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FEASIBILITY STUDY
FOR THE DEARCOP FARM SITE
SITE NUMBER 8-28-016

January 1995

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Prepared for:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS WASTE REMEDIATION
50 Wolf Road
Albany, New York 12233

ecology and environment
engineering, p.c.
BUFFALO CORPORATE CENTER
368 PLEASANTVIEW DRIVE, LANCASTER, NEW YORK 14086, TEL. 716/684-8060

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Addendum to Dearcop Farm Feasibility Study

Site # 8-28-016

February, 1995

This document amends the Feasibility Study (FS) for the Dearcop Farm Site prepared by Ecology and Environment, P.C. (E & E) and submitted January, 1995. This amendment makes two modifications to the FS:

- Revision of the area assumed needing vapor extraction for Alternative 4; and
- Removal of separate cleanup objectives for drainage ditch sediment.

Each of these issues is discussed below.

Vapor Extraction Area

To estimate the costs of Alternative 4 (Consolidation and Capping, with Soil Vapor Extraction for Soil/Fill Material, Institutional Controls and Natural Attenuation for Groundwater), E & E assumed that the area to be treated with vapor extraction would correspond to the areas of the site showing soil gas measurements greater than 10 - 100 $\mu g/m^3$. However, these measurements did not correspond to measurements of volatile organic compounds (VOCs) in soil samples taken from the surface and subsurface. VOCs were detected above the cleanup objective only in test pit 6, which is located in the area of deeper contamination south of the highway. This area corresponds to the highest soil gas readings observed ($>10,000\ \mu g/m^3$). VOC concentrations in soil gas exceeded 10,000 $\mu g/m^3$ in only one other area: in the highway median. For purposes of cost estimation, E & E assumes in this addendum that the areal extent requiring treatment by vapor extraction corresponds to the areas designated as having deep contamination on Figure 2-4 of the January, 1995 FS report. These areas do not precisely correspond to any specific soil gas VOC concentration contour. However, the areas delineated by the deep concentration zones are expected to estimate reasonably well the total amount of area needing vapor extraction treatment. Furthermore, these zones of deep contamination may represent areas where the landfill material comprised greater amounts of hazardous material, including spent solvents and other VOCs. These VOCs may be present in drums, which would explain the high soil gas concentrations detected without high soil sample concentrations.

Drainage Ditch Sediment Cleanup Objectives

Cleanup objectives for sediments were originally developed from criteria established for the protection on aquatic and benthic organisms that grow in this medium. However, the sediments at the Dearcop Farm site are in a drainage ditch rather than a stream bed or pond bottom. Because drainage ditch sediments, which are only intermittently saturated, would not be expected to support these types of organisms, it is not appropriate to set cleanup objectives based on criteria for the growth of such organisms. Thus, drainage ditch sediments will be evaluated under the same criteria as soils and fill material at this site. As no sediment samples were found to exceed soil cleanup criteria, the result of this reclassification is that no sediments would require attention in the development and evaluation of alternatives.

Major Changes to Alternatives from these Changes

The two amendments presented in this addendum make changes in the extent of the described remedies in alternatives 3, 4, and 5. For all three of these alternatives, sediments would not longer be excavated and consolidated prior to capping (alternatives 3 and 4), or disposed off-site (alternative 5). Some residential soil would still be removed and consolidated as described in the FS. For alternative 4, the size of the vapor extraction system would be reduced. Rather than having a total of 5,700 linear feet of horizontal wells, only an estimated 960 linear feet would be required. Smaller vacuum pumps and offgas treatment units would also be required.

The cost estimate for these three alternatives have been revised to reflect these changes. The revised capital, operation and maintenance (O & M), and present worth costs are as follows:

Alternative	Capital Cost	Annual O & M	Present Worth
3	$1,570,000	$27,400	$1,950,000
4	$2,130,000	$27,400-$163,000	$2,840,000
5	$6,040,000	$54,000	$6,440,000

TABLE 3-2

Alternative 1: No Action

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	30

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:				
(19 existing wells)				
sample collection	42	ea	$125.00	$5,250
sample analysis				
VOAs	42	ea	$200.00	$8,400
Metals	42	ea	$150.00	$6,300
Data Validation	42	ea	$35.00	$1,470
Report Writing	2	ea	$960.00	$1,920
SUBTOTAL O&M				$23,340
8% Legal, Administrative, & Engineering Fees-				$1,714
10% Contingencies-				$2,142
TOTAL O&M COSTS				$27,196
TOTAL O&M PRESENT WORTH				**$374,343**
TOTAL CAPITAL COSTS				**$0**
GRAND TOTAL COST				**$374,343**

TABLE 3-3

Alternative 2: Institutional Actions

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$5,680.00	$5,680
health and safety	10	day	$700.00	$7,000
fencing	9,000	lf	$15.00	$135,000
SUBTOTAL CAPITAL				$147,680
10% Legal, Administrative, & Engineering Fees-				$14,768
10% Contingencies-				$14,768
TOTAL CAPITAL COSTS				**$177,216**

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	30

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:				
(19 existing wells)				
sample collection	42	ea	$125.00	$5,250
sample analysis				
VOAs	42	ea	$200.00	$8,400
Metals	42	ea	$150.00	$6,300
Data Validation	42	ea	$35.00	$1,470
Report Writing	2	ea	$960.00	$1,920
Fence repair/maintenance	1	ls	$750.00	$750
SUBTOTAL O&M				$24,090
8% Legal, Administrative, & Engineering Fees-				$1,927
10% Contingencies-				$2.409
TOTAL O&M COSTS				$28,426
TOTAL O&M PRESENT WORTH				**$391,282**
TOTAL CAPITAL COSTS				**$177,216**
GRAND TOTAL COST				**$568,498**

TABLE 3-4

Alternative 3: Consolidation and Capping for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$48,440.00	$48,440
site services	6	month	$35,000.00	$210,000
health and safety	132	day	$700.00	$92,400
clearing/grubbing	7	acre	$1,200.00	$8,400
surveying	1	ls	$5,000.00	$5,000
decon pad	1	ls	$7,500.00	$7,500
staging area	1	ls	$10,000.00	$10,000
fencing	9,000	lf	$15.00	$135,000
well decommissioning	6	ea	$430.00	$2,580
replacement wells (4)	50	lf	$125.00	$6,250
Consolidation:				
excavate soil	150	cy	$3.00	$450
move fill	150	cy	$3.70	$555
sampling of bottom soils	10	ea	$750.00	$7,500
backfill/grading	150	cy	$15.00	$2,250
Topsoil, seeding, &mulch	150	sy	$5.00	$750
Capping:				
compaction and grading	34,400	sy	$1.55	$53,320
site improvements (culverts)	1	ls	$10,000.00	$10,000
12"-sand gas vent layer	34,400	sy	$7.00	$240,800
60-mil HDPE Geomembrane	34,400	sy	$4.25	$146,200
18"-soil layer	34,400	sy	$2.75	$94,600
6" topsoil,seeding & mulch layer	34,400	sy	$5.16	$177,504
SUBTOTAL CAPITAL				$1,259,499
10% Legal, Administrative, & Engineering Fees-				$125,950
15% Contingencies-				$188,925
TOTAL CAPITAL COSTS				**$1,574,374**

TABLE 3-5

Alternative 3: Consolidation and Capping for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	30

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:				
(17 wells)				
sample collection	38	ea	$125.00	$4,750
sample analysis				
VOAs	38	ea	$200.00	$7,600
Metals	38	ea	$150.00	$5,700
Data Validation	38	ea	$35.00	$1,330
Report Writing	2	ea	$960.00	$1,920
Fence repair/maintenance	1	ls	$750.00	$750
Cap maintenance				
Cap repair	1	ls	$1,175.00	$1,175
SUBTOTAL O&M				$23,225
8% Legal, Administrative, & Engineering Fees-				$1,858
10% Contingencies-				$2,323
TOTAL O&M COSTS				$27,406
TOTAL O&M PRESENT WORTH				**$377,232**
TOTAL CAPITAL COSTS				**$1,574,374**
GRAND TOTAL COST				**$1,951,606**

TABLE 3-6

Alternative 4: Consolidation and Capping with Soil Vapor Extraction for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$65,400.00	$65,400
site services	6	month	$35,000.00	$210,000
health and safety	132	day	$700.00	$92,400
clearing/grubbing	7	acre	$1,200.00	$8,400
surveying	1	ls	$5,000.00	$5,000
decon pad	1	ls	$7,500.00	$7,500
staging area	1	ls	$10,000.00	$10,000
fencing	9,000	lf	$15.00	$135,000
well decommissioning	6	ea	$430.00	$2,580
replacement wells (4)	50	lf	$125.00	$6,250
Consolidation:				
excavate soil	150	cy	$3.00	$450
move fill	150	cy	$3.70	$555
sampling of bottom soils	10	ea	$625.00	$6,250
backfill/grading	150	cy	$15.00	$2,250
Topsoil, seeding, &mulch	150	sy	$5.00	$750
SVE				
pilot study	1	ls	$60,000.00	$60,000
extraction trenches	960	lf	$21.57	$20,705
trenching to system	400	lf	$10.78	$4,314
extraction vaults	6	ea	$539.19	$3,235
ventillation wells and vaults	10	ea	$1,188.49	$11,885
vapor thermal oxidation	2	ea	$41,597.31	$83,195
VES (5 hp)	1	ea	$8,319.46	$8,319
VES (3 hp)	1	ea	$8,319.46	$8,319
piping	1,400	lf	$14.26	$19,967
electrical/control panel	2	ls	$26,894.66	$53,789
accessories	1	ls	$7,130.97	$7,131
equipment housing	1	ls	$23,769.89	$23,770
trench and system installation oversight	30	man-day	$600.00	$18,000
soil disposal (5% of trenched soil)	200	cy	$310.00	$62,000
System startup	5	man-day	$600.00	$3,000
Project management	1	ls	$20,000.00	$20,000
System Closeout	1	ls	$17,600.00	$17,600
Capping:				
compaction and grading	34,400	sy	$1.55	$53,320
site improvements (culverts)	1	ls	$10,000.00	$10,000
12"-sand gas vent layer	34,400	sy	$7.00	$240,800
60-mil HDPE Geomembrane	34,400	sy	$4.25	$146,200
18"-soil layer	34,400	sy	$2.75	$94,600
6" topsoil,seeding & mulch layer	34,400	sy	$5.16	$177,504
SUBTOTAL CAPITAL				$1,700,438
10% Legal, Administrative, & Engineering Fees-				$170,044
15% Contingencies-				$255,066
TOTAL CAPITAL COSTS				**$2,125,548**

TABLE 3-7

Alternative 4: Consolidation and Capping with Soil Vapor Extraction for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	5 (SVE) and 30 years (Groundwater and Cap monitoring)

Description	Duration	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:					
(17 wells)					
sample collection	30 yr	38	ea	$125.00	$4,750
sample analysis					
VOAs	30 yr	38	ea	$200.00	$7,600
Metals	30 yr	38	ea	$150.00	$5,700
Data Validation	30 yr	38	ea	$35.00	$1,330
Report Writing	30 yr	2	ea	$960.00	$1,920
Fence repair/maintenance	30 yr	1	ls	$750.00	$750
SVE Maintenance	5 yr	1	ls	$17,000.00	$17,000
SVE Power Requirements	5 yr	1	ls	$15,600.00	$15,600
SVE Analytical	5 yr	1	ls	$6,000.00	$6,000
SVE Vapor Phase Treatment	1 yr	1	ls	$60,000.00	$60,000
SVE System Project Management	5 yr	1	ls	$16,000.00	$16,000
Cap Maintenance					
Cap repair	30 yr	1	ls	$1,175.00	$1,175
SUBTOTAL O&M					$137,825
8% Legal, Administrative, & Engineering Fees-					$11,026
10% Contingencies-					$13,783
TOTAL O&M COSTS	0 to 1 yr				$162,634
	2 to 5 yr				$91,834
	6 to 30 yr				$27,406
TOTAL O&M PRESENT WORTH					**$719,426**
TOTAL CAPITAL COSTS					**$2,125,548**
GRAND TOTAL COST					**$2,844,974**

TABLE 3-8

Alternative 5: Excavation and Off-Site Disposal & Groundwater Extraction and Treatment

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$182,400.00	$182,400
site services	6	month	$35,000.00	$210,000
health and safety	132	day	$700.00	$92,400
clearing/grubbing	7	acre	$1,200.00	$8,400
decon pad	1	ls	$10,000.00	$10,000
staging area	1	ls	$10,000.00	$10,000
Excavation, Transportation, & Disposal				
Excavation	25,700	cy	$3.00	$77,100
Transportation	25,700	cy	$75.00	$1,927,500
Disposal				
PCBs>=50ppm	426	ton	$310.00	$132,060
10=<PCBs<50ppm	426	ton	$125.00	$53,250
TCLP	426	ton	$250.00	$106,500
Remaining Contaminated Soils	24,422	ton	$55.00	$1,343,210
Verification Sampling	50	ea	$125.00	$6,250
Verification Analysis	50	ea	$500.00	$25,000
Backfill and Compaction	25,700	cy	$15.00	$385,500
Topsoil/Seed & Mulch	34,550	sy	$5.00	$172,750
Groundwater Extraction Wells (4)	80	lf	$100.00	$8,000
Metals Precipitation	1	ls	$20,000.00	$20,000
Clarification	1	ls	$24,000.00	$24,000
Sludge storage/thickening	1	ls	$4,000.00	$4,000
Carbon treatment	1	ls	$2,000.00	$2,000
Tanks, piping, & instrumentation	1	ls	$25,000.00	$25,000
Treatment Building	1	ls	$10,000.00	$10,000
SUBTOTAL CAPITAL				$4,835,320
10% Legal, Administrative, & Engineering Fees-				$483,532
15% Contingencies-				$725,298
TOTAL CAPITAL COSTS				**$6,044,150**

Note: assume 1 CY = 1 Ton

TABLE 3-9

Alternative 5: Excavation and Off-Site Disposal & Groundwater Extraction and Treatment

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	10

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater & Surface Water Monitoring:				
(17 wells)				
sample collection	38	ea	$125.00	$4,750
sample analysis				
VOAs	38	ea	$200.00	$7,600
Metals	38	ea	$150.00	$5,700
Data Validation	38	ea	$35.00	$1,330
Report Writing	2	ea	$960.00	$1,920
Fence repair/maintenance	1	ls	$750.00	$750
Groundwater Pump and Treatment				
Labor (1 day/wk)	52	day	$400.00	$20,800
Carbon changeout (200 lb/mon)	12	month	$100.00	$1,200
Sludge disposal	5	ton	$250.00	$1,250
Waste transport	1	ls	$500.00	$500
SUBTOTAL O&M				$45,800
8% Legal, Administrative, & Engineering Fees-				$3,664
10% Contingencies-				$4,580
TOTAL O&M COSTS				$54,044
TOTAL O&M PRESENT WORTH				**$397,769**
TOTAL CAPITAL COSTS				**$6,044,150**
GRAND TOTAL COST				**$6,441,919**

TABLE OF CONTENTS

Table of Contents (Cont.)

Section Page

Table of Contents (Cont.)

Section Page

Table of Contents (Cont.)

Section Page

Table of Contents (Cont.)

Section Page

LIST OF TABLES

List of Tables (Cont.)

LIST OF ILLUSTRATIONS

List of Illustrations (Cont.)

1. INTRODUCTION

Ecology and Environment Engineering, P.C., (E & E), under contract to the New York State Department of Environmental Conservation (NYSDEC), was tasked to perform a Remedial Investigation/Feasibility Study (RI/FS) at the Dearcop Farm site (Site No. 8-28-016) in the Town of Gates, Monroe County, New York. This RI/FS is being performed under work assignment No. D002625-10 of E & E's State Superfund Standby Contract.

The methodology employed to conduct this work assignment was detailed in the RI/FS Work Plan (E & E 1992). This document presents the first, second, and third phases of the FS process for the Dearcop Farm site and is a companion document to the *Phase I Remedial Investigation Report* and the *Phase II Remedial Investigation Report.*

This report was prepared following the guidelines presented in the United States Environmental Protection Agency's (EPA's) *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* — EPA 540/G-89/004 (EPA 1988), and NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) 4030, *Selection of Remedial Actions at Inactive Hazardous Waste Sites* (NYSDEC 1989).

1.1 PURPOSE AND ORGANIZATION OF REPORT

The purpose of the first and second phases of the FS is to define the contaminated media of concern, develop the framework within which the contaminated media will be addressed (i.e., development of potential remedial alternatives), and initially screen developed alternatives against the short- and long-term aspects of two broad criteria: effectiveness and implementability. The purpose of this initial screening is to ensure that developed alternatives are protective of human health and the environment. The third phase of the FS analyzes retained alternatives in detail. This report also provides justification and a conceptual design of the selected remedy.

1.2 BACKGROUND INFORMATION

This section provides background information on the Dearcop Farm site including site description and history and a summary of the RI data.

1.2.1 Site Description and History

The Dearcop Farm site is an inactive 16-acre landfill located off the north end of Dearcop Drive and Varian Lane, which are residential areas that border the site on the south and southeast. The site is bordered on the east by a small man-made embankment about 70 feet west of the New York State Barge Canal, on the north by the westbound lanes of and an exit ramp from Interstate Route 490 (I-490), and on the west by Interstate Route 390 (I-390). Two Class 2 inactive hazardous-waste sites, Olin Chemical Corporation and the McKee Road Industrial Dump, are situated southeast of the site on the eastern side of the Barge Canal. One Class 2A site, Chevron USA Tank Farm, is located 0.5 mile south of the site on the southern side of Buffalo Road (State Route 33) (see Figure 1-1).

The site functioned as a disposal area from 1919 to 1970. The southern 6 acres of the site are currently owned by Mr. William L. Dearcop and Mr. Charles R. Dearcop, Jr. The northern 10 acres of the site were purchased by the New York State Department of Transportation (NYSDOT) about 1958.

Reportedly, the site received industrial waste between 1930 and 1970 from General Railway Signal Company; E.I. DuPont DeNemours and Company, Inc., (DuPont); the Pfaudler Company; and American Brakeshoe Company. When NYSDOT purchased the northern 10 acres, dumping in that area stopped.

The waste disposed of at the site included rubbish, office paper, wood, debris, scrap iron, foundry dirt, sandblasting sand, and sand castings.

Waste disposed of at the site by DuPont also included acids, heavy metals, waste oil and oil sludges, halogenated organics, and other compounds. These wastes were disposed of through open burning. The solvent burning area appears to lie beneath the current location of the I-390/I-490 interchange.

A Phase II investigation report for this site was completed in April 1988 for NYSDEC by EA Engineering, Science, and Technology, Inc. The investigation consisted of the installation and sampling of three groundwater monitoring wells, an electromagnetic (EM) conductivity survey, a magnetometer survey, surface water sampling, sediment sampling, drum sampling, and records research. During the Phase II investigation, three monitoring wells (DR-1, DR-2, and DR-3) were installed surrounding the site (see Figure 1-2). The borings indicated that at wells DR-1 and DR-2, the overburden is composed of 4 to 5 feet of a dry brown, stiff sandy-silt overlying about 5 to 10 feet of moist, dense, fine sand. The sand layer in turn overlies bedrock, which was encountered in wells DR-1 and DR-2 at depths of approximately 8.5 and 15 feet, respectively, below ground surface (BGS). At well DR-3, which was located near the former burn pit (now covered by a highway median), there is approximately 10 feet of silt overlying about 5 feet of sand. The silt layer at DR-3 contained chips of glass and scrap metal. There was also a strong sulfur odor noted during well drilling. Bedrock was encountered in well DR-3 at a depth of about 16 feet below grade. Bedrock consists of a dark gray, crystalline dolomite that is competent with very little or no weathered zone. The bedrock is resistant and hard.

Geologic cross sections of the Dearcop Farm site, developed during E & E's RI, are shown in Figures 1-3 through 1-5. These figures show stratigraphic units encountered in the overburden and bedrock monitoring wells, as well as the shallow and deep aquifer potentiometric surfaces.

Groundwater at the site is present at a depth of about 15 to 30 feet BGS, depending upon the location and season. Groundwater is estimated to have a hydraulic gradient across the site of approximately 1% and apparently flows east-northeast toward the canal. The water level in the canal is lowered sharply at the end of the boating season in November, and the quarry to the south of the site pumps an average of 200,000 gallons per day (gpd) and has the capability of pumping 1,000,000 gpd. Thus, hydraulic gradients near the canal are subject to extreme seasonal variation, and groundwater flow directions beneath the site may be affected by quarry pumping.

Analytical results of samples collected from the three Phase II investigation monitoring wells indicated that the groundwater in the area of the site is contaminated with halogenated and aromatic volatile organic compounds. The highest concentrations were detected in samples from upgradient well DR-2 and downgradient well DR-3. Surface water and sediments were not found to be contaminated. The magnetometer survey detected several high anomalous zones in the landfill adjacent north of the residential area and in the median of I-490 adjacent to monitoring well DR-3.

Sampling activities conducted by NYSDEC during 1990 included the analysis of groundwater, surface water, and soil/sediment. The results of these analyses confirmed contamination of the groundwater by volatile organic compounds (VOCs) at levels exceeding New York State Class GA groundwater standards in all three wells. Numerous chlorinated organics were detected at concentrations above Class GA groundwater standards in well DR-2, which was originally thought to be an upgradient well. Furthermore, analytical results from surface soil/sediment samples indicate elevated levels of polychlorinated biphenyls (PCBs), metals (cobalt, copper, zinc), and radioactive isotopes (radium-226 and radium-228). In June 1990, NYSDEC collected soil/sediment samples from six locations at the Dearcop Farm site. These samples were identified as 01 through 06. Elevated concentrations of PCBs were detected in samples 02 and 03 at 0.34 mg/kg and 0.24 mg/kg, respectively. Sample 02 also exhibited the highest concentration of cobalt (504 mg/kg). The highest concentrations of zinc (1,270 mg/kg) and copper (137 mg/kg) were detected in samples 04 and 05, respectively. Elevated levels of radioactive isotopes were detected in a soil sample collected on July 18, 1990, from a blue-stained surface soil deposit located in the northwest section of the site. Radium-226 and radium-228 were detected at 5.1 picocuries per gram (pCi/g) and 3.4 pCi/g, respectively.

1.2.2 RI Summary

The nature and extent of contamination at the Dearcop Farm site was described in the RI reports based primarily on the results obtained from the following field activities:

- Soil gas survey;
- Groundwater monitoring well installation and sampling;
- Subsurface soil sampling;
- Surface water and sediment sampling

- Surface soil sampling;
- Air sampling;
- Manhole water sampling; and
- Vegetable sampling.

The RI was conducted in three phases. E & E conducted Phases I and II, while NYSDEC conducted the Phase III investigation. The results of these activities are briefly summarized below.

1.2.2.1 Soil Gas Survey

The soil gas survey indicated the presence of numerous volatile organics, primarily chlorinated aliphatic hydrocarbons (see Figure 1-6 for sample locations). The highest soil gas concentrations of chlorinated aliphatic hydrocarbons (trichloroethene [TCE], 1,1-dichloroethane [1,1-DCA], and 1,1,1-trichloroethane [1,1,1-TCA] were most prevalent) were observed in sample SG-8, located in the northwest section of the area between the northern end of Varian Lane and the fenceline (the fenced area). High soil gas concentrations of chlorinated aliphatics were also observed in the highway median. The presence of purgeable aromatics was less widespread and total concentrations were of lesser magnitude. Maximum total concentrations of purgeable aromatics were randomly distributed throughout the sampled areas.

1.2.2.2 Groundwater Sampling

Using the soil gas data, as well as regional hydrogeologic information and geophysical survey data, groundwater monitoring well locations were selected. Groundwater monitoring wells were installed on and near the site to determine the nature and extent of groundwater contamination, groundwater flow directions, and horizontal and vertical hydraulic gradients.

Two water-bearing zones exist at the Dearcop Farm site. The upper water-bearing zone was screened from 5 feet above the bedrock overburden interface to 15 feet into fractured bedrock. The second water-bearing zone was screened from 15 to 36 feet into the fractured bedrock. The overall direction of groundwater movement and therefore contaminant migration is east-northeast toward the canal.

The upper water-bearing zone was found to contain low levels of purgeable aromatics in wells MW-6S and DR-2. Purgeable aromatics were found at higher concentrations in wells MW-10S and DR-1 (see Figure 1-2 for well locations). Chlorinated aliphatic hydrocarbons were found in all shallow well samples, with the exception of wells MW-4S and MW-5S. Wells MW-9S, MW-10S, DR-1, DR-2, and DR-3 were found to contain chlorinated aliphatics at higher concentrations. The lower water-bearing zone was found to contain purgeable aromatics in deep wells, with the exception of MW-6D where no VOCs were detected. Of the purgeable aromatics, toluene, xylene, and chlorobenzene were found in the highest concentrations. Chlorinated aliphatics were also found in all deep wells, again with the exception of well MW-6D. The highest concentrations of chlorinated aliphatics were found in wells MW-1D, MW-2D, and MW-9D. Acetone, 2-butanone, and carbon disulfide were also detected in a few samples below 25 μg/L. A few semivolatiles were detected in some of the wells below 25 μg/L, with the exception of phenol, which had slightly higher concentrations ranging from 9 to 72 μg/L. No pesticides or PCBs were detected in the waters of the monitoring wells. Several metals were found in all wells.

1.2.2.3 Test Pit Sampling

Seven test pits were sampled at depths of 3 to 13 feet and analyzed for Target Compound List (TCL) organics, inorganics, and asbestos fiber content. Debris was found in each test pit, in several cases, down to or near bedrock. In three of the test pits, TP-2, TP-5, and TP-6, one or more rusted drums were uncovered (see Figure 1-2). As many as 14 different VOCs were detected in the test pit samples, with the exception of test pit TP-1, which was free of VOCs. Samples TP-2C and TP-6A, both collected at a depth of 6 feet, were highly contaminated with several VOCs in excess of 100,000 μg/kg. Several semivolatiles were detected in the test pit samples. Sample TP-2C contained 2-methylphenol, 4-methylphenol, N-nitrosodiphenylamine, and phenol at 3,900, 4,000, 140,000, and 540,000 μg/kg, respectively. Several other test pits contained these phenolic compounds at considerably lower concentrations. Polynuclear aromatic hydrocarbons (PAHs) ranged from 41 μg/kg to 6,154 μg/kg in samples TP-5B and TP-7B, respectively. Pesticides were detected at low concentrations in test pits TP-1, TP-2, TP-6, and TP-7, all of varying depths. All test pit samples, with the exceptions of TP-5A and TP-5B, contained PCB concentrations under 1 ppm. The samples from TP-5 contained PCBs at concentrations exceeding 1 ppm. Several inorganics were detected in each test pit. Toxicity Characteristic Leaching Procedure (TCLP) criteria for inorganics were exceeded in sample TP-5B. Asbestos fibers were detected in five samples from the test pits. Samples 2A and 3B showed only a trace of asbestos. Samples TP-5A, TP-7A, and TP-7B contained 2% chrysotile, less than 2.5% chrysotile and amosite, and 1.8% chrysotile by point-counting procedures, respectively.

1.2.2.4 Subsurface Soil Sampling

One soil sample was collected during the Phase I RI from each of 13 subsurface sampling locations in the backyards of residents on Dearcop Drive and Varian Lane (see Figure 1-2). These samples were collected between 0 and 4 feet BGS and were analyzed for full TCL organics and inorganics. Four samples, BH-93D, BH-206D, BH-331D, and BH-33V, were also analyzed for asbestos fiber. Debris was found in four of the residential borehole samples: BH-93D, BH-102D, BH-206D, and BH-331D. All samples were free of VOCs. Semivolatiles were detected in three samples. Butylbenzylphthalate was detected in sample 32VD at 48 μg/kg, and diethylphthalate was detected in BH-206D at 50 μg/kg. Samples BH-206D and BH-33V each contained several PAHs totaling 27,500 μg/kg and 34,200 μg/kg, respectively. No PCBs were detected in the samples. Pesticides were only found in sample BH-331D at a concentration below 30 μg/kg. Only one of the four samples that were analyzed using point-counting procedures contained asbestos; BH-93D contained chrysotile at 6.5%. All soil samples from the boreholes were found to contain several inorganics.

Subsurface soil samples were collected at depths of 6 to 19.3 feet during Phase II RI monitoring well installation. Debris was found in all but two monitoring well locations, MW-7S and MW-8S. Toluene and 2-butanone were detected in MW-1D, MW-2D, MW-3D, and MW-6D. Acetone was detected in MW-3D and MW-6D. Tetrachloroethene, total 1,2-dichloroethene, and total xylenes were detected in MW-6D only. Semivolatile analysis showed diethylphthalate in samples MW-5D and MW-9S, and 4-methylphenol in sample MW-3D. Bis(2-ethylhexyl)phthalate was detected in samples MW-1D and MW-6D at concentrations above 100 μg/kg, and dibenzofuran was detected in MW-6D. PAHs were only detected in MW-3D, MW-5D, and MW-6D at total concentrations of 906 μg/kg, 190 μg/kg, and 1,185 μg/kg respectively. Pesticides were only found in sample MW-6D. PCBs were detected in samples MW-2D and MW-3D below 50 μg/kg. Total organic carbon (TOC) analysis was performed on soils samples MW-1D, MW-1DD, MW-8S, MW-9D, and MW-10D. TOC results ranged from 880 mg/kg to 32,000 mg/kg. All soil samples from the monitoring wells were found to contain several inorganics. The soil samples from the monitoring wells were also analyzed for asbestos fiber content. No asbestos fiber was detected in these samples.

Only one subsurface soil sample was taken during the Phase II RI. This sample, from 331 Dearcop Drive, contained notable amounts of lead (2,740 mg/kg).

A Phase III RI, conducted by NYSDEC, sampled surface and/or subsurface soil on all but one lot of Dearcop Drive and Varian Lane. Samples were analyzed for PAHs and metals. Only one lot was found to have greater than 10 mg/kg total PAHs in subsurface soils. A variety of metals were detected in the subsurface soil. One sample was found above ~~below~~ the federal recommended cleanup level for lead of 400 mg/kg.

1.2.2.5 Surface Water Sampling

Ten surface water samples, including two field duplicates, were collected during Phase I and Phase II (see Figure 1-2). Surface water samples SW-1 through SW-3 were collected from drainage ditches that are considered by NYSDEC to be Class D waters. Surface water sample QW-1 was collected from a nearby dolomite quarry that is also considered to be Class D waters. Surface water samples SW-4 through SW-8 were collected from various points along the Barge Canal, considered by NYSDEC to be Class C waters. Seven of these were analyzed for full TCL organics and inorganics, and three were analyzed for inorganics, pesticides, PCBs, and PAHs. All but one sample analyzed for volatile organics were found to contain VOCs below 5.0 μg/L except for sample SW-6, which was found to contain carbon disulfide at 130 μg/L. This is most likely attributed to laboratory contamination. One semivolatile, bis(2-ethylhexyl)phthalate, was detected in surface water samples SW-2 through SW-6 below 5.0 μg/L. Phthalate esters often appear in samples and are attributable to the protective rubber gloves worn during the sampling procedure. All surface water samples were found to be free of PAHs, pesticides, and PCBs. Several metals were detected in all surface water samples. An additional surface water sample, QW-1, was taken from the dolomite quarry to the southwest of the site. This sample was found to contain bis(2-ethylhexyl)phthalate and diethylphthalate, common field and laboratory contaminants, below 5.0 μg/L. No pesticides or PCBs were detected but several metals were found in this sample.

1.2.2.6 Sediment Sampling

Thirteen sediment samples, including two field duplicates, were collected during Phase I and Phase II. Seven of these were analyzed for full TCL organics, inorganics, and total organic carbon. The remaining six samples were analyzed for inorganics, pesticides, PCBs, and PAHs. VOCs were found in sample SED-6 up to 5.0 μg/kg, and sample SED-1 contained carbon disulfide at 10 mg/kg (see Figure 1-2). All other sediment samples were free of VOCs. Many semivolatiles were detected in all sediment samples. Dibenzofuran and carbazole were detected in SED-1 at 280 μg/kg and 400 μg/kg, respectively. Sample SED-5 contained butyl benzylphthalate at 73 μg/kg. Total PAH concentrations were 386 μg/kg and 47,950 μg/kg in samples SED-2 and SED-1A, respectively. Pesticides were detected in nine sediment samples, including the duplicates at up to 21 μg/kg. PCBs were detected in samples SED-4 through SED-10. Several metals were detected in each sediment sample. Total organic carbon was analyzed for samples SED-1 through SED-6. Concentrations ranged from 21,000 mg/kg in sample SED-2 to 110,000 mg/kg in sample SED-1.

1.2.2.7 Surface Soil Sampling

Thirty-eight surface soil samples and four field duplicates were collected in Phase I and Phase II. Twenty-two samples, including one background sample and two field duplicates, were analyzed for full TCL organics, inorganics, and asbestos (see Figure 1-2). The remaining 20 surface soil samples, including four background samples and two field duplicates, were analyzed for inorganics and PAHs. Two of these 20 were also analyzed for VOCs, PCBs, and pesticides. VOCs were detected at concentrations below 5.9 μg/kg in eight of the samples that were analyzed for volatile organics. Background sample SS-20 contained higher VOC levels; toluene and 1,1,1-TCA were detected at 18 and 20 μg/kg, respectively.

Semivolatiles were detected in 13 of the surface soil samples analyzed for the full TCL. SS-14 contained 56 μg/kg of carbazole, SS-17 contained 63 μg/kg of diethylphthalate, and SS-331D contained 71 μg/kg of butylbenzylphthalate. Phthalate esters are attributable to the protective gloves worn by field or analytical personnel. PAHs were detected at concentrations of 65 μg/kg and 169,760 μg/kg in samples SS-5 and SS-244D, respectively. Samples SS-3 and SS-331D contained pesticides. All other on-site samples were free of pesticides; however, the background samples SS-BG-2, SS-BG-2D, and SS-BG-3 contained pesticides below 40 μg/kg, and background sample SS-20 contained pesticides at up to 86 μg/kg. Two PCBs, Aroclor 1254 and Aroclor 1260, were detected in 13 of the surface soil samples at total concentrations below 1,000 μg/kg, except for sample SS-13, in which the total Aroclor concentration was 1,690 μg/kg. Several metals were detected in all of the surface soil samples. Asbestos fibers were analyzed for in 22 surface soil samples and were detected by point-counting procedures in only one of the samples (SS-5). Asbestos content, specifically chrysotile, in this sample was 1%.

In the Phase II RI, NYSDEC took surface soil samples from 80 of 81 residential lots on Dunlop Drive and Vairan Lane. These samples were analyzed for total PAHs using a screening technique and several metals. Sixty-three of the lots sampled had total PAH concentrations less than 1 mg/kg, and 17 had total PAHs in the range of 1 to 10 mg/kg. Most of the metals detected were typical of eastern United States soils. A high cadmium value of 11.2 mg/kg was found in sample DEAR-161B (which also contained high levels of manganese).

1.2.2.8 Head Space Gas Sampling

Three wells, MW-4D, MW-8D, and MW-10D, were sampled for head space gas contaminants using tedlar bags. These samples were analyzed for VOCs to satisfy safety concerns. All three samples contained 99% petroleum hydrocarbons, which are components of the natural gas that was being produced from these wells. Chlorinated organics were detected in well MW-8D at trace levels of less than 200 mg/m^3. Benzene, toluene, ethylbenzene, and xylene (BTEX) compounds were detected in all three samples at trace levels. Also, samples MW-8D and MW-10D were analyzed for sulfides and were found to contain 720 mg/m^3 and 320 mg/m^3, respectively.

1.2.2.9 Manhole Water Sampling

Water from four manholes was sampled for TCL organics and inorganics (see Figure 1-2). Analytical results indicated the presence of both purgeable halocarbons up to 48 μg/L and purgeable aromatics below 20 μg/L. Semivolatile analysis also indicated the presence of semivolatiles below 10 μg/L in all four samples, with the exception of diethylphthalate, which was found at 20 μg/L and 29 μg/L in sample MH-01 and MH-03, respectively. No PAHs were detected in these samples. Several metals were detected in each of the manhole samples. Cyanide was also detected at 10 μg/L in sample MH-01.

1.2.2.10 Vegetable Sampling

Vegetable samples were taken from two residences on Dearcop Drive: broccoli for sample VEG-206D and tomatoes for sample VEG-331D. A duplicate of VEG-206D was also taken. These samples were analyzed for inorganics only (see Figure 1-2). Fourteen metals were detected in both vegetable samples 206D and 331D and the duplicate of sample 206D.

1.2.2.11 Contaminant Fate and Transport

Contaminants were primarily introduced at the Dearcop Farm site through the apparently indiscriminate landfilling of industrial and domestic wastes from approximately 1919 to 1970. The site consists of fill material, mostly disturbed soils, foundry sand, and glass and metal slag, with debris intermixed throughout this fill material. The fill material and its associated contaminants were found not to be limited to the fenced site property or even the highway median, but also were found off site on residential property.

The chemicals of potential concern at the site include halogenated aliphatic hydrocarbons (mono-, di-, trichloro-ethanes and -ethenes), aromatic hydrocarbons (ethylbenzene, toluene, and xylene), PAHs, phenols, PCBs, pesticides, and metals.

The primary contaminant transport routes from the ongoing source of contamination (the fill material) to the surrounding media include diffusion into the soil gas, overland flow of surface contamination to the drainage ditches, downward percolation through the unsaturated zone, and groundwater flow in the saturated zone.

Surface and subsurface soils, as well as sediments, were found to contain contaminants of concern (i.e., elevated VOCs, semivolatiles, PCBs, pesticides, and metals). The contaminated soil and sediments were found primarily on site, but some off-site sample locations also contained contaminants at levels of concern. Local residents and those who enter the site, as well as wildlife, are potential receptors of contaminants by direct contact.

The soil gas investigation conducted at the Dearcop Farm site indicated the presence of numerous volatile organics, primarily halogenated aliphatic hydrocarbons (the most widespread class of contaminants identified in the sampled media at the site). Halogenated aliphatic hydrocarbons have generally high Henry's Law Constants. This aids in diffusing the contaminants into the soil gas surrounding the source areas of contaminated soil and into the soil gas above contaminated groundwater. The highest soil gas concentrations of aliphatic compounds were observed in the northwest portion of the vacant lot area. High soil gas concentrations were also observed in the I-490 median. Lower levels of contaminants were observed off site in the residential area immediately adjacent to the site, in discrete residential lots, some of which contained fill materials allegedly taken from the site at some time in the past.

The moderately to well-drained soil types and the minimal vegetation present at the Dearcop Farm site cause overland flow (or surface water runoff) to be limited to periods of heavy storms or snow thaw. Thus, the physical characteristics of the site minimize the potential of surface soil contaminant migration via overland flow. When overland flow does occur on site, nearby drainage ditches receive the water and transport it along and under the I-490 and into the Barge Canal north of the site. Also during periods of high water table conditions, it is assumed that groundwater discharges, in part, to these same drainage ditches.

Surface water and sediment samples generally contained contaminants that were also detected in on-site soils and groundwater. The upgradient sediment sample location also had similar results, which would indicate that the sample may not be a true background sample. Most prevalent in the surface water and sediments were metals, PAHs, pesticides, and PCBs. Contamination was detected in all surface water and sediment samples including those from the Barge Canal. However, based on contaminant type and concentration, it appears that the Barge Canal contains contamination from sources other than those attributable to the Dearcop

Farm site. Specifically, 1,1-DCA, 1,1-DCE (total), TCE, and xylene (total) were only present in SED-6, a sample taken from the canal. They were not present in the drainage ditches.

The migration pathway for surface and subsurface releases in the unsaturated zone is downward percolation toward the water table. The migration rate through the unsaturated zone is dependent on numerous factors, including moisture content of the soil (as controlled by evaporation, transpiration, and precipitation), porosity and permeability of the soil, and density of the compound. A liquid compound will first move through the overburden soils as a nonaqueous phase liquid (NAPL) under the force of gravity. However, the overburden particles in this area are quite fine (e.g., fine sand and silt). Recent studies (Schwille 1988) have shown that TCE will tend to pool on top of the water table of a fine-grained aquifer until it has enough density to push through the intergranular surface tension. This phenomena could cause source plumes of TCE to migrate to deeper zones within the saturated overburden in a pulselike fashion, similar to the migration through the unsaturated zone.

Eventually, the adsorption onto soil grains and the capillary pressure between grains (as influenced by the moisture content of the soil) inhibit continued gravitational flow. The compound would then migrate further only as a dissolved contaminant to the groundwater. The residual concentrations adhering to the soil particles will be washed into the water zone by infiltration and seasonal changes in the groundwater elevation. Precipitation, therefore, becomes the driving force of flow through the overburden. Because the physical characteristics of the site cause surface runoff to be low, most of the annual precipitation plus soil moisture must either infiltrate the soil or evaporate. The fall rains and spring snow melt mobilize residual organic contaminants in the unsaturated zone, carrying them to the groundwater. These seasonal higher-than-average volumes of water essentially move water and organic contaminants vertically through the unsaturated zone in a pulselike manner. Once dissolved in the groundwater, compounds will flow vertically and horizontally with the groundwater at a rate dependent on the vertical and horizontal hydraulic conductivity of the matrix and on the compounds' tendency to adsorb to the soil.

Volatile organics (both purgeable halocarbons and purgeable aromatics) are the primary contaminant group present in groundwater. The shallow-bedrock aquifer contained much more contamination than did the deep-bedrock aquifer. Water elevations indicate that these two aquifers are separated by a confining layer; but the presence of site contaminants in the deep aquifer indicates that this layer is discontinuous or at least breached by fractures, thus making it semiconfining. Hydrogeologic maps indicate that both aquifers generally flow to the northeast, and wells east and northeast of the site are more contaminated than those wells west and southwest of the site. Contaminants in the shallow aquifer discharge both downward into the deep aquifer and laterally to the east into the Barge Canal.

Deep aquifer contaminants presumably travel downward and downgradient to the discharge point, which is east of the site. It is most likely the Genesee River, which empties into Lake Ontario.

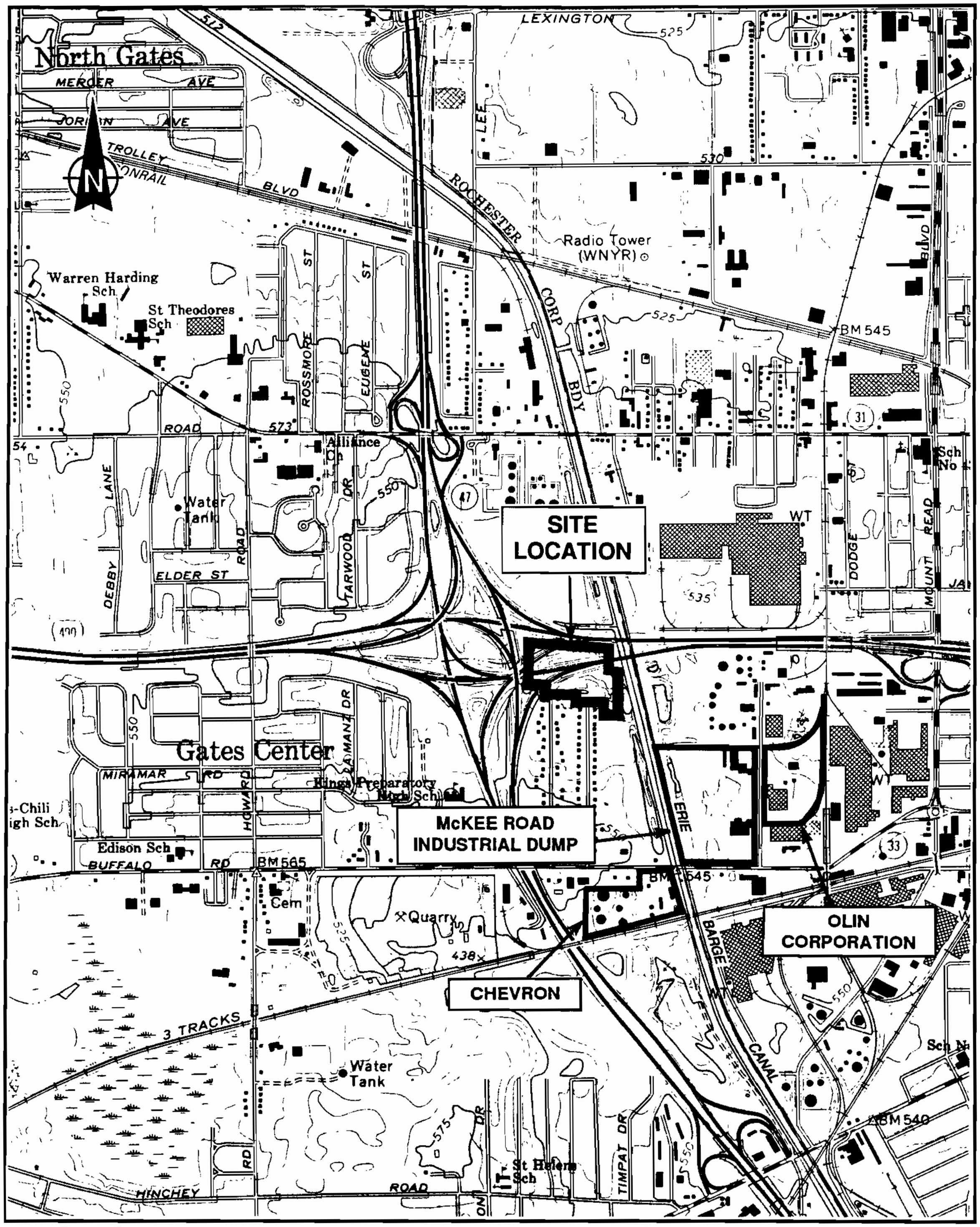
The seasonal raising and lowering of the Barge Canal by the New York State Thruway Authority also will affect hydrogeologic conditions on either side of the canal and therefore affect contaminant migration rates. Presumably, a pulselike effect could occur in the spring and summer when high canal levels will cause a more gentle gradient and slower migration rates. Lower canal levels in the fall and winter may create a steeper gradient and therefore could accelerate contaminant transport rates.

Residents in the area of the site are not affected by the use of contaminated groundwater because they obtain drinking water from a municipal source.

Review of the distribution of the chlorinated aliphatic compounds, including the parent compounds (1,1,1-TCA and TCE) and the degradation products (1,2-DCE, 1,1-DCA, 1,1-DCE, vinyl chloride, etc.), indicates that multiple source areas exist. In general, the parent compound 1,1,1-TCA is high in two potential source areas near DR-1 and MW-10S and decreases in concentration further downgradient. TCE, another parent compound, was also detected at higher concentrations in DR-2 and DR-3 and at lower concentrations farther downgradient. The degradation product of TCE, 1,2-DCE, is low in concentration at the potential source areas and higher downgradient, as would be expected. However, higher concentrations of degradation product 1,1-DCA, as opposed to the parent compound 1,1,1-TCA, were present at DR-2 and MW-10S. Vinyl chloride, which is further down the chain of degradation products, was also present at MW-10S, DR-3, and DR-1.

Contaminant migration beneath the site in the shallow overburden/bedrock aquifer is at least 800 feet from the western portion of the site to its discharge point to the east, the

Barge Canal. Groundwater flow, in general, is expected to be accelerated along bedrock fractures, as opposed to the primary porosity of the geomedia (i.e., overburden or unfractured bedrock).



SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Rochester West, NY, 1971, Photorevised 1978.

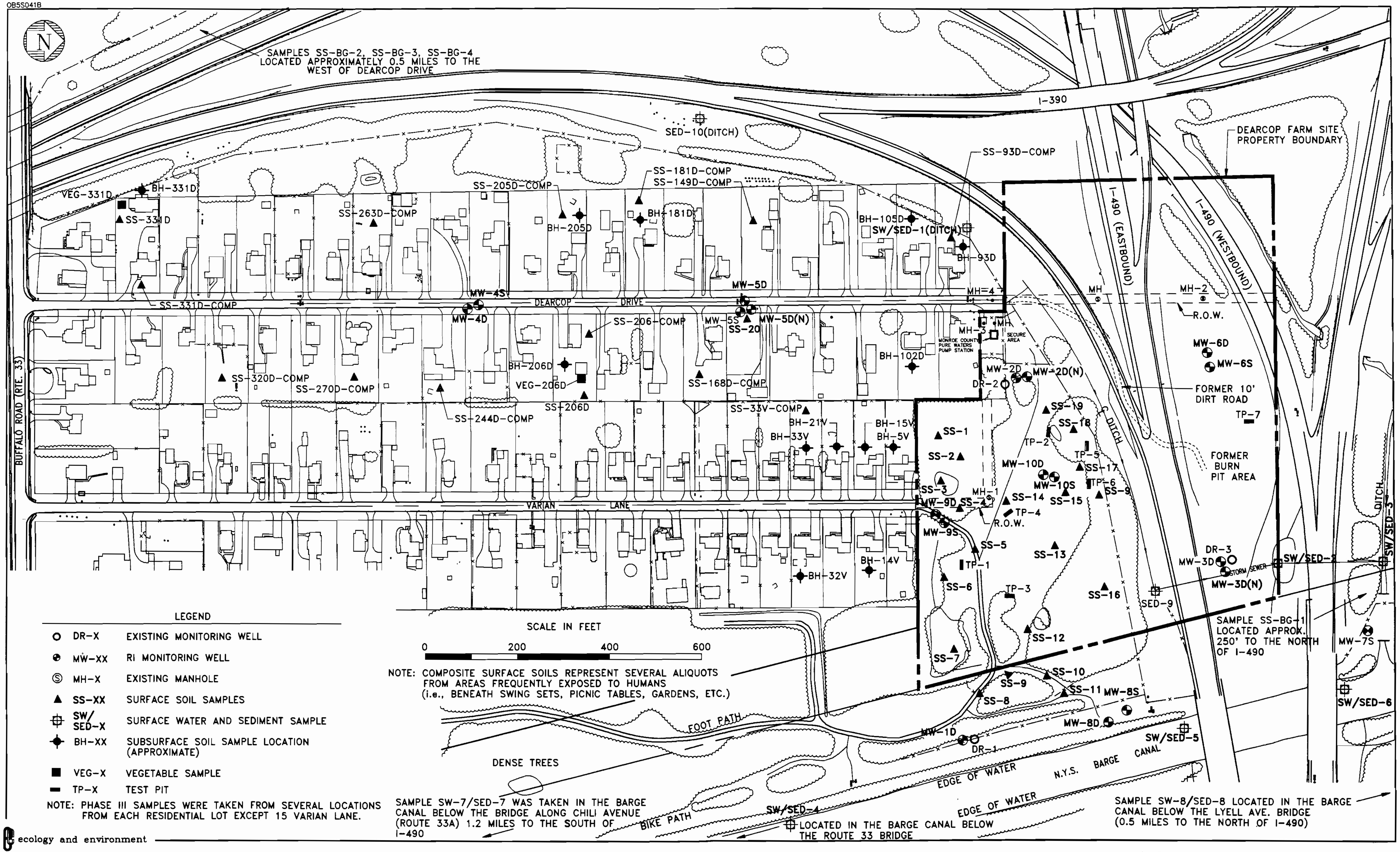
SCALE 1:24,000

0 ½ 1 Mile

0 .5 1 Kilometer

Figure 1-1
SITE LOCATION MAP, DEARCOP FARM SITE

OB5S041B



NOTE: COMPOSITE SURFACE SOILS REPRESENT SEVERAL ALIQUOTS FROM AREAS FREQUENTLY EXPOSED TO HUMANS (i.e., BENEATH SWING SETS, PICNIC TABLES, GARDENS, ETC.)

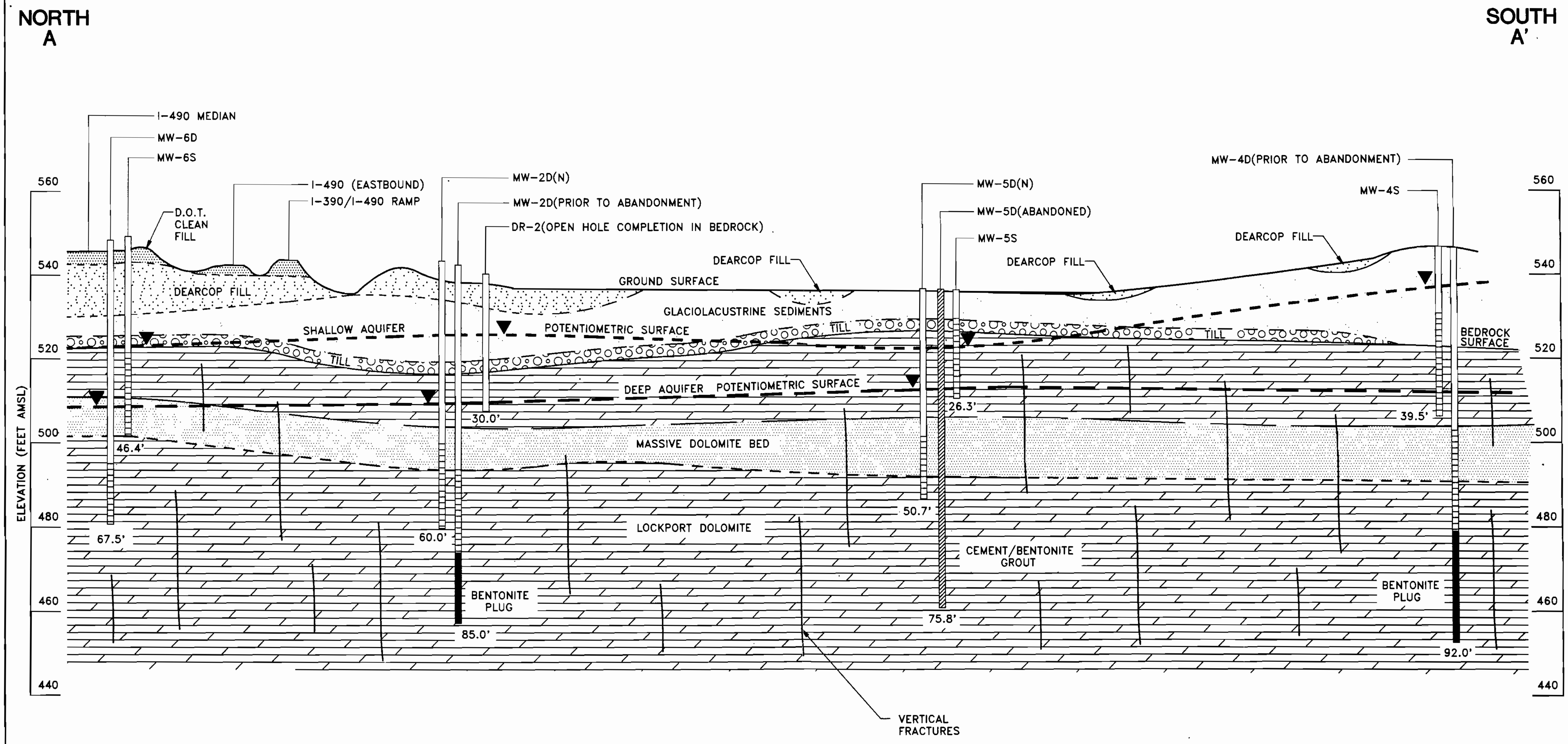
NOTE: PHASE III SAMPLES WERE TAKEN FROM SEVERAL LOCATIONS FROM EACH RESIDENTIAL LOT EXCEPT 15 VARIAN LANE.

SAMPLE SW-7/SED-7 WAS TAKEN IN THE BARGE CANAL BELOW THE BRIDGE ALONG CHILI AVENUE (ROUTE 33A) 1.2 MILES TO THE SOUTH OF I-490

SAMPLE SW-8/SED-8 LOCATED IN THE BARGE CANAL BELOW THE LYELL AVE. BRIDGE (0.5 MILES TO THE NORTH OF I-490)

Figure 1-2 PHASE I AND PHASE II SAMPLE LOCATION MAP DEARCOP FARM SITE

0B5X062B



NOTE: WATER ELEVATIONS BASED ON 4-28-93 WATER LEVEL READINGS.

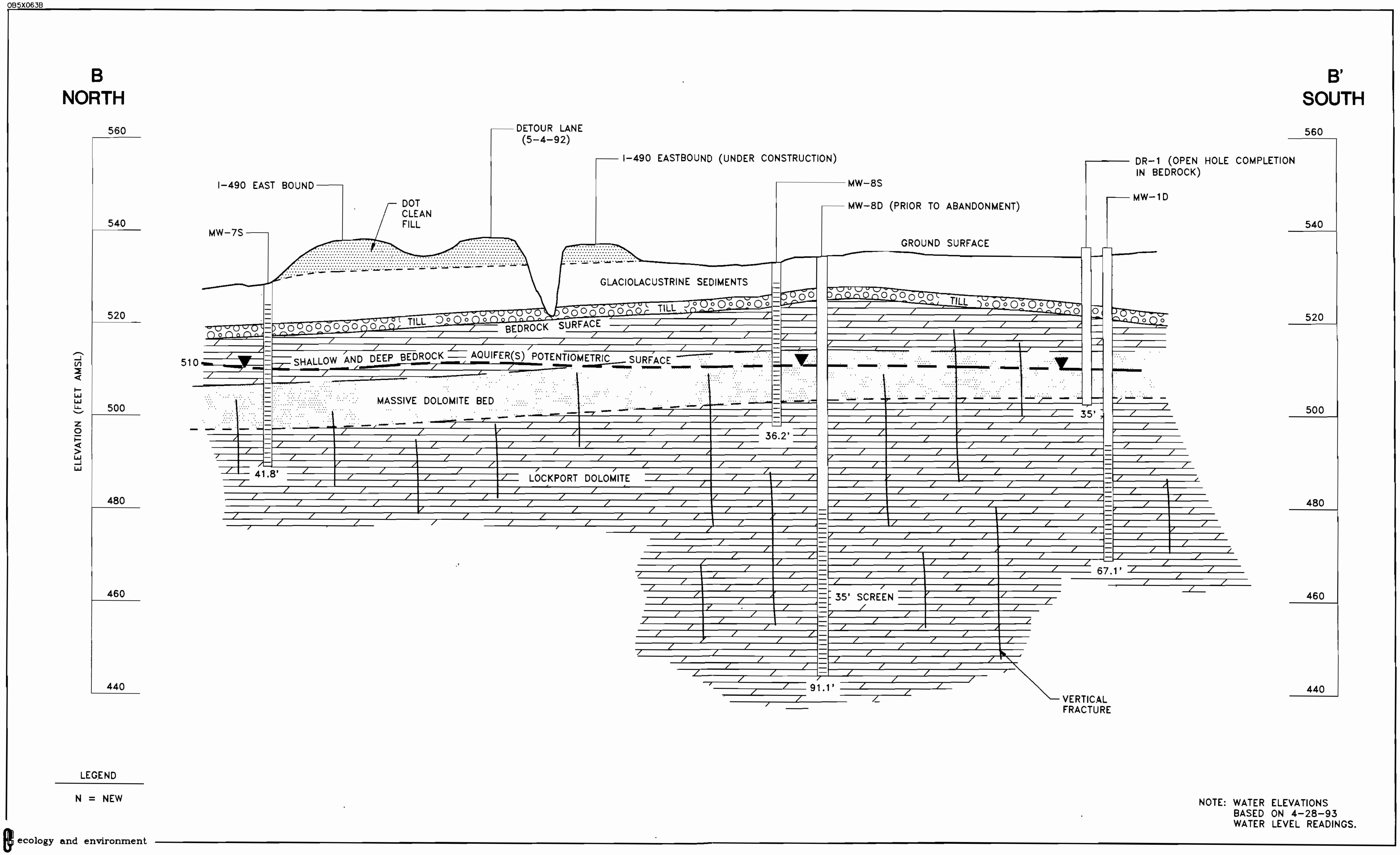
LEGEND

N = NEW

ecology and environment

Figure 1-3 GEOLOGICAL CROSS SECTION (A-A')
DEARCOP FARM SITE

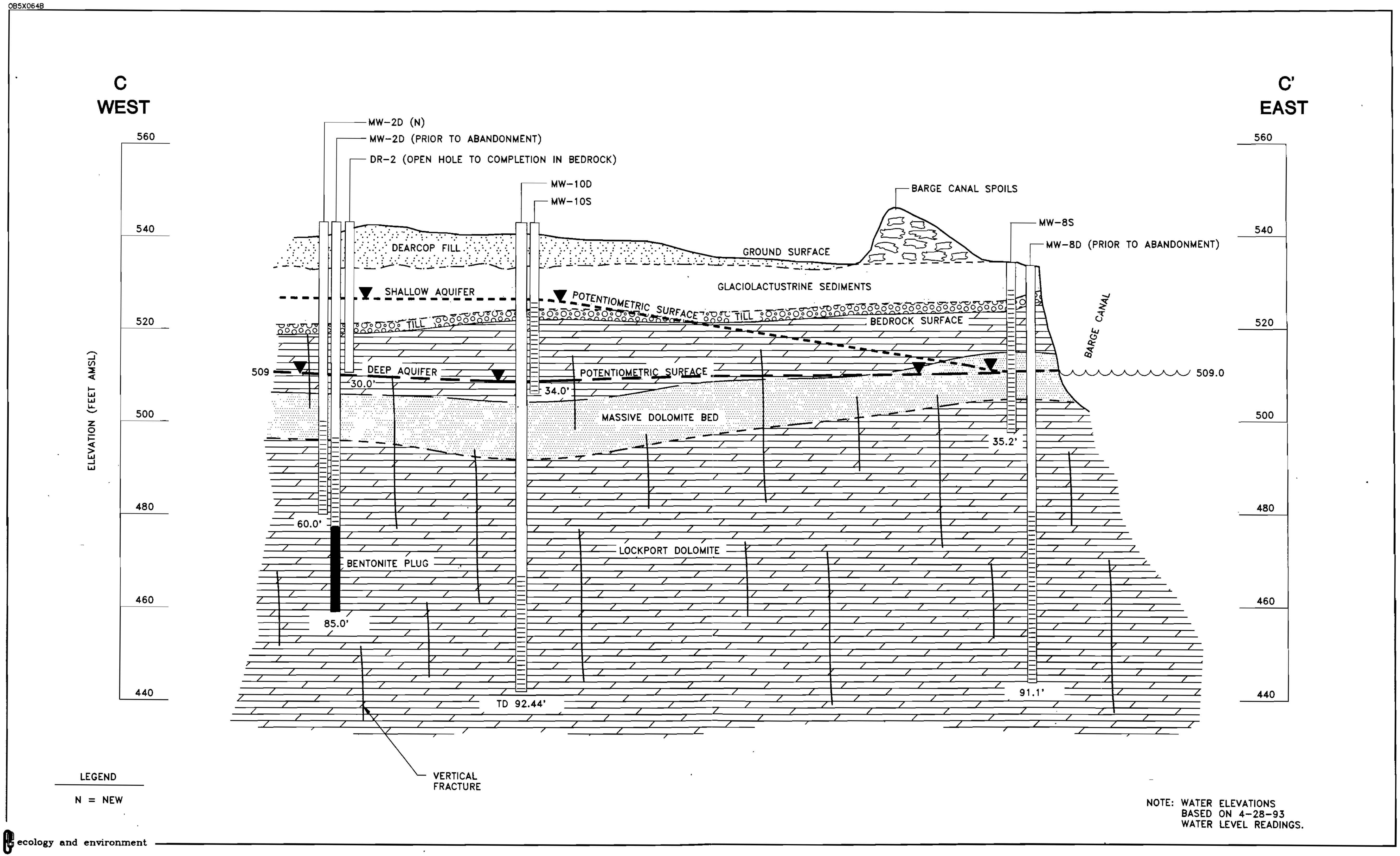
0B5X063B



NOTE: WATER ELEVATIONS
BASED ON 4-28-93
WATER LEVEL READINGS.

Figure 1-4 GEOLOGIC CROSS SECTION (B-B')
DEARCOP FARM SITE

B-1



ecology and environment

Figure 1-5 GEOLOGIC CROSS SECTION (C-C')
DEARCOP FARM SITE

085S0428

Figure 1-6 SOIL GAS LOCATION MAP DEARCOP FARM SITE

2. DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

2.1 INTRODUCTION

This section presents the first and second phases of the FS for the Dearcop Farm site. In this section, the framework for the FS is established and remedial technologies are initially screened. First, the contaminants and media of interest are identified and defined. Then, for each medium of concern, remedial action objectives for protection of human health and the environment are established. General response actions describing measures that will satisfy the remedial action objectives are then developed. Remedial technologies applicable to each general response action are then identified and screened on the basis of effectiveness and implementability to ensure that developed alternatives meet the remedial action objectives established for the site. Finally, in Section 2.5, retained technologies are assembled into comprehensive medium-specific remedial alternatives and screened for selection of those to be evaluated in the detailed analysis presented in Phase III of the FS.

2.2 REMEDIAL ACTION OBJECTIVES

Contamination at the Dearcop Farm site is present in all media, including soil, groundwater, surface water, and sediment. Remedial action objectives that are protective of human health and the environment will be established for each of these media. These remedial action objectives will be developed based on an evaluation of applicable or relevant and appropriate requirements (ARARs), other criteria and guidelines to be considered (TBCs), and findings of the site-specific baseline risk assessment presented in the Phase I RI and its addendum. This evaluation will determine levels at which the contaminants of concern are deemed protective of human health and the environment. Site cleanup goals will be based on the remedial action objectives. The methodology used is discussed in Section 2.2.1.

The terms ARARs and TBCs encompass the term SCGs (Standards, Criteria, and Guidance) defined by NYSDEC. Both the terms ARARs and standards refer to a promulgated and legally enforceable rule or regulation. TBCs, criteria, and guidance refer to policy documents that are nonpromulgated and not legally enforceable standards. To distinguish between enforceable and non-enforceable values, the terms ARARs and TBCs will be used rather than the term SCGs.

The remedial action objectives identified in this report are preliminary and will be further refined as the remedial process proceeds and final remedial measures are identified. The primary focus of this section is to identify chemical-specific ARARs, nonpromulgated federal or state standards or guidance document TBCs, and site-specific risk-based values that can serve as cleanup goals for remedial activities. The secondary purpose of this section is to identify action- and location-specific ARARs that may impact the screening and selection of remedial alternatives. Only those ARARs, TBCs, and site-specific risk-based values that apply to this site will be discussed.

Applicable or Relevant and Appropriate Requirements (ARARs)

An ARAR may be either "applicable" or "relevant and appropriate." Applicable requirements are those substantive environmental protection standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, remedial action, location, or other circumstance at a Superfund site. Relevant and appropriate requirements are those substantive environmental protection requirements promulgated under federal and state law that, although not legally applicable to the circumstances at the site, address situations sufficiently similar to those encountered at the site so that their use is well-suited to the particular site. Administrative requirements such as obtaining permits and agency approvals, record keeping, reporting, and off-site activities such as waste disposal are not included in the definition of ARARs.

Compliance with ARARs is a threshold requirement that a remedial alternative must meet to be eligible for selection as a remedy.

There are three types of ARARs:

- **Chemical-Specific ARARs** are usually health- or risk-based numerical values or methodologies that establish an acceptable amount or concentration of a chemical in the ambient environment;

- **Action-Specific ARARs** are usually technology- or activity-based requirements for remedial actions; and

- **Location-Specific ARARs** are restrictions placed on the concentration of hazardous substances or the conduct of activity solely because they occur in special locations.

The determination of ARARs in this report has been made in accordance with Section 121(d)(2) of CERCLA. They are also consistent with EPA guidance set forth in the CERCLA National Contingency Plan (NCP) (40 CFR 300); the two-part guidance document entitled *CERCLA Compliance with other Laws Manual* (OSWER Directives 9234.1-01 [Draft], August 8, 1988, and 9234.1-02, August 1989); and the guidance document entitled *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA-540/G-89/004).

TBCs

TBCs are nonpromulgated federal or state standards or guidance documents that are to be used on an "as-appropriate" basis in developing cleanup standards. Because they are not promulgated or enforceable, they do not have the same status as ARARs and are not considered required cleanup standards. TBCs generally fall into three categories:

- Health effects information with a high degree of credibility;

- Technical information on how to perform or evaluate site investigations or response actions; and

- State or federal agency policy documents.

Site-Specific Risk Assessment

CERCLA requires that remedial actions meet ARARs and be protective of human health and the environment. Health risk values as determined in the site-specific risk assessment (contaminant concentrations that represent an excess cancer risk of 10^{-6}, or a hazard index of 1) were considered in developing chemical-specific cleanup goals.

2.2.1 Development of Cleanup Objectives

2.2.1.1 Soils and Fill Material

Chemical-Specific ARARs

Under Title 40, Code of Federal Regulations (CFR), Part 761.125(c)(4), soil contaminated with PCBs in unrestricted access areas is required to be remediated to a level of 1 milligram per kilogram (mg/kg) to a depth of 10 inches and to a level of 10 mg/kg beyond 10 inches and replaced with clean fill (i.e., containing less than 1 mg/kg of PCBs). For the purpose of this ARAR evaluation, it has been assumed that the more stringent "surface soil" criterion of 1 mg/kg is an applicable criterion for establishing a cleanup objective for the PCB contamination in all soil or fill material at the Dearcop Farm site. If the site is ever developed in the future, the soil may be excavated and deeper soils may be exposed. Thus, the more stringent "surface soil" criterion of 1 mg/kg was used as an applicable ARAR.

TBCs

The NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 "Determination of Soil Cleanup Objectives and Cleanup Levels," revised January 24, 1994, are TBC criteria for this site. The TAGM states: "The cleanup goal of the Department is to restore inactive hazardous waste sites to predisposal condition to the extent feasible and authorized by law. However, it is required that restoration to predisposal conditions will not always be feasible." These nonpromalgated values are based primarily on a generic model of migration of contaminants to groundwater (for most organics) or on site background levels (for most metals). For certain contaminants (e.g., some pesticides) the levels are set for generic site exposure scenarios, similar to the EPA Region III TBCs discussed below. For most metals, this guidance recommends background concentrations as cleanup goals.

The proposed RCRA corrective-action regulations found in *Examples of Concentrations Meeting Criteria for Action Levels* (Appendix A) (set forth in 55 Federal Register (FR) 30798, July 27, 1990) identifies a number of "action levels" for contaminants in soils, including contaminants found at the Dearcop Farm site. For the purpose of developing remediation goals, these action levels have been identified as TBCs for soils. Although these regulations by definition are intended to establish the need for a RCRA corrective-measures study (rather than final cleanup goals), they are the most comprehensive listing available of risk-based values for soils. These TBCs are identified in Table 2-1.

In addition to the proposed RCRA action levels described above, remediation goals based on the EPA Region III guidance entitled *Risk Concentration Table, Fourth Quarter 1993*, setting forth risk-based concentrations of contaminants for residential soil, are also considered TBCs and are identified in Table 2-1. These risk-based concentrations have been calculated by EPA Region III for nearly 600 chemicals. These toxicity constants have been combined with standard exposure scenarios to calculate chemical concentrations corresponding to a hazard quotient of 1 or a lifetime cancer risk of 10^{-6}, whichever is lower.

Also, the EPA's interim guidance for establishing soil lead cleanup values at Superfund sites (*Revised Interim Soil Lead Guidance for CERCLA Site and RCRA Corrective Action Facilities*, EPA OSWER Directive No. 9355.4-12, July 1994) will be included in the TBCs at the Dearcop Farm site. This guidance establishes a health-based lead soil cleanup value of 400 mg/kg in a residential area with children.

A site-specific TBC applies to cadmium only. The New York State Department of Health (NYSDOH) has recommended a cadmium cleanup goal of 10 mg/kg for soils at this site.

Background concentrations are also included as TBCs. The highest analytical results from surface soil samples SS-BG-1 through SS-BG-4 were used as background concentrations for both surface and subsurface soils. These surface background values were considered to be the appropriate background values unless they were not established for a contaminant, in which case the appropriate values were considered to be 90th percentile of the common range for soils of the Eastern United States (calculated from the data of Shacklette and Boerngen 1984). Background values are included only for comparison to candidate cleanup goals. In general, no cleanup goal would be set below background concentrations.

Site Risk Assessments

Human health risk values (contaminant concentrations that represent cancer risks in excess of 10^{-6} or a hazard index of 1) were developed for contaminants found at the site for which cancer risks or hazard indices could be calculated. These values are included in Table 2-1.

Cleanup Objectives for Soils

In general, the procedure for selecting cleanup objectives for soils/fill materials consists of selecting the appropriate values from Table 2-1. Risk-based values (including ARARs, TBCs, and site-specific risk values) are evaluated using a consistent logical basis in order to select the most appropriate candidate. This value is compared against background, because cleanup objectives are not set below background concentrations. Candidate cleanup objectives are compared to the maximum observed concentrations for each compound to determine whether an objective needs to be set in each case. As a final step, the contaminants identified for cleanup are reviewed to determine whether they are site-related or are naturally occurring (despite being present above "background" levels).

Among the several risk-based levels for the soils/fill material, the concentration corresponding to a site-specific human health risk level of 10^{-6} was selected for the cleanup objective. An exception to this was PCBs (the only compound for which an ARAR exists for soil) as discussed further below. If no site-specific risk level was calculated for a compound, then the lower of the Region III RBC or the RCRA action level federal TBC was used to establish a preliminary cleanup objective.

The values recommended in the NYSDEC TAGM 4046 are the cleanup goals the NYSDEC recommends for the protection of groundwater. In most of the cases where these levels for organics were lower than other TBCs, they were based not on risks from direct exposure, but rather from a generic hypothetical model that estimated groundwater concentrations that could possibly result from migration to groundwater. Because most of the compounds for which this guidance would set lower objectives are not found in the groundwater above groundwater ARARs and the current site conditions indicate that groundwater is not being used as a drinking water source, the TAGM values were not used. For five compounds (dibenzofuran, di-n-butylphthalate, acenaphthalene, 2-methylnaphthalene, and phenanthrene), no site-specific risk-based values or federal TBCs existed. For these compounds, the TAGM 4046 value was used as a candidate cleanup objective; however, no concentrations were detected on site above the respective values for any of these compounds.) For metals, the TAGM recommends background values as cleanup goals. While many samples were found to exceed the metals content in site background samples taken at this site, their concentrations were still well within the typical range for native soil in the eastern United States. Potential toxic effects from these metals are adequately addressed in the other TBCs available for this medium. Therefore, those values were selected as candidate cleanup objectives for this site.

A special state TBC exists for cadmium. Upon review of the data from this site, the NYSDOH has recommended a cleanup goal of 10 mg/kg for cadmium. This state TBC is lower than the federal TBCs, and was selected as the candidate cleanup objective for this metal.

For PCBs in soils, the ARAR was used to establish a preliminary candidate cleanup goal even though the site-specific human health risk value was lower than the ARAR. Pursuant to NCP Section 300.430 (e)(2)(i), the 10^{-6} risk level shall be the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure. Attainment of the ARAR identified for PCBs would reduce the magnitude of cancer risk posed by soil contamination to less than 1×10^{-4}. Furthermore, EPA guidance (EPA/540/6-90-007) suggests that 1 ppm be selected as the "starting point for analysis at PCB-contaminated Superfund sites where land use is residential." This guidance indicates that while site-specific circumstances must be considered, the 1-ppm level is a reasonable PCB cleanup goal. Therefore, the ARAR will be the proposed site cleanup goal for PCBs in soils and fill material.

The final step in establishing cleanup objectives was to compare the candidate cleanup goal for each contaminant with the maximum concentration of the contaminant detected at the site. If the candidate cleanup objective was less than the maximum concentration, the candidate cleanup goal became the cleanup objective. If the maximum concentration was less than the candidate cleanup objective, no cleanup objective was needed.

The selected cleanup objectives for soils are presented in Table 2-1, and based on those cleanup objectives, the following was concluded:

- The only volatile contaminant found in site soils that exceeded cleanup objectives was 1,2-DCA. This contaminant was found only in subsurface soils. The proposed subsurface site cleanup objectives is 7,000 μg/kg (the EPA Region III RBC);

- Semivolatile contaminants in site soils that exceeded cleanup objectives were 5 PAHs and N-nitrosodiphenylamine. However, PAHs will *not* be addressed in this FS. Although benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene exceeded site-specific human health rate levels, these compounds were consistently found below 1 mg/kg on the site, which is well within a typical range in an urban area. Higher concentrations were detected off site. Because the off-site concentrations were higher, it is clear that the source of the contaminants is not site-related. PAHs may be present from a variety of common activities, including improper disposal of automobile oil, charcoal ashes, and burn barrels. For these reasons, PAHs will not be used to determine areas that would require remedial action.

- PCBs were found both in surface and subsurface soils above the proposed site cleanup objective for total PCBs of 1,000 μg/kg (based on TSCA);

- Of the 15 pesticides detected in site soils, only three exceeded cleanup objectives. The proposed soil cleanup objective for heptachlor and heptachlor epoxide are 140 and 70 μg/kg, respectively (the EPA Region III RBCs). The proposed surface cleanup objective for dieldrin is 57 μg/kg (the human health risk value);

- Of the 23 metals detected in site soils, five metals (beryllium, cadmium, chromium, lead, and nickel) exceeded cleanup objectives. The maximum concentrations of beryllium and manganese in the soils are not significantly different from background concentrations; therefore, beryllium and manganese will not be considered in determining areas needing remediation.

Location- and Action-Specific ARARs

The primary action-specific ARARs established for soils are the federal RCRA and New York State regulations (40 CFR Parts 261-268, New York Codes, Rules, and

Regulations [6 NYCRR 370-376]) and PCB disposal requirements pursuant to 40 CFR 761-60(a)(4). The federal and state requirements listed above regulate the generation, transportation, treatment, storage, and disposal of hazardous and solid waste. The hazardous waste management regulations would be applicable if:

- Hazardous wastes are treated, stored, or disposed of on site after the effective date of the RCRA requirement under consideration;
- Activity at the site constitutes treatment, storage, or disposal as defined by RCRA; and
- Activities at the site involve the management of hazardous wastes.

It was determined that some of the soils at the site exhibit the hazardous characteristic of toxicity (one sample, TP-5B, failed TCLP for chromium at 28.9 mg/L) and must be managed as hazardous wastes if excavated.

RCRA requirements of particular importance are the Land Disposal Restrictions (LDRs) for hazardous waste. These regulations, codified in 40 CFR Part 268, set treatment standards that must be met for the soil (containing characteristic contaminants above any site-specific *de minimus* levels) to be eligible for land disposal. These regulations also specify effective dates for the treatment standards.

For land disposal restrictions to be applicable to remedial action conducted under CERCLA, the remedial action must constitute placement of a restricted hazardous waste. Placement occurs if the response includes land disposal of wastes (e.g., landfill, surface impoundment, or waste piles) (EPA 1989a). For on-site disposal, placement occurs when wastes are moved from one area of contamination to another (e.g., consolidated, removed for treatment and returned, excavated, incinerated, or redeposited [EPA 1989a]). EPA delineates an area of contamination by the areal extent or boundary of contiguous contamination. Placement does not occur when wastes are treated *in situ,* capped, or consolidated within one area of contamination.

Treatment standards are developed for all listed and several characteristic hazardous wastes. These treatment standards are set at levels considered to be protective of human health and the environment when wastes are land disposed (e.g., placed in a landfill, surface impoundment, or concrete vault). These treatment standards specify the concentration limits that the waste must meet prior to land disposal in a RCRA-permitted facility. In the case of chromium, the treatment standard is 5.0 mg/L in the TCLP extract (40 CFR Part 268.41).

TSCA (40 CFR 761.60(a)(4)) requires that soil contaminated with PCBs at concentrations of 50,000 μg/kg or greater be disposed of either in a TSCA-permitted landfill or incinerator or by some alternative method that achieves a level of performance equal to incineration. Soil samples taken during the RI indicated that one sample was found to contain PCB concentrations in excess of 50 ppm (TP-5B contained 200 ppm PCBs). If these soils are excavated, TSCA disposal/treatment standards will be applicable ARARs.

For any soil/fill material found to contain greater than 50 ppm PCBs, the following NYSDEC Hazardous Waste Classification will also be applicable:

- B007—Other PCB waste, including contaminated soil, solids, sludges, clothing, rags, and dredged material [NYCRR, Title 6, Section 371.4(e)(1)]

Soil containing greater than 50 ppm PCBs will be a B007 NYSDEC-listed hazardous waste subject to treatment, storage, and disposal requirements delineated in NYCRR, Title 6, part 370-374, unless it is excluded by a petition granted by the NYSDEC commissioner in accordance with 6 NYCRR 370.3. (These regulations provide for the petitioning for exclusion of a listed waste.)

Other potential action-specific ARARs would include Occupational Safety and Health Act (OSHA) requirements set forth in 29 CFR Parts 1910, 1926, and 1904 and Hazardous Material Transportation Act regulations issued by the U.S. Department of Transportation (DOT) set forth in 49 CFR, Parts 170 and 171. The OSHA regulations specify worker protection requirements that will have to be adhered to during the implementation of remedial programs. The DOT regulations establish a variety of labeling and placarding requirements that will apply to any off-site transportation of hazardous materials resulting from site remediation activities (49 CFR Parts 170, 171.1-172.558). New York State regulatory procedures for wetlands and adjacent areas are also potential action-specific ARARs (6 NYCRR Part 663.4) because a few small wetland areas were found during the habitat-based assessment of the site. The regulatory procedures require that permits be obtained prior to engaging in certain activities.

Sections 141.47, 122.41(i), 122.44, 125.100, 125.104, and 136.1 through 136.4 of the Clean Water Act (33 USC 1344) are location-specific ARARs that relate to the discharge of groundwater treatment system effluent to waters of the United States, which include wetlands. The U.S. Army Corps of Engineers (USACE) has issued a nationwide permit pursuant to the Clean Water Act that is applicable to the "cleanup of hazardous and toxic waste" (33 CFR Part 330, Appendix A, Part B, Number 38). This permit allows remedial activities ordered or sponsored by a government agency or court that would result in discharges to a water of the United States, including wetlands. The USACE district engineer must be notified of the activity prior to commencement, and the activity must have a minimal impact on the water at issue or otherwise not be contrary to the public interest. Other permit conditions, including the substantive standards used by the USACE district engineer to determine minimal adverse impacts or impacts contrary to the public interest, are the ARARs relevant to review of the remedial action alternatives for this site. Examples of these substantive requirements are conditions regarding use of heavy equipment, erosion and siltation controls, and adverse impact of impoundment.

Certain New York laws and their implementing regulations are also location-specific ARARs for areas of the site identified as state waters and wetlands. The New York State permit regulations (6 NYCRR Part 608.4) regulate excavation or placement of fill in the New York State Barge Canal.

The fill material at the Dearcop Farm site is intermixed with debris; therefore, the Land Disposal Regulations for Debris (40 CFR Part 268) will apply in excavating and/or treating RCRA hazardous debris and fill material. These debris regulations require the use of specific treatment technologies that either extract, destroy, or immobilize the hazardous contaminants on or in the debris.

Debris is defined by EPA as a solid material exceeding a 60-millimeter (mm) particle size that is intended for disposal and that is either a manufactured object, plant or animal matter, or natural geologic material (40 CFR 268.2[g]). To be considered hazardous debris, the solid material must exhibit a characteristic of hazardous waste identified in Subpart C of 40 CFR Part 261 or contain a hazardous waste listed in Subpart C of 40 CFR Part 261. Test Pit 5 contained pieces of debris, and sample TP-5B was found to contain chromium above the treatment standard.

EPA has identified several commonly encountered types or categories of debris, including metal objects, brick, concrete, rock, pavement, glass, wood, paper, cloth, rubber, and plastic. This rule only applies to debris contaminated with hazardous wastes for which treatment standards have been established or that exhibits a characteristic for which a treatment standard has been established.

Intact containers of hazardous waste that are not ruptured and that retain at least 75% of their original volume are excluded from the definition of "debris" because containers are regulated under Part 261.7. Test pits 2, 5, and 6 each were found to contain rusty intact drums. The EPA does not consider intact tanks to be debris; thus, any hazardous waste in a tank is subject to waste-specific treatment standards. Ruptured or crushed containers are to be regulated as debris.

There are currently three alternatives for managing hazardous debris (40 CFR Part 268). Under the first option, most listed and/or characteristic hazardous debris can be treated using specific technologies from one or more of the following treatment technologies: extraction, destruction, or immobilization. These treatment technologies must be conducted in accordance with specified performance and/or design and operating standards. These treatment technologies, however, do not apply to debris contaminated with listed wastes that must be treated in accordance with a specific treatment under 40 CFR 268.42. Provided the debris does not exhibit a characteristic of hazardous waste after an approved extraction or destruction technology, it will not have to be managed as a hazardous waste. Treatment using an immobilization technology, however, does not qualify a listed waste for exclusion.

Also, the final mixtures of debris and other materials, such as soil or sludge, are regulated as debris if the mixture is composed primarily of debris (by volume) based on visual inspection.

Mixtures containing more than one type of debris or more than one contaminant must be treated to meet the standards for each contaminant and each type of debris. A single technology may not be appropriate for all contaminants and debris types present in the mixture. In this case, sequential treatments must be used, and if an immobilization treatment is used, it is to be used last.

Residues and flush water from treatment technologies must be separated from the debris using simple physical or mechanical means. This separation process does not need to produce a clean debris surface, but one free of caked residues or nondebris material such as soil or waste. These residues are then subject to the treatment standards that apply to the wastes contaminating the debris.

The second option for managing hazardous debris is to treat the debris to meet the treatment standard for the waste or wastes contaminating the debris. In this case, test pit sample TP-5B was found to be contaminated with a D007 waste (i.e., a waste containing leachable chromium); therefore, the D007 treatment standard as found in 40 CFR 268.41 would apply. If the debris were to exhibit the characteristic of ignitability, corrosivity, or reactivity (i.e., ICR debris), this second option could not be applied. ICR debris must be deactivated using one of the destruction or immobilization technologies previously discussed. However, based on data obtained in the remedial investigation, the debris would most likely not exhibit the ICR characteristics.

The third and final option is to continue to manage hazardous debris in accordance with the EPA's "contained-in" policy. Debris is not considered a solid waste in the sense of being abandoned, recycled, or inherently wastelike as defined in 40 CFR Part 261.2 (EPA 1989a). Therefore, debris contaminated with a RCRA-listed hazardous waste cannot itself be a listed hazardous waste. Rather, according to EPA's "contained-in" interpretation (referenced in OSWER Directive 9347.3-05FS), the debris must be managed only as a RCRA hazardous waste if contaminants are detected above health-based levels. This policy was explained in depth in a June 19, 1989, letter to then-NYSDEC Commissioner Thomas C. Jorling from the acting assistant administrator of EPA. In accordance with the "contained-in" policy, although debris must be managed as a hazardous waste as long as it contains the listed waste in question, if the contaminant is removed from the debris (to *de minimus* levels), the debris would no longer be considered a listed hazardous waste and would not have to be specifically delisted (EPA 1989a).

See Table 2-2 for a listing of action-specific ARARs identified for this site.

In summary, the location- and action-specific ARARs identified are:

- The federal and state RCRA regulations have been identified as action-specific ARARs for contaminated soils that are disposed of off site; soils that are excavated, incinerated, and redeposited on site; or soils consolidated or removed for treatment and returned to the site.

- Section 404 of the Clean Water Act (33 USC 1344) and Parts 700-703 and 700-758 of 6 NYCRR are location-specific ARARs that relate to alterations and/or discharges to waters of the United States, including wetlands.
- The New York State regulatory procedures (6 NYCRR Part 663.4) for wetlands requiring permits for conducting wetland activities.
- The federal RCRA regulations have been identified as action-specific ARARs for contaminated debris that is excavated and/or treated (see Table 2-2).

2.2.1.2 Sediments

Chemical-Specific ARARs

No chemical-specific ARARs were identified for the Dearcop Farm site.

TBCs

The primary TBCs identified for sediments at the Dearcop Farm site are the EPA Interim Sediment Criteria Values for Nonpolar Hydrophobic Organic Contaminants (Office of Water Regulations and Standards, May 1988), the "effects range-low" (ER-L) values from Long and Morgan (1991), and NYSDEC cleanup criteria for aquatic sediments. These values/standards were developed to evaluate the impact of sediment contamination on aquatic life, but they exist only for a limited number of contaminants. As a result, soil guidance values (i.e., RCRA action levels for soils and Region III risk-based criteria for soils) have been identified as secondary sediment TBCs.

The site-specific background surface soil value and general eastern U.S. background value (90th percentile of the common range concentration derived from Shacklette and Boerngen [1984]) are also included as TBCs.

Site Risk Assessment

Because the sediment TBCs that have been identified have been developed based on health and ecological risk considerations, no site-specific risk values have been developed for individual sediment contaminants identified at this site.

Cleanup Objectives for Sediments

The methodology used to establish sediment cleanup goals was similar to the methodology used to establish soil cleanup objectives. For contaminants for which criteria values exist, unless the values are below background, the candidate cleanup objective is the lowest value of the EPA interim sediment criteria value, the NYSDEC sediment criteria value or the Long and Morgan (1991) "effects range-low" values. If none of those values exists for a contaminant, the candidate cleanup objective is the lower of the proposed RCRA action level for soils or the Region III risk-based criteria for soils (unless that level was determined to be below background). The candidate cleanup objectives were then compared to background values. If the candidate cleanup objectives were lower than background values, then background was set as the cleanup objective. Otherwise, the candidate cleanup objectives became cleanup objectives.

All of the potential criteria and selected cleanup objectives are presented in Table 2-3. A summary of the objectives is presented below:

- Ten of 20 semivolatile contaminants in site sediments exceeded cleanup objectives. However, all 10 of these compounds were PAHs. As discussed in Section 2.2.1.1 for soils and fill material, these compounds are commonly found in urban areas in the concentrations observed at this site. Thus, PAHs will not be addressed in the FS.

- Aroclor 1254 (a PCB) exceeded a cleanup goal of 50 μg/kg.

- Three of seven pesticides in site sediments, 4,4'-DDE, 4,4'-DDT and heptachlor epoxide, exceeded cleanup objectives.

- Ten of the 21 inorganics detected in site sediments exceeded cleanup objectives. One of these metals, iron, is a naturally occurring element and is present at concentrations near the applicable RBC criteria. Thus, it will not be addressed in the development of remedial alternatives.

Action- and Location-Specific ARARs

The action- and location-specific ARARs discussed in Section 2.2.2.1 that apply to soils also apply to sediments (see Table 2-2). In summary, the principal action- and location-specific ARARs are:

- The federal and state RCRA regulations have been identified as action-specific ARARs for contaminated sediments that are disposed of off site; sediments that are excavated, incinerated, and redeposited on site; or sediments consolidated or removed for treatment and returned to the site.

- Section 404 of the Clean Water Act (33 USC 1344) and parts 700-703 and 750-758 of 6 NYCRR are location-specific ARARs that relate to alterations and/or discharges to waters of the United States, including wetlands.

- An additional action-specific ARAR that has been identified is the New York state regulations found in 6 NYCRR 663.4 requiring permits on conducting wetland activities (see Table 2-2).

2.2.1.3 Groundwater

Chemical-Specific ARARs

The federal Safe Drinking Water Act (SDWA) 42 USC 300(f) *et seq.*, 40 CFR 141.147, protects public health by establishing primary and secondary drinking-water standards for public and community water supplies. The primary drinking-water standards address toxicity and are called maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs). According to the National Oil and Hazardous Substances Contingency Plan (NCP), an MCL or nonzero MCLG is generally a relevant and appropriate chemical-specific requirement for groundwater that is a current or potential source of drinking water. As such, they are ARARs for the Dearcop Farm site.

The NYSDEC Class GA groundwater standards, set forth in NYCRR Part 703.5, are also considered ARARs for purposes of this FS. The maximum allowable concentrations for a number of substances in groundwater are contained within these regulations. A listing of state groundwater potential ARARs for the contaminants detected in groundwater are identified in Table 2-3. Federal MCLs and nonzero MCLGs and the NYSDEC Class GA groundwater standards are relevant and appropriate ARARs for this site.

TBCs

The proposed RCRA corrective action regulations table in "Examples of Concentrations Meeting Criteria for Action Levels" (Appendix A) (set forth in 55 FR 30798, July 27, 1990) identifies a number of "action levels" for water contaminants, including contaminants found at the Dearcop Farm site. Although they are, by definition, not intended to establish final cleanup goals, but rather the need for a RCRA Corrective Measures Study, these action levels have been identified as TBCs for the Dearcop Farm site .

EPA Region III risk-based concentrations for tap water criteria, secondary MCLs (SMCLs) promulgated under the SDWA, and NYSDEC Class GA Groundwater Guidance Values are also considered TBCs. Region III risk-based concentrations have been calculated by EPA Region III for nearly 600 chemicals. These toxicity constants have been combined with generic exposure scenarios to calculate chemical concentrations corresponding to a hazard quotient of 1 or lifetime cancer risk of 10^{-6}, whichever occurs at a lower level. SMCLs are TBCs, rather than ARARs, because they are not enforceable at the federal level.

Site Risk Assessment

Human health risk values (contaminant concentrations that represent excess cancer risks of 10^{-6} or a hazard index of 1) were not developed for groundwater contaminants at this site because residents do not use the groundwater as a potable water source, but rather use a municipal water source. The groundwater at the Dearcop Farm site will, in all likelihood, not be used as a source of drinking water. No site-specific ecological risk values have been developed for individual groundwater contaminants identified at this site.

Cleanup Objectives for Groundwater

The methodology followed in establishing groundwater cleanup goals was different than the methodology used for soils/fill materials and sediments.

The NYSDEC Class GA groundwater ARAR was used as the candidate cleanup objective, unless the Class GA standards had not been established, in which case, the Federal MCL ARAR was used as the candidate cleanup objective. In the event neither NYSDEC nor federal MCL ARARs have been established, the lowest of the TBC values was used as the candidate cleanup objective. If the candidate cleanup objective exceeded the maximum concentration of that contaminant found at the site, no cleanup objective was established for that contaminant; otherwise, the candidate cleanup goal became the cleanup objective.

An exception to the cleanup objective determination was made for aluminum, beryllium, iron, magnesium, and sodium. The cleanup objective for iron would be 300 μg/L using the secondary MCL. However, this criterion is based on aesthetics and is not a health-based criterion. Iron naturally occurs above this concentration. For these reasons, iron will not be addressed in the FS. Aluminum, magnesium, and sodium or also typical compounds in groundwater (for example, the bedrock, which constitutes part of the aquifer, consists of calcium magnesium carbonate). Therefore, these elements will not be addressed in the FS. Finally, beryllium is at a maximum concentration of only 4.5 μg/L, just over its criterion of 4 μg/L, and thus will not be addressed.

All of the potential criteria discussed above are presented in Table 2-4. The following is a summary of cleanup objectives for groundwater at the Dearcop Farm site:

- Thirteen of 20 volatile contaminants detected in the groundwater exceeded cleanup objectives.
- One (phenol) of the seven semivolatile contaminants detected in the groundwater exceeded cleanup objectives.
- Besides aluminum, beryllium, iron, magnesium, and sodium, 12 of the 23 inorganic contaminants that were detected in groundwater samples exceeded cleanup objectives.

Action- and Location-Specific ARARs

No action- or location-specific ARARs other than those discussed for soils and sediment were identified for groundwater (see Table 2-2). In summary, those that apply are:

- New York State Pollutant Discharge Elimination System Regulations are applicable action-specific ARARs for treated water discharges to surface waters; and
- The action- or location-specific ARARs identified for wetlands.

2.2.1.4 Surface Water

Chemical-Specific ARARs

The intent of the water quality regulations established under the federal Clean Water Act (CWA) (33 USC 1251-1376, 40 CFR 121) and 6 NYCRR Parts 700-705 water quality regulations for surface waters is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. To achieve these objectives, ambient surface water quality standards have been set. The EPA chronic values for the protection of aquatic life and of human health have been identified as relevant and appropriate ARARs and were chosen over acute values to provide a conservative approach. NYSDEC Class C and D surface water standards have also been identified as relevant and appropriate ARARs for the canal and the drainage ditches, respectively.

TBCs

No surface water TBCs have been identified at this site.

Site Risk Assessment

Because the surface water ARARs identified at this site include ecological risk-based values, no site-specific ecological risk values were used in establishing remedial action objectives.

Cleanup Objectives for Surface Water

The methodology followed in establishing surface water cleanup goals was similar to the methodology used for groundwater with the following exceptions:

- ARARs included EPA Ambient Water Quality Criteria (AWQC) for the protection of human health and AWQC for the protection of aquatic life; NYSDEC Class C surface water standards; and NYSDEC Class D surface water standards.

- No TBCs were identified.

The NYSDEC surface water standards were used as the candidate cleanup goals unless the NYSDEC ARAR had not been established, in which case, the lower of the EPA AWQC were used. If the candidate cleanup objective exceeded the maximum concentration of that contaminant found at the site, no cleanup objective was established for that contaminant. Otherwise, the candidate cleanup objective became the cleanup goal. Surface water cleanup objectives were identified for Class C surface waters (the Barge Canal), and for Class D surface waters (the drainage ditches). A summary of chemical-specific Class C and Class D surface water remedial action objectives is presented in Table 2-5. The following is a summary of proposed cleanup objectives for Class C and Class D surface water at the Dearcop Farm site that were developed based on an evaluation of ARARs:

- Bis(2-ethylhexyl)phthalate was the only semivolatile that exceeded cleanup objectives in both Class C and Class D surface waters.

- Three of 12 inorganic contaminants—aluminum, lead, and selenium—detected in Class C surface water, and three of 14 inorganic contaminants—aluminum, manganese, and mercury—detected in Class D surface water, exceeded cleanup objectives. Aluminum and iron are known to be naturally occurring; therefore, although they were present above surface water standards, they will not be addressed in the FS.

Action- and Location-Specific ARARs

No action- or location-specific ARARs other than those discussed previously for groundwater were identified for surface waters. In summary, those that apply are:

- New York State Pollutant Discharge Elimination System Regulations are applicable action-specific ARARs for treated water discharges to surface waters.

- The action- or location-specific ARARs identified for wetlands.

2.2.2 Analytical Results Above Cleanup Objectives

Table 2-6 presents a summary comparing the number of analyzed to the number of samples exceeding cleanup objectives for volatiles, semivolatiles, pesticides, metals, and PCBs. The number of samples for each category varies because all samples were not analyzed for all parameters.

2.3 GENERAL RESPONSE ACTIONS AND CONTAMINATED AREAS/VOLUMES DETERMINATION

The purpose of this section is to develop general response actions for each medium of concern or interest. General response actions are actions that may be taken to satisfy the remedial action objectives for Dearcop Farm site. Contaminants and cleanup objectives for each medium are presented in Tables 2-1, 2-3, 2-4, and 2-5. General response actions may include, but are not limited to, treatment, containment, excavation, extraction, disposal, or institutional actions. Like remedial action objectives, general response actions are medium specific. Table 2-7 presents a summary of the general response actions identified for each medium of concern.

Within this section, areas or volumes of media to which cleanup objectives might be applied were determined. This initial determination was made for each medium of interest at the site.

2.3.1 Soils and Fill Material

Pesticides, PCBs, and metals were detected in both the surface and subsurface soils and fill material at the Dearcop Farm site at concentrations exceeding cleanup objectives. However, only the subsurface soils were found to contain concentrations of 1,2-DCA exceeding cleanup objectives. Figure 2-1 shows subsurface soil samples that exceed site cleanup objectives, and Figures 2-2 and 2-3 show surface samples that exceed cleanup objectives.

Fill material, specifically foundry sand and glass and metal slag, and debris within the soils, rather than the soils themselves, comprise the majority of the soil material at the Dearcop Farm site. The areas of high concentrations and volumes requiring remediation are presented in Figure 2-4. These areas of high concentrations were defined as those areas in which contaminant concentrations were above the cleanup objectives presented in Table 2-1. These areas are also defined taking into account soil gas readings. Although no cleanup objective is set for soil gas, certain areas, such as part of the highway median and the eastern portion of the area south of the highway, are designated as potentially in need of remediation, based on soil gas measurements (see Figure 2-5). High soil gas concentration may indicate areas of VOC contamination that are not observed during the RI (due to, for example, volatilization during sampling). Volumes requiring remediation were calculated from the areas shown on Figure 2-4. Areas designated as deep contamination were assumed to be contaminated to approximately a 10-foot depth. The remaining areas, based on surface soil exceedances and/or high soil gas readings, were assumed to be contaminated to a 1-foot depth. Volumes of contaminated soils are thus estimated at 15,550 cubic yards south of the highway, and 10,000 cubic yards in the median.

These soil and fill material volumes will be used only to facilitate the FS process and are based entirely on soil contaminant concentrations detected during the RI. The deepest soil and fill material depth with contaminant concentrations of potential concern is 10 feet. Soil may be contaminated in certain areas down to bedrock because the groundwater within these areas is contaminated. For those alternatives employing excavation of contaminated soils and fill material, the actual depth of soil and fill material contamination, as well as the areal extent, would be determined based upon confirmation/verification sampling to be conducted during the remedial design/remedial action. The confirmation sampling would be based on the soil and fill material cleanup objectives presented in Table 2-1.

For soil and fill material, the overall remedial action objectives for protecting human health are to prevent direct contact with, ingestion of, and dermal adsorption of contaminated soils and fill materials, as well as leaching and air transport of contaminated debris and debris particles. General response actions for soils and fill material include containment, excavation, on- or off-site treatment, *in-situ* treatment, and no action or institutional actions.

2.3.2 Sediment

Sediment in the drainage ditches of the Dearcop Farm site was determined to be contaminated with pesticides (4,4'-DDT and heptachlor epoxide), and several metals. Using the cleanup objectives determined in Section 2.2 and the RI analytical data, drainage ditch sediment samples with concentrations exceeding site cleanup objectives were identified (see Figure 2-6). Contaminated drainage ditch sediments were assumed to extend to a depth of 6 inches.

The areas and volumes of drainage ditch sediments requiring remediation were estimated. Figure 2-7 shows the areas of contaminated drainage ditch sediments requiring remediation. The total volume of drainage ditch sediments requiring remediation is estimated to be 1,139 cubic yards.

Contaminated sediments in the Barge Canal were not found to be attributed to the Dearcop Farm site. There are a number of sources, including various inactive hazardous waste sites (see Figure 1-1), that are near the canal. Based on these circumstances, sediments in the Barge Canal will not be addressed in the FS.

For drainage ditch sediments, the overall remedial action objectives for protecting human health are to prevent direct contact with and ingestion of sediments posing excess adverse health risks and to meet ARARs. General response actions include containment, excavation, on- or off-site treatment; on- or off-site disposal, *in-situ* treatment, and no action or institutional actions.

2.3.3 Groundwater

Groundwater at the Dearcop Farm site is contaminated with both organic compounds, metals, and cyanide. Contaminants detected above cleanup objectives are shown in Figure 2-8. The primary organic contaminants include benzene, toluene, and xylenes (BTEX compounds); chlorinated aliphatic compounds; and phenol. Inorganics detected above groundwater standards are antimony, arsenic, cadmium, chromium, copper, lead, manganese, nickel, selenium, thallium, zinc, and cyanide.

Organic contamination is found in both shallow and deep wells; however, BTEX compounds above proposed site cleanup objectives are more prevalent in the deep wells than in the shallow wells. Chlorinated aliphatics above cleanup objectives are more prevalent in the shallow wells. Phenol is found above proposed site cleanup objectives exclusively in deep wells.

Inorganics are uniformly distributed between deep and shallow wells. Cadmium, chromium, and manganese above proposed cleanup levels are more prevalent in the shallow wells. Arsenic, copper, nickel, and thallium above cleanup objectives were found exclusively in shallow wells, whereas antimony, selenium, and cyanide above cleanup objectives were found exclusively in the deep wells.

For groundwater, the overall remedial action objectives for protecting human health are to prevent potential exposure via inhalation of soil gas and via potential off-site migration of contaminated groundwater. Response actions for contaminated groundwater include containment, groundwater extraction, *in situ* treatment, on- or off-site treatment, discharge/disposal, and institutional actions.

2.3.4 Surface Water

The overall remedial action objectives for surface water are to prevent risk to aquatic life, thereby preventing risk to humans consuming aquatic life. However, due to the small amount of contaminants detected, this medium will be addressed by the remediation of the source of contamination in the soils, sediments, and groundwater. Furthermore, it is generally impractical to remediate surface water bodies. The general response action for surface water will be no action, with monitoring after soil and sediment remediation to verify that the contamination levels are below standards.

For all alternatives considered, the surface water will be monitored for those contaminants presently detected in the canal (bis-[2-ethylhexyl]phthalate and metals, including aluminum, lead, and selenium) and in the drainage ditches (all the contaminants found in the canal with the exception of selenium, manganese, and mercury). Figure 2-6 presents surface water samples with contaminant concentrations exceeding site cleanup objectives. Because groundwater discharges to surface water, surface water will also be monitored to determine whether any of the volatile contamination present in the groundwater has migrated to surface water.

2.4 IDENTIFICATION OF APPLICABLE REMEDIAL TECHNOLOGIES

Applicable remedial technologies were identified for each general response action. The remedial technologies were identified based upon engineering judgment, taking into account the following:

- Site conditions and characteristics that may affect implementability;
- Physical and chemical characteristics of contaminants that determine the effectiveness of various technologies; and
- Performance and operating reliability.

The following describes each of the identified applicable technologies and briefly discusses their applicability to the Dearcop Farm site. For both the development and screening processes, the soils and sediments media have been combined. These media have similar contaminants, and the technologies used to address these contaminants would be the same. Furthermore, no remedial technologies are identified for surface water. Surface water will be remediated by addressing the source of the contamination, specifically, the soils, sediments, and groundwater (which discharges to surface water). Each of the technologies in this section was subjected to a preliminary screening process. The technologies were then screened in the following section on the basis of effectiveness and implementability. Table 2-8 lists applicable remedial technologies for each medium of concern and general response action, as well as the results of the preliminary screening.

2.4.1 Soil/ Fill Material and Sediment Remedial Technologies

Because the remedial technologies for soil and sediments are the same, these two media are addressed together in this section. Remedial technologies for the contaminated soil (and fill materials, including debris) and sediments, are used to contain, treat, or remove and dispose of the contamination in these media at the Dearcop Farm site. The remedial technologies discussed below are those initially considered for contaminated soil/fill material and sediment. The screening process is summarized in Table 2-9, and related technologies listed in Table 2-10.

2.4.1.1 Containment

Capping

Capping, or surface sealing, is applicable to all land disposal sites. Capping is a means to control air mobilization of contaminated soil and fill material, including debris; infiltration of rainwater into soil and fill material; and movement of contaminated soil and fill material into the surface water and drainage system through erosion. In general, capping isolates wastes from contact with surface water runoff and infiltration, controls off-site transport of contaminated sediments, and minimizes the potential for leachate outbreaks to the surface. Capping techniques use materials such as synthetic membranes, slags, asphalt, concrete, and chemical sealants.

Capping is generally performed when subsurface contamination at a site precludes excavation and removal of wastes because of potential hazards and/or prohibitive costs. Capping also may be performed as an interim remedial measure to reduce infiltration of precipitation and to control air releases. The main disadvantages of capping are uncertain design life and the need for long-term maintenance. However, long-term maintenance requirements can be considerably more economical than excavation and removal of the waste.

Capping techniques under consideration include single-layered and multilayered caps. Single-layered caps are typically used only as an interim remedial measure, but they may be an acceptable remedial measure if the cap will be continually monitored and maintained. For example, an asphalt cap that can be inspected frequently may be acceptable. The most effective single-layered caps are composed of concrete or asphalt. Periodic application of surface treatments for asphalt and concrete caps can greatly improve their life and effectiveness.

Multilayered caps are most common and are required for RCRA land disposal facilities by regulations 40 CFR 264, Subparts K through N. These caps can be composed of natural soils, mixed soils, a synthetic liner, or any combination of these materials. Standard design practices specify permeabilities of less than or equal to 10^{-7} centimeters per second (cm/sec) for the soil liner.

Environmental, public health, and institutional impacts of the various capping technologies would all be similar. During construction, short-term impacts would include noise, dust, and increased truck traffic through neighborhoods. Long-term groundwater pollution would be lessened because of reduced infiltration and leaching. Waste material and soil contaminants would remain on site and be a potential source of future groundwater contamination and public exposure. Future development of the site would have to be strictly controlled.

Single-Layered Caps. The following are examples of single-layered caps:

- **Sprayed Asphalt Membrane.** This technology involves clearing and grubbing, surface grading, and spray application of a 0.25- to 0.5-

inch-thick layer of asphalt to reduce infiltration and limit air mobilization of particulates from the soil surface. This technology requires little material handling and a small labor force, and is easy to implement. However, the membrane is not very durable. It is photosensitive, has poor weathering resistance, becomes brittle with age, and is susceptible to severe progressive cracking. The fragile nature of the cap may prohibit future use of the site for other purposes.

- **Portland Cement Concrete.** This technology involves clearing and grubbing, surface grading, and placement of a 6-inch-thick base course and a 4- to 6-inch-thick concrete slab (with minimum steel mesh) to minimize infiltration and eliminate emissions of particulates from the surface soil. The technology is durable and resistant to chemical and mechanical damage. However, concrete is susceptible to cracking from settlement, shrinkage, and frost heave. Installation requires the placement of forms and steel and the construction of expansion joints. Proper design and installation generally produce relatively low maintenance costs.

- **Bituminous Concrete (Asphalt).** This technology involves clearing and grubbing, surface grading, and placement of a 6-inch-thick base course and a 2- to 4-inch-thick asphalt pavement to minimize infiltration and eliminate emissions of particulates from the soil surface. This technology has proven effectiveness. However, like more rigid materials, asphalt is susceptible to cracking from settlement and shrinkage. Asphalt is photosensitive and tends to weather more rapidly than concrete. This weathering generally contributes to operation and maintenance expenses that are greater than those for concrete.

Multilayered Caps. The following are examples of multilayered caps:

- **Loam Over Clay Over Sand.** This technology involves clearing and grubbing, grading, and covering site soils with a 12-inch sand layer (the gas-venting layer) overlain by 18 inches of compacted clay to minimize infiltration and eliminate particulate emissions from the soil surface. The clay is covered with a 24 inches of loam (topsoil) to control moisture and protect the integrity of the clay layer to allow revegetation. This final cover system meets the requirements of 6 NYCRR Part 360. This technology is effective and has longevity and durability, assuming proper design, installation, and maintenance. Although it is susceptible to cracking from settlement and frost heave, it tends to be self-repairing. Long-term maintenance is required to prevent growth of deep-rooting trees and shrubs that could penetrate the clay seal.

- **Loam Over Synthetic Membrane Over Sand.** 6 NYCRR Part 360 allows substitution of a synthetic membrane for the clay layer. Thus, this technology involves clearing and grubbing, surface grading, and covering site soils with a 12-inch-thick blanket of sand (the gas-venting layer) overlain by an impermeable synthetic membrane that is covered by 24 inches of loam (topsoil) to allow revegetation. The seams in the membrane require careful installation and sealing. Flexibility of the membrane makes this technology relatively less susceptible to cracking from influences such as settlement and frost heave; however, the self-repairing capability of clay is lost. There is limited long-term experience with synthetic membranes.

- **Loam Over Sand Over Synthetic Membrane Over Clay.** This technology involves clearing and grubbing, grading, and covering site soils with a 12-inch-thick sand layer (the gas-venting layer) overlain by compacted clay (its thickness depends on the slope of the cap) and an impermeable synthetic membrane. The compacted clay and synthetic membrane act as barriers to the infiltration of water. Overlying this sequence of materials is 24 inches of loam (topsoil) to allow revegetation. This sequence of materials meets RCRA requirements for final covers and exceeds 6 NYCRR Part 360 requirements for a composite final cover. This technology takes advantage of the self-repairing properties of clay, along with the impermeable nature of a synthetic membrane. The seams in the membrane require careful installation and sealing.

Capping will be retained as an applicable technology.

2.4.1.2 Excavation

Excavation, removal, and hauling of contaminated soils, fill material, and sediments in identified "hot spots" are generally accomplished with conventional heavy construction equipment (e.g., backhoes, bulldozers, and dump trucks). Excavation of contaminated waste materials is typically followed by land disposal and/or treatment.

Factors to be considered when evaluating the usefulness of this technology include an assessment of the mobility of the wastes and the cost of disposing or treating the waste once it has been excavated. It is often possible to excavate and remove contaminant "hot spots" to eliminate a contaminant source, thus reducing exposure risk, and use other remedial measures for less-contaminated soils. Excavation will be kept as an applicable technology.

2.4.1.3 On- and Off-Site Disposal

Land disposal of contaminated wastes has historically been a popular remedial action because it often represented the quickest, most direct approach to remediating a site. Presently, the trend is toward using treatment technologies to remediate a site. This trend is generally attributable to:

- Section 121 of the Superfund Amendments and Reauthorization Act (SARA) of 1986, which requires that preference be given to remedial actions that "... permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances." SARA further states "... that off-site transport and disposal without such treatment should be the least-favored alternative remedial action where practical treatment technologies are available."
- In 1984, Congress passed the Hazardous and Solid Waste Amendment (HSWA), which mandated stringent new land-disposal restrictions known as the RCRA Land-Disposal Restrictions (LDRs).

NYSDEC concurs with SARA in the belief that it is important to implement permanent remedies, including treatment prior to disposal, wherever practicable (NYSDEC 1989a).

The two disposal options, on-site disposal in a constructed landfill or off-site disposal in a commercial facility, are discussed below.

On-Site Disposal

The construction of a secure landfill that meets RCRA and state requirements is required for on-site disposal of material from areas with high contaminant concentrations that are classified as hazardous under RCRA and New York's hazardous waste regulations and was generated by excavation of contaminated soil and fill material or by an on-site treatment or pretreatment process. Several criteria are associated with the construction of a RCRA hazardous-waste landfill, including the following:

- The landfill should be designed so that the local groundwater table will not be in contact with it;
- The landfill should be constructed of, or lined with, natural or synthetic material of low permeability to inhibit leachate migration;
- An impermeable cover should be employed to minimize infiltration and leachate production; and
- Periodic monitoring of surface water, groundwater, and soils adjacent to the facility must be conducted to confirm the integrity of the liner and leachate collection system.

At the Dearcop Farm site, where PCBs are present and chromium was found above threshold concentrations in the TCLP extract in one on-site sample, administrative approval may be difficult because of LDRs. Also, landfilling of unaltered waste does not conform with the intent of SARA. However, some nonhazardous soils may be disposed of on site to consolidate contaminated media. On-site disposal will therefore be kept as an applicable technology.

Off-Site Disposal

Off-site disposal of contaminated waste material from areas with high contaminant concentrations involves hauling excavated material to a commercial disposal facility. The type of facility chosen (either a nonhazardous/solid waste or a secure facility) would depend upon whether the material is classified as hazardous under RCRA and/or New York's hazardous waste regulations. Those materials from the identified areas of high contaminant concentrations that are not hazardous can be disposed of in a nonhazardous/solid waste facility. Hazardous wastes may only go to a RCRA-permitted facility. Prior to land disposal, most hazardous wastes must meet specific treatment standards codified in the federal regulation 40 CFR 268. Off-site disposal will be kept as an applicable technology.

2.4.1.4 On- and Off-Site Treatment

On- and off-site treatment of waste material includes techniques falling into the following three major categories:

- Thermal treatment;
- Physical/chemical treatment; and
- Biological treatment.

A discussion of each technology follows.

Thermal Treatment

Thermal treatment employs high temperatures to render hazardous wastes into less-hazardous or nonhazardous components. When subject to high temperatures, organic wastes decompose to less-toxic forms. Complete combustion yields carbon dioxide, water, and other combustion products such as sulfur dioxide, nitrogen oxides, and other gases. Some thermal treatment processes produce off-gases and ash that require further treatment or disposal in a secure landfill.

Rotary kiln incineration is the most commonly used thermal treatment method for solid hazardous wastes, but thermal treatment also includes other types of incineration (e.g., infrared, fluidized bed, or circulating fluidized bed, as well as pyrolytic processes and plasma processes).

Thermal destruction is a proven technology that can effectively and rapidly treat all organic compounds, though at high capital and energy costs. It consistently achieves the best overall results for organic contaminants, usually accomplishing well over 99% destruction. However, thermal treatment is an ineffective remedial technique for metals. Volatile metal compounds (e.g., arsenic) may present particulate emission problems. These metal particulates are difficult to remove using conventional air-pollution-control equipment because of the small size of metal-containing particulates. Nonvolatile metals (e.g., chromium) tend to remain concentrated in the solid residues (e.g., incinerator ash). Depending upon the metal concentration in the incinerator ash, the ash may require disposal in a secure facility or further treatment. At the Dearcop Farm site, the contaminants of concern include both organics and metals. For this reason, thermal treatment would not be a feasible remedial alternative at the Dearcop Farm site and is therefore not kept as an applicable technology.

Physical/Chemical Treatment

Physical/chemical treatment processes involve physical or chemical manipulation of the soils and fill material to immobilize or remove the contaminants. Types of physical/chemical treatment technologies include *in-situ* treatments, solidification/ stabilization, solvent extraction, and soil washing.

In Situ Physical Treatment Methods

A number of methods are currently being developed involving physical manipulation of the subsurface to immobilize or remove waste constituents. Types of *in situ* physical treatment methods include vitrification, soil flushing, and vacuum extraction.

Vitrification. *In situ* vitrification (ISV) is a technology that was initially developed to stabilize transuranic-contaminated wastes, and it has been found to be applicable to other hazardous waste. The technology is based upon electric meter technology, and the principle of operation is joule heating, which occurs when an electrical current is passed through a molten mass. Contaminated soil is converted into durable glass, and wastes are pyrolyzed or crystallized.

Glassification of wastes requires heating the waste to 1,500°C or higher, until the solids are molten, then cooling the molten mass to form a stable, glassy end product. The end product is extremely stable. It is projected that materials so treated will remain totally isolated for more than 10,000 years. In the process, voltage is applied across electrodes placed in the ground. Under the high voltage, the soil volume between the electrode is heated to temperatures in excess of 3,000°F, thereby melting the soils. An adequate electrical power supply would be required. The full-scale four-electrode system needed requires 3,750 kilowatts, which is not currently available from local utility companies. Upon cooling, the soils are converted to a glass and crystalline product. Operating costs would be relatively high compared to other technologies. ISV has potential to treat organic and inorganic contaminants alike. (Organic contaminants are actually destroyed by pyrolysis at these high temperatures.) A dewatering process is necessary so that soil and fill material can begin to melt.

The process is more applicable to depths greater than 7 feet, requiring staging of contaminated soils and fill material into a deeper configuration, excavation, and handling of contaminated soils. A 1- to 2-foot-thick layer of clean fill would be required over the process area to minimize the volatilization of contaminants at the surface during the process. In addition, the ISV process has the potential to cause contaminants to migrate to the treatment boundaries rather than the surface; this is known as "side migration." The initial soil and fill material boundaries must be extended to account for this effect. Furthermore, a treatability study would be required to determine the effectiveness of ISV for treatment of the soils and fill material at the site. Because of implementability obstacles, *in-situ* vitrification will not be considered as an applicable technology for the Dearcop Farm site.

Soil Flushing. Organic and inorganic contaminants can be washed from contaminated soils by means of an extraction process termed *in situ* soil flushing. An aqueous solution is injected into the area of contamination, and the contaminant elutriate is pumped to the surface for removal, recirculation, or on-site treatment and reinjection. During elutriation, sorbed contaminants are mobilized into solution because of solubility, formation of an emulsion, or chemical reaction with the flushing solution. An *in situ* soil-flushing system includes extraction wells installed in the area of contamination, injection wells installed upgradient of the contaminated soils area, and a wastewater treatment system.

This technology will not be retained as an applicable technology because the majority of the contaminants present, including PCBs, PAHs, and most metals, adsorb strongly to soil particles and would be difficult, if not impossible, to make soluble. In addition, it would be difficult, if not impossible, to select a flushing solution that would capture both the organic and inorganic contaminants because of their different chemistries.

Soil Vapor Extraction. Soil Vapor Extraction (SVE), also referred to as Vacuum Extraction, is an *in situ* technique used to remove volatile and semivolatile organics from the vadose (or unsaturated) zone of soils. The basic components of the system include production wells, monitoring wells, and high vacuum pumps. The system operates by applying a vacuum through the production wells. The vacuum system includes air flow through the soils, stripping, and volatilizing the organics from the soil matrix into the air stream. The contaminated air stream is then typically treated by using an activated carbon bed.

SVE is an appropriate treatment technique for VOC contamination. However, SVE is not applicable for the majority of site contaminants, such as PCBs, PAHs, and metals, because of their low volatility and strong adsorption to soil particles. This technology will be retained for further evaluation as a contaminant reduction method in areas of highest soil contamination with VOCs.

Solidification/Stabilization

Solidification/stabilization treatment systems, sometimes referred to as fixation systems, attempt to accomplish: improved handling and physical characteristics of the waste, reduction of surface area across which transfer or loss of contaminants can occur, and/or reduction in the solubility of hazardous constituents in the wastes. Solidification involves techniques that seal the wastes into a relatively impermeable stable block. Stabilization involves techniques that would either neutralize or detoxify the wastes, so that the contaminants are maintained in the least soluble or toxic form.

Solidification/stabilization methods used for chemical soil consolidation can immobilize contaminants. Most of the techniques involve a thorough mixing of the solidifying agent and the waste. Solidification of wastes produces a monolithic block with high structural integrity. The contaminants do not necessarily interact chemically with the solidification reagents but are mechanically locked within the solidified matrix. Stabilization methods usually involve the addition of materials that limit the solubility or mobility of waste constituents even though the physical handling characteristics of the waste may not be improved. Remedial actions involving combinations of solidification and stabilization techniques are often used.

Solidification processes available as remedial action technologies for contaminated soils include:

- Cement-based processes;
- Pozzolanic processes;
- Thermoplastic techniques;

- Organic polymer techniques;
- Surface encapsulation techniques;
- Self-cement techniques; and
- Glassification techniques.

Solidification is considered by EPA to be appropriate for large volumes of waste material containing toxic heavy metals. It has not been a preferred technology for treatment of organic-contaminated soil. Certain proprietary processes attempt to address organics in the matrix. For example, the ARCHON™ technology developed by Itex Environmental Services, Inc., volatilizes and removes VOCs during treatment through a negative air recovery and activated carbon filter system. The ARCHON™ technology is not, however, capable of removing PCBs. Solidification will be retained as an applicable treatment technology for metals.

Solvent Extraction

Solvent extraction uses a treatment tank in which soil is homogeneously mixed, flooded with a solvent, and again mixed thoroughly to allow the waste to come in contact with the solution. Once mixing is complete, the solvent is drawn off by gravity, vacuum filtration, or some other conventional dewatering process. The solids are then rinsed with a neutralizing agent (if needed), dried, and placed back on site or otherwise treated/disposed. Solvents and rinse waters are processed through an on-site treatment system and recycled for further use. The removal, handling, and treatment add to the potential exposure pathways both from wastes existing at the site and from treatment process operations. Because of the wide variety of contaminants present at the site, it would be difficult, if not impossible, to identify a solvent to remove most of the chemicals. Thus, solvent extraction will not be retained for further evaluation.

Soil Washing

Soil washing is a volume reduction technology that segregates the fine solid fractions from the coarser soils through an aqueous washing process and washing water treatment system. This technology is based on the observation that the vast majority of contaminants are found adsorbed to the fine soils due to their greater specific surface area. The coarser, clean soils could be backfilled on site while the fine fraction would require further treatment/disposal. The total volume of hot spots at the Dearcop Farm site is not large compared to many sites. Thus, a volume reduction step would not be beneficial to the remediation. Furthermore, the fine soils must be treated further. Because the soils would be exclusively fine, subsequent treatment steps (other than incineration and solidification) would be difficult because as most physical, chemical, and biological technologies work best on coarser soils. Thus, soil washing will not be retained as an applicable remedial technology.

Biological Treatment

Biological treatment processes use indigenous or selectively cultured microorganisms to mineralize hazardous organic compounds into water, carbon dioxide, and (if chlorinated) hydrogen chloride. Biological treatment processes are sensitive to temperature, pH, oxygen concentration, moisture content, availability of nutrients, and concentrations of inhibiting substances (e.g., metals). However, this technology is not well demonstrated for chlorinated aliphatic hydrocarbons or for diverse wastes found in landfills. Therefore, it will not be kept as an applicable technology.

2.4.1.5 Institutional Controls

Institutional controls are minimal actions taken to reduce the potential for exposure to the waste material and contaminated soil and may include site fencing or deed restrictions. Institutional controls will be retained as an applicable remedial technology.

2.4.2 Groundwater Remedial Technologies

Groundwater remedial technologies can be applied to contain, collect, divert, remove, or treat the groundwater in the area of the Dearcop Farm site in an effort to prevent further migration of contaminants from the site and to manage the migration that has already occurred. The screening process is summarized in Table 2-9. The retained technologies are present in Table 2-10.

2.4.2.1 Containment

Subsurface barriers are used to both vertically and horizontally contain groundwater. Barriers can also be used to divert groundwater flow away from a site so that it does not contact waste materials and become contaminated or to contain or restrict movement of contaminated groundwater. Typical subsurface barriers include slurry walls, grouting, and sheet piling. These technologies are often used in conjunction with capping (see Section 2.4.1.1). They are described below:

- **Slurry Walls.** Slurry walls are low-permeability barriers constructed through the subsurface soils to create a barrier to the flow of groundwater. This barrier can be used both to redirect the groundwater flow upgradient of the site and to contain groundwater leaving the site on the downgradient side. Slurry walls are commonly constructed using either a soil-bentonite or cement-bentonite slurry.

- **Grouting**. Grouting is a process whereby one of a variety of fluids is injected into a rock or soil mass. Once injected, it sets in place to reduce water flow and strengthen the formation. Because of costs, grouted barriers are seldom used for containing groundwater flow in unconsolidated materials around hazardous waste sites. Grouting is best suited for sealing voids in rocks. Cement, clays, bentonite, alkali silicates, silicates, and some organic polymers have been used as grouts.

- **Sheet Piling**. In addition to slurry-wall and grouted cutoffs, sheet piling can be used to form a groundwater barrier. Sheet piles can be made of wood, precast concrete, or steel. Steel sheet piling, compared to other materials that can be used for sheet piles, is most effective in terms of groundwater cutoff and cost.

Groundwater contamination is found in both overburden and bedrock wells at the Dearcop Farm site. The bedrock and overburden are actually hydraulically connected and are considered a single aquifer. It is not practical to install containment walls into bedrock. It is extremely difficult, if not impossible, to excavate a subsurface trench in the bedrock. A slurry wall extending only to bedrock would not be effective in containing contaminated groundwater. Therefore, subsurface barriers will not be retained as a viable technology.

2.4.2.2 Extraction

Groundwater extraction systems are used to control, contain, or remove groundwater contaminant plumes. Groundwater extraction can be achieved by using pumping wells or subsurface drains. They are described below:

- **Groundwater Pumping** methods involve the active manipulation and management of groundwater through the use of well systems. The selection of an appropriate well system depends upon a number of factors, including the depth of contamination and the hydrologic and geologic characteristics of the aquifer.

- **Subsurface Drains** include any type of buried conduit used to convey and collect contaminated groundwater by gravity flow. Subsurface drains function essentially like a line of extraction wells and therefore can perform many of the same functions as wells.

Both extraction technologies will be retained as viable remedial technologies.

2.4.2.3 On-Site and Off-Site Treatment

Potential groundwater treatment can be accomplished either on site or off site using one of the following four general approaches:

- On-site treatment using mobile treatment systems;

- On-site construction and operation of treatment systems;

- Pretreatment followed by discharge to a publicly owned treatment works (POTW) facility; and

- Transportation of waste to an off-site treatment facility.

Treatment processes that may be incorporated into any of these approaches include the following.

Biological Treatment

All biological treatment systems are designed to expose wastewater containing biologically degradable organic compounds to a suitable mixture of microorganisms in a controlled environment that contains sufficient essential nutrients for the biological reaction to proceed. Under these conditions, the contaminants may be biologically oxidized. Biological treatment is based on the ability of microorganisms to use organic carbon as a food source or to otherwise break down or transform the contaminants through the catalyzing action of their enzymes. The treatment is classified as either aerobic, anaerobic, or facultative. Aerobic treatment requires the availability of free dissolved oxygen for the biooxidation of the waste. Anaerobic treatment is intolerant of free dissolved oxygen and uses "chemically bound" oxygen (such as sulfates) and energy inherently present in the organic substances in breaking down the organic material. Facultative organisms can function under aerobic or anoxic conditions as the oxygen availability dictates.

Biological treatment processes are widely used and, if properly designed and operated, are capable of achieving high efficiency at removing organic substances. Such systems are given sufficient reaction time so that they can reduce the concentration of any degradable organic material to a very low concentration. Typical biological treatment systems include activated sludge, sequencing batch reactors, aerobic or anaerobic fluidized bed systems, rotating biological contractor (RBC) systems, fixed-film bioreactors, and aerated lagoons.

A great deal of research and development has focused on using methanotrophic bacteria that require the addition of oxygen and methane to break down chlorinated organics, such as trichloroethene. While this technology is still under development, a principal impediment to using this technique for treatment of chlorinated organics is the fact that contaminant removal by stripping occurs at levels comparable to rates of biodegradation, indicating that direct air-stripping would be more effective in treating extracted groundwater. Other work has focused on the use of cosubstrates other than methane (e.g., phenol), although this work is still in the developmental stage. The majority of the organic contaminants in the groundwater at the Dearcop Farm site are chlorinated organics. Because of the limited effectiveness of biological treatment of these compounds, and the presence of more viable alternative technologies, as discussed below, biological treatment will not be retained as an applicable remedial technology.

Physical/Chemical Treatment

Physical and chemical treatment processes potentially applicable for remediation of the contaminated groundwater at the Dearcop Farm site include the following:

- **Carbon Adsorption** is used to remove dissolved organic compounds from groundwater. The process has been demonstrated as an effective and reliable means of removing low-solubility organic substances over a broad concentration range. Carbon adsorption can be designed for either column or batch applications, but groundwater treatment is typically performed using columns. In column applications, adsorption involves the passage of contaminated water through a bed of activated carbon that adsorbs the contaminants into the carbon. When the activated carbon has been used to its maximum adsorptive capacity (i.e., spent), it is then removed for disposal, destruction, or regeneration.

- **Air Stripping** is a mass-transfer process in which volatile organic contaminants are transferred to the air stream by pumping the contaminated groundwater through a packed air-stripping tower. The organic-laden air stream from the tower is then typically treated using carbon adsorption. Air stripping, using packed towers, is a well-established, effective remedial technology for the removal of VOCs from groundwater.

- **UV/Ozonation** uses a combination of UV and ozone to chemically oxidize organic compounds present in water. Complex organic molecules are broken down into a series of less-complex molecules. The end products are water, carbon dioxide, and hydrogen chloride. As part of the EPA's Superfund Innovative Technology Evaluation (SITE) program, UV/ozonation was demonstrated as an effective method for treatment of groundwater containing chlorinated organic compounds (EPA 1990).

- **Filtration** is a physical process that removes suspended solids (and any associated contaminants) from solution by forcing the fluid through a filtering medium. The filtering medium may be a fibrous fabric (paper or cloth), a screen, or a bed of granular material. Fluid flow through the filtering medium may be accomplished by gravity, by inducing a partial vacuum on one side of the medium, or by exerting a mechanical pressure on a dewatered sludge enclosed by a filtering media. Filtration may be employed to remove undissolved metals present as suspended solids. Filtration could also be used as a pretreatment for air stripping, carbon adsorption, or ion exchange to reduce the potential for clogging or overloading of these processes.

- **Ion Exchange** is a process by which toxic ions are removed from the waste stream and replaced with relatively harmless ions held by ion exchange material. An interchange of ions between an aqueous solution and a solid material occurs. After the solution is removed, the exchanger is exposed to a second aqueous solution of different composition that removes the ions picked up by the exchanger. This technology is primarily applicable to inorganic contaminants.

- **Reverse osmosis (RO)** uses a semipermeable barrier that is permeable to water but impermeable to most dissolved contaminants, organic and inorganic. Pretreatment of the contaminated water is usually required to prevent plugging. The technical feasibility of using this system for remedial action at contaminated sites is unproven.

These physical/chemical technologies, with the exception of reverse osmosis, will be retained as viable remedial technologies.

2.4.2.4 *In Situ* Treatment

In situ treatment entails the use of physical, chemical, or biological methods to degrade or remove groundwater contaminants.

The most frequently used *in situ* technology for groundwater remediation is bioremediation. *In situ* bioremediation is a technique for treating zones of groundwater contamination by microbial degradation. The basic concept involves altering environmental conditions to enhance microbial metabolism of organic contaminants, resulting in the breakdown and detoxification of contaminants.

Although bioremedial techniques have been widely employed to treat groundwater contaminated with nonhalogenated chemicals such as benzene, toluene, and xylene, it has generally only been applied to remediation of groundwater containing chlorinated aliphatic hydrocarbons (e.g., trichloroethene) on a pilot or developmental scale (see Section 2.4.2.3). Because its effectiveness on chlorinated VOCs is not well demonstrated, *in situ* bioremediation will not be retained for further evaluation.

Another *in situ* treatment, air sparging, combines vapor extraction and air injection, using horizontal wells. This technology employs sparging (pumping air into) a contaminated aquifer and collecting the purged contaminants through a second well located in the vadose zone. *In situ* air sparging allows for concurrent remediation of both the groundwater and the overlying soils. Although this technology is relatively new to the United States, it appears to be effective on chlorinated volatile organics. Although it is not effective on metals, *in situ* air sparging will be retained as a viable remedial technology.

2.4.2.5 Disposal

Three technologies were identified for groundwater disposal: transport to a POTW or RCRA-permitted treatment, storage, and disposal (TSD) facility for final disposal, reinjection to groundwater, and surface water discharge:

- **POTW or TSD Facility.** Contaminated groundwater from the site may be pretreated on site (if necessary) and then transported to a POTW or TSD facility for final disposal.

- **Reinjection to Groundwater.** Treated groundwater may be reinjected into the aquifer from which it was withdrawn. This approach can be used to help direct the flow of contaminated groundwater toward the extraction wells or recovery trenches.

- **Surface Water Discharge.** Treated groundwater may be discharged to a nearby surface water body. A State Pollution Discharge Elimination System (SPDES) permit would be required for the discharge.

These disposal technologies will be retained as viable remedial technologies.

2.4.2.6 Institutional Controls

Institutional controls are those measures taken to protect human health until contaminants in the groundwater have met remedial cleanup objectives. Institutional controls can include deed restrictions, regulatory restrictions on the construction and use of private water wells, and well use advisories. Institutional controls will be retained as an applicable remedial technology.

2.5 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

In this section, retained technologies are assembled into comprehensive medium-specific alternatives. Both the soil/fill materials and sediment media are addressed together.

The groundwater medium is addressed separately. Consistent with the NCP (40 CFR 300.430), the following range of alternatives was developed:

- The no-action alternative;
- Alternatives that remove or destroy the contaminants of concern to the maximum extent possible, thereby eliminating or minimizing the need for long-term management;
- Alternatives that treat the principal contamination but vary in the degree of treatment employed and long-term management needed; and
- Alternatives that involve little or no treatment but provide protection of human health and the environment by preventing or minimizing exposure to contaminants through the use of containment options and/or institutional actions.

After alternatives are assembled, they are screened for selection of those alternatives to be evaluated in the detailed analysis to be presented in the Phase III FS. The alternative screening criteria are:

- **Effectiveness.** This criterion addresses the potential effectiveness of the technologies in meeting the remediation objectives identified in the remedial action objectives. Furthermore, it considers how proven and reliable the process is in remediating the contaminants of concern in landfill material and groundwater.
- **Implementability.** This criterion encompasses both the technical and administrative feasibility of implementing a remedial technology, as well as the potential impacts to human health and the environment during the construction and implementation phase.

These criteria were used to eliminate those remedial alternatives that are unproven, not applicable, or not expected to achieve an acceptable level of performance.

2.5.1 Soil/Fill Material and Sediment Media Remedial Alternatives

Seven alternatives for remediation of soil/fill material and sediments were developed and screened in this section:

- Alternative 1: No Action;
- Alternative 2: Institutional Controls;
- Alternative 3: Consolidation and Capping;
- Alternative 4: Capping and Vacuum Extraction;
- Alternative 5: Excavation and Off-Site Disposal;
- Alternative 6: Excavation, Solidification, and Off-Site Disposal; and
- Alternative 7: Excavation, Solidification, and On-Site Disposal.

2.5.1.1 Alternative 1: No Action

Alternative Definition/Description

The no-action alternative is presented as a baseline for comparison to the other alternatives. As the name indicates, this alternative involves no remedial action and thus would leave the contaminated soil/fill material and sediments in their present state. The no-action alternative may include some type of environmental monitoring to document site conditions. Development of the no-action alternative is a requirement of the National Oil and Hazardous Substances Contingency Plan (NCP).

Effectiveness Evaluation

The no-action alternative is ineffective and does nothing to meet the remedial action objectives for the soil/fill materials or sediment. The types of contaminants and their detected concentrations in these media indicate that risks to human health could occur through direct contact, incidental ingestion, or inhalation of contaminated debris particles or vapors. The remedial action objectives would not be met through implementation of the no-action alternative. The contaminated soil/fill material and sediment would also continue to be subjected to surface water runoff and infiltration, as well as vertical seepage, which could cause surface water contamination and further contamination of the groundwater.

Implementability Evaluation

Implementation of this alternative would be unacceptable in terms of public health concerns and environmental impact. Contaminants associated with the contaminated media likely pose unacceptable direct-contact risks to human health. Degradation of the groundwater in the bedrock aquifer has been documented (i.e., contaminant concentrations above NYSDEC Class GA standards for groundwater) and attributed to the Dearcop Farm site. Because the ARARs would continue to be exceeded, it may be difficult to implement this alternative.

2.5.1.2 Alternative 2: Institutional Controls

Alternative Definition/Description

Institutional controls include local regulatory restrictions on the construction and land use of the site.

Recommendations regarding the type or extent of such restrictions would be made to appropriate agencies or boards (i.e., local planning or zoning boards) as the final project plans develop.

Effectiveness Evaluation

This alternative would be no more effective in reducing soil/fill and sediment contamination than the no-action alternative. However, this alternative would minimize the potential for exposure to the contaminated media.

Implementability Evaluation

Technically, there is no reason not to implement this alternative. The use of institutional controls alone, however, would not be preferred because of the proximity of residences. Institutional controls would most likely be implemented in addition to other remedial measures. Because the ARARs would continue to be exceeded, it may be difficult to implement this alteration.

2.5.1.3 Alternative 3: Consolidation and Capping

Alternative Definition/Description

Alternative 3 involves covering the area where contaminated soil/fill material has been detected with a multilayer cap. The area to be capped would be in the entire shaded area shown in Figure 2-4, approximately 281,150 square feet (218,750 ft^2 south of the highway and 62,400 ft^2 in the median), plus approximately 10% additional area around the edge to ensure full coverage and to minimize access to the contaminated area. This area will cover all those parts of the site where soil/fill contaminants were found (during the RI) in subsurface samples. Selection of the area to be capped also considers the extent of contamination suggested by the soil gas results. The cap would be placed in the fenced area on site and in the highway median. Although the RI suggests contamination is under I-490, it is impractical to tear up the highway and cap the area. Because the highway itself covers the contamination, the health risks are, for the most part, eliminated in that area.

Six monitoring wells are located in the area that would be capped. These would have to be removed and properly abandoned prior to cap installation.

In addition to the area shown on Figure 2-4, there are several locations throughout the study area that also exceed cleanup objectives. These areas consist mainly of soil contaminated with lead and cadmium present in several residential backyards. Because only isolated detections of these contaminants were found in nonsystematic patterns, it is not possible to estimate the volume of soils these areas comprise. For this alternative, these isolated areas of cleanup objective exceedances would be excavated and disposed of at the area to be capped. This would consolidate the material in one place prior to containment.

Portions of the drainage ditch also would not fall under the cap. Contaminated sediments that otherwise would not be covered by the cap would, like the residential soils, be excavated and consolidated in the area to be capped. The existing drainage defined by this ditch would have to be culverted beneath the cap or directed around it.

Contaminated soil/fill material would be temporarily stored in a designated staging area. This staging area would be constructed using an impermeable liner, surface water controls, a leachate collection system, and a cover.

A decontamination pad would be constructed. This pad would be sloped to allow drainage to sump at one end. Liquids generated during decontamination would drain toward the sump. All fluids used in the decontamination procedure would be captured and properly treated and/or disposed of.

Excavation of contaminated soil/fill material would be conducted using conventional earth-moving equipment such as backhoes, bulldozers, and dump trucks. During excavation activities, dust generation would have to be controlled to acceptable levels. The specific means and methods of excavation and dust control would be determined during the remedial design.

During excavation of soils/fill material, controls may be necessary to manage groundwater levels. Actual dewatering controls/methods would be determined based on field conditions but could include pumping or groundwater diversion techniques. The effluent from the dewatering process would be transported off site for treatment/disposal.

During removal of soil/fill material from the contaminated areas, soil verification sampling would be required to ensure achievement of cleanup objectives. Soil verification sampling in these areas would consist of collecting soil samples from the bottom and edges of excavation areas for laboratory analysis. Actual sampling procedures and protocols would be outlined as part of the remedial design process, in a quality assurance plan. When verification sampling results indicate that the soil/fill material remaining at the bottom and edges of the excavation meets cleanup objectives, the excavation for that area would be considered complete. If the results are not acceptable, then additional soil/fill material would be excavated. The excavation would then be resampled and this cycle repeated until sampling and analytical testing indicate that the contaminated soil has been removed. All excavated cells would then be backfilled with clean fill, regraded and reseeded. In addition, removed shrubs, trees, fences, recreational structures, etc., would be replaced.

Guidance for cap design is found in New York State requirements for hazardous waste landfill covers (6 NYCRR Part 373-2.14[g]) and for solid waste landfill covers (6 NYCRR Part 360-2.13). The hazardous waste guidelines provide performance specifications for a landfill cap, including:

- Provide long-term minimization of migration of liquids through the closed landfill;

- Function with minimal maintenance;
- Promote drainage and minimize erosion or abrasion of the cover; and
- Have a permeability less than or equal to the permeability of any bottom liner or natural subsoils present.

Specific details for construction of a cap or final cover system are provided in the solid waste landfill guidelines.

The solid waste regulations call for a landfill cover consisting of a gas-venting layer meeting the requirements of subdivision 360-2.13(p), a low-permeability barrier layer, a barrier protection layer meeting the requirements of either subdivision 360-2.13(q) or subdivision 360-2.13(r), and a topsoil layer meeting the requirements of subdivision 360-2.13(t). For the Dearcop Farm site, a gas-venting layer would be needed because of the type of wastes disposed. Gas is generally generated in landfills by the anaerobic degradation of disposed contents. In addition, natural gas can potentially migrate upwards.

Cap installation at the Dearcop Farm site would thus consist of the following steps:

- The area to be capped would be cleared and grubbed. A minimal amount of grading would be required. The area requiring capping is estimated at approximately.
- Existing drainage ditches in the fenced area would be replaced with culvert pipes to allow road drainage to flow under the cap, discharging to a drainage ditch downgradient of the cap. A 12-inch-thick sand layer would be installed to act as a venting layer.
- Installation of an 18-inch-thick clay barrier or impermeable synthetic membrane.
- A 24-inch-thick topsoil or vegetative/protective layer, suitable to maintain vegetative growth to protect and stabilize the cap, would be installed.
- Surface drainage of the cap must be modified as necessary to allow surface water runoff to enter a drainage downgradient of the cap.

Such a cap would effectively reduce the rate of future leachate formation. Typically, this type of cap produces a reduction in infiltration of greater than 95%. Use of the site would be highly restricted by the use of institutional controls such as fencing and/or local regulatory restrictions on the construction and land use of the site.

Effectiveness Evaluation

A properly installed and maintained multilayer cap would prevent exposure to contaminated soil/fill material via dermal adsorption, ingestion, or inhalation because the contaminated material would be physically isolated. This would meet the remedial action objectives for protection of human health. However, the soil ARAR for PCBs would not be met because PCBs would remain in the soil/fill material. While the short-term risks to human health (posed by exposure to contaminated soils) are eliminated once the cap is in place, the potential still exists for long-term risks because the source of site contamination is still in place beneath the cap.

Grading of the site and surrounding areas would minimize lateral seepage by diverting surface water runoff downgradient of the site. Drainage control measures would be required to prevent ponding and erosion of the cap. Slope stability would also be taken into account.

The multilayer cap would need to be periodically inspected for cracks, settlement, ponding of liquids, or other signs of deterioration. Proper and timely maintenance of any defects would be required to preserve the integrity of the cap. In addition, periodic mowing would be required to ensure only grass grows on the vegetative layer. Growth of trees on this layer would compromise the integrity of the cap.

During construction of the cap and the peripheral grading, there could be increased health risks from dermal contact and inhalation of airborne contaminants. Protective clothing and equipment for on-site workers and appropriate dust-control measures (e.g., water or foam) would effectively minimize the potential short-term health risks associated with implementation of this alternative. Additionally, during remedial activities, air quality monitoring would be conducted on site to ensure worker safety and off site at the location of potential receptors to ensure the safety of the public.

Implementability Evaluation

The technology needed for capping the site is reliable and well-established. Several contractors are available to construct the cap and provide the necessary heavy equipment and skilled workers for its installation. Long-term monitoring and maintenance and institutional controls would be required to ensure that the integrity is maintained. In addition, a storm water management and erosion control plan should be considered to mitigate erosion.

2.5.1.4 Alternative 4: Consolidation, Capping, and Vacuum Extraction

Alternative Definition/Description

This alternative is identical to Alternative 3, with the exception of the addition of vacuum extraction. Vacuum extraction would be applied to the area to be capped as indicated on Figure 2-4.

Soil vapor extraction (SVE) is a proven technology for removing VOCs from contaminated soils in the unsaturated zone. As a result, the potential for further transport of contaminants from vapor migration and dissolution in infiltrating precipitation is reduced. SVE operates by applying a vacuum (negative pressure) through production wells. This induces air flow through the soils, stripping and volatilizing the organics from the soil into the air stream. This contaminated air stream is then treated. The ability to achieve adequate vapor flow through the contaminated soil is critical to the application of SVE technology. Because of the presence of a cap, ventilation wells may have to be installed to introduce air into the soil/fill material. A monitoring system is necessary to evaluate the progress of the treatment and determine site conditions following treatment.

Because of the relatively large area of the site (greater than nine acres) and the relatively shallow overburden, horizontal vapor extraction wells (as opposed to vertical wells) would be appropriate. Assuming that the vapor extraction wells had a radius of influence of 20 feet, approximately 6,000 feet of wells would be required south of the highway, and an additional 1,700 feet in the highway median to treat all areas where contaminants in the soil gas exceeded 10 $\mu g/m^3$. A possible arrangement of these wells is shown on Figure 2-9.

The horizontal wells would be installed by excavating trenches approximately 10 feet deep. The well piping would be placed in the trench and surrounded by a bed of sand to promote air circulation and prevent fouling or clogging of the well screen. Excavated material would be backfilled to the trenches.

Because the wells would be installed in the most heavily contaminated areas of the site, trench excavation may unearth areas of gross contamination. For example, buried drums have been observed in test pits at this site. It is possible that areas of nonaqueous phase liquid contamination would be encountered. Such grossly contaminated material would not be backfilled, but would rather be treated and/or disposed of off site. If it is RCRA hazardous material, RCRA land disposal restriction treatment standards must be met prior to final disposal. The determination of which soil would be disposed of off site would be determined in the field during trench excavation.

SVE would be implemented until system-monitoring data show that VOC contamination has been reduced to the point that it meets and maintains cleanup objectives or until the limits of this corrective action technology have been reached and the rate of contaminant removal reaches low levels.

SVE is often implemented without the aid of pilot studies; however, data obtained through pilot testing of the Dearcop Farm site can aid in calculating the soil permeability, radius of influence, and vapor flow rate. Soil permeability is the most important parameter to be considered in the successful application of SVE. The density and viscosity of vapors, combined with the permeability of the soil, significantly influence the ability of the vapor to flow through the soil. Permeability is also a key parameter in determining SVE design. Other parameters, such as water content and soil heterogeneity, should also be considered in determining an SVE system because they affect the flow of air through the vadose zone.

Contaminant vapors from extraction wells may have to be treated. Thermal treatment of vapors may be necessary at the Dearcop Farm site because of the potential presence of vinyl chloride.

Monitoring would be performed in conjunction with SVE treatment at the Dearcop Farm site to determine the amount and movement of pollutants in the soil before, during, and after remediation. Site monitoring would continue after cleanup. Adsorbed contaminants or contaminants in low-permeability zones can persist in the subsurface but may not be detected during remediation. These contaminants tend to disperse after shutdown, increasing measured contamination levels in soil gas or groundwater upon cessation of SVE treatment. Additionally, soil gas flow patterns created by extraction wells can dilute samples. After pumping stops, normal flow patterns return and concentration levels may increase.

Effectiveness Evaluation

The effectiveness of this alternative is similar to Alternative 3. However, greater protection of human health and the environment would be achieved through partial removal and destruction of site contaminants. This technology may reduce volatile contaminant concentrations to below cleanup objectives. Nonvolatile contaminants, however, would continue to be present above cleanup objectives, although they would be contained by the cap.

Implementability Evaluation

This alternative is readily implementable. SVE systems are relatively easy to install, and their use of standard, readily available equipment enables rapid, cost-effective mobilization and implementation. In addition, this *in situ* technology can be implemented with only minor disturbances at the Dearcop Farm site. The basic equipment used in SVE systems includes pumps or blowers to produce the applied vacuum; piping, valves, and instrumentation to transfer air from the wells through the system and to calculate containment concentration and total airflow; vapor pretreatment to remove soil particles and water from the vapors treated; and an emission control device to concentrate or destroy vapor-phase contaminants.

2.5.1.5 Alternative 5: Excavation and Off-Site Disposal

Alternative Definition/Description

This alternative involves excavation of contaminated soil/fill material and sediment having contaminant concentrations exceeding site cleanup objectives, followed by transportation to and disposal in an off-site TSD facility capable of accepting the excavated material.

Based on interpretation of waste material and sampling data collected in conjunction with the RI, several areas of the site would require excavation. Excavation of these materials would require a site preparation program including implementation of the following tasks:

- Clearing and grubbing of the site;

- Construction of a reinforced-concrete decontamination pad for decontaminating excavation equipment; and
- Construction of a staging area for dewatering and temporary storage of excavated drums and contaminated fill.

Clearing and grubbing of the site would involve clearing designated areas of vegetation, shrubs, and trees to the existing grade. All vegetative root systems would remain in place.

A decontamination pad would be constructed on site using reinforced concrete. This pad would be gently sloped to allow drainage to a sump at one end. Liquids generated during decontamination would drain toward the sump. All fluids used in the decontamination procedure would be captured and properly treated or disposed of.

Excavated material would be temporarily stored on site in a designated staging area. The staging area would be constructed using an impermeable liner, surface water controls, a leachate collection system, and a cover.

Excavation would be conducted using conventional earth-moving equipment such as backhoes, bulldozers, scrapers, and dump trucks. During excavation activities, dust generation would have to be controlled to acceptable levels. The specific means and methods of excavation and dust control would be determined during the remedial design.

During excavation, controls will be necessary to manage groundwater infiltration into the excavation area. Actual dewatering controls/methods would be determined based on field conditions but could include pumping or groundwater diversion techniques. The effluent from the dewatering process would be transported off site for treatment/disposal. This may pose implementation concerns in that if excavating into the groundwater table is necessary, large amounts of water would require pumping and off-site treatment/disposal. In addition, transportation to a treatment/disposal facility could be costly.

Excavated material would be placed at the on-site staging area for temporary storage and dewatering prior to disposal. Actual dewatering techniques would be evaluated during the remedial design phase but could be as simple as allowing excess moisture to drain from the soil/fill material and sediment placed in the temporary staging area.

During removal of material from the contaminated areas, verification sampling would be required to ensure achievement of cleanup objectives. Verification sampling in these areas would consist of collecting samples from the excavation cells (or areas) for laboratory analysis and analyzing for the contaminants of concern. Actual sampling procedures and protocols would be outlined as part of the remedial design process, in a quality control plan. When verification sampling results indicate that the excavation cell meets cleanup objectives, the excavation for that cell would be considered complete. If it is not acceptable, then additional soil/fill material and sediment would be excavated. The cell would then be resampled and this cycle repeated until sampling and analytical testing indicate that the cell is acceptable.

When all contaminated soil/fill material and sediment have been removed and/or an excavation cell is considered acceptable, excavation would be complete. All excavated cells would be backfilled with clean soil and properly restored.

Excavated materials would be hauled to the nearest TSD facility capable of accepting the waste. The primary transport vehicle would be a 20-cubic yard, lined dump trailer with a tarpaulin cover. Only 12 cubic yards of material could be transported per trip because of weight restrictions.

In addition, compliance with all federal and state transportation regulations would be met. Compliance with any applicable RCRA treatment standards would be required prior to disposal. It may be necessary to take a small amount of soil and fill material to a TSCA-permitted facility because of PCB levels above 50 ppm in a small area of the site. It may also be necessary to take a small amount of soil/fill material to a RCRA-permitted facility because of high chromium waste found in a small area of the site.

Effectiveness Evaluation

This alternative relies on well-established technologies for removal and off-site disposal of the contaminated soil/fill material and sediment. This alternative would incorporate groundwater dewatering techniques and vapor/dust control measures. Care would be taken because there is a potential for VOC release.

All remedial action objectives for the soil/fill material and sediment would be met at the site. Through off-site disposal, the possibility of human health risks from dermal exposure, ingestion, or inhalation would be eliminated, as would the potential for further groundwater or surface water contamination from the contaminated material.

Implementability Evaluation

There are several obstacles to excavation implementation. The first is the challenge of ensuring public and worker safety from potential VOC emissions during excavation. Excavation of the sediment and soil/fill material would release VOC vapors. The open face of the excavation would be limited to reduce the amount of VOC emissions released at one time. Institutional controls needed to protect human health could impact on implementability and cost. The duration of excavation could be extended because of the amount of confirmatory sampling required while removing the drums, sediments, and the large anticipated amount of contaminated soil/fill material.

Another concern with implementation of excavation is the heterogeneity of the soil/fill material contamination. The complete extent of contamination cannot be definitively delineated from RI data. A significant number of soil samples were taken from the portion of the site considered the most contaminated (i.e., near the highway median). These samples showed that contamination varied considerably within the "source area" and with depth, as well. Because it is most economical to segregate the clean areas from the contaminated areas prior to disposal, a significant confirmation sampling effort would be required during excavation.

Depending on the type and direction of contaminant migration pathways revealed during excavation (e.g., fractures in clay or zones of coarser soils), searching for all contaminated soil/fill material and sediment may take the remedial contractor far from the assumed highly contaminated areas presented in Figure 2-4. It is likely that contaminated soil/fill material extends beneath I-490. It is impractical to remove the fill material beneath the highway. Thus, even if all 28,140 cubic yards of the presumed highly contaminated area were excavated, additional contaminated soils/fill material would remain under the roadway. However, the roadway itself acts as a cap over the area and it provides good drainage for surface waters and prevents infiltration. Excavation of the highway median may be difficult because of the proximity of the highway and the limited area in which to maneuver excavation equipment and machinery, thereby hampering implementation. Care must be taken in excavating the median not to damage the highway and to preserve highway drainage.

Once all applicable treatment standards are met, the contaminated soil/fill material and sediment can be disposed of in a TSD or a RCRA-permitted or TSCA-permitted facility, as necessary. It is expected that the vast majority of excavated soil/fill material and sediment can be disposed directly without treatment. Should treatment be required, the disposal facility may have the capacity to treat wastes. Most likely, however, the disposal facility would not have the capability of treating the soil/fill material and sediment, and those contaminated media exceeding LDR criteria would have to be first sent to an off-site treatment facility.

2.5.1.6 Alternative 6: Solidification and Off-Site Disposal

Alternative Definition/Description

The process of solidification adds certain types of chemicals to the waste to produce a new solid material. This new solid material entraps the hazardous constituents, increases the physical strength of the waste, and reduces the leachability. The added reagents may include silicates, polymers, or lime-based material. In some cases, this technology is performed in conjunction with stabilization. Stabilization also involves the addition of a chemical reagent, but in this process, the additive reacts chemically with the waste to produce a more stable, less soluble, inert form. Under this alternative, contaminated soil/fill material would be excavated as described for alternatives. The soil would be solidified either on site or at a permitted TSD facility. Solidified material would be disposed of off site. Treatment standards for RCRA characteristic hazardous wastes must be met prior to off-site disposal.

At this time, because solidification tests have not been performed on Dearcop Farm site soil/fill material and sediments, a cement-based or pozzolanic process will be considered for the feasibility evaluation. This technique has been proven effective in treating soils contaminated with heavy metals (e.g., lead) and low-level organics. Treatability testing would be necessary to determine the viability of using a solidification/stabilization process on the Dearcop Farm site. Factors to be considered include the following:

- Effectiveness of the technology to solidify or stabilize the contaminated soil/fill material and sediments at the Dearcop Farm site;
- Structural integrity, strength, and permeability of the solidified material; and
- Volume and mass change of the contaminated soil after treatment.

Effectiveness Evaluation

Solidification techniques have been applied to numerous hazardous-waste sites for the treatment of soils contaminated by metals. Most solidification techniques are not well demonstrated or preferred by the EPA for treatment of organics-contaminated soils; however, it is claimed that some proprietary processes, such as the Itex ARCHON™ technology, are able to specifically address organic contaminants, as well.

A major issue regarding solidification is its long-term performance. Studies may be conducted during treatability testing to evaluate the effects of weathering and long-term leaching potential. The long-term reliability of the solidified material would be expected to be enhanced by placement in a secure landfill because of the capping and leachate collection provisions.

Implementability Evaluation

Solidification/stabilization techniques are widely used, are provided by numerous vendors, and can either be performed on site or at an off-site commercial facility. All on-site equipment will be fully mobile; the only major pieces of equipment required are those typically used for small-scale excavation activities. Some clearing of vegetation may be necessary; however, the majority of the remediation area is easily accessible. If solidification were to occur off site, it would be necessary to locate a facility capable of solidifying the soil prior to disposal.

Chromium-contaminated soils exhibiting the hazardous characteristic of toxicity must be treated to meet the RCRA Land Disposal Treatment Standards. Therefore, to permit disposal, the treatment standards identified in 40 CFR Part 268 must be met (i.e., the concentration of chromium in the TCLP extract from the solidified material could not exceed 5 mg/L).

2.5.1.7 Alternative 7: Solidification and On-Site Disposal

Alternative Definition/Description

This alternative is similar to Alternative 6, with the exception that the solidified material would be disposed of on site. The excavation and solidification would be executed as described for Alternative 6. The solidified material would then be placed back on site. The solidified monoliths may be placed in the excavation pits, obviating the need for clean backfill. However, if excavation is extended to the water table, such pits would be partially backfilled so that the solidified material would not be continually contacted by groundwater. Because of volume expansion during solidification, the disposed monoliths would rise above grade. The monoliths would be covered with a geotextile and topsoil and then seeded.

Effectiveness Evaluation

As discussed in Alternative 6, solidification may become less effective over the long term. Because the solidified material would not be placed in a secure landfill, the monoliths would be subject to greater weathering. Contaminants that may be released by weathering would pose threats similar to those existing presently. Despite these long-term considerations, this alternative would be effective in reducing the risks currently existing at the site.

Implementability Evaluation

There are no technical obstacles to implementing this alternative. However, soils containing PCBs may not be allowed to be disposed of on site, even after solidification. Because PCBs are classified as New York State hazardous waste B007, they would have to be disposed of in a RCRA-regulated facility. PCBs are present, though not widespread, at this site. Conceivably, PCB-contaminated soil could be segregated and treated/disposed of off site. However, if PCBs are found to be more widespread remedial confirmatory sampling, this would significantly limit the implementability of this alternative.

2.5.2 Groundwater Medium Alternatives

Four alternatives for remediation of contaminated groundwater are developed and screened in this section to address the contaminated groundwater beneath and near the Dearcop Farm site:

- Alternative 1: No Action;
- Alternative 2: Institutional Controls/Natural Attenuation;
- Alternative 3: *In situ* Air Sparging; and

- Alternative 4: Extraction and Treatment by Metals Precipitation Followed by Carbon Adsorption and Disposal.

2.5.2.1 Alternative 1: No Action

Alternative Definition/Description

Under the no-action alternative, no remedial actions would be taken to contain or treat the groundwater beneath the Dearcop Farm site. However, a groundwater monitoring program would be implemented. To effectively monitor the groundwater beneath and near the site, selected existing monitoring and domestic wells would be sampled. Selected wells would be sampled on a quarterly basis and analyzed for TCL VOCs. Quarterly sampling would continue until sufficient data are gathered regarding contaminant plume migration (including seasonal fluctuations in groundwater contaminant concentrations) to permit less-frequent sampling or until it is demonstrated that the chemical concentrations within the groundwater no longer exceed MCLs or NYSDEC Class GA standards.

Effectiveness Evaluation

This alternative would not be effective in meeting the remedial action objectives established for the groundwater.

Implementability Evaluation

Implementation of this alternative would be difficult because of ARARs continuing to be exceeded. Groundwater contaminant concentrations would continue to exceed NYSDEC Class GA standards or MCLs.

2.5.2.2 Alternative 2: Institutional Controls/Natural Attenuation

Alternative Definition/Description

Institutional controls include local regulatory restrictions on the construction and use of private water wells and other land-use restrictions on and near the site. Recommendations regarding the type or extent of such restrictions would be made to appropriate agencies or boards (i.e., local planning or zoning boards) as the final project plans develop. If this groundwater alternative was coupled with a soil/fill material alternative that treated and/or isolated contaminant sources, then natural attenuation would reduce the levels of contaminants in the groundwater. Natural attenuation uses mechanisms such as natural biological degradation, dilution, diffusion, and dispersion to reduce contaminant levels, so that cleanup objectives would eventually be met.

Effectiveness Evaluation

This alternative would be no more effective in reducing groundwater contamination than the no-action alternative. However, this alternative would minimize the potential for exposure to contaminated groundwater. Implementation of institutional controls would be required until the groundwater has naturally attenuated to drinking water quality. Natural attenuation may be accelerated if this alternative is combined with a source control alternative for the soil/fill material medium.

Implementability Evaluation

Technically, there is no reason not to implement this alternative, at least as part of the final remedial alternative selected to address the groundwater. However, ARARs would still be exceeded in the short term, potentially making this alternative administratively unimplementable. ARARs would likely be achieved in the long term through natural attenuation.

2.5.2.3 Alternative 3: *In situ* Air Sparging

Alternative Definition/Description

In situ air sparging requires the installation of vertical or horizontal wells and combines vapor extraction and air injection to allow for concurrent remediation of chlorinated VOCs in both groundwater and the overlying soils. Because many water-bearing formations are deposited as relatively thin but extensive zones, the use of horizontal wells may improve the efficiency of delivery of reactants to or recovery of contaminants from these formations. Vertical wells, however, may be less expensive to install.

Effectiveness Evaluation

Through *in situ* air sparging, chlorinated VOCs in groundwater and the overlying soils will be removed; however, air sparging does not remove PCBs or metals. *In situ* air sparging is a remedial technology that has been successfully demonstrated in Europe. In 1990, demonstration projects by the United States Department of Energy (DOE) using *in situ* air sparging have shown success in the removal or reduction of chlorinated VOCs from wastewater in the United States.

System performance can be affected by the permeability of the subsurface layers. In the cases of highly permeable subsurface layers and soils mixed with fine particles and debris, some of the injected gas and accompanying volatilized contaminants may travel through the areas of high permeability and escape the system rather than flow in the intended pathways. Such short circuiting may result in uncontrolled emissions through such things as monitoring wells or low-pressure points such as residential basements. With subsurface layers of low permeability, some of the injected gas and volatilized contaminants may concentrate just below the subsurface layer. Also, some metals may be easily oxidized by *in situ* air sparging. Oxidation of metals has the potential to clog the pores in the soil and therefore reduce permeability. At the Dearcop Farm site during sampling procedures, soil and fill material were characterized as having moderate permeability to moderately high permeability because of the slag and foundry sands in the fill material. Treatability testing in an area removed from the residences would be required to determine the effectiveness of *in situ* air sparging at the Dearcop Farm site. An *in situ* air sparging system would need to be very carefully designed because of the proximity of the residences and the potential danger of inadvertently causing vapors to migrate to these receptors.

Implementability Evaluation

This technology is only effective on volatile contaminants. Metals contamination would continue to exceed ARARs. This may limit its implementability. It is, however, technically implementable.

2.5.2.4 Alternative 4: Extraction and Treatment by Metals Precipitation Followed by Carbon Adsorption and Disposal

Alternative Definition/Description

Contaminated groundwater would be removed using an extraction system under this alternative. Extraction can be accomplished using extraction wells. Pumping may be continuous or pulsed to remove contaminants after they have been allowed to desorb from the aquifer material and equilibrate with the groundwater. Pulsed pumping is a technique whereby the pumping periods are alternated to attain equilibrium within the aquifer by diffusion from stagnant zones or zones of lower permeability. Additionally, stagnant zones may also be activated by alternating pumping of wells. The operation of a well field to remove groundwater will cause the formation of stagnation zones downgradient of the extraction wells. This effect may be accounted for in the system design through the selection of appropriate well locations based on pumping rates and drawdown.

Precipitation would be applicable for removing metals from the extracted groundwater. Precipitated metals would be physically removed from the water in a sedimentation vessel, or alternatively, by filtration. Some metals, such as manganese, can be readily precipitated from groundwater by oxidation. This can be accomplished by simple aeration. This technology would also oxidize existing manganese at elevated pHs. The oxidized manganese is then easily settled with minor pH adjustments (to near neutral).

Liquid phase carbon adsorption would be employed to remove organics. The basic principle of operation in carbon adsorption is the mass transfer and adsorption of a molecule from the liquid onto a solid surface. Hydrophobic, high surface area carbon particles attract and hold organic molecules.

The groundwater would then be disposed of at a POTW facility or a commercial chemical waste treatment facility.

Depending on the pretreatment requirements imposed by the receiving POTW, more or less treatment may be required. Potentially, extracted groundwater could be discharged directly to the POTW without pretreatment. This would depend on the POTWs ability to treat the compounds present, and on restrictions that may exist in its discharge permit.

Effectiveness Evaluation

Extraction and treatment actions are often used to remediate contaminated groundwater. However, it is sometimes found that treatment must continue for very long times (decades or longer). Furthermore, after extracted groundwater has been treated and found to be clean, contamination sometimes re-establishes once continual extraction is ceased. While contaminant leaching from source areas is actually greater during groundwater extraction induced subsurface flow, observed concentrations may be higher upon cessation of pumping due to the end of the dilution effect that subsurface flow had provided during active extraction.

Carbon adsorption has proven effective in treating groundwater contaminated with dissolved organics and is generally best for slightly contaminated groundwater (containing less than 1,000 mg/L dissolved organics). The factor that most directly impacts the effectiveness of this remedial technology is the absorbability of the contaminants of concern. This technology is effective for most of the organic compounds present in the Dearcop Farm site groundwater. This may be the only effective technology for the pesticides and PCBs.

Precipitation is a well-proven technology for the removal of metals. Manganese is routinely removed through precipitation by oxidation. Optimum pH values for complete metals removal would have to be determined in a treatability study.

Implementability Evaluation

Extraction, precipitation, and carbon adsorption are all proven technologies. No significant problems are expected with this alternative. However, treatability studies would need to be conducted to verify the effectiveness of the treatment technologies. Additionally, institutional controls would be required (e.g., land-use restrictions) for the duration of the remediation.

2.5.3 Selection of Remedial Alternative for Detailed Analysis

Alternatives developed in Section 2 for the soil/fill material, sediment, and groundwater were described, screened, and preliminarily evaluated with respect to effectiveness and implementability. The conclusions of this preliminary evaluation and the rationale for selecting the remedial alternatives to be analyzed in detail in the Phase III FS are presented herein for the media of concern.

2.5.3.1 Soil/Fill Material and Sediment Media

In Section 2.5.1, seven remedial alternatives addressing the contamination concerns for soils were developed and screened.

Five of the seven remedial alternatives developed and preliminarily screened for the contaminated soil/fill material and sediment are retained for further analysis in Section 3. These alternatives include:

- Alternative 1: No Action;
- Alternative 2: Institutional Controls;
- Alternative 3: Consolidation and Capping;
- Alternative 4: Consolidation, Capping, and Vacuum Extraction;
- Alternative 5: Excavation and Off-Site Disposal.

Alternatives 6 and 7, which both would involve solidification, were removed from consideration. Alternative 6, Solidification and Off-Site Disposal, would have provided few benefits over Alternative 5. For the vast majority of soil, solidification would not be required prior to disposal. Disposal in properly constructed landfills would minimize any additional protective benefits achieved from solidification. Alternative 6 was eliminated because of potential implementability problems arising from the presence of PCBs in the soils. These soils, which would be treated as hazardous wastes, could not have been disposed of on site.

2.5.3.2 Groundwater Medium

Three of the four remedial alternatives developed and preliminarily screened for groundwater are retained for further analysis in Section 3. These alternatives include:

- Alternative 1: No Action;
- Alternative 2: Institutional Controls; and

- Alternative 4: Extraction and Treatment by Metals Precipitation Followed by Carbon Adsorption and Disposal.

Alternative 3, *In-situ* Air Sparging, was eliminated from further consideration because of potential limitations in its effectiveness. These limitations include the possibility of causing greater migration of contamination if the system is not designed properly, or the subsurface is not completely accurately characterized.

2.5.4 Combining Medium-Specific Alternatives into Comprehensive Site-Wide Remedial Alternatives

As a final step in the alternatives screening process, soil/fill material and sediment media alternatives and groundwater medium alternatives are combined into comprehensive site-wide alternatives to be evaluated in the detailed analysis. Alternatives are combined according to the degree of complexity and aggressiveness with which they address the site's contamination. The combined alternatives are:

- Alternative 1: No Action.
- Alternative 2: Institutional Controls.
- Alternative 3: Consolidation and capping of soil/fill material and sediment; Institutional Controls/Natural Attenuation for groundwater.
- Alternative 4: Consolidation, Capping, and Vacuum Extraction Treatment for soil/fill material and sediment; Institutional Controls/Natural Attenuation for Groundwater.
- Alternative 5: Excavation and Off-site Disposal of soil/fill material and sediment; Extraction, Treatment and Disposal of groundwater.

Table 2-1

CHEMICAL-SPECIFIC SITE CLEANUP OBJECTIVES, SOILS (μg/kg)

Contaminants	ARARs		TBCs			Concentration Corresponding to Site Human Health Carcinogenic Risk Levels of 10^{-6} (unless otherwise noted)	Candidate Cleanup Objective	Maximum Concentration		Site Cleanup Objective
	Federal	State	Federal TBCs, RCRA^a, EPA^b,	State Recommended Soil Cleanup Goal^{c,e}	Background			Subsurface	Surface	
Volatile Organics										
Acetone	—	—	8,000,000^a 7,800,000^b	90	—	—	7,800,000	260,000	—	NA
Benzene	—	—	22,000^b	50	—	—	22,000	2	—	NA
2-Butanone (Methyl ethyl ketone)	—	—	4,000,000^a 74,000,000^b	180	—	—	4,000,000	44	4	NA
Carbon disulfide	—	—	8,000,000^a 7,800,000^b	2,100	—	—	7,800,000	3	2	NA
Chlorobenzene	—	—	2,000,000^a 1,600,000^b	1,300	—	—	1,600,000	3	2	NA
1,1-Dichloroethane	—	—	7,800,000^b	120	—	—	7,800,000	3,700	—	NA
1,2-Dichloroethane	—	—	8,000^a 7,000^b	60	—	—	7,000	320,000	—	7,000
1,2-Dichloroethene (total)	—	—	700,000^b	310	—	—	700,000	1,100	—	NA
Ethylbenzene	—	—	8,000,000^a 7,800,000^b	4,350	—	—	7,800,000	110,000	—	NA
4-Methyl-2-pentanone (Methyl Isobutyl ketone)	—	—	4,000,000^a 3,900,000^b	750	—	—	3,900,000	310	—	NA
Methylene Chloride	—	—	90,000^a 85,000^b	80	—	—	85,000	70,000	—	NA
Tetrachloroethene	—	—	10,000^a 12,000^b	1,100	—	—	10,000	240	—	NA
Toluene	—	—	20,000,000^a 16,000,000^b	1,200	—	—	16,000,000	3,400,000	18	NA
Trichloroethene	—	—	60,000^a 58,000^b	500	—	—	58,000	23,000	2	NA

Key at end of table.

Table 2-1

CHEMICAL-SPECIFIC SITE CLEANUP OBJECTIVES, SOILS (µg/kg)

Contaminants	ARARs		TBCs			Concentration Corresponding to Site Human Health Carcinogenic Risk Levels of 10^{-6} (unless otherwise noted)	Candidate Cleanup Objective	Maximum Concentration		Site Cleanup Objective
	Federal	State	Federal TBCs, RCRA[a], EPA[b],	State Recommended Soil Cleanup Goal[c,e]	Background			Subsurface	Surface	
1,1,1-Trichloroethane	—	—	7,000,000[a] 7,000,000[b]	600	—	—	7,000,000	880,000	20	NA
Xylenes (Total)	—	—	200,000,000[a] 160,000,000[b]	950	—	—	160,000,000	580,000	1	NA
Semivolatile Organics										
Bis(2-ethylhexyl)phthalate	—	—	50,000[a] 46,000[b]	50,000	—	—	46,000	330	300	NA
Butylbenzylphthalate	—	—	20,000,000[a] 16,000,000[b]	50,000	—	—	16,000,000	48	—	NA
Carbazole	—	—	32,000[b]	—	—	—	32,000	—	56	NA
Dibenzofuran	—	—	—	4,900	—	—	4,900	63	—	NA
Diethylphthalate	—	—	60,000,000[a] 63,000,000[b]	5,600	—	—	60,000,000	140	63	NA
Di-n-butylphthalate	—	—		6,400	—	—	6,400	110	—	NA
2-Methylphenol	—	—	3,900,000[b]	330	—	—	3,900,000	3,900	—	NA
4-Methylphenol	—	—	3,900,000[b]	670	—	—	3,900,000	4,000	—	NA
N-Nitrosodiphenylamine	—	—	100,000[a] 130,000[b]	—	—	—	100,000	140,000	—	100,000
Phenol	—	—	50,000,000[a] 47,000,000[b]	330	—	—	47,000,000	540,000	—	NA
Acenaphthene	—	—	4,700,000[b]	50,000	1,105[f]	—	4,700,000	200	26,000	NA
Acenaphthylene	—	—		32,000	100[f]	—	32,000	160	860	NA
Anthracene	—	—	23,000,000[b]	50,000	64[f]	—	23,000,000	5,900	98	NA
Benzo(a)anthracene	—	—	870[b]	330	300[f]	83.6	300	11,000	2,200	300[i]

Key at end of table.

Table 2-1

CHEMICAL-SPECIFIC SITE CLEANUP OBJECTIVES, SOILS (μg/kg)

	ARARs		TBCs					Maximum Concentration		
Contaminants	Federal	State	Federal TBCs, RCRA^{a}, EPA^{b},	State Recommended Soil Cleanup Goal^{c,e}	Background	Concentration Corresponding to Site Human Health Carcinogenic Risk Levels of 10^{-6} (unless otherwise noted)	Candidate Cleanup Objective	Subsurface	Surface	Site Cleanup Objective
Benzo(a)pyrene	—	—	88^{b}	—	180^{f}	15.5	180	3,100	8,000	180^{i}
Benzo(b)fluoranthene	—	—	870^{b}	870	260^{f}	198	260	8,300	6,300	260^{i}
Benzo(g,h,i)perylene	—	—		—	250^{f}	—	—	5,000	6,100	NA
Benzo(k)fluoranthene	—	—	8,800^{b}	870	165^{f}	—	8,800	2,400	4,700	NA
Chrysene	—	—	87,000^{b}	330	255^{f}	—	87,000	3,700	8,100	NA
Dibenz(a,h)anthracene	—	—	88^{b}	330	190^{f}	17	190	2,000	4,800	190^{i}
Fluoranthene	—	—	3,100,000^{b}	50,000	675^{f}	—	3,100,000	4,700	27,000	NA
Fluorene	—	—	3,100,000^{b}	50,000	42^{f}	—	3,100,000	140	3,000	NA
Indeno(1,2,3-cd)pyrene	—	—	870^{b}	2,500	245^{f}	189	245	4,900	6,000	245^{i}
1-Methylnaphthalene	—	—	—	—	—	—	—	—	11,000	NA
2-Methylnaphthalene	—	—	—	28,700	89^{f}	—	28,700	510	8,800	NA
Naphthalene	—	—	3,100,000^{b}	10,200	420^{f}	—	3,100,000	97	18,000	NA
Phenanthrene	—	—	—	50,000	240^{f}	—	50,000	550	17,000	—
Pyrene	—	—	2,300,000^{b}	50,000	680^{f}	—	2,300,000	5,000	17,000	NA
Pesticides/PCBs										
Aroclor 1248	1,000^{j}	—	90^{a} 83^{b}	1,000^{n,k} 10,000^{m,k}	—	—	1,000^{k}	200,000	—	1,000^{k}
Aroclor 1254	1,000^{j}	—	90^{a} 83^{b}	1,000^{n,k} 10,000^{m,k}	—	1,180	1,000^{k}	3,300	1,550	1,000^{k}
Aroclor 1260	1,000^{j}	—	90^{a} 83^{b}	1,000^{n,k} 10,000^{m,k}	—	—	1,000^{k}	945	4,200	1,000^{k}
alpha-BHC	—	—	100^{a} 100^{b}	110	—	—	100	100	—	NA

Key at end of table.

Table 2-1

CHEMICAL-SPECIFIC SITE CLEANUP OBJECTIVES, SOILS (μg/kg)

	ARARs		TBCs					Maximum Concentration		
Contaminants	**Federal**	**State**	**Federal TBCs, RCRA[a], EPA[b],**	**State Recommended Soil Cleanup Goal[c,e]**	**Background**	**Concentration Corresponding to Site Human Health Carcinogenic Risk Levels of 10^{-6} (unless otherwise noted)**	**Candidate Cleanup Objective**	**Subsurface**	**Surface**	**Site Cleanup Objective**
Alpha-Chlordane	—	—	500[a] 490[b]	540	28[f]		490	69	86	NA
Beta-BHC	—	—	4,000[a] 350[b]	150	—	507	350	180	—	NA
Endrin	—	—	20,000[a] 23,000[b]	70	—	23,500[d]	23,500	200	—	NA
Dieldrin	—	—	40[a] 40[b]	44	18[f]	57	57	39	200	57
Endosulfan I	—	—	4,000[a] 470,000[b]	640	—	—	4,000	124	—	NA
Endosulfan Sulfate	—	—	1,000[a]	800	—	—	1,000	10	—	NA
4,4'-DDD	—	—	3,000[a] 2,700[b]	2,900	—	—	2,700	41	37	NA
4,4'-DDE	—	—	2,000[a] 1,900[b]	2,100	—	—	1,900	7.0	870	NA
4,4'-DDT	—	—	2,000[a] 1,900[b]	2,100	—	—	1,900	29	1,300	NA
Gamma-BHC	—	—	500[a] 490[b]	40	—	—	490	280	—	NA
Gamma chlordane	—	—	500[a] 490[b] 540[c]	—	34[f]	—	490	170	37	NA
Heptachlor	—	—	140[b]	90	—	—	140	180	—	140
Heptachlor epoxide	—	—	70[a] 20[c]	—	36[f]	—	70	870	60	70
Methoxychlor	—	—	390,000[b] 10,000[c]	—	—	—	390,000	1,400	—	NA

Key at end of table.

Table 2-1

CHEMICAL-SPECIFIC SITE CLEANUP OBJECTIVES, SOILS (µg/kg)

Contaminants	ARARs		TBCs			Concentration Corresponding to Site Human Health Carcinogenic Risk Levels of 10^{-6} (unless otherwise noted)	Candidate Cleanup Objective	Maximum Concentration		Site Cleanup Objective
	Federal	State	Federal TBCs, RCRA[a], EPA[b],	State Recommended Soil Cleanup Goal[c,e]	Background			Subsurface	Surface	
Inorganics										
Aluminum	—	—	230,000,000[b]	SB	6,800,000[f] 100,000,000[g]	—	230,000,000	11,300,000	7,310,000	NA
Arsenic	—	—	80,000[a] 23,000[b]	SB	3,800[f] 73,000[g]	—	23,000	7,000	13,600	NA
Barium	—	—	4,000,000[a] 5,500,000[b]	SB	92,500[f] 1,500,000[g]	—	4,000,000	1,380,000	1,550,000	NA
Beryllium	—	—	20[a] 150[b]	160	410[f] 7,000[g]	—	410	710	550	410[l]
Cadmium	—	—	40,000[a] 39,000[b]	1,000[c] 10,000[e]	1,300[f] 700[g]	—	10,000	111,000	8,800	10,000
Calcium	—	—	—	SB	28,900,000[f] 280,000,000[g]	—	—	87,500,000	130,000,000	NA
Chromium[d]	—	—	400,000[a] 390,000[b]	10,000	12,500[f] 1,000,000[g]	—	400,000	432,000	77,600	400,000
Cobalt	—	—	—	SB	6,450[f] 70,000[g]	—	—	1,330,000	620,000	NA
Copper	—	—	2,900,000[b]	SB	20,200[f] 700,000[g]	—	2,900,000	1,960,000	1,540,000	NA
Iron	—	—	—	2,000,000[c]	12,675,000[f] 100,000,000[g]	—	—	66,200,000	55,100,000	NA
Lead	—	—	400,000[h]	SB	30,500[f] 300,000[g]	—	400,000	2,740,000	820,000	400,000
Magnesium	—	—	—	SB	11,200,000[f] 50,000,000[g]	—	—	26,000,000	13,900,000	NA
Manganese	—	—	390,000[b]	SB	473,000[f] 7,000,000[g]	—	473,000	3,320,000	1,240,000	473,000

Key at end of table.

Table 2-1

CHEMICAL-SPECIFIC SITE CLEANUP OBJECTIVES, SOILS (μg/kg)

Contaminants	ARARs		TBCs			Concentration Corresponding to Site Human Health Carcinogenic Risk Levels of 10^{-6} (unless otherwise noted)	Candidate Cleanup Objective	Maximum Concentration		Site Cleanup Objective
	Federal	State	Federal TBCs, RCRA[a], EPA[b],	State Recommended Soil Cleanup Goal[c,e]	Background			Subsurface	Surface	
Mercury	—	—	20,000[a] 23,000[b]	100	270[f] 3,400[g]	—	20,000	590	2,000	NA
Nickel	—	—	2,000,000[a] 1,600,000[b]	SB	10,100[f] 700,000[g]	—	1,600,000	3,620,000	160,000	1,600,000
Potassium	—	—	—	SB	879,000[f] 3,700,000[g]	—	—	2,390,000	1,500,000	NA
Selenium	—	—	390,000[b]	SB	520[f] 3,900[g]	—	390,000	900	710	NA
Silver	—	—	200,000[a] 390,000[b]	SB	1,700[f]	—	200,000	51,900	22,400	NA
Sodium	—	—	—	3,000,000	50,000,000[g]	—	—	6,880,000	3,720,000	NA
Thallium	—	—	—	20,000	—	—	—	260	230	NA
Vanadium	—	—	550,000[b]	150,000	300,000[g]	—	550,000	26,900	22,000	NA
Zinc	—	—	23,000,000[b]	20,000	2,900,000[g]	—	23,000,000	1,740,000	2,030,000	NA
Cyanide	—	—	2,000,000[a] 1,600,000[b]	—	—	—	1,600,000	8,200	1,100	NA

Key at end of table.

Table 2-1 (Cont.)

[a] RCRA Corrective Action Appendix A.

[b] Region III Risk-Based Concentration Table.

[c] NYSDEC TAGM 4046. Organic goals calculated using site-specific total organic content of 0.79%. For metals, site background is listed if lower than recommended goal.

[d] Value is based on risks due to chromium VI.

[e] NYSDOH site-specific cleanup goal. (Letter from D. Napier, NYSDOH to J. A. Fleck, NYSDEC, dated December 20, 1994).

[f] Site-specific background surface soil concentration.

[g] Upper limit of 90th percentile of common range found in Eastern U.S. Soils (calculated from data of Shacklette and Boerngen, 1984).

[h] EPA's interim guidance for establishing soil lead cleanup values at Superfund sites.

[i] Compound/element not addressed in FS. See text for discussion.

[j] Toxic Substance Control Act (TSCA) (15 USC 2601) - Surface soil cleanup criterion of 1,000 μg/kg is selected for all soils.

[k] Total PCBs.

[l] Human Health Risk Assessment Levels based on hazard index of 1.

[m] Subsurface goal.

[n] Surface goal.

Key:

— = Level has not been established.
NA = Not applicable.
SB = Site-specific background concentration.

Table 2-2

LOCATION- AND ACTION-SPECIFIC ARARs

Standards, Requirements, Criteria, or Limitations	Citation	Description
Resource Conservation and Recovery Act (RCRA) Regulations	40 CFR Parts 261, 262, 263, 264, and 268	Standards used for remedial actions, including off-site hauling and disposal of hazardous wastes, on-site capping and landfilling, groundwater monitoring, and land disposal restrictions requiring treatment.
Clean Water Act (CWA) Regulations	40 CFR Section 122.44 (a)	Discharge of groundwater treatment system effluent tributary to New York State Barge Canal.
Toxic Substances Control Act (TSCA)	15 USC 2601 40 CFR 761	TSCA provides authority to require testing and regulation of chemical substances entering the environment. Establishes 10-ppm spill cleanup objective for PCBs in unrestricted access areas.
Occupational Safety and Health Act (OSHA) Requirements	29 CFR Parts 1910, 1926, and 1904	OSHA regulations govern exposures and requirements by protection of workers engaged in on-site field activities.
Department of Transportation (DOT) Risks for Hazardous Materials	49 CFR Parts 170, 171.1-171.5	Regulates the transport of hazardous materials, including packaging, shipping equipment, and placarding.
CWA Regulations	40 CFR Sections 125.100, 125.104, 122.41 (i), 136.1-136.4, 141.147	Best management practices for discharge of groundwater treatment system effluent to New York State Barge Canal.
CWA Regulations	40 CFR Section 122.44	Ambient Water Quality Standards for discharge of groundwater treatment system effluent to New York State Barge Canal.
New York State Pollutant Discharge Elimination System (SPDES)	6 NYCRR Part 750-758	Establishes effluent limitations on a case-by-case basis.
New York Water Quality Standards	6 NYCRR Parts 700-703	State water quality guidance values for surface water and groundwater and quality standards in groundwater effluent.

Table 2-2

LOCATION- AND ACTION-SPECIFIC ARARs

Standards, Requirements, Criteria, or Limitations	Citation	Description
New York State Permit Regulation	6 NYCRR Part 608.4	Requirements for excavation or placement of fill into the New York State Barge Canal.
New York Regulatory Procedures for Wetlands	6 NYCRR Part 663.4	Permit requirements for conducting wetland activities.

Table 2-3

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES SEDIMENTS (µg/kg)

Contaminants	ARARs		TBCs		Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
	Federal	State	EPA[b,d], RCRA[a], Long & Morgan[e], NYSDEC[f]	Background			
Volatile Organics							
Carbon disulfide	—	—	8,000,000[a] 7,800,000[b]	—	7,800,000	10	NA
1,1-DCA	-	-	7,800,000[b]	—	7,800,000	3	NA
Total 1,2-DCE	—	—	700,000[b]	—	700,000	5	NA
TCE	—	—	60,000[a] 58,000[b]	—	58,000	2	NA
Xylene (total)	—	—	200,000,000[a] 160,000,000[b]	—	160,000,000	1	NA
Semivolatiles							
Butylbenzylphthalate	—	—	20,000,000[a] 16,000,000[b]	—	16,000,000	73	NA
Carbazole	—	—	32,000[b]	—	32,000	400	NA
Dibenzofuran	—	—	—	—	NA	280	NA
Acenaphthene	—	—	4,700,000[b] 150[e] 2,940[f]	1,105[h]	150	12,000	150[i]

Key at end of table.

Table 2-3

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES SEDIMENTS (µg/kg)

Contaminants	ARARs		TBCs		Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
	Federal	State	EPA^{b,d}, RCRA^{a}, Long & Morgan^{e}, NYSDEC^{f}	Background			
Anthracene	—	—	$23,000,000^{b}$ 85^{e}	64^{h}	85	1,500	85^{i}
Benzo(a)anthracene	—	—	870^{b} 230^{e}	300^{h}	300	3,000	300^{i}
Benzo(a)pyrene	—	—	88^{b} 400^{e}	180^{h}	180	2,200	180^{i}
Benzo(b)fluoranthene	—	—	870^{b}	260^{h}	870	2,300	870^{i}
Benzo(g,h,i)perylene	—	—	—	250^{h}	—	1,600	NA
Benzo(k)fluoranthene	—	—	—	165^{h}	—	1,200	NA
Chrysene	—	—	$8,800^{b}$ 400^{e}	255^{h}	400	2,000	400^{i}
Dibenz(a,h)anthracene	—	—	88^{b} 60^{e}	190^{h}	190	1,100	190^{i}
Fluoranthene	—	—	$3,100,000^{b}$ $21,240^{f}$	675^{h}	21,420	6,700	NA
Fluorene	—	—	$3,100,000^{b}$ 35^{e}	42^{h}	42	5,900	NA
Indeno(1,2,3-cd)pyrene	—	—	870^{b}	245^{h}	870	1,500	870^{i}

Key at end of table.

Table 2-3

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES SEDIMENTS (μg/kg)

Contaminants	ARARs		TBCs		Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
	Federal	State	EPA[b,d], RCRA[a], Long & Morgan[e], NYSDEC[f]	Background			
1-Methylnaphthalene	—	—	—	—	—	1,000	NA
2-Methylnaphthalene	—	—	65[e]	89[h]	89	270	89[i]
Naphthalene	—	—	3,100,000[b] 340[e]	420[h]	340	6,100	340[i]
Phenanthrene	—	—	225[e] 2,520[f]	240[h]	225	4,600	225[i]
Pyrene	—	—	2,300,000[b] 350[e]	680[h]	680	6,300	680[i]
PCBs							
Aroclor 1254	—	—	90[a] 83[b] 195[d] 50[e,p] 405.3[f,p]	—	50	110	50
Pesticides							
Alpha-chlordane	—	—	500[a] 490[b]	28[h]	490	40	NA
4,4'-DDE	—	—	2,000[a] 1,900[b] 2[e]	—	2	7.0	2

Key at end of table.

Table 2-3

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES
SEDIMENTS (μg/kg)

	ARARs		TBCs				
Contaminants	**Federal**	**State**	**EPA[b,d], RCRA[a], Long & Morgan[e], NYSDEC[f]**	**Background**	**Candidate Cleanup Objective**	**Maximum Concentration**	**Site Cleanup Objective**
4,4'-DDT	—	—	2,000[a] 1,900[b] 1[e] 0.20[d]	—	0.2	7.8	0.2
Dieldrin	—	—	40[a] 40[b] 1.3[d] 20[e] 18.9[f]	18[h]	18	8.2	NA
Endosulfan sulfate	—	—	—	—	NA	5.7	NA
Endrin ketone	—	—	—	—	NA	16	NA
Heptachlor epoxide	—	—	70[b] 2.1[f]	—	2.1	40	2.1
Inorganics							
Aluminum	—	—	230,000,000[b]	100,000,000[g] 6,800,000[h]	230,000,000	13,000,000	NA
Arsenic	—	—	80,000[a] 23,000[b] 33,000[e] 6,000[f]	73,000[g] 3,800[h]	6,000	6,200	6,000

Key at end of table.

Table 2-3

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES SEDIMENTS (μg/kg)

Contaminants	ARARs		TBCs		Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
	Federal	State	EPA[b,d], RCRA[a], Long & Morgan[e], NYSDEC[f]	Background			
Barium	—	—	4,000,000[a] 5,500,000[b]	1,500,000[g] 92,500[h]	4,000,000	104,000	NA
Beryllium	—	—	20[a] 150[b]	7,000[g] 410[h]	410	860	410
Cadmium	—	—	40,000[a] 39,000[b] 5,000[e] 6,000[f]	700[g] 1,300[h]	5,000	2,400	NA
Calcium	—	—	—	280,000,000[g] 28,900,000[h]	—	56,900,000	NA
Chromium[c]	—	—	400,000[a] 390,000[b] 80,000[e] 26,000[f]	1,000,000[g] 12,500[h]	26,000	57,400	26,000
Cobalt	—	—	—	70,000[g] 6,450[h]	—	19,400	NA
Copper	—	—	2,900,000[b] 70,000[e] 16,000[f]	700,000[g] 20,200[h]	20,200	111,000	20,200
Iron	—	—	20,000,000[f]	100,000,000[g] 12,675,000[h]	20,000,000	40,100,000	20,000,000[i]

Key at end of table.

Table 2-3

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES
SEDIMENTS (μg/kg)

Contaminants	ARARs		TBCs		Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
	Federal	State	EPA[b,d], RCRA[a], Long & Morgan[e], NYSDEC[f]	Background			
Lead	—	—	35,000[e] 31,000[f]	300,000[g] 30,500[h]	31,000	1,220,000	31,000
Magnesium	—	—	—	50,000,000[g] 11,200,000[h]	—	22,000,000	NA
Manganese	—	—	390,000[b] 460,000[f]	7,000,000[g] 473,000[h]	473,000	681,000	473,000
Mercury	—	—	20,000[a] 23,000[b] 150[e]	3,400[g] 270[h]	150	3,000	150
Nickel	—	—	2,000,000[a] 1,600,000[b] 30,000[c] 16,000[f]	700,000[g] 10,100[h]	16,000	44,900	16,000
Potassium	—	—	—	3,700,000[g] 879,000[h]	—	586,000	NA
Selenium	—	—	390,000[b]	3,900[g] 520[h]	390,000	440	NA
Silver	—	—	200,000[a] 390,000[b] 1,000[e]	—	1,000	1,600	1,000
Sodium	—	—	—	50,000,000[g]	—	1,340,000	NA

Key at end of table.

Table 2-3

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES
SEDIMENTS (µg/kg)

	ARARs		TBCs				
Contaminants	**Federal**	**State**	**EPA[b,d], RCRA[a], Long & Morgan[e], NYSDEC[f]**	**Background**	**Candidate Cleanup Objective**	**Maximum Concentration**	**Site Cleanup Objective**
Vanadium	—	—	550,000[b]	300,000[g]	550,000	26,300	NA
Zinc	—	—	23,000,000[b] 120,000[f]	2,900,000[g]	2,900,000	1,910,000	NA

[a] RCRA Corrective Action Appendix A.

[b] Region III Risk-Based Concentration Table.

[c] Value is based on risk due to chromium VI.

[d] USEPA Office of Water Regulations and Standards, May 1988 interim sediment criteria value for non polar hydrophobic organic contaminants - (assuming 1% carbon).

[e] Effects Range - Low (Long & Morgan 1991)

[f] NYSDEC Technical Guidance for Screening Contaminated Sediments (assuming 2.1% carbon), November 1993.

[g] Upper limit of 90th percentile of common range found in Eastern U.S. Soils (calculated from data of Shacklette and Boerngen 1984).

[h] Average site-specific background surface soil concentration.

[i] Compound of element not addressed in FS. See discussion in text.

[p] Total PCBs.

Key:

— =Level has not been established.
NA=Not applicable.

Table 2-4

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES
GROUNDWATER (μg/L)

	ARARs		TBCs						
Contaminant	Federal MCL	NYSDEC Class GA Groundwater Standards	Federal SMCL	NYSDEC Class GA Groundwater Guidance Values	EPA Region III Tap Water Criteria	RCRA Corrective Action Level[e]	Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
Volatiles									
Acetone	—	—	—	50	3,700	4,000	50	3	NA
Benzene	5.0	0.7	—	—	0.36	—	0.7	57	0.7[g]
2-butanone	—	—	—	—	—	—	NA	14	NA
Carbon disulfide	—	—	—	—	21	4,000	21	21	NA
Chlorobenzene	—	5.0	—	—	39	700	5.0	11	5.0[g]
Chloroform	—	7.0	—	—	0.15	6.0	7.0	3	NA
Chloroethane	—	5.0	—	—	710	—	5.0	60	5.0[g]
Chloromethane	—	5.0	—	—	1.4	—	5.0	110	5.0[g]
1,1-DCA	—	5.0	—	—	810	—	5.0	4,300	5.0[g]
1,1-DCE	7.0	5.0	—	—	0.044	—	5.0	310	5.0[g]
1,2-DCA	5.0	5.0	—	—	0.12	—	5.0	79	5.0[g]
1,2-DCE (total)	—	5.0	—	—	55	—	5.0	2,300	5.0[g]
Ethylbenzene	700	5.0	30	—	1,300	4,000	5.0	5	NA
Tetrachloroethene	5.0	5.0	—	—	1.1	0.7	5.0	2	NA
Toluene	1,000	5.0	40	—	750	10,000	5.0	480	5.0[g]
TCE	5.0	5.0	—	—	1.6	—	5.0	350	5.0[g]
1,1,1-TCA	200	5.0	—	—	1,300	3,000	5.0	2,100	5.0[g]

Key at end of table.

Table 2-4

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES GROUNDWATER (μg/L)

	ARARs		TBCs						
Contaminant	Federal MCL	NYSDEC Class GA Groundwater Standards	Federal SMCL	NYSDEC Class GA Groundwater Guidance Values	EPA Region III Tap Water Criteria	RCRA Corrective Action Level[c]	Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
1,1,2-TCA	5.0	5.0	—	—	0.19	6.0	5.0	2	NA
Vinyl chloride	2.0	2.0		—	0.019	—	2.0	660	2.0[g]
Xylenes (total)	10,000	5.0	20	—	12,000	70,000	5.0	21	5.0[g]
Semivolatiles									
Bis(2-ethylhexyl)phthalate	—	50	—	—	4.8	3.0	50	20	NA
Diethylphthalate	—	—	—	50	29,000	30,000	50	1	NA
Di-n-octylphthalate	—	—	—	50	730	—	50	1	NA
2-Methylphenol	—	—	—	—	1,800	—	1,800	1	NA
4-Methylphenol	—	—	—	—	180	—	180	8	NA
Naphthalene	—	—	—	10	—	—	10	1	NA
Phenol	—	1.0	—	—	22,000	20,000	1.0	72	1.0[g]
Inorganics									
Aluminum	—	—	500	—	110,000	—	500	90,300	500[d]
Antimony	6.0	—	—	3	15	10	6.0	52.2	6.0[g]
Arsenic	50	25	—	—	11	—	25	37.9	25
Barium	2,000	1,000	—	—	2,600	—	1,000	612	NA
Beryllium	4.0	—	—	3	0.016	0.008	4.0	4.5	4.0[d]
Cadmium	5.0	10	—	—	18	—	10	24.3	10

Key at end of table.

Table 2-4

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES GROUNDWATER (μg/L)

Contaminant	ARARs		TBCs				Candidate Cleanup Objective	Maximum Concentration	Site Cleanup Objective
	Federal MCL	NYSDEC Class GA Groundwater Standards	Federal SMCL	NYSDEC Class GA Groundwater Guidance Values	EPA Region III Tap Water Criteria	RCRA Corrective Action Level[e]			
Calcium	—	—	—	—	—	—	NA	1,400,000	NA
Chromium[b]	100	50	—	—	180	—	50	144	50
Cobalt	—	—	—	—	—	—	NA	91.3	NA
Copper	1,300	200	1,000	—	1,400	—	200	341	200
Iron	—	300	300	—			300	170,000	300[d]
Lead	15[a]	25	—	—	—	—	25	107	25
Magnesium	—	—	—	35,000	—	—	35,000	363,000	35,000[d]
Manganese	—	300	50		180	—	300	5,760	300
Nickel	100	—	—	—	730	700	100	144	100
Potassium	—	—	—	—	—	—	NA	80,500	NA
Selenium	50	10	—	—	180	—	10	13.2	10
Silver	—	50	100	—	180	—	50	2.1	NA
Sodium	—	20,000	—	—	—	—	20,000	6,000,000	20,000[d]
Thallium	1.0	—	—	4	—	—	1.0	2.4	1.0[g]
Vanadium	—	—	—	—	260	—	260	205	NA
Zinc	5,000	300	—	—	11,000	—	300	1,690	300
Cyanide	200	100	—	—	730	700	100	1,055	100

Key at end of table.

Table 2-4 (Cont.)

[a] Action level in lieu of MCL.
[b] Value is based upon risk due to Chromium VI.
[d] Element not addressed in FS. See text for discussion.
[e] 55FR 30798, July 27, 1990 - If these action levels are exceeded, the need for a RCRA Corrective Measures Study would be indicated. Not intended to establish cleanup levels.
[f] Effective January 17, 1994.
[g] Site cleanup goal is below the contract quantitation limit. Unless special analytical techniques are selected and justified during design, actual cleanup goals will be non-detect (ND).

Key:

— = Level has not been established.
NA = Not applicable.

Table 2-5

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES SURFACE WATER (μg/L)

	ARARs									
	Federal		State							
Contaminant	EPA AWQC for Protection of Aquatic Life	EPA AWQC for Protection of Human Health	NYSDEC Class C Surface Water Standards	NYSDEC Class D Surface Water Standards	Class C Candidate Cleanup Objective	Class D Candidate Cleanup Objective	Class C Maximum Concentration	Class D Maximum Concentration	Site Cleanup Objective for Class C Surface Waters	Site Cleanup Objective for Class D Surface Waters
Volatiles										
Carbon disulfide	—	—	—	—	NA	NA	130	NA	NA	NA
1,2-DCE (total)	—	—	—	—	NA	NA	2	1.5	NA	NA
Toluene	—	10,000^{b}	—	—	10,000	10,000	NA	1	NA	NA
Semivolatiles										
Bis(2-ethylhexyl)phthalate	360	1.8^{b}	0.6	—	0.6	1.8	3	4	0.6^{c}	1.8^{c}
2-Chloropyridine	—	—	—	—	NA	NA	3	NA	NA	NA
Diethylphthalate	—	23,000^{b}	—	—	23,000	23,000	NA	3	NA	NA
Inorganics										
Aluminum	87	—	100	—	100	87	494	1,230	100^{g}	87^{c}
Arsenic	—	0.018^{b}	190	360	190	360	NA	1.6	NA	NA
Barium	—	1,000	—	—	1,000	1,000	43	89.7	NA	NA
Calcium	—	—	—	—	NA	NA	83,700	128,000	NA	NA
Copper	3.0^{a}	1,300^{b}	26.8 - 27.6^{a}	45 - 65^{a}	26.8	45	3.8	11.3	NA	NA
Iron	1,000	300	300	300	300	300	836	967	300	300
Lead	0.41^{a}	50	10.8 - 11.3^{a}	290 - 478^{a}	10.8	290	11.1	11.8	10.8	NA
Magnesium	—	—	—	—	NA	NA	19,300	30,000	NA	NA

Key at end of table.

Table 2-5

CHEMICAL-SPECIFIC CLEANUP OBJECTIVES
SURFACE WATER (μg/L)

Contaminant	ARARs				Class C Candidate Cleanup Objective	Class D Candidate Cleanup Objective	Class C Maximum Concentration	Class D Maximum Concentration	Site Cleanup Objective for Class C Surface Waters	Site Cleanup Objective for Class D Surface Waters
	Federal		State							
	EPA AWQC for Protection of Aquatic Life	EPA AWQC for Protection of Human Health	NYSDEC Class C Surface Water Standards	NYSDEC Class D Surface Water Standards						
Manganese	—	50	—	—	50	50	46.1	600	NA	50
Mercury	0.012	0.14[b]	—	—	0.012	0.012	NA	0.33	NA	0.012[c]
Potassium	—	—	—	—	NA	NA	2,890	3,790	NA	NA
Selenium	5.0	104[b]	1.0[d]	—	1.0	5.0	1.8	1.6	1.0[c]	NA
Sodium	—	—	—	—	NA	NA	52,100	533,000	NA	NA
Zinc	27.1[a]	—	30	733 - 1,020[a]	30	733	23.2	260	NA	NA

[a] Value based upon hardness.

[b] Recalculated value using IRIS.

[c] Site cleanup goal is below the contract required quantitation limit. Unless special analytical techniques are selected and justified during design, actual cleanup goals will be non-detect (ND).

[d] Aquatic standard applies acid-soluble form.

Key:

— = Level has not been established for analyte.
NA = Not applicable.

Table 2-6

NUMBER OF SAMPLES EXCEEDING CLEANUP OBJECTIVES

Media	Volatiles			Semivolatiles			Pesticides		
	Number of Samples	Number of Samples Above Clean-up Objective	Percent of Samples Above Clean-up Objective	Number of Samples	Number of Samples Above Clean-up Objective	Percent of Samples Above Clean-up Objective	Number of Samples	Number of Samples Above Clean-up Objective	Percent of Samples Above Clean-up Objective
On-site surface soil	21	0	0	21	0	0	21	1	5
On-site subsurface soil	28	1	4	28	1	4	28	4	14
Sediments	13	0	0	13	0	0	13	6	46
Groundwater	47	32	72	47	4	8	22	0	0

Table 2-6

NUMBER OF SAMPLES EXCEEDING CLEANUP OBJECTIVES

Media	Metals			PCBs		
	Number of Samples	Number of Samples Above Clean-up Objective	Percent of Samples Above Cleanup Objective	Number of Samples	Number of Samples Above Cleanup Objective	Percent of Samples Above Cleanup Objective
On-site surface soil	21	0	0	21	2	10
On-site subsurface soil	28	9	32	28	3	11
Sediments	13	10	77	13	4	31
Groundwater	41	6	15	0	0	0

Table 2-7

SUMMARY OF GENERAL RESPONSE ACTIONS

Contaminated Media	Contamination Concern	General Response Action
Soil and fill material	On-site surface and subsurface contamination; Potential ingestion, dermal adsorption, direct contact; potential threat to groundwater quality; and potential leaching and air transport of debris.	• Containment • Excavation • On- or off-site treatment • On- or off-site disposal • Institutional actions • No action
Sediments	Shallow (0- to 6-inches) subsurface contamination; potential ingestion and direct contact.	• Containment • Excavation • On- or off-site treatment • On- or off-site disposal • *In-situ* treatment • Institutional actions • No actions
Groundwater	On-site groundwater contamination; potential off-site groundwater contaminant migration potential exposure via inhalation of a soil gas	• Containment • Extraction • On- or off-site treatment • *In situ* treatment • Disposal • Institutional actions • No action
Surface water	On-site surface water contamination; risk to aquatic life and human consumption of aquatic life.	• No action • Monitoring after soil and sediment remediation

Table 2-8

SOIL/FILL MATERIALS, AND SEDIMENT TECHNOLOGY SCREENING

Remedial Technology	Effectiveness	Implementability	Retain Action
Capping and Grading			
	Capping would effectively reduce surface water infiltration and minimize any direct-contact hazards. Would require long-term maintenance.	Easily implemented. Restrictions on future land use. Minimum requirement by 6 NYCRR Part 360.2.	Yes
Excavation			
	Excavation is a well-demonstrated and reliable technology for removal of contaminated debris.	Would require groundwater dewatering techniques and dust/vapor control measures. Potential for VOC release. Also potential for fires and explosions from methane gas present.	Yes
On-Site Disposal			
	Design of on-site disposal facility would have to be protective of human health and the environment. Eliminates need to transport wastes.	Construction of an on-site disposal facility that meets RCRA and/or state requirements could be difficult because of the high water table. RCRA-approved landfills can be very costly. Thus, only non-RCRA soils could be disposed of on site.	Yes
Off-Site Disposal			
	Disposal in a POTW or commercial facility would be protective of human health and the environment.	Would require a POTW or disposal facility capable of accepting the debris. RCRA treatment standards codified in 40 CFR Part 268 must be met prior to disposal. Transportation of debris required.	Yes

Table 2-8

SOIL/FILL MATERIALS, AND SEDIMENT TECHNOLOGY SCREENING

Remedial Technology	Effectiveness	Implementability	Retain Action
Thermal Treatment			
	Well-demonstrated as a reliable and effective method for treating waste with organic contaminants. Higher temperatures and longer residence times may be required because of the potential presence of PCBs. Ineffective for treatment of metals. May require pretreatment for debris.	On-site fixed and mobile incinerators are widely available commercially. Permitting for an on-site incineration system may be time-consuming and difficult because of the presence of RCRA hazardous wastes and the proximity of the site to residences. Most incineration systems require 1 to 2 acres for setup of the incinerator and ancillary equipment. Establishment of water and electrical utilities would be required for the implementation of on-site incineration. For off-site incineration, only a limited number of commercial incineration facilities have the RCRA (and possibly TSCA) permits necessary to accept the waste material from the Dearcop Farm site. These facilities are approximately 70 miles from the site.	No
Physical Treatment			
***In Situ* Treatments**			
Vitrification	Effectively treats organics and inorganics. However, the process is more applicable to depths greater than 7 feet. There is a potential for this technology to cause "side migration" of contaminants.	Treatability studies are necessary to determine effectiveness on the Dearcop Farm site. A dewatering system would be required. In addition, an adequate electrical power supply would be required.	No
Soil Flushing	Difficulty in making PCBs soluble as they sorb strongly to soil particles. It is also difficult to select a soil-flushing solution to capture both organic and inorganic contaminants	Requires installation of extraction wells and installation or a wastewater treatment system.	No
Vacuum Extraction	Effective on VOCs; however, not applicable to metals or PCBs	Requires installation of production wells, monitoring wells, and high vacuum pumps.	Yes
Solidification/ Stabilization	Proven effective on metals, although this alternative is not well-demonstrated or preferred by the EPA for treatment of organics. Produces a monolithic block with high structural integrity. Contaminants are mechanically locked within the solidified matrix.	Treatability studies necessary to determine long-term performance such as effects of weathering and long-term leaching potential. RCRA treatment standards must be met.	Yes

Table 2-8

SOIL/FILL MATERIALS, AND SEDIMENT TECHNOLOGY SCREENING

Remedial Technology	Effectiveness	Implementability	Retain Action
Solvent Extraction	Effective in removal of metals and organics. Effect on PCBs is limited because PCBs have a low solubility and would sorb to soil particles. However, the process would be difficult to optimize for both organics and inorganics.	Treatability study would be required to determine effectiveness on the Dearcop Farm site. A treatment tank and dewatering system, as well as an on-site treatment system for the recycling of solvents and rinse waters, are required. A large area would be required for these operations. There would be a need for two separate treatment processes addressing different classes of contaminants. Removal, handling, and treatment add to potential exposure pathways.	No
Soil Washing	Reduces volume by segregating fine soils from coarse soils.	Subsequent treatment steps are required because of fine soils.	No
Biological Treatment			
	Effectiveness for chlorinated VOCs (e.g., TCE and 1,1,1-TCA) is not well-demonstrated for remediation of soil. Biological treatment has, with a few exceptions, been applied to chlorinated organic contamination problems on only a pilot or developmental scale. Furthermore, the aerobic techniques under development require thorough aeration, and for some systems, the addition of methane. This procedure results in the removal of a significant fraction of chlorinated organics through volatilization, indicating that volatilization would be a more effective remedial technique than biodegradation.	Implementability is not considered because the technology is not well-demonstrated for chlorinated aliphatic hydrocarbons. In addition, pilot testing is required and the effectiveness is uncertain because results have not been demonstrated with diverse contaminants present at the Dearcop Farm site.	No
Institutional Controls			
Fencing and/or deed restrictions	May be effective in reducing the potential for exposure to contaminated soils. Does not reduce contamination.	Implementability would be dependent upon legal requirements and authority.	Yes

Table 2-9

GROUNDWATER TECHNOLOGY SCREENING

Remedial Technology	Effectiveness	Implementability	Retain Action
Subsurface Barriers			
	Subsurface barriers would not significantly minimize lateral migration of groundwater, as the aquifer extends into the bedrock; barriers cannot be installed into the bedrock.	Subsurface barriers are readily implementable. Installation of subsurface barriers would require restrictions on future land use.	No
Groundwater Extraction			
Pumping	Groundwater pumping can serve the dual purpose of active restoration and containment.	Pumping wells are readily implementable.	Yes
Subsurface drains	Subsurface drains would be effective in capturing groundwater.	Subsurface drains are readily implementable.	Yes
Biological Treatment			
	Effectiveness for chlorinated VOCs is not well-demonstrated, and the remedial technology is still under development.	Implementability is not considered because the technology is not well-demonstrated for the primary groundwater contaminants (chlorinated VOCs) at the site. Also, sludge is produced.	No
Physical/Chemical Treatment			
Activated carbon adsorption	Carbon adsorption has been well-demonstrated as an effective and reliable means of removing low-solubility organics over a broad concentration range.	This is a conventional treatment method that is easily implemented. Carbon adsorption isotherm testing would be recommended prior to implementation to estimate carbon usage. Spent carbon would require treatment and/or disposal.	Yes
Air stripping	Well-established technology for removal of VOCs found in the groundwater. Iron concentrations in the groundwater may require pretreatment to prevent plugging or fouling of the tower. Air stripping transfers organic contaminants from the water phase into the air phase. Treatment of the air phase (e.g., carbon adsorption) would be required to remove the organic contaminants.	This is a conventional treatment technique that is commercially available. Permitting may be required for air emissions.	Yes

Table 2-9

GROUNDWATER TECHNOLOGY SCREENING

Remedial Technology	Effectiveness	Implementability	Retain Action
UV/ozonation	Relatively new technology for treatment (through oxidization) of organic contaminants in groundwater. However, it has been noted that organic compounds with single bonds such as 1,1,1-TCA are relatively difficult to oxidize. Iron pretreatment would be required. Can be operated in either batch or continuous mode. A bench scale treatability study would be recommended prior to implementation.	UV/ozonation treatment systems are readily available through commercial vendors. Permitting may be required for air emissions.	Yes
Filtration	Filtration is a reliable and effective means of removing low levels of suspended solids from wastewater.	Filtration equipment is relatively simple, readily available in a wide range of sizes, and easy to operate and control.	Yes
Ion Exchange	Primarily applicable to inorganic contaminants		Yes
Reverse Osmosis	Technical feasibility of using this system for remedial action at contaminated sites is unproven	Pretreatment of groundwater is required to prevent plugging	No
***In Situ* Treatment**			
Bioremediation	Effectiveness for chlorinated VOCs not well demonstrated.	Implementability is not considered because the technology is not well-demonstrated for chlorinated VOCs.	No
Air Sparging	Effective on chlorinated VOCs in groundwater and overlying soils.	Performance can be affected by the permeability of the subsurface layers.	Yes
Groundwater Disposal			
POTW	Effectiveness and reliability dependent upon treatment system and capacity of POTW.	Implementation requires that a POTW be available. Permission from POTW required. POTW must receive RCRA permit-by-rule to accept hazardous wastes, and be in complete regulatory compliance. Water must meet pretreatment requirements of the POTW. The water would have to be trucked to the POTW because none is located nearby.	Yes
RCRA-Permitted TSD Facility	RCRA permit indicates treatment should be effective.	Water would have to be trucked to the TSD facility.	Yes

Table 2-9

GROUNDWATER TECHNOLOGY SCREENING

Remedial Technology	Effectiveness	Implementability	Retain Action
Reinjection to groundwater	Reinjection will effectively dispose of groundwater as long as injection point is part of overall remedial design.	Reinjection requires an approved discharge permit and requires monitoring. Also, complete capture of reinjected groundwater is difficult to obtain and verify.	Yes
Surface water discharge	Treated groundwater discharged to surface water will effectively dispose of groundwater.	Groundwater discharge to surface water body would require treatment and monitoring in accordance with a SPDES permit. Treatment for both organic and inorganic chemicals would most likely be necessary because both classes of contaminants were detected in the groundwater above NYSDEC Ambient Water Quality Standards (see Table 2-4).	Yes
Institutional Controls			
	Institutional controls will not restore water quality but may minimize or prevent exposure to contaminated groundwater.	Implementability would be dependent upon legal requirements and authority.	Yes

Table 2-10

REMEDIAL TECHNOLOGIES RETAINED FOR FURTHER EVALUATION

Contaminated Soil, Fill Material, and Sediment
Capping
Excavation
On-site disposal
Off-site disposal
Vacuum extraction
Solidification/Stabilization
Institutional controls
Groundwater
Institutional controls/Natural Attenuation
Groundwater extraction Pumping Subsurface drains
Physical/chemical treatment Activated carbon adsorption Air stripping UV/ozonation Filtration Ion exchange
In-situ Treatment Air sparging
Groundwater disposal POTW RCRA-permitted TSD facilities Reinjection to groundwater Surface water discharge

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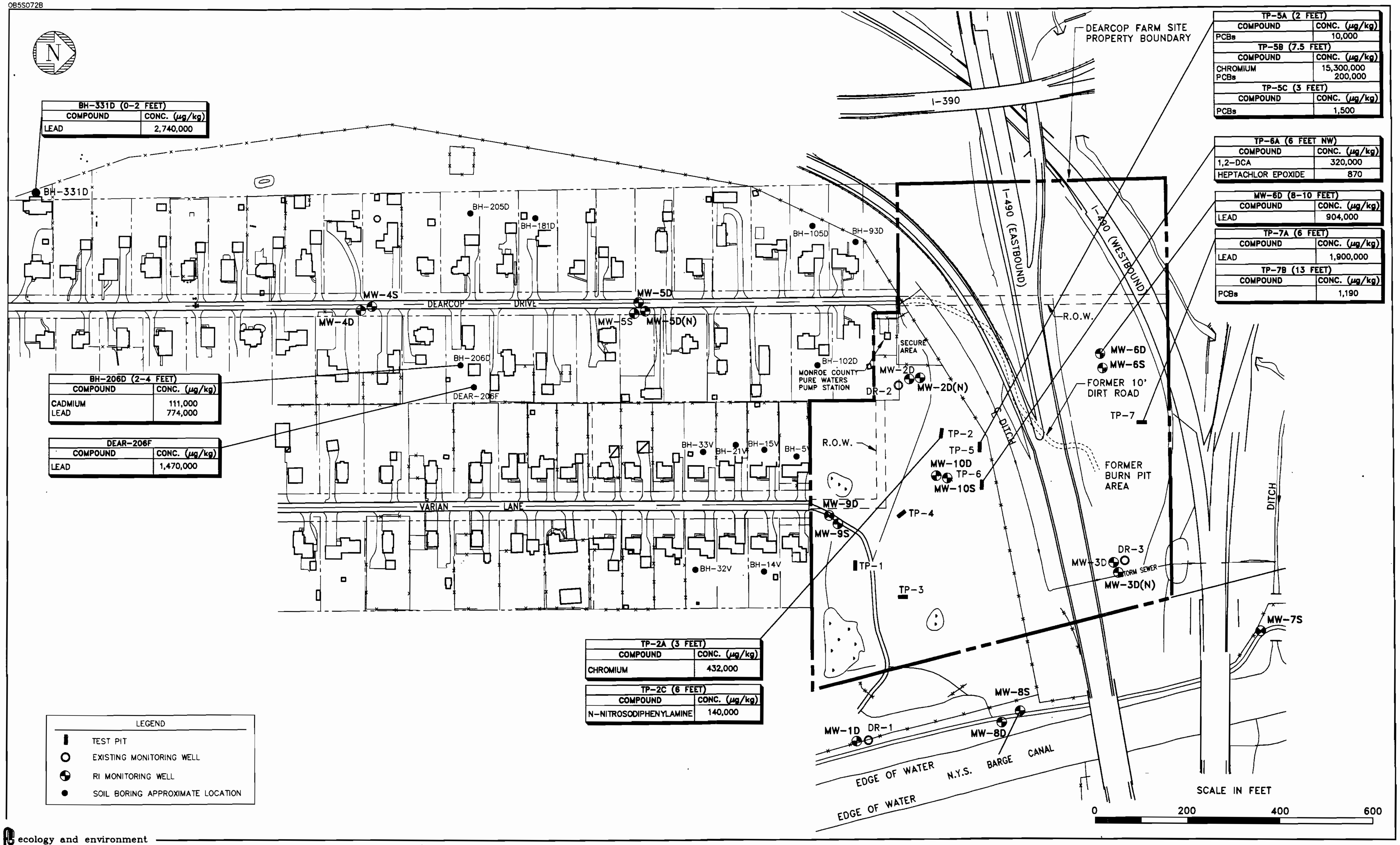


TP-5A (2 FEET)	
COMPOUND	CONC. (µg/kg)
PCBs	10,000
TP-5B (7.5 FEET)	
COMPOUND	CONC. (µg/kg)
CHROMIUM	15,300,000
PCBs	200,000
TP-5C (3 FEET)	
COMPOUND	CONC. (µg/kg)
PCBs	1,500

TP-6A (6 FEET NW)	
COMPOUND	CONC. (µg/kg)
1,2-DCA	320,000
HEPTACHLOR EPOXIDE	870

MW-6D (8-10 FEET)	
COMPOUND	CONC. (µg/kg)
LEAD	904,000

TP-7A (6 FEET)	
COMPOUND	CONC. (µg/kg)
LEAD	1,900,000
TP-7B (13 FEET)	
COMPOUND	CONC. (µg/kg)
PCBs	1,190

BH-331D (0-2 FEET)	
COMPOUND	CONC. (µg/kg)
LEAD	2,740,000

BH-206D (2-4 FEET)	
COMPOUND	CONC. (µg/kg)
CADMIUM	111,000
LEAD	774,000

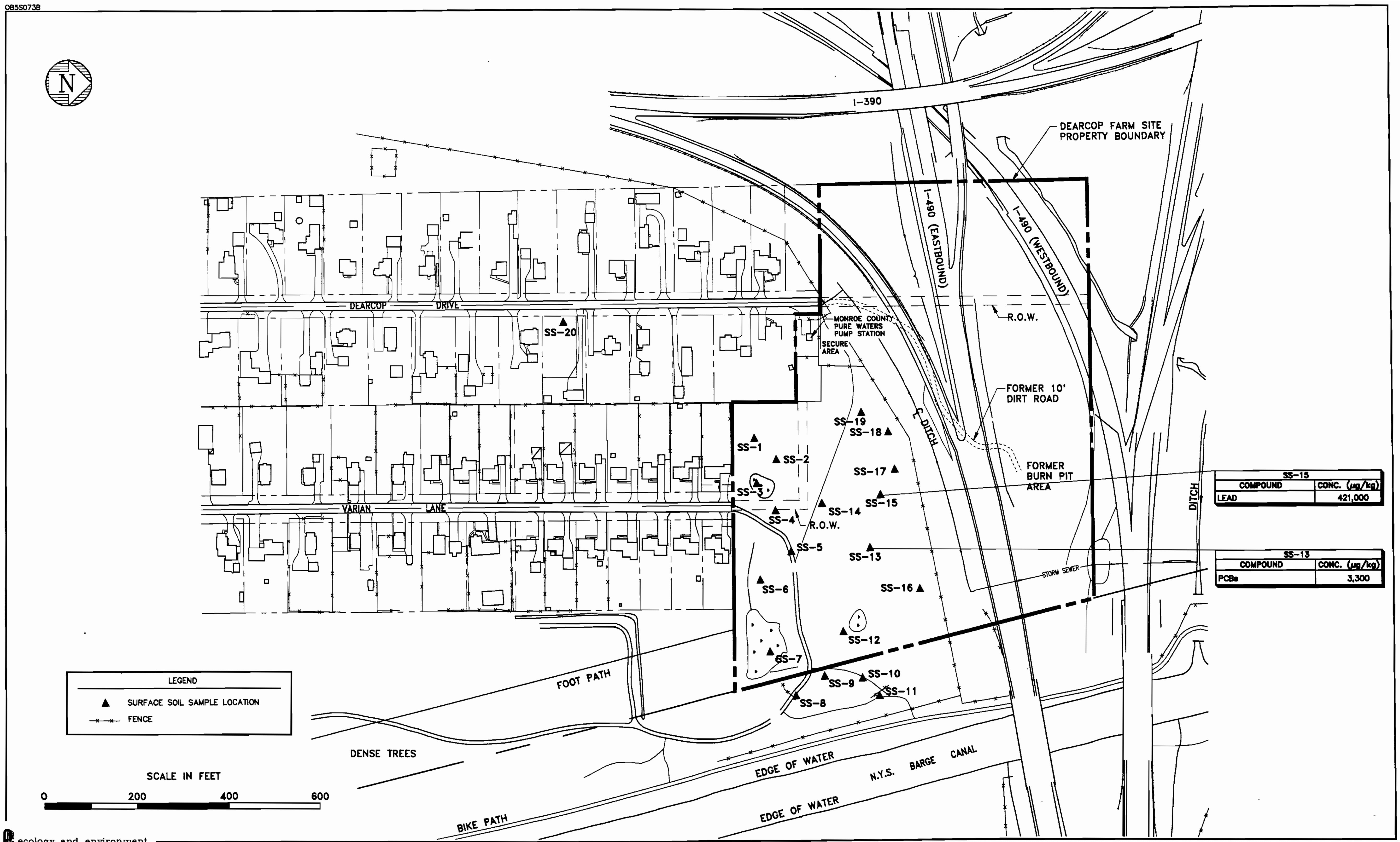
DEAR-206F	
COMPOUND	CONC. (µg/kg)
LEAD	1,470,000

TP-2A (3 FEET)	
COMPOUND	CONC. (µg/kg)
CHROMIUM	432,000

TP-2C (6 FEET)	
COMPOUND	CONC. (µg/kg)
N-NITROSODIPHENYLAMINE	140,000

LEGEND	
▮	TEST PIT
○	EXISTING MONITORING WELL
⊕	RI MONITORING WELL
●	SOIL BORING APPROXIMATE LOCATION

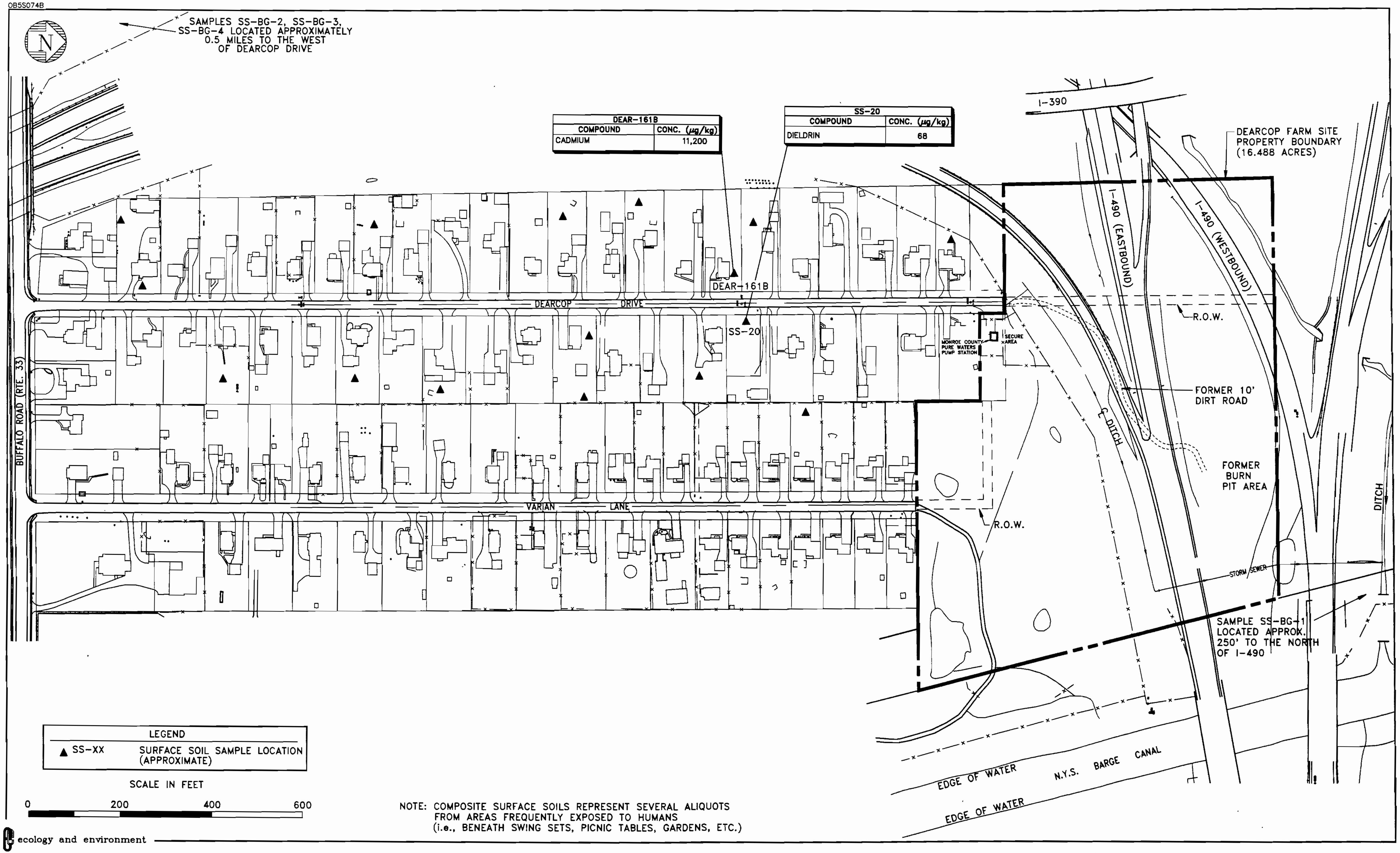
Figure 2-1 SUBSURFACE SOIL CONTAMINANTS DETECTED ABOVE CLEANUP OBJECTIVES DEARCOP FARM SITE



SS-15	
COMPOUND	CONC. (µg/kg)
LEAD	421,000

SS-13	
COMPOUND	CONC. (µg/kg)
PCBs	3,300

Figure 2-2 ON-SITE SURFACE SOIL CONTAMINANTS DETECTED ABOVE CLEANUP OBJECTIVES DEARCOP FARM SITE



DEAR-161B	
COMPOUND	CONC. ($\mu g/kg$)
CADMIUM	11,200

SS-20	
COMPOUND	CONC. ($\mu g/kg$)
DIELDRIN	68

LEGEND

▲ SS-XX SURFACE SOIL SAMPLE LOCATION (APPROXIMATE)

NOTE: COMPOSITE SURFACE SOILS REPRESENT SEVERAL ALIQUOTS FROM AREAS FREQUENTLY EXPOSED TO HUMANS (i.e., BENEATH SWING SETS, PICNIC TABLES, GARDENS, ETC.)

Figure 2-3 RESIDENTIAL SURFACE SOIL CONTAMINANTS DETECTED ABOVE CLEANUP OBJECTIVES DEARCOP FARM SITE

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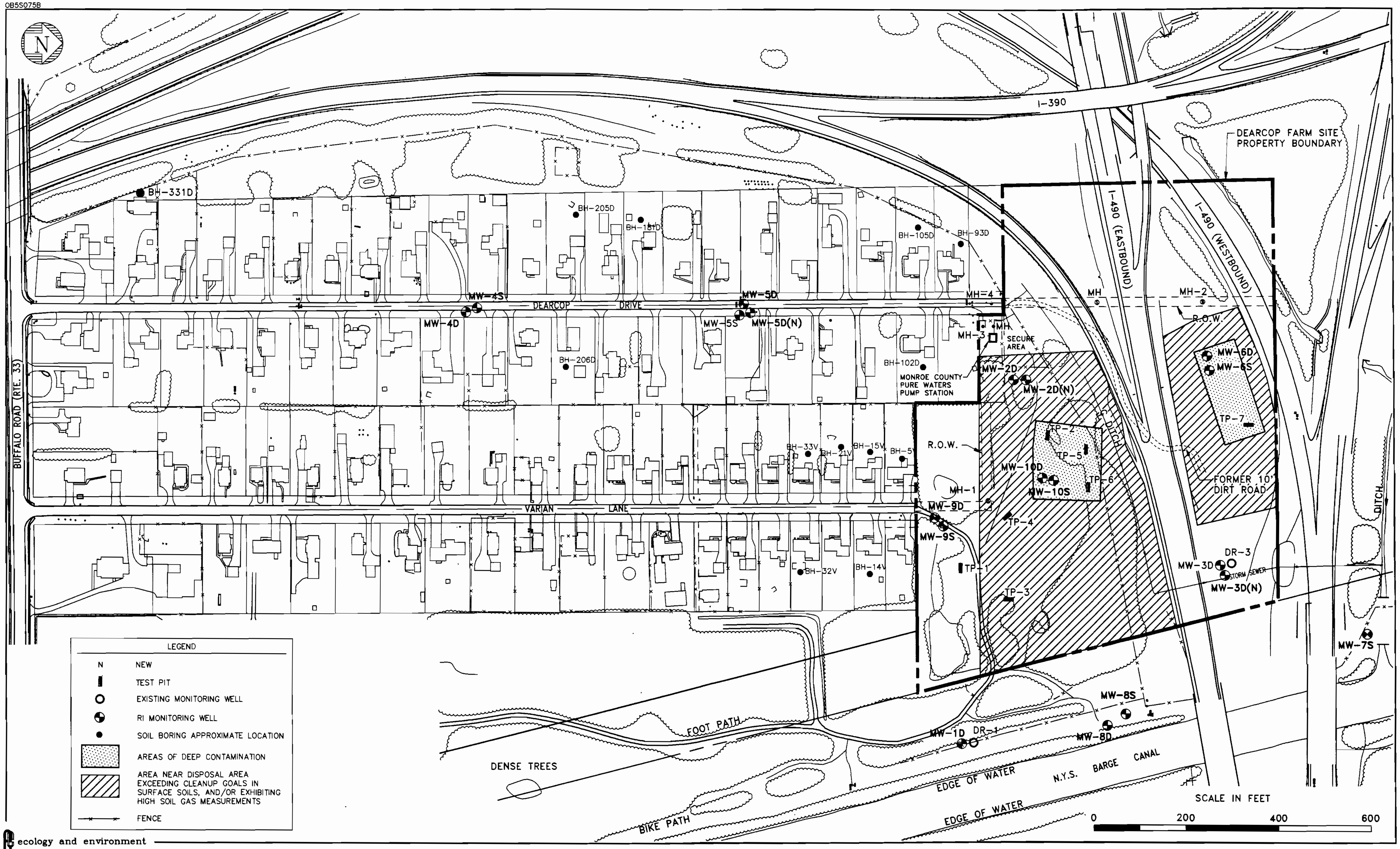


Figure 2–4 SOIL AND FILL MATERIAL AREAS NEAR DISPOSAL AREA EXCEEDING CLEANUP OBJECTIVES AND/OR EXHIBITING HIGH SOIL GAS MEASUREMENTS

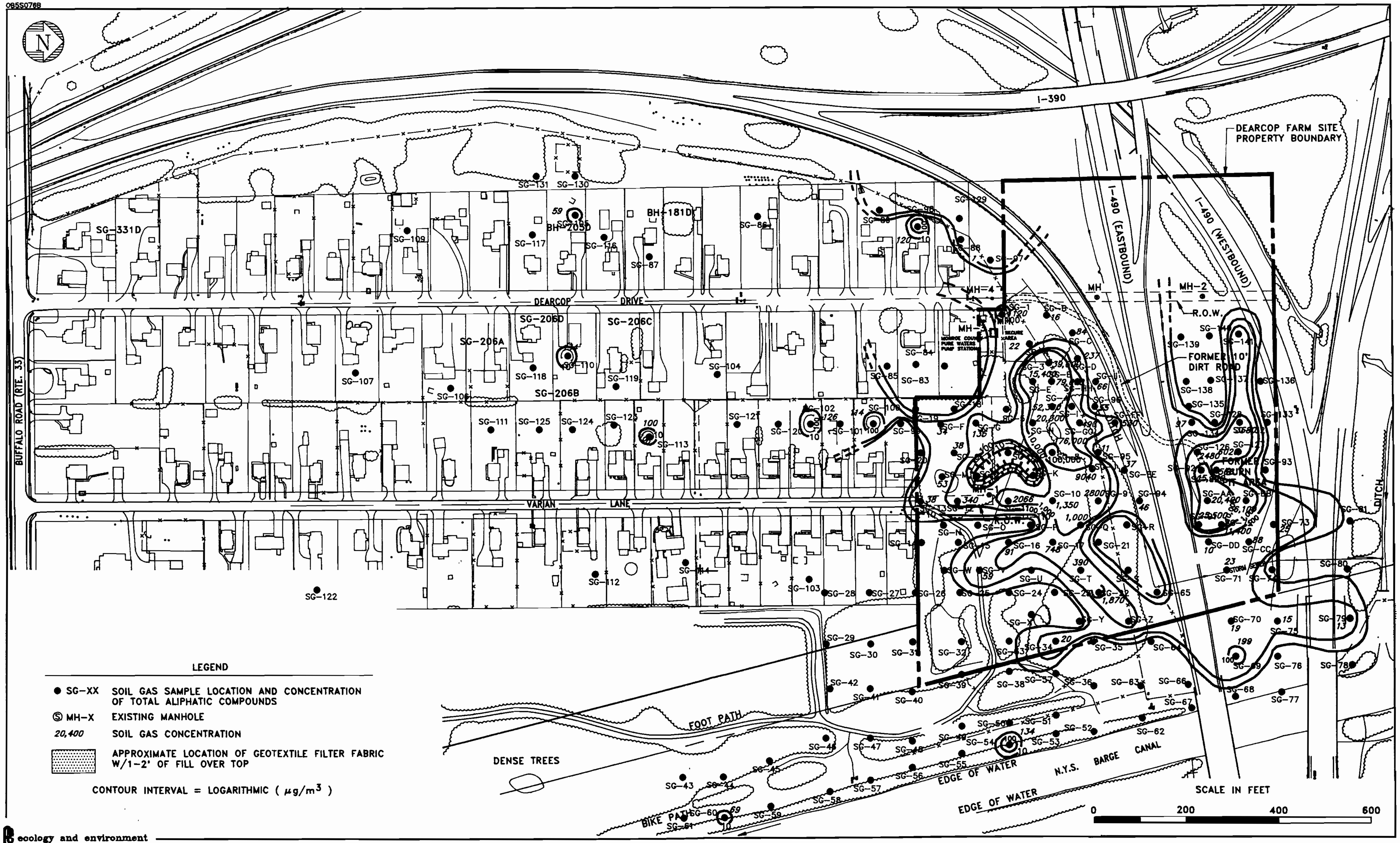
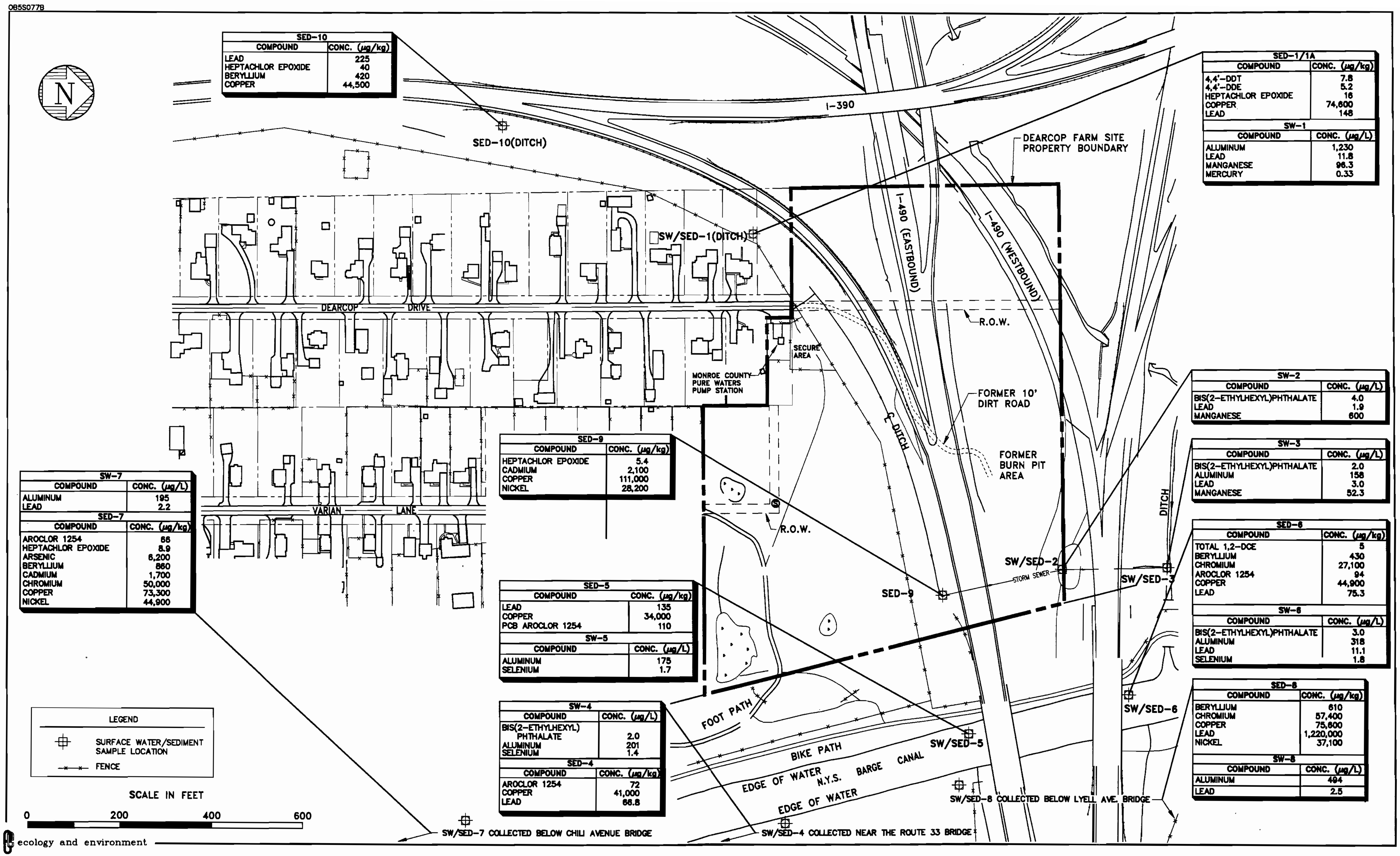


Figure 2-5 SOIL GAS TOTAL CHLORINATED ALIPHATIC PLUME BOUNDARY MAP DEARCOP FARM SITE



SED-10

COMPOUND	CONC. (µg/kg)
LEAD	225
HEPTACHLOR EPOXIDE	40
BERYLLIUM	420
COPPER	44,500

SED-1/1A

COMPOUND	CONC. (µg/kg)
4,4'-DDT	7.8
4,4'-DDE	5.2
HEPTACHLOR EPOXIDE	16
COPPER	74,600
LEAD	148

SW-1

COMPOUND	CONC. (µg/L)
ALUMINUM	1,230
LEAD	11.8
MANGANESE	96.3
MERCURY	0.33

SW-2

COMPOUND	CONC. (µg/L)
BIS(2-ETHYLHEXYL)PHTHALATE	4.0
LEAD	1.9
MANGANESE	600

SW-3

COMPOUND	CONC. (µg/L)
BIS(2-ETHYLHEXYL)PHTHALATE	2.0
ALUMINUM	158
LEAD	3.0
MANGANESE	52.3

SED-6

COMPOUND	CONC. (µg/kg)
TOTAL 1,2-DCE	5
BERYLLIUM	430
CHROMIUM	27,100
AROCLOR 1254	94
COPPER	44,900
LEAD	75.3

SW-6

COMPOUND	CONC. (µg/L)
BIS(2-ETHYLHEXYL)PHTHALATE	3.0
ALUMINUM	318
LEAD	11.1
SELENIUM	1.8

SED-8

COMPOUND	CONC. (µg/kg)
BERYLLIUM	610
CHROMIUM	57,400
COPPER	75,600
LEAD	1,220,000
NICKEL	37,100

SW-8

COMPOUND	CONC. (µg/L)
ALUMINUM	494
LEAD	2.5

SED-9

COMPOUND	CONC. (µg/kg)
HEPTACHLOR EPOXIDE	5.4
CADMIUM	2,100
COPPER	111,000
NICKEL	28,200

SED-5

COMPOUND	CONC. (µg/kg)
LEAD	135
COPPER	34,000
PCB AROCLOR 1254	110

SW-5

COMPOUND	CONC. (µg/L)
ALUMINUM	175
SELENIUM	1.7

SW-4

COMPOUND	CONC. (µg/L)
BIS(2-ETHYLHEXYL) PHTHALATE	2.0
ALUMINUM	201
SELENIUM	1.4

SED-4

COMPOUND	CONC. (µg/kg)
AROCLOR 1254	72
COPPER	41,000
LEAD	66.8

SW-7

COMPOUND	CONC. (µg/L)
ALUMINUM	195
LEAD	2.2

SED-7

COMPOUND	CONC. (µg/kg)
AROCLOR 1254	66
HEPTACHLOR EPOXIDE	8.9
ARSENIC	6,200
BERYLLIUM	860
CADMIUM	1,700
CHROMIUM	50,000
COPPER	73,300
NICKEL	44,900

Figure 2-6 SURFACE WATER AND SEDIMENT CONTAMINANTS DETECTED ABOVE CLEANUP OBJECTIVES DEARCOP FARM SITE

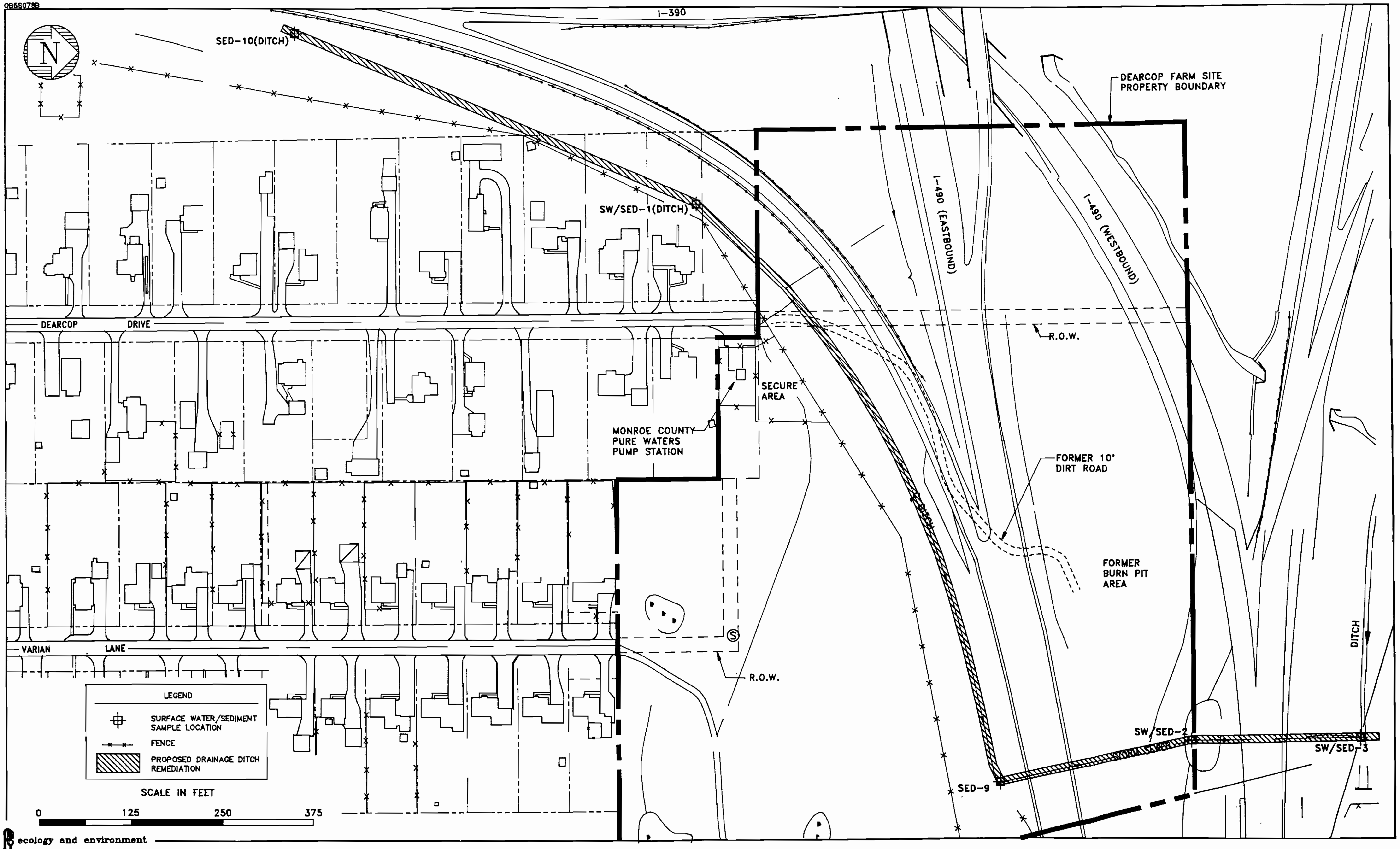


Figure 2-7 AREA AND VOLUME OF SEDIMENT TO BE EVALUATED DURING FEASIBILITY STUDY

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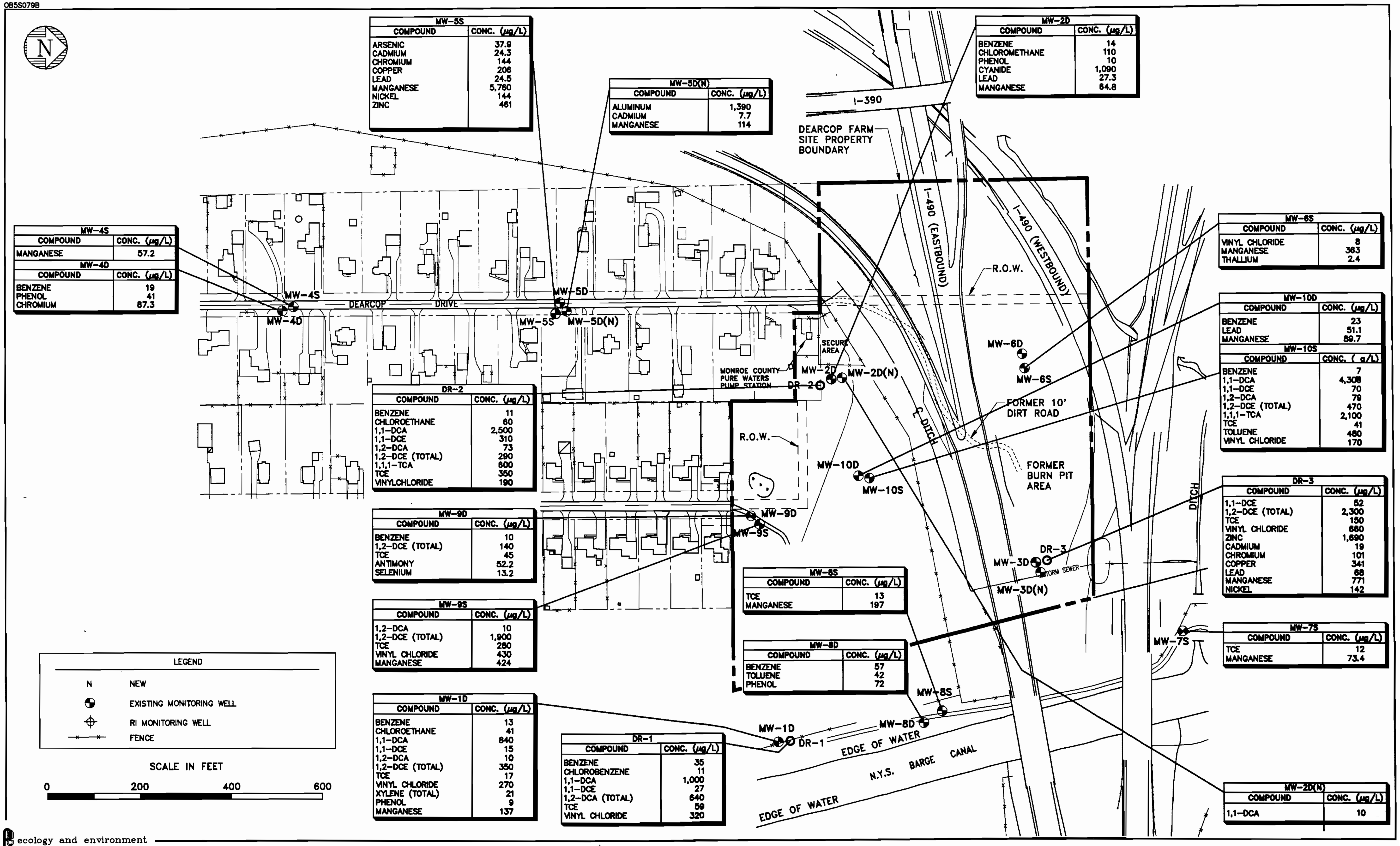

MW-5S

COMPOUND	CONC. (µg/L)
ARSENIC	37.9
CADMIUM	24.3
CHROMIUM	144
COPPER	206
LEAD	24.5
MANGANESE	5,760
NICKEL	144
ZINC	461

MW-5D(N)

COMPOUND	CONC. (µg/L)
ALUMINUM	1,390
CADMIUM	7.7
MANGANESE	114

MW-2D

COMPOUND	CONC. (µg/L)
BENZENE	14
CHLOROMETHANE	110
PHENOL	10
CYANIDE	1,090
LEAD	27.3
MANGANESE	64.8

MW-4S

COMPOUND	CONC. (µg/L)
MANGANESE	57.2

MW-4D

COMPOUND	CONC. (µg/L)
BENZENE	19
PHENOL	41
CHROMIUM	87.3

MW-6S

COMPOUND	CONC. (µg/L)
VINYL CHLORIDE	8
MANGANESE	363
THALLIUM	2.4

MW-10D

COMPOUND	CONC. (µg/L)
BENZENE	23
LEAD	51.1
MANGANESE	89.7

MW-10S

COMPOUND	CONC. (g/L)
BENZENE	7
1,1-DCA	4,300
1,1-DCE	70
1,2-DCA	79
1,2-DCE (TOTAL)	470
1,1,1-TCA	2,100
TCE	41
TOLUENE	480
VINYL CHLORIDE	170

DR-2

COMPOUND	CONC. (µg/L)
BENZENE	11
CHLOROETHANE	60
1,1-DCA	2,500
1,1-DCE	310
1,2-DCA	73
1,2-DCE (TOTAL)	290
1,1,1-TCA	600
TCE	350
VINYLCHLORIDE	190

MW-9D

COMPOUND	CONC. (µg/L)
BENZENE	10
1,2-DCE (TOTAL)	140
TCE	45
ANTIMONY	52.2
SELENIUM	13.2

DR-3

COMPOUND	CONC. (µg/L)
1,1-DCE	52
1,2-DCE (TOTAL)	2,300
TCE	150
VINYL CHLORIDE	660
ZINC	1,690
CADMIUM	19
CHROMIUM	101
COPPER	341
LEAD	68
MANGANESE	771
NICKEL	142

MW-8S

COMPOUND	CONC. (µg/L)
TCE	13
MANGANESE	197

MW-9S

COMPOUND	CONC. (µg/L)
1,2-DCA	10
1,2-DCE (TOTAL)	1,900
TCE	280
VINYL CHLORIDE	430
MANGANESE	424

MW-7S

COMPOUND	CONC. (µg/L)
TCE	12
MANGANESE	73.4

MW-8D

COMPOUND	CONC. (µg/L)
BENZENE	57
TOLUENE	42
PHENOL	72

MW-1D

COMPOUND	CONC. (µg/L)
BENZENE	13
CHLOROETHANE	41
1,1-DCA	840
1,1-DCE	15
1,2-DCA	10
1,2-DCE (TOTAL)	350
TCE	17
VINYL CHLORIDE	270
XYLENE (TOTAL)	21
PHENOL	9
MANGANESE	137

DR-1

COMPOUND	CONC. (µg/L)
BENZENE	35
CHLOROBENZENE	11
1,1-DCA	1,000
1,1-DCE	27
1,2-DCA (TOTAL)	640
TCE	59
VINYL CHLORIDE	320

MW-2D(N)

COMPOUND	CONC. (µg/L)
1,1-DCA	10

Figure 2-8 GROUNDWATER CONTAMINANTS DETECTED ABOVE CLEANUP OBJECTIVES DEARCOP FARM SITE

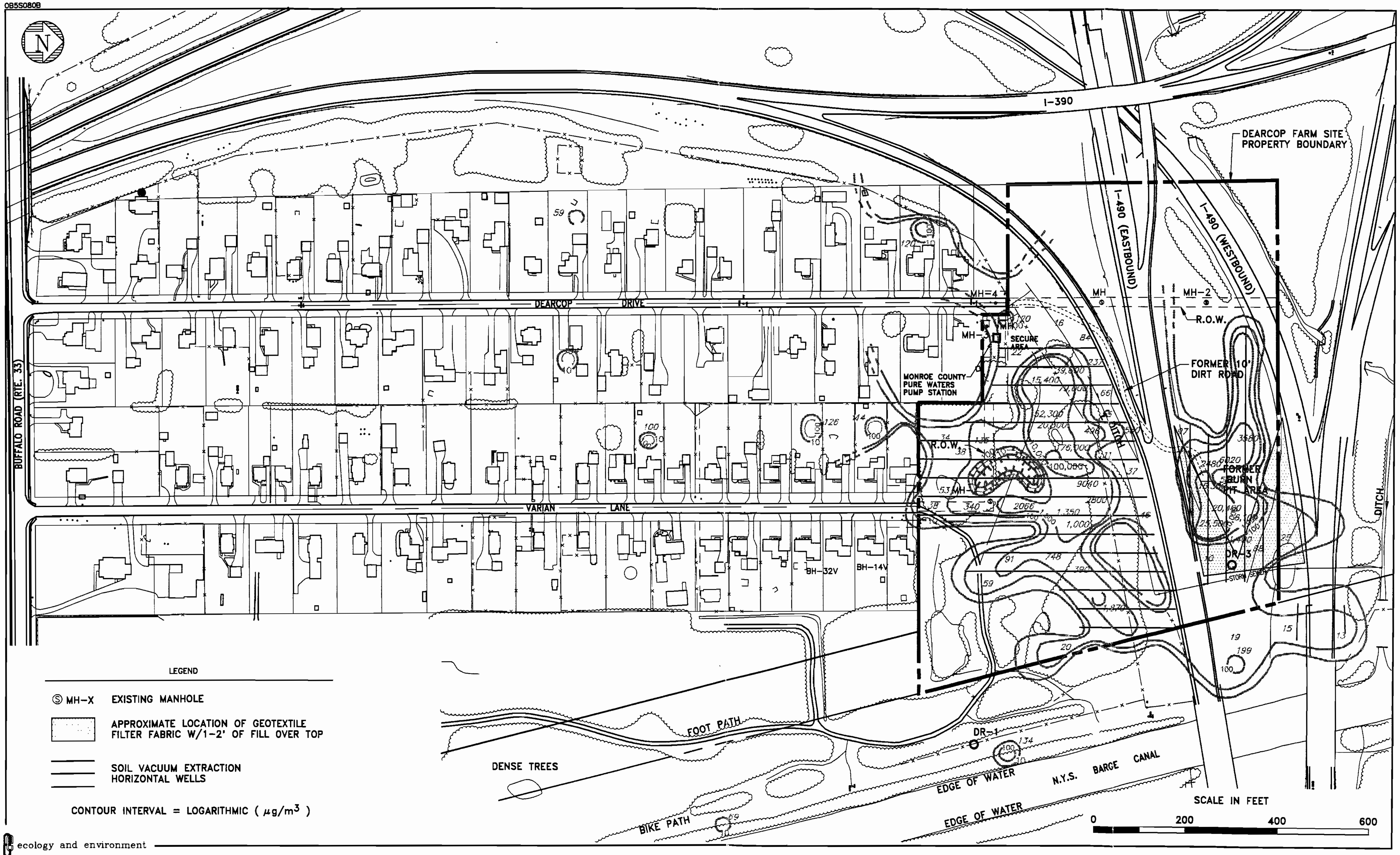

Figure 2-9 CONCEPTUAL LAYOUT OF SVE HORIZONTAL WELLS

3. DETAILED ANALYSIS OF ALTERNATIVES

In this section, Phase III of the FS, each of the five comprehensive site-wide alternatives are evaluated in detail. As necessary, additional definition of the alternatives is provided to better present a basis for cost estimation. Each alternative is then individually analyzed with regard to the following seven criteria presented in the scope of work:

- Overall Protection of Human Health and the Environment;
- Compliance with ARARs;
- Short-term Impacts and Effectiveness;
- Long-term Effectiveness and Performance;
- Reduction of Toxicity, Mobility, or Volume;
- Implementability; and
- Cost.

These factors are discussed in the following section.

Overall Protection of Human Health and the Environment

This criterion will provide a final check to assess whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Evaluation of the overall protectiveness of an alternative will focus on whether a specific alternative achieves adequate protection and will describe how site risks posed through each pathway being addressed by the FS are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation will allow for consideration of whether an alternative poses any unacceptable short- term or cross-media impacts.

Compliance with ARARs

This evaluation criterion will be used to determine whether each alternative will meet all of its identified federal and state ARARs.

The detailed analysis will summarize which requirements are applicable, relevant, and appropriate to an alternative and describe how the alternative meets these requirements.

Short-Term Impacts and Effectiveness

This evaluation criterion will address the effects of the alternative during the construction and implementation phase until remedial response objectives are met. Under this criterion, alternatives will be evaluated with respect to their effects on human health and the environment during implementation of the remedial action.

Long-Term Effectiveness and Permanence

The evaluation of alternatives under this criterion will address the results of the remedial action in terms of the risk remaining at the facility after response objectives have been met. The primary focus of this evaluation will be the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. Such an evaluation is particularly important to all alternatives.

Reduction of Toxicity, Mobility, or Volume

This evaluation criterion will address the regulatory preference for selecting remedial actions that employ treatment technologies permanently and significantly reducing the toxicity, mobility, or volume of the contaminants. This preference is satisfied when treatment is used to reduce the principal risks at a site through destruction of contaminants, for a reduction of total mass of contaminants, to attain irreversible reduction in mobility, or to achieve reduction of the total volume of contaminated media.

Implementability

The implementability criterion will address the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation.

Cost

Detailed cost analysis of the selected remedial alternatives will include the following steps:

- Estimation of capital, operations and maintenance (O & M), and institutional costs; and
- Present worth analysis.

Costs developed during the FS are expected to provide an accuracy of plus 50% to minus 30%.

Following the individual analyses, the five alternatives are comparatively evaluated to highlight specific advantages and disadvantages of the several alternatives.

3.1 ALTERNATIVE 1: NO ACTION

The No Action Alternative provides no remedial effort and thus does not require much further definition. Groundwater will, however, be monitored under this alternative. For costing purposes, it is assumed that 19 existing wells will be sampled semiannually for 30 years. These samples will be analyzed for volatile organics and TAL metals.

A detailed analysis of Alternative 1 against the seven criteria is presented in Table 3-1 and is summarized below. Because this alternative provides no remedial action, estimated risks at the site will continue to exceed 10^{-6} excess cancer deaths through the direct contact exposure routes. This alternative would also not meet chemical-specific ARARs for PCBs in soil and for several organics and metals in groundwater. These risks would persist over the long term. Although some natural attenuation of groundwater contaminants may occur, this may be offset by potential additional contributions to groundwater contamination from remaining contaminated soil/fill sources. This alternative provides for no reduction in toxicity, mobility, or volume. There would, however, be no short-term impacts. There are no technical obstacles to implementing this alternative. However, because ARARs would still be exceeded, it may be administratively difficult to implement this alternative.

Costs for this alternative arise from monitoring expenses. There are no capital costs because existing wells would be used. Annual O & M costs are estimated at $32,400 (see Table 3-2). The net present worth of this alternative, assuming a 6% discount rate, is estimated at $374,000.

3.2 ALTERNATIVE 2: INSTITUTIONAL ACTIONS

Institutional controls would include local regulatory restrictions on construction, land use, and groundwater use. Recommendations regarding the type or extent of such restrictions would be made to appropriate agencies or boards (i.e., local planning or zoning boards) as the final project plans are developed. A fence would be constructed around the contaminated area, as depicted in Figure 2-4. Groundwater monitoring would be included in this alternative to the same extent as with Alternative 1.

A detailed analysis of Alternative 2 against the seven criteria is presented in Table 3-1 and is summarized below. Institutional controls would be designed to reduce the possibility of the exposure routes identified in the risk assessment that contribute to appreciable risk at the site. However, with the exception of groundwater controls, these actions may not be sufficient to reduce the risk. For example, high risks are estimated for adolescent trespassers. Institutional controls may not be sufficient to stop this exposure route. Although groundwater consumption would be restricted by these controls, no such consumption is currently occurring, and this route was not considered in the risk assessment.

ARARs would continue to be exceeded for PCBs in soil and for several VOCs and metals in the groundwater. Existing risks would be expected to remain over the long term. However, there would be no short-term impacts from this alternative. This alternative provides no reduction in the toxicity, mobility, or volume of contamination.

Costs for this alternative arise from fencing and monitoring expenses. The cost of fence construction is estimated at $177,000. Annual O & M costs are estimated at $28,400 (see Table 3-3). The net present worth of this alternative, assuming a 6% discount rate, is estimated at $568,500.

3.3 ALTERNATIVE 3: CONSOLIDATION AND CAPPING OF SOIL/FILL MATERIAL AND SEDIMENT; INSTITUTIONAL CONTROLS/NATURAL ATTENUATION FOR GROUNDWATER

A detailed description of the consolidation and capping component of this alternative is presented in section 2.5.1.3. For costing purposes, it is assumed that only two residential yards would have to be excavated and consolidated within the capped area. Institutional controls for groundwater would be as described in the previous section. They would essentially consist of restrictions on groundwater usage. To continue effective groundwater monitoring, four new monitoring wells would be installed to replace the six that would be abandoned to allow construction of the cap.

This alternative would effectively remove the routes of exposure that contribute to the existing risks at this site. Capping would prevent direct exposure to soils. No existing exposure routes exist for groundwater; institutional controls would effectively continue this situation. Capping would also significantly reduce the rate of contaminant migration from the source soil/fill material to the groundwater, allowing natural attenuation to reduce groundwater contaminant concentrations, although ARARs may eventually not be met for all species. The cap would require continued maintenance to retain its effectiveness over the long term.

This alternative would entail some short-term impacts from the cap construction. These impacts would include increased dust and noise generation from construction equipment. Site workers would require protection against direct contact with the contaminants. However, because the majority of the contaminated material would be left in the ground, potential exposures would not be considered to be significant.

This alternative does not directly reduce the mobility, toxicity, or volume of any of the contaminants present at the site. However, contaminant migration would be reduced because of the significant reduction of water infiltration through contaminated soil and subsequent groundwater recharge resulting from the installation of a cap over the areas that would otherwise act as sources.

There are no technical or administrative obstacles to implementing this alternative. Cap construction is straightforward, and there are many firms available to perform this work. Monitoring of excavated areas (for consolidation) and of groundwater would allow easy monitoring of the effectiveness of this alternative.

Estimated costs are presented in Table 3-4 (capital) and Table 3-5 (O & M and net present worth). O & M costs are estimated assuming 13 existing wells and four new wells would be sampled semiannually and analyzed for volatiles, semivolatiles, pesticides/PCBs, VOCs, and TAL metals. Capital costs are estimated at $1,670,000. Annual O & M costs are estimated at $27,400. The total net present worth of this alternative, assuming a discount rate of 6%, is estimated at $2,050,000.

3.4 ALTERNATIVE 4: CONSOLIDATION, CAPPING, AND VACUUM EXTRACTION OF SOIL/FILL MATERIAL AND SEDIMENT; INSTITUTIONAL CONTROLS/NATURAL ATTENUATION FOR GROUNDWATER

This alternative is similar to Alternative 3. However, this alternative is augmented with the addition of soil vacuum extraction (SVE) of soil/fill material to remove volatile contaminants. A description of the SVE component of this alternative is presented in Section 2.5.1.4.

SVE would treat soil exhibiting soil gas measurements above 10 $\mu g/m^3$ as shown on Figure 2-9. This area, which is slightly larger than the area that would be capped (see Figure 2-4) is greater than 10 acres, while the depth of soil is as shallow as 15 feet. Because of the large area and relatively shallow depths, a horizontal well system would be employed. This system would be installed via excavation of trenches, and installation of perforated piping to a depth of about 10 feet. A typical horizontal well layout is shown in Figure 2-9.

Approximately 6,000 linear feet of horizontal wells are estimated to be required south of the highway, with an additional 1,700 linear feet in the highway median. This is based on an assumed radius of influence of 20 feet per well. Since the well network would traverse some of the most highly contaminated sections of the landfill, areas of gross contamination, such as buried drums or nonaqueous phase liquids (NAPL) could potentially be encountered. Such grossly contaminated material would be packaged and shipped off site for disposal. For costing purpose, it is assumed that approximately 2% of the material excavated for horizontal well installation (or 635 yd^3), would require off-site treatment and/or disposal of a RCRA-regulated facility.

Extracted vapors are assumed to be treated via thermal oxidation, using propane as fuel. It is further assumed that off-gas treatment would be required for only one year, after which vapor concentrations would decrease and could be discharged directly. It is assumed that five years of operation would be required to achieve removal of all accessible VOCs.

This alternative, like Alternative 3, would effectively remove routes of exposure that currently exist at the site. In addition, vacuum extraction provides permanent removal and destruction of VOCs from the soil/fill material. Some remediation of the groundwater would also be achieved through vacuum extraction. Reduced pressures and convection in the vadose zone cause a concentration gradient from the groundwater to the vadose zone. Though mass transfer rates are not high, volatiles would diffuse to the capillary zone and be removed and vaporize. This process would be enhanced at the Dearcop Farm site because of the cyclical changes in groundwater table elevation. The water table rises and falls each year due to the filling and draining of the adjacent Barge Canal. This fluctuating water level would promote additional transfer VOCs from within the aquifer to the capillary zone, increasing removal rates. Also, the rise, followed by fall of the water table, brings VOCs that would adsorb to the aquifer matrix, remaining behind as the level recedes. These VOCs would be available for direct removal through the vacuum extraction system. This action would only be effective on VOCs in the soil/fill material and groundwater. Metals and PCBs would remain in the soil. Metals would continue to exceed ARARs in the groundwater, although their levels would decrease over time because of natural attenuation. The rate of natural attenuation would increase due to the role of the cap in reducing infiltration, and thus minimizing production of additional contaminated groundwater.

This alternative would entail some short-term impacts from the cap construction. These impacts would include increased truck traffic and increased dust and noise generation from construction equipment. These short-term impacts would require special attention for mitigative measures due to the proximity of a residential area. Noise and dust suppression measures would be required. The vacuum compressors for the SVE system could potentially create unacceptable levels of noise. Mitigative measures such as sound battling and modified operational schedules may have to be considered to prevent unnecessary disruption to adjacent residents.

Site workers would require protection against direct contact with the contaminants. However, because the majority of the contaminated material would be left in the ground, potential exposures would not be considered to be significant.

This alternative would provide reduction in the toxicity of VOCs. Extracted VOCs would be captured on activated carbon. The carbon would be shipped off site for regeneration. During regeneration, the contaminants would be oxidized and destroyed. Alternatively, the carbon could be landfilled, rather than regenerated. In this case, a reduction in volume will have been accomplished.

This alternative is easily constructed. There are several firms that supply cap construction or vacuum extraction services. Vacuum extraction design and operation would require a pilot study to define operating parameters. After construction, it may be difficult, but not impossible, to modify the vacuum extraction system. Because the system would be installed through the cap, it would not be preferable to have to remove vacuum extraction wells or air vents, which could cause breaches in cap integrity. Likewise, adding more wells would also require measures to ensure cap integrity. The presence of the cap would also limit the ability of taking future soil gas or soil grab samples to evaluate the effectiveness of the treatment. However, these potential obstacles are not too great to bar its implementation.

The estimated capital and O & M costs are presented in Tables 3-6 and 3-7, respectively. O & M costs include both costs for groundwater sampling and analysis (using the same program as assumed for Alternative 3) and for the vacuum extraction system operation. Without conducting a pilot study, it is not possible to accurately determine the time frame needed to achieve cleanup at the site. For purposes of cost estimation, a treatment duration of 5 years was assumed. This is based on an assumed permeability of 10^{-4} to 10^{-5} cm/sec (which is typical for the types of glacio-lacustrine soils found at the site) and experience with chlorinated hydrocarbon contamination at similar sites. The capital cost is estimated at $2,900,000. Annual O & M costs are estimated at $98,200 for the first five years, and $27,400 thereafter (after completion of the vacuum extraction). The net present worth is estimated to be $3,580,000.

3.5 ALTERNATIVE 5: EXCAVATION AND OFF-SITE DISPOSAL OF SOIL/FILL MATERIAL AND SEDIMENT; EXTRACTION, TREATMENT, AND DISPOSAL OF GROUNDWATER

This alternative calls for the excavation of about 15,550 cubic yards of soil/fill material from the highway median area, about 10,000 cubic yards from the area south of the highway, and about 1,140 cubic yards of drainage ditch sediments (based on an assumed sediment depth of 6 inches). The areas to be excavated are presented on Figures 2-4 and 2-7. Most of the soil would be classified as nonhazardous and could be disposed of in a conventional nonhazardous landfill. Some of the soil from the site would be classified as hazardous. In addition to several areas of PCB-contaminated soil, a sample from Test Pit 5 failed TCLP criteria for chromium. These soils, estimated to be 5% of the total volume excavated, would have to be sent to a RCRA-permitted facility for treatment and/or disposal. Clean fill would be used to backfill areas excavated.

Groundwater would be extracted, treated, and discharged. Extraction would be through three to four wells screened at the bedrock/overburden interface (approximately 15 feet BGS). Because relatively low transmissivities were observed in site monitoring wells during purging prior to sampling, a total of only 10 gallons per minute (gpm) is expected to be collected. At least one well would be located in the highway median. Water extracted by this well would have to be pumped under the roadway to a treatment system located south of the highway. A pump test would have to be conducted during design to determine the flow rate required to capture the plume and to provide a concentration basis for designing the treatment system. The treatment system would consist of a metals precipitation/sedimentation system, followed by carbon adsorption. Precipitation would likely be accomplished by adjusting pH to a level optimized for removal of the metal present. Precipitated metals would be removed in a sedimentation vessel or a parallel plate settler. Sedimentation would be enhanced through the addition of flocculants. After clarification, the water would be sent through a bag filter to remove fine particles that would otherwise clog downstream carbon beds. Carbon, as the last component of the treatment train, would remove organics such as chlorinated or aromatic hydrocarbons. Treated water would be discharged to a local POTW. Depending on pretreatment requirements negotiated with the POTW, the treatment train may not need to be as extensive as described below. For example, metals concentrations may not need to be reduced prior to discharge.

By removal of contaminants from the site (soil/fill materials and sediment immediately, and groundwater contaminants over a number of years), this alternative would comply with all chemical-specific ARARs and provide a high level of protection of human health and the environment over the long term. Short-term impacts would be greater for this alternative than, for example, capping. Thousands of truckloads of soil would be removed, creating temporary dust and noise impacts. Off-site transport of contaminated media also poses the possibility of potential releases of hazardous wastes at shipment terminal points or *en route*. The mitigative requirements discussed for Alterative 4 would take on even greater importance for this alternative.

This alternative would reduce the toxicity, mobility, and/or volume of groundwater contamination. Metals would be concentrated into sludge, reducing their volume. The sludge may eventually be solidified at its final disposal area, in which case mobility would be reduced. Organics volume would be reduced through adsorption on carbon. The organics may also be oxidized later if the carbon is regenerated, in which case toxicity would also be reduced. This alternative provides no intrinsic reduction in the toxicity, mobility, or volume of contaminated soil/fill material and sediment. However, contaminants in these media would have restricted mobility because of their placement in a landfill, which would have controls on leachate generation and migration.

This alternative is readily implementable. Equipment and vendors are available to provide the necessary services. The remedy is readily scaled to include more or less contamination should such conditions be found during implementation. Removal of soil from the highway median would require coordination with NYSDOT. However, this would not prohibit the implementation of this alternative.

The estimated capital and O & M costs of this alternative are presented in Tables 3-8 and 3-9, respectively. These costs assume groundwater treatment will meet cleanup objectives or will be able to produce no further increases in water quality in 10 years. Groundwater monitoring is assumed to be required only for 10 years. The capital costs are estimated at $6,010,000. This assumes 1,280 cubic yards of soil are sent to a RCRA/TSCA-permitted facility, with the rest being sent to a nonhazardous landfill. O & M costs are estimated based on a groundwater treatment duration of 10 years. Actual treatment duration may be greater or less. The time to remediation would be better estimated after conducting pump tests and modeling during the design. Annual O & M costs are estimated at $54,000. The net present worth is estimated at $6,410,000.

3.6 COMPARATIVE ANALYSIS OF ALTERNATIVES

3.6.1 Overall Protection of Human Health and the Environment

The risk assessment has estimated risks from the site soil/fill material to exceed 10^{-6} excess cancer deaths. Alternative 1 would thus not be protective of human health. The institutional controls of Alternative 2 may also not be sufficient to adequately reduce these risks. All other alternatives do provide adequate overall protection of human health and the environment.

3.6.2 Compliance with ARARs

The site exceeds chemical-specific ARARs for PCBs in soil and for several contaminants in groundwater. Alternatives 1 and 2 include no remedial action and thus would not address these exceedances. Alternatives 3 and 4 address the PCBs in soil/fill material by containment. Although the PCBs would remain, they would not be subject to exposure. Alternatives 3 and 4 also significantly reduce water infiltration through contaminated soil/fill material. This will retard any growth of the plume and enable natural attenuation to reduce contaminant concentrations in the groundwater. Natural attenuation would be much less of a factor for Alternatives 1 and 2 because water infiltration through contaminated areas would generate new contaminated groundwater. Alternative 4 would provide a greater level of groundwater cleanup than Alternative 3. Through vacuum extraction (aimed principally at removing VOCs from the vadose zone), some VOCs in the groundwater would be removed as vapors, thus accelerating the decease in the concentrations of these compounds. Metals would be unaffected by this technology. Alternative 5 would actively remove chemical-specific ARARs exceedances through direct soil and groundwater removal. Groundwater contaminant removal may be limited by the rate at which groundwater can be extracted.

Alternatives 4 and 5 include treatment processes that may require compliance with action-specific ARARs. Alternative 4 would produce an off gas that may require treatment. Sludge and spent carbon generated by Alternative 5's groundwater treatment system may be subject to RCRA disposal restrictions. Alternative 5 would also include the excavation and disposal of RCRA-regulated wastes. RCRA land disposal restrictions would have to be followed in this case.

3.6.3 Short-Term Impacts and Effectiveness

Alternatives 1 and 2 would have no short-term impacts. Alternatives 3 and 4 would have some short-term impacts during cap construction. These would include increased noise, dust production, and truck traffic. Alternative 4 would also present an additional short-term increase in noise due to the operation of the SVE extraction compressors. Alternative 5 would provide the greatest amount of short-term impacts because of the greater amount of construction activity involved with excavating and transporting all contaminated soil/fill material. Alternative 5's short-term impacts would be quite significant due to the proximity of residential areas.

3.6.4 Long-Term Effectiveness and Performance

Alternatives 1 and 2 would not be effective in the long or short terms. Alternatives 3 and 4 employ capping to remove exposure routes. Without maintenance of the cap, weathering could conceivably reduce its effectiveness over the long term. However, a proactive maintenance program would avoid this situation. Alternative 5 completely removes contaminated media, thus ensuring long-term effectiveness. However, long-term proactive maintenance would be required at the landfill where the soil/fill material and sediments were disposed.

3.6.5 Reduction of Toxicity, Mobility, or Volume

Alternatives 1, 2, and 3 provide no reduction in toxicity, mobility, or volume. Alternative 3, however, would reduce the rate of migration of contaminants by reducing precipitation infiltration by installing a cap. Alternative 4 would remove and destroy VOCs in the vadose zone, and, to a lesser extent, in the groundwater via vacuum extraction. Alternative 5 provides no reduction of toxicity, mobility, or volume to soil/fill material and sediments media. Alternative 5 would, however, treat groundwater contaminants. Metals would be treated with precipitation and sedimentation, and organics by carbon adsorption, resulting in a volume reduction. Additional treatment may be employed during final disposal of the sludge and spent carbon generated by this treatment train.

3.6.6 Implementability

All alternatives are technically implementable. Alternatives 3, 4, and 5 would require construction activities in the highway median. Although this would cause some logistics problems, they would not be insurmountable. Alternatives 1 and 2 may be administratively difficult to implement because they do not address the ARAR exceedances present at the site.

3.6.7 Cost

Alternatives 1 and 2, which include no or minimal action, are the least expensive alternatives at estimated net present worths of $374,000 and $568,500, respectively. These costs are due primarily to monitoring costs. Alternatives 3 and 4 are more expensive at estimated net present worths of $2,050,000 and $3,580,000, respectively. The difference between these two alternatives is the addition of vacuum extraction to Alternative 4. This adds an estimated $1,530,000 to the remedial project. Alternative 5 is much more expensive at an estimated net present worth of $6,410,000. This high cost is in spite of a shorter assumed period of groundwater monitoring (10 years versus 30 years for other alternatives). The cost of this alternative is high due to the large volume of material requiring landfilling. Most of the volume estimated is based on surficial contamination. The cost of this alternative could increase dramatically if more contaminated material is found at depth during excavation than had been identified in the RI.

Table 3-1

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria	1. No Action	2. Institutional Controls	3. Consolidation and Capping of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	4. Consolidation, Capping, and Vacuum Extraction of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	5. Excavation and Off-site Disposal of Soil/Fill Material and Sediment; Extraction, Treatment, and Disposal of Groundwater
Overall protection of human health and the environment	The risk assessment estimated potential excess cancer risks at the site to exceed 10^{-6} under current conditions. Thus, the No-Action Alternative would not provide human health protection.	Institutional controls would reduce the potential exposure routes considered in the risk analysis. However, they may not be fully effective in providing overall protection to human health or the environment. The estimated risk for trespassers (who may circumvent institutional controls) exceeds 10^{-6}.	The alternative would effectively remove routes of exposure that contribute to existing risks at the site, thus providing a significant level of protection to human health and the environment.	This alternative would effectively remove routes of exposure that contribute to existing risks at the site. In addition, vacuum extraction provides additional, permanent removal and destruction of volatile organic contaminants. Thus, this alternative provides a significant level of protection to human health and the environment.	By removal of contaminants from the site, this alternative provides a significant level of protection of human health and the environment.
Compliance with ARARs - Chemical-specific ARARs	ARARS would continue to be exceeded in the groundwater at the site. PCBs would exceed ARARS in the soil.	ARARS would continue to be exceeded in the groundwater at the site. PCBs would exceed ARARS in the soil.	ARARs would continue to be exceeded in the groundwater at the site over the short term. PCBs above RCRA ARARs would remain in the soil; however, exposure routes to these compounds would be eliminated through capping. Cap construction would reduce infiltration, thus accelerating natural attenuation actions.	ARARS would, to a certain extent, continue to be exceeded in the groundwater over the short term. Vacuum extraction of soils would both remove potential sources of additional groundwater contamination, as well as directly remediate volatile organics in groundwater. Provision of convection and low pressures in the vadose zone can volatilize some organics in the groundwater. Cap construction would reduce infiltration, thus accelerating natural attenuation actions.	This alternative would meet chemical-specific ARARs. Attainment of groundwater ARARs may take a long time, and possibly might not be met for all contaminants. Low permeability of the aquifer and a constantly changing water table make effective extraction difficult.

Table 3-1

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria	1. No Action	2. Institutional Controls	3. Consolidation and Capping of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	4. Consolidation, Capping, and Vacuum Extraction of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	5. Excavation and Off-site Disposal of Soil/Fill Material and Sediment; Extraction, Treatment, and Disposal of Groundwater
- Action-specific and location-specific ARARs	No action specific or location specific ARARs apply to this alternative.	No action specific or location specific ARARs apply to this alternative.	No RCRA hazardous waste is expected to require consolidation. If RCRA waste is found outside the area to be capped, it would not be eligible for consolidation within the capped area unless this action were considered to be within a single RCRA Corrective Action Management Unit (CAMU). Waste may be consolidated within a CAMU without invoking RCRA land disposal restrictions.	No RCRA hazardous waste is expected to require consolidation. If RCRA waste is found outside the area to be capped, it would not be eligible for consolidation within the capped area unless this action were considered to be within a single RCRA CAMU. Some RCRA wastes may be encountered during excavation for SVE horizontal well installation. While this soil/material may be backfilled on site as part of a single solid waste management unit, some grossly contaminated material may be shipped off site for disposal. Some of this material may exhibit the hazardous characteristic of toxicity, and would thus have to meet (possibly through treatment) RCRA land disposal restriction treatment standards prior to disposal. Air emissions from the vacuum extraction system may have to be regulated under an air discharge permit. This may require installation of pollution control devices such as vapor phase carbon canisters. Spent carbon would have to be disposed of in accordance with applicable regulations.	Some areas contain metals to the extent that TCLP assays exceed RCRA standards. Soils contaminated with PCBs are also considered hazardous in New York. These soils will have to be segregated upon excavation and treated and/or disposed of in a RCRA-permitted facility. Sludge generated by the groundwater treatment system may also be characteristically hazardous, and would have to be treated and disposed of in a RCRA-permitted facility.

Table 3-1

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria	1. No Action	2. Institutional Controls	3. Consolidation and Capping of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	4. Consolidation, Capping, and Vacuum Extraction of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	5. Excavation and Off-site Disposal of Soil/Fill Material and Sediment; Extraction, Treatment, and Disposal of Groundwater
Short-term impacts and effectiveness	No short-term impacts.	No short-term impacts.	This alternative will require heavy construction, resulting in temporary increases in dust production, noise disturbance, and truck traffic while the cap is being placed. Most contaminated soil would remain undisturbed, significantly reducing short-term exposure. Site workers would require protection against dermal contact and inhalation of contaminated particulates and/or VOCs during alternative implementation.	See alternative 3. Additional short-term impacts may be caused by excessive noise from SVE vacuum compressors.	Similar to alternative 3, except the contaminated soil, fill, and sediments would be excavated and transported to an off-site disposal facility, increasing the possibility of short-term exposure. The amounts of dust, noise, and truck traffic would also be significantly increased. Off-site transport of contaminated media poses the possibility of potential releases of hazardous wastes at shipment terminal points or enroute.

Table 3-1

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria	1. No Action	2. Institutional Controls	3. Consolidation and Capping of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	4. Consolidation, Capping, and Vacuum Extraction of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	5. Excavation and Off-site Disposal of Soil/Fill Material and Sediment; Extraction, Treatment, and Disposal of Groundwater
Long-term effectiveness and performance	As no action would be performed, this alternative provides no long-term protection of human health or the environment.	Institutional actions provide controls that limit exposure to contaminants. However, these controls may not be maintained over the long term. Potential breakdown in controls limits the long-term effectiveness of this alternative.	Risks posed by soil/fill/sediment contaminants through the potential exposure pathways of inhalation, dermal adsorption, and ingestion would be eliminated as long as the cap was properly maintained. Because the source is only contained, potential long-term threats would remain, should the remedy fail. Long-term pro-active maintenance of the cap would be required to ensure long-term effectiveness. By capping the site, groundwater migration would be retarded through lack of direct recharge. This would allow groundwater contamination to naturally attenuate over the long term. Natural attenuation may or may not achieve groundwater cleanup goals over the long term.	Similar to alternative 3, except long-term effectiveness would be enhanced via the removal of volatile organic contaminants through vacuum extraction. This would reduce the chances of potential long-term threats caused by future cap failure. Also, groundwater natural attenuation would be accelerated for volatile organics through partial removal from groundwater as vapors.	Off-site disposal of contaminated soil/fill/sediments would eliminate on-site exposure risks for the material. Groundwater remediation may be more effective in the long term due to an active pump and treat program. However, it may still take quite a while to meet groundwater cleanup goals. Groundwater remediation effectiveness is limited by low permeability, aquifer media, and an unstable water table level due to fluctuating Barge Canal water levels.

Table 3-1

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria	1. No Action	2. Institutional Controls	3. Consolidation and Capping of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	4. Consolidation, Capping, and Vacuum Extraction of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	5. Excavation and Off-site Disposal of Soil/Fill Material and Sediment; Extraction, Treatment, and Disposal of Groundwater
Reduction of toxicity, mobility, or volume	No reduction in the toxicity, mobility, or volume of contaminated media.	No reduction in the toxicity, mobility, or volume of contaminated media.	This alternative provides no intrinsic reduction in the toxicity, mobility, or volume of contaminated media. However, contaminant migration will be reduced due to significant reduction of water infiltration through contaminated soil and subsequent groundwater recharge. This reduction would be due to the installation of an impermeable cap over the contaminated zone.	Similar to alternative 3, except there would be significant reductions in toxicity of volatile organic contaminants (VOCs). VOCs would be removed from the soil (and to a lesser extent, the groundwater) through vacuum extraction. Recovered vapors would either be captured as condensate or on carbon, or be directly destroyed through thermal or catalytic oxidation. Captured VOCs would eventually be destroyed or recycled off site.	This alternative would reduce the toxicity, mobility, and/or volume of contaminants recovered from the groundwater. Metals would be concentrated into a sludge, reducing their volume. The sludge may eventually be solidified at its final disposal area, in which case mobility would also be reduced. Organics volume would be reduced through adsorption onto carbon. The organics may also be oxidized later if the carbon is regenerated, in which case, toxicity would also be reduced. These reductions in mobility, toxicity, and/or volume would only be achieved on contaminants removed from the aquifer. This alternative provides no intrinsic reduction in the toxicity, mobility, or volume of contaminated soil/fill/sediment. However, contaminants in these media would have restricted mobility due to their placement in a landfill, which would have controls on leachate migration.

Table 3-1

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria	1. No Action	2. Institutional Controls	3. Consolidation and Capping of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	4. Consolidation, Capping, and Vacuum Extraction of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	5. Excavation and Off-site Disposal of Soil/Fill Material and Sediment; Extraction, Treatment, and Disposal of Groundwater
Implementability	There are no technical obstacles to implementation. However, because ARARs would be exceeded for PCBs in soil and for several contaminants in the groundwater, this alternative may not be administratively feasible.	See alternative 1.	The technology needed to implement this alternative is readily available and implementable. Confirmation sampling of areas excavated for consolidation, and monitoring of groundwater allow easy monitoring of the effectiveness of this alternative.	The technology needed to implement this alternative is readily available and implementable. Many firms provide cap construction or vacuum extraction services. Vacuum extraction design and operation would have to be developed with results of a pilot study. This study would provide data on where to install wells, vapor flow rates achievable, and whether fresh air vents would be required. Even with careful design, some modification of the vacuum extraction system may be required after construction. Because the extraction wells would be located in the capped area, it may be difficult to abandon wells or establish new wells while still maintaining the integrity of the cap. The presence of the cap would also limit direct measurement of vacuum extraction performance. However, performance could be adequately monitored through measurement of contaminant vapor concentrations. Natural attenuation of the groundwater (partially enhanced through vacuum extraction) could easily be monitored with monitoring wells.	The technology needed to implement this alternative is readily available. Capacity exists to accept excavated soil/fill/sediment for disposal. Many firms supply equipment for metals, precipitation, and carbon absorption treatment. Confirmation sampling of excavated areas and groundwater monitoring allow easy monitoring of the effectiveness of this alternative.

Table 3-1

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria	1. No Action	2. Institutional Controls	3. Consolidation and Capping of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	4. Consolidation, Capping, and Vacuum Extraction of Soil/Fill Material and Sediment; Institutional Controls/Natural Attenuation for Groundwater	5. Excavation and Off-site Disposal of Soil/Fill Material and Sediment; Extraction, Treatment, and Disposal of Groundwater
Cost					
Capital	$0	$177,000	$1,670,000	$2,900,000	$6,010,000
O & M	$32,400	$28,400	$27,400	$27,400 to $98,200	$54,000
Present Worth	$374,000	$568,500	$2,050,000	$3,580,000	$6,410,000

TABLE 3-2

Alternative 1: No Action

Operation and Maintenance Costs

interest rate (%) 6
operation and maintenance (years) 30

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:				
(19 existing wells)				
sample collection	42	ea	$125.00	$5,250
sample analysis				
VOAs	42	ea	$200.00	$8,400
Metals	42	ea	$150.00	$6,300
Data Validation	42	ea	$35.00	$1,470
Report Writing	2	ea	$960.00	$1,920
SUBTOTAL O&M				$23,340
8% Legal, Administrative, & Engineering Fees-				$1,714
10% Contingencies-				$2,142
TOTAL O&M COSTS				$27,196
TOTAL O&M PRESENT WORTH				**$374,343**
TOTAL CAPITAL COSTS				**$0**
GRAND TOTAL COST				**$374,343**

TABLE 3-3

Alternative 2: Institutional Actions

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$5,680.00	$5,680
health and safety	10	day	$700.00	$7,000
fencing	9,000	lf	$15.00	$135,000
SUBTOTAL CAPITAL				$147,680
10% Legal, Administrative, & Engineering Fees-				$14,768
10% Contingencies-				$14,768
TOTAL CAPITAL COSTS				**$177,216**

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	30

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:				
(19 existing wells)				
sample collection	42	ea	$125.00	$5,250
sample analysis				
VOAs	42	ea	$200.00	$8,400
Metals	42	ea	$150.00	$6,300
Data Validation	42	ea	$35.00	$1,470
Report Writing	2	ea	$960.00	$1,920
Fence repair/maintenance	1	ls	$750.00	$750
SUBTOTAL O&M				$24,090
8% Legal, Administrative, & Engineering Fees-				$1,927
10% Contingencies-				$2,409
TOTAL O&M COSTS				$28,426
TOTAL O&M PRESENT WORTH				**$391,282**
TOTAL CAPITAL COSTS				**$177,216**
GRAND TOTAL COST				**$568,498**

TABLE 3-4

Alternative 3: Consolidation and Capping for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$51,450.00	$51,450
site services	6	month	$35,000.00	$210,000
health and safety	132	day	$700.00	$92,400
clearing/grubbing	7	acre	$1,200.00	$8,400
surveying	1	ls	$5,000.00	$5,000
decon pad	1	ls	$7,500.00	$7,500
staging area	1	ls	$10,000.00	$10,000
fencing	9,000	lf	$15.00	$135,000
well decommissioning	6	ea	$430.00	$2,580
replacement wells (4)	50	lf	$125.00	$6,250
Consolidation:				
excavate soil	1,000	cy	$3.00	$3,000
move fill	1,000	cy	$3.70	$3,700
sampling of bottom soils	50	ea	$750.00	$37,500
backfill/grading	1,000	cy	$15.00	$15,000
Topsoil, seeding, &mulch	5,500	sy	$5.00	$27,500
Capping:				
compaction and grading	34,400	sy	$1.55	$53,320
site improvements (culverts)	1	ls	$10,000.00	$10,000
12"-sand gas vent layer	34,400	sy	$7.00	$240,800
60-mil HDPE Geomembrane	34,400	sy	$4.25	$146,200
18"-soil layer	34,400	sy	$2.75	$94,600
6" topsoil,seeding & mulch layer	34,400	sy	$5.16	$177,504
SUBTOTAL CAPITAL				$1,337,704
10% Legal, Administrative, & Engineering Fees-				$133,770
15% Contingencies-				$200,656
TOTAL CAPITAL COSTS				**$1,672,130**

TABLE 3-5

Alternative 3: Consolidation and Capping for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	30

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:				
(17 wells)				
sample collection	38	ea	$125.00	$4,750
sample analysis				
VOAs	38	ea	$200.00	$7,600
Metals	38	ea	$150.00	$5,700
Data Validation	38	ea	$35.00	$1,330
Report Writing	2	ea	$960.00	$1,920
Fence repair/maintenance	1	ls	$750.00	$750
Cap maintenance				
Cap repair	1	ls	$1,175.00	$1,175
SUBTOTAL O&M				$23,225
8% Legal, Administrative, & Engineering Fees-				$1,858
10% Contingencies-				$2,323
TOTAL O&M COSTS				$27,406
TOTAL O&M PRESENT WORTH				**$377,232**
TOTAL CAPITAL COSTS				**$1,672,130**
GRAND TOTAL COST				**$2,049,362**

TABLE 3-6

Alternative 4: Consolidation and Capping with Soil Vapor Extraction for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$89,270.00	$89,270
site services	6	month	$35,000.00	$210,000
health and safety	132	day	$700.00	$92,400
clearing/grubbing	7	acre	$1,200.00	$8,400
surveying	1	ls	$5,000.00	$5,000
decon pad	1	ls	$7,500.00	$7,500
staging area	1	ls	$10,000.00	$10,000
fencing	9,000	lf	$15.00	$135,000
well decommissioning	6	ea	$430.00	$2,580
replacement wells (4)	50	lf	$125.00	$6,250
Consolidation:				
excavate soil	1,000	cy	$3.00	$3,000
move fill	1,000	cy	$3.70	$3,700
sampling of bottom soils	50	ea	$625.00	$31,250
backfill/grading	1,000	cy	$15.00	$15,000
Topsoil, seeding, &mulch	5,500	sy	$5.00	$27,500
SVE				
pilot study	1	ls	$60,000.00	$60,000
extraction trenches	8,500	lf	$35.00	$297,500
extraction vaults	22	ea	$500.00	$11,000
ventillation wells and vaults	25	ea	$1,000.00	$25,000
vapor thermal oxidation	2	ea	$35,000.00	$70,000
VES (30 hp)	1	ea	$11,000.00	$11,000
VES (15 hp)	1	ea	$9,000.00	$9,000
piping	9,000	lf	$12.00	$108,000
electrical/control panel	1	ls	$20,000.00	$20,000
accessories	1	ls	$6,000.00	$6,000
equipment housing	1	ls	$20,000.00	$20,000
trench and system installation oversight	120	man-day	$600.00	$72,000
soil disposal (2% of trenched soil)	635	cy	$310.00	$196,850
System startup	6	man-day	$600.00	$3,600
Project management	1	ls	$20,000.00	$20,000
System Closeout	1	ls	$21,700.00	$21,700
Capping:				
compaction and grading	34,400	sy	$1.55	$53,320
site improvements (culverts)	1	ls	$10,000.00	$10,000
12"-sand gas vent layer	34,400	sy	$7.00	$240,800
60-mil HDPE Geomembrane	34,400	sy	$4.25	$146,200
18"-soil layer	34,400	sy	$2.75	$94,600
6" topsoil,seeding & mulch layer	34,400	sy	$5.16	$177,504
SUBTOTAL CAPITAL				$2,320,924
10% Legal, Administrative, & Engineering Fees-				$232,092
15% Contingencies-				$348,139
TOTAL CAPITAL COSTS				**$2,901,155**

TABLE 3-7

Alternative 4: Consolidation and Capping with Soil Vapor Extraction for Soil/Fill, Institutional Controls and Natural Attenuation for Groundwater

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	5 (SVE) and 30 years (Groundwater and Cap monitoring)

Description	Duration	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater Monitoring:					
(17 wells)					
sample collection	30 yr	38	ea	$125.00	$4,750
sample analysis					
VOAs	30 yr	38	ea	$200.00	$7,600
Metals	30 yr	38	ea	$150.00	$5,700
Data Validation	30 yr	38	ea	$35.00	$1,330
Report Writing	30 yr	2	ea	$960.00	$1,920
Fence repair/maintenance	30 yr	1	ls	$750.00	$750
SVE Maintenance	5 yr	1	ls	$20,000.00	$20,000
SVE Power Requirements	5 yr	1	ls	$18,000.00	$18,000
SVE Analytical	5 yr	1	ls	$6,000.00	$6,000
SVE System Project Management	5 yr	1	ls	$16,000.00	$16,000
Cap Maintenance					
Cap repair	30 yr	1	ls	$1,175.00	$1,175
SUBTOTAL O&M					$83,225
8% Legal, Administrative, & Engineering Fees-					$6,658
10% Contingencies-					$8,323
TOTAL O&M COSTS	0 to 5 yr				$98,206
	6 to 30 yr				$27,406
TOTAL O&M PRESENT WORTH					**$675,467**
TOTAL CAPITAL COSTS					**$2,901,155**
GRAND TOTAL COST					**$3,576,622**

TABLE 3-8

Alternative 5: Excavation and Off-Site Disposal & Groundwater Extraction and Treatment

Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$181,480.00	$181,480
site services	6	month	$35,000.00	$210,000
health and safety	132	day	$700.00	$92,400
clearing/grubbing	7	acre	$1,200.00	$8,400
decon pad	1	ls	$10,000.00	$10,000
staging area	1	ls	$10,000.00	$10,000
Excavation, Transportation, & Disposal				
Excavation	25,550	cy	$3.00	$76,650
Transportation	25,550	cy	$75.00	$1,916,250
Disposal				
PCBs>=50ppm	426	ton	$310.00	$132,060
10=<PCBs<50ppm	426	ton	$125.00	$53,250
TCLP	426	ton	$250.00	$106,500
Remaining Contaminated Soils	24,272	ton	$55.00	$1,334,960
Verification Sampling	50	ea	$125.00	$6,250
Verification Analysis	50	ea	$500.00	$25,000
Backfill and Compaction	25,550	cy	$15.00	$383,250
Topsoil/Seed & Mulch	34,400	sy	$5.00	$172,000
Groundwater Extraction Wells (4)	80	lf	$100.00	$8,000
Metals Precipitation	1	ls	$20,000.00	$20,000
Clarification	1	ls	$24,000.00	$24,000
Sludge storage/thickening	1	ls	$4,000.00	$4,000
Carbon treatment	1	ls	$2,000.00	$2,000
Tanks, piping, & instrumentation	1	ls	$25,000.00	$25,000
Treatment Building	1	ls	$10,000.00	$10,000
SUBTOTAL CAPITAL				$4,811,450
10% Legal, Administrative, & Engineering Fees-				$481,145
15% Contingencies-				$721,718
TOTAL CAPITAL COSTS				**$6,014,313**

Note: assume 1 CY = 1 Ton

TABLE 3-9

Alternative 5: Excavation and Off-Site Disposal & Groundwater Extraction and Treatment

Operation and Maintenance Costs

interest rate (%)	6
operation and maintenance (years)	10

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Groundwater & Surface Water Monitoring:				
(17 wells)				
sample collection	38	ea	$125.00	$4,750
sample analysis				
VOAs	38	ea	$200.00	$7,600
Metals	38	ea	$150.00	$5,700
Data Validation	38	ea	$35.00	$1,330
Report Writing	2	ea	$960.00	$1,920
Fence repair/maintenance	1	ls	$750.00	$750
Groundwater Pump and Treatment				
Labor (1 day/wk)	52	day	$400.00	$20,800
Carbon changeout (200 lb/mon)	12	month	$100.00	$1,200
Sludge disposal	5	ton	$250.00	$1,250
Waste transport	1	ls	$500.00	$500
SUBTOTAL O&M				$45,800
8% Legal, Administrative, & Engineering Fees-				$3,664
10% Contingencies-				$4,580
TOTAL O&M COSTS				$54,044
TOTAL O&M PRESENT WORTH				**$397,769**
TOTAL CAPITAL COSTS				**$6,014,313**
GRAND TOTAL COST				**$6,412,081**

4. SELECTION OF REMEDY AND CONCEPTUAL DESIGN

4.1 SELECTION OF REMEDY

The selected alternative for the Dearcop site is Alternative 4, Consolidation and Capping, Soil Vapor Extraction, and Groundwater Institutional Actions/Natural Attenuation. Alternatives 1 and 2 (No Action and Institutional Action, respectively) were not selected because they would not meet remedial action objectives. Alternatives 3 and 4 both use capping a primary component of the remedy. However, Alternative 4 adds vacuum extraction to address VOC contamination. Alternative 4 was judged preferable to Alternative 3 because it affords greater overall protection and provides a measure of treatment of the wastes, rather than containment alone. Alternative 5 does not provide a significantly greater level of treatment or personal/environmental protection than Alternative 4. In addition, Alternative 5 would have significantly greater short-term impacts from excavation activities and truck traffic directly adjacent to a residential neighborhood. Therefore, Alternative 4 was selected as the preferred remedy.

4.2 CONCEPTUAL DESIGN

4.2.1 Soil Excavation

4.2.1.1 Residential Soil Removal

Under the recommended alternative, several locations in nearby residential areas will require excavation. Soil contaminated with lead and cadmium was detected in concentrations that exceed cleanup objectives. Because only isolated detections of these contaminants were found in nonsystematic patterns, it is not possible to estimate the volume of these soils. It is anticipated that only two residential yards will have to be excavated with a total soil volume of 100 to 200 yd^3.

Clearing and grubbing of portions of the area to be excavated may be required in preparation for excavation and removal activities. This will involve clearing designated areas of vegetation, shrubs, and trees to the existing grade. The boundaries of the areas to be excavated may have to be surveyed and field marked prior to excavation. Once all preliminary tasks are complete, excavation activities can begin. (This includes approval of the contractor's Site Safety Plan to be developed by the contractor, describing the minimum safety, health, and emergency response requirements for the performance of all work to be conducted by the contractor).

Excavation of contaminated soil/fill material will be conducted using conventional earth-moving equipment such as backhoes, bulldozers, and dump trucks. It is not anticipated that groundwater will be encountered during excavation of the residential areas. Rubber-tired vehicles will be specified to minimize dust generation and facilitate vehicle decontamination. Soil will be kept moist by spraying it with water to minimize the generation of dust, or the contractor may employ alternative methods of dust control as defined in the Site Safety Plan. Equipment used to haul the contaminated soil/fill material will be lined with impermeable material to prevent the spread of contamination and to minimize the amount of decontamination needed. Soil/fill material will be loaded directly into dump trucks and hauled to the area to be capped.

After verification sampling (see Section 4.2.1.3), the excavated area will be backfilled with clean fill, regraded, and reseeded. In addition, any shrubs, trees, fences, recreational structures, etc., that were removed would be replaced.

4.2.1.2 Sediment Removal

In addition to the residential areas, there are portions of the drainage ditch that will not fall within the area to be capped. Contaminated sediments that would not be covered by the cap will be mechanically excavated using conventional earth-moving equipment and consolidated with the contaminated soil/fill material. The total volume of drainage ditch sediments requiring remediation is estimated to be 800 to 900 cubic yards. Prior to excavation of the ditch sediments, site clearing may be required in the area to facilitate the contractor's sediment removal activities. The contractor shall be responsible for providing erosion protection for soil from which vegetation has been removed.

Excavated sediments will be placed directly into a lined dump truck and transported to the designated staging and dewatering area. The specific means and methods of sediment removal activities will be determined by the contractor. Sediment removal activities shall not be performed prior to, during, or immediately after a precipitation event. The contractor shall have all necessary erosion control procedures in place before any removal activities begin or resume. The contractor will also be required to control dust generation to acceptable levels which will be defined in the contractor's Site Safety Plan.

Sediment verification sampling will be required upon completion of sediment removal to a depth of 6 inches to ensure that all sediments containing contaminants above the established cleanup objectives are removed. Sediment verification sampling is described in Section 4.2.1.3.

4.2.1.3 Verification Sampling

Verification samples will be collected from the bottom and edges of the excavation upon completion. For residential yard excavation, verification samples will consist of a composite sample collected from an approximately 10-foot by 10-foot area to determine whether sufficient contaminated soil has been removed to meet the required cleanup objective. Where a 10-foot by 10-foot area does not exist, the verification samples will be collected at the boundary of the excavation. A minimum of one composite sample per 20 yd^3 of excavated soil is recommended. Samples will be analyzed for metals. When verification sampling results indicate that the soil remaining at the bottom and edges of the excavation meets cleanup objectives, the excavation for that area will be complete. If the results of the verification sampling are not acceptable, then additional soil will be removed and the area resampled. This procedure will be repeated until the sampling results indicate that cleanup objectives have been met. All sampling procedures and analytical protocols shall be outlined in the contractor's Quality Assurance Project Plan (QAPjP).

Verification sampling also will be conducted after excavation of the top 6 inches of sediments. Sediment verification samples will consist of one composite sample for approximately 50 linear feet of ditch. Samples will be analyzed for pesticides, lead, and copper. If sampling results indicate that cleanup objectives have not been met, additional sediments will excavated and the area resampled.

All verification sampling locations will be staked or otherwise marked for ease of location in the event the samples exceed the cleanup objectives. Laboratory turnaround time will be stated in the project specifications to minimize the time delay.

4.2.2 Soil Consolidation

Under the recommended alternative, isolated areas where cleanup objectives were exceeded will be excavated as discussed in Section 4.2.1.1 and placed with other contaminated soil at the area to be capped. This will allow the consolidation of all contaminated material in one place prior to containment.

Because of the small volume of excavated soil, it will be placed directly in a designated location within the area to be capped. The soil will be spread out and graded prior to cap installation. Soils would not be placed on the area to be capped until the SVE horizontal wells have been installed, as described in Section 4.2.4. Excavated sediments will be temporarily stored in a staging and dewatering area prior to being consolidated with contaminated soils in the area to be capped. It is recommended that the eastern section of the site be used for the staging/dewatering area. The area should be large enough to stage at least 500 yd^3 of excavated sediments without the use of excessive slopes. The staging/dewatering area will be constructed using asphalt over a gravel base with an impermeable liner. It will be bermed and sufficiently sloped to direct drainage to a sump at one end where contaminated water will be collected. All collected water will be transported off site for proper treatment and/or disposal. The stockpiled material will be covered to prevent dispersion by wind or rain. A decontamination pad will be constructed in the staging area. The pad will be used primarily for the decontamination of heavy equipment. The pad will be sloped to allow the drainage and collection of decontamination fluids in a sump at one end of the pad. The pad will be large enough to allow the equipment to be situated on the pad when it is being decontaminated. All decontamination fluids will be containerized and treated/disposed of at an off-site facility.

4.2.3 SOIL CAPPING

The recommended alternative involves covering the area where contaminated soil/fill material has been detected with a multilayer cap. The cap will cover all those parts of the site where soil/fill contaminants were found, during the RI, in subsurface samples. The area to be capped would be in the entire shaded area shown in Figure 2-4, approximately 281,150 square feet, plus approximately 10% additional area around the edge to ensure full coverage and to minimize access to the contaminated area.

The area to be capped will be cleared and grubbed using conventional landscaping equipment. Six monitoring wells, MW-6S, MW-6D, MW-9S, MW-9D, MW-10S, and MW-10D, are located in the area to be capped. These wells will be removed and properly abandoned in accordance with federal and state regulations and policies regarding well abandonment prior to cap installation. The existing drainage ditches within the area to be capped will be replaced with concrete culvert pipes to allow surface drainage from the road to flow under the cap, discharging to an existing drainage ditch downgradient of the cap. The stockpiled soil/fill material and sediments will be moved from the staging area to the cleared area to be capped. The soil/fill material and sediments will be spread across the area to be capped. The entire area will then be compacted and graded. The contractor will be required to control dust generation to acceptable levels which will be defined in the contractor's Site Safety Plan.

The cap will consist of a 12-inch-thick sand layer for venting gases, an 18-inch-thick clay barrier layer or impermeable synthetic membrane, and a 24-inch-thick topsoil or vegetative/protective layer suitable to maintain vegetative growth. The gas-venting layer will be installed directly above the compacted soil/fill material and below the barrier layer. Venting pipes with risers will be installed within the gas-venting layer at a maximum separation of one vent per acre of final cover. According to New York State regulation, the riser pipes must be a minimum of 6-inches in diameter and at a depth of at least 5 feet into the contaminated soil/fill material. Perforated lateral extensions of the risers will extend only into the gas-venting layer. Risers will be backfilled with rounded stone or other porous material acceptable to the NYSDEC. Risers must extend at least 3 feet above the final elevation of the cap and be fitted with a gooseneck cap or other equivalent cap to allow effective venting. The gas-venting layer must be bounded on its upper and lower surfaces with a filter layer that meets the requirements of 6 NYCRR Part 360-2.13 (o). If a geomembrane is used for the low-permeability barrier layer, an upper filter layer is not required.

The low-permeability barrier layer will consist of either 18 inches of compacted clay or a geomembrane. The geomembrane must have a minimum thickness of 40 mils or 60 mils if comprised of high-density polyethylene. Field installation methods of the geomembrane will conform with manufacturer's specifications. If clay is used, the clay will be installed in uniform lifts approximately 6 inches in loose thickness. The clay will be compacted using a bulldozer, a sheepsfoot roller, or other heavy equipment to over 90% of its dry density at its optimum water content as determined by test method ASTM D-1557, or other suitable method, to meet permeability requirements of 1 x 10^{-7} cm/sec and required strength characteristics. Permeability tests will be conducted at the completion of each lift at a rate of at least two tests per acre. The final shape of the barrier layer should be the same as the final design shape. This layer must be placed on a slope of no less than 4% to promote positive drainage and at a maximum slope of 33% to minimize erosion.

A 24-inch-thick topsoil layer will be placed over the sand layer for the establishment of a vegetative cover. The installation methods and compaction specifications of this protection layer must be adequate to protect the low-permeability layer from desiccation cracking, frost action, moisture, and root penetration, as well as to resist erosion and anticipated seepage forces to allow for a stable condition on the final slopes of the cap. The appropriate selection of grasses for vegetation will be made during the final design. Periodic mowing of this layer is necessary to prevent invasion by deep-rooted vegetation and burrowing animals and should be part of the long-term operation and maintenance plan.

A stormwater management plan including run-on and runoff controls and an erosion control plan will be required for the final design.

The contractor will be required to control noise during all phases of construction and operation and maintenance to acceptable standards.

The contractor will be required to obtain all necessary state and local permits for site activities including, but not limited to, a building permit and an air permit for emissions from the landfill. Based on the emission limits established in the permit, it may be necessary to collect and treat the emissions prior to release.

4.2.4 VACUUM EXTRACTION

Soil gas sampling at the site indicated the presence of numerous volatile organics, primarily chlorinated aliphatic hydrocarbons such as TCE, 1,1-DCA, and 1,1,1-TCA. Soil vapor extraction technology will be used to remove VOCs from the contaminated soils in the unsaturated zone. This method involves applying a vacuum to the contaminated area and removing vapors trapped in the soil matrix.

Prior to final design of the SVE system, a pilot study would be conducted on site to determine design parameters. The pilot study would consist of one or two wells located in a area of average soil gas contamination. Radii of influence, gas throughput, and volatiles concentrations would be measured and used to scale the system up to full scale.

Basic components of the full-scale SVE system include extraction wells, ventilation wells (as needed), an air-water separator, a blower and associated controls, and an off-gas vapor phase treatment unit. The off-gas can be treated by carbon or other solid absorbers, a catalytic oxidizer, a thermal oxidizer, or an ultraviolet reactor.

The effectiveness of the SVE system is, in part, a function of the contaminant type and soil characteristics. At the Dearcop Farm site, the volatile contaminants can be treated by vapor extraction. The contaminants with the highest vapor pressure may be the easiest to reduce. Lower vapor pressure constituents may take longer to remediate. Contaminants with vapor pressures less than 1 mmHg may not be effectively remediated. In addition to the type of contaminant present, the soil type plays a major role in determining the duration and effectiveness of remediation. Contaminants in high permeable soils (hydraulic conductivities greater than 10^{-3} cm/sec) will be remediated faster than low permeability soils. The effectiveness of SVE declines markedly in soils with hydraulic conductivities less than 10^{-6} cm/sec. The hydraulic conductivity at the Dearcop Farm site is on the order of 10^{-4} to 10^{-6} cm/sec.

The soil also plays a major role in establishing the number and location of extraction wells. Depending upon the vacuum pressure applied to the soil, the effective radius of influence at the Dearcop Farm site may range from 20 to 30 feet. For conceptual design and costing purposes, a 20-foot radius of influence has been assumed. A series of horizontal wells are proposed to be placed within the property boundary in areas where soil gas readings exceeded 10 ppm. On the south side of the site, approximately 6,000 linear feet of horizontal wells may be needed. On the north side of the site, approximately 1,700 linear feet of horizontal wells may be needed (see Figure 2-9). Each well will be constructed by excavating a trench down to a depth of approximately 10 feet below ground surface. A 2-inch to 6-inch diameter perforated pipe will be placed in the trench and will be surrounded by 1 foot of clean sand. The trench will then be backfilled with the excavated material. The actual number and location of extraction wells will be determined during final design based on the results of a pilot study and modeling of contaminant removal rates.

In addition to the horizontal extraction wells, passive vent wells may be required at the Dearcop Farm site because a surface seal will be constructed. The vent wells allow for the introduction of fresh air into the contaminated area at the fringes of the extraction wells' radius of influence. In addition, the vent wells can increase the extraction efficiency in areas where the radius of influence from extraction wells overlap. There will be venting pipes installed in the cap to allow for the venting of landfill gases. It will be determined if the these venting pipes can be used in lieu of vent wells. For preliminary costing purposes, a total of 25 vent wells (2-inch diameter PVC pipe, 12 feet deep and 5 feet screen) are proposed.

The trenches excavated for the installation of the horizontal wells will be 10 feet deep, with side slopes of 1:1. Approximately 30,000 yd^3 of soil would be excavated, stockpiled adjacent to the trenches, and then backfilled after well placement. Some grossly contaminated soil or fill materials (*e.g.* buried drums or free product liquids) may be encountered during this installation procedure. This material will be packaged and transported off site for treatment and/or disposal at a RCRA-permitted treatment, storage, and disposal facility.

Concurrent with the well installation, the SVE equipment will be mobilized to the site and installed in a designated treatment area in the eastern portion of the site. Due to the presence of a major roadway which intersects the site, two separate systems may be required depending on cost and final design issues. Preliminary estimates for the sizes of the SVE systems were made using EPA's *Hyperventilate* SVE modeling program. A blower as large as 30 horsepower (hp) may be required on the south side of the property to withdraw contaminated vapors. A 7.5-hp blower, or larger, may be required on the north side of the property. Preliminarily, it is anticipated that the vacuum at the extraction wells could exceed 40 inches of water and the flow rate will be on the order of 10 standard cubic feet per minute (scfm) per 100 linear feet of well screen.

As part of the full-scale design, it will be determined whether the system off-gases will require treatment. Projected volatile releases would be estimated based on the pilot-scale results and from modelling. The need for off-gas treatment would be negotiated with the air permitting division of NYSDEC. It is preliminarily expected that the contaminated vapors will run through the blower and into a thermal oxidizer for treatment. The treated vapors will then be released to the atmosphere. The blower is equipped with an air-water separator which will allow only air to enter the blower. Water that accumulates in the separator will be drained as needed. The water will be treated or disposed off site. Off-gas treatment, if required, may not be necessary throughout the duration of the SVE operation. Volatile concentrations would decrease rapidly after initial operation, as the easy-to-remove contaminants are flushed out first.

Air flow and vacuum pressure will be monitored at the blower. In addition, vacuum pressures will be monitored at the extraction and vent wells. Influent (i.e., untreated) and effluent (i.e., treated) air streams will be sampled at scheduled intervals to establish contaminant removal rates, to verify adequate treatment of the air stream, and to track the extent of remediation.

The contractor will be required to control noise during all phases of construction and operation and maintenance to acceptable standards.

The contractor will be required to obtain all necessary state and local permits for site activities including, but not limited to, a building permit and an air permit for emissions from the SVE system.

4.2.5 INSTITUTIONAL CONTROLS

Institutional controls will be implemented to restrict the future use of the site. Institutional controls will include local regulatory restrictions of construction and land use. Recommendations regarding the type or extent of such restrictions will be made to appropriate agencies or boards (i.e., local planning or zoning boards) during the final remedial design. A fence will be constructed around the capped area to restrict access. Institutional controls will also be implemented to restrict the use of potentially contaminated groundwater on or near the site, such as placing local regulatory restrictions on the construction and use of private water wells and other land-use restrictions on and near the site.

4.2.6 NATURAL ATTENUATION OF GROUNDWATER CONTAMINATION

Capping will reduce the amount of infiltration percolating through contaminated soil/fill material, thereby minimizing the production of new contaminated groundwater. SVE, though primarily directed at soil/fill material, would also remove volatiles from groundwater.

By minimizing new contaminant sources and removing volatile contaminants, concentrations in groundwater would decrease. To monitor these reductions in concentration, a groundwater monitoring program will be implemented. Selected wells will be sampled on an annual basis and analyzed for Target Compound List (TCL) VOCs and metals. Annual sampling will continue until sufficient data are gathered regarding contaminant plume migration to permit less-frequent sampling or until it is demonstrated that the chemical concentrations within the groundwater no longer exceed Maximum Contaminant Levels (MCLs) or NYSDEC Class GA standards. Four replacement monitoring wells will be constructed to replace the wells removed during the installation of the cap.