United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R03-90/090
June 1990

EPA

# Superfund Record of Decision:

## Lord-Shope Landfill, PA

50272-101

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| 12. Sponsoring Organization Name and Address<br>U.S. Environmental Protection Agency<br>401 M Street, S.W.<br>Washington, D.C. 20460 | 13. Type of Report & Period Covered<br>800/000 |
| | 14. |

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 25-acre Lord-Shope Landfill site is an inactive hazardous waste landfill in Girard Township, Erie County, northwestern Pennsylvania. The site consists of a 4-acre landfill and adjacent areas of contaminated soil, surface water and ground water. The surrounding area is primarily agricultural and residential, with two unnamed tributaries of Elk Creek bordering the site to the north and west. From the mid-1950s to 1979, lustrial wastes, including spent adhesives, degreasing solvents, acids, caustics, and .ne drummed wastes were disposed of onsite from nearby facilities. During 1982 and 1983, responsible parties, under an agreement with the State, implemented a remedial alternative, which included removing 81 exposed drums, capping the landfill, and installing a low permeability ground water cutoff wall to reduce leachate production from the landfill and to divert ground water flow around the site. Landfill leachate has, however, resulted in VOC and inorganic ground water contamination both beneath and to the north of the landfill, with a contaminant plume migrating towards the north. Surface soil around the landfill has also been found to contain elevated levels of VOCs. The primary contaminants of concern affecting the landfill material, surrounding soil, and ground water are VOCs including benzene, PCE, and TCE; and metals including arsenic, chromium, and lead.
(See Attached Sheet)

17. Document Analysis a. Descriptors

Record of Decision - Lord-Shope Landfill, PA
First Remedial Action - Final
Contaminated Media: soil, gw
Key Contaminants: VOCs (TCE, PCE, benzene); metals (arsenic, chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

| 'ailability Statement | 19. Security Class (This Report) None | 21. No. of Pages 98 |
|---|---|---|
| | 20. Security Class (This Page) None | 22. Price |

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

:ract (Continued)

The selected remedial action for this site includes in-situ vapor stripping using vacuum wells to volatize and remove VOCs from the landfill material and the surrounding soil; collection and treatment of gas emissions generated by the vapor stripping process using carbon filtration; ground water pumping and treatment including pretreatment for metal removal, followed by air stripping, to halt plume migration, with final discharge of treated ground water into the nearby surface tributaries; implementation of site access restrictions and institutional controls including ground water use restrictions. The estimated present worth cost for the remedial action is $5,760,000, which includes an annual O&M cost of $420,000 for years 1 - 2, and $310,000 for years 3 - 50.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific soil criteria for the landfill material and the surrounding soil were not provided, but will be determined during the remedial design and will be based on soil contaminant levels that will not significantly impact the underlying ground water. Ground water cleanup goals will meet SDWA MCLs or proposed MCLs (PMCLs), and a 10-4 excess cancer risk or a hazard index = 1. Target ground water cleanup levels include PCE 5 ug/l (PMCL), TCE 5 ug/l (MCL), benzene 5 ug/l (MCL), arsenic 20 ug/l (based on an excess cancer risk of 10-4), chromium 50 ug/l (MCL), and lead 15 ug/l (risk-based calculation). Ground water goals will be revised to meet background levels in accordance with State ARARs. Air emissions from the air stripping of the ground water treatment system and the gas released from the in-situ vapor stripping process will be treated to meet State standards.

## DECLARATION FOR THE RECORD OF DECISION

### SITE NAME AND LOCATION

Lord-Shope Landfill Site

Girard Township, Erie County, Pennsylvania

### STATEMENT OF PURPOSE

This decision document presents the selected remedial action plan for the Lord-Shope Landfill Superfund Site (the Site) developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (CERCLA), 42 U.S.C. Section 9601 et seq., and to the extent practicable, the National Contingency Plan (NCP), 40 C.F.R. Part 300.

### STATEMENT OF BASIS

This decision is based upon and documented in the contents of the Administrative Record. The attached index identifies the items which comprise the Administrative Record. The Commonwealth of Pennsylvania has reviewed, commented upon, and concurred in this Record of Decision.

### ASSESSMENT OF THE SITE

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. Section 9606, that actual or threatened releases of hazardous substances from this

Site, as specified in Section VI, Summary of Site Risks, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to the public health, welfare, or the environment.

**DESCRIPTION OF THE SELECTED REMEDY**

The remedial action plan in this document is presented as the permanent remedy for resolving the groundwater contamination at the Site and for reducing the source of contamination. This remedy is comprised of the following components:

1. A groundwater extraction and treatment component to quickly halt plume migration, with the long-term effect of returning the groundwater to its most beneficial use;

2. The innovative technology of in situ vapor stripping that uses vacuum wells to volatilize and remove volatile organic compounds from the landfill materials and surrounding soils; and

3. The additional protection provided by institutional controls to restrict the use of contaminated groundwater and the installation of security fencing around the property to prevent direct human contact with contaminants at the Site.

STATUTORY DETERMINATIONS

Pursuant to duly delegated authority, I hereby determine that the selected remedy is protective of human health and the environment, attains federal and state requirements that are applicable or relevant and appropriate, and is cost-effective as set forth in Section 121(d) of CERCLA, 42 U.S.C. Section 9621(d). This remedy satisfies the statutory preference, as set forth in Section 121(b) of CERCLA, 42 U.S.C. Section 9621(b), for remedial actions in which treatment that reduces toxicity, mobility, or volume is a principal element. Finally, it is determined that this remedy utilizes permanent solutions and alternative technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining on-site, it will be reviewed within five years after the initiation of the remedial action in order to assure that human health and the environment are adequately protected by the remedy.

6/29/90
Date

Edwin B. Erickson
Regional Administrator

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# RECORD OF DECISION

## LORD-SHOPE LANDFILL SITE

## DECISION SUMMARY

### I. SITE NAME, LOCATION, AND DESCRIPTION

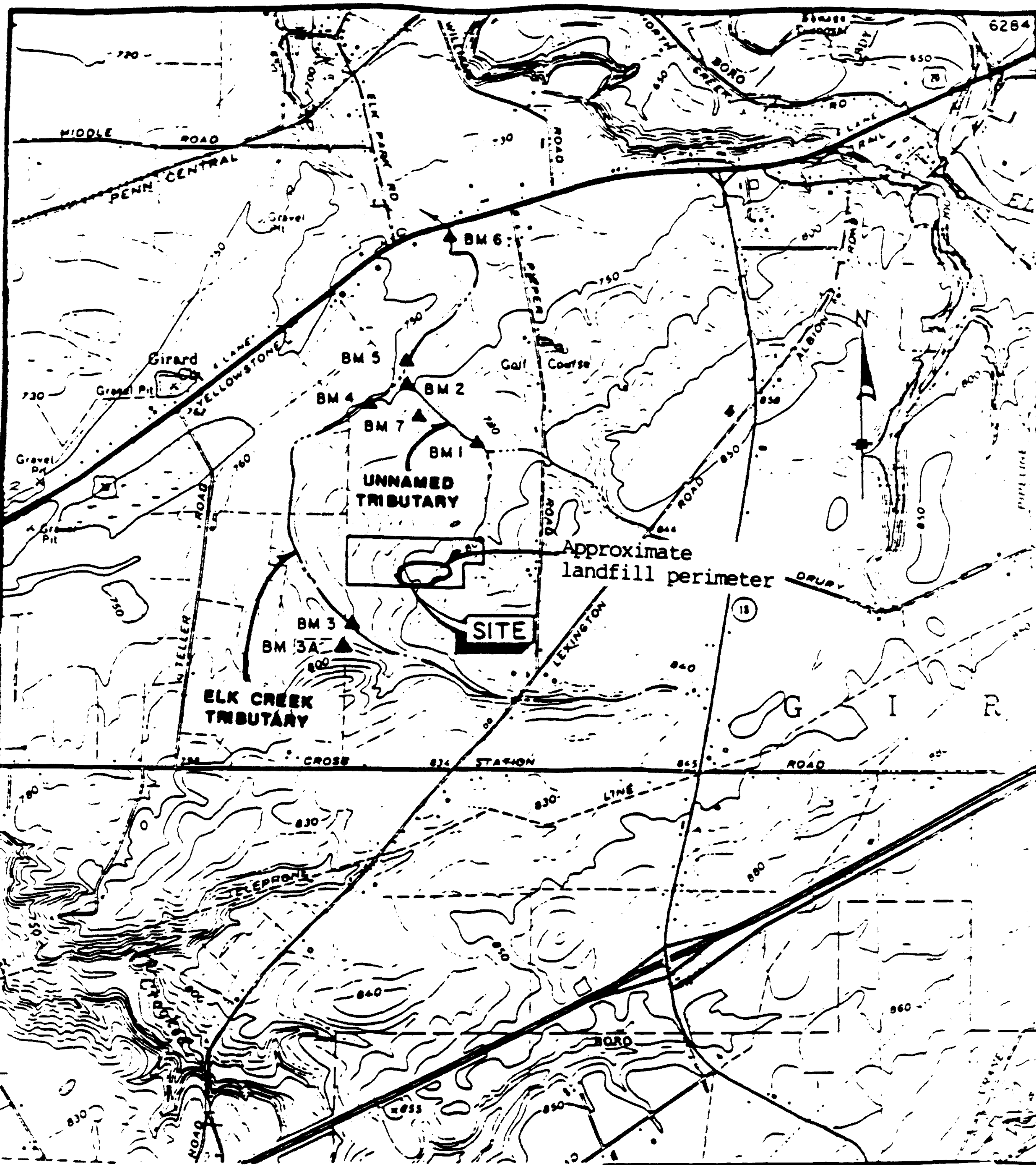
The Lord-Shope Site ("the Site") is located west of Pieper Road approximately 4500 feet south of the intersection of U.S. Route 20 and Pieper Road in Girard Township, Erie County, Pennsylvania, as shown in Figure 1. To the north of the Site and to the west of the Site are two unnamed tributaries of Elk Creek. The Site consists of an inactive, hazardous waste landfill covering approximately 4 acres, and the adjacent areas of contaminated soil, surface water, and groundwater. The 25.2 acre property containing the landfill is currently owned by the Lord Corporation ("Lord") of Erie, Pennsylvania.

The landfill currently appears as a grass covered hill which rises approximately twenty feet at its highest point. The surrounding area is primarily rural agricultural with scattered residential areas bordering the roads. The property is bounded by two residences to the east located on Pieper Road, an apple orchard and vinyard to the south, an evergreen nursery to the west, and an overgrown corn field to the north. A golf course is located to the north of the landfill property, adjacent to the corn field. The only nearby residences are located along Pieper Road to the east and along Route 20 to the north. The nearest population center, Girard Borough, is located two miles to the northeast.

### II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

From the mid-1950s until 1979, industrial wastes; including spent adhesives, degreasing solvents, cutting oils, acids and caustics; along with miscellaneous paper, wood and rubber wastes, were disposed of at the Site. Some wastes were disposed of in drums. The property was then owned by Mr. Melvin Shope, who was at that time an employee of Lord. The wastes originated at Lord's Erie (12th Street) and Saegertown plants.

In 1982, after Lord had conducted some preliminary site studies, Lord, Mr. Shope, and the Pennsylvania Department of Environmental Resources (DER) entered into a Consent Order and Agreement that called for continued monitoring and the implementation of a "remedial alternative" at the Site. The remedial alternative, implemented in 1982 and 1983, consisted of the removal of approximately 81 exposed drums of waste,



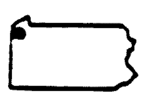

LEGEND:

BM 4 ▲ BENTHOS SAMPLING LOCATIONS

SOURCE: ALBION (1959, REV. 1969) PA. 7.5' QUADRANGLE

2000 0 2000

scale feet



MAP LOCATION

FIGURE 1.

Site Location and Surface Water Hydrology

**SHOPE'S LANDFILL SITE**
**LORD CORP.**
**GIRARD TWP., PA.**

emplacement of a composite cap over the landfill, the construction of a low permeability groundwater cutoff wall upgradient (south) of the landfill, and the regrading and revegetation of the Site. The construction of the cap included a clay layer, a synthetic membrane, and a vegetative soil cover. The objective of that remedial alternative was to reduce the amount of contamination entering the groundwater by reducing leachate production in the landfill and diverting groundwater flow around the Site.

Under provisions of CERCLA, the Site was placed on the National Priorities List (NPL) in September 1983. The regulations enacted pursuant to CERCLA generally require that a Remedial Investigation and Feasibility Study (RI/FS) be conducted at each NPL site. The purpose of an RI is to characterize conditions at the site. The subsequent FS then develops, screens, and analyzes a series of remedial alternatives which are applicable to those site conditions and might be implemented at the Site. The area studied in the Remedial Investigation for the Lord-Shope Site included the landfill and plume area, the area immediately surrounding the Site, the two tributaries and drainage patterns that make up the surface hydrology and the groundwater system below these areas ("study area").

In order to supplement the existing site information and to meet the requirements of CERCLA, DER and the U.S. Environmental Protection Agency (EPA) requested, in 1985, that Lord conduct a "focused" RI to characterize groundwater conditions, and an FS at the Site. In 1987, Lord's agreement to conduct the RI/FS was embodied in a Consent Order signed by DER and Lord. The RI was conducted and the RI report submitted by Lord's environmental consultant, AWARE INC. Following evaluation of that report, it was decided that further investigations at the Site were necessary. DER and EPA requested that a "Phase II" RI and FS be conducted. This investigation was conducted for Lord by ECKENFELDER INC. (formerly AWARE INC.) and the reports, after being finalized, were placed in the information repositories described in Section VI, Community Relations History.

Due to the landfill's leachate generation, groundwater beneath and north of the landfill contains several volatile organic compounds (VOCs) and inorganic compounds indicative of site-related contamination. Several areas around the landfill perimeter are wet in certain seasons. These areas have been designated "seep" areas. These seeps represent areas where the groundwater level rises above the ground surface and have been found to contain site-related VOCs. No flow from these areas has been observed. Air quality studies, conducted after the cap and cut-off wall construction was completed in 1983, have shown no indications that the ambient air has been degraded by the landfill or associated contaminants.

Residences and businesses in the Site vicinity, including those immediately adjacent to the landfill, rely on groundwater (private wells) for their drinking water supplies. Past and ongoing monitoring of private well water supplies indicates that the Site has not affected area water supplies.

## III. SITE CHARACTERISTICS

### A. Geologic Conditions

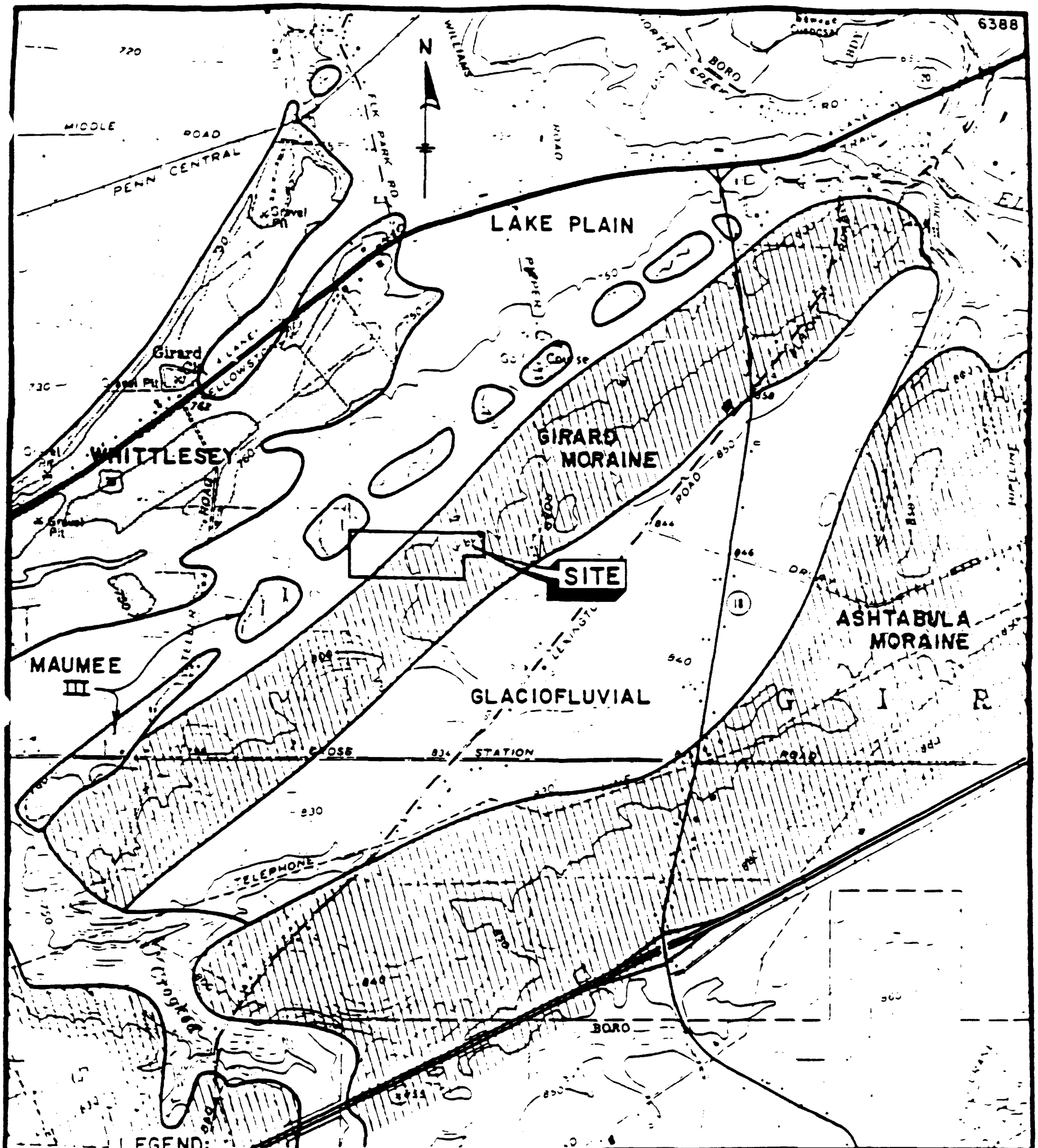
Typical geologic features in the vicinity of the Lord-Shope Landfill Site are depicted in Figure 2. This figure depicts the surficial glacial deposits as they have been reported by E.E. Schooler, in General Geology Report 64 (1974). Of primary interest are the Ashtabula and Girard end moraines and a beach ridge formed along the shoreline of the last inundation of glacial lake Maumee III. Generally, the site is underlain by a thick series of glacial deposits. These deposits include at least three laterally extensive glacio-lacustrine deposits interbedded with intervening glacial tills. Minor amounts of glaciofluvial deposits were observed at the surface. Bedrock was not encountered in any of the borings conducted during the Remedial Investigation.

### B. Groundwater Conditions

Groundwater has been found to occur within three zones beneath the Lord-Shope Landfill study area:

1. The first water bearing unit ("Water Table Zone")is unconfined and ranges in depth from 15 to 30 feet below the surface. This zone consists of the coarse-grained Ashtabula Till and Maumee III C lacustrine deposits, with lenses of fine grained materials. These shallow materials are among the most permeable that occur at the Site, with an estimated average hydraulic conductivity of $6 \times 10^{-4}$cm/sec. The Water Table Zone receives recharge predominantly through direct infiltration of precipitation. Lateral flow in this zone is primarily to the north and northwest.

2. The second water bearing unit ("Intermediate Zone") occurs within the coarser grained deposits of the Maumee III B and the coarse grained Ashtabula Till. The geologic deposits comprising this zone have a moderately low hydraulic conductivity of approximately $6 \times 10^{-5}$ cm/sec. This zone is almost completely confined by overlying materials except in some important areas. The exceptions include two areas




LEGEND:

BEACH RIDGE DEPOSITS

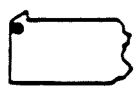
GLACIAL MORAINE

SOURCE: 1. ALBION (1959, REV. 1969) PA. 7.5' QUADRANGLE

2. SCHOOLER (1974)

2000 0 2000

scale feet



MAP LOCATION

FIGURE 2.

**REGIONAL SURFICIAL GEOLOGIC MAP**

**SHOPE'S LANDFILL SITE**
**LORD CORP.**
**GIRARD TWP., PA.**

directly beneath the northeastern edge of the landfill and in the area of the plume north of the landfill where the Intermediate Zone is in hydraulic contact with the Water Table Zone and has been shown to have a higher hydraulic conductivity. Lateral flow in this zone is also to the north and northwest.

3. The third water bearing unit ("Deep Zone") is located within the coarser grained deposits of the Maumee III A lacustrine deposits, ranging in depth from approximately 75 to 105 feet below the ground surface. This unit has a hydraulic conductivity estimated at $4 \times 10^{-5}$ cm/sec. The lateral flow in this zone is to the southwest; radically different from the two zones above it.

Zones of lower hydraulic conductivity, termed aquitards, separate each of the water bearing zones. The "Upper Aquitard" separates the Water Table Zone and the Intermediate Zone while the "Lower Aquitard" separates the Intermediate Zone from the Deep Zone.

Deeper groundwater bearing zones probably exist below those that were studied in the Remedial Investigation. These zones may be contained within deeper glacial deposits and/or bedrock that underlies the Site. These zones were not part of the studies performed at this Site as they would be beneath the Deep Zone which studies have shown to be unaffected by the Site.

**C. Surface Water Conditions**

Elk Creek Tributaries The land in the vicinity of the Site is drained by two unnamed streams that are tributaries of Elk Creek. Elk Creek is a major stream that drains directly into Lake Erie, approximately 2 1/2 miles to the north. The larger of the two unnamed streams, termed the Elk Creek Tributary, originates approximately 2/3 miles southeast of the Site and flows around the south, west, and north sides of the Site. A smaller stream, the Unnamed Tributary, originating immediately north of the Site, flows north to a point where it joins the Elk Creek Tributary. The Elk Creek Tributary flows continuously throughout the year in the vicinity of the Site. However, the smaller Unnamed Tributary stream flows only seasonally, in periods of wet weather, in the upper 1,000 ft of its length. Neither of these streams flows directly on the Lord-Shope Landfill Site.

Site Drainage Surface drainage of precipitation on the landfill cap is now well controlled by drainage improvements constructed as a part of the remedial action in 1982 and 1983. Most run-off likely recharges the water table in this area.

However, some of this flow also moves directly to a poorly defined swale that flows in a northwesterly direction from the site.

Several areas adjacent to the site are seasonally wet. These are localized areas in which the shallow water table intersects the ground surface in low-lying areas. These areas have been designated "seeps".

## D. Nature and Extent of Contamination

The nature and extent of Site-related contamination around the landfill has been evaluated by a number of investigations; the most recent being the Phase II Remedial Investigation concluded in 1989. The investigations identified the contaminated or potentially contaminated media to be the landfill materials, groundwater, subsurface soils, and, to a limited extent, surficial soils. A summary of the mean contaminant concentrations in the affected media is included as Table 1.

Groundwater Contamination A contaminant plume, consisting primarily of volatile organic compounds, has been identified to the north and northwest of the Site. The contamination appears to be migrating primarily in the Intermediate Zone, but has also been demonstrated in the Water Table Zone. In general, the plume has migrated to the north and west approximately 150 to 600 feet, however, in an area directly north of the landfill a "plume extension" has migrated approximately 1400 feet in an area shown to have a higher conductivity. The VOC contaminant plume for the Intermediate Zone is indicated in Figure 3.

A group of halogenated and non-halogenated volatile organic compounds has been identified by the CLP analytical protocols that are at present employed to analyze the Site groundwater samples. This group includes primarily methyl isobutyl ketone (MIBK), 4-methyl-2-pentanol, acetone, methyl ethyl ketone (MEK), vinyl chloride, trans-1,2-dichloroethene, and terahydrofuran (THF). In addition to each of these compounds, the GC analytical methodology that was employed prior to 1988 had identified significant concentrations of cyclohexanone, 2-butanol, isopropanol, and tetrachloroethene. These compounds correspond well to the types of wastes known to have been disposed in the landfill. The various ketones are shown to be the predominant organic constituents.

With several exceptions, semi-volatile constituents have not been detected in groundwater samples collected from the Site. The exceptions include low level detections of benzo (k) fluoranthene and benzoic acid in several of the plume wells located very close to the margin of the landfill. PCBs and pesticides were not detected.

TABLE 1.

SUMMARY OF METALS CONCENTRATIONS
(ppb)

| Medium | Aluminum | Arsenic | Barium | Cadmium | Chromium | Cobalt | Copper | Lead | Mercury | Nickel | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Groundwater - Best Estimate**[a] | | | | | | | | | | | |
| Location | W-39B | W-28 | W-20B | W-20B | W-39B | W-39B | W-34 | W-28 | W-20B | W-39B | W-39B |
| Mean | 26,000 | 4.9 | 4,200 | 8.1 | 67 | 11 | 16 | 60 | 1.5 | 75 | 160 |
| Values | 3,350<br>48,700 | 4.9 | 4,250<br>6,020<br>4,000<br>3,600<br>4,090<br>3,530<br>3,860 | 6<br>6<br>16.4<br>6.3<br>4.1<br>10 | 46<br>88 | 11 | 16 | 60 | 2.8<br>0.3 | 32<br>117 | 39<br>289 |
| **Groundwater - Upper Bound**[b] | | | | | | | | | | | |
| Location | W-1A | W-1A | W-3 | W-3 | W-7WT | W-7WT | W-3 | W-5A | W-3WT | W-7WT | W-1A |
| Mean | 37,000 | 43 | 5,800 | 9 | 111 | 71 | 4,800 | 100 | 1.5 | 129 | 5,500 |
| Values | 24,600<br>8,610<br>78,200 | 50<br>35 | 5,470<br>6,430<br>5,170<br>6,350<br>5,770 | 5<br>13 | 111 | 71 | 23,300<br>130<br>87<br>154<br>160 | 230<br>42<br>28 | 1.5 | 129 | 953<br>8,980<br>3,780<br>8,410 |
| **Surface Water - Seeps** | | | | | | | | | | | |
| Location | NE Seep | NE Seep | NE Seep | | NE Seep | | NE Seep | NE Seep | NE Seep | | NE Seep |
| Mean | 5,400 | 20 | 290 | ND[c] | 32 | ND | 32 | 50 | 12 | ND | 160 |
| Values | 729<br>15,100<br>280 | 8<br>29.6<br>23 | 278<br>329<br>268 | | 32 | | 32 | 50 | 0.3<br>23 | | 250<br>213<br>26 |
| **Stream Sediment** | | | | | | | | | | | |
| Location | SW-5 | SW-5 | SW-6 | SW-7 | SW-5 | SW-4 | SW-1 | SW-5 | SW-3 | SW-1 | SW-1 |
| Mean | 9.3E+06 | 14,000 | 81,000 | 1,600 | 10,000 | 11,000 | 23,000 | 17,000 | 110 | 19,000 | 81,000 |
| Values | 1.1E+07<br>9.2E+06<br>1.0E+07<br>6.7E+06 | 7,700<br>20,800<br>20,200<br>13,000<br>6,900 | 55,000<br>107,000<br>115,000<br>72,800<br>54,500 | 1,600 | 6,500<br>10,300<br>9,700<br>14,000<br>11,500 | 6,600<br>8,500<br>4,700<br>24,200 | 20,400<br>23,000<br>22,500<br>25,100 | 12,300<br>22,400<br>27,800<br>8,700<br>12,100 | 110 | 20,800<br>20,000<br>20,500<br>15,800 | 78,900<br>90,000<br>84,200<br>72,300 |

[a] "Groundwater - Best Estimate" includes the data for the well containing the maximum concentrations of each parameter in the group of monitoring wells located north of the Lord property line.

[b] "Groundwater - Upper Bound" includes the data for the well containing the maximum concentrations of each parameter out of all of the site monitoring wells.

[c] " indicates that the particular compound was not detected in an[illegible]ple for the noted medium.

TABLE 1. (continued)

SUMMARY OF VOLATILE ORGANIC CONCENTRATIONS (ppb)

| Medium | Benzene | Chloro-benzene | 1,1-Dichloro-ethane | Tetra chloro-ethene | Toluene | Trans-1,2-Dichloro-ethene | Trichloro-ethene | Vinyl Chloride | Methyl Ethyl Ketone | Methyl Isobutyl Ketone | Acetone | Tetra-hydro-furan | 4-methyl-2-Pentanol |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Groundwater - Best Estimate[a]** | | | | | | | | | | | | | |
| Location | W-34 | | | | | W-36B | | W-20B | W-20B | W-34 | W-34 | W-20S | W-34 |
| Mean | 7 | ND[c] | ND | ND | ND | 1,200 | ND | 1,500 | ND | 490 | 1,100 | 140 | 510 |
| Values | 7 | | | | | 1,200 | | 2,400<br>1,900<br>200 | | 490 | 1,100 | 140 | 1,000<br>28 |
| **Groundwater - Upper Bound[b]** | | | | | | | | | | | | | |
| Location | W-35B | W-3 | W-9WT | | W-3 | W-36B | W-9WT | W-20S | W-3 | W-3 | W-3 | W-[illegible]A | W-3 |
| Mean | 12 | 11 | 34 | ND | 21 | 1,200 | 56 | 1,500 | 7,400 | 25,000 | 11,000 | 360 | 52,000 |
| Values | 12 | 11 | 34 | | 27<br>14 | 1,200 | 65<br>47 | 2,400<br>1,900<br>200 | 7,400 | 48,000<br>8,400<br>42,000<br>3,400 | 37,000<br>930<br>5,800<br>960 | 250<br>460 | 11,000<br>11,000<br>180,000<br>6,900 |
| **Surface Water - Seeps** | | | | | | | | | | | | | |
| Location | | | | | | SE-Seep | SE-Seep | NE-Seep | | | | | |
| Mean | ND | ND | ND | ND | ND | 130 | 33 | 56 | ND | ND | ND | ND | ND |
| Values | | | | | | 130 | 33 | 56 | | | | | |
| **Downstream Sediment** | | | | | | | | | | | | | |
| Location | | SW-7 | | | | | | | | | SW-5 | | |
| Mean | ND | 18 | ND | ND | ND | ND | ND | ND | ND | ND | 90 | ND | ND |
| Values | | 18 | | | | | | | | | 90 | | |
| **Surficial Soils** | | | | | | | | | | | | | |
| Mean | 6.4 | ND | ND | 180 | 11 | ND | ND | ND | ND | ND | ND | ND | ND |
| Values | 6.4 | | | 11<br>72<br>32<br>620<br>9 | 7.8<br>10<br>15 | | | | | | | | |

[a]"Groundwater - Best Estimate" includes the data for the well containing the maximum concentrations of each parameter in the group of monitoring wells located north of the Lord property line.

[b]"Groundwater - Upper Bound" includes the data for the well containing the maximum concentrations of each parameter out of all of the site monitoring wells.

[c]"ND" indicates that the particular compound was not detected in any sample for the noted medium.


FIGURE 3.

LORD-SHOPE LANDFILL
MIGRATION PLUME FOR VOLATILE ORGANIC CONTAMINANTS
IN THE INTERMEDIATE GROUNDWATER ZONE

The primary plume constituents at the Shope's site are volatile organic compounds. However, a number of inorganic compounds principally consisting of a group of metals and chloride have been noted in wells installed in the plume. Statistically significant levels of metals have been detected in the Water Table and Intermediate Zones including barium, cadmium, chromium, cobalt, copper, mercury, and zinc. However, most of these metals are restricted to the wells located close to the landfill. Only barium exceeds its MCL for drinking water.

The Deep Zone has not shown evidence of any contamination. Residential wells in the area have also not shown any evidence of any contamination.

<u>Surficial Soils</u> Surficial soil contamination has been identified in several areas around the landfill. Several of these areas correspond to the seep areas in which contaminated standing water has been observed. This is the case in areas immediately northeast, north, and southwest of the landfill. Laboratory analysis of samples taken immediately below the surface indicate that surficial soil contamination is highly localized and that it exists in low concentrations for volatile organic compounds.

The most significant area of surficial soil contamination is the landfill toe area. This area is located immediately southeast of the site and is depicted in Figure 4. The highest levels of total volatile organic compounds (TVOs) observed in this area with a field photoionizer detector range up to 300 HNU units. HNU units are an approximation of TVO levels and are equal to parts per million (ppm) when measuring the compound to which the meter was calibrated and an approximation of ppm when measuring other organics. One possible explanation for contamination in this area is spillage from trucks entering the site at the time of landfill operation.

The volatile contaminants within the surficial soils have been characterized. Tetrachloroethene has been shown to be the most abundant constituent, with concentrations being detected in 12 samples at values up to 620 ppb. Toluene was detected in four samples at concentrations ranging to 15 ppb. Ethyl benzene is the only other compound found in more than one sample and was detected in three samples at concentrations ranging up to 5.3 ppb. Benzene and methylene chloride were found in only one sample each at concentrations of 6.4 and 8.0 ppb, respectively.

<u>Deep Soils</u> A deep soil study focused on the landfill perimeter indicated that the most significant levels of contamination in soils, at depths ranging from 6 to 68 inches, occurred on the hill 70 ft southeast of the landfill. TVO levels measured with the field photoionizer detector reached a maximum of 580 HNU units at a depth of 13 ft. Below that depth,

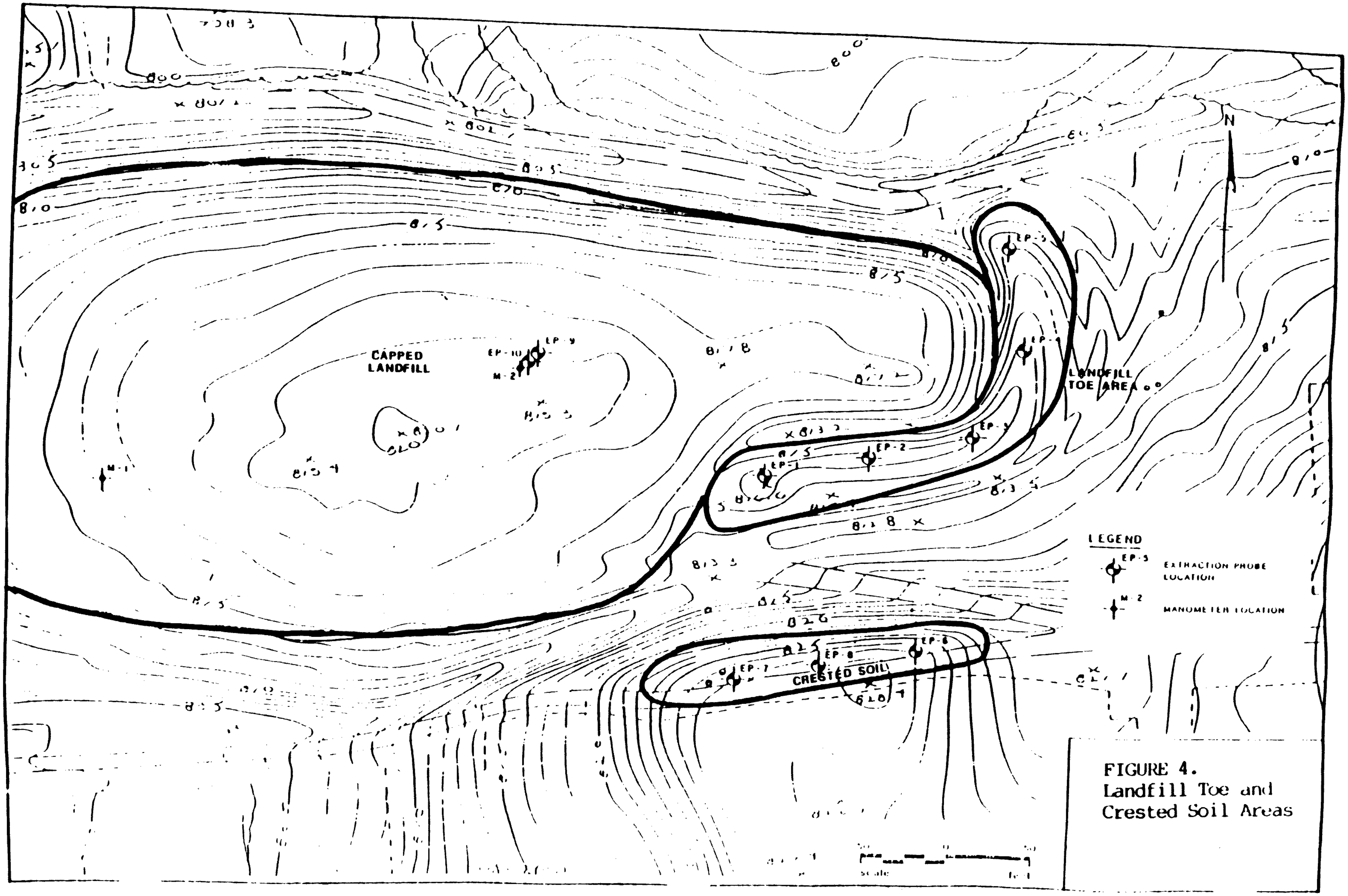



FIGURE 4.
Landfill Toe and
Crested Soil Areas

contamination levels dropped to nearly non-detectable levels at a depth of 30 ft. The magnitude and penetration of soil contamination was not as extensive in the other borings.

The volatile constituents identified by the selected laboratory analyses of the deep soils are very similar to those for the surficial soils. Tetrachloroethene was found in a number of deep samples at concentrations ranging up to 51.7 ppb. Scattered low level detections of ethyl benzene, toluene, and trichloroethene were also observed in these samples.

A second deep soil study was conducted above the plume extension in the area north of the landfill. The soils were not believed to be contaminated as a direct result of chemical leakage or spillage as are the soils on the landfill perimeter. Rather, the soil pores are believed to contain the contaminated groundwater of the plume extension.

Contamination in the soil samples correspond to the approximate location of the plume extension in the Water Table Zone and Intermediate Zone as determined by monitoring well sampling.

As with the surficial soils and the deep soils of the landfill perimeter, contamination of the deep soils in the area of the plume extension is highly localized and exists at relatively low concentrations. Compounds detected in the laboratory analyses of the soil samples, and their maximum respective concentrations, were: acetone (1.7 ppm), methyl ethyl ketone (0.3 ppm), vinyl chloride (0.3 ppm), 4-methyl-2-pentanol (2.6 ppm), 1-butanol (0.4 ppm), tetrahydrofuran (0.3 ppm), methyl isobutyl ketone (1.0 ppm), and methylene chloride (0.2 ppm).

<u>Other Environmental Media</u> Several of the other environmental media at or near the site have been sampled during the RI project and during previous investigations. These media include surface waters and sediments from the stream tributaries, seep areas, drainage swales, standing water in low-lying areas, and ambient air. The significant conclusions of the RI regarding these other media are summarized below:

- No indications of landfill-derived organic compounds have been observed in sediments of the two small streams in the vicinity of the site. There is some evidence of elevated metals in the sediments of the small stream located north of the landfill.

- Small volumes of surface water containing volatile organics have been identified in the seep areas immediately adjacent to the site. However, no observable flow emanates from these wet areas.

- The ambient air quality at and adjacent to the landfill is not being affected by the site. All photoionizer detector readings indicated non-detectable or background levels of volatile organic compounds.

## IV. SUMMARY OF SITE RISKS

A Baseline Public Health Evaluation and a Biological Evaluation were performed at the Lord Shope Landfill Site in accordance with guidelines established by EPA for performance of such evaluations at Superfund Sites. Indicator compounds were selected and associated risks were calculated for the different affected media and potential exposure routes at the Site. The results of these studies were reported in detail in the Remedial Investigation Report and are summarized here.

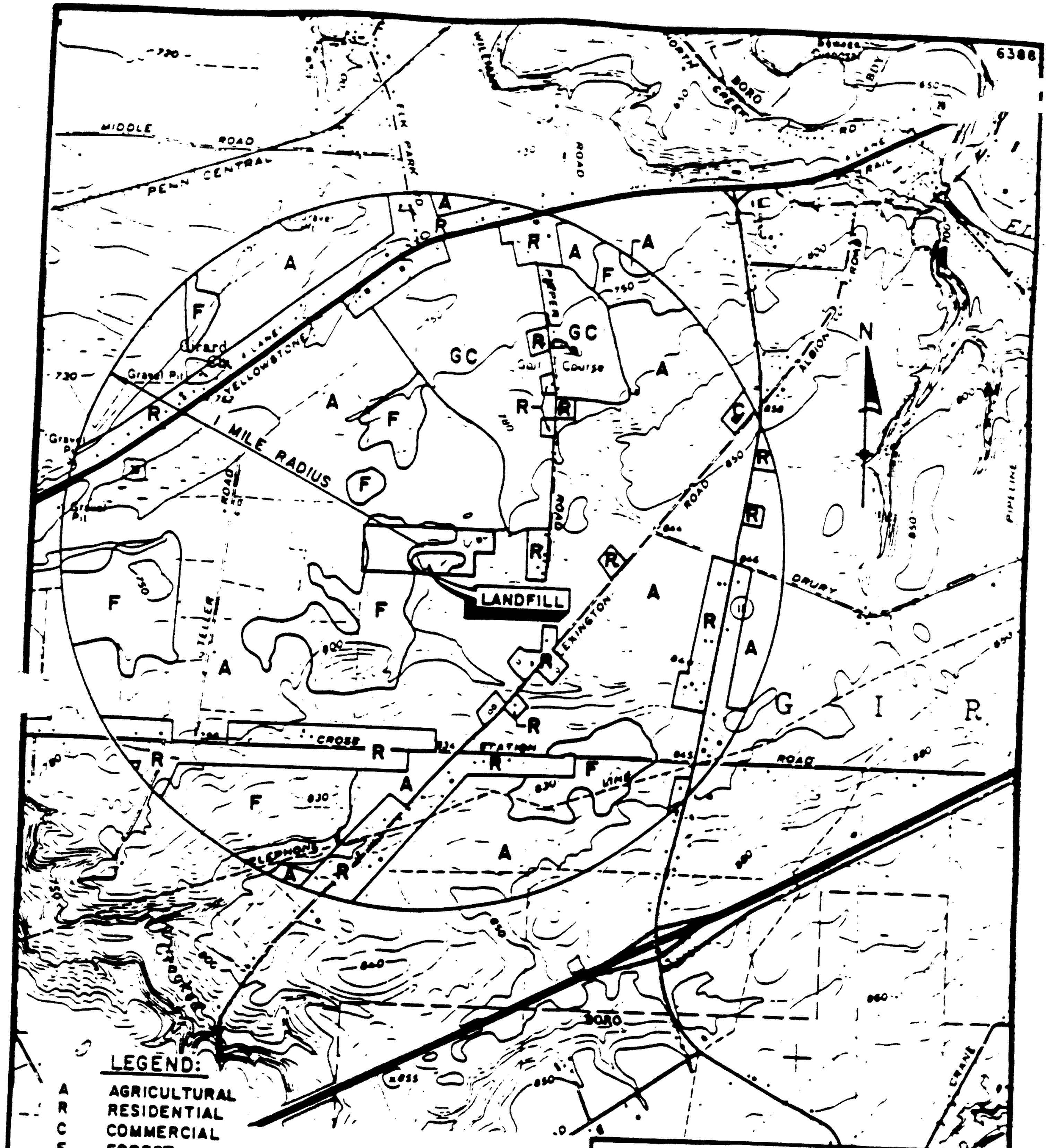
The following compounds were selected as indicator compounds for the characterization of risk because of their presence in the contaminated media at the Site and because of their potential chronic health affects:

| Carcinogenic Compounds | Noncarcinogenic Compounds |
|---|---|
| Arsenic | Acetone |
| Benzene | Barium |
| Lead | Cadmium |
| Tetrachloroethene | 1,2-trans-Dichloroethene |
| Tetrahydrofuran | Lead |
| Vinyl Chloride | Methyl ethyl ketone |
| | Methyl isobutyl ketone |
| | Tetrachloroethene |
| | Tetrahydrofuran |

Currently there is the possibility of human exposure through accidental ingestion of water from the seeps or accidental ingestion of contaminated soils or sediments at the Site.

Since the cap and vegetative cover were implemented in 1984, there has been no detection of volatile organic compounds in the breathing space. The highest detection of total volatile organics in the air was 2 parts per million at ground level near the northeast seep. Consequently, the air pathway of exposure is considered insignificant.

The greatest potential risk from Site-related contaminants is by the ingestion of contaminated groundwater. This exposure route is currently incomplete as there are no drinking water wells currently drawing water from the contamination plume. Under CERCLA, EPA must consider current and potential exposure scenarios in determining the risks from exposure to the sites. As is shown in Figures 5 and 6, although current land use in the




LEGEND:

- A AGRICULTURAL
- R RESIDENTIAL
- C COMMERCIAL
- F FOREST
- GC GOLF COURSE

SOURCE: ALBION (1959, REV. 1969) PA. 7.5' QUADRANGLE

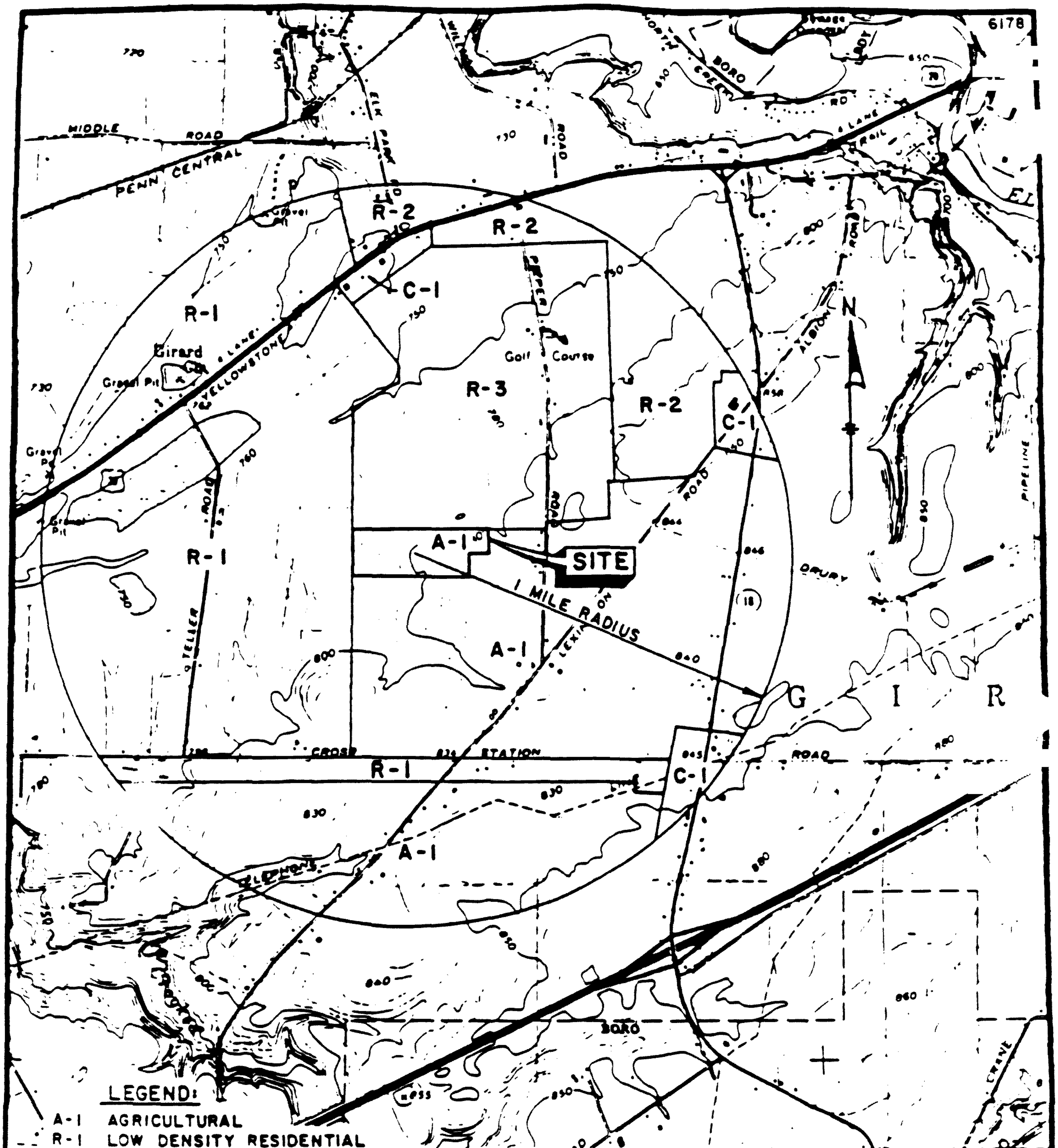
2000 0 2000
scale feet

MAP LOCATION

FIGURE 5.

**LAND USE MAP**

**SHOPE'S LANDFILL SITE**
**LORD CORP.**
**GIRARD TWP., PA.**




LEGEND:

- A-1 AGRICULTURAL
- R-1 LOW DENSITY RESIDENTIAL
- R-2 MEDIUM DENSITY RESIDENTIAL
- R-3 HIGH DENSITY RESIDENTIAL
- C-1 HIGHWAY / PLAZA COMMERCIAL

SOURCE: 1. ALBION (1959, REV. 1969) PA. 7.5' QUADRANGLE
2. GIRARD TOWNSHIP OFFICIAL ZONING MAP, (12/3/79)

2000 0 2000

scale feet

MAP LOCATION

FIGURE 6.

ZONING MAP

SHOPE'S LANDFILL SITE
LORD CORP.
GIRARD TWP., PA.

6418A

plume area north of the Site is golf course and forest, the area is zoned high density residential and thus is a potential area for residential development. In addition, a goal of the Superfund program is to restore groundwater to its most beneficial use whenever possible. Given the statutory and policy goals of the Superfund program, EPA is considering the risks from potential future use of the groundwater.

Tables 3 through 8 present the risks associated with ingestion of water from the northeast seep, ingestion of contaminated soil or stream sediments from the Site, and ingestion of groundwater.

The estimated carcinogenic risks for the groundwater, surface water (seeps), and soil ingestion routes are presented in Tables 3, 5, and 7. The carcinogenic risks reported are "excess lifetime cancer risks", determined by multiplying the estimated chronic daily intake level by the cancer potency factor. These risks are probabilities that are generally expressed using scientific notation (e.g. $1.0 \times 10^{-6}$ or 1.0E-6). An excess cancer risk of 1.0E-6 indicates that, as a plausible upper limit, an individual has an additional one in one million chance of developing cancer solely as a result of 70-year cumulative exposure to a substance under specific exposure conditions. The exposure conditions assumptions used for risk calculations at this Site are summarized in Table 2. The term "upper limit" reflects the conservative nature of the assumptions used in the calculation of the potency factor.

The potential for adverse health effects resulting from chronic exposure to noncarcinogenic compounds is estimated by comparing an average daily intake to an acceptable level such as a chronic reference dose (RfD). If the ratio exceeds one, there is a potential health risk associated with exposure to that particular compound. The ratios can be added together for exposures to multiple compounds. This sum, known as the Chronic Hazard Index, is not a mathematical prediction of the severity of the toxic effects; it is simply a numerical indicator of the transition from acceptable to unacceptable levels. The noncarcinogenic Chronic Hazard Index calculated for the Lord Shope Landfill Site are presented in Tables 4, 6, and 8. EPA considers that any Chronic Hazard Index exceeding one presents an unacceptable risk to human health.

<u>Ingestion of Groundwater</u>

As shown in Tables 3 and 4, the potential risk associated with the ingestion of groundwater is represented by an excess cancer risk of 1.0E-01 and a chronic Hazard Index of 2.8E+01. The potential risks from groundwater are calculated using the "upper bound" concentrations. For the investigations at this Site, upper bound is defined as the average concentration of the

TABLE 2

ASSUMPTIONS USED
TO ESTIMATE HUMAN INTAKE FACTORS
FOR THE EVALUATED EXPOSURE PATHWAYS

| Pathway | Average Daily Intake | Frequency of Intake (days/year) | Duration of Intake (years) | Average Body Weight (kg) | Human Intake Factor |
|---|---|---|---|---|---|
| Groundwater Ingestion | 2 l/day | 365 | 70 | 70 | 2.9E-02 l/kg/day |
| Surface water Ingestion | 1 l/day | 26 | 70 | 70 | 1.0E-03 l/kg/day |
| Sediment/soil Ingestion (Child) | 0.1 g/day | 90 | 10 | 20 | 1.8E-07 kg/kg/day |

The human intake factor for each pathway is calculated by:
Average Daily Intake x (Frequency/365 days) x (Duration/70 years) /Body Weight

TABLE 3

ESTIMATED RISKS FROM POTENTIAL CARCINOGENS
INGESTION OF GROUNDWATER, UPPER BOUND CONCENTRATIONS

| Indicator Chemical (carcinogen) | Concentration in Groundwater (mg/l) | Chronic Daily Intake (CDI) (mg/kg/day) | Potency Factor (PF) $(mg/kg/day)^{-1}$ | Estimated Risk |
|---|---|---|---|---|
| Arsenic | 0.043 | 1.2E-03 | 1.75E+00 | 2.1E-03 |
| Benzene | 0.012 | 3.5E-04 | 2.9E-02 | 1.0E-05 |
| Lead | 0.1 | 2.9E-03 | ND | ND |
| Tetrachloroethene | ND | ND | 5.1E-02 | ND |
| Tetrahydrofuran | 0.36 | 1.0E-02 | ND | ND |
| Vinyl Chloride | 1.5 | 4.4E-02 | 2.3E+00 | 1.0E-01 |
| Total Upper Bound Carcinogenic Risk | | | | 1.0E-01 |

The estimated carcinogenic risk is the sum of CDI x PF, where CDI = Chronic Daily Intake = (the Concentration x the Human Intake Factor) and PF = Potency Factor.

For the ingestion of groundwater, the Human Intake Factor = 0.029 l/kg/day.

Potency Factors obtained either from the EPA's Integrated Risk Information Service (IRIS) database (June 1989) or from the April 1989 Health Effects Assessment Summary Tables (HEAST).

NA = Not Applicable. ND = Not Detected, Not Determined or not currently available.

TABLE 4

ESTIMATED RISKS FROM NONCARCINOGENS
INGESTION OF GROUNDWATER, UPPER BOUND CONCENTRATIONS

| Indicator Chemical (noncarcinogen) | Concentration in Groundwater (mg/l) | Chronic Daily Intake (CDI) (mg/kg/day) | Reference Dose (RfD) (mg/kg/day) | Chronic Hazard Index HI = CDI/RfD |
|---|---|---|---|---|
| Acetone | 11 | 3.2E-01 | 1.0E-01 | 3.2E+00 |
| Barium | 5.8 | 1.7E-01 | 5.0E-02 | 3.4E+00 |
| Cadmium | 0.009 | 2.6E-04 | 5.0E-04 | 5.2E-01 |
| 1,2-trans-dichloroethene | 1.2 | 3.5E-02 | 2.0E-02 | 1.8E+00 |
| Lead | 0.1 | 2.9E-03 | ND | ND |
| Methyl Ethyl Ketone | 7.4 | 2.1E-01 | 5.0E-02 | 4.2E+00 |
| Methyl Isobutyl Ketone | 25 | 7.3E-01 | 5.0E-02 | 1.5E+01 |
| Tetrachloroethene | ND | ND | 1.0E-02 | ND |
| Tetrahydrofuran | 0.36 | 1.0E-02 | ND | ND |
| Total Upper Bound Chronic Hazard Index | | | | 2.8E+01 |

The estimated noncarcinogenic Chronic Hazard is the sum of CDI/RfD, where CDI = Chronic Daily Intake = (the Concentration x the Human Intake Factor) and RfD = Reference Dose (formerly termed the Acceptable Intake for Chronic Exposure).

For the ingestion of groundwater, the Human Intake Factor = 0.029 l/kg/day.

Reference Dose information obtained either from the EPA's Integrated Risk Information Service (IRIS) database (June 1989) or from the April 1989 Health Effects Assessment Summary Tables (HEAST).

NA = Not Applicable. ND = Not Detected, Not Determined or not currently available.

TABLE 5

ESTIMATED RISKS FROM POTENTIAL CARCINOGENS
INGESTION OF WATER FROM NORTHEAST SEEP

| Indicator Chemical (carcinogen) | Concentration in Seeps (mg/l) | Chronic Daily Intake (CDI) (mg/kg/day) | Potency Factor (PF) $(mg/kg/day)^{-1}$ | Estimated Risk |
|---|---|---|---|---|
| Arsenic | 0.02 | 2.0E-05 | 1.75E+00 | 3.5E-05 |
| Benzene | ND | ND | 2.9E-02 | ND |
| Lead | 0.05 | 5.0E-05 | ND | ND |
| Tetrachloroethene | ND | ND | 5.1E-02 | ND |
| Tetrahydrofuran | BMDL | ND | ND | ND |
| Vinyl Chloride | 0.056 | 5.6E-05 | 2.3E+00 | 1.34E-04 |
| Total Estimated Carcinogenic Risk | | | | 1.7E-04 |

The estimated carcinogenic risk is the sum of CDI x PF, where CDI = Chronic Daily Intake = (the Concentration x the Human Intake Factor) and PF = Potency Factor.

For the ingestion of surface water or seeps, the Human Intake Factor = 0.001 l/kg/day.

Potency Factors obtained either from the EPA's Integrated Risk Information Service (IRIS) database (June 1989) or from the April 1989 Health Effects Assessment Summary Tables (HEAST).

NA = Not Applicable. ND = Not Detected, Not Determined or not currently available. BMDL = Below Minimum Detection Limit; this indicates that the compound was present, but at a concentration below the limit for accurate or precise quantitation.

TABLE 6

ESTIMATED RISKS FROM NONCARCINOGENS
INGESTION OF WATER FROM NORTHEAST SEEP

| Indicator Chemical (noncarcinogen) | Concentration in Seeps (mg/l) | Chronic Daily Intake (CDI) (mg/kg/day) | Reference Dose (RfD) (mg/kg/day) | Chronic Hazard Index HI = CDI/RfD |
|---|---|---|---|---|
| Acetone | ND | ND | 1.0E-01 | ND |
| Barium | 0.29 | 2.9E-05 | 5.0E-02 | 5.8E-03 |
| Cadmium | ND | ND | 5.0E-04 | ND |
| 1,2-trans-dichloroethene | 0.13 | 1.3E-04 | 2.0E-02 | 6.5E-03 |
| Lead | 0.05 | 5.0E-05 | ND | ND |
| Methyl Ethyl Ketone | ND | ND | 5.0E-02 | ND |
| Methyl Isobutyl Ketone | ND | ND | 5.0E-02 | ND |
| Tetrachloroethene | ND | ND | 1.0E-02 | ND |
| Tetrahydrofuran | BMDL | ND | ND | ND |
| Total Estimated Chronic Hazard Index | | | | 1.2E-02 |

The estimated noncarcinogenic Chronic Hazard is the sum of CDI/RfD, where CDI = Chronic Daily Intake = (the Concentration x the Human Intake Factor) and RfD = Reference Dose (formerly termed the Acceptable Intake for Chronic Exposure).

For the ingestion of surface water or seeps, the Human Intake Factor = 0.001 l/kg/day.

Reference Dose information obtained either from the EPA's Integrated Risk Information Service (IRIS) database (June 1989) or from the April 1989 Health Effects Assessment Summary Tables (HEAST).

NA = Not Applicable. ND = Not Detected, Not Determined or not currently available.

TABLE 7

ESTIMATED RISKS FROM POTENTIAL CARCINOGENS
INGESTION OF SEDIMENTS OR SOILS (CHILD)

| Indicator Chemical (carcinogen) | Concentration in Sample (mg/1) | Chronic Daily Intake (CDI) (mg/kg/day) | Potency Factor (PF) $(mg/kg/day)^{-1}$ | Estimated Risk |
|---|---|---|---|---|
| Arsenic | 14 | 1.6E-08 | 1.75E+00 | 4.4E-06 |
| Benzene | 0.0064 | 1.2E-09 | 2.9E-02 | 3.5E-11 |
| Lead | 17 | 3.1E-06 | ND | ND |
| Tetrachloroethene | 0.18 | 3.2E-08 | 5.1E-02 | 1.6E-09 |
| Tetrahydrofuran | ND | ND | ND | ND |
| Vinyl Chloride | ND | ND | 2.3E+00 | ND |
| Total Estimated Carcinogenic Risk | | | | 4.4E-06 |

The estimated carcinogenic risk is the sum of CDI x PF, where CDI = Chronic Daily Intake = (the Concentration x the Human Intake Factor) and PF = Potency Factor.

For the ingestion of soil, the Human Intake Factor = 1.87 $x10^{-7}$ kg/kg/day.

Potency Factors obtained either from the EPA's Integrated Risk Information Service (IRIS) database (June 1989) or from the April 1989 Health Effects Assessment Summary Tables (HEAST).

NA = Not Applicable. ND = Not Detected, Not Determined or not currently available.

TABLE 8

ESTIMATED RISKS FROM NONCARCINOGENS
INGESTION OF SEDIMENTS OR SOILS (CHILD)

| Indicator Chemical (noncarcinogen) | Concentration in Sample (mg/l) | Chronic Daily Intake (CDI) (mg/kg/day) | Reference Dose (RfD) (mg/kg/day) | Chronic Hazard Index HI = CDI/RfD |
|---|---|---|---|---|
| Acetone | 0.09 | 1.6E-08 | 1.0E-01 | 1.6E-07 |
| Barium | 81 | 1.5E-05 | 5.0E-02 | 2.9E-04 |
| Cadmium | 1.6 | 2.9E-07 | 5.0E-04 | 5.8E-04 |
| 1,2-trans-dichloroethene | ND | ND | 2.0E-02 | ND |
| Lead | 17 | 3.1E-06 | ND | ND |
| Methyl Ethyl Ketone | ND | ND | 5.0E-02 | ND |
| Methyl Isobutyl Ketone | ND | ND | 5.0E-02 | ND |
| Tetrachloroethene | 0.18 | 3.2E-08 | 1.0E-02 | 3.2E-06 |
| Tetrahydrofuran | ND | ND | ND | ND |
| Total Estimated Chronic Hazard Index | | | | 8.7E-04 |

The estimated noncarcinogenic Chronic Hazard is the sum of CDI/RfD, where CDI = Chronic Daily Intake = (the Concentration x the Human Intake Factor) and RfD = Reference Dose (formerly termed the Acceptable Intake for Chronic Exposure).

For the ingestion of soil, the Human Intake Factor = $1.87 \times 10^{-7}$ kg/kg/day.

Reference Dose information obtained either from the EPA's Integrated Risk Information Service (IRIS) database (June 1989) or from the April 1989 Health Effects Assessment Summary Tables (HEAST).

NA = Not Applicable. ND = Not Detected, Not Determined or not currently available.

well having the highest concentrations for each of the indicator compounds. Typically these are the wells located closest to the landfill perimeter which exhibit a higher degree of contamination than those located further downgradient in the plume. The exposure assumptions used in calculating the risks from groundwater ingestion represent the daily consumption of two liters of water over a seventy year lifetime.

The cancer risk is driven by the presence of vinyl chloride while the noncarcinogenic risk is dominated by the presence of methyl isobutyl ketone and methyl ethyl ketone. As shown in the tables, other compounds are also in the unacceptable risk range.

This pathway is currently incomplete as there are no drinking water wells drawing from the contaminated groundwater plume and, therefore, no one currently drinking this water. At present, however, the plume is located under land that has the potential for residential development and if left untreated, the plume migration could impact the wells of the residences on U.S. Route 20 to the north.

Ingestion of Water from Seeps

As shown in Tables 5 and 6, the risks presented by ingestion of the water contained in the seeps are represented by an excess cancer risk of 1.7E-04 and a noncarcinogenic chronic Hazard Index of 1.2E-02. These numbers are based largely on the presence of the carcinogens arsenic and vinyl chloride and the noncarcinogens barium and 1,2-trans-dichloroethene in the northeast seep. These numbers are estimated using the conservative assumptions of consumption of a liter of water twenty-six times a year over a seventy year lifetime. Although the numbers indicate an unacceptable cancer risk for these exposure conditions, it is highly unlikely that accidental ingestion of seep water would proceed at that rate.

Ingestion of Soils or Sediments

The risks involved with the ingestion of contaminated Site soils or sediments are represented by an excess cancer risk of 4.4E-06 and a noncarcinogenic chronic Hazard Index of 8.7E-04 as presented in Tables 7 and 8. The concentrations used in the calculation of these values are a combination of the concentrations found in both the on-Site soils and the downstream sediments of the Elk Creek Tributary and the Unnamed tributary.

The assumptions used in the risk calculations for soil or sediment represent a childs accidental ingestion of 0.1 gram per day of soil ninety times a year over a ten year span. Even using these conservative assumptions the risk estimates fall within the acceptable ranges.

Exposure by Air: Inhalation of Volatiles Evaporating from Seeps

During the RI an air survey of the site using a photoionization detector found no measurable concentrations of volatile organics in the breathing zone at any location. Concentrations as high as 2 ppm were found near ground level primarily at the northeast seep. Analyses of water samples from the northeast and other seeps show total concentrations of volatile organics (TVO) as high as 700 ppb with an average of about 30 ppb. Analyses for individual compounds show vinyl chloride, 1-2-trans-dichloroethene, and trichloroethene at levels from 33 to 130 ppb. Volatilization of the organic compounds in the seep waters is the apparent source of the organics in the air.

The seeps are unlikely to cause significant risks to human health given the inaccessibility of the seeps and the consequent low probability of chronic exposure. The only area chronic exposure to volatile organics from the seeps could occur is at the nearby residences, about 1,000 ft away from the northeast seep. In order to estimate the potential risks in this area, the rate of volatilization of organic compounds from the northeast seep and the concentration in air downwind from the northeast seep have been estimated.

The rate at which volatile organic compounds evaporate from the seep can be estimated by:

$$Q = K A C$$

where:

Q = the flux from the liquid surface, g/s

K = the overall mass transfer coefficient, m/s

A = the area of the seep, $m^2$

C = the concentration in the seep, $g/m^3$

For very volatile organics, such as benzene and vinyl chloride, and moderate wind speeds, the overall mass transfer coefficient, K, is about $4 \times 10^{-6}$ m/s. This corresponds to a half-life of around 7 hours for a very shallow seep. In other words, half the volatile organics would evaporate in the first seven hours. Since water in the seeps is probably replaced more slowly than this, it is unlikely that a higher mass transfer rate could be sustained. The area of the northeast seep (the only seep on site which is permanently wet) was liberally estimated to be about 350 square meters. The high TVO reading of 700 ppb was used as the concentration in the water. With these values, the maximum rate of volatilization from the northeast seep was estimated as 0.001 g/s.

The concentration in air downwind from the seep can be estimated using a simple Gaussian plume model. At a point on the ground directly downwind from a ground level source, the concentration of contaminant in the air is given by:

$$C = \frac{Q}{\pi \sigma_y \sigma_z U}$$

where:

- $C$ = the concentration, $g/m^3$
- $Q$ = the emission rate from the seep, g/s
- $\sigma_y$ = the lateral dispersion, m
- $\sigma_z$ = the vertical dispersion, m
- $U$ = the wind speed, m/s

The model assumes a steady source, and is only valid for distances at least 100 m from the source. The dispersion coefficients depend on the distance from the source. For a 300 m distance, $o_y$ and $o_z$ can be estimated to be 27 m and 12 m, respectively. For an emission rate if 0.001 g/s and a wind speed of 3.5 m/s, the resulting concentration 300 m from the seep is $2.8 \times 10^{-7}$ $g/m^3$ or 0.3 $ug/m^3$. This analysis is expected to be conservative since it used a very high concentration of 700 ppb for volatile organics in the seeps.

Making the very conservative assumption that all the emission is vinyl chloride, the risk from inhalation can be estimated using the methodology in SPHEM (EPA, 1986) by multiplying the air concentration by the average daily intake of air (20 $m^3$/day), dividing by the average weight of an adult (70 kg) and multiplying by the potency factor for inhalation of vinyl chloride (0.025 $(mg/kg/ day)^{-1}$. The resulting potential cancer risk estimate is $2.0 \times 10^{-6}$, which is within the acceptable range.

Environmental Impact of the Lord-Scope Landfill

Two Biological Investigations were conducted at the Lord-Shope Landfill and surrounding area during the course of the Remedial Investigation to evaluate the environmental impact caused by the Site. The full results of these investigations are included as a separate volume in the Remedial Investigation Report.

Sampling was conducted near the Site and in the area of the two tributaries of Elk Creek to assess any impacts of the landfill on the benthic fauna. The sampling was conducted at the eight stations shown in Figure 1. Stations BM2 and BM7 were not sampled in the most recent investigation, conducted in 1989. The tributaries are believed to receive groundwater and surface water discharge from the areas connected with the Site.

The investigations conducted at the observation stations included classification of streambed substrates, measurement of community structure including the calculation of a number of diversity indices, and the calculation of the Hilsenhoff Biotic Index as a measure of water quality, as well as a statistical comparison of the stations to determine the existence of local effects. A wetlands evaluation was also conducted.

Results of these studies of the aquatic biota indicate that, overall, the water quality is fair to excellent with a good number of species and numbers of individual organisms. According to the Hilsenhoff Index (1987) the following water quality conditions were found during the most recent investigation:

| Station | Location | Water Quality Condition | Comments |
|---|---|---|---|
| BM1 | Downstream of Landfill | Good | Stream bottom stable |
| BM3 | Control | Very Good | Stream bottom stable |
| BM3A | Control | Good | Stream bottom stable |
| BM4 | Above Potential Influence of landfill | Fairly Poor | Stream affected by agricultural runoff |
| BM5 | 0.4 miles upstream of Highway 20 | Fair | Stream bank physically denuded |
| BM6 | At Highway 20 | Fairly Poor | Station impacted by local activities unrelated to landfill |

In the process of collecting benthic samples numerous fathead minnows were observed and released. This was the only fish species observed with the exception of two small bluegills noted at station BM6.

There are no presently recognized wetlands in the vicinity of the unnamed tributary to the north of the landfill. There are some areas upstream of the Elk Creek tributary, to the south of the Site, that include some hardwood swamp environment. These areas are not on the National Wetlands Inventory and are upstream and considered to be outside the influence of the Site or planned Site activities.

There are no special or endangered species at the Site or in the area of the Elk Creek drainage basin. There is no evidence of impacts to biota in either tributary from activities at the landfill.

Actual or threatened releases of hazardous substances from this Site, if not, addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to the public health, welfare, or the environment.

## V. SCOPE OF THIS REMEDIAL ACTION

The remedial response action that is detailed in this Record of Decision is a final action that addresses both the source of contamination and the migrating plume of contaminated groundwater. This is described in Section X, Selected Remedial Alternative.

## VI. COMMUNITY RELATIONS SUMMARY

In accordance with Sections 113 and 117 of CERCLA, 42 U.S.C. Sections 9613 and 9617, EPA, in conjunction with the Pennsylvania Department of Environmental Resources, issued a proposed plan to present the preferred remedial alternative. The proposed plan and the RI/FS reports were made available to the public in the copies of the administrative record maintained at the EPA Region III offices and at the information repositories listed below:

Girard Township Municipal Building
10140 West Ridge Road, U.S. Route 20
Girard, Pennsylvania 16417

The Willcox Library
8 Main Street West
Girard, Pennsylvania 16417

EPA then instituted a public comment period from March 26, 1990 to April 25, 1990 for the purpose of soliciting public participation in the decision process. As part of the public comment period, a public meeting was held to present information and to accept oral and written comments and to answer questions regarding the Site and the remedial alternatives. A transcript of the meeting was maintained in accordance with Section 117(a)(2) of CERCLA, 42 U.S.C. Section 9617(a)(2). Responses to the oral and written comments received during the public comment period are included in the attached Responsiveness Summary.

An announcement of the public meeting, the comment period, and the availability of the Remedial Investigation and Feasibility reports was published in the Erie Times March 23, 1990.

All documents supporting the remedy selection decisions contained in this Record of Decision are included in the Administrative Record for this Site and can be reviewed at the information repositories.

## VII. DOCUMENTATION OF SIGNIFICANT CHANGES FROM PROPOSED PLAN

The Proposed Plan for the Lord-Shope Landfill Site was released for comment in March 1990. The Proposed Plan described the alternatives studied in detail in the Feasibility Study and identified Alternative 3 as the Preferred Alternative. EPA reviewed all written and verbal comments submitted during the comment period and at the public meeting. Upon review of these comments, it was determined that no significant changes to the remedy, as presented in the Proposed Plan, were necessary.

The institutional controls described in Alternative 2, and consequently included in Alternative 3, were not originally presented as part of the proposed plan but are included in this Record of Decision as a logical and expected extension of the proposed alternative as discussed in the proposed plan and at the public meeting.

## VIII. DESCRIPTION OF ALTERNATIVES

The remedial objectives of the Feasibility Study performed at this Site were to identify alternatives to address contaminant source control and contaminated groundwater remediation. Contaminant source control is expected to reduce the rate of release of contaminants into the water-bearing zones, and contaminated groundwater remediation will minimize potential exposure of groundwater contaminants to the public and the environment and make future well water supplies available.

The Superfund Law requires that each alternative proposed to address contamination at a hazardous waste site be protective of human health and the environment, cost effective, and in accordance with statutory requirements.

Permanent solutions to contamination are to be achieved whenever possible. In addition, emphasis is placed on treating wastes on-site, wherever possible; to reduce the toxicity, mobility, or volume of Site related contaminants, and on applying alternative or innovative treatment technologies.

Technologies to implement these objectives which would meet the requirements of public health and environmental standards, and other applicable or relevant and appropriate requirements were evaluated. These technologies were also evaluated against operational, institutional, cost and other factors affecting implemntation. The technologies evaluated in the Feasibility Study were combined into remedial alternatives to address the Site.

The alternatives evaluated in the FS Report are summarized below. The costs reported for implementing each alternative represent both the preliminary estimates of initial capital outlay and the estimates of continuing operation and maintenance. Costs are reported as present worth figures calculated with a discount rate of 10%. Costs of the alternatives are compared in Table 9.

Alternative 1: No Action

This alternative is included in the FS Report for comparison with the other alternatives under investigation. It would only be selected if the Site posed little or no risk to the public health or the environment. Under this alternative, no additional measures would be undertaken to remedy contaminant sources or their migration pathways, and risks from the Site would remain and potentially increase with time. Because hazardous materials would remain on the Site, five year effectiveness reviews would be conducted.

Except for the costs involved with the five year review, no capital or operation and maintenance (O&M) costs would be incurred for this alternative, and no time expended beyond the costs and time presently expended to maintain the existing landfill cap and groundwater monitoring.

Alternative 2: Source Control and Migration Control by Groundwater Extraction and Treatment

This alternative involves the extraction and treatment of groundwater in the areas directly adjacent to the perimeter of the landfill and to the north of the landfill. The extraction and treatment would be implemented to halt the addition of new contamination to the groundwater plume and to remove the contaminants currently contained in the migrating plume. The

## TABLE 9.

COST ANALYSIS SUMMARY

| Costs 1989 Dollars | Alternative 1 No Action | Alternative 2 Source Control and Migration Control by Groundwater Extraction, Groundwater Treatment, and Discharge to Surface Water | Alternative 3 Source Control by In Situ Vapor Stripping; Source and Migration Control by Groundwater Extraction, Groundwater Treatment, and Discharge to Surface Water | Alternative 4A Source Control by Excavation, On Site Incineration; Source and Migration Control by Groundwater Extraction, Groundwater Treatment, and Discharge to Surface Water | Alternative 4B Source Control by Excavation, Off Site Incineration; Source and Migration Control by Groundwater Extraction, Groundwater Treatment, and Discharge to Surface Water |
|---|---|---|---|---|---|
| Capital | -- | 1,940,000 | 2,500,000 | 24,160,000[a] | 180,000,000[b] |
| O&M | | | | | |
| Year 1 | 0 | 310,000 | 420,000 | 5,760,000 | 465,000 |
| Year 2 | 0 | 310,000 | 420,000 | 5,760,000 | 465,000 |
| Year 3 | 0 | 310,000 | 310,000 | 5,760,000 | 465,000 |
| Year 4 | 0 | 310,000 | 310,000 | 5,760,000 | 310,000 |
| Year 5 | 0 | 310,000 | 310,000 | 5,760,000 | 310,000 |
| Year 6 | 0 | 310,000 | 310,000 | 5,760,000 | 310,000 |
| Year 7 - 50 | 0 | 310,000 | 310,000 | 310,000 | 310,000 |
| Present Worth | 0 | 5,010,000 | 5,760,000 | 50,970,000 | 183,460,000 |

[a] Major cost items; excavation, construction and operation of on site incinerator, completed within 6 yr.

[b] Major cost items; excavation, transportation and off site incineration, completed within 2½ yr.

extracted groundwater would be pumped to an on-site groundwater treatment system. At a minimum, this system would provide pretreatment for the removal of iron and other metals, which is necessary for the effective operation of the treatment system and for achieving discharge standards, and air stripping for the removal of volatile organic compounds. In the detailed design of the groundwater treatment system other components may be added, as necessary, to achieve the discharge standards. The treated groundwater would be discharged to the unnamed tributary of Elk Creek, subject to National Pollution Discharge Elimination System (NPDES) permit regulations.

With the exception of air and water vapor, the emissions of the stack gas will consist of volatile organic compounds. These emissions will meet permit regulations for atmospheric emissions in accordance with the Pennsylvania Air Pollution Control Act, 25 Pa. Code Section 127.1 requiring that emissions be the minimum attainable through the use of best available technology.

Cleanup goals for the groundwater were developed using existing or proposed Maximum Contaminant Levels (MCLs). Where no MCL was available or where the other factors set forth in Section 300.430(e)(2)(i) of the NCP so require, health-based risk levels were used in setting the cleanup goals for the groundwater at this Site. As a result of this analysis, the cleanup goals, shown in Table 10, were set to levels representing $10^{-4}$ excess cancer risks or hazard indices not exceeding 1.0 for each contaminant determined to be present in groundwater in concentrations above the appropriate MCL or health-based risk level. Further, as part of this Alternative, background concentrations of each contaminant will be determined through groundwater monitoring. To the extent that the concentration of any contaminant exceeds the background concentration, the cleanup level will be modified to or set at the background concentration unless attainment of background is determined to be infeasible or is otherwise waived under Section 121(d)(4) of CERCLA, 42 U.S.C. Section 9621(d)(4).

A further component of this alternative is the implementation of institutional controls to restrict the permitting and construction of groundwater wells in the area of the contaminated groundwater plume. This would prevent ingestion by humans and interference with the efficiency of the groundwater extraction system. These institutional controls would remain in effect until all groundwater cleanup levels are achieved in the current plume area and back to the perimeter of the landfill ("area of attainment").

This alternative also includes the installation of a security fence around the property to prevent human contact with the seeps and contaminated soils and to protect the treatment system and equipment.

TABLE 10

GROUNDWATER CLEANUP LEVEL GOALS
FOR THE LORD-SHOPE LANDFILL SITE

| Parameter | Concentration (ug/l) | Cleanup Level Basis |
|---|---|---|
| Acetone | 3,500 | Risk Based Calculation[a] |
| Arsenic | 2 | Risk Based Calculation[b] |
| Barium | 1,000 | MCL |
| Benzene | 5 | MCL |
| 1,2-trans-dichloroethene | 100 | Proposed MCL[c] |
| Lead | 15 | Risk Based Calculation[d] |
| Methyl Ethyl Ketone | 1,750 | Risk Based Calculation[a] |
| Methyl Isobutyl Ketone | 1,750 | Risk Based Calculation[a] |
| Tetrachloroethene | 5 | Proposed MCL[b] |
| Trichloroethene | 5 | MCL |
| Vinyl Chloride | 2 | MCL[e] |

[a]The risk based calculations performed for the indicated noncarcinogenic compounds are calculated by comparing chronic human intake to Reference Dose information obtained either from the EPA's Integrated Risk Information Service (IRIS) database (June 1989) or from the April 1989 Health Effects Assessment Summary Tables (HEAST). The ratio of these values is not to exceed 1.0.

[b]The risk based calculation performed for arsenic is predicated on an excess cancer risk of $10^{-4}$.

[c]proposed in Federal Register, May 22, 1989.

[d]The risk based level for lead is based on studies that indicate drinking water levels of 15 ppb and lower correlate to blood lead levels below the concern level of 10 ug/dl.

[e]Risk based calculations performed on the MCL for vinyl chloride show an excess cancer risk of $1.4 \times 10^{-4}$. This limit is based on the limit of detection for this compound and is considered to be protective.

During the RI a three dimensional groundwater flow model was used to describe and predict the characteristics of the ground water system at the Site. Results of this effort indicate that the plume migration would be halted within two months of implementation of this alternative. The estimated time period required for the remediation of the established groundwater plume to the determined cleanup levels is approximately fifty years. Potentially, continued leaching of contaminants from the landfill materials would indefinitely extend the time required for extraction and treatment of groundwater at the perimeter of the landfill. The estimated cost of this alternative is 5 million dollars.

Alternative 3: Source Control by In Situ Vapor Stripping with Groundwater Extraction and Treatment

This alternative includes the remedial activities described in Alternative 2 (groundwater extraction and treatment, security fencing, and institutional controls) plus additional source control by in situ vapor stripping of the landfill and surrounding soils (i.e., the soils contained in the landfill toe area and the crested soil area shown in Figure 4).

In accordance with SARA's preference for remedies that address the source of contamination and that utilize treatment to reduce the toxicity, mobility, or volume of hazardous substances, the in situ vapor stripping component of this alternative will remove and treat volatile and semi-volatile organics from the vadose zones of the landfill and surrounding contaminated soils. Additionally, in situ vapor stripping is expected to reduce the duration of the groundwater extraction and treatment needed to attain the cleanup levels.

In situ vapor stripping is a process in which air is introduced through vent pipes, passes through the media and is withdrawn through vapor extraction wells. As the air passes through the media, the volatile organics absorbed onto the soil or other materials are partitioned into the air stream ("off gas") and removed as the air is extracted. This air stream is then collected and treated for contaminant removal by carbon filtration or other appropriate process to be determined in the detailed design.

The total emissions from the air stripper of the groundwater treatment system described in Alternative 2 and the off gas from the in situ vapor stripping process will be treated to conform to the substantive requirements of the Pennsylvania Air Pollution Control Act as set forth in 25 Pa. Code Section 127.1.

The cleanup criteria for soils in the landfill toe area and the crested soil area will be determined during design by considering the characteristics of the soils and associated contaminants and then deriving specific levels of contaminants in the soils that would not be expected to exert a significant impact on the underlying groundwater. If that evaluation indicates that the source has not been sufficiently reduced, then further remedial action will be implemented at the Site.

Due to the heterogeneous nature of the landfill materials it is impossible to generate a single set of characteristic values that would be representative over the areal extent of the landfill. Further, efforts to collect samples of the landfill material for the generation of values to characterize subsections of the landfill could not be substantiated as being representative over a significant area. Therefore, the traditional methods for determining the completeness of the treatment and the effective end point are not applicable. Meaningful target goals for final contaminant concentrations in the landfill materials would be both difficult to establish and subsequently verify. Additionally, the sample cores necessary for intermediate and final analyses represent numerous additional events where the integrity of the existing landfill cap would be breached. Consequently, the end point for the in situ vapor stripping phase of this alternative will be determined based on performance criteria for this technology.

Indicator compounds for evaluation will be chosen according to their presence and prevalence in the initial off gas, toxicity, and physical characteristics which would affect stripping rates. It is estimated that five volatile organic indicators would be selected, along with carbon dioxide as an indicator of the breakdown of any heavier, nonvolatile organics due to biodegradation enhanced by increased air flow.

The system would operate until nondetect levels or no significant removal levels of the determined indicator compounds have been demonstrated for three consecutive months and subsequent spike values reveal nondetect or no significant removal levels.

"Spike" values refer to the initial concentrations displayed in off gas when the system is either started up initially or when the system is "pulsed" (restarted after being shut off for a period to allow the system to reequilibrate).

The "no significant removal" levels will be determined based on evaluation of concentrations of constituents in the off gas and statistical analysis of mass of constituents extracted per unit time, rate of decline of mass extraction, and spike concentrations.

At the completion of the in situ vapor stripping phase, the effectiveness of the treatment will be evaluated with respect to the levels of contaminants remaining in the landfill materials and surrounding soils and the continued impact of these media to the groundwater.

To be considered in the implementation of an in situ vapor stripping system at the Lord-Shope Landfill are the existing cap and high natural water table. These physical characteristics will effectively act as boundaries to airflow and can be used, with strategic placement of air vents and extraction wells, to increase the overall efficiency of the system. The estimated total cost of this alternative is 6 million dollars with estimated time requirements of two years for completion of the in situ vapor stripping phase and 50 years the groundwater treatment.

Alternative 4A: Source Control by Excavation and On-Site Incineration of Landfill Materials with Groundwater Extraction and Treatment

This alternative includes the remedial activities described in Alternative 2 (groundwater extraction and treatment and security fencing) plus additional source control by excavation of the landfill materials and surrounding contaminated soils for subsequent incineration in a facility that would be constructed on the Site.

Excavation of the landfill would involve removal of the engineered cap as excavation proceeded. On the north, west, and east sides of the landfill, the excavation would be extended beyond the delineated fill area an additional 10 ft horizontally and 10 ft vertically to ensure that the areas of the highest organic chemical concentrations are removed. The southern side of the landfill, which is protected by an upgradient cutoff wall, would be excavated to the cutoff wall only and not beyond.

For the on-site incineration option, approximately 144 tons per day of soil will be excavated. Approximately 270,000 tons of excavated materials will require incineration. This material will be loaded into the incinerator facility each operating day. Because of the depth to the water table, excavation dewatering will be required for the excavation of approximately 10 ft of soils beneath the landfill. The collected groundwater would require treatment prior to disposal. Runon/runoff controls would have to be installed to ensure that surface water would not be contaminated by stormwater runoff from the landfill during excavation. A stormwater collection system would need to be installed for this source control option. Since the excavation is into a landfill which held chemical wastes, the excavation contractor crew and others would be required to work safety gear, approved for the site conditions.

Typical equipment for the landfill excavation operation would include the use of a single, track-mounted, 3 cubic yard front-end loader and a 15 cubic yard, triaxle dump truck or equivalent equipment. The loader would load the dump truck approximately ten trips a day from the excavation area to the incinerator building. Site excavation for this remedial alternative would take approximately 5.5 years.

On-site Incineration involves the use of a service company which would provide and operate a complete soil incineration system on a contract basis. The incineration system would be transported to the site and erected near the landfill. The service company would provide the incineration equipment, civil construction work, operating staff, environmental permitting assistance, and the environmental monitoring and reporting required by regulatory agencies.

This alternative considers the operation of a 6 ton per hour rotary kiln unit which would burn soil 24 hours per day, 48 weeks per year on a 7 day per week basis. This is the largest mobile rotary kiln incinerator which is available. In this fashion, approximately 48,400 tons per year of contaminated soil can be incinerated. At this rate, approximately 5.6 years will be required to incinerate all of the contaminated material planned for excavation.

It is anticipated that the ash will comprise 40 percent of the total volume to be excavated and will result in disposal requirements for approximately 108,000 tons of kiln residue. There are three hazardous waste landfills within 115 miles of the Lord-Shope landfill which are suitable for disposal of solidified kiln ash.

As described above the excavation and incineration phase of this alternative would take an estimated 5.6 years, with 50 years for the groundwater treatment. The total estimated cost of this alternative is 51 million dollars.

Alternative 4B: Source Control by Excavation and Off-site Incineration of Landfill Materials and Contaminated Soils with Groundwater Extraction and Treatment

The source control by excavation, and source and migration control by groundwater extraction, groundwater treatment, and discharge to surface water elements are identical to those discussed in earlier sections. The difference in this alternative is that after excavation of the fill area and soil, the excavated materials would be transported off site for incineration at a commercial hazardous waste incineration facility.

Commercial incineration capacity for contaminated waste soils is currently limited in this country. There are only three operating hazardous waste incinerators within a 500 mile radius of the Shope site which can incinerate contaminated solid materials.

The three facilities do not currently have sufficient capacities to individually handle the volume of waste from the Lord-Shope Landfill, therefore the excavated materials would have to be distributed among different facilities according to availability. For off-site incineration, excavation would generate approximately 400 cu yd/day. Approximately 18 to 20 covered dump trailers (22 cu yd capacity) would be loaded for shipment each working day. The Site would require a dump truck loading and decontamination station and the implementation of storm water runon/runoff controls for prevention of surface water contamination.

The excavation and shipment phase of this alternative would take approximately 2.4 years, with 50 years for groundwater treatment. The total estimated cost for this alternative is 183 million dollars.

## IX. COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the five remedial alternatives has been evaluated with respect to the nine evaluation criteria in the NCP, 40 C.F.R. Part 300.430(e)(9). These nine criteria can be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria.

### Threshold Criteria

1. Overall Protection of Human Health and the Environment
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

### Primary Balancing Criteria

3. Reduction of Toxicity, Mobility, or Volume through Treatment
4. Implementability
5. Short-term Effectiveness
6. Long-term Effectiveness
7. Cost

### Modifying Criteria

8. Community Acceptance
9. State Acceptance

These evaluation criteria relate directly to requirements in Section 121 of CERCLA, 42 U.S.C. Section 9621, which measure the overall feasibility and acceptability of the alternatives. Threshold criteria must be satisfied in order for an alternative to be eligible for selection. Primary balancing criteria are used to evaluate the performance of each of the alternatives relative to the others. State and community acceptance are the modifying criteria formally taken into account after public comment is received on the Proposed Plan. The evaluations are as follows:

1. Overall Protection of Human Health and the Environment

A primary requirement of CERCLA is that the selected remedial alternative be protective of human health and the environment. A remedy is protective if it reduces current and potential risks to acceptable levels under the established risk range posed by each exposure pathway at the Site.

Alternative 1 does not reduce risk to human health from future use of groundwater or from direct contact with or ingestion of contaminated soils.

All of the other considered alternatives provide overall protection of human health and the environment through institutional controls on use of currently contaminated groundwater and through groundwater extraction and treatment for the long term reduction in groundwater contamination. The small risk posed by direct contact/ingestion will effectively be eliminated by the construction and maintenance of fencing included in these alternatives.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

This section presents a summary of the five alternatives' compliance with ARARs. Under Section 121(d) of CERCLA, 42 U.S.C. Section 9621(d), and EPA guidance, remedial actions at CERCLA sites must attain legally applicable or relevant and appropriate federal and promulgated state environmental standards, requirements, criteria, and limitations (which are collectively referred to as "ARARs"), unless such ARARs may be waived under CERCLA Section 121(d)(4), 42 U.S.C Section 9621(d)(4). Applicable requirements are those substantive environmental standards, requirements, criteria, or limitations promulgated under federal or state law that are legally applicable to the remedial action to be implemented at the Site. Relevant and appropriate requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law which, while not being directly applicable to the remedial action, do address problems or situations sufficiently similar to those encountered at the Site such that their use is well suited to the Site. ARARs may relate to the substances addressed by the remedial action (chemical-specific), to the location of the Site (location-specific), or to the manner in which the remedial action is implemented (action-specific).

Alternative 1 allows a 1 in 10 cancer risk for potential future ingestion of groundwater, and fails to meet most of the chemical-specific ARARs (as set forth in Section XI of this ROD) for this Site. All of the other alternatives are designed to meet chemical-specific ARARs to the extent feasible. There are no location-specific ARARs for this site. Alternatives 2 through 4B achieve compliance with a number of action-specific ARARs including RCRA land disposal and treatment, storage and disposal requirements, NPDES requirements, and air emissions ARARs. Alternative 4A would have RCRA incineration construction and operation requirements as an additional ARAR.

3. Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence addresses the long-term protection of human health and the environment once the remedial action goals have been achieved. This comparison focuses on the residual risk that will remain after completion of the remedial action and the adequacy and reliability of controls used to manage the untreated waste and treatment residuals.

There is virtually no residual risk associated with direct contact with soil or soil ingestion for any of the alternatives as long as the landfill cap is maintained and in the case of Alternatives 2, 3, and 4A and B, the site remains fenced. Fencing the site will eliminate potential exposure to contaminated soils in the seep areas, the landfill toe area, the crested soil area at the southeast corner of the landfill and other small areas of contaminated surficial soils.

In terms of groundwater ingestion for future users, Alternative 1 does not alleviate the potential long-term cancer risk for users downgradient of the landfill. For Alternatives 2 through 4B, any potential residual risk is eliminated using source control, plume extraction and groundwater treatment technologies. Alternatives 3, 4A, and 4B provide reduction in the source of contamination and consequently reduction in the risk of continuing release to the groundwater.

Due to the existing landfill cap, cut-off wall, and vegetative soil cover, the adequacy and reliability of all the described alternatives is sufficient to minimize leachate generation and prevent direct exposure to soils. Alternative 1 does not address the existing groundwater contamination and therefore does not have adequate controls to reduce the potential for exposure. The adequacy and reliability of controls for groundwater recovery and treatment for Alternatives 2 through 4B are the same and are adequate and reliable. Additionally, early monitoring wells which are part of the groundwater extraction and treatment system of Alternatives 2 through 4B provide backup performance monitoring by showing any continued migration of the plume. The Alternative 3 source control technology, vapor stripping, is a relatively new technology, but one which has been demonstrated as being effective in removing VOCs from soils. Field scale tests will be conducted to verify the effectiveness of vapor stripping on the landfill materials. The controls and monitoring technology for in situ vapor stripping are well established and reliable.

Alternatives 4A and 4B both feature excavation of the landfill and incineration of excavated materials as source control measures. While removal of the landfill and contaminated materials and treatment by incineration does provide a good long-term solution for site remediation, the short-term implications of excavation into the landfill and the transportation of contaminated materials off site for disposal are significant as described below. For all of the five remedial action alternatives, a 5 year review is needed to assure long-term effectiveness and permanence, and the protection of human health.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criteria addresses the degree to which a technology or remedial alternative reduces toxicity, mobility, or volume of hazardous substance at the Site. Section 121(b) of CERCLA, 42 U.S.C. Section 9621(b), establishes a preference for remedial actions that have as a principal element treatment that permanently and significantly reduces the toxicity, mobility, or volume over remedial actions which would not.

Alternative 1 does not employ a treatment process and therefore does not address the CERCLA statutory preference for treatment. Alternatives 2 through 4B result in the reduction of toxicity, mobility and volume of site contaminants through various means of treatment. In Alternative 2, the groundwater treatment technology, air stripping, provides reduction of groundwater toxicity and the reduction of the mass or volume of groundwater constituents, but does not directly reduce the source of contamination. Source and plume migration control options in Alternatives 2 through 4B reduce and eliminate the mobility of groundwater constituents in the subsurface environment. Alternatives 3, 4A, and 4B also provide reductions of contaminant mass, or volume, as subsequently noted. Alternative 3 involves vapor stripping of VOCs and some semi-volatile compounds from the landfill and its immediate area. The extracted chemicals are expected to be absorbed onto carbon and later incinerated during regeneration or treated in a biodegradation process. The statutory preference for treatment technologies which reduce toxicity is thus met. Both Alternative 4A and 4B will reduce the volume and toxicity of contaminated materials through incineration.

Alternative 1 provides no irreversible treatment as no treatment technologies are employed. In Alternatives 2 through 4B, groundwater constituents are treated by air stripping which renders VOC constituents subject to photodegradation, other forms of trans-formation, and dilution. In Alternative 3, the VOCs which are absorbed onto carbon used in the in situ vapor stripping system, will be irreversibly destroyed by incineration/carbon regeneration of landfill and surrounding area materials provides irreversible treatment. In the incineration alternatives, 4A and 4B, the source of contaminants will be irreversibly destroyed.

Alternative 1 does not provide any treatment and therefore, there are no residuals remaining. In Alternative 2 through 4B, the groundwater treatment system will produce an iron sludge which is not expected to exhibit any hazardous or toxic characteristics or have any constituent concentration levels that would render the materials hazardous or otherwise subject to land disposal restrictions. In Alternative 3, the vapor phase carbon adsorption system will produce spent carbon which will be regenerated for reuse. In Alternatives 4A and 4B, incinerator ash is generated which will be land disposed. This ash is not expected to exhibit any hazardous or toxic characteristics or have any constituent concentration levels that would render the materials hazardous.

Alternative 1 does not address the statutory preference for treatment of site contaminants. Alternatives 2 through 4B all satisfy the CERCLA statutory preference for treatment, as opposed to land disposal without treatment or abandonment in place without treatment.

5. Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to achieve protection of human health and the environment and any adverse impacts that may be posed during the construction and operation period of the remedial alternative until cleanup goals are achieved.

Alternative 1 does not present any short-term risk to the community but does present a long-term cancer risk by exposure to and ingestion of soils. Alternatives 2 and 3 do not present any substantive risk to the community. Potential releases of contaminants to the air from the installation and operation of vapor wells or the air stripping tower can be easily controlled. Excavation and operation of an on site incinerator in Alternative 4A will present short-term risk to the community of releases to the air and runoff to surface water during the operating period of 5 to 6 yr. There would be a significant increase in risk to the community in Alternative 4B resulting from the excavation as in Alternative 4A, along with the increase in traffic caused by the 18 to 20 dump trailer loads leaving the site on a daily basis.

There would be no significant risk to workers resulting from the implementation of Alternative 1. For all of the other alternatives, there would be minor risks to workers with respect to activities involving well installation, construction of the groundwater treatment facility, and other related construction. There would be significantly increased risks for workers at the site in Alternatives 4A and 4B resulting from excavation of the landfill. A substantially increased risk of worker exposure to air releases due to this activity would be expected. In addition, Alternative 4B would result in an increased risk for truck driver safety while hauling loads to distant incineration facilities.

In terms of environmental impacts, there would be no significant risk should Alternative 1 be implemented. For Alternatives 2 and 3 there are no significant detrimental environmental impacts. All air emissions, surface water discharge and disposal of residuals would be conducted in compliance with ARARs. For Alternative 4A, there would be increased local pollutant loadings to the atmosphere from on site incinerator. For Alternative 4B, there would be increased local pollutant loadings to the atmosphere at off site incinerator locations and there would be an increased chance of a release to the environment caused by a hauling accident which could result in dumping contaminated materials onto land or water.

In Alternative 1, at least 100 years is the estimate for natural attenuation and dissemination of groundwater constituents to reach MCL levels. For Alternatives 2 through 4B, design and construction of the groundwater treatment system could be completed within 18 months of EPA approval. Source and migration controls would be effective within two months of start up thus preventing the continuing movement of the contamination plume towards currently used water supplies. This component of the remedial alternative should be completed within 50 years of implementation. Site design and construction for the in situ vapor stripping phase of Alternative 3 could be completed within 18 months of agency approval. Completion of this component of this remedial action should be completed within 50 years. Site design and construction of the on site incinerator facility for

Alternative 4A should be completed within 24 months of approval. Source excavation and incineration should be completed within 5-6 years of startup. The design and construction of the excavation and truck loading areas for the excavation and shipment to off-site incinerator should be completed within 6 months of approval. Source removal could be completed within 2-3 years of startup.

6. Implementability

This evaluation criteria addresses the difficulties and unknowns associated with implementing technologies, the ability and time necessary to obtain required permits and approvals, the availability of services and materials, and the reliability and effectiveness of monitoring.

For Alternative 1, there is no action or construction to be implemented. The groundwater recovery and treatment facilities for Alternatives 2 through 4B would be relatively easy to construct and operate. The groundwater treatment system requires some operator attention. In Alternatives 3, the in situ vapor stripping system would be relatively easy to construct and operate. Because it is an innovative technology, field scale testing will be used to verify its amenability to treating the wastes at the Site. In Alternative 4A, the construction and permitting of the hazardous waste incinerator is considered to be moderately difficult and excavation of the landfill is considered to be difficult. Construction and operation of the ash landfill is considered to be relatively simple and easy to implement. In Alternative 4B, the construction of the excavation/loading area for excavated materials would be simple to construct and operate. However, excavation of the landfill is considered to be difficult.

For all of the remedial alternatives, the ability to monitor effectiveness of each remedy exists. Over 90 groundwater monitoring wells are currently installed at the site and nearby. For all Alternatives, groundwater monitoring plus the use of the early warning wells will give notice of failure of the action well before significant risk of exposure for downgradient groundwater users can occur. For Alternatives 2 through 4B routine sampling and analysis of groundwater treatment system discharges would allow monitoring of ARAR compliance. For Alternative 4A, continuous and automated sampling and monitoring of stack emissions would give the ability to monitor ARAR compliance for air emissions.

Groundwater monitoring and reporting to PADER does not require any approvals from regulatory agencies for Alternative 1. Also, minimal coordination for reporting of the data is needed. Obtaining the required RCRA, NPDES, air emissions and other permits and approvals should not be difficult to obtain for

Alternatives 2 and 3. Permits and approvals necessary for excavation and shipping of hazardous wastes for Alternative 4B are expected to be more difficult. Alternative 4A requires the acquisition of permits and approvals identical to the excavation requirements of Alternative 4B with the added requirement of obtaining permits and approvals for the construction of a landfill and a hazardous waste incinerator. Permits for these types of operations are difficult to obtain.

In terms of the availability of services and capacities, Alternative 2 requires few services and its implementation will not affect any commercially available capacities. For Alternatives 2 and 3, services and capacities needed for implementation are readily available. In addition to those services needed for the implementation of either Alternative 2 or 3, Alternative 4A has the added need for incinerator construction and site operating services, which are available. For Alternative 4B, most of the services and capacities needed for the implementation of this remedial alternative are available. However, off site incineration capacity is extremely limited and future capacity is uncertain and may not be available.

For all of the alternatives, equipment, specialists and materials are readily available. The availability of remedial technologies is not applicable to Alternative 1. The specified technologies needed are available for all of the remaining alternatives. Alternative 2 requires groundwater treatment pilot testing. Alternative 3 requires in situ vapor extraction and groundwater treatment pilot testing. Alternative 4A and 4B incinerator technologies are readily available, but groundwater treatment technology requires pilot testing.

7. Costs

CERCLA requires selection of a cost-effective remedy that protects human health and the environment and meets the other requirements of the Statute. The capital and annual operation and maintenance (O&M) costs for these alternatives on a present worth basis vary significantly. Cost estimates have been developed for direct and indirect capital costs and O&M costs. The present worth of each alternative has been calculated for comparative purposes. Direct capital costs include the following:

- Remedial action construction
- Equipment
- Buildings and services
- Waste disposal costs

Indirect capital costs include:

- Engineering expenses
- Environmental permit acquisition
- Startup and shakedown
- Contingency allowances

Annual O&M costs include the following:

- Operating and maintenance labor and material costs
- Maintenance materials and labor costs
- Chemicals, energy, and fuel
- Administrative costs and purchased services
- Monitoring costs
- Costs for periodic site review (every five years)
- Insurance, taxes, and license costs

The remedial action alternative cost estimates have an accuracy of +50 percent to -30 percent. For the purpose of the present worth calculations, Alternative 1 has a performance period of 100 years and Alternatives 2, 3, 4A, and 4B can be completed in 50 years. Major capital expenditure items are completed in 5 1/2 years for Alternative 4A and 1 1/2 years for Alternative 4B. A comparison of costs is presented in Table 9 and in the following paragraph.

Alternative 1 involves no capital costs and no O&M. The only cost for Alternative 1 is the cost associated with the five year effectiveness reviews, which are necessary in all of the evaluated alternatives. Alternatives 2 and 3 are comparable for both capital and operating costs with Alternative 2 requiring approximately $1,940,000 in capital cost compared to $2,500,000 for Alternative 3. The O&M cost for Alternative 2 is $310,000 per year compared to $420,000 per year for Alternative 3 in years 1 and 2, which then decreases to $310,000 per year. Alternative 4A is an order of magnitude higher than Alternatives 1, 2, and 3, and Alternative 4B is two orders of magnitude higher than the first three alternatives considered. Alternative 4A has an estimated capital cost of $24,160,000 and a first year O&M cost of $5,800,000. This O&M cost would drop to $310,00 in year 7 of the remedial action, when the excavation and incineration of the landfill is completed and the ash residue landfill is closed. Alternative 4B has an estimated capital cost of $180,000,000, reflecting the extremely high costs associated with off-site transportation and incineration of such a large volume of material. The first year O&M cost for this alternative is $465,000 which drops to $310,000 in year 3 of the remedial action.

8. State Acceptance

The /Commonwealth of Pennsylvania has concurred with the selection of Remedial Alternative 3, Source Control by In Situ Vapor Stripping with Groundwater Extraction and Treatment, for implementation at the Lord-Shope Landfill Superfund Site.

9. Community Acceptance

A public meeting on the Proposed Plan was held on April 3, 1990 in Girard, Pennsylvania. Comments received at that meeting and during the Comment Period are discussed in the Responsiveness Summary attached to this Record of Decision.

## X. SELECTED REMEDIAL ALTERNATIVE

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, and public comments, the remedial alternative selected for implementation ("Selected Remedy") at the Lord-Shope Landfill Superfund Site is **Alternative 3, Source Control by In Situ Vapor Stripping with Groundwater Extraction and Treatment.**

Goals

The primary goals of this Selected Remedial Alternative are to eliminate or reduce the risks posed by potential ingestion of contaminated groundwater and direct contact with the contaminated soils associated with the Site. Additional goals are to meet the statutory preference for remedies that utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, and that utilize treatment to reduce the mobility, toxicity or volume of the source of contamination.

Summary of Alternative

As discussed in Section VIII, Description of Alternatives, this Selected Remedial Alternative includes in situ vapor stripping of the landfill materials and surrounding contaminated soils to reduce the volume of contaminants currently present in the landfill materials and contaminated soils, a groundwater extraction and treatment component to remediate the existing contaminated groundwater plume to MCLs or health based levels, and the construction of a security fence surrounding portions of the Site to limit access and virtually eliminate risk from direct contact with or ingestion of contaminated soils.

Institutional controls will be implemented to restrict the use of groundwater in the area of the contaminated migration plume to provide protection from potential ingestion of contaminated groundwater. Following cessation of the in situ vapor stripping phase of this Selected Remedial Alternative, the degree to which vapor stripping has reduced the toxicity, mobility, or volume of the waste will be determined, after opportunity for review and comment by PADER.

These measures will be taken to supplement the existing remedial actions implemented in 1984 which include the composite cap and revegetation which significantly reduce percolation of incipient precipitation thereby reducing that aspect of leachate production, and the upgradient groundwater cut-off wall which further reduces leachate produced by groundwater flow through the landfill waste.

## XI. STATUTORY DETERMINATIONS

Under it's legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the Selected Remedy implemented at this Site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is justified. The Selected Remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment as a principal element to permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

### Protection of Human Health and the Environment

The Selected Remedial Alternative protects human health and the environment in the long term by using groundwater extraction and treatment to halt the migration of the existing contamination plume and to reduce the contamination in the groundwater to acceptable levels as determined by the MCLs or health based cleanup criteria. The current excess cancer risks associated with ingestion of contaminated groundwater are 1.0E-1. Implementation of the Selected Remedial Alternative is expected to reduce this risk to 1.4E-4 and is expected to lower the noncarcinogenic risks to acceptable levels. Institutional controls to restrict the use of groundwater until cleanup levels are attained will eliminate the short-term potential risk from this route of exposure. The remedy also provides protection from direct contact with contaminated soils by the installation of security fencing.

The potential for continuing contamination of the groundwater will be significantly reduced by in situ vapor stripping of the landfill materials and surrounding soils in conjunction with the existing landfill cap and groundwater cut-off wall. By reducing the contamination in the surrounding soils in situ vapor stripping will also greatly reduce the risk of direct contact.

There are no short-term risks associated with the Selected Remedy that cannot be readily controlled. In addition no adverse cross media impacts are expected to result from implementation of the Selected Remedy.

Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy of groundwater extraction and treatment and in situ vacuum extraction will comply with all applicable or relevant and appropriate chemical-, location-, and action-specific ARARs. Those ARARs are as follows:

1. Chemical-Specific ARARs

   a. Relevant and appropriate Maximum Contaminant Levels (MCLs) promulgated Under the Safe Drinking Water Act, 42 U.S.C. § 300f to 300j-26, and set forth at 40 C.F.R. §§ 141.11(b) and 141.61(a) and proposed MCLs set forth in 54 Fed. Reg. 22062 (May 22, 1989) are:

| Substance | MCL/[Proposed MCL] |
|---|---|
| Benzene | 5 ppb |
| Chlorobenzene | [100 ppb] |
| Tetrachloroethene | [5 ppb] |
| Toulene | [2000 ppb] |
| Trans-1,2 dichloroethylene | [100 ppb] |
| Trichloroethene | 5 ppb |
| Vinyl Chloride | 2 ppb |
| Arsenic | 50 ppb |
| Barium | 1000 ppb |
| Cadmium | 10 ppb |
| Chromium | 50 ppb |
| Lead | 50 ppb |

b. The Pennsylvania ARAR for groundwater for hazardous substances is that all groundwater must be remediated to "background" quality as specified by 25 Pa. Code Section 75.264(n). The Commonwealth of Pennsylvania also maintains that the requirement to remediate to background is also found in other legal authorities. As described in Section VIII of this ROD, groundwater monitoring to determine the background concentrations of the contaminants will be part of the remedial alternative. Such background levels shall be attained as part of the remedial alternative, unless it is demonstrated that attaining such levels is infeasible or otherwise waivable under CERCLA Section 121(d), 42 U.S.C. Section 9621(d).

c. The National Emissions Standards for Hazardous Air Pollutants (NESHAPs) set forth at 40 C.F.R. § 61.63 and promulgated under the Clean Air Act, 42 U.S.C. § 7401, contain an emission standard for vinyl chloride plants which is relevant and appropriate to the air stripping and in situ vapor stripping treatment. The vinyl chloride emission standard is 10 ppm (average for 3-hour period).

2. Location-Specific ARARs

No location-specific ARARs with respect to this Site have been identified.

3. Action-Specific ARARs

a. 25 Pa. Code Sections 123.1 and 123.2 are applicable to the remedial alternative, and require that dusts generated by earthmoving activities be controlled with water or other appropriate dust suppressants.

b. To the extent that new point source air emissions result from the implementation of the remedial alternative, 25 Pa. Code Section 127.12(a)(5) will apply, requiring that emissions be reduced to the minimum obtainable levels through the use of best available technology (BAT), as defined in 25 Pa. Code Section 121.1.

c. Treatment and discharge of contaminated groundwater to an unnamed tributary of Elk Creek will cause the requirements of Pennsylvania's NPDES program to apply. Those requirements, as set forth in 25 Pa. Code Sections 93.1 through 93.8, include permitting, design, discharge, and monitoring requirements which will be met in implementing the remedial alternative.

d. 25 Pa. Code Sections 102.11 through 102.24 contain relevant and appropriate standards requiring the development, implementaion, and maintenance of erosion and sedimentation control measures and facilities which effectively minimize accelerated erosion and sedimentation.

e. 25 Pa. Code Sections 105.291 through 105.314, promulgated in part under the Pennsylvania Dam Safety and Encroachments Act of 1978, set forth applicable permitting and design requirements relating to the groundwater treatment discharge pipe/headwall construction.

f. 25 Pa. Code Sections 264(o)(2),(10)-(14) and 264(v)(3)(xxvi)(F)(I),(IV)and (V) contain relevant and appropriate requirements precluding any breaches of the integrity of the existing landfill cap except under certain circumstances, which circumstances will be met by the remedial alternative.Those provisions also will require adequate repair of the landfill cap.

g. The groundwater treatment and in situ vapor stripping treatment will be implemented consistently with the requirements of 40 C.F.R. Section 262 (regarding standards applicable to generators) and the substantive requirements for the treatment, storage and disposal of hazardous wastes set forth in 40 C.F.R. Sections 263 (regarding transporters of hazardous wastes) and 264 Subparts B-H (regarding general requirements for TSD facilities).

Cost Effectiveness

The selected remedy is cost effective because it has been determined to provide overall effectiveness proportional to its costs in reducing risks associated with the Lord-Shope Landfill Site and meets the requirements of CERCLA. Compared to Alternative 2, Groundwater Extraction and Treatment alone, the selected alternative includes in situ vapor stripping to further address the source and potentially reduce the time and continuing costs necessary for extraction and treatment of groundwater. When compared to the incineration alternatives, the selected remedy achieves similar reductions in risk at a cost that is estimated to be less than 15% of either Alternative 4A or 4B.

Preference for Treatment as a Principal Element

The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element to permanently reduce the toxicity, mobility, or volume of hazardous substances. By treating the contaminated landfill materials, surrounding soils, and groundwater, the selected remedy addresses the principal threats posed by the Site through use of treatment technologies.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be utilized while providing the best balance among the other evaluation criteria. Of the alternatives that are protective of human health and the environment, the selected remedy provides the best balance in terms of long-term and short-term effectiveness and permanence; cost; implementability; reduction in toxicity, mobility, or volume of hazardous substances through treatment; state and community acceptance; and the statutory preference for treatment as a principal element.

The selected remedy utilizes the innovative technology of in situ vapor stripping to reduce the volume and toxicity of hazardous substances in the landfill and surrounding soils and the groundwater extraction and treatment technology will reduce the volume and toxicity of hazardous substances in the groundwater. Short-term, the risks posed by direct contact with contaminated materials and the potential ingestion of groundwater will be avoided through the installation of security fencing and implementation of institutional controls on groundwater use. Long-term, the groundwater extraction and treatment will return the groundwater to levels that meet federal and state criteria. The two treatment components of the selected remedy are easily implemented and cost effective.

# APPENDIX A.

# RESPONSIVENESS SUMMARY

## RESPONSIVENESS SUMMARY

This community relations responsiveness summary is divided into the following sections:

**Section I** **Overview.** A discussion of EPA's preferred remedial alternative and the public's response to this alternative.

**Section II** **Background of Community Involvement and Concerns.** A discussion of the history of community interest and concerns raised during remedial planning activities at the Lord Shope Superfund Site.

**Section III** **Summary of Major Comments Received During the Public Comment Period and Agency Responses.** A summary of comments and responses categorized by topic.

## I. OVERVIEW

EPA's preferred alternative, Alternative 3, outlined in the Proposed Plan, involves an innovative technology called in situ vapor stripping, along with groundwater extraction and treatment. This alternative involves installing specially designed wells in the Landfill and surrounding soils. These wells will apply a vacuum to volatize and remove the volatile organic compounds from the Landfill material and surrounding soil. This alternative also involves pumping extracted groundwater to an on-site groundwater treatment system and discharging it to a tributary of Elk Creek. This alternative also includes installation of a chain-link fence around the perimeter of the Landfill to prevent human contact with "seeps" and contaminated soil.

During the public comment period, the community, in general, expressed concern about the in situ vapor stripping alternative. It is perceived by the community as a non-proven solution. Several residents feel this alternative has been chosen because it is less expensive than the incineration alternatives. Some residents expressed support for an incineration alternative, feeling that it would be a more effective way to assure complete removal of contamination at the site. Residents feel strongly that making a municipal water supply available would provide them a sense of security and allay their fears that their wells will one day become contaminated or go dry.

## II. BACKGROUND OF COMMUNITY INVOLVEMENT AND CONCERNS

Community interest in the Lord Shope Landfill dates to 1979 when well water samples were taken from the homes of seven property owners living in the vicinity of the dump. Since that time, community concern and involvement have remained strong. A citizens group, Citizen's to Eliminate the Lord Shope Chemical Dump, was formed in 1983 and has been particularly vocal in expressing the concerns of the community to both the Pennsylvania Department of Environmental Resources (PADER) and the EPA. PADER met with this group in February 1984 to discuss the groundwater monitoring that was beginning at the Site. In June of the same year, Lord Corporation conducted a Site tour with the media. PADER met with the public again in 1985 to discuss the scope of work to be performed at the Site and to announce the installation of an early warning groundwater monitoring system. In September 1987, PADER established an information repository in the Girard Township Municipal Building and in October a second repository was established at the Wilcox Public Library.

Major concerns expressed during the remedial planning activities at the Lord Shope Site focused on apparently inconsistent sampling of residential wells, unavailability of sampling results, delays in getting the site cleaned up, lack of PADER and EPA communication with the community, and the refusal of authorities to provide a municipal water source to the area. These concerns and how EPA and PADER addressed them are described below.

## III. SUMMARY OF MAJOR COMMENTS RECEIVED DURING THE COMMENT PERIOD AND AGENCY RESPONSES

Comments raised during the Lord Shope Superfund Site public comment period on the proposed plan are summarized below. The comment period was held from March 26, 1990, to April 25, 1990. The comments are categorized by relevant topics.

### Remedial Alternative Preference

Each of the commentors on the Proposed Plan expressed a preference for a specific alternative.

1. PADER supports EPA's choice of a preferred alternative for the Lord Shope Superfund Site; however, PADER would like EPA to be more detailed and formalized regarding choosing a different alternative should the proposed remedy fail to perform adequately during the field tests.

   **EPA Response:** EPA believes that it is premature to select a second alternative for the following reasons.

   First, EPA is confident that the implementation of the selected remedy outlined in this Record of Decision will achieve the goals of protection of human health and the environment.

   Second, the field tests for evaluation and design of the in situ vapor stripping and groundwater treatment systems will generate additional information on the wastes contained in the Landfill. Any subsequent decision that the selected remedy is not adequate and the selection of an alternative remedy is mandated will rely, in part, on the information generated during those field tests. If that becomes the case, an amendment to this Record of Decision or a new Record of Decision will be issued.

2. Many area residents do not support EPA's choice of a preferred alternative and instead feel that Alternative 4a or 4b would be most effective in removing contamination. They asked what the actual effectiveness level of incineration is versus that of in situ vapor stripping. They feel that EPA is taking a risk by using a new technology and would rather see a proven remedy implemented at the Site. They are concerned that if the remedy does not work, they will have to wait another twelve years to get the Site cleaned up. They feel that EPA has chosen Alternative 3 because it is less expensive than Alternatives 4a and 4b.

   **EPA Response:** EPA understands the concern of area residents about the use of an innovative technology for the remediation of the Landfill and surrounding soils and the preference for a proven technology such as incineration. EPA wants to emphasize that the greatest risk from this Site is from the potential use of contaminated groundwater and that the groundwater extraction and treatment component of the selected remedy is a proven technology for the remediation of groundwater. EPA believes that, although incineration would be more effective at removing and destroying the contaminants in the landfill materials, incineration would not be significantly more effective at reducing the risks to human health and the environment. EPA also believes that excavation and incineration would introduce short term risks of releases to air or surface water.

   EPA believes that the groundwater extraction and treatment to halt migration and clean up the existing contaminated groundwater plume, with in situ vapor stripping to reduce the source of contamination, will work in combination with the existing Landfill cap and groundwater cutoff wall as an effective remediation appproach for the Site.

   Selected remedies for Superfund Sites are, by statute, required to be cost effective. However, this remedy was selected by EPA because it is expected to provide protection of human health and the environment without the short term risks of air and surface releases and worker exposure introduced by the excavation necessary for the implementation of the incineration alternatives.

   To respond to the concern that if this selected remedy does not prove effective residents will have to wait another twelve years before any action is taken, EPA wants to assure residents that the process will not have to start over. The Remedial Investigation for this Site has been completed. The field tests for evaluation and design of the in situ vapor stripping and groundwater treatment systems will generate additional information on the wastes contained in the Landfill. Any subsequent decision that the selected remedy will not perform adequately and the selection of an alternate remedy is mandated will rely on the information already generated. If that becomes the case, an amendment to this Record of Decision or a new Record of Decision will be issued in a relatively short time.

Additionally, EPA believes that any remediation that would be considered at this Site would include groundwater extraction and treatment (groundwater pump and treat); that component of the remediation would continue to progress from the field tests.

**Technical Questions/Concerns Regarding Remedial Alternatives**

1. Residents feel that the extent and direction of the groundwater plume has not been accurately defined and that perhaps the groundwater extraction and treatment portion of the various alternatives will not be able to handle the extent of contamination. Residents asked if additional studies would be performed to further identify the extent of the contamination plume.

   **EPA Response:** The extent of the contaminated groundwater plume has been extensively studied. The location of the leading edge of the plume (the point at which contamination becomes detectable) is estimated based upon analysis of samples from monitoring wells already in place. The leading edge of the plume is indicated in Attachment A (Figure 3 from the Record of Decision). Currently there are monitoring wells in place that have shown no detectable levels of contaminants. This indicates that the leading edge of the plume has not reached these wells. Additionally, there are early warning wells placed between the plume and those residents that could be affected. These wells also show no detectable levels of contaminants.

   There are Site and residential well sampling programs operating and the latest data from these programs will be used in the design of the groundwater extraction and treatment system to ensure that the entire plume is addressed.

2. Residents asked if either agency knew for certain what types of chemicals were dumped into the Landfill and whether these chemicals were still contained in drums.

   **EPA Response:** Records indicate the waste materials dumped into the Shope Landfill consisted mostly of waste rubber scrap, demolition debris, pallets, and paper. However, drummed chemical wastes consisting primarily of spent adhesives, waste paint, and paint sludges were also disposed in the Landfill. These primarily contained non-halogenated compounds including xylene, various ketones, toluene, naphtha, and only small proportions of chlorinated compounds. Some quantities of drummed wastes including chlorinated paint and degreasing solvents, non-PCB cutting oils, and miscellaneous acids and caustics were also deposited in the Landfill.

Widely accepted studies have shown that buried ferrous containers, including steel drums, have corrosion rates that can be predicted based upon the condition of the specific subsurface environment. These corrosion conditions lead to the deterioration of drums such that, at some point, liquids would no longer be contained. Particularly Mughabghab and Sullivan (1988) studied the corrosion of low carbon steel containers as part of a U.S. Nuclear Regulatory Commission funded study conducted by Brookhaven National Laboratory. This study lead to a predictive equation for the corrosion of drums for varying subsurface conditions.

Using these equations for the Lord-Shope Landfill conditions indicate that, for the most conservative assumptions, drums would be leaking from corrosion within nine years. Therefore, it is fully expected that there are no significant amounts of liquid chemical wastes contained in the drums buried at the Lord Shope Site. Furthermore, EPA believes that the present condition of drums contained in the Landfill will not inhibit the effectiveness of the processes described in the selected remedy.

3. A number of residents were concerned that the discharge of water into a tributary of Elk Creek could disrupt aquatic life in the creek. They wanted to know what the volume, quality and temperature of discharge would be. They also asked if EPA had to coordinate with other Federal and state agencies such as the Bureau of Dams and Waterways and the Fish Commission. They wanted to know if there will be some kind of safeguard built into the design in case the treatment plant can't keep up with the volume of water being pumped, i.e., a holding pond.

**EPA Response:** The estimated discharge rate for treated groundwater is approximately 80 gallons per minute (gpm); but for calculations a figure of 100 gpm was used. The mean flow for the receiving stream immediately downstream of the proposed discharge point has been calculated to be 942.5 gpm and the mean flow at a point where the two tributaries combine has been calculated to be 1525.9 gpm.

Therefore, the discharged treated water would make up approximately 10% of the resultant flow of the receiving stream and approximately 6% of the flow of the combined tributaries. The physical and chemical characteristics of the treated water would be subject to the permitting requirements of the National Pollution Discharge Elimination System (NPDES). These requirements are based on an evaluation of what the receiving stream can safely assimilate, taking into consideration the stream's physical characteristics, water quality, current and potential uses of the stream, and may include modeling and continued monitoring where deemed necessary to assure the stream quality. The Bureau of Water Quality Management of the Pennsylvania Department of Environmental Resources is responsible for setting the requirements and issuing NPDES permits.

When setting NPDES requirements, the Bureau of Water Quality Management considers the regulations and requirements of other bureaus within PADER, including the Bureau of Dams and Waterways, and other agencies such as the Fish Commission and the Game Commission in order to assure that all pertinent aspects of water quality are addressed. Specifically, the Pennsylvania Fish Commission has already been in contact with the Bureau of Water Quality Management concerning the status of the Lord-Shope remediation.

The groundwater treatment system will be designed to handle the combined flow of the extraction well pumps. Unlike sewage treatment plants, stormwater is not added to the system and will not cause overflow conditions. Additionally, the flow from the wells can be adjusted as necessary if temporary problems arise in the treatment system. The system will be designed with the appropriate safeguards so that untreated water will not be discharged.

4. Residents wanted to know what type of monitoring of Elk Creek will be done in the future if Alternative 3 is chosen.

   **EPA Response:** Any stream monitoring requirements will be determined in the process of meeting the NPDES permit requirements for discharge of the treated groundwater. It is expected that stream quality monitoring will be part of that process.

5. Residents were concerned that odors may be emitted when chemicals are extracted from the ground water.

   **EPA Response:** The air emissions from the stripping tower and from the in situ vapor stripping operations are subject to the requirements of the Pennsylvania Air Pollution Control Act, 25 PA Code 127.1, which requires that emisssions be the minimal attainable through the use of the best available technology. Emissions of chemicals at these levels, subject to further dilution in air, are not expected to display detectable odors.

6. One resident asked where the pumps for the groundwater pump and treatment portion of the cleanup would be located. He wanted to know if they would be above or below ground and how

they would be maintained.
**EPA Response:** The pumps for the groundwater extraction and treatment (pump and treat) component of the selected remedy are expected to consist of well pumps, located in the wells, and potentially, surface pumps to move the groundwater from the well locations to the treatment facility. The exact number and location of the pumps will be determined in the detailed design of the treatment system. The system will be designed to be accessible and easily maintained. The design will consider the concerns of the nearby residents and affected landowners and will be as unobtrusive as possible.

7. Residents wanted to know if there will be a building erected on the site if Alternative 3 is chosen. In addition, they were concerned about the fencing that would be erected around the site. For asthetic purposes, they were concerned about the appearance of the fence and also questioned its purpose.

   **EPA Response:** There will be a building to house some of the equipment. This will be erected on the Landfill property. The property will be surrounded by security fencing (expected to be chain link fence). The purpose of the fencing will be to protect the equipment and to further reduce the potential for direct contact exposure to contaminants in the soil and in the Landfill.

8. The residents of Pieper Road expressed strong concern that when the groundwater extraction and treatment portion of the remediation begins, they will lose the water supply to their wells. They suggested connection with a municipal water source as a way to prevent a loss of water supply to their homes. One resident asked if EPA was going to test private wells to find out which direction the water is coming from. They are concerned that if their water supply is coming from the underneath the Landfill, the groundwater pumping will cause their wells to go dry.

   **EPA response:** Preliminary studies have indicated that a series of well points and approximately five groundwater extraction wells will be used to remediate the currently contaminated groundwater plume and prevent any further contamination from leaving the area of the Landfill. These studies have estimated that the total rate of flow that will be extracted from these wells and wellpoints would approach 100 gallons per minute. In the detailed design of the extraction system, the radius of influence of the wells will be limited to an area just outside the estimated perimeter of the plume. This means that the pumping of groundwater will be designed to have no significant influence or effect on the groundwater flow or supply outside the perimeter of the groundwater plume and will have no effect on the water supply in the existing residential wells in the area.

   The groundwater extraction and treatment component of this selected remedy will be designed to halt the spread of the contamination plume, to draw the contamination away from the perimeter to a central point for treatment and ultimately eliminate the plume.

The residences are provided an added measure of safety by the continued monitoring of early warning wells located between the leading edge of the plume and the downgradient residences.

9. A resident questioned the depth of the wells EPA plans to install. She asked if the bottom of the wells would be above or below the water table and what would happen if the water table rose or fell dramatically.

   **EPA Response:** Preliminary proposals presented in the Feasibility Study indicate that vapor extraction wells in the Landfill material will be installed to a depth approximately five feet above the water table. Potential negative effects of fluctuations of the water table on the equipment is not expected to be significant due to the following factors:

   - o The water table under the Landfill will be lowered due to the combined effect of the groundwater cutoff wall and the groundwater extraction and treatment system.

   - o The vapor extraction wells are generally designed not as closed pipes with open ends, but as pipes with perforations or slots in the walls of the pipe's top allowing vapors to enter from the sides. If the water table did rise to meet the bottom of the well, the side openings would continue to be functional.

   Additionally, the falling water table under the Landfill due to the groundwater extraction and treatment component of the selected remedy will help to stabilize the water table to prevent fluctuations and increase the effective area of the in situ vapor stripping of the Landfill materials.

10. One resident asked if the possibility that the area is a wetlands area would affect the choice of an alternative. He wanted to know if EPA or PADER has determined if the area is an actual wetlands environment.

    **EPA Response:** If an area that contains a Superfund Site is determined to be a wetland this would influence the choice of a remedial alternative because potential impacts on the wetland area would be considered.

    EPA has determined that the Site is not located in a presently recognized wetland. There are some areas south of the Site which are considered to be hardwood swamp environments; however these areas are outside of the influence of any past

Landfill activity and the planned remedial activities.

11. Residents asked if there are other in situ vapor stripping plants in operation currently and if the contractor chosen by Lord Corporation to perform the process has a license to use the technique.

    **EPA Response:** There are in situ vapor stripping systems operating successfully worldwide. Included as Attachment B is a letter sent in response to a request from one resident. The letter names several Superfund and non-Superfund sites where the technology is being used.

    EPA has been assured that the contractor chosen by Lord Corporation is not infringing on any patent with regard to this technology.

12. One resident who owns property adjacent to the Landfill asked what the potential for future development of his property would be if EPA's preferred alternative is implemented.

    **EPA Response:** The potential for development of the property in question is limited by the institutional controls that will be imposed on the groundwater usage for that area and by whatever local permitting requirements are in effect for development. EPA has been in contact with this landowner and will continue this dialogue through the Remedial Design and Remedial Action phases of this response as requested.

13. Residents wanted to know whether private wells will continue to be tested over the next fifty years while the ground water is being treated.

    **EPA Response:** A residential monitoring program will be included as a component of the Remedial Design and Action as part of the determination of the effectiveness of the remedy. However, the duration of the program will be based on the progress of the remediation, not on a predetermined time period.

14. One resident asked if the six million dollar figure for the cost of performing the in situ vapor stripping process is a competitive bid.

    **EPA Response:** EPA fully expects that Lord Corporation will continue to participate in the cleanup of this Site and that the Remedial Design and Remedial Action will be conducted by Lord under EPA oversight. If this is the case, then Lord Corporation will agree to the implementation of the selected remedy; the cost negotiated by Lord will have no bearing on that agreement. If, however, Lord does not participate, EPA will conduct the Remedial Design and Action using its established contracting procedures which are competitive.

**Community Relations Concerns**

1. A representative of the Citizens to Eliminate the Lord Shope Chemical Dump organization stated that EPA credibility with that organization is low. Instead of being contacted personally, she was informed of the public meeting by a television news broadcast. She expressed concern that "one day trucks and people will just show up on site and residents will not know what is going on." She asked if residents could be kept updated during the design process so that they will know what to expect.

   **EPA Response:** The Community Relations Coordinator apologizes for the way EPA informed citizens of the meeting. She had intended resident's information letters to arrive before the media received the press release. This problem will be corrected for future meetings.

   EPA will endeavor to keep citizens up to date during the Remedial Design and Remedial Action phases at the Lord Shope Landfill. Information will be distributed by fact sheets, media coverage, public meetings, if necessary or requested, and one-on-one discussions. Citizens should also contact Amy Burrage at EPA or Steve Curcio at the Pennsylvania Department of Environmental Resources if they have any questions about the Site. Both organizations would like to foster two-way, effective communication with residents. Residents can support this process by continuing to tell EPA their concerns and needs.

2. Many residents expressed frustration over that fact that every year there are new people from the state and Federal agencies. They feel that each year they have to re-explain their problems and they would like to have some familiar faces to turn to.

   **EPA Response:** EPA employees are also frustrated by the turnover rate. EPA feels that some amount of reiteration will always be necessary both within the agency and between the agency and citizens. However, the agency will renew its efforts to retain institutional knowledge of on-going citizen interests.

3. The Committee to Eliminate the Lord Shope Chemical Dump asked if its organization could become a repository location since the hours of the other two repositories are not convenient for people who work during the day.

   **EPA Response:** Any documents sent in the future to the two established repositories, Willcox Library and the Girard Township Supervisors, will also be sent to Ms. Ann Sawin, citizen representative of the Committee to Eliminate the Lord Shope Chemical Dump.

**Remaining Concerns**

1. Residents wanted to know how long the Remedial Design process will take and when they can expect actual cleanup at the Site to begin.

   **EPA Response:** Once the Record of Decision is issued, negotiations leading to a Consent Decree with Lord Corporation will begin. After the Consent Decree is in place, the Remedial Design will commence. The Remedial Action, which is the actual field work, will proceed according to the schedules developed in the design. Although EPA wishes to facilitate the cleanup at this Site, this process can take as long as a year following issuance of the Record of Decision. If a Consent Decree with Lord Corporation can not be negotiated, other mechanisms will be activated to implement the remedy selected for this Site as quickly as possible.

2. Residents of Pieper Road have been under the impression that their private wells are to be tested every six months and in some cases it has been over ten months since the last round of testing. They were concerned that their wells are not being uniformly tested for certain contaminants. Also, residents would like to receive results of tests without having to call PADER to request the results.

   **EPA Response:** The problems with the currently implemented residential monitoring program have been caused primarily by miscommunication. When the monitoring program for the selected remedy is designed, these communication problems will be addressed and a consistent approach will be developed.

3. Early warning wells were installed on the easternmost part of Lord's property. Residents wanted to know if they could be notified when these wells are tested and what the results are.

   **EPA Response:** This information will be provided to Ms. Ann Sawin, citizen representative of the Committee to Eliminate the Lord Shope Chemical Dump.

ATTACHMENT A.


FIGURE 3.

LORD-SHOPE LANDFILL
MIGRATION PLUME FOR VOLATILE ORGANIC CONTAMINANTS
IN THE INTERMEDIATE GROUNDWATER ZONE

ATTACHMENT B.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

Mr. Robert Elwinger, President
Over Lake, Inc.
10601 Ridge Road
Girard, PA 16417

05/18/90

Dear Mr. Elwinger:

This letter is a partial response to your request for information presented verbally at the public meeting on April 3, 1990 and in your follow up writte comment dat d April 23, 1990. At the public meeting, one of your rec sts was for a list of sites where in situ vapor stripping is currently be g used.

The follow g is a list of Superfund remedial sites where in situ vapor stripping has be n chosen as part of the remedial response:

| Federal Fiscal Year 1988 | Site Name | State |
|---|---|---|
| | Groveland Well | MA |
| | Keefe Environmental | NH |
| | Bendix Flight Systems | PA |
| | Tyson's Dump | PA |
| | Airco | KY |
| | Goodrich, B.F. | KY |
| | South Valley | NM |
| | Hastings | NE |
| | Motorola | AZ |
| Federal Fiscal Year 1987 | Seymour | IN |

This is by no means a complete listing, as I have not included the remedial alternative selections for fiscal year 1989. There has also been wide usage of the technology on non-Superfund sites. Some of these sites are listed below:

Upjohn Manufacturing Company, Barceloneta, Puerto Rico
Department of Energy, South Carolina
Kinross Regional Correctional Facility, Saulte Saint Marie, MI
Sherwin Williams Paint Warehouse, Dayton, OH
Michigan Department of Transportation, Lansing MI

The above listings are just a few of the sites where in situ vapor stripping has been used. These lists represent some of the work done by two companies, Terra Vac Corp. and MWRI, Inc. Both these companies hold patents on some aspects of the technology and they are only two of the approximately 20 U.S. companies currently in in this field.

In situ vapor stripping is being used internationally to remediate volatile organic contamination. Specifically, I have enclosed a copy of a presentation describing a site in Germany, similar to the Lord-Shope Landfill, where the technology has been used effectively.

The other concerns brought up at the public meeting are still being addressed and you will be receiving further information as it is developed. If you have any questions on the above or any other items, please call me at (215)597-8309.

Very truly yours,

James J. Feeney

James J. Feeney (3HW21)
SE Pennsylvania Remedial Section

cc: P. Anderson
A. Burrage

# ADDENDUM

Partial Listing of the Superfund sites planning in situ vapor stripping as part of the remedial response in federal fiscal year 1989

| Federal Fiscal Year 1989 | Site Name | State |
| --- | --- | --- |
| | Midco I | IN |
| | Fairchild (Mt. View/ Intel Raytheon) | CA |
| | IBM | CA |
| | Kellogg-Deering | CT |
| | Union Carbide | OH |
| | Hastings | NE |

# INTEGRATED SOIL-VAPOR/GROUNDWATER CLEANING SYSTEM
# AT
# SELECTED SITES IN WEST GERMANY

Authors

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Presented at

The Second Forum on
Innovative Hazardous Waste Technologies:
Domestic and International
Philadelphia, Pennsylvania
May 15 - 17, 1990

## INTEGRATED SOIL-VAPOR/GROUNDWATER CLEANING SYSTEM

### I. INTRODUCTION

Ed. Züblin AG is an international civil engineering firm headquartered in Stuttgart, West Germany. It is represented in the U.S. by its operating subsidiary, ZDI Construction Services, Herndon, Virginia.

Ed. Züblin has provided the European and International markets with construction related services for over 92 years. For the past decade their Department of Environmental Engineering has been involved in the treatment and containment of hazardous material. These areas include:

Asbestos - removal and disposal
Hazardous waste site containment - HDPE lined slurry walls
Thermal incineration of contaminated soil with rotary kilns
Integrated soil-vapor/groundwater cleaning systems

Vacuum extraction of soil-vapor is not a unique process. It is, in fact, the standard method in Europe today for cleaning up sites contaminated with VOC's. [Chlorinated Hydrocarbons (Solvents TCE-PCE-DCE) and Aromatics (Petroleum Products - BTEX)]

Combining a soil-vapor extraction and treatment system with a groundwater treatment system for the remediation of a VOC's contaminated site is a sensible decision. The vadose zone can be remediated by vacuum extraction with relative ease and economy. This process removes the source of the groundwater contamination. Thus the groundwater only needs to be cleaned of residual contamination. Removal of the source pollution shortens the duration of the treatment process since percolation of volatile substances through the soil horizons into the groundwater can take decades. The costs and effectiveness of remediation can be vastly improved by using the combined phase treatment process.

This paper presents two case studies utilizing Züblin's integrated treatment process incorporating this procedure. Züblin has installed and operated dozens of these systems during the past decade. With typical German efficiency, the company designed a highly flexible, efficient and functional system to recover solvent contaminants and minimize discharge into the biosphere.

### II. SCHERWIESEN SITE

This study deals with a landfill, for industrial sludges, animal processing, and household waste which had been operating since 1967. Following its closure in 1980, the landfill was excavated to a depth of three (3) feet and capped with a one meter thick compacted clay seal.

Engineering studies performed in early 1984, showed that hydroxide sludges and chlorinated hydrocarbons were present throughout the site and had started to contaminate the groundwater. The contamination plume had extended over 650 meters (2,100 feet from the site). At this point it had contaminated a natural spring which was the primary drinking water source of a nearby village. Remediation of the site was ordered by the appropriate authorities.

In 1987 Zublin's Department of Environmental Engineering was awarded the project to extract and treat both the soil-vapor and the contaminated water in the perched water table (source contaminants) as well as the contaminated spring water. Starting with commencement of the operation, a study was conducted to record the effects of the treatment process. The data collected during this study is presented herein. The plant is still in operation today. Figure 1 is a schematic diagram of the treatment system. A site plan of the project is shown in Figure 9.

## III. TREATMENT PROCESS

### A. Soil-Vapor

Initially, ten (10) soil-vapor extraction wells were constructed with varying depths of 13 to 17 feet at the points of highest contaminant concentrations at the site. A set of vacuum pumps extracted 250 cubic meters per hour from a five (5) well manifold with a negative pressure of approximately 200 mbar. The manifold was shifted to different wellheads when the vapor concentration decreased. The soil at the site is a heavy clay. Its zone of influence for each soil-vapor well was only 10 to 16 feet. With a permeability of the soil of $10^{-6}$ cm/s, the need to drill additional wells was apparent. As a result, in 1988, a year later, twenty (20) additional soil-vapor extraction wells were installed.

The extracted soil-vapor passes through a water separator which removes the water particles picked-up by the vacuum, along with the soil-vapor, from the soil. The water from the separator, which may contain trace contaminants, mixes with and is cleaned in the water treatment phase of the system. The vapor, which has been heated by the energy produced by the vacuum pump, is cooled prior to entering the activated carbon filter for maximum adsorption by the carbon.

Two carbon filters are used: As one filters the influent air the other is either on stand-by or being regenerated. Prior to the on-line filter reaching break-through, the order is reversed. In this fashion the treatment continues uninterrupted without the need to exchange and dispose of spent carbon filter material.

During the regeneration process, steam desorbes the solvent from the activated carbon. The contaminant laden steam is then condensed. Subsequently, the solvent and water are separated resulting in recovery of the solvent. This solvent is 99% pure and can then be recycled or properly disposed. The contact water is fed back into the liquid phase of the system for cleaning. During the first year over 3,000 kg of solvent was recovered at this site.

Contaminant concentrations of the soil-vapor were reduced from 8,000 ppm to between 30 - 50 ppm. Figure 3 shows the influent concentrations of the soil-vapor. Air volume was measured with an integrated flywheel anemometer. The total volume extracted and treated over this period of time exceeded 2.5 million cubic meters. This is graphically demonstrated in Figure 4. The air discharge concentrations were well below the German standards of 100 µg/l. Figures 5 and 6 show the air discharge concentrations and quantity of air treated. Figures 7 and 8 illustrate quantities of solvent recovered by the plant.

As can be seen in looking at these curves there are instances of several upward shifts. The primary cause for these shifts are two. The first is the result of climatic conditions. As the clay dries, cracking occurs: These cracks provide paths for the extraction of ambient air and lower the concentration measured in the influent air stream. Further evidence of this occurrence is the "decrease" in the negative pressure measured at the vacuum pump.

The second reason for a shift is caused by interruption of the extraction process at one or more of the wells. The phenomena of increased contaminant concentration in the extracted soil-vapor after a shut-off well resumes extraction is common. During this shut-off period the volatiles have a chance to re-establish equilibrium in the "vacuumed" section of the soil. That is, the volatiles inside the soil have a chance to diffuse into the soil-air space. Consequently, concentrations following start-up are higher than those recorded prior to shut down.

Other minor factors affecting the peaks are due to: shut downs of the plant which occurred in December 1987, and June 1989 depicted on Figure 6; and, precipitation - since a partial saturation of the vadose zone impedes removal of the VOC's. The important point of the graphs, however, is to note the trend of decreasing concentration in the contaminants.

## B. <u>Water</u>

In order to expedite remediation of the site, a groundwater extraction and treatment phase was implemented in conjunction with the soil-vapor treatment. Five (5) of the original ten (10) wells were used to extract the perched groundwater. A shallow ditch was constructed encompassing the site to capture and treat the surface run-off.

The perched water is part of the aquifer that feeds the spring. It is greatly influenced by precipitation as shown in Figure 2. The perched water with a flow rate of 200 liters per hour it is pumped into a storage tank. From there it is fed through a sand filter into two activated carbon filters operating in series. The initial concentration of the water measured at the plant was 23,500 µg/l with point measurements at the monitoring well (P-12) as high as 166,000 µg/l of chlorinated hydrocarbons. Following treatment, effluent concentrations of the discharged water were well within the German drinking water standards of total CHC's less than 20 µg/l.

It should be noted that after constant and continuous remediation of 2-1/2 years, the contaminant concentration of the perched water was reduced to 1.9 mg/l.

## IV. ECONOMIC ANALYSIS

A cost analysis of the plant follows: Costs are in 1987 dollars at a conversion ratio of 1.6 DM to $1.00 US.

| Site Operations | | DM | US |
|---|---|---|---|
| 1. | Soil-Vapor System | | |
| | a. Installation | 17.025 DM | $10,640 |
| | b. Operation and Maintenance (12 mos.) | 5.235 | 3,275 |
| 2. | Solvent Recovery System | | |
| | a. Installation | 52.200 | 32,625 |
| | b. Operation and Maintenance (12 mos.) | 18.070 | 11,295 |
| 3. | GAC System | | |
| | a. Installation | 13.500 | 8,440 |
| | b. Operation and Maintenance (12 mos.) | 2.160 | 1,350 |
| | Total | 108.190 DM | $67,625 |

**Installation Costs**

| | | | |
|---|---|---|---|
| 1. | Site | | |
| | a. Soil-Vapor System | 17.025 DM | $10,640 |
| | b. Solvent Recovery System | 52.200 | 32,625 |
| | c. GAC System | 13.500 | 8,440 |
| | Total | 82.725 DM | $51,705 |

**Operation and Maintenance**

| | | | |
|---|---|---|---|
| 1. | Site | | |
| | a. Soil-Vapor | 5.230 DM | $ 3,270 |
| | b. Solvent Recovery | 18.070 | 11,295 |
| | c. GAC | 2.160 | 1,350 |
| | Total | 25.460 DM | $15,915 |

**These Costs Include:**

1. Site preparation for the plant
2. Mechanical and electrical installation charges
3. Labor, material and equipment
4. Operating supplies, utility costs, and maintenance

**These Costs Exclude:**

1. Well installation
2. Permitting costs
3. Replacement charges (depreciation)
4. Carbon replacement - liquid phase
5. Engineering charges for the sampling/testing study

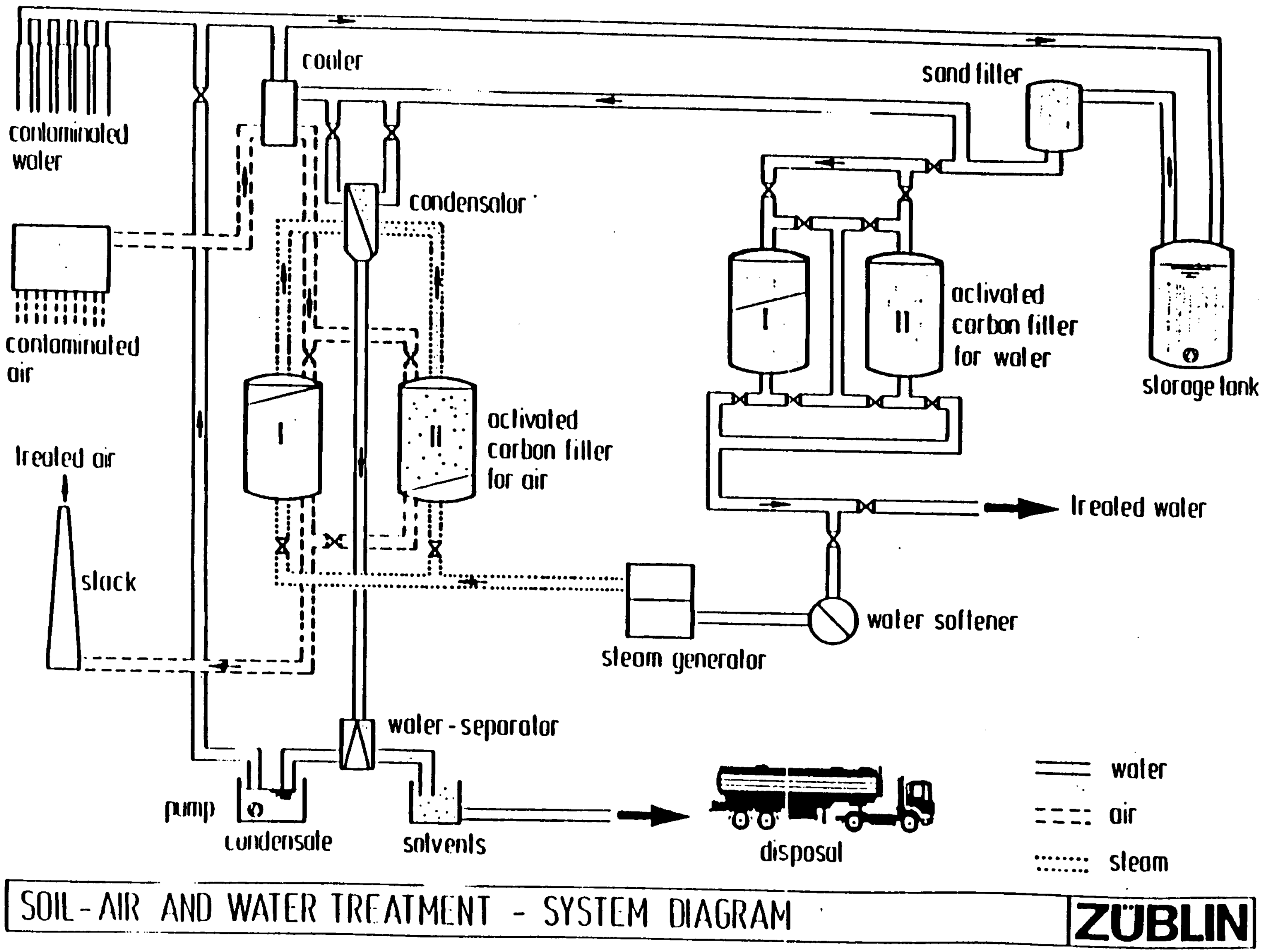



Figure 1. Schematic of the soil - air and water treatment system

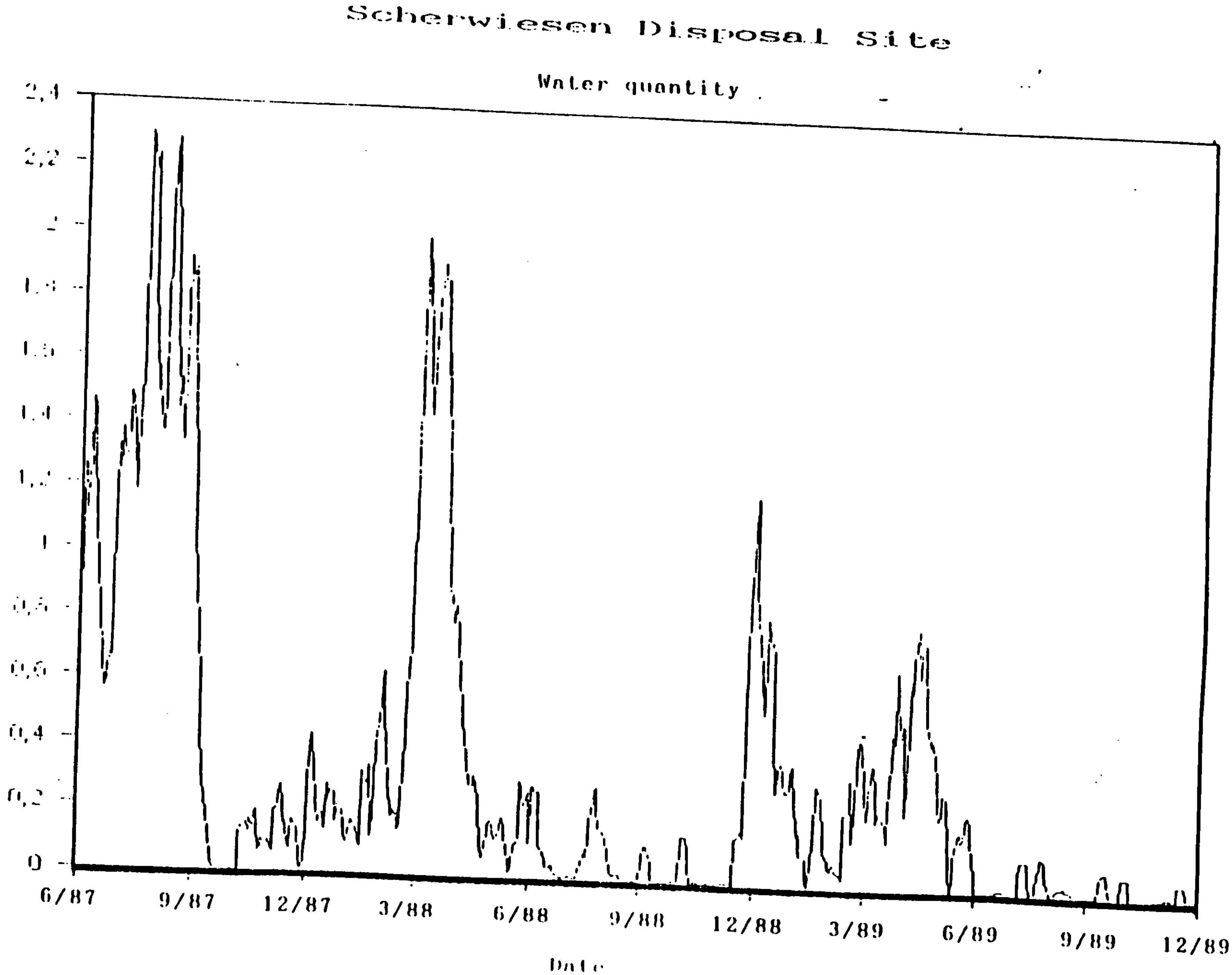



Figure 2. Quantity of perched water extracted and treated by the ...

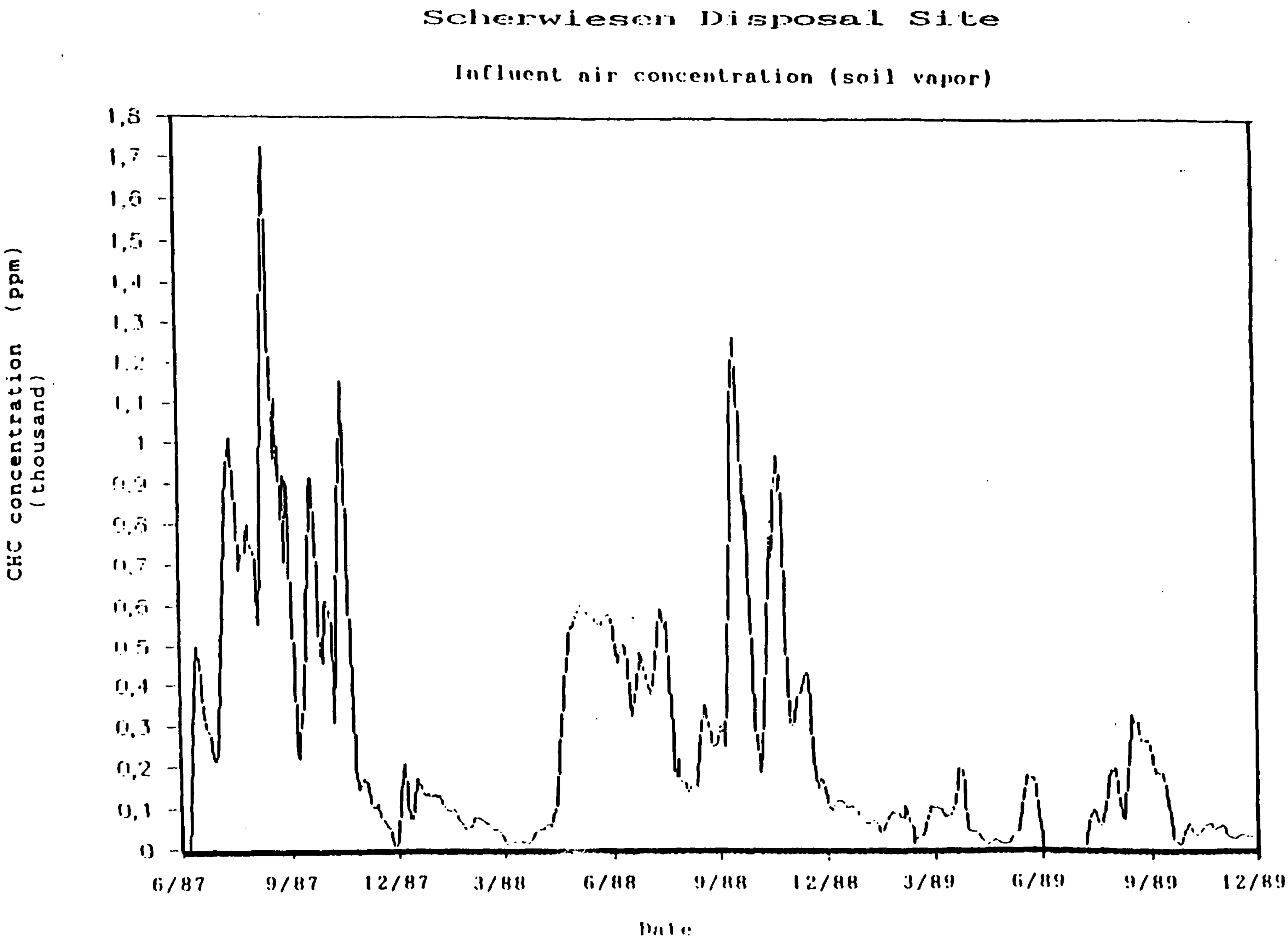



Figure 3. Influent concentrations o the soil vapor over time.

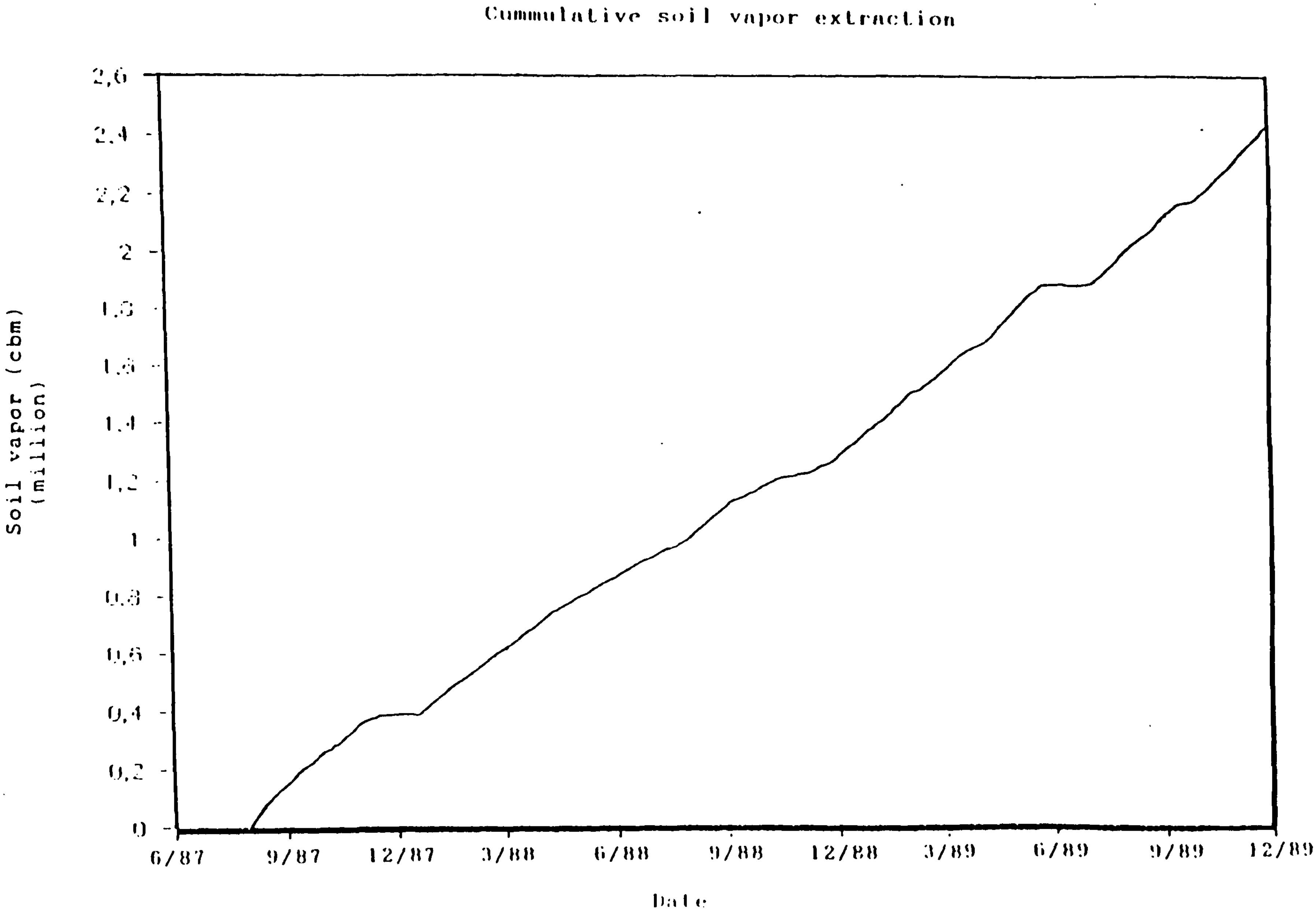



Figure 4. Cummulative quantity of soil vapor extracted and treated.

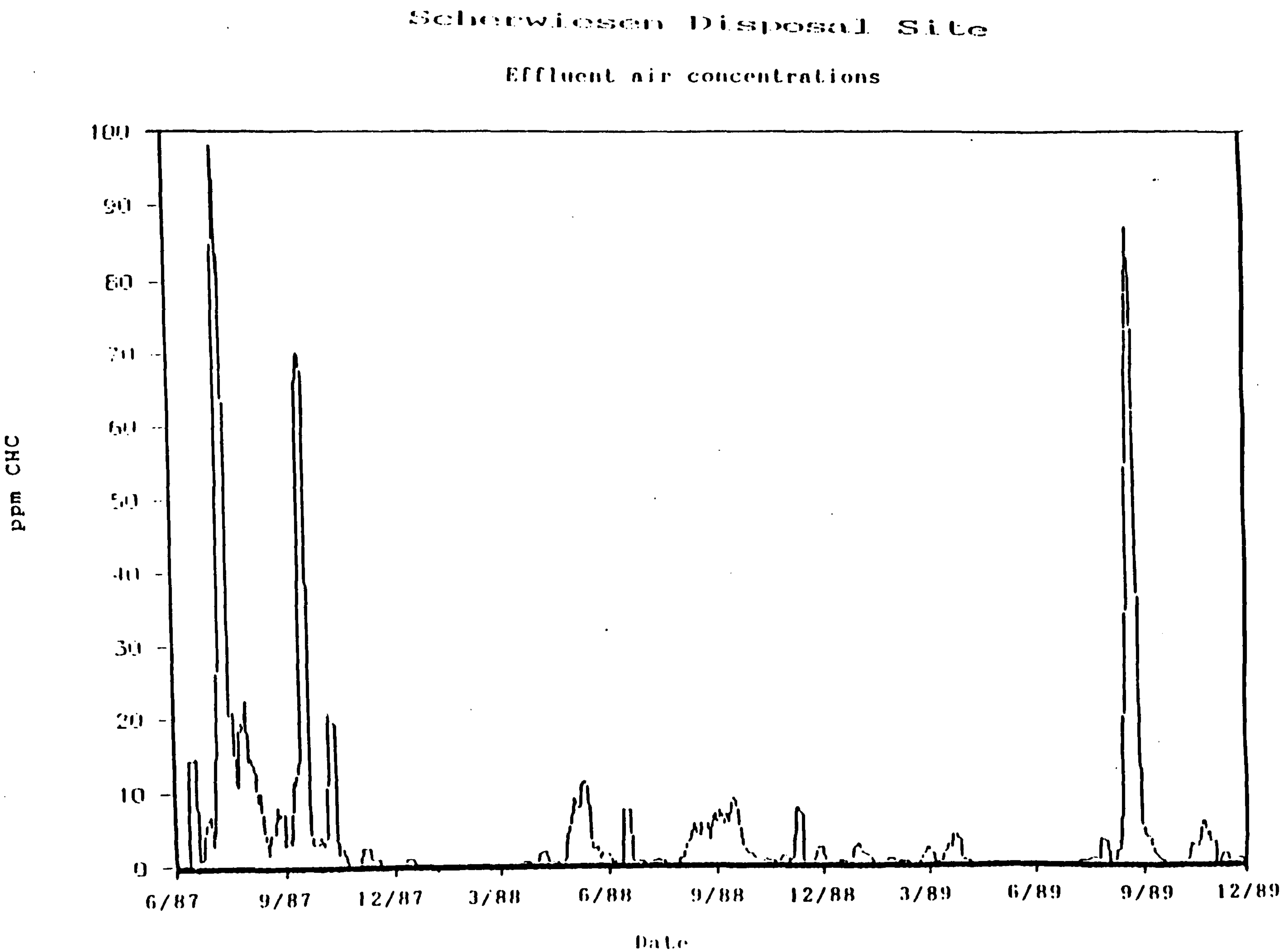



Figure 5. Effluent air concentrati    of the soil vapor extraction system.

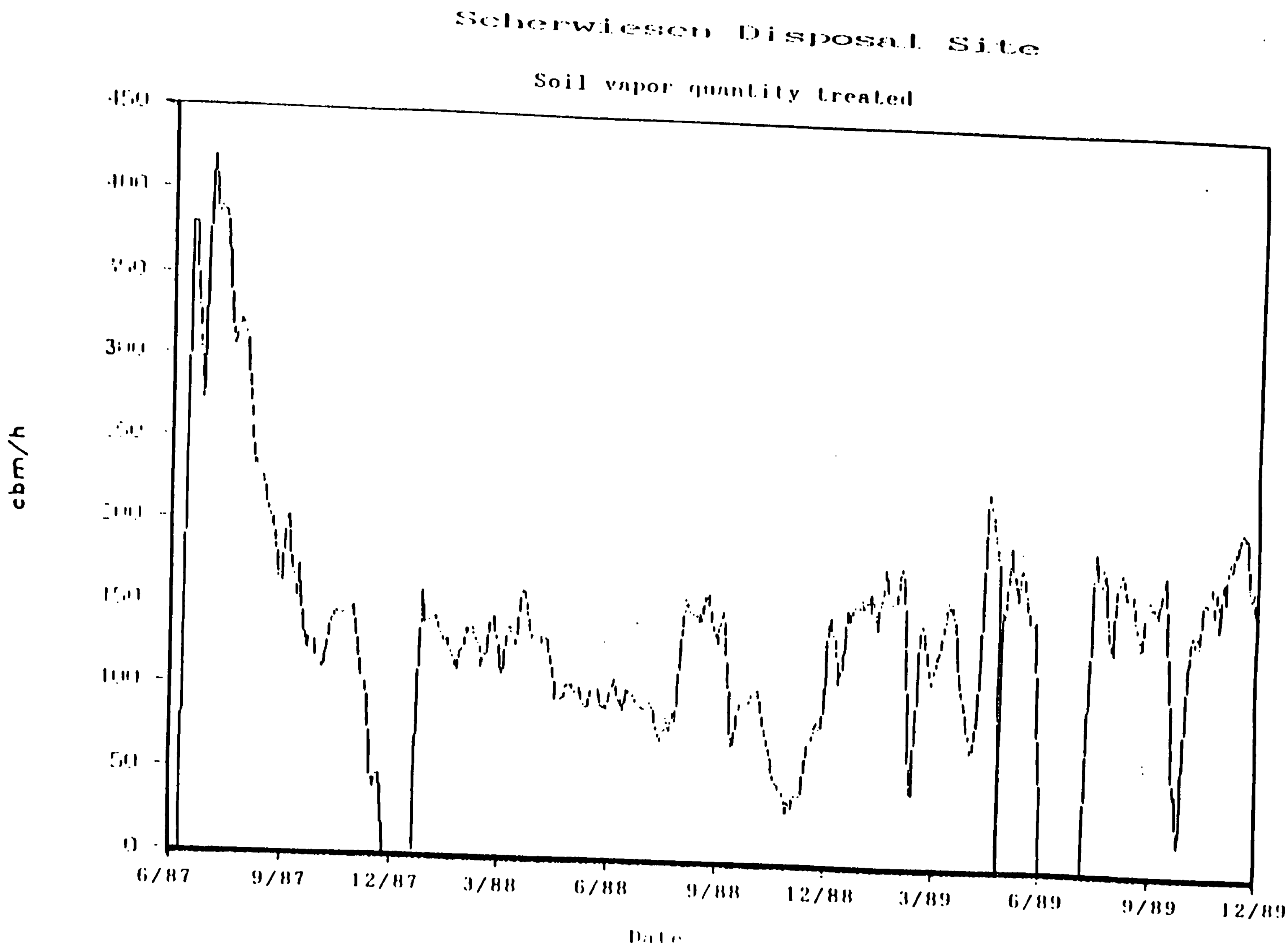



Figure 6. Soil vapor quantity treated over time.

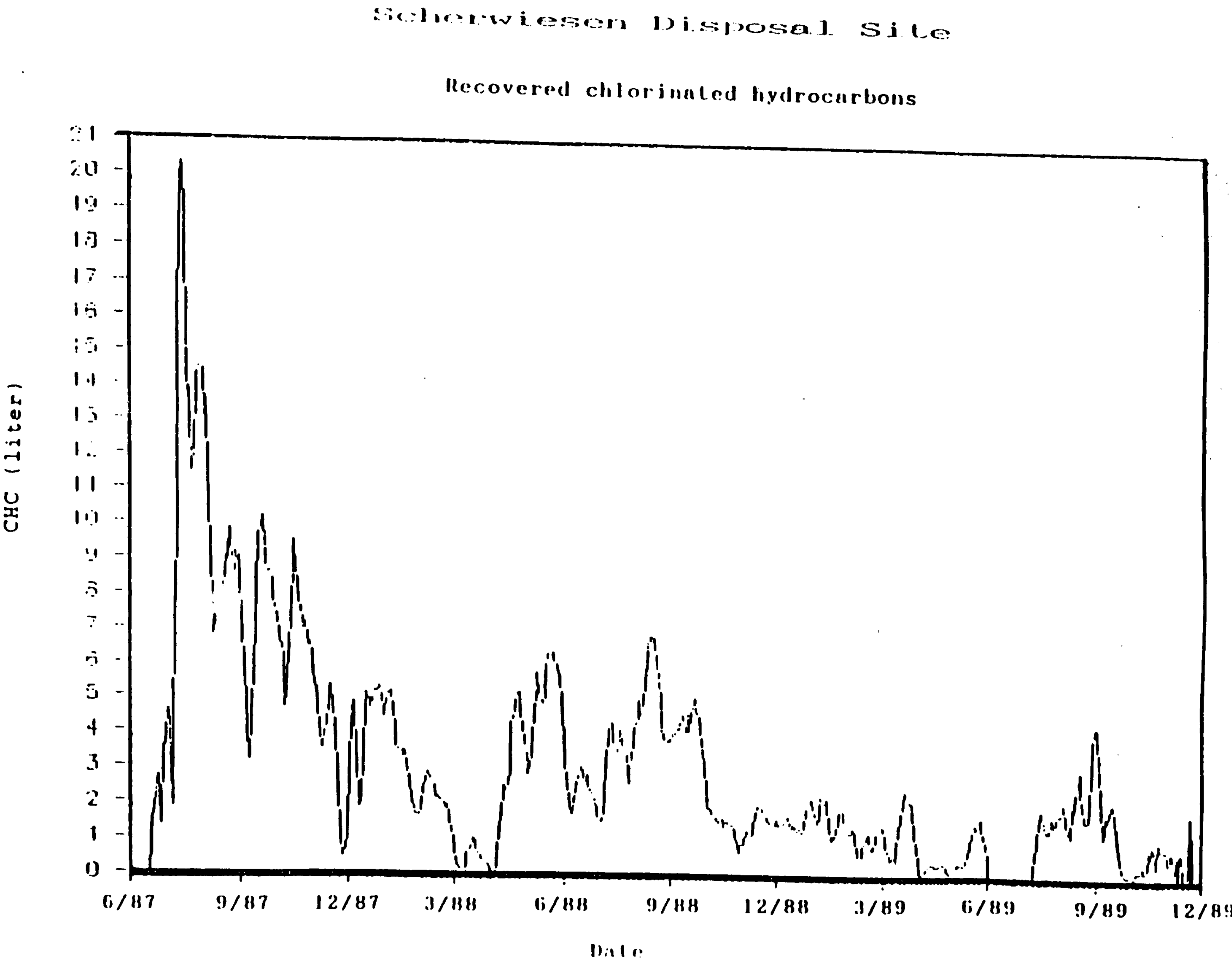



Figure 7. Chlorinated hydrocarbons covered over time.

## Scherwieser Disposal Site

Total recovered chlorinated hydrocarbons

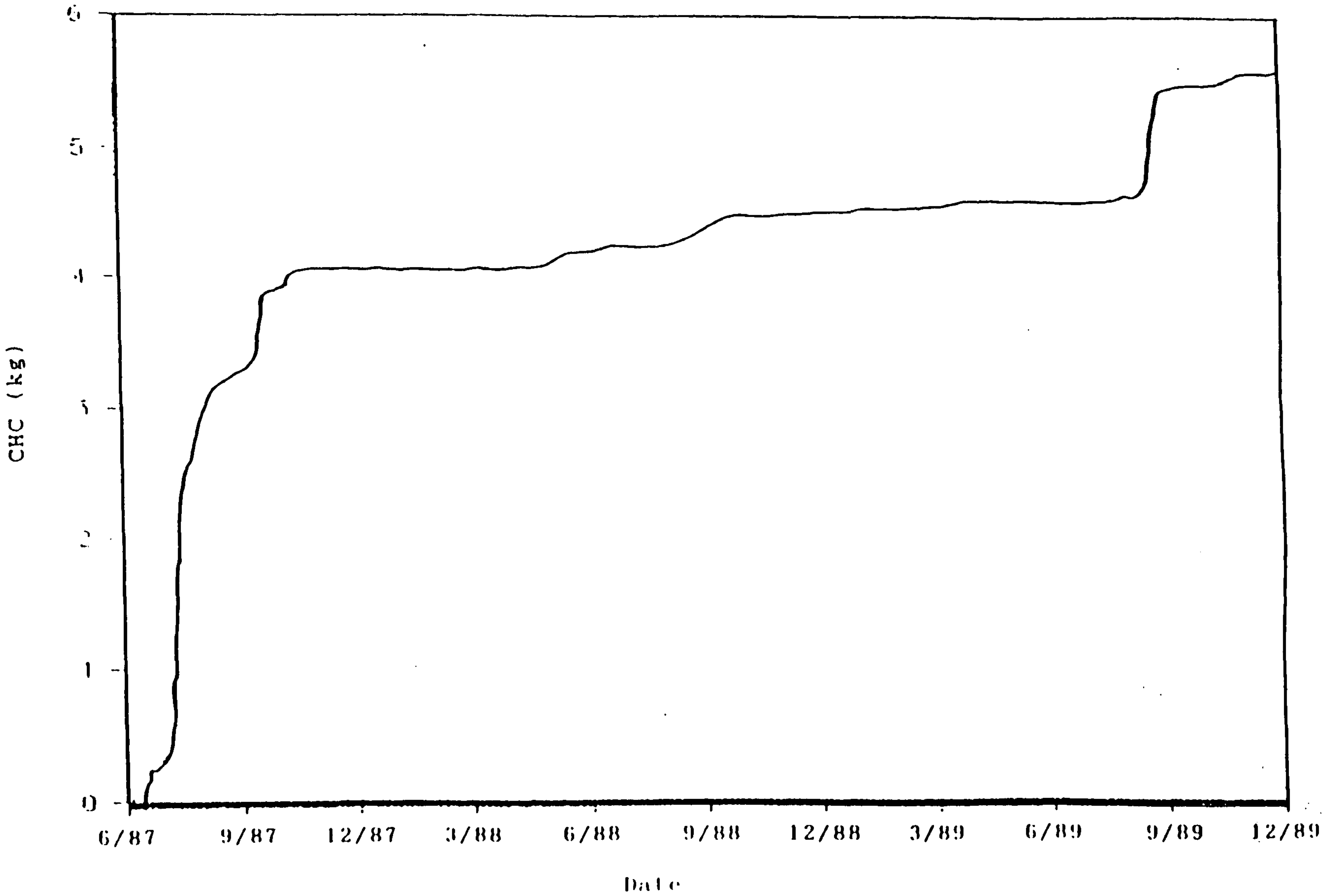
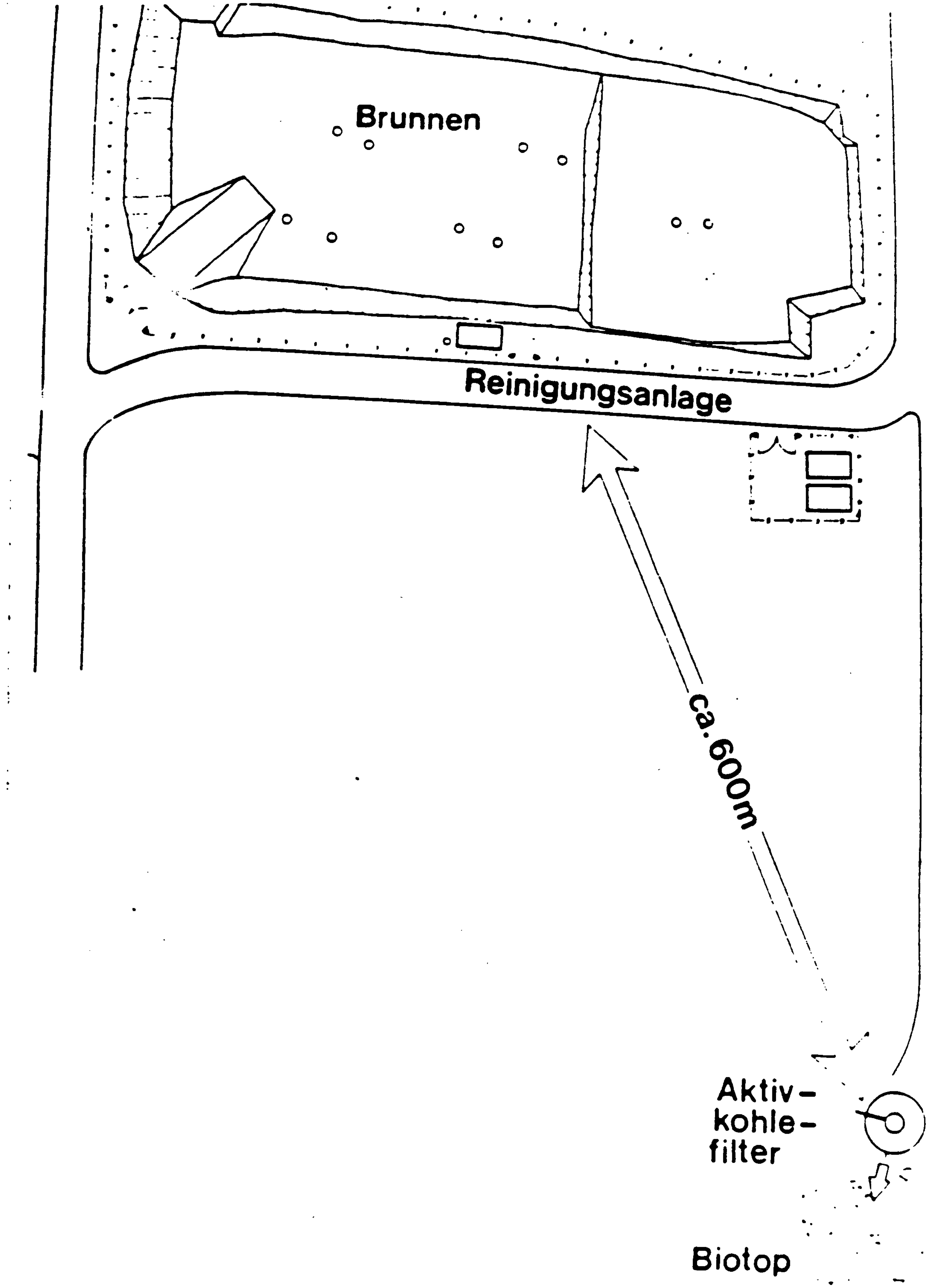



Figure 8. Cummulative solvent recovered by soil vapor treatment.




**Übersichtsplan Scherwiesen** ZÜBLI

# APPENDIX B.

# ADMINISTRATIVE RECORD INDEX

# LORD SHOPE LANDFILL
# ADMINISTRATIVE RECORD FILE *
# INDEX OF DOCUMENTS

## I. SITE IDENTIFICATION

1) Report: Site Inspection of Lord Shope for the Hazardous Site Control Division, U.S. EPA, prepared by NUS Corporation, 6/21/84. P. 100001-100199.

* Administrative Record File Available 3/23/90, update 4/12/90.

Note: Company or organizational affiliation is identified in index only when it appears in file.

## II. REMEDIAL ENFORCEMENT PLANNING

1) Letter to Mr. Eugene A. Miller, Lord Corporation, from Mr. Mark E. Gorman, Pennsylvania Department of Environmental Resources, re: Transmittal of the Consent Order and Agreement, 11/12/87. P. 200001-200022. The Consent Order and Agreement are attached.

2) Letter to Mr. Lawrence A. Demase, Esq., Rose, Schmidt, Hasley & DiSalle, from Mr. Stephen R. Wassersug, U.S. EPA, re: Review of proposed Consent Agreement and Consent Order, 12/16/87. P. 200023-200024.

3) Lord-Shope Landfill Drum Disposal Summary, summarized by Mr. J. Feeney, U.S. EPA, 8/89. P. 200025-200025.

4) Sworn Statement of Melvin Shope, 4/12/84. P. 200026-200104.

III. REMEDIAL RESPONSE PLANNING

1) Report: Hydrogeologic Summary Report, Shope's Landfill, prepared by AWARE Incorporated, 9/85. P. 300001-300119.

2) Letter to Mr. Mark Gorman, Bureau of Waste Management, from Mr. Eugene A. Miller, Lord Corporation, re: Transmittal of the second draft of the Feasibility Study Work Plan, 10/30/87. P. 300120-300147. A transmittal letter and revised Work Plan for the Feasibility Study are attached.

3) Desk Memorandum to Mr. Hector Abreu, U.S. EPA, from Mr. Mark Gorman, Pennsylvania Department of Environmental Resources, re: Transmittal of a letter, regarding Feasibility Study Work Plan Approval, 1/8/88. P. 300148-300150. The letter is attached.

4) Desk memorandum to Mr. Hector Abreu, U.S. EPA., from Mr. Mark Gorman, Pennsylvania Department of Environmental Resources, re: Phase II Remedial Investigation Work Plan, 3/11/88. P. 300151-300153. A letter, regarding the submittal of the Work Plan by Lord Shope is attached.

5) Report: Proposed Work Plan, Phase II Remedial Investigation Lord/Shope Site, prepared by AWARE Incorporated, 4/88. P. 300154-300213.

6) Letter to Mr. Eugene A. Miller, Lord Corporation, from Mr Mark E. Gorman, Pennsylvania Department of Environmental Resources, re: Review of Phase II Work Plan and revision of schedule, 6/21/88. P. 300214-300219. The Project Schedule is attached.

7) U.S. EPA Memorandum to File from Mr. Jim Feeney, re: Documentation of comments on the RI/FS made by Region III Bioassessment Work Group at September 13, 1989 meeting, 3/21/89. P. 300220-300221. A memorandum notifying Federal Natural Resource Trustees of upcoming RD/RA negotiations is attached.

8) Letter to Mr. Abraham Ferdas, U.S. EPA from Mr. Stephen D. Von Allmen, Department of Health & Human Services, re: Transmittal of completed Health Assessments for Lord Shope Landfill, 4/10/89. P. 300222-300239. The Health Assessment is attached.

9) Letter to Ms. Alyce Fritz, NOAA CRC, from Mr. Jim Feeney, U.S. EPA, re: Transmittal of the RI/FS report, 7/21/89. P. 300240-300240.

10) Report: Feasibility Study, Shope's Landfill, Girard Township, Pennsylvania, Volume I, prepared by Eckenfelder Inc., 7/89. P. 300241-300473.

11) Report: Feasibility Study, Shope's Landfill Girard Township, Pennsylvania, Volume II-Appendices, prepared by Eckenfelder Inc., 7/89. P. 300474-300694.

12) Report: Phase II, Remedial Investigation Report, Lord/Shope Site, Volume III-Appendices, prepared by Eckenfelder Inc., 7/89. P. 300695-301155.

13) Report: Shope's Landfill, Remedial Investigation Report, Biological Investigation, prepared by Eckenfelder Inc., 7/89. P. 301156-301209.

14) Report: Revised Baseline Public Health Evaluation, Phase II Remedial Investigation, Lord/Shope Site, prepared by Eckenfelder Inc., 7/89. P. 301210-301386.

15) U.S. EPA memorandum to Mr. Jim Feeney, from Mr. Dominic C. DiGiulio, through Mr. Dick Scalf, re: Review of Soil Vacuum Extraction Field Test at the Lord-Shope Site, 9/20/89. P. 301387-301391.

16) Report: Refined Groundwater Model Report, Lord/Shope Site, prepared by Eckenfelder Inc., 10/89. P. 301392-301440.

17) Letter to mr. Eugene A. Miller, Lord Corporation, from mr. Donald J. Benczkowski, Pennsylvania Department of Environmental Resources, re: Review of the draft Remedial Investigation/Feasibility Study Report, 12/5/89. P. 301441-301443.

18) Report: Feasibility Study, Shope's Landfill Girard Township, Pennsylvania, Volume I, prepared by Eckenfelder Inc., 7/89, Revised 1/90. P. 301444-301675.

19) Report: Phase II, Remedial Investigation Report, Lord/Shope Site, Volume I, prepared by Eckenfelder Inc., 7/89 Revised 1/90. P. 301676-301913.

L

## V. COMMUNITY INVOLVEMENT/CONGRESSIONAL CORRESPONDENCE/ IMAGERY

1) Press Release, Pennsylvania Department of Environmental Resources, re: Public comment period, regarding the Remedial Investigation Report, 9/9/87. P. 500001-500002.

2) Press Release, Pennsylvania Department of Environmental Resources, re: Public Informational Meeting, 11/29/87. P. 500003-500004.

3) Fact Sheet and Public Information Packet, re: Public Meeting, Lord Shope Superfund Site, October 7, 1987, (undated). P. 500005-500024. The Fact Sheet and Information Packet are attached.

4) Imagery: Shope's Landfill, Phase II, Remedial Investigation Report, Volume II, Hydrogeologic Maps, prepared by Eckenfelder Inc., 7/89. P. 500025-500046.

5) Press Release, Pennsylvania Department of Environmental Resources, re: Recommendations Available for Public Review, 8/4/89. P. 500047-500047.

6) Proposed Plan for the Remediation of the Lord-Shope Superfund Site in Girard Township, Erie County, Pennsylvania, (undated), (author unknown), P. 500048-500058.