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REMEDIAL INVESTIGATION REPORT
WELLSVILLE-ANDOVER LANDFILL SITE
TOWNS OF WELLSVILLE AND ANDOVER
ALLEGANY COUNTY, NEW YORK
SITE NUMBER 9-02-004

VOLUME I: REPORT

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Prepared for:

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1. INTRODUCTION

1.1 PURPOSE OF REMEDIAL INVESTIGATION

Ecology and Environment Engineering, P.C. (E & E), under contract to the New York State Department of Environmental Conservation (NYSDEC), Division of Hazardous Waste Remediation (DHWR), was requested to perform a Remedial Investigation and Feasibility Study (RI/FS) at the Wellsville-Andover Landfill, site number 9-02-004, an inactive municipal landfill in the towns of Wellsville and Andover, Allegany County, New York. The objectives of the RI were to identify the probable cause, extent, and possible effects of the presence of hazardous materials in the project area. Based on the fieldwork and data evaluation conducted during the RI, the FS was designed to identify and evaluate remedial alternatives selected to mitigate contamination problems that pose threats to the environment or to public health and to recommend remedial alternatives.

This document summarizes the RI portion of the work performed at this site. The FS report is provided under separate cover. The RI/FS was conducted in accordance with criteria presented in the State Superfund Standby Contract (Work Assignment No. D002625-8.2).

1.2 SITE DESCRIPTION

The Wellsville-Andover Landfill site is located along the east side of Snyder Road (formerly Gorman Road) in a sparsely populated rural area of eastern Allegany County, New York (see Figure 1-1). The site straddles the border between the towns of Wellsville and Andover, with approximately the southern third in Wellsville and the northern two-thirds in Andover. The property is owned by the Village of Wellsville and is roughly rectangular in shape, measuring approximately 4,000 feet north-to-south by 1,500 feet east-to-west, for a

total area of approximately 120 acres. The northernmost portion of the property, consisting of approximately 35 acres, has not been used for waste deposition and was not included in the site investigation.

The landfill is located on a hillside on the west side of Duffy Hollow with nearly 200 feet of relief from north to south. The north end of the property is on top of the hill at an approximate elevation of 2,230 feet above mean sea level (MSL). This area is currently used by a local community group, the Wellsville Area Small Plane Society (WASPS), for recreational purposes. Access to the unfilled portion of the property used by the WASPS is gained only by a central dirt road that runs north-south through the filled areas. The east side of the site is bounded by open fields and patches of mature beech and sugar maple forests and slopes downward to Duffy Creek at grades of 14% to 20%. Numerous permanent and seasonal residences exist along Duffy Creek approximately 1,400 to 1,500 feet east of the eastern border of the site. The southern border of the site is fenced with barbed wire and lies adjacent to fields often grazed by horses. The nearest residence south of the site is seasonal and located 600 feet to the southeast (LaDue). Snyder Road borders the southern third of the site to the west. One permanent and one seasonal residence exist along the west side of Snyder Road within 300 feet of the landfill (Teller and Rosini, respectively). The remainder of the west side is bounded by mature beech and sugar maple forests, with one seasonal residence (Penn Hill Hunt Club) located approximately 500 feet west of the site.

Approximately 1,500 feet east of the site is Duffy Creek, a Class C stream (6 NYCRR 821.6). An unnamed intermittent tributary to Duffy Creek begins along the west side of the site and flows south-southeast until it converges with Duffy Creek approximately 3,000 feet southeast of the site. Duffy Creek flows south, eventually joining Dyke Creek 1.8 miles south-southeast of the site. Dyke Creek, also a Class C stream, is a direct tributary of the Genesee River.

Numerous man-made containment ditches exist at the site for the purpose of diverting surface runoff from the filled areas. Surface water from the northeast area of the site is collected in a drainage collection pond in the center of the site. This pond, which contains water perennially, is designed with an overflow to allow excess water to drain via ditches toward Snyder Road. Surface water from other areas of the site generally flows to the south and west, eventually draining into a ditch along the east side of Snyder Road. A series of culverts then divert this water directly into the unnamed tributary west of the site.

Leachate outbreaks exist or have existed at many on-site locations. Leachate from these seeps has not been observed migrating directly off site; however, overflow from the leachate holding pond and from Pump Station 2 has been seen flowing onto adjacent properties and then into the unnamed tributary west of the site.

1.3 SITE HISTORY

The following site history contains information and data from numerous sources that have not been combined in a single document before. The primary sources of data include NYSDEC's 1983 Phase I Report by Engineering-Science, Inc. and the Village of Wellsville's 1986 Phase II Report prepared by Malcolm Pirnie.

The Wellsville-Andover Landfill was operated by the Village of Wellsville from 1964 until 1983. The site consists of four fill areas, as shown on Figure 1-2. The fill areas occupy approximately 50 acres of the 120-acre property. The south, south-central, and northwest fill areas accepted municipal, industrial, and what is currently defined as hazardous waste between 1964 and 1978. According to NYSDEC's 1983 Phase I Report, the Rochester Button Company of Wellsville, New York disposed of unknown quantities of methylene chloride (MC) and possibly trichloroethene (TCE) at the site between 1968 and 1973. However, the Phase II report prepared for the Village of Wellsville states that Rochester Button disposed of these wastes between 1964 and 1968. Correspondence between the Rochester Button Company and the Village of Wellsville Department of Public Works (DPW) indicates that the waste stream reaching the landfill consisted of two phases, solid and sludge (Massey 1978). The solid portion reportedly consisted of polymerized polyester scraps, while typical sludge, composed of 65% solids, consisted of approximately 44% pumice, 22% polyester fines, 35% water, trace amounts of talc and detergent, and 0.04 parts per minute (ppm) lead carbonate. The total amount of solid waste produced by the Rochester Button Company (including paper and office waste) was reportedly 481,500 pounds per year (Massey 1978).

The northeast fill area, open from 1978 to 1983, accepted municipal and industrial solid waste similar to the solid wastes described above. No wastes currently defined as hazardous are known to have been disposed of in the northeast fill area. As described in the 1983 Phase I report, other wastes disposed of at the landfill included plastics, sodium cyanide

salt, cutting oils, chromium and zinc chromate paints, solvents, coolants, and lubricating oils (NYSDEC 1983a).

In addition to the above wastes, the landfill also accepted water-soluble cutting oils from two Wellsville area heavy metal manufacturing plants, C.E. Air Preheater Company, Inc. and Turbodyne Division of McGraw-Edison (MacFarquhar 1973).

Of the four fill areas, only the northeast area had a leachate collection system installed prior to waste deposition. However, as was the case with the other three fill areas, no liner was installed beneath the waste. The three older areas were in operation prior to modern regulatory requirements for design and operation of landfills. Apparently, no accurate documentation of the location or construction of cells in these areas was recorded. The available information suggests that the trench method of landfill operation was used and that the depth of waste varies but probably is less than 14 feet below ground surface.

In 1986, the Village of Wellsville prepared a Phase II Superfund investigation report under an Order on Consent filed by NYSDEC in August 1985. As described in this Phase II report prepared by Malcolm Pirnie, the Village of Wellsville installed a leachate collection system along the west side and central portion of the site in 1984 and 1985 to curtail the off-site migration of leachate. The system consists of a series of perforated 6-inch polyvinyl chloride (PVC) pipes in trenches backfilled with number 2 round stone. The trenches were excavated to depths of approximately 9 to 14 feet, which was stated to be below the estimated depth of the fill material. The layout of the system was based on the assumed direction of local groundwater flow—that is, from north to southwest in the central and western portion of the landfill. As shown in Figure 1-2, one main collection line runs along the west side of the site, adjacent to the northwest fill area. This line is joined at the northern access gate by another main line, which runs along the east side of the northwest fill area and joins with the system installed in the northeast fill area. A separate main line was installed along the south side of the south fill area. Lateral lines with vertical risers at the terminal ends were extended from the main lines into areas displaying visible leachate seeps. Leachate collected in the northwest, northeast, and south-central fill areas flows by gravity to a sump adjacent to Pump Station 1 (see Figure 1-2). Leachate from the south fill area flows by gravity to Pump Station 2, consisting of a cistern with a submersible pump, where it is then supposed to be pumped to the sump at Pump Station 1. However, during the Phase I and II RI, this pump was not observed to be functional, and leachate commonly overflowed from Pump Station 2.

Leachate arriving at the sump at Pump Station 1 is stored in two 10,000-gallon holding tanks adjacent to Pump Station 1. An 80,000-gallon pond located on site near the southern access gate stores leachate that overflows from the two holding tanks. This unlined pond is rarely dry and has been observed overflowing on occasion.

During E & E's site visit in February 1991, Pump Station 2 was full, and excess leachate was flowing off site to the south onto the property of Mr. D. LaDue.

Between July and December 1991, during the Phase I RI field work, E & E observed the conditions of the pump stations and pond. The excess-leachate holding pond was found to be full on numerous occasions, but no evidence of overflow from this pond was observed. During the dry mid- to late-summer months, the pond was often drained by the DPW, and no overflow from the sumps at either pump station was observed. During E & E's investigation, it was noted that the DPW removed leachate from the holding tanks at Pump Station 1 up to five times per day. The frequency of leachate removal was dependent upon the amount of leachate in the tanks and holding pond. Precipitation increased in September and October 1991, and during this time, leachate was observed overflowing from Pump Station 2 and migrating south onto Mr. LaDue's property.

In addition, during a site visit in February 1992, leachate was observed overflowing from Pump Station 2 as well as from the holding pond. Leachate overflow from the pond was directly observed entering the unnamed stream west of the site.

During the Phase II RI fieldwork conducted from June to September 1993, the leachate level in the holding pond fluctuated with precipitation, but was not observed overflowing. However, leachate was seen overflowing at Pump Station 2 at the beginning of August and mid-September 1993.

The results of sampling programs at the site prior to 1986 were discussed in the Phase II investigation report prepared by Malcolm Pirnie for the Village of Wellsville in 1986. The sampling performed prior to the Phase II investigation concentrated on leachate, Duffy Creek, and residential wells in the vicinity of the landfill. The residential wells showed low-level cyanide and zinc contamination but at concentrations below NYSDEC Class GA standards. Duffy Creek samples showed low-level zinc contamination but at concentrations below the NYSDEC Class C standard. Analyses of the leachate indicated the presence of phenol, cadmium, chromium, and lead. No other analyses for toxic organic substances were

performed. The accuracy of this reported data is questionable because appropriate NYSDEC Contract Laboratory Program (CLP) methods were not utilized.

On March 25, 1983, NYSDEC collected a sample of leachate from the site (Sample number R-0951-03) and submitted it to Recra Environmental Laboratories for analysis. Organic compounds detected in this sample include phenol (550 micrograms per liter [μg/L]), naphthalene (33 μg/L), benzene (54 μg/L), 1,1-dichloroethane (25 μg/L), 1,1-dichloroethene (9.2 μg/L), trans-1,2-dichloroethene (20,000 μg/L), 1,2-dichloropropane (14 μg/L), ethyl-benzene (5,200 μg/L), methylene chloride (1,300 μg/L), tetrachloroethene (6.7 μg/L), toluene (3,400 μg/L), trichloroethene (45 μg/L), trichlorofluoromethane (13 μg/L), and vinyl chloride (3,800 μg/L). Inorganics detected in this leachate sample include arsenic (20 μg/L), chromium (32 μg/L), copper (16 μg/L), lead (180 μg/L), and zinc (862 μg/L) (NYSDEC 1983b).

NYSDEC sampled a number of private wells and springs in the vicinity of the Wellsville-Andover Landfill in 1984. The samples were tested for oil and grease, phenols, volatile organic compounds (VOCs), and metals. Analytical results indicated that:

- Phenols were not detected in any of the samples;
- No metals were detected above NYSDEC Class GA groundwater quality standards;
- All samples were free from VOCs, with the exception of those collected from the LaDue spring, which contained 150 ppb of trans-1,2-dichloroethene (tDCE) and 9 ppb of TCE; and
- All of the samples, with the exception of those collected from the LaDue spring, showed low levels of oil and grease contamination.

VOC results of this sampling effort are presented in Table 1-1, along with Allegany County Department of Health (ACDOH) sampling results for residential water supplies in the area. Figure 1-3 depicts the approximate residential well and spring locations sampled between 1984 and 1989. The property parcels shown on Figure 1-3 are listed along with the owner's names in Table 1-4.

NYSDEC again sampled a number of residential water supplies in August 1987. The results of this sampling effort, which are also included in Table 1-1, indicate the following:

- The Miller spring contained 20 μg/L tDCE and 15 μg/L TCE; and

- The LaDue spring contained 40 μg/L tDCE and 23 μg/L TCE.

As summarized in Table 1-1, ACDOH has sampled numerous residential water supplies in the vicinity of the site. The only locations found to contain VOCs were the LaDue and Miller springs, as follows:

- In April 1985, the LaDue spring contained 67 μg/L tDCE, 16 μg/L TCE, and 20 μg/L benzene;
- In May 1989, the LaDue spring contained 17 μg/L of cis-1,2-dichloroethene (cDCE) and 14 μg/L TCE;
- In December 1989, the LaDue spring contained 18 μg/L tDCE, 10 μg/L TCE, and 1 μg/L bromodichloromethane (a trihalomethane); and
- In December 1989, the Miller spring contained 2 μg/L cDCE and 1 μg/L of TCE.

Sampling performed by Malcolm Pirnie in 1986 during the Phase II investigation included analyses of leachate, groundwater, residential well and spring water, surface water, and sediment. The leachate, groundwater, and residential water supplies were analyzed for priority pollutant metals (unfiltered), organic substances, cyanide, pH, and conductivity. The surface waters were analyzed for the same five constituents as well as temperature and dissolved oxygen. Sediment samples were analyzed for priority pollutant metals, organic substances, and cyanide. Tables 1-2 and 1-3 summarize the residential water, groundwater, and leachate sampling results. A summary of the results is as follows:

- The presence of cyanide or chromium at the significantly elevated levels indicated by the Phase I investigation was not confirmed in the various media sampled.
- Seven VOCs were detected in the leachate, including MC, acetone, vinyl chloride (VC), tDCE, 2-butanone, toluene, and ethyl benzene. Cadmium and manganese were also detected at elevated levels in the leachate.
- Two of the three downgradient groundwater monitoring well samples exhibited elevated levels of acetone and/or MC. In addition, one groundwater sample exhibited an elevated pH value. One potable residential water source (the LaDue spring) contained tDCE and TCE at levels exceeding NYSDEC Class GA standards. The Miller spring,

which is not a source of potable water, contained MC, tDCE, and TCE at concentrations above regulatory levels.

- Iron was detected above the NYSDEC Class GA standard in an upgradient seep and downgradient groundwater, residential well, and spring water samples. Manganese was detected above the Class GA standard in downgradient groundwater, residential well water, and leachate samples. Sodium was detected above the NYSDEC Class GA standard in the groundwater and leachate samples but not in the residential water supply samples. No other metals were detected in excess of Class GA standards.

- Iron was detected at levels above the Class C surface water standard in the on-site drainage pond and Duffy Hollow Creek downstream samples.

Under contract to NYSDEC, E & E began a Phase I RI in July 1991 in order to expand on the previous investigations. The Phase I RI was conducted in accordance with the NYSDEC-approved workplan, and fieldwork was completed in February 1992. In March 1992, E & E submitted a draft report to NYSDEC summarizing the Phase I RI methodologies and results. Following a period of public review, NYSDEC recommended a Phase II RI in order to fill existing data gaps and ensure that adequate data were collected for completion of the site FS. Phase II RI fieldwork was conducted between June and September 1993. This report summarizes the data collected during both phases of the RI.

Table 1-1

ACDOH AND NYSDEC RESIDENTIAL WATER SUPPLY VOC SAMPLING RESULTS

Name	Date	Organic Compounds Detected (µg/L)				
		cDCE	tDCE	TCE	THM	Benzene
Baker[a]	5-1-89[c]	—	—	—	—	—
	8-5-87[b]	—	—	—	—	—
Bauer	11-14-84[b]	—	—	—	—	—
Fanton	11-14-84[b]	—	—	—	—	—
Gephart	12-3-89[c]	—	—	—	1	—
Green	11-14-84[b]	—	—	—	—	—
Kelley, Jr.	11-14-84[b]	—	—	—	—	—
LaDue	12-3-89[c]	—	18	10	1	—
	5-1-89[c]	17	—	14	—	—
	8-5-87[b]	—	40	23	—	—
	4-30-85[c]	—	67	16	—	20
	11-14-84[b]	—	150	9	—	—
Miller	12-4-89[c]	2	—	1	—	—
	8-5-87[b]	—	20	15	—	—
Ormsby	5-1-89[c]	—	—	—	—	—
Rosini	5-1-89[c]	—	—	—	—	—
	11-14-84[b]	—	—	—	—	—
Teller	5-1-89[c]	—	—	—	—	—
	11-14-84[b]	—	—	—	—	—

[a] Former Fitzgibbon residence.
[b] Sampled by NYSDEC.
[c] Sampled by ACDOH.

Key:

cDCE = cis-1,2-Dichloroethene.
tDCE = trans-1,2-Dichloroethene.
TCE = Trichloroethene.
THM = Total trihalomathanes.

Sources: Vossler 1989a, 1989b, 1989c, 1989d, 1989e, 1990a, 1990b, and 1990c; Clare 1987; and Bates 1986.

Table 1-2

PHASE II INVESTIGATION[a]
GROUNDWATER AND LEACHATE SAMPLING RESULTS
(JUNE 1986)

Sample	Organic Compounds Detected (µg/L)								Inorganics Above Standards[b] (µg/L)			
	VC	MC	Acet	tDCE	2-But	Tol	EB	TCE	Cd	Fe	Mn	Na
Groundwater												
CW-3B	—	19	470	—	—	—	—	—	—	17,400	707	25,600
CW-4A	—	—	5,100	—	—	—	—	—	—	10,200	4,240	20,900
CW-4B	—	—	—	—	—	—	—	—	—	18,500	4,110	45,500
Leachate												
Trench	670	—	—	1,400	—	—	—	—	—	914	689	—
Sump	—	J	2,100	8,300	3,200	540	950	—	47	529	22,900	135,000

[a] Performed by Malcolm Pirnie in 1986.

[b] Indicates only those inorganic analytes detected above NYSDEC Class GA standards per 6 NYCRR Part 701.

Key:

VC = Vinyl chloride.
MC = Methylene chloride.
Acet = Acetone.
tDCE = trans-1,2-Dichloroethene.
2-But = 2-Butanone.
Tol = Toluene.
EB = Ethylbenzene.
TCE = Trichloroethene.
Cd = Cadmium.
Fe = Iron.
Mn = Manganese.
Na = Sodium.
J = Detected below sample quantitation limit.

Source: Village of Wellsville 1986.

DRAFT

Table 1-3

PHASE II INVESTIGATION[a]
RESIDENTIAL WATER SUPPLY SAMPLING RESULTS
(JUNE 1986)

Name	Organic Compounds Detected (µg/L)						Inorganics above MCLs[b] (µg/L)	
	MC	tDCE	TCE	DEP	Phenol	4MP	Iron	Manganese
Fitzgibbon	--	--	--	--	--	--	--	--
Kelly	--	--	--	--	--	--	--	--
LaDue	--	72	34	--	--	--	--	--
Miller	24	32	21	J	J	1,900	1,130	--
Rosini	--	--	--	--	--	--	650	508
Teller	22	--	--	--	--	--	--	--

a Performed by Malcom Pirnie in 1986.

b Indicates only those inorganic analytes detected above Maximum Contaminant Levels (MCLs) for public water supplies per 10 NYCRR Subpart 5-1.

Key:

MC = Methylene chloride.
tDCE = trans-1,2-Dichloroethene.
TCE = Trichloroethene.
DEP = Diethylphthalate.
4MP = 4-Methylphenol.
J = Detected below sample quantitation limit.

Source: Village of Wellsville 1986.

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02:OB3900_D4423-11/05/93-D1

Table 1-4

TAX MAP PARCEL IDENTIFICATION

Parcel ID	Owner/Resident February 1993	Domestic Water Sampling Conducted		
		Pre-RI	Phase I RI	Phase II RI
201-1-2	L. Morris			
201-1-3	L. Morris			
201-1-4.1	H. Graffath			
201-1-4.2	J. Graffath			
201-1-5	C. Wahl			
201-1-11.1	P. Buirch			
201-1-11.4	W. Kincaid			
201-1-12.1	G. Cutry			
201-1-12.2	L. Catanzaro			
201-1-13.1	J. Fanton	X		X
201-1-13.21	M. Fletcher			X
201-1-13.22	J. Fanton			
201-1-13.23	J. Fanton			
201-1-14.1	M. Giambrone			
201-1-14.2	E. Ormsby	X		X
201-1-14.3	M. Giambrone			
201-1-15.1	N. D'Ovidio			X
201-1-15.2	Village of Wellsville			
201-1-16	Penn Hill Hunt Club			
201-1-17	B. Lehman			
201-1-18	J. Gryczan			
201-1-19	J. Brady			
201-1-20	Village of Wellsville			
214-1-1	B. Lehman			

Key at end of table.

Table 1-4

TAX MAP PARCEL IDENTIFICATION

Parcel ID	Owner/Resident February 1993	Domestic Water Sampling Conducted		
		Pre-RI	Phase I RI	Phase II RI
214-1-2.1	Village of Wellsville			
214-1-2.2	R. Teller	X	X	X
214-1-3.1	E. Ormsby			
214-1-3.2	J. Urban[a]			X
214-1-3.3	G. Harris			
214-1-4	M. Fletcher			
214-1-5	T. Whispell			X
214-1-6	J. Vaccaro[b]	X	X	
214-1-7	G. Cutry			
214-1-47.2	G. Meisenzahl			X
214-1-48	R. Geffers			X
214-1-49.1	B. Schettine			X
214-1-49.2	A. Green	X		X
214-1-49.3	D. Hoag/R. Dodge			X
214-1-49.4	D. Green			
214-1-51	A. Hurd			
214-1-52	Penn Hill Hunt Club			
214-1-53.1	D. LaDue	X	X	X
214-1-53.2	R. Rosini	X	X	X
214-1-53.3	V. Miller	X	X	X
214-1-54	G. Cutry			
214-1-56	D. LaDue			
214-1-57	H. Bauer	X	X	
214-1-58	J. Hauselt			
214-1-59	J. Hauselt			

Key at end of table.

Table 1-4

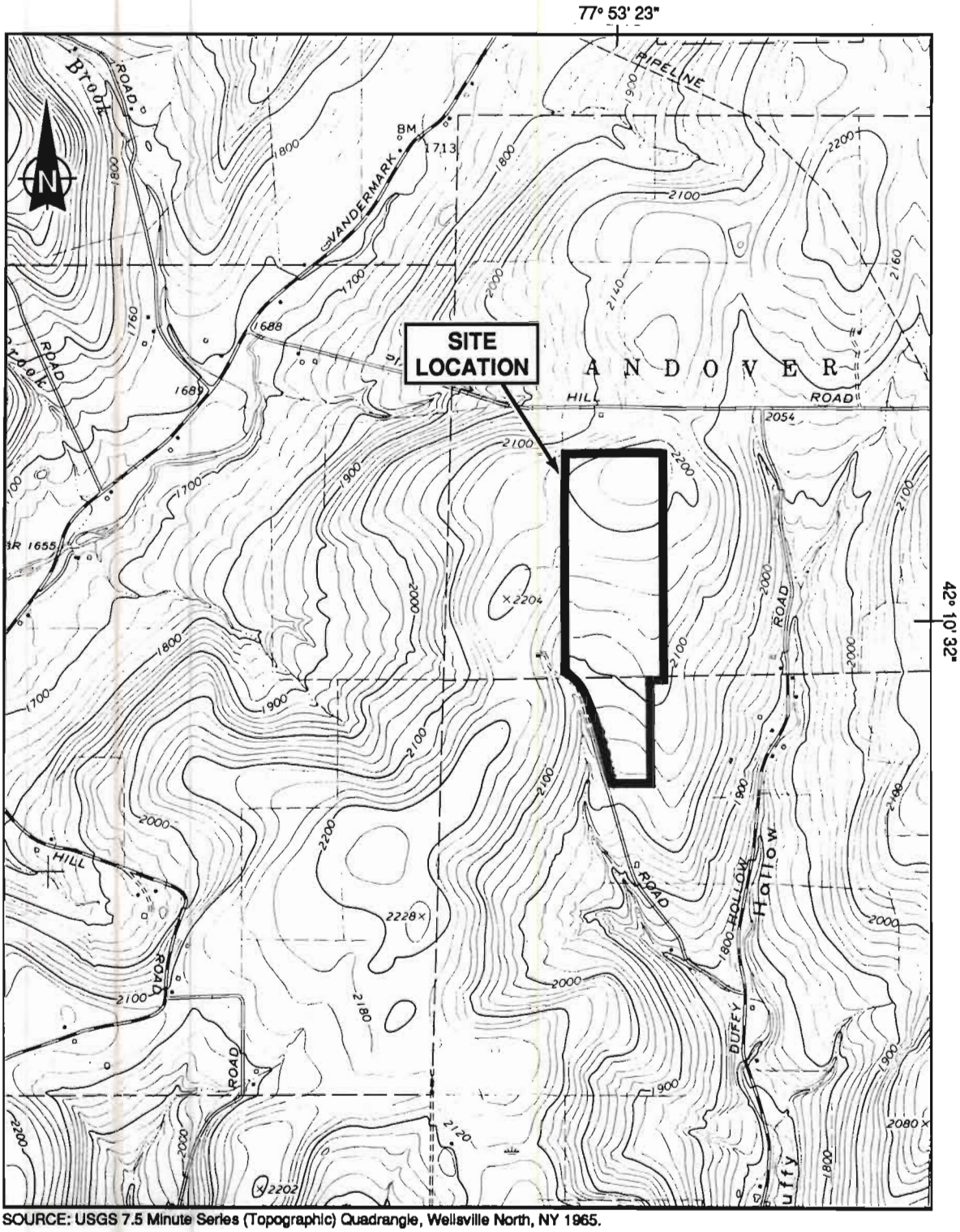
TAX MAP PARCEL IDENTIFICATION

Parcel ID	Owner/Resident February 1993	Domestic Water Sampling Conducted		
		Pre-RI	Phase I RI	Phase II RI
214-1-60	M. Gephart	X		X
214-1-61	M. Bace			
214-1-62	D. LaDue			
214-1-63	D. LaDue			
214-1-64	D. LaDue			
227-1-4	B. Inferrera			
227-1-5	A. Kelley			
227-1-6.1	W. Cornell			X
227-1-6.2	N. Kelley			
227-1-6.3	R. Fanton			X
227-1-6.4	F. Kelley, Jr.	X	X	X
227-1-22.2	J. Randall			
227-1-22.3	J. Lindsay			

[a] J. Urban's spring is on E. Ormsby's parcel 201-1-14.2.

[b] Property formerly owned by Fitzgibbon then Baker. The Baker spring was located on this parcel while the Fitzgibbon spring was formerly located across Duffy Hollow Road on parcel 214-1-3.2.

Source: Allegany County 1993.



SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle, Wellsville North, NY 1965.

SCALE 1:24,000

0 ½ 1 Mile

0 .5 1 Kilometer

Figure 1-1
SITE LOCATION MAP, WELLSVILLE-ANDOVER LANDFILL

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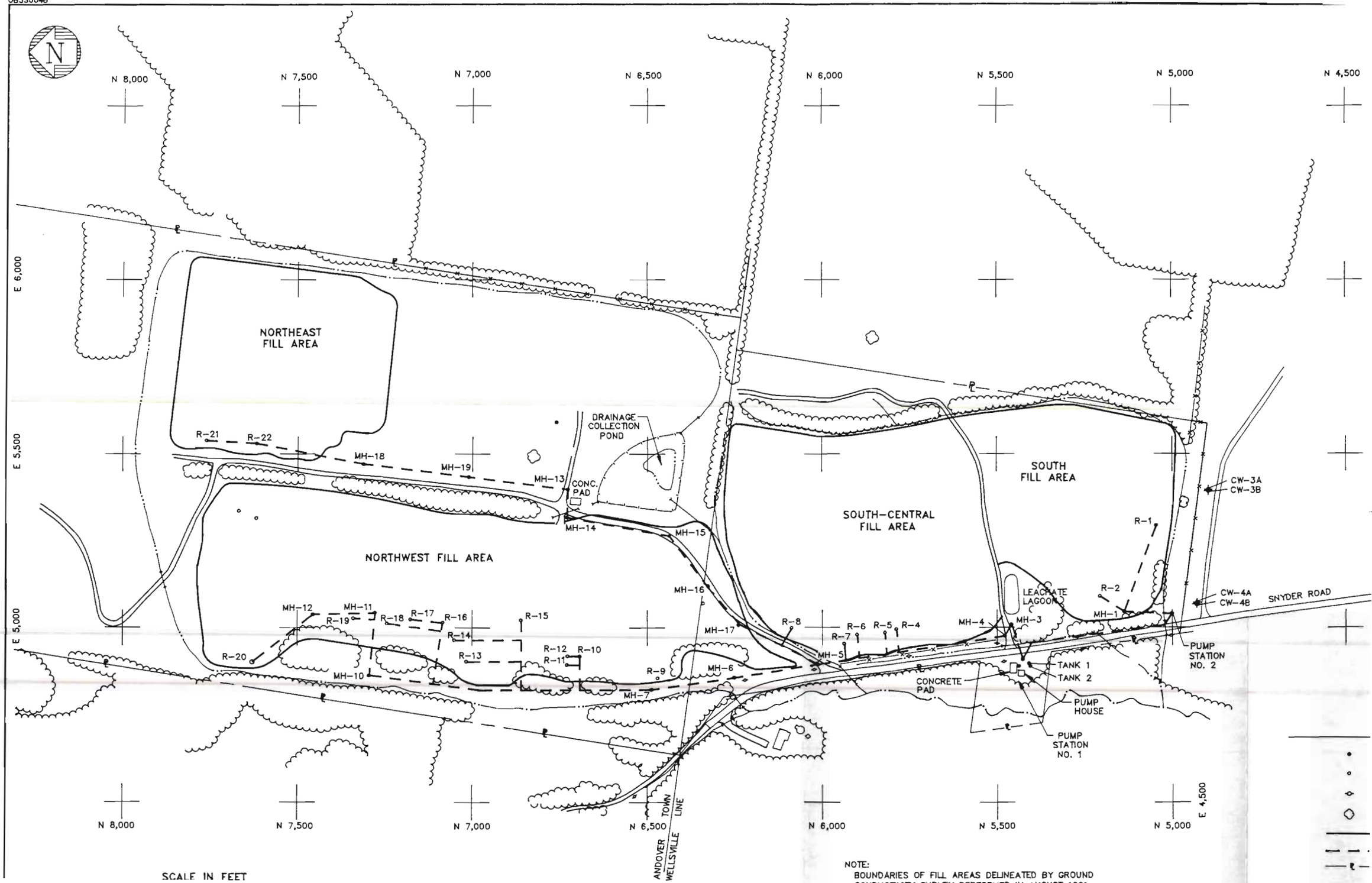
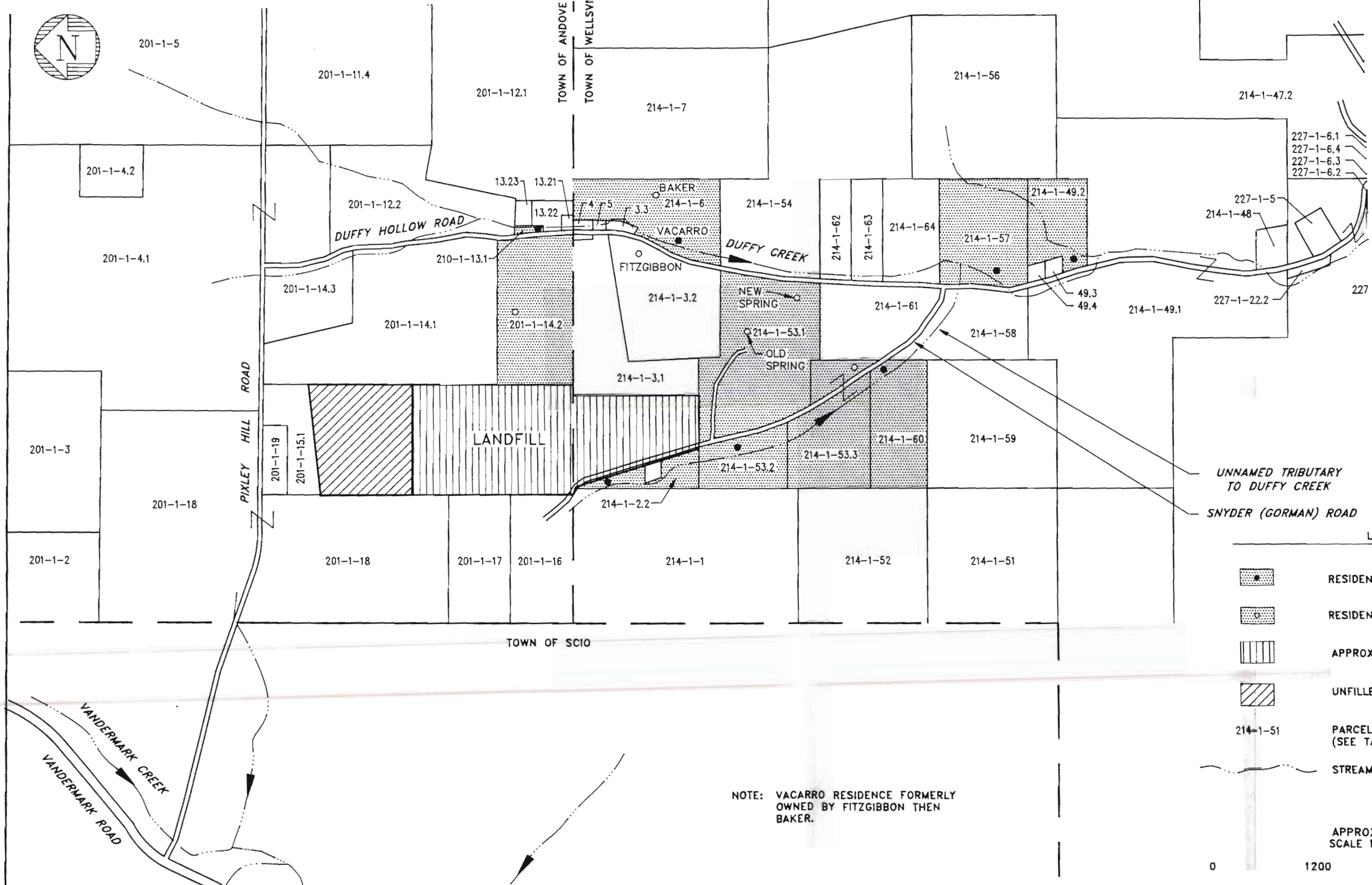


SCALE IN FEET

NOTE:
BOUNDARIES OF FILL AREAS DELINEATED BY GROUND



NOTE: VACARRO RESIDENCE FORMERLY OWNED BY FITZGIBBON THEN BAKER.

2. ENVIRONMENTAL SETTING

2.1 INTRODUCTION

This section discusses the physical setting of the Wellsville-Andover area to provide a framework for a detailed discussion of the Wellsville-Andover Landfill site. Specific discussions regarding site characteristics (i.e., geology, topography, hydrology, and hydrogeology) are presented in Section 4.

2.2 PHYSIOGRAPHY AND TOPOGRAPHY

Wellsville is located in southeast Allegany County in the southern tier of New York State. The area is part of the Allegheny Plateau region of the Appalachian physiographic province (Woodruff 1942) and is characterized by a mature, medium-textured upland of moderate relief developed on sedimentary rocks with a gentle southward regional dip (Muller 1957). All of Allegany County was affected by moderate glaciation during two or more episodes of the Pleistocene Epoch and therefore contains the characteristic open valleys, glacially scoured summits, and drift deposits of the southern New York section of the Appalachian province (Muller 1957).

While glacial history has played an important role in the topographic development of the area, the underlying Paleozoic strata also influence topography. Interbedded shales, sandstones, and occasional conglomerates produce scarplets and benches in many areas with relatively erosion-resistant caprock of sandstone and conglomerate.

Allegany County includes some of the most rugged topography in Western New York, with a maximum relief of 1,400 feet. Average local relief is approximately 600 to 800 feet. The highest elevation in the area is Alma Hill, northwest of the site near Belmont, New York, with a summit elevation of 2,548 feet above mean sea level (MSL). The lowest

elevation in Allegany County is along its northern border where the Genesee River crosses into Wyoming County at an elevation of less than 1,120 feet above MSL (Muller 1957 and Woodruff 1942).

Locally, the site occupies a hillside on the west side of Duffy Hollow. The hilltop north of the landfill is at an elevation greater than 2,220 feet above MSL. The north border of the landfill is at an approximate elevation of 2,180 feet above MSL and the site slopes south with the south border at about 2,020 feet above MSL (United States Geological Survey [USGS] 1965). As part of the RI, a topographic map of the site was created by Erdman Anthony using photogrammetry (see Figure 2-2 in back pocket). This map utilizes relative elevations which differ from the above USGS elevations. In this figure, the landfill has been assigned elevations ranging from 260 feet along the north border to 100 feet along the south border.

Duffy Creek flows north to south through Duffy Hollow and begins at an approximate elevation of 2,100 feet above MSL. Approximately three miles south of where it begins, Duffy Creek converges with Dyke Creek at an approximate elevation of 1,550 feet above MSL. An unnamed tributary (6 NYCRR 821.6 waters index number ONT. 117-184-4-1) of Duffy Creek flows from the southwest side of the site joining Duffy Creek near the intersection of Snyder and Duffy Hollow roads. This tributary begins near the town line at an approximate elevation of 2,100 feet above MSL and converges with Duffy Creek at an approximate elevation of 1,730 feet above MSL (USGS 1965).

2.3 REGIONAL GEOLOGY

2.3.1 Soils

The following discussion of the regional soil types is based primarily on the soil survey for Allegany County prepared by the United States Department of Agriculture (USDA) in 1956.

The soils in Allegany County are derived from a variety of glacial materials, creating the large variation of soil types throughout the county. The soils identified by USDA on or adjacent to the site include members of the Bath, Freemont, Lordstown, Mardin, and Volusia series. These soils range from level or gently sloping to hilly and moderately steep, are found in upland areas, and range from well-drained to poorly and imperfectly drained.

A large portion of the landfill site is composed of Volusia channery silt loam. Volusia soils are the most extensive in the county. In general, they are characterized by high acidity and poor drainage, occur on gentle slopes, and may receive seepage water from higher lying areas. Volusia soils have a gray-brown surface horizon underlain by a light-colored horizon that is periodically saturated. Below this lies a mottled zone underlain by a very firm hardpan. This hardpan restricts permeability, causing increased runoff and, consequently, increased erosion.

Freemont soils are found in relatively level to gently sloping areas near the high plateau. The soil is described as a yellow-brown silt loam with a mottled layer below 7 to 10 inches, indicating the presence of water at this depth periodically. Hardpan occurs at a depth of 18 inches. Freemont soils are imperfectly drained and grade into the poorly drained Volusia. In some locations, the two soils cannot be distinguished.

Lordstown soils are shallow to moderately deep, strongly acidic, well-drained, and have a bright yellow-brown subsoil. The soil contains flat stone fragments throughout, derived locally from weathered sandstone and shale. These soils are commonly found in areas with strongly sloping terrains. Bedrock generally occurs at depths between 18 and 30 inches.

Mardin soils are strongly acidic and moderately well drained. These soils occur on uniform slopes ranging from gently sloping to steep and formed from glacial till consisting mainly of sandstone and shale. The surface soil is almost black with an underlying bright yellow-brown subsoil. A mottled horizon exists at about 14 inches, and the underlying hardpan is compact enough to restrict the downward movement of groundwater.

Prior to filling, the northwest and northeast portions of the site were composed mainly of Volusia channery silt loam. These portions also included small areas of Lordstown flaggy silt loam and Freemont and Mardin channery silt loams. These soil types are described above.

The south-central fill area was composed chiefly of Volusia channery silt loam with small areas of Lordstown flaggy silt loam, Mardin channery silt loam, and Bath channery loam. The Bath soils are yellow-brown, strongly acidic, deep, and well drained. These soils generally occur on the highest hills of the county at elevations of 2,000 to 2,500 feet. They were derived from glacial till and contain a high percentage of thinly bedded sandstone and shale fragments.

The soils in the vicinity of the south fill area included Mardin channery silt loam, Lordstown flaggy silt loam, and Bath Channery silt loam, all of which have been described previously.

2.3.2 Bedrock

The Late Devonian strata of the Wellsville area are some of the least understood in the New York Devonian sequence. Different group and formation names as well as different time relationships have been used by different authors. The majority of the following discussion is based on the works of Woodruff 1942, Rickard 1957, and Rickard 1975, using the names and temporal relationships described by Rickard 1975.

The stratigraphic section exposed in Allegany County consists primarily of inter-bedded shale and sandstone, with numerous locally conspicuous conglomerate layers in the upper portion of the column. While the majority of the county consists of Upper Devonian formations, the strata became progressively younger to the south, and outcrops of Mississippi-an units and Pennsylvanian conglomerate can be found near the New York-Pennsylvania state line. Regional dip is to the south at a fraction of a degree; however, the strata have been warped into open folds with anti- and synclinal axes trending northeast-southwest. This gentle folding causes local variation and reversal of dip (Woodruff 1942).

The Upper Devonian strata of Allegany County represent lateral facies changes that occurred during deposition of the Catskill Delta. As the Catskill mountains shed debris westward into a shallow sea, a progression of depositional environments developed from east to west across New York State. Deep depositional environments occur to the west and near the bottom of the stratigraphic section. Shallow depositional environments occur to the east and near the top of the section. As the basin filled and the sea regressed, progressively shallower type sediments were deposited in the Wellsville area.

In the Wellsville area, the base of the Upper Devonian section is formed by the Genesee and Sonyea groups (see Figure 2-1). These groups consist primarily of shales including the Geneseo, Penn Yan, West River, Middlesex, and Cashagua formations. These groups represent deposition in a relatively deep, anaerobic, distal basin. Above the Sonyea Group is the West Falls Group. At the base of the West Falls is the Rhinestreet Shale, which was deposited in an environment similar to that of the Genesee and Sonyea groups. Above the Rhinestreet, but within the West Falls Group, are numerous formations consisting of

shale, siltstone, and sandstone representing deposition in a proximal basin and on an open shelf well below the wave base (Rickard 1975).

Atop the West Falls Group is the Canadaway Group. At the base of this group is the Hume shale, a dark gray to black shale. The Hume is considered the base of the Dunkirk Shale, which is prominent west of Wellsville. Above the Hume is the Caneadea Shale, which extends upward to the base of the Rushford Sandstone. The Caneadea consists of gray, silty shales and gray siltstones. The Hume and Caneadea were deposited under conditions similar to that of the upper West Falls Group. The upper part of the Canadaway Group is dominated by the interbedded shales, siltstones, and sandstones of the Wellsville and Whitesville formations. Originally thought to be two distinct units separated by a sandstone unit (Woodruff 1942), both formations are now considered the same and are thought to represent lateral facies changes (Rickard 1975). The Wellsville-Andover Landfill site is underlain by these units. Originally thought to be above the Cuba Sandstone (Woodruff 1942), the Wellsville and Whitesville formations are now believed to lie beneath the Cuba Sandstone (Rickard 1975). The Cuba, which marks the top of the Canadaway Group, consists of gray siltstones and fine-grained sandstones. The Wellsville and Cuba formations include material deposited in a diverse subtidal shelf (includes prodelta, delta front sands, and delta platform) and in the nearshore zone (e.g., distributary mouth bars, channels, estuaries, tidal flats, swamps, and marshes). The Whitesville represents peritidal deposits--i.e., cyclic interbeds of marine and non-marine deposits (Rickard 1975).

Above the Cuba is the Conneaut Group. This group consists of reddish shales interbedded with greenish-gray sandstones and may be part of the Germania Formation of Woodruff (1942) or part of the Cattaraugus Formation of Rickard (1975). Like the Whitesville, the Conneaut Group represents peritidal deposits (Rickard 1975).

Above the Conneaut Group, the Wolf Creek conglomerate forms the base of the Conewango Group. The lower part of the Conewango, especially to the west, consists of the interbedded red and green shales and greenish-gray sandstones of the Cattaraugus Formation. Above the Cattaraugus are the upper Sunfish shales and sandstones. The Cattaraugus, like the Whitesville, represents peritidal deposits, while the Sunfish consists of piedmont and alluvial floodplain deposits (Rickard 1975).

The site is underlain by the Wellsville and/or Whitesville formations of the upper Canadaway Group. Older formations from the lower Canadaway Group are exposed west and

northwest of the site in the Genesee River and Vandermark Creek. Small areas of the younger Conewango Group are still exposed on hilltops south of Dyke Creek (Rickard and Fisher 1970).

The nearest known fault to the site exists approximately 7 miles to the southeast and is of an undetermined nature. Additionally, three topographic linear features have been observed on high altitude photographs. One is more than 25 miles long and trends northwest-southeast through the center of the Village of Wellsville. Another is approximately 3.5 miles long and trends northeast-southwest along Dyke Creek. The third is approximately 2 miles long and trends northwest-southeast joining the second feature where Dyke Creek enters the village (Isachsen and McKendree 1977a).

Two pervasive joint sets have been mapped in the Wellsville area. One set of unspecified prominence with vertical and subvertical planes trends N20°W/S20°E. The second set, also of unspecified prominence, trends N29°W/S29°E (dip not given) (Isachsen and McKendree 1977b).

2.4 REGIONAL HYDROLOGY

The Wellsville-Andover Landfill is located within the Genesee River Basin. The basin extends from the mouth of the Genesee River at Lake Ontario to northern Pennsylvania and has a total drainage area of 2,480 square miles (NYSWRC 1966). This section summarizes the hydrologic features of this basin in order to provide a framework for the discussion of the site hydrology presented in Section 4.

2.4.1 Surface Water

The Genesee River drains three-fourths of Allegany County. The river enters the county in the southeast, generally flows north, and exits the county to the north. A small southeastern portion of the county is drained by the Allegheny River, which flows south. Surface waters of the northeastern part of the county drain through tributaries of the Canisteo River into the Susquehanna River system, and surface waters from the northwestern corner of Allegany County drain into Lake Erie (USDA 1956). The Wellsville area is part of the Genesee River drainage basin. The major tributary streams to the Genesee River are Cryder, Dyke, and Angelica creeks east of the river and VanCampen, Black, and Caneadea creeks to

the west. The principal lakes in the Genesee basin are the Little Finger Lakes: Conesus, Honeoye, Canadice, and Hemlock (NYSWRC 1966).

Springs, both intermittent and continuous, are common throughout the county. In upland areas, the underlying bedrock is close to the surface and is generally covered by glacial till with very low permeability. Water seeps downslope above the till layer and often comes to the surface as springs in wet seasons. If the impermeable layer is deep, permanent springs may be present (USDA 1956).

The Village of Wellsville relies on the Genesee River as its potable water source, while most residents outside the village rely on groundwater wells and/or springs.

2.4.2 Groundwater

Within Allegany County, water is found in both the overburden and the bedrock. Most of the unconsolidated sediments were deposited during glaciation. Low-lying areas were flooded and filled with sediments ranging from clays to coarse gravel. In the upland areas, till is the most common overburden material.

The greatest potential for groundwater exists in unconsolidated glacial outwash deposits in partially buried valleys in the central portions of the Genesee River drainage basin. In the northern portion of the basin, groundwater occurs at shallow depths but is highly mineralized (NYSWRC 1966).

The thick deposits of sand and gravel outwash contain little silt and clay and, therefore, are the most permeable water-bearing units. Recharge to these areas tends to be high due to their location in valley bottoms. Outwash deposits can supply sufficient quantities of groundwater for municipal and industrial use (Frimpter 1974).

Deposits in the upland areas are generally composed of till. Due to large variations in composition ranging from clays to gravels, tills tend to have low permeability and do not yield large quantities of groundwater. However, wells completed in till are sometimes adequate for domestic water supplies (Frimpter 1974).

Glacial deposits of clay and silt have low permeabilities and may confine underlying or perch overlying water-bearing deposits. Moraine deposits, where present, often lie above the water table. Where these moraine deposits are saturated, sand and gravel lenses within the deposits are capable of yielding sufficient water supplies for domestic use (Frimpter 1974).

Wells completed in the shale, siltstone, and sandstone bedrock of the area yield dependable supplies of groundwater for domestic or farm use. The quantity of groundwater is dependent on the occurrence of joints, fractures, and other secondary porosity characteristics of the bedrock. Wells are more likely to intercept and receive water from horizontal joints and fractures than vertical joints and fractures. However, vertical joints and fractures may act as conduits to recharge deeper portions of the aquifer (Frimpter 1974).

2.5 CLIMATOLOGY

Allegany County has a continental climate characterized by fairly high summer daytime temperatures and cool summer nights. Winters are usually long and severe. The hill and valley topography of the county causes many local variations in precipitation and wind patterns. The stations closest to Wellsville recording climatological data are Angelica and Alfred, New York. The Angelica data record covers the years 1925 through 1991 and was obtained from the Northeast Regional Climate Center at Cornell University in Ithaca, New York. The Alfred data record covers the period from 1951 to 1980, and is found in a publication of the National Oceanic Atmospheric Administration (NOAA 1985).

The average yearly temperature is about 45° F, with a mean summer temperature of 66° F and a mean winter temperature of 24° F. Summer daytime temperatures have been as high as 98° F, and it has been as cold as -38° F in winter. Relative humidity in summer is relatively low, with only occasional intrusion of humid air.

The annual average rainfall is 34.1 inches at Angelica and 36.8 inches at Alfred; annual snowfall averages 56 inches at Angelica and 83 inches at Alfred. Precipitation is rather evenly distributed by month throughout the year. However, the maximum average monthly precipitation occurs in June for both Angelica and Alfred (4.06 and 4.09 inches, respectively), while the minimum average monthly precipitation occurs in February (2.17 and 2.02 inches for Angelica and Alfred, respectively). The greatest monthly precipitation occurred in June 1972, when monthly rainfall measured 16.6 inches at Alfred and 12.6 inches at Angelica. The greatest daily precipitation also occurred in June 1972, when daily rainfall measured 5.83 inches in Alfred and 4.35 inches in Angelica. When precipitation occurs, it falls in a long, steady manner, rather than in torrential brief downpours. Flash floods are rare for the area. The driest year recorded only 22 inches of rain, while the wettest year had 54 inches of rain.

Prevailing winds are from the west; however, local variations in wind speed and direction can occur due to topography, especially during fair-weather, light-wind conditions. Destructive wind velocities are rare, but the area does experience severe thunderstorms during the late spring and early summer months.

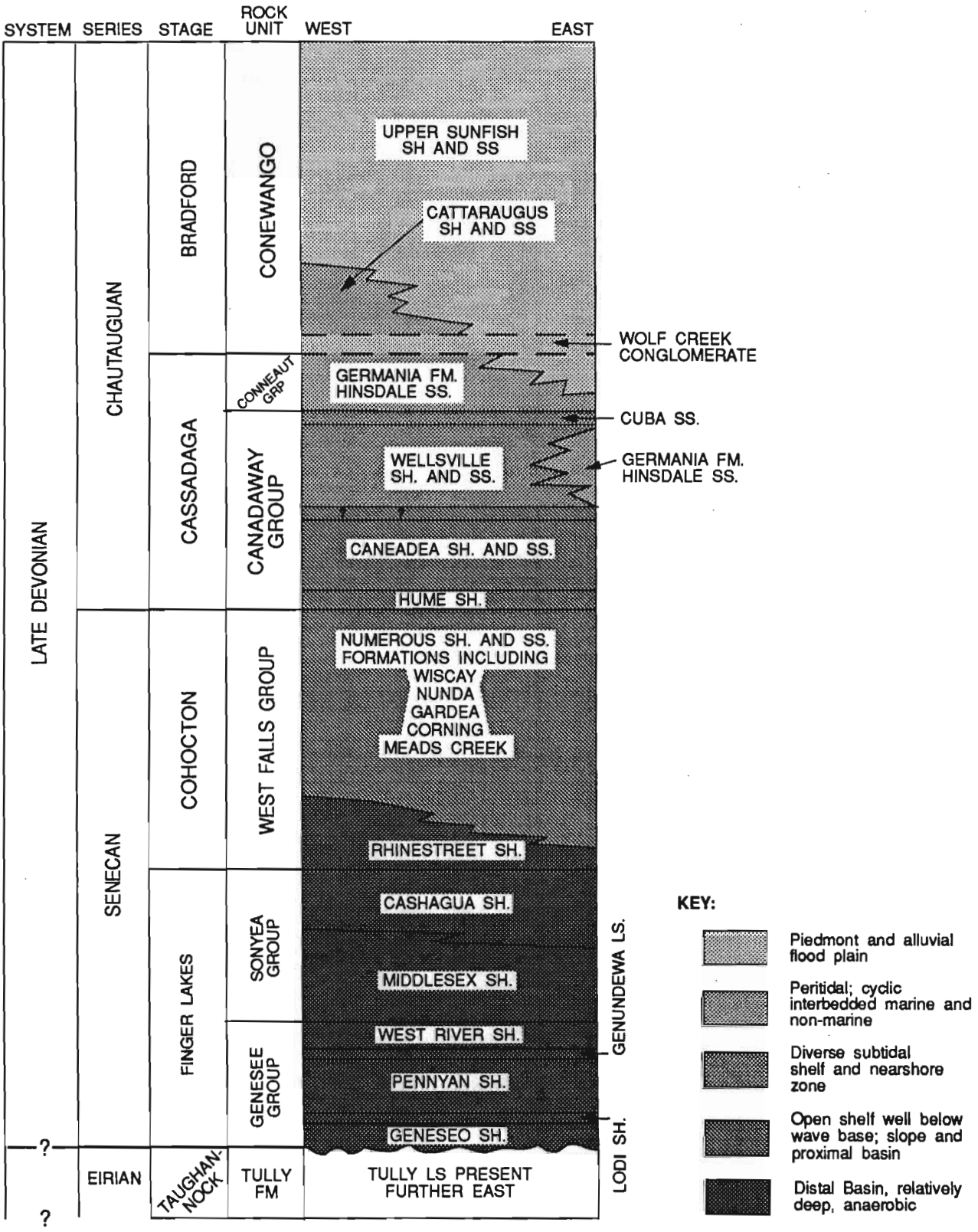


Figure 2-1
STRATIGRAPHIC CORRELATION CHART
FOR THE WELLSVILLE AREA

3. SITE INVESTIGATION METHODOLOGY

3.1 INTRODUCTION

Two phases of field investigation activities were performed on and adjacent to the Wellsville-Andover Landfill site. The Phase I RI was conducted between July 15, 1991, and February 27, 1992. Phase II RI fieldwork was conducted between June 14 and September 16, 1993. The primary objectives of the field investigation were to:

- Determine the nature and extent of on-site contamination;
- Determine the geologic and hydrogeologic characteristics of the site that may affect contaminant migration; and
- Assess possible contaminant migration off site.

The field tasks that were performed during the Phase I RI in order to complete these objectives were as follows:

- Base map development;
- Geophysical surveys (total earth field magnetics, ground conductivity, and seismic refraction);
- Trench excavation;
- Monitoring well installation (including description of the overburden and upper bedrock geology);
- Subsurface soil sampling;
- Groundwater sampling;
- Residential well and spring sampling;

recycled paper

- Surface water and sediment sampling;
- Surface soil sampling;
- Leachate sampling;
- Air sampling;
- Leachate collection system evaluation; and
- Habitat-based ecological assessment.

Based on the results of these tasks, it was determined that additional field tasks were necessary in order to more fully define site characteristics. Therefore, during the Phase II RI, the following field tasks were performed:

- Installation of additional monitoring wells and groundwater piezometers both within and outside of the fill boundaries;
- Test pit excavation to confirm fill boundaries defined by geophysics;
- Groundwater sampling;
- Residential well and spring sampling;
- Surface water and sediment sampling;
- Leachate and seep sampling;
- Aquifer testing;
- Perimeter explosive gas survey; and
- Expansion of the habitat-based ecological assessment.

All samples collected during the Wellsville-Andover Landfill RI were subject to the analytical protocols of the NYSDEC Contract Laboratory Program (CLP) as defined in the Analytical Services Protocol (ASP) of September 1989. All analyses were performed by E & E's Analytical Services Center (ASC), with the exception of the air and geotechnical analyses. Air samples were analyzed by Method TO-14 by Air Toxics, Ltd., of Rancho Cordova, California, and geotechnical analyses were performed by GZA GeoEnvironmental of New York, in Cheektowaga, New York. A summary of the analytical methods employed

appears in Table 3-1. Field and laboratory quality assurance (QA) and quality control (QC) procedures are discussed in the Quality Assurance Project Plan (QAPjP) prepared by E & E for the site (provided under separate cover).

3.2 BASE MAP DEVELOPMENT

A base map of the site was developed to delineate the locations of man-made on-site structures, site topographic features, and sampling points within the site. Initial surveying was completed in July 1991. Surveying of on-site buildings, roads, manholes, etc. and the establishment of a 200-foot by 200-foot grid system were accomplished during the initial site survey. Additional site surveying was performed in November 1991 consisting of the locations of all on-site sampling points, the elevation and location of all existing monitoring wells, and the elevation of the leachate collection system. In August 1993, near the completion of the Phase II RI, the locations of the Phase II RI test pits and the elevations and locations of the newly installed monitoring wells and piezometers were surveyed. All elevations were vertically surveyed to within 0.05 foot, and all locations were horizontally surveyed to within 1 foot. A summary of well elevation data is presented in Table 3-8.

In order to supplement ground-based data collected at the site, an aerial photograph was taken on March 4, 1992. Data derived from this photograph were used in conjunction with the ground survey during the development of the base maps used in this report and the FS. A contour map of the site with a contour interval of two feet was generated by Erdman Anthony Consulting Engineers based on aerial photography. This map is included as Figure 2-2 in the back pocket at the end of this report. Topographic contour data from this map and E & E's survey data were incorporated into one site base plan which is included as Figure 3-11 in the back pocket of this report.

As recommended and approved by NYSDEC, the use of infrared sensing techniques during aerial photography was deemed unnecessary and not performed during the RI.

3.3 GEOPHYSICAL INVESTIGATION

The geophysical investigation program was designed to accomplish several objectives:

- To locate and delineate the boundaries of subsurface, ferrous objects of concern (e.g., 55-gallon drums);

- To define waste disposal areas and, if possible, delineate the cells within the disposal areas;
- To detect and define the boundary of potential shallow groundwater contaminant plumes containing conductive heavy metals;
- To determine the depth to, and morphology of, the bedrock surface and delineate subsurface stratigraphy; and
- To assist in the selection of monitoring well locations.

Three surface geophysical surveying techniques were selected to accomplish the preceding goals: total earth field magnetics, electromagnetic ground conductivity, and seismic refraction.

A grid system was established over the site during the initial survey in July 1991. Transect lines trending north-south and east-west were surveyed with a node spacing of 200 feet. Within this surveyed grid, geophysical survey data points were located on a 40-foot north-south by 20-foot east-west grid system.

Data collected in the unfilled area north of the containment ditch are considered representative of background conditions and have been used for comparison with data collected in filled and disturbed areas.

3.3.1 Total Earth Field Magnetics

Total earth field magnetic data were collected with an EG&G model G856 magnetometer. The magnetometer was used to delineate subsurface ferrous objects and screen monitoring well locations prior to drilling. Data were collected every 20 feet along east-west transects spaced 40 feet north to south as described above.

In order to correct for diurnal variations in the earth's magnetic field, periodic readings were made at a single background location. Due to the vast extent of the survey area, it was impractical to periodically return to the same background location. Therefore, a second G856 magnetometer was employed at the background location. This magnetometer was used to collect data at 15-minute intervals from the beginning until the end of the magnetometer survey, thus allowing for correction of diurnal drift. The background location, or base station, was located in the tree line between the northwest fill area and the central access road. The exact location and magnitude of the readings are relatively unimportant; the fluctuations in the earth's magnetic field, however, are of primary importance.

All magnetic data were stored directly in the memory of the G856 magnometer. At each location, the G856 stores the magnetic field strength, time, station number (incremented by one for each reading), and assigned survey line number. These data, along with the data collected at the base station, were downloaded into an IBM-compatible computer using the software package MAGPAC, version 4.1.5, by EG&G Geometrics. MAGPAC allows the field data to be corrected for diurnal drift (using the base station data) and then converted to a form with x and y coordinates suitable for contouring. The corrected data were then plotted and contoured using the software package Surfer, version 4.10, by Golden Software, Inc. The final total earth field magnetics contour map and a discussion of the results are presented in Section 4.2.2.

3.3.2 Electromagnetic Ground Conductivity

Ground conductivity data were collected with a Geonics model EM31 conductivity meter equipped with a digital data logger (polycorder). This instrument was selected because its maximum depth of influence is 18 feet, and the depth of fill is estimated to be less than 14 feet. The EM31 was used to define waste disposal areas and individual cells, delineate conductive shallow groundwater contaminant plumes, and screen monitoring well locations prior to drilling. Data were collected every 20 feet along east-west transects spaced 40 feet north to south as described previously. At each data collection node, a measurement was recorded in both the horizontal and vertical dipole modes. The depth of penetration in the vertical dipole mode is approximately 18 feet. The depth of penetration in the horizontal dipole mode is approximately 8 to 10 feet, and the instrument is more sensitive to shallow subsurface features than in the vertical dipole mode.

All conductivity data were stored directly in the memory of the polycorder. At each location, the polycorder stores the magnitude of the ground conductivity along with the x and y coordinates of that location for both the vertical and horizontal dipole modes. These data were then downloaded into an IBM-compatible computer using the software package DAT31, version 2.03, by Geonics, Ltd. DAT31 allows the field data to be converted into a form suitable for contouring. The adjusted data were then plotted and contoured using Surfer version 4.10 by Golden Software, Inc. The final electromagnetic ground conductivity contour map and a discussion of the results are presented in Section 4.2.2.

3.3.3 Seismic Refraction Survey

In order to preliminarily delineate subsurface stratigraphy and aid in monitoring well placement, a seismic refraction survey was performed. Data were collected with a Geometrics Ltd., model 2401, 24-channel, signal enhancement seismograph. Data were collected along six lines, labeled A through F (see Figure 1, Appendix A), in separate 24-channel spreads consisting of 24 geophones laid out at 10-foot intervals along the 230-foot spread cable. Energy for the seismic survey was provided by a sledgehammer impacting on a steel plate. Multiple hammer blows were recorded at each shot-point and digitally stacked in order to obtain sufficient energy and reduce the signal-to-noise ratio. In two instances, the signal-to-noise ratio was high and these two spreads were redone. Shot-points were located in the middle, at each end, and offset 115 feet from each end of the spread cable.

All recorded data were downloaded to a computer for interpretation. Interpretation included picking the first arrivals from each record, plotting time-distance graphs, and analyzing these graphs to assign arrival times. The site was found to best fit a three-layer model representing overburden, weathered bedrock, and competent bedrock. Data were analyzed using the RF software package developed by the U.S. Bureau of Reclamation, which uses algorithms from the widely-accepted Society of Exploration Geophysicists' General Reciprocal Method (GRM).

Appendix A contains the seismic refraction survey report prepared by Davenport/Hadley for this site. This report contains detailed information on the collection, interpretation, and analysis of the seismic refraction data.

3.4 TRENCH AND TEST PIT EXCAVATION

3.4.1 Phase I RI Trenching

The results of the total earth field magnetics and electromagnetic ground conductivity surveys indicated that numerous anomalies with varying intensity and areal extent exist at the site. Based on these results, which are discussed in Section 4.2.2, five areas were selected for trench excavation. These locations are shown in Figure 3-1. Trench 1 was excavated in the northwest corner of the northwest fill area in an area of very strong magnetic and ground conductivity (in both the horizontal and vertical dipoles) anomalies. Trench 2 was excavated in the central portion of the northeast fill area in an area exhibiting strong ground conductivity anomalies (in both the horizontal and vertical dipoles) and adjacent to a strong

magnetic anomaly. Trench 3 was excavated in the southeast portion of the northwest fill area in an area exhibiting a very strong ground conductivity anomaly (in both the horizonal and vertical dipoles) and a moderately strong magnetic anomaly. Trench 4 was excavated in the northeast corner of the south-central fill area in an area exhibiting a very strong ground conductivity anomaly (in both the horizontal and vertical dipoles) and a moderately strong magnetic anomaly. Trench 5 was excavated in the central portion of the south fill area in an area exhibiting a very strong ground conductivity anomaly (in both the horizontal and vertical dipoles) and a moderately strong magnetic anomaly.

In terms of temporal distribution, landfilling reportedly proceeded in a south-to-north direction, beginning with the south fill area followed by the south-central, northwest, and northeast fill areas, respectively (Village of Wellsville 1986). Therefore, Trench 5 represents the oldest fill followed by Trench 4, Trench 3, Trench 1, and Trench 2, respectively. During excavation of Trench 3, a newspaper dated 1967 was found. Newspapers found in Trench 1 and Trench 2 date these areas to 1974 and 1980, respectively.

All trenches were excavated by E & E's subcontractor, Entech Management Services Corporation, using a Caterpillar Model 426 backhoe equipped with non-sparking teeth. All trenches were excavated approximately 3 feet wide by 12 to 15 feet long. The trench depths were dependent upon the material encountered and are discussed in Section 4.4.1. All trenches were excavated until the probable source of the anomaly was determined. The cover material was removed and placed alongside the trench. The waste was then removed and placed on the opposite side of the trench on plastic sheeting. After excavation and sampling were complete, the waste was placed back in the trench and the cover soil replaced on top. In all cases, additional clean fill (bank run gravel) was spread on top of the excavated area followed by hay. A description of the trenching and materials encountered is presented in Section 4.4.1.

During excavation, downwind air quality conditions were monitored with an HNu brand photoionization detector (PID), flame ionization detector (organic vapor analyzer [OVA]), and MIE aerosol monitor (miniram). In addition, conditions near the backhoe were monitored with a combustible gas and oxygen (CG/O_2) meter.

One composite soil/waste sample was collected from each trench for laboratory analysis. All samples were collected from the bucket of the backhoe or from the pile of excavated material using dedicated stainless-steel spoons, precleaned according to the

procedures described in Section 3.14. All samples were analyzed by E & E's ASC for full Target Compound List (TCL) parameters according to NYSDEC CLP protocols. Table 3-2 describes the samples collected. For QA/QC purposes, additional volume was collected with sample TP-5 for matrix spike and matrix spike duplicate (MS/MSD) analyses. All sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP.

3.4.2 Phase II RI Test Pits

Shallow test pits were excavated in five areas of the site on August 3, 1993. The test pits were installed to verify the validity of the geophysical survey in delineating the boundaries of the fill areas. The locations chosen for the excavations were areas where topographic clues regarding the presence of fill were absent or conflicted with the geophysical survey results.

All test pits were excavated with a backhoe by E & E's subcontractor Sterling Environmental Services of Amherst, New York. All test pit material was visibly inspected for the presence of fill. Air monitoring was performed continuously using an OVA and CG/O_2 meter. A total of 17 test pits were excavated in the five areas shown on Figure 3-1 and discussed below.

Area 1 was located along the northern side of the northwest fill area. Three test pits, T2-1A, T2-1B, and T2-1C, were excavated in this area to define the northern extent of the landfill. Fill was present in T2-1A at a depth of 1 foot below ground surface (BGS), but was not present in T2-1B. A third test pit, T2-1C, was located between T2-1A and T2-1B and the excavation was extended between T2-1B and T2-1C to determine the edge of the fill (see Figure 3-1).

Area 2 was located southwest of the drainage collection pond between the northwest fill area and the south-central fill area. Geophysical data indicated that the northwest fill area extended under the road and that fill was nearly continuous between the two landfill areas. Five test pits (T2-2A through T2-2E) were excavated and all indicated the presence of fill at depths no greater than 4 feet.

Area 3 was located near the southwest corner of the northwest fill area. An unnatural mound exists in this area, yet the extent of fill was not clearly defined by the

geophysical survey. Three test pits, T2-3A, T2-3B, and T2-3C, were excavated. Fill was present at all three locations at depths ranging from 0.5 to 2.0 feet BGS.

Area 4 was located east of the leachate holding pond. The geophysical survey indicated that fill material was present in close proximity to the pond. Five test pits were excavated to verify these results (T2-4A through T2-4E). Fill material was encountered at locations T2-4A and T2-4B, located 108 and 78 feet east of the leachate pond, respectively. The fill was present at depths ranging from 0.5 to 1.0 feet BGS. Native materials were found in T2-4C, located 20 feet east of the holding pond. Test pit T2-4C was extended 15 feet eastward and no fill was encountered. Two additional test pits, T2-4D and T2-4E, were excavated approximately 58 and 33 feet east of the leachate pond, respectively. Fill was encountered at both locations at depths ranging from 0.5 to 1.0 feet BGS (see Figure 3-1).

The fifth area to be excavated was located along the southern edge of the south fill area to verify the southernmost extent of the landfill. One trench was excavated in this area (T2-5). Excavation began on the north side of the drainage ditch that runs along the south side of the landfill and was extended northward until fill was encountered 12 feet north of the drainage ditch.

All test pits were backfilled with the material removed, covered with the soil excavated at that location, and topped with hay. Decontamination of the backhoe was performed following the completion of all test pits by high-pressure steam cleaning the bucket over the leachate holding pond.

3.5 GROUNDWATER MONITORING WELLS AND PIEZOMETERS

3.5.1 Monitoring Well and Piezometer Installation

3.5.1.1 Phase I RI Wells

A total of 18 wells were installed between August 26 and October 4, 1991. All monitoring wells were installed by American Auger and Ditching Company, Inc., a subcontractor of E & E, under the guidance of an E & E geologist and site safety officer. All monitoring wells were installed in accordance with E & E's June 1991 Health and Safety Plan. Eight pairs of shallow and deep wells and two separate deep wells were installed. The shallow wells were screened across the water table, while the deep wells were screened either across the water table or within the first water-bearing zone below the first relatively competent bedrock layer encountered. The primary purposes of these wells were to establish

groundwater flow direction, determine horizontal and vertical hydraulic gradients, describe the subsurface geology, and provide groundwater sampling points.

Monitoring well locations are shown on Figures 3-1 and 3-11. MW-1D was installed north and upgradient of the filled areas to assess background groundwater conditions in the bedrock aquifer. A shallow background well could not be installed because of the lack of water encountered in the overburden at this location. Additionally, due to the comparatively greater depth at which water was encountered in the bedrock, it was expected that very little water would exist in the overburden, even during periods of high precipitation. Three pairs of shallow and deep wells and a single deep well were installed along the eastern perimeter of the site. Monitoring well pair MW-2S/2D was installed southeast of the northeast fill area in order to intercept possible groundwater contamination migrating from that area. MW-2S was installed 66 feet south of MW-2D near a small pond that is assumed to be spring fed based on its continual presence during the dry summer. MW-4D was installed as a single bedrock well at the northern end of the southern borrow pit. Competent bedrock was encountered at 9 feet, thereby precluding the installation of an overburden well. Monitoring well pair MW-5S/5D was installed northeast of the southern fill area to intercept possible contamination from the south-central and/or south fill areas. Monitoring well pair MW-6S/6D was installed just east of the south fill area to assess that fill area's impact on the groundwater.

Three well pairs were installed along the western perimeter of the site. Monitoring well pair MW-10S/10D was installed just west of the northwest fill area and the leachate collection system. MW-9S and MW-9D were installed near the north access gate to assess the potential for contamination migrating south from the northwest area. MW-8S and MW-8D were installed immediately west of the south fill area in a bedrock "trough" identified during the seismic survey. However, after completion, MW-8D was deemed unusable due to the presence of grout in the well casing. While subsurface information collected during the drilling of MW-8D has been used in this report, MW-8D was not used as a groundwater sampling point because the PVC casing had apparently collapsed and rendered the well inoperable. This well was subsequently abandoned and a new one drilled in its place (as directed by NYSDEC on February 4, 1992) on February 26 and 27, 1992.

In addition to the perimeter wells, MW-3S and MW-3D were installed near the center of the site in a wide drainage swale adjacent to the drainage collection pond. Two

additional wells were installed south of the site. MW-7D was installed to penetrate an assumed bedrock trough trending north-south. At this location, no water was encountered in the overburden. Therefore, rather than install MW-7S, a new location was chosen approximately 190 feet west and downhill of MW-7D. This well was designated MW-11S.

Phase I RI Deep (Bedrock) Wells

All deep wells were screened entirely within the bedrock underlying the site. The screened intervals were determined in the field based on such factors as the presence of fractures, drilling water loss or gain, and well recharge determined by a bailer test. The bailer test consisted of bailing out the standing water in the open core hole and measuring the subsequent recharge. Additionally, an attempt was made to set all bedrock well screens in the same horizon near the top of bedrock across the site. However, due to the relief at the site as well as the lateral and vertical variability of the bedrock geology, different types of bedrock were encountered at different locations.

During drilling, 2-foot split-spoon samples were collected continuously in the overburden. Split-spoon sampling was performed in conjunction with a standard penetration test as described in the American Society for Testing and Materials (ASTM) Designation D 1586-84, "Standard Method for Penetration Test and Split-Barrel Sampling of Soils." A 2-foot by 1½-inch inside diameter (ID) hardened steel split-barrel sampler with shoe was driven in 2-foot depth intervals by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler 6 inches was recorded as the blow count on the subsurface boring log. These blow counts were used to assess the relative density of the overburden at each well location.

All split-spoon recoveries were logged in the field by an E & E geologist. Special note was made of all soil types encountered, changes in lithology, and the depth at which groundwater was encountered. Soil descriptions were based on the Unified Soil Classification System (USCS). In addition, all recovered soil was screened for VOCs with an HNu and OVA. Soil samples were retained from each deep well boring for chemical and geotechnical analyses as outlined in Section 3.5.3. In addition to monitoring with an HNu and OVA, the borehole was continuously monitored with a CG/O_2 meter, and the surrounding area downwind of the drilling location was monitored with a miniram.

The boreholes were advanced with 4¼-inch ID, continuous-flight, hollow-stem augers until bedrock refusal. Bedrock was then cored to the total depth of the well using HQ-size water coring techniques, yielding a nominal 4-inch diameter corehole. Water drilling techniques were chosen instead of air drilling techniques in order to suppress the escape of any VOCs encountered during drilling. The augers remained in place until the well was nearly completed to serve as temporary surface casing. All drill water was held for discharge to the leachate holding pond near the southern access gate. All soil cuttings were left at the borehole location because no recovered soils exhibited HNu readings in excess of 5 ppm above background.

Auger refusal was encountered twice in MW-1D. First, at a depth of 15 feet, refusal occurred on a competent siltstone layer approximately 1.5 feet thick. Below this layer was clay, derived from weathered shale, that was too soft to core. Therefore, augering resumed until refusal at a depth of 44 feet. Below this depth, the well was cored.

Once a bedrock well was drilled to its total depth and sufficient water was encountered, 10 feet of 2-inch ID, 0.010-inch machine-slotted, schedule 40, PVC screen was set in the bottom of the corehole. Flush-joint, threaded, schedule 40, PVC riser of the same diameter was positioned above the screen to an approximate height of 2.5 feet above the ground surface. A quartz sand filter-pack was then poured around the screen. The height of sand above the screen varied from 1.5 feet to 6 feet and was determined by the depth of the well and the depth at which water was encountered. Number 2 Q-Rok® quartz/silica sand was used in all wells except MW-7D and MW-10D, where number 3 Q-Rok® was used. A bentonite seal was then placed above the sand pack. All deep wells were sealed within bedrock or across the interface to prevent direct overburden/bedrock communication within the well. All deep wells except MW-4D were sealed by mixing a slurry of 4 to 5 gallons of Benseal® (Wyoming bentonite chips) and pumping it downhole with tremie lines. This resulted in a 3.9- to 8.5-foot seal, depending on the amount of void space surrounding the riser. Since MW-4D was relatively shallow, a 2.5-foot bentonite pellet seal was emplaced by hand. Table 3-3 summarizes the monitoring well construction data for each well.

The remainder of the annulus around the well was filled to the surface with grout consisting of Portland cement and 5% bentonite. Bentonite was not used in the upper 3 feet of the grout to ensure stability for the locking steel protective casing that was furnished for each well. Each well was completed with a concrete drainage pad constructed on the ground

surface around the protective casing to divert surface runoff away from the well. All wells were secured with a No. 3252 Master® lock. Figure 3-2 depicts the typical deep (bedrock) well design.

Phase I RI Shallow (Overburden) Wells

One shallow well was installed at each monitoring well location depicted on Figure 3-1, with the exception of the locations adjacent to MW-1D, MW-4D, and MW-7D. As discussed previously, these locations were not suitable for overburden wells. All shallow wells were screened entirely within the overburden at and around the site. The depth of each shallow well was predetermined during split-spoon sampling of the adjacent deep well. Where possible, the screens in the overburden wells were set at such a depth as to intercept the water table and to allow for anticipated seasonal variations in the elevation of the water table.

The boreholes were advanced to the appropriate depth below the water table with 4¼-inch ID, hollow-stem, continuous-flight augers. Two-inch ID, 0.010-inch machine-slotted, schedule 40, PVC well screen was then placed into the borehole. Ten feet of screen was used in all wells except MW-2S and MW-6S. Because of the shallow depths of these wells, 4 feet of screen was used in MW-2S and 7 feet was used in MW-6S. Number 2 Q-Rok® quartz/silica sand was then placed around the screen to serve as a filter pack. The height of sand above the screen varied from 1 foot to 5 feet and was determined by the depth of the well and the depth to water. In all shallow wells except MW-2S, a 2-foot thick bentonite seal was placed above the sand using hydrated Wyoming bentonite pellets. Because MW-2S was only 9 feet deep, there was only sufficient room for a 1-foot seal. The remainder of each well was constructed identically to the deep wells, as described previously. Figure 3-3 depicts the typical shallow (overburden) well design, and Table 3-3 contains monitoring well construction data.

As with the deep wells, an HNu, OVA, CG/O_2 meter, and miniram were used to monitor the borehole. All soil cuttings were left uncontained at the well location because no recovered soils exhibited HNu readings in excess of 5 ppm above background.

On September 20, 1991, a sample of the water used for drilling and decontamination was collected from the driller's holding tank as a field blank for later comparison with the groundwater samples. This sample, identified as DW-1, was analyzed for full TCL

parameters according to NYSDEC CLP protocols. The water used for decontamination and drilling was obtained with the permission of the Village of Wellsville from a hydrant located at the Wellsville water treatment plant. This water is obtained from the Genesee River, treated, and used as potable water within the village. Analysis indicated that this water was free of organic contaminants, but contained calcium at 19,500 μg/L, iron at 245 μg/L, magnesium at 5,330 μg/L, and sodium at 9,920 μg/L as well as low concentrations (below the contract-required quantitation limits [CRQLs]) of aluminum, barium, potassium, and silver.

Subsurface boring logs for all of the wells installed during the Phase I RI are included in Appendix B.

3.5.1.2 Phase II RI Wells and Piezometers

As part of the Phase II RI fieldwork, a total of 12 wells and 14 piezometers were installed at the site between June 16 and July 23, 1993. These include four off-site bedrock and overburden well pairs (MW-12D/12S, MW-13D/13S, MW-14D/14S, and MW-16D/16S); one off-site bedrock and overburden well triplet (MW-15D/15DA/15S); one on-site very deep bedrock well (MW-5VD); four on-site nonfill piezometers (PZ-1, PZ-4, PZ-5, and PZ-6); and 10 on-site landfill piezometers (PZ-2, PZ-3, and PZ-7 through PZ-14). All Phase II RI wells and piezometers were installed by Advanced Drilling Investigations (ADI) under the supervision of Joseph C. Lu, P.E., P.C. (JCL), a subconsultant of E & E. All work followed the safety procedures detailed in JCL's Health and Safety Plan submitted to E & E prior to the start of the field activities.

Figures 3-1 and 3-11 show the locations of the wells and piezometers. Tables 3-7 and 3-8 summarize the construction data for each well and piezometer. The boring logs and well construction details for each well and piezometer installed during the Phase II RI are included in Appendix H.

All of the monitoring wells installed during the Phase II RI, except for MW-5VD, were placed further east and south (downgradient) of the fill areas relative to the Phase I RI wells to further delineate the horizontal extent of contaminant migration away from the site. MW-5VD was installed to aid in determining the vertical extent of contamination and to further explore the bedrock lithology to determine if a confining layer exists beneath the bedrock previously investigated. The piezometers were installed to gather data regarding

groundwater interaction with the fill areas and to obtain information concerning the hydraulic gradient immediately beneath and adjacent to the fill areas.

Phase II RI Off-Site Deep (Bedrock) Wells

All deep wells were installed using similar methodologies as were used during the installation of the deep wells in the Phase I RI in 1991. The only exception involved the use of 4-inch ID temporary casing to contain drill water during rock coring. In the previous work, augers were left in place for coring and no temporary casing was used. An effort to follow this protocol resulted in excessive loss of water. The NYSDEC on-site representative concurred with the use of temporary casing during rock coring.

The boreholes were advanced using either 4¼-inch ID or 3¼-inch ID hollow-stem augers. Continuous split-spoon samples were obtained as the augers were advanced. Upon bedrock refusal, the augers were removed from the borehole and 4-inch ID temporary steel casing was lowered into the borehole and driven into bedrock to create a seal. Debris was flushed from the temporary casing using water pumped through a tricone roller bit. After flushing, the drilling was continued to its total depth using HQ-size water coring techniques yielding a nominal 4-inch-diameter hole.

All borings were completed with 2-inch ID, schedule 40, PVC wells using similar specifications as were used during the installation of the wells in 1991. Figure 3-4 illustrates the typical design for the off-site bedrock wells installed during the Phase II RI in 1993.

During the installation of MW-15D, auger and split-spoon refusal was encountered at 18.5 feet BGS after encountering an approximately 6-inch-thick competent sandstone layer. A clay layer was encountered below this sandstone layer, which was too soft to core. Therefore, the boring was advanced using a tricone bit to competent rock at 22.3 feet BGS. Two-foot split-spoon samples were collected continuously until refusal. Below this depth, the well was cored using HQ water coring techniques as in the other bedrock wells.

A similar situation was encountered during the installation of MW-16D. Initial refusal was met at 18 feet BGS, where a 1-foot-thick sandstone layer was encountered. Soil similar to that above the sandstone was also found beneath it. Therefore, this boring was also advanced using a tricone bit taking continuous split-spoon samples to competent bedrock at 37 feet BGS. Below this depth the well was cored.

MW-15D was found to be dry upon development even though indications of water were present during drilling. With NYSDEC's concurrence, an additional bedrock well, MW-15DA, was installed adjacent to MW-15D. MW-15DA was advanced to bedrock refusal at 22 feet BGS using 3¼-inch ID hollow-stem augers and then advanced from the soil/rock interface to 36.5 feet with a tricone bit. HQ rock coring techniques were used to drill from 36.5 feet BGS to the well's total depth at 53.5 feet BGS. The borehole was hand bailed and allowed to recharge overnight. After verifying the presence of groundwater, the boring was completed with a 2-inch ID, schedule 40, PVC well using specifications similar to the other wells.

Phase II RI Off-Site Shallow (Overburden) Wells

Shallow wells were paired with the five off-site deep well locations. These shallow wells were installed using similar methodologies to those used during the installation of the shallow wells in the Phase I RI. The only exceptions were MW-13S and MW-14S. Instead of 10-foot sections of screen, MW-13S and MW-14S were installed using 5- and 8-foot sections of 0.010-inch slotted PVC screen, respectively. These screen lengths were used because the shallow bedrock encountered at these two well locations precluded the installation of longer screens. Figure 3-5 illustrates the typical well design for the off-site shallow wells installed during the Phase II RI. No split-spoon samples were collected during drilling of the shallow wells, as lithology was predetermined during drilling of the adjacent deep well.

MW-12S, 13S, 14S, and 15S were dry immediately after installation, despite the fact that they were screened across moist soil zones indicating a potential water bearing zone. This may be due to the unusually dry summer and seasonal fluctuations in the groundwater table. In September 1993, MW-13S and MW-15S were found to contain water.

Phase II RI On-Site Very Deep Bedrock Well

One very deep well, MW-5VD, was installed adjacent to existing well pair MW-5D/5S. This area was selected because these wells contained the highest concentration of site-related contamination during the Phase I RI. The boring for MW-5VD was advanced to bedrock at 21.5 feet BGS using 6¼-inch ID hollow-stem augers. No split-spoon samples were collected since MW-5D was sampled. The augers were removed from the boring and 6-inch ID temporary steel casing was installed. Using a 5⅞-inch tricone bit, a rock socket

was installed 28.5 feet into bedrock (48.2 feet BGS). Four-inch ID permanent steel casing was installed in the boring and grouted in place. Using HQ coring techniques, the corehole was then advanced to 140 feet BGS. The rock core revealed an apparent aquiclude from 114.2 to 121.2 feet BGS. To prevent possible cross-contamination of aquifers, the corehole was backfilled with silica sand to 117 feet BGS and capped with a 5-foot bentonite chip seal from 117 to 112 feet BGS.

MW-5VD was completed with a 2-inch ID, schedule 40, PVC well with 20 feet of 0.030-inch machine-slotted screen installed from 110 to 90 feet BGS. A number 2 Morie® sand pack was installed from 2 feet below the screened interval (i.e., 112 feet BGS) to 3.5 feet above the screened interval (i.e., 86.5 feet BGS). A 6.5-foot-thick bentonite chip seal was installed above the sand pack from 86.5 to 80 feet BGS. The remainder of the annulus around the well was filled with a Portland cement/5% bentonite grout to grade. The well was finished with a locked protective casing, installed into a concrete drainage pad. The well construction detail for MW-5VD is provided as Figure 3-6.

Phase II RI On-Site Nonfill Piezometers

Four piezometers, PZ-1, PZ-4, PZ-5, and PZ-6, were installed within the site boundary but outside the fill areas. Three of them, PZ-1, PZ-5 and PZ-6, were drilled into the bedrock before encountering the first significant water-bearing zone. PZ-4 was the only nonfill piezometer installed completely in the overburden.

PZ-4 was advanced using 4¼-inch hollow-stem augers to its total depth. Split-spoon samples were collected at 5-foot intervals in the unsaturated zone and continuously after encountering water at 12.9 feet BGS.

PZ-1, PZ-5, and PZ-6 were advanced using 4¼-inch hollow-stem augers to bedrock. Split-spoon samples were taken at 5-foot intervals because saturated conditions were not encountered. Using the hollow-stem augers as temporary casing, the boring for PZ-1 was continued to its total depth using HQ water coring techniques. Because of the excessive water loss, 4-inch ID temporary casing was installed for coring PZ-5 and PZ-6.

These four piezometers were completed with a 2-inch ID, schedule 40, PVC well with 10 feet of 0.010-inch slotted screen. A number 0 Morie® sand pack was placed around the screen to serve as a filter pack. The sand pack extended from 1 foot beneath the screen to 2.0 feet to 3.9 feet above the screened interval. A bentonite chip seal with a thickness of 2.9

feet to 3.7 feet was placed above the sandpack. The remaining annulus around each piezometer was filled with a Portland cement/5% bentonite grout. The piezometer was completed with a 4-inch locked protective casing installed into a concrete drainage pad. The construction of PZ-4 is similar to that of the typical shallow (overburden) wells shown in Figure 3-5. The construction of PZ-1, PZ-5, and PZ-6 is similar to that of the deep (bedrock) wells shown in Figure 3-4.

On-Site Landfill Piezometers

Ten piezometers, PZ-2, PZ-3, and PZ-7 through PZ-14, were installed through the reported fill areas. Except for PZ-3, landfill debris was encountered at all boring locations. Table 3-9 shows the landfill cover thickness and the depth of the debris.

The boreholes for the landfill piezometers PZ-2 and PZ-7 through PZ-14 were advanced using 4¼-inch ID hollow-stem augers to a depth of 6.5 feet to 10.3 feet below the landfill debris. No split-spoon samples were collected.

PZ-3 is the only landfill piezometer in which no fill was encountered and that was installed in bedrock. The boring at PZ-3 was advanced to bedrock refusal at 14 feet BGS with 4¼-inch ID hollow-stem augers. No split-spoon samples were taken. Using the hollow-stem augers as temporary casing, the boring was advanced to its total depth at 22.5 feet BGS using NQ coring techniques (3-inch diameter corehole). The corehole was widened with a tricone roller bit to 4 inches prior to the installation of the well.

All borings were completed using 5 feet of 0.010-inch slotted 2-inch ID, schedule 40, PVC screen and 2-inch ID, schedule 40, PVC riser to 2.5 feet above ground surface. The only exception was PZ-2, which was installed with a 4-foot section of PVC screen. A number 0 Morie® sand filter pack was installed around the screen. The height of the sand pack varied from 1 to 2 feet above the screen. A bentonite chip seal of approximately 3 feet in thickness was installed above the sand pack and was placed across the landfill debris/overburden interface in order to prevent direct hydraulic communication with the fill. The remaining annulus around the riser was filled with a Portland cement/5% bentonite grout. The piezometer was completed with a 4-inch ID steel protective casing installed into a concrete drainage pad. Following installation, PZ-2 and PZ-10 were dry; however, both contained water in August and September 1993. Figure 3-7 illustrates the typical design for the on-site landfill piezometers and Figure 3-8 is a construction detail for PZ-3.

3.5.2 Well Development

Phase I RI

Following the completion of Phase I RI drilling activities, the 17 wells installed at the site (excluding MW-8D) were developed to offset any formation changes caused by the drilling operation, thereby tending to restore the natural hydraulic properties of the aquifer, as well as to enhance water flow into the wells. Data collected during the development of each well are included in tabular form in Appendix C.

All wells were developed by water evacuation and surging. Well MW-5D was initially developed on September 26, 1991, by surging with a PVC bailer and then pumping at a low flow rate with a centrifugal pump. Wells MW-1D, MW-2D, MW-3D, MW-3S, MW-4D, MW-5S, MW-10D, and MW-11S were initially developed between October 8 and 11, 1991. These wells were all purged with a PVC bailer and then pumped at a low flow rate with a submersible pump. In addition to pumping, wells MW-10D and MW-11S were purged of 10 and 16 gallons, respectively, with a PVC bailer. Wells MW-6D, MW-6S, MW-7D, MW-8S, MW-9D, MW-9S, and MW-10S were initially developed between October 8 and 11, 1991, by surging and subsequent evacuation with a PVC bailer.

Following initial development, all wells underwent additional development. Because of the high silt and clay content of the materials screened by the wells, the water remained well above the NYSDEC development goal of 50 nephelometric turbidity units (NTU) after initial development of each well. Therefore, NYSDEC requested additional development. Between October 15 and 18, 1991, all wells, with the exception of MW-1D and MW-2D, were surged with a rubber surge block and then bailed with a stainless-steel bailer. MW-1D and MW-2D were bailed with a stainless-steel bailer only. MW-2S was not developed prior to October 15, 1991, due to a lack of water in the well.

During development, periodic measurements of the pH, conductivity, temperature, and turbidity of the groundwater were recorded. These data are presented in Appendix C, along with the volume of water removed from each well. The number of well volumes purged from each well varied from 5.8 to 143.4 and was a function of the well recharge and amount of standing water in the well. All readings stabilized prior to completion of development; however, the turbidity of the disturbed groundwater remained well above the NYSDEC development goal of 50 NTU in all cases.

Because of the high percentage of silt and clay in the formation, the turbidity goal of 50 NTU could not be achieved without sacrificing the integrity of the wells. However, when the wells were allowed to recharge and stabilize prior to sampling, much of the suspended material settled out, yielding relatively clear samples (see Section 4.4.2).

Phase II RI

Following the completion of the drilling activities, seven monitoring wells and 12 piezometers containing water were developed. These included MW-5VD, MW-12D, MW-13D, MW-14D, MW-15DA, MW-16S and MW-16D, and all the piezometers with the exception of PZ-2 and PZ-10. The remaining monitoring wells (MW-12S, MW-13S, MW-14S, MW-15S and MW-15D) and piezometers (PZ-2 and PZ-10) were dry and therefore were not developed.

Development began no sooner than 24 hours after well installation was completed. Health and safety protocol similar to that used during the well installation was followed. With the exception of MW-15DA, all wells were developed using a hand pump equipped with a foot valve and discharge line. MW-15DA was developed by hand bailing. Based on the development conducted during the Phase I RI, it was decided that each of the Phase II RI monitoring wells would be actively developed for approximately 2 hours. This time period allowed for sufficient well development. The piezometers were developed for about 1 hour each. It was contended that piezometers designed solely for the collection of water level data require less rigorous development than monitoring wells. The on-site NYSDEC representative was in concurrence with the development schedule.

During development, periodic measurements of pH, conductivity, temperature and turbidity of the groundwater were recorded. All readings stabilized prior to completion of development. However, the turbidity remained very high in all cases because of the large amount of silt and clay in the formation. As in the Phase I RI, when the wells were allowed to recharge and stabilize following purging but prior to sampling, most of the suspended material settled out, yielding relatively clear samples. The well development data for each well and piezometer are included in Appendix H, Attachment 2.

3.5.3 Subsurface Soil Sampling

During subsurface drilling activities, the deep boring from each monitoring well pair was continuously sampled with a split spoon as described in Section 3.5.1. The samples were logged by a field geologist and monitored for the presence of VOCs using an HNu and OVA. During the Phase I RI, two subsurface soil samples were obtained from each of the 10 deep wells, with the exception of MW-2D. Due to the shallow depth to bedrock and the coarseness of the overburden, only one sample was collected from MW-2D. Including the duplicate sample, a total of 20 samples were collected for laboratory analysis during the Phase I RI. Eight samples were collected and analyzed for full TCL parameters according to NYSDEC CLP methods: two samples from the upgradient well MW-1D and two each from MW-6D, MW-7D, and MW-8D. Samples from MW-2D, MW-3D, MW-4D, MW-5D, MW-9D, and MW-10D were collected and analyzed for TCL VOCs and inorganic substances only. No subsurface soil samples were collected for laboratory analysis during the Phase II RI. Table 3-4 lists the Phase I RI samples collected, and Figure 3-1 depicts the monitoring well/boring locations.

In addition to the samples retained for chemical analyses, subsurface soil samples were also collected during the Phase I RI from each deep boring for geotechnical analyses (see Table 3-4). Samples were collected from each major lithologic unit encountered at each well pair location. Geotechnical samples were retained until all drilling was complete. At that time, 19 representative samples were chosen for moisture content, grain-size distribution, hydrometer, and Atterberg limits testing. No geotechnical samples were collected during the Phase II RI.

All split-spoon samples were screened with an HNu and OVA immediately upon opening the spoon. Any sample in which VOCs were detected with the HNu were screened with vinyl chloride Draeger tubes because this compound was found to be present during earlier investigations. No readings were observed with the Draeger tubes.

No HNu readings were observed on any split-spoon sample from the monitoring wells except in MW-1D and MW-5D. HNu readings up to 5 ppm were observed in the upper 4 feet of MW-1D; however, these readings were interpreted as interference from water vapor in the topsoil. Fluctuating HNu readings of 0 to 2 ppm and 0 to 1 ppm were observed in the 6- to 8-foot and 8- to 10-foot interval split spoons, respectively, in MW-5D. Various OVA readings up to 10 ppm were observed in numerous wells. However, based on associated HNu

readings, these readings were interpreted as methane and other light hydrocarbons. During drilling of the Phase II RI piezometers, only PZ-1, PZ-4, PZ-5, and PZ-6 were split-spoon sampled. No HNu readings above background were detected from these samples; however, various OVA readings were detected and interpreted to be methane.

Phase I RI subsurface soil samples for chemical analysis were collected in areas exhibiting the greatest VOC concentration whenever possible. However, because of coarse soils and poor split-spoon recoveries, this was not always possible. Therefore, sample collection was also based on field observation of physical characteristics. Each split-spoon sampler was decontaminated prior to use, as described in Section 3.14. Preservation, shipping, and handling procedures were performed in accordance with the QAPjP.

Field QA/QC samples collected during subsurface soil sampling included one field duplicate, one rinsate blank, and one MS/MSD sample set for full TCL analysis, as well as one MS/MSD sample set for TCL VOC and inorganic substance analyses. The field duplicate for full TCL analysis was collected from MW-8D, and the MS/MSD sample set for full TCL analysis was collected from MW-6D. The MS/MSD sample set for TCL VOC and inorganic substance analyses was collected from MW-10D. The rinsate blank consisted of deionized water passed through a previously decontaminated split spoon. All sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP.

3.5.4 Groundwater Sampling

Phase I RI

Monitoring wells sampled during the Phase I RI included 17 of the 18 newly installed wells (excluding MW-8D) and the four wells installed during the 1986 Phase II study. Not including field QA/QC samples, a total of 21 groundwater samples were collected between October 22 and 24, 1991 and analyzed for full TCL parameters according to NYSDEC CLP methods.

Prior to groundwater sampling, static water levels were measured to within 0.01 foot in each well. All wells were then purged of three times the volume of water standing in the casing, with the exception of MW-2S and CW-3A. Because of very slow recharge rates, these wells were purged dry and only 2 and 1.4 well volumes, respectively, could be purged

prior to sampling. Temperature, conductivity, and turbidity measurements were recorded at the time of sampling and are presented in Section 4.4.2 and Table 4-8.

Because of the presence of silt and clay in the surrounding formation, the turbidity in all wells sampled during the Phase I RI remained above 50 NTU following development. Therefore, after purging, only the organic portion of the sample was collected. The well was then allowed to recharge, and the suspended sediment was allowed to settle overnight. Within 24 hours of purging, the inorganic portion of the sample was carefully collected in order to minimize sample turbidity. The turbidity of both the organic and inorganic sample portions was recorded and is presented in Section 4.4.2. This procedure was utilized because turbidity has little effect on the organic portion of the sample, but it has a strong effect on the metals content.

Dedicated, disposable, polyethylene bailers with dedicated polyethylene or nylon rope were used to purge and sample all the monitoring wells. Vials for VOC analysis were filled first, and care was taken not to agitate the sample. When the inorganic sample portion was collected, the bailer was used to carefully remove water from the top of the standing water column to minimize agitation of the settled sediment. The sample bottles for total metals analysis were filled prior to the bottles for cyanide analysis, and both turbidities were recorded. Ten of the 21 samples for total metals analysis had turbidities less than 50 NTU, while only two (GW-2S and GW-9S) had very high turbidities (>4,000 NTU).

Because of very slow recharge, sufficient sample volume could not be collected from MW-2S, MW-9S, and CW-3A for full TCL analysis. Therefore, samples GW-2S, GW-9S, and CW-3A were analyzed only for VOCs and metals.

All analyses were performed on unfiltered samples. Field QA/QC samples included a trip blank analyzed for TCL VOCs, as well as one field duplicate and one MS/MSD sample set analyzed for full TCL parameters. The field duplicate, designated GW-11SDD, was collected from MW-11S, and the MS/MSD sample set was collected from MW-10D. Sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP for all groundwater samples.

Phase II RI

During the Phase II RI, a total of 31 monitoring wells were sampled. This includes the four pre-RI wells, all 18 Phase I RI wells, and nine of the 12 Phase II RI wells.

MW-12S, MW-14S, and MW-15D remained dry during field activities and thus were not sampled. Samples from all remaining wells except MW-13S, MW-15S, and MW-15DA were collected on July 29 and 30, 1993, and submitted to E & E's ASC for TCL VOC and inorganic analyses according to NYSDEC CLP methods. MW-13S, MW-15S, and MW-15DA were dry during this sampling trip and thus were not sampled with the others. On August 3, 1993, approximately ½ foot of water was present in MW-15DA and a sample was collected. However, because of the limited volume, this well was sampled for TCL VOCs only and without prior purging. On September 16, 1993, water was observed in MW-13S and MW-15S. Therefore, these wells were purged dry but were sampled for TCL VOCs only due to the limited amount of water present. MW-12S, MW-14S, and MW-15D remained dry throughout the Phase II RI field activities and were not sampled.

In addition to the above parameters, samples MW2-2D, MW2-5D, MW2-5S, MW2-11S, and CW2-3B were analyzed for total suspended solids (TSS), 5- and 28-day biological oxygen demand (BOD_5 and BOD_{28}), chemical oxygen demand (COD), and total Kjeldahl nitrogen (TKN).

Prior to Phase II RI groundwater sampling, a complete round of static water level measurements were recorded. All wells to be sampled were then purged by hand bailing of three times the volume of water standing in the casing or until dry. Because of slow recharge rates, MW-1D, MW-2S, MW-3S, MW-3D, MW-6D, MW-8D, CW-3A, CW-4A, and CW-4B were purged dry after removing amounts ranging from 1.4 to 2.7 standing well volumes. The remainder of the wells sampled were purged of at least three volumes except MW-15DA, which was not purged as discussed above. Temperature, pH, conductivity, and turbidity measurements were recorded at the time of sampling and are presented in Section 4.4.2 and Table 4-27.

Like the Phase I RI wells, the turbidity in the Phase II RI wells remained above 50 NTU following development because of the presence of silt and clay in the formations. Therefore, after purging, the wells were allowed to recharge and the suspended material was allowed to settle for a period of up to 24 hours. Samples were then collected using techniques similar to those discussed above for Phase I RI samples.

All analyses were performed on unfiltered samples. Field QA/QC samples included one MS/MSD sample set (MW2-3D) and two duplicates (MW2-5SD and CW2-3BD) for TCL VOC and inorganic analyses, as well as four trip blanks for TCL VOC analysis. Sample

preservation, shipping, and handling procedures were performed in accordance with the QAPjP.

3.6 RESIDENTIAL WELL AND SPRING SAMPLING

Phase I RI

Five residential wells (Rosini, Teller, Kelley Jr., Bauer, and Vacarro) and two groundwater springs (LaDue and Miller) were sampled during the Phase I RI on October 24 and 25, 1991 (see Figure 3-9). All samples were analyzed for full TCL parameters according to NYSDEC CLP methods, with the exception of VOCs, which were analyzed according to United States Environmental Protection Agency (EPA) Drinking Water Method 524.2.

Following sample collection, measurements of conductivity, temperature, and turbidity were recorded. These data are presented in Section 4.4.4 and Table 4-11. Due to an instrument malfunction, no pH data were collected.

Samples DW-2, DW-3, DW-4, and DW-7 (from the Teller, Kelley Jr., Bauer, and Vacarro residences, respectively) were collected from the cold water tap of the kitchen sink. The Tellers and Vacarros use their wells for drinking and washing, whereas the Kelleys and Bauers use their wells only for washing. All wells are used on a regular basis, and none is equipped with any type of filtration or conditioning system. In each case, the cold water tap was allowed to run for 3 to 5 minutes. Vials of water for VOC analysis were collected first and in a manner that minimized disturbance.

The Vacarro residence is the site of the Fitzgibbon spring, sampled during previous investigations. The now-dry Fitzgibbon spring was located on the hillside west of Duffy Creek and Duffy Hollow Road. Following the sale of the Fitzgibbon property to the Bakers, the new owners utilized a spring on the hillside east of Duffy Creek. This spring still exists. The property was then purchased by Vacarro, and a bedrock well was drilled adjacent to the east side of Duffy Creek. Sample DW-7 was collected from this well to determine if contamination from the site has passed east of Duffy Creek.

Sample DW-1 (Rosini) was collected from an outside spigot. The Rosini well is used only for washing; however, since this is not a permanent residence, the well had not been used in several weeks. Therefore, three well volumes (approximately 425 gallons) were purged from the well prior to sample collection. Water was pumped, using the existing

pump, through the spigot used for sample collection and allowed to discharge on the ground downgradient of the well. The sample was collected in a manner similar to that described previously for other residential water samples.

Sample DW-5 (LaDue) was collected from the spring currently used for drinking and washing at LaDue's seasonal residence. The spring that was sampled is approximately 500 feet east and downhill of the spring sampled during previous investigations. During the summer of 1991, Mr. LaDue deepened his old spring in an attempt to increase the flow rate. However, Mr. LaDue reported that he broke through a confining clay layer, causing all of the water to flow down and out of the spring. Therefore, he dug a new spring further downhill. This spring, which is approximately 6 to 8 feet deep, is the one that was sampled. Because the spring is enclosed, water was collected from a PVC overflow pipe that allows excess water to exit at the base of the enclosure. Because water flows continuously from this pipe, the sample was collected immediately after arrival and in a manner similar to that described previously. Water from this spring is not filtered prior to use.

Sample DW-6 (Miller) was not collected from the spring sampled during previous investigations. That spring, which was located in the hillside northeast of the Miller's seasonal residence, was found to be dry at the time of sampling. Therefore, E & E dug an 18-inch-deep sump in a marshy area downhill from the former Miller spring and other active springs noted during the investigation. The bottom of the sump was an impervious clay and silt layer on which perched groundwater flows. When this location was sampled, the sump was noted to be overflowing with a continuous supply of clear water. Sample DW-6 was collected by carefully submerging the sample bottles in the sump. The sample portions for VOC and metals analyses were collected first in a manner that minimized disturbance of the settled sediment at the bottom of the sump.

In addition to the above samples, QA/QC samples collected included a duplicate (DW-5D) from the LaDue spring and additional volume from the Teller well (DW-2) for MS/MSD analyses.

Sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP for all domestic water samples.

Phase II RI

Fifteen residential wells and four groundwater springs were sampled during the Phase II RI between August 2 and August 6, 1993 (see Figure 3-9). Two exceptions to this sampling schedule were the Meisenzahl well, an artesian well sampled on September 15, 1993, and the Rosini well sampled on July 29, 1993. Of the 19 residences sampled, eight are seasonal (Rosini, LaDue, D'Ovidio, Whispell, Miller, Gephart, Urban, and Meisenzahl) and 11 are year round. Tables 1-4 and 4-31 list the homes sampled during the Phase II RI. All samples were analyzed for VOCs by EPA drinking water method 524.2 and TCL inorganics by NYSDEC CLP methods, with the exception of samples DW2-5A, DW2-9, and DW2-10. Sample DW2-5A was analyzed for VOCs only, while samples DW2-9 and DW2-10 were analyzed for inorganics only. Measurements of pH, conductivity, temperature, and turbidity were recorded for each collected sample, with the exception of DW2-1, DW2-5A, and DW2-21. Measurements were not made for these three samples because the appropriate equipment was not on hand since these samples were not collected at the time of the others. These parameters are discussed in Section 4.4.4 and presented in Table 4-31.

Residential well water samples DW2-1 (Rosini), DW2-8 (D'Ovidio), DW2-9 (Cornell), DW2-10 (R. Fanton), DW2-11 (Geffers), DW2-12 (Green), DW2-13 (Schettine), DW2-17 (J. Fanton), and DW2-18 (Dodge) were collected from outdoor spigots (DW2-9 was collected from a spigot in the garage of the Cornell residence). Sample DW2-19 (Gephart) was collected from a spigot in the basement. Well water at the Dodge and Gephart residences is treated by filtration systems. The sample from the Dodge residence, DW2-18, was collected after it passed through a conditioning system, since unconditioned water was not accessible. At the Gephart residence, a spigot at the well head, believed not to be connected to the conditioning system, was used to collect the sample. A "Water Soft" brand conditioner was reportedly installed to remove sulfur. The sample had a distinct sulfur odor and appeared to contain precipitated iron sulfide. Therefore, it is believed that the Gephart sample was untreated.

Sample DW2-21 was collected at the Meisenzahl residence from a flowing artesian well. The cistern, approximately 3 feet by 5 feet by 3 feet deep, was housed in a shed on the property. This artesian well is not the well currently in use at the Meisenzahl's trailer; however, the owner indicated that they will replace the current well during the winter of 1993/1994 with the artesian well as their source of water. Collection of a water sample from

the currently used well at the Meisenzahl residence was not possible because the electric pump was turned off and no one was home at the time of sampling.

Residential well and spring water samples DW2-2, DW2-3, DW2-14, and DW2-15 were collected from the cold water tap of the kitchen sinks in the Teller, Kelley Jr., Fletcher, and Whispell residences, respectively. In each case, the outdoor spigot was inaccessible, nonexistent, or not in working order.

Spring water samples DW2-5 (LaDue), DW2-16 (Ormsby), and DW2-20 (Urban) were collected from outdoor spigots. Analytical problems with sample DW2-5 (LaDue) resulted in rejection of the VOC results for this sample. The inorganic analytical results from DW2-5 were used in the contamination assessment. VOC results from the duplicate sample, DW2-5D, were used in place of the DW2-5 VOC results. An attempt to recollect a sample on September 15, 1993, from the outdoor spigot at the LaDue residence was unsuccessful because the electric pump was off and no one was home at that time. Therefore, an alternate sample, DW2-5A, was collected for VOC analysis directly from the overflow at the spring downslope from the house. This is the same location that was sampled during the Phase I RI.

Sample DW2-6, also a spring water sample, was collected on the Miller property using an 18-inch-deep sump dug at the same location as during the Phase I RI.

All sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP. Where samples for VOC analysis were collected, care was taken to minimize disturbance during sampling. Field QA/QC samples pertaining to the Phase II RI domestic water sampling included one duplicate for inorganics only (DW2-5D), one MS/MSD sample set (DW2-2), and five trip blanks shipped with samples on July 29, August 2, 3, and 6, and September 15, 1993.

3.6.1 Residential Well Survey

A residential well survey was sent out to 36 residences in the vicinity of the site as part of the RI/FS process in an attempt to determine water usage within 1 mile of the site. The survey was sent out in May 1993 by NYSDEC. To date, 16 responses have been forwarded to E & E and incorporated into this report. The survey requested information concerning the following:

- Number of people occupying the residence and for what duration;

- Sources of water that exist at the residence and its current/historic uses;
- Location, depth, and current status of any well or spring;
- General water quality;
- Water treatment; and
- Previous water testing and results.

The completed residential well surveys received by E & E as of the date of this report are provided in Appendix J. Of those responding, nine of the homes are full-time residences, and seven are used on a seasonal basis. Additionally, all but one (V. Miller) use spring or well water as a potable source, for washing, and/or for recreation.

3.7 SURFACE WATER AND SEDIMENT SAMPLING

Phase I RI

During the Phase I RI, a total of six surface water samples were collected from the two streams in the area of the site. At each surface water sampling location, a sediment sample was also obtained. These Phase I RI samples were collected on October 2, 1991. The approximate locations of the surface water and sediment samples are shown in Figure 3-4 and are described as follows:

- Two samples were collected as far upgradient in each stream as possible, in order to determine background conditions. One sample (SW-1/SED-1) was obtained from the unnamed tributary north of Pump Station 1. The furthest upstream that SW-1/SED-1 could be collected was where surface runoff from the site first enters the tributary. Upstream of this location, the tributary was nearly dry and did not facilitate sample collection. Therefore, SW-1/SED-1 is not considered representative of background conditions in the unnamed tributary. Sample SW-2/SED-2 was taken from Duffy Creek west of Duffy Hollow Road, approximately 1,000 feet south of Pixley Hill Road. This sample was expected to represent background conditions in Duffy Creek.
- Sample SW-3/SED-3 was collected from a pool in the unnamed tributary west and slightly downstream of Pump Station 1.

- Sample SW-4/SED-4 was obtained from a pool downstream of the site in Duffy Creek, approximately 500 feet upstream of its confluence with the unnamed western tributary.

- Sample SW-5/SED-5 was collected approximately 350 feet downstream of the confluence of Duffy Creek and its unnamed western tributary.

- Sample SW-6/SED-6 was obtained approximately 800 feet downstream of the confluence of Duffy Creek and its unnamed western tributary to determine if there is any downstream risk associated with the site.

Samples were collected from downstream to upstream so that any disturbances (turbulence) caused by sampling activities would not affect downstream sampling locations. Additionally, the surface water samples were collected prior to the sediment samples at each location. Samples were collected by carefully submerging precleaned bottles directly into the creek in such a way as to minimize agitation of the water.

The six surface water samples were analyzed for full TCL parameters, as well as hardness, by the methods described in Section 3.1. All samples were analyzed unfiltered. Field QA/QC samples included one field duplicate (SW-4D) for full TCL and hardness analyses and one MS/MSD sample set for full TCL analysis, both of which were collected from the same location as SW-4.

The six corresponding sediment samples were analyzed for full TCL parameters according to the NYSDEC CLP methods, as well as percent organic matter by ASTM methods (see Section 3.1). Field QA/QC samples include one field duplicate for full TCL and percent organic matter analyses (SED-4D) and one MS/MSD sample set for full TCL analysis, both of which were collected from the same area as SED-4.

Sample locations were chosen from places where sediment accumulates. Sediment samples were collected from near shore with minimal disturbance, using dedicated stainless-steel spoons, and transferred directly into appropriate prelabeled sample containers.

Sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP for all surface water and sediment samples.

Phase II RI

During the Phase II RI, at NYSDEC's request, E & E attempted to collect surface water and sediment samples further upstream than those collected during the Phase I RI. On July 9, 1993, when Phase II sampling was conducted, no standing water was observed in the unnamed tributary west of the site upstream of SW-1/SED-1. Therefore, no additional samples were collected from this stream. In Duffy Creek, no water was found anywhere in the northeast branch or in the northwest branch near Pixley Hill Road. The furthest upstream water encountered that was suitable for sampling was a small pool about 900 feet upstream of where Duffy Creek first crosses Duffy Hollow Road and about 600 feet downstream of Pixley Hill Road (see Figure 3-9). Therefore, one surface water sample (SW2-1) and one sediment sample (SED2-1) were collected at this location. This location was also used as the upstream sampling station for the habitat-based ecological assessment (see Section 6).

Surface water sample SW2-1 was submitted for TCL VOC and inorganic analyses as well as hardness analysis by NYSDEC CLP methods. Sediment sample SED2-1 was analyzed for TCL VOCs and inorganics by NYSDEC CLP methods as well as percent organic matter by ASTM methods. Results are discussed in Sections 4.4.5 and 4.4.6.

Phase II RI samples were collected and preserved according to the previously described methods for Phase I RI samples.

3.8 SURFACE SOIL SAMPLING

During the Phase I RI, biased surface soil samples (0 to 4 inches deep) were collected from 12 locations where physical evidence of contamination existed (SS-3 through SS-14). These locations were selected in the field based on visual observations (i.e., leachate outbreaks, stained soil, etc.) and HNu readings. These samples consisted of leachate-stained sediment and soil as well as other surficial materials including the cover material. Two additional samples (SS-1 and SS-2) were collected from undisturbed areas in the vicinity of the upgradient monitoring well, MW-1D (upgradient of the fill areas), to serve as background soil samples. All surface soil samples were collected on October 4, 1991. Table 3-5 describes the location of each surface soil sample. Figure 3-1 depicts the soil sampling locations.

Surface soil samples were collected with precleaned, dedicated, stainless-steel spoons. An appropriate amount of soil, excluding gravel, roots, and organic matter, was

placed directly into precleaned, prelabeled sample jars. VOC sample bottles were filled first with material that was as undisturbed as possible.

All 14 surface soil samples were analyzed for full TCL parameters according to NYSDEC CLP methods. Field QA/QC samples included one field duplicate (SS-10D) collected from the same location as SS-10 and an MS/MSD sample set collected from the same location as SS-11 for full TCL analysis. Analytical methods are summarized in Section 3.1. All preservation, shipping, and handling procedures were performed in accordance with the QAPjP.

No additional surface soil samples were collected during the Phase II RI.

3.9 LEACHATE AND SEEP SAMPLING

Phase I RI

Leachate samples were to be collected from six locations within the on-site leachate collection system during the Phase I RI. Four of the samples were to be collected from manholes on the mainline and two from 6-inch-diameter PVC risers on the lateral lines. The manholes and risers to be sampled were to be those containing the highest concentrations of VOCs as determined during the air monitoring described below in Section 3.10. However, when the selected manholes and risers were opened, no liquid leachate was found. The remaining manholes were then checked, and most were found to contain no liquid leachate or an amount insufficient to sample. The drain pipes at the bottom of the manholes were found to contain sediment, with the leachate most likely flowing through the sediment and/or the stone surrounding the drain pipe.

Due to the lack of liquid leachate, only two locations were sampled. Sample L-1 was collected from Manhole 4 across Snyder Road from Pump Station 1. Through this manhole, leachate from the northeast, northwest, and south-central fill areas passes prior to entering the sump at Pump Station 1. Sample L-2 was collected from the sump at Pump Station 2, which collects leachate from the south fill area only. These locations are shown on Figure 3-1 and all manholes and risers are shown on Figure 3-11.

The following procedures were used to collect the leachate samples:

- Upon opening the manhole, the head space and breathing zone were monitored with an HNu.

Table 3-5

PHASE I RI SURFACE SOIL SAMPLE LOCATIONS OCTOBER 4, 1991

Sample Number	Description
SS-1	Background soil sample from undisturbed ground approximately 50 feet northwest of MW-1D.
SS-2	Background soil sample from shallow ditch along west side of dirt road, due west of MW-1D.
SS-3	Head of active leachate seep at southwest corner of northeast fill area. Seep is not stained orange and red like other seeps on site.
SS-4	East bank of the small standing surface water body adjacent to and west of MW-2S.
SS-5	Bottom of the southeast corner of the drainage collection pond at a point where runoff from the northeast portion of the site enters the pond.
SS-6	Head of an active leachate seep in the east-central portion of the northwest fill area. Soil was stained dark red.
SS-7	Head of an active leachate seep in the southwest portion of the northwest fill area. Soil, which was stained red, was collected near point of bubbling gas escape.
SS-8	Base of an active leachate seep (immediately west of bubbling seep) in the southwest portion of the northwest fill area. Soil was stained red.
SS-9	In the confluence of two ditches adjacent to the gate at the northern access road in order to assess the potential for off-site contaminant migration. One ditch runs along the west side of the northwest fill area and the other along the east and south sides of that fill area.
SS-10	South of the sump at Pump Station 2 where leachate often overflows. Soil was stained red.
SS-10D	Duplicate of SS-10.
SS-11	Head of an inactive leachate seep in the center of the south fill area. Soil was stained reddish-orange.
SS-12	In a shallow runoff ditch cut into the cover along the south side of the south-central fill area.
SS-13	In a ditch along the south side of the dirt access road to LaDue's home. Collected near a culvert where leachate from Pump Station 2 can pass onto LaDue's property, in order to assess the potential for off-site contaminant migration.
SS-14	In a shallow ditch on the property of E. Ormsby east and downhill of the northeast fill area, in order to assess the potential for off-site contaminant migration.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 3-6

PHASE I RI AIR SAMPLES COLLECTED FROM THE LEACHATE COLLECTION SYSTEM DECEMBER 19, 1991

Sample Number	Canister Number	Manhole/Riser	Description
A-1	11302	MH-10	Collected to evaluate the relative VOC contribution from the northern portion of the northwest fill area.
A-2	11303	R-10	Collected to evaluate a "hot spot" in the northwest fill area.
A-3	11306	MH-6	Collected to evaluate the relative VOC contribution from the southern portion of the northwest fill area.
A-4	11305	MH-15	Collected to evaluate the relative VOC contribution from the northeast fill area.
A-5	11300	R-2	Collected to evaluate a "hot spot" as well as the relative VOC contribution from the south fill area.
A-6	11301	R-2	Duplicate of A-5 for QA/QC.
A-7	11299	MH-3	Collected to assess the relative VOC contribution from the south-central fill area.
A-8[a]	11298	NA	Field blank for QA/QC.

[a]Purified nitrogen from E & E's ASC collected on 12-20-91.

Source: Ecology and Environment Engineering, P.C. 1991.

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Table 3-7

PHASE II RI MONITORING WELL AND PIEZOMETER CONSTRUCTION[a]

Well/ Piezometer	Depth to Bedrock	Total Depth	Depth of Screened Interval	Depth of Sandpack	Depth of Bentonite Seal	Completion Date
PZ-1	30	45	34 - 44	31.7 - 45	28 - 31.7	6-21-93
PZ-2	23	23	19 - 23	18 - 23	15 - 18	7-13-93
PZ-3	14	23	17 - 22	16 - 23	13 - 16	7-13-93
PZ-4	—	20	9 - 19	6.9 - 20	4 - 6.9	6-29-93
PZ-5	20.5	27	16 - 26	14 - 27	10.8 - 14	6-28-93
PZ-6	50	60.1	49 - 59	47 - 60.1	43.8 - 47	6-24-93
PZ-7	—	20	13.5 - 18.5	12.5 - 20	9.5 - 12.5	7-14-93
PZ-8	—	20	14 - 19	13 - 20	10 - 13	7-14-93
PZ-9	—	21	15 - 20	13 - 21	9.3 - 13	7-15-93
PZ-10	—	18.3	12.3 - 17.3	10.3 - 18.3	7.3 - 10.3	7-15-93
PZ-11	—	28	22.5 - 27.5	21.9 - 28	18.8 - 21.9	7-16-93
PZ-12	—	18	12.5 - 17.5	11.4 - 18	8.4 - 11.4	7-19-93
PZ-13	—	21	15.5 - 20.5	14.8 - 21	11.8 - 14.8	7-19-93
PZ-14	—	17.5	12 - 17	11 - 17.5	8.8 - 11	7-20-93
MW-5VD[b]	21.5	140	90 - 110	86.5 - 112	80 - 86.5	7-19-93
MW-12S	18	18	7 - 17	6 - 18	4 - 6	7-7-93
MW-12D	26	42	31 - 41	28 - 42	25 - 28	7-7-93
MW-13S	11.5	11.5	6 - 11	5 - 11.5	3 - 5	7-9-93
MW-13D	11.5	25	14 - 24	13 - 25	10 - 13	7-8-93

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Table 3-7

PHASE II RI MONITORING WELL AND PIEZOMETER CONSTRUCTION[a]

Well/ Piezometer	Depth to Bedrock	Total Depth	Depth of Screened Interval	Depth of Sandpack	Depth of Bentonite Seal	Completion Date
MW-14S	14	14	6 - 14	5 - 14	3 - 5	7-19-93
MW-14D	14.5	31	21 - 31	18.8 - 31	13.5 - 18.8	7-19-93
MW-15S	19.5	19.5	9 - 19	7.1 - 19.5	3.4 - 7.1	7-2-93
MW-15D	22.3	36.5	26.5 - 36.5	25.2 - 36.5	20 - 25.2	7-2-93
MW-15DA	21	53.5	43 - 53	41 - 53.5	38 - 41	7-22-93
MW-16S	—	17	6 - 16	5 - 17	3 - 5	7-2-93
MW-16D	37	51	40 - 50	38 - 51	35 - 38	7-1-93

a All depths are feet below ground surface (BGS).

b An additional sand pack was placed in the boring from 117 - 140 BGS with a bentonite seal from 112 - 117 BGS to fill and seal the borings at a confining layer in the bedrock.

Data Source: Joseph C. Lu, P.E., P.C. 1993.

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Table 3-8

MONITORING WELL AND PIEZOMETER ELEVATION DATA[a]

Well Number	Elevation (feet)		
	Ground	Top of Inner Casing	Top of Outer Casing
MW-1D	277.63	280.27	280.44
MW-2D	208.30	211.01	211.10
MW-2S	204.59	207.29	207.56
MW-3D	174.80	178.05	178.16
MW-3S	175.10	177.56	177.72
MW-4D	176.49	178.95	179.09
MW-5D	151.52	153.55	153.79
MW-5S	151.55	154.12	154.28
MW-5VD	152.10	154.38	154.63
MW-6D	132.81	134.83	135.08
MW-6S	132.15	134.79	135.08
MW-7D	96.48	98.99	99.14
MW-8D	110.12	111.82	111.97
MW-8S	109.78	112.23	112.39
MW-9D	156.26	158.93	159.07
MW-9S	156.71	159.12	159.20
MW-10D	184.40	186.65	186.79
MW-10S	184.65	187.20	187.36
MW-11S	88.32	90.32	90.58
MW-12D	197.61	200.17	200.31
MW-12S	197.61	200.06	200.18
MW-13D	129.02	131.49	131.91
MW-13S	128.08	130.97	131.11
MW-14D	143.75	146.06	146.20
MW-14S	144.00	146.11	146.32
MW-15D	106.95	109.81	109.95
MW-15DA	107.17	109.68	109.80
MW-15S	106.85	109.81	109.94

Table 3-8

MONITORING WELL AND PIEZOMETER ELEVATION DATA[a]

Well Number	Elevation (feet)		
	Ground	Top of Inner Casing	Top of Outer Casing
MW-16D	8.85	11.89	12.29
MW-16S	9.31	12.15	12.29
CW-3A	98.26	100.43	100.60
CW-3B	99.43	100.59	100.79
CW-4A	91.65	92.53	92.62
CW-4B	91.66	92.81	93.03
PZ-1	259.76	262.17	261.32
PZ-2	261.21	263.40	263.58
PZ-3	249.79	252.22	252.36
PZ-4	229.84	232.04	232.19
PZ-5	194.87	197.03	197.17
PZ-6	258.33	260.78	260.93
PZ-7	235.94	238.56	238.70
PZ-8	210.13	213.10	213.24
PZ-9	195.73	198.56	198.69
PZ-10	177.50	179.72	179.84
PZ-11	164.82	167.80	167.91
PZ-12	161.14	163.64	163.78
PZ-13	136.61	139.30	139.44
PZ-14	122.29	124.92	125.05

[a] Elevation reference: Site benchmark BM-1 = 296.15 feet.

Source: Ecology and Environment Engineering, P.C. 1993.

Table 3-9

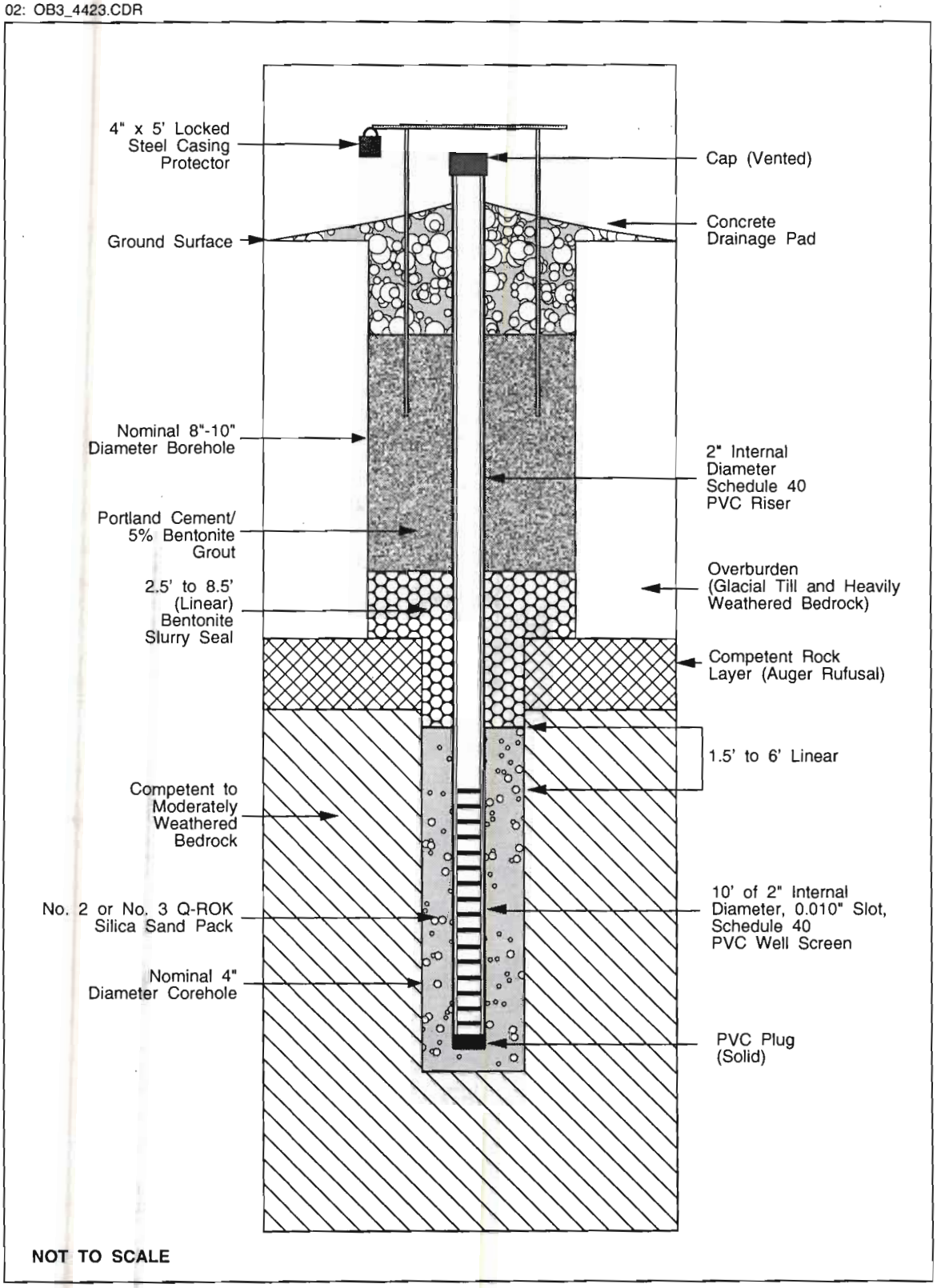
LANDFILL COVER THICKNESS AND DEPTH OF DEBRIS[a]

Piezometer	Depth to Bedrock	Total Depth to Piezometer	Landfill Cover Depth	Debris Depth
PZ-2	23	23	0 - 2.5	2.5 - 15.5
PZ-3	14	23	—	None encountered
PZ-7	—	20	0 - 7	7 - 12
PZ-8	—	20	0 - 4	4 - 11
PZ-9	—	21	0 - 6	6 - 12
PZ-10	—	18.3	0 - 3	3 - 8
PZ-11	—	28	0 - 4	4 - 20
PZ-12	—	18	0 - 4	4 - 9
PZ-13	—	21	0 - 3	3 - 13
PZ-14	—	17.5	0 - 3	3 - 9

[a] All depths are in feet below ground surface (BGS).

Data Source: Joseph C. Lu, P.E., P.C. 1993.

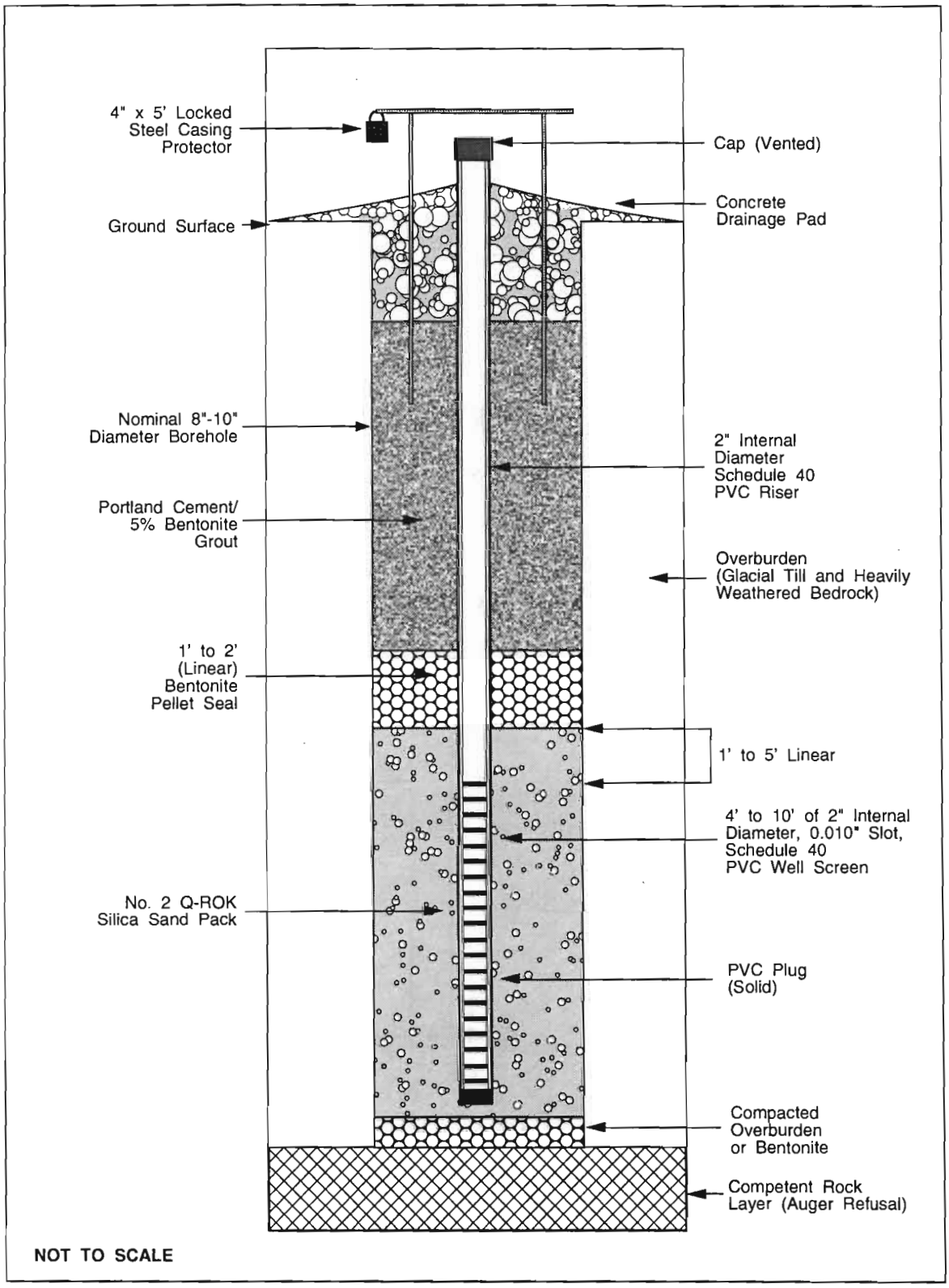
02: OB3_4423.CDR



SOURCE: Ecology and Environment Engineering, P.C.

Figure 3-2 PHASE I REMEDIAL INVESTIGATION DEEP MONITORING WELL CONSTRUCTION

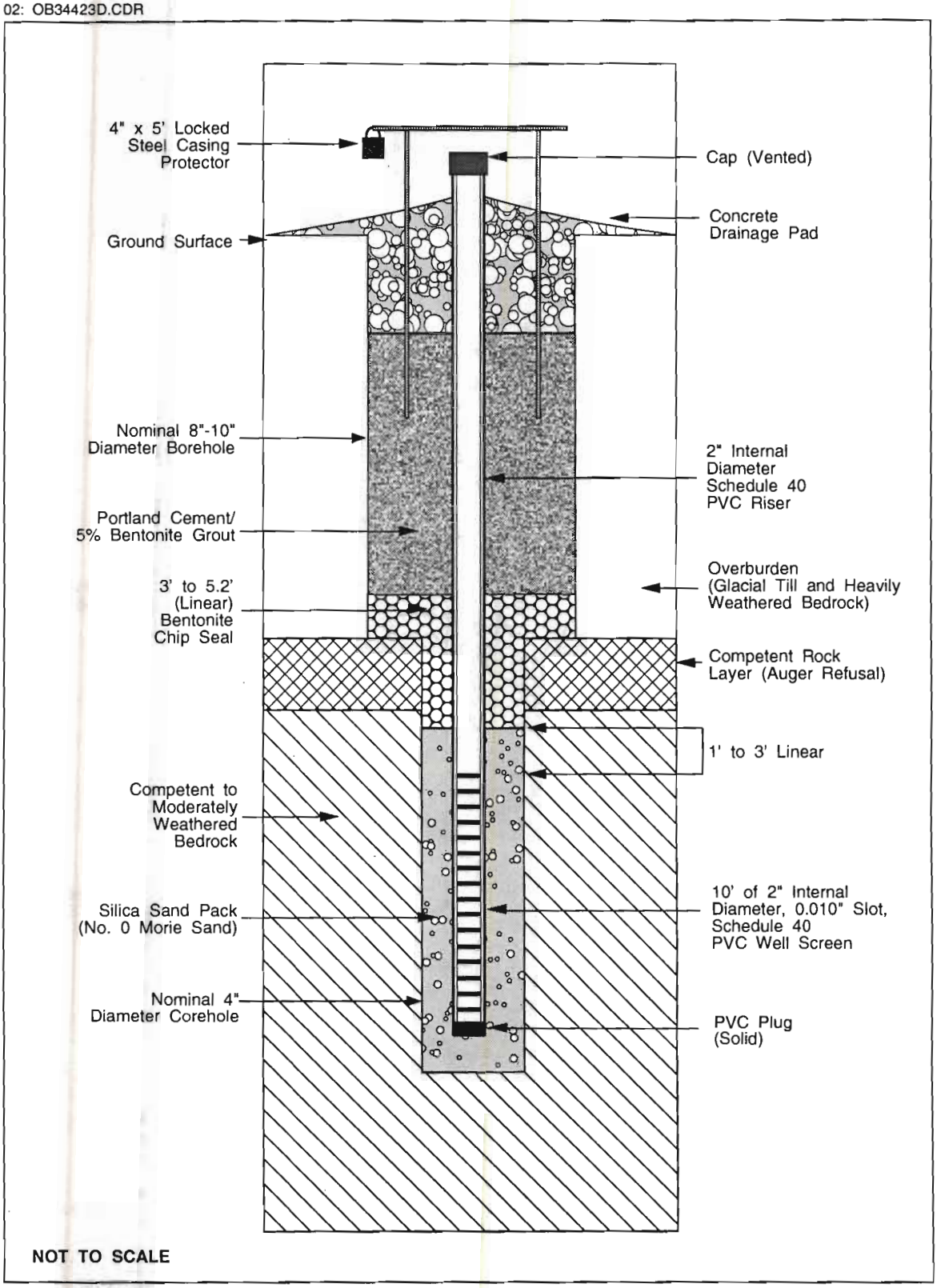
02: OB34423A.CDR



SOURCE: Ecology and Environment Engineering, P.C.

Figure 3-3 PHASE I REMEDIAL INVESTIGATION SHALLOW MONITORING WELL CONSTRUCTION

02: OB34423D.CDR



SOURCE: Ecology and Environment Engineering, P.C.

Figure 3-4 PHASE II REMEDIAL INVESTIGATION DEEP MONITORING WELL CONSTRUCTION

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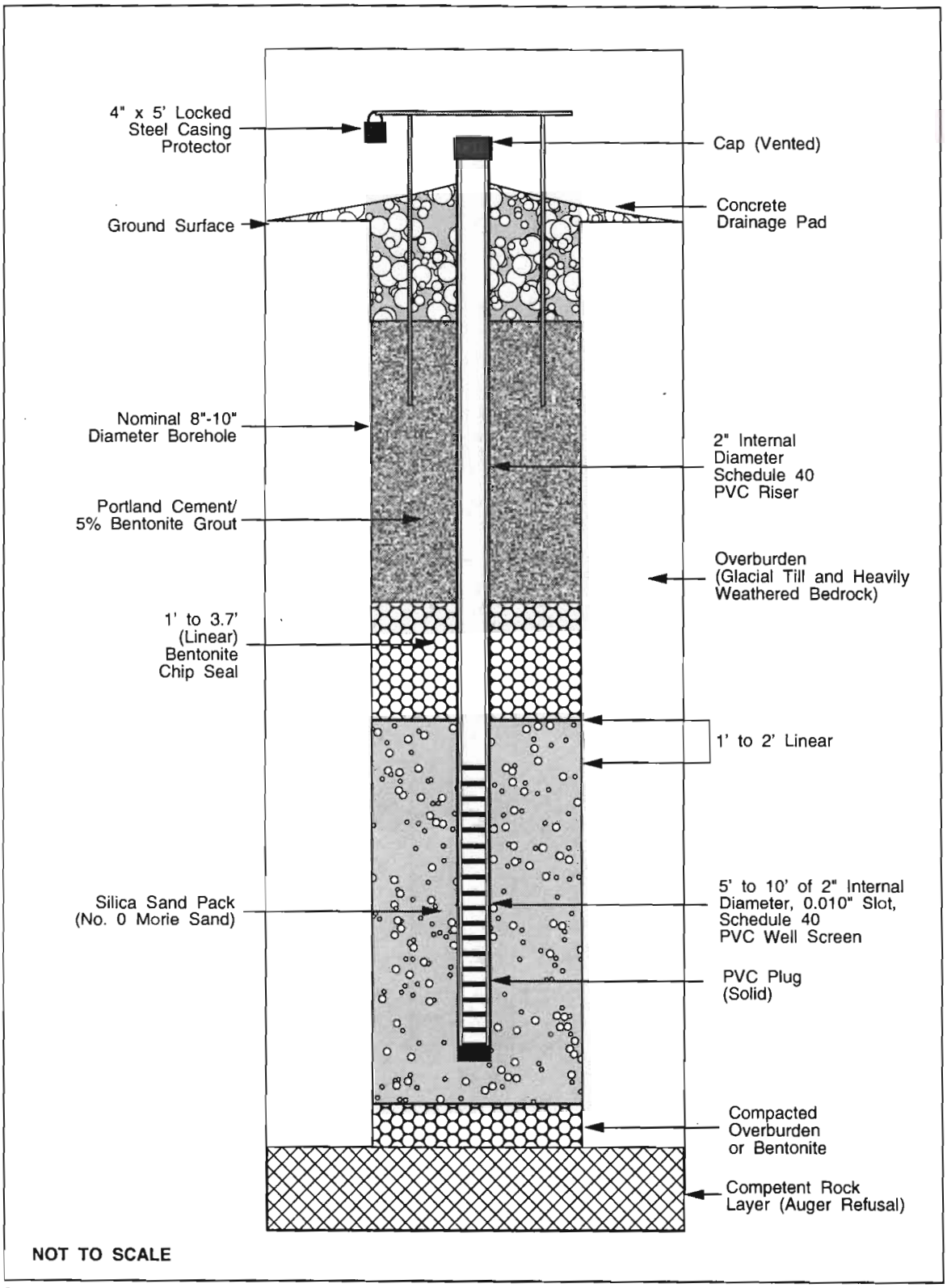
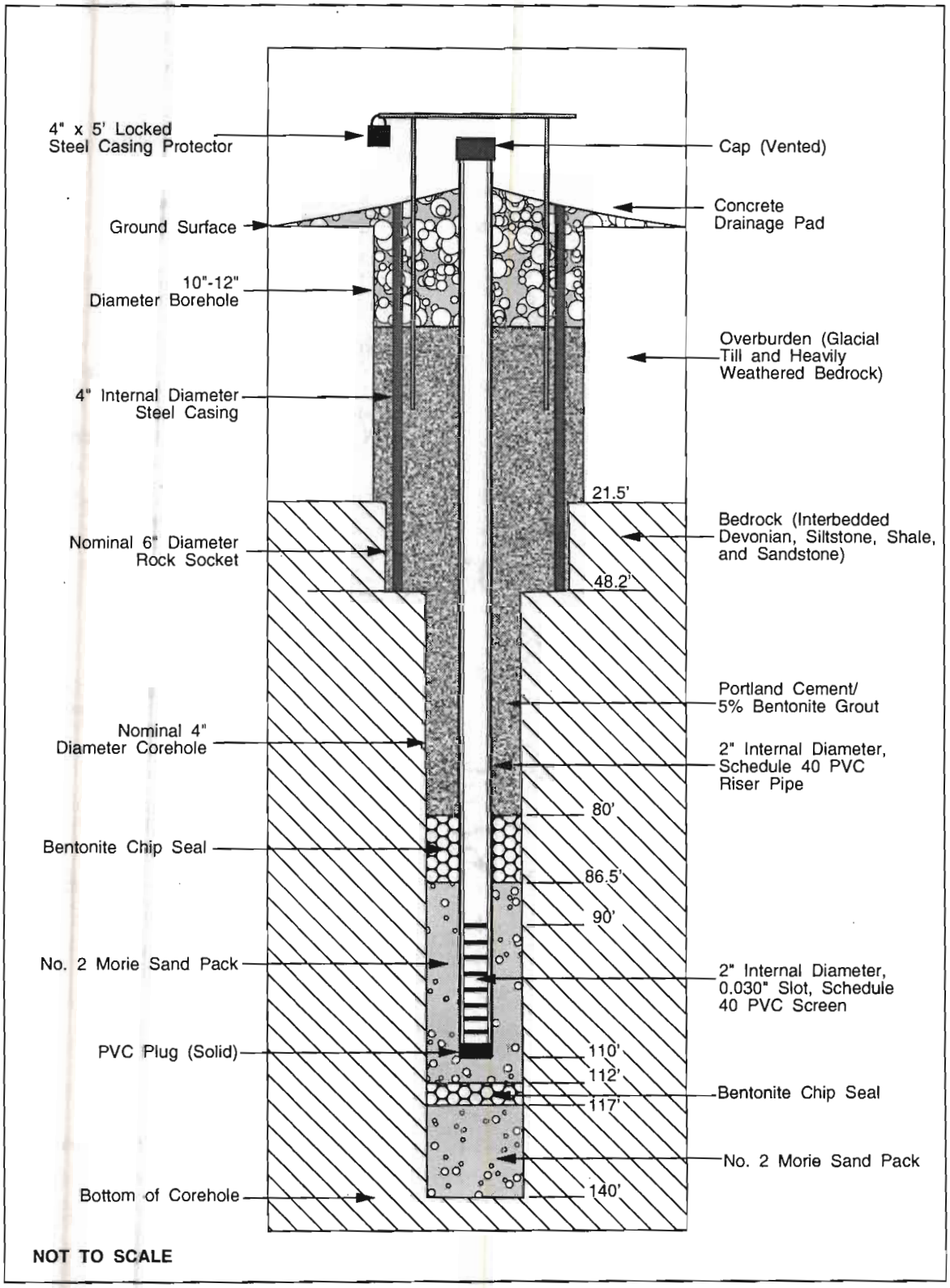
02: OB34423E.CDR



SOURCE: Ecology and Environment Engineering, P.C.

Figure 3-5 PHASE II REMEDIAL INVESTIGATION SHALLOW MONITORING WELL CONSTRUCTION

02: OB34423F.CDR



SOURCE: Ecology and Environment Engineering, P.C.

Figure 3-6 PHASE II REMEDIAL INVESTIGATION VERY DEEP MONITORING WELL (MW-5VD) CONSTRUCTION

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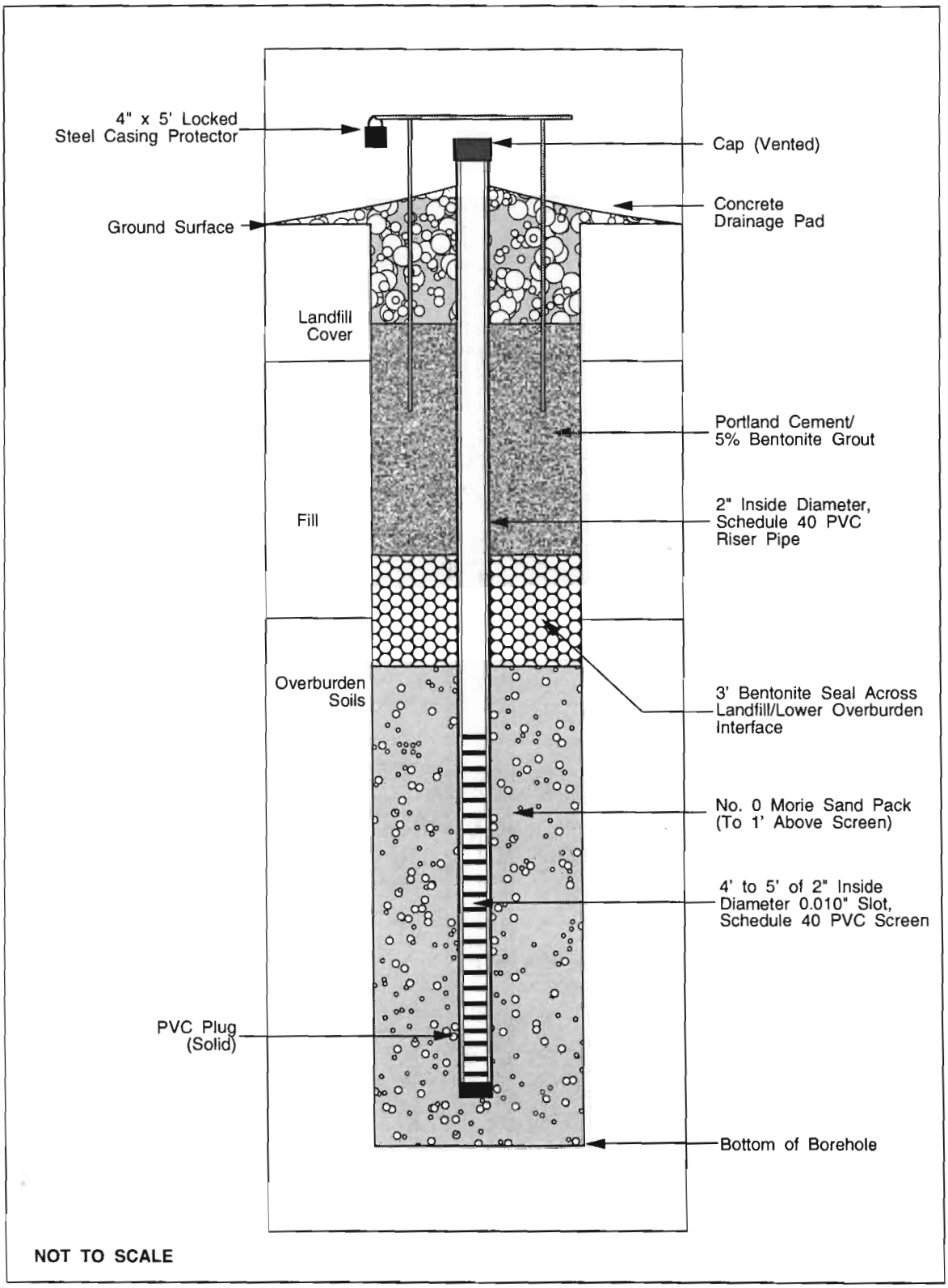
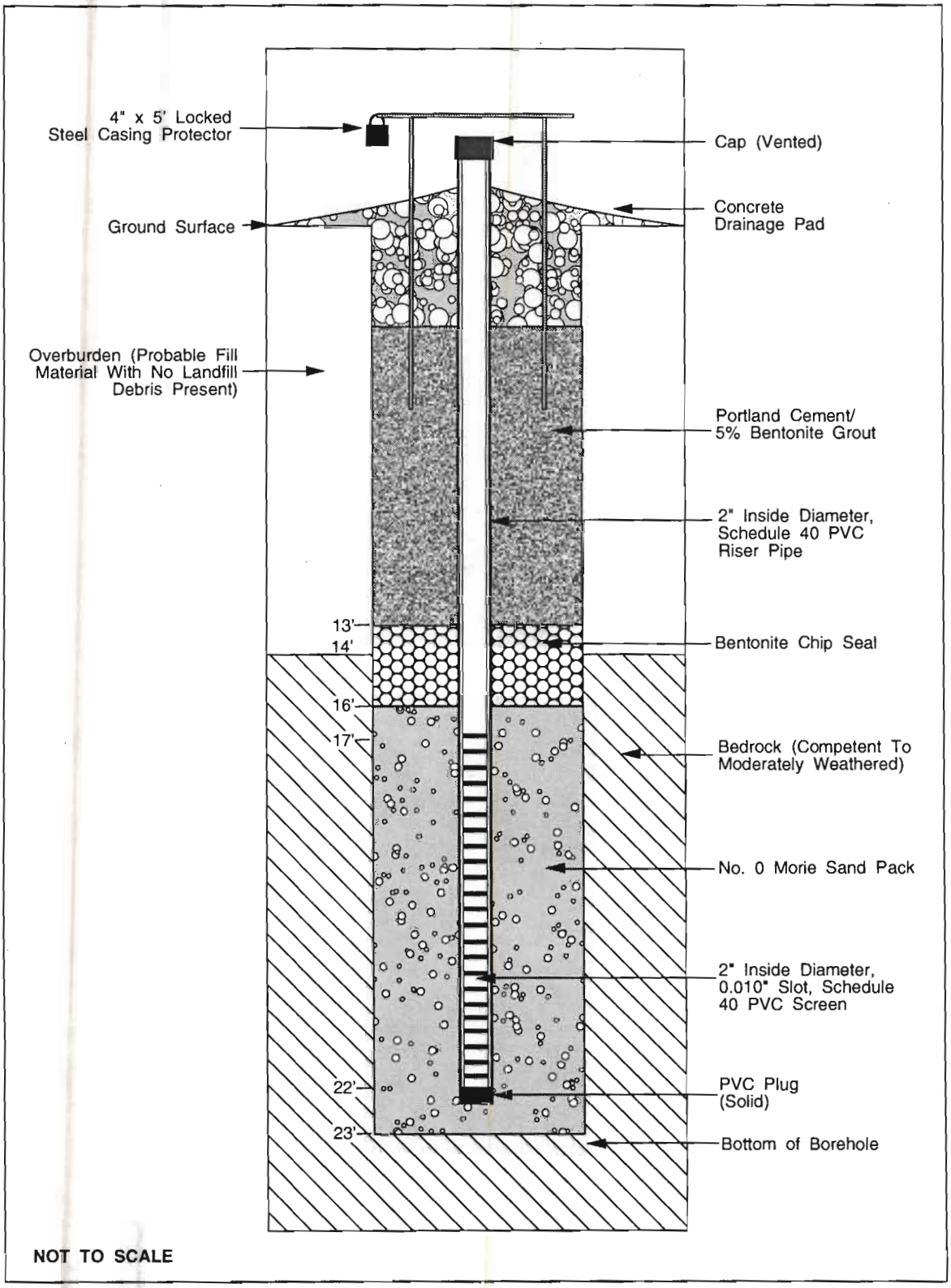
02: OB34423B.CDR



SOURCE: Ecology and Environment Engineering, P.C.

Figure 3-7 PHASE II REMEDIAL INVESTIGATION
TYPICAL ON-SITE LANDFILL PIEZOMETER CONSTRUCTION

02: OB34423C.CDR



SOURCE: Ecology and Environment Engineering, P.C.

Figure 3-8 PHASE II REMEDIAL INVESTIGATION PIEZOMETER PZ-3 CONSTRUCTION

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- A dedicated polyethylene bailer was lowered slowly into the manhole as often as necessary to fill the required sample jars. VOC sample bottles were filled from the initial bail of leachate at each location.

- Leachate samples were poured carefully from the bailer into pre-cleaned and prelabeled sample bottles.

- Preserving, shipping, and handling procedures were performed in accordance with the QAPjP.

Field parameters, including pH and conductivity, were measured. These results are discussed in Section 4.4.7.

The two samples collected from the leachate collection system were analyzed for full TCL parameters according to NYSDEC CLP methods. Field QA/QC samples included one MS/MSD sample set for full TCL analysis collected from the same location as L-2. Analytical methods are outlined in Section 3.1.

In accordance with the work plan, no leachate samples were collected from the pump stations for Toxicity Characteristic Leaching Procedure (TCLP) analysis because the analytical results from L-1 and L-2 did not warrant this analysis.

Phase II RI

During the Phase II RI, the site was reexamined in order to identify new or changed leachate seeps. Additional downgradient areas east and south of the site were also examined in order to identify seeps, springs, and other potential groundwater receptors. During this investigation, four areas were identified for leachate and seep sampling. At all four locations, holes were dug with a precleaned shovel and water was allowed to collect in the hole prior to sampling.

Leachate sample SP2-1 was collected on June 21, 1993, at the head of the leachate seep at the southwest corner of the northeast fill area where deer have been observed drinking. While digging a hole for this sample, about 6 inches of brown topsoil with some orange staining was found overlying mottled grey and tan clay. The liquid sampled had a sheen, an orange-brown color, a high turbidity, and a landfill gas odor.

Seep sample SP2-2 was collected on June 21, 1993, from a wet area on the Ormsby cow pasture near the eastern border of the site. The soil here consisted of 6 to 8 inches of

brown topsoil underlain by brown silty clay. The water sampled was brown with a moderately high turbidity and no sheen or odor. Minor orange stains were observed in the seep area.

Seep sample SP2-3 was collected on June 22, 1993, from a small stream on the west side of Duffy Hollow Road between the Ormsby and Giambrone properties. This stream flows east down the hillside and drains into the ditch on the west side of the road. On June 16, 1993, an orange-stained seep with a sheen was observed approximately 50 feet upstream from the road. At the time of sampling, orange and red stains remained on the sediment, but no sheen was observed. Based on similar observations in upgradient areas, it is likely that this staining and the sheen resulted from the naturally high iron content of the rocks and/or algae growth.

Seep sample SP2-4 was collected on June 22, 1993, on the Urban property approximately 200 feet northwest of the Urban house. A hole was dug in a low-lying swampy area along a broad swale in the general vicinity of the former Fitzgibbon spring. No staining was observed in this area. Figure 3-1 depicts the surveyed locations of SP2-1 and SP2-2; however, samples SP2-3 and SP2-4 are not shown because they were collected at locations off this map.

All leachate/seep samples were collected by direct immersion of appropriate sample containers. Samples were mistakenly submitted for full TCL analysis and all results are discussed in Section 4.4.8. However, since only TCL VOCs and inorganics were originally planned, only these results were third-party qualified.

Field QA/QC samples included one duplicate (SP2-1D), one MS/MSD sample set (SP2-4), and one trip blank. All sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP.

3.10 AIR SAMPLING

Air monitoring and sampling were performed within the leachate collection system during the Phase I RI. The sampling strategy involved a graduated approach. On September 30, 1991, all of the manholes and risers in the leachate collection system were screened using an HNu, OVA, and vinyl chloride (VC) Draeger tubes. The screening was accomplished by inserting the probe directly into the manhole or riser, either through an existing hole or by lifting the cover just enough to admit the probe. This procedure was used to avoid venting the manholes and risers and dispersing any gas collected in them. The readings obtained

reflect the total concentration of the VOCs (aromatics such as benzene, toluene, and xylene and chlorinated alkenes such as tetrachloroethene [PCE], TCE, DCE, and VC) of interest from a risk standpoint. Originally, leachate samples were to be collected from various areas of the leachate collection system in order to assess the relative contributions of contaminants from each fill area. However, due to insufficient liquid sample volume, the air sampling strategy was altered to achieve that goal and support the risk evaluation. Rather than selecting the six locations with the highest PID readings, the "hottest" manholes and/or risers near each fill area were sampled. Four manholes and two risers were selected for formal gas sampling on December 19, 1991. Prior to gas sampling, the manholes and risers were again monitored with an HNu. Table 3-6 summarizes the samples collected. Figure 3-1 depicts the locations of the manholes and risers sampled. Results of the air monitoring and sampling activities are presented in Section 4.4.8.

The formal sampling was done using EPA method TO-14 (USEPA 600/4-84-041, April 1984; Second Supplement, June 1988), which involves drawing a whole air sample into a 6-liter SUMMA® passivated canister. SUMMA® passivation involves coating the interior of the stainless-steel canister with a nickel-chromium oxide that deters VOCs from adhering to the interior walls. Evacuated canisters were obtained from Air Toxics, Ltd., the analytical laboratory subcontracted to perform the analyses.

A sample of 4 to 6 liters was drawn from the manhole or riser through a 2-foot Teflon tube attached to the canister inlet with a 1-foot stainless-steel tube. Sampling was performed over a short time period (i.e., 2 to 3 minutes) because conditions in the collection system are expected to remain relatively stable.

Once the samples were collected, they were shipped to the laboratory for Method TO-14 analysis. Method TO-14 involves cryogenically trapping the VOCs in the sample and analyzing them using a high-resolution gas chromatograph coupled with the appropriate detectors.

In addition to the samples collected from the manholes and risers, a duplicate sample and field blank were also analyzed for QA purposes. The duplicate sample, designated A-6, was collected from Riser R-2. The field blank consisted of a previously evacuated canister into which 4 to 6 liters of purified nitrogen was run. The purpose of the blank was to act as a trip blank and to assess the VOC contribution made by the attached tubing.

No additional air sampling was performed during the Phase II RI.

3.11 LEACHATE COLLECTION SYSTEM EVALUATION

In conjunction with the ground-based survey and leachate sampling, E & E collected data in order to determine the effectiveness of the leachate collection system as well as means to increase its effectiveness, if necessary. In order to evaluate the system, the following information regarding its construction and operation was collected:

- Verification of vertical and horizontal layout of the collection system by means of a ground survey;
- Review of selected records from the Village of Wellsville wastewater treatment facility regarding delivery of leachate from the landfill in an attempt to determine seasonal and climatic trends; and
- Estimation of flow rates at various points in the collection system to determine the relative contribution of leachate from the individual fill areas.

Data will be used in the determination of which areas, if any, are suited for phased or interim remedial actions in addition to the development of final remedial solutions. Results pertaining to the leachate collection system are not included in this RI report but are discussed in the FS report, Phased/Interim Remedial Alternatives Report (E & E 1992a), and Leachate Investigation Report (E & E 1992b).

During the fieldwork associated with both phases of the RI, leachate outbreaks and off-site migration of leachate were directly observed. During the geophysical survey performed in July and August 1991, numerous areas of dry, stained soil were observed in the southern half of the northwest fill area and in the central portion of the south fill area. During fieldwork in the fall of 1991, six flowing seeps were observed. Surface soil sample SS-3 was collected at the head of a seep at the southwest corner of the northeast fill area. This seep consisted of clear liquid, with stressed vegetation only at its head. Deer have been seen drinking from this seep, and many deer hoofprints have been seen here on numerous occasions.

Two active leachate seeps were observed in the east-central portion of the northwest fill area. Soil sample SS-6 was collected at the head of one of these seeps. Both seeps consisted of orange-stained water and soil with some stressed vegetation. Two other active seeps were observed at the south end of the northwest fill area. Soil sample SS-7 was

collected at the head of one, while SS-8 was collected at the foot of the other. Both seeps consisted of orange-stained water and soil, along which reeds proliferated. Sample SS-7 was collected where leachate emerged from the ground along with gas bubbles consisting primarily of methane. This seep is the only one that did not dry out during periods of low precipitation, and gas bubbles have been observed throughout the RI.

One active seep consisting of orange-stained water and soil with stressed vegetation was observed near the center of the south fill area. This seep frequently dried out.

During the Phase II RI fieldwork, only two of the above leachate seeps were observed to be actively flowing. The seep at the southwest corner of the northeast area increased significantly in area and consisted of orange-stained water and soil at the head only. Sample SP2-1 was collected from this leachate. Deer were observed drinking from this seep. The other active seep was located in the southern part of the northwest fill area where SS-7 was collected. This outbreak was still bubbling with methane. Also during the Phase II RI, two wet areas were observed in the Ormsby cow pasture east of MW-2D. One of these contained water with minor orange staining. Sample SP2-2 was collected here.

In February 1992, leachate was observed migrating off site from the holding pond. Overflow on the south side of the pond moved westward to the ditch between Snyder Road and the south fill area. Stained water was seen flowing southward in this ditch until it crossed under Snyder Road through a culvert near well pair MW-8D/8S. This stained water then flowed southwest through the Rosini property, eventually flowing into the unnamed tributary of Duffy Creek.

During both phases of the RI, leachate was observed overflowing from the sump at Pump Station 2. This leachate flowed south past well pair CW-4A/4B onto the LaDue property. The pump at this pump station was never observed to be operational during RI field activities.

3.12 PERIMETER EXPLOSIVE GAS SURVEY

An explosive gas survey was performed on June 22 and 23, 1993, along the perimeter of the individual fill areas in order to determine whether subterranean explosive gases (or vapors) are present at the landfill boundary. This survey had been proposed in an effort to quantify the concentrations of gaseous contaminants that may exist in the air-filled

pores within the vadose zone and to aid in the design of a proper gas venting system, should this be chosen as part of the remedial alternative.

The survey method involved driving a 3-foot-long, nickel-plated steel soil gas probe approximately 2 to 2.5 feet into the soil at 200-foot intervals along the landfill perimeter. The probe consisted of a steel shaft, drive point, top drive mandrel, and sampling port. At the base of the shaft were four thin slots, each 6 inches long. The slotted section of the probe provided a cross-section of subsurface soil from which gas was extracted. An electric hammer drill was used to drive the probe to the specified depth. Figure 3-10 depicts the appropriate survey locations.

The sampling port was fitted with Tygon tubing, and the OVA pump was used to purge two to three probe volumes of gas. The OVA pump rate was measured using a rotameter and was found to be approximately ½ liter per minute. The OVA was allowed to pump for several minutes and its response was noted. The OVA was then disconnected and a PID and CG/O_2 meter were then connected in succession. The instruments used during the survey were a Foxboro Century OVA 128, an HNu ISPI 101 PID with a 10.2 eV probe, and a Gastechtor 1214S CG/O_2 meter. Comparisons of relative instrument responses to measured background conditions were used to determine the subsurface VOC concentrations. Results of the survey are discussed in Section 4.4.11.

3.13 AQUIFER TESTING

Slug tests were performed during the Phase II RI investigation to estimate the hydraulic conductivity and transmissivity of the aquifer in the immediate vicinity of each well. All wells were tested except MW-12D/12S, MW-13D/13S, MW-14D/14S, and MW-15D/15DA/15S, which either had insufficient water to conduct the tests at that time or were inaccessible. None of the piezometers were tested.

At each well where the screen was not fully saturated, a bailer was placed into the well and the water level was allowed to equilibrate. Then the bailer containing water was removed, causing water levels to decrease. A 10 pounds per square inch gauge (psig) transducer and a Hermit 2000 data logger were used to measure the change in water level as the well returned to static conditions (rising head test). The volume of water removed was measured and recorded. This volume ranged from 275 to 900 ml.

At well locations that had saturated screens and sandpacks, a known volume of water was added to each well, causing water levels to rise. Volumes added ranged from 1 to 3.8 liters. Water levels were measured with a transducer and data logger as the well returned to static conditions (falling head test). Laboratory deionized water was used when water was added to any of the wells. At one location, MW-4D, both falling and rising head tests were performed to compare the methodologies used. Very similar results were obtained for both methods. Section 4.4.12 and Table 4-24 summarize the wells tested, methods used, and results.

Following data collection, the slug test data were downloaded into a computer and analyzed using the software program SLUGIX (Interpex Ltd. 1988) according to the methods of Bouwer and Rice (1976) and/or Cooper *et al.* (1967). The Bouwer and Rice analysis is applicable to unconfined aquifer conditions and confined conditions where some leakage occurs in the overlying confining layer. Cooper *et al.* is applicable to confined conditions. In addition, some data were also analyzed using the software Graphical Well Analysis Package (GWAP) by Groundwater Graphics (1987) according to the methods of Cooper *et al.* (1967). The results obtained using GWAP were then compared with the results obtained using SLUGIX. In general, where both methods were used, results were within the same order of magnitude. Both programs plot the data on a time versus drawdown graph and determine the best fit line equation to calculate the hydraulic conductivity and transmissivity. When more than one slope was present (e.g., MW-6S and MW-6D) and the well screen was not saturated, the later curve data were considered to be the most representative (Bouwer 1989); the later curve data were therefore used to create the line match. The test data and graphical results are presented in Appendix I.

3.14 HABITAT-BASED ECOLOGICAL ASSESSMENT

In order to characterize the ecological resources associated with the Wellsville-Andover Landfill site, E & E conducted initial background research. E & E biologists then conducted an initial field reconnaissance of the terrestrial and aquatic communities existing at and in the general vicinity of the site during the Phase I RI on October 24, 1991.

Phase II RI Habitat-Based Assessment (HBA) fieldwork was expanded to include areas around the site not previously studied during the Phase I HBA. Therefore, E & E biologists conducted an additional field reconnaissance on July 9, 1993. This additional work

was performed in order to characterize the terrestrial communities further downgradient of the site and to provide additional characterization of Duffy Creek further up and downstream than previously provided.

E & E's scope of work addresses items identified in Step 1 and Step 2, parts A and B, of the NYSDEC document *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites* (1991b).

The following is a brief discussion of the approach E & E used to characterize ecological communities associated with the Wellsville-Andover Landfill site.

Terrestrial Ecosystems

Prior to field work, E & E analyzed current USGS topographic maps, United States Department of Agriculture (USDA) Soil Conservation Service (SCS) soils maps, and NYSDEC Wetland Maps to distinguish vegetative cover types. Cover type designations correlate to cover types described by the New York State Natural Heritage Program (NYSNHP) in its *Ecological Communities of New York State.* Both the NYSNHP and NYSDEC regional offices, as well as any other pertinent agencies, were contacted to identify any significant habitats known to occur on or near the site.

Field reconnaissance was used to verify the initial cover type mapping. Each cover type was surveyed in the field by traversing random but representative transects. Within each cover type, dominant species in the overstory, understory, and herbaceous layers were identified.

Potential wetlands were characterized and map-delineated following procedures detailed in the *Corps of Engineers Wetland Delineation Manual* (Department of the Army 1987) that use hydric soils, wetland hydrology, and hydrophytic vegetation for making wetland determinations.

Evidence of disturbed or stressed vegetation was noted, and each cover type was evaluated with regard to its relative value for wildlife habitat. Potential wildlife utilization was determined primarily through literature review supported by in-field observations. Because of the mobile and often nocturnal habits of mammals and the transitory nature of avifauna, verification relied on evidences of wildlife utilization in the form of browse, tracks, burrows, or scat. Bird species were identified by sight and call.

Aquatic Ecosystems

Collection of information characterizing the aquatic ecosystem relied primarily on project field surveys. As for the terrestrial ecosystems, NYSNHP and NYSDEC were contacted to identify any significant communities or species in the vicinity of the Wellsville-Andover Landfill site, as well as typical species that might be expected.

Duffy Creek and its unnamed tributary were surveyed to characterize their various ecological features and infer their relative quality based primarily on the type, number, and diversity of benthic organisms present. In addition, basic water chemistry data were collected.

To characterize the physical nature of the streams, depth, width, bottom composition, stream flow, bank height, and fish habitat characteristics were observed and recorded at sampling locations. Riparian vegetation adjacent to the stream was characterized as to successional stage, species composition, and canopy closure. The presence or absence of instream submergent and emergent vegetation was used to assess the relative health of the aquatic community.

The locations of aquatic sampling stations as well as a complete discussion of the results of the HBA are provided in Section 6 of this report.

3.15 QUALITY CONTROL SAMPLES AND PROCEDURES

All Phase I RI fieldwork and sampling activities at the site were performed in accordance with E & E's June 1991 *Quality Assurance Project Plan (QAPjP), Phase I Remedial Investigation/Feasibility Study (RI/FS) for the Wellsville-Andover Landfill Site in Wellsville, New York* as well as the June 1991 *Remedial Investigation/Feasibility Study, Health and Safety Plan (HASP) for the Wellsville-Andover Site.* Phase II RI fieldwork and sampling activities were performed in accordance with E & E's June 1993 revised QAPjP and June 1993 HASP.

Phase I RI

As described in the June 1991 QAPjP and work plan, several field QC samples were required for the various media sampled. Duplicate samples were collected for subsurface soils (SB-8AD), groundwater (GW-11SDD), domestic water (DW-5D), surface water (SW-4D), sediment (SED-4D), surface soil (SS-10D), and air (A-6). MS/MSD sample sets were collected for test pit samples (TP-5), subsurface soil (SB-6A and SB-10A), groundwater

(GW-10D), domestic water (DW-2), surface water (SW-4), sediment (SED-4), leachate (L-2), and surface soil (SS-11). All of the above samples were analyzed for full TCL parameters, with the exception of the MS/MSD set collected from SB-10A, which was analyzed for VOCs and inorganic substances only, and the air sample duplicate, which was analyzed for VOCs only by Method TO-14.

Other field QC samples collected include one rinsate (R-1), one air sample blank (A-8), and three trip blanks. The rinsate sample, collected at the time of subsurface soil sampling, was collected by pouring laboratory deionized water through a split spoon previously decontaminated according to the procedures in Section 3.14. This sample, analyzed for full TCL parameters, was used to check the decontamination procedure. The air sample blank consisted of an unopened SUMMA® canister transported to and from the field with the other canisters in order to assess potential leakage and ambient conditions. This sample was analyzed for VOCs by Method TO-14. Three trip blanks, analyzed for VOCs only, were incorporated with sample shipments containing water samples on October 2, 4, and 25, 1991.

In addition to the above, a sample of the water used for drilling and decontamination (DW-1) was collected from the driller's holding tank. This water, analyzed for full TCL parameters, consisted of potable water collected from a hydrant at the Village of Wellsville's water treatment plant.

Phase II RI

As prescribed in the June 1993 revised QAPjP, several field QC samples were collected during the Phase II RI. Duplicate samples were collected for seeps/springs (SP2-1D), groundwater (MW2-5SD and CW2-3BD), and domestic water (DW2-5D). Because of analytical difficulties, the VOC results for DW2-5 were rejected and DW2-5D was substituted for the original sample. Therefore, no duplicate for residential well and spring VOC results exists; however, DW2-5D remains as a duplicate sample for the inorganic results.

MS/MSD sample sets were collected for all media sampled, including seeps/springs (SP2-4), surface water (SW2-1), sediment (SED2-1), groundwater (MW2-3D and MW2-5D), and domestic water (DW2-2). All MS/MSD and duplicate samples were analyzed for the same parameters as the associated field sample.

Other field QC samples collected include one field blank (FB2-1) and ten trip blanks. The field blank consisted of deionized water poured into appropriate containers at the Gephart home in an attempt to assess ambient conditions during residential well and spring sampling. The field blank was analyzed for Method 524.2 VOCs and TCL inorganics. Trip blanks consisting of deionized water were included with each shipment of water samples. Four trip blanks were analyzed for Method 524.2 VOCs and six were analyzed for TCL VOCs. Trip blanks were shipped with seep samples on June 22, 1993; with the surface water sample on July 9, 1993, with groundwater samples on July 29 and 30, August 3, and September 16, 1993; and with domestic water samples on July 29, August 2 and 6, and September 15, 1993. Analytical results for the QC samples are included in the data summary forms in Appendix D.

3.16 DECONTAMINATION PROCEDURES

All decontamination was performed in accordance with NYSDEC-approved procedures. Sampling methods and equipment were chosen to minimize decontamination requirements and prevent the possibility of cross-contamination. All drilling equipment was decontaminated prior to drilling, after drilling each monitoring well, and after the completion of all monitoring wells. Specific attention was given to the drilling assembly, augers, split spoons, and PVC casing and screens. Decontamination of drilling equipment consisted of:

- Removal of foreign matter, followed by
- High-pressure steam-cleaning.

During the Phase I RI, split spoons were decontaminated between each use by the above procedure. During the Phase II RI, split spoons were decontaminated between wells by the above procedure. However, because the water truck and steam cleaner were not easily moved, split spoons used within the same borehole were decontaminated at the drilling site according to the following procedure:

- Removing foreign matter;
- Washing in a trisodium phosphate (TSP) solution;
- Rinsing with potable water;

- Rinsing with pesticide-grade methanol;
- Rinsing with distilled water; and
- Air drying.

This same procedure was used to decontaminate the soil gas probes between each use during the explosive gas survey, except that a methanol rinse was not used.

Sampling equipment, including stainless-steel spoons, was decontaminated using the following procedure:

- Washing in a TSP solution;
- Rinsing with potable water;
- Rinsing with 10% nitric acid;
- Rinsing with deionized water;
- Rinsing with pesticide-grade methanol;
- Rinsing with deionized water; and
- Air drying.

A temporary decontamination pad was constructed east of the leachate holding pond using plywood, sand, and heavy plastic sheeting. The primary purpose of the pad was to support decontamination of heavy equipment, such as the drill rig and augers. Fluids generated during decontamination were pumped from the pad directly into the leachate holding pond.

No soil cuttings generated during monitoring well or nonfill piezometer installation exhibited HNu readings greater than 5 ppm above background. Therefore, except for off-site wells, all soil was left on the ground near the monitoring well or nonfill piezometer. For all off-site wells, the soil was transported to the site and deposited in low-lying areas.

The cuttings generated during drilling of the landfill piezometers were containerized in United States Department of Transportation (DOT)-approved 17H drums. The cuttings from MW-5VD were also drummed because approximately three gallons of diesel fuel spilled during drilling at this well.

All waters generated by decontamination or by drilling, developing, purging, or pumping monitoring wells were collected and disposed of in the leachate holding pond. All expendable materials generated during the investigation (i.e., Tyvek clothing, gloves, spoons, plastic sheeting from the decontamination pad, etc.) were placed in DOT-approved 17H drums and stored at a central location on site. All drums containing investigation-derived waste were labeled with type of generated material, the site name, the location where the material was generated, and the date when the material was generated.

Personal decontamination was performed in accordance with the HASP.

Table 3-1

ANALYTICAL METHODS SUMMARY

Method Reference	Method Number	Brief Description of Method	Matrix
Atterberg Limits ASTM	D4318-84	Liquid and plastic limit, plasticity index	Soil
Biochemical Oxygen Demand (BOD) ASP	405.1	5 days, 20°C	Water
ASP	405.1	28 days, 20°C	Water
Chemical Oxygen Demand (COD) ASP	410.1	Titrimetric, Mid-Level	Water
ASP	410.2	Titrimetric, Low-Level	Water
Cyanide-Total ASP	335.2	Spectrophotometric	Water
ASP	9010	Colorimetric	Soil
Grain Size ASTM	D422-63	Sieve and hydrometer analysis	Soil
Hardness ASP	130.2	Titrimetric, EDTA	Water
Moisture Content ASTM	D2216-90	Heat to 110°C	Soil
Percent Organic Matter ASTM	D2974-87	Ash content, heat to 440°C in muffle furnace	Sediment
Total Kjeldahl Nitrogen (TKN) ASP	351.3	Colorimetric	Water
Total Suspended Solids (TSS) ASP	160.2	Gravimetric, Dried at 103 - 105°C	Water
Aluminum ASP CLP	200.7-M	ICP	Soil, Water
Arsenic ASP CLP	206.2-M	Furnace AA	Soil, Water
ASP	6010	ICP	Soil, Water
Barium ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water

Table 3-1

ANALYTICAL METHODS SUMMARY

Method Reference	Method Number	Brief Description of Method	Matrix
Beryllium ASP CLP	200.7-M	ICP	Soil, Water
Cadmium ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water
Calcium ASP CLP	200.7-M	ICP	Soil, Water
Chromium ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water
Cobalt ASP CLP	200.7-M	ICP	Soil, Water
Copper ASP CLP	200.7-M	ICP	Soil, Water
Iron ASP CLP	200.7-M	ICP	Soil, Water
Lead ASP CLP	239.2-M	Furnace AA	Soil, Water
ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water
Magnesium ASP CLP	200.7-M	ICP	Soil, Water
Manganese ASP CLP	200.7-M	ICP	Soil, Water
Mercury ASP CLP	245.1-M	Manual cold vapor	Soil, Water
ASP	7470	Cold vapor-liquid	Water
Nickel ASP CLP	200.7-M	ICP	Soil, Water
Potassium ASP CLP	200.7-M	ICP	Soil, Water
Selenium ASP CLP	270.2-M	Furnace AA	Soil, Water
ASP	6010	ICP	Soil, Water

Table 3-1

ANALYTICAL METHODS SUMMARY

Method Reference	Method Number	Brief Description of Method	Matrix
Silver			
ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water
Sodium			
ASP CLP	200.7-M	ICP	Water
Thallium			
ASP CLP	279.2-M	Furnace AA	Soil, Water
Vanadium			
ASP CLP	200.7-M	ICP	Soil, Water
Zinc			
ASP CLP	200.7-M	ICP	Soil, Water
Base/Neutral/Acid Extractables			
ASP CLP	89-2	Extraction, GC/MS	Soil, Water
Volatile Organic Compounds			
ASP CLP	89-1	Purge & Trap, GC/MS	Soil, Water
ASP	524.2	Purge & Trap, GC/MS	Drinking water
Pesticides/PCBs			
ASP CLP	89-3	Extraction, GC/ECD	Soil, Water

Key:

AA = Atomic absorption spectroscopy.
ASP = NYSDEC Analytical Services Protocol, September 1989.
ASTM = American Society of Testing and Materials, 1991.
GC/MS = Gas chromatograph/mass spectrometer.
GC/ECD = Gas chromotograph/electron capture detector.
CLP = Contract Laboratory Program SOW, July 1988, modified.
ICP = Inductively coupled argon plasma.

Source: Ecology and Environment Engineering, P.C. 1992.

Table 3-2

SOIL/WASTE SAMPLES COLLECTED DURING PHASE I RI TRENCH EXCAVATION

Sample Number	Trench Number	Date	Approximate Depth (feet)	Analysis	Description
TP-1	1	12-19-92	6	Full TCL	Saturated dark gray clay loam with minor trash fragments onto which black liquid contents of drum leaked.
TP-2	2	12-19-92	5 to 6	Full TCL	Moist, dark gray to black clay loam with minor trash fragments. Collected from bucket that scraped along full 12-foot length of trench.
TP-3	3	12-19-92	6	Full TCL	Saturated dark gray and brown clay loam with minor trash fragments collected from northeast end of trench near unknown scrap metal.
TP-4	4	12-18-92	3	Full TCL	Moist brown clay loam containing pieces of plastic buttons from trench as well as fragments of pink and white plastic material from drums. Includes material directly from partially removed drum.
TP-5	5	12-18-92	4	Full TCL	Saturated medium gray clay loam with rock and municipal trash fragments collected at the level of the water table below a crushed oil drum.

Source: Ecology and Environment Engineering, P.C. 1992.

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ecology and environment

Table 3-3

PHASE I RI MONITORING WELL CONSTRUCTION DATA[a]

Well Number	Depth to Auger Refusal	Total Depth	Depth of Screened Interval	Depth of Sand Pack	Depth of Bentonite Seal	Completion Date
MW-1D	44.0	74.5	64.5 - 74.5	61.9 - 74.5	58.0 - 61.9	8-30-91
MW-2D	24.0	61.0	49.0 - 59.0	43.0 - 61.0	36.5 - 43.0	9-4-91
MW-2S	9.0[b]	9.0	5.0 - 9.0	4.0 - 9.0	3.0 - 4.0	10-3-91
MW-3D	25.0	41.6	30.0 - 40.0	28.0 - 41.6	22.5 - 28.0	9-6-91
MW-3S	19.0[b]	19.0	9.0 - 19.0	7.0 - 19.0	5.0 - 7.0	10-3-91
MW-4D	9.0	23.3	12.0 - 22.0	10.0 - 23.3	7.5 - 10.0	9-9-91
MW-5D	23.5	36.8	26.5 - 36.5	25.0 - 36.8	19.0 - 25.0	9-10-91
MW-5S	–	22.0	10.0 - 20.0	8.0 - 22.0	6.0 - 8.0	9-11-91
MW-6D	14.6	28.3	18.0 - 28.0	16.0 - 28.3	11.0 - 16.0	9-12-91
MW-6S	14.8	13.5	6.5 - 13.5	5.0 - 13.5	3.0 - 5.0	9-12-91
MW-7D	26.0	45.4	35.1 - 45.1	31.0 - 45.4	24.0 - 31.0	10-2-91
MW-8D[c]	64.0	77.0	67.0 - 77.0	65.5 - 77.0	57.0 - 65.5	9-30-91
MW-8D[d]	55	71.3	61.0-71.0	58.0-71.3	35.0-58.0	2-27-92
MW-8S	–	20.7	7.0 - 17.0	5.5 - 20.7	3.5 - 5.5	10-1-91
MW-9D	29.0	45.4	35.1 - 45.1	32.0 - 45.4	26.0 - 32.0	9-19-91
MW-9S	–	19.3	9.0 - 19.0	7.0 - 19.3	5.0 - 7.0	9-19-91
MW-10D	29.0	43.4	33.1 - 43.1	31.0 - 43.4	26.0 - 31.0	9-17-91
MW-10S	–	24.3	14.0 - 24.0	9.0 - 24.3	7.0 - 9.0	9-17-91
MW-11S	>24	23.6	8.0 - 18.0	6.0 - 23.6	4.0 - 6.0	10-4-91

a All depths are in feet below ground surface (BGS).
b Different depths to auger refusal in shallow well achieved due to change in bit type.
c Well found to be incompetent after completion and was later reinstalled.
d Redrilled and existing well.

Source: Ecology and Environment Engineering, P.C. 1992.

Table 3-4

SUBSURFACE SOIL SAMPLES COLLECTED DURING PHASE I RI WELL DRILLING

Well Number	Sample ID	Depth (feet)	Date	Analysis
MW-1D	SB-1A	12 - 14	8-27-91	Full TCL
	SB-1B	1 - 2	8-29-91	Full TCL
	1D[a]	0 - 2	8-30-91	Geotechnical
MW-2D	SB-2A	6.5 - 7.5	9-3-91[a]	TCL volatiles and inorganics
	2D[a]	4 - 6	9-3-91	Geotechnical
MW-3D	SB-3A	1 - 2	9-5-91[a]	TCL volatiles and inorganics
	SB-3B	10 - 12	9-5-91[a]	TCL volatiles and inorganics
	3D[a]	5 - 6	9-5-91	Geotechnical
	3D[b]	22 - 24	9-5-91	Geotechnical
MW-4D	SB-4A	2 - 4	9-9-91	TCL volatiles and inorganics
	5B-4B	7 - 9	9-9-91	TCL volatiles and inorganics
	4D[a]	1 - 2	9-9-91	Geotechnical
MW-5D	SB-5B	8 - 9	9-10-91	TCL volatiles and inorganics
	SB-5C	18 - 19	9-10-91	TCL volatiles and inorganics
	5D[a]	8 - 10	9-10-91	Geotechnical
MW-6D	SB-6A[b]	6 - 10	9-11-91	Full TCL
	SB-6B	12 - 14	9-12-91	Full TCL
	6D[a]	2 - 4	9-11-91	Geotechnical
	6D[b]	12 - 14	9-12-91	Geotechnical
MW-7D	SB-7A	8 - 10	10-1-91	Full TCL
	SB-7B	20 - 21 and 22 - 23	10-1-91	Full TCL
	7D[a]	10.5 - 11	10-1-91	Geotechnical
	7D[b]	20 - 22	10-1-91	Geotechnical
MW-8D	SB-8A	7 - 9	9-20-91	Full TCL
	SB-8AD[c]	7 - 9	9-20-91	Full TCL
	SB-8B	21 - 23	9-20-91	Full TCL
	8D[a]	1 - 3	9-20-91	Geotechnical
	8D[b]	11 - 12	9-20-91	Geotechnical
	8D[c]	43 - 44	9-25-91	Geotechnical
MW-9D	SB-9A	4 - 6	9-18-91	TCL volatiles and inorganics
	SB-9B	26 - 27.5	9-18-91	TCL volatiles and inorganics
	9D[a]	1 - 3	9-18-91	Geotechnical
	9D[b]	14 - 16	9-18-91	Geotechnical
MW-10D	SB-10A[b]	5 - 7	9-13-91	TCL volatiles and inorganics
	SB-10B	18 - 19	9-16-91	TCL volatiles and inorganics

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Table 3-4

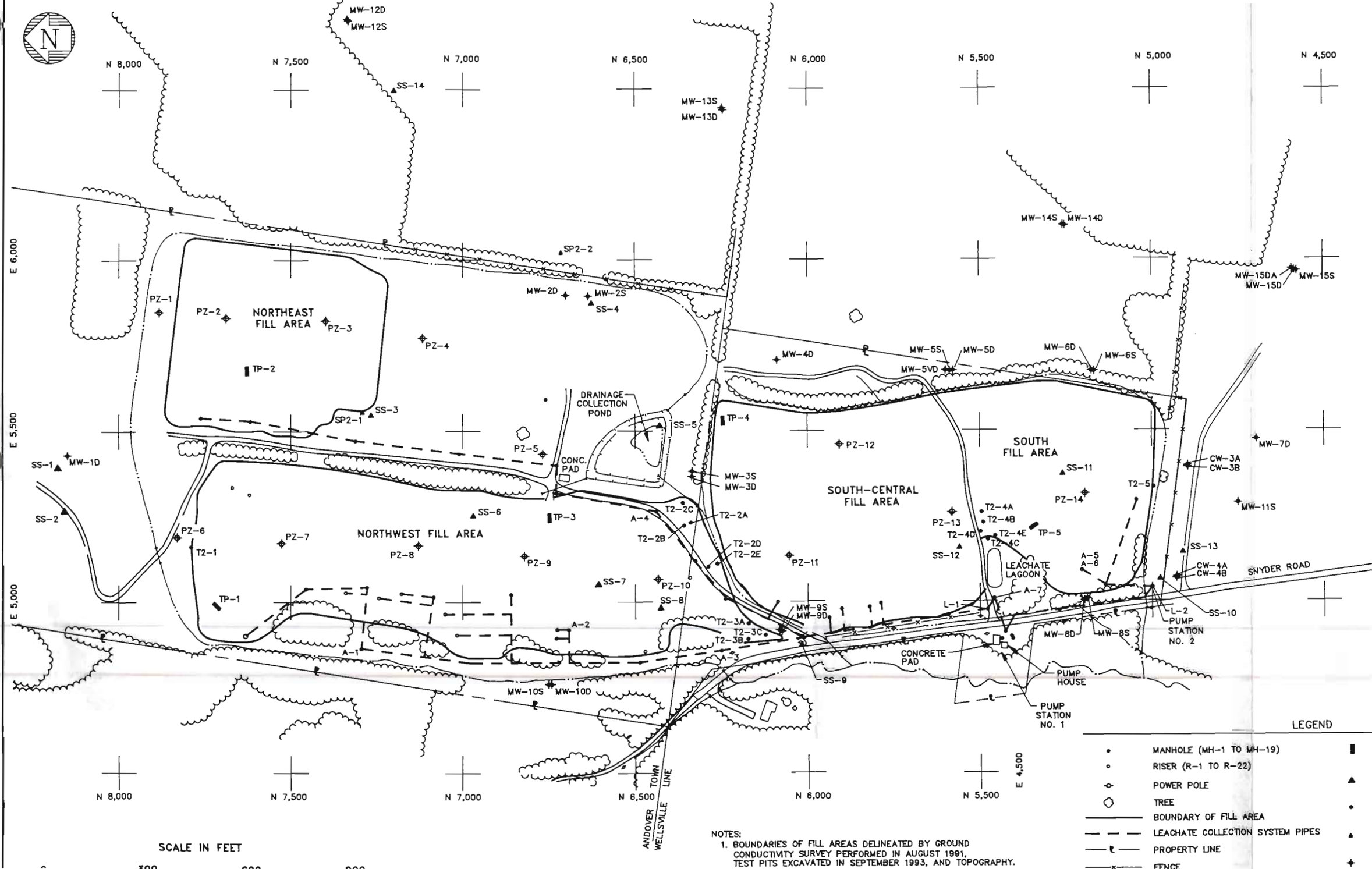
SUBSURFACE SOIL SAMPLES COLLECTED DURING PHASE I RI WELL DRILLING

Well Number	Sample ID	Depth (feet)	Date	Analysis
MW-11S	11S[a]	17 - 18	10-3-91	Geotechnical
--	CL-1[d]	1.5 - 2	10-25-91	Geotechnical

Note: Geotechnical analysis refers to moisture content, grain size and hydrometer analysis and Atterberg limits testing.

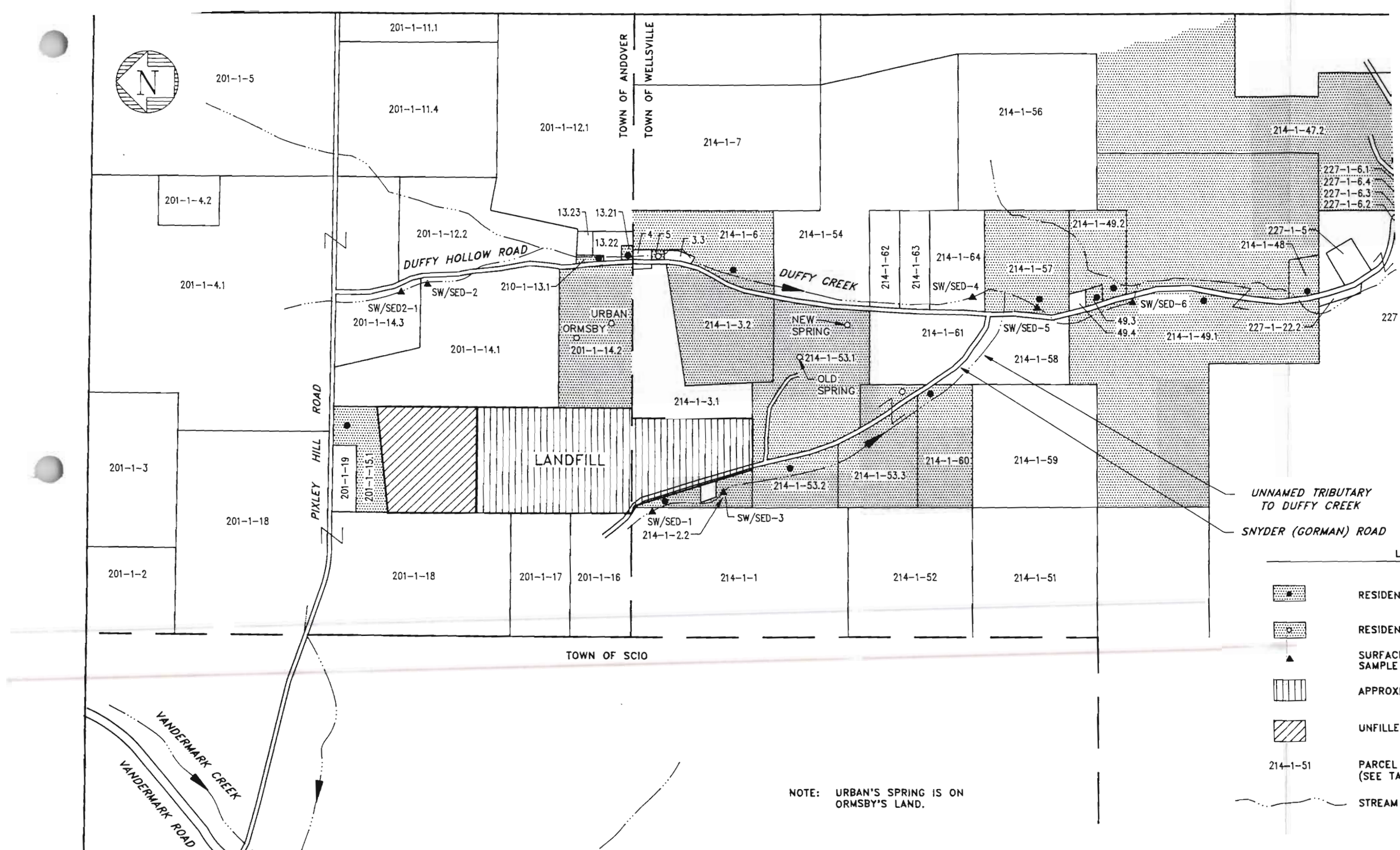
[a] Portion for TCL volatile analysis re-collected 10-3-91.
[b] MS/MSD sample set also collected for QA/QC.
[c] Duplicate sample for QA/QC.
[d] Sample of confining layer material collected from area of Miller spring.

Source: Ecology and Environment Engineering, P.C. 1991.

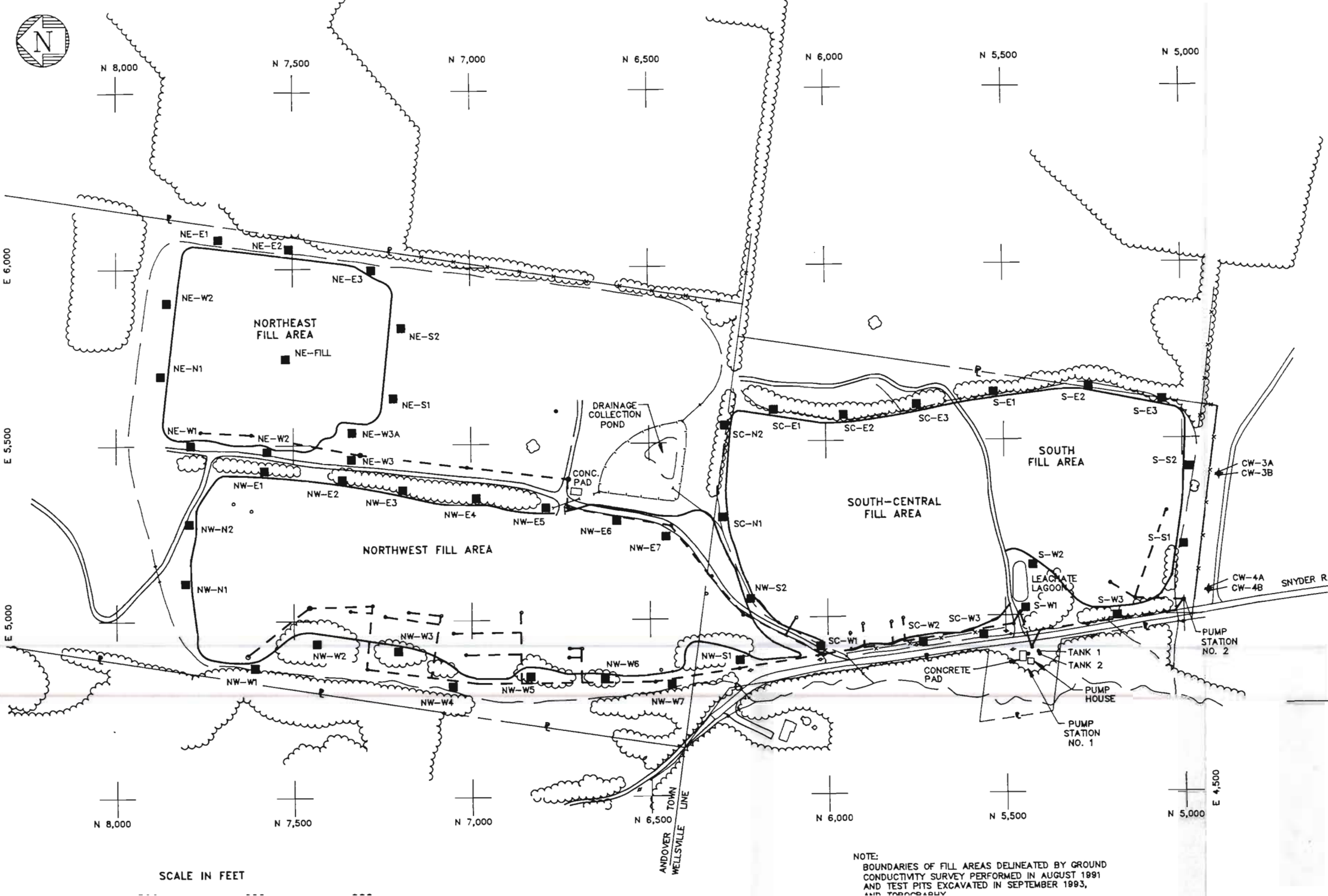


NOTES:

1. BOUNDARIES OF FILL AREAS DELINEATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991, TEST PITS EXCAVATED IN SEPTEMBER 1993, AND TOPOGRAPHY.



NOTE: URBAN'S SPRING IS ON ORMSBY'S LAND.



SCALE IN FEET

NOTE:
BOUNDARIES OF FILL AREAS DELINEATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991 AND TEST PITS EXCAVATED IN SEPTEMBER 1993, AND TOPOGRAPHY

4. NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

To develop an understanding of the nature and extent of contamination at the Wellsville-Andover Landfill site, this section discusses the primary environmental media that influence contaminant migration, such as geology, surface hydrology, and hydrogeology. This is followed by a discussion of the concentrations and areal extent of contamination that exist in these media.

All analytical data (including field and laboratory blanks) are presented on data summary sheets in Appendix D. Tables summarizing the organic and inorganic analytes detected in each sample type are provided in this section.

4.2 SITE GEOLOGY

4.2.1 Introduction

The geology at the Wellsville-Andover Landfill and throughout Allegany County can be subdivided into two primary units. One unit is the Paleozoic sedimentary rocks that underlie all of western New York and northern Pennsylvania. The second unit is a thin overburden of unconsolidated Pleistocene glacial deposits and recent alluvium. Section 2.3 provides a discussion of the regional geology. Site-specific interpretations of the geology at the Wellsville-Andover Landfill site were developed using primarily the following techniques:

- Field observations of soils as well as local bedrock outcrops;
- Interpretation of geophysical surveys;
- Examination of split-spoon samples and rock cores collected during the drilling of the 17 bedrock monitoring wells;

- Geotechnical analyses performed on selected samples; and
- Review of drilling log records and photos.

Subsurface boring logs were developed for each of the monitoring wells installed during the Phase I RI and are presented in Appendix B. Subsurface boring logs for all Phase II RI monitoring wells and piezometers are presented in Appendix H. Geologic and hydrogeologic cross-sections and groundwater potentiometric surface contour maps were generated from data collected from the monitoring wells and piezometers and are discussed below.

4.2.2 Geophysical Survey Interpretation

Geophysical investigations performed at the site included total earth field magnetics, electromagnetic ground conductivity, and seismic refraction surveys. Data collection methods are described in Section 3.3 of this report.

As discussed in Section 3.3.1, magnetometer data were corrected for diurnal variations and then contoured using Surfer, version 4.10 (see Figure 4-1). Magnetic field strength in undisturbed areas was approximately 55,500 to 56,000 gammas. Anomalous areas of unusually high or low magnetic field strength were then noted for possible trench excavation. Several unusual features were noted on the generated contour map. Among them is the east-west linear feature with high magnetic field strength, located at the north end of the site. This feature correlates with the cut-off ditch at the north end of the filled areas. Since it is unlikely that metallic objects exist below the ditch, it is assumed that the sidewalls of the ditch interfered with the magnetic field. Another linear feature noted on Figure 4-1 occurs along the north side of the northeast fill area. This feature may represent a buried linear object or may again be due to magnetic field interference caused by the sloped embankment of the northeast fill area.

As discussed in Section 3.3.2, Surfer was used to generate contour maps of ground conductivity in both the horizontal and vertical dipole modes of the EM31 (see Figures 4-2 and 4-3). The ground conductivity in undisturbed areas was approximately 5 to 15 micromhos per meter (μmhos/m) in the horizontal dipole mode and approximately 10 to 20 μmhos/m in the vertical mode. The horizontal dipole was especially effective in defining the fill areas. In addition, Figure 4-2 appears to indicate that linear east-west cells were filled in the northeast area, while irregularly shaped cells exist in the other fill areas. Anomalous

areas were noted on the contour maps, and those that correlated with magnetic anomalies were selected for Phase I RI trenching. The locations of the Phase I RI trenches are shown on Figure 3-1. The strong anomaly near coordinate 815,1285 on both Figures 4-2 and 4-3 was due to a concrete pad adjacent to the central access road.

As discussed in Section 3.3.3, seismic refraction data were collected around the perimeter of the fill area as well as along two transects across the center of the site (see Figure 1, Appendix A). Data interpretation involved selecting the first-break arrival times from the seismic traces. These measurements represent the arrival times of the primary wave (P-wave) of the seismic energy refracted along layers exhibiting significant velocity contrast. A P-wave is the fastest-propagating type of seismic wave. The number of layers and their associated velocities are determined from the first-break data.

Algorithms from the general reciprocal method (GRM) were used to convert the data from measurements of time to measurements of layer thickness. The approximate accuracy of this method is $\pm 15\%$. Due to lack of borehole control at the time the survey was performed and analyzed, absolute depth estimates varied. However, the relative changes in bedrock topography interpreted along seismic profiles can be used to evaluate changes in overburden stratigraphy and bedrock topography.

A complete seismic report prepared by Davenport/Hadley, including seismic profiles, is presented in Appendix A. Based upon these results, overburden thickness appears to be consistent with topography with localized variations caused by erosional alteration of the bedrock surface. In general, the seismic data indicate three layers are present. The upper layer ranges in P-wave velocity from 1,090 to 2,220 feet per second (fps), typical of unconsolidated, unsaturated surficial soil. Generally, this layer is less than 10 feet thick. The middle layer ranges in velocity from about 2,090 to 5,400 fps, which is representative of dense soils or weathered rock. Velocities in excess of 5,000 fps represent saturated conditions. Based on subsurface boring information, the middle layer is thought to represent dense soil with many rock fragments derived from the local bedrock. The third layer generally has P-wave velocities in excess of 10,000 fps and was interpreted as competent rock. However, the subsurface boring logs indicate that the third layer may represent an increase in density from dense soil to either very dense soil with structurally intact rock lenses or to relatively competent, yet still highly fractured, bedrock.

4.2.3 Characteristics of the Overburden

As previously described, the Wellsville-Andover Landfill occupies a hill between Duffy Creek and its unnamed tributary. The site slopes generally to the south at approximately 5% to 6%. A description of the soils encountered in the area is provided in Section 2.3.1. In general, the soils consist of glacial till of local derivation underlain by hardpan and soils formed *in situ*.

The nature of the overburden was characterized using the results from the subsurface investigation. Split-spoon sampling was performed in MW-11S and each of the deep wells installed at the site. Split-spoon sampling was performed in accordance with ASTM Designation D1586-84. In general, blow counts recorded during split-spoon sampling indicate mixed soils of varying density; however, the general pattern appears to be medium-density soils (10 to 29 blows/ft) underlain by dense (30 to 49 blows/ft) to very dense ($\geq$50 blows/ft) soils, as expected.

The thickness of overburden at the site does not appear to change with topography; rather, localized bedrock erosional patterns and anthropogenic alterations control overburden thickness. This is seen in the seismic cross sections in Appendix A. In borrow areas, the overburden is artificially thin (9 feet at MW-4D). Overburden thickness in undisturbed areas ranged from about 10 feet in MW-2D to 64 feet in MW-8D.

Nineteen subsurface soil samples were collected at and around the site for geotechnical analyses. All samples were subject to Atterberg limits testing (ASTM D4318), grain size analysis including hydrometer (ASTM D422), and water content analysis (ASTM D2216). The results of these analyses, including classification by the Unified Soil Classifications System (ASTM D2487-85), are presented in Appendix E. In general, the soil samples collected were well graded, with a fairly uniform distribution of gravels, sands, silts, and clays. Ten samples, including those from the north end (MW-1D) and south end (MW-8D) of the site, were classified as sandy lean clay with gravel (CL) or gravelly lean clay with sand (CL). Seven samples from various depths across the site were classified as clayey gravel with sand (GC) or clayey sand with gravel (SC). The general trend is for finer-grained soils (CL) to overlie coarser-grained soils (GC and SC).

One soil sample (CL-1) was collected from the Millers' property south of the site at the same location as the Millers' domestic water sample. At this location, perched water flowed on top of an unsaturated clay and silt layer. This sample contained more clay than

any sample collected on site (24%) but contained enough silt (47%) and sand (16%) and was of sufficiently low plasticity to be classified as a silt with sand (ML). The clay portion of this sample has a low enough activity to be considered a mixture of illite and kaolinite (Holtz and Kovacs 1981). The low activity of the clay in the remainder of the samples suggests that most clay found at the site is illite. The presence of the clay- and silt-rich layer, as well as the existence of springs south of the site, suggests that as glacial ice receded from Duffy Hollow, outwash or glaciolacustrine deposits of fine-grained soils were deposited in the area. These low-permeability units create perched water zones that emerge from hillsides as springs.

Trench excavation indicated that local materials were used for cover and that this material also contained a uniform grain-size distribution. Visual classification during trenching indicated the presence of various grain sizes from clay to boulder. Boulders consisted of locally derived sandstone ranging up to an 8-inch thick flagstone 6 feet in diameter.

4.2.4 Bedrock Geology

The characterization of the bedrock was determined from literature published regarding local geology as well as site investigation activities, including the seismic refraction survey and well drilling.

The site lies within the glaciated Allegany Plateau section of the Appalachian Plateau physiographic province. This area is known locally as the Southwestern Plateau (USDA 1956). The entire region is underlain by Paleozoic sedimentary strata. The bedrock beneath the site is part of the Late Devonian Canadaway Group (Rickard 1975). As described in Section 2.3.2, this group consists of approximately 700 to 1,200 feet of subtidal and peritidal deposits of shale, siltstone, and sandstone. Specifically, the bedrock beneath the site consists of the Wellsville Formation (called the Whitesville Formation to the east and the Forty Bridge to the west) (Rickard 1975). The Wellsville Formation consists of thin sandstones and siltstones, generally 0.5 to 3 inches thick, interbedded with primarily argillaceous but sometimes arenaceous shales. The formation is generally olive green to gray, weathering to greenish brown or brownish gray. In addition, some brown to dull red beds have been noted in the upper Wellsville. Calcareous shale and siltstone beds are present throughout the

section. Many beds exhibit cross-bedding, ripple marks, and mud flows, and many are highly fossiliferous, containing mostly brachiopods (Woodruff 1942).

Definition of the upper bedrock surface at the site is very difficult due to the high degree of weathering of the bedrock as well as erosional irregularities in the surface. Bedrock was encountered in each of the deep wells and six of the piezometers installed across the site. In general, auger refusal was achieved on a relatively competent, light gray, laminated, calcareous siltstone or fine-grained sandstone ranging in thickness from 1 to 5 feet. However, as indicated by the seismic refraction survey, the former bedrock surface may also be defined by changes in soil density or type; i.e., from glacial till to clays weathered in place from native shale. In many instances, the first competent calcareous siltstone layer encountered was underlain by rock so severely weathered it may be considered soil. Geologic cross-sections of lines AA' and BB' (see Figure 4-4) are provided as Figures 4-5 and 4-6. Cross-section AA' runs N4°E/S4°W along the east side of the site. Cross-section BB' runs N54°W/S54°E across the center of the site. Both cross-sections indicate a complex, interbedded formation, with various layers appearing, disappearing, or lying unconformably on others. This complex interbedding indicates deposition in a very active subtidal and nearshore environment.

The seismic survey indicates that the bottom refractor dips south at approximately 3° to 5°. However, correlation of coal stringers encountered in wells MW-3D, MW-5D, and MW-6D and subsequent correction to an east-west strike (Woodruff 1942) indicates that the bedrock beneath the site dips approximately 1.4° south.

With the exception of the occasional competent sandstone bed, the majority of the bedrock encountered was extremely weathered and very highly fractured. In general, shale beds were more highly fractured and weathered than the silt and sandstone beds, and contained subhorizontal to subvertical fractures. Numerous fractures in a variety of beds were open, with visible oxidation residues present on the fracture surfaces. Horizontal and vertical clay-filled fractures were also encountered across the site.

One very deep well (MW-5VD) was drilled at the location of the highest detected groundwater contamination in order to assess the potential for vertical contaminant migration. Steel casing was grouted in place from the ground surface to 50 feet BGS to isolate this well from the adjacent pair (MW-5D/5S). MW-5VD was then cored from 50 to 140 feet. The bedrock encountered from 50 to 114 feet BGS was similar to the shallow bedrock encountered

in the existing bedrock wells. The rock consisted of interbedded shale, siltstone, and sandstone, with grain sizes increasing and decreasing throughout the section. These units were primarily light to dark grey, with infrequent maroon sandstone beds occurring. Occasional orange oxidation stains were seen throughout to a depth of 110 feet BGS. The interval between 50 and 114 feet was heavily fractured, containing both horizontal and vertical open fractures. At 114 feet, competent, massive, gray shale was encountered. This shale extended to approximately 122 feet BGS and contained only two minor horizontal and one short vertical fracture. Below 122 feet was light grey sandstone with wavy siltstone seams and minor subhorizontal fracturing. Due to the presence of this competent rock, the bottom of the hole was plugged to 112 feet in order to restrict potential vertical contaminant flow. The boring log for this well is presented in Appendix H.

4.3 SITE HYDROLOGY

4.3.1 Surface Water and Runoff

The Wellsville-Andover Landfill occupies a hillside that slopes to the south at approximately 5% to 6%. In addition, the majority of the site dips gently to the southwest toward the unnamed tributary to Duffy Creek. The hillside adjacent to the east side of the site slopes more steeply to Duffy Creek at approximately 14% to 20%. However, due to the presence of a low ridge along the east side of the site, the vast majority of surface water drains toward the unnamed tributary.

Numerous ditches were excavated at the site to divert surface runoff away from the filled areas. The northernmost trench, located approximately 160 feet north of the northeast fill area, runs east-west, diverting flow around the northeast and northwest fill areas. Flow diverted to the east runs via shallow ditches into the drainage collection pond. This pond is meant for temporary storage, as water can drain out to the west via a culvert. Pond overflow drains in a ditch toward the northern access gate. In addition, runoff on the west side of the site flows to the northern access gate, as does runoff from the north central portion of the site. All runoff that reaches the northern access gate flows through a culvert under Snyder Road directly into Duffy Creek's unnamed tributary. Ditches also exist around the perimeters of the south and south-central fill areas. Runoff in these areas is also diverted to the west, eventually ending up in the unnamed tributary via culverts under Snyder Road.

Throughout the field investigation, ponded surface water was present in the drainage collection pond as well as in a small depression adjacent to MW-2S, even when all ditches were dry. This suggests that springs may be present in these areas.

The unnamed tributary that flows along the west side of the site is registered as a Class C water body (6 NYCRR 821.6). This stream is shown to be intermittent by the USGS (1965b), and this was confirmed during surface water sampling. At the time of sampling, the stream consisted only of isolated pools. Duffy Creek, also classified as Class C (6 NYCRR 821.6), consisted primarily of pools connected by very low flow streams at the time of surface water sampling. Detailed characterization of these two streams is provided in Section 6 of this report.

As previously discussed in Sections 1.2 and 3.11 as well as in E & E's 1992 Leachate Investigation Report, several leachate outbreaks exist or have existed at the site. Leachate from these seeps is capable of flowing overland to the existing ditches, thereby entering the unnamed tributary. Additionally, the excess leachate holding pond often overflows during wet months and following periods of snowmelt. This overflow directly enters the unnamed tributary via culverts under Snyder Road. Orange, iron oxide-stained rocks were observed in the unnamed tributary behind both Rosini's and Miller's properties (parcels 214-1-53.2 and 214-1-53.3 on Figure 3-9).

4.3.2 Groundwater Hydrogeology

Groundwater data were collected from the 17 bedrock and 13 overburden wells and the 14 piezometers installed during the RI as well as the four pre-existing wells. During the Phase I RI, water levels were measured in each of the wells after development but prior to sampling in October 1991 and then again in November 1991. During the Phase II RI, complete rounds of water level measurements were recorded prior to sampling in July 1993 and prior to aquifer testing in September 1993. These data are presented in Table 4-1.

During drilling and split-spoon sampling of the wells, significant zones of saturated soils were not encountered, except in MW-11S. In this well, the soil became moist to wet at 15 to 16 feet BGS. Prior to sampling, the water level in MW-11S rose to 5.7 feet BGS. In the remaining wells, either thin alternating zones of wet, moist, and dry soils or no moisture at all was encountered. In general, the coarser-grained zones (sands and gravels) were drier than the fine-grained zones (clays and silts). The presence of moisture in the slow-draining

clays and silts is interpreted as residual moisture from a fluctuating water table. In general, however, some moisture was first noticed at 6 to 8 feet BGS in most wells.

After well development but prior to Phase I RI sampling in October 1991, water levels in the overburden wells ranged from 1.1 feet BGS in MW-5S to 17.9 feet BGS in MW-9S. At this same time, water levels in the bedrock wells ranged from 1.3 feet BGS in MW-5D to 64.2 feet BGS in MW-1D. In general, water levels in November 1991 were similar to those in October 1991. Most water levels rose slightly by November, except in MW-1D, MW-2D, and MW-3D, where they dropped slightly, and in MW-9D, MW-10D, MW-10S, CW-3A, and MW-3B, where they dropped from 0.5 to 8.8 feet. In addition, the water level rose significantly (8.2 feet) in MW-3S between October and November 1991.

During the Phase II RI, a complete round of water level measurements was recorded on September 15, 1993, prior to aquifer testing. By this time, all wells had been undisturbed for nearly seven weeks since groundwater sampling in July 1993. Water levels in the overburden wells ranged from 0.01 feet BGS in MW-5S to 18.00 feet BGS in MW-15S. Wells MW-12S, MW-14S, and MW-15DA were dry. Water levels in the bedrock wells and bedrock piezometers ranged from 0.28 feet BGS in MW-5D to 66.71 feet BGS in MW-1D. Water levels in the landfill piezometers ranged from 2.34 feet BGS in PZ-12 to 21.09 feet BGS in PZ-2.

Between November 1991 and September 1993 the water levels rose in all Phase I RI wells except MW-1D, MW-2S, and MW-6D where the levels dropped by 2.27, 0.53, and 0.52 feet, respectively. Water levels increased by 0.07 to 6.15 feet in the remaining wells with an average increase of 2.02 feet. Table 4-1 lists the water level data in terms of elevation.

The water level data indicate that perched water may exist in the overburden at isolated locations at and around the site, supporting data collected during well drilling and geotechnical analyses regarding the soils.

Using the data collected in November 1991, various hydraulic gradients were calculated. The vertical hydraulic gradient was calculated by dividing the difference in water surface elevations by the distance between screens as follows:

$$i_v = (H_S - H_D) / (d_S - d_D)$$

Where:

i_v = vertical hydraulic gradient;

H_S = water surface elevation in the shallow well (feet);

H_D = water surface elevation in the adjacent deep well (feet);

d_S = shallow well screen-bottom elevation (feet);

d_D = adjacent deep well screen-bottom elevation (feet).

Table 4-22 summarizes the vertical gradients calculated from both Phase I and II RI water level data.

Vertical gradients are difficult to interpret at this site and may be misleading due to the possible presence of perched water. Nonetheless, the vertical gradient was found to be moderately uniform across the site in November 1991, ranging from 0.3 to 0.6 ft/ft (downward) based on well pairs MW-3D/3S, MW-6D/6S, MW-9D/9S, and MW-10D/10S. The vertical gradient at well pair MW-5D/5S was found to be significantly less than that above (0.01 ft/ft downward).

Vertical hydraulic gradients were again calculated based on the September 1993 water level data (see Table 4-22). Vertical gradients were similar to those calculated during the Phase I RI and ranged from 0.3 to 0.7 ft/ft (downward) based on the same four well pairs listed above as well as pairs MW-13D/13S and MW-16D/16S. Again the gradient in well pair MW-5D/5S was significantly less than in all other wells (0.02 ft/ft downward). Vertical gradients exceeded 1 ft/ft downward in pairs MW-15D/15S and MW-5D/5VD. This indicates that the well screens and water surfaces in these pairs are separated by an unsaturated zone that includes an aquitard between two different aquifers. The vertical and horizontal extent of these unsaturated zones cannot be determined based on existing information. However, based on site geology, it is likely that numerous small perched aquifers and hence aquitards exist, especially between the zones monitored by MW-5D and MW-5VD, which are separated vertically by over 73 feet. While aquitards and/or perched zones are present in some areas, geologic conditions change laterally, and isolated aquifers may merge at certain points. Based on existing hydrogeologic data, it appears that the overburden and bedrock potentiometric surfaces may merge south of the site, discharging to a common point (Duffy Creek or its unnamed tributary).

Horizontal hydraulic gradients were calculated by dividing the difference in water surface elevations in two wells by the distance between those wells. Table 4-23 summarizes the horizontal hydraulic gradients (i_h) calculated for both phases of the RI. Based on the November 1991 bedrock well water levels, the average horizontal gradient across the entire site is to the south and was calculated to be 0.04 ft/ft between MW-1D and MW-7D. This is similar to but slightly less than the topographic gradient between these wells (0.05 ft/ft south), showing that the potentiometric surface is strongly influenced by topography. At the north end of the site, the horizontal hydraulic gradient is approximately 0.03 ft/ft south as calculated between MW-1D and MW-10D, MW-3D, and MW-2D. This is less than the topographic gradient of 0.06 ft/ft in this area. At the south end of the site, the horizontal gradient increases to a maximum of 0.10 ft/ft between MW-6D and MW-7D, which is greater than the topographic gradient between these wells (0.07 ft/ft). In some areas, the horizontal hydraulic gradient is reversed. For example, between MW-2D and MW-4D, the gradient is 0.01 ft/ft down to the north, indicating the presence of a groundwater divide.

Based on the September 1993 bedrock well water levels, the same or similar horizontal hydraulic gradients were calculated for the above wells. Additionally, the overall gradient between MW-1D and MW-16D was calculated to be 0.05 ft/ft south. This gradient is somewhat greater than the gradient between MW-1D and MW-7D because the horizontal gradient increases south of the site (0.10 ft/ft south between MW-7D and MW-16D). On the east side of the site, a horizontal hydraulic gradient of 0.07 ft/ft southeast was calculated between MW-2D and MW-13D. Horizontal hydraulic gradients were also calculated for landfill piezometers in the northwest and south-central/south fill areas. Between PZ-7 and PZ-10 a gradient of 0.06 ft/ft south was calculated, and between PZ-11 and PZ-14 the gradient was found to be 0.04 ft/ft south. Table 4-23 summarizes these results along with the topographic gradient for comparison.

Contouring of November 1991 water surface elevations for the bedrock wells indicates that groundwater flow generally mimics topography with a generalized flow direction in the northern and central portions of the site to the south-southwest (see Figure 4-7). An exception to this is seen on the west side of the site, where groundwater flows southwest toward the unnamed tributary to Duffy Creek. Additionally, flow at the south end of the site is directed more to the south. The contours also indicate that a groundwater divide exists on the east side of the site trending approximately north to N7°W. The presence of this divide is

also supported by the reversal in horizontal hydraulic gradient between wells MW-2D and MW-4D, and MW-2D and MW-3D. Groundwater flow on the east side of the site is to the east, following the steep topographic gradient down to Duffy Creek. Some of this flow likely emerges as the springs present on the lower hillside between the site and Duffy Creek.

Figure 4-8 depicts the groundwater potentiometric surface contour map for September 1993 based on all wells and piezometers installed in the shallow bedrock (i.e., excluding MW-5VD). This map shows basically the same groundwater flow pattern as depicted in Figure 4-7 for November 1991, with two exceptions. First, the gradient in the northeast fill area is steeper than shown for November 1991 because of the relatively high water surface elevations observed in PZ-1 and PZ-3. Second, MW-8D was not included in Figure 4-7 because it was redrilled in February 1992. The new water level data include this well, and Figure 4-8 depicts a groundwater depression in this area. Auger refusal was encountered at 64 feet BGS during the drilling of MW-8D (and then at 55 feet BGS during redrilling), indicating a corresponding low point in the bedrock in this area. The bedrock groundwater contour map depicts a relative high point in the borrow area between MW-2D and PZ-5 as well as near MW-4D. This is interpreted as resulting from increased bedrock aquifer recharge rates due to overburden removal in the two borrow areas.

Due to the presence of complicating perched zones and the lack of data in fill areas, a contour map of groundwater flow in the overburden was not created for the Phase I RI data. However, comparison of water levels suggested that groundwater flow in the overburden was similar to the flow depicted in the bedrock.

A groundwater potentiometric surface contour map based on overburden wells and piezometers was generated for the Phase II RI data. Figure 4-9 depicts the September 1993 data collected from the overburden wells and piezometers. This contour map shows a very similar groundwater flow pattern to that for the bedrock wells and piezometers shown in Figure 4-8. In both cases, groundwater flow is dictated primarily by topography. The fill areas seem to act as aquifer recharge zones, elevating the water table in those areas. While the flow patterns are very similar, the head values in the overburden wells are generally higher than in the bedrock wells, indicating a downward hydraulic gradient, except near MW-5D/5S and CW-3A/3B where the two potentiometric surfaces converge.

Figures 4-10 and 4-11 depict hydrogeologic cross sections along lines AA', CC', and DD' as shown on Figure 4-4. These cross sections depict the ground surface topography, the

location and extent of fill, the depth of bedrock, and both the overburden and bedrock water tables. These cross sections were generated using data collected during well and piezometer installation, water level measurements, surveying, and the potentiometric surface contour maps depicted in Figures 4-8 and 4-9. Since these cross sections were generated based on the most recent hydrologic data (September 1993), information regarding the presence of water in the fill is not included. Note, however, that during Phase I RI trench excavation, water was encountered near the surface in most trenches. Fill areas typically have a much higher permeability than the surrounding undisturbed soil areas. Therefore, groundwater recharge due to infiltration is expected to be greater in fill areas than in the surrounding areas, resulting in an elevated groundwater table. Based on this information, it is reasonable to assume that each of the fill areas is nearly fully saturated. The higher recharge rates in these fill areas, in turn, recharge the underlying overburden and bedrock aquifers, resulting in elevated groundwater surface elevations. The overburden groundwater surfaces shown on Figures 4-10 and 4-11 are based on wells and piezometers installed beneath and adjacent to the fill. Since no wells or piezometers were screened within the fill, the groundwater levels in the fill areas are not shown on these figures. If direct surface infiltration to the permeable fill areas is eliminated, and the existing water in the fill is removed or allowed to naturally drain out, then the water table beneath the fill areas should drop. However, the extent of this decrease in hydraulic head cannot be predicted. Figures 4-10 and 4-11 show that the current hydraulic head in the piezometers installed beneath the fill is already below the bottom of the fill in the northeast, south-central, and south fill areas, but not in the northwest fill area.

Based on the water level data as well as subsurface boring logs, the overburden and bedrock beneath the site are interpreted as being one continuous aquifer on a site-wide scale. That is, no confining layer was found to be consistently present between the overburden and bedrock, and groundwater appears to be able to pass freely from one medium to the next. Low permeability zones of clayey silt are present throughout the overburden in the area as discussed; however, they appear to be discontinuous, creating perched water-bearing zones. The springs in the area are interpreted as resulting from the convergence of some of these perched zones with the ground surface.

Generally, groundwater flow in the overburden is restricted vertically by clay and silt lenses but is facilitated in sandy and gravelly zones. In the bedrock, the major component of flow appears to be the result of secondary porosity features of the bedrock--i.e., fractures and

joints. Open and clay-filled fractures of all orientations were observed in both arenaceous and argillaceous beds, indicating that water can flow both horizontally and vertically and is generally unrestricted by what are usually low-permeability shale beds. Interstitial flow due to the primary porosity of the bedrock is expected to be a relatively minor component. Interstitial pore flow is most likely restricted both horizontally and vertically by the presence of shale beds. The most confining layer encountered during well drilling was a competent, massive shale observed in the cores of MW-5VD from 114 to 122 feet BGS. Above this unit, continual fracturing indicated the potential for contaminant migration to this depth.

Based on the results of the slug tests discussed in Section 3.13, hydraulic conductivities were found to range from 2.3×10^{-6} to 1.4×10^{-4} centimeters per second (cm/s) for the overburden wells tested. Variations observed in hydraulic conductivities are due to differences in the materials screened by the wells. A hydraulic conductivity range of 1.8×10^{-5} to 1.1×10^{-2} cm/s was found for the bedrock wells tested. Variations in bedrock well hydraulic conductivities are due to variations in the composition of the bedrock screened by the well and the extent of fracturing and weathering of the bedrock in the vicinity of the well. Table 4-24 summarizes the slug test results. The raw data as well as the interpretive curves used to derive the hydraulic conductivities are presented in Appendix I.

Slug tests provide an estimate of the hydraulic conductivity and transmissivity of the aquifer in the immediate vicinity of the well. Because both the overburden and bedrock exhibit lateral and vertical anisotropy, the hydraulic conductivities within the wells is highly dependent upon the composition of the materials screened by each well. For example, wells intercepting sand, sandstone, or highly fractured zones will have higher hydraulic conductivities than wells intercepting silt, shale, or zones of less intense fracturing.

An estimate of the groundwater velocity was made using the following formula (Freeze and Cherry 1979):

$$v = \frac{K}{n} \cdot \frac{dh}{dl}$$

where:

v = groundwater velocity in cm/s;

K = hydraulic conductivity in cm/s;

$\frac{dh}{dl}$ = i_h = horizontal hydraulic gradient (unitless); and

n = effective porosity of the aquifer (unitless).

For the overburden wells, groundwater velocities were calculated using the lowest and highest hydraulic conductivity values obtained, an average hydraulic gradient of 0.07, and an assumed effective porosity of 10% for silts and clays (Walton 1985). The resulting groundwater velocity for the overburden wells ranged from 1.6×10^{-6} cm/s (1.7 ft/year) to 1.0×10^{-4} cm/s (100 ft/year) to the south.

This porosity value was selected because flow through such clay is likely controlled by secondary porosity features resulting from glacial unloading, reworking, etc., rather than interstitial flow.

Groundwater velocities were also calculated for the bedrock wells. Again, the lowest and highest hydraulic conductivity values for the bedrock wells were used. Additionally, an average hydraulic gradient of 0.05 and an assumed porosity of 15% for fractured sedimentary rocks (Freeze and Cherry 1979) were used. The resulting groundwater velocity for the bedrock wells ranged from 6.0×10^{-6} cm/s (6.2 ft/yr) to 3.7×10^{-3} cm/s (3,800 ft/yr) to the south.

The groundwater velocity may vary based on changes in the hydraulic conductivity, hydraulic gradient, or effective porosity across the site. The uncertainty regarding actual effective porosity for the underlying geologic units and its significance in the calculation of groundwater velocity should be considered in the evaluation and use of the calculated velocities for the site and the immediate area. Thus, the calculated groundwater velocity can only be considered a rough estimate because of the uncertainties inherent in the hydraulic conductivity and gradient calculations in addition to the values for the effective porosity.

4.4 EXTENT OF CONTAMINATION OF ENVIRONMENTAL MEDIA

The following sections include a summary of the chemical contamination discovered at the Wellsville-Andover Landfill site during the Phase I RI between August and December

1991 and the Phase II RI between June and September 1993. The following media were sampled in order to assess the extent of contamination on and off the site:

- Subsurface soil and waste from trenches (Phase I RI);
- Subsurface soil from borings (Phase I RI);
- Groundwater (Phase I and II RI);
- Residential wells and springs (Phase I and II RI);
- Surface water (Phase I and II RI);
- Sediment (Phase I and II RI);
- Surface soil (Phase I RI);
- Leachate (Phase I and II RI);
- Soil gas (Phase II RI); and
- Air (Phase I RI).

Tables 4-2 through 4-21, and Tables 4-25 through 4-37 contain a summary of the analytical data for the various media sampled. Appendix D contains a tabulation of all analytical results including tentatively identified compounds (TICs).

All of the RI analytical data were independently qualified and then reviewed by E & E prior to reporting. A discussion of the data qualification is presented in Section 4.5 of this report. In general, common laboratory contaminants including methylene chloride, acetone, and phthalate compounds are not discussed in this section when these compounds were detected in the field samples at concentrations similar to those in the method or field blanks.

4.4.1 Subsurface Soil/Waste Samples From Trenches

As discussed in Section 3.4, five trenches were excavated at the site during the Phase I RI, the locations of which were based upon the geophysical surveys performed. One soil/waste sample was collected from each trench shown in Figure 3-1. A description of the samples (TP-1 to TP-5) is provided in Table 3-2.

Trench 1 was excavated on December 19, 1991 in the northwest corner of the northwest fill area. The top 1.5 feet consisted of brown channery loam of local derivation consisting of clay- to boulder-sized material. This was underlain by approximately 1.5 feet of gray clay and silt containing large sandstone fragments. Municipal trash was encountered at 3 to 4 feet and continued down to at least 15 feet. No cause for the geophysical anomaly was observed, so a second trench was excavated 10 feet north of the first. In both, water was found to flow into the excavation at approximately 5 feet below grade. In the second excavation, two 55-gallon drums were encountered at approximately 6 feet. These drums were heavily rusted and contained a black liquid that may or may not have been groundwater that entered the breached drums. Sample TP-1 was collected from soil adjacent to the drums on which the liquid had spilled. No markings were noted on the drums.

Trench 2 was excavated on December 19, 1991 in the central portion of the northeast fill area. The cover material consisted of only about 1.5 feet of brown channery loam of local derivation containing clay- to boulder-sized material. This trench was excavated to 7 or 8 feet, and only municipal trash was encountered. The source of the geophysical anomaly was determined to be numerous metal objects, including a steel trash can, an aluminum storm door, a roll of steel chicken wire, and copper tubing. Sample TP-2 was collected from this trench and consisted of soil composited from the full length of the trench at about 5 to 6 feet below grade.

Trench 3 was excavated on December 18 and 19, 1991 near the southeast corner of the northwest fill area. At this location, approximately 3 feet of cover material was encountered, consisting of medium brown and dark gray channery loam (clay- to boulder-sized material). Municipal trash in an ash-like matrix was encountered at 3 to 4 feet. Water was found to enter the trench at 4 and 6 feet. Excavation of the trench was completed the morning of December 19, 1991, and water had filled the trench to about 1.5 feet below grade by that time. The source of the geophysical anomaly was determined to be a large piece of scrap metal at 6 feet as well as numerous truck tire rims. Sample TP-3 consisted of a mixture of the soil and ash-like substance collected at about 6 feet BGS.

Trench 4 was excavated on December 18, 1991 in the northeast corner of the south-central fill area. The cover material at this location consisted of about 2 to 2.5 feet of medium brown channery loam (clay- to boulder-sized material). Immediately below the cover, five heavily rusted and dented 55-gallon drums were encountered along the 15- to

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20-foot length of the trench. These drums, which were all lying on their sides in the same orientation, contained a pink, white, gray, and brown mottled solid material. This material seemed to be a low-density plastic with many air bubbles. No markings were observed on the drums; however, the soil around the drums contained more than 50% plastic buttons and plastic scraps from which these buttons were apparently punched. Sample TP-4, composited from all five drums, consisted of soil, plastic scraps, and small fragments of the plastic-like material from the drums.

Trench 5 was excavated on December 17 and 18, 1991 in the central portion of the south fill area. The cover consisted of about 2 feet of brown channery loam (clay- to boulder-sized material). This trench contained municipal trash as well as construction and demolition debris. The source of the geophysical anomaly was found to be a car fender, a roll of steel barbed wire, and one empty, crushed 55-gallon drum marked "oil," all of which were found at less than 6 feet below grade. Water was found to enter the trench at approximately 4 feet and had a very slight oil sheen. Sample TP-5 was collected from the soil and waste below the crushed drum where water entered the trench.

Samples TP-1 through TP-5 were analyzed by E & E's ASC for full TCL parameters according to NYSDEC CLP methods. Sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP. For QC purposes, additional sample volume was collected with TP-5 for MS/MSD analyses.

The organic compounds detected in the samples collected are included in Table 4-2. Numerous VOCs were detected in the samples including ketones, aromatic hydrocarbons, and chlorinated alkenes and alkanes. Acetone, a common laboratory contaminant, is included in Table 4-2 because it was detected in four of the samples but not in the laboratory method blank. However, even the relatively high acetone concentration in TP-1 may be due to laboratory contamination because this sample was analyzed as a medium-concentration sample, which amplifies the amount of laboratory contaminants, such as acetone, detected. Other ketones detected include 2-butanone and 2-hexanone in TP-1 and TP-5, and 4-methyl-2-pentanone in TP-1 only.

Several aromatic hydrocarbons were detected in the samples. Benzene was detected in TP-5 only, at an estimated concentration of 78 μg/kg. Ethylbenzene was detected in all five samples at estimated concentrations ranging from 31 μg/kg in TP-2 to 33,000 μg/kg in TP-1. Toluene was also detected in all five samples, ranging from an estimated 11 μg/kg in

TP-2 to 3,200 μg/kg in TP-4. Styrene was detected in two samples only: 45 μg/kg in TP-1 and 4,200 μg/kg in TP-4. Xylenes were detected in all samples except TP-3, ranging from an estimated 51 μg/kg in TP-2 to 1,700 μg/kg in TP-1.

Several chlorinated aliphatic compounds were also detected in the trench samples. 1,1-Dichloroethane (1,1-DCA) was detected in TP-1 at 710 μg/kg. Total 1,2-dichloroethene (total 1,2-DCE) was detected in all samples except TP-2, ranging from an estimated 21 μg/kg in TP-5 to 3,900 μg/kg in TP-1. Tetrachloroethene (PCE) was detected in TP-4 only, at an estimated concentration of 520 μg/kg. Trichloroethene (TCE) was detected in TP-1 at 73 μg/kg and TP-4 at 5,300 μg/kg. Vinyl chloride (VC) was detected in TP-1 only, at an estimated concentration of 980 μg/kg. Methylene chloride (MC), a common laboratory contaminant, is included in Table 4-2 because it was detected in TP-5 at concentrations significantly higher than in the associated method blank.

Several semivolatile organic compounds were detected in the trench samples, including phthalates, polynuclear aromatic hydrocarbons (PAHs), and phenols. Five phthalates were detected in the samples. While these compounds are common laboratory and field contaminants, most of the concentrations detected are higher than would be expected for background contamination. Bis(2-ethylhexyl)phthalate was detected in all samples except TP-3, ranging from an estimated 1,100 μg/kg in TP-1 and TP-2 to 8,300 μg/kg in TP-4 and TP-5. Butylbenzylphthalate was detected at 16,000 μg/kg in TP-2 and estimated concentrations of 1,000 and 2,700 μg/kg in TP-4 and TP-5, respectively. Di-n-butylphthalate was detected in all samples except TP-1 and TP-3, ranging from an estimated 270 μg/kg in TP-2 to 14,000 μg/kg in TP-4. Diethylphthalate was detected only in TP-1 and TP-3 at estimated concentrations of 110 and 25 μg/kg, respectively. Dimethylphthalate was detected only in TP-4 and TP-5, at estimated concentrations of 910 and 530 μg/kg, respectively.

Numerous PAHs were detected in samples TP-1, TP-2, and TP-5, but none was detected in TP-3 or TP-4. Benzo(b)fluoranthene, benzo(a)pyrene, and chrysene were detected in sample TP-2. 2-Methylnaphthalene and naphthalene were detected in TP-2 and TP-5. Fluoranthene, phenanthrene, and pyrene were detected in samples TP-1, TP-2, and TP-5. Concentrations of individual PAHs ranged from an estimated 130 μg/kg (phenanthrene in TP-1) to approximately 720 μg/kg (fluoranthene in TP-2).

Several phenolic compounds were also detected in the trench samples. 4-Chloro-3-methylphenol was found only in TP-2, at approximately 300 μg/kg. 4-Methylphenol was

detected in all of the samples except TP-4, ranging from an estimated 370 to 1,600 μg/kg. Pentachlorophenol was detected only in TP-5, at approximately 6,600 μg/kg.

In addition to the above compounds, benzyl alcohol was detected in TP-4 at approximately 1,200 μg/kg, and 1,2-dichlorobenzene was detected in TP-4 and TP-5 at estimated concentrations of 1,200 and 670 μg/kg, respectively.

No PCBs were detected in any of the five samples; however, several pesticides were detected at low concentrations in TP-1, TP-2, and TP-5. Sample TP-1 was found to contain beta-BHC at approximately 12 μg/kg, and TP-5 contained 4,4'-DDD at 120 μg/kg. TP-2 was found to contain dieldrin; 4,4-'DDE; 4,4'-DDD; and 4,4'-DDT at estimated concentrations ranging from 13 to 130 μg/kg.

Table 4-3 summarizes the inorganic analytes detected in the trench samples. Of the 24 inorganics analyzed for, 17 were detected. Concentrations of metals in the trench samples were compared to the common range detected in eastern United States soils as well as to the upper limit of the 90th percentile in order to preliminarily screen the metals of interest (Shacklette and Boerngen 1984). The upper limit of the 90th percentile, indicating the value below which 90% of background samples should fall, was calculated using the following formula:

$$\text{90th percentile} = M*D^{1.282}$$

where:

> M is the geometric mean, D is the geometric standard deviation, and 1.282 is the alpha value pertaining to the 90th percentile, provided in Shacklette and Boerngen (1984).

Aluminum, barium, beryllium, calcium, chromium, iron, manganese, potassium, sodium, and vanadium were detected in all five samples but at concentrations within the 90th percentile for eastern U.S. soils. Arsenic exceeded the 90th percentile only in TP-1 at an estimated 20.9 milligrams per kilogram (mg/kg). Cobalt exceeded the 90th percentile in all samples, ranging from 20.8 to 28.1 mg/kg. Copper exceeded the 90th percentile in TP-3 at 194 mg/kg. Elevated concentrations of lead were detected in all samples except TP-3 and ranged from approximately 15.3 mg/kg in TP-3 to about 86.9 mg/kg in TP-4. Nickel exceeded the 90th percentile in TP-1 only, at a concentration of 43.2 mg/kg. Zinc exceeded the 90th percentile in all samples except TP-4 and ranged from approximately 87.4 mg/kg in

TP-4 to an estimated 269 mg/kg in TP-3. While many of the above metals exceeded the upper limit of the 90% percentile, none exceeded the observed range. In addition, no cyanide was detected in any of the samples.

In summary, TP-1 contained five metals above the 90th percentile for common eastern U.S. soils, while the remaining samples contained three such metals. Cobalt was detected at elevated concentrations in all samples but with a small difference between concentrations. This suggests that cobalt may be naturally abundant in the area. Chlorinated aliphatics were detected in four of the five samples, ranging from 21 μg/kg in TP-5 to 8,720 μg/kg in TP-4. Aromatic hydrocarbons were detected in all five samples and ranged from 93 μg/kg in TP-2 to 35,900 μg/kg in TP-1. PAHs were detected in three of the five samples, with the highest total concentration (3,170 μg/kg) detected in TP-2. Phthalates, detected in all of the samples, ranged from 204 μg/kg in TP-3 to 24,200 μg/kg in TP-4. Phenols ranged up to 6,870 μg/kg in TP-5. Pesticides, detected in three samples, ranged up to 201 μg/kg in TP-2.

No subsurface soil/waste samples were collected during the Phase II RI.

4.4.2 Subsurface Soil Samples From Borings

As discussed in Section 3.5.3, 20 subsurface soil samples were collected during boring of the 10 Phase I RI deep monitoring wells. Samples from wells MW-1D, MW-6D, MW-7D, and MW-8D were analyzed for full TCL organic substances and inorganic substances, while samples from MW-2D, MW-3D, MW-4D, MW-5D, MW-9D, and MW-10D were analyzed for TCL VOCs and inorganic substances only. All analyses were performed according to NYSDEC CLP methods. Tables 4-4 and 4-5 summarize the organic and inorganic analytes detected in the subsurface soil samples, respectively.

VOCs were detected only in the soil samples collected from monitoring well MW-5D. Three chlorinated aliphatic compounds were detected in samples SB-5B and SB-5C. Sample SB-5B, collected from 8 to 9 feet below grade, contained total 1,2-DCE at 87 μg/kg, TCE at 22 μg/kg, and VC at 21 μg/kg. Sample SB-5C, collected from 18 to 19 feet below grade, contained 61 μg/kg of total 1,2-DCE, 13 μg/kg of TCE, and an estimated 7 μg/kg of VC. No semivolatile substances, PCBs, or pesticides were detected in any of the samples analyzed for those compounds.

Of the 24 inorganic analytes tested, 19 were detected in at least one subsurface soil sample. Concentrations of the metals detected were compared to the common range detected in eastern U.S. soils as well as to the upper limit of the 90th percentile (Shacklette and Boerngen 1984). Aluminum, barium, beryllium, chromium, copper, iron, potassium, sodium, vanadium, and zinc were detected in all or most of the samples, but all at concentrations within the 90th percentile. Cadmium was detected above the contract-required detection limit (CRDL) only in SB-2A and SB-10A, and mercury was detected only in SB-8B; however, all three concentrations were within the 90th percentile.

Arsenic, which was detected in all subsurface soil samples, exceeded the 90th percentile in samples SB-3A, SB-9A, and SB-9B at concentrations of 16.4 (estimated), 17.4, and 17.9 mg/kg, respectively. Calcium and magnesium, both detected in all samples, exceeded the 90th percentile in sample SB-10B only, at concentrations of 77,500 and 17,100 mg/kg, respectively. Cobalt, detected in all samples, exceeded the 90th percentile in all samples except SB-10B (including both background samples). Cobalt concentrations ranged from 14.5 to only 33.2 mg/kg, indicating a possible natural abundance of this metal in the area. Lead was detected in all samples except SB-4A, exceeding the 90th percentile in SB-6B and SB-10A at estimated values of 35.6 and 45.3 mg/kg, respectively. Manganese, detected in all samples, exceeded the 90th percentile in SB-4A only, at 1,670 mg/kg. Nickel, also detected in all samples, exceeded the 90th percentile in SB-1A, SB-4A, SB-4B, SB-6A, SB-7A, and SB-7B, with the highest concentration, 53.4 mg/kg, detected in background sample SB-1A. No cyanide was detected in any of the subsurface soil samples.

In summary, organic compounds were detected only in the subsurface soil samples from MW-5D and consisted of the three chlorinated aliphatics of primary concern at this site. In terms of inorganic substances, no sample contained more than three metals above the 90th percentile for typical eastern U.S. soils, including cobalt, which appears to be naturally abundant. Of those metals above the 90th percentile, none exceeded the common range detected in eastern U.S. soils (Shacklette and Boerngen 1984).

4.4.3 Groundwater Samples

Phase I RI

As discussed in Section 3.5.4, groundwater samples were collected in October 1991 from the 17 competent monitoring wells installed during the first phase of the RI and the four pre-existing wells. All samples were unfiltered and were analyzed for full TCL organic substances and inorganic substances according to NYSDEC CLP methods, with the exception of GW-2S, GW-9S, and GW-12S, which, due to insufficient sample volume, were analyzed for TCL VOCs and inorganic substances only. Tables 4-6 and 4-7 summarize the organic substances and inorganic substances detected in the Phase I RI groundwater samples, respectively. Table 4-8 summarizes the sampling parameters pertaining to the Phase I RI groundwater samples. All samples remained unfiltered; therefore, the suspended sediment in each well was allowed to settle out prior to sampling, as discussed in Section 3.5.4. By doing so, the metals portion of 10 samples had a turbidity below 50 NTU, and all but three samples had turbidities below 250 NTU. The high turbidities of samples GW-2S and GW-9S were due to the small amount of water in these wells.

Several organic substances, including aromatic hydrocarbons and chlorinated aliphatic compounds, were detected in various Phase I RI groundwater samples. Acetone was detected in GW-3S at 33 μg/L. While acetone is a common laboratory contaminant, it is included in Table 4-6 because it was not detected in the method blank related to GW-3S. However, based on the low concentration and its presence in GW-3S alone, the acetone is assumed to result from laboratory contamination. One trihalomethane was detected in the groundwater samples--chloroform in GW-9S--but at a concentration below the NYSDEC Class GA standard.

Several chlorinated aliphatic compounds were detected across the site. Chloroethane was detected above the Class GA standard in GW-11S at an estimated concentration of 8 μg/L. 1,1-DCA was detected above the Class GA standard in samples GW-5D and GW-5S at estimated concentrations of 6 and 11 μg/L, respectively. 1,1-DCE was detected above the standard in samples GW-5D, GW-5S, GW-11S, and GW-11SDD at estimated concentrations ranging from 9 to 12 μg/L. 1,1-DCE was also detected below the standard in GW-2D. Total 1,2-DCE was detected at or above the standard in samples GW-2D, GW-5D, GW-5S, GW-6D, GW-6S, GW-11S, GW-11SDD, and CW-3B at estimated concentrations of 5 to 5,600

μg/L. In addition, total 1,2-DCE was detected below the standard in GW-10D, CW-3A, and CW-4A. MC was detected in CW-3B below the Class GA standard. This compound is a common laboratory contaminant but is included in Table 4-6 because it was not detected in the method blank associated with CW-3B. 1,1,1-Trichloroethane (1,1,1-TCA) was detected only in GW-2D and GW-5S, both at levels below the Class GA standard. TCE was detected above the standard in GW-2D, GW-5D, GW-5S, GW-6D, GW-11S, GW-11SDD, and CW-3A at concentrations ranging from 38 to 1,200 μg/L. TCE was also detected below the standard in GW-3D, GW-4D, and GW-10D. VC was detected above the Class GA standard in samples GW-2D, GW-5D, GW-5S, GW-6D, GW-11S, GW-11SDD, and CW-3B at concentrations ranging from an estimated 45 to 2,100 μg/L.

Two aromatic hydrocarbons were also detected at the site. Ethylbenzene was detected below the standard in GW-5D, and toluene was detected at or above the standard in GW-5D, GW-5S, and CW-3A at concentrations ranging from 5 to an estimated 9 μg/L.

No semivolatile substances, PCBs, or pesticides were detected in any of the groundwater samples analyzed.

Of the 24 inorganic substances analyzed for, 17 were detected in the Phase I RI groundwater samples. Aluminum, arsenic, barium, beryllium, calcium, cobalt, copper, nickel, potassium, vanadium, and zinc were detected in various samples across the site, as detailed in Table 4-7, but all at concentrations below Class GA standards. Chromium, detected only in seven samples including the background, exceeded the standard only in GW-2S at 110 μg/L. Iron was detected and exceeded the standard in all samples, including the background, at concentrations ranging from 316 to an estimated 110,000 μg/L. Lead was detected in all but eight samples and exceeded the standard in GW-2S and GW-12S at an estimated 38.1 and 125 μg/L, respectively. Magnesium was detected in all samples but exceeded the Class GA guidance value only in GW-2S and GW-8S at 50,500 and 56,000 μg/L, respectively. Manganese was detected in all samples, exceeding the standard in 15 samples at concentrations ranging from 387 to 8,530 μg/L. Sodium was also detected in all the samples and exceeded the standard in 12 samples at concentrations ranging from 20,400 to 516,000 μg/L. No cyanide was detected in any sample.

The high inorganic content in many of the wells, especially GW-2S, is likely a result of the high turbidity of those samples. However, the elevated levels of many inorganics are also likely to have resulted from on-site disposal of heavy metal waste. In terms of organic

substances, the two most contaminated wells are MW-5D and MW-5S, with total VOC concentrations of approximately 6,300 and 8,100 μg/L, respectively. The presence of such organics in downgradient wells such as these are undoubtedly site-related.

Following initial installation of the Phase I RI monitoring wells, MW-8D was found to be incompetent. Therefore, it was not sampled and no Phase I RI results exist for this well. A new well was drilled at the same location in February 1992 and the old MW-8D was abandoned. During a site visit on July 23, 1992, NYSDEC collected a groundwater sample from the new MW-8D. This sample was submitted to Recra Environmental, Inc., for full TCL analysis according to NYSDEC CLP methods. Since these data have not been qualified or reviewed, the results are not included on the data summary forms in Appendix D; rather, the original EPA/NYSDEC CLP Form 1s have been included. The results are discussed below, but have not been tabulated.

No semivolatiles, PCBs, or pesticides were detected in the July 1992 sample from MW-8D. However, four VOCs were detected, including acetone at 19 μg/L, 2-butanone at an estimated 3 μg/L, and benzene and toluene at estimated concentrations of 1 and 0.6 μg/L, respectively. While not detected in the laboratory method blank, the presence of low concentrations of acetone and 2-butanone in the sample is suspected to be the result of common laboratory contamination.

Twelve inorganic analytes were detected in the July 1992 sample from MW-8D at concentrations greater than those detected in the laboratory method blanks. Of those 12, the following were detected below NYSDEC Class GA standards, or have no standard: aluminum (2,000 μg/L); barium (260 μg/L); calcium (73,500 μg/L); chromium (24.0 μg/L); magnesium (29,700 μg/L); nickel (73.0 μg/L); potassium (6,990 μg/L); and zinc (57.3 μg/L). The following four metals were detected at concentrations exceeding the Class GA standards shown in Table 4-7: iron (5,070 μg/L); lead (39.0 μg/L); manganese (1,480 μg/L); and sodium (40,100 μg/L).

Phase II RI

As discussed in Section 3.5.4, groundwater samples were collected primarily in July 1993 from 27 of the Phase I and II RI wells and the four preexisting wells. All samples were unfiltered and were analyzed for TCL VOCs and inorganics, with the exception of MW2-13S, MW2-15DA, and MW2-15S, which, due to insufficient sample volume, were analyzed for

TCL VOCs only. Wells MW-12S, MW-14S, and MW-15D were dry and never sampled. Tables 4-25 and 4-26 summarize the organic and inorganic substances detected in the Phase II RI groundwater samples, respectively. Table 4-27 summarizes the sampling parameters pertaining to the Phase II RI groundwater samples. The metals portion of 13 samples had turbidities of 53 NTU or less and all but MW2-2S, MW2-6S, MW2-8D, MW2-8S, and CW2-3B had turbidities less than 200 NTU. The high turbidities of the five samples discussed resulted from the small amount of water in those wells.

As shown in Table 4-25, three aromatic hydrocarbons and eight chlorinated aliphatic compounds were detected in various Phase II RI groundwater samples. Benzene was detected in one sample, MW2-15DA at 14 μg/L, which exceeds the NYSDEC Class GA standard. Because of the extremely limited volume of water, this is the only well that was not purged prior to sampling.

Ethylbenzene was detected in two samples: MW2-5S at an estimated 4 μg/L; and above the NYSDEC Class GA standard in MW2-5D at 11 μg/L. While ethylbenzene did not exceed the Class GA standard of 5 μg/L in MW2-5S, its concentration was estimated as 5 μg/L in the field duplicate from MW-5S. Toluene was detected above the Class GA standard of 5 μg/L in samples MW2-5D and MW2-5S, but below the standard in CW2-3A.

Similar chlorinated aliphatic compounds were detected in the Phase I and II RI groundwater samples. In the Phase II samples, chloroethane was detected in one sample, MW2-11S, at 13 μg/L. 1,1,2-TCA was found in sample MW2-5S at an estimated 1 μg/L (2 μg/L in the duplicate). 1,1-DCA was detected in two samples, MW2-5D and MW2-5S, at estimated concentrations of 3 and 9 μg/L, respectively. In addition to 1,1-DCA, MW2-5D and MW2-5S each contained relatively low concentrations (< 10 μg/L) of 1,1-DCE and 1,1,1-TCA. These samples (including the duplicate MW2-5SD) also contained relatively high concentrations of total 1,2-DCE (1,800 to 4,400 μg/L); TCE (130 to 280 μg/L); and VC (920 to 1,800 μg/L). Additionally, total 1,2-DCE was detected in 12 other wells (and duplicate CW2-3BD) at estimated concentrations ranging from 3 to 870 μg/L. 1,1-DCE was also detected in MW2-2D and MW2-11S at estimated concentrations of 2 and 9 μg/L, respectively. Other than MW2-5D and MW2-5S, MW2-2D contained 1,1,1-TCA at an estimated 2 μg/L. TCE was also detected in MW2-2D, MW2-4D, MW2-6D, MW2-10D, MW2-11S, MW2-14D, MW2-15DA, MW2-15S, and CW2-3A at concentrations ranging from an estimated 5 to 1,800 μg/L. In addition to MW2-5D and MW2-5S, VC was also detected in

MW2-2D, MW2-4D, MW2-6D, MW2-11S, and CW2-3B and its duplicate at estimated concentrations ranging from 8 to 230 μg/L. The NYSDEC Class GA groundwater standard for each of the above compounds is 5 μg/L with the exception of VC, which is 2 μg/L.

Of the 24 inorganic analytes tested for, 19 were detected in various Phase II RI groundwater samples. Every sample had at least one metal above its respective Class GA standard, including upgradient sample MW2-1D, with the exception of MW2-7D. This one sample contained no inorganics above standards. The only inorganics detected that did not exceed NYSDEC Class GA standards, were those for which no standard exists: aluminum, calcium, cobalt, nickel, potassium, and vanadium. These metals were detected at highly variable concentrations across the site as detailed in Table 4-26. Metals that exceeded Class GA standards or guidance values were detected as follows:

- Arsenic in MW2-8D at approximately 45.5 μg/L and MW2-8S at 28.3 μg/L;
- Barium in MW2-8D at an estimated 1,470 μg/L;
- Beryllium in MW2-8D at an estimated 3.2 μg/L;
- Cadmium in MW2-8D at an estimated 10.8 μg/L;
- Chromium in MW2-2S, MW2-8D, and MW2-8S from 50.8 to approximately 291 μg/L;
- Copper in MW2-8D and MW2-16S at 208 μg/L each;
- Iron in all but three samples from 309 to approximately 131,000 μg/L;
- Lead in MW2-2S, MW2-8D, and CW2-3A from 30.7 to 484 μg/L;
- Magnesium in MW2-2S, MW2-3D, MW2-8D, MW2-8S, CW2-3B, and CW2-3BD at 38,700 to about 71,500 μg/L;
- Manganese in 16 of the samples from 334 to approximately 7,570 μg/L;
- Sodium in 11 of the samples from 20,100 to approximately 49,200 μg/L; and
- Zinc in MW2-8D at approximately 548 μg/L.

In addition to the above metals, cyanide was detected in MW2-3D, MW2-4D, CW2-4A, and CW2-4B at concentrations ranging from 21.0 to 160 μg/L. Cyanide exceeded the Class GA standard only in CW2-4B. While the presence of many of the metals at elevated concentrations is certainly site related, note that the samples with the highest metals content and the most metals exceeding standards were those with the highest turbidities. This is most notable in MW2-8D and MW2-8S.

In summary, VOCs were detected in 14 of the 31 wells sampled during the Phase II RI. The most contaminated wells were MW-5D and MW-5S. In terms of inorganics, wells MW-2S, MW-8D, and MW-8S contained the highest concentrations of metals, but these were also the most turbid samples. The remainder of the downgradient wells contained few inorganics above NYSDEC Class GA standards, the most notable exceptions being CW-3A, which contained high lead, and CW-4B, which contained high cyanide.

As discussed in Section 3.5.4, five samples (plus one duplicate) were also analyzed for BOD_5, BOD_{28}, COD, TKN, and TSS. These analyses were performed in order to assess groundwater contamination with respect to surface water standards and to thereby evaluate treatment methods that would discharge treated groundwater to a publicly owned treatment works (POTW) or to surface waters. These results are summarized in Table 4-28.

4.4.4 Residential Well and Spring Samples

Phase I RI

As discussed in Section 3.6, water samples were collected in October 1991 from five residential wells and two springs. All samples were analyzed for TCL semivolatile substances, PCBs, pesticides, metals, and cyanide according to NYSDEC CLP methods, as well as volatiles by EPA Method 524.2. Tables 4-9 and 4-10 summarize the organic and inorganic analytes detected, respectively. At the time of sampling, conductivity, temperature, and turbidity data were collected for each of the samples. These data are presented in Table 4-11.

The only volatile substance detected in the samples collected, other than those attributable to laboratory contamination, was TCE. This chlorinated aliphatic compound was detected only in water from the LaDue spring (DW-5) at 2.6 μg/L. TCE was also detected in the field duplicate collected at the LaDue spring (DW-5D) at 2.9 μg/L. No semivolatile substances, PCBs, or pesticides were detected in any of the samples.

Of the 24 inorganic analytes tested for, 14 were detected in the residential water samples. Aluminum, barium, calcium, magnesium, and potassium were detected in all the samples at concentrations below NYSDEC Class GA standards and guidance values and New York State Department of Health (NYSDOH) Maximum Contaminant Levels (MCLs) for public water supplies. Chromium, copper, lead, mercury, and cyanide were detected in some of the samples, but none was detected at concentrations exceeding NYSDEC Class GA standards or NYSDOH MCLs.

Iron, present in all but DW-2, exceeded the Class GA standard and MCL in DW-1, DW-3, DW-4, DW-5, and DW-6 at concentrations ranging from 534 to 1,300 μg/L. Manganese, present in all samples, exceeded the Class GA standard and MCL in DW-1 at 510 μg/L. Iron and manganese are both considered secondary contaminants by NYSDOH, with MCLs based on aesthetic quality. Both are also commonly high in unfiltered groundwater samples.

Sodium, present in all samples, exceeded the NYSDEC Class GA standard in samples DW-1, DW-3, DW-4, and DW-7 at concentrations ranging from 31,600 to 58,000 μg/L. No MCL for this secondary contaminant exists; however, the sodium content in the above four samples exceeds the NYSDOH guideline for people on severely restricted sodium diets. No sodium concentrations exceeded the NYSDOH guideline for people on moderately restricted sodium diets (10 NYCRR 5-1.52).

Zinc, detected in all samples, exceeded the NYSDEC Class GA standard in DW-4 at a concentration of 338 μg/L. However, this concentration is below the MCL for this secondary contaminant.

NYSDOH Sampling Results

According to the information provided to E & E, NYSDOH collected samples from four residential wells on November 13, 1991. Samples were collected from the homes of William Cornell, Robert Fanton, Arnold Green, and Rosalie Rosini. These samples were reportedly submitted to NYSDOH's Wadsworth Center for Laboratories and Research in Albany, New York, and analyzed for VOCs, ketones, pesticides, PCBs, semivolatile organic compounds (priority pollutants) and metals, with the exception of the Rosini sample, which was analyzed for bacteria by the standard plate count method (Rafferty 1992a, 1992b, 1992c, and 1992d).

Due to the high turbidity of the Rosini sample, the results were inconclusive (Rafferty 1992d). In the remaining three samples, no organic compounds were detected. In the Cornell sample, several metals were detected at "concentrations that naturally occur in groundwater," and none exceeded the NYSDOH MCLs for public water supplies (Rafferty 1992a). In the Fanton sample, several metals were detected, most at "concentrations that naturally occur in groundwater," but with manganese exceeding the MCL at 2,120 μg/L (Rafferty 1992b). In the Green sample, several metals were also detected, but none exceeded the MCL except at 93,900 μg/L (Rafferty 1992c). NYSDOH MCLs for public water supplies state that people on severely restricted sodium diets should not use water containing more than 20,000 μg/L of sodium (10 NYCRR 5-1.52).

Phase II RI

As discussed in Section 3.6, domestic water samples were collected from 19 homes in the vicinity of the site between July and September 1993. All samples were analyzed for VOCs by EPA Method 524.2 and TCL inorganics, with the exception of DW2-9 (Cornell) and DW2-10 (R. Fanton), which were analyzed for TCL inorganics only. Tables 4-29 and 4-30 summarize the VOC and inorganic analytes detected in the Phase II RI samples, respectively. At the time of sampling, pH, temperature, conductivity, and turbidity data were recorded for most samples. These data appear in Table 4-31.

Acetone was detected in two samples and is therefore included in Table 4-29. However, while this common laboratory contaminant was not detected in the method blank, its presence is highly suspected to have resulted from laboratory contamination because it was not present in the groundwater samples or the domestic water samples immediately down-gradient of the site. The presence of 1,2-DCA is a suspected laboratory artifact from the acid preservation of water samples. This compound has not been detected in air or liquid samples from the leachate collection system, in waste samples, or in monitoring well samples. Therefore, it is likely a laboratory artifact. Additionally, the presence of carbon disulfide (CS_2) in DW2-21 is suspected to be an artifact of preservation. This is supported by the fact that E & E collected an unpreserved sample at this location for internal QC and no VOCs, including CS_2, were detected. CS_2 commonly appears in acid-preserved samples with a high sulfide content.

Other than the above suspected laboratory contaminants, the only VOC detected in the domestic water samples was TCE in DW2-5D and DW2-5A. In the sample collected from LaDue's outdoor spigot (DW2-5D), TCE was detected at 6.2 μg/L. In the sample collected directly from the LaDue spring overflow (DW2-5A), TCE was detected at 5.1 μg/L. These concentrations, which exceed both the NYSDOH MCL for public water supplies and the NYSDEC Class GA groundwater standard of 5 μg/L, are approximately double the concentration detected in October 1991.

Of the 24 inorganics analyzed for, 16 were detected in one or more of the samples analyzed. Table 4-30 summarizes these results. The following 10 metals were all detected in one or more samples at concentrations below NYSDOH MCLs for public water supplies and NYSDEC Class GA standards, or have no applicable standard:

- Aluminum in four samples from approximately 26.0 to 335 μg/L;
- Antimony in two samples at estimated concentrations of 35.6 and 39.7 μg/L;
- Arsenic in four samples at estimated concentrations ranging from 1.5 to 7.5 μg/L;
- Barium in all samples at estimated concentrations ranging from 21.3 to 135 μg/L;
- Calcium in all samples from 5,890 to 48,300 μg/L;
- Lead in four samples ranging from approximately 2.0 to 20.1 μg/L;
- Magnesium in all samples ranging from about 3,060 to 21,600 μg/L;
- Mercury in DW2-20 at 0.29 μg/L;
- Potassium in all samples at estimated concentrations ranging from 556 to 2,210 μg/L; and
- Selenium in DW2-1 only at approximately 1.7 μg/L.

In addition to the above metals, cyanide was detected in two samples, DW2-1 and DW2-16, at 84.0 and 10.0 μg/L, respectively, both of which are less than the NYSDEC Class GA groundwater standard.

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Five metals were detected in one or more samples at concentrations exceeding applicable New York State Standards, Criteria, and/or Guidelines (NYS SCGs). Copper was detected in all but three samples at a range of approximately 2.2 to 2,070 μg/L. Copper exceeded the NYSDEC Class GA standard of 200 μg/L in DW2-10 and DW2-16 but it exceeded the NYSDOH MCL for public water supplies (1,000 μg/L) only in DW-16. Iron was detected in all but six samples ranging from an estimated 24.6 to 10,600 μg/L and exceeding both the MCL and NYSDEC standard in DW2-1, DW2-6, DW2-8, DW2-10, DW2-16, DW2-19, and DW2-20. Manganese was detected in all but three samples, ranging from approximately 2.6 to 2,050 μg/L and exceeding both the MCL and NYSDEC standard in DW2-1, DW2-6, and DW2-10. Sodium was detected in all samples at concentrations ranging from an estimated 1,620 to 110,000 μg/L and exceeding the NYSDEC standard in 10 samples. Zinc, detected in all but three samples, ranged from approximately 5.4 to 471 μg/L and exceeded the NYSDEC standard in DW2-16 and DW2-20, but did not exceed the NYSDOH MCL for public water supplies in any sample. Table 4-30 details the above inorganic data.

4.4.5 Surface Water Samples

Phase I RI

As discussed in Section 3.7, six surface water samples plus one field duplicate were collected on October 2, 1991, from Duffy Creek and its unnamed tributary. Two samples were collected from Duffy Creek (SW-2 and SW-4), two were collected from its tributary (SW-1 and SW-3) upstream of their confluence, and two were collected downstream of the confluence (SW-5 and SW-6). All samples were analyzed for full TCL organic substances and inorganic substances. Tables 4-12 and 4-13 summarize the organic substances and inorganic substances detected in the surface water samples, respectively.

No VOCs other than common laboratory contaminants were detected in the surface water samples. Two semivolatile compounds were detected in the samples. Di-n-butylphthalate was detected at low concentrations in SW-1, SW-2, SW-4, and SW-6. In addition, di-n-octylphthalate was detected at a low concentration in SW-2. Phthalates are common laboratory contaminants but are included here because neither was detected in the method blank associated with these samples. Phthalates are also common field contaminants

resulting from the use of rubber-based protective clothing. The phthalates detected in the downstream samples are assumed not to be site-related because they were also detected upstream (SW-2).

No PCBs or pesticides were detected in any of the surface water samples.

Of the 24 inorganics analyzed for, 13 were detected in the Phase I RI samples. Barium, calcium, magnesium, manganese, potassium, sodium, vanadium, and zinc were present in most or all of the samples analyzed but at concentrations below NYSDEC Class C standards. Aluminum was present in all samples and exceeded the Class C standard in all samples except SW-6, collected the furthest downstream of the site. Aluminum concentrations ranged from 119 to 578 μg/L in the samples, exceeding the Class C standard, and was present at 307 μg/L in the background sample from Duffy Creek (SW-2). Copper and nickel were both detected only in the background sample (SW-2), and both were detected at concentrations below Class C standards. Iron was detected in all seven samples, exceeding the standard in all except SW-4 and SW-6. The highest concentration of iron was detected in SW-2, the background sample (estimated to be 3,840 μg/L). Lead was detected in all seven samples, ranging from estimated concentrations of 1.1 to 4.9 μg/L. The Class C standard for lead was exceeded in samples SW-3, SW-4, SW-4D, and SW-5 but not in the sample closest to the site (SW-1) nor furthest downstream (SW-6).

The surface water samples were also analyzed for hardness, as indicated on Table 4-13. All seven samples fall near the border between soft and moderately hard water.

Phase II RI

As discussed in Section 3.7, one surface water sample (SW2-1) was collected as far upstream as possible in Duffy Creek on July 9, 1993. This sample was collected far enough upstream to avoid any potential surface runoff from the filled portion of the site. This sample was analyzed for TCL VOCs and inorganics as well as hardness.

No VOCs were detected in SW2-1 at concentrations above those detected in the field and laboratory blanks.

Table 4-32 lists the inorganics detected in SW2-1 as well as its hardness. Fourteen of the 24 inorganics analyzed for were detected in SW2-1. Of these, four metals were detected at concentrations exceeding NYSDEC Class C surface water standards, including aluminum

(4,670 μg/L); iron (7,500 μg/L); lead (7.5 μg/L); and zinc (53.7 μg/L). The hardness of this sample falls near the border between soft and moderately hard water.

4.4.6 Sediment Samples

Phase I RI

As discussed in Section 3.7, sediment samples were collected on October 2, 1991, from six locations in Duffy Creek and its unnamed tributary. These samples were collected from the same locations as the surface water samples discussed in Section 4.4.5. Tables 4-14 and 4-15 summarize the organic and inorganic analytes detected in the sediment samples, respectively.

The only VOC detected in any of the sediment samples was acetone, which was present in all samples except SED-6 at concentrations ranging from approximately 10 to 38 μg/kg. Acetone is a common laboratory contaminant but is discussed here because it was not detected in the associated method blank. However, due to the low concentrations detected, as well as its presence in the upstream sample (SED-2), the presence of acetone in these samples is assumed to be due to laboratory contamination.

The only semivolatile substance detected was butylbenzylphthalate in sample SED-3 at an estimated concentration of 24 μg/kg. Phthalates are common field and laboratory contaminants resulting from the use of rubber-based protective clothing. No sediment criteria exist for either acetone or butylbenzylphthalate (NYSDEC 1989b).

No PCBs or pesticides were detected in any of the sediment samples.

In addition to the above analyses, the sediment samples were also analyzed for organic matter according to ASTM Designation D2974-87. The results, which are presented in Table 4-14, ranged from 3.2 to 7.3%.

Of the 24 inorganics analyzed for, 17 were detected in the sediment samples. Aluminum, barium, beryllium, calcium, chromium, cobalt, lead, magnesium, potassium, and vanadium were detected in all seven samples at concentrations below the sediment criteria or have no applicable criteria. Sodium, detected only in SED-2, has no applicable criterion. Arsenic, detected in all samples at concentrations ranging from 8.1 to 14.3 μg/kg, exceeded the sediment criterion but not the limit of tolerance in all samples, including the background sample (SED-2). The sediment criteria represent the geometric mean of the "no-effect" and

"lowest-effect" levels based on toxicity studies in benthic organisms. The limits of tolerance are the concentrations that would be detrimental to the majority of potentially affected species (NYSDEC 1989b). Copper was detected in all of the sediment samples at concentrations ranging from 15.7 to 23.0 µg/kg and exceeded the criteria, but not the limit of tolerance, in SED-1, SED-4, and SED-4D. Iron exceeded the sediment criterion in all samples, with concentrations ranging from 31,600 to 43,200 µg/kg. Iron also exceeded the limit of tolerance in SED-2, the background sample, and in SED-6. Manganese exceeded the sediment criterion in all samples, with concentrations ranging from 705 to 2,440 µg/kg, and it exceeded the limit of tolerance in samples SED-1, SED-2, SED-3, and SED-5. The highest concentrations of iron and manganese were detected in the background sample SED-2, suggesting that the presence of these metals at high concentrations is not site-related.

Nickel exceeded the sediment criterion but not the tolerance limit in all of the samples, with concentrations ranging from 33.4 to 42.2 µg/kg. Zinc, detected in all samples, exceeded the criterion in SED-2, SED-3, and SED-4D, but not the tolerance limit. The background sample, SED-2, contained one of the highest concentrations of zinc.

Phase II RI

As discussed in Section 3.7, one sediment sample (SED2-1) was collected as far upstream as possible in Duffy Creek on July 9, 1993, at the same location as surface water sample SW2-1. This sample was analyzed for TCL VOCs and inorganics as well as organic matter (ASTM D2974-87).

No VOCs other than common laboratory contaminants were detected in SED2-1. The organic matter analysis yielded a result of 17%.

Table 4-33 lists the inorganic analytes detected in SED2-1. Of the 24 inorganics analyzed for, the same 17 were detected as in the Phase I RI background sample (SED-2) and at similar concentrations. Twelve metals were detected at or below their respective sediment criteria or have no criteria. Arsenic (12.3 mg/kg), iron (25,500 mg/kg), manganese (2,040 mg/kg), nickel (31.4 mg/kg), and zinc (112 mg/kg) were each detected above their respective criteria but all were below their limits of tolerance.

4.4.7 Surface Soil Samples

As discussed in Section 3.8, two background (SS-1 and SS-2) and 12 biased (SS-3 through SS-14) surface soil samples were collected at and around the site during the Phase I RI. All 14 samples were analyzed for full TCL organic and inorganic substances according to NYSDEC CLP methods. Tables 4-16 and 4-17 summarize the organic and inorganic analytes detected in the surface soil samples, respectively.

Three VOCs were detected in the surface soil samples. Acetone was detected in one sample (SS-11) at a concentration that was not directly attributable to laboratory contamination. Chloromethane was detected in SS-7 at an estimated concentration of 40 μg/kg, and ethylbenzene was detected in SS-6 and SS-7 at estimated concentrations of 1 and 18 μg/kg, respectively. No other chlorinated aliphatic compounds were detected in any of the surface soil samples.

Several semivolatile compounds, including phthalates and PAHs, were detected in several soil samples. Two phthalate compounds were detected at concentrations not directly attributable to laboratory contamination, including bis(2-ethylhexyl)phthalate at 2,100 μg/kg in SS-3 and butylbenzylphthalate at estimated concentrations of 50 and 260 μg/kg in SS-10D and SS-13, respectively. Phthalates are common laboratory and field contaminants due to their presence in rubber gloves and other protective equipment.

As summarized in Table 4-15, several PAHs were detected in numerous samples. The total estimated PAH concentrations in these samples are 53 μg/kg in SS-3; 160 μg/kg in SS-7; 40 μg/kg in SS-9; 980 μg/kg in SS-10; 140 μg/kg in SS-12; and 410 μg/kg in SS-14. Individual PAHs found to exceed typical ranges detected in rural soils (ASTDR 1989) include benzo(b)fluoranthene in SS-10 and SS-14; chrysene in SS-10 and SS-14; fluoranthene in SS-7 and SS-10; indeno(1,2,3-cd)pyrene in SS-12; phenanthrene in SS-7, SS-10, and SS-14; and pyrene in SS-3, SS-7, SS-10, and SS-14.

No PCBs or pesticides were detected in any of the surface soil samples.

Of the 24 inorganic analytes tested for, 18 were detected in the surface soil samples. Concentrations of metals in the surface soil samples were compared to the common range detected in eastern United States soils as well as to the upper limit of the 90th percentile (Shacklette and Boerngen 1984).

Aluminum, arsenic, barium, beryllium, chromium, copper, magnesium, potassium, sodium, and vanadium were detected in all or most samples but at concentrations within the observed range and 90th percentile.

The concentrations of calcium in SS-3 and SS-9 were found to exceed the 90th percentile but fell within the observed range. Cobalt was detected at concentrations exceeding the 90th percentile in all samples except background sample SS-2 (including background sample SS-1). However, all cobalt concentrations fell within the observed range except in SS-11, where it was detected at 87.3 mg/kg. Iron was found to exceed the upper limit of the 90th percentile in SS-3, SS-10, SS-10D, and SS-11 at concentrations ranging from 54,300 to 283,000 mg/kg. Lead was found to exceed the 90th percentile in SS-3 and SS-11 at 35.5 and 56.1 mg/kg, respectively, while manganese exceeded this limit in SS-3 and SS-13 at estimated concentrations of 4,540 and 1,940 mg/kg, respectively. Nickel exceeded the 90th percentile in SS-3, SS-6, SS-7, and SS-11 at concentrations ranging from 39.4 to 88.0 mg/kg. Zinc was detected above the 90th percentile in SS-3, SS-11, and SS-13 at concentrations ranging from 131 to 356 mg/kg. All of these metals, with the exception of iron in SS-3 and SS-11, fell within the observed range.

In addition to these metals, cyanide was detected in one sample, SS-11, at an estimated concentration of 3.5 mg/kg.

In summary, SS-3 contained seven metals at concentrations above the 90th percentile, and SS-11 contained five as well as cyanide. The remainder of the samples contained zero to three metals above the 90th percentile. The presence of cobalt in all of the surface samples at relatively similar concentrations suggests a natural local abundance of this metal. In terms of organic compounds, low concentrations of VOCs were detected in three samples. Additionally, phthalates and PAHs were detected at relatively low concentrations in numerous samples.

No surface soil samples were collected during the Phase II RI.

4.4.8 Leachate and Seep Samples

Phase I RI

As discussed in Section 3.9, two leachate samples of liquid matrix were collected from the on-site leachate collection system. Sample L-1 was collected from Manhole 4 (MH-4), which is the next-to-last manhole before leachate from the northwest, northeast, and

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south-central fill areas enters the sump at Pump Station 1. Sample L-2 was collected from the sump at Pump Station 2, which contains leachate from the south fill area only. Both samples were analyzed for full TCL organic substances and inorganic substances according to NYSDEC CLP methods. Tables 4-18 and 4-19 summarize the organic and inorganic analytes detected in the leachate samples.

Leachate sample L-1, which consisted of a reddish-orange liquid of pH 7.02 and conductivity of 860 ppm, contained two VOCs: total 1,2-DCE at 8 μg/L and TCE at an estimated concentration of 2 μg/L. Sample L-2, a reddish-orange liquid of pH 6.63 and conductivity of 1,170 ppm, contained three VOCs: TCE at 14 μg/L, chlorobenzene at an estimated 3 μg/L, and total 1,2-DCE at an estimated concentration of 2 μg/L.

Sample L-1 contained no semivolatile substances, PCBs, or pesticides, while L-2 did not include any PCBs or pesticides. However, several semivolatile substances were detected in L-2 at estimated concentrations as follows: 4-chloro-3-methylphenol at 4 μg/L; 1,4-dichlorobenzene at 1 μg/L; di-n-butylphthalate at 2 μg/L; naphthalene at 1 μg/L; and n-nitrosodiphenylamine at 1 μg/L. Di-n-butylphthalate, a common laboratory and field contaminant, is included in this discussion because it was not detected in the laboratory method blank.

Since leachate on site has in the past flowed directly into the unnamed tributary to Duffy Creek and the potential still exists for this to occur, the leachate results were compared to NYSDEC Class C surface water standards in order to preliminarily assess the leachate's potential impact on the creek. The only organic substances found to exceed these standards and guidance values were TCE and 4-chloro-3-methylphenol in L-2.

Of the 24 inorganic analytes tested for, 17 were detected in the leachate samples, as detailed in Table 4-19. Arsenic, barium, beryllium, cadmium, chromium, copper, magnesium, manganese, nickel, potassium, and sodium were all detected in one or both leachate samples at concentrations below NYSDEC Class C standards. Aluminum, cobalt, iron, lead, and zinc were detected in concentrations above Class C standards in both samples. Vanadium exceeded the imposed standard in L-1 only.

In summary, the leachate from the south fill area contained more organic compounds than the leachate collected at MH-4. However, the concentration of VOCs in the leachate is much less than in the air above the leachate as discussed in Section 4.4.9. In terms of

inorganic substances, several metals exceeded Class C standards; however, most appear ubiquitous at the site, with the exception of lead and vanadium.

On April 22, 1992, NYSDEC collected a single leachate sample from MH-4 for comparison with Phase I RI sample L-1, which was collected during a period of relatively low flow (October 1991). Sample MH-4 was analyzed for full TCL organics and inorganics by Recra Environmental, Inc. The results of this analysis are included in Tables 4-18, 4-19, and 4-34; however, these results have not been qualified or reviewed.

Table 4-18 lists the organic compounds detected in NYSDEC leachate sample MH-4. Twelve VOCs were reported, the most prevalent of which were total 1,2-DCE at 240 μg/L, ethylbenzene at 37 μg/L, and VC at 18 μg/L. Two semivolatiles, 4-methylphenol and diethylphthalate, were also detected at low concentrations in this sample.

Table 4-19 lists the inorganic analytes detected in sample MH-4. Twelve metals were detected in this sample compared to the 17 detected in E & E's October 3, 1991, sample from the same location. In all cases, the concentrations detected in the April 1992 sample were less than those detected in the October 1991 sample. The only inorganics found to exceed NYSDEC Class C surface water standards in sample MH-4 were aluminum at 203 μg/L and iron at 16,700 μg/L.

NYSDEC's April 1992 sample was also analyzed for BOD_5, COD, nitrate, and TSS. These results are summarized in Table 4-34.

As part of the draft Leachate Investigation Report prepared for NYSDEC by E & E in July 1992, several leachate samples were collected and analyzed for conventional parameters, including pH, BOD_5, BOD_{28}, COD, TKN, TSS, and iron. Discrete samples were collected from the sump at Pump Station 1 in May, June, and July 1992 and were identified as S1-1, S1-2, and S1-3, respectively. Samples were also collected in May and June 1992 from Pump Station 2 (PS2-1 and PS2-2, respectively) as well as from Manhole 3 near the leachate lagoon (MH3-1 and MH3-2, respectively). The results of this sampling effort appear in Table 4-35.

Phase II RI

As discussed in Section 3.9, four leachate/seep samples were collected during the Phase II RI on June 21 and 22, 1993. Sample SP2-1 consisted of leachate from the northeast fill area. Sample SP2-2 was collected from a seep in the Ormsby cow pasture near the

east-central site border. Sample SP2-3 was collected from what appeared to be a naturally occurring orange-stained seep in a small stream on the west side of Duffy Hollow Road. Sample SP2-4 was collected from a small wetland area on Mr. Urban's property. All four samples were analyzed for full TCL organics and inorganics according to NYSDEC CLP methods.

Table 4-36 lists the organic compounds detected in the seep samples. Since the media from which these samples were collected has the greatest potential to impact surface water, NYSDEC Class C surface water standards are included in Table 4-36 for comparison. 1,2-DCA was detected in all four samples as well as the duplicate. However, its presence is a suspected laboratory artifact related to acid preservation. This is supported by the fact that 1,2-DCA has not been detected elsewhere on site (i.e., air, groundwater, waste, etc.). Toluene was detected in leachate sample SP2-1 as well as in seep sample SP2-2 at an estimated concentration of 2 μg/L. No other organic compounds were detected in the off-site samples. Several other VOCs, however, were detected in sample SP2-1 and its duplicate, including chlorobenzene (6 to 7 μg/L); chloroethane (40 to 49 μg/L); 1,1-DCA (8 to 9 μg/L); ethylbenzene (140 to 150 μg/L); and total xylenes (420 to 470 μg/L).

No semivolatiles were detected in the off-site samples; however, seven compounds were detected in leachate sample SP2-1 or its duplicate. These include two phenols, one chlorinated benzene, two naphthalenes, and one phthalate (see Table 4-36). N-nitrosodiphenylamine was detected only in the field duplicate sample. No PCBs or pesticides were detected in any of the samples.

Of the 24 inorganics analyzed for, 17 were detected in one or more of the leachate/seep samples. Table 4-37 details the metals detected. Ten metals were detected below NYSDEC Class C surface water standards or have no standards, including arsenic, barium, beryllium, calcium, chromium, magnesium, manganese, nickel, potassium, and sodium. Seven metals were found to exceed Class C standards in at least two samples. The following metals exceeded standards in all four samples: aluminum (1,020 to 35,900 μg/L); cobalt (5.9 to 66.2 μg/L); iron (8,850 to 104,000 μg/L); and zinc (40.5 to 181 μg/L). Copper and lead exceeded their standards in SP2-2, SP2-3, and SP2-4 (5.3 to 49.4 μg/L for copper and 7.2 to 67.9 μg/L for lead). Vanadium exceeded its standard in SP2-2 and SP2-3 (15.1 and 53.7 μg/L, respectively). Note that the highest detected concentrations of

aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc were found in seep sample SP2-2 from the Ormsby cow pasture.

4.4.9 Air Samples

As discussed in Section 3.10, the manholes and risers of the leachate collection system were surveyed during the Phase I RI with air monitoring equipment in order to locate "hot spots" and identify leachate and air sampling locations. Data were collected on September 30, 1991 prior to the Phase I RI leachate sampling. These data, along with data from the additional survey performed on December 17 and 18, 1991, prior to Phase I RI air sampling, are presented in Table 4-20. Since only two Phase I RI leachate samples could be collected (see Section 3.9), air samples were collected from the "hottest" manholes and risers from each fill area, as detailed on Table 3-6. Eight air samples were collected, including one field duplicate and one field blank. All samples were analyzed for VOCs by EPA method TO-14, which utilizes SUMMA® canisters. The analytical results provided by Air Toxics, Ltd. are provided in Appendix F.

As detailed in Table 4-21, several VOCs were detected in the air samples, including aromatic hydrocarbons (including benzene, ethylbenzene, 1,2,4-trimethylbenzene, toluene, and o-, m-, and p-xylene), chlorinated aliphatic hydrocarbons (including chloroethane; 1,1-DCA; DCE; MC; 1,1,1-TCA; TCE; and VC), and chlorofluorocarbons (CFCs) (including Freon® 11 [fluorotrichloromethane], Freon® 12 [dichlorodifluoromethane], Freon® 113 [1,1,2-trichloro-1,2,2-trifluoroethane], and Freon® 114 [dichlorotetrafluoroethane]).

Sample A-1 (MH-10) contained 22,100 parts per billion by volume (ppbv) of aromatic hydrocarbons and 71,000 ppbv of chlorinated aliphatic compounds, totaling 93,100 ppbv VOCs. Sample A-2 (R-10) contained 12,500 ppbv aromatics, more than 100,000 ppbv chlorinated aliphatics, and 2,910 ppb CFCs, totaling 116,000 ppbv VOCs. Sample A-3 (MH-6) contained 29,600 ppbv aromatics and approximately 102,000 ppbv chlorinated aliphatic compounds, totaling 131,000 ppbv VOCs. Sample A-4 (MH-15) contained approximately 10,300 ppbv aromatics; 2,370 ppbv chlorinated aliphatics; and 2,660 ppbv CFCs, totaling 15,400 ppbv VOCs. Sample A-5 (R-2) contained 234 ppbv aromatics, 106 ppbv chlorinated aliphatics, 19.8 ppbv CFCs, and 3.8 ppbv chlorinated aromatics, totaling 360 ppbv VOCs. Duplicate sample A-6 contained similar compounds to A-5 but at about half the concentration, totaling 170 ppbv VOCs. Sample A-7 (MH-3) contained 8,090 ppbv aromatics and 18,600

ppbv chlorinated aliphatics, totaling 26,700 ppbv VOCs. Sample A-8, the field blank through which purified nitrogen was run, contained 3.6 ppbv 1,2-dichlorobenzene and 2.8 ppbv Freon® 113, neither of which was detected in any other sample. In addition, A-8 was found to contain 1.6 ppbv of MC, which was also detected in A-2, but at a significantly high enough concentration that it is not considered background contamination in A-2.

In summary, the samples containing the highest concentrations of VOCs were those collected nearest the northwest fill area. Manhole 6, located at the southern end of the northwest fill area before the junction with the line from the northeast fill area, contained the highest concentration of VOCs. The air samples contained much higher concentrations of VOCs than the liquid leachate samples. This indicates that the collection system is efficiently removing VOCs from the leachate or it is serving as a direct migratory pathway for VOCs from the fill areas, or both.

No air sampling was performed during the Phase II RI.

4.4.10 Leachate Collection System Evaluation

As discussed in Section 3.11, information regarding the leachate collection system was collected during the RI by means of visual inspection, surveying, and file review. Since these data pertain to the FS, results are not discussed in the RI report.

4.4.11 Perimeter Explosive Gas Survey

A perimeter explosive gas survey was conducted in June 1993 as described in Section 3.12. The survey was performed to determine if subterranean explosive gases (or vapors) were present beyond the landfill boundary. The existence of gases could necessitate the installation of vents in these areas after capping.

A total of 31 locations were monitored at 200-foot intervals immediately adjacent to the perimeter of each landfill area. Two additional samples were collected from within the northeast fill area. Location NE-FILL in the center of the fill area was included for comparison with perimeter survey results. Location NE-W3A was included to help identify the fill boundary in that area. Figure 3-10 depicts the gas survey locations. A summary of the results is provided in Table 4-38 and is discussed below.

At each sample location, the soil gas was measured using an OVA, an HNu, and a CG/O_2 meter. At several locations, there were high OVA peaks within a few seconds after

attaching the probe tubing to the OVA. These readings occurred before one volume of air was purged from the soil gas probe. Therefore, these peaks do not likely represent natural stable conditions and may have been the result of volatilization in the soil caused by the excessive heat generated by driving the probe. These quick peak results are not included in Table 4-38. The data included in this table represent stable conditions following initial purging of the probe.

Northwest Fill Area

Eighteen locations were monitored around the northwest fill area perimeter (see Figure 3-10). VOCs were detected above background levels by the OVA in six of the samples: NW-E1, NW-W1, NW-W2, NW-W5, NW-W7, and NW-S2. The volatile organic concentrations were generally low in five of the samples, ranging from 0.4 ppm to 4 ppm. The remaining sample, NW-S2, had a concentration of 130 ppm. No VOCs were detected by the HNu. Only one sample, NW-S2, had elevated readings detected by the CG/O_2 meter above background at 1%. Due to the OVA and CG/O_2 meter readings detected at NW-S2, it is possible that this sample location is very close to or within the fill or that methane is migrating through the soil at this location.

Northeast Fill Area

Twelve locations were monitored at the northeast fill area: 10 around the perimeter and two from within the landfill as discussed above (see Figure 3-10). Of the 10 perimeter samples, five samples contained VOCs at concentrations ranging from 0.2 ppm to 2.7 ppm on the OVA. One sample, NE-N1, had concentrations of VOCs above 1,000 ppm. No perimeter samples produced responses on the HNu. One perimeter sample, NE-N1, had combustible gas present at 2%. Due to the OVA readings and the presence of combustible gas at location NE-N1, it is possible that fill is present at or very near this location or that methane is present at relatively high concentrations in the soil gas.

Volatile organic concentrations for the two fill samples NE-FILL and NE-W3A, were greater than 1,000 ppm for both samples as measured by the OVA, and 0 ppm and 1.0 ppm, respectively, on the HNu. Combustible gas measurements for both fill samples were greater than 100%.

South Fill Area

Eight samples were collected around the perimeter of the south fill area (see Figure 3-10). Two of these samples, S-W1 and S-W2, contained VOCs above background at concentrations of 1 ppm and 0.6 ppm, respectively, on the OVA, and 1.2 ppm and 0.5 ppm, respectively, on the HNu. No samples elicited responses on the CG/O_2 meter.

South Central Fill Area

Eight locations were monitored along the perimeter of the south central fill area (see Figure 3-10). Three samples, SC-W3, SC-N2, and SC-E2, contained VOCs above detection limits at concentrations of 0.3 ppm, 90 ppm, and greater than 1,000 ppm, respectively, on the OVA, and concentrations of 1.0 ppm, 0.3 ppm, and 1.5 ppm, respectively, on the HNu. Two of the same samples, SC-N2 and SC-E2, also contained combustible gases at concentrations of 1% and 60%, respectively. The OVA and CG meter responses for SC-E2 suggests that fill may be present at or near this location.

4.5 DATA ASSESSMENT SUMMARY

Phase I RI

All analytical data generated for this remedial investigation have been reviewed by a third-party data validator for compliance, completeness, and data usability. QA/QC concerns that may have an effect on data usability are summarized below with the appropriate data qualifiers.

- Low levels of MC, acetone, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate were attributable to laboratory background contamination because they were present in the method blanks at comparable levels. In some instances, the method blanks did not exhibit contamination by one or more of these common contaminants. However, because MC and acetone are widely used laboratory solvents and phthalate esters are present in the gloves used in handling samples, their presence is most likely due to laboratory/field contamination. Di-n-butylphthalate in TP-4 and TP-5 and bis(2-ethylhexyl)phthalate in TP-1, TP-2, TP-4, and TP-5 are at levels higher than those usually found for laboratory or field contamination.

- Volatile analysis holding time of seven days was exceeded by one day for the following samples: SB-2A, SB-3A, SB-3B, SS-10D-RE, and SS-13-RE. The holding time was exceeded by three to four days for samples TP-1 to TP-5, TP-1DL, and TP-2 MS/MSD. Sample TP-1DL was analyzed according to medium level protocol, so no qualification was necessary. Positive results and quantitation limits for aromatic volatiles in these samples were qualified "J" and "UJ" as estimated. However, samples SB-2A, SB-3A, and SB-3B were re-collected and analyzed within the holding time.

- Surrogate recovery for bromofluorobenzene was below QC limits for volatile analysis of the following samples: GW-5D, TB-1, SS-1, SS-2-RE, SS-13, and SS-13-RE. Matrix interference was substantiated for SS-13 because reanalysis gave similar results. Surrogate recoveries for toluene-d8 and bromofluorobenzene were below QC limits for sample TP-1DL. Positive results and limits for all volatile substances in these samples were qualified "J" and "UJ" as estimated.

- Several samples indicated one or more high surrogate recoveries for volatile analysis, including TB-1-RE, SS-1-RE, SS-2, SS-7, SS-7-RE, SB-7A, SB-7B, SB-10B, GW-5S, GW-6S, GW-11S, GW-12D, GW-12D-RE, GW-13D, and GW-13S. Matrix interferences were substantiated for SS-7 and GW-12D because reanalysis gave similar results. Positive results only in these samples were qualified "J" as estimated.

- Positive results for 2-butanone in TP-1 and TP-5 were qualified "J" as estimated due to a relative standard deviation result of greater than 35% for the initial calibration of 2-butanone.

- Low internal standard (IS) areas for volatile analysis of several samples were noted. Samples SS-1, SS-2-RE, SS-7, SS-7-RE, SS-10D, and SS-13 gave low IS areas for chlorobenzene-d5, and sample SS-7 also gave a low IS area for bromochloromethane. Positive results and limits for the compounds quantitated using these ISs were qualified "J" and "UJ" as estimated in these samples.

- Base/neutral/acid extractable (BNA) extraction holding time of five days was exceeded by one day for samples SB-6A and SB-6B; by 23 days for samples GW-2D-RE, GW-8S, and GW-10S-RE; and by 28 days for sample GW-11-SDD-RE. Positive results and limits for BNAs in these samples were qualified "J" and "UJ" as estimated.

- Two or more acid phenol (AP) surrogates gave recoveries of less than 10% for BNA analysis in the following samples: GW-2D, GW-2D-RE, GW-10S, GW-10S-RE, GW-11-SDD, GW-13D, and GW-13D-RE. Reanalysis of GW-11-SDD gave one recovery below 10%. AP quantitation limits for GW-11SDD-RE were qualified "UJ" as

estimated, while AP limits for the other samples were qualified "R" as rejected. Matrix interferences were substantiated by poor AP recoveries for the reanalysis of these samples.

- Low IS areas for BNA analysis of several samples were noted. The following samples had low IS areas for chrysene-d12 and perylene-d12: SS-12, SS-13, SS-14, and their reanalyses. In addition, samples SS-9 and SS-14 had low IS areas for perylene-d12 only. Four IS areas were low for sample TP-5: acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12. In most instances, matrix interferences were substantiated by similar results for reanalyses or MS/MSD analyses. Positive results and limits for the compounds quantitated using these ISs were qualified "J" and "UJ" as estimated in the associated samples.

- Pesticide/PCB extraction holding time of five days was exceeded by one day for samples SB-6A and SB-6B. Positive results and limits for pesticide/PCBs in these samples were qualified "J" and "UJ" as estimated.

- Several pesticides gave percent difference (%D) values greater than 20% for continuing calibration, including beta-BHC; dieldrin; 4,4'-DDE; 4,4'-DDD; and 4,4'-DDT. Positive results for these compounds in samples TP-1 and TP-2 were qualified "J" as estimated.

- Volatile analysis of residential well samples by Method 524.2 indicated zero percent recovery for 1,2-dibromo-3-chloropropane in both laboratory-fortified blank spikes. The quantitation limit for this compound was qualified "R" as rejected in all residential well samples.

- Cobalt results for SW-1 to SW-6 were qualified "U" as undetected because cobalt was detected at 6.1 μg/L in the associated preparation blank. Manganese results for SW-4, SW-4D, and SW-6 were qualified "U" because manganese was detected at 3.2 μg/L in the preparation blank. Manganese and zinc results for DW-1 were qualified "U" because of manganese detected at 2.6 μg/L and zinc at 4.9 μg/L in the preparation blank. The iron result for GW-7D was qualified "U" because of iron detected at 15.9 μg/L in the preparation blank.

- Field blank results for rinsate sample R-1 were used to qualify the associated soil samples. Cadmium results for SB-8AD, SB-8B, and SB-9B were qualified "U" as undetected because of cadmium detected at 6.5 μg/L in R-1. All other contaminants found in R-1 were either present at greater than five times the blank level or not detected in the associated samples.

- The cyanide holding time of 12 days was exceeded by six days for samples TP-1, TP-2, and TP-3. Quantitation limits for cyanide in these samples were qualified "UJ" as estimated.

- For samples TP-1 to TP-5, inorganic spike recoveries were zero percent for antimony and selenium; between 30% and 75% for arsenic, silver, thallium, and zinc; and greater than 125% for lead. Quantitation limits for antimony and selenium were qualified "R" as rejected; arsenic, lead, and zinc positive results were qualified "J" as estimated; and silver and thallium limits were qualified "UJ" as estimated.

- Inorganic spike recovery was less than 30% for antimony in four spike analyses. Quantitation limits for antimony were qualified "R" as rejected in the associated samples SB-1A to SB-6A, SB-1B to SB-6B, SB-5C, and SB-10A. Arsenic, selenium, and silver results and limits for these samples were qualified "J" and "UJ" as estimated, due to spike recoveries between 30% and 75%.

- For water samples L-1 (MH-4) and L-2 (PS#2), antimony and silver gave spike recoveries between 30% and 75%, while arsenic and selenium gave recoveries less than 30%. For soil samples SS-1 to SS-14, antimony and silver gave zero percent recoveries, while mercury and selenium gave recoveries between 30% and 75%. Antimony and silver quantitation limits were qualified "UJ" as estimated for the waters and "R" as rejected for the soils. Arsenic results were qualified "J" as estimated, while arsenic and selenium limits were qualified "R" as rejected for the waters. Mercury and selenium limits were qualified "UJ" as estimated for the soils.

- For soil samples SB-7A, SB-7B, and SED-1 to SED-6, antimony and silver gave spike recoveries less than 30%, and selenium gave a recovery between 30% and 75%. For water samples SW-1 to SW-6, selenium gave a recovery between 30% and 75%. Antimony and silver limits were qualified "R" as rejected for the soils, and selenium limits were qualified "UJ" as estimated for both soils and waters.

- Duplicate results gave relative percent difference (RPD) values greater than QC limits for the following: manganese for soil samples SB-1A to SB-6A, SB-1B to SB-6B, SB-5C, and SB-10A; lead for water samples L-1 (MH-4) and L-2 (PS#2); barium, manganese, and cyanide for soil samples SS-1 to SS-14; lead and iron for water samples SW-1 to SW-6; lead for water samples GW-1D to GW-4D, GW-2S, GW-3S, GW-8S to GW-10S, GW-9D, and GW-10D, and barium and zinc for soil samples TP-1 to TP-5. Positive results for these analytes in the associated samples were qualified "J" as estimated.

- Serial dilution results for water samples L-1 (MH-4) and L-2 (PS#2) gave %D values greater than 10% for aluminum and zinc. For soil samples SS-1 to SS-14, the %D for iron exceeded 10%. For water samples DW-1 to DW-7, GW-5D to GW-7D, GW-5S to GW-7S, GW-11S to GW-13S, GW-11-SDD, GW-12D, and GW-13D, the %D for aluminum exceeded 10%. Positive results for these analytes that exceeded 50 times the instrument detection limit (IDL) were qualified "J" as estimated in the associated samples.

Phase II RI

All analytical data generated for this remedial investigation have been reviewed by a third-party data validator for compliance, completeness, and data usability. The organic and inorganic data are considered usable for risk evaluation purposes, except for any data qualified "R" as rejected and unusable or "B" as due to presence in the blank. The qualifiers "J" or "UJ" as estimated have no effect on the data usability for risk evaluation. The wet chemistry data (BOD_5, BOD_{28}, COD, TKN, and TSS) are considered usable for determination of treatability options. QA/QC concerns that may have an effect on data usability are summarized below with the appropriate data qualifiers.

Phase II results are qualified differently from Phase I results, regarding blank contamination. For Phase II data, the "B" qualifier is added to both organic and inorganic results considered due to field or laboratory contamination. For Phase I data, the "U" qualifier is used for field or laboratory contamination, with results less than the CRQL being raised to the CRQL. In Phase II, the laboratory inorganic "B" qualifier for results less than the CRQL but greater than the IDL is changed to "J" as estimated for validation purposes. In Phase I, the laboratory inorganic "B" qualifier remains in place.

VOCs

Low levels of MC and, in most instances, acetone were attributable to field or laboratory contamination due to their presence in field and/or method blanks. Acetone in samples DW2-2 and DW2-11RE could not be directly attributed to field or laboratory contamination, but is most likely laboratory background contamination. Acetone and MC are common laboratory solvents.

Carbon disulfide was detected at low concentrations in sample DW2-2 as well as the associated trip and field blank. It is considered a laboratory artifact resulting from the acid preservation of water samples containing sulfide. The presence of chloroform in a few trip

blanks and one field blank and bromodichloromethane in one trip blank indicates that the water used came from a chlorinated water supply.

1,2-Dichloroethane (1,2-DCA) in sample SW2-1 and its associated trip blank is considered a laboratory artifact resulting from acid preservation of volatile samples. 1,2-DCA in SP2-1, SP2-1D, SP2-2, SP2-3, and SP2-4 is most likely a laboratory artifact as well. This conclusion is supported by laboratory statements and previous field work.

Several tentatively identified compounds (TICs) found in the volatile analyses are siloxanes and are considered column bleed, not site contamination. This situation was noted with an "S" for siloxane on the data summary forms (DSFs) for information purposes. If TICs present in the samples were also detected in the field/laboratory blank, the "B" qualifier was added.

Sample MW2-2D required dilution analysis for VC and total 1,2-dichloroethene, but it was not performed due to laboratory oversight. The results for these two compounds are qualified "J" as estimated in sample MW2-2D.

Samples DW2-3, DW2-6, DW2-11, DW2-12, DW2-13, DW2-14, and DW2-15 were reanalyzed for VOCs due to instrument problems, which gave poor surrogate recoveries in the original analyses. Except for sample DW2-12, the reanalysis results gave recoveries within quality control limits. Reanalysis results for these samples are considered more acceptable with DW2-12RE results and limits qualified "J" and "UJ" as estimated.

Sample DW2-5 (sampled August 2, 1993) required reanalysis for VOCs due to poor surrogate recoveries, but insufficient sample remained for this reanalysis. The results were rejected and a similar location was resampled for VOCs on September 15, 1993. VOC analysis was acceptable for sample DW2-5A (sampled September 15, 1993).

For the field blank (FB2-1) and all the DW-designated samples, except DW2-5A (sampled September 15, 1993) and DW2-21, acetone and 2-butanone gave relative response factors (RRF) of less than 0.05 but greater than 0.01. Results and limits for these two compounds are qualified "J" and "UJ" as estimated in these samples. Acetone quantitation limits in DW2-5 (sampled September 15, 1993), DW2-21, and the associated trip blank are qualified "R" as rejected and unusable due to an RRF of less than 0.01 in the continuing calibration. Reanalysis was not attempted because the holding time had expired.

Inorganics

Samples SP2-3 and SP2-4 were analyzed four days past the holding time for cyanide due to possible contamination problems with an initial analysis within the holding time. Quantitation limits for cyanide are qualified "UJ" as estimated in these two samples. Samples DW2-1 and MW2-8D were insufficiently preserved for metals analysis. Results and limits for metals are qualified "J" and "UJ" as estimated in these two samples.

The chromium result for sample SW2-1 is qualified "B" because of chromium's presence in the preparation blank at 6.7 μg/L. Selenium results for samples CW2-4A, CW2-4B, DW2-1, MW2-1D, MW2-2D, MW2-2S, MW2-3D, and MW2-3S are qualified "B" due to the presence of selenium at 1.1 μg/L in the preparation blank. Copper in samples MW2-5D, MW2-9S, MW2-10D, MW2-10S, MW2-12D, and MW2-13D is qualified "B" due to the presence of copper in the preparation blank at 2.4 μg/L. Zinc in sample DW2-21 is qualified "B" due to the presence of zinc in the preparation blank at 6.5 μg/L. The following sample results are qualified "B" due to aluminum at 31.8 μg/L, iron at 11.8 μg/L, and lead at 1.3 μg/L in the preparation blank:

- Aluminum in DW2-2, DW2-3, DW2-5, DW2-5D, DW2-8, DW2-11, DW2-13, DW2-14, DW2-15, and DW2-18;
- Iron in DW2-2, DW2-5D, DW2-9, DW2-13, DW2-15, DW2-17, and FB2-1; and
- Lead in DW2-5, DW2-5D, DW2-6, DW2-8, DW2-9, DW2-11, DW-2-13, DW2-15, DW2-16, DW2-17, DW2-18, and DW2-19.

Lead results in samples SP2-1 to SP2-4 are qualified "J" as estimated due to a low spike recovery of 69.5% and a high RPD value of 85.8% for the associated lead spike and duplicate analyses. The lead result for SED2-1 and the aluminum result for SW2-1 are qualified "J" as estimated due to high spike recoveries for lead and aluminum of 128% and 208%, respectively. Aluminum results in all CW-designated and MW-designated water samples are qualified "J" as estimated due to high spike recoveries of 140% and 164%.

Aluminum results in samples SP2-1 to SP2-4 are qualified "J" as estimated due to a serial dilution %D of 28.5%. Potassium results in samples CW2-3A, CW2-3BD, MW2-2S, and MW2-8D are qualified "J" as estimated due to a 14.3%D. Sodium results in all

CW-designated samples and samples DW2-1, MW2-2S, MW2-3D, MW2-3S, MW2-7D, and MW2-8D are qualified "J" as estimated due to a 12.1%D.

The lead result in DW2-10 is qualified "J" as estimated based on a correlation coefficient of less than 0.995 for the standard addition method.

Field Duplicates

Four sets of field duplicates were collected: CW2-3B/CW2-3BD, DW2-5/DW2-5D, MW2-5S/MW2-5SD, and SP2-1/SP2-1D. The DW2-5/DW2-5D set can be considered as field duplicates for inorganics only, since the volatile analysis of DW2-5 was rejected and the location resampled. Acceptable precision was generated for all volatile and inorganic parameters, with the following exceptions:

- High RPDs were noted for BOD_{28} (160%) and TSS (160%) analyses of the field duplicate set, MW2-5S/MW2-5SD. The original sample, MW2-5S, had higher values for these two parameters and should be used for determination of treatability options for this location.

- The field duplicate set, CW2-3B/CW2-3BD, gave high RPDs for aluminum, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, potassium, vanadium, and zinc with values ranging from 60% to 100%. The field duplicate, CW2-3BD, gave consistently higher results compared to sample CW2-3. A check of the field logbook revealed that these two samples had high turbidity readings. The amount of suspended solids in each and the amount of settling undoubtedly influenced the inorganic results. The data are usable for risk evaluation with no qualification and with both sets of sample values being used.

Table 4-1

WATER LEVEL ELEVATION DATA[a]

Well	Elevation (feet)				
	10/22/91 through 10/24/91	11/20/91	7/1/93	7/28/93	9/15/93
MW-1D	213.40	213.19	210.41	210.32	210.92
MW-2D	158.41	158.31	159.55	159.19	159.40
MW-2S	197.54	198.60	198.20	197.48	198.07
MW-3D	164.10	163.91	167.72	166.83	166.65
MW-3S	162.16	170.39	174.23	173.66	172.78
MW-4D	166.69	167.38	167.26	164.13	168.54
MW-5D	150.25	150.27	150.27	149.84	151.24
MW-5S	150.48	150.49	150.67	149.72	151.54
MW-5VD	—	—	—	74.04	74.73
MW-6D	116.69	116.79	116.27	115.89	116.27
MS-6S	122.44	123.10	122.22	122.21	123.17
MW-7D	65.13	65.40	65.71	65.70	66.48
MW-8D	—	—	71.78	71.64	72.16
MW-8S	102.96	103.11	103.45	102.64	103.59
MW-9D	130.76	129.15	131.31	131.09	134.44
MW-9S	138.83	141.77	148.90	148.91	147.08
MW-10D	163.18	161.24	163.24	162.44	162.12
MW-10S	172.90	172.39	178.30	176.91	175.46
MW-11S	82.61	83.71	85.61	85.07	85.50
MW-12D	—	—	—	164.10	164.19
MW-12S	—	—	—	<180.02	<180.02
MW-13D	—	—	—	108.25	112.72
MW-13S	—	—	—	117.85	118.67
MW-14D	—	—	—	119.99	119.94
MW-14S	—	—	—	<130.96	<130.96
MW-15D	—	—	—	71.24	71.34
MW-15DA	—	—	—	53.42	<53.31

Table 4-1

WATER LEVEL ELEVATION DATA[a]

Well	Elevation (feet)				
	10/22/91 through 10/24/91	11/20/91	7/1/93	7/28/93	9/15/93
MW-15S	—	—	—	88.34	88.85
MW-16D	—	—	—	-18.94	-18.77
MW-16S	—	—	—	0.38	3.70
CW-3A	94.77	85.95	92.84	94.89	92.10
CW-3B	90.29	87.81	89.02	89.26	88.84
CW-4A	88.37	89.18	88.55	87.88	89.77
CW-4B	88.39	88.50	89.12	88.46	89.86
PZ-1	—	—	229.19	227.18	226.79
PZ-2	—	—	—	240.12	240.12
PZ-3	—	—	—	230.01	230.42
PZ-4	—	—	219.98	219.68	219.87
PZ-5	—	—	178.69	177.32	175.98
PZ-6	—	—	208.11	202.53	200.09
PZ-7	—	—	—	220.48	226.00
PZ-8	—	—	—	198.86	204.38
PZ-9	—	—	—	181.06	190.40
PZ-10	—	—	—	< 161.4	163.42
PZ-11	—	—	—	139.16	145.35
PZ-12	—	—	—	158.02	158.80
PZ-13	—	—	—	123.92	123.17
PZ-14	—	—	—	109.54	112.99

[a] Elevation reference: Site benchmark, BM-1 = 296.15 feet (approximate actual elevation is 2,216 feet above MSL).

Data Source: Ecology and Environment Engineering, P.C. 1993.

Table 4-2

ORGANIC COMPOUNDS DETECTED IN PHASE I RI SUBSURFACE SOIL/WASTE SAMPLES COLLECTED DURING TRENCH EXCAVATION DECEMBER 17, 18, AND 19, 1991

(all values reported in µg/kg)

Compound	TP-1	TP-2	TP-3	TP-4	TP-5
Volatiles					
Acetone	4,500 DJ	230 J	1,800 J	ND	370 J
Benzene	ND	ND	ND	ND	78 J
2-Butanone	490 J	ND	ND	ND	75 J
1,1-Dichloroethane	710	ND	ND	ND	ND
1,2-Dichloroethene (total)	3,900 DJ	ND	2,200	2,900	21 J
Ethylbenzene	33,000 J	31 J	12,000 J	830 J	1,200 J
2-Hexanone	120	ND	ND	ND	44 J
Methylene chloride	U	U	U	U	110
4-Methyl-2-pentanone	260 J	ND	ND	ND	ND
Styrene	45	ND	ND	4,200	ND
Tetrachloroethene	ND	ND	ND	520 J	ND
Toluene	970 J	11 J	760 J	3,200 J	33 J
Trichloroethene	73	ND	ND	5,300	ND
Vinyl chloride	980 DJ	ND	ND	ND	ND
Xylenes (total)	1,700 J	51 J	ND	690 J	350 J
Semivolatiles					
Benzo(b)fluoranthene	ND	370 J	ND	ND	ND
Benzo(a)pyrene	ND	280 J	ND	ND	ND
Benzyl alcohol	ND	ND	ND	1,200 J	ND
Bis(2-ethylhexyl)phthalate	1,100 J	1,100 J	U	8,300	8,300 J
Butylbenzylphthalate	ND	16,000	ND	1,000 J	2,700 J
4-Chloro-3-methylphenol	ND	300 J	ND	ND	ND
Chrysene	ND	410 J	ND	ND	ND
Di-n-butylphthalate	ND	270 J	U	14,000	4,100 J
1,2-Dichlorobenzene	ND	ND	ND	1,200 J	670 J

Key at end of table.

Table 4-2

**ORGANIC COMPOUNDS DETECTED IN PHASE I RI
SUBSURFACE SOIL/WASTE SAMPLES COLLECTED DURING TRENCH EXCAVATION
DECEMBER 17, 18, AND 19, 1991
(all values reported in µg/kg)**

Compound	TP-1	TP-2	TP-3	TP-4	TP-5
Diethylphthalate	110 J	ND	25 J	ND	ND
Dimethylphthalate	ND	ND	ND	910 J	530 J
Fluoranthene	280 J	720 J	ND	ND	300 J
2-Methylnaphthalene	ND	180 J	ND	ND	190 J
4-Methylphenol	1,600 J	820 J	870	ND	370 J
Naphthalene	ND	140 J	ND	ND	150 J
Pentachlorophenol	ND	ND	ND	ND	6,600 J
Phenanthrene	130 J	540 J	ND	ND	610 J
Pyrene	190 J	530 J	ND	ND	340 J
Pesticides					
beta-BHC	12 J	ND	ND	ND	ND
Dieldrin	ND	13 J	ND	ND	ND
4,4'-DDE	ND	15 J	ND	ND	ND
4,4'-DDD	ND	43 J	ND	ND	120
4,4'-DDT	ND	130 J	ND	ND	ND

Key:

D = Reported result is taken from diluted sample analysis.
J = Associated numerical value is considered estimated.
ND = Not detected.
U = The compound was detected in the method blank at comparable level and is considered undetected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-3

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL/WASTE SAMPLES COLLECTED DURING TRENCH EXCAVATION DECEMBER 17, 18, AND 19, 1991

(all values reported in mg/kg)

Analyte	TP-1	TP-2	TP-3	TP-4	TP-5	Common Range in Eastern U.S. Soils[a]	
						Observed Range	Upper Limit of 90th Percentile
Aluminum	13,200	9,450	13,900	12,000	14,600	7,000 - 100,000	128,000
Arsenic	20.9 J	14.3 J	12.2 J	11.5 J	12.7 J	<0.1 - 73	16.0
Barium	132 J	121 J	121 J	85.7 J	215 J	10 - 1,500	867
Beryllium	0.74 B	0.47 B	0.71 B	0.60 B	0.64 B	<1 - 7	1.81
Calcium	4,350	9,890	1,610	1,850	2,710	100 - 280,000	14,400
Chromium	28.8	18.2	23.2	24.3	26.9	1 - 1,000	112
Cobalt	28.1	20.8	24.9	26.0	24.5	<0.3 - 70	19.8
Copper	29.0	28.4	194	25.4	34.6	<1 - 700	48.7
Iron	36,400	23,900	31,700	35,100	38,300	100 - >100,000	54,100
Lead	33.4 J	53.5 J	15.3 J	86.9 J	62.5 J	<10 - 300	33.0
Magnesium	5,070	4,470	4,240	4,130	3,330	50 - 50,000	10,700
Manganese	760	422	661	784	709	<2 - 7,000	1,450
Nickel	43.2	25.8	33.5	35.0	31.9	<5 - 700	38.2
Potassium	2,160	1,970	2,230	1,570	1,670	50 - 37,000	23,500
Sodium	509 B	289 B	323 B	71.2 B	276 B	<500 - 50,000	17,400

Key at end of table.

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Table 4-3

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL/WASTE SAMPLES COLLECTED DURING TRENCH EXCAVATION DECEMBER 17, 18, AND 19, 1991

(all values reported in mg/kg)

Analyte	TP-1	TP-2	TP-3	TP-4	TP-5	Common Range in Eastern U.S. Soils[a]	
						Observed Range	Upper Limit of 90th Percentile
Vanadium	17.8	15.1	22.0	18.6	26.2	<7 - 300	140
Zinc	173 J	258 J	269 J	87.4 J	263 J	<5 - 2,900	104

[a]Shacklette and Boerngen 1984.

Key:

B = Result is greater than IDL but less than CRDL.
J = Reported value is estimated due to variance from quality control limits.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-4

ORGANIC COMPOUNDS DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991

(all values reported in µg/kg)

Compound	SB-1A[a] (12-14')	SB-1B[a] (1-2')	SB-2A (6.5-7.5')	SB-3A (1-2')	SB-3B (10-12')	SB-4A (2-4')	SB-4B (7-9')	SB-5B (8-9')	SB-5C (18-19')
Volatiles									
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	ND	ND	87	61
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	22	13
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	21	7 J
Semivolatiles	ND	ND	NA	NA	NA	NA	NA	NA	NA

Key at end of table.

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Table 4-4

ORGANIC COMPOUNDS DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991

(all values reported in µg/kg)

Compound	SB-6A (6-10')	SB-6B (12-14')	SB-7A (8-10')	SB-7B (20-21' and 22-23')	SB-8A (7-9')	SB-8AD[b] (7-9')	SB-8B (21-23')	SB-9A (4-6')	SB-9B (26-27.5')	SB-10A (5-7')	SB-10b (18-19')
Volatiles											
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatiles	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA

[a]Background samples from well MW-1D.
[b]Field duplicate of sample SB-8A.

Key:

J = The reported value is estimated.
NA = Not analyzed for.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-5

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991

(all values reported in mg/kg)

Analyte	SB-1A[a] (12-14')	SB-1B[a] (1-2')	SB-2A (6.5-7.5')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	18,100	16,200	15,600	7,000 - 100,000	128,000
Arsenic	2.9 J	6.8 J	12.7 J	<0.1 - 73	16.0
Barium	31.2 B	72.3	109	10 - 1,500	867
Beryllium	0.64 B	0.50 B	1.1 B	<1 - 7	1.81
Cadmium	ND	ND	1.3	NA	NA
Calcium	1,180	1,050 B	850 B	100 - 280,000	14,400
Chromium	27.6	21.1	20.8	1 - 1,000	112
Cobalt	33.2	25.8	30.2	<0.3 - 70	19.8
Copper	37.0	7.7	29.3	<1 - 700	48.7
Iron	43,700	32,900	45,200	100 - >100,000	54,100
Lead	6.6 J	18.4 J	11.6 J	<10 - 300	33.0
Magnesium	6,680	3,650	6,710	50 - 50,000	10,700
Manganese	431 J	1,750 J	686 J	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	53.4	25.8	42.1	<5 - 700	38.2
Potassium	1,870	1,520	2,430	50 - 37,000	23,500
Sodium	54.6 B	34.2 B	99.5 B	<500 - 50,000	17,400
Vanadium	21.9	24.8	19.0	<7 - 300	140
Zinc	96.5 J	75.2 J	87.3 J	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991
(all values reported in mg/kg)

Analyte	SB-3A (1-2')	SB-3B (10-12')	SB-4A (2-4')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	15,500	12,800	13,600	7,000 - 100,000	128,000
Arsenic	16.4 J	7.1 J	1.3 J	<0.1 - 73	16.0
Barium	71.3	137	281	10 - 1,500	867
Beryllium	0.69 B	0.59 B	0.63 B	<1 - 7	1.81
Cadmium	ND	ND	ND	NA	NA
Calcium	360 B	1,150	1,640	100 - 280,000	14,400
Chromium	18.6	18.2	22.2	1 - 1,000	112
Cobalt	29.2	22.5	30.1	<0.3 - 70	19.8
Copper	9.8	12.8	21.1	<1 - 700	48.7
Iron	35,100	30,600	32,500	100 - >100,000	54,100
Lead	32.8 J	20.1 J	ND	<10 - 300	33.0
Magnesium	3,590	4,570	5,820	50 - 50,000	10,700
Manganese	1,140 J	668 J	1,670 J	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	25.7	30.4	41.9	<5 - 700	38.2
Potassium	1,510	1,840	1,780	50 - 37,000	23,500
Sodium	35.5 B	71.7 B	ND	<500 - 50,000	17,400
Vanadium	21.4	16.9	18.9	<7 - 300	140
Zinc	56.9 J	65.7 J	74.6 J	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991

(all values reported in mg/kg)

Analyte	SB-4B (7-9')	SB-5B (8-9')	SB-5C (18-19')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	14,500	13,800	11,100	7,000 - 100,000	128,000
Arsenic	12.7 J	9.0 J	5.0 J	<0.1 - 73	16.0
Barium	42.8 B	132	80.7	10 - 1,500	867
Beryllium	0.86 B	0.77 B	0.49 B	<1 - 7	1.81
Cadmium	ND	ND	ND	NA	NA
Calcium	1,440	1,230	1,370	100 - 280,000	14,400
Chromium	21.1	20.1	15.4	1 - 1,000	112
Cobalt	32.7	25.6	21.3	<0.3 - 70	19.8
Copper	18.3	15.7	26.3	<1 - 700	48.7
Iron	41,400	33,700	26,000	100 - >100,000	54,100
Lead	8.0 J	13.0 J	12.7 J	<10 - 300	33.0
Magnesium	6,020	5,030	4,260	50 - 50,000	10,700
Manganese	1,010 J	694 J	551 J	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	48.0	36.4	30.1	<5 - 700	38.2
Potassium	1,990	1,710	1,110 B	50 - 37,000	23,500
Sodium	ND	ND	ND	<500 - 50,000	17,400
Vanadium	20.6	18.7	15.8	<7 - 300	140
Zinc	78.0 J	72.1 J	64.6 J	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991
(all values reported in mg/kg)

Analyte	SB-6A (6-10')	SB-6B (12-14')	SB-7A (8-10')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	13,500	13,100	13,000	7,000 - 100,000	128,000
Arsenic	10.6 J	15.7 J	11.7	<0.1 - 73	16.0
Barium	64.9	67.2	129	10 - 1,500	867
Beryllium	0.58 B	0.65 B	0.80 B	<1 - 7	1.81
Cadmium	ND	ND	ND	NA	NA
Calcium	742 B	777 B	1,600	100 - 280,000	14,400
Chromium	18.7	17.5	22.0	1 - 1,000	112
Cobalt	26.5	21.7	27.7	<0.3 - 70	19.8
Copper	15.5	12.5	23.6	<1 - 700	48.7
Iron	36,700	32,800	33,500	100 - >100,000	54,100
Lead	27.7 J	35.6 J	20.3 J	<10 - 300	33.0
Magnesium	4,660	4,720	5,130	50 - 50,000	10,700
Manganese	1,040 J	461 J	849	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	38.5	31.5	39.0	<5 - 700	38.2
Potassium	1,520	1,720	1,680	50 - 37,000	23,500
Sodium	54.3 B	67.0 B	44.4 B	<500 - 50,000	17,400
Vanadium	15.9	14.8	19.0	<7 - 300	140
Zinc	71.6 J	66.7 J	72.0	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991 (all values reported in mg/kg)

Analyte	SB-7B (20-21' and 22-23')	SB-8A (7-9')	SB-8AD[b] (7-9')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	12,500	12,100	13,200	7,000 - 100,000	128,000
Arsenic	14.5	14.1	10.4	<0.1 - 73	16.0
Barium	43.0	111	111	10 - 1,500	867
Beryllium	0.94 B	0.51 B	0.61 B	<1 - 7	1.81
Cadmium	ND	ND	U	NA	NA
Calcium	1,420	1,180	1,320	100 - 280,000	14,400
Chromium	21.7	15.1	18.8	1 - 1,000	112
Cobalt	27.0	21.8	24.9	<0.3 - 70	19.8
Copper	16.7	17.3	16.9	<1 - 700	48.7
Iron	35,800	29,400	32,700	100 - >100,000	54,100
Lead	13.3 J	13.9	12.3	<10 - 300	33.0
Magnesium	4,600	4,130	4,890	50 - 50,000	10,700
Manganese	909	996	828	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	40.1	32.2	34.7	<5 - 700	38.2
Potassium	2,710	1,470	1,790	50 - 37,000	23,500
Sodium	54.1 B	52.4 B	56.6 B	<500 - 50,000	17,400
Vanadium	21.0	14.0	16.2	<7 - 300	140
Zinc	71.3	60.1	66.2	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27, THROUGH OCTOBER 3, 1991
(all values reported in mg/kg)

Analyte	SB-8B (21-23')	SB-9A (4-6')	SB-9B (26-27.5')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	11,500	13,800	13,900	7,000 - 100,000	128,000
Arsenic	10.6	17.4	17.9	<0.1 - 73	16.0
Barium	90.2	122	87.7	10 - 1,500	867
Beryllium	0.59 B	0.65 B	0.92 B	<1 - 7	1.81
Cadmium	U	ND	U	NA	NA
Calcium	1,540	1,700	1,800	100 - 280,000	14,400
Chromium	14.8	18.9	15.1	1 - 1,000	112
Cobalt	23.2	25.4	30.1	<0.3 - 70	19.8
Copper	12.6	17.9	22.9	<1 - 700	48.7
Iron	33,900	33,300	35,100	100 - >100,000	54,100
Lead	11.8	22.4	8.0	<10 - 300	33.0
Magnesium	4,900	5,450	5,200	50 - 50,000	10,700
Manganese	1,420	771	894	<2 - 7,000	1,450
Mercury	0.12	ND	ND	0.01 - 3.4	0.265
Nickel	31.1	35.6	37.9	<5 - 700	38.2
Potassium	1,560	1,840	2,100	50 - 37,000	23,500
Sodium	61.6 B	64.2 B	80.1 B	<500 - 50,000	17,400
Vanadium	14.2	16.1	16.6	<7 - 300	140
Zinc	62.1	69.3	75.2	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN PHASE I RI SUBSURFACE SOIL SAMPLES FROM BORINGS AUGUST 27 THROUGH OCTOBER 3, 1991

(all values reported in mg/kg)

Analyte	SB-10A (5-7')	SB-10B (18-19')	Common Range in Eastern U.S. Soils[c]	
			Observed Range	Upper Limit of 90th Percentile
Aluminum	13,400	5,550	7,000 - 100,000	128,000
Arsenic	14.1 J	3.1	<0.1 - 73	16.0
Barium	182	40.5 B	10 - 1,500	867
Beryllium	0.67 B	ND	<1 - 7	1.81
Cadmium	1.8	ND	NA	NA
Calcium	1,150	77,500	100 - 280,000	14,400
Chromium	18.6	9.3	1 - 1,000	112
Cobalt	27.0	14.5	<0.3 - 70	19.8
Copper	15.1	9.5	<1 - 700	48.7
Iron	32,100	14,700	100 - >100,000	54,100
Lead	45.3 J	7.3	<10 - 300	33.0
Magnesium	4,250	17,100	50 - 50,000	10,700
Manganese	1,430 J	290	<2 - 7,000	1,450
Mercury	ND	ND	0.01 - 3.4	0.265
Nickel	31.7	16.9	<5 - 700	38.2
Potassium	1,340	630 B	50 - 37,000	23,500
Sodium	38.3 B	103	<500 - 50,000	17,400
Vanadium	19.1	11.0	<7 - 300	140
Zinc	64.8 J	56.3	<5 - 2,900	104

Key at end of table.

Table 4-5 (Cont.)

[a] Background samples from well MW-1D.
[b] Field duplicate of sample SB-8A.
[c] Shacklette and Boerngen 1984.

Key:

B = Result is greater than IDL, but less than CRDL.
J = Reported value is estimated due to variance from quality control limits.
NA = No applicable values given.
ND = Not detected.
U = Analyte was detected in preparation blank at comparable level and is considered undetected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-6

ORGANIC COMPOUNDS DETECTED IN PHASE I RI GROUNDWATER SAMPLES
OCTOBER 22 THROUGH 25, 1991
(all values reported in µg/L)

Compound	GW-1D	GW-2D	GW-2S	GW-3D	GW-3S	GW-4D	GW-5D	GW-5S	GW-6D	GW-6S	GW-7D	GW-8S	GW-9D
Volatiles													
Acetone	ND	ND	ND	ND	33	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	6 J	11 J	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	3 J	ND	ND	ND	ND	11 J	12 J	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	ND	520 D	ND	ND	ND	ND	4,600 DE	5,600 DE	200 D	5 J	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	3 J	ND	ND	ND	ND	ND	ND
Methylene chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	9 J	8 J	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	1 J	ND	ND	ND	ND	ND	4 J	ND	ND	ND	ND	ND
Trichloroethene	ND	230 D	ND	2 J	ND	1 J	310 D	370 D	7	ND	ND	ND	ND
Vinyl chloride	ND	160 D	ND	ND	ND	ND	1,400 D	2,100 D	63	ND	ND	ND	ND
Semivolatiles	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

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Table 4-6

ORGANIC COMPOUNDS DETECTED IN PHASE I RI GROUNDWATER SAMPLES
OCTOBER 22 THROUGH 25, 1991
(all values reported in µg/L)

Compound	GW-9S	GW-10D	GW-10S	GW-11S	GW-11SDD[a]	CW-3A[b]	CW-3B	CW-4A	CW-4B	NYSDEC Class GA Groundwater Standard[c]
Volatiles										
Chloroethane	ND	ND	ND	8 J	ND	ND	ND	ND	ND	5
Chloroform	2 J	ND	ND	ND	ND	ND	ND	ND	ND	7
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
1,1-Dichloroethene	ND	ND	ND	9 J	9	ND	ND	ND	ND	5
1,2-Dichloroethene (total)	ND	3 J	ND	390 D	390 D	3 J	9 J	4 J	ND	5
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
Methylene chloride	ND	ND	ND	ND	ND	ND	4 J	ND	ND	5
Toluene	ND	ND	ND	ND	ND	5	ND	ND	2 J	5
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
Trichloroethene	ND	3 J	ND	1,200 D	1,200 D	38	ND	ND	ND	5
Vinyl chloride	ND	ND	ND	110 J	110	ND	45 J	ND	ND	2
Semivolatiles	NA	ND	ND	ND	ND	ND	NA	ND	ND	–

Key at end of table.

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Table 4-6 (Cont.)

[a] Field duplicate of sample GW-11S.
[b] Reported results from reanalysis of sample CW-3A
[c] 6 NYCRR 703.5.

Key:

ND = Not detected.
G = General organic guidance value (NYSDEC 1990a).
J = The reported value is estimated.
D = Reported result is taken from diluted sample analysis.
E = Reported value is estimated because it exceeds the calibration limit.
NA = Sample not analyzed for semi-volatiles due to insufficient volume.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-7

INORGANIC ANALYTES DETECTED IN PHASE I RI GROUNDWATER SAMPLES
OCTOBER 22 THROUGH 25, 1991
(all values reported in µg/L)

Analyte	GW-1D	GW-2D	GW-2S	GW-3D	GW-3S	GW-4D	GW-5D	GW-5S	GW-6D	GW-6S	GW-7D	GW-8S	GW-9D
Aluminum	364	742	42,700	252	3,040	393	3,140 J	531	131 B	8,990 J	29.5 B	217	3,650
Arsenic	2.9 B	9.1 B	17.8	ND	2.4 B	ND	3.5 B	2.5 B	ND	6.4 B	ND	ND	4.3 B
Barium	273	49.0 B	342	101 B	53.4 B	13.9 B	110 B	12.8 B	20.0 B	40.2 B	10.2 B	61.4 B	43.4 B
Beryllium	ND	ND	2.2 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	21,800	30,600	53,600	49,700	31,900	13,100	9,160	16,300	16,000	12,800	30,200	85,200	26,400
Chromium	11.6	ND	110	ND	ND	ND	49.6	ND	ND	14.2	ND	ND	ND
Cobalt	ND	8.1 B	102	ND	14.7 B	ND	ND	ND	ND	11.3 B	ND	11.5 B	13.4 B
Copper	ND	3.3 B	115	ND	7.7 B	ND	46.2	3.2 B	ND	15.3 B	ND	ND	9.7 B
Iron	972 J	1,910 J	110,000 J	524 J	6,270 J	634 J	2,480	650	316	15,700	U	542 J	8,290 J
Lead	ND	4.1 J	38.1 J	ND	6.0 J	ND	2.4 B	ND	ND	10.8	ND	11.0 J	5.7 J
Magnesium	8,600	15,600	50,500	21,400	19,100	12,100	5,400	12,300	11,000	12,200	21,700	56,000	13,100
Manganese	227	1,820	8,530	41.2	1,300	72.3	1,060	563	828	514	16.4	2,200	179
Nickel	ND	ND	155	ND	ND	ND	ND	ND	ND	22.3 B	ND	ND	ND
Potassium	2,090 B	14,900	17,500	18,800	5,960	1,990 B	8,800	1,750 B	1,230 B	5,020	2,520 B	4,940 B	18,300
Sodium	4,690 B	19,700	20,900	29,800	20,400	9,730	516,000	9,920	6,080	7,450	19,000	35,500	32,600
Vanadium	ND	7.3 B	67.1	6.4 B	10.2 B	7.0 B	ND	ND	ND	10.1 B	ND	8.7 B	12.7 B
Zinc	ND	16.0 B	230	ND	24.1	ND	154	63.5	6.7 B	64.3	12.4 B	7.1 B	62.4

Key at end of table.

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Table 4-7

INORGANIC ANALYTES DETECTED IN PHASE 1 RI GROUNDWATER SAMPLES
OCTOBER 22 THROUGH 25, 1991
(all values reported in µg/L)

Analyte	GW-9S	GW-10D	GW-10S	GW-11S	GW-11SDD[a]	CW-3A	CW-3B	CW-4A	CW-4B	NYSDEC Class GA Groundwater Standard[c]
Aluminum	342	1,250	1,760	2,230 J	2,480 J	910 J	2,760 J	2,640 J	286	NA
Arsenic	ND	5.6 B	4.1 B	ND	ND	ND	3.1 B	3.5 B	ND	25
Barium	36.8 B	262	208	69.5 B	71.3 B	36.4 B	91.9 B	211	85.7 B	1,000
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	3 G
Calcium	67,900	25,300	15,700	43,800	44,000	71,300	31,000	47,500	54,600	NA
Chromium	ND	ND	ND	ND	10.0	11.0	22.2	ND	ND	50
Cobalt	9.0 B	9.5 B	10.5 B	ND	ND	ND	ND	ND	ND	NA
Copper	ND	8.0 B	ND	3.7 B	9.1 B	11.6 B	9.0 B	4.7 B	ND	200
Iron	1,630 J	3,270 J	4,620 J	4,260	4,440	736	5,780	5,130	414	300[b]
Lead	1.2 J	7.6 J	3.3 J	3.5	4.6	ND	125	3.6	ND	25
Magnesium	30,600	8,090	6,300	22,100	22,200	37,300	3,100 B	21,500	24,800	35,000 G
Manganese	1,490	387	4,110	2,030	2,040	24.6	123	2,370	2,770	300[b]
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Potassium	11,300	27,100	4,380 B	2,140 B	1,970 B	2,540 B	38,000	4,340 B	2,320 B	NA
Sodium	33,200	20,200	5,720	14,600	18,700	33,300	41,700	21,200	24,800	20,000
Vanadium	7.2 B	8.4 B	7.8 B	ND	ND	ND	27.9 B	ND	ND	NA
Zinc	5.7 B	27.2	11.0 B	26.4	39.8	41.0	83.4	54.6	5.6 B	300

Key at end of table.

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Table 4-7 (Cont.)

[a] Field duplicate of sample GW-11S.
[b] Total concentration of iron and manganese shall not exceed 500 µg/L.
[c] 6 NYCRR 703.5.

Key:

J = Reported value is estimated due to variance from quality control limits.
B = Result is greater than IDL, but less than CRDL.
NA = No applicable NYS SCG.
ND = Not detected.
G = Guidance value (NYSDEC 1990a).
D = Reported result is taken from diluted sample analysis.
U = Analyte was detected in preparation blank at comparable level and is considered undetected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-8

PHASE I RI GROUNDWATER SAMPLE PARAMETERS

Sample Number	Well Number	Organic Sample Portion[a]				Inorganic Portion[b]	
		Conductivity (ppm)	Temperature (°C)	Turbidity (NTU)	Date/Time	Turbidity[c] (NTU)	Date/Time
GW-1D	MW-1D	123	11.0	146	10-22-91/1740	14	10-23-91/0910
GW-2D	MW-2D	218	11.5	210	10-22-91/1525	38	10-23-91/0925
GW-2S[d]	MW-2S	416	11.0	>4,000	10-22-91/1728	>4,000	10-23-91/0929
GW-3D	MW-3D	315	13.0	600	10-22-91/1555	20	10-23-91/0855
GW-3S	MW-3S	248	13.5	2,800	10-22-91/1618	160/>1,000	10-23-91/0858
GW-4D	MW-4D	124	13.0	141	10-22-91/1613	18	10-23-91/0835
GW-5D	MW-5D	182	14.0	660	10-24-91/1100	18	10-25-91/0845
GW-5S	MW-5S	166	14.5	585	10-24-91/1110	19	10-25-91/0850
GW-6D	MW-6D	138	12.5	770	10-24-91/1120	7	10-25-91/0900
GW-6S	MW-6S	121	14.0	2,000	10-24-91/1125	440	10-25-91/0903
GW-7D	MW-7D	265	11.0	361	10-23-91/1625	17	10-24-91/1035
GW-8S	MW-8S	586	14.0	>4,000	10-22-91/1654	15/960	10-23-91/1010
GW-9D	MW-9D	222	11.5	190	10-22-91/1634	240	10-23-91/1000
GW-9S[d]	MW-9S	NA	NA	>4,000	10-22-91/1634	>4,000	10-23-91/1002
GW-10D	MW-10D	145	11.0	1,600	10-22-91/1715	110/200	10-23-91/0940
GW-10S	MW-10S	116	13.0	2,700	10-22-91/1710	140/540	10-23-91/0937
GW-11S	MW-11S	322	12.0	309	10-23-91/1625	125	10-24-91/1025
GW-12D	CW-3A	449	14.0	182	10-23-91/1640	31	10-24-91/1043

Key at end of table.

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Table 4-8

PHASE I RI GROUNDWATER SAMPLE PARAMETERS

Sample Number	Well Number	Organic Sample Portion[a]				Inorganic Portion[b]	
		Conductivity (ppm)	Temperature (°C)	Turbidity (NTU)	Date/Time	Turbidity[c] (NTU)	Date/Time
GW-12S[d]	CW-3B	NA	14.0	270	10-23-91/1640	173	10-24-91/1042
GW-13D	CW-4A	391	15.0	>4,000	10-23-91/1655	114	10-24-91/1055
GW-13S	CW-4B	386	14.0	1,600	10-23-91/1655	75	10-24-91/1053

[a] Organic portion refers to VOC, BNA, PCB, and pesticides analyses except where noted.
[b] Inorganic portion refers to metals and total cyanide except where noted.
[c] Where two turbidities are listed, the first is for the metals portion and the second is for the cyanide portion.
[d] Due to low well volume, water was collected for VOC and metals analyses only.

Key:

NA = Data not acquired.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-9

ORGANIC COMPOUNDS DETECTED IN PHASE I RI RESIDENTIAL WELL AND SPRING SAMPLES OCTOBER 24 AND 25, 1991

(all values reported in µg/L)

Compound	DW-1 Rosini	DW-2 Teller	DW-3 Kelley Jr.	DW-4 Bauer	DW-5 LaDue	DW-5D[b] LaDue	DW-6 Miller	DW-7 Vacarro	NYSDOH MCL[b]	NYSDEC Class GA Groundwater Standard[c]
Volatiles										
Trichloroethene	ND	ND	ND	ND	2.6	2.9	ND	ND	5	5
Semivolatiles	ND	ND	ND	ND	ND	ND	ND	ND	ND	—

[a] Field duplicate of sample DW-5.

[b] Maximum contaminant level for public water supplies per 10 NYCRR 5-1.52.

[c] 6 NYCRR 703.5

Key:

ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-10

**INORGANIC ANALYTES DETECTED IN PHASE I RI
RESIDENTIAL WELL AND SPRING SAMPLES
OCTOBER 24 AND 25, 1991
(all values reported in µg/L)**

Analyte	DW-1 Rosini	DW-2 Teller	DW-3 Kelley, Jr.	DW-4 Bauer	DW-5 LaDue
Aluminum	107 B	25.6 B	741	200 B	645
Barium	32.8 B	72.8 B	67.0 B	54.7 B	26.4 B
Calcium	40,100	37,400	21,300	33,300	44,900
Chromium	ND	ND	11.1	ND	ND
Copper	4.5 B	ND	29.8	3.6 B	7.3 B
Iron	534	U	693	730	535
Lead	ND	1.8 B	ND	ND	ND
Magnesium	13,300	13,400	6,070	12,100	19,600
Manganese	510	148	17.7	150	54.6
Mercury	ND	ND	ND	0.46	ND
Potassium	1,450 B	1,240 B	1,150 B	1,400 B	1,810 B
Sodium	50,400	8,200	31,600	58,000	17,000
Zinc	8.8 B	134	39.4	338	26.7
Cyanide	ND	ND	ND	ND	ND

Key at end of table.

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Table 4-10

INORGANIC ANALYTES DETECTED IN PHASE I RI RESIDENTIAL WELL AND SPRING SAMPLES OCTOBER 24 AND 25, 1991 (all values reported in µg/L)

Analyte	DW-5D[a] LaDue	DW-6 Miller	DW-7 Vacarro	NYSDOH MCL[b]	NYSDEC Class GA Groundwater Standard[e]
Aluminum	134 B	400	16.9 B	NA	NA
Barium	24.3 B	31.5 B	34.7 B	1,000 P	1,000
Calcium	44,800	13,400	21,800	NA	NA
Chromium	ND	ND	ND	50 P	50
Copper	ND	ND	33.8	1,000 S	200
Iron	193	1,300	107	300[c] S	300[c]
Lead	ND	ND	ND	50 P	25
Magnesium	19,600	8,160	8,230	NA	35,000 G
Manganese	41.1	166	76.9	300[c] S	300[c]
Mercury	ND	ND	ND	2 P	2
Potassium	1,680 B	1,100 B	1,450 B	NA	NA
Sodium	8,540	4,110 B	55,100	NA[d]	20,000
Zinc	7.9 B	9.7 B	5.3 B	5,000 S	300
Cyanide	ND	19.0	ND	NA	100

a Field duplicate of sample DW-5.

b Maximum contaminant level for public water supplies per 10 NYCRR 5-1.52.

c Total concentration of iron and manganese shall not exceed 500 µg/L.

d Water containing >20,000 µg/L of sodium should not be used for drinking by people on severely restricted sodium diets. Water containing >270,000 µg/L of sodium should not be used for drinking by people on moderately restricted sodium diets.

e 6 NYCRR 703.5.

Key:

B =Result is greater than IDL, but less than CRDL.
G =Guidance value (NYSDEC 1990a).
NA =No applicable NYS SCG.
ND =Not detected.
P =NYSDOH Primary Contaminant.
S =NYSDOH Secondary Contaminant.
U =Analyte was detected in preparation blank at a comparable level and is considered undetected.

Date Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-11

PHASE I RI RESIDENTIAL WELL AND SPRING SAMPLE PARAMETERS

Sample	Owner	Type	Sample Date	Conductivity (ppm)	Temperature (°C)	Turbidity (NTU)
DW-1	Rosini	150-foot well	10-25-91	329	14.0	4.2
DW-2	Teller	120-foot well	10-24-91	218	14.0	5.0
DW-3	Kelley, Jr.	56-foot well	10-24-91	162	13.5	1.2
DW-4	Bauer	130-foot well	10-24-91	319	15.0	9.0
DW-5	LaDue	Spring	10-24-91	269	15.0	18
DW-6	Miller	Spring[b]	10-25-91	126	15.5	8.0/51[a]
DW-7	Vacarro	Well	10-25-91	260	19.0	1.5

[a] First value pertains to VOA, metals, and cyanide portions, which were filled first. Second value pertains to BNA and PCB/Pesticide portions that caused disturbance in spring when sampled.

[b] No drinking water source exists; therefore, sample was collected from wetland where springs on Miller property converge.

Data Source: Ecology and Environment Engineering, P.C., 1991.

Table 4-12

ORGANIC COMPOUNDS DETECTED IN PHASE I RI SURFACE WATER SAMPLES OCTOBER 2, 1991 (all values reported in µg/L)

Compound	SW-1	SW-2	SW-3	SW-4	SW-4D	SW-5	SW-6	NYSDEC Class C Surface Water Standard[a]
Volatiles	ND	ND	ND	ND	ND	ND	ND	—
Semivolatiles								
Di-n-butylphthalate	2 J	1 J	ND	2 J	ND	ND	1 J	50 G
Di-n-octylphthalate	ND	2 J	ND	ND	ND	ND	ND	50 G

[a] 6 NYCRR 703.5.

Key:

G = General organic guidance value (NYSDEC 1990a).
J = The reported value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C., 1991.

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Table 4-13

INORGANIC ANALYTES DETECTED IN PHASE I RI SURFACE WATER SAMPLES OCTOBER 2, 1991

(all values reported in µg/L except as noted)

Analyte	SW-1	SW-2	SW-3	SW-4	SW-4D[a]	SW-5	SW-6	NYSDEC Class C Surface Water Standard[e]
Aluminum	578	307	496	119 B	274	874	96.0 B	100
Barium	35.4 B	43.6 B	99.3 B	49.5 B	50.8 B	57.7 B	49.2 B	NA
Calcium	15,400	15,900	19,800	18,000	17,900	18,300	17,200	NA
Copper	ND	5.8 B	ND	ND	ND	ND	ND	7.75[b]
Iron	1,110 J	3,840 J	778 J	150 J	387 J	1,610 J	130 J	300
Lead	2.2 J	1.7 J	4.8 J	4.9 J	2.5 J	2.7 J	1.1 J	1.48 - 1.90[c]
Magnesium	4,490 B	7,200	7,010	6,600	6,600	6,800	6,360	NA
Manganese	533	3,090	143	U	U	68.5	U	NA
Nickel	ND	30.6 B	ND	ND	ND	ND	ND	65.6[d]
Potassium	2,980 B	1,770 B	1,480 B	1,430 B	1,490 B	1,790 B	1,250 B	NA
Sodium	4,170 B	22,100	8,980	14,800	14,700	15,000	13,800	NA
Vanadium	6.5 B	6.3 B	6.1 B	ND	5.5 B	5.8 B	7.3 B	14
Zinc	8.5 B	19.4 B	10.7 B	4.1 B	7.3 B	6.8 B	ND	30
Hardness (mg/L $CaCO_3$)	54	61	62	62	61	66	65	NA

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Table 4-13 (Cont.)

[a] Duplicate sample of SW-4.
[b] Standard is a function of hardness. For SW-2 only, standard is 7.75 µg/L.
[c] Standard is a function of hardness as follows: SW-1 (1.48 µg/L); SW-2 (1.72); SW-3 (1.75); SW-4 (1.75); SW-4D (1.72); SW-5 (1.90); and SW-6 (1.87 µg/L).
[d] Standard is a function of hardness. For SW-2 only, standard is 65.6 µg/L.
[e] 6 NYCRR 703.5.

Key:

B = Result is greater than IDL, but less than CRDL.
J = Reported value is estimated due to variance from quality control limits.
NA = No applicable NYS SCG.
ND = Not detected.
U = Analyte was detected in preparation blank at comparable level and is considered undetected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-14

ORGANIC COMPOUNDS DETECTED IN PHASE I RI SEDIMENT SAMPLES OCTOBER 2, 1993

(all values reported in µg/kg except as noted)

Compound	SED-1	SED-2	SED-3	SED-4	SED-4D[a]	SED-5	SED-6	Sediment Criteria[b]	Limit of Tolerance[c]
Volatiles									
Acetone	20	30	10 J	31	38	11 J	ND	NA	NA
Semivolatiles									
Butylbenzylphthalate	ND	ND	24 J	ND	ND	ND	ND	NA	NA
Organic matter (%)	7.3	6.6	3.4	5.3	5.2	3.2	3.2	NA	NA

[a] Field duplicate of sample SED-4.

[b] Geometric mean of "no-effect" and "lowest-effect" levels based on toxicity studies in benthic organisms (NYSDEC 1989b).

[c] Concentration which would be detrimental to the majority of species (NYSDEC 1989b).

Key:

J = The reported value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-15

INORGANIC ANALYTES DETECTED IN PHASE I RI SEDIMENT SAMPLES OCTOBER 2, 1991

(all values reported in mg/kg)

Analyte	SED-1	SED-2	SED-3	SED-4	SED-4D[a]	SED-5	SED-6	Sediment Criteria[b]	Limit of Tolerance[c]
Aluminum	12,800	13,000	12,400	14,500	16,900	11,200	11,000	NA	NA
Arsenic	12.7	10.9	11.0	9.6	14.3	8.1	13.5	5	33
Barium	123	97.4	175	169	202	192	129	NA	NA
Beryllium	0.81 B	0.96 B	0.89 B	0.91 B	1.1 B	0.85 B	0.85 B	NA	NA
Calcium	2,010	1,320 B	1,290	1,470 B	1,760 B	1,150 B	999 B	NA	NA
Chromium	22.5	21.3	18.5	20.9	24.4	18.5	18.3	26	111
Cobalt	26.9	27.8	26.1	24.8	29.7	27.9	25.4	NA	NA
Copper	20.5	16.0	16.0	19.8	23.0	16.7	15.7	19	114
Iron	32,400	43,200	36,000	31,600	38,400	39,000	40,200	24,000	40,000
Lead	26.1 J	20.8 J	20.7 J	20.2 J	26.7 J	3.2 J	18.9 J	27	250
Magnesium	3,900	3,630	3,720	4,270	5,010	3,660	3,510	NA	NA
Manganese	1,180	2,440	1,200	705	891	1,480	808	428	1,110
Nickel	40.1	33.4	37.7	36.2	42.2	38.1	36.0	22	90
Potassium	1,200 B	1,310 B	1,230 B	1,790 B	2,140 B	1,110 B	1,060 B	NA	NA
Sodium	ND	108 B	ND	ND	ND	ND	ND	NA	NA
Vanadium	22.8	22.1	19.7	21.4	25.3	17.5	18.2	NA	NA

Key at end of table.

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Table 4-15

INORGANIC ANALYTES DETECTED IN PHASE I RI SEDIMENT SAMPLES OCTOBER 2, 1991 (all values reported in mg/kg)

Analyte	SED-1	SED-2	SED-3	SED-4	SED-4D[a]	SED-5	SED-6	Sediment Criteria[b]	Limit of Tolerance[c]
Zinc	84.7	96.3	107	81.0	96.9	78.7	76.1	85	800

a Field duplicate of sample SED-4.

b Geometric mean of "no-effect" and "lowest-effect" levels based on toxicity studies in benthic organisms (NYSDEC 1989b).

c Concentration which would be detrimental to the majority of species (NYSDEC 1989b).

Key:

B = Result is greater than IDL, but less than CRDL.
J = Reported value is estimated due to variance from quality control limits.
NA = No applicable NYS SCG.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-16

ORGANIC COMPOUNDS DETECTED IN PHASE I RI
SURFACE SOIL SAMPLES
OCTOBER 4, 1991
(all values reported in µg/kg)

Compound	Background		SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	Background PAH Concentrations in Rural soils[b]
	SS-1	SS-2							
Volatiles									
Acetone	U	U	U	U	ND	U	U	U	
Chloromethane	ND	ND	ND	ND	ND	ND	40 J	ND	
Ethylbenzene	ND	ND	ND	ND	ND	1 J	18 J	ND	
Semivolatiles									
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	NA
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	20 - 30
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	10 - 110
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	ND	ND	10 -70
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	2 - 1,300
Bis(2-ethylhexyl)phthalate	U	U	2,100	U	U	U	U	U	NA
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	NA
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	38
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	NA
Fluoranthene	ND	ND	ND	ND	ND	ND	55 J	ND	0.3 - 40
Ideno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	10 - 15
Phenanthrene	ND	ND	ND	ND	ND	ND	46 J	ND	30
Pyrene	ND	ND	53 J	ND	ND	ND	59 J	ND	1 - 19.7

Key at end of table.

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Table 4-16

ORGANIC COMPOUNDS DETECTED IN PHASE I RI SURFACE SOIL SAMPLES OCTOBER 4, 1991 (all values reported in µg/kg)

Compound	SS-9	SS-10	SS-10D	SS-11	SS-12[a]	SS-13[a]	SS-14	Background PAH Concentrations in Rural soils[b]
Volatiles								
Acetone	ND	U	ND	240	ND	ND	U	
Chloromethane	ND	ND	ND	ND	ND	ND	ND	
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	
Semivolatiles								
Anthracene	ND	27 J	ND	ND	ND	ND	ND	NA
Benzo(b)fluoranthene	ND	67 J	ND	ND	ND	ND	140 J	20 - 30
Benzo(k)fluoranthene	ND	44 J	ND	ND	ND	ND	ND	10 - 110
Benzo(g,h,i)perylene	ND	ND	ND	ND	47 J	ND	ND	10 -70
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	88 J	2 - 1,300
Bis(2-ethylhexyl)phthalate	U	U	U	U	U	U	U	NA
Butylbenzylphthalate	ND	ND	50 J	ND	ND	260 J	ND	NA
Chrysene	40 J	100 J	ND	ND	ND	ND	48 J	38
Dibenz(a,h)anthracene	ND	ND	ND	ND	44 J	ND	ND	NA
Fluoranthene	ND	370 J	ND	ND	ND	ND	42 J	0.3 - 40
Ideno(1,2,3-cd)pyrene	ND	ND	ND	ND	45 J	ND	ND	10 - 15
Phenanthrene	ND	94 J	ND	ND	ND	ND	41 J	30
Pyrene	ND	280 J	ND	ND	ND	ND	49 J	1 - 19.7

Key at end of table.

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Table 4-16 (Cont.)

[a]Indicates results from reanalyzed sample.
[b] ATSDR 1989

Key:

J = The reported value is estimated.
NA = No applicable data provided.
ND = Not detected.
U = Compound was detected in method blank at comparable level and is considered undetected.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-17

INORGANIC ANALYTES DETECTED IN PHASE I RI
SURFACE SOIL SAMPLES
OCTOBER 4, 1991
(all values reported in mg/kg)

Analyte	Background						Common Range in Eastern U.S. Soils[b]	
	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	Observed Range	Upper Limit of 90th Percentile
Aluminum	13,100	10,400	1,030	12,300	10,300	14,300	7,000 - 100,000	128,000
Arsenic	10.3	13.5	7.3	10.0	11.9	12.6	<0.1 - 73	16.0
Barium	97.3 J	90.8 J	741 J	43.9 J	99.8 J	96.5 J	10 - 1,500	867
Beryllium	0.61 B	0.47 B	ND	0.49 B	0.52 B	0.70 B	<1 - 7	1.81
Calcium	3,390	915 B	173,000	176 B	1,070 B	925 B	100 - 280,000	14,400
Chromium	17.3	12.9	23.3	19.6	16.3	23.6	1 - 1,000	112
Cobalt	22.4	17.7	53.0	20.9	23.4	29.1	<0.3 - 70	19.8
Copper	11.3	6.6	1.5 B	18.4	17.8	28.2	<1 - 700	48.7
Iron	27,400 J	24,900 J	182,000 J	30,300 J	26,700 J	42,500 J	100 - >100,000	54,100
Lead	17.5	17.3	35.5	15.1	15.1	13.2	<10 - 300	33.0
Magnesium	2,440	1,710	2,950	3,840	3,860	5,290	50 - 50,000	10,700
Manganese	1,260 J	1,170 J	4,540 J	418 J	987 J	446 J	<2 - 7,000	1,450
Nickel	21.0	15.8	40.0	28.8	33.6	43.3	<5 - 700	38.2
Potassium	1,130 B	853 B	1,230 B	1,300	1,240 B	1,950	50 - 37,000	23,500
Sodium	90.9 B	74.8 B	1,610 B	49.1 B	40.1 B	78.8 B	<500 - 50,000	17,400
Vanadium	22.3	21.7	12.6 B	19.0	14.4	19.4	<7 - 300	140
Zinc	58.2	43.0	356	51.4	92.0	74.5	<5 - 2,900	104
Cyanide	ND	ND	ND	ND	ND	ND	NA	NA

Key at end of table.

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Table 4-17

INORGANIC ANALYTES DETECTED IN PHASE I RI
SURFACE SOIL SAMPLES
OCTOBER 4, 1991
(all values reported in mg/kg)

Analyte	SS-7	SS-8	SS-9	SS-10	SS-10D[a]	SS-11	Common Range in Eastern U.S. Soils[b]	
							Observed Range	Upper Limit of 90th Percentile
Aluminum	14,300	11,100	9,740	10,600	11,000	7,340	7,000 - 100,000	128,000
Arsenic	10.5	11.8	11.8	9.6	9.7	6.4	<0.1 - 73	16.0
Barium	135 J	105 J	84.8 J	151 J	147 J	309 J	10 - 1,500	867
Beryllium	0.71 B	0.57 B	0.49 B	0.60 B	0.56 B	ND	<1 - 7	1.81
Calcium	1,200 B	2,360	31,300	4,550	3,120	5,460	100 - 280,000	14,400
Chromium	24.0	19.3	15.9	19.8	20.0	40.4	1 - 1,000	112
Cobalt	27.5	27.1	21.1	31.6	30.1	87.3	<0.3 - 70	19.8
Copper	26.5	19.6	19.1	18.0	18.0	14.7	<1 - 700	48.7
Iron	40,200 J	45,600 J	26,300 J	60,300 J	54,300 J	283,000 J	100 - >100,000	54,100
Lead	23.8	14.5	15.6	15.8	22.4	56.1	<10 - 300	33.0
Magnesium	5,040	3,510	9,060	4,320	3,720	2,790	50 - 50,000	10,700
Manganese	374 J	548 J	1,000 J	922 J	880 J	798 J	<2 - 7,000	1,450
Nickel	39.4	32.2	26.9	34.3	33.0	88.0	<5 - 700	38.2
Potassium	1,930	1,870	1,400	1,570	1,750	2,250	50 - 37,000	23,500
Sodium	85.9 B	134 B	95.3 B	76.3 B	71.0 B	ND	<500 - 50,000	17,400
Vanadium	21.7	19.4	17.7	18.9	19.9	21.0 B	<7 - 300	140
Zinc	77.4	61.6	102	98.1	95.2	193	<5 - 2,900	104
Cyanide	ND	ND	ND	ND	ND	3.5 J	NA	NA

Key at end of table.

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Table 4-17

INORGANIC ANALYTES DETECTED IN PHASE I RI SURFACE SOIL SAMPLES OCTOBER 4, 1991 (all values reported in mg/kg)

Analyte	SS-12	SS-13	SS-14	Common Range in Eastern U.S. Soils[b]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	13,100	11,500	10,500	7,000 - 100,000	128,000
Arsenic	12.3	13.4	4.0	<0.1 - 73	16.0
Barium	87.4 J	107 J	90.8 J	10 - 1,500	867
Beryllium	0.70 B	0.71 B	0.56 B	<1 - 7	1.81
Calcium	1,680	3,110	650 B	100 - 280,000	14,400
Chromium	18.8	20.3	17.0	1 - 1,000	112
Cobalt	26.3	31.6	22.8	<0.3 - 70	19.8
Copper	12.8	17.3	11.7	<1 - 700	48.7
Iron	29,800 J	46,400 J	23,800 J	100 - >100,000	54,100
Lead	17.9	23.0	16.4	<10 - 300	33.0
Magnesium	3,120	3,700	2,920	50 - 50,000	10,700
Manganese	1,190 J	1,940 J	235 J	<2 - 7,000	1,450
Nickel	25.3	32.6	24.2	<5 - 700	38.2
Potassium	1,670	1,670	1,510	50 - 37,000	23,500
Sodium	ND	94.8 B	ND	<500 - 50,000	17,400
Vanadium	25.6	22.7	20.7	<7 - 300	140
Zinc	59.3	131	72.3	<5 - 2,900	104
Cyanide	ND	ND	ND	NA	NA

Key at end of table.

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Table 4-17 (Cont.)

[a] Field duplicate of sample SS-10.
[b] Shacklette and Boerngen 1984.

Key:

B =Result is greater than IDL, but less than CRDL.
J =Reported value is estimated due to variance from quality control limits.
NA =No applicable values given.
ND =Not detected.

Data Source: Ecology and Environment Engineering, P.C., 1991.

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Table 4-18

ORGANIC COMPOUNDS DETECTED IN PHASE I RI AND NYSDEC LEACHATE SAMPLES
(all values reported in µg/L)

Compound	October 3, 1991 L-1 (MH-4)	October 3, 1991 L-2 (PS-2)	April 22, 1992 MH-4 (NYSDEC)	NYSDEC Class C Surface Water Standard[a]
Volatiles				
Vinyl chloride	ND	ND	18	50 G
Methylene chloride	B	B	3 J	50 G
Acetone	ND	ND	17	50 G
Chlorobenzene	ND	3 J	ND	5
1,1-Dichloroethane	ND	ND	8 J	50 G
1,2-Dichloroethane	ND	ND	0.8 J	50 G
2-Butanone	ND	ND	10	50 G
1,1,1-Trichloroethane	ND	ND	1 J	50 G
1,2-Dichloroethene (total)	8	2 J	240	50 G
Trichloroethene	2 J	14	6 J	11 G
Toluene	ND	ND	8 J	50 G
Ethylbenzene	ND	ND	37	50 G
Xylenes (total)	ND	ND	2 J	50 G
Semivolatiles				
4-Methylphenol	ND	ND	3 J	5[b]
4-Chloro-3-methylphenol	ND	4 J	ND	1[c]
1,4-Dichlorobenzene	ND	1 J	ND	5[d]
Diethylphthalate	ND	ND	0.9 J	50 G
Di-n-butylphthalate	ND	2 J	ND	50 G
Naphthalene	ND	1 J	ND	50 G
N-Nitrosodiphenylamine	ND	1 J	ND	50 G

Key at end of table.

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Table 4-18 (Cont.)

[a] 6 NYCRR 703.5.
[b] Applies to total of unchlorinated phenols.
[c] Applies to total of chlorinated phenols.
[d] Applies to sum of meta, ortho, and para isomers.

Key:

B = Compound was detected in the preparation blank and is therefore considered undetected.
G = Guidance value (NYSDEC 1990a).
J = Reported value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Data Sources: Ecology and Environment, P.C. 1991; NYSDEC 1992a.

Table 4-19

INORGANIC ANALYTES DETECTED IN PHASE I RI AND NYSDEC LEACHATE SAMPLES
(all values reported in µg/L except as noted)

Analyte	October 3, 1991 L-1 (MH-4)	October 3, 1991 L-2 (PS-2)	April 22, 1992 MH-4 (NYSDEC)	NYSDEC Class C Surface Water Standard[a]
Aluminum	27,600 J	774 J	203	100
Arsenic	12.5 J	R	ND	190
Barium	406	577	148 J	NA
Beryllium	0.96 J	ND	ND	1,100
Calcium	191,000	123,000	116,000	NA
Chromium	39.9	15.2	11.0	962 / 791 / 604[b]
Cobalt	58.4	55.4	ND	5
Copper	35.2	8.0 J	10.5 J	58.8 / 47.9 / 36.2[b]
Iron	71,900	165,000	16,700	300
Lead	47.9 J	27.2 J	ND	34.6 / 25.6 / 16.9[b]
Magnesium	42,800	50,300	19,500	NA
Manganese	3,670	1,880	2,420	NA
Nickel	54.5	38.8 J	42.5	398 / 332 / 258[b]
Potassium	50,700	33,400	6,830	NA
Sodium	33,600	71,500	11,700	NA
Vanadium	52.2	11.6 J	ND	14
Zinc	151 J	227 J	10.0 J	30
Hardness (mg/L $CaCO_3$)[c]	653	514	370	NA

[a] 6 NYCRR 703.5.
[b] Standard is a function of hardness. First value is for L-1, second is for L-2, and third is for MH-4 (NYSDEC).
[c] Hardness was calculated from reported concentrations of Ca^{2+} and Mg^{2+} (Freeze and Cherry 1979).

Key:

J = Reported value is estimated.
R = Reported value is unusable due to variance from quality control limits.
NA = No applicable NYS SCG.
ND = Not detected.

Data Source: Ecology and Environment, P.C. 1991; NYSDEC 1992a.

Table 4-20

RESULTS OF PHASE I RI LEACHATE COLLECTION SYSTEM AIR MONITORING SURVEY

Manhole/Riser	9-30-91			12-17/18-91
	HNu (ppm)	OVA (ppm)	Draeger Tube[a] (ppm)	HNu (ppm)
MH-1	0	>1,000	0	0
MH-2	NA	NA	NA	NA
MH-3	3	>1,000	3	6 - 8
MH-4	1.2	120	0	0
MH-5	0	>1,000	0	25
MH-6	<1	>1,000	0	92
MH-7	<1	>1,000	0	73
MH-8	NA	NA	NA	NA
MH-9	NA	NA	NA	NA
MH-10	<1	>1,000	0	40
MH-11	<1	>1,000	0	1.5
MH-12	0	250	0	0
MH-13	0	>1,000	0	0
MH-14	0	>1,000	0	0
MH-15	<1	>1,000	0	0
MH-16	<1	>1,000	0	0
MH-17	<1	>1,000	0	0
MH-18	NA	NA	NA	0
MH-19	NA	NA	NA	0
R-1	3	0[b]	0	6
R-2	7	>1,000	0	18 - 22
R-3	0	100	0	NA
R-4	0	30	0	15
R-5	0	250	0	0
R-6	0	>1,000	0	0
R-7	0	350	0	20
R-8	0	>1,000	0	0
R-9	0	20	0	2

Key at end of table.

Table 4-20

RESULTS OF PHASE I RI LEACHATE COLLECTION SYSTEM AIR MONITORING SURVEY

Manhole/Riser	9-30-91			12-17/18-91
	HNu (ppm)	OVA (ppm)	Draeger Tube[a] (ppm)	HNu (ppm)
R-10	<1	400	0	125
R-11	<1	>1,000	0	100
R-12	<1	150	0	5
R-13	<1	10	0	6
R-14	<1	35	0	0
R-15	0	>1,000	0	0
R-16	11	>1,000	11	0
R-17	0	>1,000	0	0
R-18	0	>1,000	0	0
R-19	0	3	0	4 - 5
R-20	0	0	0	NA
R-21	0	>1,000	0	0
R-22	0	>1,000	0	0
R-23	0	>1,000	0	NA
Pump Station 2	34	>1,000	0	0
Pump Station 1				
Sump	0	300	0	NA
Tank No. 1	<1	180	0	NA
Tank No. 2	<1	100	0	NA

[a] Draeger tube for vinyl chloride (numerous chlorinated alkenes interfere and are also detected).

[b] Questionable data due to instrument malfunction.

Key:

NA = Data not acquired due to equipment malfunction or manhole not located.

Data Source: Ecology and Environment Engineering, P.C. 1991.

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Table 4-21

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE I RI
AIR SAMPLES
DECEMBER 19, 1991

Compound	Amount Detected (ppbv)							
	A-1 (MH-10)	A-2 (R-10)	A-3 (MH-6)	A-4 (MH-15)	A-5 (R-2)	A-6[a] (R-2)	A-7 (MH-3)	A-8[b] (Blank)
Benzene	ND	240	ND	ND	150	76	ND	ND
Chloroethane	ND	ND	ND	820	74	46	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	3.6
1,1-Dichloroethane	1,700	1,400	ND	55	6.9	ND	ND	ND
cis-1,2-Dichloroethene	55,000	87,000 E	100,000	190	4.6	ND	16,000	ND
Ethylbenzene	15,000	7,700	21,000	7,900 E	26	11	5,600	ND
Freon®11	ND	210	ND	180	ND	ND	ND	ND
Freon®12	ND	2,700	ND	1,500	16	7.2	ND	ND
Freon®113	ND	ND	ND	ND	ND	ND	ND	2.8
Freon®114	ND	ND	ND	980	3.8	ND	ND	ND
Methylene chloride	ND	860	ND	ND	ND	ND	ND	1.6
1,2,4-Trichlorobenzene	ND	ND	ND	ND	3.8	ND	ND	ND
1,1,1-Trichloroethane	2,300	800	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	390	ND	ND	4.4	ND	ND	ND
1,2-4-Trimethylbenzene	ND	ND	ND	34	ND	ND	ND	ND
Toluene	5,300	4,200	8,600	520	5.7	ND	1,500	ND

Key at end of table.

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Table 4-21

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE I RI AIR SAMPLES DECEMBER 19, 1991

Compound	Amount Detected (ppbv)							
	A-1 (MH-10)	A-2 (R-10)	A-3 (MH-6)	A-4 (MH-15)	A-5 (R-2)	A-6[a] (R-2)	A-7 (MH-3)	A-8[b] (Blank)
Vinyl chloride	12,000	9,700	1,700	1,300	16	6.6	2,600	ND
m,p-Xylene	1,800	370	ND	1,600	46	21	990	ND
o-Xylene	ND	ND	ND	290	6.4	3.2	ND	ND
MDL[c]	1,400	210	3,700	28	3.7	3.0	310	1.0

[a] Field duplicate of sample A-5.
[b] Blank consisting of purified nitrogen.
[c] Minimal detection limit.

Key:

E = Exceeds instrument calibration range, but within linear range.
ND = Not detected.
ppbv = Parts per billion by volume.

Data Source: Air Toxics Ltd. 1992.

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Table 4-22

VERTICAL HYDRAULIC GRADIENTS

Well Pair	November 1991 i_v	September 1993 i_v
MW-2S/2D	0.81	0.77
MW-3S/3D	0.31	0.29
MW-5S/5D	0.01	0.02
MW-5D/5VD	—	1.04
MW-6S/6D	0.44	0.48
MW-8S/8D	—	0.58
MW-9S/9D	0.48	0.48
MW-10S/10D	0.58	0.70
MW-13S/13D	—	0.46
MW-15S/15D	—	1.00
MW-16S/16D	—	0.66

Note: A positive gradient indicates downward flow.

Data Source: Ecology and Environment Engineering, P.C. 1993.

Table 4-23

HORIZONTAL HYDRAULIC AND TOPOGRAPHIC GRADIENTS

Wells	September 1991 i_h	November 1991 i_h	Topographic Gradient
MW-1D/7D	0.04	0.04	0.05
MW-1D/3D	0.03	0.02	0.06
MW-1D/10D	0.03	0.03	0.05
MW-1D/2D	0.03	0.03	0.05
MW-1D/16D	—	0.05	0.06
MW-6D/7D	0.10	0.10	0.07
MW-7D/16D	—	0.11	0.11
MW-2D/4D	-0.01	-0.01	0.05
MW-2D/13D	—	0.07	0.11
PZ-7/10	—	0.06	0.05
PZ-11/14	—	0.04	0.06
MW-2S/16S	—	0.07	0.07
MW-5S/16S	—	0.08	0.08

Notes: A positive gradient indicates a slope downward from the first well listed to the second (generally down to the south). A negative gradient indicates a slope upward from the first well listed to the second (generally down to the north).

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-24

SUMMARY OF AQUIFER TEST RESULTS
AUGUST 15 AND 16, 1993

Well ID	Total Depth of Well (feet TOIC)	Depth to Water (feet TOIC)	Slug Test Method	Analytical Program	Solution Method	Hydraulic Conductivity (cm/s)	Transmissivity (cm^2/s)
MW-1D	77.61	69.35	Withdrawal	Slugix	Bouwer & Rice	2.2×10^{-5}	6.7×10^{-3}
MW-2D	61.79	51.61	Withdrawal	Slugix	Cooper *et al.*	1.1×10^{-2}	3.4
MW-2S	11.75	9.22	Withdrawal	Slugix	Bouwer & Rice	5.9×10^{-5}	9.0×10^{-3}
MW-3D	43.58	11.40	Injection	GWAP	Cooper *et al.*	2.6×10^{-5}	8.0×10^{-3}
MW-3S	21.47	4.78	Injection	Slugix	Bouwer & Rice	2.3×10^{-6}	6.9×10^{-4}
MW-4D	24.73	10.41	Injection	Slugix	Bouwer & Rice	2.6×10^{-4}	7.8×10^{-2}
			Withdrawal	Slugix	Bouwer & Rice	1.8×10^{-4}	5.4×10^{-2}
MW-5D	38.80	2.31	Injection	Slugix	Bouwer & Rice	2.3×10^{-4}	7.1×10^{-2}
MW-5S	22.50	2.58	Injection	Slugix	Bouwer & Rice	1.4×10^{-4}	4.3×10^{-2}
MW-5VD	112.20	79.65	Injection	GWAP	Cooper *et al.*	3.5×10^{-4}	0.21
MW-6D	30.50	18.56	Withdrawal	Slugix	Bouwer & Rice	2.3×10^{-5}	6.9×10^{-3}
MW-6S	16.0	11.62	Withdrawal	Slugix	Bouwer & Rice	6.0×10^{-5}	1.8×10^{-2}
MW-7D	48.07	32.51	Injection	Slugix	Bouwer & Rice	4.1×10^{-5}	1.2×10^{-2}
MW-8D[a]	72.51	39.66	Injection	—	—	—	—
MW-8S	18.70	8.64	Injection	Slugix	Bouwer & Rice	1.9×10^{-5}	5.8×10^{-3}
MW-9D	48.24	24.49	Injection	Slugix	Cooper *et al.*	4.6×10^{-4}	0.14
				GWAP	Cooper *et al.*	5.2×10^{-4}	0.16
MW-9S	21.87	12.04	Withdrawal	Slugix	Bouwer & Rice	2.1×10^{-5}	6.3×10^{-3}

Key at end of table.

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Table 4-24

SUMMARY OF AQUIFER TEST RESULTS
AUGUST 15 AND 16, 1993

Well ID	Total Depth of Well (feet TOIC)	Depth to Water (feet TOIC)	Slug Test Method	Analytical Program	Solution Method	Hydraulic Conductivity (cm/s)	Transmissivity (cm^2/s)
MW-10D	45.72	24.53	Injection	Slugix	Bouwer & Rice	3.2×10^{-5}	9.8×10^{-3}
				Slugix	Cooper *et al.*	6.9×10^{-5}	2.1×10^{-2}
MW-10S	26.84	11.74	Injection	Slugix	Bouwer & Rice	1.9×10^{-5}	5.8×10^{-3}
MW-11S	20.46	4.82	Injection	Slugix	Bouwer & Rice	2.0×10^{-4}	6.2×10^{-2}
MW-16D	52.42	30.66	Injection	Slugix	Cooper *et al.*	1.2×10^{-4}	3.6×10^{-2}
				GWAP	Cooper *et al.*	4.9×10^{-4}	1.5×10^{-1}
MW-16S	18.69	8.45	Injection	Slugix	Bouwer & Rice	1.2×10^{-5}	3.7×10^{-3}
CW-3A[a]	27.44	8.33	Injection	—	—	—	—
CW-3B	38.01	11.75	Injection	Slugix	Bouwer & Rice	1.4×10^{-4}	2.1×10^{-2}
				Slugix	Cooper *et al.*	1.2×10^{-4}	1.7×10^{-2}
CW-4A	19.31	2.76	Injection	Slugix	Bouwer & Rice	4.4×10^{-5}	6.7×10^{-3}
CW-4B	30.25	2.95	Injection	Slugix	Bouwer & Rice	1.8×10^{-5}	2.8×10^{-3}

[a] Due to equipment malfunction, no useful data were collected for wells MW-8D and CW-3A.

Key:

TOIC = Measurements taken from top of inner casing.

Sources: Ecology and Environment Engineering, P.C. 1993; Slugix Software by Interpex 1988; GWAP Software by Groundwater Graphics 1987; Bouwer & Rice 1976; Cooper *et al.* 1967.

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Table 4-25

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 THROUGH SEPTEMBER 16, 1993

(all values reported in µg/L)

Compound	MW2-1D	MW2-2D	MW2-2S	MW2-3D	MW2-3S	MW2-4D	MW2-5D
Benzene	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	3 J
1,1-Dichloroethene	ND	2 J	ND	ND	ND	ND	3 J
1,2-Dichloroethene (total)	ND	870 J	ND	ND	ND	35	1,800
Ethylbenzene	ND	ND	ND	ND	ND	ND	11
Toluene	ND	ND	ND	ND	ND	ND	6 J
1,1,1-Trichloroethane	ND	2 J	ND	ND	ND	ND	3 J
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	160	ND	ND	ND	17	130
Vinyl chloride	ND	230 J	ND	ND	ND	8 J	920

Key at end of table.

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Table 4-25

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 THROUGH SEPTEMBER 16, 1993

(all values reported in µg/L)

Compound	MW2-5S	MW2-5SD[a]	MW2-5VD	MW2-6D	MW2-6S	MW2-7D	MW2-8D
Benzene	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	9 J	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	8 J	9 J	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	4,200	4,400	ND	390	13	ND	ND
Ethylbenzene	4 J	5 J	ND	ND	ND	ND	ND
Toluene	9 J	11	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	6 J	6 J	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	1 J	2 J	ND	ND	ND	ND	ND
Trichloroethene	270	280	ND	8 J	ND	ND	ND
Vinyl chloride	1,700	1,800	ND	220	ND	ND	ND

Key at end of table.

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Table 4-25

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 THROUGH SEPTEMBER 16, 1993

(all values reported in µg/L)

Compound	MW2-8S	MW2-9D	MW2-9S	MW2-10D	MW2-10S	MW2-11S	MW2-12D
Benzene	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	13	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	9 J	ND
1,2-Dichloroethene (total)	ND	ND	ND	3 J	ND	390	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	5 J	ND	1,800	ND
Vinyl chloride	ND	ND	ND	ND	ND	140	ND

Key at end of table.

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Table 4-25

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 THROUGH SEPTEMBER 16, 1993

(all values reported in µg/L)

Compound	MW2-13D	MW2-13S	MW2-14D	MW2-15DA[c]	MW2-15S	MW2-16D	MW2-16S
Benzene	ND	ND	ND	14	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	ND	ND	43	43	57	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	7 J	6 J	15	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

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Table 4-25

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 THROUGH SEPTEMBER 16, 1993

(all values reported in µg/L)

Compound	CW2-3A	CW2-3B	CW2-3BD[a]	CW2-4A	CW2-4B	NYSDEC Class GA Groundwater Standard[b]
Benzene	ND	ND	ND	ND	ND	0.7
Chloroethane	ND	ND	ND	ND	ND	5
1,1-Dichloroethane	ND	ND	ND	ND	ND	5
1,1-Dichloroethene	ND	ND	ND	ND	ND	5
1,2-Dichloroethene (total)	7 J	12	13	3 J	ND	5
Ethylbenzene	ND	ND	ND	ND	ND	5
Toluene	1 J	ND	ND	ND	ND	5
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	5
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	5
Trichloroethene	160	ND	ND	ND	ND	5
Vinyl chloride	ND	33	35	ND	ND	2

[a] Field duplicate.
[b] 6 NYCRR 703.5
[c] Collected 8-3-93 prior to purging the well.

Key:

J = The associated numerical value is estimated.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-26

INORGANIC ANALYTES DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 AND 30, 1993 (all values reported in µg/L)

Analyte	MW2-1D	MW2-2D	MW2-2S	MW2-3D	MW2-3S	MW2-4D	MW2-5D	MW2-5S
Aluminum	72.2 J	6,520 J	35,100 J	1,160 J	5,980 J	741 J	2,120 J	1,770 J
Arsenic	1.7 J	11.8	7.0 J	3.9 J	3.9 J	1.2 J	7.4 J	2.3 J
Barium	266	191 J	367	116 J	99.4 J	19.9 J	94.2 J	23.4 J
Beryllium	ND	ND	2.3 J	ND	ND	ND	ND	ND
Cadmium	ND	ND	4.7 J	ND	ND	ND	ND	ND
Calcium	26,000	88,800	39,800	63,800	39,000	16,700	20,700	16,900
Chromium	ND	13.2	113	ND	18.3	ND	ND	ND
Cobalt	ND	9.0 J	58.0	ND	9.3 J	ND	ND	ND
Copper	2.6 J	14.5 J	149	4.2 J	18.3 J	ND	B	2.6 J
Iron	317	16,400	77,900	2,520	13,300	1,340	3,250	2,030
Lead	ND	7.1	30.7	3.2	5.0	1.3 J	2.0 J	1.9 J
Magnesium	9,190	29,000	45,500	38,700	27,600	15,600	15,100	13,300
Manganese	188	3,900	5,440	43.6	1,350	29.4	2,350	426
Nickel	ND	16.5 J	124	ND	21.3 J	ND	ND	ND
Potassium	2,810 J	7,360	9,550 J	5,070	4,660 J	2,050 J	2,800 J	2,280 J
Sodium	5,900	15,600	25,600 J	28,400 J	26,200 J	12,400	7,290	7,850
Vanadium	ND	8.9 J	46.6 J	ND	9.1 J	ND	ND	ND
Zinc	4.2 J	107	216	32.3	231	13.0 J	39.8	40.6
Cyanide	ND	ND	ND	21.0	ND	53.0	ND	ND

Key at end of table.

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Table 4-26

INORGANIC ANALYTES DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 AND 30, 1993 (all values reported in µg/L)

Analyte	MW2-5SD[a]	MW2-5VD	MW2-6D	MW2-6S	MW2-7D	MW2-8D	MW2-8S	MW2-9D
Aluminum	1,240 J	41.1 J	502 J	5,040 J	30.8 J	51,300 J	22,700 J	184 J
Arsenic	2.3 J	ND	1.0 J	2.9 J	ND	45.5 J	28.3	1.2 J
Barium	22.1 J	36.5 J	34.4 J	37.3 J	14.0 J	1,470 J	251	30.0 J
Beryllium	ND	ND	ND	ND	ND	3.2 J	1.2 J	ND
Cadmium	ND	ND	ND	ND	ND	10.8 J	3.7 J	ND
Calcium	16,700	48,800	20,700	9,430	33,200	173,000 J	75,800	27,900
Chromium	ND	ND	ND	5.2 J	ND	291 J	50.8	ND
Cobalt	ND	ND	ND	ND	ND	109 J	34.5 J	ND
Copper	3.4 J	ND	ND	8.5 J	ND	208 J	48.3	ND
Iron	2,170	208	1,110	8,490	143	131,000 J	51,700	309
Lead	1.8 J	ND	5.5	8.2	ND	110 J	24.0	1.6 J
Magnesium	13,300	19,100	14,500	8,570	22,800	71,500 J	56,500	15,800
Manganese	437	334	1,070	297	42.0	7,570 J	3,450	99.8
Nickel	ND	ND	ND	17.1 J	ND	366 J	61.6	ND
Potassium	2,580 J	2,390 J	1,110 J	1,760 J	2,130 J	18,500 J	7,140	5,720
Sodium	7,740	8,550	6,710	6,000	19,600 J	44,400 J	29,800	15,200
Vanadium	ND	ND	ND	ND	ND	57.8 J	29.3 J	ND
Zinc	53.0	26.0	18.0 J	137	4.1 J	549 J	196	51.7
Cyanide	ND	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

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Table 4-26

INORGANIC ANALYTES DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 AND 30, 1993 (all values reported in µg/L)

Analyte	MW2-9S	MW2-10D	MW2-10S	MW2-11S	MW2-12D	MW2-13D	MW2-14D	MW2-16D
Aluminum	808 J	207 J	1,490 J	192 J	1,390 J	3,790 J	1,280 J	306 J
Arsenic	1.5 J	1.7 J	3.9 J	ND	2.9 J	3.7 J	1.7 J	ND
Barium	44.0 J	250	144 J	30.4 J	14.7 J	79.5 J	48.8 J	31.7 J
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	52,800	38,400	11,800	45,700	10,100	14,100	16,000	47,300
Chromium	6.7 J	ND	6.5 J	ND	ND	ND	ND	ND
Cobalt	ND	ND	5.3 J	ND	ND	4.4 J	ND	ND
Copper	B	B	B	ND	B	B	76.5	52.7
Iron	1,910	438	4,120	275	2,560	6,760	2,240	606
Lead	3.1	ND	2.1 J	ND	13.5	2.7 J	1.4 J	ND
Magnesium	30,000	9,160	5,340	27,100	8,250	4,260 J	15,500	23,100
Manganese	133	398	3,910	844	60.8	155	93.7	179
Nickel	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	4,430 J	2,390 J	2,040 J	832 J	1,260 J	2,390 J	1,690 J	1,660 J
Sodium	20,100	5,690	4,750 J	15,000	3,250 J	3,500 J	8,780	17,000
Vanadium	ND	ND	ND	ND	ND	4.2 J	ND	ND
Zinc	48.9	52.2	69.2	91.7	32.1	43.9	30.0	32.6
Cyanide	ND	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

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Table 4-26

INORGANIC ANALYTES DETECTED IN PHASE II RI GROUNDWATER SAMPLES JULY 29 AND 30, 1993 (all values reported in µg/L)

Analyte	MW2-16S	CW2-3A	CW2-3B	CW2-3BD[a]	CW2-4A	CW2-4B	NYSDEC Class GA Groundwater Standard[c]
Aluminum	695 J	1,200 J	8,390 J	25,600 J	3,410 J	800 J	NA
Arsenic	ND	3.3 J	3.0 J	4.3 J	2.5 J	2.4 J	25
Barium	59.9 J	37.7 J	103 J	256	151 J	199 J	1,000
Beryllium	ND	ND	ND	1.7 J	ND	ND	3 G
Cadmium	ND	ND	ND	4.4 J	ND	3.4 J	10
Calcium	25,400	30,800	70,200	78,400	65,700	60,900	NA
Chromium	ND	ND	14.4	42.4	ND	ND	50
Cobalt	ND	ND	9.6 J	27.1 J	6.2 J	ND	NA
Copper	208	7.2 J	16.8 J	42.4	6.4 J	2.5 J	200
Iron	1,020	2,010	18,900	54,600	6,540	1,750	300[b]
Lead	ND	484	8.4	17.2	3.8	2.3 J	25
Magnesium	13,400	1,510 J	38,900	46,100	31,100	26,800	35,000 G
Manganese	81.8	44.4	129	367	4,230	2,700	300[b]
Nickel	ND	ND	21.0 J	51.1	11.6 J	ND	NA
Potassium	2,680 J	42,100 J	4,870 J	9,070 J	3,490 J	3,420 J	NA
Sodium	18,600	49,200 J	21,600 J	22,400 J	24,700 J	28,800 J	20,000
Vanadium	ND	7.2 J	12.3 J	38.0 J	6.8 J	ND	NA
Zinc	28.2	48.0	92.2	147	39.0	34.4	300
Cyanide	ND	ND	ND	ND	41.0	160	100

Key at end of table.

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Table 4-26 (Cont.)

[a] Field duplicate.
[b] Total concentration of iron and manganese shall not exceed 500 µg/L.
[c] 6 NYCRR 703.5.

Key:

B = Analyte was detected in preparation blank at a comparable level and is considered undetected.
G = Guidance value (NYSDEC 1990a).
J = The associated numerical value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-27

PHASE II RI GROUNDWATER SAMPLE PARAMETERS

Sample Number	Date	pH	Temperature (°F)	Conductivity (μS/cm)	Turbidity[a] (NTU)	Analyses Performed
MW2-1D	7-29-93	7.62	63.0	216	40.5	A
MW2-2D	7-29-93	8.21	63.6	350	198	A and B
MW2-2S	7-29-93	NA	NA	NA	>200	A
MW2-3D	7-29-93	8.40	65.8	570	29	A
MW2-3S	7-29-93	7.35	66.2	516	95	A
MW2-4D	7-29-93	6.12	63.7	299	51	A
MW2-5D	7-29-93	6.40	59.5	289	92	A and B
MW2-5S	7-29-93	6.07	63.5	261	53	A and B
MW2-5VD	7-29-93	7.27	58.5	504	18	A
MW2-6D	7-29-93	6.55	58.1	233	26	A
MW2-6S	7-29-93	5.99	57.3	118	~300	A
MW2-7D	7-29-93	6.84	60.2	437	7	A
MW2-8D	7-29-93	9.90	58.0	385	~1,000	A
MW2-8S	7-29-93	6.76	58.7	784	~500	A
MW2-9D	7-30-93	7.35	56.8	323	18	A
MW2-9S	7-30-93	7.26	54.9	513	50	A
MW2-10D	7-30-93	8.72	54.1	204	21	A
MW2-10S	7-30-93	6.16	60.3	139	86	A
MW2-11S	7-29-93	6.61	61.9	527	8	A and B
MW2-12D	7-30-93	6.30	56.9	129	65	A
MW2-13D	7-30-93	6.06	56.9	114	175	A
MW2-13S	9-16-93	NA	NA	NA	NA	C
MW2-14D	7-30-93	5.99	54.9	232	71	A
MW2-15DA[b]	8-3-93	7.45	NA	825	NA	C
MW2-15S	9-16-93	NA	NA	NA	NA	C
MW2-16D	7-29-93	7.03	59.1	428	20	A
MW2-16S	7-29-93	6.85	57.6	297	68	A

Key at end of table.

Table 4-27

PHASE II RI GROUNDWATER SAMPLE PARAMETERS

Sample Number	Date	pH	Temperature (°F)	Conductivity (μS/cm)	Turbidity[a] (NTU)	Analyses Performed
CW2-3A	7-29-93	11.55	65.5	1,010	50	A
CW2-3B	7-29-93	6.55	58.2	684	>200	A and B
CW2-4A	7-29-93	6.10	63.9	721	155	A
CW2-4B	7-29-93	6.17	63.9	676	61	A

a The turbidity of the sample was measured from the portion for metals analysis.
b Due to the small amount of water in the well, this sample was collected without prior purging.

Key:

A = TCL VOCs and inorganics.
B = TSS, BOD_5, BOD_{28}, TKN, and COD.
C = TCL VOCs only.
NA = Data not acquired.

Data Source: Ecology and Environment Engineering, P.C. 1993.

Table 4-28

PHASE II RI GROUNDWATER WET CHEMISTRY DATA
JULY 29 AND 30, 1993
(all values reported in mg/L)

Sample	BOD_5	BOD_{28}	COD	TKN	TSS
MW2-2D	ND	6.5	6.2	ND	120
CW2-3B	11	40	8.6	ND	130
MW2-5D	ND	ND	ND	ND	53
MW2-5S	ND	32	8.6	0.46	200
MW2-5SD[a]	ND	3.9	13	0.43	25
MW2-11S	2.8	15	ND	ND	9.0

[a] Field duplicate of MW2-5S.

Key:

ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-29

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLES JULY 29 THROUGH SEPTEMBER 15, 1993
(all values reported in µg/L)

Compound	DW2-1 Rosini	DW2-2 Teller	DW2-3 Kelley, Jr.	DW2-5D[d] LaDue	DW2-5A[d] LaDue	DW2-6 Miller	DW2-8 D'Ovidio	DW2-9 Cornell	DW2-10 R. Fanton	DW2-11 Geffers	DW2-12 Green
Acetone[a]	ND	16 J	ND	ND	ND	ND	ND	NA	NA	19 J	ND
1,2-Dichloroethane[b]	ND	ND	ND	ND	ND	ND	ND	NA	NA	ND	ND
Trichloroethene	ND	ND	ND	6.2	5.1	ND	ND	NA	NA	ND	ND
Carbon disulfide[a]	ND	B	ND	ND	ND	ND	ND	NA	NA	ND	ND

Key at end of table.

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Table 4-29

VOLATILE ORGANIC COMPOUNDS DETECTED IN PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLES JULY 29 THROUGH SEPTEMBER 15, 1993

(all values reported in µg/L)

Compound	DW2-13 Schettine	DW2-14 Fletcher	DW2-15 Whispell	DW2-16 Ormsby	DW2-17 J. Fanton	DW2-18 Dodge	DW2-19 Gephart	DW2-20 Urban	DW2-21 Meisenzahl	NYSDOH MCL[c]	NYSDEC Class GA Groundwater Standard[e]
Acetone[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	50	50 G
1,2-Dichloroethane[b]	ND	ND	ND	ND	ND	ND	ND	1.0	ND	5	5
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	5
Carbon disulfide[a]	ND	ND	ND	ND	ND	ND	ND	ND	0.4 J	50	50 G

a While not detected in the method or field blanks for these samples, the presence of these compounds is highly suspected to be the result of laboratory or preservation contamination.
b Since this compound has not been detected on site, it is suspected to be a laboratory artifact.
c Maximum contaminant level for public water supplies per 10 NYCRR 5-1.52.
d Sample DW2-5D was collected from the outdoor spigot at the house, while DW2-5A was collected directly from the spring overflow.
e 6 NYCRR 703.5.

Key:

B = Compound was detected at a comparable level in the trip and field blanks and is therefore considered undetected.
G = General organic guidance value (NYSDEC 1990a).
J = The associated numerical value is estimated.
NA = Not analyzed for TCL organics.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-30

INORGANIC ANALYTES DETECTED IN PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLES JULY 29 THROUGH SEPTEMBER 15, 1993

(all values reported in µg/L)

Analyte	DW2-1 Rosini	DW2-2 Teller	DW2-3 Kelley, Jr.	DW2-5 LaDue	DW2-5D[a] LaDue	DW2-6 Miller	DW2-8 D'Ovidio	DW2-9 Cornell
Aluminum	ND	B	B	B	B	335	B	ND
Antimony	ND	ND	39.7 J	ND	ND	ND	ND	ND
Arsenic	ND	1.8 J	ND	ND	ND	7.5 J	5.2 J	ND
Barium	32.8 J	73.2 J	67.6 J	23.2 J	23.2 J	32.1 J	135 J	100 J
Calcium	44,600 J	38,800	22,600	48,300	44,100	14,800	40,700	25,600
Copper	5.3 J	ND	29.1	14.4 J	6.6 J	3.2 J	4.4 J	2.2 J
Iron	1,380 J	B	64.0 J	74.8 J	B	5,060	592	B
Lead	2.0 J	ND	ND	B	B	B	B	B
Magnesium	15,700 J	14,300	6,610	21,600	20,200	9,050	18,300	6,480
Manganese	838 J	146	ND	3.7 J	2.6 J	1,640	112	ND
Mercury	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	1,910 J	1,080 J	1,150 J	1,640 J	1,480 J	711 J	1,680 J	1,090 J
Selenium	1.7 J	ND	ND	ND	ND	ND	ND	ND
Sodium	38,800 J	7,970	20,600	8,720	8,000	3,290 J	6,950	6,910
Zinc	5.4 J	66.5	17.0 J	53.9	35.8	8.2 J	12.7 J	ND
Cyanide	84.0	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

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Table 4-30

INORGANIC ANALYTES DETECTED IN PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLES JULY 29 THROUGH SEPTEMBER 15, 1993
(all values reported in µg/L)

Analyte	DW2-10 R. Fanton	DW2-11 Geffers	DW2-12 Green	DW2-13 Schettine	DW2-14 Fletcher	DW2-15 Whispell	DW2-16 Ormsby	DW2-17 J. Fanton
Aluminum	ND	B	ND	B	B	B	313	ND
Antimony	ND	ND	ND	35.6 J	ND	ND	ND	ND
Arsenic	ND	ND	1.5 J	ND	ND	ND	ND	ND
Barium	31.5 J	60.7 J	31.3 J	86.7 J	23.1 J	25.0 J	30.1 J	38.1 J
Calcium	16,100	21,400	24,900	31,000	24,700	10,300	34,100	25,800
Copper	243	10.3 J	ND	9.7 J	2.6 J	75.2	2,070	6.2 J
Iron	1,590	77.7 J	127	B	103	B	347	B
Lead	12.5 J	B	20.1	B	ND	B	B	B
Magnesium	5,640	7,770	9,320	10,900	8,250	4,310 J	14,900	8,920
Manganese	2,050	98.3	53.5	176	89.5	ND	17.6	14.5 J
Mercury	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	996 J	1,060 J	1,170 J	1,290 J	1,420 J	556 J	1,420 J	1,560 J
Selenium	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	18,300	85,900 J	84,300	43,100	110,000	2,980 J	6,200	91,500
Zinc	17.9 J	31.2	47.8	22.5	5.5 J	ND	339	19.5 J
Cyanide	ND	ND	ND	ND	ND	ND	10.0	ND

Key at end of table.

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Table 4-30

INORGANIC ANALYTES DETECTED IN PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLES
JULY 29 THROUGH SEPTEMBER 15, 1993
(all values reported in µg/L)

Analyte	DW2-18 Dodge	DW2-19 Gephart	DW2-20 Urban	DW2-21 Meisenzahl	NYSDOH MCL[b]	NYSDEC Class GA Groundwater Standard[c]
Aluminum	B	ND	925	26.0 J	NA	NA
Antimony	ND	ND	ND	ND	NA	NA
Arsenic	ND	ND	ND	ND	50	25
Barium	31.4 J	34.5 J	21.3 J	62.5 J	1,000 P	1,000
Calcium	23,800	39,200	5,890	29,900	NA	NA
Copper	54.4	2.6 J	61.0	ND	1,000 S	200
Iron	294	500	10,600	24.6 J	300[c] S	300[c]
Lead	B	B	6.8	ND	50 P	25
Magnesium	8,720	17,800	3,060 J	9,650	NA	35,000 G
Manganese	64.9	174	107	87.6	300[c] S	300[c]
Mercury	ND	ND	0.29	ND	2 P	2
Potassium	1,650 J	1,980 J	1,200 J	2,210 J	NA	NA
Selenium	ND	ND	ND	ND	10	10
Sodium	102,000	43,000	1,620 J	48,500	NA[d]	20,000
Zinc	21.4	212	471	11.7 J	5,000 S	300
Cyanide	ND	ND	ND	ND	NA	100

Key at end of table.

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Table 4-30 (Cont.)

[a] Field duplicate of DW2-5.
[b] Maximum contaminant level for public water supplies per 10 NYCRR 5-1.52.
[c] Total concentration of iron and manganese shall not exceed 500 µg/L.
[d] Water containing >20,000 µg/L of sodium should not be used for drinking by people on severely restricted sodium diets. Water containing >270,000 µg/L of sodium should not be used for drinking by people on moderately restricted sodium diets (10 NYCRR 5-1.52).
[e] 6 NYCRR 703.5.

Key:

B = Analyte was detected in preparation blank at a comparable level and is therefore considered undetected.
G = Guidance Value (NYSDEC 1990a).
J = The associated numerical value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-31

PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLE PARAMETERS

Sample	Owner	Type	Sample Date	pH	Conductivity (µS/cm)	Temperature (°F)	Turbidity (NTU)
DW2-1	R. Rosini	150-foot well	7-29-93	NA	NA	NA	NA
DW2-2	R. Teller	120-foot well	8-2-93	7.42	312	63.3	0.8
DW2-3	F. Kelley, Jr.	56-foot well	8-2-93	6.92	229	64.1	0.9
DW2-5	D. LaDue	Spring	8-2-93	7.22	385	63.3	1
DW2-5A	D. LaDue	Spring	9-15-93	NA	NA	NA	10
DW2-6	V. Miller	Spring[a]	8-3-93	6.70	217	64.1	30
DW2-8	N. D'Ovidio	85-foot well	8-2-93	7.34	340	58.2	101
DW2-9	W. Cornell	Well	8-2-93	7.87	198	64.8	0.9
DW2-10	R. Fanton	Well	8-2-93	6.73	182	62.5	0.8
DW2-11	R. Geffers	150-foot well	8-2-93	7.96	533	64.0	1.0
DW2-12	A. Green	97-foot well	8-2-93	7.73	533	61.5	0.9
DW2-13	B. Schettine	110-foot well	8-2-93	7.42	389	67.5	0.5
DW2-14	M. Fletcher	50-foot well	8-2-93	7.92	602	66.5	1.0
DW2-15	T. Whispell	Spring	8-2-93	6.65	101	66.8	0.3
DW2-16	E. Ormsby	Spring	8-3-93	7.24	300	66.5	4
DW2-17	J. Fanton	55-foot well	8-3-93	7.73	520	62.7	1.0
DW2-18	R. Dodge	Well[b]	8-3-93	7.83	525	59.1	1.5
DW2-19	M. Gephart	Well	8-6-93	5.24	396	66.3	4

Key at end of table.

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Table 4-31

PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLE PARAMETERS

Sample	Owner	Type	Sample Date	pH	Conductivity (μS/cm)	Temperature (°F)	Turbidity (NTU)
DW2-20	J. Urban	Spring	8-6-93	5.27	58.9	64.7	100
DW2-21	R. Meisenzahl	Artesian well	9-15-93	NA	NA	NA	1

[a] No drinking water source exists; therefore, sample collected from wetland where springs on Miller property converge.
[b] Sample collected after water conditioner.

Key:

NA = Data not acquired.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-32

INORGANIC ANALYTES DETECTED IN THE PHASE II RI SURFACE WATER SAMPLE JULY 9, 1993
(all values reported in µg/L except as noted)

Analyte	SW2-1	NYSDEC Class C Surface Water Standard[a]
Aluminum	4,670 J	100
Arsenic	3.6 J	190
Barium	172 J	NA
Calcium	18,800	NA
Copper	7.3 J	8.5[b]
Iron	7,500	300
Lead	7.5	2.0[b]
Magnesium	7,210	NA
Manganese	437	NA
Nickel	14.3 J	71[b]
Potassium	3,070 J	NA
Sodium	8,090	NA
Vanadium	6.1 J	14
Zinc	53.7	30
Hardness (mg/L $CaCO_3$)	68	NA

[a] 6 NYCRR 703.5.
[b] Standard is a function of hardness.

Key:

J = Associated numerical value is estimated.
NA = No applicable NYS SCG.

Data Source: Ecology and Environment Engineering, P.C. 1993.

Table 4-33

INORGANIC ANALYTES DETECTED IN THE PHASE II RI SEDIMENT SAMPLE JULY 9, 1993 (all values reported in mg/kg)

Analyte	SED2-1	Sediment Criteria[a]	Limit of Tolerance[b]
Aluminum	9,890	NA	NA
Arsenic	12.3	5	33
Barium	236	NA	NA
Beryllium	0.94 J	NA	NA
Calcium	2,810	NA	NA
Chromium	16.0	26	11
Cobalt	19.4 J	NA	NA
Copper	19.0	19	114
Iron	25,500	24,000	40,000
Lead	24.1 J	27	250
Magnesium	2,880	NA	NA
Manganese	2,040	428	1,110
Nickel	31.4	22	90
Potassium	879 J	NA	NA
Sodium	235 J	NA	NA
Vanadium	19.9 J	NA	NA
Zinc	112	85	800

a Geometric mean of "no-effect" and "lowest-effect" levels based on toxicity studies in benthic organisms (NYSDEC 1989b).

b Concentration that would be detrimental to the majority of species (NYSDEC 1989b).

Key:

J = Reported value is estimated.
NA = No applicable NYS SCG.

Data Source: Ecology and Environment Engineering, P.C. 1993.

Table 4-34

**NYSDEC LEACHATE SAMPLE
WET CHEMISTRY DATA
APRIL 22, 1992
(all values reported in mg/L)**

Parameter	MH-4
BOD_5	20.0
COD	77.6
Nitrate	0.24
TSS	30.8

Data Source: NYSDEC 1992a.

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Table 4-35

LEACHATE INVESTIGATION REPORT ANALYTICAL RESULTS
(all values reported in mg/L except as noted)

Parameter	S1-1 5/1/92	S1-2 6/26/92	S1-3 7/2/92	PS2-1 5/7/92	PS2-2 6/26/92	MH3-1 5/7/92	MH3-2 6/26/92
pH (s.u.)	6.9	7.0	6.4	6.6	NA	6.5	NA
BOD_5	340	350	430	ND1	ND2	430	500
BOD_{28}	580	NA	NA	NA	NA	NA	NA
COD	640	660	680	200	NA	740	NA
TKN	17	22	42	20	NA	18	NA
TSS	140	120	160	100	NA	97	NA
Iron	132	161	80	98	NA	181	NA

Key:

NA = Not analyzed.
ND1 = Not detected. Detection limit was 200 mg/L.
ND2 = Not detected. Detection limit was 20 mg/L.

Data Source: Ecology and Environment Engineering, P.C. 1992.

Table 4-36

ORGANIC COMPOUNDS DETECTED IN PHASE II RI LEACHATE/SEEP SAMPLES
JUNE 21 AND 22, 1993
(all values reported in µg/L)

Compound	SP2-1	SP2-1D[a]	SP2-2	SP2-3	SP2-4	NYSDEC Class C Surface Water Standards[g]
Volatiles						
Chlorobenzene	6 J	7 J	ND	ND	ND	5
Chloroethane	40	49	ND	ND	ND	NA
1,1-Dichloroethane	8 J	9 J	ND	ND	ND	NA
1,2-Dichloroethane[b]	5 J	9 J	10	9 J	10	NA
Ethylbenzene	140	150	ND	ND	ND	NA
Toluene	2 J	2 J	2 J	ND	ND	NA
Xylenes (total)	420	470	ND	ND	ND	NA
Semivolatiles[c]						
4-Chloro-3-methylphenol	21	21	ND	ND	ND	1[d]
1,4-Dichlorobenzene	4 J	4 J	ND	ND	ND	5[e]
Diethylphthalate	17	18	ND	ND	ND	NA
2,4-Dimethylphenol	4 J	ND	ND	ND	ND	5[f]
2-Methylnaphthalene	5 J	5 J	ND	ND	ND	NA
Naphthalene	12	11	ND	ND	ND	NA
N-Nitrosodiphenylamine	ND	1 J	ND	ND	ND	NA

a Field duplicate of SP2-1.
b The presence of this compound is a suspected laboratory artifact related to acid preservation.
c Results of the semivolatile analysis have not been data qualified.
d Applies to total of chlorinated phenols.
e Applies to sum of meta, ortho, and para isomers.
f Applies to total of unchlorinated phenols.
g 6 NYCRR 703.5.

Key:

J = The associated numerical value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1993.

Table 4-37

INORGANIC ANALYTES DETECTED IN PHASE II RI LEACHATE/SEEP SAMPLES
JUNE 21 AND 22, 1993
(all values reported in µg/L except as noted)

Analyte	SP2-1	SP2-1D[a]	SP2-2	SP2-3	SP2-4	NYSDEC Class C Surface Water Standards[b]
Aluminum	1,550 J	1,520 J	35,900 J	8,340 J	1,020 J	100
Arsenic	5.7 J	6.2 J	28.0	15.4	8.3 J	190
Barium	420	432	511	172 J	47.5 J	NA
Beryllium	ND	ND	1.7 J	ND	ND	11/1,100[c]
Calcium	153,000	153,000	45,600	14,900	9,060	NA
Chromium	17.1	19.8	36.3	18.4	ND	87.6 - 1,140[d]
Cobalt	22.9 J	23.2 J	66.2	14.5 J	5.9 J	5
Copper	24.0 J	29.9	49.4	16.9 J	5.3 J	4.8 - 70[e]
Iron	96,700	104,000	53,300	20,900	8,850	300
Lead	29.9	30.8	67.9	11.8	7.2	0.9 - 45[f]
Magnesium	102,000	102,000	61,300	7,920	3,010 J	NA
Manganese	2,320	2,290	15,100	2,550	1,130	NA
Nickel	50.7	48.8	73.0	23.5 J	ND	43 - 465[g]
Potassium	58,500	72,500	43,500	2,700 J	1,800 J	NA
Sodium	170,000	166,000	111,000	2,040 J	1,050 J	NA
Vanadium	6.8 J	7.6 J	53.7	15.1 J	ND	14

Key at end of table.

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Table 4-37

INORGANIC ANALYTES DETECTED IN PHASE II RI LEACHATE/SEEP SAMPLES
JUNE 21 AND 22, 1993
(all values reported in µg/L except as noted)

Analyte	SP2-1	SP2-1D[a]	SP2-2	SP2-3	SP2-4	NYSDEC Class C Surface Water Standards[b]
Zinc	141	170	181	68.2	40.5	30
Hardness (mg/L $CaCo_3$)[h]	801	801	365	69.7	35.0	NA

a Field duplicate of SP2-1.
b 6 NYCRR 703.5.
c Standard is a function of hardness as follows: 11 µg/L when hardness is <75 mg/L and 1,100 µg/L when hardness is >75 mg/L.
d Standard is a function of hardness as follows: SP2-1 (1,140); SP2-2 (598); SP2-3 (154); and SP2-4 (87.6). Standard for hexavalent chromium only is 11 µg/L.
e Standard is a function of hardness as follows: SP2-1 (70); SP2-2 (36); SP2-3 (8.7); and SP2-4 (4.8).
f Standard is a function of hardness as follows: SP2-1 (45); SP2-2 (17); SP2-3 (2.0); and SP2-4 (0.9).
g Standard is a function of hardness as follows: SP2-1 (465); SP2-2 (256); SP2-3 (73); and SP2-4 (43).
h Hardness calculated from reported concentrations of Ca^{2+} and Mg^{2+} (Freeze and Cherry 1979).

Key:

J = Reported value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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Table 4-38

PHASE II RI PERIMETER EXPLOSIVE GAS SURVEY RESULTS
JUNE 22 TO 24, 1993

Sample Location	OVA (ppm)	HNu (ppm)	CG (% LEL)	Date
Northwest Fill Area				
NW - N1	0	0	0	6-23-93
NW - N2	0	0	0	6-23-93
NW - E1	0.4	0	0	6-23-93
NW - E2	0	0	0	6-23-93
NW - E3	0	0	0	6-23-93
NW - E4	0	0	0	6-23-93
NW - E5	0	0	0	6-23-93
NW - E6	0	0	0	6-23-93
NW - E7	0	0	0	6-23-93
NW - W1	4	0	0	6-23-93
NW - W2	1	0	0	6-23-93
NW - W3	0	0	0	6-23-93
NW - W4	0	0	0	6-23-93
NW - W5	1	0	0	6-23-93
NW - W6	0	0	0	6-23-93
NW - W7	0.5	0	0	6-23-93
NW - S1	0	0	0	6-23-93
NW - S2	130	0	1	6-23-93
Northeast Fill Area				
NE - W1	0	0	0	6-23-93
NE - W2	0.2	0	0	6-23-93
NE - FILL	>1,000	0	>100	6-23-93
NE - W3	2.7	0	0	6-23-93
NE - W3A	>1,000	1.0	>100	6-23-93
NE - S1	0.5	0	0	6-23-93
NE - S2	1	0	0	6-23-93
NE - E1	0	0	0	6-23-93

Key at end of table.

Table 4-38

PHASE II RI PERIMETER EXPLOSIVE GAS SURVEY RESULTS
JUNE 22 TO 24, 1993

Sample Location	OVA (ppm)	HNu (ppm)	CG (% LEL)	Date
NE - E2	2	0	0	6-23-93
NE - E3	0	0	0	6-23-93
NE - N1	>1,000	0	2	6-23-93
NE - N2	0.5	0	0	6-23-93
South Central Fill Area				
SC - W1	0	0	0	6-24-93
SC - W2	0	0	0	6-24-93
SC - W3	0.3	1.0	0	6-22-93
SC - N1	0	0	0	6-24-93
SC - N2	90	0.3	1	6-24-93
SC - E1	0	0	0	6-24-93
SC - E2	>1,000	1.5	60	6-24-93
SC - E3	0	0	0	6-24-93
South Fill Area				
S - E1	0	0	0	6-24-93
S - E2	0	0	0	6-24-93
S - E3	0	0	0	6-24-93
S - S1	0	0	0	6-24-93
S - S2	0	0	0	6-24-93
S - W1	1	1.2	0	6-22-93
S - W2	0.6	0.5	0	6-22-93
S - W3	0	0	0	6-24-93

Key:

CG = Combustible gas meter (percent of the lower explosive limit).
HNu = Photoionization detector with 10.2 eV probe.
OVA = Organic Vapor Analyzer (flame ionization detector) without charcoal filtering.

Data Source: Ecology and Environment Engineering, P.C. 1993.

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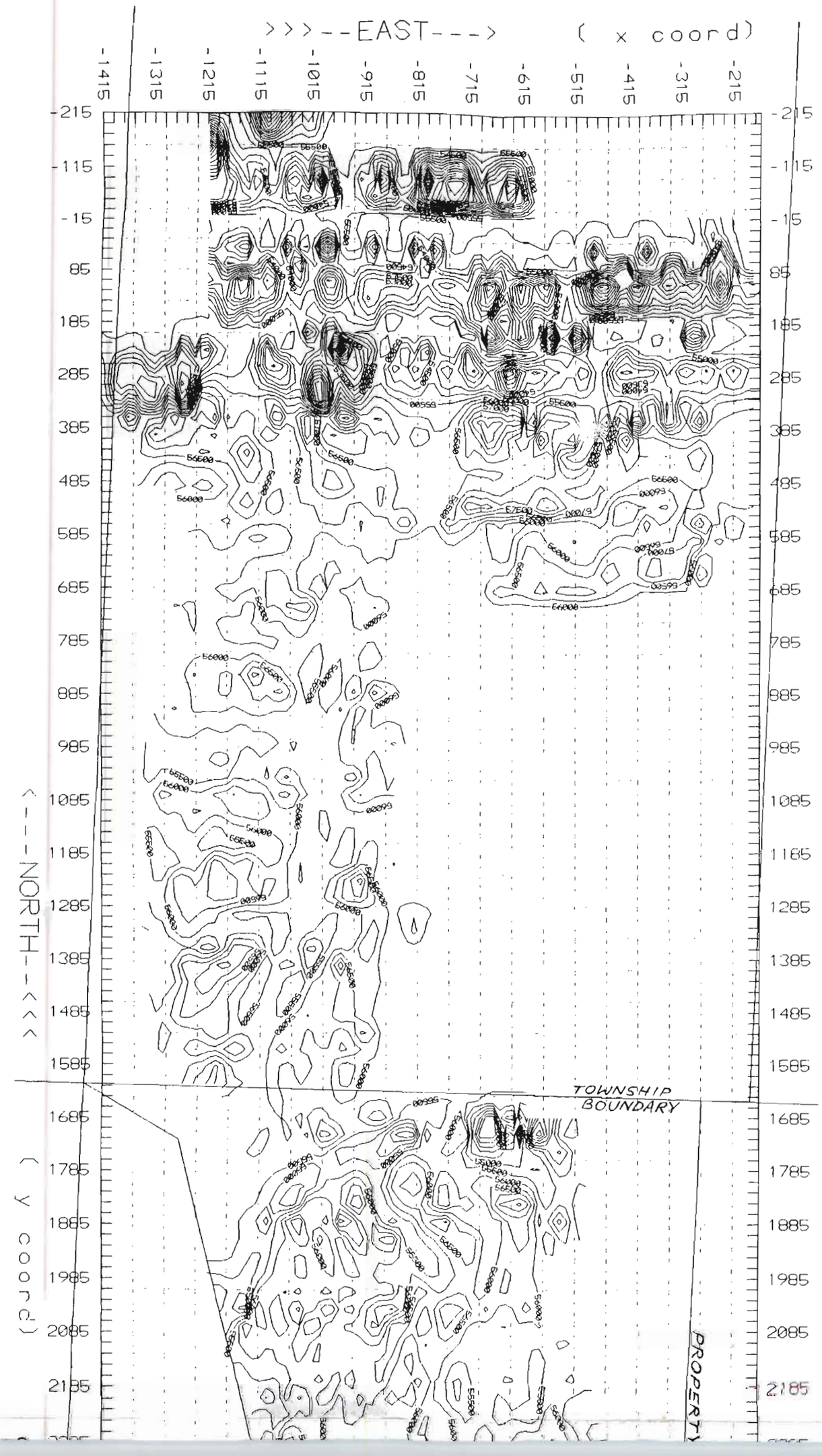
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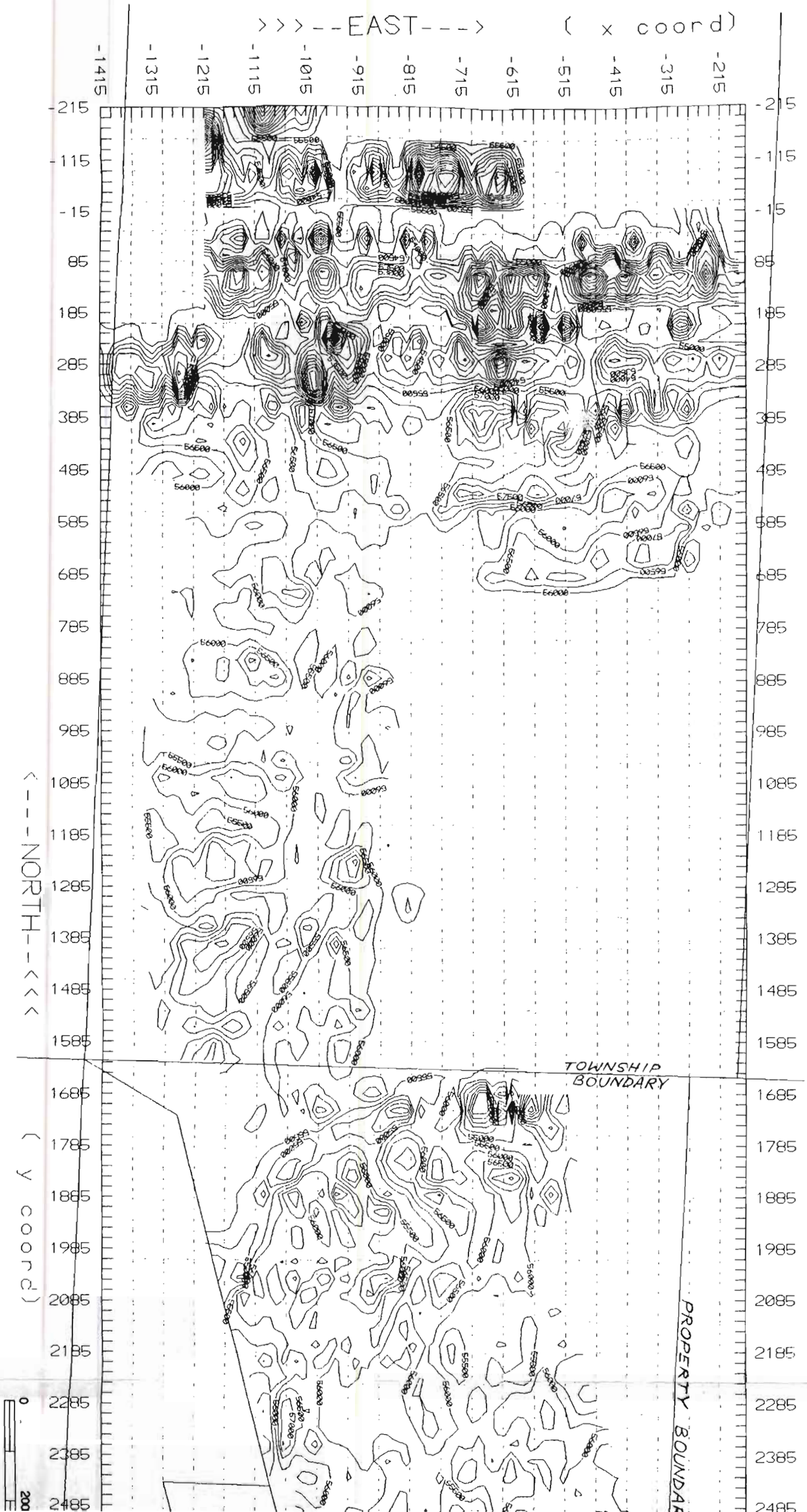
BOUNDARY
PROPERTY



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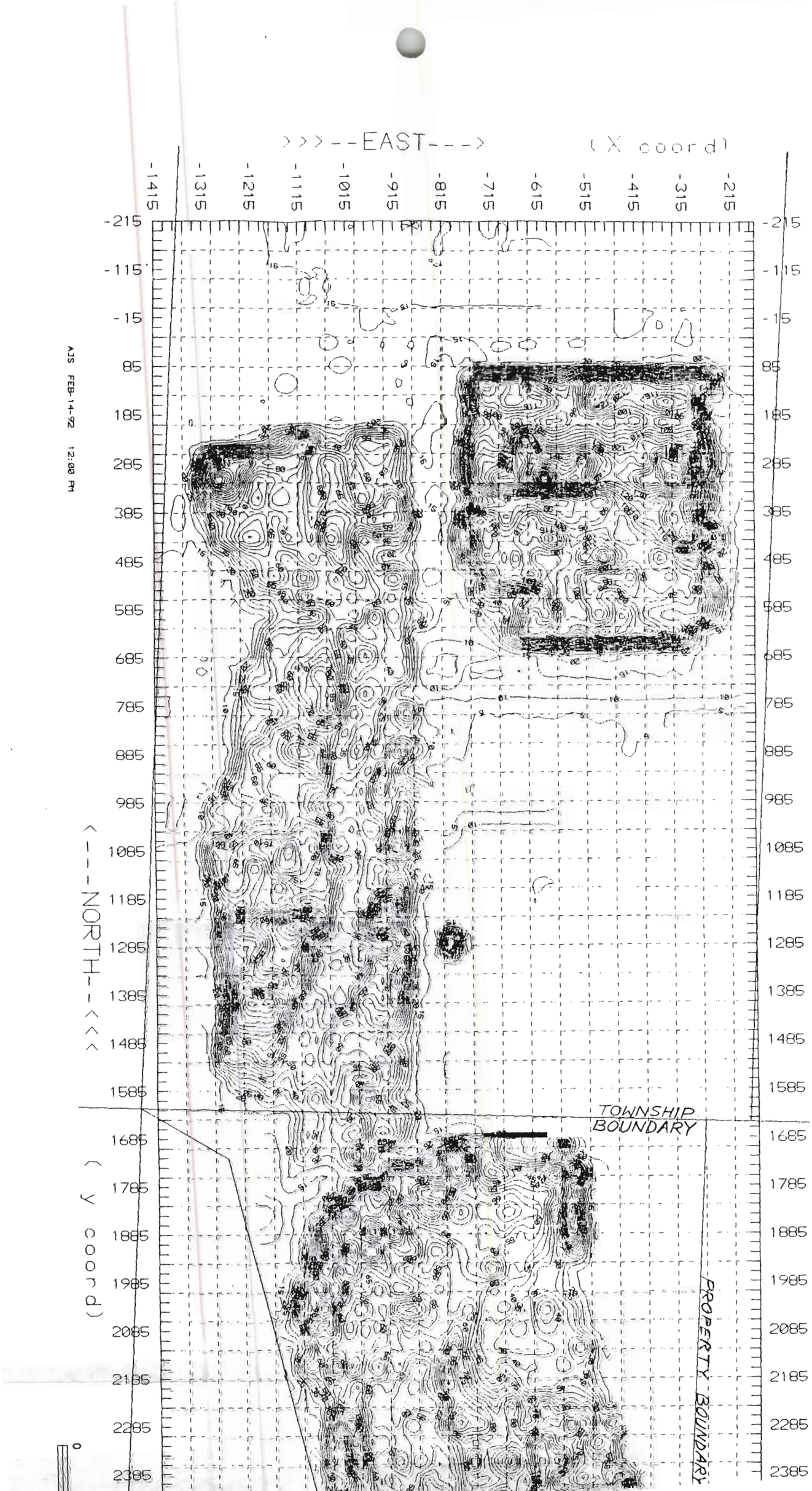
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-1115
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-915
-815
-715
-615
-515
-415
-315
-215
-215
-115
-15
85
185
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485
585
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785
885
985
1085
1185
1285
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1685
1785
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2185
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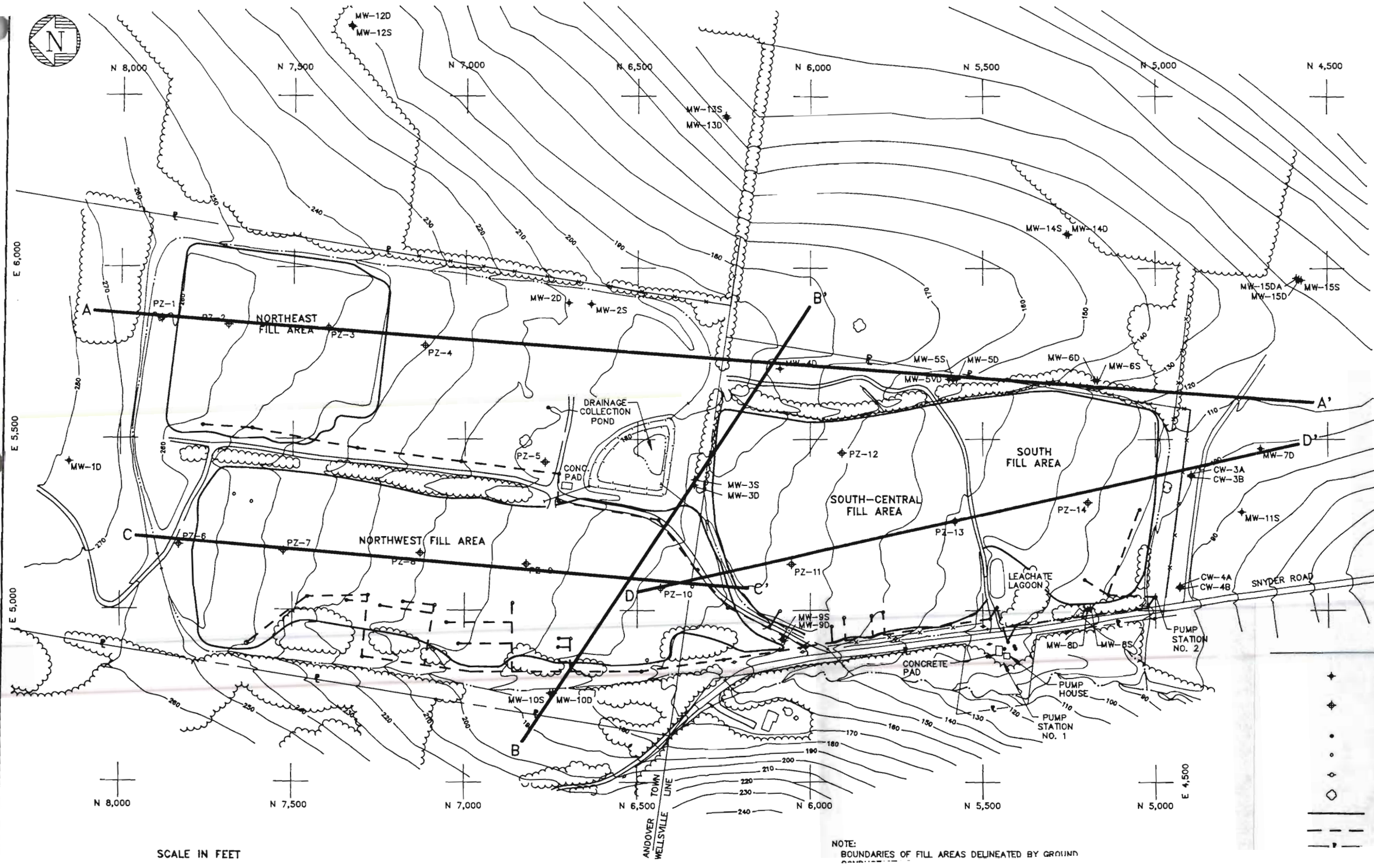
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MW-15S
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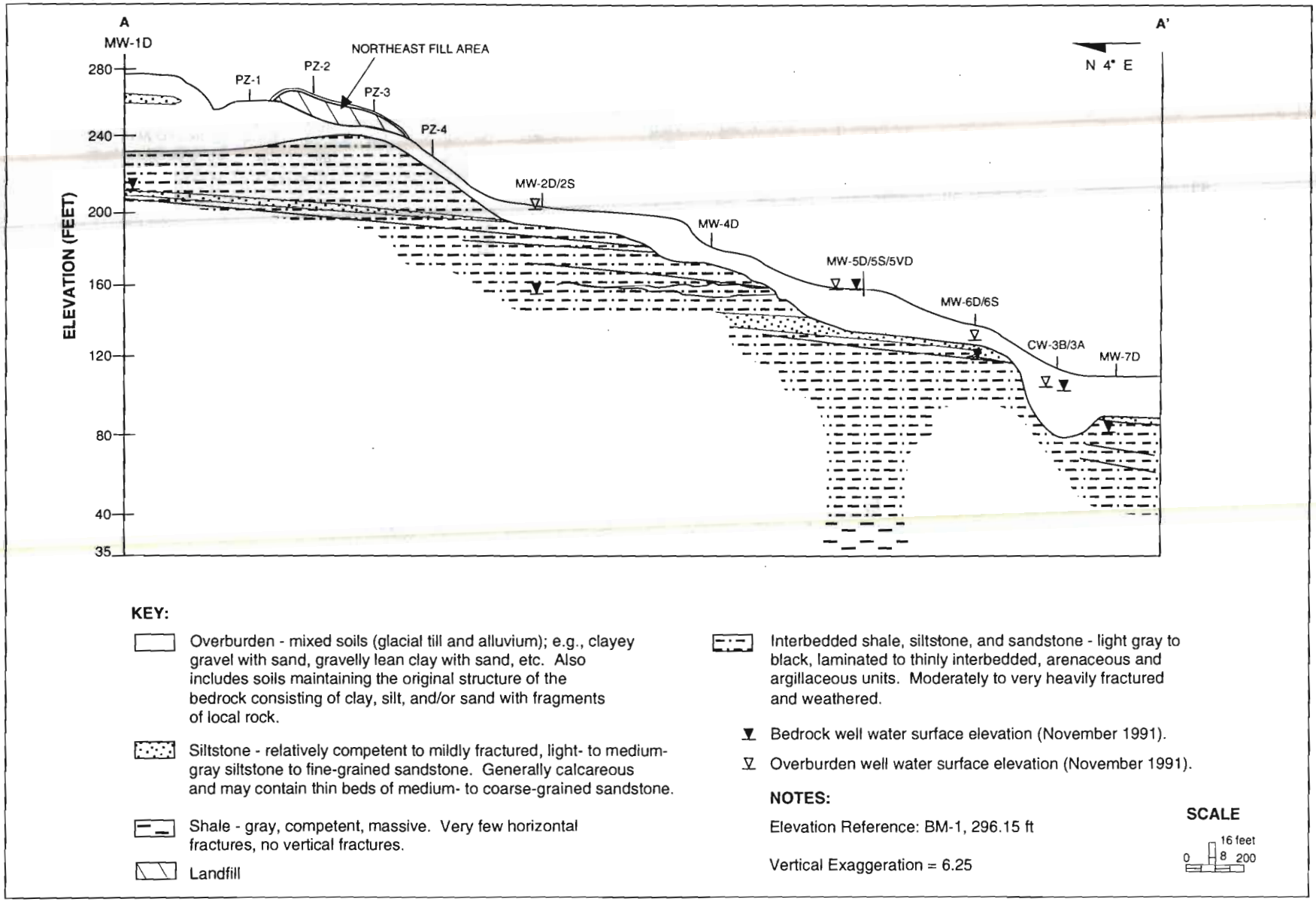
MW-1D
MW-4D
MW-5S
MW-5D
MW-5VD
MW-6D
MW-6S
MW-7D
MW-11S
MW-3S
MW-3D
MW-9S
MW-9D
MW-10S
MW-10D
MW-8D
MW-8S
PZ-1
PZ-2
PZ-3
PZ-4
PZ-5
PZ-6
PZ-7
PZ-8
PZ-10
PZ-11
PZ-12
PZ-13
PZ-14
NORTHEAST FILL AREA
NORTHWEST FILL AREA
SOUTH-CENTRAL FILL AREA
SOUTH FILL AREA
DRAINAGE COLLECTION POND
CONC PAD
LEACHATE LAGOON
CONCRETE PAD
PUMP HOUSE
PUMP STATION NO. 1
PUMP STATION NO. 2
CW-3A
CW-3B
CW-4A
CW-4B
SNYDER ROAD
ANDOVER TOWN LINE
WELLSVILLE
A
A'
B
B'
C
C'
D
D'
SCALE IN FEET
NOTE:
BOUNDARIES OF FILL AREAS DELINEATED BY GROUND

02:\OB4423.CDR



SOURCE: Ecology and Environment Engineering, P.C. 1993

**Figure 4-5 GEOLOGIC CROSS SECTION A A'
WELLSVILLE-ANDOVER LANDFILL**

recycled paper
ecology and environment

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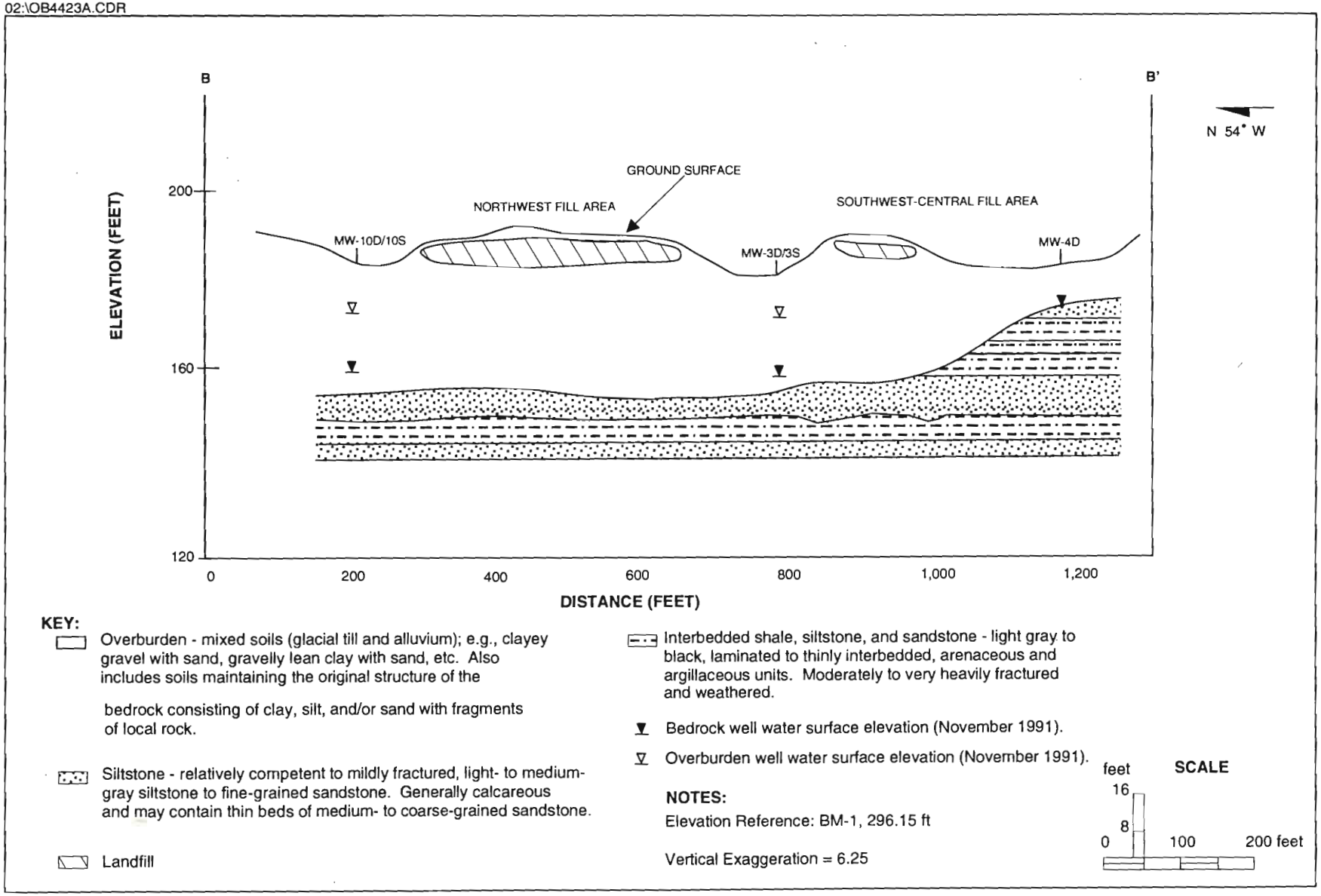
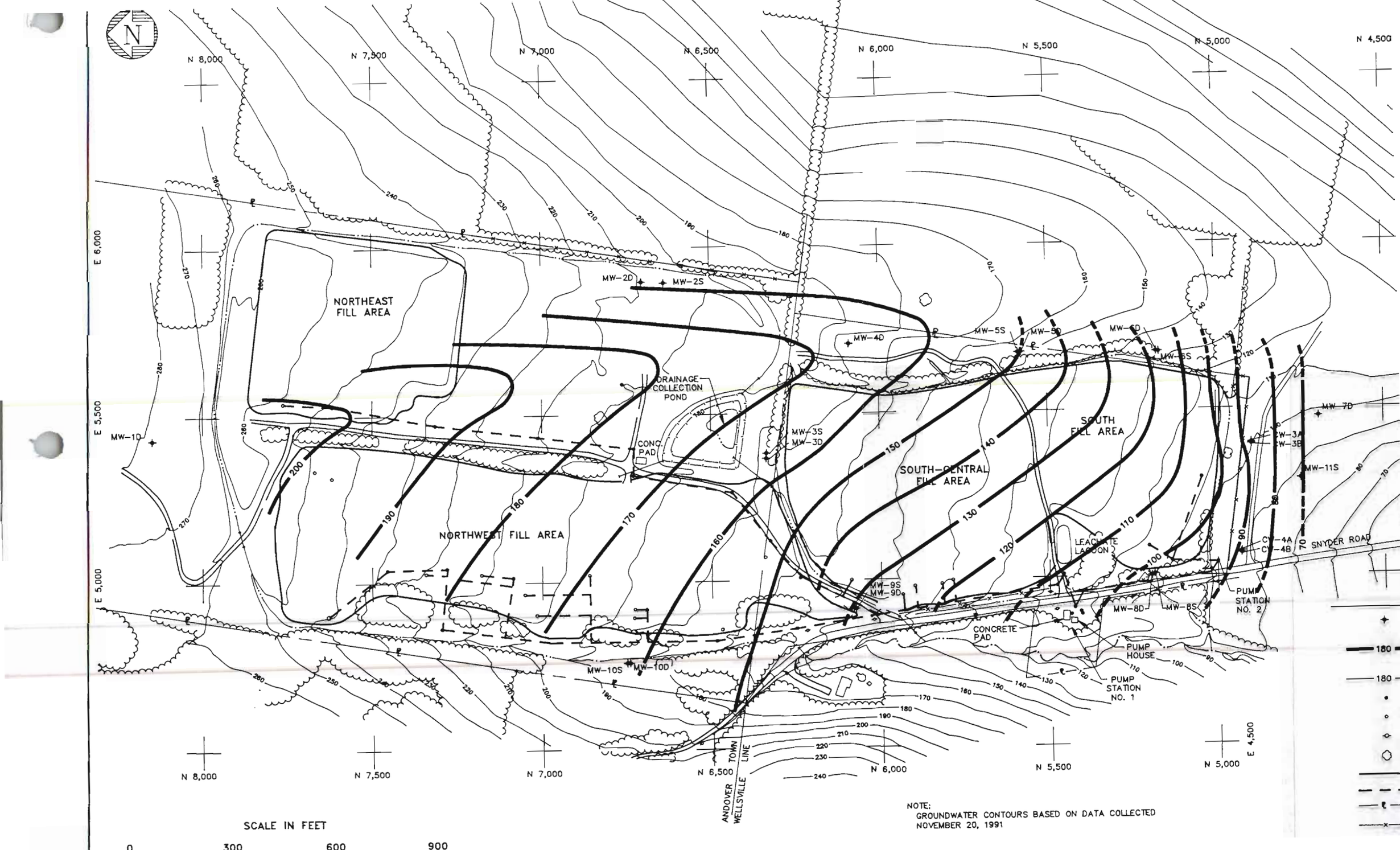


SOURCE: Ecology and Environment Engineering, P.C. 1993

Figure 4-6 GEOLOGIC CROSS SECTION B B'
WELLSVILLE-ANDOVER LANDFILL

DRAFT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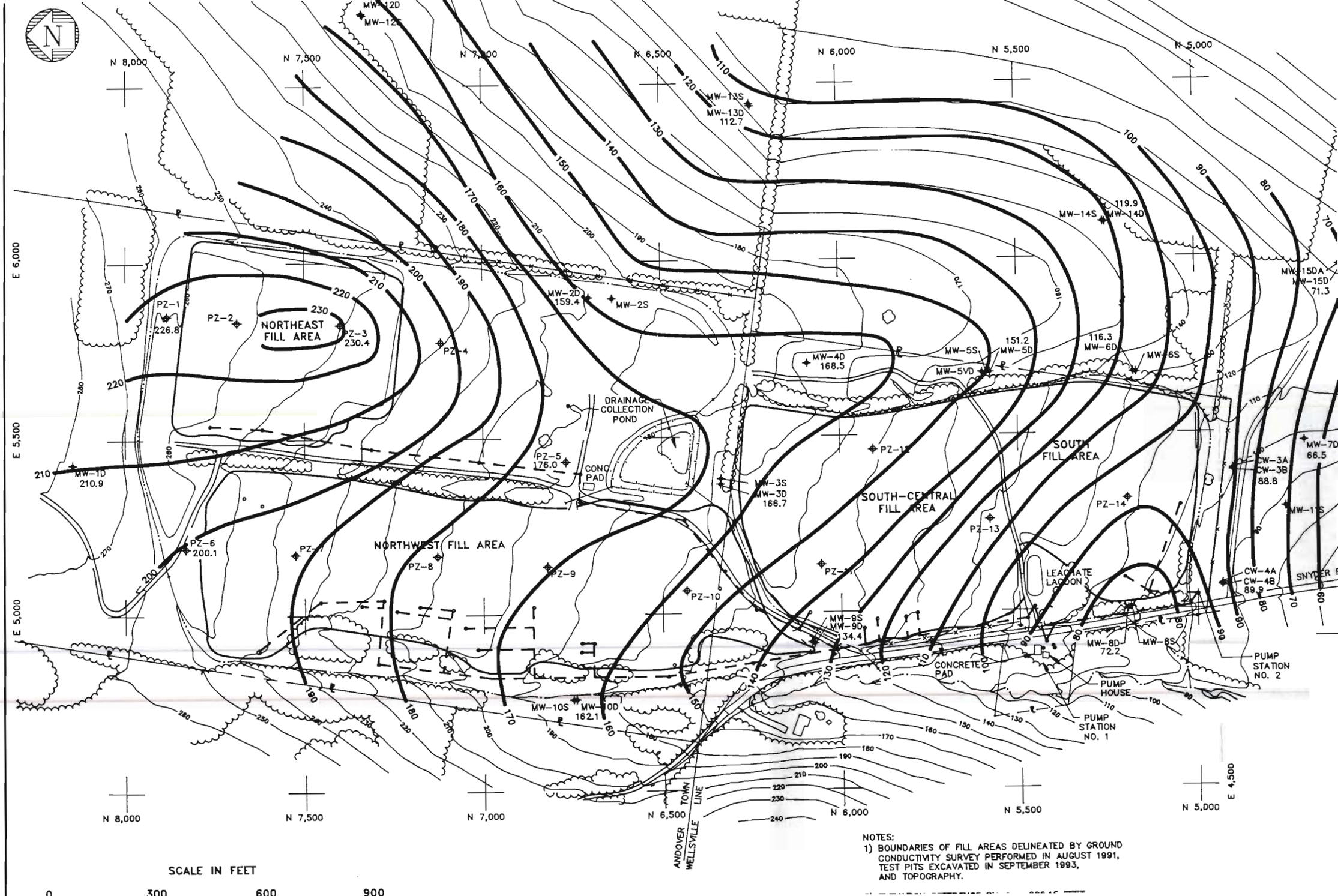
NORTHEAST FILL AREA
NORTHWEST FILL AREA
SOUTH-CENTRAL FILL AREA
SOUTH FILL AREA
DRAINAGE COLLECTION POND
CONC. PAD
LEACHATE LAGOON
CONCRETE PAD
PUMP HOUSE
PUMP STATION NO. 1
PUMP STATION NO. 2
SNYDER ROAD
ANDOVER TOWN LINE
WELLSVILLE
MW-1D
MW-2D
MW-2S
MW-3S
MW-3D
MW-4D
MW-5S
MW-5D
MW-6D
MW-6S
MW-7D
MW-8D
MW-8S
MW-9S
MW-9D
MW-10S
MW-10D
MW-11S
CW-3A
CW-3B
CW-4A
CW-4B
SCALE IN FEET
0
300
600
900
NOTE:
GROUNDWATER CONTOURS BASED ON DATA COLLECTED NOVEMBER 20, 1991



SCALE IN FEET

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NOTES:
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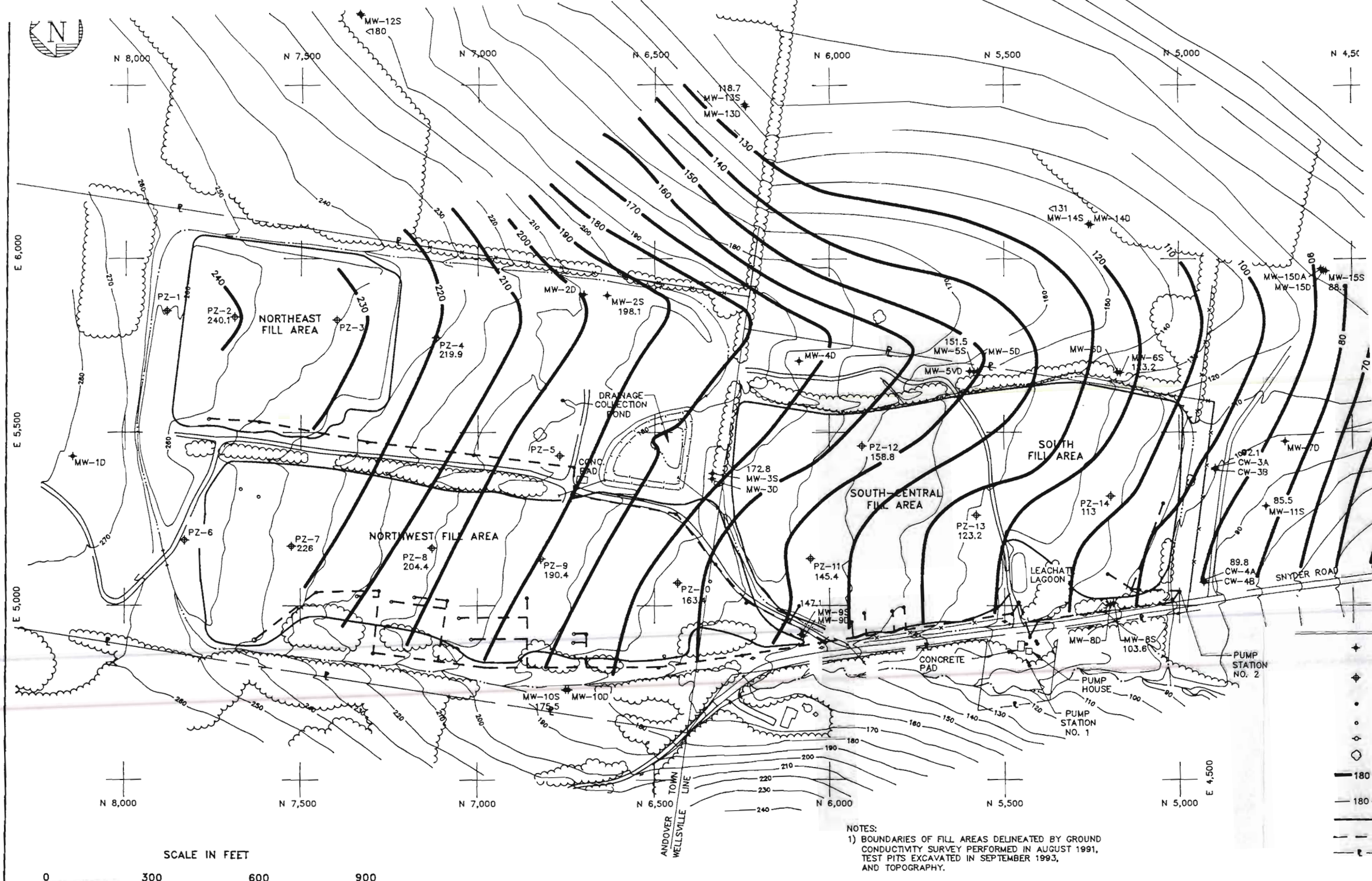

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NOTES:
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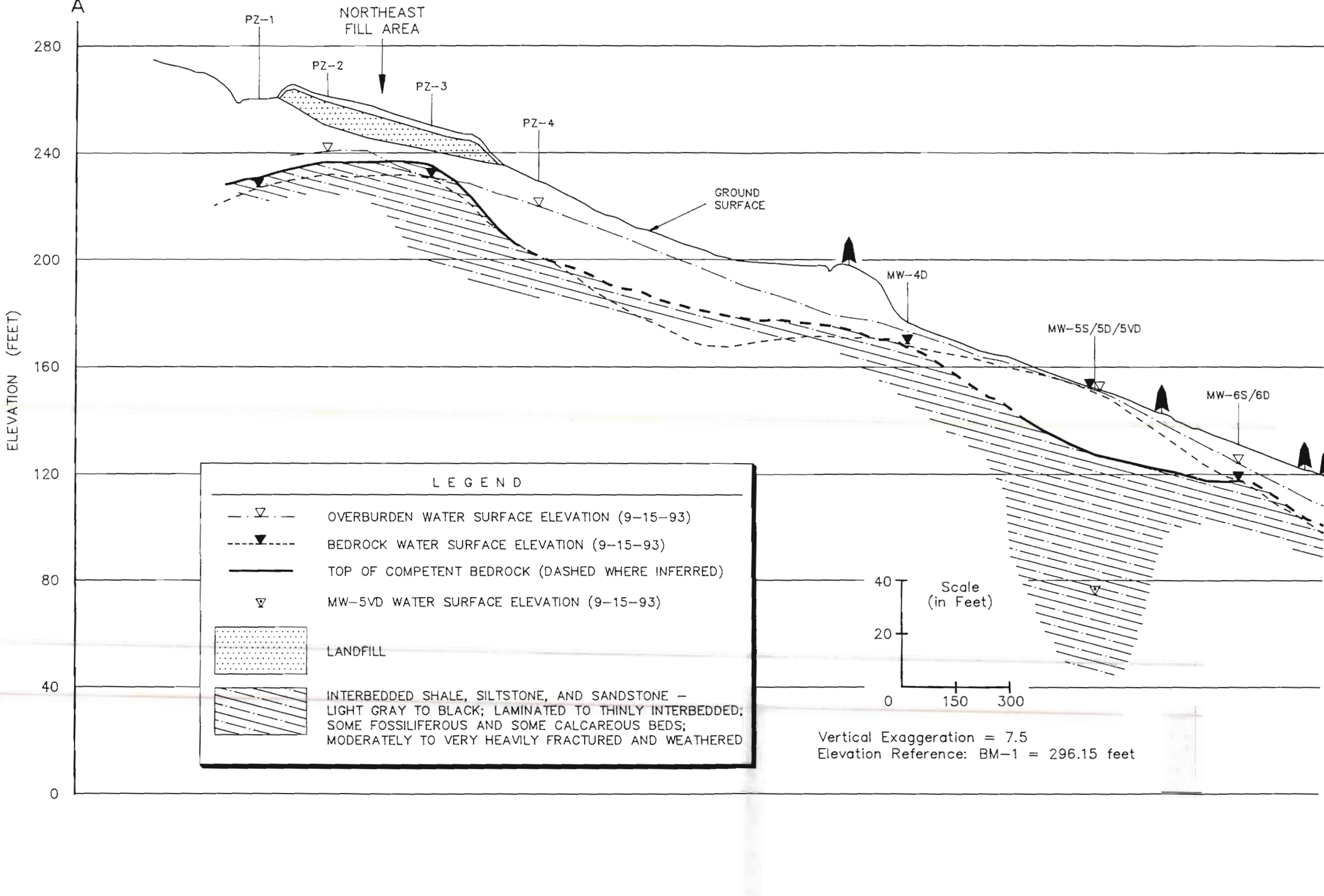
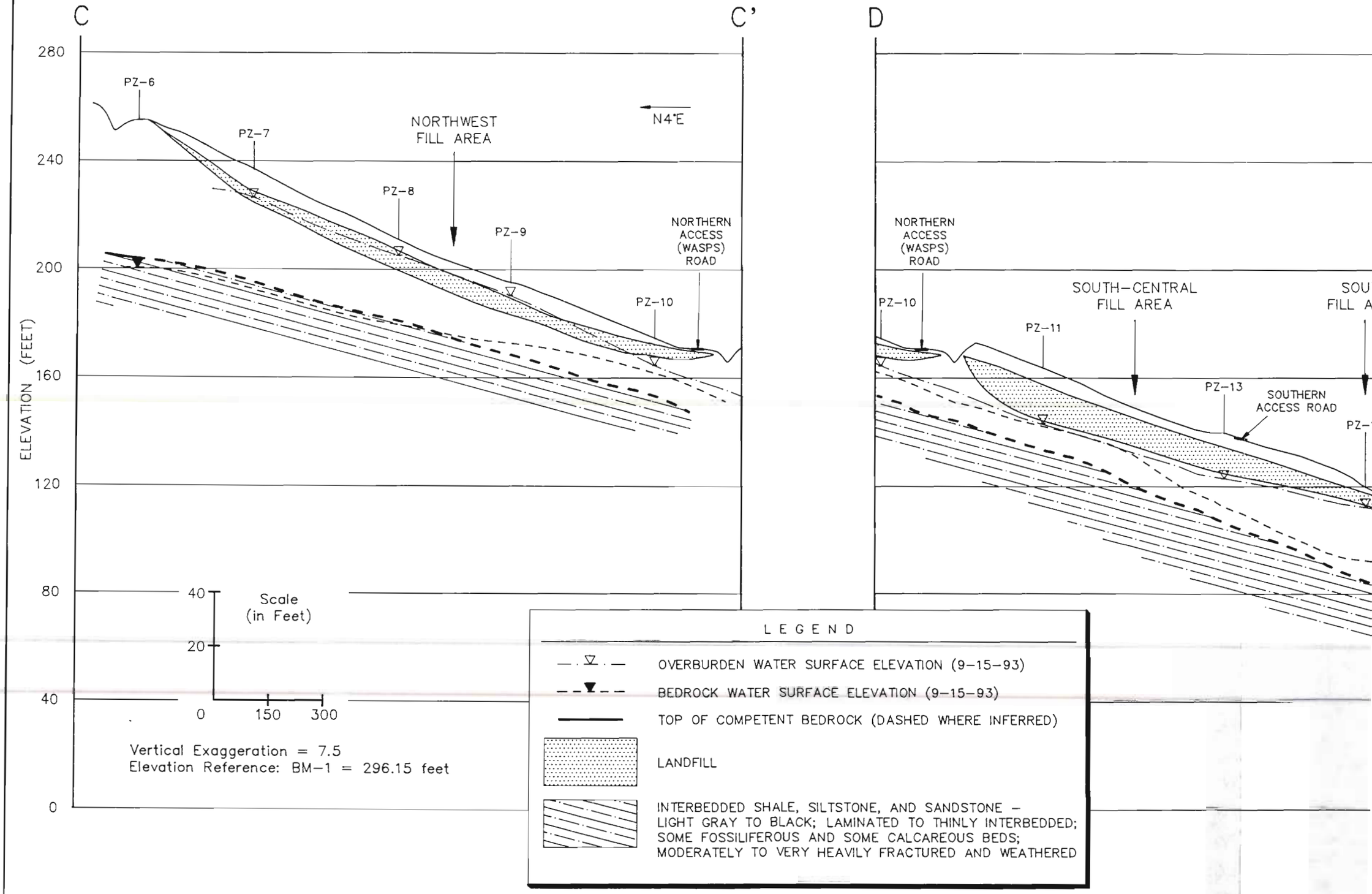

A
PZ-1
NORTHEAST
FILL AREA
PZ-2
PZ-3
PZ-4
GROUND
SURFACE
MW-4D
MW-5S/5D/5VD
MW-6S/6D
ELEVATION (FEET)
280
240
200
160
120
80
40
0
LEGEND
OVERBURDEN WATER SURFACE ELEVATION (9-15-93)
BEDROCK WATER SURFACE ELEVATION (9-15-93)
TOP OF COMPETENT BEDROCK (DASHED WHERE INFERRED)
MW-5VD WATER SURFACE ELEVATION (9-15-93)
LANDFILL
INTERBEDDED SHALE, SILTSTONE, AND SANDSTONE -
LIGHT GRAY TO BLACK; LAMINATED TO THINLY INTERBEDDED;
SOME FOSSILIFEROUS AND SOME CALCAREOUS BEDS;
MODERATELY TO VERY HEAVILY FRACTURED AND WEATHERED
40
20
0
Scale
(in Feet)
150
300
Vertical Exaggeration = 7.5
Elevation Reference: BM-1 = 296.15 feet


C
C'
D
280
240
200
160
120
80
40
0
ELEVATION (FEET)
PZ-6
PZ-7
PZ-8
PZ-9
PZ-10
PZ-11
PZ-13
NORTHWEST
FILL AREA
N4°E
NORTHERN
ACCESS
(WASPS)
ROAD
SOUTH-CENTRAL
FILL AREA
SOUTHERN
ACCESS ROAD
Scale
(in Feet)
40
20
0
150
300
Vertical Exaggeration = 7.5
Elevation Reference: BM-1 = 296.15 feet
LEGEND
OVERBURDEN WATER SURFACE ELEVATION (9-15-93)
BEDROCK WATER SURFACE ELEVATION (9-15-93)
TOP OF COMPETENT BEDROCK (DASHED WHERE INFERRED)
LANDFILL
INTERBEDDED SHALE, SILTSTONE, AND SANDSTONE -
LIGHT GRAY TO BLACK; LAMINATED TO THINLY INTERBEDDED;
SOME FOSSILIFEROUS AND SOME CALCAREOUS BEDS;
MODERATELY TO VERY HEAVILY FRACTURED AND WEATHERED

5. HUMAN HEALTH RISK EVALUATION

5.1 INTRODUCTION

5.1.1 Overview

The Wellsville-Andover Landfill site is an inactive municipal landfill. It consists of approximately 50 acres of fill situated on approximately 120 acres of property and was shared by the towns of Wellsville and Andover in Allegany County, New York.

Between 1964 and 1983, municipal, industrial, and wastes currently defined as hazardous were disposed of at the Wellsville-Andover Landfill. Some wastes that may have been disposed of include scraps of polymerized polyester, MC, TCE, plastics, sodium cyanide, cutting oils, chromium and zinc chromate paints, unspecified solvents, coolants, and lubricating oils (NYSDEC 1983; Village of Wellsville 1986). Each of these products contains, or could contain, a number of chemicals that could potentially pose a threat to human health. The objective of this risk evaluation is to identify whether chemicals associated with the site could potentially pose such a threat. This determination will be accomplished by the following:

- Comparison of site analytical data to appropriate background levels, and standards and guidelines set forth by NYSDEC, NYSDOH, and EPA;
- Selection of chemicals of potential concern (COPCs);
- Discussion of potential exposure pathways and receptors; and
- Discussion of toxicological properties of the COPCs.

5.1.2 Site Description and Setting

The Wellsville-Andover Landfill is located in a sparsely populated, rural area of Allegany County, New York. A number of permanent and seasonal residences are located along Duffy Creek, approximately 1,400 to 1,500 feet east of the site. Seasonal residences are located approximately 600 feet southeast of the site (LaDue), 500 feet west of the site (Penn Hill Hunt Club), and 300 feet southwest of the site (Rosini). Additionally, one permanent residence (Teller) is located approximately 200 feet west of the northern access gate to the site (see Figure 3-1 or 3-11). The western side of the site is bounded by a mature beech and sugar maple forest. No schools, parks, or other public facilities are located in the immediate vicinity of the site, and the demographics of the area suggest the nearby population would not be expected to include exceptionally high percentages of potentially sensitive subpopulations such as young children or the elderly.

The site is unpaved, with most of the area covered by grasses. Dirt access roads pass through the site, and the site is easily approachable from all sides. A barbed wire fence exists along the southern and eastern borders of the site. The east side of the site is bounded mainly by pasture, with some patches of mature beech and sugar maple forests remaining. No natural barriers exist that would hinder the approach and entrance of wildlife or humans. In fact, the northernmost area of the site, on top of a hill at an approximate elevation of 2,230 feet, is used for recreational purposes by the WASPS, a local community group. Access to this portion of the site is gained by the northern access road that bisects the northern half of the site (see Figure 3-1 or 3-11).

Although no streams cross the site, an unnamed tributary begins along the west side of the site and flows south-southeast until it converges with Duffy Creek approximately 3,000 feet southeast of the site. Duffy Creek is a Class C stream, indicating that its best potential use is to support fish propagation. Also present at the site are a number of man-made ditches, which divert surface runoff away from the filled areas. All surface runoff eventually flows to the unnamed tributary west of the site.

Groundwater in the area flows from north to southwest in the central and western portion of the landfill. A groundwater divide exists along the east side of the site, and groundwater on the east side flows southeast toward Duffy Creek. Shallow groundwater in the area emerges in springs south and east of the site. Both permanent and seasonal residences in the area utilize private wells and springs for drinking water supply purposes.

5.2 SUMMARY OF SITE INVESTIGATION

Six landfill gas samples were collected from the hottest areas of the leachate collection system during the Phase I RI. Several VOCs were detected in these samples, including TCE and VC, which were detected at concentrations exceeding 1,000 x NYSDEC annual guidance concentration (AGC). One sample, collected from R-10, contained an elevated level of TCE, while all six samples contained VC at concentrations exceeding 1,000 x NYSDEC AGC.

The site investigation focused on characterizing the nature and extent of contamination associated with the site and identifying potential migration pathways that could result in exposure of human receptors to site contaminants. During Phase I, samples were collected from a variety of media and locations at the site, including:

- Landfill gas;
- Surface soils from drainage ditches and seep areas on and around the landfill;
- Subsurface soils and waste materials from the landfill; and
- Subsurface soils from borings around the landfill.

In addition, samples were collected from the following media during both Phases I and II:

- Surface water from streams draining the site;
- Stream sediments;
- Groundwater from monitoring wells on and around the site;
- Groundwater samples from residential wells and springs near the site that are used for drinking water supply purposes; and
- Landfill leachate and seeps.

A summary of contaminants detected at the site can be found in Tables 5-1 through 5-14. These tables include the ranges of detected concentrations, not including the non-detects. A dash in the minimum concentration column of the tables indicates that the chemical was detected in only one sample, in which case the detected concentration appears in the maximum concentration column. COPCs were selected based on the analytical results for

all media sampled. The COPCs selected are indicated in Tables 5-1 through 5-14 and are summarized in Table 5-15.

Two leachate samples were collected during the Phase I RI and a third sample, which has been incorporated into the Phase I results, was taken on April 22, 1992, by NYSDEC. Results of this sampling indicated that aluminum, cobalt, iron, lead, vanadium, and zinc were present at concentrations exceeding the NYSDEC Class C surface water standard (see Table 5-2). Class C surface water standards have been compared to the leachate results since leachate has been observed flowing off site into the unnamed tributary and, therefore, directly impacts surface water. Concentrations of 4-chloro-3-methylphenol, ethylbenzene, 1,1-DCA, toluene, TCE, and VC were also detected at concentrations exceeding the NYSDEC Class C standard.

Four leachate/seep samples were collected during the Phase II RI sampling. One sample, SP2-1, consisted of leachate flowing out of the northeast fill area; the other three samples may more appropriately be considered seep samples. The analytical results of these samples indicate that aluminum, cobalt, copper, iron, lead, vanadium, and zinc were present above the NYSDEC Class C standard (see Table 5-3). Chlorobenzene, chloroethane, 1,1-DCA, 1,2-DCA, ethylbenzene, and total xylenes were also detected at concentrations exceeding the NYSDEC Class C standard. All of the organics detected in Phase II leachate/seep sampling, except 1,2-DCA and toluene, were detected in only one sample, SP2-1, collected from the southwest corner of the northeast fill area. 1,2-DCA was detected in all four leachate samples, but the results are highly suspected to be a laboratory artifact resulting from acid preservation. Toluene was detected below the NYSDEC standard at identical concentrations in samples SP2-2 and SP2-1. The concentration of 1,1-DCA detected in sample SP2-1 exceeded the NYSDEC Class C standard.

Maximum concentrations of inorganics were detected in samples SP2-1 and SP2-2. The lowest concentrations of inorganics were generally detected in sample SP2-4; however, samples from several media show elevated levels of cobalt, iron, manganese, and zinc. These elevated concentrations seem to occur throughout the area and are not necessarily site derived. Although lead was found in leachate samples at levels above relevant criteria, these elevated lead concentrations were associated with elevated aluminum concentrations, which are indicative of suspended soil minerals (sediment) in the samples. The results of these leachate/seep samples are consistent with the sample locations; that is, organics were detected

in the sample closest to the landfill and concentrations generally decreased with distance from the landfill. Maximum concentrations of chemicals detected in Phase II RI samples were generally higher than the maximum concentrations detected in the Phase I RI samples.

Phase I RI surface water samples contained aluminum, iron, and lead at concentrations exceeding the NYSDEC Class C surface water standard. However, the elevated concentrations of inorganics appear to be a result of suspended sediment in the samples, as discussed above and, therefore, are unlikely to be site related. One surface water sample was taken during Phase II RI sampling. This sample was collected upstream from the Phase I RI sampling location and is considered a background sample. Based on the results obtained from the Phase II RI sample, it is unlikely that the elevated inorganic concentrations in the Phase I RI samples are associated with the landfill because the Phase II RI analytical results were consistently higher than those obtained during Phase I RI sampling (see Tables 5-5 and 5-6). One possible explanation for the elevated inorganic concentrations is the level of suspended sediment in the samples. The only organic contaminants detected, di-n-butylphthalate and di-n-octylphthalate, were detected in the Phase I RI samples. Since these organics are common laboratory and field contaminants, it is likely that their presence is not site related.

Two organics, acetone and butylbenzylphthalate, were detected in Phase I RI sediment samples. Both of these chemicals are also common laboratory contaminants; thus, it does not appear that their presence can be attributed to activities at the landfill. No organic contaminants were detected in the Phase II RI sediment sample, which was taken in the same location as the background surface water sample. In the Phase I RI, arsenic exceeded the sediment criterion, but not the benchmark background concentration. Copper and iron exceeded the NYSDEC Aquatic Sediment Criteria, but not the benchmark background concentration. Some samples contained manganese, nickel, and zinc at concentrations exceeding both the benchmark background concentration and NYSDEC criteria. The highest concentrations of iron and manganese were detected in the background sediment sample; therefore, it is unlikely that the presence of these analytes in downstream sediments is site related. Manganese and zinc exceeded the benchmark background concentration in the Phase II RI sediment sample. Arsenic, iron, manganese, nickel, and zinc exceeded the NYSDEC Aquatic Sediment Criteria; however, given the location of this sediment sample, it is unlikely

that these elevated concentrations can be attributed to activities at the landfill (see Tables 5-7 and 5-8).

Some PAHs were found in a surface soil sample taken from the southwest corner of the site and in subsurface soil/waste material samples (see Table 5-9). The levels found were comparable to concentrations for PAHs in rural soils reported in the ATSDR toxicological profile for PAHs. Therefore, PAHs were not selected as COPCs at this site. 1,2-DCE, TCE, and VC were detected in the subsurface soil taken from the south-southeast portion of the site (MW-5D) and were selected as COPCs (see Table 5-10). No other soil samples contained elevated levels of organic contaminants.

Phase I RI groundwater samples from the southeast corner of the site contained levels of TCE that were above both the NYSDOH MCL for public water supplies and the NYSDEC Class GA groundwater standard (see Table 5-11). This groundwater also contained elevated concentrations of 1,1-DCE, total 1,2-DCE, and VC. Several Phase II RI monitoring well samples, particularly those collected in the south and southeastern portions of the site, contained concentrations of 1,1-DCE, total 1,2-DCE, TCE, and VC that exceeded applicable criteria (see Table 5-12). Fifteen inorganic analytes were detected in Phase I RI groundwater samples. Several of these inorganics were detected at concentrations below the applicable criteria. Iron, lead, magnesium, manganese, and sodium were detected at concentrations exceeding the appropriate criteria; however, the high inorganic content of many of these samples is likely the result of elevated levels of suspended sediment in the samples.

Elevated concentrations of several inorganics were detected in Phase II RI monitoring wells. Of the 19 inorganic analytes detected in the Phase II RI samples, the highest concentrations of 15 of these chemicals were detected in MW-8D, which is located in the southwest portion of the site. Three of the remaining maximum concentrations were detected in well CW-3A, located to the southeast of MW-8D. Although these monitoring wells, which are screened across fine-grained materials, were purged one day and sampled the next, several samples had high turbidities, including MW-8D.

TCE was detected in one Phase I and one Phase II RI residential spring sample (see Tables 5-13 and 5-14). In each case, TCE was detected in a residential spring sample collected on the LaDue property. The Phase II RI sample from the LaDue house contained TCE at a level (6.2 μg/L) that exceeds the NYSDEC Class GA standard (5 μg/L). The level detected in the Phase II RI sample was higher than that detected in the Phase I RI sample (2.9

μg/L) collected on the LaDue property. Acetone, carbon disulfide, and 1,2-DCA were also detected in Phase II RI residential well and spring samples. The acetone is likely related to laboratory contamination, while the 1,2-DCA and carbon disulfide are thought to be artifacts of sample preservation.

Several inorganics were detected in residential wells and springs. Most of the inorganics were detected in downgradient wells near the landfill, particularly to the southeast, but elevated levels of antimony and manganese were also detected in wells further downgradient from the landfill. Two downgradient samples (DW2-13 and DW2-3) contained elevated levels of antimony; however, antimony was not detected in any downgradient wells located closer to the landfill. Thus, it is believed that the concentrations of antimony in these two wells are not site related. Two downgradient samples (DW2-6 and DW2-10) contained elevated concentrations of manganese; however, elevated concentrations of manganese were not detected in other nearby downgradient wells. Therefore, it is unlikely that the elevated concentrations of manganese are attributed to the site.

5.3 CONTAMINANT MIGRATION AND EXPOSURE PATHWAYS

Contaminants in the environmental media at the Wellsville-Andover Landfill site seem to be located primarily at the southwest corner of the site, at the southern border of the site where a leachate sump overflowed, and in the south-southeast portion of the site. Although historical data have shown the presence of organic contamination in downgradient residential wells and springs, the only potable water contamination by site-related organics found in the Phase I and Phase II RI samples was TCE in the LaDue spring. This may be due to the overflow of the leachate sump at the southern border of the site, but is more likely due to groundwater contamination originating elsewhere on site. This was the only evidence of off-site contaminant migration of COPCs directly impacting local residents.

Potential exposure pathways are shown schematically in Figure 5-1, the conceptual site model. Substantial concentrations of several VOCs were found in landfill gas samples collected from the leachate collection system. Investigations at another mixed waste landfill (Strasburg Landfill in Pennsylvania) that had substantial landfill gas generation showed that VOC concentrations in ambient air around the top of the landfill were about 1,000 times lower than concentrations in the soil gas. The empirical relationship observed between contaminant concentrations in the soil gas and ambient air also were in excellent agreement

with the relationship predicted by an EPA model for the pressure-driven migration of vapors through soil. Therefore, the NYSDEC AGCs, which apply to ambient air, were multiplied by 1,000 in order to obtain suitable benchmarks for evaluating the significance of the landfill gas concentrations.

Chemicals were selected as COPCs if they were detected at concentrations exceeding NYSDEC and NYSDOH criteria, and if their presence at those concentrations in more than one medium suggests they are site-related chemicals. COPCs selected as a result of this evaluation are indicated in Tables 5-1 through 5-14, and are listed separately in Table 5-15.

Waste materials placed in the landfill were covered with clean local fill. Therefore, direct contact with waste materials is not considered a potential exposure pathway. The sampling results did not reveal the presence of COPCs in surface soils, surface water, or stream sediments. Therefore, direct contact with COPCs on most of the site and adjacent areas does not appear to be a complete exposure pathway.

One Phase I RI leachate sample contained TCE at a level above its NYSDEC Class C surface water standard. Samples taken from manholes near the holding pond did not reveal significant contamination above criteria values. Toluene and 1,1-DCA were detected in Phase II leachate samples collected near the northeast fill area. 1,1-DCA was detected in this sample at a concentration exceeding the NYSDEC Class C surface water standard. Because leachate has flowed into the unnamed tributary of Duffy Creek, the potential for surface water contamination exists. In addition, dermal contact with contaminated landfill leachate is a potential pathway of concern for site visitors and nearby residents.

COPCs were detected in landfill gas samples from the leachate collection system at levels above benchmark concentrations. These volatile organic chemicals could migrate to the landfill surface and into the ambient air, where site visitors and nearby residents might inhale them. This is a potentially complete exposure pathway.

COPCs were found in site groundwater and also in one off-site residential spring. Some of the same contaminants also have been found historically in other domestic wells downgradient of the site. Water from these wells is used for general domestic supply purposes. Thus, residents could potentially be exposed to contaminants in the water by drinking the water or by showering or bathing in it. Since the COPCs in the groundwater are VOCs, they might also migrate from the groundwater via soil gas into ambient air or into

indoor air in areas downgradient from the landfill. If this were to occur, nearby residents might also be exposed to site contaminants through inhalation.

5.4 HEALTH EFFECTS SUMMARIES

The health effects summaries describe the potential toxic properties of the COPCs at the Wellsville-Andover Landfill site. In most cases, the majority of the information is drawn from the public health statement in the ATSDR toxicological profile for the given chemical (ATSDR 1988-1992). Where available, minimum risk levels (MRLs) for the COPCs have been included. MRLs are provided in the ATSDR toxicological profiles for some chemicals. The MRLs are estimates of exposure levels posing minimum risk to humans. Exposures to concentrations below the MRL are not expected to result in adverse noncarcinogenic health effects. MRLs include adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from laboratory animal data to humans. The MRLs were developed using generic exposure assumptions appropriate for the general population.

In cases where the EPA has evaluated the carcinogenicity of a chemical, its classification has been listed. These classifications are:

Group A: Human carcinogen; sufficient evidence from epidemiological studies

Group B: Probable human carcinogen

- B1: At least limited evidence of carcinogenicity to humans
- B2: Usually a combination of sufficient evidence for animals and inadequate data for humans

Group C: Possible human carcinogen; limited evidence of carcinogenicity in animals and an absence of human data

Group D: Not classified; inadequate animal evidence of carcinogenicity

Group E: Non-carcinogen; no evidence of carcinogenicity in animals or man.

1,1-Dichloroethane (1,1-DCA)

1,1-DCA is a man-made liquid chemical that is used industrially as a solvent and in the manufacture of other chemicals. When 1,1-DCA is released to surface water or surface soil, the chemical will evaporate into air. Although its water solubility is low, 1,1-DCA can migrate from soil into groundwater. Some 1,1-DCA found in the environment is a break-down product of 1,1,1-trichloroethane. Human exposure to 1,1-DCA can result from breathing contaminated air or eating or drinking contaminated food or water.

Relatively little information is available on the health effects of 1,1-DCA in humans or animals. 1,1-DCA was once used as a surgical anesthetic gas, although this use was discontinued when it was discovered that irregular heartbeats were induced at anesthetic doses. Exposure to high levels of 1,1-DCA in air has caused death in animals. Long-term exposure to high levels of 1,1-DCA has caused kidney damage in laboratory animals. In addition, exposure of pregnant rats to 1,1-DCA in air resulted in delayed development in the offspring. There is no evidence of similar harmful health effects in humans.

One laboratory study suggests 1,1-DCA may cause increased tumors in rats and mice, but the results are inconclusive. There is no evidence 1,1-DCA is carcinogenic in humans. In light of the results of animal studies, the EPA has classified 1,1-DCA as a Group C possible human carcinogen.

1,1-Dichloroethene (1,1-DCE)

1,1-DCE is a man-made chemical that does not occur naturally in the environment. It is a clear, colorless liquid that has a mild, sweet, chloroform-like odor. 1,1-DCE is used to make plastic products such as Saranwrap and flame-retardant fabrics.

High levels of exposure to 1,1-DCE can occur among workers in plants making or using this chemical. Low levels of 1,1-DCE have been detected in the environment. 1,1-DCE sometimes has been detected at background levels of less than 1 part per million in indoor and outdoor air. Higher concentrations of 1,1-DDE have been found in air near factories that make or use 1,1-DCE and some chemical waste sites. Surveys of U.S. drinking water supplies have found a small percentage of drinking water supplies contain detectable 1,1-DCE.

1,1-DCE usually enters the body via inhalation and/or ingestion. It may also enter the body through the skin. The human health effects resulting from exposure to 1,1-DCE are

unknown. In animal studies, brief exposures to high concentrations of 1,1-DCE have caused liver, kidney, heart, and lung damage, nervous system disorders, and death. Prolonged exposure to lower concentrations of 1,1-DCE has also produced liver damage.

An increased risk for cancer was observed in one study of animals exposed to 1,1-DCE, although most studies do not show an increased cancer risk. Based upon this one positive study, 1,1-DCE is classified as a Group C possible human carcinogen.

MRLs for short- and long-term exposures (also based upon animal studies) are, respectively, 0.1 and 0.004 ppm in air and 4 and 10 ppm in food and/or water.

1,2-Dichloroethene (1,2-DCE)

1,2-DCE is a man-made flammable liquid with a sharp, harsh order. 1,2-DCE is primarily used in the production of solvents and as an additive to dyes, lacquer solutions, perfumes, and thermoplastics. There are two forms of 1,2-DCE, cis-1,2-DCE and trans-1,2-DCE, which may occur separately or as a mixture.

In the environment, 1,2-DCE evaporates rapidly. When 1,2-DCE is released to either surface soil or surface water, almost all of the chemical will evaporate into air. When 1,2-DCE occurs underground, such as in landfills and chemical waste sites, 1,2-DCE can dissolve in water and migrate into groundwater. In groundwater, 1,2-DCE breaks down to VC, which ultimately breaks down to water, carbon dioxide, and chloride ions. VC, the initial breakdown product, is more toxic than 1,2-DCE.

1,2-DCE can enter the body by drinking water, eating food, or breathing air that contains 1,2-DCE. Because 1,2-DCE evaporates readily, inhalation is the most likely route of human exposure. Inhalation of high levels of 1,2-DCE can cause nausea, drowsiness, dizziness, and may result in death. Liver, heart, and lung damage were observed in laboratory animals after short- or long-term exposure to 1,2-DCE in air. Liver and lung damage was reported in animals fed 1,2-DCE. Death can also occur in animals fed large amounts of 1,2-DCE. Changes in blood chemistry is the critical or most sensitive effect and serves as the basis of the RfD used in the risk assessment.

The long-term health effects resulting from exposure to 1,2-DCE are unknown. Increased risk of cancer has not been reported in humans or animals exposed to 1,2-DCE.

Toluene

Toluene is used as a solvent in the production of a variety of products and as a constituent in the formulation of gasoline and aviation fuels. Toluene is volatile and, when released to surface water and soil, tends to evaporate quickly. Nonvolatilized toluene undergoes microbial degradation and, therefore, does not tend to build up over time. Toluene can enter and affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed.

Exposure to toluene can cause many CNS effects. Toluene may cause fatigue, weakness, confusion, headache, dizziness, drowsiness, and irritation of the eyes, respiratory tract, and skin. These symptoms have been reported in association with occupational exposure to airborne concentrations of toluene ranging from 50 ppm (189 mg/m^3) to 1.500 ppm (5,660 mg/m^3). Symptoms generally increase in severity with increased exposures.

Toluene does not appear to cause cancer in humans or animals. No increased risk of cancer was detected in studies of occupationally exposed men, and toluene has not been shown to cause cancer in rats and mice exposed via inhalation.

The MRL for short-term exposure to toluene in air is 1.0 ppm. The MRL for long-term exposure to toluene in air is 0.3 ppm (1.1 mg/m^3). The MRL for oral exposure to toluene is 460 ppm and 84 ppm for short- and long-term exposures, respectively.

Trichloroethene (TCE)

TCE is a man-made chemical widely used as a cleaning agent and solvent for degreasing operations. Most TCE released into surface water or surficial soil will rapidly evaporate into the air. In the subsurface, TCE is moderately to highly mobile and can migrate to groundwater. TCE biodegrades very slowly in subsurface soils and groundwater. Microbial degradation products include dichloroethene and VC.

Humans are most likely to be exposed to TCE in air. TCE also may occur in drinking water supplies and consumer products including metal cleaners, spot removers, rug cleaning fluids, paints, and paint removers. TCE may cause adverse health effects following exposure via inhalation, ingestion, or skin or eye contact. Exposure to high levels of TCE can cause central nervous system effects including drowsiness, dizziness, headache, blurred vision, lack of coordination, mental confusion, flushed skin, tremors, nausea, vomiting, fatigue, irregular heartbeat, and in some cases death. In the past, TCE was used as an

anesthetic, but that use was discontinued when it was found to cause irregular heartbeats. Chronic exposure to TCE can cause liver damage and skin reactions, as well as central nervous system effects.

Exposure of laboratory animals to TCE has been associated with an increased incidence of a variety of tumors, including kidney, liver, and lung cancers. However, it is uncertain whether people exposed to TCE have a higher risk of cancer. EPA has classified TCE as Group B2, probable human carcinogen.

MRLs for noncarcinogenic effects have been derived for oral and inhalation exposure. The MRL for TCE in air is 0.1 ppm for both short- and long-term exposures. The MRL for ingestion of TCE is 0.125 ppm for short-term and 0.1 ppm for long-term exposure.

Vinyl Chloride (VC)

VC, which is a gas or pressurized liquid at ambient temperature, is primarily used in the chemical manufacturing industry in the production of polymeric chemicals (e.g., PVC) that are in turn used to manufacture a variety of plastic and vinyl products. In addition, VC is a known degradation product of many chlorinated solvents including tetra-, tri-, and dichloroethenes. Most of the VC in the environment comes from the plastic industry's releases to air or water. In surface water or surface soil, VC evaporates readily. Once in the air, VC breaks down rapidly to nonhazardous chemicals. VC can dissolve in water and migrate to groundwater. Once in the groundwater VC can persist for many years.

People are most likely to be exposed to VC in the air, although it is also possible to be exposed to VC in drinking water. Levels of VC have not been detected in background air samples, but it has been detected in the air near some plastics factories, landfills, and chemical waste sites. VC has also been detected in tobacco smoke.

VC may cause adverse health effects following exposure by inhalation, ingestion, or by dermal or eye contact. VC inhalation can cause dizziness or sleepiness. Breathing very high levels of VC can cause unconsciousness and in some cases death. On skin, exposure to liquid VC can cause burns. Noncarcinogenic effects associated with long-term occupational VC exposure include hepatitis-like changes in the liver, immune response, and nerve damage.

VC has been shown to cause liver and lung cancer in rats, and liver cancer in workers occupationally exposed to air concentrations in the range of less than 25 ppm to greater than 200 ppm. Based on this evidence, EPA has classified VC as Group A, human

carcinogen. Air standards as low as 1 ppm are specified for occupational exposure to VC in many countries.

An intermediate-term inhalation MRL of 0.002 ppm for a six-day exposure has been calculated for VC based on animal studies. A chronic oral MRL of 2×10^{-5} mg/kg/day has also been derived.

5.5 CONCLUSION

A preliminary evaluation of the potential risks posed by the Wellsville-Andover Landfill was conducted by comparing concentrations of contaminants found at or near the landfill with background levels, human health risk based concentrations, and applicable NYSDEC and NYSDOH standards and guidelines. COPCs were chosen based on this comparison process and the presence of elevated concentrations of a chemical in more than one media. COPCs are listed in Table 5-15 and include 1,1-DCA, 1,1-DCE, 1,2-DCE, toluene, TCE, and VC.

The results of the Phase I and Phase II RI for the site indicate that significant levels of contaminants exist in the landfill leachate and landfill gas and that contaminants are migrating from the landfill through the groundwater. Contaminants may also be migrating directly to the ambient air through gases and vapors released from the landfill. Results from the Phase I and Phase II RI monitoring well and residential well/spring samples suggest that groundwater contamination is migrating in a south/southeasterly direction.

Under existing conditions at the site, the most important potential exposure pathway appears to be the use of contaminated groundwater downgradient from the site as a source of drinking water. Other potential pathways include inhalation of vapors emanating directly from the landfill or from contaminated groundwater, and contact with landfill leachate at seeps and the holding pond. In the future, new residences may be built closer to the landfill and would probably also use groundwater as a drinking water source. If this were to occur, the exposure pathways would be the same as those described for existing conditions, except exposure levels could be much higher because the levels of groundwater contamination were observed to be much higher closer to the landfill. This would result in higher ingestion and inhalation exposures through the groundwater and an increased possibility of vapors infiltrating the residences directly from the contaminated groundwater. Adverse effects that

might occur as a result of these possible exposures are discussed in this evaluation as well as Section 5.4.

As discussed above, the analytical results of the Phase I and Phase II RI samples were screened against applicable criteria. This screening process involved comparison of detected concentrations with applicable regulatory standards, criteria, guidelines, and benchmark concentrations geared toward protecting human health. The health-risk-based benchmark concentrations and the regulatory standards are intentionally conservative to protect human health even when exposure occurs frequently for many years. Therefore, chemicals with concentrations falling below these levels can confidently be eliminated from further consideration. On the other hand, because the criteria concentrations assume frequent long-term exposure (daily for 30 years, for example), concentrations that exceed these levels might pose potentially significant risks, depending on the frequency and duration of exposure that might actually occur at a particular site. Exceedance of generic benchmark concentrations is an indication that potential exposures might pose significant risks and that these risks need to be assessed on a more site-specific basis.

This preliminary risk evaluation was intended to determine whether environmental contamination associated with the Wellsville-Andover Landfill site has the potential to pose significant risks to human health and warrants further site-specific assessment. A number of chemicals including 1,1-DCA, 1,1-DCE, 1,2-DCE, toluene, TCE, and VC exceeded their screening level criteria; therefore, a site-specific risk assessment appears to be warranted. This preliminary evaluation was not intended to provide site-specific, health-based remedial goals for use in a feasibility study or as the basis for remedial action. Because the screening criteria are based on conservative exposure assumptions, they would be adequately protective if used as remedial goals. However, if the reasonable maximum exposure for the site is substantially lower than the conservative default assumptions, use of the screening levels as remedial goals would be unnecessarily conservative and could lead to the selection of excessive or even unnecessary remedial action.

Table 5-1

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI LANDFILL GAS SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (ppb)		1000x NYSDEC AGC (ppb)[a]	Exceedance Frequency
		Minimum	Maximum		
Volatile Organic Compounds					
Benzene	2/6	113	240	38	2/6
Chloroethane	2/6	60	820	NA	NA
1,1-Dichloroethane[b]	4/6	4	1,700	124,000	0/6
cis-1,2-Dichloroethene[b]	6/6	2	87,000	479,000	0/6
Ethylbenzene	6/6	19	21,000	230,000	0/6
Freon®11	2/6	180	210	125,000	0/6
Freon®12	3/6	12	27	NA	NA
Freon®114	2/6	2	980	NA	NA
Methylene chloride	1/6	—	860	7,770	0/6
1,2,4-Trichlorobenzene	1/6	—	2	1,210	0/6
1,1,1-Trichloroethane	2/6	800	2,300	183,000	0/6
Trichloroethene[b]	2/6	2	390	80	1/6
1,2,4-Trimethylbenzene	1/6	—	34	59,000	0/6
Toluene[b]	6/6	3	8,600	531,000	0/6
Vinyl chloride[b]	6/6	11	12,000	8	6/6
m,p-Xylene	5/6	34	1,800	69,000	0/6
o-Xylene	2/6	5	290	161,000	0/6

[a] Annual Guidance Concentration (NYSDEC 1991c) converted from $\mu g/m^3$ to ppb and multiplied by 1,000 (see text for explanation).

[b] Chemical of potential concern.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

Table 5-2

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI LEACHATE SAMPLES

Chemical	Detection Frequency[a]	Range of Detected Concentrations (µg/L)		NYSDEC Class C Surface Water Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum		
INORGANIC SUBSTANCES					
Aluminum	3/3	203	27,600	100	3/3
Arsenic	1/3	—	12.5	190	0/3
Barium	3/3	148	577	NA	NA
Calcium	3/3	116,000	191,000	NA	NA
Chromium	3/3	11.0	39.9	962 / 791[c]	0/3
Cobalt	2/3	55.4	58.4	5	2/3
Copper	2/3	10.5	35.2	58.8 / 47.9[c]	0/3
Iron	3/3	16,700	165,000	300	3/3
Lead	2/3	27.2	47.9	34.6 / 25.6[c]	2/3
Magnesium	3/3	19,500	50,300	NA	NA
Manganese	3/3	1,880	3,670	NA	NA
Nickel	2/3	42.5	54.5	398 / 332[c]	0/3
Potassium	3/3	6,830	50,700	NA	NA
Sodium	3/3	11,700	71,500	NA	NA
Vanadium	1/3	—	52.2	14	1/3
Zinc	3/3	10	227	30	2/3
ORGANIC SUBSTANCES					
Acetone	1/3	—	17	NA	NA
2-Butanone	1/3	—	10	NA	NA
Chlorobenzene	1/3	—	3	5	0/3
4-Chloro-3-methylphenol	1/3	—	4	1[e]	1/3
1,4-Dichlorobenzene	1/3	—	1	5[f]	0/3
1,1-Dichloroethane[d]	1/3	—	8	5	1/3
1,2-Dichloroethane	1/3	—	0.8	5	0/3

Key at end of table.

Table 5-2

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI LEACHATE SAMPLES

Chemical	Detection Frequency[a]	Range of Detected Concentrations (µg/L)		NYSDEC Class C Surface Water Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum		
1,2-Dichloroethene[d] (total)	3/3	2	240	NA	NA
Di-n-butylphthalate	1/3	—	2	NA	NA
Diethylphthalate	1/3	—	0.9	NA	NA
Ethylbenzene	1/3	—	37	5	1/3
Methylene chloride	1/3	—	3	5	0/3
4-Methylphenol	1/3	—	3	NA	NA
Naphthalene	1/3	—	1	NA	NA
n-Nitrosodiphenylamine	1/3	—	1	NA	NA
Toluene[d]	1/3	—	8	5	1/3
1,1,1-Trichloroethane	1/3	—	1	5	0/3
Trichloroethene[d]	3/3	2	14	11	1/3
Vinyl chloride[d]	1/3	—	18	5	1/3
Xylenes (total)	1/3	—	2	5	0/3

[a] Includes sample taken April 22, 1992 by a Region 9 NYSDEC representative.
[b] 6 NYCRR 703.5.
[c] Standard is a function of hardness; first value is for sample L-1, and second value is for sample L-2.
[d] Contaminant of potential concern.
[e] Standard applies to total chlorinated phenols.
[f] Standard applies to the sum of ortho, meta, and para isomers.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

Table 5-3

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI LEACHATE/SEEP SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDEC Class C Surface Water Standard (μg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
INORGANIC SUBSTANCES					
Aluminum	4/4	1,020	35,900	100	4/4
Arsenic	4/4	5.9[b]	28.0	190	0/4
Barium	4/4	47.5	511	NA	NA
Beryllium	1/4	—	1.7	11 - 1,100[c]	0/4
Calcium	4/4	9,060	153,000	NA	NA
Chromium	3/4	18.4	36.3	87.6 - 1,140[d]	0/4
Cobalt	4/4	5.9	66.2	5	4/4
Copper	4/4	5.3	49.4	4.8 - 70[d]	1/4
Iron	4/4	8,850	100,350[b]	300	4/4
Lead	4/4	7.2	67.9	0.9 - 45[d]	1/4
Magnesium	4/4	3,010	102,000	NA	NA
Manganese	4/4	1,130	15,100	NA	NA
Nickel	3/4	23.5	73.0	43 - 465[d]	0/4
Potassium	4/4	1,800	65,500[b]	NA	NA
Sodium	4/4	1,050	168,000[b]	NA	NA
Vanadium	3/4	7.2[b]	53.7	14	2/4
Zinc	4/4	40.5	181	30	4/4
ORGANIC SUBSTANCES					
Volatiles					
Chlorobenzene	1/4	—	6.5[b]	5	1/4
Chloroethane	1/4	—	44.5[b]	5	1/4
1,1-Dichloroethane[e]	1/4	—	8.5[b]	5	1/4
1,2-Dichloroethane	4/4	7[b]	10	5	4/4
Ethylbenzene	1/4	—	145[b]	5	1/4

Key at end of table.

Table 5-3

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI LEACHATE/SEEP SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDEC Class C Surface Water Standard (µg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
Xylenes (total)	1/4	—	445[b]	5	1/4
Toluene	2/4	—	2[f]	5	0/4

[a] 6 NYCRR 703.5.
[b] Value is average of sample and duplicate.
[c] Standard is a function of hardness as follows: 11 µg/L when hardness is <75 mg/L and 1,100 µg/L when hardness is > 75 mg/L.
[d] Standard is a function of hardness.
[e] Contaminant of potential concern.
[f] Samples contained identical concentrations.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 5-4

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentration (mg/kg)[a]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	5/5	9,450	14,600	128,000	0/5	NA	NA
Arsenic	5/5	11.5	20.9	16	1/5	80	0/5
Barium	5/5	85.7	215	867	0/5	4,000	0/5
Calcium	5/5	1,610	9,890	14,400	0/5	NA	NA
Chromium	5/5	18.2	28.8	112	0/5	80,000	0/5
Cobalt	5/5	20.8	28.1	19.8	5/5	NA	NA
Copper	5/5	25.4	194	48.7	1/5	3,000[c]	0/5
Iron	5/5	23,900	38,300	54,100	0/5	NA	NA
Lead	5/5	15.3	86.9	33	4/5	250	0/5
Magnesium	5/5	3,330	5,070	10,700	0/5	NA	NA
Manganese	5/5	422	784	1,450	0/5	20,000	0/5
Nickel	5/5	31.9	43.2	38.2	1/5	2,000	0/5
Potassium	5/5	1,570	2,160	23,500	0/5	NA[d]	NA
Vanadium	5/5	15.1	26.2	140	0/5	600	0/5
Zinc	5/5	87.4	269	104	4/5	20,000	0/5

Key at end of table.

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Table 5-4

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Health Risk Value (mg/kg)[b]	Exceedance Frequency
		Minimum	Maximum		
ORGANIC SUBSTANCES					
Volatiles					
Acetone	4/5	0.23	4.5	6,000	0/5
Benzene	1/5	—	0.078	24	0/5
2-Butanone	2/5	0.075	0.49	NA	NA
1,1-Dichloroethane[c]	1/5	—	0.71	8,000	0/5
1,2-Dichloroethene[c] (total)	4/5	0.021	3.9	800[f]	0/5
Ethylbenzene	5/5	0.031	33	8,000	0/5
2-Hexanone	2/5	0.044	0.12	NA	NA
Methylene chloride	1/5	—	0.11	93	0/5
4-Methyl-2-pentanone	1/5	—	0.26	NA	NA
Styrene	2/5	0.045	4.2	23	0/5
Tetrachloroethene	1/5	—	0.52	14	0/5
Toluene[c]	5/5	0.011	3.2	20,000	0/5
Trichloroethene[c]	2/5	0.073	5.3	64	0/5
Vinyl chloride[c]	1/5	—	0.98	0.36	1/5
Xylenes (total)	4/5	0.051	1.7	200,000	0/5

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Table 5-4

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Health Risk Value (mg/kg)[b]	Exceedance Frequency
		Minimum	Maximum		
ORGANIC SUBSTANCES (CONT.)					
Semivolatiles					
Benzo(a)fluoranthene	1/5	—	0.37	0.22	1/5
Benzo(a)pyrene	1/5	—	0.28	0.061	1/5
Benzyl alcohol	1/5	—	1.2	20,000	0/5
Bis(2-ethylhexyl)phthalate	5/5	0.13	8.3	50	0/5
Butylbenzylphthalate	3/5	1.0	16	20,000	0/5
4-Chloro-3-methylphenol	1/5	—	0.30	NA	NA
Chrysene	1/5	—	0.41	NA	NA
Di-n-butylphthalate	4/5	0.049	14	8,000	0/5
1,2-Dichlorobenzene	2/5	0.67	1.2	7,000	0/5
Diethylphthalate	2/5	0.025	0.11	60,000	0/5
Dimethylphthalate	2/5	0.53	0.91	80,000	0/5
Fluoranthene	3/5	0.28	0.72	3,000	0/5
2-Methylnaphthalene	2/5	0.18	0.19	NA	NA
4-Methylphenol	4/5	0.37	1.6	NA	NA

Key at end of table.

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Table 5-4

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Health Risk Value (mg/kg)[b]	Exceedance Frequency
		Minimum	Maximum		
ORGANIC SUBSTANCES (CONT.)					
Semivolatiles (Cont.)					
Naphthalene	2/5	0.14	0.15	300	0/5
Pentachlorophenol	1/5	—	6.6	2,000	0/5
Phenanthrene	3/5	0.13	0.61	NA	NA
Pyrene	3/5	0.19	0.53	2,000	0/5
Pesticides					
beta-BHC	1/5	—	0.012	3.9	0/5
Dieldrin	1/5	—	0.013	0.044	0/5
4,4'-DDD	2/5	0.043	0.12	2.9	0/5
4,4'-DDE	1/5	—	0.015	2.1	0/5
4,4'-DDT	1/5	—	0.13	2.1	0/5

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Table 5-4 (Cont.)

[a] Upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984);
[b] Guidance derived from direct ingestion pathway (NYSDEC 1991c).
[c] RCRA CMS action level for soil (USEPA 1990).
[d] NYSDEC value was derived from potassium cyanide and is inappropriate for this use.
[e] Contaminant of potential concern.
[f] Derived from cis-1,2-Dichloroethene.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

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Table 5-5

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SURFACE WATER

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDEC Class C Surface Water Standard (µg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
INORGANIC SUBSTANCES					
Aluminum	5/6	137	874	100	5/6
Calcium	6/6	15,400	19,800	NA	NA
Iron	6/6	130	3,840	300	4/6
Lead	6/6	1.1	4.8	1.48 - 1.90[b]	3/6
Magnesium	5/6	6,360	7,200	NA	NA
Manganese	4/6	68.5	3,090	NA	NA
Sodium	5/6	8.980	22,100	NA	NA
ORGANIC SUBSTANCES					
Semi-Volatiles					
Di-n-butyl phthalate	4/6	1	2	NA	NA
Di-n-octyl phthalate	1/6	–	2	NA	NA

[a] 6 NYCRR 703.5.

[b] Standard is a function of hardness.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

Table 5-6

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI SURFACE WATER

Chemical	Detection Frequency	Detected Concentration (µg/L)	NYSDEC Class C Surface Water Standard (µg/L)[a]	Exceedance Frequency
Inorganic Substances				
Aluminum	1/1	4,670	100	1/1
Arsenic	1/1	3.6	190	0/1
Barium	1/1	172	NA	NA
Calcium	1/1	18,800	NA	NA
Copper	1/1	7.3	8.5[b]	0/1
Iron	1/1	7,500	300	1/1
Lead	1/1	7.5	2.0[b]	1/1
Magnesium	1/1	7,210	NA	NA
Manganese	1/1	437	NA	NA
Nickel	1/1	14.3	71[b]	0/1
Potassium	1/1	3,070	NA	NA
Sodium	1/1	8,090	NA	NA
Vanadium	1/1	6.1	14	0/1
Zinc	1/1	53.7	30	1/1

a 6 NYCRR 703.5

b Standard is a function of hardness.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 5-7

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SEDIMENT SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[a]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria (mg/kg)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	6/6	1,000	15,700	128,000	0/6	NA	NA
Arsenic	6/6	8.1	13.5	16	0/6	5	6/6
Barium	6/6	97.4	192	867	0/6	NA	NA
Calcium	2/6	1,290	2,010	14,400	0/6	NA	NA
Chromium	6/6	18.3	22.7	112	0/6	26	0/6
Cobalt	6/6	25.4	27.9	19.8	6/6	NA	NA
Copper	6/6	15.7	21.4	48.7	0/6	19	2/6
Iron	6/6	32,400	43,200	54,100	0/6	24,000	6/6
Lead	6/6	3.2	26.1	33	0/6	27	0/6
Magnesium	6/6	3,510	4,640	10,700	0/6	NA	NA
Manganese	6/6	798	2,440	1,450	2/6	428	6/6
Nickel	6/6	33.4	40.1	38.2	2/6	22	6/6
Potassium	1/6	–	1,070	23,500	1/6	NA	NA
Vanadium	6/6	17.5	23.4	140	0/6	NA	NA

Key at end of table.

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Table 5-7

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SEDIMENT SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[a]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria (mg/kg)[b]	Exceedance Frequency
		Minimum	Maximum				
Zinc	6/6	76.1	107	104	1/6	85	3/6
ORGANIC SUBSTANCES							
Volatiles							
Acetone	5/6	0.01	0.035	NA	NA	NA	NA
Semi-Volatiles							
Butylbenzylphthalate	1/6	--	0.024	NA	NA	NA	NA

a Upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984).
b Geometric mean of "no-effect" and "lowest effect" levels based on studies in benthic organisms (NYSDEC 1991b).

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

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Table 5-8

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI SEDIMENT SAMPLES

Chemical	Detection Frequency	Detected Concentration (mg/kg)	Benchmark Background Concentrations (mg/kg)[a]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria[b]	Exceedance Frequency
INORGANIC SUBSTANCES						
Aluminum	1/1	9,890	128,000	0/1	NA	NA
Arsenic	1/1	12.3	16	0/1	5	1/1
Barium	1/1	236	867	0/1	NA	NA
Beryllium	1/1	0.94	1.81	0/1	NA	NA
Calcium	1/1	2,810	14,400	0/1	NA	NA
Chromium	1/1	16.0	112	0/1	26	0/1
Cobalt	1/1	19.4	19.8	0/1	NA	NA
Copper	1/1	19.0	48.7	0/1	19	0/1
Iron	1/1	25,500	54,100	0/1	24,000	1/1
Lead	1/1	24.1	33	0/1	27	0/1
Magnesium	1/1	2,880	10,700	0/1	NA	NA
Manganese	1/1	2,040	1,450	1/1	428	1/1
Nickel	1/1	31.4	38.2	0/1	22	1/1
Potassium	1/1	879	23,500	0/1	NA	NA
Sodium	1/1	235	17,400	0/1	NA	NA
Vanadium	1/1	19.9	140	0/1	NA	NA

Key at end of table.

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Table 5-8

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI SEDIMENT SAMPLES

Chemical	Detection Frequency	Detected Concentration (mg/kg)	Benchmark Background Concentrations (mg/kg)[a]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria[b]	Exceedance Frequency
INORGANIC SUBSTANCES						
Zinc	1/1	112	104	1/1	85	1/1

[a] Upper 90th percentile of concentrations in eastern U.S. soils (Schacklette and Boerngen 1984).
[b] Geometric mean of "no-effect" and "lowest effect" levels based on studies in benthic organisms (NYSDEC 1991b).

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 5-9

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SURFACE SOIL SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	14/14	1,030	14,300	128,000	0/14	NA	NA
Arsenic	14/14	4.0	13.5	16	0/14	80	0/14
Barium	14/14	43.9	741	867	0/14	4,000	0/14
Calcium	8/14	1,680	173,000	14,400	2/14	NA	NA
Chromium	14/14	12.9	40.4	112	0/14	80,000	0/14
Cobalt	14/14	17.7	87.3	19.8	13/14	NA	NA
Copper	13/14	6.6	28.2	48.7	0/14	3,000[c]	0/14
Iron	14/14	23,800	283,000	54,100	3/14	NA	NA
Lead	14/14	13.2	56.1	33	2/14	250	0/14
Magnesium	14/14	1,710	9,060	10,700	0/14	NA	NA
Manganese	14/14	235	4,540	1,450	2/14	20,000	0.14
Nickel	14/14	15.8	88	38.2	4/14	2,000	0/14
Potassium	10/14	1,300	2,250	23,500	0/14	NA[d]	0/14
Vanadium	13/14	14.4	25.6	140	0/14	600	0/14
Zinc	14/14	43	356	104	3/14	20,000	0/14

Key at end of table.

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Table 5-9

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SURFACE SOIL SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
Cyanide	1/14	--	3.5	NA	NA	2,000	0/14
ORGANIC SUBSTANCES							
Volatiles							
Acetone	1/14	--	0.240	NA	NA	6,000	0/14
Chloromethane	1/14	--	0.040	NA	NA	NA	NA
Ethylbenzene	2/14	0.001	0.018	NA	NA	8,000	0/14
Semi-Volatiles							
Anthracene	1/14	--	0.014	NA	NA	20,000	0/14
Benzo(b)fluoranthene	2/14	0.034	0.140	0.020 - 0.030	2/14	0.22	0/14
Benzo(k)fluoranthene	1/14	--	0.022	0.010 - 0.110	0/14	0.22	0/14
Benzo(g,h,i)perylene	1/14	--	0.047	0.010 - 0.070	0/14	NA	NA
Benzo(a)pyrene	1/14	--	0.088	0.002 - 1.3	0/14	0.061	1/14
Bis(2-ethylhexyl)phthalate	1/14	--	2.1	NA	NA	50	0/14
Butylbenzylphthalate	2/14	0.025	0.260	NA	NA	20,000	0/14
Chrysene	3/14	0.040	0.050	0.038	3/14	NA	NA
Dibenz(a,h)anthracene	1/14	--	0.044	NA	NA	0.014	1/14

Key at end of table.

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Table 5-9

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SURFACE SOIL SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
Fluoranthene	3/14	0.042	0.185	0.003 - 0.040	3/14	3,000	0/14
Indeno(1,2,3-cd)pyrene	1/14	--	0.045	0.010 - 0.015	1/14	NA	NA
Phenanthrene	3/14	0.041	0.047	0.030	3/14	NA	NA
Pyrene	4/14	0.049	0.140	0.001 - 0.197	0/14	2,000	

a Guidance derived from human direct ingestion pathway (NYSDEC 1991c).

b For inorganics, benchmark value is the upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984); for PAHs, benchmark value is the background value found in rural soils (ATSDR 1989).

c RCRA CMS action level for copper in soil (USEPA 1990).

d NYSDEC value was derived from potassium cyanide and is inappropriate for this use.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

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Table 5-10

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SUBSURFACE SOIL FROM BORINGS

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Value (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	19/19	5,550	18,100	128,000	0/19	NA	NA
Arsenic	19/19	1.3	17.9	16	3/19	80	0/19
Barium	16/19	43	281	867	0/19	4,000	0/19
Cadmium	2/19	1.3	1.8	NA	NA	80	0/19
Calcium	14/19	1,150	77,550	14,400	1/19	NA	NA
Chromium	19/19	9.3	27.6	112	0/19	80,000	0/19
Cobalt	19/19	14.5	33.2	19.8	18/19	NA	NA
Copper	19/19	7.7	37	48.7	0/19	3,000[c]	0/19
Iron	19/19	14,700	45,200	54,100	0/19	NA	NA
Lead	18/19	6.6	45.3	33	2/19	250	0/19
Magnesium	19/19	3,590	17,100	10,700	1/19	NA	NA
Manganese	19/19	431	1,750	1,450	2/19	20,000	0/19
Mercury	1/19	--	0.12	0.265	0/19	20	0/19
Nickel	19/19	16.9	53.4	38.2	7/19	2,000	0/19
Potassium	17/19	1,340	1,990	23,500	0/19	NA[d]	0/19

Key at end of table.

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Table 5-10

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI SUBSURFACE SOIL FROM BORINGS

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Value (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
Vanadium	18/19	14.2	24.8	140	0/19	600	0/19
Zinc	19/19	56.3	96.5	104	0/19	20,000	0/19
ORGANIC SUBSTANCES							
Volatiles							
1,2-Dichloroethene[f] (total)	2/19	0.061	0.087	NA	NA	800[e]	0/19
Trichloroethene[f]	2/19	0.013	0.022	NA	NA	64	0/19
Vinyl chloride[f]	2/19	0.007	0.021	NA	NA	0.36	0/19

a Guidance derived from human direct ingestion pathway (NYSDEC 1991c).
b Upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984).
c RCRA CMS action level for soils (USEPA 1990).
d NYSDEC value was derived from potassium cyanide and is inappropriate for this use.
e Derived from cis-1,2-dichloroethene.
f Contaminant of potential concern.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

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Table 5-11

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	19/21	217	42,700	NA	NA	NA	NA
Arsenic	1/21	--	17.8	50 P	0/21	25	0/21
Barium	5/21	208	342	1,000 P	0/21	1,000	0/21
Calcium	21/21	9,160	85,200	NA	NA	NA	NA
Chromium	7/21	5	110	50 P	1/21	50	1/21
Cobalt	1/21	--	102	NA	NA	NA	NA
Copper	2/21	46.2	115	1,000 S	0/21	200	0/21
Iron	20/21	316	110,000	300 S[c]	20/21	300[c]	20/21
Lead	12/21	1.2	125	50 P	1/21	25	2/21
Magnesium	20/21	5,400	56,000	NA	NA	35,000 G	3/21
Manganese	21/21	16.4	8,530	300 S[c]	14/21	300[c]	14/21
Potassium	10/21	5,020	38,000	NA	NA	NA	NA
Sodium	20/21	7,450	51,600	NA S	NA	20,000	12/21
Vanadium	1/21	--	67.1	NA	NA	NA	NA
Zinc	11/21	24.1	230	5,000 S	0/21	300	0/21

Key at end of table.

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Table 5-11

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
ORGANIC SUBSTANCES							
Volatiles							
Acetone	1/21	–	33	50 G	0/21	5	1/21
Chloroethane	1/21	–	4	5	0/21	5	0/21
Chloroform	1/21	–	2	7	0/21	7	0/21
1,1-Dichloroethane[d]	2/21	6	11	5	2/21	5	2/21
1,1-Dichloroethene[d]	4/21	3	12	5	3/21	5	3/21
1,2-Dichloroethene[d] (total)	10/21	3	5,600	5	7/21	5	7/21
Ethylbenzene	1/21	–	3	5	0/21	5	0/21
Methylene chloride	1/21	–	4	5	0/21	5	0/21
Toluene[d]	4/21	2	9	5	3/21	5	3/21
1,1,1-Trichloroethane	2/21	1	4	5	0/21	5	0/21
Trichloroethene[d]	9/21	1	1,200	5	6/21	5	6/21

Key at end of table.

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Table 5-11

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
Vinyl chloride[d]	6/21	45	2,100	2	6/21	2	6/21

[a] Maximum Contaminant Level for public water supplies (10 NYCRR 5-1.52).
[b] 6 NYCRR 703.5.
[c] Total concentration of iron and manganese is not to exceed 500 µg/L.
[d] Contaminant of potential concern.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

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Table 5-12

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	28/28	30.8	51,300	NA	NA	NA	NA
Arsenic	23/28	1.0	45.5	50 P	0/28	25	2/28
Barium	28/28	14.0	1,470	1,000 P	1/28	1,000	1/28
Beryllium	4/28	1.2	3.2	NA	NA	3 G	1/28
Cadmium	4/28	3.4	10.8	50 P	0/28	10	1/28
Calcium	28/28	9,430	173,000	NA	NA	NA	NA
Chromium	9/28	5.2	291	50 P	3/28	50	3/28
Cobalt	9/28	4.4	109	NA	NA	NA	NA
Copper	16/28	2.5	208	1,000 S	0/28	200	2/28
Iron	28/28	143	131,000	300 S[c]	25/28	300[c]	25/28
Lead	21/28	1.3	484	50 P	2/28	25	3/28
Magnesium	28/28	1,510	71,500	NA	NA	35,000 G	6/28
Manganese	28/28	29.4	7,570	300 S[c]	14/28	300[c]	14/28
Nickel	8/28	11.6	366	NA	NA	NA	NA
Potassium	28/28	832	42,100	NA	NA	NA	NA

Key at end of table.

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Table 5-12

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
Sodium	28/28	3,250	49,200	NA	NA	20,000	9/28
Vanadium	9/28	4.2	57.8	NA	NA	NA	NA
Zinc	28/28	4.1	549	5,000 S	0/28	300	1/28
Cyanide	4/28	21.0	160	NA	NA	100	1/28
ORGANIC SUBSTANCES							
Volatiles							
Benzene	1/31	—	14	5	1/31	0.7	1/31
Chloroethane	1/31	—	13	5	1/31	5	1/31
1,1-Dichloroethane[e]	2/31	3	9	5	1/31	5	1/31
1,1-Dichloroethene[e]	4/31	2	9	5	2/31	5	2/31
1,2-Dichloroethene[e] (total)	13/31	3	4,300[d]	5	11/31	5	11/31
Ethylbenzene	2/31	4.5[d]	11	5	1/31	5	1/31
Toluene[e]	3/31	1	10[d]	5	2/31	5	2/31
1,1,1-Trichloroethane	3/31	2	6	5	1/31	5	1/31
Trichloroethene[e]	9/31	5	1,800[d]	5	10/31	5	10/31
1,1,2-Trichloroethane	1/31	—	1.5[d]	5	0/31	5	0/31

Key at end of table.

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Table 5-12

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
Vinyl chloride[e]	8/31	8	1,750[d]	5	8/31	2	8/31

a Maximum Contaminant Level for public water supplies (10 NYCRR 5-1.52) .
b NYCRR 703.5.
c Total concentration of iron and manganese is not to exceed 500 µg/L.
d Average of duplicate samples.
e Contaminant of potential concern.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 5-13

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI RESIDENTIAL WELL AND SPRING SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	3/7	323	741	NA	NA	NA	NA
Barium	0/7	NA	NA	1,000 P	0/7	1,000	0/7
Calcium	7/7	13,400	44,850	NA	NA	NA	NA
Chromium	1/7	–	11.1	50 P	0/7	50	0/7
Copper	1/7	–	33.8	1,000 S	0/7	200	0/7
Iron	6/7	107	1,300	300 S[c]	5/7	300[c]	5/7
Lead	0/7	NA	NA	50 P	0/7	25	0/7
Magnesium	7/7	6,070	19,600	NA	NA	35,000 G	0/7
Manganese	7/7	17.7	510	300 S[c]	1/7	300[c]	1/7
Mercury	1/8	–	0.46	2 P	0/7	2	0/7
Potassium	0/7	NA	NA	NA	NA	NA	NA
Sodium	6/7	8,200	58,000	NA	NA	20,000	4/7
Zinc	4/7	13.4	338	5,000 S	0/7	300	1/7
Cyanide	1/7	–	19	NA	0/7	100	0/7

Key at end of table.

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Table 5-13

SUMMARY OF CONTAMINANTS DETECTED IN PHASE I RI RESIDENTIAL WELL AND SPRING SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
ORGANIC SUBSTANCES							
Volatiles							
Trichloroethene[d]	1/7	--	2.9	5	0/7	5	0/7

a Maximum Contaminant Level for public water supplies (10 NYCRR 5-1.52).
b 6 NYCRR 703.5.
c Total concentration of iron and manganese is not to exceed 500 µg/L.
d Contaminant of potential concern.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Source: Compiled by Ecology and Environment Engineering, P.C. 1992.

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Table 5-14

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	4/19	26	925	NA	NA	NA	NA
Antimony	2/19	35.6	39.7	NA	NA	3 G	2/19
Arsenic	4/19	1.5	7.5	50 P	0/19	25	0/19
Barium	19/19	21.3	135	1,000 P	0/19	1,000	0/19
Calcium	18/19	5,890	46,200[d]	NA	NA	NA	NA
Copper	19/19	2.2	2,070	1,000 S	1/19	200	2/19
Iron	14/19	24.6	10,600	300 S[c]	7/19	300[c]	7/19
Lead	4/19	2.0	20.1	50 P	0/19	25	0/19
Magnesium	19/19	3,060	20,900[d]	NA	NA	35,000 G	0/19
Manganese	16/19	3.2[d]	2,050	300 S[c]	3/19	300[c]	3/19
Mercury	1/19	—	0.29	2 P	0/19	2	0/19
Potassium	19/19	556	1,980	NA	NA	NA	NA
Sodium	19/19	1,620	110,000	NA	NA	20,000	10/19
Zinc	16/19	5.4	471	5,000 S	0/19	300	2/19
Cyanide	2/19	10.0	84.0	NA	NA	100	0/19

Key at end of table.

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Table 5-14

SUMMARY OF CONTAMINANTS DETECTED IN PHASE II RI RESIDENTIAL WELL AND SPRING SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)	Exceedance Frequency
		Minimum	Maximum				
ORGANIC SUBSTANCES							
Volatiles							
Acetone	2/17	16	19	5	1/17	NA	NA
Carbon disulfide	1/17	—	0.4	NA	NA	NA	NA
1,2-DCA	1/17	—	1.0	5	0/17	5	0/17
Trichloroethene[e]	1/17	—	5.7[d]	5	1/17	5	1/17

a Maximum Contaminant Level for public water supplies (10 NYCRR 5-1.52).
b 6 NYCRR 703.5.
c Total concentration of iron and manganese is not to exceed 500 µg/L.
d Value represents average of sample and duplicate.
e Contaminant of potential concern.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 5-15 CHEMICALS OF POTENTIAL CONCERN
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene
Toluene
Trichloroethene
Vinyl chloride

2:OB30CSM.pm4

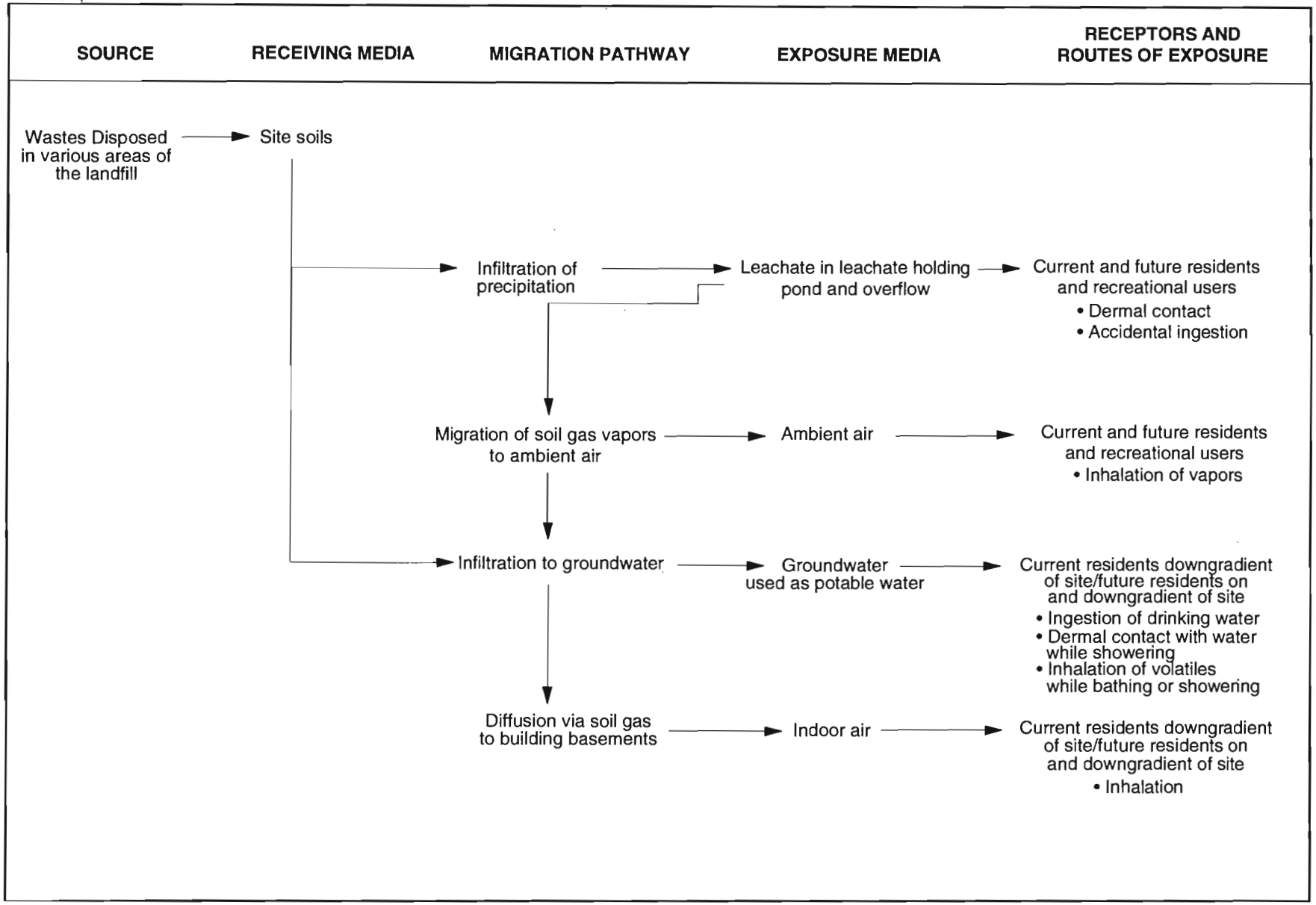

Figure 5-1
CONCEPTUAL SITE MODEL FOR WELLSVILLE-ANDOVER LANDFILL

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6. HABITAT-BASED ASSESSMENT

6.1 INTRODUCTION

This section assesses the potential impact of site-related contaminants on the ecological resources associated with the Wellsville-Andover Landfill site. The HBA followed New York State guidance for characterizing threats to fish and wildlife at hazardous waste sites (*Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites*, June 18, 1991 - NYSDEC Division of Fish and Wildlife). In addition, methods of investigation and analysis were consistent with EPA guidance for environmental evaluation of hazardous waste sites (EPA 1989, 1992a).

The purpose of the HBA is to determine if there are actual or potential threats to fish and wildlife at the site posed by site-related contamination detected in surface water collected from Duffy Creek and its tributary, leachate and seeps, sediment, and surface soil. The HBA report consists of four main sections:

- A description and characterization of ecological resources present at the site;
- An evaluation of the potential pathways for exposure of fish and wildlife to site-related contaminants of concern;
- A comparison of concentrations of contaminants of concern to regulatory criteria for the protection of fish and wildlife; and
- An assessment of the toxicity of site-related contaminants of concern based on literature-derived benchmarks.

From this analysis, preliminary conclusions were drawn regarding the exposures and risks to fish and wildlife associated with contaminants at the site.

6.2 REGIONAL ECOLOGY

6.2.1 Aquatic Ecosystems

The Wellsville-Andover Landfill site is located in the Genesee River drainage basin, which is in the south Lake Ontario subbasin of the Great Lakes basin of New York State (USGS 1985). The Genesee basin is a long narrow valley that extends southward into Pennsylvania and is characterized by fairly short tributaries flowing into the main stem. Water bodies of interest for this investigation include Duffy Creek, which is approximately 1,500 feet east of the site, and an unnamed tributary to Duffy Creek which is approximately 3,000 feet southeast of the site (see Figure 6-1). Duffy Creek converges with Dyke Creek approximately 1.8 miles south-southeast of the site, then flows southwest for approximately 4 miles, where it converges with the Genesee River.

NYSDEC has designated many water bodies in the Genesee River drainage basin as Class B. Class B waters are to be maintained as suitable habitat for fish and other aquatic life as well as for primary and secondary contact recreation. Class B streams cannot be used as a source of drinking water. Some water bodies within this watershed are designated Class A, which indicates that the water may be used as a public water supply, while some are designated Class C, indicating that the waters are suitable for fishing and fish propagation as well as secondary contact recreation but not primary contact recreation.

Duffy Creek and its tributaries are designated Class C (6 NYCRR 821.6). Dyke Creek is designated Class C between the Village of Andover and the Genesee River. In addition to Class C standards, trout water standards apply to Dyke Creek from 1 mile above its mouth to Andover. Trout standards indicate a cold-water stream. According to a 1990 report by NYSDEC's Division of Water, Dyke Creek downstream of Andover is considered Class C partially due to impairment from failing septic systems. The Genesee River is designated Class C from the mouth of Dyke Creek downstream to the dam at Belmont, New York, which is more than 10 miles from the site. Immediately upstream of Dyke Creek, the Genesee is designated Class A due to the presence of Village of Wellsville water intakes.

6.2.2 Terrestrial Ecosystems

The Wellsville-Andover Landfill is located within beech-maple forest cover types (Eyre 1980). A variety of plant communities occur in the vicinity of the site. The chief determinants of the existing plant communities are topography, soils, moisture, and land use.

Since the terrain and land use history at the site are diverse, the associated plant communities are also quite diverse. Hence, the vegetative cover is a mosaic of early successional fields, hedge rows, early successional forests, and mature beech-maple forests. The area surrounding the landfill is a relatively high-quality area for wildlife because of the terrain, lack of development, and large tracts of unbroken forest on relatively steep hills.

The landfill and surrounding area appears to support an abundance and diversity of animal life. Food sources including seeds, fruits, and browse are available in abundance. Year-round cover is available from the mature forests. Mature forests also provide den trees and raptor nest trees. Water is available in ample supply from streams, springs, and ponds.

6.3 ECOLOGICAL CHARACTERIZATION

Prior to the initiation of field work, federal and state natural resource agencies were contacted regarding species-of-concern, significant habitats, and fishery resources that are within a 2-mile radius of the landfill site.

Literature and map resources were reviewed prior to the initiation of field work. These resources included the 1965 USGS Wellsville North topographic quadrangle map, the 1985 U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Wellsville North quadrangle map, 1992 NYSDEC Freshwater Wetland Map-Wellsville North quadrangle, and the *Soil Survey of Allegany County* (USDA 1956).

E & E conducted two field surveys of the site and surrounding areas on October 24, 1991 (Phase I RI), and July 9, 1993 (Phase II RI). The findings of these surveys are described below in Section 6.4.

6.3.1 Methods

Aquatic Ecosystems

A two-member field team surveyed the two streams adjacent to the site on October 24, 1991, and July 9, 1993. Duffy Creek and its unnamed tributary were surveyed in order to characterize their ecological features and to infer their relative quality based on type, number, and diversity of benthic organisms. In addition, some basic water chemistry data were collected during the October 24, 1991, field survey. The results of this survey are presented in Section 6.3.2.

The objective of the survey was to determine if aquatic resources such as biota may be impacted by site-related contaminants. This involved the identification of available habitat in the streams as well as identification of the actual aquatic and benthic species present.

At selected points along the two streams, physical parameters were observed and recorded (see Figure 6-1). These observations included stream location, bank height and composition, stream substratum composition, and flow estimates. Stream flow was measured by timing a floating object for a known (measured) distance. Field measurements of temperature, pH, alkalinity, and conductivity were recorded only for the Phase I RI samples collected on October 24, 1991. Temperature, conductivity, and pH were measured using a Cambridge Instruments meter. Alkalinity was measured using a Hach kit. Samples for water hardness were collected and delivered to E & E's ASC for analysis.

Systematic sampling was conducted to determine type, number, and subsequent diversity of benthic organisms at four locations in Duffy Creek (a perennial tributary to Dyke Creek) and at one location in the intermittent tributary to Duffy Creek. Sampling methods were to include disturbing a known area of the bottom substrate in flowing water and collecting invertebrates swept downstream with a net positioned immediately downstream of the disturbed area. However, conditions in the streams were such that a less quantitative approach was necessitated. Due to the low discharge of the streams, stones were overturned and examined, and leaf debris and woody debris were examined to determine whether invertebrates were present, and if so, what taxon they belonged to. Because no samples were collected and preserved, identification of benthic macroinvertebrates extend no further than order.

Terrestrial Ecosystems

The objectives of the terrestrial survey were to map and describe plant communities present on and adjacent to the site, observe wildlife species present in the vicinity of the landfill, identify and evaluate significant ecological resources that could be impacted by site contamination, and note evidence of plant or animal stress that may be a result of site contamination. The results of this survey are presented in Section 6.4.

Vegetative cover-type boundaries were identified and mapped. Each cover type was traversed and described in terms of plant species composition, vegetative structure, edaphic conditions, and land use. Dominant plant species were identified within each strata (i.e., tree

sapling, shrubs, liana, and herb). Each vegetative cover type identified was classified according to the New York State Natural Heritage Program's *Ecological Communities of New York State* (Reschke 1990).

Wetlands were delineated using procedures described in the *U.S. Army Corps of Engineers Wetland Delineation Manual* (United States Department of the Army 1987). Soil, vegetation, and hydrology were sampled at suspected wetland areas. Wetland function and value was assessed for each wetland.

Wildlife use was evaluated using literature sources as well as field observations. Species lists were generated by reviewing literature for relatively common species that occur within Allegany County, New York. These species lists were augmented by wildlife sightings made during the field survey. Wildlife sightings included direct observations as well as identification based on vocalizations, tracks, burrows, browse, and scat. General wildlife values (i.e., food and cover availability) of each cover type were also noted.

Evidence of physical stress to flora and fauna observed during the field survey was noted. Areas that exhibited evidence of stress were studied closely for indications of whether or not the stress may have been caused by site contaminants. Site contaminants include organics such as 1,4-dichlorobenzene, trichloroethene, and chlorobenzene, and inorganics such as arsenic, cobalt, copper, manganese, nickel, and zinc.

6.4 SITE CHARACTERIZATION

6.4.1 Aquatic Ecosystems

As shown on Figure 6-1, two stream sampling stations (Site 1 and Site 4) in Duffy Creek were located upstream of any potential runoff from the landfill (according to the USGS topographic map). The validity of one sampling location (Phase I RI Site 1) was questioned by NYSDEC. Therefore, a second location was surveyed during the Phase II RI as far upstream as possible in Duffy Creek. The chosen location is north and upstream of the filled portions of the property. The other three sampling stations were located downgradient of the landfill drainage. Stream widths and depths at all locations were all indicative of first-order streams.

Results of water chemistry analyses from October 24, 1991, are provided in Table 6-1. Results of the benthic macroinvertebrate survey for both October 24, 1991, and July 9,

1991, are given in Table 6-2. The locations of the sampling points on the streams are shown on Figure 6-1.

Site 1 (Duffy Creek - Upstream)

The Phase I RI upstream sampling location (Site 1) in Duffy Creek was surveyed on October 24, 1991, and had a substratum composed of 60% cobble, 30% boulder, and 10% silt/pebble. Pooled areas contained primarily silt and leaf debris.

At Site 1, the east bank was 10 feet high, 3 feet from shore. The bank had exposed roots covered with moss. Riparian vegetation consisted of a mature American beech *(Fagus grandifolia)* and hemlock *(Tsuga canadensis)* forest. Many sawtimber-sized trees were present, and the understory had a sparse herbaceous cover. The reproductive layer consisted of beech, sugar maple *(Acer saccharum)*, and hemlock interspersed with white ash *(Fraxinus americana)*. The west bank was 15 feet high, 10 feet from shore. Some herbaceous cover was present on the bank, and pole-sized ironwood *(Carpinus caroliniana)*, white ash, and beech as well as sapling-sized maples were present.

Stream depth at Site 1 was less than 1 inch in the deepest areas. Flow was negligible, correlating with the USGS topographic map showing the stream as intermittent at this point. Stream width was 2 to 3 feet, with the majority of this area being outside of the main channel.

Water chemistry parameters at the upstream site in Duffy Creek were within the expected range of results for a first-order stream for this geographic area at the time of day the parameters were measured. The upstream portion of Duffy Creek is reasonably well buffered, with an alkalinity of 80 mg/L as $CaCO_3$. The water here is moderately hard to hard (120 mg/L as $CaCO_3$) (see Table 6-1). The normal range for alkalinity is 20 to 200 mg/L as $CaCO_3$ (Lind 1979). According to the classification of Brown, Skougstad, and Fishman (1970), hardness is classified as follows: 0 to 60 mg/L $CaCO_3$ is soft, 61 to 120 mg/L $CaCO_3$ is moderately hard, 121 to 180 mg/L $CaCO_3$ is hard, and 181 mg/L $CaCO_3$ and above is very hard. At the time of surveying, the pH was 6.87; the normal diel range for pH in this geographic location is 6.0 to 9.0 (Cole 1979). Duffy Creek is a Class C stream (6 NYCRR 821.6). No standards are given for any of the parameters measured, except pH. According to 6 NYCRR 701.19, pH shall be between 6.5 and 8.5, and water from Site 1 meets this standard.

Invertebrates collected at the upstream site consisted of a single order of insect larvae, caddisflies *(Trichoptera)*. All individuals were found on the bottom of cobble and boulders; no individuals of any taxon were observed in leaf litter, sand, or woody debris. A monotypic assemblage such as this is often indicative of a stressed system. A probable major stress on this stream system is its intermittent nature. At the time of the survey, little to no water was present in this portion of the stream.

Site 2 (Duffy Creek - Downstream)

The Phase I RI downstream sampling location in Duffy Creek (Site 2) was surveyed on October 24, 1991, and had a stream substratum composed of 70% cobble, 5% boulder, 15% pebble, and 10% silt. At Site 2, the east bank was 2 feet high, 25 feet from shore. Bank vegetation was mostly herbaceous until the first bank shelf. There, pole-sized quaking aspen *(Populus tremuloides)*, black cherry *(Prunus serotina)*, and ironwood were present. The understory was sparsely populated with raspberry *(Rubus spp.)*. The second bank shelf had an upland pole-sized forest dominated by beech with occasional ironwood and black cherry. The understory was open, with sensitive ferns *(Onoclea sensibilis)* and sapling beech trees present. The west bank was 10 feet high, 5 feet from shore. This bank was eroded, with sparse herbaceous vegetation and exposed roots. The top of the west bank adjacent to the Duffy Hollow Road was a late successional field containing willow *(Salix spp.)*, raspberry, sapling- to pole-sized black cherry, sapling-sized ironwood trees, and apple trees *(Malus spp)*.

Stream depth at downstream Site 2 was 1 inch in riffle areas and 8 to 12 inches in pooled areas. Flow was measured as 0.66 feet per second. Stream width ranged from 6 to 8 feet.

Water chemistry results are given in Table 6-1; results fall within the expected range of results for a first-order stream for this geographic area. The downstream portion of this stream had a hardness of 76 mg/L as $CaCO_3$, (moderately hard water). The system is reasonably well buffered, with an alkalinity of 60 mg/L as $CaCO_3$. No Class C standards for which data were collected were exceeded at this location.

Invertebrates collected at the downstream site area are listed in Table 6-2. Six orders of insects were represented by nine individuals. The taxa present are generally indicative of average-to-good water quality. Mayflies *(Ephemeroptera)* and stoneflies *(Plecoptera)*

generally require well-oxygenated water, and dobsonflies *(Megaloptera)* are rarely found in areas lacking a healthy riparian vegetation zone. Cranefly larvae *(Tipulidae)* are found in areas high in organic material because these invertebrates are generally detrital feeders (shredders). Numbers of individuals are low, but this may be related to a lack of available habitat.

In the pooled area, several fish were observed, including two sculpins and three minnows.

Site 3 (Tributary to Duffy Creek)

This Phase I RI location (Site 3) in the unnamed tributary to Duffy Creek was surveyed on October 24, 1991, and had a substratum of cobbles, boulders, and leaf litter. The stream meanders, and very little water was present.

Bank morphology was variable at Site 3; some banks were high and steep, and others were low. Banks had exposed roots. Riparian vegetation included large red oak *(Quercus rubra)* and sugar maple, pole-sized white ash, beech, hop hornbeam *(Ostrya virginiana)*, and ironwood. A sparse understory consisted of raspberry and sapling beech trees.

Stream depth at Site 3 was approximately 1 inch, and water was found only in small pools. Flow was negligible. This correlates with the USGS topographic map, which indicates that the stream is intermittent. Stream width was 2 feet.

Water chemistry parameters were within the expected range of results for a first order stream in this geographical area, with an alkalinity of 60 mg/L as $CaCO_3$, and pH 6.96. No NYSDEC water quality standards were exceeded for any parameter measured in this stream (see Table 6-1).

The benthic macroinvertebrate population in this stream at the locus sampled was not heavily colonized by invertebrates: only two taxa were present, represented by only three individuals. The species found here are species commonly found in small first-order streams as well as ephemeral ponds. Lack of high diversity here is likely a reflection on the transient, intermittent nature of the water body.

During the field survey, rust-colored seeps were noted on the banks. Based on similar seeps observed in upstream areas during the Phase II RI, these seeps are interpreted as resulting from algae growth. Downstream from these seep areas, however, the rocks were

coated with a rust-colored substance. This staining most likely resulted from leachate overflow, which has been observed flowing off site into this stream.

Site 4 (Duffy Creek - Upstream)

A new upstream location (Site 4) was surveyed in Duffy Creek during the Phase II RI on July 9, 1993 (see Figure 6-1). The substratum at this site was composed of 20% boulder, 60% cobble, and 20% silt/pebble. Pool areas contained primarily pebbles, with moderate siltation. Associated with each pooled area were varying pockets of coarse particulate organic matter (CPOM). The stream meanders and exhibits defined channelization. At the time of sampling, the flow of water in the riffle/run area was negligible.

Bank morphology was variable at the site; the east bank was approximately 20 to 25 feet high with a slope of 50%, while the west bank varied in both height and slope. The riparian vegetation included large red maple (*Acer rubrum*) and hemlock, pole-sized beech, hop hornbeam, and red oak. A sparse understory consisted of spotted jewelweed (*Impatiens capensis*), jack-in-the-pulpit (*Arisaema atrorubens*), and woodfern (*Dryopteris spp.*).

Stream depth within the riffle/run area was approximately 2 inches, with maximum pool depths of 6 inches. The average width of the stream was 3 feet from high water mark to high water mark. The only standing surface water found was within the pools at a 1-inch depth.

The invertebrates collected from Site 4 are listed in Table 6-2. Six orders of insects were represented by 130 individuals. The taxa found during sampling were generally associated with average to good water quality. Caddisflies, mayflies, and stoneflies typically require well-oxygenated systems and were found to be the most numerous taxa.

Site 5 (Duffy Creek - Downstream)

An additional downstream location (Site 5) was surveyed in Duffy Creek during the Phase II RI on July 9, 1993 (see Figure 6-1). The substratum of this site consisted of 15% boulder, 50% cobble, and 35% silt/pebble. The pools found within the area contained primarily pebbles, with high siltation. No CPOM was seen within the area. The stream was still meandering in these low sections; however, the bends were further apart.

Bank morphology was uniform, with a height of approximately 15 feet and a slope of 20% on both sides. The vegetated banks were dominated with pole-sized red maple, willows, and sedges.

Stream depth within the riffle/run area was approximately 2 inches, with pool depths up to 5 inches. The average width of the stream from high water mark to high water mark was 25 feet. At the time of sampling, the only surface water available was within the pools at a depth of 3 inches.

The invertebrates collected from the site are listed in Table 6-2. Eight orders of insects were represented by 140 individuals, including caddisflies, mayflies, and stoneflies. As discussed for Site 4, these taxa are generally associated with average to good water quality. This is also true for the remaining taxa; however, caddisflies, mayflies, and stoneflies are able to tolerate moderate impairments to water quality.

Other Aquatic Resources On Site

The amount of surface water in the drainage collection pond (Pond 1) varies; however, the total area of this impoundment is approximately 0.01 acre (see Figure 6-1). Pond 1 collects surface runoff from the north end of the site. This pond is bounded by the borrow area to the north and east and by landfill to the south and west. These areas are covered by an early successional field. Pond 1 has an emergent wetland containing broadleaf cattails *(Typha latifolia)*, sedges *(Carex spp.)*, and rushes *(Juncus spp.)*. Green frogs were observed in the littoral zone of the pond.

Pond 2, the leachate holding pond, also contains variable amounts of water but encompasses approximately 0.006 acre. This pond collects excess leachate from the northeast, northwest, and south-central fill areas. Pond 2 is bounded by landfill, which is covered by an early successional field. The pond has no visible submerged or emergent macrophytes. Water in this pond is a rust-orange color and a rust-colored film covered the southern 25% of the pond during the survey. The presence and size of this film was noted to vary. Grass bordering the pond was stained rust-orange. Frogs were observed in this water.

6.4.2 Terrestrial Ecosystems

A total of 11 distinct vegetation plant communities were identified within the vicinity of the landfill. The boundaries between these cover types are depicted in Figure 6-2. Dominant plant species identified within the landfill site are listed in Table 6-3.

Each plant cover type present within the landfill site is described below in terms of plant species composition, vegetation structure, edaphic conditions, and land use. Whenever possible, these areas were classified according to the New York State Natural Heritage Program's *Ecological Communities of New York State* (Reschke 1990).

Cover Type 1A: Beech-Maple Mesic Forest

This area is located along the western boundary of the landfill. American beech and sugar maple were codominants in this 60- to 70-foot tall overstory. The understory was fairly sparse and open with sapling beech trees and various raspberry shrubs *(Rubus spp.)*. The ground was predominantly covered with leaf litter, with little herbaceous growth except for a few Christmas ferns *(Polytichum acrostichoides)*.

This cover type is rather large and appears to extend well west of the area surveyed. This forest occurs on a hillside with a slope ranging between 20% and 40%. This cover type provides benefits to a variety of animals because many wildlife species include the seeds, bark, and leaves in their diet. In addition, the trees provide nesting and roosting areas for songbirds and gamebirds, as well as valuable cover for whitetail deer *(Odocoileus virginianus)*, eastern gray squirrel *(Sciurus cardinensis)*, and eastern chipmunk *(Tamias striatus)*. Beechnuts are eaten by birds as well as mammals and are a particularly important food for gray squirrels, eastern chipmunk, and black bear (*Ursus americanus*). Maple seeds provide food for squirrels and chipmunks, which store them in caches. Birds use the leaves and seed stalks commonly in nest building (Martin *et al.* 1961).

Cover Type 1B: Beech-Maple Mesic Forest

This pole-sized forest, dominated by beech and sugar maple, is an island surrounded by grassy field. A minor component of the canopy was quaking aspen. The understory consisted of beech saplings. There was no ground cover at the time of survey.

This forest is basically similar in structure and species composition to Cover Type 1A. Therefore, the value of this community to wildlife is expected to be basically similar to

that of Cover Type 1A. The size of the island is a factor limiting the size population that it may support.

Cover Type 1C: Beech-Maple Early Successional Forest

This cover type is dominated by pole-sized and sapling beech trees, and sugar maple and quaking aspen saplings. It had a thick shrub layer consisting of staghorn sumac *(Rhus typhina)* and raspberries. A dense herbaceous layer was present at the edge of this area and was dominated by grasses (*Poa spp.*) and goldenrod (*Soladago spp.*). The leachate collection system runs through this area.

Sumacs do not provide choice or preferred food for wildlife; however, they are an important winter food for upland gamebirds such as ruffed grouse (*Bonasa umbellus*) and wild turkey (*Meleagris gallopavo*). Songbirds such as the cardinal *(Cardinalis cardinalis)* and American robin (*Turdus migratorious*) also utilize sumac fruit, and whitetail deer feed on the twigs and fruit. The value of the beech and sugar maple to wildlife is described for Cover Type 1A. Beechnuts are an important food item for squirrels, chipmunks, songbirds, and bears. Maples provide food and nesting material (Martin *et al.* 1961).

Cover Type 2: Red Oak-Maple Forest

Cover Type 2 consists of a pole- to sawtimber-sized forest dominated by sugar maple and red oak. Minor components of the canopy included ironwood, white ash, and pin cherry *(Prunus pensylvanica)*. There was a dense reproductive/shrub area dominated by beech and maple saplings and wild raisin (*Viburnum cassinoides*). The ground was covered with ferns.

This cover type is rather large and appears to extend well north and east of the area surveyed for this ecological characterization. Numerous snag trees are present.

The abundance of red oak results in a high-quality wildlife area. Oak acorns are valuable fall and winter wildlife foods. Upland game birds such as ruffed grouse and wild turkey feed heavily upon acorns in season. A few songbirds, including the blue jay *(Cyanocitta cristata)* and northern flicker *(Colaptes avratus)*, feed on acorns. Acorns are also important food items in the diets of several rodents, including the northern flying squirrel *(Glaucomys sabrinus)*, eastern gray squirrel, and chipmunks. White-tail deer and black bear also feed heavily upon acorns during fall and winter months (Martin *et al.* 1961).

The snag trees provide nesting cavities for wildlife species such as the barred owl *(Strix varia)* and downy woodpecker *(Picoides pubescens)*. These snags, as well as the saplings and shrubs for deer browse and late summer fruit, contribute to habitat quality.

Cover Type 3: Red Oak/Maple Early Successional Forest

This cover type is an approximately 25-foot wide woodland area bordering a drainage ditch. At the time of survey, no water was present in the ditch. This area consisted of a few large red oak and cottonwood (*Populus deltoides*) trees interspersed with pole-sized red maple. The reproductive layer was dense and consisted of red maple, green ash (*Fraxinus pensylvanica*), cottonwood, and staghorn sumac. The herbaceous layer was sparse and dominated by goldenrods.

Acorns from the red oak provide a valuable food source. Oaks retain their dried dead leaves through much of the winter thereby providing cover. Several species of birds use oak leaves and twigs for nest building. Cottonwoods increase the value of this area. Their resinous buds and catkins are an important winter food. Rabbits and deer feed on the twigs and foliage (Martin *et al.* 1961). The drainage ditch provides a source of drinking water as well as a potential breeding habitat for various amphibians. Only the size of this cover type limits the population and diversity of wildlife it can support.

Cover Type 4: Early Successional Field

Cover Type 4 is the most prevalent cover type found within the boundaries of the landfill. The dominant species included goldenrod *(Solidago spp.)*, timothy grass (*Phleum pratensis*), and panic grass *(Panicum sp.)*. Other herbs occurring in lesser abundance included Queen Anne's Lace *(Daucus carota)*, yarrow *(Achillea millefolium)*, teasel *(Dipsacus sylvestris)*, and red clover *(Trifolium pratense)*. Saplings and shrubs such as quaking aspen and wild raisin are sparse and beginning to invade this field. Some evidence of stressed vegetation was observed in the south-central landfill area. The fields adjacent to the site are used as pastureland for cows and horses.

This grassy field area serves as a small opening that provides edge and food. Panic grass produces seed that is eaten by songbirds such as the song sparrow *(Melospiza melodia)*, field sparrow *(Spizella pusilla)*, and rufous-sided towhee *(Pipilio erythrophthalmus)*. The wild raisin produces fruit that is important in the diets of a variety of songbirds, such as the

American robin. These shrubs also provide browse for whitetail deer and eastern cottontail *(Sylvilagus floridanus)* (Martin *et al.* 1961). The sparse nature of these shrubs will not support a large population of fruit-eating species.

Cover Type 5: Wetland 1

This cover type is a herbaceous wet area on the Miller property dominated by cattail and reed grass *(Phragmites communis)*. A soil test pit revealed an impervious clay layer approximately 6 inches below ground surface that had water flowing on it.

This area meets the hydrophytic vegetation and wetland criteria of the U.S. Army Corps of Engineers wetland delineation process (United States Department of the Army 1987). Soils were not sampled; however, the hydric soil criterion is assumed to be met based on the presence of hydrophytic vegetation and wetland hydrology. This area therefore is classified as a jurisdictional palustrine emergent wetland.

Due to the small size of this wetland area, its value for wildlife is limited. Wildlife species from the surrounding area may forage at this area.

Cover Type 6: Hedgerow

This cover type is composed of a single row of trees and shrubs that bordered the eastern edge of the landfill. These trees were pole-sized white ash, quaking aspen, sugar maple, red oak, and hemlock.

The quality and size of this area make it markedly poor habitat for wildlife species. The trees do supply a source of food and wildlife may forage in this hedgerow.

Cover Type 7: Mowed Lawn

This cover type is dominated by clipped grasses. It is located around the WASPS airfield located north of the site. Characteristic birds of these areas include robin, killdeer *(Charadrius vociferus)*, and starling *(Sturnus vulgaris)*. Otherwise, this area is a low-quality wildlife habitat.

Cover Type 8: Borrow Field

The soil from this area was removed and used for cover in the fill areas. This area is barren, with a sparse herbaceous covering.

Due to the barren nature of this area, it is a low-quality wildlife habitat.

Cover Type 9: Drainage Collection Pond

This area contains a pond that collects surface runoff from the north end of the site. Surrounding this pond is emergent wetland vegetation. This includes broad-leaf cattail, sedges, and rushes. This pond is mapped on the NWI maps as a palustrine, unconsolidated bottom, permanently flooded, impounded (PUBHh) wetland (USFWS 1985).

This area meets the hydrophytic vegetation and wetland hydrology criteria of the U.S. Army Corps of Engineers wetland designation process (United States Department of the Army 1987). Soils were not sampled; however, the hydric soil criterion is assumed to be met based on the presence of hydrophytic vegetation and wetland hydrology. This pond area is therefore classified as a jurisdictional wetland.

Due to the small size of this wetland area, its value for wildlife is limited. Amphibians such as the green frog *(Rana clamitans)* and bull frog *(Rana catesbeiana)* may use the pond for breeding. Wildlife species from the surrounding area may forage and drink water from this pond.

Cover Type 10: Leachate Overflow Collection Pond

This area collects excess leachate from the northeast, northwest, and south-central fill areas. The grasses surrounding the pond were stained by the leachate. The pond itself is void of any vegetation and is a low-quality wildlife habitat.

Cover Type 11: Hemlock-Northern Hardwood Forest

Cover Type 11 consists of pole- to sawtimber-sized forest dominated by hemlock, with beech and sugar maple present. This forest type is found on the middle to lower slopes of ravines. The understory was fairly sparse, with hemlock, beech, and sugar maple saplings. The herbaceous layer was sparse with a few ferns scattered. This cover type appears to extend for some distance east of the site.

This cover type provides benefits to a variety of animals, such as those described for Cover Type 1A. Also, the dense covering of hemlock provides excellent deer wintering areas. Hemlock provides food and shelter through the winter months.

6.4.3 Freshwater Wetlands

New York State freshwater wetland maps were reviewed to identify the presence of state-regulated wetlands. No state wetlands exist within the 2-mile-radius general study area.

The USFWS NWI map for the Wellsville North, New York, quadrangle was reviewed for NWI wetlands present within the general study area. Federal wetlands located within the 2-mile radius general study area are summarized in Table 6-4.

6.4.4 Value of Fish and Wildlife Resources

Fish and wildlife resources in the site study area are typical for the Great Lakes Plain ecozone (Reschke 1990). The site and adjacent areas appear to support a low diversity of fish and aquatic wildlife because of the limited aquatic resources, but a relatively high diversity and abundance of terrestrial wildlife. Herptiles (amphibians and reptiles), birds, and mammals expected to occur within the detailed study area are listed in Tables 6-5, 6-6, and 6-7, respectively. No endangered, threatened, or species of concern are known to occur within the detailed study area (Buffington 1993; Corin 1993), nor were they observed during the field surveys.

The relatively high diversity and abundance of wildlife present within the detailed adjacent area is probably a factor of the high diversity of cover types, the high interspersion of these cover types, and the resulting abundance of edge that occurs within the area.

The area surrounding the site apparently supports consumptive and nonconsumptive uses of fish and wildlife. This area is likely used heavily for deer and small game hunting.

6.4.5 Applicable Fish and Wildlife Regulatory Criteria

Site-specific criteria that are applicable to the remediation of the fish and wildlife resources associated with the Wellsville-Andover Landfill site are:

- Regulations pertaining to streams and navigable water bodies (Article 15 ECL, 6 NYCRR, Part 608); and

- Water quality standards and guidance values (6 NYCRR Parts 701-703 and TOGS 1.1.1), and sediment criteria for the protection of fish and wildlife NYSDEC.

6.5 EXPOSURE ASSESSMENT

This subsection identifies contaminants of potential ecological concern (CPEC) as well as the potential source of contamination, potential ecological receptors, and potential pathways of contaminant migration.

6.5.1 Contaminants of Ecological Concern

Selection of inorganic CPECs for ecological receptors was based on the comparison of chemical concentrations with media-specific screening criteria. If the concentration exceeded the criteria, the potential exists for biota to be impacted. All organics and inorganics detected above detection limits were considered CPECs. Note, however, that while not detected in field or laboratory method blanks, the presence of acetone and butyl benzylphthalate in the sediment and di-n-butylphthalate and di-n-octylphthalate in the surface water are suspected field and/or laboratory contaminants. These compounds were not considered contaminants of concern. Table 6-8 lists CPECs for the Wellsville-Andover Landfill site by media.

6.5.2 Contaminant Release, Migration, and Fate

The Wellsville-Andover Landfill site is a potential source of contamination to Duffy Creek and the intermittent tributary to Duffy Creek. Two potential contaminant migration pathways are viable at the site: surface water runoff/leachate overflow and groundwater. CPEC migration via wind erosion, while possible, is not likely because of the dense vegetation on and surrounding the site and the relatively low concentrations of CPECs detected in the surface soils.

Contaminants in the groundwater may migrate to streams or emerge as springs, seeps, or leachate outbreaks. Particularly near leachate outbreaks, these contaminants may then be found at the surface. Surface soils are subjected to bulk migration via erosion by surface water runoff. Contaminants migrating in this way may be found in the water and sediments of Duffy Creek and the intermittent stream. However, CPECs detected on site have not been detected off site in surface water or sediment samples. Furthermore, concentrations of the

various inorganics detected in downstream samples were not significantly elevated above concentrations detected in the upstream sample.

6.5.3 Fish and Wildlife Receptors

As indicated in the field survey (Section 6.4), fish and wildlife resources in the Wellsville-Andover Study Area are typical for the Great Lakes Plain ecozone. The field survey found that fish and wildlife resources were diverse and abundant in the study area.

The site itself contains a typical old field habitat with islands of successional northern hardwoods (Covertype 1C, 3, and 6) and borrow fields (Cover type 8). The site is surrounded by mature beech-maple and oak-maple forests and agricultural pastures. The value of the site habitats for populations of fish and wildlife is low because of the habitat's common occurrence in the adjacent areas and the small size. The value of adjacent habitats identified for populations of fish and wildlife is high due to the large contiguous nature of the forest and limited human interference.

Plants growing on or adjacent to the site may uptake site-related contaminants. Evidence of physiological stress to plants was observed during the field surveys in the south central landfill area. Portions of this landfill area were devoid of vegetation and the surface was heavily covered with gravel. However, no evidence of physiological stress to animals was observed during the field surveys. Therefore, potential impacts to terrestrial plants and wildlife inhabiting the site itself are moderate. The site survey identified no critical habitat or endangered or threatened species in the 0.5-mile-radius detailed study area.

Duffy Creek, the unnamed tributary, and the two ponds located on site are not important recreational fisheries. However, aquatic and benthic organisms residing in the creek or ponds could be potentially exposed to site-related contaminants. Semiaquatic and terrestrial wildlife that depend on the aquatic environment for a fraction of their food could also be exposed to site-related contaminants. In addition, wildlife could be exposed to contaminants from the site through ingestion of groundwater that has reached the surface as a seep. These pathways were supported by the significant number of deer tracks around the seep areas and pond areas on site. The sampling results indicate the presence of CPECs in sediment from Duffy Creek and the intermittent stream; surface water collected from Duffy Creek, the intermittent tributary, and seep samples; and surface soils. Therefore, the potential impacts to the species inhabiting these areas is moderate.

6.5.4 Potential Exposure Pathways

Three major exposure pathways exist at the Wellsville-Andover Landfill site. First, benthic and aquatic invertebrates would be expected to have contact with contaminated sediment particles and surface water from Duffy Creek, the unnamed tributary, and the ponds located on the site through direct contact and absorption, direct ingestion, and feeding on contaminated food. Also, uptake of contaminants from sediments (via interstitial water) by aquatic plants could occur.

Second, semiaquatic wildlife and some terrestrial species could be exposed through direct contact, absorption, and incidental ingestion of contaminated sediment from Duffy Creek, the unnamed tributary, and the ponds and surface water, including same sources as the sediment as well as seeps and leachate outbreaks. Some of these receptors could also be exposed via the food chain.

Third, plants growing on the site or adjacent to the waterbodies could be exposed through uptake by the roots. Upland terrestrial wildlife could be exposed through direct contact with contaminated soil, accidental ingestion, or exposure through the terrestrial food chain.

These potential exposure pathways and ecological receptors were evaluated for the existence of possible risk on the basis of affected media and CPEC. Potential risk exists for aquatic and benthic organisms due to their potential exposure to elevated levels of metals in the sediments. Potential risks exist for semiaquatic wildlife such as frogs and salamanders due to potential exposure to both contaminated sediments, surface water (including seep areas), and surface soils. On the site itself, potential risk exists to secondary consumers, especially small mammals using the area for food and cover, and deer that forage and drink water from the area.

Low levels of PAHs were detected in the surface soil. PAHs are ubiquitous in nature and the levels detected on the Wellsville-Andover Landfill site are indicative of background in an urban area. However, the levels of some PAHs are slightly elevated when compared to expected concentrations in soils in a rural area. Even so, minimal risk from PAHs to secondary consumers is expected from site soils. In addition, no evidence of physiological stress to animals was observed during the field surveys. Therefore, the potential impacts to terrestrial wildlife from organics occurring in site soils are not considered significant. There is, however, a potential risk to wildlife through elevated metals from direct contact and

incidental ingestion of contaminated soil. Elevated levels of volatiles and metals were detected in the seep samples on site. Deer tracks were located around these areas. Therefore, the potential risk to wildlife from these contaminants is considered significant.

6.6 CRITERIA - SPECIFIC TOXICITY ASSESSMENT

Potential contaminants of concern are the chemicals detected in surface water, sediment, and surface soil samples from the Wellsville-Andover Landfill site. Surface water includes the samples from the streams, seep areas, and leachate. The chemicals and levels of contamination are summarized in Section 4. They include organic chemicals (volatiles, semivolatiles, and PAHs) and inorganic chemicals.

6.6.1 Surface Water

The NYSDEC Ambient Water Quality Standards and Guidance Values (AWQS/GVs) for the protection of freshwater aquatic life were used to evaluate the contaminant levels. Values used are for Class C waters (secondary contact recreation and fishing and fish propagation) because Duffy Creek and its tributary are classified as Class C streams. These values are generally based on acute toxicity endpoints from laboratory studies of aquatic species, or on endpoints related to bioaccumulation. Bioaccumulation criteria (also known as fish flesh or wildlife residue criteria) have been developed to protect piscivorous wildlife, and are based on laboratory data from mammalian species or birds (NYSDEC 1990a). All surface water standards were obtained from 6 NYCRR 703.5 and guidance values were obtained from TOGS 1.1.1 (NYSDEC 1990a).

Concentrations were also compared to the EPA Ambient Water Quality Criteria (AWQC) (EPA 1992b). Values used are the freshwater chronic criteria, which are intended to protect aquatic life (and organisms that depend on aquatic life) from adverse effects of long-term exposure to toxins. The NYSDEC AWQS/GVs are in some cases the same as or derived from the EPA criteria.

In addition, one site background sample was collected from Duffy Creek. Even though this is not a statistically valid value, samples were compared to the background.

Results are provided in Table 6-9. Criteria are generally unavailable for organics detected at the site. Surface water was collected from seven sampling locations including background in Duffy Creek and the intermittent tributary. In addition, two leachate samples

and four seep samples were collected. Only 1,4-dichlorobenzene, trichloroethene, and chlorobenzene had a criteria value and only one seep sample (SP2-1) exceeded the criteria for chlorobenzene. Seep sample SP2-1 also exceeds the general use inorganic guidance value for ethylbenzene.

Surface water samples exceeded NYSDEC criteria for aluminum and iron in all samples collected from the streams, springs, seeps, and leachate samples, except for SW-6. Concentrations of lead exceeded NYSDEC criteria for samples collected from the streams, seeps, and leachate. Concentrations of cobalt, copper, vanadium, and zinc exceeded NYSDEC criteria in samples collected from seeps and leachate.

Concentrations of arsenic, beryllium, chromium, nickel, and cyanide did not exceed NYSDEC criteria. However, cyanide was detected above EPA criteria for cyanide for one spring sample, while the remaining samples did not exceed EPA criteria.

Levels of organic substances were found to exceed site background in seep and leachate samples (see Table 6-9). In addition, levels of inorganics were found to exceed background in the seep samples (see Table 6-9).

Due to the exceedances of NYSDEC AWQS/GVs at several locations and the few available criteria for evaluating surface water contamination at the site, potential surface water hazards to fish and wildlife at the site are further evaluated in the Toxicity/Hazard Assessment (see Section 6.7).

6.6.2 Sediments

The NYSDEC sediment criteria for the protection of freshwater aquatic life were used to evaluate the contaminant levels. Evaluation criteria for organic substances have been derived using the equilibrium partitioning approach and are normalized for organic carbon content of sediments (see Table 6-10) (NYSDEC 1989b). Metals criteria are based on empirical data from laboratory and field studies (see Table 6-10). In addition, Ontario Ministry of the Environment (OME) sediment of quality criteria for inorganics are presented in Table 6-10 for comparison. The EPA and OME guidelines are generally less conservative than NYSDEC criteria, and exceedances of these guidelines could indicate highly polluted sediments.

Concentrations were also compared to the site background sample (SED2-1). One background sample was collected from Duffy Creek. One sample is not considered a statistical representative of background.

Levels of inorganic substances were found to exceed sediment criteria (see Table 6-10). Arsenic, copper, manganese, nickel, and zinc were found at concentrations exceeding the NYSDEC criteria at one or more locations. Moreover, arsenic, manganese, and nickel levels exceeded OME guidelines at sample locations in both streams. In addition, barium exceeds EPA Region V criteria at all of the sediment locations.

Levels of inorganic substances were found to exceed site background (see Table 6-10). Aluminum, arsenic, beryllium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, and vanadium were found at concentrations exceeding the site background at one or more locations.

Due to the exceedances of sediment criteria and guidelines and the few available criteria for evaluating sediment contamination at the site, potential sediment hazards to fish and wildlife at the site are further evaluated in Section 6.7.

6.6.3 Soils

Risks posed by organics in site soils were considered insignificant. Therefore, no criteria specific toxicity assessment was conducted. The levels of PAHs detected in surface soil are indicative of background concentrations for urban soils and are slightly elevated for rural soils (Eisler 1987).

NYSDEC does not have criteria for inorganics in soil with regard to the protection of wildlife. Instead, the soils were compared to Shacklette and Boerngen (1984) background element concentrations in soils from the eastern United States. The upper 90% confidence level was used. This indicates 90% of all naturally occurring metals are below the reported concentrations. Exceedances could indicate contaminated soil. Shacklette and Boerngen does not evaluate cadmium instead Lindsey (1977) was used to compare levels of cadmium. Results are provided in Table 6-11. In addition, the soil samples were compared to surface soil samples SS-1 and SS-2. These samples were collected in an area not influenced by site contaminants; therefore, these samples are considered site background.

Levels of inorganic substances exceeded Shacklette and Boerngen background levels. Cobalt, iron, lead, manganese, nickel, and zinc were found at concentrations exceeding

Shacklette and Boerngen background at one or more sampling locations. When the samples were compared to site background, all metals except sodium exceeded the concentration detected in samples SS-1 and SS-2. Only barium, calcium, nickel, and zinc were detected in one or more samples at concentrations greater than five times the site background.

Due to the exceedances of soil inorganics over background, potential soil hazards to wildlife at the site are further evaluated in Section 6.7.

6.7 TOXICITY/HAZARD ASSESSMENT

Potential contaminants of concern at the Wellsville-Andover Landfill site were evaluated relative to Toxicity Benchmark Criteria (TBC). Best available data were used to derive TBC; in most cases, sources were acute or chronic lowest observed effect levels (LOELs) published in the EPA "Gold Book" (EPA 1986). TBC were multiplied by an uncertainty factor (UF) to provide a margin of safety for the protection of aquatic life from adverse effects of site-related contaminants. The product of the TBC multiplied by the UF is the environmental concern level (ECL) for that chemical. Exceedances of ECLs would generally indicate a potential for adverse effects on aquatic life.

6.7.1 Surface Water

ECLs for organics and inorganics detected at the site are derived in Table 6-12. As a conservative approach for determining risk, the maximum concentration detected in surface water was used to determine the exposure point concentration (EPC). The ratio of EPC/ECL is referred to as the toxicity quotient (TQ); a TQ greater than 1 indicates that contaminant concentrations are above the level at which adverse effects are expected. The comparisons provided in Table 6-12 indicate a TQ greater than 1 for 1,4-dichlorobenzene; 4-chloro-3-methylphenol; trichloroethene; aluminum; cobalt; copper; iron; lead; vanadium; and zinc for all other surface water contaminants, TQ is less than 1.

The ECLs for organics in Table 6-12 are generally based on acute toxicity endpoints. The results of the hazard assessment indicate that, other than bioaccumulatory toxins, impacts on fish and wildlife due to surface water contamination from organic substances are likely to be minimal.

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The ECLs for inorganics in Table 6-12 are generally based on the chronic toxicity endpoints. The results of the hazard assessment indicate that impacts of aluminum, cobalt, copper, iron, lead, and zinc on wildlife may be moderate from surface water contamination.

The form of iron normally found in pooled stream water is unlikely to adversely affect wetlands or aquatic life downgradient from the site, despite a TQ greater than 1 for iron.

In summary, surface water contamination from leachate and the seeps appears to pose a moderate risk of impacts to fish and wildlife. Surface water from Duffy Creek and its tributary appears to pose little risk of impacts to fish and wildlife.

6.7.2 Sediments

Analyses of the sediment samples collected from Duffy Creek and its tributary indicated that no organics were detected except common laboratory contaminants.

Following NYSDEC guidance, the magnitude of metals contamination of sediments was evaluated by comparison to "limits of tolerance," which are concentrations likely to be detrimental to most species. Iron concentrations in samples were slightly greater than the limits of tolerance (see Table 6-14). Therefore, potential risk to wildlife from iron in sediments is low. Manganese concentrations in samples were greater than the limits of tolerance. Therefore, potential risk to wildlife from manganese in the sediments cannot be ruled out. Further characterization and/or calculations involving indicator species are necessary to fully analyze the risk to wildlife from manganese. This is beyond the scope of this phase of the RI. Significant impacts from the other inorganic contaminants of sediments are unlikely on the site.

6.7.3 Soils

An assessment of soils cannot be complete without calculating dose estimates in indicator species. This is beyond the current scope of work for this RI. A potential risk from elevated levels of cadmium, cobalt, lead, nickel and zinc cannot be ruled out because these contaminants occur above Shacklette and Boerngen background levels.

6.8 CONCLUSIONS

Limited sampling of surface water and sediments from Duffy Creek, the unnamed tributary, seep areas, and leachate at the Wellsville-Andover Landfill site indicates contamination above levels of concern for the following inorganic compounds: iron, lead, zinc, cobalt, copper, manganese, and aluminum. The concentrations of these contaminants pose a low to moderate risk of impacts to fish and wildlife populations, based on the following:

- Acute toxicity thresholds for the protection of Class C waters are exceeded by site-related contaminant levels; and
- Toxin concentrations downgradient of the site are likely to be reduced as a result of dispersion and dilution, thereby lowering the risk to wildlife downstream of the site.

Potential impacts of inorganic toxins on fish and wildlife reproduction or survival are expected to be minimal on and in the vicinity of the site; however, further investigation would be required to evaluate risks of exposure and chronic toxicity to organisms in downgradient streams and wetlands from surface water contamination. Also, further investigation would be required to evaluate exposure and chronic toxicity to wildlife residing on-site to elevated levels of metals in the soils, as well as to wildlife exposed to elevated levels of manganese and iron in sediments.

Table 6-1

STREAM WATER CHEMISTRY
OCTOBER 24, 1991

Sampling Station	Temperature (°F)	pH (s.u.)	Alkalinity (mg/L as $CaCO_3$)	Specific Conductance (μS/cm)	Hardness (mg/L as $CaCO_3$)
Site 1	57	6.87	80	335	120
Site 2	59	6.99	60	259	76
Site 3	61.5	6.96	60	171	NA

Key:

NA = Water not present in sufficient quantity to sample without disturbing sediment.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 6-2

AQUATIC BIOTA (INVERTEBRATES) ENCOUNTERED DURING STREAM SURVEY OCTOBER 24, 1991 AND JULY 9, 1993

Sampling Station	Taxon (order)	Common Name	Number of Individuals
Site 1	*Trichoptera*	Caddisfly	15
Site 2	*Diptera*[a]	Cranefly	3
	Trichoptera	Caddisfly	1
	Megaloptera[b]	Dobsonfly	1
	Ephemeroptera	Mayfly	1
	Plecoptera	Stonefly	2
	Hemiptera[c]	Water strider	1
Site 3	*Gastropoda*[d]	Snail	4
	Oligochaeta[d]	Aquatic earthworm	1
Site 4	*Ephemeroptera*	Mayfly	33
	Plecoptera	Stonefly	6
	Trichoptera	Caddisfly	63
	Colleoptera	Beetle	8
	Diptera	True fly	15
	Megaloptera	Dobsonfly	4
Site 5	*Ephemeroptera*	Mayfly	21
	Plecoptera	Stonefly	41
	Trichoptera	Caddisfly	38
	Colleoptera	Beetle	2
	Diptera	True fly	24
	Megaloptera	Dobsonfly	5
	Gastropodia	Snail	2

a *Tipulidae*.
b *Corydalus cornutus*.
c *Gerridae*.
d Class.

Source: Ecology and Environment Engineering, P.C. 1991.

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Table 6-3

PLANT SPECIES IDENTIFIED AT THE WELLSVILLE-ANDOVER LANDFILL

Common Name	Scientific Name
Black Cherry	*Prunus serotina*
Blackberry	*Rubus allegheniensis*
Willow	*Salix spp.*
Ironwood	*Carpinus caroliniana*
Quaking aspen	*Populus tremuloides*
Beech	*Fagus grandifolia*
White ash	*Fraxinus americana*
Red maple	*Acer rubrum*
Sugar maple	*Acer saccharum*
Hemlock	*Tsuga canadensis*
Apple tree	*Malus spp.*
Grasses	*Poa spp.*
Small white aster	*Aster vimineus*
Goldenrod	*Solidago spp.*
Queen Anne's lace	*Daucus carota*
Yarrow	*Achillea millefolium*
Teasel	*Dipsacus sylvestris*
Daisy fleabane	*Erigeron annuus*
Alsike clover	*Trifolium hybridum*
Red oak	*Quercus rubra*
Broadleaf cattail	*Typha latifolia*
Sedges	*Carex spp.*
Rushes	*Juncus spp.*
Hop hornbeam	*Ostrya virginiana*
Staghorn sumac	*Rhus typhina*
Pin cherry	*Prunus pensylvanica*
Wild raisin	*Viburnum cassinoides*
Northern arrowwood	*Viburnum recognitum*
Wild strawberry	*Fragaria virginiana*

Table 6-3

PLANT SPECIES IDENTIFIED AT THE WELLSVILLE-ANDOVER LANDFILL

Common Name	Scientific Name
Sensitive fern	*Onoclea sensibilis*
Black raspberry	*Rubus phoenicolasius*
Christmas fern	*Polytichum aerostichoides*
Yellow goatsbeard	*Tragopogon pratensis*
Dandelion	*Taraxacum officinale*
Cow vetch	*Vicia cracca*
Crown vetch	*Coronilla varia*
Spotted jewelweed	*Impatiens capensis*
Wood fern	*Dryopteris spp.*
Poison ivy	*Rhus radicans*
Jack-in-the-pulpit	*Arisaema atrorubens*
Cottonwood	*Populus deltoides*
Green ash	*Fraxinus pensylvanica*
Reed grass	*Phragmites communis*
Birdsfoot trefoil	*Lotus corniculatus*
Timothy grass	*Phleum pratense*
Orchard grass	*Dactylis glomerata*
Deptford pink	*Dianthus armeria*
Chickory	*Cichorium intybus*
Wild geranium	*Geranium maculatum*
Tall buttercup	*Ranunculus acris*
Common milkweed	*Asclepias syriaca*
Oxeye daisy	*Chrysanthemum leucanthemum*
Field thistle	*Cirsium discolor*
Ragweed	*Ambrosia artemisiifolia*
Yellow sweet clover	*Melilotus officinalis*
Hop clover	*Trifolium agrarium*
White sweet clover	*Melilotus alba*
Red clover	*Trifolium pratense*

Table 6-3

PLANT SPECIES IDENTIFIED AT THE WELLSVILLE-ANDOVER LANDFILL

Common Name	Scientific Name
Rugosa rose	*Rosa rugosa*
May apple	*Podophyllum peltatum*
Coltsfoot	*Tussilago farfara*
Wild madder	*Galium mollugo*
Wild leek	*Allium tricoccum*
Black-eyed susan	*Rudbeckia serotina*
Sulphur cinquefoil	*Potentilla recta*
Orange hawkweed	*Hieracium aurantiacum*
White clover	*Trifolium repens*

Source: Ecology and Environment Engineering, P.C. 1993.

Table 6-4

FEDERALLY DESIGNATED FRESHWATER WETLANDS LOCATED WITHIN THE GENERAL STUDY AREA

Direction from Site	Vegetation Type	Distance from Site (mile)
On site	PUBHh	—
Southeast	PUBHh	0.25
Southeast	PUBHh	0.77
Southeast	PUBHh	1.06
Southeast	PEM1C	1.60
Southeast	R2USA	1.78
Southeast	R2USA	1.80
South	PEM[a]	Adjacent
South	PUBHh	1.80
South	PFO1A	1.82
South	R2USA	1.95
Southwest	PUBHh	1.00
Southwest	PUBF	1.18
Southwest	PUBHh	1.26
Southwest	PUBHh	1.38
Southwest	PUBHh	1.56
West	PUBHh	0.43
West	PUBHh	1.12
West	R3USA	1.13
West	PUBHh	1.26
West	PUBHh	1.95
Northwest	PUBHh	0.47
Northwest	PUBHh	0.50
Northwest	PUBHh	0.62
Northwest	R3UBH	0.72
Northwest	PUBHh	0.73
Northwest	R3USA	0.81

Key at end of table.

Table 6-4

FEDERALLY DESIGNATED FRESHWATER WETLANDS LOCATED WITHIN THE GENERAL STUDY AREA

Direction from Site	Vegetation Type	Distance from Site (mile)
Northwest	PUBHh	0.90
Northwest	PUBFb	0.98
Northwest	R3USA	1.02
Northwest	PUBF	1.97
North	PUBHh	1.00
North	PUBHh	1.44
North	R3UBH	1.72
Northeast	PUBHh	0.51

[a] Wetland delineated in the field.

Key:

PEM1C = Palustrine, emergent, persistent, seasonally flooded.
PF01A = Palustrine, forested, broad-leaved deciduous, temporarily flooded.
PUBF = Palustrine, unconsolidated bottom, semipermanently flooded.
PUBFb = Palustrine, unconsolidated bottom, semipermanently flooded, beaver.
PUBHh = Palustrine, unconsolidated bottom, permanently flooded, diked/impounded.
R2USA = Riverine, lower perennial, unconsolidated shore, temporarily flooded.
R3USA = Riverine, upper perennial, unconsolidated shore, temporarily flooded.
R3UBH = Riverine, upper perennial, unconsolidated bottom, permanently flooded.

Source: Ecology and Environment Engineering, P.C. 1993.

Table 6-5

REPTILES AND AMPHIBIANS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
Snapping turtle (common)	*Chelydra serpentina*
Wood turtle	*Clemmys insculpta*
Spotted turtle	*Clemmys guttata*
Stinkpot	*Sternotherus odoratus*
Midland painted turtle	*Chrysemys picta*
Eastern garter snake	*Thamnophis sirtalis*
Northern red-bellied snake	*Storeria occipitomaculata*
Northern brown snake	*Storeria dekayi*
Northern ringneck snake	*Diadophis punctatus*
Eastern green snake	*Opheodrys vernalis*
Northern black racer	*Coluber constrictor*
Black rat snake	*Elaphe obsoleta*
Eastern milk snake	*Lampropeltis triangulum*
Red-spotted newt	*Notophthalmus viridescens*
Jefferson salamander	*Ambystoma jeffersonianum*
Spotted salamander	*Ambystoma maculatam*
Mountain dusky salamander	*Desmognathus ochrophaeus*
Northern dusky salamander	*Desmognathus fuscus*
Northern spring salamander	*Gyrinophilus porphyriticus*
Slimy salamander	*Plethodon glutinosus*
Red-backed salamander	*Plethodon cinereus*
Four-toed salamander	*Hemidactylium scutatum*
Northern two-lined salamander	*Eurycea bislineata*
Long-tailed salamander	*Eurycea longicauda*
American toad	*Bufo americanus*
Northern spring peepers	*Pseudacris crucifer*
Gray treefrogs	*Hyla versicolor and Hyla chrysoscelis*
Green frogs	*Rana clamitans*
Bull frog	*Rana catesbeiana*

Table 6-5

REPTILES AND AMPHIBIANS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
Pickerel frog	*Rana palustris*
Wood frog	*Rana sylvatica*

Compiled by Ecology and Environment Engineering, P.C. 1991.

Source: Conot 1975.

Table 6-6

BIRDS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
Barn owl	*Tyto alba*
Common screech-owl	*Otus asio*
Great horned owl	*Bubo virginianus*
Chimney swift	*Chaetura pelagica*
Ruby-throated hummingbird	*Archilochus colubris*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Red-bellied woodpecker	*Melanerpes carolinus*
Yellow-bellied sapsucker	*Sphyrapicus varius*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*
Eastern pewee	*Contopus virens*
Willow fly catcher	*Dmpidonax traillii*
Least fly catcher	*Empidonax minimus*
Eastern phoebe[a]	*Sayornis phoebe*
Great crested flycatcher	*Myiarchus crinitus*
Eastern kingbird[a]	*Tyrannus tyrannus*
Horned lark	*Eremophila alpestris*
Purple martin	*Progne subis*
Tree swallow	*Iridoprocne bicolor*
Barn swallow	*Hirundo rustica*
Blue jay[a]	*Cyanocitta cristata*
American crow[a]	*Corvus brachyrhynchos*
Black-capped chickadee[a]	*Parus atricapillus*
Tufted titmouse	*Parus bicolor*
White-breasted nuthatch	*Sitta carolinensis*
Brown creeper	*Certhia familaris*
House wren	*Troglodytes aedon*
Sharp-shinned hawk	*Accipiter striatus*

Table 6-6

BIRDS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
American woodcock[a]	*Philohela minor*
Cedar waxwing	*Bombycilla cedrorum*
Cooper's hawk	*Accipiter cooperii*
Northern goshawk	*Accipiter gentilis*
Red-shouldered hawk	*Buteo lineatus*
Broad-winged hawk	*Buteo platypterus*
Red-tailed hawk	*Buteo jamaicensis*
American kestrel	*Falco sparverius*
Ring-necked pheasant	*Phasianus colchicus*
Ruffed grouse	*Bonasa umbellus*
Wild turkey[a]	*Meleagris gallopavo*
Killdeer	*Charadrius vociferus*
Rock dove (domestic pigeon)	*Columba livia*
Mourning dove	*Zenaida macroura*
Black-billed cuckoo	*Coccyzus erythropthalmus*
Yellow-billed cuckoo	*Coccyzus americanus*
Barred owl	*Strix varia*
Pileated woodpecker	*Dryocopus pileatus*
Rough-winged swallow	*Stelgidopterixy ruficollis*
Bank swallow	*Riparia riparia*
Veery	*Catharus fuscescens*
Northern mockingbird	*Mimus polygottos*
Yellow-throated vireo	*Vireo flavifrons*
Warbling vireo	*Vireo gilvus*
Red-eyed vireo	*Vireo olivaceus*
Blue-winged warbler	*Vermivora pinus*
Yellow warbler	*Dendroica petechia*
Chestnut-sided warbler	*Dendroica pensylvanica*
Black-throated green warbler	*Dendroica virens*

Table 6-6

BIRDS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
American redstart	*Setophaga ruticilla*
Mourning warbler	*Oporornis philadelphia*
Turkey vulture	*Cuthartes aura*
Brown thrasher	*Toxostoma rufum*
Gray catbird	*Dumetella carolinensis*
Common yellow throat[a]	*Geothlypis trichas*
Black-throated blue warbler	*Dendroica caeralescens*
Black-and-white warbler	*Mniotilta varia*
Scarlet tanager	*Piranga olivacea*
Northern cardinal	*Cardinalis cardinalis*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Indigo bunting	*Passerina cyanea*
Rufous-sided towhee[a]	*Pipilo erythrophthalmus*
Chipping sparrow	*Spizella passerina*
Field sparrow[a]	*Spizella pusilla*
Savannah sparrow	*Passerculus sandwichensis*
Song sparrow[a]	*Melospiza melodia*
Bobolink[a]	*Dolichonyx oryzivorus*
Red-winged blackbird[a]	*Agelaius phoeniceus*
Eastern meadowlark	*Sturnella magna*
Common grackle[a]	*Quiscalus quiscula*
Brown-headed cowbird	*Molothrus ater*
Northern oriole	*Icterus galbula*
Purple finch	*Carpodacus purpureus*
American goldfinch[a]	*Carduelis tristis*
House sparrow	*Passer domesticus*
Starling	*Sturnus vulgaris*
American robin[a]	*Turdus migratorious*
Wood thrush	*Hylocichla mustelina*

Table 6-6

BIRDS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
Vesper sparrow	*Pooecetes gramineus*

[a] Observed by sight and song during July 9, 1993, field reconnaissance.

Compiled by Ecology and Environment Engineering, P.C. 1991.

Source: Andrle and Carrol 1988.

Table 6-7

MAMMALS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
Opossum	*Didelphis marsupialis*
Masked shrew	*Sorex cinereus*
Smoky shrew	*Sorex fumeus*
Longtail shrew	*Sorex dispar*
Pygmy shrew	*Microsorex hoyi*
Least shrew	*Cryptosis parva*
Shorttail shrew	*Blarina brevicauda*
Hairytail mole	*Parascalops breweri*
Starnose mole	*Condylura cristata*
Keen myotis	*Myotis keeni*
Little brown myotis	*Myotis lucifugus*
Small-footed myotis	*Myotis subulatus*
Silver-haired bat	*Lasionycteris noctivagans*
Eastern pipistrel	*Pipistrellus subflavus*
Big brown bat	*Eptesicus fuscus*
Red bat	*Lasiurus borealis*
Hoary bat	*Lasiurus cinereus*
Raccoon[a]	*Procyon lotor*
Shorttail weasel	*Mustela erminea*
Longtail weasel	*Mustela frenata*
Striped skunk	*Mephitis mephitis*
Red fox	*Vulpes fulva*
Gray fox	*Urocyon cinereoargenteus*
Woodchuck[a]	*Marmota monax*
Black bear	*Ursus americanus*
Eastern chipmunk[a]	*Tamias striatus*
Eastern gray squirrel	*Sciurus carolinensis*
Red squirrel	*Tamiasciurus hudsonicus*
White-footed mouse	*Peromyscus leucopus*

Table 6-7

MAMMALS THAT MAY OCCUR AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Common Name	Scientific Name
Deer mouse	*Peromyscus maniculatus*
Coyote	*Canis latrans*
Boreal redback vole	*Clethrionomys gapperi*
Meadow vole	*Microtus pennsylvanicus*
Pine vole	*Pitymys pinetorum*
Meadow jumping mouse	*Zapus hudsonius*
Southern flying squirrel	*Glaucomys volans*
Northern flying squirrel	*Glaucomys sabrinus*
Eastern cottontail	*Sylvilagus floridanus*
Whitetail deer[a]	*Odocoileus virginianus*
Porcupine	*Erethizon dorsatum*

[a] Observed by sight or tracks during July 9, 1993, field reconnaissance.

Compiled by Ecology and Environment Engineering, P.C. 1991.

Source: Burt and Grossenheider 1976.

Table 6-8

CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Compound	Surface Water	Sediment	Surface Soil	Seeps	Leachate
Volatiles					
Vinyl chloride					X
Acetone			X		
1,1-Dichloroethane				X	X
1,2-Dichloroethane				X	
Toluene			X	X	X
Chlorobenzene			X	X	X
Ethylbenzene				X	X
Xylenes (total)				X	X
1,1-Dichloroethylene			X		
Chloroethane				X	
Benzene			X		
1,2-Dichloroethene (total)					X
Trichloroethene					X
Semivolatiles					
1,4-Dichlorobenzene					X
Bis(2-ethylhexyl)phthalate			X		
N-nitrosodiphenylamine					X
Butylbenzylphthalate			X		
Di-n-butylphthalate					X
4-methylphenol					X
4-chloro-3-methylphenol					X
Fluoranthene			X		
Phenanthrene			X		
Pyrene			X		
Anthracene			X		
Chrysene			X		
Benzo(b)fluoranthene			X		

Table 6-8

CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN AT THE WELLSVILLE-ANDOVER LANDFILL SITE

Compound	Surface Water	Sediment	Surface Soil	Seeps	Leachate
Benzo(k)fluoranthene			X		
Benzo(g,h,i)perylene			X		
Benzo(a)pyrene			X		
Dibenzo(g,h)anthracene			X		
Indeno(1,2,3-cd)pyrene			X		
Naphthalene					X
Inorganics					
Aluminum	X	X	X	X	X
Arsenic	X	X	X	X	X
Barium	X	X	X	X	X
Beryllium	X			X	X
Calcium	X	X	X	X	X
Chromium	X	X	X	X	X
Cobalt	X	X	X	X	X
Copper	X	X	X	X	X
Iron	X	X	X	X	X
Lead	X	X	X	X	X
Magnesium	X	X	X	X	X
Manganese	X	X	X	X	X
Nickel	X	X	X	X	X
Potassium	X			X	X
Sodium	X			X	X
Vanadium	X	X	X	X	X
Zinc	X	X	X	X	X
Cyanide			X		

Compiled by Ecology and Environment Engineering, P.C. 1993.

Table 6-9

SURFACE WATER INCLUDING LEACHATE AND SEEP SAMPLES CRITERIA FOR PROTECTION OF FISH AND WILDLIFE

Chemical	NYSDEC AWQS/GV[a] (µg/L)	EPA AWQC[b] (µg/L)	Sampling Location with Concentrations Above Criterion	Analytical Results of SW2-1 Sample Representing Site Background (µg/L)	Sample Locations with Concentrations Above Site Background Sample Result
Organics					
Chloroethane	50	—	None	ND	SP2-1
1,2-Dichloroethane	50	20,000[d]	None	ND	SP2-1, SP2-2, SP2-3, SP2-4, MH-4
1,1-Dichloroethane	50	—	None	ND	SP2-1, MH-4
1,4-Dichlorobenzene	5	—	None	ND	L-2
4-Chloro-3-methylphenol	1.0[c]	—	None	ND	L-2
Trichloroethene	11	—	L-2	ND	L-1, L-2, MH-4
Toluene	50	—	None	ND	SP2-1, SP2-2, MH-4
Chlorobenzene	5	—	SP2-1	ND	SP2-1, L-2
Ethylbenzene	50	—	SP2-1	ND	SP2-1, MH-4
Xylenes (total)	50	—	None	ND	MH-4
1,2-Dichloroethene (total)	50	—	MH-4	ND	L-1, L-2, MH-4
Naphthalene	50	—	None	ND	L-2
N-Nitrosodiphenylamine	50	—	None	ND	L-2
Di-n-butylphthalate	50	—	None	ND	L-2

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Table 6-9

SURFACE WATER INCLUDING LEACHATE AND SEEP SAMPLES CRITERIA FOR PROTECTION OF FISH AND WILDLIFE

Chemical	NYSDEC AWQS/GV[a] (µg/L)	EPA AWQC[b] (µg/L)	Sampling Location with Concentrations Above Criterion	Analytical Results of SW2-1 Sample Representing Site Background (µg/L)	Sample Locations with Concentrations Above Site Background Sample Result
4-Methyl phenol	50	—	None	ND	MH-4
Vinyl chloride	50	—	None	ND	MH-4
Inorganics					
Aluminum	100	—	SP2-1, SP2-2, SP2-3, SP2-4, DW-5, SW-1, SW-2, SW-3, SW-4, SW-5, SW2-1, L-1, L-2	4,670	SP2-2, SP2-3
Arsenic	190	190	None	3.6	SP2-1, SP2-2, SP2-3, SP2-4
Barium	—	—	—	172	SP2-1, SP2-2, SP2-3
Beryllium	11[d]	5.3	None	ND	SP2-2
Calcium	—	—	—	18,800	SP2-1, SP2-2, SW-3
Chromium	158[e]	210	None	ND	SP2-1, SP2-2, SP2-3
Cobalt	5	—	SP2-1, SP2-2, SP2-3, SP2-4, L-1, L-2	ND	SP2-1, SP2-2, SP2-3, SP2-4
Copper	8.9[e]	12	SP2-1, SP2-2, SP2-3	7.3	SP2-1, SP2-2, SP2-3
Iron	300	1,000	SP2-1, SP2-2, SP2-3, SP2-4, DW-5, SW-1, SW-2, SW-3, SW-4, SW-5, SW2-1, L-1, L-2	7,500	SP2-1, SP2-2, SP2-3, SP2-4

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Table 6-9

SURFACE WATER INCLUDING LEACHATE AND SEEP SAMPLES CRITERIA FOR PROTECTION OF FISH AND WILDLIFE

Chemical	NYSDEC AWQS/GV[a] (µg/L)	EPA AWQC[b] (µg/L)	Sampling Location with Concentrations Above Criterion	Analytical Results of SW2-1 Sample Representing Site Background (µg/L)	Sample Locations with Concentrations Above Site Background Sample Result
Lead	2.1[e]	3.2	SP2-2, SP2-3, SP2-4, SW-1, SW-3, SW-4, SW-5, SW2-1, L-1, L-2	7.5	SP2-1, SP2-2, SP2-3
Magnesium	—	—	—	7,210	SP2-1, SP2-2, SP2-3
Manganese	—	—	—	437	SP2-1, SP2-2, SP2-3, SP2-4, SW-1, SW-2
Nickel	74.3	160	None	14.3	SP2-1, SP2-2, SP2-3, SW-2
Potassium	—	—	—	3,070	SP2-1, SP2-2
Sodium	—	—	—	8,090	SP2-1, SP2-2, SW-2, SW-3, SW-4, SW-5, SW-6
Vanadium	14	—	SP2-2, SP2-3, L-1	6.1	SP2-1, SP2-2, SP2-3, SW-1, SW-2, SW-6
Zinc	30	110	SW2-1, SP2-1, SP2-2, SP2-3, SP2-4	53.7	SP2-1, SP2-2, SP2-3

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Table 6-9 (Cont.)

[a] Ambient Water Quality Standards and Guidance Values for Class C waters (NYSDEC 1990a) and 6 NYCRR 703.5. Where specific guidance values are not available, the general organic guidance value of 50 µg/L was used.

[b] Ambient Water Quality Criteria (EPA 1992), Freshwater Chronic Criteria, unless otherwise noted.

[c] Applies to the sum of chlorinated phenols.

[d] Standard when hardness is ≤75 mg/L; criteria is 1,100 µg/L when hardness is ≥75 mg/L.

[e] Hardness-based criteria - average hardness of 61.7 mg/L in Duffy Creek shown on table. Criteria based on the samples analyzed for hardness (Chromium/Copper/Lead) are: SW-1: 94.2/4.8/0.42, SW-2: 104.1/9.6/0.49, SW-3: 105.5/9.7/0.51, SW-4: 105.5/9.7/0.51, SW-5: 105.5/9.7/0.55, SW-6: 111.0/10.3/0.54, L-1: 725.5/72.7/10.0, L-2: 555.9/59.3/7.4.

Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 6-10

SEDIMENT CRITERIA FOR PROTECTION OF FISH AND WILDLIFE

Chemical	NYSDEC Criteria[a] (mg/kg)	Ontario Ministry of Environment Criteria[b] (mg/kg)	Sampling Location with Concentrations Above Criterion	Analytical Results of SED2-2 Sample Representing Site Background (mg/kg)	Sample Locations with Concentrations Above Site Background Sample Result
Inorganics					
Aluminum	—	—	—	9,890	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6
Arsenic	5	5.5	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6, SED2-1	12.3	SED-1, SED-6
Barium	—	60[c]	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6, SED2-1	236	None
Beryllium	—	—	—	0.94	SED-2, SED-4
Calcium	—	—	—	2,810	None
Chromium	26	31	None	16.0	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6
Cobalt	—	—	—	19.4	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6
Copper	19	25	SED-1, SED-4	19.0	SED-1, SED-4
Iron (%)	2.4%	3%	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6, SED-2-1	2.6%	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6
Lead	27	31	None	24.1	SED-1, SED-4
Magnesium	—	—	—	2,880	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6

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Table 6-10

SEDIMENT CRITERIA FOR PROTECTION OF FISH AND WILDLIFE

Chemical	NYSDEC Criteria[a] (mg/kg)	Ontario Ministry of Environment Criteria[b] (mg/kg)	Sampling Location with Concentrations Above Criterion	Analytical Results of SED2-2 Sample Representing Site Background (mg/kg)	Sample Locations with Concentrations Above Site Background Sample Result
Manganese	428	457	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6, SED2-1	2,040	SED-2
Nickel	22	31	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6, SED2-1	31.4	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6
Potassium	—	—	—	879	SED-1, SED-2, SED-3, SED-4, SED-5, SED-6
Sodium	—	—	—	235	None
Vanadium	—	—	—	19.9	SED-1, SED-2, SED-4
Zinc	85	110	SED-2, SED-3, SED-4, SED2-1	112	None

a NYSDEC 1989.

b OME 1990. Sediment Quality Criteria (μg/g Dry Weight for Metals and Nutrients) proposed by the Ontario Ministry of Environment (lowest effect level).

c EPA Region V dredged sediment guidelines for Great Lakes harbor sediments (EPA 1977).

Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 6-11

COMPARISON OF INORGANICS IN SITE SURFACE SOILS REPORTED AND SITE BACKGROUND CONCENTRATIONS

Chemical	Analytical Results of Soil Samples Representing Site Background (mg/kg)		Sample Locations with Concentrations Above Site Background Sample Results	Upper Limit of 90th Percentile[a]	Sample Locations with Concentrations Above Upper Limit 90th Percentile
	SS-1	SS-2			
Aluminum	13,100	10,400	SS-10, SS-12, SS-13, SS-14, SS-4, SS-6, SS-7, SS-8	128,000	None
Arsenic	10.3	13.5	SS-9, SS-12, SS-13, SS-5, SS-6, SS-7, SS-8	16.0	None
Barium	97.3	90.8	SS-3, SS-5, SS-6, SS-7, SS-8, SS-10, SS-11, SS-13	867	None
Beryllium	0.61	0.47	SS-8, SS-9, SS-10, SS-12, SS-13, SS-14, SS-4, SS-5, SS-6, SS-7	1.81	None
Calcium	3,390	915	SS-3, SS-9, SS-10, SS-11	14,400	SS-3, SS-9
Chromium	17.3	12.9	SS-8, SS-9, SS-10, SS-11, SS-12, SS-13, SS-14, SS-3, SS-4, SS-5, SS-6, SS-7	112	None
Cobalt	22.4	17.7	SS-11, SS-12, SS-13, SS-14, SS-7, SS-8, SS-9, SS-10, SS-3, SS-4, SS-5, SS-6	19.8	SS-3, SS-6 SS-10, SS-12, SS-14, SS-11, SS-13, SS-1, SS-4, SS-7, SS-8, SS-9
Copper	11.3	6.6	SS-9, SS-10, SS-11, SS-12, SS-13, SS-14, SS-4, SS-5, SS-6, SS-7, SS-8	48.7	None
Iron	27,400	24,900	SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9, SS-10, SS-11, SS-12, SS-13	54,100	SS-3, SS-11, SS-10
Lead	17.5	17.3	SS-11, SS-12, SS-13, SS-3, SS-7, SS-10	33	SS-11, SS-3

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Table 6-11

COMPARISON OF INORGANICS IN SITE SURFACE SOILS REPORTED AND SITE BACKGROUND CONCENTRATIONS

Chemical	Analytical Results of Soil Samples Representing Site Background (mg/kg)		Sample Locations with Concentrations Above Site Background Sample Results	Upper Limit of 90th Percentile[a]	Sample Locations with Concentrations Above Upper Limit 90th Percentile
	SS-1	SS-2			
Magnesium	2,400	1,710	SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9, SS-10, SS-11, SS-12, SS-13, SS-14	10,700	None
Manganese	1,260	1,170	SS-3, SS-12, SS-13	1,450	SS-3, SS-13
Nickel	21.0	15.8	SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9, SS-10, SS-11, SS-12, SS-13, SS-14	38.2	SS-11, SS-3, SS-7
Potassium	1,130	853	SS-4, SS-6, SS-7, SS-8, SS-9, SS-10, SS-11, SS-12, SS-13, SS-14	23,500	None
Sodium	90.9	74.8	None	17,400	None
Vanadium	22.3	21.7	SS-12, SS-13	140	None
Zinc	58.2	43.0	SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9, SS-10, SS-11, SS-12, SS-13, SS-14	104	SS-3, SS-11, SS-13
Cyanide	ND	ND	SS-11	—	—

[a] Shacklette and Boerngen, 1984, United States Geological Survey Paper 1270, Element Concentrations in Soils and Other Surficial Material, Eastern United States, values from 95th percentile, based on average element concentrations and deviations.

Compiled by Ecology and Environment Engineering, P.C. 1993.

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Table 6-12

TOXICITY QUOTIENTS - SURFACE WATER (INCLUDING SEEPS AND LEACHATE)

Chemical	TBC[a] (µg/L)	Endpoint/ Source[b]	UF[c]	ECL[d] (µg/L)	EPC[e] (µg/L)	TQ[f]
Organics						
Vinyl chloride	—	—	—	—	18	—
Chloroethane	—	—	—	—	49	—
4-methyl phenol	—	—	—	—	10	—
1,2-dichloroethane	118,000	3	0.1	11,800	10	0.001
1,1-dichloroethane	118,000	3	0.1	11,800	18	0.002
1,4-dichlorobenzene	5	4	0.1	0.5	1	2.0
4-Chloro-3-methylphenol	30	1	0.1	3	4	1.33
Trichloroethene	11	4	1	11	14	1.27
Toluene	17,500	1	0.1	1,750	8	0.004
Chlorobenzene	—	—	—	—	7	—
Ethylbenzene	32,000	1	0.1	3,200	150	0.05
Xylenes (total)	—	—	—	—	470	—
1,2-dichloroethene (total)	11,600	1	0.1	1,160	240	0.21
Naphthalene	620	2	0.1	62	1	0.02
N-nitrasodiphenylamine	—	—	—	—	1	—
Di-n-butylphthalate	—	—	—	—	2	—
Di-n-octylphthalate	—	—	—	—	2	—
Inorganics						
Aluminum	100	4	1	100	35,900	359
Arsenic	190	4	1	190	28.0	0.15
Barium	50,000	1	0.1	5,000	577	0.12
Beryllium	11	4	1	11	1.7	0.15
Calcium	—	—	—	—	191,000	—
Chromium	158	5	1	158	39.9	0.25
Cobalt	5	4	1	5	66.2	13.24

Key at end of Table

Table 6-12

TOXICITY QUOTIENTS - SURFACE WATER
(INCLUDING SEEPS AND LEACHATE)

Chemical	TBC[a] (µg/L)	Endpoint/ Source[b]	UF[c]	ECL[d] (µg/L)	EPC[e] (µg/L)	TQ[f]
Copper	8.9	5	1	8.9	49.4	5.55
Iron	300	4	1	300	165,000	550
Lead	2.1	5	1	2.1	67.9	32.3
Magnesium	—	—	—	—	102,000	—
Manganese	—	—	—	—	15,100	—
Nickel	74.3	5	1	74.3	54.5	0.73
Potassium	—	—	—	—	72,500	—
Sodium	—	—	—	—	170,000	—
Vanadium	14	4	1	14	53.7	3.8
Zinc	30	5	1	30	227	7.6
Cyanide	22	4	1	22	2	6.09

[a] TBC = Toxicity Benchmark Criterion.

[b] Endpoint/Source: Acute LOEL for chemical class, EPA 1986; Chronic LOEL for chemical class, EPA 1986; Acute LOEL for 1,2-Dichloroethane, EPA 1986; NYSDEC Surface Water Criterion for protection of aquatic life (fish survival or bioaccumulation), NYSDEC 1990.

[c] UF = Uncertainty Factor: 0.1 used to estimate NOEL from LOEL; 0.1 used to estimate NOEL from structurally related compounds (EPA 1984).

[d] ECL = Environmental Concern Level = TBC x UF.

[e] EPC = Exposure Point Concentration = maximum detected concentration.

[f] TQ = Toxicity quotient - EPC/ECL ratio.

Key:

— = Insufficient data to derive a criterion.

Compiled by Ecology and Environment Engineering, P.C. 1993.

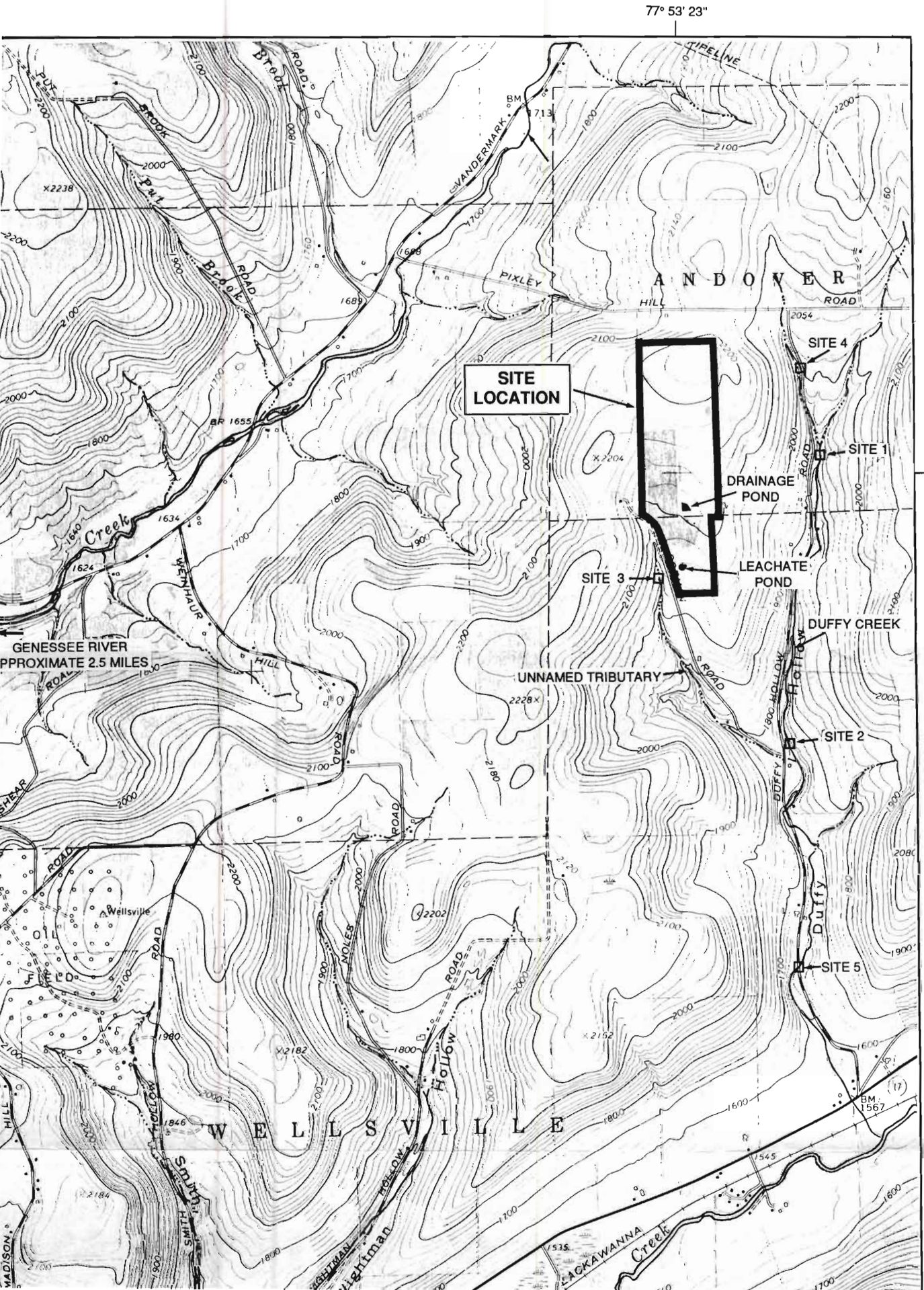
Table 6-13

SITE-SPECIFIC SEDIMENT TOXICITY QUOTIENTS FOR INORGANICS

Chemical	Sediment Criteria[a] (mg/kg)	EPC[b] (mg/kg)	TQ[c]	Sample Location Point Used for EPC[d]
Aluminum	—	14,500	—	SED-4
Arsenic	33	13.5	0.41	SED-6
Barium	—	236	—	SED2-1
Calcium	—	2,010	—	SED-1
Chromium	111	22.5	0.20	SED-1
Copper	114	20.5	0.18	SED-1
Iron	4%	4.3%	1.08	SED-2
Lead	250	26.1	0.10	SED-1
Magnesium	—	4,270	—	SED-4
Manganese	1,100	2,440	2.22	SED-2
Nickel	90	40.1	0.45	SED-1
Vanadium	—	22.1	—	SED-1
Zinc	800	107	0.13	SED-3
Cobalt	—	26.9	—	SED-1

a Sediment Criteria Limit of Tolerance (NYSDEC 1989).
b EPC = Estimated point concentration: Highest concentration measured at sediment sampling location.
c TQ = Toxicity Quotient = EPC/Sediment Criterion.

Compiled by Ecology and Environment Engineering, P.C. 1993.


77° 53' 23"
42° 10' 32"
SITE LOCATION
DRAINAGE POND
LEACHATE POND
SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
DUFFY CREEK
UNNAMED TRIBUTARY
GENESSEE RIVER
PPROXIMATE 2.5 MILES
ANDOVER
WELLSVILLE
Wellsville
Creek
Duffy
Hollow
Smith
Hollow
Creek
PIXLEY
HILL
ROAD
VANDERMARK
BROOK
Put
Brook
WEINHAUR
HILL
NOLES
ROAD
LACKAWANNA
Creek
TIPELINE
BM 1713
BM 1567
BR 1655
2054
2228
2202
2182
2152
2184
1689
1688
1634
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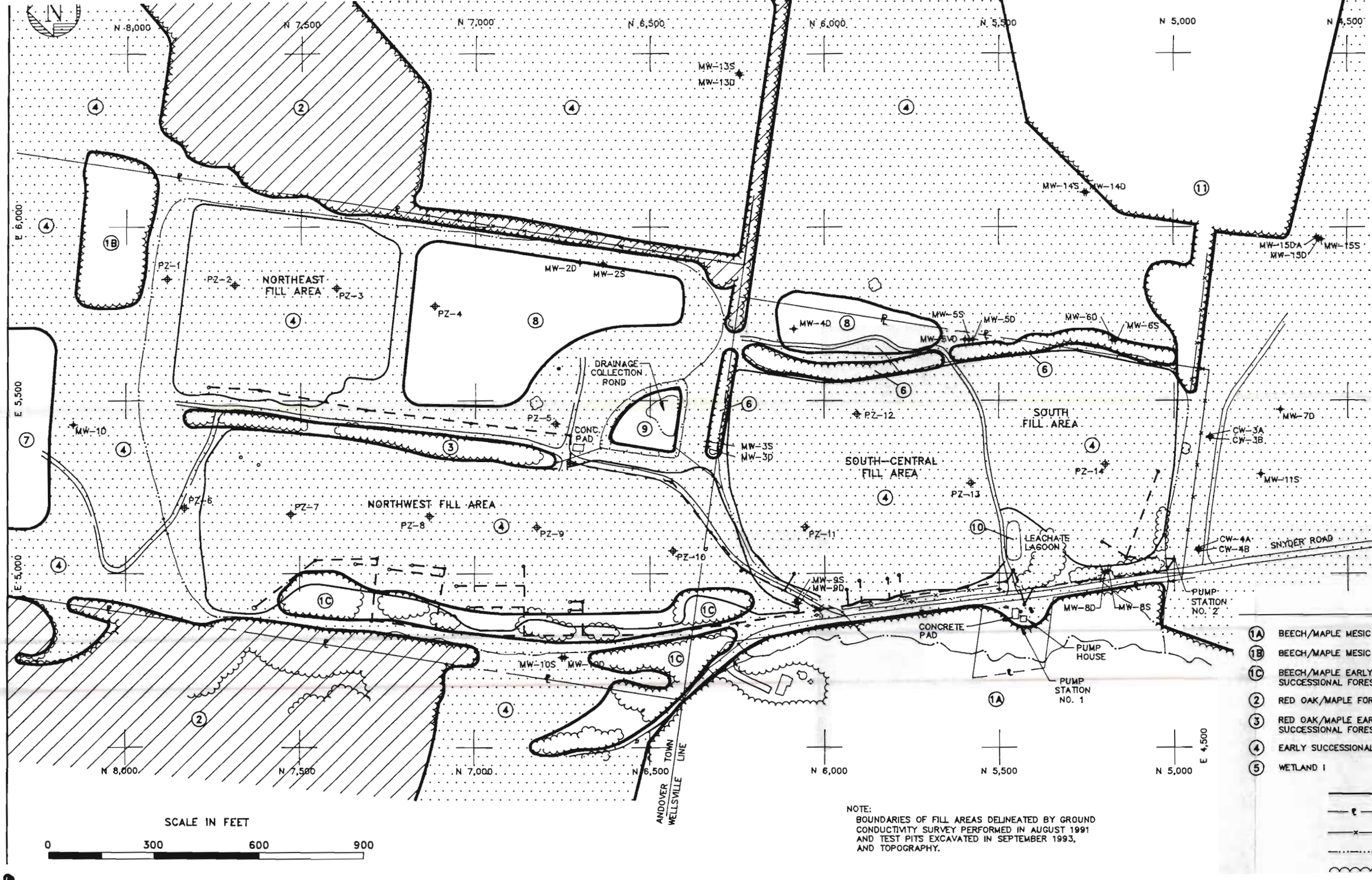
1640
1980
1846
1545
1535
2204
2238



NOTE:
BOUNDARIES OF FILL AREAS DELINEATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991 AND TEST PITS EXCAVATED IN SEPTEMBER 1993, AND TOPOGRAPHY.

7. SUMMARY AND CONCLUSIONS

7.1 SUMMARY

The Phase I and Phase II RI for the Wellsville-Andover Landfill, NYSDEC Site No. 9-02-004, in the towns of Wellsville and Andover, Allegany County, New York, was performed by E & E under contract to NYSDEC. Site work for the Phase I field activities was performed from August 1991 through February 1992. Site work for the Phase II field activities was performed from June 1993 through September 1993. The objectives of the RI were to identify the cause, extent, and possible effects of the hazardous materials present in the project area.

Prior to the Phase I RI, a Phase I study was performed for NYSDEC in 1983 and an independent Phase II study was subsequently performed by the Village of Wellsville in 1986. The primary factors of concern indicated by these studies were contaminated groundwater potentially impacting local residents and the generation of leachate contaminated with VOCs and metals.

7.1.1 Preliminary Field Activities

During the Phase I RI site characterization, preliminary field activities performed prior to sampling of environmental media included a ground-based survey, the development of a base map, and the performance of three geophysical surveys.

The ground-based survey was used to locate site features and establish a grid for use during the geophysical surveys. The ground-based survey data were combined with aerial photogrammetry to create a site topographic map and base plan (see Figures 2-2 and 3-11).

The geophysical investigation included a total earth field magnetics survey, a ground conductivity survey, and a seismic refraction survey. The purposes of the geophysical investigation were to:

- Locate subsurface ferrous objects;
- Define waste-disposal areas;
- Detect potential shallow groundwater contaminant plumes;
- Determine the morphology and stratigraphy of the subsurface; and
- Assist in the selection of monitoring well locations.

7.1.2 Soil/Fill

The boundaries of the four fill areas were identified by the geophysical investigation and depicted on the site base map (see Figure 3-11 in back pocket). Based on the contour patterns shown on the geophysical investigation maps (see Figures 4-1, 4-2, and 4-3), waste disposal appears to have been performed in a cellular fashion in the northeast fill area, while in the other areas, filling appears to have occurred in a more haphazard manner. Trench excavation further supported the idea that mixed fill types are present throughout the landfill. That is, wastes do not appear to have been segregated based on type, and municipal, industrial, and hazardous wastes are likely mixed. No contaminant plume was detected outside the fill areas during the geophysical survey; however, the depth to groundwater and high natural metal content of the area soils were expected to have interfered with detection of a plume. Seismic profiles for the site were generated, depicting subsurface stratigraphy, and these profiles were used to aid in the selection of monitoring well locations.

The results of this investigation allowed E & E to detect five consistently anomalous locations within the fill areas. Each area was excavated and the cause of the anomaly determined. Steel 55-gallon drums were located in three of the five geophysically anomalous locations excavated. One empty, crushed oil drum was located in the south fill area. Five rusted drums were located in the northeast corner of the south-central fill area. These drums contained a solid, plastic-like material and were surrounded by plastic buttons and scraps, presumably from the Rochester Button Company. Two rusted, liquid-filled drums with no identifiable markings were discovered in the northwest corner of the northwest fill area. Liquid, however, may not have been the original contents, as these drums had been broken open. The causes of the other two anomalies were determined to be numerous metal objects, including a steel trash can, aluminum storm door, a roll of steel chicken wire, copper tubing, and truck tire rims.

Soil and waste samples collected from the five trenches indicate the presence of numerous contaminants, including chlorinated aliphatic compounds (1,2-DCE, TCE, VC, 1,1-DCA, PCE, etc.); aromatic hydrocarbons (benzene, ethylbenzene, toluene, xylene, and styrene); a chlorinated aromatic (1,2-dichlorobenzene); ketones (acetone, 4-methyl-2-pentanone, etc.); PAHs; phthalates; phenols; and pesticides. Sample TP-2 from the northeast fill area contained relatively low amounts of the above contaminants, except for PAHs, phthalates, and pesticides, which were found at comparatively higher concentrations. The phthalates in sample TP-2 most likely resulted from the relatively large amount of plastic municipal waste present in this disposal area compared to other areas. Sample TP-1 from the northwest fill area contained relatively high concentrations of many contaminants, including approximately 5,700 μg/L of chlorinated aliphatic compounds and approximately 36,000 μg/L of aromatic hydrocarbons. TP-4 from the south-central fill area where the five drums were located contained the highest concentration of total chlorinated aliphatics (approximately 9,800 μg/L) and phthalates (approximately 24,000 μg/L).

The inorganics detected in the soil/waste samples from the trenches were compared to observed ranges in eastern U.S. soils. Concentrations of cobalt, lead, and zinc were found to be slightly elevated across the site (approximately one to two times the 90th percentile of the observed range in eastern U.S. soils), while arsenic and nickel were slightly elevated in the northwest fill area (10 to 25% above the 90th percentile of the observed range in eastern U.S. soils). Copper was found to be approximately four times the 90th percentile of the observed range in eastern U.S. soils in the southeast corner of the northwest fill area.

The boundaries of the individual fill areas were defined using topographic clues and the geophysical survey results. These boundaries were later verified by Phase II test pit excavation, resulting in a map with sufficient accuracy for use in the FS. During Phase I RI trenching and Phase II RI piezometer installation, existing landfill cover and fill depths were found to vary. In the northeast fill area, fill was encountered to a depth of 15.5 feet and the cover ranged from 1.5 to 2.5 feet thick. In the northwest area, fill extended to depths of 8 to 12 feet and the cover was between 3 and 7 feet thick. In the south-central fill area, fill was found at maximum depths of 9 to 20 feet with 2.5 to 4 feet of cover. In the south fill area, fill was encountered to a depth of 9 feet with 2 to 3 feet of cover. Variations in cover thickness are likely due to settling and the subsequent addition of more soil. With the exception of encountering fill from 4 to 20 feet BGS in PZ-11 in the south-central fill area, the remaining fill depths are consistent with the Phase II

report, which stated that the maximum depth of fill was approximately 9 to 14 feet (Village of Wellsville 1986).

Subsurface soil samples were collected for chemical analysis from each of the Phase I RI deep well borings. The only organic substances detected were 1,2-DCE, TCE, and VC in the two samples from MW-5D. A total of 130 μg/kg were detected at 8 to 9 feet, and approximately 81 μg/kg were detected at 18 to 19 feet. In the subsurface soils, several inorganic substances (including arsenic, calcium, cobalt, lead, magnesium, manganese, and nickel) exceeded the 90th percentile of the observed range in eastern U.S. soils. However, of the above inorganics, the highest detected concentrations of cobalt, manganese, and nickel were detected in the background sample. Concentrations of arsenic, cobalt, lead, and nickel were also similar to those detected in the trench samples.

7.1.3 Groundwater

Phase I

During the Phase I RI, E & E collected groundwater samples from 21 overburden and bedrock monitoring wells at the site. Organic compounds detected in the groundwater samples included the chlorinated aliphatic compounds chloroethane, 1,1-DCA, 1,1-DCE, 1,2-DCE, 1,1,1-TCA, TCE, and VC and the aromatic hydrocarbons ethylbenzene and toluene. The monitoring wells containing these compounds above NYSDEC Class GA groundwater standards included MW-2D, MW-5D, MW-5S, MW-6D, MW-11S, CW-3A, and CW-3B. All of these wells are on the east or south side of the site. No organic compounds were detected in the upgradient well. Concentrations of total chlorinated aliphatic compounds ranged up to a maximum of approximately 8,100 μg/L in GW-5S.

Inorganic substances detected above Class GA standards in the Phase I RI groundwater samples included iron, manganese, and sodium in numerous samples, magnesium in MW-2S, MW-8S, and CW-3B, chromium in MW-2S, and lead in CW-3A and MW-2S. The sample from MW-2S had a very high turbidity, which is likely the reason for the high metals contents.

Phase II

During the Phase II RI, five additional monitoring well pairs were installed further east and south of the site than the existing wells, and one very deep well was installed. Groundwater

samples were then collected from all possible wells (excluding three dry wells) totalling 31 samples. The same VOCs found in the Phase I RI samples were detected in the Phase II RI groundwater samples, with the following exceptions:

- Benzene was detected off site in well MW-15DA; and
- The common laboratory contaminants acetone, MC, and chloroform, which were each detected in one Phase I RI sample, were not detected in the Phase II RI samples.

Fourteen monitoring wells were found to contain chlorinated aliphatics and/or aromatic hydrocarbons. All but one of these 14 samples (CW-4A) contained at least one compound above NYSDEC Class GA groundwater standards. All of the wells found to contain VOCs were on the east and south sides of the site, with the exception of MW-10D on the west side of the site. MW-10D contained a total VOC concentration of approximately 7 μg/L. Concentrations of total chlorinated aliphatic compounds in Phase II RI groundwater samples ranged up to a maximum of approximately 6,200 μg/L in MW-5S. In addition to numerous on-site wells, VOCs were detected in three of the new off-site wells (MW-14D, MW-15DA, and MW-15S). Deep monitoring well MW-5VD contained no organic contamination, indicating a lack of vertical contaminant migration to the depth range screened by this well (90 to 110 feet BGS).

Thirteen inorganic analytes were detected above NYSDEC Class GA standards in the Phase II RI groundwater samples. Of these 13 analytes, arsenic, barium, beryllium, cadmium, and zinc exceeded standards in only one highly turbid sample, MW-8D. The remaining inorganics detected above standards included iron, manganese, and sodium in numerous samples; chromium in MW-2S and MW-8S; copper in MW-8D and MW-16S; lead in MW-2S, MW-8D, and CW-3A; magnesium in MW-2S, MW-3D, MW-8D, MW-8S, and CW-3B; and cyanide in CW-4B. Every Phase II RI groundwater sample contained at least one inorganic analyte above NYSDEC Class GA standards, including iron in the background well, MW-1D. The high turbidities of samples MW-2S, MW-8D, MW-8S, and CW-3B are likely part of the reason for the high metals content in these samples.

7.1.4 Wells and Springs

Phase I

Seven residential wells and springs in the area were sampled during the Phase I RI. The only organic compound detected was TCE, which was found below the NYSDEC Class GA groundwater standard in the LaDue spring south-southeast of the site. Inorganic substances above Class GA standards include iron and sodium in more than half the samples, manganese in the Rosini well, and zinc in the Bauer well. All four of these metals are considered secondary contaminants by NYSDOH. That is, their standards are based on aesthetics, not the protection of human health.

Phase II

During the Phase II RI, domestic water samples were collected from 19 residences in Duffy Hollow. As in the Phase I RI, site-related organics were detected in the LaDue spring. TCE was detected at a concentration above the NYSDEC Class GA groundwater standard in samples collected from both the outdoor spigot and the spring overflow. These concentrations, 6.2 μg/L and 5.1 μg/L, respectively, are approximately double those detected during the Phase I RI.

In the Phase II RI domestic water samples, at least one inorganic was detected above NYSDEC Class GA standards at 15 homes as follows:

- Iron in the Rosini, Miller, D'Ovidio, R. Fanton, Ormsby, Gephart, and Urban samples;
- Manganese in the Rosini, Miller, and R. Fanton samples;
- Sodium in the Rosini, Kelley, Jr., Geffers, Green, Schettine, Fletcher, J. Fanton, Dodge, Gephart, and Meisenzahl samples;
- Copper in the R. Fanton and Ormsby samples; and
- Zinc in the Ormsby and Urban samples.

Concentrations of inorganic analytes were very similar in those locations sampled during both phases of the RI, with few exceptions. The most notable changes are as follows:

- In the Rosini sample, aluminum decreased while iron, lead, and cyanide increased;
- In the Teller sample, aluminum and zinc decreased while arsenic increased slightly;
- In the Kelley, Jr., sample, iron, manganese, and zinc decreased while antimony increased;
- In the LaDue sample, aluminum, iron, manganese, and sodium decreased while copper and zinc increased; and
- In the Miller sample, arsenic, copper, iron, and manganese increased while other inorganics remained about the same.

None of the above changes were of a large magnitude, suggesting that these changes represent natural fluctuations to what may be natural or site-related preexisting concentrations, with the exception of cyanide, which does not appear to be site related.

7.1.5 Surface Water

A total of seven surface water and seven sediment samples were collected from Duffy Creek and its unnamed tributary during both phases of the RI. No organic or inorganic analytes in either medium were found to significantly exceed (by more than approximately 50%) the concentrations detected in the background sample except manganese in surface water sample SW-2, which was six times the background value, and potassium in sediment sample SED-4, which was two times the background value.

7.1.6 Surface Soils

Twelve biased and two background surface soil samples were collected at the site during the Phase I RI. Analysis indicated the presence of chloromethane and/or ethylbenzene in samples collected near seeps in the northwest fill area. In addition, several PAHs were detected at various concentrations in leachate seeps and ditches on and off the site. Inorganic analysis of these surface soil samples indicated concentrations of calcium, cobalt, iron, lead, manganese, nickel, and zinc above those expected based on a literature review; however, based on the background samples and other on-site data, all of these substances appear to be naturally ubiquitous at the concentrations detected. Exceptions to this appear to be calcium, iron, and zinc in SS-3 and cobalt and iron in SS-11. Both samples were collected from areas of leachate-stained soil.

7.1.7 Leachate

Liquid leachate samples were collected from two locations along the leachate collection system during the Phase I RI. Inorganic substances exceeding NYSDEC Class C surface water standards in the leachate were aluminum, lead, and zinc in both samples and vanadium in one sample (L-1). Volatile and semivolatile compounds were also detected in these samples; however, the concentrations were significantly less than expected based on air sampling results. NYSDEC collected one leachate sample from the same location as L-1 during a period of relatively higher leachate flow. Analysis indicated that the total VOC content was slightly higher, but that the total inorganic content decreased.

7.1.8 Air

Six air (landfill gas) samples were collected at various points along the leachate collection system during the Phase I RI. Analysis indicated the presence of relatively high concentrations of chlorinated aliphatic compounds and aromatic hydrocarbons. The relatively high concentrations of VOCs in the air samples suggests that the leachate may not be the only source of the VOCs. Risers and lateral lines may allow VOCs in the fill to migrate directly to the main line of the leachate collection system. To help determine if VOCs are also migrating away from the fill areas via soil gas, a perimeter soil gas survey was performed during the Phase II RI. No samples were collected; however, air monitoring instruments were used to quantify the VOCs present in the soil gas around each fill area. Several locations very near the fill showed high concentrations of VOCs in the soil gas; however, the vast majority of the locations exhibited little or no VOCs.

Landfill gas sampling results indicated that the majority of the VOCs in the collection system are emanating from the northwest fill area. Samples collected from manholes MH-6 and MH-10 and riser R-10 contained one to two orders of magnitude more VOCs than the other samples analyzed. Air monitoring results support these analyses.

7.1.9 Aquifer Characterization

Aquifer testing was conducted in many of the on-site wells during the Phase II RI. Results indicated that the hydraulic conductivity range in the vicinity of the overburden wells (10^{-6} to 10^{-4} cm/s) was typical for glacial till and silt, but not unweathered clays (Freeze and Cherry 1979). The hydraulic conductivity range for the bedrock wells (10^{-5} to 10^{-2} cm/s) was typical for sandstones and fractured rocks, but not unweathered shale (Freeze and Cherry 1979).

Groundwater flow in both the overburden and bedrock is strongly influenced by topography. A groundwater flow divide is present along the east side of the site. On the east side of the divide, flow is to the southeast toward Duffy Creek. On the west side of the divide, flow is to the southwest toward the unnamed tributary (6 NYCRR 821.6 Waters Index Number ONT. 117-184-4-1).

Several isolated aquifers appear to exist in many areas at and around the site. However, based on site geology and the extent of fracturing, these aquifers likely merge in several places. The bedrock and overburden potentiometric surfaces are expected to converge at common discharge points such as Duffy Creek and its tributary.

7.1.10 Human Health Risk Evaluation

A preliminary human health risk evaluation was conducted based on Phase I and II RI data. Analytical results for all media sampled were compared to background levels and appropriate NYS SCGs. COPCs were then chosen based on the above comparisons and their presence in more than one media. The COPCs identified are the chlorinated aliphatic compounds 1,1-DCA, 1,1,-DCE, 1,2-DCE, TCE, and VC, as well as the aromatic hydrocarbon toluene. Contaminant migration appears to be primarily to the south-southeast in the groundwater and the TCE is affecting the LaDue spring. Potential routes of exposure identified for the COPCs include:

- Dermal contact or accidental ingestion of leachate on site;
- Inhalation of vapors resulting from migration of gas through the existing cover or from the leachate;
- Ingestion of, dermal contact with, or inhalation of vapors from groundwater at downgradient residences; and
- Inhalation of indoor air contaminated with VOCs that have migrated from the groundwater through the soil gas and into downgradient residences.

7.1.11 Habitat-Based Ecological Assessment

In addition to the above site characterization, a habitat-based ecological assessment was performed at the site to characterize the ecological resources associated with this site. The scope of work performed addressed items in Steps 1, 2A, and 2B of *Fish and Wildlife Impact Analysis*

for Inactive Hazardous Waste Sites (NYSDEC 1991b). A background search and a field reconnaissance were performed to characterize both the terrestrial and aquatic ecosystems at the site. Flora and fauna were identified in the site area, with emphasis on sensitive receptors. A cover-type map of the site and surrounding area was generated. Analytical data collected during the RI were compared to site background and applicable criteria for the protection of fish and wildlife. Based on this comparison, several contaminants of potential ecological concern (CPECs) were identified for each applicable media; that is, surface water (including leachate), sediment, and surface soil.

CPECs were then evaluated with respect to toxicity benchmark criteria (TBCs). No organics were found to pose a threat to fish and wildlife in the three media discussed. On-site leachate and seeps were found to pose a moderate risk to fish and wildlife due to the inorganic CPECs aluminum, cobalt, copper, iron, lead, and zinc. Duffy Creek and its unnamed tributary were found to pose little or no threat. Based on a background and benchmark comparison, the risk due to manganese in sediment could not be ruled out as all other metals were. Additional evaluation would be necessary to conclusively determine whether manganese in sediment is site related and poses a risk to fish and wildlife. In the surface soil, five CPECs (cadmium, cobalt, lead, nickel, and zinc) remained as possible threats to fish and wildlife. No TBCs exist for surface soil; therefore, calculation of dose estimates in indicator species is required to evaluate the risk of the above five CPECs in surface soil. Dose estimate calculations are part of Step 2C of the HBA (NYSDEC 1991b). Since site remediation is expected to affect the surface soils, this step was not deemed necessary at this time.

7.2 CONCLUSIONS

The RI has identified several contaminants of concern that occur in significant concentrations at the Wellsville-Andover Landfill site. As identified by the preliminary human health risk evaluation, the significant contaminants of potential concern are 1,1-DCA, 1,1-DCE, 1,2-DCE, toluene, TCE, and VC. These contaminants were detected at elevated concentrations in a variety of media, including subsurface soil and waste, surface soil, groundwater, leachate, and air (landfill gas).

The primary migratory pathway for contaminants on site is from the fill to the groundwater via infiltration and leaching. Because fill areas have a much higher (two or three orders of magnitude) permeability than the surrounding native soils and the landfill cover is also

expected to be more permeable than the surrounding soils (but less permeable than the fill), the fill areas are assumed to be acting as primary groundwater recharge units in the immediate vicinity of the site. The infiltrating rainwater leaches the COPCs out of the fill and is either intercepted in the leachate collection system or enters into the groundwater.

The RI has shown that the surface groundwater table probably intercepts the northwest fill area (and that groundwater most likely does not intercept the other fill areas). It is reasonable to assume that when this area was excavated to serve as a land fill, it was not excavated into the groundwater table at that time. During wet periods, however, groundwater levels could have risen into the landfill area and surface runoff could have collected in the area while it was being filled. If direct surface infiltration to the permeable fill areas is eliminated, and the existing water in the fill is removed or allowed to naturally drain out, then the water table beneath the fill areas should drop. However, the extent of this decrease in hydraulic head cannot be predicted, but it would likely drop to at least pre-landfill conditions (assumed to be below the fill at least seasonally) and possibly further because infiltration would be eliminated.

A primary migratory pathway for site-related contaminants to move off site is groundwater. Organic contamination has been detected off site to the east on Mr. Urban's property in monitoring well MW-14D. Organic contamination was also detected south and southeast of the site on Mr. LaDue's property in his spring and in numerous monitoring wells. To the southeast, TCE has been detected as far as 1,500 feet away from the site in LaDue's spring. Immediately south of the site, contaminants are present 300 feet from the landfill in MW-11S, but not in MW-16D/16S approximately 1,200 feet from the site. Based on this information, it appears that a groundwater contaminant plume in the overburden and shallow bedrock is emanating from the site and moving hydraulically (and topographically) downgradient to the south and southeast. TCE appears to be at the leading edge of this plume. TCE has traveled at least as far as the LaDue spring and probably further in the last 15 to 30 years.

Organic contamination was detected on site in the bedrock to a maximum depth of 50 to 60 feet BGS in MW-2D. However, no VOCs were present at 60 to 70 feet BGS in MW-8D or at 90 to 110 feet BGS in MW-5VD, indicating that 60 feet may be the approximate maximum depth of VOC contamination.

No significantly elevated levels of inorganics were detected in MW-5VD. However, the presence of inorganic contamination at depth cannot easily be determined because two of the deep

wells with the highest total metals content (MW-2D and MW-8D) also had relatively high turbidities.

Inorganics were not identified as COPCs because none were present at consistently elevated levels in more than one media. The impact of potentially site-related inorganics is difficult to discern in water samples. This is because the metal content of a water sample can be affected by its turbidity. That is, the higher the turbidity, the higher the suspended sediment content and the increased likelihood of higher total metal content. The LaDue spring, impacted with a site-related COPC, contained no inorganics above NYSDEC Class GA groundwater standards. This indicates that metals from the site have had little impact on the groundwater in this area.

As expected, the concentrations of many metals in groundwater and domestic water samples varied considerably with location. Metal content in a water sample is highly dependent on the geologic materials screened by a well or providing water to a spring. The precise composition of geologic materials in an area such as Duffy Hollow will naturally vary widely due to the variability of glacial till, the complex nature of the interbedded sedimentary bedrock and the topographic relief. That is, with nearly flat-lying bedrock units and over 500 feet of topographic relief between the site and where Duffy Creek joins Dyke Creek, there is considerable variation in the geologic materials screened. Additionally, the composition of a single bedrock unit varies laterally in the area's Devonian sedimentary strata. These variations result in comparable chemical variations in groundwater. This is especially true for common metals such as aluminum, calcium, iron, magnesium, manganese, sodium, all of which (along with many others) are natural components of soil, rock and, therefore, groundwater.

This does not imply, however, that all elevated concentrations of inorganics detected in the groundwater and domestic water samples are naturally occurring. The presence of elevated levels of some metals in groundwater near the site may be site related, but away from the site along Duffy Creek, these metals seem to be naturally occurring because elevated levels are not consistently present in the direction of the organic contaminant plume. However, cyanide does appear to be site related. While it did not exceed the NYSDEC Class GA groundwater standard, cyanide was present in the Rosini, Ormsby, and Miller samples at 84.0 μg/L, 10.0 μg/L, and 19.0 μg/L, respectively. Cyanide was also detected on site and immediately south of the site in numerous wells, but was not detected upgradient.

Iron, manganese, and sodium were detected at elevated levels in the Rosini well. Each was detected at four to seven times the concentrations found in the upgradient monitoring well, indicating a possible site release. However, sodium was detected at similarly elevated levels in the background domestic water sample (Meisenzahl). Additionally, the Rosini well had not recently been used prior to sampling. Concentrations of metals such as iron and manganese are expected to be higher in such instances due to the buildup of sediment that may occur.

East of the site, iron was detected in the Urban spring, copper was detected in the Ormsby spring, and zinc was detected in the Ormsby and Urban springs at concentrations significantly elevated above other domestic water samples. This implies that these metals are impacting shallow groundwater in this area. However, these metals were not detected at significantly elevated levels in the bedrock wells in this area (MW-12D, MW-13D, and MW-14D). Therefore, it cannot be conclusively determined whether the presence of these metals to the east is site related or the soils in that area contain naturally high concentrations of these metals.

The spring sample from the Miller property contained iron and manganese elevated above NYSDEC Class GA groundwater standards. This sample was collected from a sump dug just prior to sampling. Therefore, the presence of these two metals at elevated levels is likely the result of the relatively high turbidity of this sample.

Sodium was detected at elevated concentrations in many groundwater and domestic water samples in many different locations. However, similar concentrations were detected in a variety of locations, indicating that sodium is naturally ubiquitous. The highest concentrations of sodium were detected in the Fletcher and Dodge samples (110,000 μg/L and 101,000 μg/L, respectively). Both concentrations exceed the NYSDEC Class GA groundwater standard of 20,000 μg/L; however, both are less than the NYSDOH guideline of 270,000 μg/L, the concentration above which people on moderately restricted sodium diets should not use the water for drinking. The elevated level in the Dodge sample is likely the result of their water conditioner. Most conditioners soften water by replacing magnesium and calcium with sodium.

If the elevated levels of sodium detected in the residential water supplies along Duffy Creek were site related, then elevated levels of sodium would be expected between the site and these downgradient wells or in Duffy Creek and its tributary. Since this pattern is not apparent, it is likely that locally elevated and variable sodium levels result from variation in the geologic materials screened. This logic also applies to the elevated concentration of manganese in the R.

Fanton sample. If the elevated levels of manganese were site related, a high concentration of manganese should be present between the site and R. Fanton's well. It is likely that the variability in manganese concentrations detected in the immediate area of the R. Fanton well is related to variability in the geologic materials screened by these wells.

The lack of organic contamination on the west side of the site, especially in wells MW-9S and MW-10S, suggests that the leachate collection system is intercepting and/or removing VOCs from the groundwater in these areas. Air monitoring and landfill gas sampling along the leachate collection system have indicated that the northwest fill area is contributing the highest concentrations of VOCs to the leachate collection system. However, the wells installed near this fill area at depths similar to the leachate collection system are free of VOC contamination.

In addition to the groundwater, leachate is a potential major migratory pathway for site-related contaminants. Numerous organic and inorganic constituents of the leachate were present at elevated levels and leachate has been observed flowing off site. The risk evaluations performed as part of the RI identified the leachate as a potential threat to both human health and ecological resources.

Based on analytical results of surface water and sediment samples, neither Duffy Creek nor its unnamed tributary appear to act as significant migratory pathways for site-related contaminants. However, surface water and sediment samples were only collected during the summer and fall. Therefore, the impact of the site on local surface water cannot be determined for periods of relatively higher leachate and surface water flow (i.e., winter and spring). A leachate sample collected in April 1992 indicated that the total VOC concentration increased and that the inorganic content decreased when compared to the October 1991 leachate sample from the same location. This suggests that the greatest potential for organic contamination of surface water is in the winter and spring when leachate flow is higher. Inorganics do not appear to pose as much of a threat to surface water in the winter and spring, except for iron, which was significantly elevated in both leachate samples. This is supported by the iron-oxide staining observed in the unnamed tributary. The leachate is what directly impacts surface water quality; therefore, additional characterization of the surface water is unnecessary because the off-site flow of leachate is expected to be corrected.

Based on the perimeter explosive gas survey, soil gas does not appear to be a major contaminant migration pathway. However, based on the detection limits of the survey equipment (ppm range) and the lack of downgradient ambient air and soil gas samples, the volatilization of

site-related VOCs from contaminated groundwater cannot conclusively be eliminated as a migratory pathway.

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