Final Feasibility Study (Detailed Analysis)

Remedial Investigation/Feasibility Study

Korkay Inc.

Village Of Broadalbin, New York

Site Number 5-18-014
Work Assignment #D002925-3

Prepared for:

New York State
Department Of Environmental Conservation
50 Wolf Road, Albany, New York 12233

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Executive Summary

At the request of the New York State Department of Environmental Conservation (NYSDEC), and in accordance with the State Superfund Standby Contract (SSSC) between NYSDEC and Camp Dresser and McKee Inc. (CDM), CDM has prepared this Phase III Feasibility Study (FS) under Work Assignment #D002925-3 for the Korkay Inc. (Korkay) site, located in the Village of Broadalbin, Fulton County, New York.

The purpose of this Phase III FS is to provide NYSDEC with relevant information needed to select a remedial alternative for the Korkay site. The remedial alternative recommended in this FS was selected based on its protectiveness of human health and the environment, compliance with NYS Standards, Criteria and Guidelines (SCGs), significant and permanent reduction of toxicity, mobility and volume of hazardous waste, and cost effectiveness. The Phase III FS was based on the results of the initial phase and Phase II remedial investigations, conducted during September/October 1993 and October 1994, respectively; a baseline human health risk assessment completed in May 1994, and human health risk assessment addendum completed in May 1995; and the Phase I and II Feasibility Studies completed in February 1995.

Background Information

Site history indicates that from 1887 to 1964 the site was owned by the Crosley Glove Company, a leather goods manufacturer. Following this period, Korkay operated a chemical supply company at the site that bought and stored bulk chemicals and blended these chemicals into products such as car waxes, spray cleaners and hand cleaners. Site activities that impacted soil and groundwater quality included the washing and relining of previously-used barrels, of which the former contents were unknown. Operations at the site reportedly ceased in 1988. The site is currently vacant.

Site hydrogeology is characterized by surface and shallow fine- to medium- grained sand underlain by a silty clay. The silty clay unit (an aquitard) is located at a depth ranging from 9.5 to 42 ft below land surface (bls). Beneath this silty clay is a thin sand and gravel unit that overlies a dense silt till (34 to 54 feet bls), which is underlain by bedrock. The shallow water-bearing unit was encountered at a depth of 7.5 to 8 feet bls. The deep water-bearing unit was encountered beneath the site at depths ranging from 32 to 43 feet bls.

In general, the remedial alternatives considered are based on the areas of the site where organic constituent contamination in soil exceed the Department of Environmental Conservation Technical and Administrative Guidance Memorandum (DEC TAGM) criteria. In Area 1, the western building alcove area, volatile organic compound/semi-volatile organic compound (VOC/SVOC) concentrations exceeding DEC TAGM criteria generally occupy a layer estimated to be 5-feet thick straddling the shallow water table from approximately 5 to 10 feet bls. Area 1 had the highest VOC concentrations detected on-site with xylene concentrations in the soil up to 78 mg/kg and trichloroethene (TCE) concentrations in the soil up to 21 mg/kg. In Areas 2 and 3 (the western and northern portion of the site) the VOC/SVOC concentrations exceeding DEC TAGM criteria generally occupy a layer estimated to be about 4-feet thick straddling the shallow water table 5-9 feet bls. Pesticides were found to exceed DEC TAGM criteria in the surface soils and subsurface soils. Concentrations in the shallow water-bearing unit exceed NYSDEC and NYSDOH standards for VOCs, SVOCs and pesticides.

The baseline human health risk assessment (Dynamac, 1994) estimated that the exposure pathways of concern were ingestion (of alpha chlordane, gamma chlordane, dieldrin, heptachlor epoxide, TCE and manganese), inhalation and dermal adsorption (of alpha chlordane, gamma chlordane, dieldrin, heptachlor epoxide) in the shallow groundwater; and surface soils and subsurface soil ingestion (of alpha chlordane, gamma chlordane and arsenic). The risk assessment also indicated that ingestion of manganese in the deeper groundwater represented a potential exposure pathway. However, the manganese concentrations in the groundwater are not believed to be derived from the site.

Based on the results of the initial phase RI data, the risk assessment was expanded to include a hypothetical scenario incorporating human health risk assessment due to the consumption of vegetables, if grown on the adjacent Hayes property. Due to the soil contamination found on the Hayes property, the results of the risk assessment addendum indicated that receptors who ingest vegetables grown on the Hayes property could be exposed to both carcinogenic and non-carcinogenic health risk that exceed federal standards.

Development of Remedial Alternatives and Screening

The Phase I and II Feasibility Study (CDM, 1995a) concluded that the following four remedial alternatives should be evaluated in the Phase III detailed analysis of remedial alternatives:

Alternative 1 No Action

Alternative 2 Institutional Controls/Deed Restrictions and Media Monitoring

Alternative 3 Institutional Controls/Deed Restriction, Media Monitoring, Soil Excavation, Off-Site Disposal of Excavated Soils, and Soil Vegetative Cover

Alternative 4 Institutional Controls/Deed Restriction, Media Monitoring, Soil Excavation, Off-Site Disposal of Excavated Soils, Soil Vegetative Cover, and Soil Vapor Extraction/Combined Air Sparging and Soil Vapor Extraction (SVE/CASVE).

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Detailed Analysis of Remedial Alternatives

The Phase III detailed analysis evaluated each of the remedial alternatives with respect to seven criteria:

- o Compliance with Standards, Criteria and Guidelines
- o Overall Protection of Human Health and the Environment
- o Short-Term Effectiveness
- o Long-Term Effectiveness
- o Reduction of Toxicity, Mobility and Volume
- o Implementability
- o Cost

With respect to each of the remedial alternatives considered, Alternative 4 would provide the Korkay site with the greatest:

1) degree of compliance with SCGs;
2) overall protection of human health and the environment;
3) permanence and long term effectiveness; and
4) reduction in toxicity, mobility and volume of contaminants.

The costs for the four alternatives range from $183,000 and $189,000 for Alternatives 1 and 2, respectively, and to $578,000 and $734,000 for Alternatives 3 and 4 , respectively.

The significant cost elements associated with the remedial alternatives are:

1) the 30-year groundwater monitoring and reporting common to all alternatives, estimated at $183,000;
2) capital costs for soil excavation and disposal for Alternatives 3 and 4, estimated at $395,000; and
3) the additional cost for SVE/CASVE for a portion of the site proposed in Alternative 4, estimated at $156,000.

Although Alternative 4 is the most costly, it is the preferred alternative. For a portion of the site where VOC contamination is the most concentrated, Alternative 4 will remove the source of surface soil contamination in a portion of the site, reduce VOC contamination in the subsurface soil and shallow water-bearing unit in a portion of the site, and eliminate the potential exposure pathways for a portion of the site, even though residual non-volatile organics would remain in the subsurface soils at the site.

It is recommended that Alternatives 1 and 2 should be eliminated from consideration because they do not meet SCGs, nor do they provide adequate protection of human health and the environment. Alternative 3 would provide protection of human health by removing the source of surface soil contamination. However, Alternative 3 cannot assure that VOC contaminant concentrations will be reduced below SCGs. Over time, natural flushing probably would reduce groundwater VOC contaminant concentrations, but the rate of subsurface soil and groundwater cleanup would be accelerated with implementation of Alternative 4. Thus, Alternative 3 is not as protective of the environment as Alternative 4, since VOC concentrations in the subsurface soil and the shallow-water bearing unit would be reduced by SVE/CASVE. It is recommended that the additional cost for SVE/CASVE for a portion of the site proposed in Alternative 4 ($156,000) is worth the additional environmental benefit.

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Section 1
Introduction

At the request of the New York State Department of Environmental Conservation (NYSDEC), and in accordance with the State Superfund Standby Contract (SSSC) between the NYSDEC and Camp Dresser & McKee Inc. (CDM), CDM is conducting a Remedial Investigation/ Feasibility Study (RI/FS) under Work Assignment #D002925-3 for the Korkay Inc. (Korkay) site, which is located in the Village of Broadalbin, Fulton County, New York. The RI/FS for the Korkay site is being performed with funds allocated under the New York State (NYS) Superfund Program.

The first phase of the site Remedial Investigation (RI) was completed in April 1994 (CDM 1994a). Phase II of the RI was completed in May 1995 (CDM 1995b). The Phase I and II Feasibility Study was completed February 1995 (CDM, 1995a). It included a development of site remedial action alternatives (Phase I FS) and the preliminary screening of these alternatives (Phase II FS) based on the results of the Phase I RI. As requested by the NYSDEC, the Korkay site Phase I and II FS was a focused FS (e.g., based on the results of the Phase I RI, only potentially applicable remedial actions have been considered in the site FS (NYSDEC 1994a-j)).

This final FS (Phase III) includes a detailed analysis of the potentially applicable alternatives identified during the Phase I and II FS, and a recommended remedial alternative for the site. It is based on the results of the Phase I and II Feasibility Studies and the results of the initial phase and Phase II Remedial Investigations. In addition to detailed Phase III analysis, this FS also provides a summary of remedial investigations, risk assessment, the Phase I FS and the Phase II FS.

1.1 Purpose of Feasibility Study

The purpose of the Phase III FS, the detailed analysis of alternatives, is to provide the NYSDEC with the relevant information needed to select a remedial remedy for the Korkay Inc. site. The specific requirements of a remedial alternative selected are to:

1) be protective of human health and the environment;

2) attain DEC Standards, Criteria and Guidelines (SCGs) or explain why compliance was not needed to protect human health and the environment;

3) significantly and permanently reduce toxicity, mobility and volume of hazardous waste, or provide explanation why it does not; and

4) be cost effective

During the Phase III analysis each remedial alternative is assessed against seven criteria:

1) short-term impacts and effectiveness;

2) long-term effectiveness and performance;

3) reduction of toxicity, mobility or volume;

4) implementability;

5) compliance with SCGs;

6) overall protection of human health and the environment; and

7) cost

The detailed analysis (Phase III FS) is presented in Section 4 and a recommended alternative is presented in Section 5 of this study. The following subsections provide results of the remedial investigations and risk assessment.

1.2 Background Information

1.2.1 Site Description

The following sections present the site location, environmental setting and land use, topography and surface drainage, hydrogeology, meteorology, and potable water supply at and in the immediate vicinity of the site.

Site Location

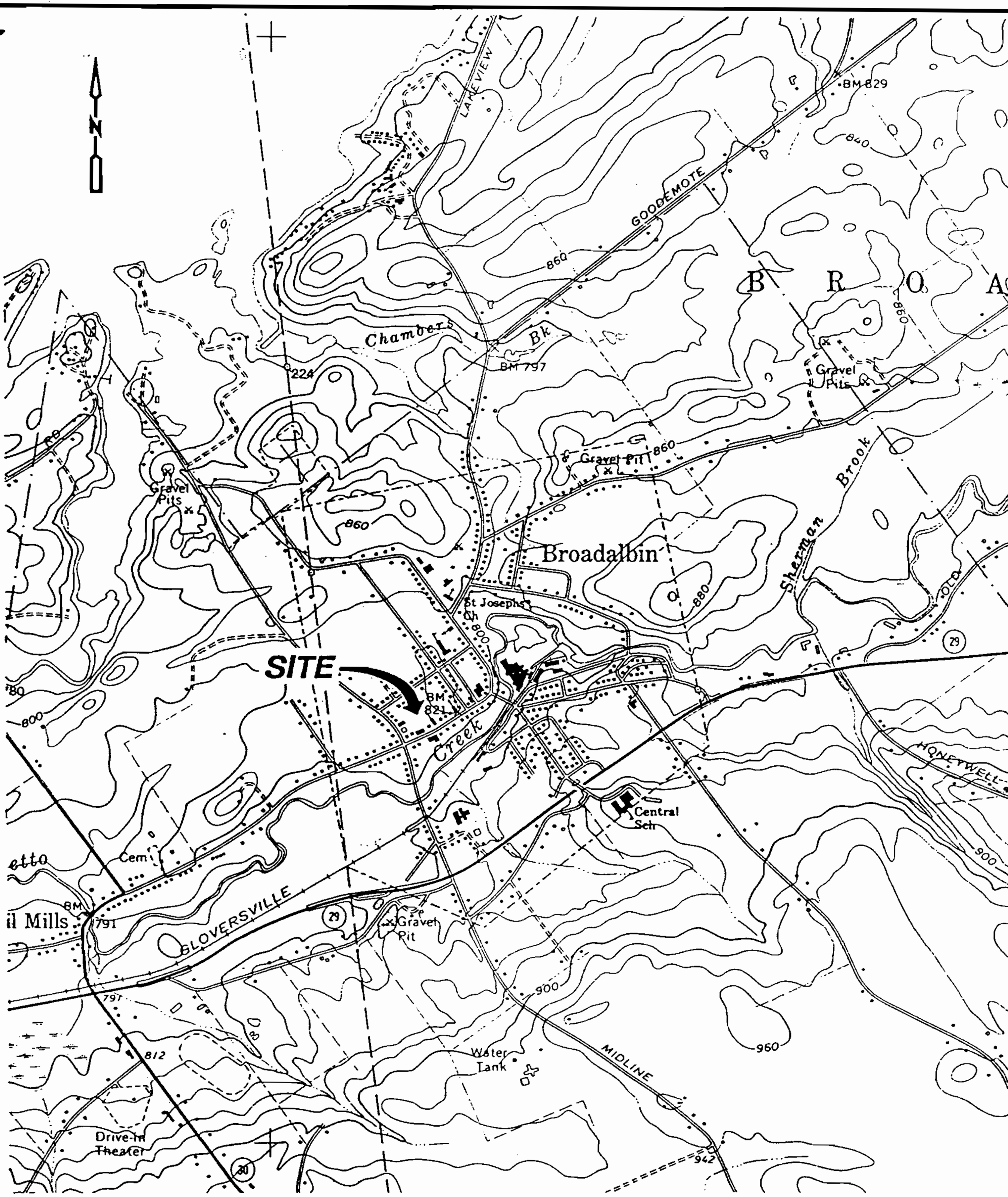
The Korkay site is a one acre parcel of land located at 70 West Main Street, in the Village of Broadalbin, Fulton County, New York (see Figure 1-1). It is located about 40 miles northwest of Albany, New York.

The site is bounded on the north by a lumber yard/residences, on the south by West Main Street, on the east by a church, and on the west by a residence (see Figure 1-2). There is a mix of residential and commercial properties in the vicinity of the site (CDM 1994a). Figure 1-3 shows the site areas and the initial phase and Phase II RI sampling locations.

Environmental Setting and Land Use

The Korkay site is now vacant. The majority of the site is occupied by the site building, and a fence and gates were installed along the north, east, and western boundaries of the site (see Figure 1-3). Although drums are no longer stored outdoors, they are stacked two to three high, as well as on their sides, inside the site building.

Land uses surrounding the site include a lumber yard/residences to the north, West Main Street to the south, a church to the east, and a residence to the west of the site. The site is zoned industrial. Properties immediately adjacent to the north side of the site and directly across the street from the site (south) are zoned commercial; properties immediately adjacent to the east and west sides of the site are zoned residential (CDM 1994a).



Source of map: Broadalbin, NY Quadrangle, USGS

Figure 1-1

Location Map

Korkay Inc. Site - Broadalbin, New York
NYSDEC Site #5-18-014

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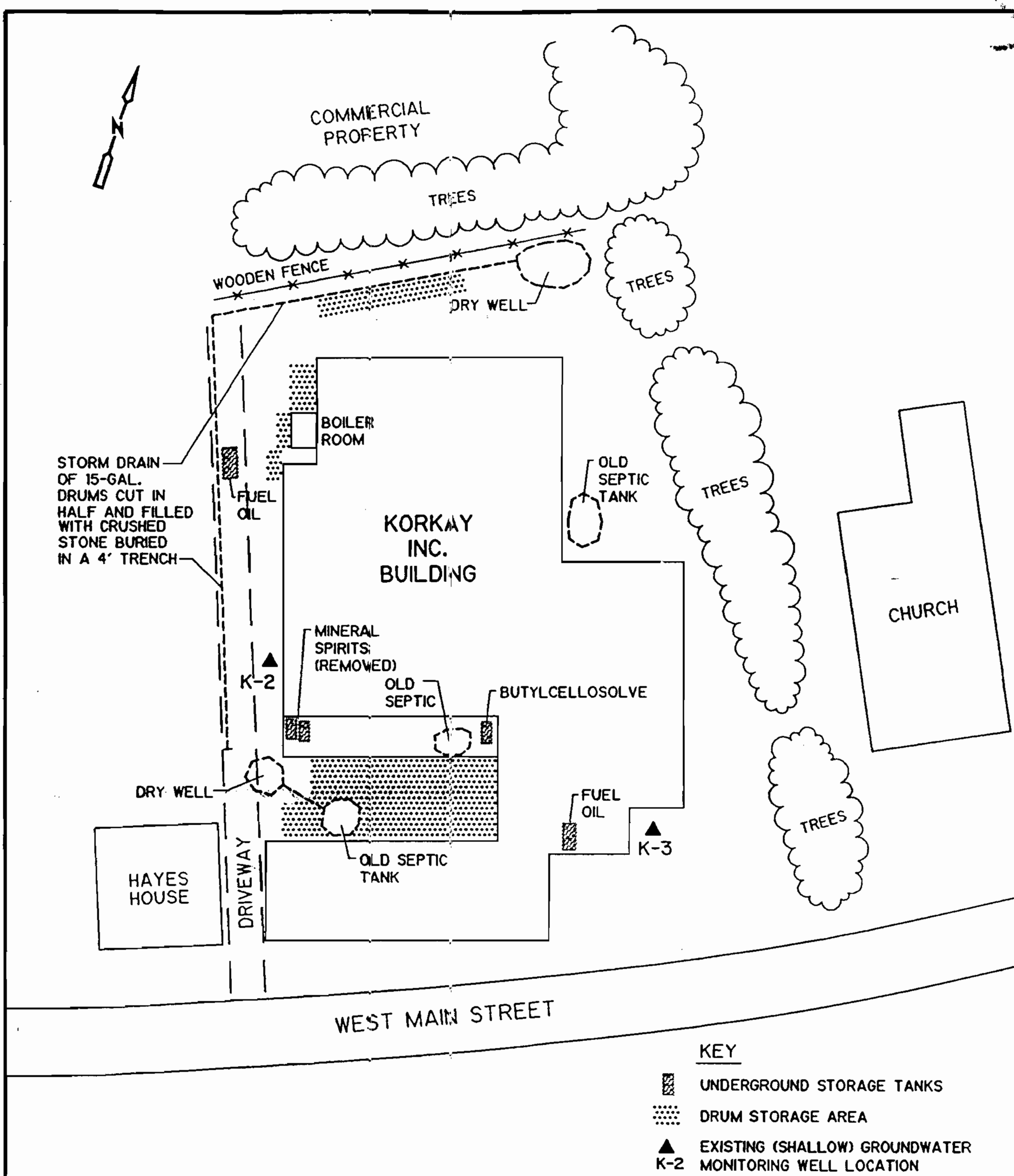

Source of base map: EA Phase II Investigation Report, April 1988

Not to Scale.

Figure 1-2

Site Map

Korkay Inc. Site - Broadalbin, New York
NYSDEC Site #5-18-014

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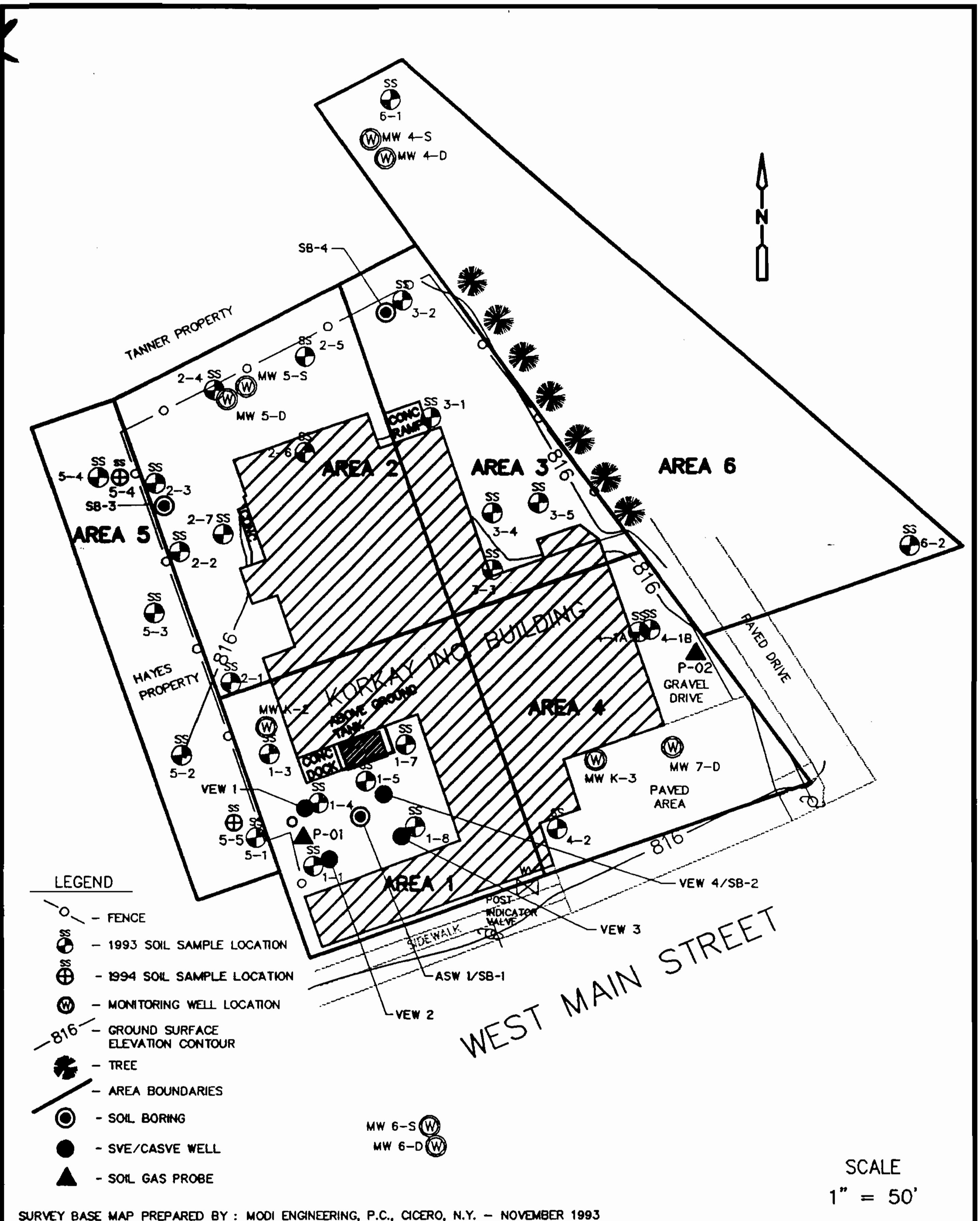

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Figure 1-3

SOIL SAMPLE AND WELL LOCATION MAP

Korkay Inc. Site – Broadalbin, New York
NYSDEC Site #5-18-014

Topography and Surface Drainage

The site topography is relatively flat (not varying more than 2 ft in any one direction) with reportedly poor drainage. The site elevation is about 815 to 816 ft above mean sea level (msl).

In the past, site stormwater had reportedly drained to adjacent properties located north and west of the site. During wet weather, water would reportedly pond behind the site building. Also, to improve drainage conditions at the site, Korkay constructed its own storm sewer system consisting of several 15-gallon drums that were cut opened, placed end to end, and filled with crushed stone within a 4-ft deep, backfilled trench beginning midway along the western boundary, and ending at the northeastern corner, of the site as shown in Figure 1-2 (CDM 1994a).

Hydrogeology

Shallow soil at the site is characterized by fine to medium-grained sand above silty clay. The silty clay unit, interbedded with lenses of clayey silt, silt, and sand, is present at depths ranging from about 9.5 to 42 ft below land surface (bls). Beneath this geologic unit is a thin sand and gravel unit that overlies dense silt till, which is present at depths ranging from about 34 to 54 ft bls. The till is underlain by Dolomite bedrock of the Cambrian Age Little Falls Formation (CDM 1994a).

Kennyetto Creek and the Great Sacandaga Lake are the closest surface water bodies to the Korkay site. Kennyetto Creek is located on the south side of West Main Street, about 600 ft south of the site, and flows in a southwesterly direction past the site. At the next town west of the site (Town of Mayfield), the creek turns and flows north to northeast, and discharges into the Great Sacandaga Lake (CDM 1994a).

Shallow groundwater was encountered at the site in the unconsolidated overburden at a depth of 7.5 to 8 ft bls. Deep groundwater was encountered at the site beneath the silty clay unit (aquitard) at depths ranging from 32 to 43 ft bls.

Based on one round of water level measurements obtained during the Phase I RI, it appeared that groundwater flow in the shallow unconsolidated water-bearing zone is in a southerly direction. The direction of flow in the deep unconsolidated water-bearing zone appears to be east-southeasterly. However, due to the presence of thin and possibly discontinuous sand layers in the deep zone within which water levels were obtained, as well as the existence of a significant vertical hydraulic gradient at the site, a second round of water level measurements was collected during the Phase II RI to confirm the direction of groundwater flow in the deep zone (CDM 1994a; CDM 1994b).

Meteorology

Precipitation data for Broadalbin, New York (based on monthly and annual precipitation normals from 1961 to 1990) ranges from a minimum of 2.63 inches in February to a maximum of 4.10 inches in June. In 1992, the total annual precipitation recorded at Albany, New York (which is located about 40 miles southeast of the site was 31.9 inches. In the vicinity of the site, the warmest month of the year is July, with an average temperature of about 69 degrees Fahrenheit (F), and the coldest is January, with an average temperature of about 18 degrees F.

Wind velocities in the Albany area are moderate; in 1992, the average annual wind speed recorded in Albany was 8.9 miles per hour (mph). During periods of lighter winds, the Hudson River Valley, which runs north to south, has a marked effect on wind speed and direction. Hence, in the summer, it influences the average wind direction towards the south. (CDM 1994a).

Water Supply Wells

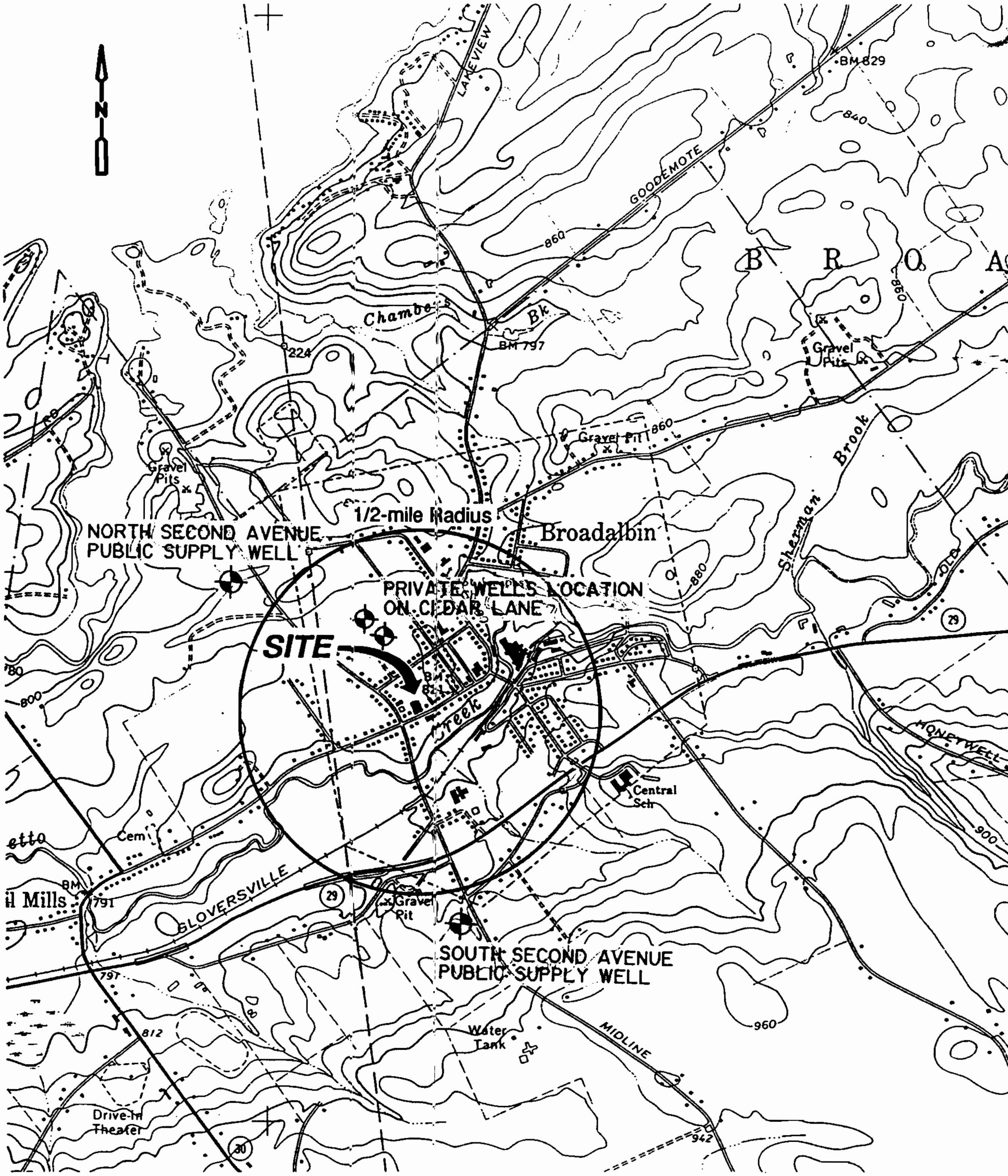
Water supply wells are discussed in detail in the April 1994 Final RI Report for this site.

The Village of Broadalbin public water supply wells include the North Second Avenue and South Second Avenue wells, which are shown in Figure 1-3A.

According to the Village Clerk's office, except for eight residences, all of the households in the village are connected to the public water supply. These eight residences are believed to have their own supply of water (wells). Two of the village residences, located on Cedar Lane, are within approximately 1,700 feet of the site. The two nearby private well sites located on Cedar Lane to the north/northwest of the Korkay site are shown on Figure 1-3A. The other six village residences are located approximately one-half of a mile or more from the Korkay site, to the north and the northeast. According to verbal information provided by the Cedar Lane residents and the driller who installed both of these water supply wells (Junquerre Brothers of Northville, New York), these wells were installed at the same time and thus were similarly constructed. Well information includes the following:

	Guiffre Well	Jones Well
Date of installation	Oct. 1986	Oct. 1986
Well depth	~55 ft.	~66 ft.
Casing material	6 in. steel no screen	6 in. steel no screen
Pump	submersible	submersible
Formation pumped	gravel/sand (not in bedrock)	gravel/sand (not in bedrock)
Treatment Installed	"Culligan system" installed for iron	No softening system

Residents in the surrounding towns of Mayfield and Broadalbin reportedly have their own drinking water supply wells, since they are not hooked up to the village water supply. The nearest residential wells outside the village in the Town of Mayfield are reportedly approximately 1,700 to 1,800 feet to the west of the site.



Source of Map: Broadalbin, NY Quadrangle, USGS

Note: Well locations are approximate.

Figure 1-3A

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Public & Private Well Location Map

Korkay Inc. Site - Broadalbin, New York
NYSDEC Site #5-18-014

1.2.2 Site History

From 1887 to 1964, the site was owned by the Crosley Glove Company, a leather manufacturer. Following this period, Korkay operated a chemical supply company at the site that bought and stored bulk chemicals, and blended these chemicals into products such as car waxes, spray cleaners, and hand cleaners.

Between 1969 and 1980, Korkay obtained previously-used barrels, the former contents of which were unknown, and stored, washed, and relined the barrels on-site. Some of Korkay's final products were packaged in these barrels. Barrel washwaters, with washwaters from spill cleanups and vat cleaning were discharged to on-site septic systems.

A site inspection was conducted by the New York State Department of Health (NYSDOH) and NYSDEC in August 1979. (This inspection was performed in response to a resident's complaint that vegetation on his property, as well as on a neighbor's (Hayes') property west of the site, was adversely affected by run-off from the Korkay barrel washing area [see Figure 1-2]. During this inspection, approximately 100 to 200 barrels were noted at the site, many of which were observed to be leaking onto the ground.

Beginning in 1980, barrels were shipped off-site to be washed and an aboveground, 4,000-gallon holding tank was installed (next to former mineral spirit underground storage tanks [see Figure 1-2] to contain spill cleanup and vat cleaning washwaters, which were subsequently disposed off-site. As also shown on Figure 1-2, there are 5 underground tanks which were used for the storage of fuel oil and bulk chemicals at the site (CDM 1994a).

In August 1983, the NYSDEC initiated a Preliminary Site Assessment at the Korkay site. As a result, investigations of site environmental conditions began in 1985. Sample analytical data collected during these investigations indicated the presence of acetone, 1,1,1-trichloroethane (TCA), tetrachloroethane (PCE), xylene, trichloroethane (TCE), chlordane, iron and manganese in site groundwater (CDM 1994a; EA Science and Technology (EA) 1988a,b). Operations at the site reportedly ceased in 1988 (CDM 1994a).

The NYSDEC conducted Interim Remedial Measures (IRMs) at the site in late 1992/early 1993 based on a site inspection performed by the NYSDEC in December 1992. These IRMs included the relocation of 10 on-site drums to the site building, and the installation of a fence and gates around the rear of the site (along the north, east, and western boundaries). The site is currently vacant (CDM 1994a).

1.2.3 Nature and Extent of Contamination

The final Phase II RI Report (CDM, 1995b) data confirmed that a number of organic constituents are present in the soils and groundwater, at concentrations that exceed NYS SCGs (New York State Standard, Criteria and Guidelines). Inorganic constituents present in the soils and groundwater at concentrations that exceeded NYS SCGs, in general, were attributed to natural conditions. Phase II data collected also confirmed that Kennyetto Creek water quality may not be unaffected by human activity. The Phase II RI sampling data also confirmed previous preliminary site assessment and remedial investigation results.

1.2.3.1 Soils

In Area 1, it was concluded that volatile organic compound/semi-volatile organic compound (VOC/SVOC) concentrations exceeding Department of Environmental Conservation Technical and Administrative Guidance Memorandum (DEC TAGM) criteria generally occupy a layer estimated to be 5-feet thick straddling the shallow water table, from approximately 5 to 10 feet below grade. Around the concrete dock and aboveground tank, VOC/SVOC concentrations exceeding DEC TAGM criteria are generally present from the ground surface to 10 feet in depth. VOC/SVOC concentrations were found to be below DEC TAGM soil criteria in soil samples collected at 12 to 14 feet below grade. During both RI phases, none of the pesticide/ PCB concentrations were found to exceed DEC TAGM soil criteria in samples collected.

In Area 2, VOC/SVOC concentrations exceeding DEC TAGM criteria generally occupy a layer estimated to be about 4-feet thick straddling the shallow water table, from approximately 5 to 9 feet below grade. VOC and SVOC concentrations were found to be below DEC TAGM soil criteria in the samples from 6 to 8 and 8 to 10 feet below grade, respectively. Surficial VOC/SVOC soil contamination is generally present in two of the seven samples collected. During both RI phases, pesticide/PCB concentrations were found to exceed DEC TAGM soil criteria in surficial and subsurface soils. Pesticide/PCB concentrations were found to exceed DEC TAGM criteria generally in the first 6 to 8 feet of soil below grade in at least a portion of the area. It should be noted that pesticides detected at the site were not believed to be used in site related manufacturing activities, and therefore are not listed wastes and not subject to land disposal regulations.

In Area 3, VOC/SVOC concentrations exceeding DEC TAGM criteria generally occupy a layer estimated to be 4-feet thick straddling the shallow water table, from approximately 5 to 9 feet below grade. VOC/SVOC concentrations were found to be below DEC TAGM soil criteria at approximately 11-feet below grade. No surficial VOCs/SVOCs were detected. During both RI phases, pesticide/PCB concentrations were found to exceed DEC TAGM soil criteria in surficial and subsurface soils. Pesticide/PCB concentrations were found to exceed DEC TAGM criteria generally in the first 6 to 8 feet of soil in at least a portion of the area. It should be noted that pesticides detected at the site were not believed to be used in site related manufacturing activities, and therefore are not listed wastes and not subject to land disposal regulations.

In Area 4, no organic constituent concentrations above DEC TAGM soil criteria were detected.

In Area 5, the initial phase RI samples revealed that VOC, SVOC, and pesticide/PCB concentrations found on the Hayes property were similar in nature to those compounds found at Korkay. Concentrations exceeding DEC TAGM soil criteria were detected in three of the four 0 to 0.5 foot samples collected and in one of the four 1.5 to 2.0 foot samples collected. During the Phase II RI work, additional samples at greater depths were collected to vertically delineate the contamination. In these deeper samples, collected at 2 to 4 feet and 5 to 7 feet, detected values of organic compounds were relatively lower than those samples closer to the surface, and none of the values exceeded the DEC TAGM soil criteria.

Concentrations of Target Compound List (TCL) organics have been delineated vertically in the areas of concern, meeting the objective of the Phase II RI work.

Approximate areal extent of TCL organic soil contamination exceeding DEC TAGM criteria, including VOC, SVOC, pesticides, and all organic fractions, are shown on Figures 1-4, 1-5, 1-6, and 1-7, respectively. The areal extent shown is approximated from sample point to sample point based on the initial phase and phase II RI data collected. However, soil concentrations between sample points may be more than or less than DEC TAGM criteria. Target Analyte List (TAL) metals were detected above DEC TAGM criteria in almost all of the soil samples collected at the site. With a few exceptions, they were found at concentrations within the range of naturally occurring metals in northeastern United States or site background soil concentrations. DEC believes that, based on available site history information, use of metals was not part of the Korkay operations; therefore TAL metals are not considered to be primary contaminants of concern.

Background Samples: During the initial phase RI work, background samples were collected in Area 6, on the adjacent church property. Concentrations exceeding DEC TAGM soil criteria were detected in the background samples collected. DEC requested a new set of background samples be collected in an area free from the influences of hazardous waste sites or any other sources of contaminants. The new set of background samples collected during Phase II RI work also appear to have concentrations in excess of DEC TAGM soil criteria. These Phase II RI samples were collected even further away from the site than the earlier set of background samples. Sample depth increments included 0-6 inches and 18-24 inches. The first background sample, BG-1, was located along the northeast border in the backyard of the neighboring church property, approximately 145 feet from MW-4S. A surficial sample, BG-1A, and a subsurface sample, BG-1B, were collected. The second background sample, BG-2, was located on the southeast corner of Second Avenue and School Street, approximately 8 feet south of fire hydrant. A surficial sample, BG-2A, and subsurface sample, BG-2B, were collected. The concentrations found in these background samples would not appear to be related to the contamination found at the Korkay site. The background sample results were usable for comparison purposes, particularly for inorganic comparisons.

The VOC, SVOC, and pesticide concentrations detected in the soil exceeding DEC recommended guidelines for soil cleanup warrant institutional controls or future remediation of the property, as discussed in the Phase I & II Feasibility Study, (CDM, 1995a).

One of the soil cleanup alternatives under consideration includes soil excavation. The approximate size of the areas in square feet was determined from the areal extent shown on Figure 1-7. The volume of organic-contaminated soil to be removed, based on assuming different excavation depths from one foot to four feet and a contingency factor of approximately 33%, is estimated to be:

	Approximate Size of Area (square feet)	Depth (feet)	Range of Soil Volume to be excavated (in-place cubic yards)
Areas 1, 2, 3, 5	13,100	1	600 to 700
Areas 1, 2, 3, 5	13,100	2	1,200 to 1,300
Areas 1, 2, 3, 5	13,100	3	1,800 to 1,900
Areas 1, 2, 3, 5	13,100	4	2,400 to 2,500

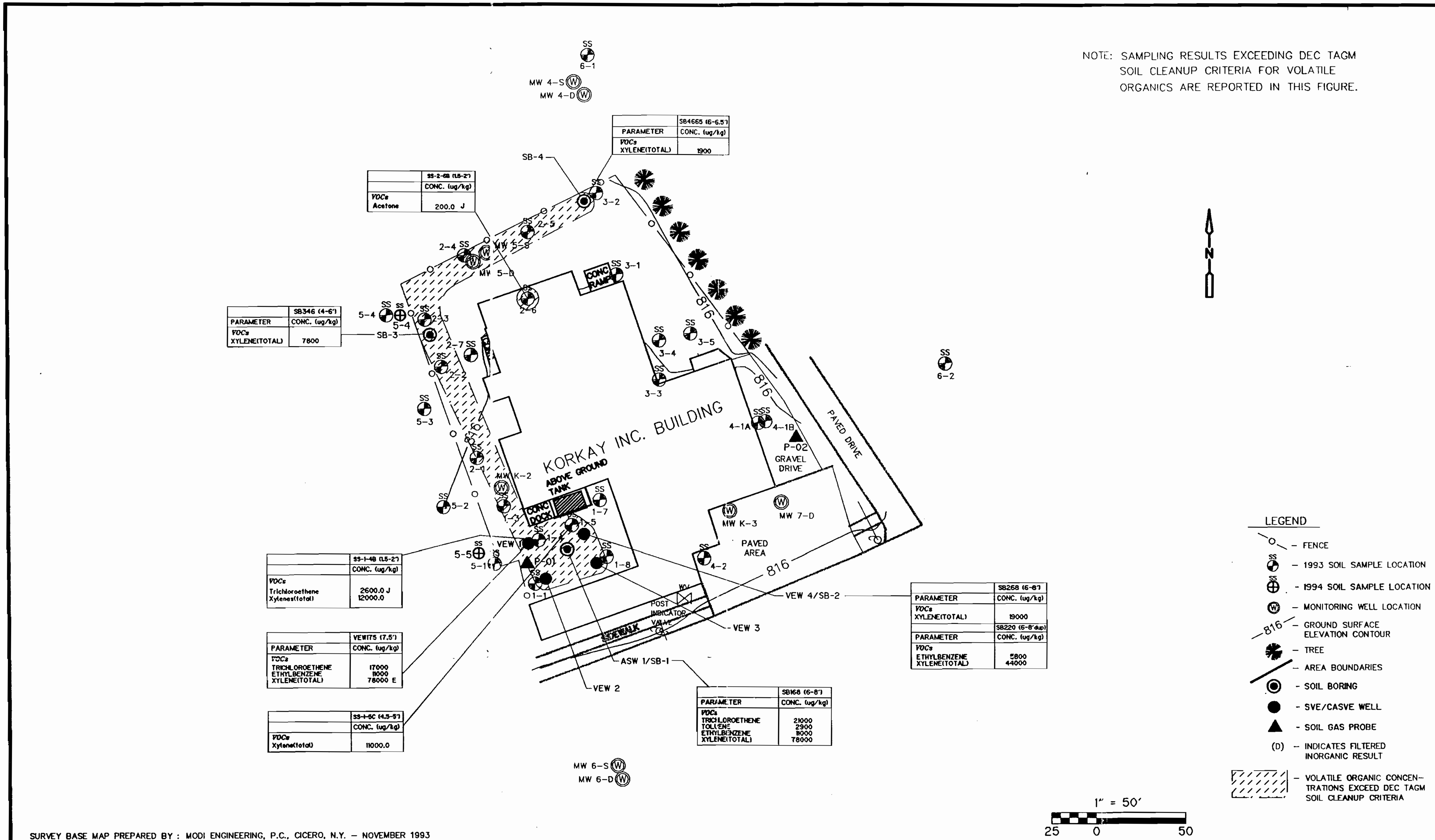

Figure 1-4

Areal Extent of VOC Soil Contamination Exceeding Criteria

Korkay Inc. Site – Broadalbin, New York
NYSDEC Site #5-18-014

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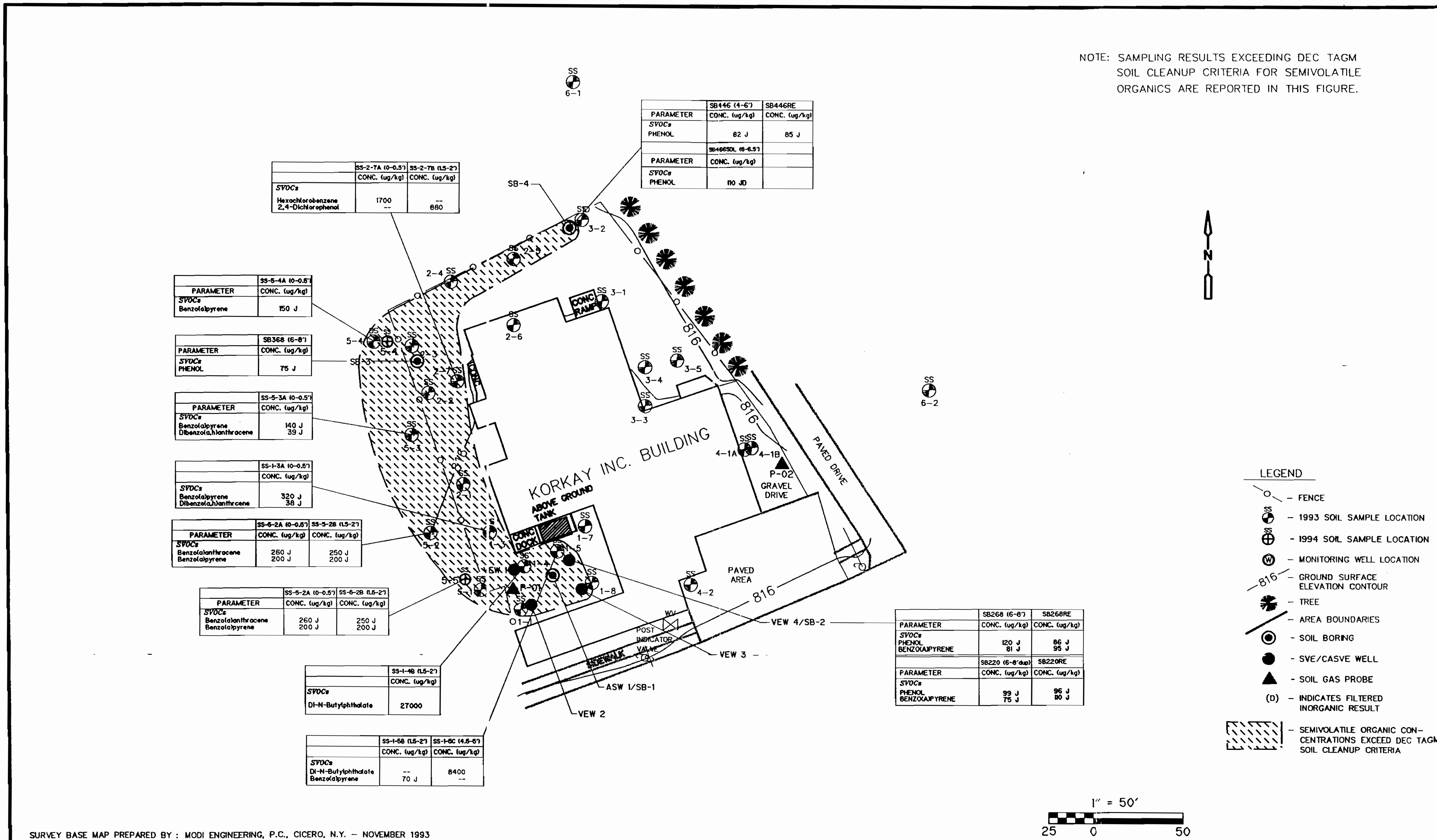

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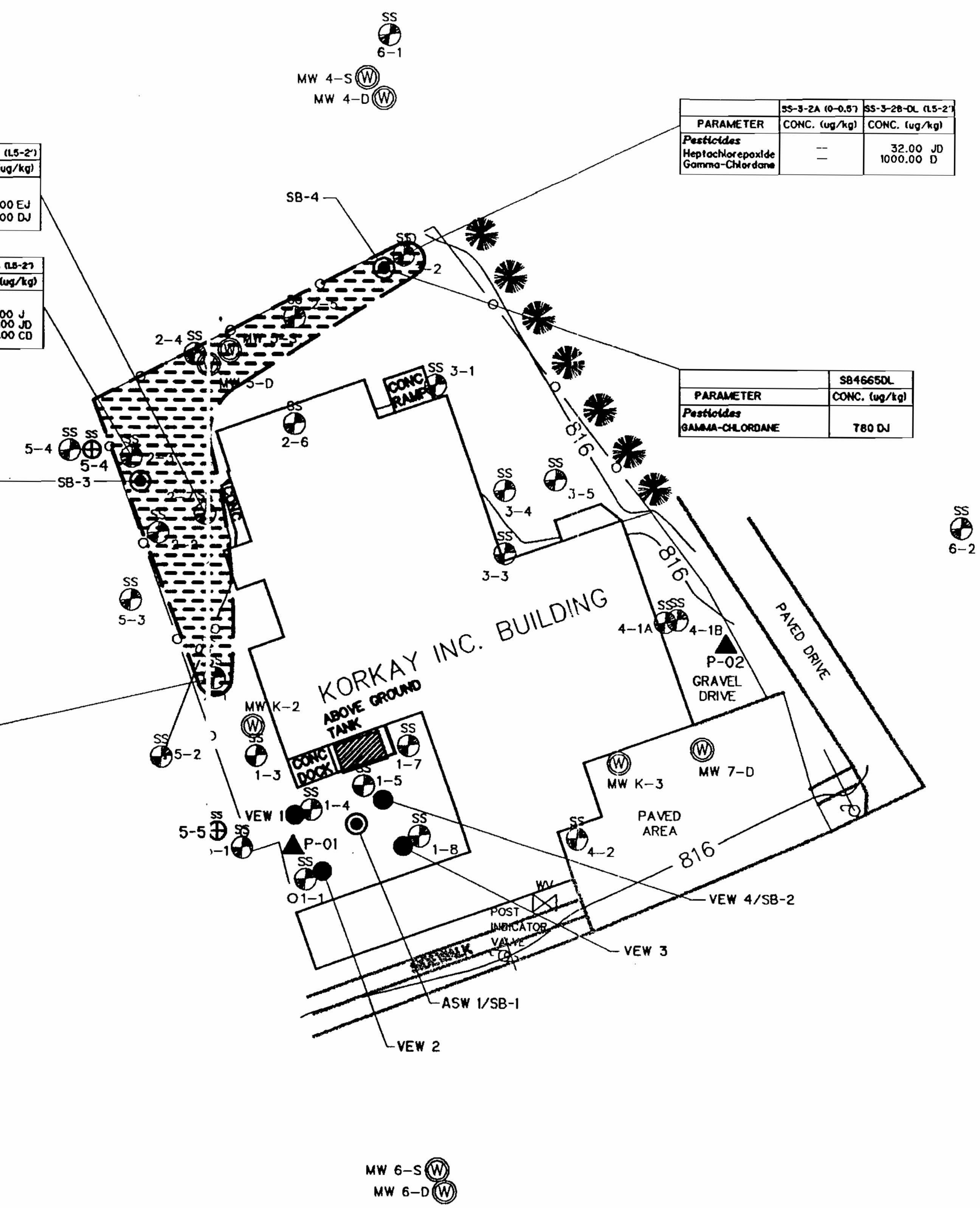
Figure 1-5

Areal Extent of SVOC Soil Contamination Exceeding Criteria

Korkay Inc. Site – Broadalbin, New York

NYSDEC Site #5-18-014

NOTE: SAMPLING RESULTS EXCEEDING DEC TAGM SOIL CLEANUP CRITERIA FOR PESTICIDES ARE REPORTED IN THIS FIGURE.



	SS-2-7A (0-0.5')	SS-2-7B (1.5-2')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
Heptachlorepoxide	--	37.00 EJ
Gamma-Chlordane	1800.00 DJ	1600.00 DJ

	SS-2-3A (0-0.5')	SS-2-3B (1.5-2')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
Aldrin	81.00 P	51.00 J
Heptachlorepoxide	170.00 P	110.00 JD
Gamma-Chlordane	8900.00 EC	4600.00 CD

	SB324 (2-4')	SB324DL
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
ENDRIN, TOTAL	130 E	---
GAMMA-CHLORDANE	—	2700 DJ
	SB346 (4-6')	SB346DL
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
HEPTACHLOR EPOXIDE	110 J	---
DIELDRIN	51 JN	—
ENDRIN, TOTAL	220 JN	---
GAMMA-CHLORDANE	630 E	4600 DJ
	SB368 (6-8')	SB368DL
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
HEPTACHLOR EPOXIDE	27 J	---
GAMMA-CHLORDANE	---	890 DJ

	SS-2-1A-DL (0-0.5')	SS-2-1B-DL (3.5-4')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
Heptachlorepoxide	--	47.00 JD
Gamma-Chlordane	920.00 D	2400.00 CDJ

	SS-3-2A (0-0.5')	SS-3-2B-DL (1.5-2')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
Heptachlorepoxide	--	32.00 JD
Gamma-Chlordane	—	1000.00 D

	SB4665DL
PARAMETER	CONC. (ug/kg)
Pesticides	
GAMMA-CHLORDANE	780 DJ

LEGEND

- FENCE
- 1993 SOIL SAMPLE LOCATION
- 1994 SOIL SAMPLE LOCATION
- MONITORING WELL LOCATION
- 816 – GROUND SURFACE ELEVATION CONTOUR
- TREE
- AREA BOUNDARIES
- SOIL BORING
- SVE/CASVE WELL
- SOIL GAS PROBE
- (D) – INDICATES FILTERED INORGANIC RESULT
- PESTICIDE CONCENTRATIONS EXCEED DEC TAGM SOIL CLEANUP CRITERIA

1" = 50'
25 0 50

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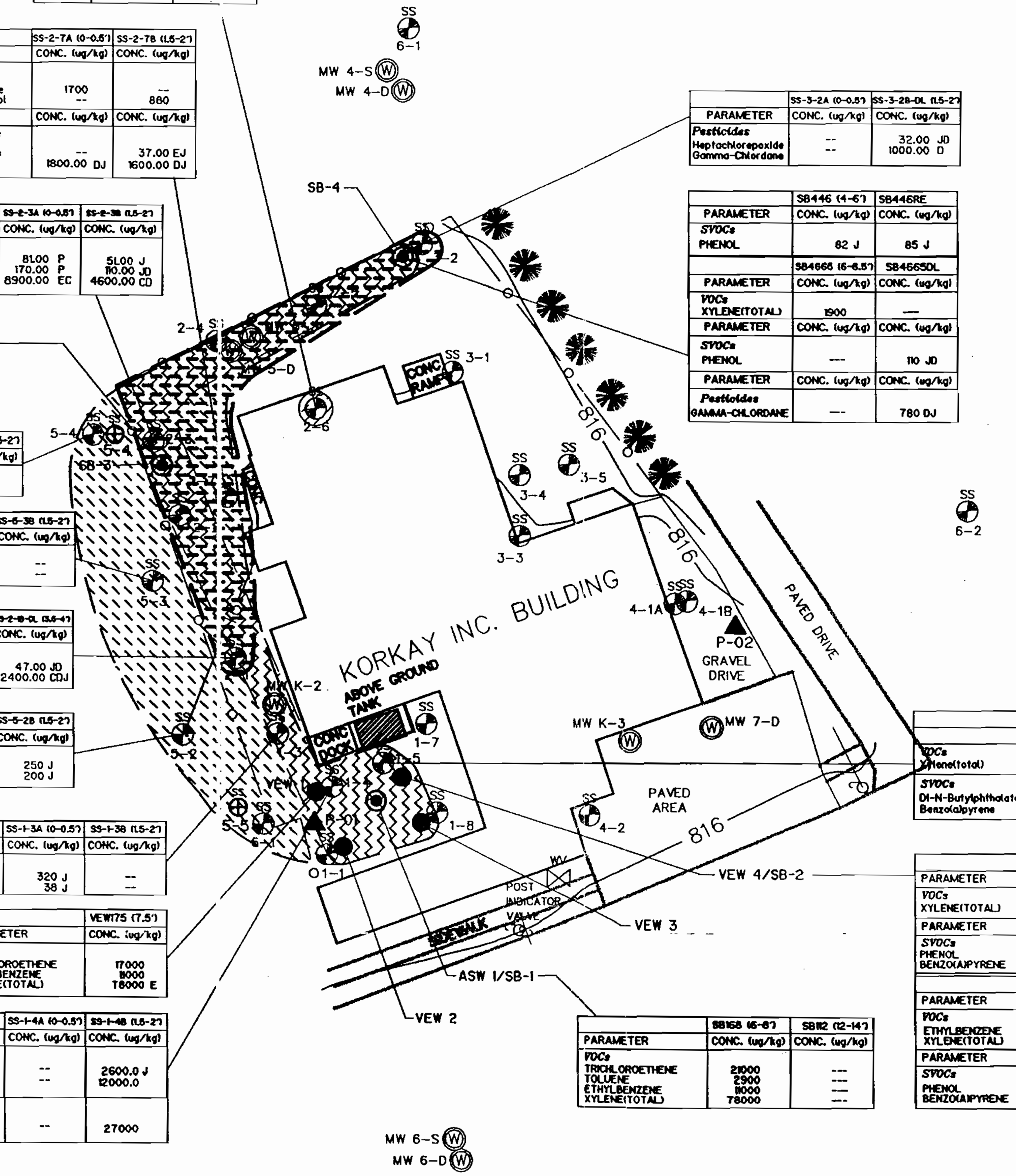
Figure 1-6

Areal Extent of Pesticide Soil Contamination Exceeding Criteria

Korkay Inc. Site – Broadalbin, New York
NYSDEC Site #5-18-014

NOTE: SAMPLING RESULTS EXCEEDING DEC TAGM SOIL CLEANUP CRITERIA ARE REPORTED IN THIS FIGURE.



	SB324 (2-4')	SB324DL
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
ENDRIN, TOTAL	130 E	---
GAMMA-CHLORDANE	---	2700 DJ
	SB346 (4-6')	SB346DL
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
VOCs		
XYLENE(TOTAL)	7800	---
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
HEPTACHLOR EPOXIDE	110 J	—
DIELDRIN	51 JN	---
ENDRIN, TOTAL	220 JN	---
GAMMA-CHLORDANE	630 E	4600 DJ
	SB368 (6-8')	SB368DL
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
PHENOL	75 J	—
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
HEPTACHLOR EPOXIDE	27 J	—
GAMMA-CHLORDANE		890 DJ

	SS-2-6A (0-0.5')	SS-2-6B (1.5-2')
	CONC. (ug/kg)	CONC. (ug/kg)
VOCs		
Acetone	--	200.0 J

	SS-2-7A (0-0.5')	SS-2-7B (1.5-2')
	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
Hexachlorobenzene	1700	--
2,4-Dichlorophenol	--	880
	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides/PCBs		
Heptachlorepoxide	--	37.00 EJ
Gamma-Chlordane	1800.00 DJ	1600.00 DJ

	SS-2-3A (0-0.5')	SS-2-3B (1.5-2')
	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
Aldrin	81.00 P	51.00 J
Heptachlorepoxide	170.00 P	110.00 JD
Gamma-Chlordane	8900.00 EC	4600.00 CD

	SS-5-4A (0-0.5')	SS-5-4B (1.5-2')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
Benzo(a)pyrene	150 J	--

	SS-5-3A (0-0.5')	SS-5-3B (1.5-2')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
Benzo(a)pyrene	140 J	--
Dibenzo(a,h)anthracene	39 J	--

	SS-2-1A-DL (0-0.5')	SS-2-1B-DL (3.5-4')
	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
Heptachlorepoxide	--	47.00 JD
Gamma-Chlordane	920.00 D	2400.00 CDJ

	SS-5-2A (0-0.5')	SS-5-2B (1.5-2')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
Benzo(a)anthracene	260 J	250 J
Benzo(a)pyrene	200 J	200 J

	SS-1-3A (0-0.5')	SS-1-3B (1.5-2')
	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs–Detected		
Benzo(a)pyrene	320 J	--
Dibenzo(a,h)anthracene	38 J	--

	VEW175 (7.5')
PARAMETER	CONC. (ug/kg)
VOCs	
TRICHLOROETHENE	17000
ETHYLBENZENE	11000
XYLENE(TOTAL)	78000 E

	SS-1-4A (0-0.5')	SS-1-4B (1.5-2')
	CONC. (ug/kg)	CONC. (ug/kg)
VOCs		
Trichloroethene	--	2600.0 J
Xylenes(total)	--	12000.0
SVOCs		
DI-N-Butylphthalate	--	27000

	SS-3-2A (0-0.5')	SS-3-2B-DL (1.5-2')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
Heptachlorepoxide	--	32.00 JD
Gamma-Chlordane	--	1000.00 D

	SB446 (4-6')	SB446RE
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
PHENOL	82 J	85 J
	SB466S (6-6.5')	SB466SDL
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
VOCs		
XYLENE(TOTAL)	1900	—
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
PHENOL	---	110 JD
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
Pesticides		
GAMMA-CHLORDANE	---	780 DJ

	SS-1-5A (0-0.5')	SS-1-5B (1.5-2')	SS-1-5C (4.5-5')
	CONC. (ug/kg)	CONC. (ug/kg)	CONC. (ug/kg)
VOCs			
Xylene(total)	--	--	11000.0
SVOCs			
DI-N-Butylphthalate	—	--	8400
Benzo(a)pyrene	—	70 J	--

	SB268 (6-8')	SB268RE
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
VOCs		
XYLENE(TOTAL)	19000	—
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
PHENOL	120 J	86 J
BENZO(A)PYRENE	81 J	95 J
	SB220 (6-8' dup)	SB220RE
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
VOCs		
ETHYLBENZENE	5800	—
XYLENE(TOTAL)	44000	—
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
SVOCs		
PHENOL	99 J	96 J
BENZO(A)PYRENE	76 J	110 J

	SB168 (6-8')	SB112 (12-14')
PARAMETER	CONC. (ug/kg)	CONC. (ug/kg)
VOCs		
TRICHLOROETHENE	21000	---
TOLUENE	2900	---
ETHYLBENZENE	11000	---
XYLENE(TOTAL)	78000	---

LEGEND
- FENCE
- 1993 SOIL SAMPLE LOCATION
- 1994 SOIL SAMPLE LOCATION
- MONITORING WELL LOCATION
- GROUND SURFACE ELEVATION CONTOUR
- TREE
- AREA BOUNDARIES
- SOIL BORING
- SVE/CASVE WELL
- SOIL GAS PROBE
- (D) INDICATES FILTERED INORGANIC RESULT
- SEMIVOLATILE ORGANIC CONCENTRATIONS EXCEED DEC TAGM SOIL CLEANUP CRITERIA
- VOLATILE ORGANIC CONCENTRATIONS EXCEED DEC TAGM SOIL CLEANUP CRITERIA
- PESTICIDE CONCENTRATIONS EXCEED DEC TAGM SOIL CLEANUP CRITERIA

1" = 50'

25 0 50

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Figure 1-7

Areal Extent of Organic Soil Contamination Exceeding Criteria

Korkay Inc. Site – Broadalbin, New York
NYSDEC Site #5-18-014

Based on the findings of the addendum to the Human Health Baseline Risk Assessment, risks were identified with ingestion of vegetables rooted in contaminated soil within at least 2 feet of the ground surface. The additional volume of organic-contaminated soil to be removed in Area 5, in the Hayes backyard, is estimated to be:

	Approximate Size of Area (square feet)	Depth (feet)	Range of Soil Volume to be excavated (in-place cubic yards)
Hayes backyard (remaining area 55' x 170')	9,350	1	450 to 550
Hayes backyard (remaining area 55' x 170')	9,350	2	900 to 1,000

Although metals are not primary contaminants of concern, soil excavation would also beneficially reduce metals and arsenic concentrations in surface soils through removal. Once affected soils are excavated, the exposed area would be backfilled with clean soil to prevent exposure to the residual contaminated media.

The effectiveness of treating, in situ, primarily the elevated volatile organic contamination found in the soil in Area 1, has been evaluated during the Soil Vapor Extraction/Combined Air Sparging and Vapor Extraction (SVE/CASVE) treatability study conducted at the site. The treatability study results indicate that the volatile organic contamination at the site is amenable to this method of treatment.

1.2.3.2 Groundwater

The groundwater flow direction of the shallow water bearing unit is generally south, toward Kennyetto Creek. In the shallow water bearing zone, the gradient is slightly steeper toward the southern edge of the study area than it is toward the north. The data collected in the deep water bearing zone suggests that groundwater flow is generally easterly in this zone. Three of the wells (MW-4D, MW-5D, and MW-6D) are screened at the top of the till and water levels from these three wells suggest groundwater flow to the east. A fourth deep well, MW-7D, while screened stratigraphically deeper, also supports this finding. However, because of the heterogeneity, the easterly flow in the deep zone is considered an approximation.

As suspected from the earlier investigations, the organic constituents found in the soil have migrated into the uppermost water-bearing zone. The groundwater data from samples collected in the uppermost water-bearing zone indicate concentrations of organic and metals constituents in excess of DEC and NYSDOH standards. The data suggest that the site is the source of many of the organic contaminants detected and that they are migrating off site with the shallow water toward Kennyetto Creek located to the south of the site. The southern horizontal extent of the plume in the uppermost water bearing unit has been determined during the Phase II RI work.

The shallow water unit discharges at the seep location. Based on the surrounding land uses downgradient of the site, including residences with septic systems and other industrial land uses, Korkay may not be the sole contributor to the off site contamination detected.

The relatively impermeable nature of the aquitard encountered at the site effectively retards downward movement of organic contaminants. During initial phase RI sampling, organic concentrations exceeding NYS SCGs were not found in any of the deep well samples. During Phase II RI sampling, concentrations of xylene were detected above the DEC and NYSDOH water criteria of 5 ppb in one deep well and di-n-butylphthalate was detected slightly above the criteria of 50 ppb in two deep wells. The organic compounds detected above criteria are similar to those found on the Korkay site, but could also be attributable to other outside sources. For example, of the nine wells at the site, these two wells are both flush mount wells and are located just off West Main Street. Flush mount wells can be more susceptible to outside sources of contamination than stick-up wells. Furthermore, di-n-butylphthalate is a ubiquitous pollutant due to its widespread use primarily as a plasticizer, and is known to be a common laboratory contaminant. In the well samples, di-n-butylphthalate was also found in the two water method blanks at low levels. The di-n-butylphthalate levels found in the deep well samples slightly exceed the DEC and NYSDOH criteria.

The two on site deep wells, MW-7D and MW-5D, were resampled by the DEC personnel on April 14, 1995. Samples for VOC analysis were collected. DEC's results indicate that no VOC compounds were detected in either sample collected. Therefore, it is concluded that the organic contamination above DEC and NYSDOH standards which were detected in the deeper water bearing zone (beneath the aquitard) during Phase II sampling may have been due to outside factors such as possibly cross-contamination during sample collection or analysis.

The approximate on-site and off-site (in the direction of Kennyetto Creek) extent of TCL organic contamination in the shallow water bearing zone exceeding criteria, including the VOC, SVOC, pesticide fractions, is shown on Figures 1-8 and 1-9, respectively. The plume boundaries shown have been approximated from sample location to sample location based on the phase II RI data collected, since organic concentrations were generally higher than initial phase data results. However, concentrations between sample locations may be more than or less than the groundwater criteria. Since there were no sampling points outside the area as shown, the lateral and upgradient boundaries are uncertain. During Phase II RI sampling, both filtered and unfiltered water samples were collected from both shallow and deep wells to confirm the presence of dissolved versus total metals concentrations. Of the metals detected in shallow groundwater samples, only iron, manganese, sodium, thallium, and antimony exceeded standards in the filtered samples from the shallow water bearing unit. Of these, the thallium and antimony data are suspect because they were not detected in the unfiltered samples. Iron, manganese, and sodium are particularly common in groundwater. DEC has found high levels of iron in samples collected in the vicinity of the study area and local water supply wells have occasionally had elevated iron and manganese. Since there is no history of metals discharge at the Korkay site, these metals are believed to be naturally occurring in the groundwater. Iron exceeded both the DEC and NYSDOH standards in several deep well samples, both dissolved and total. Total and dissolved sodium both exceeded the DEC groundwater standard in several samples. These metals are believed to be naturally occurring. No other filtered metals samples exceeded the standards in the deep water bearing unit.

MW4S	
PARAMETER	CONC. (ug/l)
Pesticides	
4,4'-DDT	0.013 JN

MW5S	
PARAMETER	CONC. (ug/l)
VOCs	
TETRACHLOROETHENE	6 J
XYLENE(TOTAL)	42
Pesticides	
ENDOSULFAN I	0.29 J
4,4'-DDE	0.019 JN
ENDRIN, TOTAL	0.057 J

PARAMETER	MWK2 CONC. (ug/l)	MWK20 (dup) CONC. (ug/l)
VOCs		
1,2-DICHLOROETHENE(TOTAL)	11	17
TRICHLOROETHENE	53	68
ETHYLBENZENE	33	76
XYLENE(TOTAL)	170	440 J
SVOCs		
NAPHTHALENE	49	20
DI-N-BUTYLPHTHALATE	---	59
Pesticides		
ALDRIN	---	0.14 JN
HEPTACHLOR EPOXIDE	0.084	0.063 JN
DIELDRIN	0.034 JN	0.026 JN
4,4'-DDE	0.17 JN	0.14 JN
ENDRIN, TOTAL	0.24 J	0.26 J
GAMMA-CHLORDANE	0.51 JN	0.58 JN
4,4'-DDD	---	0.02 JN
4,4'-DDT	---	0.046 JN

PARAMETER	MW6S CONC. (ug/l)	MW6SDL CONC. (ug/l)
VOCs		
1,2-DICHLOROETHENE(TOTAL)	40 J	34 J
TRICHLOROETHENE	12	9 J
BENZENE	2 J	---
TOLUENE	110	99 J
ETHYLBENZENE	80	31 J
XYLENE(TOTAL)	880 E	1100 J
SVOCs		
1,2-DICHLOROBENZENE	32	39 D
2,4-DIMETHYLPHENOL	---	59 D
NAPHTHALENE	100 E	110 D
DI-N-BUTYLPHTHALATE	69	78 D
Pesticides		
ALDRIN	0.32 JN	---

NOTE: SAMPLING RESULTS EXCEEDING DEC GROUNDWATER AND/OR DOH DRINKING WATER VALUES ARE REPORTED IN THIS FIGURE.

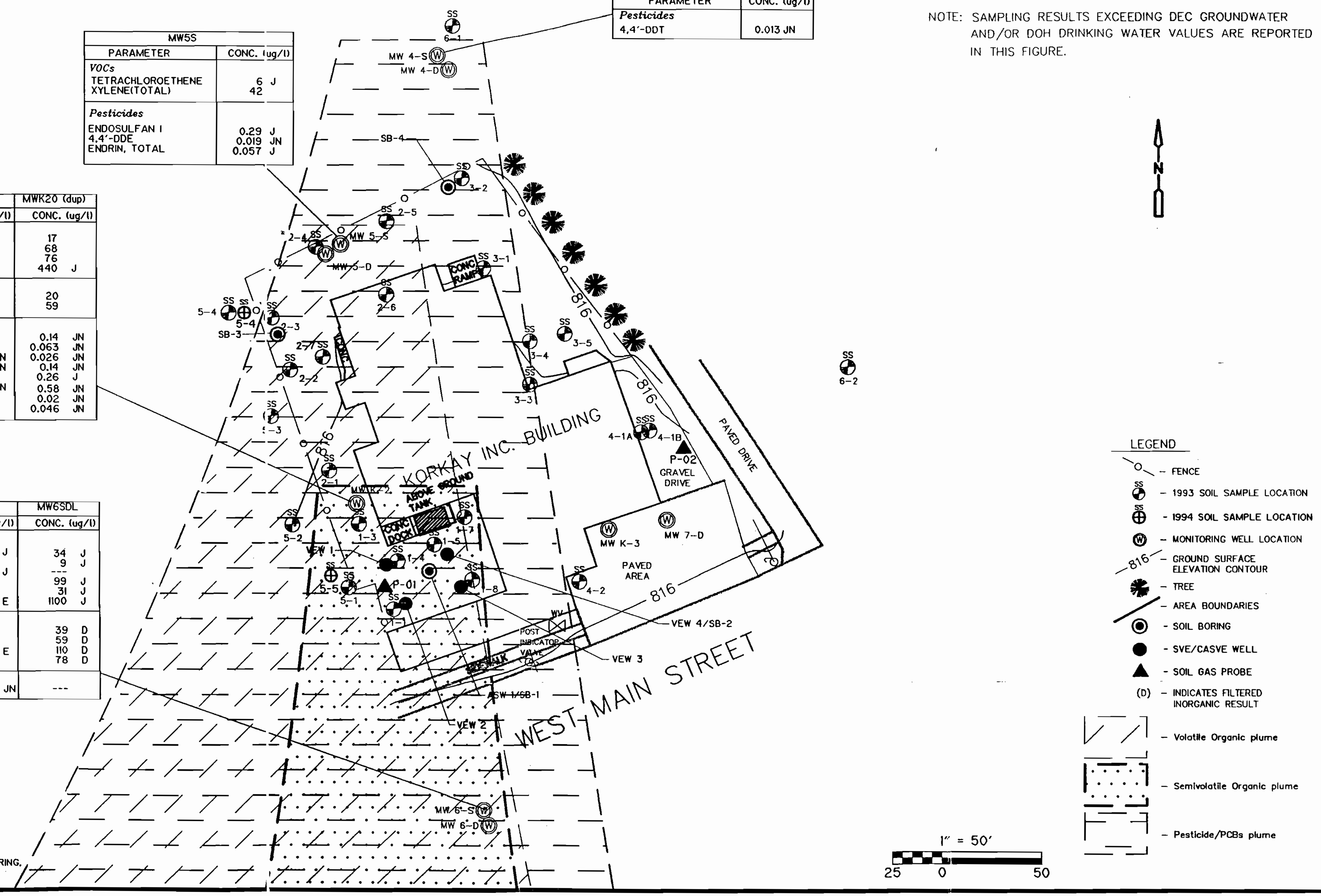

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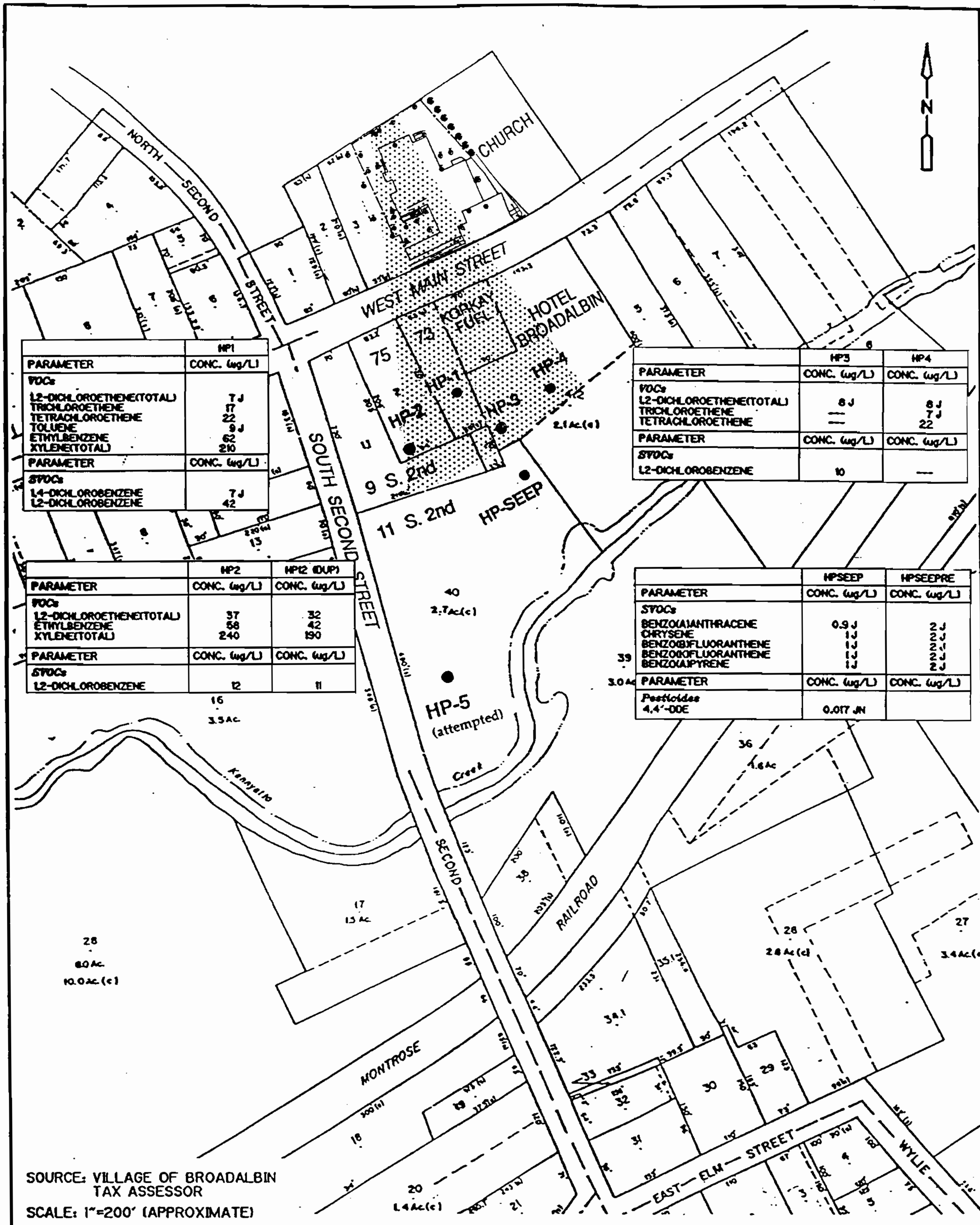
Figure 1-8
Boundary of Organic Groundwater Contaminants Exceeding Criteria
Shallow Water Bearing Zone
Korkay Inc. Site – Broadalbin, New York
NYSDEC Site #5-18-014



PARAMETER	HP1 CONC. (ug/L)
VOCs	
1,2-DICHLOROETHENE(TOTAL)	7 J
TRICHLOROETHENE	17
TETRACHLOROETHENE	22
TOLUENE	9 J
ETHYLBENZENE	62
XYLENE(TOTAL)	210
PARAMETER	**CONC. (ug/L)**
SVOCs	
1,4-DICHLOROBENZENE	7 J
1,2-DICHLOROBENZENE	42

PARAMETER	HP3 CONC. (ug/L)	HP4 CONC. (ug/L)
VOCs		
1,2-DICHLOROETHENE(TOTAL)	8 J	8 J
TRICHLOROETHENE	—	7 J
TETRACHLOROETHENE	—	22
PARAMETER	**CONC. (ug/L)**	**CONC. (ug/L)**
SVOCs		
1,2-DICHLOROBENZENE	10	—

PARAMETER	HP2 CONC. (ug/L)	HP12 (DUP) CONC. (ug/L)
VOCs		
1,2-DICHLOROETHENE(TOTAL)	37	32
ETHYLBENZENE	58	42
XYLENE(TOTAL)	240	190
PARAMETER	**CONC. (ug/L)**	**CONC. (ug/L)**
SVOCs		
1,2-DICHLOROBENZENE	12	11

PARAMETER	HPSEEP CONC. (ug/L)	HPSEEPRE CONC. (ug/L)
SVOCs		
BENZO(A)ANTHRACENE	0.9 J	2 J
CHRYSENE	1 J	2 J
BENZO(B)FLUORANTHENE	1 J	2 J
BENZO(K)FLUORANTHENE	1 J	2 J
BENZO(A)PYRENE	1 J	2 J
PARAMETER	**CONC. (ug/L)**	**CONC. (ug/L)**
Pesticides		
4,4'-DDE	0.017 JN	

Figure 1-9

Boundary of Organic Contaminants Exceeding Criteria (Including Offsite Samples) Shallow Water Bearing Zone

Korkay Inc. Site — Broadalbin, New York

NYSDEC Site #5-18-014

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Based on the groundwater flow directions determined, southerly for shallow water and easterly for deeper water, the two Village of Broadalbin private water supply wells proximal to the site on Cedar Lane (to the north of the site) are at little to no risk of being impacted by groundwater contamination at the Korkay site.

1.2.3.3 Surface Water & Sediment

Based on the surrounding land uses of the site, including residences with septic systems and other industrial land uses, it is likely that Korkay may not be the sole contributor to impacts of surface water and sediment quality.

TCE, found at the Korkay site, was also detected in a surface water sample above criteria, at a location upstream of where the seep was observed to intersect the creek. The TCE concentration found in the sediment sample is below the DEC TAGM soil criteria. The SVOC compound found in the surface water may be attributable to sample collection or sampling handling in the laboratory. Bis(2-ethylhexyl)butylphthalate is known to be a common laboratory contaminant. The SVOC compounds detected in the sediment, below the DEC TAGM soil criteria, are similar in nature to those found on site and include PAHs commonly found in diesel and fuel oils. It is suspected that other sources of SVOC contamination may exist in the area between Korkay and the creek. No pesticides were detected in the surface water, and were detected at low concentrations in sediment samples. The metals detected in the surface water and the sediment are similar in nature to those found in the area.

The quality of the surface water and sediment in Kennyetto Creek, a Class C stream, has been determined. While there are exceedances of criteria, it is likely that the Korkay site is not the sole contributor of contamination, particularly since contamination was also found in the upstream sample.

1.2.3.4 Soil Vapor Extraction/Combined Air Sparging Vapor Extraction (SVE/CASVE) Treatability Study

The SVE/CASVE treatability study was conducted in October 1994, as part of the Phase II RI, to evaluate and determine its effectiveness in treating primarily the volatile organic contaminants found in Area 1 of the site. Based on the study conducted and the data collected, it was concluded that this treatment technology is effective to reduce contamination concentrations of the VOCs, and to a lesser degree, several of the lighter-fraction SVOCs, found in the Areas 1 soils. The VOCs found in Areas 2 and 3 in the vadose zone would also benefit from SVE. Although air sparging will not have an affect on pesticides removal, based on available site history information, DEC believes that use of pesticides was not part of the regular Korkay operations. Furthermore, no impact of the pesticides in the groundwater on Kennyetto Creek at any significant levels was found.

1.2.4 Contaminant Fate and Transport

1.2.4.1 Introduction

In Section 1.2.3, the analytical data were presented that established the type, magnitude, and the extent of contamination present at the site. In this section, the observed contaminant data will be used to evaluate the potential fate and transport pathways as it relates to soil and groundwater contamination.

Four potential contaminant release and transport pathways were considered for the Korkay, Inc. site including:

- o Direct discharge of chemicals or waste material onto the ground via surface spills with subsequent adsorption of chemical contaminant on soil;
- o The migration of chemical contaminants present in soil via surface run-off and windblown dusts;
- o The volatilization of chemical contaminants present in surface soil into the ambient air;
- o Leaching of contaminants into the groundwater through percolation of precipitation through contaminated soil.

1.2.4.2 Contaminant Characterization and Fate

To determine the persistence and migration of contaminants from soil, it is necessary to identify these contaminants that are likely to leach, degrade (biotically or abiotically), or volatilize. Accordingly, contaminants that will persist in the subsurface are those that are likely to adsorb to soil, form insoluble precipitates, or resist biodegradation, hydrolysis, and volatilization. The chemical, physical, and biological factors that affect persistence and migration of contaminants are described in this section.

Organic Compounds

The potential mobility and persistence of a contaminant in the environment is established by evaluating the physical and chemical properties of each contaminant, the environmental transformation processes affecting it, and the properties of the media through which it migrates. Factors that affect the fate and transport of organic contaminants in the environment include:

- o water solubility
- o volatility
- o adsorption
- o redox potential and pH
- o hydrogeology
- o biodegradation
- o total organic carbon content
- o geological/soil characteristics

The water solubility of a substance is a critical property affecting environmental fate. Highly soluble chemicals can be rapidly leached from soils and are generally mobile in groundwater.

Volatilization of a compound will depend on its vapor pressure and temperature, water solubility, and molecular weight. Highly water soluble compounds generally have lower volatilization rates than water. Vapor pressure, a relative measure of the volatility of chemicals in their pure state, ranges from 0.001 to 760 mm Hg for liquids at ambient temperature, with solids ranging down to 10^{-7}. Henry's Law constant, which combines vapor pressure with solubility and molecular weight, is more appropriate for estimating releases to air from water. Compounds with Henry's Law constants in the range of 10^{-3} and larger can be expected to volatilize rapidly from water; those with values ranging from 10^{-3} to 10^{-5} are associated with possibly significant but not rapid volatilization, while compounds with values less than 10^{-5} will volatilize slowly from water (Lyman et al. 1982).

Volatilization is an important process to assess for impacts on surficial soils. The octanol-water partition coefficient (K_ow) and the organic carbon partition coefficient (K_{oc}) reflect the propensity of a compound to sorb to the organic matter found in soil. The normal range of K_{oc} values extends to 10-^7 (or Log K_{oc}=7), with higher values indicating greater sorption potential.

The soil-water partition coefficient (K_d) relates the adsorption of the compound to the actual soil. The K_d has been calculated by normalizing the K_{oc} against the organic carbon content (om) of the soil as follows (EPA, 1989):

$$K_d = K_{oc} \times om/1.724$$

An organic carbon content of 10,000 mg/kg was used to represent the organic carbon content of soils, based on DEC's recommendation.

Using this relationship and K_{oc} values for selected organic compounds detected in groundwater and/or soil, an idea of the relative mobility of each selected organic compound was calculated and summarized in Table 1-1.

The redox potential of the subsurface will greatly affect the speciation of contaminants, and hence their mobility or persistent in the environment (EPA, 1989). Oxidizing environments generally are not widely encountered in aquifers because of their inherently "enclosed" nature (Olsen and Davis, 1990), but may be significant in surface water systems. Microbial activity and organic contaminants may provide reducing conditions. The pH of soils and groundwater will affect hydrolysis rates, equilibrium partitioning conditions, and contaminant solubility.

Site specific hydrogeologic properties will determine groundwater flux, and, therefore, contaminant transport rates.

Contaminants detected in the soils that may be expected to bioaccumulate/ bioconcentrate include metal species such as lead and mercury, and pesticides and PCBs. Bioconcentration is not expected to be significant for most VOCs and SVOCs (Howard, 1990).

Table 1-1 summarizes the relative relationships between K_{oc}, K_d and R_f (retardation factor; see Section 1.2.3.4 for detailed description) for several of the organic contaminants detected in significant concentrations at the Korkay, Inc. site.

Table 1-1
Select Fate and Transport Properties

CONTAMINANT	Koc * (L/kg)	Kd	Rf	log Rf
VOCs				
Xylenes	240	1.392	8.425	0.93
Ethylbenzene	1100	6.381	35.029	1.54
Toluene	300	1.740	10.281	1.01
Tetrachloroethene	277	1.607	9.569	0.98
Trichloroethene	126	0.731	4.898	0.69
Acetone	2.2	0.013	1.068	0.03
2-Butanone	4.5	0.026	1.139	0.06
1,1,1-Trichloroethane	152	0.882	5.702	0.76
1,1-Dichloroethene	65	0.377	3.011	0.48
1,2-Dichloroethene(cis)				
1,2-Dichloroethene(trans)	59	0.342	2.825	0.45
SVOCs				
1,2-Dichlorobenzene	1700	9.861	53.591	1.73
1,4-Dichlorobenzene	1700	9.861	53.591	1.73
Benzo(b)fluoranthene	550000	3190.255	17015.695	4.23
Benzo(k)fluoranthene	550000	3190.255	17015.695	4.23
Phenanthrene	4365	25.319	136.035	2.13
Fluoranthene	38000	220.418	1176.561	3.07
Pyrene	13295	77.117	412.292	2.62
Benzo(a)pyrene	5500000	31902.552	170147.945	5.23
Indeno(1,2,3-cd)pyrene	1600000	9280.742	49498.293	4.69
2-Methylphenol	15	0.087	1.464	0.17
4-Methylphenol	17	0.099	1.526	0.18
Naphthalene	1300	7.541	41.217	1.62
2-Methylnaphthalene	727	4.217	23.490	1.37
Anthracene	14000	81.206	434.101	2.64
Bis-2-ethylhexylphthalate	8706	50.499	270.327	2.43
Diethylphthalate	142	0.824	5.393	0.73
Butylbenzylphthalate	2430	14.095	76.174	1.88
Di-n-butylphthalate	162	0.940	6.012	0.78
Di-n-octylphthalate	2346	13.608	73.575	1.87
Chrysene	200000	1160.093	6188.162	3.79
Benzo(a)anthracene	1380000	8004.640	42692.415	4.63
Benzo(g,h,i)perylene	1600000	9280.742	49498.293	4.69
2,4-Dichlorophenol	380	2.204	12.756	1.11
Dibenzo(a,h)anthracene	33000000	191415.313	1020882.671	6.01
Hexachlorobenzene	3900	22.622	121.650	2.09
Pesticides/PCBs				
4,4-DDD	770000	4466.357	23821.572	4.38
4,4-DDE	440000	2552.204	13612.756	4.13
4,4-DDT	243000	1409.513	7518.401	3.88
Dieldrin	10700	62.065	332.013	2.52
Endrin	9157	53.115	284.279	2.45
Aldrin	96000	556.845	2970.838	3.47
Endosulfan II	8168	47.378	253.684	2.40
Endosulfan I	8031	46.584	249.445	2.40
Endosulfan Sulfate	10038	58.225	311.534	2.49
Heptachlor	12000	69.606	372.230	2.57
Heptachlor Epoxide	220	1.276	7.806	0.89
Alpha-BHC	3800	22.042	118.556	2.07
Beta-BHC	3800	22.042	118.556	2.07
Delta-BHC	6600	38.283	205.176	2.31
Gamma-BHC	1080	6.265	34.411	1.54
Methoxychlor	25637	148.706	794.101	2.90
Gamma-chlordane	140000	812.065	4332.013	3.64
PCBs	17510	101.566	542.686	2.73

* Source: TAGM. 1994. Technical and Adminsitrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels (HWR-94-4046). Prepared by Division of Hazardous Waste Remediation of NYSDEC. January 24.

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TAL Metals

The transport of inorganics in the environment is more difficult to predict than for organics, and is a function of several site specific conditions. The mobility of inorganics is affected by such factors as speciation, presence of chelating/complexing agents, pH, soil composition, and soil organic carbon content. Generally, metals exhibit moderate to high mobility in sandy, loamy sand, sand sandy loam soils, while exhibiting low to moderate mobility in clay and silty clay soils. In addition, high organic carbon content in soils decreases the mobility of metals.

In a study of metals retention in soils, the relative mobility of 11 metals in various soils types are assessed (EPA, 1978). The study concluded that chromium, mercury, and nickel are among the most mobile, while lead and copper are the least mobile. For the other metals studied, the mobility varied with the conditions, although the order of mobility was generally:

Most Mobile---- As V Se Cd Zn Be ------Least Mobile

A variety of factors affect the mobility of metals in soil/water systems. The major factors include:

- the presence of water (soil moisture content);
- the presence of other complexing chemicals in solution
- the pH and oxidation/reduction potential, which affect the speciation of all metals and complexing agents;
- the temperature; and
- soil properties, such as cation exchange, the presence of hydrous oxides of iron and magnesium, and the presence of organic matter.

High variability in environmental conditions and the value of certain physical parameters, however, lend some uncertainty to estimates of metal mobilities. Soil sorption constants, in particular, may vary a great deal. The constants may vary over several orders of magnitude for a given metal in different soils and/or under different environmental conditions. Thus, there is a no single sorption constant describing the binding of metals in solution to soils and no unique mobility holds for all environmental conditions.

1.2.4.3 Conceptual Site Contaminant Transport Model

Organic compounds may move through the subsurface guided by a variety of transport processes. In this analysis, three potential subsurface flow scenarios were examined:

- the vertical migration of non-aqueous phase liquid organics through the unsaturated zone to the saturated zone (light and dense);

- the vertical migration of chemicals dissolved in rainwater percolating through the unsaturated zone to the saturated zone;

- the flow of chemicals dissolved in ground water flowing through the saturated zone; and

- volatilization of organics from soil and groundwater.

Under the first scenario, pure organic liquids or mixtures of solvents are assumed to be flowing through the unsaturated zone. Such liquids may originate from direct discharge, leaking underground tanks, or surface spills.

It is unlikely, however, that pure product flows are present within the site. During RI subsurface investigation, there was no evidence of residual liquids observed in the unsaturated soils, and concentrations in groundwater do not indicate the presence of non-aqueous phase liquids in the saturated zone. In addition, based on available historical information, it is more likely that a mixture of various chemicals were used.

The second scenario assumes that organic chemicals are dissolved in infiltrating rainwater. In this case, the relative mobility of the contaminants is based on their solubility and relative ability to sorb or adhere to subsurface materials. The greater a compound's sorption, the greater the retardation affecting its flow.

Under the third scenario, organic contaminants are transported as chemicals dissolved in the ground water, flowing through the saturated zone. The relative rates at which contaminants move in the saturated zone are, based to a large degree, on the chemicals' sorption capacities, characteristics of advective transport of the water bearing unit such as conductivity, porosity, and gradient, dispersion, and adsorption

Under the fourth scenario volatile organic contaminants are released from soil and groundwater. This fourth scenario will be occurring at the site during each of the three previous scenarios.

The likely pathway along which contaminants are moving at the site begins with the transport through the unsaturated zone as an aqueous solute dissolved in infiltrating rainwater. Subsequent transport is vertically through the unsaturated zone. The aqueous solute is diluted in groundwater after it leaves the unsaturated zone.

Organic Compounds

To characterize the behavior of each of the organic contaminants along the predicted flow path, their physical and chemical properties were used to establish a scheme of relative mobilities. A "retardation factor" was approximated for each compound found in the soil samples from the site. These factors serve as estimates of the relative mobilities of each compound based on the partition coefficient between soil and water media (K_{oc}) values included in the DEC TAGM for Determination of Soil Cleanup Objectives and Cleanup Levels, dated November 16, 1992 (revised January 24, 1994).

Retardation factors are based on four parameters, assumed for this analysis as follows: the bulk density of the subsurface material (1.6 kg/L); the fraction of organic matter in the subsurface material (f_{oc} = .00058); the effective porosity of the subsurface material (0.3); and an adsorption coefficient for each compound. The equation for calculating the retardation factor is as follows:

$R_f = 1 + p^*K_d/n$
$= 1 + p^*K_{oc}{}^*f_{oc}/n$

R_f = retardation factor (dimensionless)
p = soil bulk density (kg/l)
K_d = sorption constant (l/kg)
K_{oc} = organic carbon normalized sorption constant (l/kg)
f_{oc} = weight fraction organic carbon in soil ($0 \leq foc \leq 1$) (dimensionless)
n = soil porosity ($0 \leq n \leq 1$) (dimensionless)

Estimates of the first three parameters were made based on an assumption of saturated soil conditions. The fraction of organic carbon has been assumed to be 10,000 mg/kg, a DEC recommended assumption.

The fourth parameter, adsorption, is independent of position in the subsurface soils and is, instead, particular to each chemical. The adsorption coefficient reflects a compound's tendency to distribute itself as a solute dissolved in groundwater or adsorbed to soil.

Thus combining these four parameters, one retardation factor for each compound was estimated in the saturated zone (see Table 1-2).

The movement of contaminants in the unsaturated zone could be expected to be slower than in the saturated zone. Aerobic degradation and volatilization also play a role in reducing the mobility of some of the volatile organic contaminants in the unsaturated zone.

As discussed previously, there are clay or silty clay materials at the site which could preclude contaminant migration vertically from the uppermost water bearing unit to the first water bearing unit encountered below this aquitard. The quality of the deeper water samples is significantly better than the quality of the shallow water samples. Only two organic compounds were detected in the deeper water samples in trace amounts.

As shown in Table 1-2, the ranges of retardation factors for the several site specific contaminants span several orders of magnitude. Using these values, contaminants were grouped into 7 categories, shown in Table 1-1, and are described in terms of their flow rate relative to ground water. This process of assigning degrees of mobility allows the contaminants to be ranked according to their relative mobility along a theoretical pathway. These mobilities are presented for individual groups of contaminants.

Of the several classes of compounds detected in the soil samples from the site, the ketones, chlorinated ethers, and select aromatics and phthalates were found to be within the saturated zone. These compounds have very low retardation factors, with flow rates approaching that of groundwater.

In general, the PAHs and pesticides have a moderate to low mobility, with flow rates approximately one to six orders of magnitude slower than groundwater. Benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)- anthracene have very low mobilities, with an estimated flow rate 4 to 6 orders of magnitude slower than groundwater.

Table 1-2
Sorted Retardation Factors Used to Compare Flow
Rates of Dissolved Organics in the Saturated Zone

CONTAMINANT	Rf	log Rf	
Acetone	2.2	0.03	
2-Butanone	4.5	0.06	
2-Methylphenol	15	0.17	
4-Methylphenol	17	0.18	
1,2-Dichloroethene(trans)	59	0.45	
1,1-Dichloroethene	65	0.48	**GROUP A**
Trichloroethene	126	0.69	Flow rate same order
Diethylphthalate	142	0.73	of magnitude as water
1,1,1-Trichloroethane	152	0.76	
Di-n-butylphthalate	162	0.78	
Heptachlor Epoxide	220	0.89	
Xylenes	240	0.93	
Tetrachloroethene	277	0.98	
Toluene	300	1.01	
2,4-Dichlorophenol	380	1.11	
2-Methylnaphthalene	727	1.37	
Gamma-BHC	1080	1.54	
Ethylbenzene	1100	1.54	**GROUP B**
Naphthalene	1300	1.62	Flow rate 1 order
1,2-Dichlorobenzene	1700	1.73	of magnitude slower
1,4-Dichlorobenzene	1700	1.73	than water
Di-n-octylphthalate	2346	1.87	
Butylbenzylphthalate	2430	1.88	
Alpha-BHC	3800	2.07	
Beta-BHC	3800	2.07	
Hexachlorobenzene	3900	2.09	
Phenanthrene	4365	2.13	
Delta-BHC	6600	2.31	
Endosulfan II	8031	2.40	**GROUP C**
Endosulfan I	8[illegible]68	2.40	Flow rate 2 orders
Bis-2-ethylhexylphthalate	8706	2.43	of magnitude slower
Endrin	9[illegible]57	2.45	than water
Endosulfan Sulfate	10038	2.49	
Dieldrin	10700	2.52	
Heptachlor	12000	2.57	
Pyrene	13295	2.62	
Anthracene	14000	2.64	
PCBs	17510	2.73	
Methoxychlor	25637	2.90	
Fluoranthene	38000	3.07	**GROUP D**
Aldrin	96000	3.47	Flow rate 3 orders
Gamma-chlordane	140000	3.64	of magnitude slower
Chrysene	200000	3.79	than water
4,4-DDT	243000	3.88	
4,4-DDE	440000	4.13	
Benzo(k)fluoranthene	550000	4.23	
Benzo(b)fluoranthene	550000	4.23	**GROUP E**
4,4-DDD	770000	4.38	Flow rate 4 orders of magnitude slower than water
Benzo(a)anthracene	1380000	4.63	
Indeno(1,2,3-cd)pyrene	1600000	4.69	
Benzo(g,h,i)perylene	1600000	4.69	
Benzo(a)pyrene	5500000	5.23	**GROUP F**
			Flow rate 5 orders of magnitude slower than water
Dibenzo(a,h)anthracene	33000000	6.01	**GROUP G**
			Flow rate 6 orders of magnitude slower than water

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Under ideal conditions, considering the type of soils underlying the study area, the relative mobility of each contaminant class would be reflected in its occurrence in the various environmental media and could be used to predict the occurrence and fate of each contaminant class in the future. For example, high mobility contaminants would be expected to occur in a variety of media. If the soils in a particular area were acting as a source, contaminants should also be detected in the ground water; if high mobility compounds, with low retardation factors, were present, they would move readily from soils into solution in the groundwater. Conversely, low-mobility compounds detected in the soils would not be expected in aqueous media due to their tendency to adhere to organic matter.

Based on the types of organic contaminants detected in the study area, it may be expected that halogenated hydrocarbons, ketones (i.e., acetone), phenols, non-aromatics (i.e., trichloroethane, tetrachloroethane, 1,1,1-trichloroethane, 1,2-dichloroethene), and aromatics (i.e., naphthalene, toluene and xylenes) in the soil would be found in the groundwater. This was usually the case. However, for example, acetone was detected in the soil samples but not detected in the groundwater. An explanation for the lack of acetone in recent groundwater samples is that its high water solubility and low retardation may result in instantaneous dilution at the water table, thereby lowering the concentration in the ground water to below analytical detection limits. PAHs, phthalates, pesticides (DDD, DDT and DDE) would be less likely detected in the groundwater. This was not always the case. For example, the pesticides were detected exceeding criteria in the water samples, perhaps attributable to colloidal effects (i.e., particles suspended in water), particularly in the immediate vicinity of the source contamination.

Other classes of highly mobile organic compounds, including the aromatics and chlorinated hydrocarbons detected in the soils, were present in the saturated zone at varying concentrations. Likewise, the more mobile PAHs, such as naphthalene and 2-methylnaphthalene detected in the soils, and pesticides were also present in the saturated zone. The presence of the organic compounds in the saturated zone indicates that contaminants have migrated vertically downward through the unsaturated zone into the uppermost water bearing unit and the soils are acting as a contaminant source. This dissolved phase in the uppermost water bearing unit has began to migrate from the site in the direction of Kennyetto Creek.

TAL Metals

The relative mobilities assigned to the inorganic contaminants detected within the study area are shown in Table 1-3:

Table 1-3
Relative Mobilities of Inorganic Constituents

HIGH	MEDIUM	LOW
Antimony	Aluminum	Cobalt
Calcium	Arsenic	Copper
Magnesium	Barium	Lead
Potassium	Cadmium	Mercury

Selenium	Iron	Nickel
Sodium	Manganese	Zinc
Vanadium	Silver	
	Thallium	
	Chromium	
	Beryllium	

Under the ideal or "average" conditions assumed to estimate these mobilities, their relative assigned values would be reflected in the occurrence of each metal in the groundwater. The relative mobilities could then be used to predict the occurrence and fate of each compound in the future. As described previously for the organic contaminants, those metals with high mobilities would be expected to have migrated from their source materials into the groundwater. Furthermore, their migration into areas outside the study area could also be expected. On the other hand, those metals with relatively lower mobilities would not be expected to have infiltrated the groundwater nor to have migrated far from the study area.

The nature and extent of inorganic contamination as outlined in Section 1.2.3 suggests that this simple model is partially applicable to the study area since the inorganic contaminants exceeding two times DEC TAGM soil cleanup criteria that have medium to high relative mobilities are also found in the water samples. Inorganic metals in the water appear to be elevated and do not display established distribution patterns, possibly due to the natural constituents of groundwater as a result of the water's interaction with the soil deposit and the silty nature of the formation. According to DEC project personnel, high iron, lead and calcium levels are commonly encountered in glacial till water samples collected in and around the area, and the Village water supply has historically had elevated levels of iron and manganese, presumably that are naturally-occurring.

1.2.5 Human Health Risk Assessment

In May 1994, the risk assessment findings were submitted to DEC under separate cover in a report entitled "Human Health Risk Assessment for the Korkay, Inc. Site". Since the Korkay, Inc. site is located in a mixed residential area, the possible risks associated with potential future residential use of the site were evaluated in the risk assessment. In summary, three potential exposure routes were considered for the resident: inhalation, ingestion, and dermal adsorption. The exposure media considered were the shallow and deep water bearing units, surficial soils, and subsurface soils.

The conservative rationale for selection of contaminants of concern used in the risk assessment was based on EPA risk assessment guidance. Based upon the initial phase RI data and applicable regulatory criteria, the potential chemicals of concern for ingestion were alpha chlordane, gamma chlordane, dieldrin, heptachlor epoxide, TCE, and manganese for the shallow water bearing unit; manganese for the deeper water bearing unit; alpha chlordane, gamma chlordane and arsenic for the surface soil; and alpha chlordane, gamma chlordane and arsenic for the subsurface soil. In addition, for lead in soil, although there are currently no quantitative toxicity criteria available for lead from EPA, EPA recommends a residential soil lead action level of 500 mg/kg based on the results of a standard application of the biokinetic lead uptake model. This level is exceeded in three samples collected in Areas 1 and 5 during initial phase RI work.

The highest risks are associated with the human consumption and household use of the water in the shallow water-bearing zone; however, this is an unlikely scenario given that the Village of Broadalbin has a public water supply. Risks for ingestion, dermal contact, and inhalation of contaminants volatilized from shallow groundwater are above or within the target risk range recommended by EPA. Risks for ingestion for surface and subsurface soil are also within the EPA target risk range.

The human health risk associated with ingesting vegetables grown in the upper two feet of soil as the Hayes property was assessed in an addendum to the Human Health Baseline Risk Assessment in May 1995 (Dynamac, 1995b). This assessment showed vegetables grown in this soil would pose an unacceptable health risk. The site risks were driven by exposure to arsenic, barium, beryllium, cadmium, copper, manganese, mercury, heptachlor epoxide and benzo(a) pyrene.

1.2.6 Habitat Assessment

CDM provided a Final Habitat Assessment - Step 1 (CDM, 1994) of the Korkay site that evaluated the value of the natural habitats in the vicinity of the site; and potential exposure of organisms to contamination from the site. The findings of the habitat value study indicated that:

1) there were no known habitats for state or federal endangered or threatened species within the vicinity of the site;

2) that the habitats within 0.5 miles of the site did not appear to be of significant value and

3) there were a number of high value habitats within a 2 mile radius of the site.

The exposure assessment also indicated that there does not appear to be any contaminant exposure to aquatic or terrestrial organisms associated with surface water or wetland (particularly, Kennyetto Creek). However, terrestrial organisms could be exposed to site chemicals by incidental ingestion while foraging. But, since the site is small and the soils are an unsuitable habitat for many organisms, it is unlikely that organisms will use the site for foraging.

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Section 2
Development of Remedial Alternatives (First Phase Feasibility Study)

2.1 Introduction

Alternatives for remediation are developed by assembling combinations of technologies, and the media to which they would be applied, into alternatives that address contamination on a site-wide basis. This process consists of the following:

- develop site Remedial Action Objectives (RAOs) to address the constituents and media of concern, and potential exposure pathways (see Section 2.3).
- develop general response actions for each medium of concern that may be taken to satisfy the site RAOs.
- identify volumes or areas of media to which general response actions might be applied, taking into account the requirements for protectiveness as identified in the RAOs and the chemical and physical characterization of the site (See Section 1.2.3).
- identify and screen the technologies applicable to each general response action to eliminate those that cannot be implemented technically at the site.
- identify and evaluate technology process options to select a representative process for each technology type retained for consideration.
- assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations, as appropriate.

As requested by the NYSDEC, the Phase I and II FS for the Korkay site was a focused FS, i.e., based on the results of the Phase I RI, only the following potentially applicable remedial actions have been considered in this FS: institutional/deed restrictions, media monitoring, soil excavation and off-site disposal of excavated soils, residual soil containment (soil cover), and soil vapor extraction/combined air sparging and soil vapor extraction (SVE/CASVE)(NYSDEC 1994a-j).

2.2 Potential Migration and Exposure Pathways of Constituents of Concern

Constituents of concern (COCs) are those constituents that exceed established SCGs and contribute to human health risks. Based on the Phase I and II RI sample analytical results (CDM 1994a), applicable SCGs, and the site risk assessment (RA) (Dynamac 1994), the constituents of concern at the Korkay site are as shown in Table 2-1. VOCs, SVOCs, and pesticides of concern are listed for soil and for groundwater. Although TAL metals in soil have been detected above applicable SCGs, DEC believes that, based on available site history

Table 2-1
Constituents of Concern in Soil Above Criteria

Contaminant	Phase I			Phase II			NYSDEC Soil Criteria (1)(2)	Units
	# of samples above criteria	# of samples analyzed	Range of results above criteria	# of samples above criteria	# of samples analyzed	Range of results above criteria		
AREA 1								
VOCs:								
Trichloroethene	1	14	2,600	2	12	17,000-21,000	700	ug/kg
Xylene (Total)	3	14	11,000-12,000	4	12	19,000-78,000	1,200	ug/kg
Ethylbenzene	0	14	--	3	12	5,800-11,000	5,500	ug/kg
Toluene	0	14	--	1	12	2,900	1,500	ug/kg
Acetone	0	14	--	0	12	--	200	ug/kg
SVOCs:								
Di-n-butylphthalate	3	15	8,400-27,000	0	11	--	8,100	ug/kg
Benzo(a)pyrene	3	15	70-320	4	11	75-110	61	ug/kg
Dibenzo(a,h)anthracene	2	15	38-47	0	11	--	14	ug/kg
2,4-Dichlorophenol	0	15	--	0	11	--	400	ug/kg
Hexachlorobenzene	0	15	--	0	11	--	410	ug/kg
Benzo(a)anthracene	0	15	--	0	11	--	220	ug/kg
Phenol	0	15	--	4	11	86-120	30	ug/kg
Pesticides:								
Gamma-chlordane	0	14	--	0	9	--	540	ug/kg
Aldrin	0	14	--	0	9	--	41	ug/kg
Heptachlor epoxide	0	14	--	0	9	--	20	ug/kg
Endrin (Total)	0	14	--	0	9	--	100	ug/kg
Dieldrin	0	14	--	0	9	--	44	ug/kg
AREA 2								
VOCs:								
Trichloroethene	0	14	--	0	4	--	700	ug/kg
Xylene (Total)	0	14	--	1	4	7800	1200	ug/kg
Ethylbenzene	0	14	--	0	4	--	5500	ug/kg
Toluene	0	14	--	0	4	--	1500	ug/kg
Acetone	1	14	200	0	4	--	200	ug/kg
SVOCs:								
Di-n-butylphthalate	0	13	--	0	4	--	8100	ug/kg
Benzo(a)pyrene	0	13	--	0	4	--	61	ug/kg
Dibenzo(a,h)anthracene	0	13	--	0	4	--	14	ug/kg
2,4-Dichlorophenol	1	13	880	0	4	--	400	ug/kg
Hexachlorobenzene	1	13	1700	0	4	--	410	ug/kg
Benzo(a)anthracene	0	13	--	0	4	--	220	ug/kg
Phenol	0	13	--	1	4	75	30	ug/kg
Pesticides:								
Gamma-chlordane	10	26	920 - 8900	4	7	630 - 4600	540	ug/kg
Aldrin	2	26	51 - 81	0	7	--	41	ug/kg
Heptachlor epoxide	5	26	37 - 170	2	7	27 - 110	20	ug/kg
Endrin (Total)	0	26	--	2	7	130 - 220	100	ug/kg
Dieldrin	0	26	--	1	7	51	44	ug/kg

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Table 2-1

Constituents of Concern in Soil Above Criteria

Contaminant	Phase I			Phase II			NYSDEC Soil Criteria (1)(2)	Units
	# of samples above criteria	# of samples analyzed	Range of results above criteria	# of samples above criteria	# of samples analyzed	Range of results above criteria		
AREA 3								
VOCs:								
Trichloroethene	0	9	--	0	4	--	700	ug/kg
Xylene (Total)	0	9	--	1	4	1900	1200	ug/kg
Ethylbenzene	0	9	--	0	4	--	5500	ug/kg
Toluene	0	9	--	0	4	--	1500	ug/kg
Acetone	0	9	--	0	4	--	200	ug/kg
SVOCs:								
Di-n-butylphthalate	0	9	--	0	6	--	8100	ug/kg
Benzo(a)pyrene	0	9	--	0	6	--	61	ug/kg
Dibenzo(a,h)anthracene	0	9	--	0	6	--	14	ug/kg
2,4-Dichlorophenol	0	9	--	0	6	--	400	ug/kg
Hexachlorobenzene	0	9	--	0	6	--	410	ug/kg
Benzo(a)anthracene	0	9	--	0	6	--	220	ug/kg
Phenol	0	9	--	3	6	82 - 110	30	ug/kg
Pesticides:								
Gamma-chlordane	1	10	1000	1	7	780	540	ug/kg
Aldrin	0	10	--	0	7	--	41	ug/kg
Heptachlor epoxide	1	10	32	0	7	--	20	ug/kg
Endrin (Total)	0	10	--	0	7	--	100	ug/kg
Dieldrin	0	10	--	0	7	--	44	ug/kg
AREA 4								
VOCs:								
Trichloroethene	0	3	--	N/A	N/A	N/A	700	ug/kg
Xylene (Total)	0	3	--	N/A	N/A	N/A	1200	ug/kg
Ethylbenzene	0	3	--	N/A	N/A	N/A	5500	ug/kg
Toluene	0	3	--	N/A	N/A	N/A	1500	ug/kg
Acetone	0	3	--	N/A	N/A	N/A	200	ug/kg
SVOCs:								
Di-n-butylphthalate	0	3	--	N/A	N/A	N/A	8100	ug/kg
Benzo(a)pyrene	0	3	--	N/A	N/A	N/A	61	ug/kg
Dibenzo(a,h)anthracene	0	3	--	N/A	N/A	N/A	14	ug/kg
2,4-Dichlorophenol	0	3	--	N/A	N/A	N/A	400	ug/kg
Hexachlorobenzene	0	3	--	N/A	N/A	N/A	410	ug/kg
Benzo(a)anthracene	0	3	--	N/A	N/A	N/A	220	ug/kg
Phenol	0	3	--	N/A	N/A	N/A	30	ug/kg
Pesticides:								
Gamma-chlordane	0	3	--	N/A	N/A	N/A	540	ug/kg
Aldrin	0	3	--	N/A	N/A	N/A	41	ug/kg
Heptachlor epoxide	0	3	--	N/A	N/A	N/A	20	ug/kg
Endrin (Total)	0	3	--	N/A	N/A	N/A	100	ug/kg
Dieldrin	0	3	--	N/A	N/A	N/A	44	ug/kg

Table 2-1

Constituents of Concern in Soil Above Criteria

Contaminant	Phase			Phase II			NYSDEC Soil Criteria (1)(2)	Units
	# of samples above criteria	# of samples analyzed	Range of results above criteria	# of samples above criteria	# of samples analyzed	Range of results above criteria		
AREA 5								
VOCs:								
Trichloroethene	0	10	--	0	4	--	700	ug/kg
Xylene (Total)	0	10	--	0	4	--	1200	ug/kg
Ethylbenzene	0	10	--	0	4	--	5500	ug/kg
Toluene	0	10	--	0	4	--	1500	ug/kg
Acetone	0	10	--	0	4	--	200	ug/kg
SVOCs:								
Di-n-butylphthalate	0	10	--	0	8	--	8100	ug/kg
Benzo(a)pyrene	6	10	95 - 200	0	8	--	61	ug/kg
Dibenzo(a,h)anthracene	1	10	39	0	8	--	14	ug/kg
2,4-Dichlorophenol	0	10	--	0	8	--	400	ug/kg
Hexachlorobenzene	0	10	--	0	8	--	410	ug/kg
Benzo(a)anthracene	2	10	250 - 260	0	8	--	220	ug/kg
Phenol	0	10	--	0	8	--	30	ug/kg
Pesticides:								
Gamma-chlordane	0	10	--	0	4	--	540	ug/kg
Aldrin	0	10	--	0	4	--	41	ug/kg
Heptachlor epoxide	0	10	--	0	4	--	20	ug/kg
Endrin (Total)	0	10	--	0	4	--	100	ug/kg
Dieldrin	0	10	--	0	4	--	44	ug/kg

Notes: 1) NYSDEC TAGM, HWR-94-4046, January 24,1994.

2) NYSDEC criteria specified in this table is based on soil organic carbon content of 1%.

"--" designates that compound was not detected above the criteria

"N/A" designates no samples were collected

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Table 2-1

Constituents of Concern in Groundwater Above Criteria

Contaminant	K2		K3		4S *		4D *		5S		5D		6S**		6D**		7D		NYSDEC Criteria (1)	NYSDOH Criteria (2)	Units
	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II			
VOCs:																					
Tetrachloroethene	--	--	--	--	--	--	--	--	--	6J	--	--	--	--	--	--	--	--	5.0	5.0	ug/l
Trichloroethene	21	53	--	--	--	--	--	--	12	--	--	--	--	12	--	--	--	--	5.0	5.0	ug/l
1,2-Dichloroethene (Total)	--	11	--	--	--	--	--	--	16	--	--	--	--	40J	--	--	--	--	5.0	5.0	ug/l
Xylene (Total)	110	170	--	--	--	--	--	--	7	42	--	--	61	880E	--	--	--	12	5.0	5.0	ug/l
Ethylbenzene	19	33	--	--	--	--	--	--	--	--	--	--	--	80	--	--	--	--	5.0	5.0	ug/l
Benzene	--	--	--	--	--	--	--	--	--	--	--	--	--	2J	--	--	--	--	0.7	5.0	ug/l
Toluene	--	--	--	--	--	--	--	--	--	--	--	--	6	110	--	--	--	--	5.0	5.0	ug/l
SVOCs:																					
Naphthalene	23	49	--	--	--	--	--	--	--	--	--	--	29	100E	--	--	--	--	10.0	50.0	ug/l
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	16	32	--	--	--	--	4.7	5.0	ug/l
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	5.0	50.0	ug/l
Di-n-butylphthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	69	--	66	--	54	50.0	50.0	ug/l
2,4-Dichlorophenol	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--	ug/l
Pesticides:																					
Aldrin	.01J	--	--	--	--	--	--	--	--	--	--	--	--	0.32JN	--	--	--	--	0.01	--	ug/l
Heptachlor expoxide	0.11	0.084	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.2	ug/l
Dieldrin	0.02J	0.034JN	0.01J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	--	ug/l
4,4-DDE	0.21J	0.17JN	--	--	--	--	--	--	0.10J	0.019JN	--	--	--	--	--	--	--	--	0.01	--	ug/l
Endrin	--	0.24J	--	--	--	--	--	--	--	0.057J	--	--	--	--	--	--	--	--	0.01	0.2	ug/l
Gamma-chlordane	0.82J	0.51JN	--	--	--	--	--	--	0.77	--	--	--	--	--	--	--	--	--	0.1	--	ug/l
4,4-DDT	--	--	--	--	--	0.013JN	--	--	--	--	--	--	--	--	--	--	--	--	0.01	--	ug/l
Beta-BHC	--	--	--	--	--	--	--	--	0.05J	--	--	--	--	--	--	--	--	--	0.05	--	ug/l
Endosulfan I	--	--	--	--	--	--	--	--	--	0.29J	--	--	--	--	--	--	--	--	0.1	--	ug/l

Notes: (1) NYSDEC Division of Water, Technical and Operational Guidance Series (TOGS 1.1.1) / Ambient Water Quality Standards and Guidance Values, October 22, 1993.

(2) NYSDOH Drinking Water Supply MCLs, January 5,1993.

"--" designates that compound was not detected above the criteria

"*" designates background well

"**" designates off-site well (MW-6S is downgradient of site)

"JN" - tentatively identified with approximated concentration

"J" - the associated numerical value is an estimated quantity

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information, use of metals was not part of site operations, and are not considered constituents of concern. TAL metals in groundwater detected above applicable SCGs are believed to be naturally occurring and are not considered to be constituents of concern.

Based on the baseline human health risk assessment, the exposure pathways of concern include:

- Shallow Groundwater:
  - Ingestion (*alpha chlordane, gamma chlordane, dieldrin, heptachlor epoxide, TCE, manganese)*
  - Inhalation (*alpha chlordane, gamma chlordane, dieldrin, heptachlor epoxide)*
  - Dermal Absorption (*alpha chlordane, gamma chlordane, dieldrin, heptachlor epoxide)*

- Deep Groundwater
  - Ingestion (*manganese)*

- Surface Soil
  - Ingestion (*alpha chlordane, gamma chlordane, arsenic)*

- Subsurface Soil
  - Ingestion (*alpha chlordane, gamma chlordane, arsenic)*

The highest estimated risks of adverse health effects are associated with ingestion and dermal absorption of shallow groundwater.

2.3 Remedial Action Objectives and SCGs

2.3.1 Remedial Action Objectives

Site-specific remedial action objectives (RAOs) have been established for the development and evaluation of remedial action alternatives for the Korkay site. These objectives are based on public health and environmental concerns, the National Contingency Plan (NCP), NYSDEC and USEPA guidance, NYS statutes, and the requirements of other applicable federal and local statutes. Specifically, the RAOs for the Korkay site are:

> To eliminate, to the greatest extent possible, on-site soils as a source of contamination to on-site groundwater and improve the quality of groundwater at and in the vicinity of the site. Also, to eliminate human exposure to on-site soils.

The site RAOs are designed to protect human health and the environment, and address the following:

- the constituents of concern (COCs) at the site;

- the potential exposure routes and receptors of each COC; and

- acceptable target remediation levels or ranges of levels for each COC with respect to its exposure route and New York State Standards, Criteria, and Guidelines (SCGs).

2.3.2 Identification of Standards, Criteria, and Guidelines (SCGs)

As stipulated in the May 15, 1990, NYSDEC Technical and Administrative Guidance Memorandum (TAGM)(NYSDEC 1990), the development of potentially applicable remedial action alternatives for an inactive hazardous waste site (such as the Korkay site) requires the consideration of applicable or relevant and appropriate NYS Standards, Criteria, and Guidelines (SCGs). These standards should also include federal standards that are more stringent than SCGs. The following sections present the three categories of SCGs: chemical-, location-, and action-specific.

2.3.2.1 Chemical-Specific

Chemical-specific SCGs are health risk-based numbers that limit the concentration of a constituent that may be discharged into the ambient environment. These SCGs are independent of the location of the discharge, but may be related to the intended use of the environmental medium to which discharges are made. Potentially applicable chemical-specific SCGs for the Korkay site are presented in Table 2-2.

2.3.2.2 Action-Specific

Action-specific SCGs are based on the implementation and limitation(s) of a particular remedial action. Potentially applicable action-specific SCGs for the Korkay site are presented in Table 2-3.

2.3.2.3 Location-Specific

Depending on the location of the site, several SCGs may require consideration during the FS. These SCGs often include criteria for the protection of sensitive flood plains, as well as wetlands and natural reserves with endangered species. Potentially applicable location-specific SCGs for the Korkay site are presented in Table 2-4.

2.4 General Response Actions

General response actions have been developed for the Korkay site that may be taken, singly or in combination, to satisfy the site remedial action objectives. Like remedial action objectives, general response actions are medium-specific.

The general response actions for the Korkay site are as follows:

No Action - No action is a general response action that is required by the USEPA and National Contingency Plan (NCP) to be carried forward to the detailed analysis phase of the FS (Section 4.0). It is defined as no proactive steps taken to remediate affected media (i.e., natural attenuation). It provides a baseline for comparison of all other potentially applicable remedial action alternatives.

Institutional Controls - Institutional actions may be implemented at the site to provide limited remedial action. Institutional controls as general response actions for the remediation of site soils and groundwater include access restrictions and media monitoring.

Table 2-2
Potentially Applicable Chemical-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Federal			
* *Groundwater*			
National Primary Drinking Water Standards	40 CFR Part 141	Applicable to the use of public water systems; establishes maximum contaminant levels (MCLs), monitoring requirements and treatment techniques.	
National Secondary Drinking Water Standards	40 CFR Part 143	Applicable to the use of public water systems; controls contaminants in drinking water that primarily effect the aesthetic qualities relating to public acceptance of drinking water.	
Safe Drinking Water Act	Pub. L 95-523, as amended by Pub. L. 96502, 22 USC 300 et. seq.	Sets limits to the maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs).	
SDWA MCL Goals	40 CFR 141.50 FR 46936	Established drinking water quality goals set at levels of anticipated adverse health effects with an adequate margin of safety.	
USEPA Office of Drinking Water Health Advisories		Standards issued by the USEPA Office of Drinking Water.	
**Surface Water*			
Clean Water Act (CWA)	33 USC 1251 et.seq.	Applicable for alternatives involving treatment with point source discharges to surface water.	Criteria available for water and fish ingestion, and fish consumption for human health. Point source discharge of treated waters not anticipated.

Table 2-2
Potentially Applicable Chemical-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Toxic Pollutant Effluent Standards	40 CFR Part 129	Applicable to the discharge of toxic pollutants into navigable waters.	Effluent limitation for toxic pollutants are based on the Best Available Technology Economically Achievable for point source discharges. Discharge to navigable waters is not anticipated.
General Provisions for Effluent Guidelines and Standards	40 CFR 401	Establishes legal authority and general definitions that apply to all regulations issued concerning specific classes and categories of point sources.	Provides for point source identification. Aplicable to remedial action with effluent discharge.
* Air			
Clean Air Act	42 USC 7401 Section 112 (as amended 1993)	Establishes upper limits on parameter emissions to atmosphere.	Pollutants deemed hazardous or non-hazardous based on public health.
National Primary and Secondary Ambient Air Quality Standards	40 CFR 50	Establishes primary and secondary NAAQS under Section 109 of the Clean Air Act.	Primary NAAQS define levels of air quality necessary to protect public health. Secondary NAAQS define levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Applicable to remedial action alternatives that may emit pollutants to the atmosphere.
National Emissions Standards for Hazardous Air Pollutants	40 CFR 61	Establishes NESHAPs.	
**RCRA*			
Resource Conservation and Recovery Act- Identification and Listing of Hazardous Wastes	40 CFR 264.1	Defines those wastes which are subject to regulations as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270,271.	

Table 2-2
Potentially Applicable Chemical-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
RCRA Maximum Concentration Limits	40 CFR 264	Ground Water protection standards for toxic metals and pesticides.	These provisions are applicable to RCRA regulated units that are subject to permitting.
**Other*			
USEPA Office of Research and Development Reference Doses		Reference dose issued by USEPA.	To Be Considered.
USEPA Environmental Criteria and Assessment Office- Carcinogenic Potency Factors		As develpoed by USEPA.	To Be Considered.
New York State			
** Soil*			
NYSDEC Soil Cleanup Objectives	NYSDEC TAGM, HWR-94-4046, January 24, 1994.	Applicable to the cleanup of contaminated soils. Cleanup goals recommended based on human health criteria, ground water protection, background levels, and laboratory quantification levels.	These objectives provide the maximum values for determining soil cleanup levels.
** Air*			
NYSDEC Division of Air Guidelines for the Control of Toxic Ambient Air Contaminants	Air Guide 1	Establishes air quality standards.	May be applicable if remedial alternatives include discharge to air.
New York Ambient Air Quality Standards	6 NYCRR 256-257	Establishes air quality standards.	May be applicable if remedial alternatives include discharge to air.

Table 2-2
Potentially Applicable Chemical-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
** Surface Water & Ground Water*			
NYSDEC Ground Water Quality Regulations	6 NYCRR Part 702	Applicable to existing surface water quality and the discharge of runoff and contaminated groundwater into surface waters.	Applicable to groundwater cleanup levels.
NYSDEC Ground Water Quality Regulations	6 NYCRR Part 703	Applicable to the groundwater quality of both the shallow and deep aquifers; sets forth criteria for the consumption of potable water.	
Ambient Water Quality Standards and Guidance Values	TOGS 1.1.1, October 22, 1993	Establishes groundwater quality standards.	
New York Water Classifications and Quality Standards	6 NYCRR Parts 609, 700-704	Describes classification system for surface water and groundwater. Establishes standards of Quality and Purity.	Establishes required clean-up criteria based on water classification.
NYSDEC Standards Raw Water Quality	10 NYCRR 170.4	Provides water quality standards.	May be applicable to groundwater clean-up levels.
** NYSDOH Sanitary Code*			
Drinking Water Supplies	10 NYCRR Support 5-1	Applicable for consumption of potable water from public water supplies.	
**Hazardous Waste*			
New York Identification and Listing of Hazardous Waste Regulations	6 NYCRR part 371	Identifies hazardous wastes.	May be applicable if hazardous wastes are generated, stored or transported during remediation.
NYSDEC Land Disposal Restrictions	6 NYCRR Part 376	Identifies hazardous wastes that are subject to land disposal restrictions.	May be applicable if site remediation involves land disposal of contaminated soils.

Table 2-3
Potentially Applicable Action-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Federal			
Clean Air Act	42 U.S.C. 7401	Applicable if alternatives will impact ambient air quality.	Relevant if remedial action causes air pollution above primary or secondary ambient air quality standards.
National Ambient Air Quality Standards	40 CFR Part 50	Applicable to alternatives that may emit pollutants to the air; establishes standards to protect public health and welfare.	May be relevant and appropriate if treatment of groundwater or soils involves air emissions.
Resource Conservation and Recovery Act (RCRA)	42 USC 6901-6987 40 CFR part 264 RCRA Subtitle C	Applicable to the treatment, storage, transportation and disposal of hazardous wastes and wastes listed under 6 NYCRR Part 371.	May be required for contaminated soil disposal options. Testing of soils to determine hazardous characterisitics needs to be performed.
	40 CFR Part 264 RCRA Subtitle D	Applicable to management and disposal of non-hazardous wastes.	
	40 CFR Part 265	Interim standards for owners of hazardous waste facilities.	Includes design requirements for capping, treatment, and post closure care.
	40 CFR Part 262 and 263	Applicable to generators and transporters of hazardous waste.	Applicable to off-site disposal or treatment of hazardous material. Soils on-site may be deemed hazardous.
	40 CFR Part 268	Applicable to alternatives involving off-site disposal of hazardous waste; requires treatment to diminish waste toxicity.	May be required for soil disposal options.

Table 2-3
Potentially Applicable Action-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
CERCLA/SARA/NCP	40 CFR Part 300	Applicable to remedial actions at CERCLA and NYS Superfund Sites.	The Korkay Site is a designated NYS Superfund Site.
	40 CFR 270,124	EPA administers hazardous waste permit program for CERCLA/Superfund Sites.	Covers basic permitting, application, monitoring, and reporting, requirements for off-site hazardous waste management facilties.
Clean Water Act	33 USC 1251	Restoration and maintenance of the chemical, physical and biological integrity of the nation's water.	May be applicable if groundwater and Kenyatto Creek are found to be negatively impacted by the site.
Safe Drinking Act Underground Injection	40 CFR Parts 144 and 146	Applicable to waste water treatment alternatives involving underground injections that may endanger drinking water sources.	
New York State			
NYSDEC TAGM	HWR-90-4030	Guidance for Selection of Remedial Actions at Inactive Hazardous Waste Sites.	Issued May 15, 1990.
NYS Uniform Procedures	6 NYCRR Part 621	Applicable to projects requiring permits.	Applicable to the construction/ operation of hazardous waste treatment facilities.
Hazardous Waste Management	6 NYCRR Part 373	Standards for owners of hazardous waste facilities.	Includes design requirements for soil capping and treatment options, and post-closure care.

Table 2-3
Potentially Applicable Action-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Transportation of Hazardous Materials	6 NYCRR Part 364	Regulates transportation of hazardous materials.	May be relevant if action results in off-site transport of hazardous soils.
Occupational Safety and Health Act	29 CFR Part 1910 and 300.38	Applicable to workers and the work place during remediation of the site.	Applies to all response activities under the NCP.
Hazardous Materials Transportation Act	49 USC ss 1801-1813, 49 CFR Parts 107, 171	Applicable to transporters of hazardous materials.	May be relevant if action results in sludge, waste or soil being transported off-site.
*Air			
New York State Air Regulations	(6 NYCRR Parts 200 through 207,210,211,212 and 219)		
	6 NYCRR Part 212	General process emission sources.	Sets allowable emissions for remedial options resulting in air emissions.
	6 NYCRR Part 201, 202	Permits for construction/operations of air pollution sources.	Describes permit requirements to construct and operate the above options.
	6NYCRR Part 219	Particulate emission limits.	Limits are based on the refuse charged (lb/hr) for the above options.
	6NYCRR Part 211	Regulates fugitive dust emissions.	Requires control of fugitive dust emissions from excavations and transport.
	6 NYCRR Part 257	Air quality standards.	Requires control for on-site treatment

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Table 2-4
Potentially Applicable Location-Specific SCGs

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
***Federal**			
Fish and Wildlife Coordination Act	16 USC	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.	There are no major surface water bodies in the area surrounding the site. However, ground-water on site eventually flows into Kenyatto Creek.
Endangered Species Act	40 CFR 6.302 (g)	Requires Federal agencies to ensure that actions they authorize, fund or carry out are most likely to jeapordize the continued existence of endangered/threatened species or adversely modify the critical habitats of such species.	No endangered species are believed to be present in the study area.
Executive Order On Floodplain Management	Execiitive Order No. 11988 40 CFR 6.302(a) and Appendix A	Requires Federal agencies to evaluate potential effects of actions that may take place in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	No floodplain is located in the immediate vicinity of the site.
Farmlands Protection	7 USC 4201 et. seq.	Protects significant or important agricultural lands from irreversible conversion to uses which result in loss of an environmental or essential food production resource.	

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Access restrictions involve physical (such as fences or barriers) or legal (such as deed restrictions, zoning changes, or security restrictions) actions prohibiting access to, and use of, site soils and/or groundwater. However, access restrictions do not apply to soils or groundwater at adjacent properties controlled by other parties and, therefore, are limited to a source control strategy. Media monitoring involves scheduled, periodic sampling and analysis of site soils and/or groundwater. Media monitoring is implemented to provide a database and evaluate changes in site conditions over time. Continued monitoring of site soils and/or groundwater over time enables the determination of restoration rates occurring through natural attenuation
and biodegradation.

Removal - The removal of affected soils at and in the vicinity of the site for disposal is a general response action that would eliminate these soils as a source of contamination to shallow groundwater. The most common soil removal technology is excavation; it is a well-established removal technology that involves standard engineering practices.

Containment - Containment may be implemented at the site to reduce and/or prevent direct human exposure to affected residual soils (following soil excavation) as well as to reduce and/or prevent the migration of residual soil constituents, if any, to shallow groundwater. Capping is an effective means by which to achieve soil containment. A soil cap (or cover) will reduce and/or prevent the infiltration of precipitation and surface water run-off, thereby reducing/mitigating the migration of soil constituents to shallow groundwater.

In-Situ Treatment - In-situ treatment of site subsurface soils and groundwater is another method by which to accomplish the RAOs for the site. In-situ treatment refers to those technologies that are applied to affected soil and groundwater in place. The result of in-situ treatment is a reduction in constituent mobility, volume, and/or toxicity.

Disposal - The final general response action for the Korkay site is disposal with respect to excavated soils. Excavated soils will be disposed off-site.

2.5 Identification and Initial Screening of Remedial Technologies

The general response actions presented in Section 2.4 provide the basis for identifying potentially applicable remedial technologies and process options, which are subsequently screened for technical feasibility.

2.5.1 No Action

No action is defined as no proactive steps taken to remedy site conditions. It is included in this FS to provide a baseline for comparison with other potential remedial action alternatives.

2.5.2 Institutional Actions

Institutional actions provide limited remedial action and include access and/or deed restrictions, and media monitoring.

2.5.2.1 Institutional Controls/Deed Restrictions

Institutional controls may include deed restrictions, such that the site property deed would include restrictions on site activities and use, and/or fencing. Deed restrictions could also be implemented to prohibit the consumption of groundwater at the site. However, it is noted that the long term permanence of this option may be limited because the NYSDEC has limited authority to restrict uses of a site after the site has been remediated and delisted from the registry.

As shown on Figure 1-3, there is a fence (with gates) along the north, east, and western boundaries of the site that serves to reduce unrestricted access to the site. Site fencing is a feasible technology and highly reliable if periodic inspections and maintenance of the fence are performed. This technology is easily implemented, restricts site access, and prevents public exposure to potential on-site soil-contact hazards. Site access may also be restricted by increasing public awareness of site conditions and remedies. Through meetings, written notices, and news releases concerning the site, unintended exposures may be prevented.

Institutional controls/deed restrictions may also include water-use controls. Water-use controls include well permits to regulate the drilling of new wells at and in the vicinity of the site, and the inspection and/or sealing of existing wells.

Institutional controls/deed restrictions are technically feasible and will be considered further in the preliminary screening of remedial alternatives.

2.5.2.2 Media Monitoring

Media monitoring involves scheduled, periodic sampling and analysis of site groundwater. Implementation of media monitoring at the Korkay site would be implemented to augment the existing site database and evaluate changes in site conditions over time. Continued monitoring of site media will enable the determination of restoration rates occurring through natural attenuation and biodegradation.

Groundwater monitoring is technically feasible at the site; monitoring wells are already in-place and, if necessary, more wells could be installed. If affected media should remain on-site, a groundwater monitoring program could be implemented at the site to track off-site constituent migration.

Media monitoring at the Korkay site will be considered further in this FS.

2.5.3 Removal of Affected Soils

Removal refers to the action of physically relocating affected soils. Once affected soils are excavated, the exposed areas are backfilled with clean fill, compacted and graded and covered to reduce the infiltration of precipitation. Excavation of affected soils is a commonly used source removal technique that utilizes standard construction equipment such as backhoes and loaders.

Underground utilities, if any, must be sufficiently marked to prevent damage by the heavy equipment required in excavating soils. Also, disposal options for affected soils must be evaluated to ascertain whether treatment will be required prior to land disposal.

During the excavation of affected soils, the health and safety of workers, and others nearby, are of concern because a potential exists for exposure to constituents found in the soils through inhalation, ingestion, and dermal contact. A site-specific health and safety plan (HASP) must be developed and implemented for the proper conduct of this activity to control potential exposures. Excavation must be performed in accordance with Occupational Safety and Health Administration (OSHA) standards, especially standards governing worker safety during hazardous waste operations (20 CFR 1910). To limit exposure of workers and nearby residences to site constituents of concern (COCs), it may be necessary to implement in-situ treatment options, such as soil vapor extraction, prior to excavation.

The excavation of affected soils will be considered further in this FS.

2.5.4 Containment of Residual Soils

The excavation of surface soils will partially remove the source of non-volatile constituents of concern at and in the vicinity of the site. Based on the results of the Phase I and II RI, following excavation, residual soil contamination will exist, consisting primarily of metals and VOC compounds in Area 1. However, metals of concern were not detected in groundwater at or downgradient of the site and, in fact, metals will tend to adsorb to, rather than desorb from, soils. But to limit migration of the residual soil constituents within shallow groundwater, a soil cover may be installed at the site. VOC compounds may need further treatment, since groundwater has VOC contamination.

A soil cover will effectively reduce the infiltration of precipitation and surface run-off, thereby reducing the transport of soil constituents to/within groundwater. Soil and vegetative cover can also reduce risks associated with direct human contact with affected residual soils, if any (the placement of clean fill in excavated areas will serve to prevent direct contact with residual site soils). The source of much of the non-volatile organics contributing to groundwater contamination would be removed through excavation. A vegetative soil cover would control residual risk due to contamination. Run-off would be partially absorbed by the vegetative soil cover, thereby reducing the infiltration of these waters to deep subsurface soils.

The containment of residual soils with seeded soil cover and maintained vegetation will be considered further in this FS.

2.5.5 In-Situ Treatment

In-situ treatment refers to those technologies that are applied to affected media in-place. Air sparging, also referred to as in-situ air stripping, is a treatment technology for removing VOCs from the saturated zone. Contaminant-free air is injected into groundwater to remove volatile constituents from the saturated zone and effectively capture them with a soil vapor extraction (SVE) system. Sparged air displaces water in the soil pore spaces and causes the soil constituents to desorb, volatilize, and enter the saturated zone vapor phase (SZVP). The mechanical action of the air passing through the saturated zone increases turbulence and mixing in the groundwater. Dissolved groundwater constituents volatilize into the SZVP and migrate up through the aquifer to the unsaturated zone. The SVE system creates a negative pressure gradient in the unsaturated zone, which pulls the constituent vapors toward the SVE wells, effectively capturing subsurface constituents. Air sparging also enhances aerobic biodegradation of constituents in the subsurface. Because vacuum extraction and air sparging increase air flow through contaminated areas, oxygen availability is enhanced and natural biodegradation stimulated, further increasing the rate of remediation (Noonan et. al. 1993).

Soil vapor extraction/combined air sparging and soil vapor extraction (SVE/CASVE) will address residual (following excavation) subsurface VOC contamination both above and below the water table. Specifically, SVE/CASVE will effectively address VOCs of concern detected in shallow groundwater as well as remove any residual source of this contamination (i.e. soil gas) present in subsurface soils at the site. It should be noted that the excavation of surface soils will effectively remove COCs at the ground surface. Also, it is noted that it may be necessary to implement soil vapor extraction (SVE) prior to the excavation of surface soils to limit the exposure of workers and nearby residences to site constituents of concern (COCs) during excavation. A SVE/CASVE treatability study was conducted during the Phase II RI and found to be an applicable technology for remediation at the site.

SVE/CASVE will be considered further in this FS.

2.5.6 Disposal

Due to the limited site size, excavated soil will be disposed off-site. During the Phase II RI, soil samples collected at the site were analyzed by the toxicity characteristic leaching procedure (TCLP). None of the analytical results exceeded the TCLP limits. It is anticipated that 95 percent of the soil will pass the TCLP test. If sample analytical results from excavated soils exceed USEPA TCLP limits, excavated soil will be hauled and disposed off-site as Resource Conservation and Recovery Act- (RCRA-) hazardous waste. Such soil may require treatment at an approved off-site facility prior to disposal due to USEPA Land Disposal Restrictions.

Excavated soil accepted for landfilling will be hauled to the disposal site in containers or in bulk form in accordance with federal and State Department of Transportation (DOT) and RCRA regulations for off-site transport of hazardous materials. The landfill used for disposal of affected soils must be properly permitted.

Off-site disposal of excavated soils will be considered further in this FS.

2.6 Assemblage of Remedial Action Alternatives

Based on the results of the Phase I RI (CDM 1994a), the following remedial action alternatives have been developed for the Korkay site:

- Alternative 1: No Action.

- Alternative 2: Institutional Controls/Deed Restrictions, Media Monitoring.
- Alternative 3: Institutional Controls/Deed Restrictions, Media Monitoring, Soil Excavation, Off-Site Disposal of Excavated Soils, and Soil Vegetative Cover.
- Alternative 4: Institutional Controls/Deed Restrictions, Media Monitoring, Soil Excavation, Off-Site Disposal of Excavated Soils, Soil Vegetative Cover, and Soil Vapor Extraction/Combined Air Sparging and Soil Vapor Extraction (SVE/CASVE).

These alternatives will be screened, based on their effectiveness and implementability, in the next phase of the site FS (Phase II FS).

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Section 3
Preliminary Screening of Remedial Alternatives (Second Phase Feasibility Study)

During the Korkay site Phase II FS, the remedial alternatives assembled for the site were evaluated against the short-and long-term aspect of two broad criteria: effectiveness and implementability. The effectiveness of each assembled alternative was evaluated in terms of its ability to protect human health and the environment. Each alternative was assessed based on the degree of both short-and long-term effectiveness provided and the reductions in constituent toxicity, mobility, or volume achieved. Implementability serves to measure both the technical and administrative feasibility of construction, operation, and maintenance of the remedial action alternative.

Specifically, the effectiveness of each assembled alternative was evaluated with respect to the following:

- Attainment of RAOs (based on public health and environmental considerations).
- Long-term effectiveness: magnitude of residual risk and adequacy, and reliability of controls.
- Short-term effectiveness: protection of community and workers, environmental impacts and time required to achieve RAOs.

Similarly, the implementability of each assembled alternative has been evaluated with respect to the following:

- ability to construct and operate the technology, including scheduling;
- reliability of the technology;
- ability to monitor the effectiveness of the remedy;
- ease of undertaking additional remedial actions;
- availability of technology, equipment, and specialists; and
- compliance with regulatory requirements.

Remedial action alternatives determined to be effective and implementable will be considered further, in a detailed analysis, in the Phase III FS (Section 4.0).

3.1 Alternative 1 - No Action

No action is defined as no proactive steps taken to remedy affected media at the Korkay site. The flushing of site soil by precipitation events may eventually wash the constituents from soils to the shallow water-bearing zone at the site. However, natural attenuation and biodegradation of constituents will occur. The toxicity and mobility of site constituents will not be reduced by the no action alternative, but the volume of contamination may decrease over time. This alternative will not be effective in meeting site RAOs in the short-term. The implementability criteria does not apply to this alternative because there is no action to implement. The no action alternative will be included in the detailed FS analysis (Section 4.0) to provide a baseline for comparison with other potential remedial action alternatives.

3.2 Alternative 2 - Institutional Controls/Deed Restrictions and Media Monitoring

Remedial action Alternative 2 includes institutional controls/deed restrictions, and media monitoring. These are easily implemented at the site in a relatively short period of time.

Institutional controls may include deed and/or well restrictions, and fencing. These restrictions may be imposed to reduce human and environmental exposure to affected media at the site, but they will not satisfy SCGs or site RAOs in the short-term. The flushing of site soil by precipitation events may eventually wash constituents from soils to the shallow water-bearing zone at the site. However, natural attenuation and biodegradation of constituents will occur. Access restrictions do not reduce constituent mobility or toxicity, but the volume of contamination may be reduced over time through natural attenuation and biodegradation. Deed restrictions do not apply to media at adjacent properties controlled by other parties (e.g., the Hayes property) and are therefore limited to a source control strategy. Fencing requires long-term maintenance; site fencing could be used to control site access during construction and operation of remedial technologies (Section 4.0).

Media monitoring would indicate the natural attenuation of COCs as well as the migration of COCs off-site, if any. Media monitoring will also indicate the attainment of RAOs. Monitoring activities may be conducted for many years and would require long-term management efforts.

Remedial action Alternative 2 will be retained for further consideration in the Phase III FS (Section 4.0).

3.3 Alternative 3 - Institutional Controls Deed Restrictions, Media Monitoring, Soil Excavation, Off-Site Disposal of Excavated Soils, and Soil Vegetative Cover

Remedial action Alternative 3 includes all actions included in Alternative 2 (Section 3.2) plus the excavation of contaminated surface soil, off-site disposal of excavated soil, and the installation of a soil vegetative cover at the site. Alternative 3 is easily implemented and will serve to partially remove a source of groundwater contamination at the site, and will therefore meet the site RAOs. Excavation involves the physical removal of contaminated surface soils for off-site disposal. Once affected soils are excavated, the exposed area may be backfilled with clean soil to prevent exposure to residual media. Media monitoring may then be implemented to monitor the natural attenuation and biodegradation of residual contamination. Underground utilities, if any, must be sufficiently marked to prevent damage by the heavy equipment required in excavating soils. Substantial areas are required for the excavation of soils, as well as staging pads and heavy equipment.

A vegetative soil cover will reduce the mobility of constituents through the subsurface soil because precipitation and run-off will partially be absorbed by the vegetation thus reducing the infiltration rate to deeper subsurface soil. Vegetative cover also reduces risks associated with direct human contact with surface soils. Limited degradation of the cover over time may require some maintenance or repair.

Excavated soil will be disposed off-site as deemed appropriate by the results of TCLP analyses.

Remedial action Alternative 3 will be retained for further consideration in the Korkay site Phase III FS (Section 4.0).

3.4 Alternative 4 - Institutional Controls/Deed Restrictions, Media Monitoring, Soil Excavation, Off-Site Disposal of Excavated Soils, Soil Vegetative Cover, and Soil Vapor Extraction/Combined Air Sparging and Soil Vapor Extraction (SVE/CASVE)

Remedial action Alternative 4 includes all actions included in Alternatives 2 and 3, plus the implementation of SVE/CASVE at the site. The addition of SVE/CASVE will provide removal of residual VOC contamination. It is also noted that it may be necessary to implement SVE/CASVE prior to the excavation of affected site soils to limit the exposure of workers and nearby residences to site constituents of concern (COCs) during excavation.

A SVE/CASVE treatability study was conducted during the Phase II RI and it was determined that this technology is applicable at the site.

Remedial Action Alternative 4 will be retained for further consideration in the Korkay site Phase III FS (Section 4.0).

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Section 4
Detailed Analysis Of Remedial Alternatives

4.1 Introduction

4.1.1 Goals

The remedial program goal for the Korkay site is to restore the site to pre-disposal conditions, to the extent feasible and authorized by law. At a minimum, the remedy selected shall eliminate or mitigate all significant threats to public health and to the environment presented by potentially hazardous discharges at the site through the proper application of scientific and engineering principles.

4.1.2 Remedial Action Objectives

The remedial action objectives, as referenced by NYSDEC (NYSDEC,1995c), for the Korkay site are as follows:

- o to eliminate to the greatest extent possible, on-site soils as a source of contamination to on-site groundwater;
- o to eliminate or reduce human exposure to on-site and off-site contamination;
- o to reduce impacts (if any) to wildlife exposed to migration of site-related contaminations to nearby surface water (Kennyetto Creek);
- o to protect wildlife (if any) that could potentially be impacted by the contamination at the site; and
- o to prevent contaminants at the site from impacting the nearby private potable water supply wells.

4.1.3 Requirements of the Detailed Analysis

The specific requirements to be addressed in this Phase III feasibility study, as listed in the NYSDEC TAGM for the Selection of Remedial Actions at Inactive Hazardous Waste Sites, are:

- o to be protective of human health and the environment;
- o attain New York State Standards, Criteria and Guidelines (SCGs) or explain why compliance with SCGs is not needed to protect public health and the environment;
- o satisfy the preference for treatment that significantly and permanently reduces toxicity, mobility, or volume of hazardous waste as a principal element (or provide explanation why it does not); and
- o be cost effective.

The seven criteria used to evaluate each of the remedial alternatives incorporate the requirements and considerations listed above. The seven criteria are as follows:

- o Compliance with Applicable New York State Standards, Criteria and Guidelines (SCGs)
- o Overall Protection of Human Health and the Environment
- o Short-term Impacts and Effectiveness
- o Long-term Effectiveness and Permanence
- o Reduction of Toxicity, Mobility and Volume
- o Implementability
- o Cost

Each of these criteria are discussed in this section for each remedial action alternative considered.

4.1.4 Remedial Alternatives to be Analyzed

Four remedial alternatives were discussed in the Phase I and II Feasibility Study, prepared by Camp Dresser and McKee in February 1995, that were retained for further examination during this Phase III feasibility study. Based on the results of the Phase II RI, the only change to these alternatives from the Phase I and II Feasibility Study was removal of the use of an alternative water supply for nearby residences with private, potable water wells. The remedial alternatives to be examined in this study are as follows:

Alternative 1:	No Action
Alternative 2:	Institutional Controls/Deed Restrictions and Media Monitoring
Alternative 3:	Institutional Controls/ Deed Restrictions, Media Monitoring, Soil Excavation with Off-site Disposal of Excavated Soils, and Soil Vegetative Cover.
Alternative 4:	Institutional Controls/ Deed Restrictions, Media Monitoring, Soil Excavation with Off-site Disposal of Excavated Soils, Soil Vegetative Cover, and Soil Vapor Extraction/Combined Air Sparging and Soil Vapor Extraction (SVE/CASVE).

4.2. Alternative 1 - No Action

4.2.1 Alternative 1 - Description of Alternative

The "no action" alternative does not provide any proactive actions or activities to promote the remediation of the contaminated media. The only means of remediation would be natural attenuation of the contaminants at the site. This alternative provides baseline site conditions as a comparison for all the potentially applicable remedial action alternatives.

At the Korkay site, the "no action" alternative would mean that soil and groundwater would not be remediated, that site access would not be intentionally limited and that no institutional controls or deed restrictions would be placed on the property. However, the site fencing currently enclosing the contaminated soil would remain intact and would prevent unintentional site trespassing. Active maintenance of site fencing is not included as part of the no action alternative. Some contaminants, such as the volatile organics in the shallow water-bearing unit, may attenuate over time, but other contaminants, such as the SVOCs, pesticides, and arsenic in the surface soils would remain bioavailable for long periods of time.

In order to comply with NYSDEC requirements, the no action alternative would require periodic monitoring of the groundwater for 30 years following remediation. Groundwater monitoring would be conducted on an annual basis for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and pesticides. Reporting requirements would include a public health evaluation every 5 years to assess the potential risks to human health and the environment.

4.2.2 Alternative 1 - Evaluation

Alternative 1 - Compliance with Applicable New York State Standards, Criteria and Guidelines (SCGs)

The no action alternative would not bring the site into compliance with SCGs for soil or groundwater.

Alternative 1 - Overall Protection of Human Health and the Environment

No measures for the protection of human health and the environment would be undertaken. The potential human health risk associated with the site would be the same as that discussed in the Final Risk Assessment, dated May 4, 1994. In this risk assessment exposure pathways (for a residential scenario) and contaminants with non-carcinogenic hazard indices greater than 1.0 and lifetime cancer risk greater than 1×10^{-6} were determined to be the following: 1) Shallow groundwater ingestion, inhalation and dermal adsorption of alpha chlordane, gamma chlordane, dieldrin, heptachlor epoxide, as well as, ingestion of trichloroethene and manganese; 3) Surface soil ingestion of alpha chlordane, gamma chlordane and arsenic; and 4) Subsurface soil ingestion of alpha chlordane, gamma chlordane and arsenic. The highest estimated risks were associated with ingestion (5.83×10^{-5}) and dermal adsorption (5.71×10^{-5}) of shallow groundwater. The estimated risk for ingestion of surface soil and subsurface soil were 1.54×10^{-5} and 1.05×10^{-5}, respectively.

Alternative 1 - Short-term Impacts and Effectiveness

Since this alternative does not involve a remedial action, there would be no additional short-term impact to the community, workers or environment as a result of the implementation of this alternative.

Alternative 1 - Long-term Effectiveness and Permanence

Long-term potential health risks associated with this site would be similar to the baseline risk assessment cited above, except there would be some long term attenuation, dispersion and volatilization of volatile organic compounds in the shallow water-bearing unit and soil.

There would be no controls on the containment of contaminants in the soil, particularly pesticides, arsenic and metals. Thus, most of the health risk associated with the soil would remain.

Alternative 1 - Reduction of Toxicity, Mobility and Volume

This alternative would not reduce the toxicity, mobility or volume of contaminants at the site beyond what may be achieved by natural attenuation and volatilization.

Alternative 1 - Implementability

This alternative is easily implemented since no remedial actions are required. Periodic groundwater monitoring is easily implemented.

Alternative 1 - Cost

The costs associated with the implementation of Alternative 1 site are summarized in Table 4-1. There are no capital costs. The only operational costs would be annual groundwater monitoring and reporting every five years. These costs are estimated to be $9,000 per year for groundwater monitoring and $2,000 for data reporting every five years, exclusive of data review or technical evaluation (NYSDEC, 1995e). The total present worth of this alternative is estimated to be $183,000 based on a 3 percent interest rate after inflation over a 30-year period.

4.3. Alternative 2 - Institutional Controls / Deed Restrictions And Environmental Monitoring

4.3.1 Alternative 2 - Description of Alternative

The second alternative would include institutional controls/deed restrictions and environmental monitoring. Access restriction would be achieved with the existing site fencing. The site is fenced on the northern, eastern and western boundaries. The fencing is attached to the building and completely encloses the area of concern.

Deed restrictions would limit on-site excavation and groundwater usage. Any on-site excavation would require a NYSDEC approved workplan to address potential exposure to contaminated soil. Groundwater use would be prohibited unless it was treated to NYSDEC drinking water standards and with NYSDEC and NYS Department of Health (NYSDOH) approval prior to use.

Environmental monitoring would include groundwater monitoring for VOCs, SVOCs, and pesticides on an annual basis. Reporting requirements would include a public health

Table 4-1
Costs for Remedial Alternative 1
No Action

ITEM	COST
CAPITAL COSTS	$0
OPERATION AND MAINTENANCE COST Annual Groundwater Monitoring 4 wells sampled and analyzed for VOCs, SVOCs and pesticides Present-worth value at $9,000 per year for 30 years (3% nominal interest after inflation)	$175,000
Present-worth value (3% interest after inflation) for 5 year monitoring reports* at $2,000 each	$8,000
OPERATION AND MAINTENANCE SUBTOTAL	*$183,000*
TOTAL COST	**$183,000**

Notes:
1) Present-worth value is estimated assuming continuously compounded interest.
2) The 3% interest rate is based on a 6.99% interest for the 30-year U.S. Treasury Bond (Wall Street Journal May 15, 1995) minus a 4% inflation rate.
* Exclusive of data review and technical evaluation, trend analysis, etc.

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evaluation every five years to assess the potential risks to human health and the environment.

4.3.2 Alternative 2 - Evaluation

Alternative 2 - Compliance with Applicable New York State Standards, Criteria and Guidelines (SCGs)

Alternative 2 would not bring the site into compliance with SCGs.

Alternative 2 - Overall Protection of Human Health and the Environment

The only additional protection of human health that Alternative 2 would provide over the "no action" Alternative 1 is to legally restrict excavation of soil and use of groundwater and restrict site access. This would reduce the possibility of incidental ingestion or dermal adsorption of contaminants from the surface soil by non-site related personnel. However, this alternative would not reduce the health risk of any on-site personnel.

Alternative 2 - Short-term Impacts and Effectiveness

Since this alternative involves a minimal remedial action (i.e., deed restrictions), there would be no additional short-term impact to the community, workers or environment as a result of the implementation of this alternative.

Alternative 2 - Long-term Effectiveness and Permanence

Long-term potential health risks associated with this site would be similar to the baseline risk assessment, except the secure and maintained fencing would reduce the possible risk of incidental ingestion of or dermal contact with contaminated soil. As with Alternative 1, there would be some long term attenuation, by natural flushing, dispersion and volatilization of volatile organic compounds in the shallow water-bearing unit and soil.

Alternative 2 - Reduction of Toxicity, Mobility and Volume

This alternative would not reduce the toxicity, mobility or volume of contaminants at the site beyond what may be achieved by natural attenuation and volatilization.

Alternative 2 - Implementability

This alternative is easily implemented, since the only remedial action required is site fencing which is already installed. Site inspection and periodic monitoring of the groundwater is easily implemented.

Alternative 2 - Cost

The costs associated with the implementation of Alternative 2 are summarized in Table 4-2. The only capital costs/fees associated with this alternative are $6,000 for deed restriction legal fees.

Table 4-2
Costs for Remedial Alternative 2
Institutional Controls/Deed Restrictions and Environmental Monitoring

ITEM	COST
CAPITAL COSTS/FEES	
Deed Restrictions - legal fees	$6,000
CAPITAL COST SUBTOTAL	*$6,000*
OPERATION AND MAINTENANCE COST	
Annual Groundwater Monitoring	
4 wells sampled and analyzed for VOCs, SVOCs and pesticides	
Present-worth value at $9,000 per year for 30 years (3% nominal interest after inflation)	$175,000
Present-worth value (3% interest after inflation) for 5 year monitoring reports* at $2,000 each	$8,000
OPERATION AND MAINTENANCE SUBTOTAL	*$183,000*
TOTAL COST	**$189,000**

Notes:
1) Present-worth value is estimated assuming continuously compounded interest.
2) The 3% interest rate is based on a 6.99% interest for the 30-year U.S. Treasury Bond (Wall Street Journal May 15, 1995) minus a 4% inflation rate.
* Exclusive of data review and technical evaluation, trend analysis, etc.

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Operational and maintenance costs would include: annual groundwater monitoring inspection and reporting every five years. These costs are estimated to be $9,000 per year for groundwater monitoring and $2,000 for data reporting every five years, exclusive of data review or technical evaluation (NYSDEC, 1995e). The 30-year present worth operations and maintenance costs of this alternative are estimated to be $183,000 based on a 3 percent interest rate after inflation. The total cost for this alternative is estimated to be $189,000.

4.4. Alternative 3 - Institutional Controls / Deed Restrictions, Environmental Monitoring, Soil Excavation With Off-Site Disposal of Excavated Soils and Soil Vegetative Cover

4.4.1 Alternative 3 - Description of Alternative

This alternative would include:

- o Institutional controls, such as site fencing;
- o Deed restrictions limiting the excavation of soil below the depth that contaminated soil is excavated (unless a workplan is submitted to and approved by the NYSDEC), and limiting use of the groundwater, unless groundwater is treated to drinking water standards prior to its use and approved by NYSDEC and NYSDOH;
- o Periodic monitoring of groundwater from up to four on-site and off-site wells for VOCs, SVOCs and pesticides;
- o Excavation of surface soil from the site (one foot depth) and the abutting Hayes property (two foot depth) and off-site disposal of 1530 cubic yards of soil;
- o Backfilling excavated areas with clean fill that will be compacted, graded and covered with vegetation to reduce infiltration of rainwater and reduce erosion.

The horizontal limits of soil to be remediated are discussed in Section 1.2.3 and are shown in Figure 1-7 of this report. Soil will be removed to a depth of one foot in Areas 1, 2, and 3, and two feet in Area 5 and the Hayes property (NYSDEC, 1995d). To minimize impacts of the excavation on the building foundation, it is assumed that the excavation limits will be at least ten feet away from the building. If additional contamination requires excavation within ten feet of the building, then the limits of the contamination will be further delineated prior to re-excavation to minimize impacts of excavation on the building foundation. (Costs associated with potential re-mobilization, additional soil removal near the building, and stability of the foundation have not been included in the feasibility cost estimate.) Following excavation, and prior to backfilling with clean soil, the limits of the excavation will be sampled, assuming a 50 x 50 foot sampling grid, every 50 feet along the perimeter of the excavated area. Soil samples would be analyzed for TCL VOCs, SVOCs and pesticides.

After backfilling of the site with clean fill, the site would be seeded with vegetative cover to further reduce potential soil erosion and re-fenced to limit on-site trespassing.

Based on the initial phase and Phase II RI results, it is anticipated that some of the subsurface soil remaining at the site will have VOC, SVOC and pesticide levels exceeding SCGs. However, the remaining contamination will pose a reduced health risk because exposure pathways for soil ingestion and dermal contact would be limited by the addition of clean fill at the surface and seeding of vegetative cover. Some natural attenuation of the subsurface contaminants over time, due to flushing of the soil by rainwater, is anticipated.

4.4.2 Alternative 3 - Evaluation

Alternative 3 - Compliance with Applicable New York State Standards, Criteria and Guidelines (SCGs)

Removal of the contaminated soil will bring site surface soil concentrations in compliance with SCGs. The contaminated surface soils are a source of contaminants migrating into the groundwater. Removal of the surface soil will eliminate a contaminant source for the groundwater. Over time, natural flushing of the shallow groundwater and natural attenuation should reduce the contaminant levels in the groundwater. However, this alternative cannot assure that groundwater contaminant levels will be reduced below the SCGs.

It should be noted that Alternative 3 will allow subsurface soils with organic contaminant concentrations exceeding the SCGs to remain on site. However, this alternative will remove the surface soil ingestion and dermal contact exposure pathways, thereby reducing potential risk.

Alternative 3 - Overall Protection of Human Health and the Environment

Excavation of surface soil with clean fill replacement proposed in this alternative would remove the soil ingestion and dermal contact as potential routes for exposure to contaminants. In addition, as mentioned above, elimination of the contaminant source would reduce future migration of contaminants to the groundwater. Given enough time, the groundwater quality would improve due to flushing of the groundwater by percolation, natural attenuation and dispersion of organic contaminants. In addition, deed restrictions would limit the use of groundwater and subsurface soil excavation at the site.

Alternative 3 - Short-term Impacts and Effectiveness

Soil excavation could create some airborne contaminated dust that would be blown off site, since the excavation is located at property boundaries and off site. To address this potential short-term impact, during excavation, there should be regular fence line and on-site dust monitoring. In addition, dust control measures, such as covering piles of contaminated soil and open excavation areas with plastic when not active, and wetting exposed soil during active excavation activities, should be implemented. If soils are to be wetted, water addition should not be allowed to create runoff.

Another potential short-term environmental impact during excavation is the erosion runoff of exposed, contaminated soil. To limit this potential impact, erosion and stormwater controls, such as plastic covering, should divert runoff water from abutting properties from the excavated area. Rainwater falling in the area of excavation should be contained within the excavation area. In addition, the excavation should be sequenced to limit the area of contaminated soil exposed at any given time.

Workers should be required to wear appropriate personal protective equipment and adhere to safe construction practices to minimize potential hazards.

Alternative 3 - Long-term Effectiveness and Permanence

This alternative would have a permanent impact on the site, with regard to surface soils. Removal of the surface soil contamination source would provide a long-term benefit to the underlying groundwater.

After the completion of Alternative 3, the potential health risk posed by soil and groundwater would be reduced. The surface soil exposure pathways would be eliminated by excavating the contaminated soil, replacing with clean fill and imposition of deed restrictions. Groundwater exposure pathways would be limited by deed restrictions that disallow pumping and use of groundwater without water treatment and approval of NYSDEC and NYSDOH. However, the permanence of institutional controls such as site fencing and deed restrictions for site excavation and groundwater could be changed by the owner to meet future needs, and NYSDEC has limited authority of enforcement.

Alternative 3 - Reduction of Toxicity, Mobility and Volume

The principal threat to human health, the ingestion of and dermal contact with surface soils, would be eliminated with this remedial alternative. In addition, the second possible threat to human health, ingestion of and dermal contact with the shallow water-bearing zone would be limited, since the shallow water-bearing zone is not currently used as a potable source and deed restrictions would further limit its use.

Much of the source area would be removed, thus significantly reducing the volume and mobility of contaminants at the site. However, it is possible that contaminants adsorbed to soil at a greater depth and contamination in the shallow water-bearing zone would not be addressed. It is assumed that with natural attenuation the contaminants at a greater depth and in the shallow water-bearing unit would eventually reduce contaminant levels.

Alternative 3 - Implementability

This alternative would employ common excavation techniques. Limiting factors could include the need for obtaining a remedial construction right-of-way from the owners of the abutting properties since excavation would be conducted to the limits of the property. However, the excavation should be staged to eliminate the need for obtaining a right-of-way on abutting properties. (The cost estimate assumes that additional right-of-ways for construction are not needed.) In addition, due to limited on-site areas, stockpiling of excavated soil could only be handled in the northeastern corner where no excavation is planned. To protect the uncontaminated soils below the stockpile, an asphalt pad should be constructed (space for a 20 foot by 60 foot pad is available) and erosion controls should be implemented. Stockpiled soils would need to be sampled and analyzed with one or two day turn-around-time to determine if it should be classified and disposed of as hazardous or non-hazardous waste. Phase II remedial investigation results indicate that it is likely that the soils would pass the Toxicity Characteristic Leaching Procedure (TCLP) test and be classified as non-hazardous waste. Based on Phase II RI results, it has been assumed that 95 percent of the soil to be disposed is non-hazardous and 5 percent is hazardous waste. A total of ten TCLP samples have been costed (NYSDEC, 1995e).

Deed restrictions and site fencing would be easily implemented. Future, periodic groundwater sampling and analysis are standard procedures and readily implemented.

Alternative 3 - Cost

The costs associated with the implementation of this alternative at this site are summarized in Table 4-3. Capital costs/fees listed in Table 4-3 include: excavation, backfilling and seeding, asphalt pad for soil stockpiling (leaving pad onsite), post-excavation soil sampling, soil disposal, new fencing, site closure report and deed restrictions. Capital costs are estimated to be $395,000 without any provisions for contingencies (NYSDEC, 1995d). Costs are exclusive of engineering design, subcontractor markups (e.g., overhead, profit, administrative and contractor/construction management fees), sales taxes, and vegetative cover maintenance, and assuming no price escalation factors. It is assumed that construction run-off and wash water will not require special collection or handling. Operational and maintenance costs would include: annual groundwater sampling and analysis and five-year monitoring reports, exclusive of data review and technical evaluation (NYSDEC, 1995e). The 30-year present-worth (at 3 percent interest after inflation) operation and maintenance costs are estimated to be $183,000. The total cost for this alternative is estimated to be $578,000.

Table 4-3
Costs for Remedial Alternative 3
Institutional Controls/Deed Restrictions, Environmental Monitoring,
Soil Excavation with Off-site Disposal of Excavated Soils and Vegetative Cover

ITEM	COST
CAPITAL COSTS/FEES	
Excavation/Fill/Seeding for 1 ft excavation in Areas 1, 2, and 3 and for 2 ft excavation on Hayes property	$56,000
Excavation Oversite and Health and Safety Monitoring	$25,000
Asphalt pad for soil storage prior to disposal - to remain on site	$1,500
Post Excavation soil sampling Assume a 50 ft x 50 ft sampling grid and 50 ft interval along perimeter (44 samples analyzed for TCL VOCs, SVOCs, pesticides, metals)	$61,500
Soil disposal sampling to determine hazardous versus non-hazardous disposal Toxic Characteristic Leachate Procedure (TCLP) sampling (10 samples)	$25,000
Soil Disposal Assume 5% hazardous and 95% non-hazardous 1530 cubic yards total	$181,000
New fencing after remediation	$9,000
Site Closure Report	$30,000
Deed Restrictions -legal fees	$6,000
CAPITAL COST SUBTOTAL	*$395,000*
OPERATION AND MAINTENANCE COST	
Annual Groundwater Monitoring 4 wells sampled and analyzed for VOCs, SVOCs and pesticides Present-worth value at $9,000 per year for 30 years (3% nominal interest after inflation)	$175,000
Present-worth value (3% interest after inflation) for 5 year monitoring reports* at $2,000 each	$8,000
OPERATION AND MAINTENANCE SUBTOTAL	*$183,000*
TOTAL COST	**$578,000**

Notes:
1) Present-worth value is estimated assuming continuously compounded interest.
2) The 3% interest rate is based on a 6.99% interest for the 30-year U.S. Treasury Bond (Wall Street Journal May 15, 1995) minus a 4% inflation rate.
3) Costs are exclusive of vegetative cover maintenance and decon trailer.
4) See page 4-11 for other cost assumptions.
* Exclusive of data review and technical evaluation, trend analysis, etc.

4.5 Alternative 4 - Institutional Controls/Deed Restrictions, Environmental Monitoring, Soil Excavation With Off-Site Disposal of Excavated Soils and Soil Vegetative Cover and Soil Vapor Extraction/Combined Air Sparging and Soil Vapor Extraction (SVE/CASVE)

4.5.1 Alternative 4 - Description

This alternative would include all of the remedial aspects of Alternative 3 with the addition of soil vapor extraction/and combined air sparging and soil vapor extraction (SVE/CASVE).

This alternative would include:

- Institutional controls, such as site fencing;
- Deed restrictions limiting the excavation of soil below the depth that contaminated soil was excavated (unless a workplan is submitted to and approved by the NYSDEC), and limiting use of the groundwater, unless groundwater is treated to drinking water standards prior to its use and approved by NYSDEC and NYSDOH;
- Periodic monitoring of groundwater from up to four on-site and off-site wells for VOCs, SVOCs, and pesticides;
- Excavation of surface soil from the site (one foot depth) and the abutting Hayes property (two foot depth) and off-site disposal of 1530 cubic yards of soil;
- Backfilling excavated areas with clean fill that will be compacted, graded and covered with vegetation to reduce infiltration of rainwater and reduce erosion;
- Installation of soil vapor extraction wells and groundwater extraction/air sparging wells with subsequent soil vapor extraction for one year and groundwater air sparging, on an as needed/optional basis, in Area 1 (alcove area) with the highest contaminant levels; and
- Surface water discharge permit (SPDES) equivalence for treated groundwater discharge to the storm sewer and air discharge permit equivalence for the SVE operations. Although public-approved permits are not required, the substantive requirements of the permits must be met. The appropriate NYSDEC agencies will approve the permit equivalences.

Soil excavation would be similar to excavation discussed for Alternative 3.

After backfilling of the site with clean fill, the site would be seeded with vegetative cover to further reduce potential soil erosion and re-fenced to limit on-site trespassing.

Based on the Phase I and II RI results, it is anticipated that remaining subsurface soil will have VOC, SVOC and pesticide concentrations exceeding SCGs. However, the residual

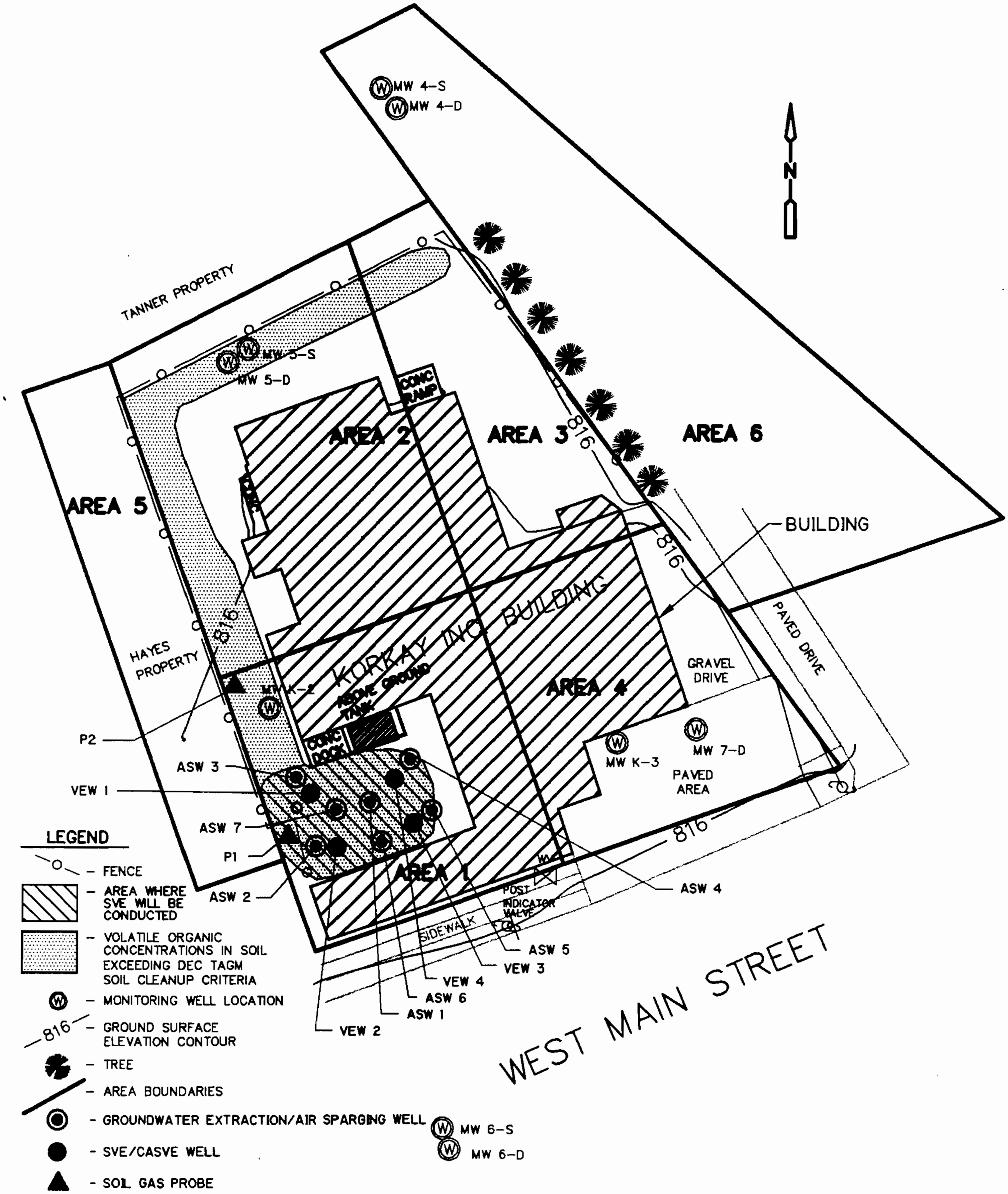
VOCs in Area 1 would be removed by SVE/CASVE and the exposure pathways for soil ingestion and dermal contact would be limited by the addition of clean fill and vegetative cover. VOC concentration in Area 2 and 3 soils exceed TAGM soil criteria but were detected at significantly lower concentrations than those detected in Area 1. In Areas 2 and 3, xylene concentrations detected were one-tenth or less of the highest concentration detected in Area 1. Areas 2 and 3 are not believed to be source areas (NYSDEC, 1995e). Therefore, soil vapor extraction will be conducted in Area 1 only (NYSDEC, 1995d).

Following fencing of the site, additional groundwater extraction/ air sparging wells, ASW-2 through ASW-7, would be installed as shown on Figure 4-1. Figure 4-2 details specific locations for the installation of four additional groundwater extraction wells and three groundwater monitoring points in Area 1, which can be converted to air sparging, on an as needed/optional basis, following an initial round of soil vapor extraction. Figure 4-3 illustrates a schematic process flow diagram for the treatment of the air stream, from soil vapor extraction, and groundwater from the groundwater extraction wells.

Based on the soil vapor extraction pilot study, which is summarized in a report titled "SVE/CASVE Treatability Study Report" and included in the Final Phase II RI Report (CDM, 1995b), the suggested mode of operation is first to conduct soil vapor extraction, until the contaminant concentration in the vapor stream has been significantly reduced (presumably to a relatively constant level). Based on the SVE/CASVE pilot data, VOCs in the soil and groundwater should be reduced to SCGs within 2.5 years. However, based on its program experience at other sites, NYSDEC believes that the site may be remediated within one year. Therefore, costs for site cleanup are based on one year of SVE/CASVE system operation (NYSDEC, 1995d). During the vapor extraction phase, the groundwater table would be lowered 1 to 2 feet in the alcove area (Area 1) to the west of the building to enhance the removal of volatiles that may be adsorbed to soil near the interface of the saturated and unsaturated zones. Groundwater would be treated by solids removal and liquid phase carbon prior to discharge to a local storm sewer. Following the initial soil vapor extraction phase, groundwater removal would cease and the groundwater pumping wells would be used for the injection of air for groundwater air sparging, on an as needed/optional basis. Soil vapor extraction would continue during air sparging, if needed, to capture contaminant vapors.

Figure 4-4 shows a more detailed schematic of a possible groundwater air sparging operation combined with the soil vapor extraction operation in Area 1. Preliminary conceptual design criteria used in the development of a combined SVE/CASVE cost estimate includes:

- 25 foot vapor extraction well spacing,
- depth to water of 8 feet,
- SVE air flow rate of 50 scfm/well at a vacuum pressure of 40 inches of water (200 scfm total for 4 wells),
- groundwater pumping rate of 3-6 gpm from several wells,
- air sparging air injection rate of up to 10 scfm per well at 3-4 psig with 5-8 wells in operation.

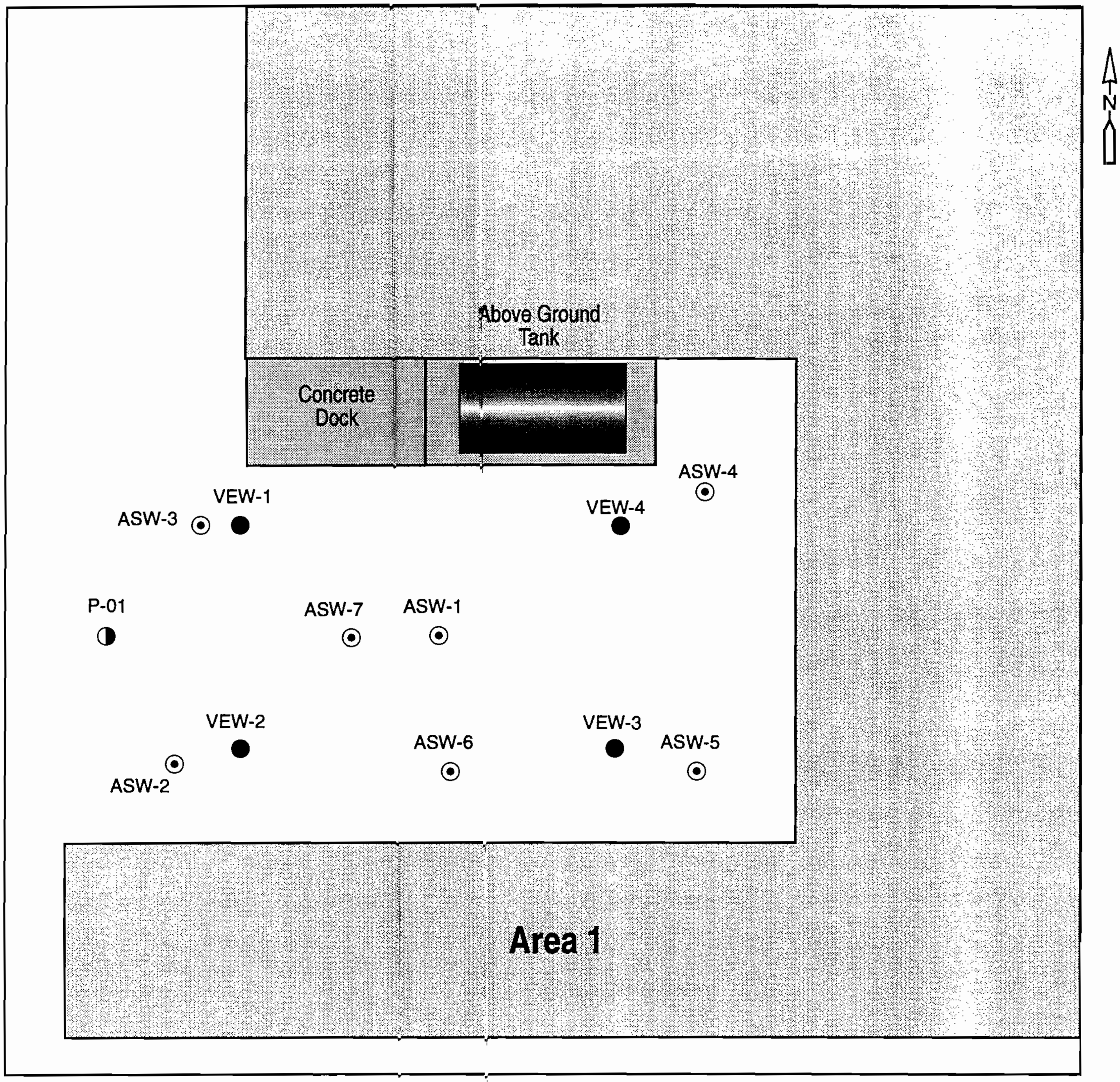


SURVEY BASE MAP PREPARED BY : MODI ENGINEERING, P.C., CICERO, N.Y. – NOVEMBER 1993

SCALE
1" = 50'

Figure 4-1
SOIL VAPOR EXTRACTION AND GROUNDWATER EXTRACTION/AIR SPARGING WELL LOCATION MAP
Korkay Inc. Site – Broadalbin, New York
NYSDEC Site #5-18-014

CDM Camp Dresser & McKee



VEW-2 ● Soil Vapor Extraction Well

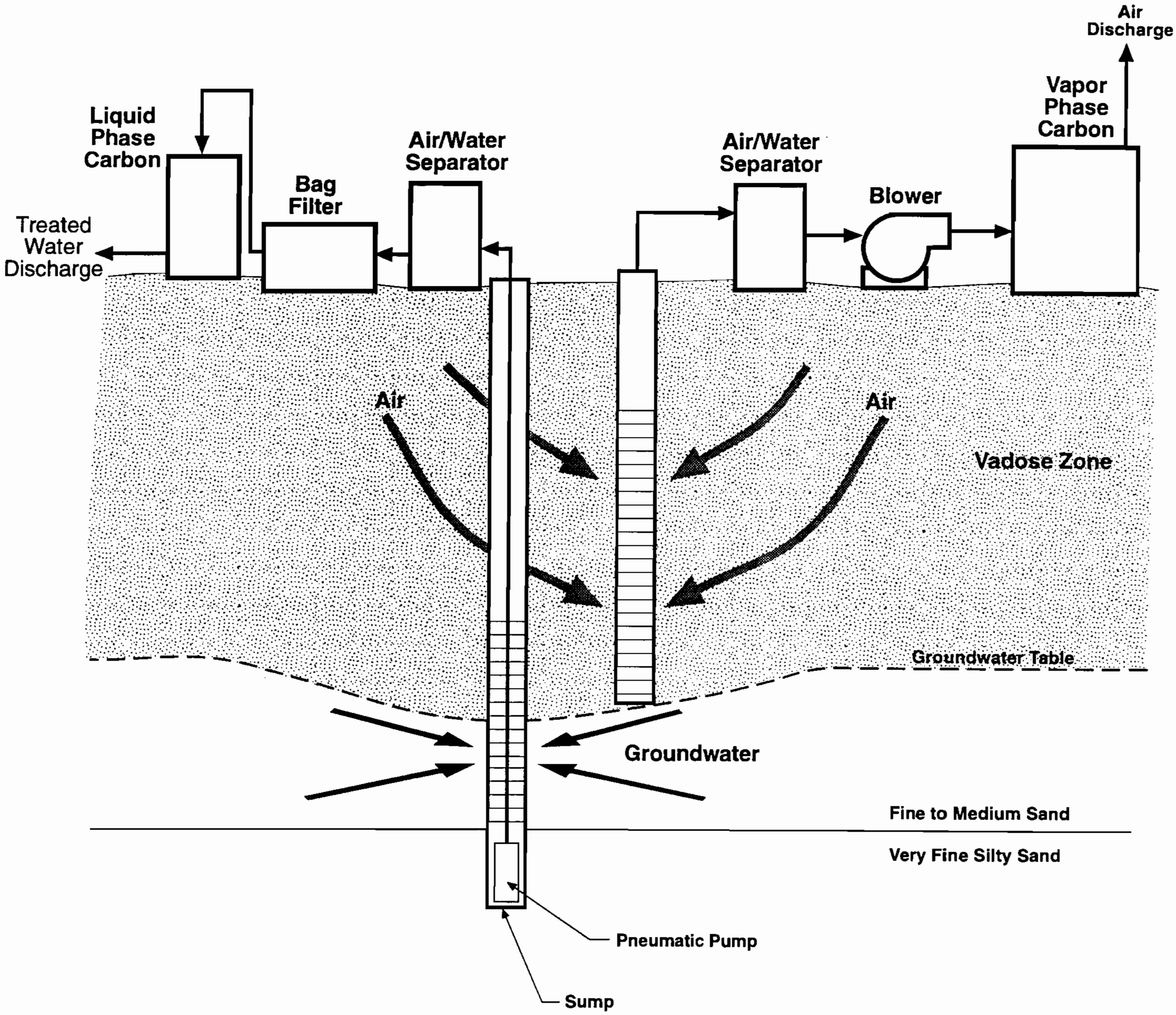
ASW-2 ⊙ Groundwater Extraction/Air Sparging Well

◑ Soil Gas Probe

APPROXIMATE SCALE
1"= 20'

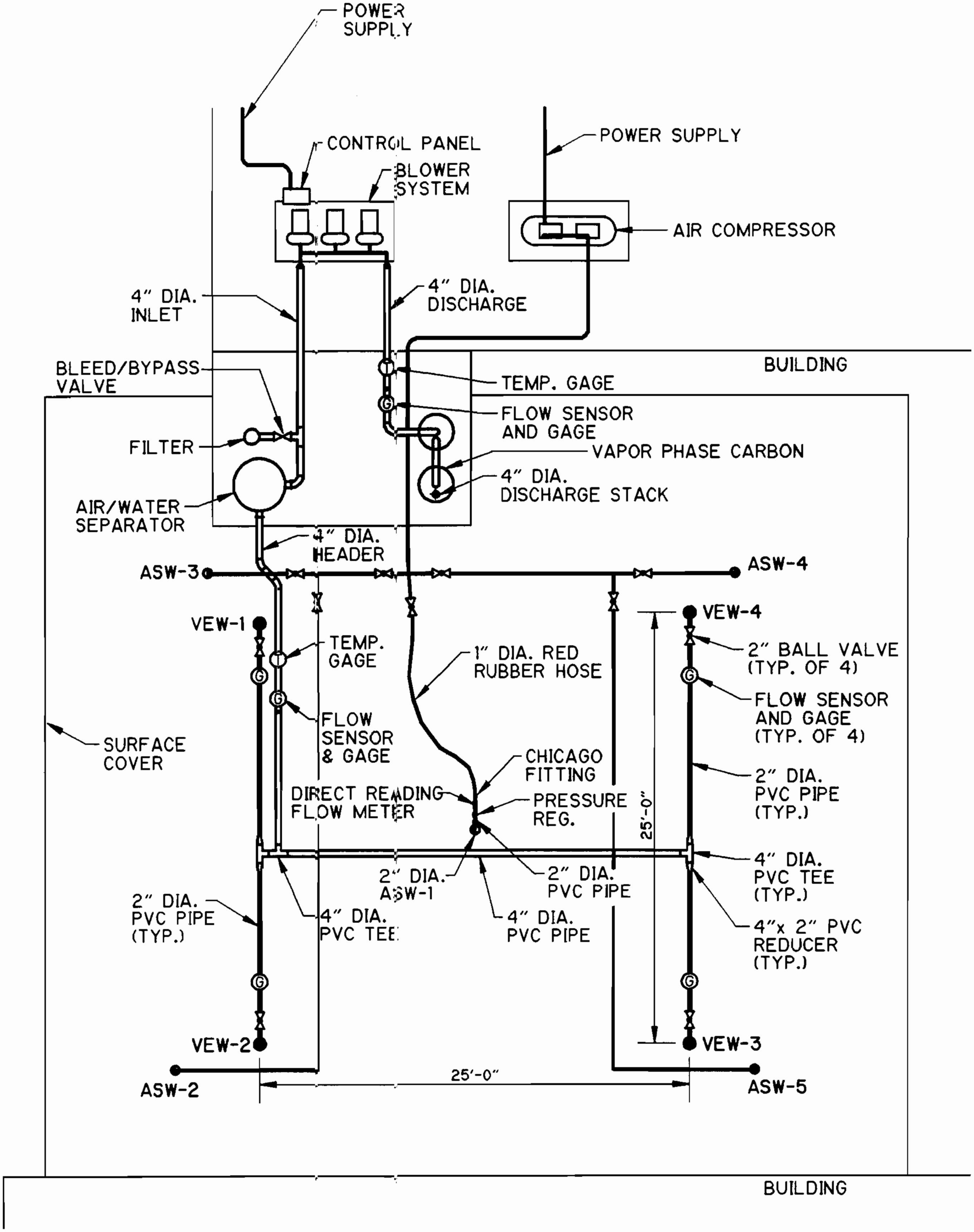
Figure 4-2
Area 1: Soil Vapor Extraction and Air Sparging Well Locations
Korkay Inc. Site - Broadalbin, NY
NYSDEC Site No. 5-18-014

CDM Camp Dresser & McKee



Not to scale

Figure 4-3
Schematic Process Diagram for
SVE and Groundwater Extraction



SCALE: 1/8"=1'-0" (APPROX.)

Figure 4-4

POSSIBLE SVE/CASVE SYSTEM

Korkay Inc. Site - Broadalbin, New York
NYSDEC Site #5-18-014

CDM Camp Dresser & McKee

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These preliminary design criteria were based on results of the pilot study. Since operating conditions may vary from the pilot, it is recommended that SVE and air sparging proceed on an as needed basis/optional basis. For example, following the initial soil vapor extraction phase, the groundwater should be sampled and analyzed for VOCs to determine if indeed air sparging is still needed to remove residual VOCs (NYSDEC, 1995e). Air sparging will be performed on an as needed/optional basis. In addition, the groundwater removal rate was estimated from two slug tests documented in the Phase II RI Report (CDM, 1995b). The actual pumping rate needed may vary for each well from the pumping rate estimated above, and it is possible that more pumping wells may be needed to lower the water table one to two feet. Also, the groundwater pumping rate may vary seasonally, and may need to be adjusted over time.

4.5.2 - Alternative 4 Evaluation

Alternative 4 - Compliance with Applicable New York State Standards, Criteria and Guidelines (SCGs)

Over time, it is anticipated that this alternative would result in surface soil and groundwater contaminant concentrations that comply the applicable SCGs. The surface soil excavation should remove the pesticide, SVOC and arsenic surface sources. Soil vapor extraction conducted in Area 1 should remove the residual volatile compounds in the subsurface soils. Groundwater air sparging should reduce VOC contamination in the vicinity of the contaminant source (the Area 1 alcove). Subsurface soils will have residual pesticide and SVOC concentrations and VOC concentrations in Areas 2 and 3 that exceed SCGs. However, as previously discussed, excavation and backfilling would reduce the exposure pathways of soil ingestion and dermal contact. Thus, further remediation of these contaminants would not be necessary to protect human health. Residual VOC, SVOC and pesticide groundwater contamination should be reduced over time by natural attenuation and flushing of the aquifer.

Treated groundwater that is discharged to the local stormwater system should have concentrations that comply with NYSDEC discharge criteria for a SPDES permit equivalence. Also, treated effluent air concentrations should comply with air quality standards for an air emission permit equivalence and air emissions under NYSDEC Air Guide 1.

Alternative 4 - Overall Protection of Human Health and the Environment

This alternative would reduce risks to human health for all exposure scenarios. Removal of contaminated surface soil and backfilling with clean soil would eliminate the soil ingestion and dermal contact pathways. In addition, fencing would limit public access. Soil vapor extraction and groundwater air sparging, on an as needed/optional basis, would reduce volatile contaminants adsorbed to soil in the vadose zone in Area 1 and consequently the shallow water bearing zone over time. Exposure scenarios involving ingestion or dermal contact with groundwater are limited since there are no water supply wells down gradient of the site. Also, deed restrictions would limit on-site groundwater use.

Alternative 4 - Short-term Impacts and Effectiveness

Soil excavation could create some airborne contaminated dust that would be blown off site, since the excavation is located at the property boundaries of the site and off-site. In order to address this potential short-term impact, during excavation there should be regular fence line and on-site dust monitoring. In addition, dust control measures, such as covering piles of contaminated soil and open excavation areas with plastic when not active, and wetting exposed soil during active excavation activities, should be implemented. If soils are to be wetted, water addition should not be allowed to create runoff.

Another potential short-term environmental impact during excavation is the erosion runoff of exposed, contaminated soil. In order to limit this potential impact, erosion and stormwater controls (such as plastic covering) should be used to divert runoff water from abutting properties from the excavated area. Rainwater in the area of excavation should be contained within the excavation area. In addition, the excavation should be sequenced to limit the area of contaminated soil exposed at any given time.

On-site workers should be required to wear appropriate personal protective equipment and adhere to safe construction practices to minimize potential hazards.

During the soil vapor extraction activities, air emissions would require periodic monitoring to ensure that toxic compounds have not been released to ambient atmosphere. In addition, treated groundwater would need periodic monitoring to ensure compliance with SPDES discharge criteria.

Alternative 4 - Long-term Effectiveness and Permanence

This alternative would have a permanent impact on the site, with regard to surface soils. The removal of surface soil contamination would provide a long-term benefit to the underlying groundwater. In addition, soil vapor extraction and groundwater air sparging would reduce the VOC concentrations in shallow water over time.

After completion of this remedial alternative, the remaining potential health risk posed by soil and groundwater would be reduced. The potential health risks posed by surface soil exposure pathways would be eliminated because excavating the contaminated surface soil and replacing with clean fill as well as the imposition of deed restrictions would eliminate the surface soil exposure pathway. SVE/CASVE would reduce the VOC concentrations in the subsurface soil in Area 1 and consequently in the shallow-water bearing unit over time. Groundwater exposure pathways would be limited by deed restrictions that disallow pumping and use of groundwater without water treatment and approval of the NYSDEC and NYSDOH.

However, the permanence of institutional controls such as deed restrictions for site excavation and groundwater use may be subject to future needs.

Alternative 4 - Reduction of Toxicity, Mobility and Volume

The principal threat to human health, the ingestion of and dermal contact with surface soils, would be eliminated with this remedial alternative. In addition, the second possible threat to human health, ingestion of and dermal contact with groundwater, would be limited, since the groundwater is not currently used as a potable source and deed restriction would further limit its use.

In Area 1, much of the VOC source area would be removed, thus significantly reducing the volume and mobility of VOC contaminants. However, it is possible non-volatile contaminants adsorbed to soil at a greater depth and non-volatile contamination in the groundwater, such as SVOCs and pesticides, would not be addressed. The VOC contamination in Areas 2 and 3 would not be addressed. It is assumed that with natural attenuation, these contaminants at a greater depth and in the groundwater would eventually be reduced.

Alternative 4 - Implementability

This alternative would employ common excavation techniques, as discussed in Alternative 3. The implementation of soil vapor extraction in Area 1 with groundwater removal (to lower the water table) and treatment, followed by soil vapor extraction with groundwater air sparging, would also employ standard construction and operation techniques. The additional vapor extraction wells and groundwater pumping/sparging wells would be installed by conventional drilling methods. Equipment needed for vapor extraction, groundwater removal and treatment and air sparging would be skid-mounted and are readily available. Operation of the treatment, system would require regular weekly monitoring to ensure effectiveness and compliance air emission and treated water standards.

Deed restrictions and site fencing would be easily implemented. Future, periodic groundwater sampling and analysis would be performed using standard procedures that are easily implemented.

Alternative 4 - Cost

The costs associated with the implementation of Alternative 4 are summarized in Table 4-4. Capital costs associated with this alternative include: excavation, backfilling and seeding, an asphalt pad installation without removal, post-excavation sampling, soil disposal, new fencing, site closure report and deed restrictions, air and water discharge permit equivalencies, installation of wells, soil vapor extraction in Area 1, groundwater treatment and air sparging equipment. Capital costs are estimated to be $551,000, excluding any contingency (NYSDEC, 1995d). Costs are exclusive of engineering design, subcontractor markups (e.g., overhead, profit, administrative and contractor/construction management fees), sales taxes, and vegetative cover maintenance, and assuming no price escalation factors. It is assumed that construction run-off and wash water will not require special collection or handling. Since SVE/CASVE will be operational for one year (NYSDEC, 1995d), a system evaluation at the end of one year is recommended; however, costs are exclusive of this

Table 4-4
Costs for Remedial Alternative 4
Institutional Controls/Deed Restrictions, Environmental Monitoring,
Soil Excavation with Off-site Disposal of Excavated Soils, Vegetative Cover,
Combined Air Sparging and Soil Vapor Extraction

ITEM	COST
CAPITAL COSTS/FEES	
EXCAVATION	
Excavation/Fill/Seeding for 1 ft excavation in Areas 1, 2, and 3 and for 2 ft excavation on Hayes property	$56,000
Excavation Oversite and Health and Safety Monitoring	$25,000
Asphalt pad for soil storage prior to disposal - to remain on site	$1,500
Post Excavation soil sampling Assume a 50 ft x 50 ft sampling grid and 50 ft interval along perimeter (44 samples analyzed for TCL VOCs, SVOCs, pesticides, metals)	$61,500
Soil disposal sampling to determine hazardous versus non-hazardous disposal Toxic Characteristic Leachate Procedure (TCLP) sampling (10 samples)	$25,000
Soil Disposal Assume 5% hazardous and 95% non-hazardous 1530 cubic yards total	$181,000
SOIL VAPOR EXTRACTION	
Installing Wells: 7 GW removal/AS wells wells (14 feet drilling per well)	$12,000
SVE/GW removal skid mounted equipment including, blower, carbon vessels, and control panel	$20,000
Power supply	$3,000
SVE/GW well connection single-wall piping above ground	$3,000
Plastic ground cover for SVE	$400
Pneumatic pumps	$11,000
Compressor for pneumatic pumps	$3,000
SVE/GW removal installation cost (25% of capital cost of SVE/GW removal equipment, piping and plastic)	$10,000
Additional Equipment	
Gas Chromatograph	$10,000
Organic Vapor Monitor	$4,000
Dust Monitor	$4,000
GW quality meter	$4,000
M-scope	$1,000
Consumables for 1 year SVE	
liquid phase carbon	$3,000
vapor phase carbon	$8,000
electricity	$12,000
GC gases/expendables	$3,000

Table 4-4
Costs for Remedial Alternative 4
Institutional Controls/Deed Restrictions, Environmental Monitoring,
Soil Excavation with Off-site Disposal of Excavated Soils, Vegetative Cover,
Combined Air Sparging and Soil Vapor Extraction

ITEM	COST
CONTINUED FROM PREVIOUS PAGE	
SVE oversight (start-up and operation 1 year)	$38,000
AIR SPARGING (optional)	
Installing Wells: 7 GW sparging wells (14 feet drilling per well) [same 7 wells as GW removal wells]	$0
2 Vapor probes	$1,300
Compressor	$0
PERMIT EQUIVALENCES	
Air discharge and SPDES permits to be pursued by DEC	
Provide limited technical support to DEC	$5,000
POST-REMEDIATION ACTIVITIES	
New fencing after remediation	$9,000
Site Closure Report	$30,000
Deed Restrictions -legal fees	$6,000
CAPITAL COST SUBTOTAL	*$551,000*
OPERATION AND MAINTENANCE COST	
Annual Groundwater Monitoring	
4 wells sampled and analyzed for VOCs, SVOCs and pesticides	
Present-worth value at $9,000 per year for 30 years (3% nominal interest after inflation)	$175,000
Present-worth value (3% interest after inflation) for 5 year monitoring reports* at $2,000 each	$8,000
OPERATION AND MAINTENANCE SUBTOTAL	*$183,000*
TOTAL COST	**$734,000**

Notes:
1) Present-worth value is estimated assuming continuously compounded interest.
2) The 3% interest rate is based on a 6.99% interest for the 30-year U.S. Treasury Bond (Wall Street Journal May 15, 1995) minus a 4% inflation rate.
3) Costs are exclusive of vegetative cover maintenance and decon trailer.
4) Assumes SVE system is housed indoors in an existing onsite structure.
5) See page 4-21 for other cost assumptions.
* Exclusive of data review and technical evaluation, trend analysis, etc.

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evaluation. Operational and maintenance costs would include: annual groundwater sampling and analysis and five year monitoring reports, exclusive of data review and technical evaluation (NYSDEC, 1995e). The 30-year present-worth (at 3 percent interest after inflation) operation and maintenance costs are estimated at be $183,000. The total cost for this alternative is estimated to be $734,000.

4.6 Comparative Analysis Of Remedial Alternatives

In this section, the seven criteria listed below are used to evaluate each of the remedial alternatives with respect to each other.

- Compliance with SCGs
- Overall Protection of Human Health and the Environment
- Short-Term Effectiveness
- Long-Term Effectiveness
- Reduction of Toxicity, Mobility and Volume
- Implementability
- Cost

The purpose of this evaluation is to identify the relative advantages and disadvantages of each remedial alternative.

4.6.1 Compliance with SCGs

Alternatives 1 and 2 will not comply with SCGs for soil or groundwater. Alternative 3 will comply with SCGs for surface soil and may eventually comply with the SCGs for the subsurface soil and consequently groundwater over time through the natural attenuation process. However, initially subsurface soils will have areas that exceed SCGs for VOCs, SVOCs, and pesticides. Alternative 4 will also comply with SCGs for surface soil, and with implementation of SVE/CASVE would comply with SCGs for VOCs in subsurface soil in Area 1 and consequently groundwater over a shorter time interval than Alternative 3. Thus, Alternative 4 would comply with the SCGs for surface soils and VOCs in subsurface soils in Area 1 and consequently groundwater in the shortest time period.

4.6.2 Overall Protection of Human Health and the Environment

Alternative 1, the "no action" alternative, and Alternative 2, Institutional Controls/Deed Restrictions and Environmental Monitoring, do not provide adequate protection of human health and the environment. Alternative 3 provides adequate protection of human health by removing the exposure pathways for soil ingestion and dermal exposure through excavation of the surface soil and backfilling with clean fill and limiting the exposure pathways for groundwater ingestion and dermal exposure with deed restrictions on the use groundwater. Alternative 4 also removes the exposure pathways due to surface soil, and limits groundwater pathways with deed restriction, as well as further protecting the environment by removing VOCs in subsurface soil in Area 1 and consequently from the shallow water-bearing unit over time in the area of greatest concern. Also, Alternative 4 would accelerate the natural attenuation process in the groundwater by further removing potential source

VOCs from subsurface soils in Area 1. Alternative 4 would provide the greater overall protection to human health and the environment.

4.6.3 Short-Term Effectiveness

Alternatives 1 and 2 would nominally provide the greatest short term effectiveness, because they do not involve disturbing site soil or generating any air emissions or surface water discharge. However, these alternatives do not adequately address remedial goals.

Some airborne soil particulate emissions and surface water runoff could be anticipated during soil excavation for Alternatives 3 and 4. To minimize release of contaminated soil to air or runoff, dust control and erosion control measures should be implemented during excavation.

Alternative 4 would involve treated air emissions from soil vapor extraction and surface water discharge from treated groundwater removal. However, these releases would be regularly monitored during remediation to ensure that air and water treatment systems were functioning properly. Thus, the overall short-term effectiveness of Alternative 4 is almost the same as that for Alternative 3.

4.6.4 Long-Term Effectiveness

Alternatives 1 and 2 would not provide long-term effectiveness for the removal of contaminants, except through natural attenuation of contaminants in the soil and groundwater.

Alternatives 3 and 4 would provide a greater degree of long-term effectiveness. Both alternatives would remove the surface soil contaminant source and exposure pathways in the surface soil from the site. In addition, both alternatives would restrict usage of the groundwater. However, Alternative 4 would provide a higher degree of long-term effectiveness because a greater percentage of the subsurface VOCs in Area 1 would be removed in a shorter period of time. This would reduce the time period needed to flush residual VOCs from the shallow groundwater by natural attenuation processes.

4.6.5 Reduction of Toxicity, Mobility and Volume

Alternatives 1 and 2 would not provide any reduction in the toxicity, mobility of volume of contaminants at the site. Any reduction of contaminants under Alternatives 1 and 2 would be solely by natural attenuation processes. Both Alternatives 3 and 4 include removing the surface soil source of contamination, thus greatly reducing toxicity, mobility and volume of soil contamination. Alternative 4 would further reduce the volume, mobility and toxicity of the groundwater by removing volatile contaminants from the subsurface soil in Area 1 and consequently the shallow water-bearing unit over time. Thus, Alternative 4 would provide the greater reduction of contaminant toxicity, mobility and volume.

4.6.6 Implementability

Alternatives 1 and 2 could be easily implemented since they involve minimal remedial activities.

Alternatives 3 and 4 both involve a higher degree of planning to provide proper execution of the remedial alternatives. Under both alternatives the excavation could require a remedial construction right-of-way on abutting properties. If a right-of-way was needed, then remedial activities would involve some pre-remediation and post-remediation sampling of these properties to ensure that contaminated soil was not accidentally released onto these properties. To reduce this added expense and liability, all truck traffic could be restricted to the site. However, this means that some staging of excavation and backfilling could be necessary to provide access to all areas to be excavated. In addition, if excavation is to be conducted prior to SVE/CASVE, then special care would be needed during excavation to avoid removal of or damage to existing PVC wells.

Alternatives 3 and 4 will also require measures for dust control and erosion control, and on-site and fenceline air monitoring for health and safety purposes.

SVE/CASVE remediation under Alternative 4 would be relatively straightforward to install and operate. Weekly monitoring of the system would be required once the system was under operation.

Alternative 1 is the easiest to implement, but does not provide the required environmental protection.

4.6.7 Cost

The costs for the four alternatives range from $183,000 and $189,000 for Alternatives 1 and 2, respectively, to $578,000 and $734,000 for Alternatives 3 and 4 , respectively. The major costs associated with the remedial alternatives are: 1) the 30 year groundwater monitoring and reporting common to all alternatives estimated at $183,000; 2) capital costs for soil excavation and disposal for Alternatives 3 and 4, estimated at $395,000 (based on Table 4-3 for Alternative 3); and 3) the additional cost for SVE/CASVE proposed in Alternative 4 is estimated at $156,000 (based on Table 4-4 for Alternative 4).

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Section 5
Recommendations

The remedial action alternatives have been ranked with respect to each of the seven criteria discussed in Section 4.0. A comparative analysis and relative ranking of the remedial action alternatives is provided in Table 5-1. Based on this qualitative and semi-quantitative ranking, Alternative 4 would provide the site with the greatest:

1) degree of compliance with SCGs;
2) overall protection of human health and the environment;
3) permanence and long-term effectiveness; and
4) reduction in toxicity, mobility and volume of contaminants.

Although Alternative 4 is the most costly alternative, it is preferred since this remedial action will remove the source of surface soil contamination, reduce VOC contamination in the subsurface soils in Area 1 and consequently the shallow-water bearing unit over time, and eliminate the potential exposure pathways of the remaining constituents of concern.

Based on the comparative analysis discussed in Section 4.0, Alternative 1 (no action) should be eliminated from consideration because it will not meet SCGs or provide adequate protection of human health and the environment. For similar reasons, Alternative 2 should also be eliminated from consideration.

Alternative 3, which includes removal of contaminated surficial soil and clean fill replacement with vegetative cover, would provide protection of human health by removing the source of surface soil contamination and reduce the potential exposure to the remaining contaminated subsurface soil by covering the soil. However, with Alternative 3, the potential exposure pathways for VOCs would not be eliminated and VOC contaminant concentrations would not readily be reduced below SCGs. Over time, natural flushing could reduce groundwater contaminant levels potentially to below SCGs.

However, with Alternative 4, the rate of VOC contaminant removal would be accelerated, since VOC concentrations in the subsurface soil in Area 1 and the shallow-water bearing unit would be actively reduced through soil vapor extraction and combined air sparging and soil vapor extraction. In comparison to Alternative 3, Alternative 4 provides an increase in the overall level of protection of human health and the environment with active removal of VOCs from Area 1. Alternative 4 is the most costly at a 27 percent increase in cost over Alternative 3. However, it is recommended that the additional cost ($156,000) for Alternative 4, which includes addressing VOC contamination in soil in Area 1, and consequently the shallow water-bearing unit via soil vapor extraction and combined air sparging and soil vapor extraction, is worth the additional environmental benefit.

Ultimately, the alternative selected by NYSDEC should be based on what is collectively determined by the agencies involved to be the most likely future use of the site. Any other perceived ecological, environmental, and economic benefits that are not part of the evaluation criteria used in this FS should also be considered when making this selection.
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Table 5-1
Comparative Analysis Summary of Remedial Alternatives
Relative Ranking of Alternatives

REMEDIAL ALTERNATIVE	SCG COMPLIANCE	PROTECTION OF HEALTH/ ENVIRONMENT	SHORT-TERM IMPACTS/ EFFECTS	LONG-TERM EFFECTS/ PERMANENCE	REDUCTION IN TOXICITY, MOBILITY, VOLUME	IMPLEMENT-ABILITY	COST	CUMULATIVE RANKING
1 - No Action	4*	4	1**	4	4	1	1	4
2 - Institutional Controls/ Deed Restrictions and Media Monitoring	4*	3	1**	3	3	2	2	3
3 - ~~Institutional Controls/~~ Deed Restrictions, Media Monitoring, Excavation, Disposal, Vegetative Cover	2	2	2	2	2	3	3	2
4 - Institutional Controls/ Deed Restrictions, Media Monitoring, Excavation, Disposal, Vegetative Cover, Comb. Air Sparging & Soil Vapor Extraction	1	1	3	1	1	4	4	1

Key to ranking:
1 = Most favorable
2 = Second most favorable
3 = Third most favorable
4 = Least favorable

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* neither alternative provides physical remediation, thus having the same level of SCG non-compliance.

** neither alternative causes short-term impact or effect, thus having the same favorable ranking.

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Section 6
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