intermediate in the synthesis of chlorinated solvents and compounds. It has also been used as a solvent for waxes, resins, acetylcellulose, perfumes, dyes, lacquers, thermoplastics, fats, and phenols. It is used in the extraction of rubber, as a refrigerant, in the manufacture of pharmaceuticals and artificial pearls, and in the extraction of oils and fats from fish and meat. It has also been used as a low-temperature extraction solvent for organic materials such as decaffeinated coffee. The trans- isomer is more widely used in industry than either the cis- isomer or the commercial mixture.

Sources of environmental exposure to 1,2-dichloroethene include: process and fugitive emissions from its production and use as a chemical intermediate; evaporation from waste water streams, landfills, and solvents; emissions from combustion or heating of polyvinyl chloride and some vinyl copolymers; formation via anaerobic biodegradation of some chlorinated solvents; and leaching from landfills. Most of the 1,2-dichloroethene released in the environment will eventually enter the atmosphere or groundwater, where it may be subject to further biotic or abiotic degradation processes.

Inhalation of high levels of 1,2-dichloroethene can cause drowsiness, nausea, tiredness, and in extreme cases, death. Ingestion of cis-1,2-dichloroethene can cause decreased levels of hemoglobin and hematocrit in the blood. The USEPA has assigned cis-1,2-dichloroethene a weight-of-evidence rating of "D" – "Not classifiable as to carcinogenicity".

2-Hexanone (Amdur et al., 1991; ATSDR 1995c)

2-Hexanone is a clear, colorless liquid with a sharp odor. It is used as a paint thinner, cleaning agent and solvent for dye printing and to dissolve oils and waxes; it is also used in the lacquer industry. It is no longer manufactured or used in the United States due to its harmful health effects. It is formed, however, as a waste product resulting from industrial activities such as making wood pulp and producing gas from coal, and in oil shale operations.

2-Hexanone dissolves easily in water, and evaporates quickly into the air. In the atmosphere, it may be broken down into other chemicals or may be removed by precipitation. Also, microorganisms may metabolize 2-hexanone. Typically, 2-hexanone does not bind to soils or sediment, and does not accumulate in plants and animals.

Inhalation of 2-hexanone can cause damage to the nervous system, including weakness, numbness, and tingling in the skin of the hands and the feet.

2-Hexanone has not undergone a complete evaluation and determination by the USEPA for evidence of human carcinogenic potential.

<u>4-Methyl-2-pentanone</u> (NTP Chemical Health and Safety Data, 1991b)

4-Methyl-2-pentanone is used as a solvent for paints, varnishes, nitrocellulose, lacquers, fats, oils, waxes, natural and synthetic gums, resins, cellulose esters and other coating systems. It is also used in adhesives, as an alcohol denaturant, in the manufacture of methyl amyl alcohol, and in extraction processes including extraction of uranium from fission products and in organic synthesis.

This chemical is a poison by intraperitoneal route, moderately toxic by ingestion, and mildly toxic by inhalation. It is an irritant of the skin, eyes and mucous membranes, is narcotic in high concentrations, and is readily absorbed by the skin. Adverse health effects resulting from exposure to 4-methyl-2-pentanone also include mental sluggishness, irritation of the respiratory tract, gastroenteritis, dizziness, unconsciousness, weakness, headache, nausea and vomiting. Lightheadedness, narcosis, incoordination, loss of appetite, and diarrhea have also been reported. Exposure to high concentrations may cause central nervous system depression, and prolonged skin contact may cause drying of the skin.

4-Methyl-2-pentanone has not undergone a complete evaluation and determination by the USEPA for evidence of human carcinogenic potential.

Styrene (ATSDR, 1995d)

Styrene is a colorless liquid characterized by a sweet smell. However, it is commonly combined with other chemicals which contribute to a sharper, less pleasant odor. It is primarily a synthetic chemical which does not dissolve easily in water.

Styrene is manufactured for used in rubber, plastic, fiberglass, pipe, automobile parts, food containers, and carpet backing products. Styrene is commonly found in products as a polymer (polystyrene). Also, low levels of styrene occur in foods such as fruits, vegetables, nuts, beverages, and meats.

Styrene enters the environment during the manufacture, use, and disposal of styrene-based products, and can be found in the air, water, and soil. It breaks down in the air within 1-2 days, and evaporates from shallow soils and surface water. It does not bind easily to soils and sediments. The half-life of styrene in surface water is usually several days, whereas in groundwater, the half-life is between 1-7 months. Bacteria metabolize styrene in soil and water, and styrene is not known to accumulate in animals.

Inhalation of styrene can cause depression, concentration problems, muscle weakness, tiredness, nausea, and irritation of the eyes, nose, and throat. Ingestion of styrene is associated with red blood cell and liver effects.

Styrene has not undergone a complete evaluation and determination by the USEPA for evidence of human carcinogenic potential.

SEMI-VOLATILE ORGANIC COMPOUNDS

Polycyclic Aromatic Hydrocarbons (PAHs) (Amdur et al., 1991; ATSDR, 1995f)

This class of chemicals consist of annelated aromatic (benzene) rings, and includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, among others. These chemicals are probable human carcinogens (the USEPA has assigned these chemicals a weight-of-evidence rating of "B2"), and occur in a number of environmental products such as soot, coal tar, tobacco smoke, petroleum, combustion engine exhaust, and cutting oils. These chemicals tend to occur in groups, and are products of natural processes including volcano eruptions, forest fires, and combustion (particularly incomplete combustion) of coal, gas, wood, oil, and garbage. As pure chemicals, PAHs generally exist as colorless, white, or pale yellow-green solids. They can have a faint or pleasant odor.

The movement of PAHs in the environment depends on physicochemical factors such as water solubility, and ability to evaporate into the air. PAHs generally do not dissolve in water. They are present in air as vapors or stuck to small solid particles. Some PAHs evaporate into the atmosphere from surface waters, but most stick tightly to solid particles and settle to the bottoms of rivers or lakes. In soils, PAHs are most likely to stick tightly to particles. PAHs can break down to longer-lasting products by reacting with sunlight and other airborne chemicals. Breakdown in soil and water can be mediated by microorganisms.

Inhalation of PAHs have been linked with respiratory and immunological effects in human beings, as well as with lung cancer.

Carbazole (NTP Chemical Health and Safety Data, 1991a)

Carbazole appears as white crystals, plates or leaflets. It is an important dye intermediate and is used in making photographic plates sensitive to ultraviolet light. It is a reagent for lignin, carbohydrates and formaldehyde. It is also used in the manufacture of reagents, explosives, insecticides, lubricants and rubber antioxidants. It is an odor inhibitor in detergents.

This chemical occurs in the products of incomplete combustion of nitrogen-containing organic matter. It has been identified in mainstream cigarette smoke, crude oils and coal tar. Carbazole may be harmful by ingestion, inhalation and skin absorption, and may cause irritation. When heated to decomposition it emits toxic fumes of carbon monoxide, carbon dioxide and nitrogen oxides.

Carbazole has not undergone a complete evaluation and determination by the USEPA for evidence of human carcinogenic potential.

PESTICIDES/PCBs

Aldrin (Amdur et al., 1991)

Aldrin is an organochlorine pesticide classified as a carbamate. It is a tan to dark brown solid with a mild chemical odor. As an insecticide, it acts by poisoning the central nervous system of the target organisms. It is known to interfere with membrane transport of ions, inhibit selective enzymatic activities, and contribute to the release and/or persistence of chemical transmitters at nerve endings. While aldrin is known to alter immune function in rodents, it is unclear whether similar effects can be had on human beings.

Aldrin is classified as a probable human carcinogen by the USEPA (weight-of-evidence rating of "B2"), and can be epoxidized to another pesticide – dieldrin.

Aroclor 1254, Aroclor 1260 (ATSDR, 1997f)

Aroclor 1254 and Aroclor 1260 are congeners of the polychlorinated biphenyls (PCBs) class of chemicals. These are synthetic chemicals of high stability and low flammability; they are either oily liquids or solids, are colorless to light yellow, and have no known smell or taste. PCBs enter the environment as mixtures containing from 12 to 68 percent chlorine, and are known to be highly persistent in the environment. Commercial uses of PCBs include insulating material in electrical capacitors and transformers, plasticizers, in waxes, and in paper manufacturing. PCBs are known to bioconcentrate in fish and marine mammals: they have been detected in these organisms at levels hundreds of thousand times higher than the levels in the water. In general, the higher degree of chlorination, the more resistant to biodegradation and the more persistent in the environment PCBs are.

PCBs are ubiquitous in the environment. Besides exposure via animal ingestion (because of the ability of PCBs to bioconcentrate, these chemicals have been found at various points in the food chain, including birds, dairy cattle, and so forth), indoor air inhalation of PCBs, and dermal contact and ingestion of PCBs via contaminated soil are also possible. It has been found that PCB levels in air, water, and soil have generally decreased since their halt in production in 1977.

Health effects of PCBs include skin irritation (e.g., acne and rashes), irritation of the nose and lungs, general weakness, numbness of the limbs, respiratory symptoms, altered immune response, and damage to the liver. PCBs have been classified as probable human carcinogens (USEPA-assigned WOE of "B2") by the USEPA.

INORGANIC CHEMICALS

Metals (Williams and Burson, 1985)

Metals can result from numerous industrial operations. Their use by human beings influences the potential for health effects in at least two significant ways: first, by environmental transport via air, water, soil, and food; second, by altering the speciation or biochemical form of the element.

Metals can be absorbed by the human body via respiratory and gastrointestinal (GI) absorption. They can then be excreted by the kidneys, GI tract, enterohepatic circulation, and through minor pathways such as the hair, nails, saliva, perspiration, exhalation, lactation, and exfoliation of skin.

The mechanisms by which metals exert toxic effects are enzyme inhibition, indirect effects, substitution for essential metals, and metals imbalance. Similar to other toxic chemicals, there is often little correlation between the sensitivity of an organ or tissue to the toxic effects of a metal and the concentration of the metal in that tissue. Some tissues can sequester toxic metals in more or less biologically inactive forms.

Of the COPCs selected, the following is classified as a "human carcinogen" (USEPA-assigned weight-of-evidence rating of "A"): arsenic.

Arsenic and arsenic compounds found in nature tend to be less harmful than inorganic arsenic compounds. Inorganic arsenic compounds are used in wood preservation, insecticides, and weed killers. Exposure to inorganic arsenic can cause swelling, nausea, vomiting, diarrhea, cardiovascular damage, and death. Arsenic is known to increase risks to lung, skin, bladder, kidney, and liver cancers (ATSDR, 1993a).

The following inorganic COPCs are classified as "probable human carcinogens" (USEPA-assigned weight-of-evidence rating of "B1" or "B2"): antimony, beryllium, cadmium, and lead.

Antimony is a silvery-white metal used as a component in alloys which are then used in lead storage batteries, solder, sheet and pipe metal, bearings, castings, and pewter. Antimony compounds are also used in paints, ceramics, and fireworks. Exposure to antimony can cause irritation to the eyes and lungs, heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers (ATSDR, 1995b).

Beryllium is a hard, grayish metal found in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and the beryllium is purified for use in electrical, machine, and aircraft parts, ceramics, nuclear weapons, and mirrors. Exposure to beryllium can cause inflammatory reactions, pneumonia, weakness, and fatigue (ATSDR, 1993b).

Cadmium is a naturally occurring soft, silver-white metal. It is usually found as a mineral combined with other elements such as oxygen, chlorine, or sulfur. All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Cadmium has no definite taste or odor. Inhalation of cadmium can cause lung and bone damage. Ingestion of cadmium can cause stomach irritation, vomiting, diarrhea, and kidney damage (ATSDR, 1999b).

Lead is a naturally occurring bluish-gray metal used in batteries, ammunition, solder, pipes, roofing, paints, and X-ray shielding apparati. Chronic exposure to low levels of lead may result in hematologic (blood and blood-forming), neurobehavioral, kidney, and other effects in humans. Effects such as slowed nerve conduction velocities, altered testicular function, reduced hemoglobin production, and other signs of impaired heme synthesis, and blood pressure effects have been observed in adults. Children, who represent a sensitive portion of the population, may experience an array of pathophysiological effects. Electrophysiological effects, impaired cognitive performance (as measured by IQ tests, performance in school, and other means), heme synthesis impairment, inhibition of pyrimidine and alanine synthesis, interference with vitamin D hormone synthesis, and early childhood growth reductions have been observed in children. In addition, factors influencing neurological development such as low birth weights and decreased gestational age and deficits in mental indices have been reported in infants (ATSDR, 1999d).

The following inorganic COPCs are "not classifiable as to human carcinogenicity" (USEPA-assigned weight-of-evidence rating of "D"): aluminum, barium, chromium (III), copper, manganese, mercury, selenium, silver, and zinc.

Aluminum is a flexible, silver-white metal used in cooking utensils, containers, appliances, and building materials. Exposure to high levels of aluminum can cause skin rashes, respiratory problems, nervous system disorders, and bone disease (ATSDR, 1999a).

Barium is a naturally occurring silvery-white metal. Barium compounds are used by the oil and gas industries to make drilling muds, and in paint, bricks, tiles, glass, rubber, and in medical examinations. Exposure to barium can lead to difficulties in breathing, increased blood pressure, changes in heart rhythm, stomach irritation, brain swelling, muscle weakness, and damage to the liver, kidney, heart, and spleen (ATSDR, 1995b).

Chromium is a naturally occurring metal which is found in several oxidation states. It is used in the production of stainless steel, chrome pigments, chrome salts, and as an anticorrosive in cooking systems, boilers, and oil drilling muds. Chromium III is not known to convert to chromium VI (which is known to be carcinogenic) and is not associated with irritation and corrosiveness, although chromic compounds and manufacturing processes are known to have such effects (Amdur et al., 1991). All forms of chromium can be toxic at high levels, but chromium III is less toxic than chromium VI. (ATSDR, 1993c)

Copper is a reddish metal that occurs naturally in rock, soil, water, sediment, and air. It is used in U.S. pennies, electrical wiring, water pipes, and alloys such as brass and bronze. Exposure to copper can lead to nose, mouth, and eye irritation, headaches, dizziness, nausea, stomach cramps, and diarrhea (ATSDR, 1990a).

Manganese is a naturally occurring essential metal used in alloys, dry-cell batteries, electrical coils, ceramics, matches, glass, dyes, fertilizers, welding rods, and as animal food additives. Exposure to manganese can lead to respiratory disorders, liver cirrhosis, and central nervous system damage, including irritability, difficulty in walking, and speech disturbances (ATSDR, 1992).

Mercury is a naturally occurring metal which can be found as a shiny, silver-white, odorless liquid, and if heated, as a colorless, odorless gas. Mercury is often used in compounds as "salts," and are often white powders or crystals. Metallic mercury compounds are used to produce chlorine gas and caustic soda, in thermometers, dental fillings, batteries; mercury salts are used in skin-lightening creams and as antiseptic creams and ointments. Exposure to mercury can cause damage to the brain, kidneys, and developing fetus, as well as lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and diarrhea (ATSDR, 1999e).

Selenium is a naturally occurring metal commonly found in rocks and soil. It is typically found combined with sulfide minerals, or with silver, copper, lead, and nickel minerals. Selenium compounds are used in anti-dandruff shampoos, and in other industrial applications.

Selenium particles can settle to the ground, or be removed from the air by precipitation. Soluble selenium compounds in agricultural fields can leave the field in irrigation drainage water. Also, selenium can collect in animals that live in water containing high levels of selenium.

Exposure to high levels of selenium can cause dizziness, fatigue, pulmonary edema, and bronchitis. Dermal contact can lead to rashes, swelling, and pain. Although selenium is required in the human diet, overconsumption of selenium can lead to brittle hair, deformed nails, and loss of feeling and control in the arms and legs (ATSDR, 1997e).

Silver is a naturally occurring metal which is used in eating utensils, coins, and jewelry; silver compounds are used in the manufacture of photographic plates, indelible inks, and for medicinal purposes. Exposure to silver and silver compounds can cause eye, skin, and lung irritation, and damage to the gastrointestinal system, kidneys, lungs, and cardiovascular system (ATSDR, 1990b).

Zinc is a bluish-white shiny metal found commonly in the earth's crust. It is used in rust-preventing coatings, dry cell batteries, alloys, paint, rubber, dyes, wood preservatives, and ointments. Zinc is an essential dietary element, but overexposure can lead to stomach cramps, nausea, vomiting, anemia, pancreas damage, and lower levels of high density lipoprotein cholesterol. Inhalation of zinc dust can cause lung damage and fever (ATSDR, 1995h).

The following inorganic COPCs do not have USEPA-assigned weight-of-evidence ratings: iron, nickel, thallium, and vanadium.

Iron is a malleable, ductile, and metallic silver-white metallic element. It is found in meteorites and in most igneous rocks. Iron is the most widely used metal, and is used in numerous applications. It is an essential element in the human diet and is utilized in the formation of hemoglobin and is contained in some enzymes. Iron tends to be conserved in the human body, and is excreted through the gastrointestinal tract and through the loss of blood. Chronic oral iron intoxication can lead to hemosiderosis (a generalized increase in the iron content of the body tissues, particularly the liver or the spleen), or hemochromatosis (marked by the accumulation of iron and fibrotic changes in the affected organ, most often the liver). Pulmonary siderosis can result from inhalation of iron dust or fumes (Amdur et al., 1991).

Nickel is a hard silvery-white metal used to make stainless steel and other metal alloys. Exposure to nickel can cause skin rashes, asthma attacks, and respiratory disorders (found primarily in workers exposed to nickel dust) (ATSDR, 1997d).

Thallium is a bluish-white metal used mostly in manufacturing electronic devices, switches, and closures, primarily for the semiconductor industry, and in the manufacture of special glass and for certain medical procedures. Exposure to thallium can cause nervous system effects, vomiting, diarrhea, temporary hair loss, effects on the heart, lungs, liver, and kidneys, and death (ATSDR, 1995e).

Vanadium is a naturally occurring white-to-gray metal, often found as crystals, and is usually found in compound form with oxygen, sodium, sulfur, or chloride. Vanadium is used in alloys for special kinds of steel which are used for automotive parts, springs, and ball bearings; vanadium is also used in rubber, plastics, ceramics, and in aircraft engines. Exposure to vanadium can cause lung, throat, and eye irritation, and chest pain (ATSDR, 1995g).

OTHER CHEMICALS

Cyanide (ATSDR, 1997b)

Cyanide and hydrogen cyanide are used in electroplating, metallurgy, chemical and plastic production, and photographic development. Cyanide can cause breathing difficulties, heart pains, vomiting, headaches, brain and heart damage, and death. Cyanide is "not classifiable as to human carcinogenicity" (USEPA-assigned weight-of-evidence rating of "D").

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ATTACHMENT III

TOXICOLOGICAL PROFILES FOR CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

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Volatile Organic Chemicals

Volatile organic chemicals of concern have high vapor pressures and, therefore, would be expected to volatilize readily from surface water to the atmosphere. Once released to the atmosphere, these chemicals are rapidly photodegraded.

In subsurface soil, these chemicals degrade slowly, are water soluble, and may leach into groundwater. These chemicals have low octanol/water coefficients (log K_{ow}) and, therefore, do not adsorb to sediment or particulate matter present in the water column.

Bioconcentration is usually reported as the bioconcentration factor (BCF), which is the concentration of the chemical in the organism at equilibrium divided by the concentration of the chemical in water. BCFs correlate with the octanol/water coefficients and solubility of a chemical. Since volatile organic chemicals have low octanol/water coefficients and high water solubility, these chemicals have a low potential to bioconcentrate in organisms (Howard, 1990).

Carbon disulfide

Carbon disulfide is a clear, colorless, flammable liquid that is heavier than water. It is moderately soluble in water. Concentrations of between 1 to 1,000 milligrams will mix with a liter of water. Carbon disulfide is non-persistent in water, with a half-life of less than 2 days. About 99.8% of carbon disulfide will eventually end up in air; the rest will end up in the water.

Acute toxic effects may include the death of animals, birds, or fish, and death or low growth rate in plants. Acute effects are seen two to four days after animals or plants come in contact with a toxic chemical substance. Carbon disulfide has moderate acute toxicity to aquatic life. No data are available on the short-term effects of carbon disulfide to plants, birds, or land animals.

Chronic toxic effects may include shortened life span, reproductive problems, lower fertility, and changes in appearance or behavior. Chronic effects can be seen long after first exposure(s) to a toxic chemical. Carbon disulfide has high chronic toxicity to aquatic life. No data are available on the long term effects of carbon disulfide to plants, birds, or land animals.

The concentration of carbon disulfide found in fish tissues is expected to be somewhat higher than the average concentration of carbon disulfide in the water from which the fish was taken.
(Source: gopher://ecosys.drdr.Vi...xics/Carbon%20Disulfide)

Semi-Volatile Organic Chemicals

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs contain only carbon and hydrogen and consist of two or more fused benzene rings in linear, angular or cluster arrangements. In general, most PAHs can be characterized as having low vapor pressure, low water solubility, low Henry's Law constants, high log K_{ow}, and high organic carbon partition coefficients (K_{oc}).

High partition coefficients and low solubilities suggest that PAHs are likely to be adsorbed onto sediment or soil particles. Conversely, these properties indicate that most PAHs will not readily volatilize into the atmosphere.

Although PAHs are regarded as persistent in the environment, they are degradable by microorganisms. Environmental factors, microbial flora and physicochemical properties of the PAHs themselves influence degradation rates and degree of degradation. Important environmental factors influencing degradation include temperature, pH, redox potential and microbial species. Physicochemical properties include chemical structure, concentration and lipophilicity.

In general, PAHs show little tendency to biomagnify in food chains, despite their high lipid solubility, probably because most PAHs are rapidly metabolized (Eisler, 1987). Plant roots are not discriminating in the uptake of small organic molecules (molecular weight less than 500) except on the basis of polarity. The more water-soluble molecules pass through the root epidermis and translocate throughout the plant and are eventually volatilized from the leaves (Efroymson *et al.*, 1997). Wildlife will have limited exposure to these chemicals. Potential exposure could occur through direct contact with or accidental ingestion of contaminated soil or through the terrestrial food chain.

Inorganic Chemicals

In a terrestrial setting, inorganic chemicals released to the environment accumulate in the soil (Sposito and Page, 1984). Mobility of these trace elements in soil is low and accumulated inorganics are depleted slowly by leaching, plant uptake, erosion, or chelation. The half-life of trace elements in a temperate climate ranges from 75 years for cadmium to more than 3,000 years for zinc.

The transport of trace elements in soil may occur via the dissolution of inorganic chemicals into pore water and leaching to groundwater, or colloidal or bulk movement (i.e., wind or surface water erosion). The rate of trace element migration in soil is affected by the chemical, physical and biological characteristics of the soil. The most important characteristics include: Eh-pH system; cation exchange capacity and salt content; quantity of organic matter; plant species; water content and temperature; and microbial activity.

Most inorganic chemicals may exist mainly as cations in the soil solution, and their adsorption therefore depends on the density of negative charges on the surface colloids (Alloway, 1990). Sandy soils, such as those found at the site, characteristically have low cation exchange capacities, low organic content and low pH. This suggests that the inorganic chemicals at the site are not adsorbed to soil particles as readily as to clayey soil. These inorganic chemicals could be mobilized to deep soil layers, to groundwater, or to the aquatic environment.

Inorganic chemicals that do mobilize from the soil into the water column are most mobile under acid conditions and increasing pH usually reduces their bioavailability. Generally, inorganic chemicals do not exist in soluble forms for long and generally accumulate in bottom sediment. Once in the sediment, most inorganic chemicals sorb onto hydrous iron and manganese oxides, clayey minerals and organic materials and are eventually partitioned into the sediments. Inorganic bioavailability from the sediment is enhanced under conditions of low pH, high dissolved oxygen, high temperature, and oxidation state. During these conditions, inorganic chemicals become soluble and freely move in the interstitial pore water and the water column (McIntosh, 1992).

Inorganic chemicals may be bound to exterior exchange sites on plant roots and not actually taken up. They may enter the root passively in organic or inorganic complexes or actively by way of metabolically controlled membrane transport. Once in the plant, an inorganic chemical can be stored in the root or translocated to other plant parts. Wildlife will have limited exposure to these chemicals. Potential exposure could occur through direct contact with or accidental ingestion of contaminated soil or through the terrestrial food chain.

Like the terrestrial food chain, chemicals could be mobilized in the aquatic food chain. Roots of aquatic macrophytes can mobilize and uptake chemicals that are bound to sediments. Wildlife could be exposed by contact or ingestion of surface water and sediment or through the aquatic food chain. Therefore, a moderate potential for exposure exists for aquatic macrophytes and wildlife inhabiting the site to the chemicals of potential ecological concern.

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