ECKENFELDER INC.

AR301676

PHASE II
REMEDIAL INVESTIGATION REPORT
LORD/SHOPE SITE
VOLUME I

Prepared for

Lord Corporation
2000 W. Grandview Boulevard
Erie, Pennsylvania 16512

Prepared by

ECKENFELDER INC.
Nashville, Tennessee
and
Mahwah, New Jersey

July 1989
Revised January 1990

6476

ECKENFELDER INC.

January 17, 1990 6476

Mr. Eugene A. Miller
Lord Corporation
2000 West Grandview Boulevard
Erie, Pennsylvania 16512

RE: Revised Lord/Shope Remedial Investigation Report

Dear Mr. Miller:

We are pleased to present Volumes I and II of the revised Phase II Remedial Investigation Report (RI) for the Lord/Shope site located in Girard Township, Pennsylvania. These volumes include the text and the hydrogeologic maps, respectively. The Phase II RI report was originally submitted on July 10, 1989 in accordance with the Proposed Work Plan for a Phase II Remedial Investigation Study, dated April, 1988. This report has been revised to incorporate the comments received in a letter from the Pennsylvania Department of Environmental Resources (PADER) on December 6, 1989. The Appendices contained in Volume III have not been transmitted as they were not revised.

All of PADER's comments regarding the RI were addressed in the revised submission. These have been incorporated into the RI in the form of text revisions, changes to several tables and figures and additions to each of the sheets.

If you have any questions regarding this or any other matter, please do not hesitate to contact us.

Very truly yours,

ECKENFELDER INC.,

Scott D. MacMillin
Senior Manager

Robert D. Mutch, Jr., P.Hg., P.E.
Executive Vice President

/cas

AR301678

1200 MacArthur Boulevard
Mahwah, New Jersey 07430
201.529.0900
FAX 201.529.0818

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EXECUTIVE SUMMARY

This report presents the results of the Phase II Remedial Investigation of the Shope's Landfill site in Girard Township, Pennsylvania. The site was previously owned and operated by Melvin Shope, who disposed of various industrial wastes that originated from two Lord Corporation plants located in Erie and Saegertown, Pennsylvania. The site, which was operated until 1979, received waste rubber scrap, demolition debris, and drummed waste consisting primarily of spent adhesives, waste paint, and paint sludges plus some smaller quantities of solvents, cooling oils, acids and caustics.

A remediation of the landfill was voluntarily conducted in accordance with an Administrative Consent Order by Lord Corporation in 1982-83. This included removal of exposed drums, construction of a composite landfill cap, the construction of an upgradient groundwater cutoff wall and the regrading and revegetation of the landfill. The stated objective of this work was to reduce the generation and release of new leachate by 99 percent. Post construction monitoring data have indicated that this reduction has taken place, based upon the assumptions presented in Section 2.2.

Numerous site studies have been conducted since 1980. These studies included the investigation of groundwater, surficial soils, deep soils, surface water, and the water quality monitoring of site monitoring wells and nearby residential water supply wells.

A two-phased, comprehensive field investigation has been conducted in conjunction with the preparation of this Phase II Remedial Investigation Report. The Phase II field investigation included the drilling of test borings at seven locations. Nine new, individual wells or piezometers were installed bringing the site total to 92. Other activities included hydraulic conductivity testing on numerous wells and piezometers, and the sampling and analysis of soils, surface water, sediment and numerous new and existing monitoring wells. The data from this investigation have been combined with the substantial existing database, including the data from the Supplemental (Phase I) Remedial Investigation, to provide this comprehensive site document. Finally, the resultant database has been placed into perspective as to the

existing and potential future impact that the site may have with respect to public health (presented in a separate report).

By way of summary, the following conclusions regarding the hydrogeologic and environmental conditions of the Shope's Landfill site can be drawn:

- 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.

- Discrete, laterally continuous water-bearing zones have been identified that correspond to the coarse-grained subunits of each of the glacio-lacustrine units and to adjacent coarse-grained tills. These water-bearing zones have been termed Water Table, Intermediate and Deep.

- None of the water-bearing zones except for the surficial Water Table Zone and one area of the Intermediate Zone north of the landfill can be termed an aquifer due to their relatively low hydraulic conductivities. Likewise, the groundwater flow rate in most of the Intermediate Zone and in the Deep Zone is relatively slow. The groundwater flow rate in the water table is significantly more rapid.

- Groundwater within the Water Table and Intermediate zones flows toward the north and northwest in response to the site topography. The Deep zone flows toward the southwest.

- Vertical hydraulic gradients between the Water Table Zone and the underlying Intermediate Zone are downward beneath the landfill and upward north of the site. Vertical gradients from the Intermediate Zone to the Deep Zone are strongly downward throughout the site area.

- Surficial soils are found to contain volatile organic compounds around the immediate perimeter of the landfill. These correspond to

wet "seep" areas and to an area of possible waste spillage to the southeast of the site. Volatile organics in this southeastern area have been observed to extend to a maximum depth of 30 feet.

- A well defined groundwater plume has been identified consisting primarily of non-halogenated volatile organic compounds, but also containing halogenated volatiles. The plume is restricted primarily to the Intermediate zone but is also found at lower concentrations in the water table zone. In general, the plume has migrated approximately 150 to 600 feet toward the north and west. An exception is a plume extension north of the landfill that has migrated approximately 1400 feet from the landfill in an area shown to have a higher hydraulic conductivity.

- Elevated levels of metals have also 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.

- Relatively low levels of semi-volatile organics have been observed in only a small number of wells, primarily located at the landfill margin.

- PCBs and pesticides have not been observed in any samples.

- No evidence of landfill-derived constituents has been observed in the deep zone downgradient of the site.

- No residential wells have been affected by the groundwater plume.

- 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.

- No indication of landfill derived organic compounds has been observed in the two small streams in the vicinity of the site. There is some

evidence of elevated metals in the small stream located north of the landfill.

- Low levels of tetrahydrofuran and several metals were detected in several of the Intermediate Zone wells located east of the landfill in a cross-gradient direction. The presence of these compounds in cross-gradient wells is attributed to spillage that may have occurred along the site access road. The landfill is not considered to be a viable source of these compounds at this location.

- Improvement of water quality in water table and intermediate zone wells located downgradient of the site provides a further indication of the benefits of these remedial measures. However, these measures have not addressed the existing groundwater plume located further downgradient of the site.

Sec 1

1.0 INTRODUCTION

This report presents the results of both phases of the Remedial Investigation that has been conducted at the Shope's Landfill site in Girard Township, Pennsylvania. This site was formerly owned and operated by Melvin Shope, who disposed of industrial waste generated by two Lord Corporation Plants located at 12th Street in Erie, and in Saegertown, Pennsylvania. Lord has taken over the property and is now responsible for all aspects of the site, including environmental remediation.

The Phase II Remedial Investigation (RI) has been conducted on behalf of Lord Corporation in order to supplement the existing data that were collected during previous investigations. This work included two hydrogeologic investigations conducted in 1979-80 by Dr. Samuel Harrison followed by additional hydrogeologic work by Wehran Engineering in 1981. A number of remedial options were evaluated on the basis of those hydrogeologic data. An option was selected that included the removal of exposed drums, construction of a composite cap, an upgradient groundwater cutoff wall, and improvements to site drainage. Those remedial measures were voluntarily implemented during 1982-83. A consent order was entered into by Lord Corporation and the Pennsylvania Department of Environmental Resources (PADER) which included, in addition to the requirements associated with the remedial action, the development and implementation of a monitoring program. Additional monitoring wells were installed by AWARE* in 1984 in order to expand the existing monitoring well network. A hydrogeologic summary report was prepared in 1985 on the basis of data collected from these newly installed monitoring wells.

A considerable body of hydrogeologic and water quality data was in place as a result of the above-described programs, prior to the initiation of the subject Remedial Investigation (RI). This current investigation, which has been conducted in accordance with the RI guidance under CERCLA, has addressed these existing data in addition to presenting the new data. In this way, this report serves as a comprehensive report of the field investigations that have been conducted at the site by ECKENFELDER INC. (formerly AWARE Incorporated).

Note: *On March 1, 1989, AWARE Incorporated became ECKENFELDER INC.

The investigation described in this report was conducted in two phases. The initial phase of work (Phase I RI) was conducted during 1986 and 1987, and was reported in the Shope's Landfill Remedial Investigation Report (AWARE, 1987). The second phase of work (Phase II RI) was conducted during 1988 and 1989. This Phase II report contains the new data collected to date and is essentially an update of the original 1987 report. The RI report primarily addresses the hydrogeologic characterization of the site. However, other media such as site surface water and air quality have been addressed as well. In addition, a Biota Study and a Revised Baseline Public Health Evaluation have been conducted and are presented as separate reports.

This report is contained within three volumes. Volume I contains the Phase II Remedial Investigation Report. As previously stated, this report is an update of the 1987 RI report. In addition, the RI report has relied extensively on the existing Hydrogeologic Summary Report (AWARE, 1985) and the Remedial Effectiveness Report (AWARE, 1986b), much of which are contained within. The hydrogeologic maps are presented in Volume II as a bound set of 2' x 3' sheets. The Appendices are found in Volume III.

Sec I

2.0 SITE CHARACTERISTICS

2.1 SITE OPERATION AND DESCRIPTION

In this section, the location, physical features, and a brief history of the operation of the landfill are presented.

2.1.1 Site Location

The Shope's Landfill site is located in Girard Township, Erie County, Pennsylvania (Figure 2-1). The property encompasses approximately 25.2 acres and is situated between U.S. Route 20 to the north and Interstate Route 90 to the south. The property is bounded on the east by two residential properties including that of Melvin Shope, an apple orchard and vineyard to the south, an evergreen nursery to the west, and an overgrown cornfield to the north. The nearest population center, Girard Borough, is located two miles to the northeast. The only nearby residences are located along Pieper Road, to the east and northeast and along Route 20 to the north. The Overlake Golf Course is located close to the site, to the north.

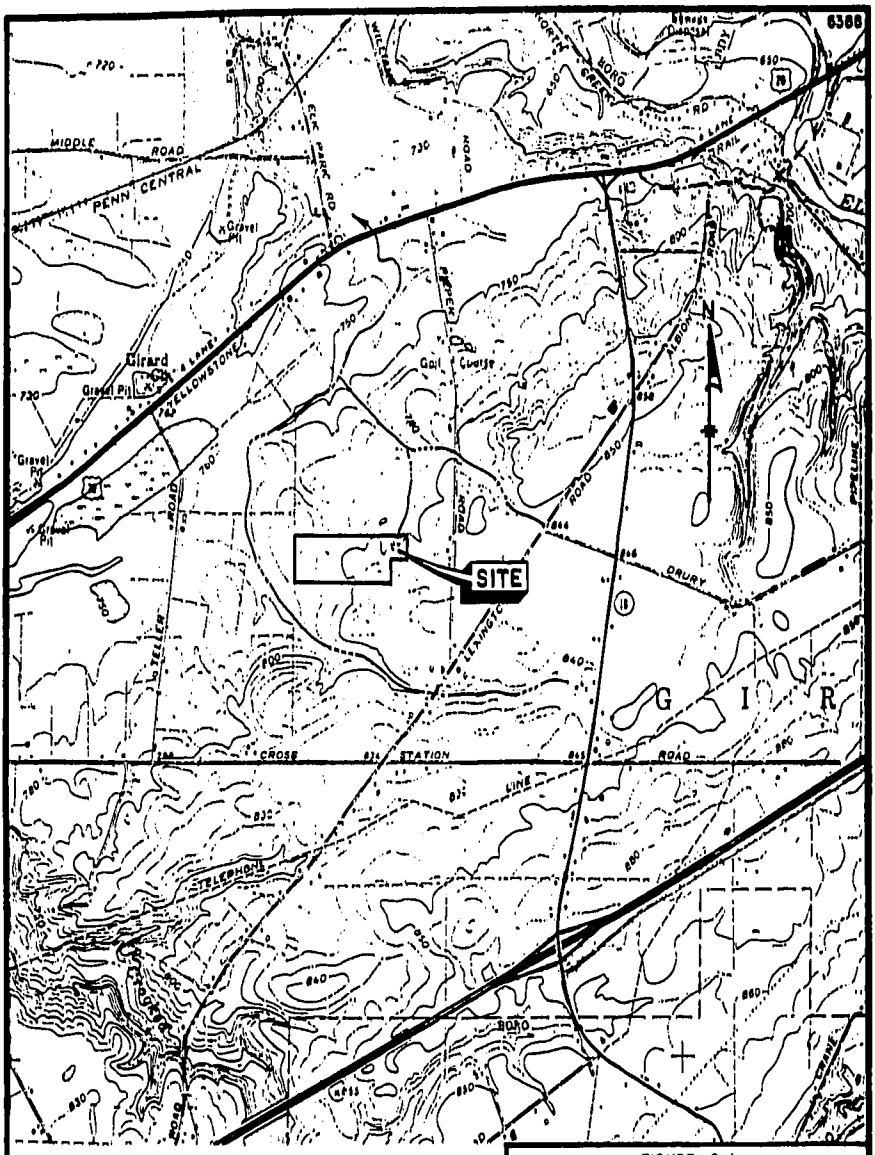
2.1.2 Site Layout

The landfill occupies approximately four acres of the central portion of the property (Sheet 1 of 21). The remainder of the Lord property includes mowed grass on the east and forest on both the north and west.

The property ranges in elevation from a maximum of 820.1 feet on the landfill cap to less than 780 feet in the northwest corner of the property. The landfill itself is manifested as a grass covered mound, rising a maximum of 20 feet. The adjoining land slopes gently to the north and northwest.

2.1.3 Site History and Waste Components

The Lord/Shope site was formerly used as an industrial waste landfill. The site was owned and operated by Melvin Shope whose wife still [illegible] east of the landfill. Mr. Shope, who worked for Lord Corporation in the



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

2000 0 2000
scale feet

MAP LOCATION

FIGURE 2-1

LOCATION MAP

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

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

Maintenance Department, hauled and disposed of waste generated from Lord's 12th Street, Erie and Saegertown plants. No waste other than that generated by these Lord facilities is reported to have been disposed at the Shope's site. The landfill was operated from the late 1950s until its closure on June 28, 1979.

The waste contained in the landfill was disposed of directly on the original ground surface. On this basis, the thickness of the waste does not exceed a maximum of 20 feet. The approximate landfill base grade is presented on Figure 2-2. This map was prepared on the basis of borings drilled through the landfill and a pre-remediation (1982) site topographic map.

The waste contained in the landfill reportedly consists 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, and naphtha and only small proportions of chlorinated compounds. Minor 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. Disposal of drummed waste was discontinued following a fire that occurred at the landfill on June 26, 1971.

2.2 SITE REMEDIATION

A remedial action was undertaken in 1982 and 1983 in accordance with an Administrative Consent Order. The remediation included the removal of exposed drums, the construction of a composite cap, the construction of an upgradient cutoff wall, and the regrading and revegetation of the site. The effectiveness of this remedial action has been evaluated and it is believed that it has been approximately 99 percent effective. The evaluation of effectiveness is presented in detail in Appendix H.

The stated objective of the remedial work was to reduce the volume of new leachate that was generated and released from the landfill. Leachate is generated through the percolation of incident precipitation through the

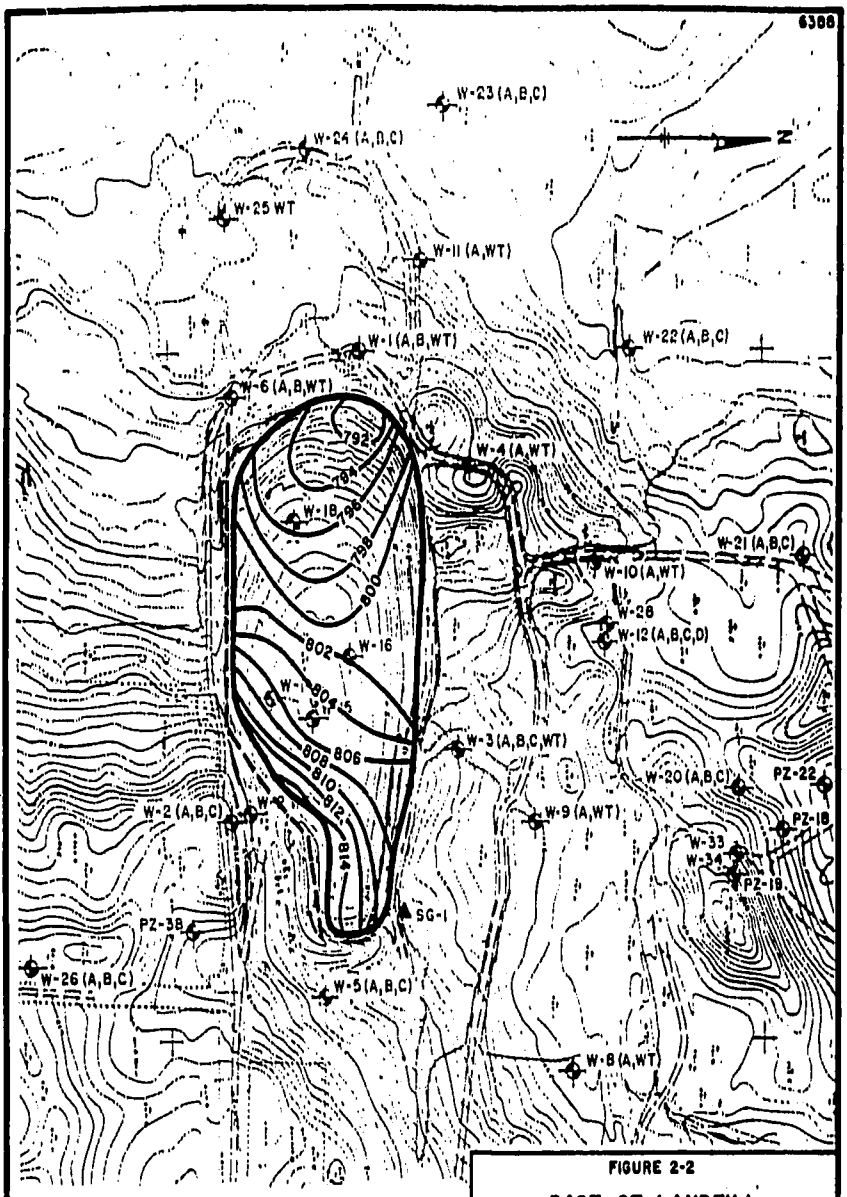


FIGURE 2-2

BASE OF LANDFILL CONTOUR MAP

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

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

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landfill surface and from groundwater inflow through the landfill. The cap was intended to virtually eliminate the infiltration of precipitation into the landfill. The cutoff wall was intended to reduce the volume of groundwater inflow into the landfill from upgradient sources.

The effectiveness of the remedial work has been evaluated on the basis of pre- and post-construction monitoring data. These data indicate that approximately 87.5 percent of the leachate had been generated through the percolation of precipitation in the landfill. This source has been almost completely eliminated by the construction of the landfill cap. Furthermore, direct groundwater flow through the base of the landfill has been reduced approximately 94 percent through the combined effect of the upgradient cutoff wall and the landfill cap. The actual combined effect of these improvements is difficult to assess; however, it is believed that an estimated 99 percent reduction in leachate reduction has taken place. (Appendix H)

2.3 ENVIRONMENTAL SETTING

2.3.1 Land Use

The area surrounding the Shope's landfill is primarily rural. Figure 2-3 indicates that the area within the vicinity of the landfill is predominantly used for agricultural purposes. With the exception of a number of scattered residential areas bordering the roads, the only other significant land use is that of the golf course located to the north and north-northeast of the site.

The scattered residences within the vicinity of the site are supplied with water from private wells and use septic systems. The nearest residences which are in downgradient directions from the landfill are located at least 3,000-4,500 feet away.

Zoning regulations exist in Girard Township. The zoning in the vicinity of the site is depicted on Figure 2-4. The site and the adjacent land to the south is presently zoned A-1 (Agricultural). The adjoining land to the north is zoned R-3 (High Density Residential), although it is presently vacant.

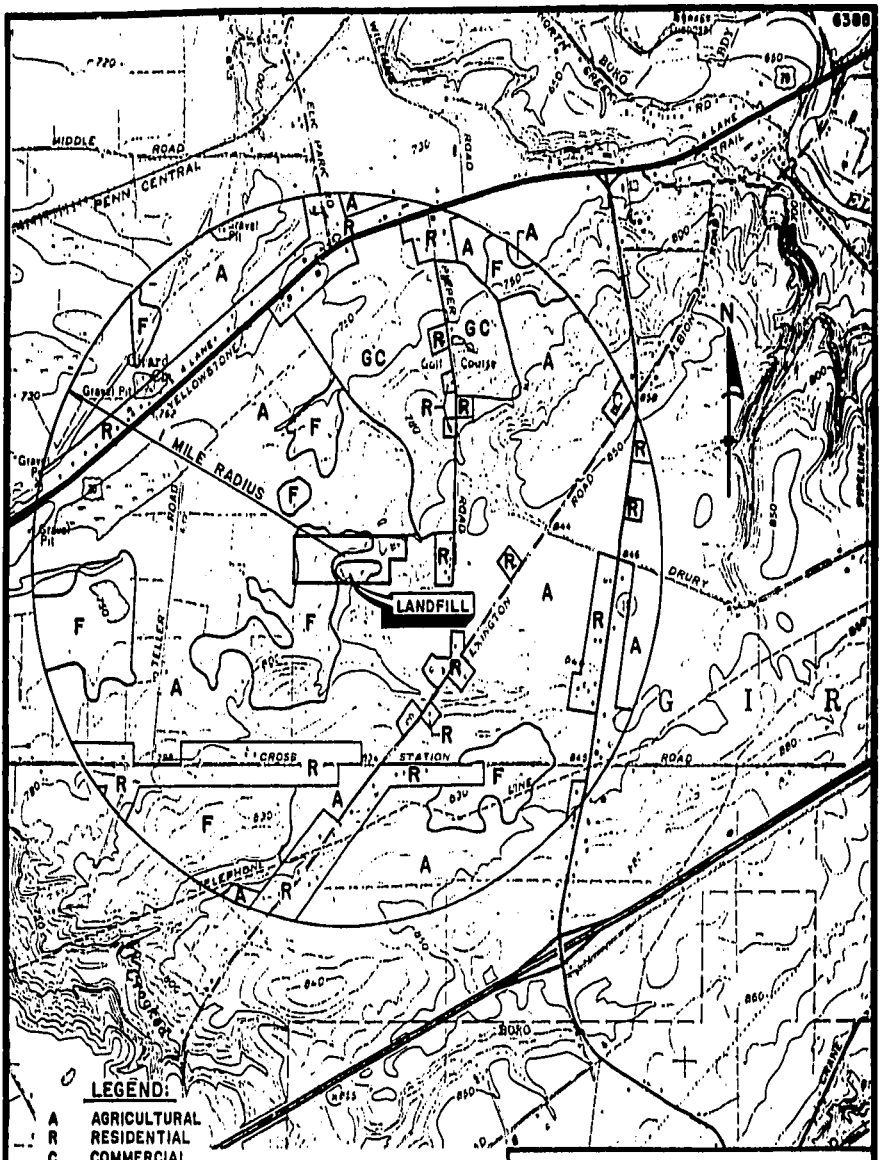

FIGURE 2-3

LAND USE MAP

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

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

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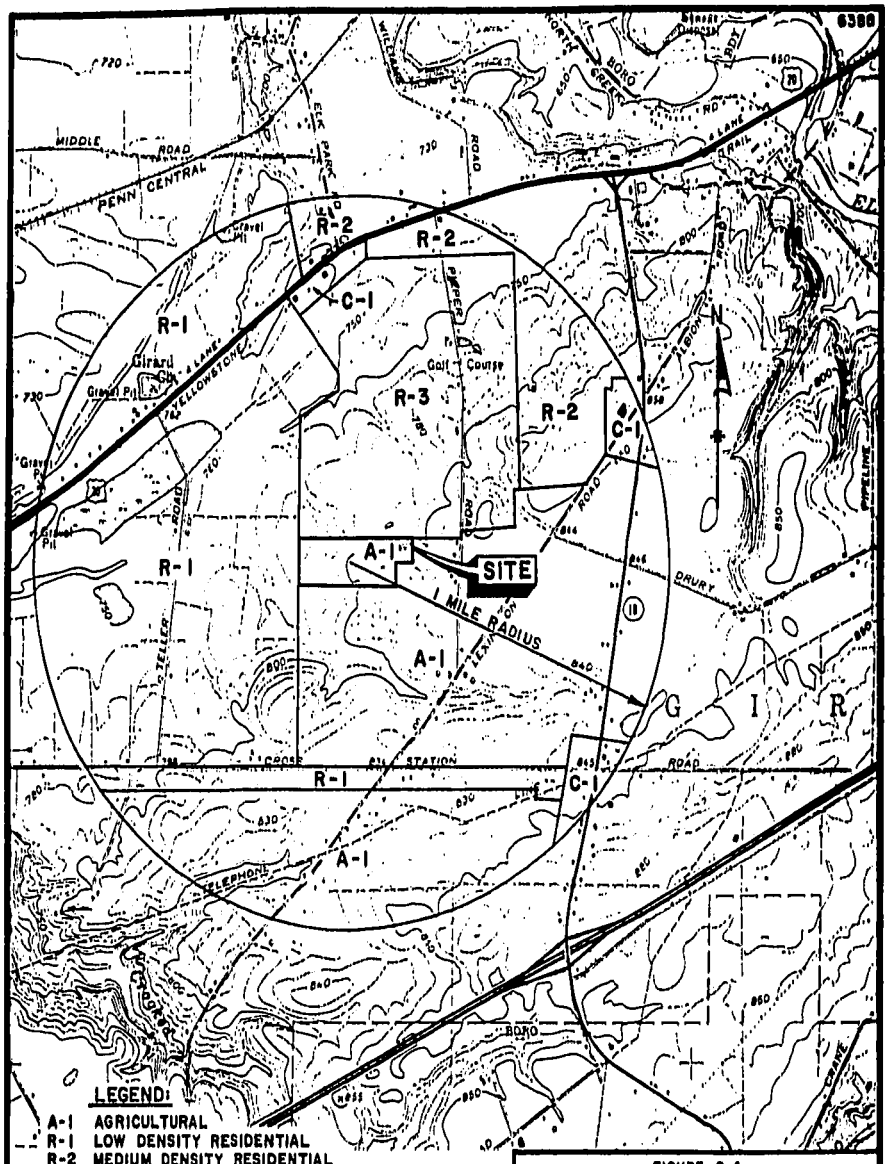

FIGURE 2-4

ZONING MAP

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

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

2.3.2 Climate and Meteorology

Climatological data have been recorded at the NOAA measuring station located at the Erie International Airport, approximately 11 miles northeast of Shope's Landfill. The climate in this part of the state is characterized as continental; however, the presence of nearby Lake Erie is a major factor with regard to the overall climate. The lake generally moderates the temperatures and produces an excess of cloudiness and frequent snow and rain squalls.

Temperatures (Table 2-1) range from a normal daily maximum of 78.2°F in July to a normal daily minimum of 17.7°F in February. The precipitation (Table 2-2) is relatively evenly distributed throughout the year with the highest mean monthly precipitation being recorded in September at 3.66 inches and the lowest mean being recorded in February at 2.39 inches. The most significant snowfall occurs in January with an average monthly accumulation of 21.6 inches. A summary of the monthly wind data is presented on Table 2-3. On an annual basis, the prevailing wind direction is from the south on an average of 11.2 mph.

2.3.3 Surface Water

The land in the vicinity of the Shope's 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 two and one-half miles to the north. Both of these streams likely represent man-made drainage channels excavated many years ago to provide site drainage for agricultural production in this area. The larger of the two streams, termed "unnamed" 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 originating immediately north of the site flows north to a point where it joins the unnamed tributary. Neither of these streams flows directly on the Lord/Shope property.

The unnamed tributary flows continuously throughout all periods of the year in the vicinity of the site. However, the upper 1,000 feet of the smaller stream flows only seasonally in periods of wet weather. The locations of the streams are designated on Figure 2-1.

TABLE 2-1
TEMPERATURE DATA SUMMARY
ERIE, PENNSYLVANIA
(1951 - 1980)

Month	Normal Daily Maximum (Deg. F)	Normal Daily Minimum (Deg. F)	Normal Monthly (Deg. F)
January	30.9	18.0	24.5
Febuary	32.2	17.7	25.0
March	41.1	25.8	33.5
April	53.7	36.1	44.9
May	64.6	45.4	55.0
June	74.0	55.2	64.6
July	78.2	59.9	69.1
August	77.0	59.4	68.2
September	71.0	53.1	62.0
October	60.1	43.2	51.7
November	47.1	34.3	40.7
December	35.7	24.2	30.0
Annual	55.5	39.4	47.4

Source: NOAA (1984)

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TABLE 2-2
PRECIPITATION DATA SUMMARY
ERIE, PENNSYLVANIA
(1873 - 1984)

Month	Mean Precipitation (Inches)	Mean Snowfall (Inches)
January	2.67	21.6
Febuary	2.39	15.3
March	2.78	10.5
April	3.11	2.5
May	3.36	0.0
June	3.47	0.0
July	3.29	0.0
August	3.29	0.0
September	3.66	0.0
October	3.51	0.4
November	3.49	11.1
December	2.89	20.6
Annual	37.91	81.9

Source; NOAA (1984)

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TABLE 2-3
WIND DATA SUMMARY
ERIE, PENNSYLVANIA
(1873 - 1984)

Month	Mean Speed (mph)	Prevailing Direction (through 1963)
January	13.3	WSW
Febuary	12.2	WSW
March	12.2	NNE
April	11.7	WSW
May	10.0	WSW
June	9.5	S
July	9.0	S
August	8.9	S
September	9.9	S
October	11.2	SSE
November	13.0	SSW
December	13.5	SSW
Annual	11.2	S

Source; NOAA (1984)

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2.3.4 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 1982-83. Cap runoff is directed through several swales off the cap and around the perimeter of the landfill towards the woods west of the site. Most of this runoff likely recharges the water table in this area west of the site. However, some of this flow also moves directly to a poorly defined swale that flows in a northwesterly direction from the site.

Prior to the construction of the site cap and the associated drainage swales, a significant quantity of uncontrolled surface flow occurred to the north of the site into the small stream. In an effort to stem this flow, a shallow drainage swale was constructed by the northern, adjacent property owner. This swale was constructed parallel to the present northern property line to direct the flow in an easterly direction toward the small stream.

Several areas adjacent to the site are seasonally wet. These areas have previously been termed "seep" areas by representatives of the Pennsylvania Department of Environmental Resources (PADER). However, for the most part, they are not truly seeps as no flow is observed to emanate from these areas. Rather, these "seeps" represent areas in which the shallow water table intersects the ground surface in low lying areas. The degree to which standing water exists in these areas is reflected in the seasonal position of the water table. That is, the "seep" areas are observed to be wettest in the spring and early summer. The locations of the designated "seep" areas are indicated on Sheet 1 of 21.

2.4 DEMOGRAPHY

As described in the previous section, Girard Township is in a predominantly rural part of Erie County, Pennsylvania. Demographic data for the Township has been characterized on the basis of 1980 census data.

The population of Girard Township has steadily increased since 1930. The projected population in 1986 was 4,380 as compared to a 1930 population of 1,465. The most rapid growth occurred from 1970 to 1980 during which the population increased from 3,074 to 4,306. The census projections indicate that the Township will continue to grow due to large amounts of land that are available for development.

The age distribution in Girard Township in 1980 was relatively young with a median age of 27.7 years. A complete compilation of the age distribution is presented on Table 2-4.

The household and ethnic composition of Girard Township from 1960 to 1980 is presented on Table 2-5. During this period, the number of households has increased by 65 percent, while the number of persons per household has decreased by 15 percent.

The total labor force of people residing in Girard Township in 1980 was 2,104. Manufacturing and retail trades represent the predominant occupation of Township residents. Additional data on labor and employment are presented on Table 2-6.

The total number of housing units available in Girard Township in 1980 was 1,587, as presented on Table 2-7. The number of vacant units was 100. The median value of the houses at that time was $44,200 (Table 2-8).

TABLE 2-4

1980 AGE DISTRIBUTION DATA
Girard Township, Pennsylvania

Age	Male	Female	Total	Percent
0-2	103	94	197	4.58
3-6	140	146	286	6.64
7-14	352	316	668	15.51
15-24	379	415	794	18.44
25-34	365	332	697	16.19
35-44	249	280	529	12.29
45-54	212	208	420	9.75
55-64	172	191	363	8.43
65+	167	185	352	8.17
Total	2,139	2,167	4,306	100%
Median Age	27.4	28.0	27.7	

Source: 1980 Census, Erie County, PA

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TABLE 2-5

SUMMARY OF 1960, 1970, and 1980
POPULATION CHARACTERISTICS

	1960	1970	1980
Total Population	2,432	3,074	4,306
Male Population	1,262	1,535	2,139
Female Population	1,170	1,522	2,167
White Population	2,425	3,068	4,287
Black and Other Population	7	6	19
Median Age	NA	24.7	27.7
Percent 18 and Under	NA	38.8	17.0
Percent 65 and Over	NA	6.7	8.17
Number of Households	646	871	1,438
Persons Per Household	3.76	3.53	2.99

Source: 1980 Census, Erie County, PA
1979 Girard-Lake City Area Background
Analysis and Comprehensive Plan

AR301710

TABLE 2-6

GIRARD TOWNSHIP
EMPLOYMENT AND LABOR FORCE STATUS
16 YEARS AND OVER
1980

Total Labor Force	Male	Female
Employed	1,152	652
Unemployed	97	203
Not in Labor Force	229	695

Employed Persons by Industry

Agriculture, Forestry, Fisheries, Mining	91
Construction	49
Manufacturing:	
Nondurable Goods	228
Durable Goods	584
Transportation	77
Communication, Other Public Utilities	37
Wholesale Trade	61
Retail Trade	221
Finance, Insurance, and Real Estate	68
Business and Repair Services	64
Personal, Entertainment, and Recreation Services	19
Professional and Related Services:	
Health Services	125
Educational Services	129
Other Professional and Related Services	29
Public Administration	22

Source: 1980 Census of Population and Housing, Erie County, PA

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TABLE 2-7

GIRARD TOWNSHIP
INCOME PROFILE

Per Capita Income

1979	1981[1]	1983[1]	1985[1]
6,567	7,296	7,660	8,635

Households With Income In 1979 By Income Type

	Total	Mean
Earnings	1,198	$20,526
Wage or Salary	1,116	$19,170
Non-farm Self-Employment	184	$15,311
Farm Self-Employment	67	$ 5,666
Interest, Dividend, or Net Rental Income	632	$ 1,256
Social Security	323	$ 3,728
Public Assistance	111	$ 1,888
All Other	473	$ 2,075

Source: 1980 Census of Population and Housing, Erie County, PA

[1] Projected Data

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TABLE 2-8

GIRARD TOWNSHIP
HOUSING INFORMATION
1970 and 1980

	1970	1980
Total Housing Units[1]	1,011	1,587
Median Value	$13,749	$44,200
Median Contract Rent	$ 78.00	$168.00
Number of Vacant Units[2]	N/A	100
Number of Occupied Units[2]	N/A	1,419

[1] Including vacant seasonal and migratory units
[2] Year-round housing units by occupancy status

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SEC 3

3.0 HYDROGEOLOGIC INVESTIGATION

3.1 METHODS AND PROCEDURES

A two phased hydrogeologic field investigation was conducted as a part of the Remedial Investigation, in accordance with the two Proposed RI/FS work plans (AWARE, 1986a, 1988a). The methods and procedures utilized during the investigation are described below:

3.1.1 Drilling and Well Installation

An extensive drilling and well installation program was conducted from July to December 1986, in July 1987, and in November and December 1988 as a part of the Remedial Investigation (RI). The objectives of the program are as follows:

- To provide a background monitoring well cluster
- To define the plume extension north of the landfill
- To provide wells and piezometers to be utilized for aquifer testing
- To provide additional detection monitoring wells immediately downgradient of the plume
- To provide a secondary ring of monitoring wells between the plume and groups of residential water supply wells.

Drilling was conducted primarily by Pennsylvania Drilling Company, Inc. of Pittsburgh, Pennsylvania, using an Acker Model 81 truck-mounted drill rig. One well, (W-34) was drilled in June, 1987 by Empire Soils Investigations, Inc. of Orchard Park, New York, also with the use of an Acker drill rig.

All drilling was completed under the continuous supervision of an experienced geologist from ECKENFELDER INC. The geologist maintained a continuous log of the work as it proceeded and directed the well installation operation.

Soils were sampled either continuously or at five foot intervals at all boring locations. Soils were visually classified in the field according to a system modified after Burmister (1958). Representative portions of each sample were stored in glass jars for later observation. Logs for wells and test borings are presented in Appendix A.

The following section describes the rationale for the installation of wells and piezometers during each of the phases of drilling. The specific drilling and well installation methods are described subsequently in Section 3.1.1.3. The locations of all of the test borings, wells and piezometers, except the early warning wells, are depicted on Sheet 1 of 21.

3.1.1.1 Phase I Drilling (1986-1987)

Background Well Clusters

Well cluster, W-26 (A, B, C), was installed at a position that would serve as background location for the water table and intermediate zones, as shown on Sheet 1 of 21. This new background cluster replaced two existing well clusters, W-7 and W-8, that had previously been utilized for the determination of background water-quality conditions. The new cluster, W-26, consists of three single-cased monitoring wells constructed in the water table, intermediate, and deep water-bearing zones. The wells have been constructed according to the specifications contained in Section 3.1.1.3.

Definition of Plume Extension

Additional work was conducted in order to define the lateral extent of the plume in the intermediate water-bearing zone. This was done with a series of test borings conducted in two phases followed by the installation of two monitoring well clusters.

Seventeen test borings were drilled in the area north of the landfill in an effort to delineate the extent of the plume. Split-spoon samples were collected continuously to a depth below the intermediate water-bearing zone. These soil samples were visually classified in order to identify any

stratigraphic characteristics that could have influenced contaminant flow toward this area. The samples were also analyzed in the field for volatile organics with the use of an HNU Model PI-101 photoionization trace gas detector as per the method described in Section 3.1.1.3. The selection of successive boring locations was determined in a stepwise manner dependent upon the field determinations from the previous borings. In addition, selected samples were analyzed in the laboratory to confirm the HNU results. This was continued until the areal extent of the plume extension was determined.

Two of these test borings were completed as small diameter (1-1/4 inch) piezometers. These piezometers, designated PZ-11 and PZ-13, are intended for water level determinations.

Wells W-20B and W-20C were originally installed as piezometer detection wells in an area that was previously believed to be uncontaminated. However, levels of organic contaminants have been detected at this location.

On the basis of the observed hydrogeologic conditions, it was concluded that the deep well, W-20C, should not be contaminated. This conclusion was supported by lithium chloride tracer testing that suggested that annular leakage in Well W-20C could have occurred. This would have allowed small quantities of contaminants from the Intermediate Zone, in which W-20B is screened, to migrate into Well W-20C. On this basis, W-20C was completely removed. The borehole was subsequently reamed and grouted.

Perimeter Well Installation

Two additional perimeter well clusters were installed at locations north of, and downgradient of, the plume extension as identified by the test borings. These wells have been designated as W-27 (A, B, and C) and W-32 (A and B). These were installed as well clusters in the same water-bearing zones as the existing monitoring wells. The shallow water well was installed as a single-cased well. The intermediate and deep well in each cluster were constructed as double-cased monitoring wells. The drilling and well construction specifications are described in Section 3.1.1.3.

Residential Early Warning Wells

Monitoring wells were installed at three locations between the landfill and groups of downgradient residences with domestic water supply wells. These wells, designated as W-29, W-30, and W-31, are located 1000 to 2000 feet downgradient of the existing plume and serve to provide additional protection as an "early warning" in the extremely unlikely event that contaminants from the landfill were to migrate as far as these residences. The wells have been placed in locations such that if contamination occurred, a sufficient amount of time would remain, on the basis of known groundwater flow rates, that an alternate water supply could be secured before the domestic water supply wells would become contaminated. It should be noted that groundwater from the vicinity of the site would require a lengthy period of time to reach the nearest downgradient domestic wells, based upon existing groundwater data for the area near the site. Furthermore, natural attenuation mechanisms would probably prevent any contaminants from moving this great a distance.

The early warning wells have been installed at the same depth as the domestic wells in each group of homes. For this purpose it was necessary to determine the depth of these wells. The domestic well construction specifications were determined from existing records, where possible. However, since little data exist regarding these wells, a house-by-house telephone survey was conducted to contact most of the homeowners. In addition, discussions held with area drillers who installed each of the wells yielded additional data regarding the depth and construction of the wells.

One early warning well was installed upgradient of each of three groups of homes at locations as shown on Figure 3-1. It was not necessary to install multiple depth wells (clusters) at any of the early warning well locations because it was established that the depths of the domestic wells were fairly uniform. Each of the wells was installed as a two-inch diameter single-cased monitoring well. The wells were installed as per the specifications in Section 3.1.1.3.

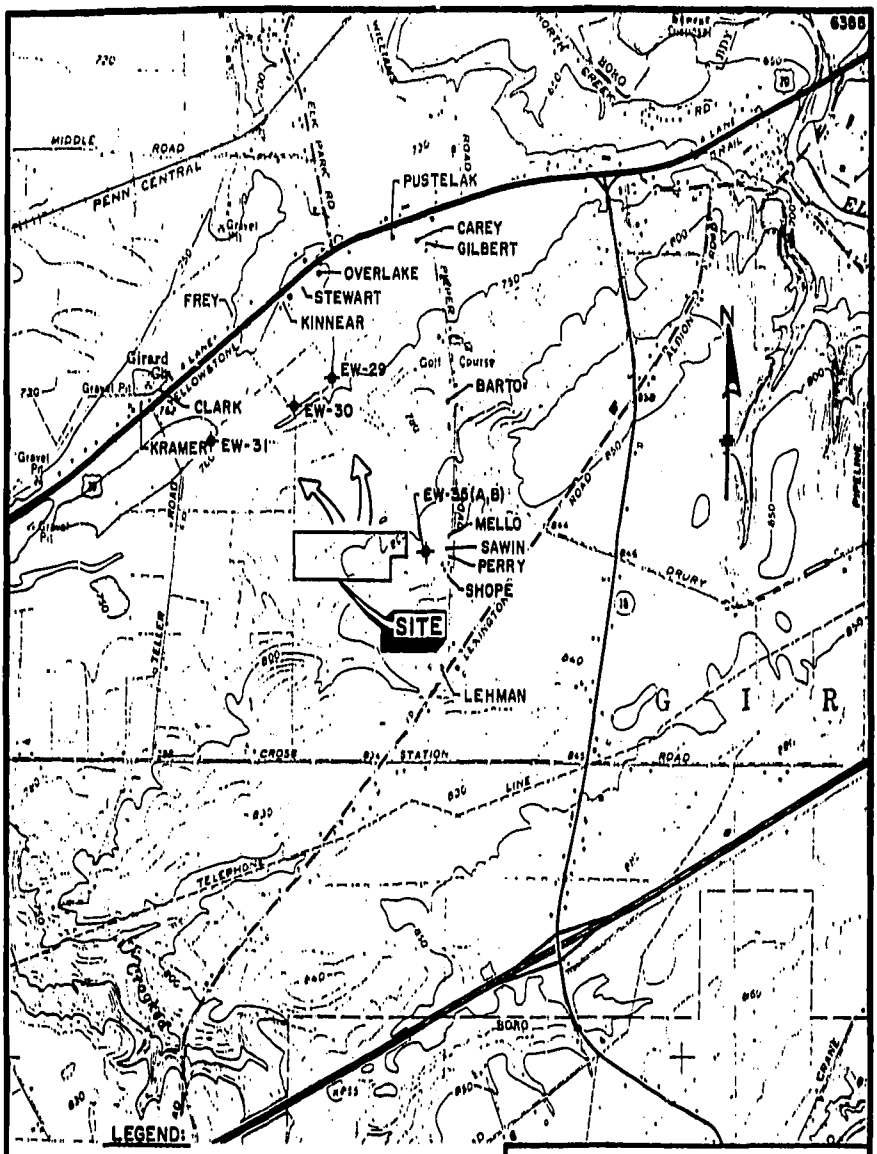


FIGURE 3-1

RESIDENTIAL & EARLY WARNING WELL LOCATIONS

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

ECKENFELDER INC. Nashville, Tennessee / Mahwah, New Jersey

AR301719

Aquifer Test Pumping Wells and Piezometers

Two large diameter (4 inch) wells were installed for the purpose of conducting long term (72 hour) pump tests. One well, W-28, was installed in the Intermediate Zone in an area that is typical of stratigraphic conditions beneath the majority of the site. The other well, W-33, was installed in the most coarse-grained materials in the center of the plume extension. This area is stratigraphically distinct from the rest of the site.

Three additional piezometers, PZ-18, PZ-19, and PZ-22, were installed in the vicinity of well W-33. These piezometers were intended for water level determinations during the aquifer test. Test borings B-86-20 and B-86-21 were not completed as piezometers, as had been intended, due to the insufficient thickness of the coarse-grained deposits at their respective locations.

Well W-33 was installed approximately six months prior to initiation of the aquifer test. It was discovered at the time of the test that the efficiency of the well had declined to the point where the well was incapable of sustaining a sufficient yield for the pump test. On this basis a new well, W-34, was installed in July 1987, adjacent to W-33, as described in Section 3.1.1.3.

3.1.1.2 Phase II Drilling (1988)

Definition of Plume Extension

Three additional monitoring well clusters were installed in the Plume Extension area, located north of the landfill. One well cluster, W-37 (A,B), was installed outside of the probable extent of the plume in the golf course to the east. This cluster is intended to be used in concert with the existing Perimeter-Detection wells to monitor the leading edge of the plume. Two other well clusters, W-36 (A,B) and W-39 (A,B), were installed within the probable area of the plume in order to better define water quality conditions along its perimeter.

Each monitoring well cluster consists of two wells constructed in the Water Table Zone and Intermediate Zone, respectively. The wells were constructed

according to the specifications contained in Section 3.1.1.3. The Intermediate Zone well was constructed with a double casing.

Residential Early Warning Wells

An additional Early Warning well cluster, designated W-35 (A,B), was installed between the landfill and the Pieper Road residences. This cluster is intended to provide additional protection as an "early warning" in the unlikely event that contaminants from the landfill were to migrate in a cross-gradient direction toward these residences. The early warning well(s) were located to provide sufficient advance warning to protect the quality of existing, domestic water supply wells.

The early warning wells were installed at the same approximate depths as the domestic wells in this group of homes based upon a survey of the residential wells. In this way, a monitoring well couplet was installed with wells in both the water table and Intermediate Zone. The shallow water table well was installed as a single-cased well. The Intermediate well was installed with a double casing. The wells were constructed according to the specifications described in Section 3.1.1.3.

Deep Zone Perimeter Detection Wells

A deep, confined water-bearing zone has been identified at a depth of approximately 75 to 105 feet below the ground surface. This unit is confined by a low hydraulic conductivity aquitard that is believed to protect this zone from landfill-derived contamination. However, unlike the shallower water-bearing zones that flow toward the north and northwest, the Deep Zone has been shown to flow toward the southwest.

On the basis of the demonstrated direction of groundwater flow, no true downgradient wells have previously existed in the Deep Zone. Therefore, a new monitoring well was installed in the Deep Zone at the location of the existing W-6 cluster, designated W-6B. This well was installed as a double-cased well as per the specifications in Section 3.1.1.3.

Well Abandonment

Two existing deep wells, W-1 and W-3C, have previously exhibited the presence of landfill contaminants. These wells were screened immediately below the most highly concentrated portions of the plume and were believed to have leaking annular seals, as was the case of deep well W-20C. Wells W-1 and W-3C were installed at the same or at an earlier time, using the same methodology. The well seal methodology in use at that time did not employ an oversized borehole and the use of double casings as has most recently been employed. Therefore, it is likely that contamination that has been observed in the deep wells had resulted from movement downward through a leaking seal under the influence of the strong downward hydraulic gradient.

Wells W-1 and W-3C were permanently abandoned. This was accomplished at W-3C by drilling around the well casing with hollow-stem augers and pulling out the well casing. The borehole was subsequently reamed and then sealed with cement/bentonite grout emplaced by the tremie method.

This procedure was not possible with well W-1. This small diameter well appeared to be constructed within an ungrouted six-inch steel casing driven into an undersized borehole, presumably by the cable tool method. An attempt to pull both the small diameter PVC riser and the steel casing was unsuccessful. Both broke off a short distance below the ground surface. It was not possible to drill over the six-inch casing with augers as was done in the case of W-3C, due to its large diameter.

Due to the difficulties in removing the casing, the only remedy available for the abandonment of W-1 was to fill the PVC riser and the annular space between the riser and the steel casing with grout. This should be adequate in that it is believed that a bentonite pellet seal exists immediately below the steel casing, and that the steel casing is sufficiently close to mechanical contact with the formation to limit vertical movement. Details regarding each of the well abandonment procedures are found on the boring logs (Appendix A).

Background Area

The piezometric data indicated the existence of an apparent groundwater divide in the Intermediate water-bearing zone, located between the background well, W-26B, and the site. The elevation and location of this divide is important in the evaluation of Well W-26B as a background well. Accordingly, a piezometer was installed.

A piezometer, PZ-38, was installed at a location between W-26B and the site. This piezometer is intended to be used only for the measurement of water level data in the Intermediate Zone in order to demonstrate the presence of this apparent divide. This piezometer was installed in the same manner as a single-cased monitoring well.

3.1.1.3 Drilling and Well Installation Methods. Pilot borings for the installation of monitoring wells were performed using one of several drilling methods. These included hollow stem auger and water rotary. The drilling equipment was decontaminated prior to use on the site, including all augers, rods, split-spoons, and other tools that may have been introduced into the subsurface. The decontamination effort involved steam cleaning with a portable unit.

Single-Cased Monitoring Wells

Each single-cased monitoring well was constructed with a two-inch diameter, five-foot long wire-wound, stainless steel well screen installed on a two-inch diameter black steel riser (Figure 3-2). Clean, coarse sand was placed in the annular space around the well screen and riser from the base of the screen to at least two feet above the screen. A layer of bentonite pellets, two to five feet thick, was placed above the sand pack. To prevent preferential migration of surface water or groundwater through the well annulus, a cement/bentonite grout was placed by the "tremie" method from the top of the bentonite pellet seal to a point several feet below the existing ground surface. A lockable protective casing consisting of four-inch diameter steel pipe was set in concrete approximately three feet below grade.

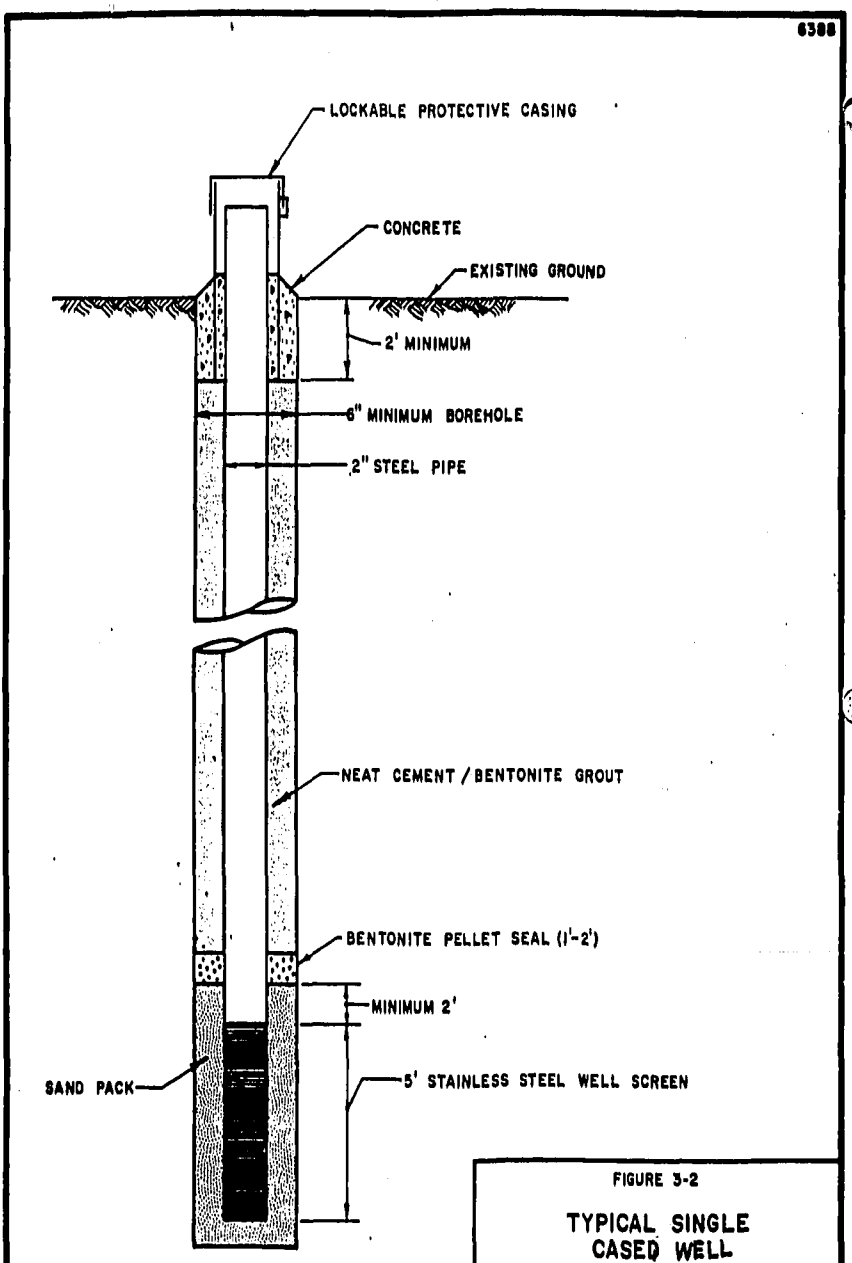


FIGURE 3-2

TYPICAL SINGLE CASED WELL

LORD / SHOPE SITE
GIRARD TWP., PA.

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

Double-Cased Monitoring Wells

Each double-cased monitoring well was constructed as a two-inch diameter well within an exterior steel casing which serves as a double well seal. The double seal is intended as extra protection against annular leakage (Figure 3-3).

A ten-inch minimum diameter borehole was drilled to a point at least ten feet below the top of the aquitard. A six-inch diameter steel casing was then pressure grouted from the bottom of the borehole. After the initial grout seal had set, a five and one-half inch diameter borehole was continued to the desired completion depth. A two-inch well was installed in the completed borehole. The well was constructed with a five-foot long stainless steel, wire-wound well screen on a two-inch black steel riser. Clean, coarse sand was placed in the annular space around the well screen and riser from the base of the screen to at least two feet above the screen. A layer of bentonite pellets, two to five feet thick, was placed above the sand pack. To prevent preferential migration of surface water or groundwater through the well annulus, a cement/bentonite grout was placed by the "tremie" method from the top of the bentonite pellet seal to the existing ground surface. A lockable cap was then welded to the top of the outer steel casing.

A concrete pad was constructed at least three inches above grade and was mounded to direct run-off away from the well. Each newly-installed monitoring well was fully developed upon completion by repetitive surging with oil-free compressed air.

Test Borings for Chemical Analysis

Test borings were utilized in order to collect soil samples for chemical analysis. The test borings were drilled with hollow stem augers. Soil samples for chemical analysis were collected at specified intervals with a large diameter (3-inch) split-spoon sampler. Each soil sample was placed in two glass jars, each equipped with aluminum foil-lined lids. One jar was used for analysis in the field and then discarded. Each of the second jar samples from each boring was stored for potential confirmatory laboratory analysis.

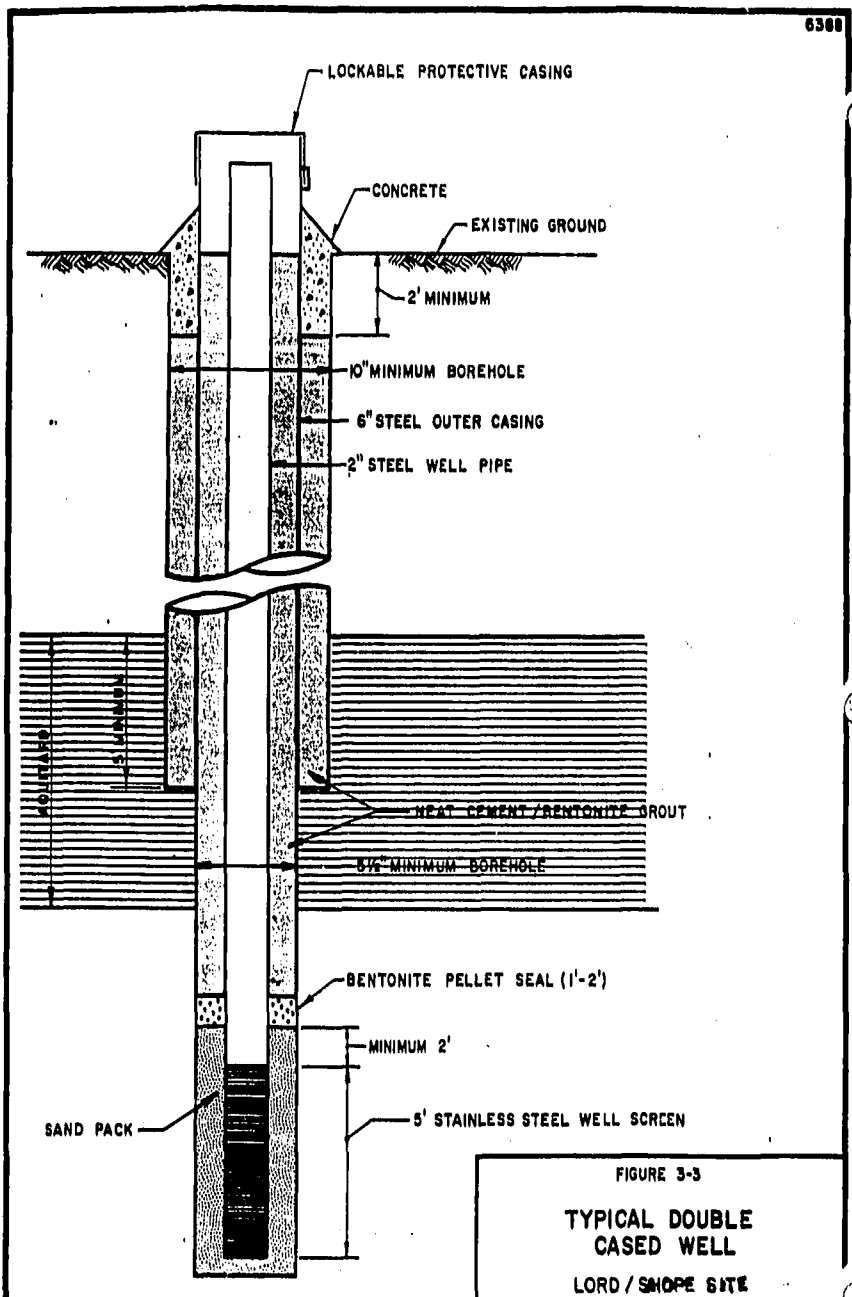


FIGURE 3-3

TYPICAL DOUBLE CASED WELL

LORD / SHOPE SITE
GIRARD TWP., PA.

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

SCALE: NONE

The analyses were performed with an HNU Model PI-101 photoionization detector (PID) trace gas meter, equipped with a 10.2 eV lamp, referenced to benzene. The data presented in Section 7.0 indicate that this instrument is sufficiently sensitive to the majority of the volatile organic parameters present in the groundwater plume.

The sampling devices (i.e., split-spoon) used to collect soil samples for chemical analysis were thoroughly cleaned prior to each use as described in Section 3.1.3.4. Each test boring was pressure grouted upon its completion with cement/bentonite grout.

The field analyses were conducted by the head space method using the PID meter. The sample was allowed to equilibrate to a standardized temperature, typically 20°C. The lid was then removed from the sample jar, thus exposing the foil which was then pierced by the analyzer probe to allow a trace gas measurement to be taken.

3.1.2 Aquifer Testing

Aquifer tests were conducted on wells W-28 and W-34 in order to achieve the following objectives:

- To evaluate the water-bearing zone characteristics such as hydraulic conductivity (k) and storage coefficient (s).
- To provide estimates of the maximum safe yield of these and any subsequent recovery wells.

Tests on each of wells W-28 and W-34 were conducted on two separate occasions. For each test, the well was pumped with a 1/2 horsepower, four inch diameter submersible pump which was operated by a diesel-powered portable generator. The discharge from the wells was maintained at a constant rate which was determined by measuring the amount of time that was necessary to fill a known volume and/or with the use of an in-line flow meter. The discharge was subsequently pumped to a 10,000 gallon capacity swimming pool, located near well W-9, where it was temporarily held for transfer to tank trucks for disposal at a waste-water treatment plant in Albion, Pennsylvania.

Prior to the commencement of the aquifer tests, In-Situ, Inc. Model SE-1000B environmental data loggers (Hermits) were installed in selected piezometers within the vicinity of each of the pumping wells. These data loggers monitored the water levels in the piezometers at short term intervals for a number of days. In addition to the data loggers, a continuous recording barometer was also set up on the site in order to measure the changing barometric pressure before, during, and after the pump test. A review of the barometric data allowed for the determination of any corresponding changes in the water levels which were a result of the changing barometric pressure. These data were used to determine the barometric efficiency of the aquifer which indicates the degree to which the water level in the piezometer will be affected by changes in the barometric pressure. These data can be used in order to adjust changes in water levels which are a result of barometric pressure changes as opposed to changes imposed as a result of the pump test.

Prior to the commencement of each aquifer test, a yield test was conducted at each of the wells in order to determine their respective maximum yield. This test consisted of pumping the well for a limited amount of time (minimum 2-3 hours) and measuring the resulting drawdown in the well. This test indicated a sustainable pumping rate of 0.25 to 0.5 gal/min for W-28 and approximately 0.5 to 1.0 gal/min for well W-33. The resulting yield in W-33 was far below the anticipated yield of 15 gal/min which was estimated from the soil samples collected during the drilling and the in-situ recovery tests which were conducted on the well shortly after its completion. This is believed to be due to clogging of the well screen by iron bacteria. An extensive effort was made to redevelop and treat the well in order to obtain the expected yield. These efforts, however, were not successful, and further recovery tests indicated that the hydraulic conductivity measured at W-33 had decreased by approximately one and one half orders of magnitude. As a result of these findings, it was determined that it would be unproductive to conduct the aquifer test utilizing well W-33. On this basis, it was decided to install and develop an additional well adjacent to W-33, designated W-34. Subsequent yield tests indicated the maximum yield at W-34 was approximately 10 gal/min. This value was deemed to be reasonable with respect to the observed hydrogeologic conditions.

Data Collection

The pump test on well W-28 was conducted at a pumping rate of 0.25 gal/min. This low volume was obtained by using a recirculation drum. This recirculation system consisted of a 55-gallon drum equipped with a valve located approximately one half the distance from the top of the drum and a discharge hose located approximately one quarter of the distance from the top. Water was pumped from W-28 with the one-half horsepower submersible pump at a rate of 5 gal/min directly into the drum. The valve was adjusted to allow for a discharge of 0.25 gal/min. The remaining 4.75 gal/min of flow was recirculated back down the well. Thus, the effective discharge rate from the well was 0.25 gal/min.

The resultant 0.25 gal/min discharge from the well was temporarily stored in additional 55-gallon drums and then periodically pumped to the swimming pool with a small centrifugal pump.

During the aquifer test, water levels in the pumping well and selected wells and piezometers were monitored at regular intervals. These data were subsequently used to determine the characteristics of the water-bearing zone which are presented in detail in Section 3.4.1.1.

The aquifer test on W-34 was conducted at a rate of 7 gal/min. The discharge rate was monitored continuously using an in-line flow meter. This discharge was periodically confirmed by measuring the volume discharged in a given amount of time. The discharge from the well was pumped directly to the swimming pool. The water in the pool was subsequently pumped to the tank trucks at approximately 10-hour intervals.

Water levels in the pumping well and selected wells and piezometers were monitored throughout the pump test at regular intervals. These data were subsequently used in the calculations to determine the characteristics of the water-bearing zone and are presented in detail in Section 3.4.1.1.

3.1.3 Groundwater Quality Sampling

Numerous groundwater quality samples have been collected prior to and during the course of the RI. Many of these samples have been collected as a part of the ongoing routine groundwater monitoring program, as described in Section 3.1.3.1. However, samples have also been collected to provide specific data for the RI, as described in Sections 3.1.3.2 and 3.1.3.3. On this basis, numerous groundwater quality data are available from the background, perimeter, and selected plume wells. The laboratory analyses performed on all samples collected prior to July 1988, included a group of volatile organics determined by gas chromatography (GC), a group of five metals, and a number of indicator parameters (Table 3-1). The indicator parameters included a total volatile organic (TVO) and total halogenated volatile organic scan (THVO) by GC. The particular laboratory methodology utilized for the TVO and THVO scans is very sensitive, while providing an excellent indicator of the presence of volatile organic compounds. For these reasons, the TVO and THVO data have been previously relied upon in the inspection of earlier water quality data.

All samples collected subsequent to July 1988 have been analyzed for Target Compound List (TCL) parameters following Contract Laboratory Protocol (CLP) or equivalent. This list of parameters is significantly more comprehensive than that previously employed. The specific analytical methodologies are described in detail in the "Quality Assurance Project Plan for the Recharacterization of and Interim Monitoring of the Lord-Shope Landfill Site, Girard Township - Pennsylvania" (QAPP, Lord, 1988). The laboratory analyses and Quality Assurance/Quality Control (QA/QC) procedures have been conducted by Lord Corporation, or their contract laboratory, according to the methods described in the QAPP.

All of the water quality data, along with the routine monitoring data, have allowed for the detailed evaluation of the position of the plume as it relates to the perimeter wells. A summary of these data is presented in Appendix F and on tables in Section 5.0. The complete field and laboratory data for these samples, including QA/QC, are on file at Lord Corporation.

TABLE 3-1
ANALYTICAL PARAMETERS
PRIOR TO 1988

Category A

Chlorinated hydrocarbons

- vinyl chloride
- chloroform
- carbon tetrachloride
- methyl chloride
- trichloroethylene
- tetrachloroethylene
- 1,1 dichloroethylene
- 1,1 dichloroethane
- 1,2 trans-dichloroethylene
- methylene chloride
- 1,1,1 trichloroethane

Category B

Heavy Metals

- arsenic
- barium
- cadium
- chromium
- lead

Category C

Non-Chlorinated Hydrocarbons

- methyl isobutyl ketone
- methyl ethyl ketone
- acetone
- 4-methyl, 2-pentanol
- tetrahydrofuran
- benzene
- toluene
- xylene

Category D

Indicators

- pH
- conductivity
- sulfate
- total dissolved solids (TDS)
- chemical oxygen demand (COD)
- chloride
- total volatile organic scan (purge and trap GC with FID Detector)
- total volatile halogenated organic scan (purge and trap with EC or Hall Detector)

3.1.3.1 Interim Groundwater Monitoring Program. A periodic groundwater monitoring program has been in effect for the duration of the RI. It is intended that this interim program will remain in effect until the operation of additional site remedial measures takes place, at which time the monitoring plan may be modified.

The specific details of the Interim Monitoring Program have changed somewhat over the course of the RI. However, the basic objectives have remained the same. The objectives of this program are as follows:

- To monitor background water quality conditions
- To track the physical boundary of the perimeter of the plume, both laterally and vertically
- To provide an "early warning" system between the site and groups of downgradient domestic water wells
- To directly monitor selected domestic water supply wells.

Phase I - Interim Groundwater Monitoring

The monitoring during Phase I consisted of the sampling of thirty-five wells. These include a background well cluster and seven clusters of perimeter-detection wells located downgradient of the site. In addition, early warning wells have also been monitored. These consist of wells located between the site and downgradient residential water supply wells. Early warning wells are also located between the site and one group of cross-gradient residences. Finally, a number of residential water supply wells have also been monitored. Table 3-2 lists the identification of each of the wells in the program. The well locations are depicted on Sheet 1 of 21 and Figure 3-1.

Samples were collected and analyzed semi-annually using equipment that has been dedicated to each monitoring well in order to eliminate the potential for cross contamination. The specific sample collection methodology is described in the following section.

TABLE 3-2
R1 - PHASE I
REVISED INTERIM MONITORING PROGRAM
MONITORING WELL DATA

Well Number	Monitoring Well Group	Geologic Zone	Well Depth (ft)
Monitoring Wells			
W-26A	Background	Water Table	25.0
W-26B	Background	Intermediate	56.5
W-26C	Background	Deep	128.0
W-7WT	Early Warning	Water Table	13.0
W-7	Early Warning	Intermediate	48.0
W-7A	Early Warning	Deep	107.0
W-29	Early Warning	WT/Int	35.0
W-30	Early Warning	WT/Int	39.0
W-31	Early Warning	WT/Int	40.0
W-20A	Perimeter-Detection	Water Table	16.0
W-21A	Perimeter-Detection	Water Table	14.5
W-21B	Perimeter-Detection	Intermediate	48.5
W-21C	Perimeter-Detection	Deep	105.5
W-22A	Perimeter-Detection	Water Table	10.5
W-22B	Perimeter-Detection	Intermediate	42.0
W-22C	Perimeter-Detection	Deep	80.0
W-23A	Perimeter-Detection	Water Table	13.5
W-23B	Perimeter-Detection	Intermediate	37.0
W-23C	Perimeter-Detection	Deep	84.0
W-24A	Perimeter-Detection	Water Table	10.0
W-24B	Perimeter-Detection	Intermediate	59.0
W-24C	Perimeter-Detection	Deep	86.0
W-25WT	Perimeter-Detection	Water Table	15.0
W-27A	Perimeter-Detection	Water Table	26.0
W-27B	Perimeter-Detection	Intermediate	49.0
W-27C	Perimeter-Detection	Deep	90.0
W-32A	Perimeter-Detection	Water Table	20.0
W-32B	Perimeter-Detection	Intermediate	50.0
W-37A	Perimeter-Detection	Water Table	20.0
W-37B	Perimeter-Detection	Intermediate	47.0
Residential Water Supply Wells			
Barto			
Carey			
Frey			
Gilbert			
Kinear			
Pustulak			
Stewart			

The Phase I analytical parameters are listed on Table 3-1. Briefly, the samples were analyzed annually for the Category A, Chlorinated Hydrocarbons; Category B, Heavy Metals; and the Category C, Non-Chlorinated Hydrocarbons. In addition, the wells were analyzed semi-annually for the Category D, Indicator Parameters.

Phase II - Interim Groundwater Monitoring

The Phase II groundwater monitoring objectives have been met through the continued use of 37 wells. These include a background well cluster and nine perimeter-detection well clusters/locations located downgradient of the site. In addition, five early warning wells have been monitored. These consist of wells located between the site and both downgradient and cross-gradient residential water supply wells. Finally, seven residential water supply wells have continued to be monitored. Table 3-3 lists the identification of each of the wells in the program.

Samples have been collected and analyzed periodically following the methodology described in Section 3.1.3.4. The samples have been collected on a semi-annual basis. These and all other samples collected during Phase II have been analyzed for the TCL parameters.

3.1.3.2 Site Recharacterization. Samples collected from selected locations have been analyzed for Target Compound List (TCL) parameters following Contract Laboratory Protocol (CLP) or equivalent. These locations included select Plume wells, the background well cluster, as well as select surface water sampling stations. These locations were described on page 18 of the December 24, 1987 letter, Re: RI report from Mark Gorman of PADER to Eugene A. Miller. The data collected as a part of this program have been evaluated along with the data collected from the Interim Groundwater Monitoring and plume characterization programs.

3.1.3.3 Plume Characterization. The Interim Groundwater Monitoring Plan, as previously described, serves only to document the bounds of the plume. This has been accomplished through the placement of wells that AR300734 the plume's leading edge. However, additional data were also collected from wells

TABLE 3-3

RI - PHASE II
INTERIM MONITORING PROGRAM
MONITORING WELL DATA

Well Number	Monitoring Well Group	Geologic Zone	Well Depth (ft)
Monitoring Wells			
W-26A	Background	Water Table	25.0
W-26B	Background	Intermediate	56.5
W-26C	Background	Deep	128.0
W-29	Early Warning	WT/Int	35.0
W-30	Early Warning	WT/Int	39.0
W-31	Early Warning	WT/Int	40.0
W-35A	Early Warning	Water Table	20.5
W-35B	Early Warning	Intermediate	52.5
W-6B	Perimeter-Detection	Deep	90.5
W-20A	Perimeter-Detection	Water Table	16.0
W-21A	Perimeter-Detection	Water Table	14.5
W-21B	Perimeter-Detection	Intermediate	48.5
W-21C	Perimeter-Detection	Deep	105.5
W-22A	Perimeter-Detection	Water Table	10.5
W-22B	Perimeter-Detection	Intermediate	42.0
W-22C	Perimeter-Detection	Deep	80.0
W-23A	Perimeter-Detection	Water Table	13.5
W-23B	Perimeter-Detection	Intermediate	37.0
W-23C	Perimeter-Detection	Deep	84.0
W-24A	Perimeter-Detection	Water Table	10.0
W-24B	Perimeter-Detection	Intermediate	59.0
W-24C	Perimeter-Detection	Deep	86.0
W-25WT	Perimeter-Detection	Water Table	15.0
W-27A	Perimeter-Detection	Water Table	26.0
W-27B	Perimeter-Detection	Intermediate	49.0
W-27C	Perimeter-Detection	Deep	90.0
W-32A	Perimeter-Detection	Water Table	20.0
W-32B	Perimeter-Detection	Intermediate	50.0
W-37A	Perimeter-Detection	Water Table	10.0
W-37B	Perimeter-Detection	Intermediate	45.0
Residential Water Supply Wells			
Barto			
Carey			
Frey			
Gilbert			
Kinnear			
Pustulak			
Stewart			

that are placed within the plume in order to more fully characterize the plume. Twelve plume wells have been sampled up to a total of four times each. These include six wells that represent the most concentrated portion of the plume, located immediately adjacent to the landfill margin including W-1WT, W-1A, W-3WT, W-3, W-4WT, and W-4A. The remaining six wells are located in the plume extension to the north of the site and include W-20B, W-34, W-36, W-36B, W-39A, and W-39B.

The plume wells have been sampled according to the methodology described in Section 3.1.3.4. All of these samples have been analyzed for the full TCL list.

3.1.3.4 Groundwater Sampling Methodology. Monitoring wells have been sampled using one of several methods, dependent upon their construction. The wells have been constructed of five different specifications. Older existing wells were constructed of 3/4-inch steel, 3/4-inch PVC, and 1-1/2-inch diameter steel. All recently installed monitoring wells are constructed of 2-inch steel. The pump test wells are constructed of 4-inch steel.

The wells have been sampled by personnel from Lord Corporation, using the following general method:

- The wells are inspected for any visible damage to the well casing or seal.

- The static water level in each well is measured and recorded. These data and the known dimensions of the well permit the volume of water in the well to be calculated.

- Each well is purged of at least three volumes of water or evacuated one and one-half times, dependent upon the well hydraulics. The method that is employed is specific to each type of well and is discussed in greater detail below.

- Samples are collected by methods specific to each well type discussed below.

- pH and Specific Conductance are measured in the field upon collection of each sample.

- Samples for metals analysis are field filtered through a 0.45 micron membrane filter prior to preservation.

- Samples are preserved in accordance with USEPA protocol and shipped on ice to the Lord Corporation laboratory or to the particular contract laboratory.

The following specific methods were employed for purging and sampling each group of wells:

3/4-inch Steel Wells - The 3/4-inch steel wells were purged and sampled through the use of a dedicated gas-lift device with the use of compressed nitrogen.

3/4-inch PVC Wells - The 3/4-inch PVC wells were purged and sampled with the use of a peristaltic pump with teflon tubing that is permanently dedicated to each well. The suction end of the tubing is placed at the top of the water column in order to remove all stagnant water standing in the well.

1-1/2-inch and 2-inch Steel Wells, Shallow - The 1-1/2-inch steel wells that were sufficiently shallow were purged with the use of a peristaltic pump with teflon tubing that is permanently dedicated to each well. The suction end of the tubing is placed at the top of the water column in order to remove all stagnant water standing in the well. The samples were collected with the use of a teflon or stainless steel bailer.

1-1/2-inch and 4-inch Steel Wells, Deep - The 1-1/2-inch and 4-inch wells that were too deep, contain too large a volume, or which recover too slowly to pump with a peristaltic pump, were purged and sampled with a PVC, teflon, or stainless steel bailer.

2-inch Steel Wells, Intermediate and Deep - The 2-inch steel wells were purged and sampled with non-contact, gas-driven bladder pumps (ISCO Model 2600).

All monitoring wells that have been used in conjunction with the Interim Monitoring Program were purged and sampled with the use of dedicated monitoring equipment.

Any wells sampled that were not part of the Interim Monitoring Program may have been purged and sampled with non-dedicated equipment. Under no conditions, however, has the same equipment been used in low level or non-contaminated wells that has been used in plume wells.

Any equipment in contact with the samples, including the tubing within the peristaltic pump, that is not dedicated to each well was washed by the following method:

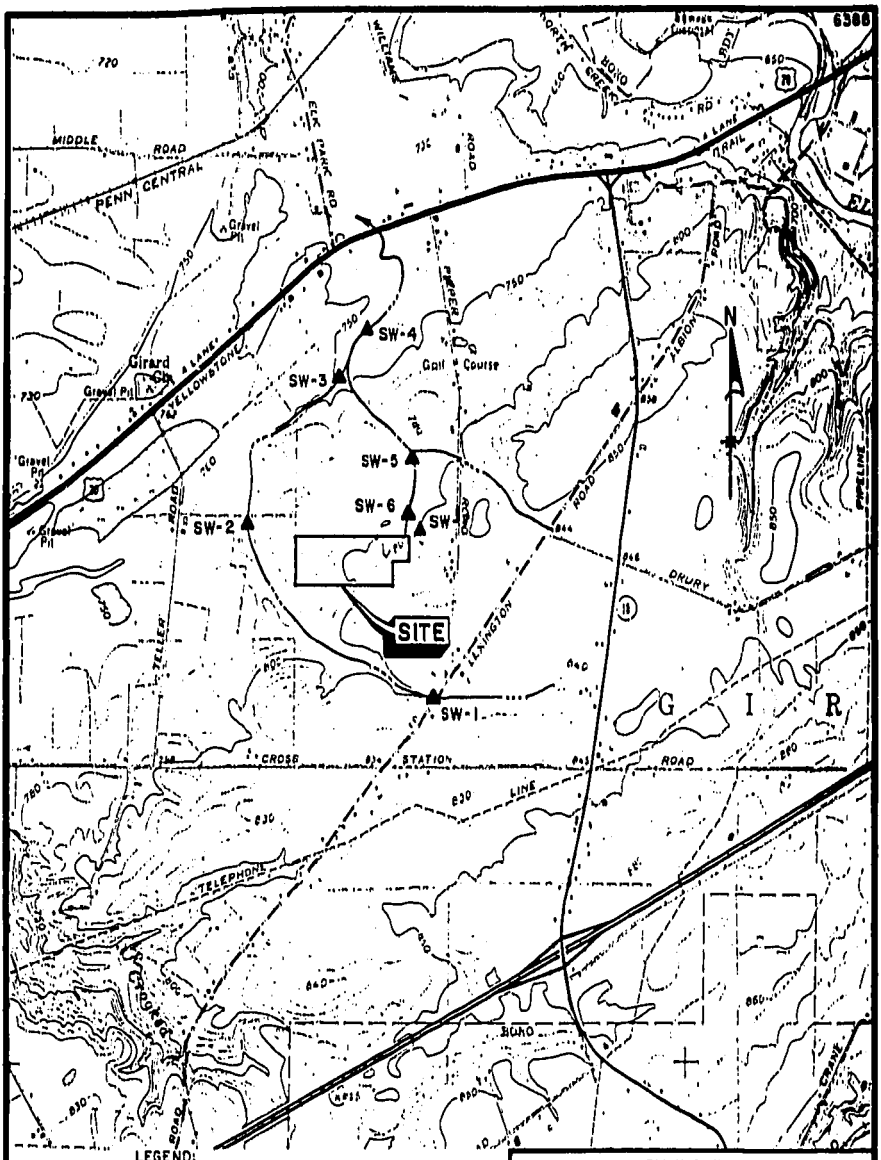
- Wash in tap water and laboratory detergent with a brush to remove deposits of soil or sediment
- Rinse with tap water
- Rinse with high purity hexane or acetone from a Teflon® wash bottle
- Rinse with high purity water from a Teflon® wash bottle.

The equipment was wrapped in new aluminum foil unless it was used immediately.

3.1.4 Surface Water Data

Surface water data, consisting primarily of hydrologic and water quality data, were collected as a part of the RI. The surface water investigation was conducted through the following tasks.

3.1.4.1 Stream Flow Data. The total stream flow was determined at each of six stations as depicted on Figure 3-4. It was intended to make these measurements on a quarterly basis for one year in order to provide some characterization of seasonal stream flow variation. However, the mandated schedule required the compression of these measurements into a much shorter time period. The stream flow stations correspond to those used for surface water quality stations, SW-1 through SW-6.



LEGEND:

▲ STREAM SAMPLING LOCATIONS (WATER & SEDIMENT)

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

2000 0 2000
scale feet

MAP LOCATION

FIGURE 3-4

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

AR301739

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

Stream flow has been measured through the use of one of two methods, dependent upon volume of flow in the stream. If the flow was sufficiently large, a current meter, such as a Price A-A, was used following United States Geological Survey methodology described in "Discharge Measurements at Gaging Stations" (USGS, 1973). Stream flow was also determined using the triangular weir method in cases where the stream flow was observed to be too small to use the current meter.

Current Meter Method

A current meter was used for the determination of stream flow if flow rates were sufficiently large. In such cases, flow rates were measured using a Price A-A current meter equipped with a top set wading rod. The methodology described in USGS (1973) "Discharge Measurements of Gauging Stations" was followed. Briefly, this methodology involved a series of velocity and depth measurements at closely spaced intervals along a line oriented perpendicular to the stream.

Triangular Weir Method

The triangular weir method was employed for the determination of total stream flow if the total flow was too small to utilize a current meter:

- A triangular weir was temporarily installed in the stream bed such that the total flow of the stream was intercepted. The weir was constructed with a metal plate and was held in place with sand bags.
- The weir was constructed with an 88° angle V-notch.
- The discharge over the weir is a function of its geometry and the head (h) of flow over the weir.
- The flow over an 88° V-notch weir was determined by the following formula:

$$Q = 8/15\ C(2g)^{1/2}H^{5/2} \tan 1/2\theta$$

where: Q = flow rate (ft^3/sec)
C = coefficient of discharge = 0.60
H = static head (ft)
θ = Weir angle

- The weir was removed upon completion of the test.

3.1.4.2 Surface Water and Sediment Quality. Surface water and bottom sediment samples were collected from six locations in the two small streams in the vicinity of the site as shown on Figure 3-4. One additional sample was also collected from a seventh station located just upstream from SW-6. Furthermore, water samples were also collected from eight additional locations. The six initial sampling stations were sampled four times in the Phase II RI to provide sufficient data in order to statistically evaluate the stream samples with regard to background. Sample stations SW-1 and SW-2 were utilized as background. Each of these samples was subjected to the full TCL list of parameters. The data for the surface water samples are presented in Appendix F and in tables in Section 6.0. The complete field and laboratory data for these samples will be submitted under separate cover by Lord Corporation.

Water samples were collected near the mid-stream point where the stream is well mixed unless certain conditions dictated otherwise. Ideally, the selected sampling station would not be highly turbulent so as to minimize the loss of volatiles. The samples have been collected directly into the sample container wherever possible. In the event that a separate sample collection vessel was required, care was exercised to minimize any sample disturbance. The sample vessel or any other equipment that was in contact with the sample was thoroughly cleaned between each use.

Sediment samples were collected as grabs, at the same prespecified sample stations as many of the water samples. In all cases, each sediment sample was collected after the corresponding water sample in order to avoid disturbance of the water. The sediment sample was collected either directly into the

sample container or with the use of a sample corer, dependent upon the accessibility of the sample.

3.1.5 Statistical Analysis of Data

Statistical analysis was used to determine if the concentrations in various groundwater and surface samples were significantly higher than in the background samples. This was employed only for metals data. The analysis followed the methodology in the Federal Register (1988) and EPA guidance for statistical analysis of groundwater monitoring data (USEPA, 1989). An exception to this is that instead of analyzing data from all wells together using analysis of variance (ANOVA), individual wells were compared to background wells using standard statistical tests: the Student's t tests and the Mann-Whitney test (Davis, 1986, Mosteller and Rourke, 1973). Measurements below the minimum detection limit were handled, as suggested by the EPA (USEPA, 1989), by using one-half the detection limit or by using a test of proportions. These statistical tests are described below.

The measured concentrations are assumed to be random samples of an infinite set of possible concentrations. The set of possible measurements is described by a "distribution" function which gives the probability of observing a particular range of concentrations as a function of concentration. In reality, the true distribution function for the concentration in a well is unknown and must be assumed or estimated from the data.

The most commonly assumed distribution function is the normal distribution which can be characterized by two parameters, the mean, or central value, and the standard deviation, which is a measure of the width, or spread, of the distribution. There is a 68% probability that a measured value will be within one standard deviation of the mean and a 96% probability that it will be within two standard deviations of the mean. The "population" or "true" mean and standard deviation can be estimated from the data by calculating the sample mean and standard deviation:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

$$s = \left(\sum_{i=1}^{n} (x_i - \bar{x})^2/(n-1) \right)^{1/2}$$

where $\bar{x}$ is the sample mean,

n is the number of samples,

x_i is the value of the ith sample,

and s is the sample standard deviation.

Concentration data frequently cannot be adequately described by a normal distribution. This is especially true if the standard deviation is larger than the mean and, therefore, a significant fraction of the normal distribution is below zero. A better distribution to use in these cases is the lognormal which assumes that the logarithms of the measured values are normally distributed. The lognormal distribution includes only positive concentrations. For lognormally distributed data the mean concentration can be estimated by the geometric mean:

$$\mu_G = \left[\prod_{i=1}^{n} x_i \right]^{1/2} = \exp \left(\sum_{i=1}^{n} \ln(x_i)/n \right) = \exp (\mu_L)$$

where μ_G is the geometric mean,

and μ_L is the mean of the log-transformed data.

The standard test for the difference between the means of two sets of normally distributed data is the Student's t-test (Davis, 1986). Ths statistical measure is the number of standard errors between the means:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_D}$$

$$s_D = \frac{(n_1 - 1)\ s_1^2 + (n_2 - 1)\ s_2^2}{n_1 + n_2 - 2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)^{1/2}$$

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where t is the test statistic,

n_1, n_2 are the number of samples in sets 1 and 2, respectively,

$\bar{x}_1$, $\bar{x}_2$ are the mean values of sets 1 and 2, respectively,

s_1, s_2 are the standard deviations of sets 1 and 2, respectively,

and s_D is the standard error of the pooled samples.

The standard error is an estimate of the standard deviation of the mean and is related to how closely the sample mean can be expected to approximate the true mean. A large value of t means that there is little probability that the measured values come from the same distribution, or, in other words, that there is a high probability that the mean values are different. The meaning of "large" can be quantified using the Student's t distribution which depends on the total number of samples and takes into account the fact that the estimates of the means and standard deviations will be poor for small numbers of samples. Comparison of the value of t with the Student's t distribution for the total number of samples allows calculation of the probability that a value of t this extreme could have occurred by chance if the mean values were the same. This probability is called the significance level of the test for the null hypothesis that the distributions are the same for the two sets.

The t-test assumes that the data are normally distributed (or log normally distributed if the test is applied to log-transformed data.) This can lead to errors if the data are poorly approximated by a normal distribution. Errors can also arise if the data are mostly normal, but there are a few outliers: extreme values which are very improbable for the assumed distribution. These problems can be avoided by using a nonparametric test, i.e., one that does not depend on the underlying distribution. An appropriate nonparametric test for comparing two sets of data is the Mann-Whitney test (Mosteller and Rourke, 1973) which is based on sorting the data and ranking it. If most of the data in one set rank higher than the data in the other set, the sets are unlikely to have the same central value. Ranking the data serves two purposes: it reduces the data to a known distribution, uniform on the set of integers from one to the total number of samples, and it reduces the effect of extreme values since the largest value, for example, will have the same rank if it is one unit higher than the next largest value or 10,000 units higher. The non-parametric Mann-Whitney and parametric Student's t tests are complementary.

The Mann-Whitney is more "robust" in not being dependent on the distribution; the t-test is more powerful when the data are, in fact, normally distributed. Both tests were used to analyze the metals data, but the Mann-Whitney test was given more weight in interpreting the results.

Statistical tests can be one-tailed or two-tailed. A two-tailed test looks for any difference, positive or negative, between the means of the sets. A one-tailed test looks for differences in one direction only. For the water quality data the comparisons were one-tailed and only cases where the concentration was higher in the downgradient wells than in the background wells were considered significant.

One question that must be settled before a statistical analysis is performed is the level of significance which is required before a difference in mean values is considered to be "real". This must balance the probability of "false positive" errors (deciding that the concentrations are significantly different when they are not) against the risk of "false negative" results (missing a real difference). For this study, two significance levels were used: five percent for determining significant differences and one percent for indicating very significant differences. A significance level of five percent means that there is only one chance in 20 that the differences seen could have occurred by chance if the means were really the same. It is not appropriate to set a less stringent significance level, say ten percent, since false positives could become a serious problem. In fact, with data from some seventy wells and a five percent significance level, false positives can be expected to occur for at least a few wells for each metal. On the other hand, a true difference would be expected to show up for at least some of the wells and the overall pattern should be interpretable.

Many of the measurements were reported as below a "detection limit." Non-detects are not a serious problem for nonparametric tests since they end up tied in the lowest rank. Parametric tests, however, require an estimate of the mean and standard deviation of the data set. Some reasonably good approaches exist, such as maximum likelihood estimation and lognormal extrapolation (Gilliom and Helsel 1986), but they all require at least two values above the detection limit in the set. In general, the water quality

data from the Shope's site do not satisfy this requirement for both background and test well data. Therefore, the less accurate approach of setting the non-detects to a constant had to be used. The constant selected was one-half of the detection limit as suggested in the EPA guidance (USEPA, 1989).

The results of both the t-test and the Mann-Whitney test become suspect when the number of non-detects make up more than about half the total number of samples. In this case a nonparametric test of proportions becomes more appropriate (USEPA, 1989). This test considers only the proportions of detected values in each set. The test calculates the number of standard errors between the proportions in the test and background sets:

$$z = \frac{P_u - P_d}{S_D}$$

$$S_D = \left(P(1-P) \left(\frac{1}{n_1} + \frac{1}{n_2}\right)\right)^{1/2}$$

where z is the test statistic

S_D is the standard error of the difference in proportions

$P_u = m_u/n_u$ is the proportion of detections in the background set

m_u is the number of detections in the background set

n_u is the total number of samples in the background set

$P_d = m_d/n_d$ is the proportion of detections in the test set

m_d is the number of detections in the test set

n_d is the total number of samples in the test set

$P = m/n$ is the proportion of detections in the combined sets

$m = m_u + m_d$ is the number of detections in the combined sets

and $n = n_u + n_d$ is the total number of samples in the combined sets.

The test statistic z is compared to the normal distribution approximation to the binomial distribution. For the approximation to be adequate, there must be at least five detected and at least five non-detected values in the combined set.

The results of the statistical evaluation are presented in Sections 5.0, 6.0, and Appendix G.

3.1.6 Environmental Tritium Study

Tritium is a naturally-occurring isotope of hydrogen which has apparently always been found in precipitation due to cosmic ray interactions in the upper atmosphere and other factors. However, with the advent of atmospheric testing of nuclear weapons in the early 1950s, levels of tritium in precipitation rose dramatically (Freeze and Cherry, 1979). By 1963, levels of tritium in precipitation over North America had risen to levels approaching 10,000 tritium units. (A tritium unit is equivalent to 3.2 picocuries per liter.) Tritium levels in precipitation prior to atmospheric testing of nuclear weapons are estimated to be in the range of 5-10 tritium units. With the signing of the nuclear test ban treaty, levels of atmospheric tritium have declined substantially. Current levels, however, remain above pre-1950 levels.

Tritium has a half-life of 12.43 years. Accordingly, tritium levels in groundwater resulting from recharge of precipitation will decline by a factor of one-half each 12.43 years. It is therefore often possible to discriminate "old" groundwater which recharged prior to 1950 from more recent groundwater. Where sufficient data exist, it is sometimes possible to estimate the date at which a certain groundwater recharged based upon current tritium levels.

Tritium samples were collected from each of the wells at clusters W-23, W-26, W-27, and W-32 and from W-20A using the same methodology as previously described. These wells were selected because they have been constructed with double-casing seals thus affording the highest degree of protection against interaquifer exchange through the annular seal. The analyses were performed by the Tritium Laboratory of the University of Miami in Miami, Florida. Using the enriched technique, a sensitivity of 0.1 tritium units has been possible. Assuming that pre-1950 tritium levels were approximately 10 tritium units, relic tritium in groundwater which resulted from precipitation as long ago as roughly 1930 can be detected. Groundwater which recharged prior to 1930 would be expected to exhibit non-detectable levels of tritium at this time. Thus, using this dating technique, the vertical velocity of groundwater flow (and thus potential contaminant migration) through the lower glacial till aquitard can be estimated. It is anticipated that these data would be used in

conjunction with other estimates of hydraulic conductivity and groundwater velocity. A discussion of the results from the tritium testing is presented in Section 3.5.1.4.

3.1.7 Other Hydrogeologic Data

Miscellaneous hydrogeologic data have been collected in order to supplement the existing data and, in particular, to aid in the further calibration of a computer-based groundwater model. The miscellaneous data are described in the following sections.

3.1.7.1 Water Level Measurements. Water level measurements were determined for all new and existing wells and the stream gauges. These measurements were referenced to a datum established by a licensed surveyor.

3.1.7.2 Survey. The locations and elevations of all new monitoring wells were precisely determined by a licensed surveyor. The locations of the wells are referenced to the existing site grid. The elevations were determined to a tolerance of 0.01 feet and are referenced to an existing site benchmark.

3.1.7.3 In Situ Hydraulic Conductivity Testing. In situ hydraulic conductivity tests have been performed on all new and on selected existing wells that have not been previously tested. The tests were conducted by the "variable head" borehole method developed by Hvorslev for the U.S. Army Corps of Engineers, as summarized by Cedergren (1977) and as described in Section 3.5.1.2.

3.1.7.4 Laboratory Soils Testing. A number of "undisturbed" soil samples from both the intermediate and the deep aquitard were collected for laboratory analysis. These "thin-wall" tube samples were collected in the borehole during the installation of various wells. "Pushed" samples were collected where conditions allowed. However, the great density of the lower tills required the use of a continuous auger sample to collect the tube samples. These samples were subjected to testing for hydraulic conductivity, mechanical sieving, hydrometer, Atterberg limits, and moisture content.

3.2 PREVIOUS INVESTIGATIONS

A significant amount of hydrogeologic work was conducted prior to the aforementioned Remedial Investigation at the Lord/Shope site. These various phases of field investigation are listed as follows:

Monitoring Well Installation	Urban Engineering	1980
Monitoring Well Installation	Dr. S. S. Harrison	1980
Monitoring Well Installation	Wehran Engineering	1981
Surficial Soil Borings	Wehran Engineering	1983
Surficial Soil Borings	ECKENFELDER INC.	1984-85
Deep Soil Borings	ECKENFELDER INC.	1984-85
Monitoring Well Installation	ECKENFELDER INC.	1984
Water Quality Monitoring	Lord Corporation	Ongoing

The field work conducted by other consultants prior to ECKENFELDER INC.'s involvement is described in a number of documents as listed in the References. However, available logs for each of the associated wells and borings are presented, herein, in Appendix A. The details of the field work conducted by ECKENFELDER INC. since 1984 are described in the following Sections.

3.2.1 Deep Soil Study - 1984-85

A surficial soil survey for chemical analysis was conducted in the area southeast of the landfill by Wehran in 1983. This study identified an area in which soils were moderately contaminated. However, several surficial soil sample locations indicated significantly higher levels of volatile organic constituents. These data indicated that the potential existed for the presence of subsurface levels of volatile constituents at these particular locations. On this basis, it was recommended that a study of the deep soils at these locations be conducted.

Soil samples were collected from four deep soil borings. These soil borings were drilled southeast of the landfill at the locations identified by the previously described surficial soil study. Logs for each of the borings are found in Appendix A.

The test borings were drilled with the use of hollow stem augers. Soil samples for chemical analysis were collected continuously at two-foot intervals with a large diameter (3-inch) split-spoon sampler. The soil sample was carefully trimmed to remove any surfaces that may have been in contact with sediment or fluids within the borehole. Each soil sample was placed in two one-pint glass jars, each equipped with aluminum foil-lined lids. One jar was used for analysis in the field and then was discarded. Each of the second jar samples, from each boring, was sealed for potential laboratory analysis on the basis of the field determinations. The field analyses were conducted using the PID meter following the method described in Section 3.1.1.3.

The sampling devices (i.e., split-spoon) used to collect soil samples for chemical analysis were thoroughly cleaned prior to each use. The sampler was scrubbed with potable water, followed by an acetone scrub, an acetone rinse, and a distilled water rinse.

Each test boring was pressure grouted upon its completion with cement/bentonite grout. The grout was prepared using a ratio of one bag (94 lbs.) of Portland cement and 1/10 bag (9 lbs) of bentonite mixed with seven gallons of water.

3.2.2 Surficial Soil Study - 1984-85

Shallow soil samples were collected in the area immediately around the landfill in an effort to determine the areal extent of the volatile organics within surficial soils. This study serves as a confirmation of the Wehran soil study as previously mentioned. However, the current study employed more controlled field methods and was conducted in a wide area around the entire landfill. In fact, the study was extended until the maximum extent of surficial soil contamination had been completely delineated.

A series of 94 shallow soil borings was drilled in October 1984. The borings were located at 100 foot intervals around the landfill, as depicted on Figure 4-1. The borings were advanced with the use of a hand-operated bucket auger. Most of the borings were advanced to a maximum depth of 3.5 feet.

Soil samples were collected from the lower 0.5 feet of the borings. Each soil sample was placed in two separate glass jars. The field analyses were conducted with the PID meter using the same methodology as was described in previous Section 3.1.1.3.

The PID meter data, expressed as HNU units, have been plotted on a site map, Figure 4-1, which provided the basis for determining the areal extent and density of the field investigation.

On the basis of the PID meter data, 22 samples were selected for laboratory analysis for volatile organic compounds. The laboratory data are presented on Table 4-1.

3.2.3 1984-85 Hydrogeologic Field Investigation

A comprehensive hydrogeologic investigation was conducted during November and December 1984. The investigation focused primarily on the installation of new monitoring wells as specified in the proposed Long Term Monitoring Plan (AWARE, 1984). The locations of the wells are depicted on Sheet 1 of 21. Other field work including variable head hydraulic conductivity testing, laboratory soils testing and water level monitoring was conducted as well.

Twenty new monitoring wells were installed at the Shope's site. Fifteen of these were installed as triplets at five separate locations. These wells are designated W-20 through W-24 with A, B, and C suffixes corresponding, respectively, to shallow, intermediate and deep wells. Two wells, W-1WT and W-25WT, were installed as replacement and new shallow wells, respectively. The remaining three wells, W-3C, W-7A, and W-12D, were all installed as deep wells immediately adjacent to existing shallower wells. The drilling and well installation was conducted during November and December 1984.

The borings were advanced either with the use of hollow stem augers or hydraulic rotary using either water or a thin mud mixed only with pure bentonite. Split-spoon soil samples were collected for visual identification of the soils. In addition, undisturbed Shelby tube samples were collected from three selected borings. These samples were used for [illegible] laboratory analysis.

Monitoring wells were constructed in each boring. These wells were constructed of two inch "black" steel pipe with welded couplings. Each well was equipped with a five-foot length of wire-wound stainless steel well screen with a 0.010-inch slot size.

Each well screen was backfilled with a uniform size sandpack. The sandpack was sealed with bentonite pellets or "tremie" emplaced bentonite slurry followed by a "tremie" emplaced cement bentonite grout. Following their construction, each well was developed with compressed air. The development efficiency was not great due to the low flow rate to the well as controlled by the moderately low hydraulic conductivity of the formation. Logs of each of the monitoring wells are found in Appendix A.

Water quality samples were collected by personnel from Lord as a part of this investigation. The methodology for sample collection was similar to that described in Section 3.1.3. One exception is that most metals samples collected prior to September 1986 were not field filtered as they are currently. In addition, most samples collected as part of this investigation were analyzed only for the volatile organics listed as the Category A and C Parameters on Table 3-1 in addition to a scan for total volatile organics (TVO) and total halogenated volatile organics (THVO).

3.3 GEOLOGIC CONDITIONS

In this section, the characteristics and extent of the geologic materials encountered within the area under consideration are described. In order to put the site into perspective within the larger geologic framework of the region and to describe the geologic history that led to the formation of each of the stratum, a brief discussion of the regional geology is presented. This discussion of the regional geology is based on the published geologic data for the area, as well as the results of our field investigation. The geology of the actual site is then described in detail based upon our interpretation of the existing data.

3.3.1 Regional Geologic Setting

The Shope's site is situated on the edge of the Lake Plain subprovince of the Central Lowland physiographic province. The site is underlain

sequence of glacially deposited materials that is, in turn, underlain by shales of Upper Devonian age. The region is geologically bounded to the south by the escarpment of the glaciated section of the Appalachian Plateaus Province and to the north by Lake Erie.

The bedrock consists of shale of the lower Conneaut Group which is locally termed the Girard Shale (Tomikeo and Sheeps, 1967). These shales were deposited during the Upper Devonian and serve as a transitional zone from fine grained shales of the underlying Canadaway Formation to coarse-grained shales and sandstones of the overlying upper Conneaut group. The Girard Shale is locally exposed only in deeply eroded beds of major streams in the area.

The bedrock is overlain by a thick sequence of glacial material. These materials are reported by Shepps, et al (1959) to exist at a thickness of 40 to 80 feet, but locally have been shown to be significantly thicker. These glacial materials were deposited by a number of the seven separate advances of the continental ice sheet that blanketed the area during the Pleistocene Epoch. The glacial deposits that directly overlie the bedrock were deposited by the early glacial advances with the upper material being deposited by successively more recent glaciation.

Glacial till was deposited by the glacial ice which repeatedly advanced over the region. The materials in the glacial till had been picked up both locally in northeastern Pennsylvania and from other locations to the northeast. Other related glacial materials were deposited by meltwater flowing adjacent to or through the ice or emanating from the front of the ice sheet. Lacustrine deposits were laid down during interglacial events when lake waters filled what is now the Lake Erie basin. Figure 3-5 provides a perspective as to the overall sequence of the glacial advances and associated glacial deposition that took place during the Pleistocene Epoch.

Each successive glacial advance extended a lesser distance into northwestern Pennsylvania. The last three advances--the Lavery, Hiram and Ashtabula--extended only a few miles beyond the present Lake Erie shoreline. A series of closely spaced ridges parallel to the lake shore correspond to the end of each of these three glacial advances. These ridges, which are termed end moraines,

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STAGE	SUBSTAGE	GLACIAL ADVANCE	MORAINE	GLACIAL TILL UNIT	GLACIAL LACUSTRINE UNIT	AGE BEYOND 1950
WISCOSIN	WOODFORDIAN	ASHTABULA	GIRARD	ASHTABULA		12,950
					MAUMEE IIIc	
			ASHTABULA	ASHTABULA		13,600
					MAUMEE IIIb	
			PAINESVILLE	ASHTABULA		14,100
					MAUMEE IIIa	
			EUCLID	ASHTABULA		
					MAUMEE II	
	CARY	HIRAM	DEFIANCE	HIRAM		14,500
		LAVERY	LAVERY	LAVERY		15,500
		KENT	CLEVELAND	KENT		
	FARMDALIAN					
	ALTONIAN	TITUSVILLE				
SANGAMONIAN ?						
ILLINOIAN ?		MAPLE DALE				
PRE-ILLINOIAN ?		SLIPPERY ROCK				

FIGURE 3-5

GLACIAL ADVANCES & ASSOCIATED DEPOSITION IN NORTHWESTERN PENNSYLVANIA

LORD / HOPE SITE

GIRARD TWP., PA.

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

consist of glacial till that was transported by and deposited at the leading edge of the ice that corresponds to each of the advances.

The Ashtabula advance had four minor subadvances and associated retreats. As a result, the Ashtabula moraine can be subdivided into four additional moraines termed (from oldest to youngest) Euclid, Painesville, Ashtabula and Girard. This series of moraine ridges was termed the "Lake Escarpment Moraine System" by Leverett (1902). The Girard moraine was deposited as recently as 12,950 years before present (Fullerton, 1980).

A glacial meltwater lake filled the present day Erie basin contemporaneous with the Ashtabula advances. This lake, termed Maumee III, was dammed by the Ashtabula ice and drained westward to an outlet at Fort Wayne, Indiana. Maumee III had a surface elevation of approximately 780 feet based upon the elevation of existing beach strand lines and ridges associated with this glacial lake (Schooler, 1974). As the Ashtabula ice temporarily receded, the waters of Maumee III inundated the area between the ice front and the previously deposited moraine into which lacustrine deposits were then laid down. These lacustrine deposits were overrun by subsequent ice advances with the deposition of additional glacial till. In this manner, a series of glacial tills corresponding to each of the Ashtabula end moraines was deposited in the area, each of which was separated by continuous deposits of glaciolacustrine material laid down during the inundation by glacial Lake Maumee III.

The vicinity of the Shope's site is depicted on Figure 3-6. This figure depicts the surficial glacial deposits as they have been mapped by Schooler (1974). Of primary interest are the Ashtabula and Girard end moraines and a beach ridge formed along the shoreline of the last inundation of Lake Maumee III.

3.3.2 Site Specific Geologic Conditions

A conceptual geologic model for the Lord/Shope site and vicinity has been presented in the previous section. This model is based upon the [illegible] regional setting as well as upon an interpretation of data generated by this

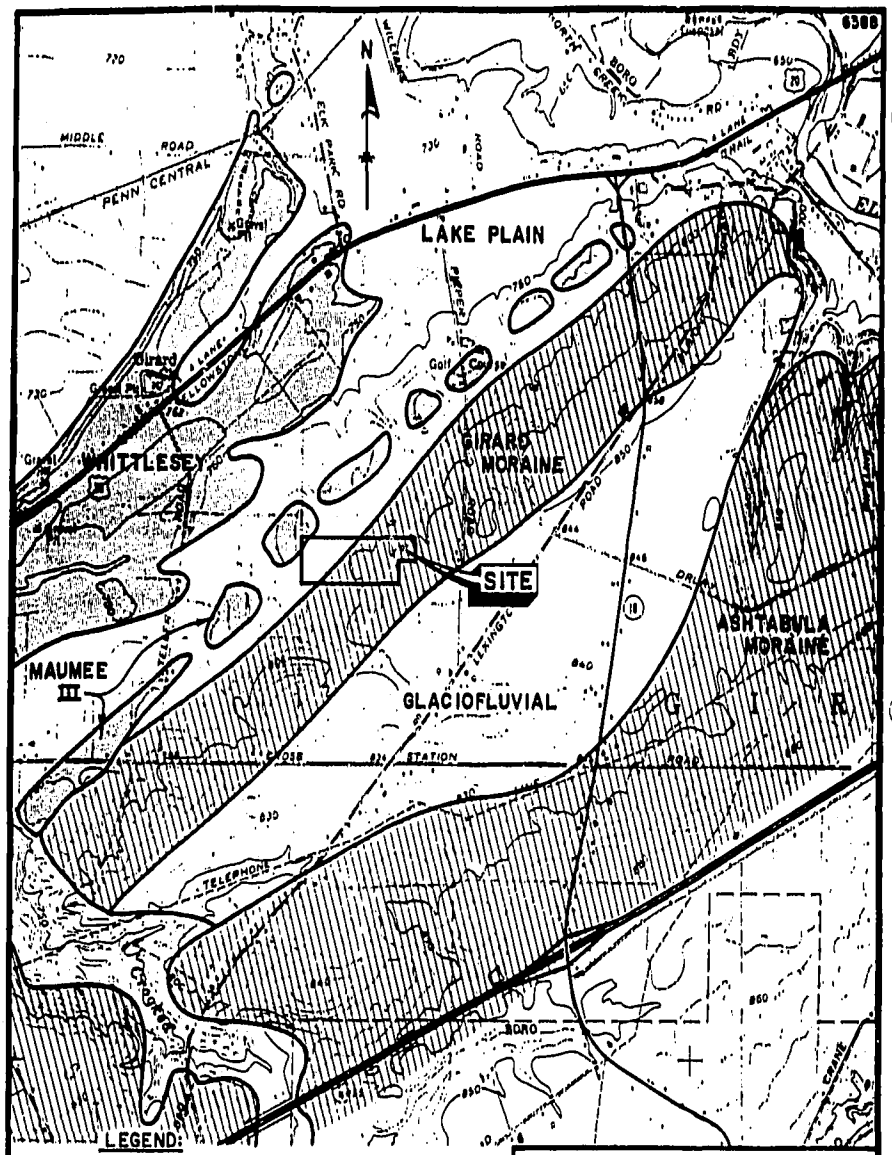

FIGURE 3-6

REGIONAL SURFICIAL GEOLOGIC MAP

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

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investigation and by previous studies. With a database consisting of more than 65 test borings and more than 90 individual wells and piezometers, a considerable degree of confidence in the conceptual model is possible.

Detailed descriptions of the materials encountered on site are presented on the boring logs in Appendix A. The soil descriptions presented are based on visual examination, the results of laboratory grain size analysis, and index testing. The descriptions are in accordance with a modification of the soil classification system suggested by D. M. Burmister (1958). The results of the laboratory tests are presented in Appendix E.

A summary of the character and thickness of the geologic units at the site is presented in the Geologic Column (Figure 3-7). The geologic strata are graphically depicted on the geologic cross sections on Sheets 3, 4, and 5 of 21. The orientation of these cross sections is depicted on Sheet 2 of 21.

In this discussion of site specific geologic conditions, the units will be described in reverse stratigraphic sequence, that is, in the order in which they were encountered from the land surface. In general, these units consist of a sequence of interbedded glacial tills and glaciolacustrine deposits with minor surficial occurrences of glaciofluvial deposits. Each of the units has been shown to be laterally extensive throughout the site. Bedrock has not been encountered in any of the borings that have been drilled to date at the Shope's site.

3.3.2.1 Glaciofluvial Deposits. Glaciofluvial deposits are found as a veneer of sediments only on the topographically higher areas of the southern portion of the site. These deposits range in thickness up to 7 feet. This unit is composed predominantly of stratified sand with minor amounts of silt. The glaciofluvial deposits represent the reworking of the glacial till by glacial meltwater along the margin of the retreating glacial ice.

3.3.2.2 Ashtabula Till. The Ashtabula Till has been encountered in all of the areas of the site that have been investigated. In all, four separate subunits of the Ashtabula Till have been observed. These subunits correspond to the Painesville, Ashtabula, and Girard subadvances, and possibly to an

PERIOD	EPOCH	STAGE	UNIT	THICKNESS (FT)	GENERALIZED DESCRIPTION
QUATERNARY	PLEISTOCENE	WISCONSIN	GLACIO-FLUVIAL DEPOSITS	0-7	Brown f-m SAND, little to and SILT, Stratified, well sorted.
			ASHTABULA TILL (GIRARD)	3-32	COARSE SUBUNIT f-m SAND, some to and f-m GRAVEL, little to some SILT, non-stratified poorly sorted. FINE SUBUNIT Silt, little to and f SAND, trace to little Gravel
			MAUMEE III_C LACUSTRINE DEPOSITS	3-33	COARSE SUBUNIT (Predominant) SAND, trace to and SILT, trace to and GRAVEL, freq. interbedded with SILT & CLAY. FINE SUBUNIT SILT to SILT & CLAY, no to and SAND.
			ASHTABULA TILL (ASHTABULA)	3-42	FINE SUBUNIT CLAYEY SILT, little to and SAND, trace to little GRAVEL. COARSE SUBUNIT SAND, little to some SILT, little to and GRAVEL
			MAUMEE III_B LACUSTRINE DEPOSITS	2-26	FINE SUBUNIT SILT, trace to some SAND. COARSE SUBUNIT Coarse zones of stratified SAND, trace to some SILT, trace to and GRAVEL.
			ASHTABULA TILL (PAINESVILLE)	14-51	FINE SUBUNIT (Predominant) CLAYEY SILT, little to and SAND, tr GRAVEL grading to SILT & CLAY, tr to some SAND, tr GRAVEL. COARSE SUBUNIT SAND, some SILT and CLAY, little to some GRAVEL
			MAUMEE III_A LACUSTRINE DEPOSITS	2-20	FINE SUBUNIT Laminated CLAY & SILT, no to little SAND, no to trace GRAVEL. COARSE SUBUNIT Stratified SAND, no to some SILT.
			ASHTABULA TILL (EUCLID)	?	SILT & CLAY, trace to little SAND, trace GRAVEL.

FIGURE 3-7
TYPICAL
GEOLOGIC SECTION

LORD / SHOPE SITE
GIRARD TWP., PA.

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older subadvance (Euclid) of the Ashtabula ice sheet as indicated on Figure 3-5. Each subunit is described as follows:

Girard Subunit

The uppermost subunit of the Ashtabula Till corresponds to the last readvance of the Ashtabula ice sheet that occurred subsequent to the inundation by Lake Maumee III. This till forms the Girard Moraine which is the northernmost ridge in the Lake Moraine System. This till has been observed at thicknesses ranging from 3 to 32 feet.

The Girard has been observed to be the coarsest subunit of the Ashtabula Till. It can be described typically as "SAND, some to and Gravel, little to some Silt & Clay." Some fine grained subunits have also been observed described as "SILT, little to and f Sand, trace to little f Gravel." The predominantly coarse-grained nature of this till probably represents the scouring and subsequent redeposition of the glacial lake beach deposits.

Ashtabula Subunit

The Ashtabula subunit was encountered in all of the borings in the study area, ranging in thickness from 3 to 42 feet. This subunit is predominately fine grained, consisting of "Clayey SILT, little to and SAND, trace to little Gravel." Coarser grained deposits within this till subunit were observed in a number of borings, particularly in southern portions of the study area in the vicinity of the disposal area. These coarser grained deposits probably represent the reworking of lacustrine beach deposits and consist typically of "SAND, little to some Silt, little to and Gravel."

Painesville Subunit

The Painesville subunit of the Ashtabula Till was found to be substantially more fine-grained than the overlying tills with a thickness ranging from 14 to 51 feet. This till, which was encountered in all of the deep borings, consists typically of "Clayey SILT, little to and Sand,

trace Gravel." However, occasional coarse-grained zones consisting of "SAND, some Silt and Clay, little to some Gravel" occur discontinuously within this subunit.

Euclid Subunit

The upper surface of the Euclid subunit was encountered in only three of the deepest borings, W-20, W-21 and W-27. However, the Euclid subunit is believed to continuously underlie the entire study area. The Euclid was observed to consist typically of SILT & CLAY, trace to little Sand, trace Gravel. The permeability of this subunit is presumed to be low.

3.3.2.3 Maumee III Lacustrine Deposits. Lacustrine deposits corresponding to Lake Maumee III have been observed as interbedded sequences between each of the subunits of the Ashtabula Till. The Maumee III has been subdivided, for the purpose of this report, into three subunits based upon their position relative to the till subunits. These lacustrine subunits have been designated Maumee III A, III B, and III C. Definition of the various Maumee III subunits has been an important focus of this investigation in that they serve as a controlling factor in the migration of groundwater at the site.

The Maumee III units have been observed to be laterally extensive across the study area. However, the distribution of fine and coarse zones is somewhat discontinuous. This is particularly true in the upper III C subunit, which has made this subunit difficult to characterize.

III C Subunit

The Maumee III C was exposed at the ground surface and/or was encountered at shallow depth in nearly all of the borings. Where encountered, this subunit ranges in thickness from 3 to 33 feet. The III C is predominantly coarse-grained and is probably representative of lake shore, beach deposition.

The Maumee III C consists typically of "SAND, trace to and Silt, trace to and Gravel," frequently interbedded with laminations of Silt & Clay.

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However, discontinuous fine grained zones of the III C were also encountered in a number of borings. These deposits consist of "laminated SILT & CLAY, no to and SAND."

It is important to note that although the Maumee III C is continuous throughout the site, it has been difficult to characterize the respective fine and coarse-grained zones due to their significantly discontinuous nature. The thicker, coarse-grained "zones" will have a significantly greater transmissivity when compared to the overall transmissivity value for the sediment. These "zones" therefore will play a significant role with regard to potential contaminant transport and the overall characteristics of the Water Table Zone.

The coarse-grained portion of the III C has provided a major focus in this investigation as it plays the most significant role in the character of the Water Table Zone. The thickness of the III C Sand is believed to range around 10 feet on the north-central and northwest sides of the site. However, the III C Sand is observed to be significantly thicker in the area due north of the site, in the vicinity of well W-34, as depicted on Sheet 6 of 21. In this area the III C Sand attains a thickness of 32 feet. North of this area, in the area of borings 4, 5 and 10, the III C thins to less than 10 feet.

The III C is observed to thicken again in the northernmost part of the study area in the vicinity of boring B-86-16. It is this portion of the III C that has been mapped by Schooler (1974) as the exposed Maumee III C beach strand line (Figure 3-7). This exposed deposit is presently mined in the area north of wells W-27 and W-32.

The Ashtabula Till underlying the thickest portions of the III C, in the area north of the site around well W-34 and Boring B-86-2, appears to become thinner. The result is that the III C may be in partial hydraulic communication with the underlying III B subunit. This will be described in more detail in later sections.

III B Subunit

The III B subunit was encountered at intermediate depths beneath the study area at a thickness ranging between 2 and 26 feet. This subunit consists alternately of relatively coarse zones and fine zones. The coarse zones can be typically described as "stratified fine SAND, trace to some Silt, trace to and Gravel", occasionally interbedded with laminations of Silt & Clay. The finer-grained zones typically consist of "laminated SILT, trace to some Sand."

The upper surface of the subunit is depicted on a Structural Contour Map (Sheet 7 of 21). The undulating surface is shown to slope to the northeast toward Lake Maumee III basin. The thickness of the coarse-grained subunit is relatively constant, as depicted on Sheet 8 of 21, ranging from zero to 13 feet.

III A Subunit

The III A Subunit was encountered at the bottom of each of the deep borings at a thickness ranging from 2 to more than 20 feet. The III A is more fine-grained than the overlying lacustrine deposits, and is probably representative of slightly off-shore depositional environment. However, coarser-grained zones were occasionally encountered in each of the borings in which the deepest wells were screened. The fine-grained zones consist of "laminated CLAY & SILT, no to little Sand, no to trace Gravel." The coarse zones consist of "stratified fine SAND, no to some Silt."

The upper surface of the coarse portion of the III A subunit is depicted with the use of a structural contour map on Sheet 9 of 21. It has been shown to slope to the north and east with a topographically high area located immediately beneath the landfill.

3.4 GROUNDWATER CONDITIONS

3.4.1 Hydraulic Conductivity Testing

A number of methods were employed for the determination of hydraulic conductivity. These methods are described in the following sections.

3.4.1.1 Aquifer Test Analyses. Aquifer testing was conducted separately on each of wells W-28 and W-34 in 1987, as described previously in Section 3.1.2. Aquifer testing data yields the most accurate estimate of water-bearing zone characteristics. This is because well loss errors are eliminated and because the test is better able to assess larger scale conditions within the water-bearing zone. The analysis of the collected data and an associated summary are described in this section. The complete data plots and calculations are contained in Appendix C.

Background barometric and water level changes for selected wells and piezometers within the vicinity of W-28 and W-34 have been plotted and are presented in Appendix C-1. An inverse relationship between measured water levels and the barometric pressure is often observed in confined or semi-confined aquifers. However, no direct relationship was discerned from the data for either test and as a result no barometric correction factor was applied to the data.

Static water levels were measured in all wells and piezometers selected for monitoring, prior to each aquifer test. Measurements of drawdown were then determined at frequent time intervals throughout the duration of each test. The frequency of measurements was determined by the distance of the monitoring point to the pumping well, the anticipated drawdown, and the elapsed time of the test. These data (drawdown, time and distance) were then plotted in three different fashions to aid in the data evaluation. The plot types and the analytical methods to which each plot applies are summarized below:

Data	Plot Scales	Analytical Method
time-drawdown	log-log	Theis non-equilibrium well formula
time-drawdown	semi-log	Jacob straight line method
distance-drawdown	semi-log	Jacob straight line method

Theis Non-equilibrium Well Formula

In 1935, C. V. Theis developed a non-equilibrium well formula which takes into account the effect of pumping time on drawdown (Fetter, 1980). This

analytical technique uses a curve matching process particularly well suited to early-time data. Good estimates of aquifer hydraulic conductivity and storage coefficient can be made without first attaining steady-state conditions. The Theis formula is based on the following assumptions:

- The water-bearing formation is uniform in character and hydraulic conductivity in both horizontal and vertical directions.
- The formation has uniform thickness.
- The formation has infinite areal extent.
- No recharge boundaries are encountered by the cone of influence, during the test.
- The pumped well penetrates and receives water from the full thickness of the water-bearing formation.
- The water removed from storage is discharged instantaneously with lowering of the head.

Although the hydrogeologic environments encountered at the Lord/Shope site do not meet all these assumptions, the observed conditions and resulting data are considered sufficiently favorable to the successful application of this method.

The curve matching technique for a fully confined artesian system requires that a "type" curve be constructed by plotting 1/u versus the well function of u, W(u) where;

$$u = \frac{2693\, r^2\, S}{Tt} \quad \text{and} \quad \text{Eq 3.1}$$

$$W(u) = -0.5772 - \log_e u + u - \frac{u^2}{2.2!} + \frac{u^3}{3.3!} + \frac{u^4}{4.4!} \ldots \text{Eq 3.2}$$

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where;

Q = pumping rate, in gpm

s = drawdown, in feet

T = coefficient of transmissivity of the water-bearing zone, in gpd per ft

r = distance from the center of the pumped well to the point where drawdown is measured in feet

S = coefficient of storage, dimensionless

t = time since pumping started, in minutes

The curve matching techniques for unconfined, water table conditions require the plotting of $1/u_a$, $1/u_b$ versus the well function w (u_a, u_b, B) where:

$$u_a = \frac{r^2 S}{4Tt} \quad \text{(for early drawdown data)} \qquad \text{Eq. 3.3}$$

$$u_b = \frac{r^2 Sy}{4Tt} \quad \text{(for later drawdown data)} \qquad \text{Eq. 3.4}$$

$$B = \frac{r^2 k v}{b^2 K_h} \qquad \text{Eq. 3.5}$$

and $W(U_a, U_b, B)$ is the well function discussed previously

where;

Q = pumping rate, in ft^3/day

s = drawdown, in feet

T = coefficient of transmissivity of the water-bearing zone in gpd/ft

r = distance from the center of the pumped well to the point where the drawdown is measured, in feet

S = coefficient of storage, dimensionless

t = time since pumping started in days

K_v vertical hydraulic conductivity

K_h = horizontal hydraulic conductivity

b = initial saturated thickness

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The Theis Type curve (confined conditions) and the water table Type curves are presented in Appendix C-4. Log-log plots of drawdown versus time for selected monitoring wells have also been prepared for each of the aquifer tests (W-28 and W-34).

It was decided to use the confined, Theis type curve for the W-28 analysis and the water table type curves for the W-34 analysis based upon the conditions found in the field, the shape of the resulting log-log plots and the quality of the "fit" which was obtained between the plots and the type curves. Type curves for semi-confined, leaky artesian systems were evaluated but not selected due to their poor fit. The resulting values obtained for the coefficient of storativity and specific yield fall within the expected ranges for each of these types of water-bearing zones and further support these assumptions.

The characteristics of the water-bearing zone in the vicinity of the pumping well are obtained by overlaying the type curve on the drawdown plots, adjusting the plots to provide a "best fit" (keeping the axes parallel) and selecting an arbitrary match point. The match point values for 1/u, w(u), s and t and $1/u_a$, $1/u_b$, w (u_a,u_b, B), s and t, selected for each plot, are indicated on the calculation sheets presented in Appendices E-2 and E-3. These data are then used in the following formulas to calculate the T and S parameters.

Eq 3.5, 3.7

$$T = \frac{114.6\ Q}{s} W(u) \quad \text{and} \quad S = \frac{uTt}{2693\ r^2} \quad \text{for confined conditions (W-28)}$$

$$T = \frac{Q}{4\ s} W(U_a,\ U_b,\ B) \quad \text{and} \quad Sy = \frac{4Tt\ u_a}{r^2} \quad \text{Eq 3.8, 3.9 for water table conditions (W-34)}$$

Hydraulic conductivity may then be calculated by dividing the transmissivity value by the saturated thickness of the aquifer in the vicinity of the pumping well. Transmissivity, storage coefficient, and hydraulic conductivity values were calculated for each monitoring well and are summarized in Table 3-4.

Two observations are worth noting from a review of the plots and resulting calculations from W-34. First, a good match with the type curve was typically

TABLE 3-4
SUMMARY OF AQUIFER TEST DATA

Observation Well Number	Method	Transmissivity (gal/day/ft)	S (dimensionless)	Hydraulic Conductivity (cm/sec)
W-28 TEST				
W-12B	Theis	30.2	1.9E-02	2.9E-04
	Jacob	59.5	8.7E-03	5.6E-04
W-10	Theis	81.9	2.0E-05	7.7E-04
	Jacob	93.0	1.7E-05	8.8E-04
W-4	Theis	115	2.2E-04	1.1E-03
	Jacob	83.5	1.8E-04	7.9E-04
W-21B	Theis	46.2	1.3E-04	4.4E-04
	Jacob	37.3	6.7E-05	3.5E-04
All	Dist-Drdwn	52.8	6.8E-05	5.0E-04
	Geometric Mean	61.2	2.2E-04	5.8E-04
W-34 TEST				
W-33	Theis (A)	1780	3.0E-02	1.7E-02
	Theis (B)	1230	6.8E-01	1.2E-02
PZ-19	Theis (A)	1780	3.7E-02	1.7E-02
	Theis (B)	1000	5.8E-01	9.4E-03
PZ-18	Theis (A)	80.2	2.0E-03	7.6E-04
	Theis (B)	882	2.4E-02	8.3E-03
PZ-22	Theis (A)	893	6.0E-04	8.4E-03
	Theis (B)	1600	1.3E-02	1.5E-02
	Geometric Mean	890	2.5E-02	8.4E-03

only obtained for the later-time drawdown data (Type b curves). The earlier portions of the curve were not as well defined and partially masked by scattered data points due to recharge from heavy rains which fell during the test, thus making the interpretation more difficult.

Secondly, the calculated specific yield for W-34 was considerably lower than what would be expected for unconfined conditions (0.1 to 0.3). This would indicate that there is delayed drainage as the water table is lowered. This conclusion is further supported by the fact that layering and gradational changes in grain size were noted in the borings surrounding and including W-34.

The aquifer testing did not allow the determination of the vertical hydraulic conductivity of the aquitards. This is due to the relatively low pumping rate that was possible as a consequence of the low relative hydraulic conductivity of the water-bearing zones that were pumped during the test. This is coupled with the fact that the aquitards are believed to have a very low hydraulic conductivity. Therefore, the existing conditions of the site did not allow sufficient stress to be applied such that observable drawdowns could be induced in the water-bearing zones either above or below those being tested.

Jacob Time-Drawdown Method

The Jacob Time-Drawdown Method is a modification of the Theis non-equilibrium formula which can be applied to the later-time portions of the data. This method does not take into account the effects of dewatering and was therefore only used for analysis of the W-28 test data. In addition to the assumptions listed for the Theis formula, the Jacob method assumes that "t" is sufficiently large and "r" is sufficiently small. Thus, this method is more ideally suited to observation wells which are located close to the pumping well and for times well into the aquifer test. In order to successfully apply this method of analysis, it is recommended that the data points which are used should be taken from a point in time greater than the value of $5r^2s/T$ at which point the data plots on a straight line (Fetter, 1980). This test was applied to each of the monitoring wells and the results are presented with the calculations in Appendix E-2.

Transmissivity and storage coefficient estimates are calculated using the Jacob method directly from semi-log plots of time and drawdown. "Best fit" straight lines were drawn through the later portions of the data points and the slope, delta s (drawdown per one full log cycle) was then calculated. This value is then applied to the following equation.

$$T = \frac{264\ Q}{\text{delta s}} \qquad \text{Eq 3.10}$$

The value of transmissivity obtained from equation 3.10 and the time associated with straight line intercept (t_o) of zero drawdown, is then entered into the following equation to calculate the storage coefficient:

$$S = \frac{T\ t_o}{4780_r 2} \qquad \text{Eq 3.11}$$

Transmissivity, storage coefficient and hydraulic conductivity values derived using the Jacob time-drawdown method are summarized in Table 3-4.

Jacob Distance-Drawdown Method

Another semi-log straight line method developed for later-time data analysis is the Jacob distance-drawdown method (Fetter, 1980). This method requires that at least three observation points are available at varying radial distances from the pumping well and that steady-state conditions be reached. The advantage of this method over the previously discussed methods, is that it provides a more regional evaluation of aquifer characteristics. Rather than relying on only those wells in close proximity to the pumping well, data from wells over 600 feet away can be utilized, which may not have the sufficient early-time data necessary for the Theis method. Although true steady-state conditions were not reached, it is estimated that "steady-shape" of the cone of influence was achieved and that the results provide a reasonable estimate of the aquifer parameters.

A semi-log plot of distance versus drawdown was constructed for the W-28 aquifer test using the last complete set of measured water levels. A best fit

straight line was again drawn through the data points and transmissivity and storage coefficient values calculated using the following formulas:

$$T = \frac{528\ Q}{\text{delta s}} \quad \text{and} \quad S = \frac{0.3Tt}{r_o^2} \qquad \text{Eq 3.12, Eq 3.13}$$

A distance-drawdown graph of the W-34 test data was not constructed since only two of the observation wells would pass the validity test for appropriate use of this method.

The above-described data is presented in Table 3-4. It should be noted that some variability in the computed values of T and S are observed. However, the range of this variability is well within acceptable limits. For the purposes of evaluation, the geometric mean of all of the values for each test will be utilized. These resultant values are considered to be the best measure of the water-bearing zone characteristics of any that are available for the site.

3.4.1.2 Variable Head Hydraulic Conductivity Testing. Hydraulic conductivity tests were performed on selected monitoring wells and well points by the use of the "variable head" method, as described below. These tests have been conducted in all phases of the investigation from 1984 to the present. The results of these tests represent determination of the horizontal hydraulic conductivity of the geologic materials adjacent to the screened interval of each well.

The particular "variable head" borehole test utilized for this project was developed by Hvorslev for the United States Army Corps of Engineers, and is summarized in Cedergren (1977). These tests were conducted as follows:

- The static water level in the well to be tested was measured and recorded.
- The water level in the well was then lowered by bailing or pumping, and a measurement of the depressed water level or drawdown was recorded.

- At frequent time intervals, the water level in the well and the respective time elapsed from the beginning of the recovery period was measured and recorded.

The method of analysis assumes that the rate of inflow to the well screen after evacuation is proportional to the hydraulic conductivity (k), expressed in cm/sec, and to the unrecovered head distance. A plot of the unrecovered head distance or Head Ratio versus Time (t) indicates an exponential decline in the recovery rate with time. Equation (3.14) is used to calculate the hydraulic conductivity.

$$k = \frac{r^2 \ln(L/R) \ln H_1/H_2}{2L\,(t_2 - t_1)} \qquad \text{Eq 3.14}$$

Where:
- R = sand pack radius (cm)
- r = riser radius (cm)
- L = effective intake length
- t_1 = time interval corresponding to h_1 (sec)
- t_2 = time interval corresponding to h_2 (sec)
- h_1 = head ratio at t_1 (dimensionless)
- h_2 = head ratio at t_2 (dimensionless)
- k = hydraulic conductivity (cm/sec)

The individual test plots are presented in Appendix B. The results of the hydraulic conductivity testing are summarized on Table 3-5.

3.4.1.3 Laboratory Soil Testing. A number of soil samples were selected for laboratory soils testing as a part of the 1984-85 AWARE Investigation and as a part of Phase II of the RI. Eleven split-spoon samples were subjected to mechanical grain size testing including mechanical sieving and Atterberg limits testing. In addition, six undisturbed tube samples collected from the upper aquitard were tested for vertical hydraulic conductivity, grain size distribution, Atterberg limits, and moisture content.

The soil testing procedures followed in all of the performed [illegible] consistent with standard laboratory procedures. The hydraulic conductivity

TABLE 3-5
SUMMARY OF FIELD VARIABLE HEAD HYDRAULIC CONDUCTIVITY TEST DATA

Well Number	Test Date	Hydraulic Conductivity (cm/sec)
Water Table Aquifer		
W-9WT (R)	08-Dec-88	5.7E-05
W-12C	22-Jul-81	2.9E-05
W-22A	12-Dec-84	9.2E-04
W-33	07-Jan-87	9.6E-04
W-27A	18-Jan-89	2.1E-04
W-32A	18-Jan-89	8.6E-05
W-35A	08-Dec-88	3.9E-06
W-36A	08-Dec-88	4.0E-06
W-37A	08-Dec-88	4.9E-04
W-39A	19-Jan-89	1.1E-03
PZ-22	18-Jan-89	1.6E-06
	Geometric Mean	7.4E-05
Intermediate Water Bearing Zone		
W-7	17-Jan-89	4.2E-07
W-8A	17-Jan-89	6.7E-06
W-9	17-Jan-89	4.1E-06
W-12A	22-Jul-81	7.2E-07
W-20B	18-Jan-89	1.1E-04
W-21B	12-Dec-84	5.2E-07
W-22B	12-Dec-84	2.1E-05
W-24B	12-Dec-84	2.6E-06
W-26B	19-Jan-89	4.6E-06
W-27B	18-Jan-89	3.2E-05
W-28	07-Jan-87	7.6E-05
W-32B	07-Jan-87	7.2E-06
W-35B	08-Dec-88	6.6E-06
W-36B	08-Dec-88	5.5E-06
W-37B	08-Dec-88	2.6E-06
W-39B	19-Jan-89	1.1E-03
PZ-11	18-Jan-89	2.1E-05
PZ-13	19-Jan-89	8.2E-07
PZ-38	19-Jan-89	6.6E-06
	Geometric Mean	7.3E-06
Deep Water Bearing Zone		
W-6B	08-Dec-88	6.1E-07
W-21C	12-Dec-84	9.7E-07
W-22C	12-Dec-84	1.1E-06
W-23C	12-Dec-84	1.1E-04
W-24C	12-Dec-84	5.3E-04
W-27C	07-Jan-87	7.5E-07
	Geometric Mean	5.5E-06
Upper Aquitard		
Maumee IIIB (Fine)		
W-23B	12-Dec-84	1.8E-07
Ashtabula Till (Fine)		
W-12B	22-Jul-81	8.3E-07

tests on the undisturbed tube samples were performed in a flexible-walled triaxial permeameter under falling head conditions. This apparatus is considered superior to a conventional rigid-walled permeameter because it allows placing the soil specimen under a confining pressure before and during testing. The confining pressure insures that sample fracturing and effluent bypass will not occur during testing. Also, the confining pressure can be adjusted to equal the in situ confining pressure experienced by the soil under natural conditions. Furthermore, this system allows application of the effluent under significant back pressures which insure saturation of specimens prior to actual testing.

The laboratory test data is presented in Appendix E. The vertical hydraulic conductivity data are summarized on Table 3-6.

3.4.1.4 Tritium Testing. The levels of tritium observed in 12 monitoring wells are presented in Table 3-7. The mean tritium level observed in the three Deep Zone wells of 2.09 is apparently representative of a groundwater which originally recharged in approximately 1950. Assuming that precipitation contained 10 tritium units in 1950, groundwater resulting from recharge of that precipitation would now be expected to exhibit such low levels of tritium.

The mean tritium level from wells in the Intermediate Zone is 5.58. This would seem to be representative of groundwater which may have originated as precipitation in the late 1950s. However, the level observed in these wells could either have originated as precipitation falling in 1959 or 1977.

The vertical hydraulic conductivity of the aquitard can be determined using the age of the groundwater in each Deep Zone well, the known thickness of the aquitard, and the vertical hydraulic gradient across the aquitard. It has been assumed that dispersivity would have the effect of smoothing out the observed seasonal fluctuations in rainfall tritium levels but would not significantly alter the rate of advance of the tritium vertically through the aquitard.

It is assumed that groundwater moves downward across the aquitard from the time at which the groundwater was dated to the test date. These data and the

TABLE 3-6
SUMMARY OF LABORATORY HYDRAULIC CONDUCTIVITY TEST DATA

Well Number	Test Interval (ft below ground)	Test Date	Hydraulic Conductivity (cm/sec)
Upper Aquitard			
Maumee IIIC (Fine)			
W-20B	22 - 23	15-Jan-85	2.8E-07
W-20B	23 - 24	15-Jan-85	8.4E-07
Upper Aquitard			
Ashtabula TIII (Fine)			
W-12D	22 - 24	15-Jan-85	1.0E-07
W-20B	34 - 36	15-Jan-85	1.4E-07
		Geometric Mean	2.4E-07
Lower Aquitard			
Ashtabula TIII (Fine)			
W-6B	58.5 - 60	08-Jun-89	2.0E-07
W-6B	51 - 52	08-Jun-89	1.6E-08
		Geometric Mean	5.7E-08

Table 3-7

TABULATION OF TRITIUM DATA

Well Number	Date	Tritium Units
Water Table Aquifer		
W-20A	13-Jan-86	31.0
W-23A	13-Jan-86	36.7
W-26A	13-Jan-86	27.0
W-27A	16-Jan-87	23.8
W-32A	16-Jan-87	23.4
	Mean	28.38
Intermediate Zone		
W-23B	13-Jan-86	1.46
W-26B	13-Jan-86	15.0
W-27B	16-Jan-87	0.34
W-32B	16-Jan-87	5.53
"	Mean	5.58
Deep Zone		
W-23C	13-Jan-86	1.21
W-26C	13-Jan-86	3.41
W-27C	16-Jan-87	1.66
	Mean	2.09

aquitard thickness allow the calculation of the vertical seepage velocity (V_s). The vertical hydraulic conductivity of the aquitard can be calculated from the following equation:

$$k = \frac{V_s n_e}{i} \qquad \text{Eq 3.15}$$

Where: V_s = seepage velocity, (cm/sec)
n_e = effective porosity, (dimensionless)
i = hydraulic gradient, (dimensionless)
k = hydraulic conductivity, (cm/sec)

It has been assumed that the average effective porosity is 0.3 (Freeze and Cherry, 1979). The vertical hydraulic gradient is calculated from the head differences between the Intermediate and Deep Zones and the known thickness of the aquitard. Employing the above equation, the mean hydraulic conductivity of the aquitard is found to be 4.4×10^{-7} cm/sec. The calculations are summarized on Table 3-8.

3.4.1.5 Summary of Hydraulic Conductivity Testing. As described above, hydraulic conductivity testing using both field and laboratory methods has been conducted at the site. These data will be placed in perspective with the hydrogeologic system in the discussion that follows.

Water-bearing Zones

The variable head test and aquifer test data have been used to evaluate the individual water-bearing zones. However, the Hvorslev-method, variable head test methods have typically been shown to under-estimate the actual hydraulic conductivity by a factor ranging from two to greater than ten. Several factors contribute to the underestimation. Perhaps the most significant is that the variable head tests sample a relatively small volume of the aquifer and are less likely to include the most permeable pathways that control the effective hydraulic conductivity of the system. In addition, the installation of a monitoring well inevitably disturbs the formation, resulting in smearing of finer-grained materials on the walls of the borehole.

TABLE 3-8

SUMMARY OF HYDRAULIC CONDUCTIVITY
CALCULATED FROM TRITIUM DATA

Well Couplet	Aquitard Thickness	Travel Time (Years)	Seepage Velocity (cm/sec)	Vertical Head Difference (Feet)	Vertical Hydraulic Gradient	Maximum Vertical Hydraulic Conductivity (cm/sec)
W-23	36.5	36	9.8E-07	28.8	0.79	3.7E-07
W-26	51.0	36	1.4E-06	64.0	1.25	3.3E-07
W-27	38.6	37	1.0E-06	16.9	0.44	6.9E-07
				Geometric Mean		4.4E-07

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variable head methods do not account for frictional head losses as water passes through the well screen. At this site, comparison of variable head test results at Wells W-28 and W-34, where aquifer tests have been conducted, indicates that the variable head test values are less then pump test values by a uniform factor of approximately 8.0.

On the basis of the previous discussion, it has been conservatively assumed that all of the variable head data have underestimated the hydraulic conductivity of the water-bearing zones by a factor of 8.0. Therefore, the hydraulic conductivity values most representative of each water-bearing zone will be assumed to be the geometric mean of the variable head data for each multiplied times a factor of 8.0. These values are summarized on Table 3-9. The distribution of the hydraulic conductivity in the intermediate water-bearing zone has been mapped, as presented on Sheet 12 of 21. This zone has been shown to provide the primary conduit for contaminant migration from the landfill. In general, the hydraulic conductivity of much of this zone ranges around 1×10^{-4} to 1×10^{-5} cm/sec. However, an area of significantly higher hydraulic conductivity exists north of the site with values ranging up to approximately 1×10^{-2} cm/sec.

Aquitards

The hydraulic conductivity of the upper and lower aquitards has been evaluated using laboratory data and tritium data. These data are somewhat limited. In addition, it was not possible to quantify the hydraulic conductivity of the aquitards through the use of the aquifer testing method that was employed due to the low vertical conductivity of the aquitard and to the relatively low hydraulic conductivity of the water-bearing zones.

Laboratory hydraulic conductivity data exist for four samples collected from the upper aquitard. These data are shown to have a geometric mean of 2.4×10^{-7} cm/sec. The lower aquitard has visually been shown to be even more fine-grained and much more continuous than the upper aquitard. In fact, the laboratory hydraulic conductivity data for two samples from this zone indicate a mean value of 6.8×10^{-8} cm/sec.

TABLE 3-9
SUMMARY OF REPRESENTATIVE HYDROGEOLOGIC DATA

Hydrogeologic Zone	Hydraulic Conductivity (cm/sec)	Porosity	Hydraulic Gradient	Groundwater Flow Rate (ft/yr)
Horizontal Flow				
Water Table	6E-04	0.3	0.04	82
Intermediate				
Mean	6E-05	0.3	0.05	10
North of LF	1E-03	0.3	0.02	69
Deep	4E-05	0.3	0.01	1.5
Vertical Flow				
Lower Confining Layer	4E-07	0.3	0.76	1.1

Laboratory testing has often suggested lower hydraulic conductivities than actual (Olsen & Daniel, 1979). By virtue of the extremely small size of laboratory samples relative to the aquitard as a whole, laboratory samples often fail to predict the influence of macro-scale features on aquitard behavior. The tritium data for the aquitard at well cluster W-23 suggest a maximum vertical hydraulic conductivity of 4.4×10^{-7} cm/sec. This value is consistent with the limitation of the laboratory data as discussed above. Therefore, this is considered to be conservatively representative of the vertical hydraulic conductivity of the lower aquitard.

3.4.2 Groundwater Flow

The geologic conditions beneath the study area have been described in detail in the preceding section. This section describes the occurrence of groundwater as it is contained within the geologic framework. Groundwater has been observed to occur within three zones beneath the Shope's study area:

- As an unconfined Water Table Aquifer within the shallow soils.
- As an intermediate depth confined zone within the coarser grained soils of the Maumee III B and the coarse-grained Ashtabula Till.
- As a deep confined zone within the coarser grained deposits of the Maumee III A.

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

Monitoring wells and piezometers have been installed in each of these zones, allowing the determination of their respective piezometric surfaces. Groundwater measurements from all of the monitoring wells are presented in Table 3-10.

TABLE 3-10

WATER LEVEL DATA

Lords\Snape Site
Girard Twp, Pennsylvania

LOCATION NUMBER	COORDINATES NORTH	COORDINATES EAST	ELEVATION REFERENCE	ELEVATION GROUND	WELL DEPTH	GEOLOGIC ZONE	GW ELEVATION (in feet) 16-Jan-85	09-Sep-86	10-Oct-86	06-Jan-87	21-May-87	25-Jun-87	06-Dec-88	13-Jan-89	17-Jan-89
Monitoring Wells															
W-1	323	902	791.27	789.7	101.5	Deep	744.9	744.0	743.8	744.4	744.5	744.1	--	--	--
W-1A	323	902	791.87	790.2	28.0	Int	785.1	783.3	785.8	786.3	784.7	783.8	786.8	786.7	786.7
W-1B	323	902	791.94	790.5	21.0	WT/Int	786.8	785.7	788.3	788.7	787.0	786.2	788.7	789.0	789.2
W-1WT	323	902	793.36	790.2	15.0	WT	785.1	783.0	786.1	785.7	784.3	783.7	787.3	786.7	786.7
W-2	100	1185	829.55	827.3	61.3	Int	811.8	810.9	810.1	812.7	814.1	812.8	811.2	812.6	812.8
W-2A	100	1185	829.01	826.7	52.5	Int	811.0	808.9	809.0	810.8	810.9	814.8	808.9	809.3	810.3
W-2B	100	1185	829.55	827.3	37.5	WT/Int	--	813.3	812.0	814.4	812.1	811.2	809.9	811.4	811.5
W-2C	100	1185	829.55	827.3	29.0	WT/Int	814.8	--	--	--	--	813.0	812.8	812.9	812.9
W-2WT	135	1175	818.72	815.5	24.0	WT	812.8	810.7	810.7	813.1	812.8	811.6	810.5	812.2	812.1
W-3	490	1080	800.66	799.2	37.0	Int	795.3	792.9	794.2	795.3	794.6	793.8	794.9	795.3	795.1
W-3A	490	1080	800.79	799.6	28.0	Int	795.6	792.7	793.9	795.3	794.5	793.7	794.8	795.2	795.3
W-3B	490	1080	800.84	800.0	15.8	WT/Int	795.6	792.4	793.9	795.8	794.7	793.7	795.5	795.7	795.8
W-3C	490	1080	800.61	800.0	85.5	Deep	--	--	772.9	774.1	775.3	774.8	--	--	--
W-3WT	490	1080	803.83	800.2	13.5	WT	800.0	795.5	797.0	801.0	798.2	796.9	799.3	800.9	800.9
W-4	505	668	797.22	794.7	48.8	Int	779.2	776.3	776.4	779.2	778.7	777.3	777.0	778.3	778.6
W-4A	505	668	797.06	795.6	34.0	Int	786.3	780.6	779.3	785.1	784.7	782.5	780.9	784.1	784.6
W-4WT	505	668	796.70	795.0	13.5	WT	793.9	783.6	783.2	794.0	790.8	788.1	752.5	794.5	794.6
W-5	350	1441	815.20	812.5	51.0	Int	804.2	802.6	802.8	804.2	803.9	802.9	802.6	803.6	803.6
W-5A	350	1441	815.20	812.5	41.5	Int	807.0	805.3	805.4	807.0	808.6	807.3	805.2	806.2	806.2
W-5B	350	1441	814.33	810.9	19.3	WT/Int	809.2	808.3	810.3	809.6	809.3	808.3	807.5	808.4	808.4
W-5WT	350	1441	817.73	812.8	10.0	WT	811.1	809.0	809.8	811.3	811.2	809.9	808.7	809.9	809.9
W-6A	105	580	793.60	790.9	27.2	Int	793.4	791.1	791.7	793.6	792.0	791.4	793.0	793.4	793.4
W-6B	104	558	793.25	790.6	90.5	Deep	--	--	--	--	--	--	740.5	743.9	743.9
W-6WT	105	580	794.78	791.6		WT	789.9	786.2	789.5	790.2	789.3	788.6	790.3	790.2	790.2
W-7	470	1760	811.81	809.0	48.0	Int	804.2	801.5	802.6	805.1	802.9	801.5	802.9	803.5	803.5
W-7A	470	1760	812.56	809.6	107.0	Deep	748.6	747.8	748.2	748.5	747.6	747.1	746.7	747.2	747.2
W-7WT	470	1760	811.62	809.4	13.0	WT	808.0	801.8	807.9	808.8	804.3	803.9	809.1	809.0	809.0
W-8	680	1550	796.86	794.4		Int	--	791.6	791.6	--	792.7	791.9	792.8	793.4	--
W-8A	680	1550	796.86	794.4	38.5	Int	794.5	--	--	--	793.4	792.5	793.6	794.0	794.3
W-8WT	680	1550	796.38	794.6	9.5	WT	794.2	791.4	794.0	794.2	793.5	792.9	793.9	794.3	794.2
W-9	616	1185	797.38	795.2	85.0	Int	790.7	787.9	789.1	790.5	789.7	788.8	789.9	790.4	790.5
W-9A	616	1185	797.38	795.2	31.0	Int	794.6	792.3	794.0	--	793.9	793.5	794.3	794.9	795.0
W-9WT	616	1185	797.04	794.7	8.5	WT	794.4	791.0	793.6	794.6	793.4	793.2	--	--	--
W-9WT(Deep)	616	1185	797.81	795.2	14.0	WT	--	--	--	--	--	--	794.0	794.0	794.1
W-10	720	810	795.85	793.7	57.0	Int	779.9	778.2	778.6	780.7	780.0	778.7	779.3	780.0	780.1
W-10A	720	810	795.85	793.7	32.5	Int	781.5	777.4	777.7	781.8	780.3	778.2	779.4	781.5	781.6
W-10WT	720	810	795.85	793.7	21.0	WT	781.4	777.5	777.4	781.7	779.9	777.9	779.3	781.5	781.4
W-11	427	373	785.07	781.9	59.0	Int	779.2	777.3	778.0	779.5	779.1	778.1	778.6	779.0	779.1
W-11A	427	373	785.07	781.9	31.1	Int	779.1	776.9	777.7	779.2	778.8	777.8	778.5	778.9	779.1
W-11WT	427	373	784.98	782.3	7.5	WT	779.7	775.7	778.4	780.0	778.0	776.9	780.6	780.9	780.8
W-12A	735	926	790.83	788.8	52.5	Int	783.8	777.8	781.1	779.9	779.3	778.3	778.7	779.3	779.6
W-12B	738	926	792.23	788.9	28.0	Int	783.8	777.2	778.0	783.8	781.6	782.0	781.1	784.1	784.1
W-12C	735	926	791.34	788.8	20.0	WT	780.3	779.1	780.6	784.4	783.8	778.3	782.6	784.6	784.7
W-12D	735	926	791.13	788.2	94.0	Deep	748.1	746.2	746.4	747.7	747.8	747.5	747.4	747.5	747.6
W-14	172	1007	820.62	817.3	11.0	WT	807.0	805.3	806.4	806.1	806.2	805.5	803.2	805.2	805.2
W-15	240	1037	820.97	819.1	13.0	WT	804.2	804.4	803.9	804.6	805.1	804.6	--	804.0	803.9
W-16	303	947	820.67	818.6	18.0	WT	798.7	799.2	798.8	799.0	799.4	799.3	798.7	799.3	799.1
W-18	207	753	816.41	812.5	18.0	WT	796.2	795.6	795.4	796.2	796.1	795.7	795.7	796.2	796.1
W-20A	960	1140	790.82	787.9	16.0	WT	784.7	780.5	783.3	784.9	782.8	781.4	785.0	785.5	785.3
W-20B	960	1140	790.26	787.4	47.0	Int	--	--	--	--	--	791.6	790.3	787.5	787.8
W-20C	960	1140	791.14	788.1	86.0	Deep	749.2	--	--	--	--	--	--	--	--
W-21A	1070	800	795.04	792.7	14.5	WT	778.9	774.9	776.1	779.0	777.5	776.2	777.9	779.1	779.0
W-21B	1070	800	795.66	792.8	46.5	Int	779.2	771.4	775.8	778.7	778.2	777.1	777.8	778.5	778.6
W-21C	1070	800	794.85	793.1	105.5	Deep	751.8	747.2	751.0	751.8	752.0	751.7	751.1	751.6	751.5
W-22A	780	500	777.74	775.0	10.5	WT	773.0	771.9	772.8	773.2	773.0	773.7	773.1	773.2	773.2
W-22B	780	500	777.37	775.0	52.0	Int	--	774.9	777.0	777.4	777.4	776.0	--	--	--
W-22C	780	500	777.35	775.0	80.0	Deep	748.5	745.9	747.2	747.6	747.7	747.6	--	--	--
W-23A	465	150	779.28	776.5	13.5	WT	777.2	772.9	774.3	776.4	775.6	774.4	776.8	777.3	777.0
W-23B	465	150	779.73	776.6	37.0	Int	774.8	755.9	771.2	773.6	773.0	771.8	773.2	772.9	773.8
W-23C	465	150	779.41	776.4	84.0	Deep	744.7	743.2	743.3	744.1	744.0	743.8	744.1	744.1	744.1

TABLE 3-10

WATER LEVEL DATA

Lordstown Site
Girard Twp., Pennsylvania

LOCATION NUMBER	COORDINATES NORTH	COORDINATES EAST	ELEVATION REFERENCE	ELEVATION GROUND	WELL DEPTH	GEOLOGIC ZONE	OR ELEVATION (in feet) 16-Jan-85	09-Sep-86	10-Oct-86	06-Jan-87	21-May-87	25-Jun-87	06-Dec-88	13-Jan-89	17-Jan-89
W-24A	230	210	786.66	783.8	10.0	WT	782.5	778.8	781.8	782.8	781.4	780.4	783.4	783.5	783.3
W-24B	230	210	786.66	783.5	59.0	INT	777.4	774.3	769.0	777.1	776.5	775.9	776.5	776.6	777.0
W-24C	230	210	786.31	783.1	86.0	DEEP	743.7	738.1	739.8	743.3	743.3	742.8	742.6	742.8	743.1
W-25NT	90	310	789.18	786.1	15.0	WT	785.4	781.8	785.2	785.3	785.4	784.8	785.4	785.3	785.4
W-26A	+253	1396	834.29	832.0	25.0	WT	--	818.4	817.4	820.9	820.9	819.2	817.1	820.2	820.1
W-26B	+236	1397	834.41	831.9	56.5	INT	--	810.6	809.9	810.9	811.5	810.5	809.2	810.0	810.3
W-26C	+221	1398	834.01	831.7	128.0	DEEP	--	745.4	745.6	746.1	746.0	745.9	745.9	746.0	746.1
W-27A	1864	1014	777.76	775.2	26.0	WT	--	--	--	766.4	766.0	764.7	764.4	765.9	766.0
W-27B	1865	1008	778.31	775.2	49.0	INT	--	--	--	768.9	768.1	767.1	767.5	768.4	768.5
W-27C	1873	1007	777.89	775.2	101.0	DEEP	--	--	--	757.2	756.5	757.3	748.1	751.5	752.6
W-28	739	898	790.61	789.2	54.0	INT	--	777.8	779.1	780.5	780.0	778.9	779.5	780.1	780.2
W-29	3031	471	747.11	744.4	35.0		--	743.4	744.0	745.0	744.6	--	744.9	745.0	745.1
W-30			750.16	748.0	39.0		--	744.7	744.8	745.7	745.9	--	745.4	744.5	744.9
W-31			751.86	749.7	40.5		--	745.6	746.0	746.6	746.3	--	746.3	746.7	746.8
W-32A	2011	1440	775.87	773.2	20.0	WT	--	--	--	769.8	765.0	764.5	765.6	766.0	765.8
W-32B	2018	1478	775.73	773.2	90.0	INT	--	--	--	771.0	769.6	769.0	770.0	770.6	770.5
W-33	947	1238	795.95	794.5	41.0	WT\INT	--	--	--	786.4	785.6	784.9	786.5	786.8	786.7
W-34	958	1234	796.84	794.9		WT\INT	--	--	--	--	--	784.9	--	786.7	786.7
EW-35A	437	1989	809.36	806.4	20.5	WT	--	--	--	--	--	--	803.6	806.3	806.4
EW-35B	433	1994	809.79	807.2	52.5	INT	--	--	--	--	--	--	804.3	804.9	804.9
W-36A	1646	1386	781.07	778.9	20.0	WT	--	--	--	--	--	--	771.5	774.4	774.4
W-36B	1640	1385	781.16	778.9	47.0	INT	--	--	--	--	--	--	774.8	775.3	775.2
W-37A	1315	1855	783.16	783.2	9.5	WT	--	--	--	--	--	--	780.3	780.2	779.8
W-37B	1313	1858	783.21	783.3	45.0	INT	--	--	--	--	--	--	778.4	781.4	782.0
W-39A	1156	1463	791.30	788.7	16.0	WT	--	--	--	--	--	--	781.9	783.1	783.1
W-39B	1168	1462	791.84	788.4	57.5	INT	--	--	--	--	--	--	789.2	789.6	789.5
Piezometers															
PZ-11	1411	1052	780.70	777.8	55.0	INT	--	769.3	770.2	771.6	771.2	770.0	770.7	771.5	771.6
PZ-13	1618	1549	782.30	780.0	50.0	INT	--	773.4	774.8	775.5	--	774.1	774.8	775.2	775.0
PZ-18	1023	1199	786.67	785.8	29.0	WT\INT	--	--	--	--	785.0	784.7	785.7	785.7	785.7
PZ-19	948	1267	798.35	796.8	35.0	WT\INT	--	--	--	786.7	786.0	785.2	786.7	787.0	786.8
PZ-22	1103	1136	783.90	781.2	20.0	WT	--	--	--	780.0	780.1	778.9	779.9	779.9	779.9
PZ-36	+31	1347	830.10	827.8	60.0	INT	--	--	--	--	--	--	807.0	807.8	807.9
Test Borings															
B-84-1	105	1205		827.0	41.5										
B-84-2	90	1198		827.0	31.5										
B-84-3	102	1295		826.0	21.5										
B-84-4	150	1295		820.0	31.5										
B-85-1	105	1205		827.0	31.5										
B-85-2	90	1198		827.0	82.0										
B-85-3	102	1295		826.0	19.5										
B-85-4	150	1295		820.0	35.5										
B-86-1	746	1109		790.5	62.0										
B-86-2	881	1241		798.8	66.0										
B-86-3	1012	1391		792.0	66.0										
B-86-4	1361	1316		788.1	82.0										
B-86-5	1167	1035		787.7	66.0										
B-86-6	1076	1210		784.6	57.0										
B-86-7	1310	1650		784.7	67.0										
B-86-8	782	1618		792.7	67.0										
B-86-9	844	1050		789.8	67.0										
B-86-10	1421	1530		784.7	62.0										
B-86-11	1411	1052		777.8	62.0										
B-86-12	1349	1832		781.7	67.0										
B-86-13	1618	1549		780.0	67.0										
B-86-14	1476	1145		778.9	30.0										
B-86-15	1889	1477		775.0	59.0										
B-86-16	1831	1263		776.4	57.5										
B-86-17	1603	975		782.7	73.5										

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TABLE 3-10

WATER LEVEL DATA

Lordstown Site
Girard Twp, Pennsylvania

LOCATION NUMBER	COORDINATES NORTH	COORDINATES EAST	ELEVATION REFERENCE	ELEVATION GROUND	WELL DEPTH	GEOLOGIC ZONE	GW ELEVATION (in feet) 16-Jan-85	09-Sep-86	10-Oct-86	06-Jan-87	21-May-87	25-Jun-87	06-Dec-88	13-Jan-89	17-Jan-89
B-86-18	1033	1199		785.8	37.0										
B-86-19	948	1267		796.8	42.0										
B-86-20	1159	1438		789.7	36.0										
B-86-21	1199	1294		785.1	36.0										
B-86-22	1105	1136		781.2	37.0										
Stream Gauges															
SG-1	395	1321	805.02				802.4	802.6	802.2	802.4	802.0	--	802.3	--	
SG-2	1105	1480	785.88				--	782.2	782.6	782.7	782.7	782.8	782.8	782.7	
SG-3	1902	1749	769.97				--	766.1	766.0	766.2	765.9	767.8	768.8	767.8	
SG-4	4397	1375	736.41				--	732.4	732.6	734.5	--	--	733.8	--	
SG-5	3732	729	740.34				--	--	737.0	736.3	--	--	736.5	--	
SG-6	2441	-222	746.57				744.4	744.7	744.6	--	--	--	744.7	--	

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Deeper water-bearing zones probably exist below those that were studied as a part of this investigation. These zones may be contained within deeper glacial deposits and/or bedrock that underlies the site.

3.4.2.1 Water Table Aquifer. An unconfined Water Table Aquifer occurs within the shallow soils beneath the study area and ranges in depth from 15 to 30 feet. These shallow soils primarily consist of the coarse-grained Ashtabula Till and Maumee III C lacustrine deposits but intermittently consist of fine grained soils as well. An isolith map indicating the composite thickness of these two coarse-grained subunits is depicted in Sheet 13 of 21. Overall, however, these shallow soils are among the most permeable that occur at the site, with an estimated average hydraulic conductivity of approximately 6×10^{-4} cm/sec.

The unconfined Water Table Aquifer receives recharge predominately through direct infiltration of precipitation. As such, the surface of this zone is more sensitive to seasonal variations than are the deeper units.

The surface of the unconfined aquifer occurs at relatively shallow depths beneath the site, ranging from zero to approximately ten feet below ground surface, except below the waste disposal area where it is somewhat deeper. Contours of equal water table elevation have been interpolated from water level data obtained from the wells. The water table has been assumed to intersect surface water on the site so that available stream gauge data have been employed for water table contouring, as well. The water table surface generally reflects the ground surface topography with a gradient ranging from 0.02 to 0.06. The water table surface as shown on Sheet 14 of 21 is very similar to that configured previously by Harrison (1980), Wehran (1981) and AWARE (1985 and 1987).

The direction of lateral groundwater flow is assumed to be perpendicular to the groundwater contours as indicated on the water table contour map. Flow is generally to the north and northwest. Groundwater flow within the Water Table Aquifer presumably flows toward and discharges to the two small streams located north and west of the site. The water table surface is shown to be nearly coincident with the ground surface at several locations north and west

of the site. These seasonally wet areas thus represent the surface expression of the water table. Several of these areas located immediately adjacent to the landfill, termed "seep-areas" by PADER, have been the subject of much interest because they contain contaminated groundwater. However, the term seep is really a misnomer in that little or no observable flow emanates from these areas.

The rate of horizontal groundwater flow within the Water Table Zone can be estimated through the use of Equation 3.16.

$$Vs = \frac{Ki}{N_e} \qquad \text{Eq 3.16}$$

Where:

Vs = seepage velocity (cm/sec)
K = hydraulic conductivity (cm/sec)
i = hydraulic gradient (dimensionless)
N_e = effective porosity (dimensionless)

The hydraulic conductivity has been estimated at 6×10^{-4} cm/sec. The average hydraulic gradient is 0.04. A typical value of the effective porosity can be assumed at 0.3 (Freeze and Cherry, 1979). Inserting the above data in Equation 3.16 yields a typical maximum horizontal flow rate of approximately 82 feet per year.

3.4.2.2 Intermediate Depth Zone. Groundwater occurs under confined and/or semi-confined conditions in the laterally continuous Intermediate Zone. This zone is found primarily in the coarse-grained soils of the Maumee III B Lacustrine deposits but is also found in the coarse-grained Ashtabula Till beneath the southern portion of the site. The geologic deposits comprising this zone have a moderately low hydraulic conductivity shown previously to have a mean value of approximately 6×10^{-5} cm/sec. However, this unit cannot truly be termed an aquifer as it probably would not be capable of transmitting significant quantities of water under ordinary hydraulic gradients (Freeze and Cherry, 1979). Therefore, this unit will be termed a "water-bearing zone."

This water-bearing zone is almost completely confined by overlying fine grained till and lacustrine deposits represented, respectively, by the Ashtabula subunit and the Maumee III B subunit. The hydraulic conductivity of these confining subunits has previously been shown from laboratory testing to be on the order of 2.4×10^{-7} cm/sec. The confined nature of this zone has been demonstrated by the well W-28 pump test. However, in several areas, notably that beneath the landfill and in the plume extension area north of the site, the Intermediate Zone has been shown to be only semi-confined.

The piezometric surface has been defined through the use of water level measurements from monitoring wells screened in the same stratigraphic position in the Maumee III B. The configuration of this surface has been depicted on the Intermediate Depth Piezometric Surface Contour Map, Sheet 15 of 21. This surface is shown to slope to the northwest in a similar but more subdued manner than that of the overlying Water Table Aquifer. The configuration of these contours is very similar to that which was depicted previously by Harrison (1980) and AWARE (1985 and 1987).

The installation of an intermediate piezometer, PZ-38, has served to further define the piezometric surface in the upgradient direction from the landfill. Previous piezometric data suggested the presence of a groundwater divide between the landfill and the upgradient well W-26B. Newly available piezometric data from all of the wells, including PZ-38, indicate a slight reversal of groundwater flow does exist toward the unnamed tributary located to the south of the site. However, these data solidify the fact that water levels in well W-26B are significantly higher than the landfill and that this well is completely suited as a background well for the intermediate zone.

A prominent lobe in the piezometric contours has been depicted in the area of the plume extension. This apparent local reduction in the magnitude of head loss through the formation may indicate a local increase in hydraulic conductivity in this immediate area as shown on the Hydraulic Conductivity Contour Map (Sheet 12 of 21).

The potential direction of the vertical component of flow through the confining layer overlying the Intermediate Zone tends to

dependent upon the relative topographic position of the overlying Water Table Aquifer. In the topographically higher areas of the site such as beneath the landfill and the hill at W-2, the water table surface is significantly higher than the piezometric surface in the intermediate confined zone. This provides the potential for downward flow. In the topographically lower areas of the site such as that to the north of the landfill, the piezometric surface is significantly higher than the water table surface. In fact, at several locations, such as W-20 and W-22, the piezometric surface is above the ground surface. Under these conditions, the potential exists for upward flow through the confining layer. The direction and magnitude of the difference in head between the two units is graphically depicted on Sheet 16 of 21.

Several areas exist in which little or no hydraulic separation is afforded between the Intermediate Zone and the overlying Water Table Aquifer as previously mentioned. This fact likely has a profound effect on contaminant transport routes when coupled with the known head differential between the two zones. A downward gradient existing beneath the landfill allows contaminants to migrate downward into the Intermediate Zone which is only semi-confined in this area. After traveling laterally to the north, a portion of this flow may migrate vertically upward under the influence of the strong upward gradients that have been observed in the vicinity of well W-20.

Wells W-33 and W-34 are located in the area of the plume extension shown to have very little hydraulic separation between the water table aquifer and the underlying intermediate zone. As such, each of these wells exhibits water levels that are approximately midway between each of the two zones even though they are screened within the stratigraphic unit that comprises the water table zone. Due to the relative lack of a confining layer at this location, observed water quality within wells W-33 and W-34 appear to be more representative of the intermediate zone due to the strong upward vertical gradient that results in an upwelling of groundwater flow from the intermediate zone in this area.

The previously described lobe in the piezometric surface may partially be the result of this discharge to the overlying Water Table Aquifer. The hydraulic conductivity of the Water Table Aquifer in this area is shown to be relatively high which may have a controlling influence on this localized upward migration.

Therefore, the relative reduction in head loss in the Intermediate Zone occurs, and is manifested as a localized lobe in the piezometric surface.

The rate of horizontal flow through the Intermediate Zone can be estimated with the use of Equation 3.16. The data required for this calculation includes the hydraulic conductivity and hydraulic gradient that have been determined, respectively, at 6×10^{-5} cm/sec and 0.05 and an assumed effective porosity of 0.3. This calculates to a rate of 10 ft/yr.

This flow rate compares very closely to the known contaminant travel distance on the north-central and northwest sides of the site. However, the situation in the plume extension area directly north of the site is somewhat more complex as described in Section 3.5.3.

The rate of groundwater flow in the area north of the landfill is believed to be significantly greater due to the observed zone of higher hydraulic conductivity soils. The hydraulic conductivity and gradient in this area are observed to be 5×10^{-3} cm/sec and 0.02, respectively. Using Equation 3.16, a maximum flow rate of approximately 69 feet per year has been calculated. This flow is consistent with the maximum observed extent of the groundwater plume.

3.4.2.3 Deep Confined Zone. A deep confined water-bearing zone has been identified at a depth ranging from approximately 75 to 105 feet below the ground surface. This zone is contained within the coarser grained layers of the Maumee III A lacustrine deposits. The Maumee III A has been described previously as possessing a hydraulic conductivity on the order of 4×10^{-5} cm/sec. This zone is fully confined by the Lower Aquitard represented by the fine-grained Glacial Till with a hydraulic conductivity believed to be less than 5×10^{-7} cm/sec.

The piezometric surface in this Deep Zone has been depicted on the Deep Confined Zone, Piezometric Contour Map (Sheet 17 of 21). This map was prepared from water level measurements obtained from the deepest site wells. However, the water level datum from one well, W-3, was omitted from this map. This particular datum is believed to be in error based upon a comparison of the water levels from the other wells on the same date and the data from the same

well, W-3, indicating that the annular seal of well W-3 may be leaking in the same manner as has been demonstrated for well W-20C.

The piezometric surface for the Deep Zone indicates that groundwater in the deep confined zone flows toward the southwest. This is significantly different than the direction of flow in the previously described overlying zones.

The deep confined zone probably receives its recharge through the very slow downward flow through the confining layer that necessarily would occur under the influence of the considerable downward vertical gradient that has been identified. Other upgradient recharge zones may also exist north of the site. This flow path is shown to be directly to the regionally low area represented by Crooked Creek to the southwest of the site. Therefore, Crooked Creek most likely serves as the discharge point of this deep confined zone.

The rate of groundwater flow to the deep confined zone is likely to be very slow on account of the low hydraulic conductivity of the confining layer. This rate can be calculated with the use of Equation 3.16. The vertical hydraulic conductivity of the confining layer is conservatively estimated at 4×10^{-7} cm/sec. A vertical hydraulic gradient across the confining layer typical of the site was measured at W-12 at 0.76. The effective porosity is assumed at 0.30. On the basis of these data, groundwater moves downward through the confining layer at a rate of no greater than 1.1 feet per year.

The rate of horizontal flow through the deep confined zone can also be calculated with the use of Equation 3.16. The horizontal hydraulic conductivity of the zone has been shown to be on the order of 4×10^{-5} cm/sec, the hydraulic gradient is approximately 0.01 and the effective porosity is assumed at 0.3. Based upon these data, it can be seen that water moves through this zone at a rate of approximately 2.4 feet per year.

3.5 SURFACE WATER FLOW

The land in the area around the site is drained by two unnamed streams as described previously. Each of these streams likely represent man-made

drainage channels as indicated by their straight, linear character (Sheet 1 of 21). These streams are in communication with and receive groundwater discharge from the shallow water table aquifer. This has been confirmed through stream flow measurements, as described below.

Stream flow measurements were made at six locations in the two small streams (Figure 3-4) following the methods as described in Section 3.1.4.1. The stream flow in the unnamed tributary was sufficient to allow the use of the Current Meter Method with the use of a Price A-A meter. The magnitude of flow in the small stream, immediately north of the site, was too small for the current meter so that the use of a triangular weir was required. The stream flow measurements were made on three separate dates in November and December 1988, as presented on Table 3-11.

Stream flow in the unnamed tributary, from upstream to downstream, were measured in stations SW-1 through SW-4, respectively. The mean flow rate increases from 1.2 cubic feet/second at the Lexington Road Bridge to 3.4 cubic feet/second at a point below the confluence with the small stream. The mean difference between the flows from stations SW-3 to SW-4 of 1.1 cubic feet/second represents the contribution of the small stream that enters the unnamed tributary between these stations. However, the weir measurements made in the unnamed tributary at stations SW-5 and SW-6 indicate a flow in excess of 1.1 cubic feet/second. This inconsistency is probably due to differences in the measurement methods and the fact that a free drop over the weir may not have been maintained, thus yielding an excessively high rate of flow for that method. Therefore, the flow rate in the small stream will be considered as the differential rate between SW-3 and SW-4 or 1.1 cubic feet/second, which is approximately one third the flow of the unnamed tributary. This is consistent with general observations of the flow in the two streams.

The time span over which these measurements were made was very short. Therefore, these data are insufficient to characterize the high and low flow conditions of these streams. In fact, the small stream has frequently been observed to be dry in the summer months. These stream flow measurements serve to provide typical rates of flow in these small streams.

TABLE 3-11
SUMMARY OF STREAMFLOW DATA

Station Number	Test Method	Test Date	Streamflow Velocity (ft^3/sec)
Unnamed Elk Creek Tributary			
SW-1	Price AA Meter	23-Nov-88	1.9
SW-1	Price AA Meter	02-Dec-88	0.8
SW-1	Price AA Meter	07-Dec-88	0.8
		Mean	1.2
SW-2	Price AA Meter	23-Nov-88	2.6
SW-2	Price AA Meter	02-Dec-88	2.7
SW-2	Price AA Meter	07-Dec-88	1.0
		Mean	2.1
SW-3	Price AA Meter	23-Nov-88	2.5
SW-3	Price AA Meter	02-Dec-88	2.2
SW-3	Price AA Meter	07-Dec-88	2.0
		Mean	2.2
SW-4	Price AA Meter	23-Nov-88	6.2
SW-4	Price AA Meter	02-Dec-88	2.0
SW-4	Price AA Meter	07-Dec-88	2.1
		Mean	3.4
Small Stream			
SW-5	Weir	23-Nov-88	4.2
SW-5	Weir	02-Dec-88	3.0
SW-5	Weir	07-Dec-88	3.4
		Mean	3.5
SW-6	Weir	23-Nov-88	4.2
SW-6	Weir	02-Dec-88	3.0
SW-6	Weir	07-Dec-88	3.4
		Mean	3.5

SEC 4

4.0 CHEMICAL ANALYSIS OF SOILS

Several investigations have been conducted for the purpose of investigating the presence of volatile organic constituents within the surficial and deep soils as described previously in Sections 3.1 and 3.2. The results of this work will be discussed in the following sections.

4.1 SURFICIAL SOILS

Samples were collected from 94 locations immediately around the landfill in order to determine the areal extent of volatile organics within the surficial soils. The distribution of the samples was extended until areas of volatile organics had been completely delineated on the basis of a field measurement with a HNU PID meter referenced to benzene. The results of the photoionizer data are plotted on Figure 4-1.

The presence of volatile organics within the surficial soils has been identified in several areas around the landfill. Several of these areas correspond to the so-called "seep" areas in which standing water containing volatile organics has been observed. This is the case in the areas immediately northeast, north and southwest of the landfill. These levels, expressed in HNU units, range from 5.0 up to 92 but are typically much lower.

The most significant area of volatile organics within the surficial soils is located immediately southeast of the site. One possible explanation for this area is spillage from trucks entering the site at the time of landfill operation. The highest levels of volatiles in this area range up to 300 ppm HNU units in a sample located very close to the landfill.

A number of duplicate soil samples were selected for confirmatory laboratory analysis. Soil samples were selected from each of the areas identified to contain volatile organic soils as well as from background areas. The original soil samples collected in 1984 were inadvertently contaminated by the laboratory. Replicate samples were collected in April, 1985 from the selected sample locations. PID meter data from these replicate 1985 samples, compared

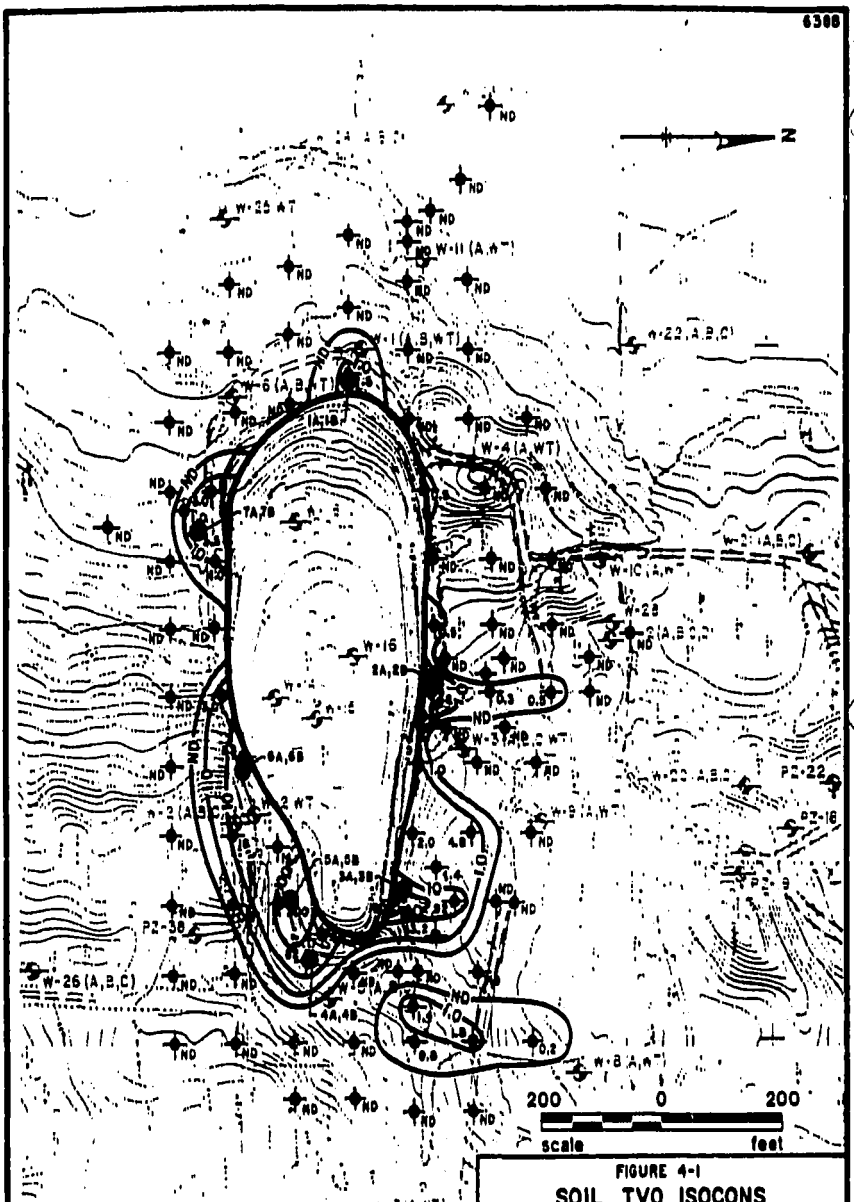

FIGURE 4-1
SOIL TVO ISOCONS
SURFICIAL SOIL
(10.2 BY P.I.D.)
SHOPE'S LANDFILL SITE
LORD CORP.
GIRARD TWP., PA.

ECKENFELDER INC. Nashville, Tennessee Mahwah, New Jersey

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very closely to the 1984 data. The samples were analyzed for volatile organics, the results of which are tabulated on Table 4-1. The laboratory data correlates closely with the field (PID meter) data, thus supporting the validity of the field data and the associated depiction of the distribution of volatile organics within the surficial soils (Figure 4-1).

Seven additional soil samples were collected in 1988 from areas shown by the 1984 PID data (Figure 4-1) to contain the highest levels of volatile contamination. These samples were subjected to laboratory analyses for the TCL volatile organics scan as a re-confirmation of the previous analyses (Table 4-1). These data are presented on Table 4-2. The parameters detected in this TCL scan compare favorably with the 1985 data.

The volatile constituents within the surficial soils can be characterized on the basis of the 1985 and 1988 laboratory data. 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, while trichloroethene was detected in four samples ranging to 5.4 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.

4.2 DEEP SOILS

Deep soil samples were collected with the aid of a test boring drill rig as a part of two separate investigations. The first investigation addressed the perimeter area immediately southeast of the landfill. The second investigation focused upon the groundwater plume extension area north of the landfill.

4.2.1 Landfill Perimeter Borings. Four deep test borings were drilled in order to determine the depth to which volatile organics had penetrated the soils in the landfill perimeter area located immediately southeast of the landfill. Soil samples from the borings, designated B-84-1 through B-84-4,

TABLE 4-1
SOIL DATA

VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Ford/Stone Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon tetra-chloride	Chloro-benzene	Chloro-dibromo-methane	Chloro-ethane	2-chloro ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl Benzene
1A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5A	Soil 1'	12/14/88	Microbac	6.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1?1	Soil 1'	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
155	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
156	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
157	Soil 3'	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
158	Soil 3'	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
159	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
160	Soil 3'	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
161	Soil 3'	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
162	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
163	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
164	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
165	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
166	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
167	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
168	Soil 3	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
169	Soil 4	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.3
170	Soil 4	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4
171	Soil 4	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
172	Soil 4	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
173	Soil 4	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
174	Soil 4	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
175	Soil 5	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
182	Soil 5	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
183	Soil 6	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.3
191	Soil 6	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
192	Soil 10	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
186	Soil 12	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.7
188	Soil 12	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
193	Soil 14	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
181	Soil 20	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
187	Soil 22	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
189	Soil 22	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
183	Soil 28	04/08/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
190	Soil 31	04/11/85	Tree-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 4-1
SOIL DATA
VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Load/Shaw Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene chloride	1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	Methyl Ethyl Ketone	Methyl Iso Butyl Ketone
1A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2A	Soil 1'	12/14/88	Microbac	ND	ND	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3A	Soil 1'	12/14/88	Microbac	ND	ND		ND	ND	7.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	33	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7A	Soil 1'	12/14/88	Microbac	ND	ND	ND	ND	32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
171	Soil 1	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
1B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	620	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7B	Soil 3'	12/15/88	Microbac	ND	ND	ND	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
155	Soil 3	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
156	Soil 1'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
157	Soil 1'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
158	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
159	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	5.4	ND	ND	ND	ND		
160	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	4.9	ND	2.5	ND	ND	ND	2.0	ND	ND	ND	ND		
161	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	33.0	ND	ND	ND	ND	ND	3.5	ND	ND	ND	ND		
162	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
163	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
164	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
165	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
166	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
167	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
168	Soil 3	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
169	Soil 3'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
170	Soil 3	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
171	Soil 1'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
172	Soil 3	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
173	Soil 1'	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
174	Soil 3	04/08/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
175	Soil 5	04/08/85	Free-Col	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
192	Soil 5'	04/08/85	Free-Col	ND	ND	ND	ND	140	4.8	ND	ND	ND	1.3	ND	ND	ND	ND	ND		
193	Soil 5	04/11/85	Free-Col	ND	ND	ND	ND	9.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
191	Soil 5	04/11/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
192	Soil 10	04/11/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
194	Soil 12	04/11/85	Free-Col	ND	ND	ND	ND	51.2	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND		
195	Soil 12	04/11/85	Free-Col	ND	ND	ND	ND	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
196	Soil 18	04/11/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
197	Soil 20	04/11/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
198	Soil 22	04/11/85	Free-Col	ND	ND	ND	ND	2.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
199	Soil 22'	04/11/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
183	Soil 28'	04/11/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
181	Soil 30	04/11/85	Free-Col	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		

TABLE 4-1
SOIL DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Todd/Shipe Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro-1,2-trifluoro-ethane	4-methyl-2-pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1-Dichloro ethylene	Cyclo-hexanone	Xylene	2-Butanol	Iso propanol	Total of Unknown Compounds
1A	Soil 1'	12/14/88	Microbac	ND	ND										
2A	Soil 1'	12/14/88	Microbac	ND	ND										
3A	Soil 1'	12/14/88	Microbac	ND	ND										
4A	Soil 1'	12/14/88	Microbac	ND	ND										
5A	Soil 1'	12/14/88	Microbac	ND	ND										
6A	Soil 1'	12/14/88	Microbac	ND	ND										
7A	Soil 1'	12/14/88	Microbac	ND	ND										
171	Soil 1'	04/08/85	Free-Col							ND					
1B	Soil 3'	12/15/88	Microbac	ND	ND										
2B	Soil 3'	12/15/88	Microbac	ND	ND										
3B	Soil 3'	12/15/88	Microbac	ND	ND										
4B	Soil 3'	12/15/88	Microbac	ND	ND										
5B	Soil 3'	12/15/88	Microbac	ND	ND										
6B	Soil 3'	12/15/88	Microbac	ND	ND										
7B	Soil 3'	12/15/88	Microbac	ND	ND										
155	Soil 1'	04/08/85	Free-Col							ND					
156	Soil 1'	04/08/85	Free-Col							ND					
157	Soil 3'	04/08/85	Free-Col							ND					
158	Soil 3'	04/08/85	Free-Col							ND					
159	Soil 3'	04/08/85	Free-Col							ND					
160	Soil 1'	04/08/85	Free-Col							ND					
161	Soil 3'	04/08/85	Free-Col							ND					
162	Soil 3'	04/08/85	Free-Col							ND					
163	Soil 1'	04/08/85	Free-Col							ND					
164	Soil 3'	04/08/85	Free-Col							ND					
165	Soil 3'	04/08/85	Free-Col							ND					
166	Soil 1'	04/08/85	Free-Col							ND					
167	Soil 3'	04/08/85	Free-Col							ND					
168	Soil 1'	04/08/85	Free-Col							ND					
169	Soil 1'	04/08/85	Free-Col							ND					
172	Soil 1'	04/08/85	Free-Col							ND					
173	Soil 3'	04/08/85	Free-Col							ND					
174	Soil 1'	04/08/85	Free-Col							ND					
179	Soil 5'	04/08/85	Free-Col							ND					
182	Soil 5'	04/08/85	Free-Col							ND					
185	Soil 5'	04/11/85	Free-Col							ND					
191	Soil 5'	04/11/85	Free-Col							ND					
192	Soil 10'	04/11/85	Free-Col							ND					
196	Soil 12'	04/11/85	Free-Col							ND					
198	Soil 12'	04/11/85	Free-Col							ND					
199	Soil 18'	04/11/85	Free-Col							ND					
183	Soil 20'	04/08/85	Free-Col							ND					
187	Soil 22'	04/11/85	Free-Col							ND					
189	Soil 22'	04/11/85	Free-Col							ND					
184	Soil 28'	04/08/85	Free-Col							ND					
190	Soil 30'	04/11/85	Free-Col							ND					

TABLE 4-2
CORRECTED SOIL DATA
1986 SOIL BORINGS
(all data expressed as ppm)

Lord\Shope Site
Girard Twp., Pennsylvania

Boring Number	Sample Depth	Lab	HNu Units (10.2 ev)	Lab TVO	Acetone	MEK	Vinyl Chloride	4-methyl 2-Pentanol	2-Butanol	THF	MIBK	Methylene Chloride
B-86-1	36-48	IT	43	5.0	1.7	ND	0.3	2.6	0.4	ND	ND	ND
B-86-1	41-42	IT	40	3.1	1.5	ND	ND	0.6	ND	ND	ND	ND
B-86-2	42-44	Lord	13	2.0	0.6	ND	ND	ND	ND	0.3	1.0	ND
B-86-2	52-54	IT	1.4	0.6	0.5	ND	ND	0.2	ND	ND	ND	ND
B-86-4	24-26	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-4	40-42	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-4	55-56	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-6	18-20	IT	14	0.4	0.4	ND	ND	ND	ND	ND	ND	ND
B-86-7	12-14	IT	5.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-7	28-30	IT	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-7	46-48	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-8	32-34	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-8	38-42	IT	8.0	0.5	0.2	ND	ND	ND	0.1	ND	ND	0.2
B-86-8	44-46	Lord	ND	0.1	0.1	ND	ND	ND	ND	ND	ND	ND
B-86-8	46-48	IT	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-9	26-28	IT	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-9	52-54	IT	7.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-9	65-67	IT	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	6-8	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	8-10	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	10-12	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	22-24	IT	5.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	36-38	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	38-40	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	52-54	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	54-56	IT	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-11	60-62	Lord	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-12	30-32	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-12	34-36	IT	ND	0.2	ND	0.2	ND	ND	ND	ND	ND	ND
B-86-12	40-42	IT	ND	0.3	ND	0.3	ND	ND	ND	ND	ND	ND
B-86-12	42-44	IT	ND	0.2	ND	ND	ND	ND	0.2	ND	ND	ND
B-86-12	44-46	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-12	50-52	IT	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-12	58-60	IT	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	6-8	IT	ND	0.1	ND	0.1	ND	ND	ND	ND	ND	ND
B-86-13	10-12	Lord	0.8	0.4	ND	ND	ND	0.1	0.3	ND	ND	ND
B-86-13	12-14	Lord	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	22-24	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	24-26	IT	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	26-28	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	38-40	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	40-42	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	48-50	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	54-56	Lord	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	58-60	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND

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TABLE 4-2
CORRECTED SOIL DATA
1986 SOIL BORINGS
(all data expressed as ppm)

Lord\Shope Site
Girard Twp., Pennsylvania

Boring Number	Sample Depth	Lab	HNU Units (10.2 eV)	Lab TVO	Acetone	MEK	Vinyl Chloride	4-Methyl 2-Pentanol	2-Butanol	THF	MIBK	Methylene Chloride
B-86-13	60-62	IT	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-13	66-68	IT	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-14	6-8	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-14	10-11	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-14	11-12	Lord	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-14	20-22	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-14	24-26	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-14	28-30	IT	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-15	16-18	IT	4.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-15	26-28	IT	9.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-15	34-36	IT	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-15	36-38	IT	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-15	56-58	IT	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-16	-	IT		ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-16	22-24	IT	3.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-16	26-28	IT	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-16	46-48	IT	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-86-16	56-58	IT	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

1. ND indicates not detected.

2. Only those data (P.I.D. or laboratory) deemed reliable are presented on this table. Complete soil P.I.D. data are presented on boring logs.

3. Difficulties experienced with soil data that were not presented include the following:

   - o Field analytical data (P.I.D.) that were unreliable largely due to temperature, humidity and other conditions as noted on the individual boring logs
   - o Apparent low level contamination of discrete sample batches with acetone and/or methylene chloride while soil samples were in storage in laboratory pending analysis.

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were analyzed in the field with the PID meter. Samples were selected from each boring for confirmatory analysis in the laboratory. Because these soil samples were also inadvertently contaminated by the laboratory, duplicate borings were conducted the following year, designated B-85-1 through B-85-4, for the purpose of recollecting soil samples for laboratory analysis. The laboratory data are presented on Table 4-1. The complete photoionizer data is found on the boring logs in Appendix A.

The data indicate that the most significant levels of deep soil contamination occur in boring B-85-2 located on the hill approximately 70 feet southeast of the landfill. Volatile organics, quantified as HNU units, reach a maximum level of 580 at a depth of 13 feet in boring B-85-2. Below that depth, contamination levels dropped to nearly non-detectable levels at a depth of 30 feet. The magnitude and penetration of soil contamination was not as extensive in the other borings, with Boring B-85-3, also located on the hill, showing the lowest levels of contaminants.

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.

4.2.2 Plume Extension Borings. Twenty-two test borings, designated B-86-1 through B-86-22, were drilled in 1986 in the area north of the landfill. The purpose of most of these borings was to examine, what was at that time, an apparent water quality anomaly in monitoring well W-20B. The borings were used to collect both stratigraphic data and also data regarding the presence of volatile organics in the soils. The soils were not believed to be contaminated, per se, as are the soils on the landfill perimeter. Rather, the soil pores were believed to be filled with groundwater containing dissolved volatile organics of a "plume extension". In this way, determination of volatile organics in the soil levels served as an indicator for the approximate delineation of the plume extension so that additional perimeter detection wells could be intelligently sited.

The geologic data obtained from the test borings aided greatly in the determination of stratigraphic conditions in the area north of the site. These data have been discussed previously.

Volatile organic levels in the soil samples were determined with the use of the PID meter. These data indicated the approximate configuration of a plume extension in the water table and intermediate water-bearing zones. The individual photoionizer data are presented on the boring logs in Appendix A.

The conditions of the plume extension as it was defined by the 1986 test boring data are depicted on Sheets 10 and 11 of 21. These maps have been prepared by plotting the highest levels of reliable PID data, expressed as HNU units, in or nearly adjacent to each of the surficial and intermediate zones and contouring the results. The resultant depictions closely match the observed stratigraphic conditions. That is, volatile organic levels have been identified in those areas in which the Maumee III C and the adjacent coarse grained soils are shown to be thickest. Therefore, it appears that the configuration of these units has a controlling influence on the migration of the plume extension, based upon the test boring data.

Three additional perimeter detection well clusters, W-27 (A, B, and C), W-32 (A and B), and W-37 (A, B, and C), were sited and constructed based upon the data obtained during this test boring investigation. Subsequent analyses of these wells indicated that they are located beyond the plume.

A number of samples were selected from each boring for subsequent laboratory confirmatory analyses. An analysis of the laboratory and corresponding photoionizer data indicate that a relationship does exist, thus confirming the field results. However, some difficulties with both the PID meter data and laboratory data exist, as listed below.

- Detection limits of initial laboratory analyses using conventional GC methods available at that time were insufficiently sensitive.

- Several field data (PID meter) measurements were unreliable already due to temperature, humidity and other conditions that are noted on the boring logs.

- Apparent low level laboratory contamination of discrete batches of laboratory samples with acetone and/or methylene chloride.

Those data that have not been subject to the above mentioned conditions are presented on Table 4-2.

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5.0 GROUNDWATER QUALITY

The perspective gained by the analysis of groundwater flow conditions has aided greatly in the interpretation of the groundwater quality data. This has allowed the interpretation and prediction of groundwater contaminant flow in discrete hydrogeologic zones.

Groundwater impacts have been identified primarily in the water table and Intermediate Zones. However, contaminants are observed to be migrating from the site primarily within the Intermediate Zone. These impacts will be discussed in detail in the following sections.

A variety of compounds have been identified at the site including both metals and organic constituents. The organics primarily include a suite of halogenated and non-halogenated volatile organics. This observed pattern of plume constituents has not been significantly changed with the adoption of new analytical protocols in mid-1988. Laboratory analyses are now run for the TCL parameters following CLP protocols. Prior to 1988, a smaller group of volatile organics, metals, and indicator parameters were analyzed, as listed on Table 3-1.

The laboratory data have been summarized on a series of tables. These summary tables are presented Appendix F.

Selected data have been presented in tables contained in the text. The individual TCL volatile organic data are presented separately for groups of wells in each of the three water-bearing zones and the Residential wells on Tables 5-1, 5-2, 5-3, and 5-4. The semi-volatile data are presented for each of the three water-bearing zones on Tables 5-5, 5-6, and 5-7. The metals data are presented in a series of statistical summaries on Tables 5-8 through 5-12. Other parameter groups for which analyses were conducted have not been included in the tables contained in the text (Appendix F). These include the specific metals data, and the base/neutral and acid extractable organics, referred to herein as semi-volatiles.

Many of the tentatively identified volatile and semi-volatile organic compounds from the GC/MS library search have not been individually tabulated. Rather, the sum of these detections has been listed in one column.

The list of semi-volatile organic compounds is too long to efficiently present all of the data. Accordingly, only those semi-volatile compounds that have been positively detected have been tabulated. Any others can be assumed to be non-detected. Pesticides and PCBs were not detected in any of the analytical samples. As a result, this group of compounds has not been tabulated.

Several notations are utilized on the data tables. Compounds that have not been detected are reported as "ND". Compounds that have been quantified by the laboratories at levels below the detection limit are reported simply with a "BMDL" notation. The concentration value presented on the laboratory report has not been presented due to it's inherent unreliability. The laboratories have also reported a number of samples with a "B" indicating that the internal method blank sample associated with the particular analyses contained some level of this compound indicating inadvertent contamination of the sample in the laboratory. These "B" notations are reported on the data tables.

The field data sheets, chain of custody records and laboratory summary reports have been compiled in a separate volume which has been transmitted under separate cover by Lord Corporation.

5.1 PARAMETERS

5.1.1 Organic Compounds

A group of halogenated and non-halogenated volatile organic compounds has been identified by the CLP analytical protocols that are presently 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 tetrahydrofuran (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 that are not

detected using current analytical methodology. These compounds correspond well to the types of wastes known to have been disposed in the landfill. In this way, the various ketones are shown to be the predominant organic constituents.

Several other volatile organic compounds that have been observed in the laboratory data are believed to represent laboratory contamination rather than actual chemical parameters present in the sample. The most common of these are methylene chloride, chloroform, and various chlorofluorocarbons. THF and acetone were also occasionally observed as lab contaminants. Many of these compounds are very common laboratory solvents and refrigerants. Furthermore, the Lord laboratory routinely handles large quantities of THF. Despite the use of the most stringent laboratory practices, inadvertent contamination of samples by these compounds is not unusual. Many of these occurrences have been noted by the lab with a "B". This notation indicates that the particular compound has also been found in an associated lab blank sample thus raising a question as to it's actual presence in the sample. However, the absence of such a "B" notation for other samples does not ensure that a sample has not been inadvertently contaminated in the laboratory, as well. This is because the method blank that is run every ten samples provides only a snapshot of the entire laboratory procedure. Furthermore, the presence of a "B" notation does not automatically mean that the sample does not contain this compound, as in a sample that contains a much higher level of a compound than it could ever have received due to unintentional contamination. Therefore, it is apparent that some judgment is required in the interpretation of the analytical data. On this basis, individual compounds that are believed to be laboratory contaminants, as noted above, will not be considered in the following characterization of the water quality at the site.

With several exceptions, semi-volatile constituents that represent actual conditions have not been detected in groundwater samples collected from the site. The exceptions include the 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.

Inadvertent laboratory contamination was observed in the majority of the semi-volatile organic samples. This was primarily represented by various phthalate compounds which are inherent contaminants of various materials used in the laboratory in the analysis of semi-volatile organic compounds.

The characterization of the tentatively identified compounds is more difficult than the above described phthalate detections. Both known and unknown tentatively identified compounds have been indicated in nearly all of the samples. No particular pattern of the tentatively identified compounds has been observed between groups of wells believed to be in the plume and those that are clean based on other parameters. In fact, the only pattern that has been observed relates more to chronological groups of analyses than to a particular group of wells. This would suggest subtle conditions relating to the tuning of laboratory instrumentation that may be constant during a particular analytical run. In summary, the tentatively identified semi-volatile organic analyses provide little additional insight into the characterization of the parameters contained in the site groundwater plume.

5.1.2 Inorganic Compounds

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. Earlier data showed that the combined effects of these and other compounds serve to elevate the TDS and Specific Conductance levels in the plume. However, these compounds have not been shown to be as sensitive as the organic constituents in the delineation of the leading edge of the plume.

Elevated levels of a group of metals have been observed in a number of wells. However, most of the metals data from samples collected prior to September 1986, particularly for the plume wells, are based upon unfiltered samples. Therefore, these metals data have been viewed with a degree of suspicion and have not been utilized in the statistical evaluation of metals. Furthermore, the samples collected prior to 1988 included analyses only for five metals including arsenic, barium, cadmium, chromium, and lead. The ICL parameters list now in effect includes a much more comprehensive list of metals.

The soluble metals data collected since September 1986 have been statistically evaluated. This evaluation is described below.

For the five original tested metals (arsenic, barium, cadmium, chromium, and lead), there are typically three to five samples from each well, enough to perform direct statistical comparisons with the background wells. For the seven metals added as a part of the TCL analyses (antimony, cobalt, copper, mercury, nickel, vanadium, and zinc), there is typically only one sample per well, and data from several wells must be combined to perform the statistical analyses. The plume wells are an exception; they have been sampled frequently since 1988 and sufficient data are available for all metals without combining wells. A compilation of all the metals data is given in Appendix F.

Most metals have results above the detection limit in most wells, including the background wells. This makes statistical analysis possible, but it is still necessary to deal with those results that are reported as below the detection limit. The detection limit used was sometimes slightly different for the different laboratories and sometimes for the same laboratory on different dates. This has made interpretation of the non-detects difficult. Therefore, the approach used was to assume the CLP detection limits for all samples and to set non-detects to one-half of this value. One result of this choice is that a number of reported concentrations are lower than the detection limit and a few are lower even than one-half the detection limit. The net effect of this treatment of non-detects on the calculated mean concentrations and significance levels should be small, except in cases where non-detects are frequent (more than about half the total number of samples) in which case the statistical results should be viewed with suspicion. Of the metals tested, the data for antimony, cobalt, mercury, and nickel have a very low percentage of detections and the statistical results are uncertain. The data for arsenic, cadmium, copper, lead, and vanadium have a higher percentage of detections, and the statistical results are more reliable, but still somewhat suspect. The data for barium, chromium, and zinc have very few non-detects and the statistical results should be relatively unaffected by them.

As a first step in the statistical analysis, the mean and standard deviation were calculated for each metal and well, or group of wells (see results in Appendix G.) In many cases there is enough scatter in the measured concentrations to make the standard deviation larger than the mean value. As discussed in Section 3.1.5, the log-normal distribution is more appropriate in such cases. For consistency and simplicity, the log normal transformation and geometric mean were used in analyzing all metals in all wells. This is appropriate since, in cases where the data are not scattered and a log transformation is not required, there is little difference between normal and lognormal distributions and between mean and geometric mean values.

Statistical analyses were performed separately for the water table, intermediate, and deep water-bearing zones, and the residential wells. Several older wells apparently span both the water table and Intermediate Zones. Of these, well W-5B was assigned to the Water Table Zone, and wells W-33 and W-34 were assigned to the Intermediate Zone for the purpose of this analysis. In fact, in the vicinity of wells W-33 and W-34 the Water Table and Intermediate Zones appear to be in partial hydraulic communication with each other and the distinction may be unimportant. The residential wells were arbitrarily assigned to the Water Table Zone for analysis but will be discussed separately below.

Each well, or group of wells was compared to the background wells using three statistical tests, the parametric Student's t test, the non-parametric Mann-Whitney test, and the test of proportions. The first two tests were performed in all cases, but the test of proportions was only performed in cases where there was a high percentage (>50%) of non-detects in the data, in which case it may be the most reliable test. The tests were one-tailed since only concentrations higher than background are of interest.

The selection of the set of background wells in each zone requires further discussion. The most appropriate choice for a particular zone would be all wells up-gradient of the landfill in that zone. There is no problem in the Deep Zone where there are four up-gradient wells and therefore at least four samples for all metals. However, in the Water Table and Intermediate Zones there is only a single up-gradient well (W-26A and W-26B, respectively) in

each zone. These wells have been sampled only twice since analysis of all 12 metals began in 1988, so there is insufficient data for a good statistical comparison. In order to have enough data, the early warning wells, W-29, W-30, and W-31, were added to the background set in both the Water Table and Intermediate Zones. The early warning wells were selected because they are the furthest downgradient wells and, therefore, the least likely to have been impacted by the landfill. Furthermore, they are far beyond the outer perimeter detection wells which yield no signs of any volatile organics, and metals are, in general, less mobile than organics.

As an added check of the background wells, data from well W-26A has been statistically compared with the early warning wells for the five metals for which sufficient data exist (Table 5-8). An equivalent comparison for the Intermediate Zone was also made, as presented on Table 5-9. Here the tests are two-tailed since any departure from equality is of interest. At the five five percent level of confidence, the barium concentration is significantly elevated relative to W-26A and W-26B in all three early warning wells. Arsenic concentrations are significantly elevated in well W-30 relative to both W-26A and W-26B. Arsenic in well W-29 and lead in well W-30, are significantly elevated relative to well W-26A only. The significant differences found for barium appear to be partially explained by the unusually low levels in well W-26A and W-26B. Arsenic concentrations are also unusually low in both up-gradient wells, with only one detected value out of eleven samples. These differences in metal concentrations are extremely unlikely to have arisen from migration of metals from the landfill, for reasons noted above, and may instead reflect natural variations in soil metals concentrations. As will be seen later, using the early warning wells as part of the background set does not prevent the detection of significantly elevated barium and arsenic concentrations in the plume wells.

The results of the statistical analyses are summarized in Tables 5-10, 5-11, and 5-12 for the Water Table, Intermediate and Deep Zones, respectively. Detailed statistical results are presented in Appendix G. The tables give geometric means for each metal in each well and for each group of wells. Also indicated are the calculated significance level of the difference in mean concentration between each well and the background wells: three asterisks

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indicates significance at the one percent level, two asterisks indicate significance at the five percent level, and one asterisk is used to show possible significance at the five percent level. Note that in cases where there was only one sample for a well (indicated by parentheses around the one measured value) no assessment of significance was made. Since two or three tests were performed in each case, they sometimes disagreed on the significance of the results. Since the Mann-Whitney test is independent of the choice of distribution and less sensitive to extreme values than the t-test, it was accepted when it showed a higher significance level than the t-test. More typically, the t-test indicated a higher significance level than the Mann-Whitney. If this occurred around the five percent level, one asterisk was assigned to show possible significance. If the disagreement was at the one percent level, three asterisks were assigned if the Mann-Whitney result was less than two percent, otherwise two asterisks were assigned. The results of the test of proportions were also considered in the few cases where it was appropriate: less than 50 percent detections, but at least five detections total.

5.2 WATER QUALITY DISTRIBUTION

The distribution of water quality constituents within each water-bearing zone will be discussed in this section. The interpreted distribution of organic constituents is based primarily upon the TCL data collected during 1988 and 1989. Pre-1988 organic data are also discussed in order to place the site in an historic framework. The metals distribution is based upon the period during which soluble (filtered) metals data have been available, that is, from September 1986 to the present.

The water quality database for some groups of wells is not continuous throughout the entire period of the investigation. This reflects the various monitoring strategies in place at a given time as well as the installation sequence of individual monitoring wells.

The groups of wells and their approximate dates of reliable data availability are listed as follows:

Plume Wells	Aug. 1982 - Dec,1985, 1988 - Present
Plume Extension Wells	Jan. 1986 - present
Cross-Gradient Wells	Aug. 1983 - present
Perimeter Wells	Jan. 1986 - present
Background Wells	Sep. 1986 - present
Early Warning Wells	Aug. 1986 - present
Residential Wells	Nov. 1986 - present

5.2.1 Water Table Aquifer

5.2.1.1 Volatile Organic Compounds (Water Table). Primary impacts upon water quality in the Water Table Aquifer have been observed only a relatively short distance past the downgradient margin of the landfill on the basis of volatile organic compounds. However, a low level volatile plume has been identified to emanate from the landfill and be spread out to the north in a downgradient direction. This plume has been characterized based upon the 1988-89 TCL volatile organic data.

The Water Table Aquifer plume has been difficult to characterize using the 1988-89 TCL data because the compounds in various areas of the plume vary widely from one another. For example, of the wells located close to the landfill, W-9WT showed that trans-1,2-Dichloroethene and trichloroethene are the primary constituents, W-1WT showed that vinyl chloride is the primary constituent, while well W-3WT has been observed to he nearly free of organic constituents. This heterogeneity is even more marked in the wells located further from the landfill. Examples of this are seen in well W-21A which has shown very low levels of tetrachloroethene, MIBK, and 4-Methyl,2-Pentanol in one sample and was free of volatiles in other samples, and in W-32A, which had a very low level of trans-1,2-dichloroethene in one sample but was clean in another.

The observed heterogeneity of constituents may reflect the fact that wastes containing different compounds were disposed in different areas of the landfill. Furthermore, the heterogeneity may be explained in that the plume is fairly mature and that the detection of different compounds in different areas of the plume may reflect varying constituent migration rates as well as the breakdown of various compounds.

The total volatile organic plume, based on the 1988-89 TCL data, has been mapped, as presented on Sheet 20 of 21. More than one set of sample data are available for most of the wells that have been characterized. A total volatile organic value was determined for each well by summing the concentrations of each of the detected compounds from the most highly concentrated sample available for each of these wells. Compounds that have been shown to represent laboratory contaminants, as described previously, have not been included in this summation. Using only the data with the highest levels of volatiles for the group of available data provides a very conservative depiction of the plume. In fact, a number of wells which are mapped with a positive detection of volatiles showed nondetectable analytical results from other sample dates.

Volatile organic constituents within the Water Table Aquifer likely migrate downward into the underlying semi-confined, Intermediate Water-Bearing zone. This movement occurs under the influence of the substantial downward vertical gradient that exists beneath and immediately north of the landfill as depicted on the Differential Head Distribution Map (Sheet 16 of 21).

The plume had been previously characterized based upon TVO scan data obtained from 1983 to 1987. These data showed that the water table plume in 1987 was located only at the immediate margin of the landfill site. Furthermore, the data showed that water quality in wells located close to the landfill had a continual improvement in quality over time, as depicted on Figure 5-1. More recent total volatile organic data based upon the TCL analyses have not been plotted on this figure since the TVO scan data by GC cannot be directly be compared to the sum of the TCL volatiles. The fact that the water table plume is now shown to be further from the site (Sheet 20 of 21) than previously described may be due, in part, to the fact that the plume may be continuing to migrate from the site with little additional contribution from the landfill. Furthermore, subtle differences in the laboratory methods may also contribute to the mapping difference. Finally, the assumptions that were used to construct the current water table plume map are more conservative than those used in the previous characterization of the plume.

5.2.1.2 Other Organic Compounds (Water Table). Semi-volatile organic compounds were detected in only three samples collected from three plume wells. Semi-volatiles in the Water Table Zone have been characterized by the presence of Benzo (k) fluoranthene in plume wells W-1WT and W-3WT at levels ranging up to 52 ppb. This compound was also detected in one sample from well W-39A at a level of 48 ppb. This type of compound is commonly associated with coal and petroleum derivatives which may or may not be be related to the landfill.

PCBs and Pesticides were not detected in any wells in this zone.

5.2.1.3 Metals (Water Table). A statistical analysis was performed on metals data from wells in the Water Table Zone. As discussed above, the background set consisted of data from well W-26A and the early warning wells, W-29, W-30, and W-31. Compared to this background set, Table 5-10 indicates that significantly elevated concentrations were found in some cross-gradient wells and in plume wells W-1WT and W-3WT. There were no elevated concentrations in any of the perimeter wells. In the cross-gradient wells, arsenic is significantly elevated in W-5WT and W-8WT (geometric means of 7 ppb and 5.7 ppb compared to background mean of 2.5 ppb), chromium is elevated in W-8WT and perhaps W-5WT (geometric means of 22 ppb, and 20 ppb, respectively, compared to background mean of 7 ppb) and lead is elevated in W-5B (geometric mean 68 ppb, compared to background mean of 7.5 ppb). When all cross-gradient wells are combined, arsenic, chromium, copper and vanadium are significantly elevated at the 1 percent level, cobalt, lead and nickel are elevated at the five percent level and zinc may be elevated as well. The only metals that do not show significantly elevated concentrations are antimony and mercury, which are not detected, and barium and cadmium. These results are hard to explain since the cross-gradient wells should not be impacted by the landfill. In the plume wells, barium is elevated at the one percent level in well W-1WT (geometric mean, 514 ppb, compared to background mean of 140 ppb) and mercury may be elevated there. Arsenic and chromium may be elevated in well W-3WT. No significantly elevated concentrations appear in any other plume wells. The results from the plume wells are consistent with previous results.

5.2.2 Intermediate Zone

The Intermediate Water-Bearing zone provides the primary conduit for the movement of constituents from the site. A plume has been defined emanating from the site and moving toward the north and northwest under the influence of the direction of groundwater flow.

5.2.2.1 Volatile Organic Compounds (Intermediate Zone). Groundwater quality within the Intermediate Zone has been characterized on the basis of the TCL volatile organic data available from samples collected in 1988 and 1989. These data have been difficult to characterize for many of the same reasons as described previously for the Water Table Zone. In particular, the concentrations of the detected parameters have been observed to fluctuate to a large degree. However, the singular identity of the volatile constituents observed in these wells is somewhat better defined than those in the Water Table Zone. The primary plume constituents in the Intermediate Zone include MIBK, 4-methyl 2-pentanol, acetone, MEK, vinyl chloride, trans-1,2-dichloroethene, and THF.

The total volatile organic plume in the Intermediate Zone has been mapped based upon the 1988-89 TCL data (Sheet 21 of 21). Multiple sets of volatile organic data are available for most of the wells that have been characterized. A total volatile organic value for each well was determined by summing each of the detected compounds from the most concentrated sample available for each of these wells. Compounds that represent laboratory contaminants, as described previously, were not included in this summation. As with the Water Table Zone map, this technique results in a very conservative depiction of the position of the plume. Many of the wells that are mapped with a positive detection of volatiles have at other times been shown to be free of volatile organic compounds.

The lateral bounds of the plume, as depicted on Sheet 21 of 21 are well defined. The downgradient end of the plume is bounded with perimeter wells that have either not shown the detection of any volatiles or have indicated only the one-time detection of low level volatiles, as in the case of wells

W-21B and W-22B. Furthermore, the volatiles observed to the east cannot be attributed to the landfill as these wells are clearly located in a cross-gradient direction from the site.

The groundwater plume as depicted on Sheet 21 of 21 is quite comparable to the Intermediate Zone, Soil TVO Isocon Map (Sheet 11 of 21). The Soil TVO isocon map was previously prepared based upon P.I.D. data obtained from soil borings drilled in 1986 as a preliminary means to identify the approximate bounds of the volatile organic plume. The similarity of these maps indicates that the use of soil TVO measurements was successful in this preliminary definition of the plume.

The Intermediate Zone groundwater plume can be separated into several distinct areas. Much of the plume is migrating slowly to the northwest within the moderately low transmissivity materials that constitute the majority of the Intermediate Zone. In addition some low level volatile organics are present in an area located east in a cross-gradient direction from the landfill. However, most of the plume is likely migrating more rapidly through the area of higher transmissivity directly north of the landfill.

The portion of the plume northwest of the site has migrated approximately 150 to 600 feet past the margin of the landfill. This rate of movement corresponds very well to the measured hydraulic conductivity values, as previously mentioned.

Low levels of volatile organics consisting of tetrahydrofuran (THF) have been observed in several of cross-gradient wells located east of the site. THF has been observed in wells W-5, W-7 and W-8A at concentrations as high as 5.0, 70 and 89 ppb, respectively. These data from the cross-gradient wells are consistent with available historical data in which THF has been the primary parameter that was observed previously on the basis of GC data. However, it should be noted that the THF levels that are currently observed in these wells are significantly lower than those that were previously detected. Furthermore, no volatile organic compounds have been detected in any of the residential wells located to the east of this particular area.

A low level of benzene, at 12 ppb, was observed in the initial sample collected from the cross-gradient early warning well, W-35B. This was not repeated in later samples and has been attributed to inadvertent contamination during drilling.

The hydrogeologic conditions of the Intermediate Zone to the east of the landfill are similar to the area northwest of the landfill in that groundwater flows to the northwest at a relatively slow rate. However, on the basis of these data, it is difficult to directly attribute these detections of volatiles to the landfill due to it's cross gradient position with respect to these wells. The presence of these volatiles may be due to spillage that may have occurred along the landfill access road.

The conditions of volatile organic migration in the area north of the landfill are somewhat different than that described previously for the discrete Water Table and Intermediate Zones. This northern plume has migrated a greater distance past the landfill than the other portions of the plume. This movement is believed to be under the influence of the higher hydraulic conductivity conditions that have been identified in this area. In addition, the separation between the Water Table and Intermediate Zones is not as pronounced as has been observed elsewhere on the site. The two water-bearing zones behave almost as one within the area directly north of the landfill.

The water quality data available for wells W-20B and W-34 represent the typical TVO levels in this northern plume. Vinyl chloride has been consistently observed in well W-20B at concentrations ranging from 200 ppb to 2,400 ppb. Other detected compounds have included acetone and THF. Samples from well W-34 have contained lower levels of vinyl chloride at concentrations ranging from ND to 23 ppb. Other compounds observed in W-34 include MIBK, acetone, THF, and 4-methyl, 2-pentanol at a total concentration of 1,500 ppb.

Other water quality data show that the volatile organic levels decrease rapidly to the north. Therefore, these northern areas may represent an area of low level "fringe" contamination. An exception to this is well W-36B, where trans-1,2-Dichloroethene was observed in one sample at 1,200 ppb, while other samples from this well have been free of volatiles.

The Intermediate Zone and the overlying Water Table Zone appear to behave as one combined unit in the area that contains the highest levels of volatile organics. In this area, volatiles migrating through the Intermediate Zone can move upward under the influence of the observed upward vertical gradients. Thus, the migration of contaminants may be partially controlled by the more highly transmissive but laterally discontinuous units of the Water Table Zone.

The migration rate of the plume in this northern area is controlled primarily by the localized stratigraphic conditions observed during this investigation. The rate of groundwater movement in the vicinity of well W-34 probably provides a maximum plume travel rate in that deposits have been observed to be thicker (Sheet 13 of 21) and more coarse-grained in this area than in other areas of the site. This localized migration rate may be estimated with use of Equation 3.16. Using hydraulic conductivity for this area of 1×10^{-3} cm/sec, an observed hydraulic gradient of 0.02 and a porosity of 0.3, this yields a maximum flow rate of approximately 70 feet per year. In fact, this is very consistent with the observed migration of the volatile plume.

The constituents in this northern plume will probably not migrate into a regional flow system such that they would impact existing downgradient residential wells. The present maximum extent of the plume has been defined by the uncontaminated conditions of perimeter well clusters W-27 (A and B) and W-32 (A and B). If the plume migrated beyond the perimeter wells, it is not likely to present a threat to the downgradient residential wells. This is due to naturally occurring attenuation mechanisms and to the fact that a significant amount of the plume would be expected to discharge to the stream due to the observed upward hydraulic gradients. Furthermore, the anticipated remedial efforts described in the Feasibility Study (FS) report will pull back this plume through the installation of pumping wells, thus preventing any substantial future migration.

The Intermediate Zone groundwater plume was previously characterized on the basis of GC TVO scan data obtained from 1983 to 1987. These data showed water quality improvements in a number of Intermediate Zone monitoring wells located close to the landfill, as depicted on Figure 5-2. The most concent TCL

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volatile organics were not plotted on this figure because the TVO scan data by GC cannot be directly compared to the sum of the TCL volatiles. Therefore, this trend cannot be confirmed out to the present time.

5.2.2.2 Other Organic Compounds (Intermediate Zone). Semi-volatile organic compounds were detected in only a limited number of samples collected from the Intermediate Zone wells. Benzo (k) fluoranthene was detected in two wells located at the margin of the landfill, W-1A and W-3, at levels ranging up to 57 ppb. This compound was also detected in one sample collected from well W-39B at a concentration of 55 ppb. In addition, benzoic acid at levels ranging up to 4300 ppb was detected in well W-3. No other semi-volatiles were detected at levels above the detection limit.

PCBs and Pesticides were not detected in any wells in this zone.

5.2.2.3 Metals (Intermediate Zone). The statistical analysis of metals in the Intermediate Zone utilized a background set consisting of data from well W-26B and the early warning wells, W-29, W-30, and W-31. Relative to this background data, the statistical analyses indicate (Table 5-11) significantly elevated concentrations of arsenic in some perimeter wells, especially, W-32B and W-23B (geometric means 5.5 ppb and 3.8 ppb, respectively, compared to background mean of 2.5 ppb). Lead is also elevated in W-32B (geometric mean 30 ppb, compared to background mean of 12 ppb). Arsenic and lead are also significantly elevated in some cross-gradient Intermediate Zone wells: W-5A and W-8A for arsenic (geometric means 6.5 ppb and 7.7 ppb) and W-5A for lead (geometric mean 65 ppb). As in the Water Table Zone, these results are difficult to interpret, but the fairly large percentage of non-detects in the data for both arsenic and lead may be affecting the results.

The results for the plume wells are consistent with earlier results. Barium, for example, has geometric mean concentrations as high as 5,800 ppb in wells near the landfill and lower concentrations further away from the landfill. These barium concentrations are mapped on Sheet 19 of 21. The elevated barium concentrations are significant at the one percent level in AR301820 W-3, W-20B, W-33, W-34, and W-39B (geometric means 1,200, 5,800, 4,100, 600,

1,300, and 1,500 ppb, respectively, compared to background mean of 60 ppb). Other metals which have significantly higher concentrations (at the 1 percent level) in plume wells are cadmium in W-20B (6 ppb, compared to 2.5 ppm background), chromium in W-39B (64 ppb, background 12 ppb), copper in W-3 (365 ppb, background 36 ppb), and zinc in W-1A (4,100 ppb, background 600 ppb). When reviewed on an individual well basis and including possibly significant results at 5 percent or less, well W-1A shows elevated concentrations for 9 metals, well W-3 for 4 metals, wells W-20B and W-39B for 3, well W-33 for 2, and wells W-4A and W-34 for 1 each. This is roughly consistent with the distance of the wells from the landfill and the previously determined boundaries of the plume.

5.2.3 Deep Zone

5.2.3.1 Volatile Organic Compounds (Deep Zone). Water quality in the Deep Zone has been shown to be unaffected by volatile organic constituents from the landfill. This conclusion is based largely upon the results from newly installed Deep Zone well W-6B which is located immediately downgradient form the landfill in which no volatiles were observed above the detection limit. In addition, well W-24C, which is located marginally downgradient from the landfill, showed no positive detection of volatiles with the exception of one time detections of low levels of MEK and acetone.

The direction of groundwater flow in the Deep Zone is nearly in the opposite direction of the overlying zones. Therefore, well cluster locations that are downgradient of the landfill in the upper zones serve as upgradient, background locations in the Deep water-bearing zone. The upgradient wells in the Deep Zone include W-7A, W-21C, W-22C, and W-27C.

The deep water-bearing zone has always been believed to be unaffected by landfill-derived volatile constituents. This zone is confined by an aquitard of low hydraulic conductivity. Even with the strong downward vertical hydraulic gradient that has been observed, the aquitard has been adequate to prevent the downward migration of contaminants to this zone.

Two Deep Zone wells located immediately upgradient of the landfill, W-1 and W-3C, have previously contained substantial levels of volatile organics. However, this has been shown to represent vertical leakage through the well's annular seals, rather than evidence of water quality degradation in the Deep Zone. On this basis, wells W-1 and W-3C were removed as previously described.

5.2.3.2 Other Organic Compounds (Deep Zone). Semi-volatile organic compounds attributable to the landfill have not been detected in any of the deep monitoring wells. Low levels of 2,6-dinitrotoluene were detected in one sample from each of wells W-23C and W-27C. However, neither of these parameters have been observed in any of the plume wells. Moreover, these are not located in a downgradient direction from the landfill.

PCBs and Pesticides were not detected in any wells in this zone.

5.2.3.3 Metals (Deep Zone). The statistical evaluation of metals in the Deep Zone utilized four upgradient, background wells, W-7A, W-21C, W-22C, and W-27C. The only true downgradient well is W-6B; the remaining three deep wells are classified as cross-gradient. Statistical tests indicate (Table 5-12) that there are no significantly elevated concentrations for any metal in the downgradient well. This finding is consistent with the organic data that indicated no impact of the landfill on the deep water-bearing zone. A few significantly elevated concentrations do show up in the cross-gradient wells, notably arsenic in wells W-23C and W-26C (geometric means 4.8 and 5.1 ppb, respectively, compared to background mean of 2.8 ppb) and barium in W-23C (770 ppb, background 180 ppb). These elevated cross-gradient concentrations are attributed to natural variability in groundwater quality rather than any impact from the landfill.

5.2.4 Residential Wells

A residential water supply well survey was conducted, as previously described. This survey indicated that most of the residential wells are relatively shallow and probably intercept the Water Table Aquifer and/or the Intermediate Zone. Water quality data have been obtained from a number of residential wells, the results of which are described in the following sections.

AR300122

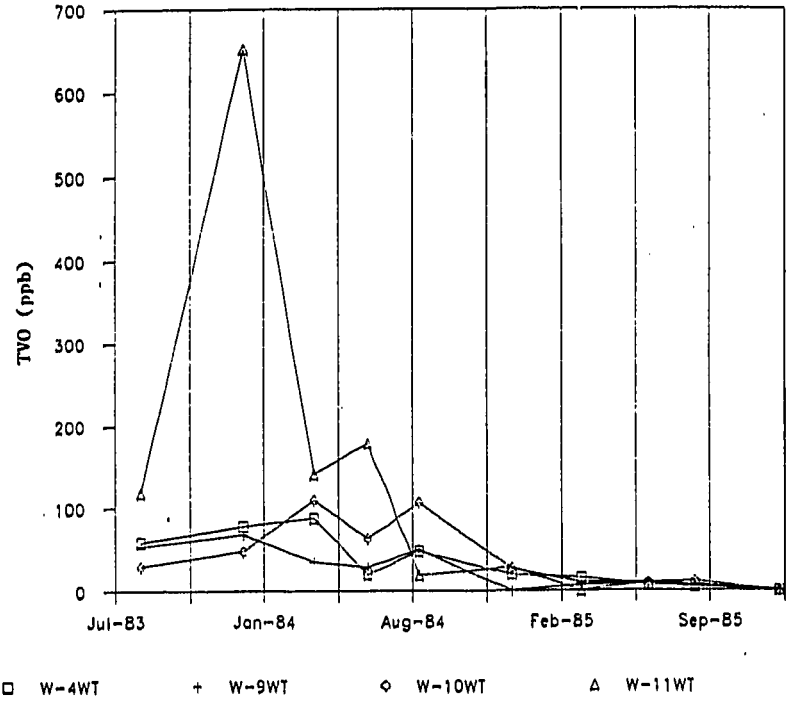
5.2.4.1 Organic Compounds. The volatile organic data for the residential water supply wells are presented on Table 5-4. No volatile organic compounds were detected in any of these wells at any time.

PCBs and pesticides were not detected in any of the residential wells.

5.2.4.2 Metals. The metals data results for the residential wells have been statistically compared with the Water Table Zone background set as presented in Table 5-1. Little would change if the Intermediate Zone background set were used instead since the bulk of the background data is from wells W-29, W-30, and W-31 in both sets. The results indicate no significantly elevated concentrations for any metal in the residential wells.

FIGURE 5-1

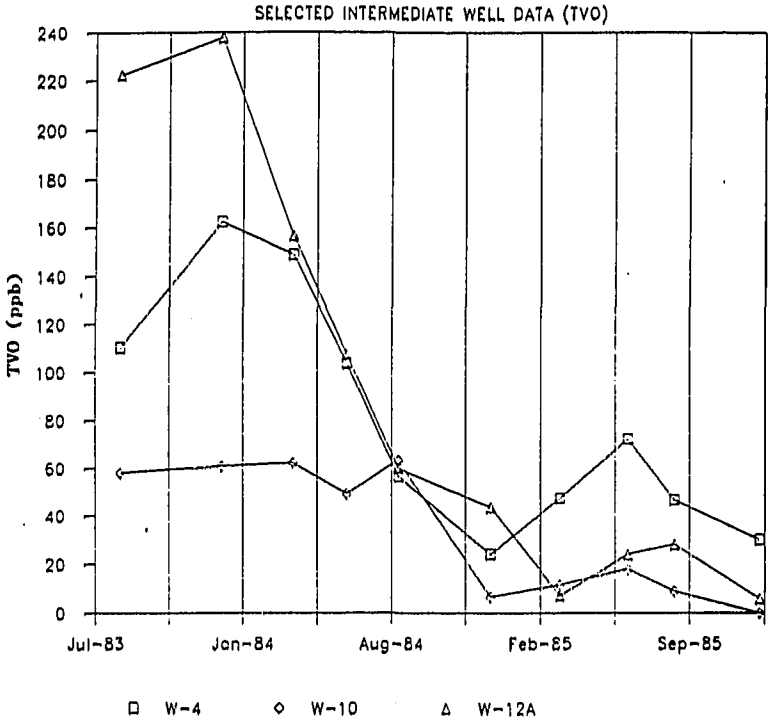
SELECTED WATER TABLE WELL DATA (TVO)



AR301024

FIGURE 5-2

SELECTED INTERMEDIATE WELL DATA (TVO)



AR301825

TABLE 5-1
WATER TABLE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample number	Sample location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon tetra-chloride	Chloro-benzene	Chloro dibromo methane	Chloro-ethane	2 chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,3-Dichloro ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl benzene
SW1	On cross Grad	08/30/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
2W1	On cross Grad	08/30/88	IT	ND	ND	ND	ND	ND			ND	[illegible]			ND	ND	ND	ND	ND	ND
BW1	On cross Grad	08/30/88	IT	ND	ND	ND	ND	ND			ND	[illegible]			ND	ND	ND	ND	ND	ND
7I	On Tarly Barn	01/06/89	Lord	5	ND	ND	ND	ND			ND	5	ND		ND	ND	ND		ND	ND
35A	On Tarly Barn	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
35A	On Tarly Barn	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
35A	On Tarly Barn	01/13/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
35A	On Tarly Barn	04/22/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	5.2	B		ND	ND	ND	ND	ND	ND
20A	On Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND		ND	ND
20A	On Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
21A	On Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
21A	On Perimeter	01/13/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
22A	On Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
22A	On Perimeter	01/13/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
23A	On Perimeter	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
23A	On Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
24A	On Perimeter	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
24A	On Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
25AI	On Perimeter	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
25AI	On Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	ND
27A	On Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
27A	On Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	1	ND	ND		ND	ND
32A	On Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND		88	1	ND	ND	ND	ND	ND
32A	On Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND		ND	ND
37A	On Perimeter	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND		ND	ND
37A	On Perimeter	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND				ND	ND	ND	ND	ND
37A	On Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
37A	On Perimeter	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	6				ND	ND	ND	ND	ND
1BI	On Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
1BI	On Plume	02/13/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
1BI	On Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
3BI	On Plume	07/01/88	IT	ND	ND	ND	ND	ND			ND	ND				ND	ND	ND	ND	ND
3BI	On Plume	01/23/89	Lord	5	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
3BI	On Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	22				ND	ND	ND	ND	ND
3BI	On Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
4BI	On Plume	01/23/89	Lord	5	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
4BI	On Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	12				ND	ND	ND	ND	ND
4BI	On Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	5				ND	ND	ND	ND	ND
7BI	On Plume	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		33	ND	ND	ND	ND	ND
7BI	On Plume	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND				ND	ND	ND	ND	ND
7BI	On Plume	01/13/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
34A	On Plume	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
34A	On Plume	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND				ND	ND	ND	ND	ND
34A	On Plume	01/13/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
34A	On Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND
34A	On Plume	02/13/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			ND	ND	ND	ND	ND

TABLE 5-1
WATER TABLE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon Tetra-chloride	Chloro benzene	Chloro-dibrom-methane	Chloro-ethane	2-chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl benzene
23A	Ck-Pipe	01/05/89	LT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
23A	Ck-Pipe	01/23/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
23A	Ck-Pipe	02/14/89	Lord	ND	ND	ND	ND	ND		ND	ND	9			ND	ND	ND	ND	ND	ND
24A	Ck-Upgrad	07/01/88	LT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
24A	Ck-Upgrad	08/23/88	LT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND

Notes: 1 - ND indicates compound not detected at or above the detection limit
2 - Data indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 - B indicates that compound was found in a blank.

07/07/89

TABLE 5-1
WATER TABLE WELLS

WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Lord/Shipe Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene Chloride	1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2 Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	Methyl Ethyl Ketone	Methyl Iso Butyl Ketone
5A1	On Cross Grad	08/20/88	IT			8 B	ND	ND	ND	ND	ND	ND	ND	26 J	ND				ND	ND
7A1	On Cross Grad	08/20/88	IT			6 B	ND	ND	BMDL	ND	ND	ND	ND	30 J	ND				ND	ND
8A1	On Cross Grad	08/20/88	IT			28 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
11	On Early Warn	01/06/89	Lord	ND		60 B	ND	ND	ND	ND	ND		ND	16 B	ND					
15A	On Early Warn	12/21/88	Lord	ND		95 B	ND	ND	ND	ND	ND		ND	7 BJ	ND					
15A	On Early Warn	01/05/89	IT			10 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
15A	On Early Warn	01/13/89	Lord	ND		57 B	ND	ND	ND	ND	ND		ND	12 B	ND					
15A	On Early Warn	04/22/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND				ND	ND
20A	On Perimeter	10/29/88	IT			14 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
20A	On Perimeter	01/06/89	Lord	ND		67 B	ND	ND	ND	ND	ND		ND	7 BJ	ND					BMDL
21A	On Perimeter	10/29/88	IT			13 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
21A	On Perimeter	01/13/89	Lord	ND		59 B	ND	5	ND	ND	ND		ND	6 BJ	ND					11
22A	On Perimeter	10/29/88	IT			14 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
22A	On Perimeter	01/13/89	Lord	ND		97 B	ND	ND	ND	ND	ND		ND	ND	ND					
23A	On Perimeter	08/13/88	IT			BMDL	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
23A	On Perimeter	01/06/89	Lord	ND		70 B	ND	ND	ND	ND	ND		ND	9 BJ	ND					
24A	On Perimeter	08/13/88	IT			17 B	ND	ND	ND	ND	ND	ND	ND	10 J	ND				ND	ND
24A	On Perimeter	01/06/89	Lord	ND		130 B	ND	ND	ND	ND	ND		ND	13 B	ND					
25A1	On Perimeter	08/13/88	IT			7 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
25A1	On Perimeter	01/06/89	Lord	ND		40 B	ND	ND	ND	ND	ND		ND	ND	ND					
27A	On Perimeter	10/29/88	IT			10 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
27A	On Perimeter	01/06/89	Lord	ND		40 B	ND	ND	ND	ND	ND		ND	5 BJ	ND					
32A	On Perimeter	10/29/88	IT			8 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
32A	On Perimeter	01/06/89	Lord	ND		88 B	ND	ND	ND	6	ND		ND	10 B	ND					
37A	On Perimeter	12/21/88	Lord	ND		110 B	ND	ND	ND	ND	ND		ND	13 B	ND					
37A	On Perimeter	01/05/89	IT			9 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
37A	On Perimeter	01/06/89	Lord			56 B	ND	ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
37A	On Perimeter	02/14/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND				ND	BMDL
3A1	On Plume	01/23/89	Lord		ND	51 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
3A1	On Plume	02/14/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	13 B	ND				ND	ND
3A1	On Plume	02/21/89	Lord	ND		22 B	ND	ND	ND	ND	ND		ND	ND	750					
3A1	On Plume	07/01/88	IT			BMDL	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
3A1	On Plume	01/23/89	Lord	ND		59 B	ND	ND	ND	ND	ND		ND	ND	ND					
3A1	On Plume	02/14/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	13 B	ND				ND	ND
3A1	On Plume	02/21/89	Lord	ND		19 B	ND	ND	ND	ND	ND		ND	ND	ND					
4A1	On Plume	01/23/89	Lord	ND		53 B	ND	ND	ND	ND	ND		130	ND	ND					
4A1	On Plume	02/14/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND				ND	BMDL
4A1	On Plume	02/21/89	Lord	ND		25 B	ND	ND	ND	ND	ND		ND	ND	BMDL					
4A1	On Plume	12/21/88	Lord	ND		140 B	ND	ND	ND	170	ND		65	7 BJ	12					
4A1	On Plume	01/05/89	IT			8 B	ND	ND	ND	200	ND	ND	47		BMDL				ND	ND
4A1	On Plume	01/13/89	Lord	ND		54 B	ND	ND	ND	200	ND		ND	8 BJ	ND					
34A	On Plume	12/21/88	Lord	ND		95 B	ND	ND	ND	ND	ND		ND	11 B	ND					
34A	On Plume	01/05/89	IT			6 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
34A	On Plume	01/13/89	Lord	ND		58 B	ND	ND	ND	ND	ND		ND	12 B	ND					
34A	On Plume	01/23/89	Lord	ND		60 B	ND	ND	ND	12	ND		ND	8 BJ	ND					
34A	On Plume	02/14/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND				ND	ND

TABLE 5-1
WATER TABLE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Ford/Shaw Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene Chloride		1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane		Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro benzene	1,4-Dichloro benzene	Methyl Ethyl Xylene	Methyl Iso butyl Xylene
3SA	Ox-Plume	01/05/89	IT			7	B	ND	ND	ND	ND	ND	ND	ND			ND				ND	ND
3SA	Ox Plume	01/23/89	Lord			84	B	ND	ND	ND	ND	14	B	ND	ND		ND				ND	ND
3SA	Ox Plume	02/14/89	Lord		ND			ND	ND	ND	ND	ND		ND	ND	10	B 22				ND	ND
24A	Ox Ingrad	07/01/88	IT			17	B	ND	ND	ND	ND	ND		ND	ND			ND			ND	ND
24A	Ox Ingrad	08/13/88	IT			25	B	ND	ND	ND	ND	ND		ND	ND			ND			ND	ND

Notes: 1 ND indicates compound not detected at or above the detection limit.
2 Bold indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank

07/07/89

TABLE 5-1
WATER TABLE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Lindstrom Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetrahydrofuran	1,1,2-Trichloro-1,2,2-Trifluoroethane	4-Methyl-2-Pentanol	Dichlorodifluoromethane	Dichloromethane	1,1-Dichloroethylene	Cyclohexanone	Xylene	2-Butanol	ISO Propanol	Total of Unknown Compounds	
5A1	Ox Cross Grad	08/20/88	IT	BMEK		22	BJ									
7A1	Ox Cross Grad	08/20/88	IT	BMEK		18	BJ									
8A1	Ox Cross Grad	08/20/88	IT	BMEK		8	BJ									
11	Ox Early Warn	01/06/89	Lord	ND	12	B	ND			ND	ND	ND	ND			
15A	Ox Early Warn	12/21/88	Lord	ND	10	B	ND			ND	ND	ND	ND			
15A	Ox Early Warn	01/05/89	IT	ND		7.8 J										
15A	Ox Early Warn	01/13/89	Lord	ND	5	BJ	ND			ND	ND	ND	ND			
15A	Ox Early Warn	06/22/89	Lord	ND	ND		ND									
20A	Ox Perimeter	10/29/88	IT	BMEK											4	J
20A	Ox Perimeter	01/06/89	Lord	ND	B	BJ	ND			ND	ND	ND	ND			
21A	Ox Perimeter	10/29/88	IT	BMEK											4	J
21A	Ox Perimeter	01/13/89	Lord	ND	24	B	77			ND	ND	5	ND			
22A	Ox Perimeter	10/29/88	IT	10 B											4	J
22A	Ox Perimeter	01/13/89	Lord	ND	5	BJ	BMEK			ND	ND	ND	ND			
23A	Ox Perimeter	08/13/88	IT	ND		5	J									
23A	Ox Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND			
24A	Ox Perimeter	08/13/88	IT	38		10	BJ									
24A	Ox Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND			
25A1	Ox Perimeter	08/13/88	IT	ND		22	BJ									
25A1	Ox Perimeter	01/06/89	Lord	ND	6	BJ	BMEK			ND	ND	ND	ND			
27A	Ox Perimeter	10/29/88	IT	14 B		5	J		40 J	ND	ND	ND	ND		53	J
27A	Ox Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND			
32A	Ox Perimeter	10/29/88	IT	BMEK		36	J		88 J							
32A	Ox Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND			
37A	Ox Perimeter	12/21/88	Lord	11	B 9	BJ	ND			ND	ND	ND	ND			
37A	Ox Perimeter	01/05/89	IT	ND												
37A	Ox Perimeter	01/06/89	Lord	ND	ND		BMEK									
37A	Ox Perimeter	02/14/89	Lord	ND	ND		BMEK									
1A1	Ox Plume	01/23/89	Lord	19	B 140	B	4	BJ								
1A1	Ox Plume	02/14/89	Lord	ND	64	B	ND									
1A1	Ox Plume	02/21/89	Lord	3000	B 110	B	ND			ND	ND	ND	ND		300	K
1A1	Ox Plume	07/01/88	IT	12	B	9	BJ									
2A1	Ox Plume	01/23/89	Lord	ND	29	B	ND			ND	ND	ND	ND			
2A1	Ox Plume	02/14/89	Lord	ND	ND		ND									
3A1	Ox Plume	01/21/89	Lord	30	B 56	B	ND			ND	ND	ND	ND			
3A1	Ox Plume	02/21/89	Lord	ND	ND		10	B		ND	ND	ND	ND			
3A1	Ox Plume	02/14/89	Lord	ND	ND		12									
4A1	Ox Plume	01/21/89	Lord	27	B 5	BJ	ND			ND	ND	ND	ND			
4A1	Ox Plume	02/21/89	Lord	ND	10	B	ND			ND	ND	ND	ND			
4A1	Ox Plume	01/05/89	IT	ND		14	J									
4A1	Ox Plume	01/13/89	Lord	ND	ND		ND			ND	ND	ND	ND			
34A	Ox Plume	02/21/88	Lord	13	B 9	BJ	ND			ND	ND	ND	ND			
34A	Ox Plume	01/05/89	IT	ND		5.5	J									
34A	Ox Plume	01/13/89	Lord	ND	ND		ND			ND	ND	ND	ND			
34A	Ox Plume	01/23/89	Lord	ND	11	B	ND			ND	ND	ND	ND			
34A	Ox Plume	02/14/89	Lord	ND	ND		BMEK									

TABLE 5-1
WATER TABLE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Trichloro-1,2-trifluoro ethane	4-Methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1-Dichloro ethylene	Cyclo-hexanone	Xylene	2-Butanol	ISO propanol	Total of UNKNOWN compounds
39A	Op Plume	01/05/89	IT	ND		17	1								
39A	Op Plume	01/23/89	Lord	ND	ND										
39A	Op Plume	02/14/89	Lord	ND	ND										
24A	Op Upgrad	07/01/88	IT	10 B											
24A	Op Upgrad	08/13/88	IT	11		21	81								

Notes 1 ND indicates compound not detected at or above the detection limit
2 PMQL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

07/07/89

TABLE 5-2
INTERMEDIATE ZONE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Ford/Kelsey Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon Tetra-chloride	Chloro-benzene	Chloro-dibromo-methane	Chloro-ethane	2-Chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl Benzene
5	Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
5	Cross Grad	08/20/88	IT	ND	ND	ND	BRK	ND		ND	ND	BRK			ND	ND	ND	ND	ND	ND
5R	Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
7	Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
8	Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
8A	Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
29	Early Warn	08/20/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
29	Early Warn	01/04/89	Lord	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
30	Early Warn	08/20/88	IT	ND	ND	ND	ND	ND		ND	ND	7	ND		ND	ND	ND	ND	ND	ND
30	Early Warn	01/06/89	Lord	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
31	Early Warn	08/20/88	IT	ND	ND	ND	ND	ND		ND	ND	6	ND		ND	ND	ND	ND	ND	ND
35B	Early Warn	12/21/88	Lord	12	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
35R	Early Warn	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
35B	Early Warn	06/22/89	Lord	ND	ND	ND	ND	ND		ND	ND	5.1	B		ND	ND	ND	ND	ND	ND
21B	Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
21B	Perimeter	01/13/89	Lord	ND	ND	5		ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
22B	Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
22B	Perimeter	01/13/89	Lord	8	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
23B	Perimeter	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
23B	Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND	4	B1	ND	ND	ND	ND	ND
23B	Perimeter	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
23B	Perimeter	01/04/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
27B	Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
27B	Perimeter	01/04/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
32B	Perimeter	10/29/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
32R	Perimeter	01/06/89	Lord	ND	ND	ND	ND	ND			ND	ND	ND		ND	ND	ND		ND	ND
37B	Perimeter	12/21/88	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
37B	Perimeter	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
37R	Perimeter	01/04/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
1A	Plume	01/23/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
1A	Plume	02/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
1A	Plume	02/21/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
3	Plume	07/01/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
3	Plume	01/23/89	Lord	ND	ND	ND	ND	33		ND	ND	ND	ND		ND	ND	ND		ND	ND
3	Plume	02/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
3	Plume	02/21/89	Lord	ND	ND	ND	ND	ND		ND	ND	16	ND		ND	ND	ND		ND	ND
31	Plume	01/23/89	Lord	5	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
31	Plume	02/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	4	ND		ND	ND	ND	ND	ND	ND
31	Plume	02/21/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
39B	Plume	01/23/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	5	ND	ND
39R	Plume	02/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	B	ND	ND
39R	Plume	02/21/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
41	Plume	01/23/89	Lord	7	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	11	ND	ND
41	Plume	02/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	B	ND	ND
41	Plume	02/21/89	Lord	ND	ND	ND	ND	ND		ND	ND	5	ND		ND	ND	ND		ND	ND
74B	Plume	12/21/88	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND

TABLE 5-2
INTERMEDIATE ZONE WELLS

WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon Tetra-chloride	Chloro-benzene	Chloro-dibromo-methane	Chloro-ethane	2-chloro ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl benzene
348	Dr-Plume	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
348	Dr-Plume	01/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
348	Dr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
348	Dr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND		ND	ND	5			ND	ND	ND	ND	ND	ND
348	Dr-Plume	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND		12	1	ND	ND	ND	ND	ND	ND
348	Dr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND				ND	ND	ND	ND	ND	ND
348	Dr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND		ND	ND	12				ND	ND	ND	ND	ND	ND
348	Dr-Upgrad	07/01/88	IT	ND	ND	ND	ND	ND			ND	ND				ND	ND	ND	ND	ND	ND
348	Dr-Upgrad	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND				ND	ND	ND	ND	ND	ND
348	Dr-Upgrad	01/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND			ND	ND	ND		ND	ND

Notes: 1 ND indicates compound not detected at or above the detection limit.
2 Bmx indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank

07/07/89

TABLE 5-2
INTERMEDIATE ZONE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Todd/Shane Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene Chloride	1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	Trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	Methyl Ethyl Ketone	Methyl Isobutyl Ketone
5	Girard Twp.	08/20/88	TI		5 B	ND	ND	ND	ND	ND	ND	ND	ND	12 J	ND				ND	ND
5A	Girard Twp.	08/20/88	TI		BWEK	ND	ND	ND	ND	ND	ND	ND	BWEK		ND				ND	ND
5R	Girard Twp.	08/20/88	TI		5 B	ND	ND	ND	ND	ND	ND	ND	ND	27 J	ND				ND	ND
7	Girard Twp.	08/20/88	TI		6 B	ND	ND	BWEK	ND	ND	ND	ND	ND	51 J	ND				ND	ND
8	Girard Twp.	08/20/88	TI		5 B	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
8A	Girard Twp.	08/20/88	TI		BWEK	ND	ND	ND	ND	ND	ND	ND	ND	13 J	ND				ND	ND
9	Girard Twp.	08/20/88	TI		11 B	ND	ND	ND	ND	ND	ND	ND	ND	7 J	ND				ND	ND
9R	Girard Twp.	01/06/89	Lord	ND	44 B	ND	ND	ND	ND	ND	ND		ND	5 BJ	ND					
10	Girard Twp.	08/20/88	TI		14 B	ND	ND	ND	ND	ND	ND	ND	ND	6 J	ND				ND	ND
10R	Girard Twp.	01/06/89	Lord	ND	38 B	ND	ND	ND	ND	ND	ND		ND	ND	ND					
11	Girard Twp.	08/20/88	TI		17 B	ND	ND	ND	ND	ND	ND	ND	ND	5 J	ND				ND	ND
11R	Girard Twp.	12/21/88	Lord	ND	140 B	ND	ND	ND	ND	ND	ND		ND	26 B	ND					
11R	Girard Twp.	01/05/89	TI		6 B	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
11R	Girard Twp.	04/22/89	Lord		ND	ND	ND	ND	ND	ND	ND		ND	ND	ND				ND	ND
21R	Perimeter	10/29/88	TI		33 B	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
21R	Perimeter	01/13/89	Lord	ND	44 B	BWEK	7	ND	ND	ND	ND		ND	7 BJ	ND				14	
22R	Perimeter	10/29/88	TI		11 B	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
22R	Perimeter	01/13/89	Lord	ND	2400 B	ND	ND	ND	ND	ND	ND		ND	35 B	ND				BWEK	
23R	Perimeter	08/13/88	TI		14 B	ND	ND	ND	ND	BWEK	ND	ND	ND	45 J	ND				ND	ND
23R	Perimeter	01/06/89	Lord	ND	120 B	ND	ND	ND	ND	ND			ND	ND	ND					
24R	Perimeter	08/13/88	TI		21 B	ND	ND	ND	ND	ND	ND	ND	ND	73 J	ND				ND	ND
24R	Perimeter	01/06/89	Lord	ND	64 B	ND	ND	ND	ND	ND	ND		ND	13 B	ND					
27R	Perimeter	10/29/88	TI		9 B	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
27R	Perimeter	01/06/89	Lord	ND	62 B	ND	ND	ND	ND	ND	ND		ND	ND	ND					
32R	Perimeter	10/29/88	TI		7 B	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
32R	Perimeter	01/06/89	Lord	ND	52 B	ND	ND	ND	ND	ND	ND		ND	33 B	ND					
37R	Perimeter	12/21/88	Lord	ND	98 B	ND	ND	ND	ND	ND	ND		ND	19 B	ND					
37R	Perimeter	01/05/89	TI		8 B	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
37R	Perimeter	01/06/89	Lord		738	ND	ND	ND	ND	ND	ND	ND	ND	10 B	ND				ND	ND
1A	Plume	01/23/89	Lord	ND	52 B	ND	ND	ND	ND	ND	ND		ND	5 BJ	54					17
1A	Plume	02/14/89	Lord		320 B	ND	ND	ND	ND	ND	ND	ND	ND	BWEK	ND				ND	130
1A	Plume	02/21/89	Lord	ND	23 B	ND	ND	ND	ND	ND	ND		ND	ND	ND					6
3	Plume	07/01/88	TI		BWEK	ND	ND	27	11	ND	ND	ND	ND		500 J				2400	48000
3	Plume	01/23/89	Lord	ND	60 B	ND	ND	14		ND	ND		10	21 B	40					8800
3	Plume	02/14/89	Lord		180 B	ND	ND			ND	ND	ND	ND	ND	1200				ND	12000
3	Plume	02/21/89	Lord	ND	23 B	ND	ND	ND	ND	ND	ND		ND	ND	240					3300
11	Plume	02/23/89	Lord	ND	62 B	ND	ND	ND	ND	ND	ND		ND	ND	ND					
11	Plume	02/14/89	Lord		ND	ND	ND	ND	ND	ND	ND	ND	ND	12 B	ND				ND	BWEK
11	Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND					
26R	Plume	02/21/89	Lord	ND	50 B	ND	ND	ND	ND	ND	ND		ND	ND	2400					BWEK
26R	Plume	02/14/89	Lord		170 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	1900				ND	BWEK
26R	Plume	02/21/89	Lord	ND	23 B	ND	ND	ND	ND	ND	ND		ND	ND	200					
33	Plume	01/23/89	Lord	ND	60 B	ND	ND	ND	ND	ND	ND		ND	ND	ND					
33	Plume	02/14/89	Lord		32 B	ND	ND	ND	ND	ND	ND	ND	ND	16 B	23				ND	490
33	Plume	02/21/89	Lord	ND	22 B	ND	ND	ND	ND	ND	ND		ND	ND	20					
34R	Plume	02/21/89	Lord	ND	27 B	ND	ND	ND	ND	ND	ND		ND	12 B	ND					

TABLE 5-2
INTERMEDIATE ZONE WELLS

WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (GROUP 2 of 3)
(ppb)

Lord/Stipp Site
Girard Twp., Pennsylvania

Sample number	Sample location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene chloride	1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	Trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro benzene	Methyl Ethyl Ketone	Methyl Iso Butyl Ketone
WD1	Gw Plume	01/05/89	IT			7 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
WD1	Gw Plume	01/13/89	Lord	ND		57 B	ND	ND	ND	ND	ND		ND	10 B	ND					
WD1	Gw Plume	01/23/89	Lord	ND		100 B	ND	ND	ND	1200	ND		ND	4600 B	ND					
WD1	Gw Plume	02/14/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
WD6	Gw Plume	01/05/89	IT			5 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
WD6	Gw Plume	01/23/89	Lord			59 B	ND	ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
WD6	Gw Plume	02/14/89	Lord			ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND				ND	16
WD8	Gw Upgrad	07/01/88	IT			14 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
WD8	Gw Upgrad	08/11/88	IT			6 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
WD8	Gw Upgrad	01/13/89	Lord	ND		60 B	ND	ND	ND	ND	ND		ND	ND	ND					

Notes 1 ND indicates compound not detected at or above the detection limit.
2 BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3 B indicates that compound was found in a blank.

07/07/89

TABLE 5-2
INTERMEDIATE ZONE WELLS

WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Sheet 3 of 3)
(ppb)

Ford/Shaw Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro-1,2-trifluoro-ethane	4-Methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1-Dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	ISO Propanol	Total of UNKNOWN Compounds
5	Ob-Cross Grad	08/20/88	IT	ND	10 J	37	BJ								
5A	Ob-Cross Grad	08/20/88	IT	BMDL	ND	24	BJ								
5B	Ob-Cross Grad	08/20/88	IT	ND		16	BJ								
7	Ob-Cross Grad	08/20/88	IT	BMDL	20 J	21	BJ								
8	Ob-Cross Grad	08/20/88	IT	BMDL		24	BJ								
8A	Ob-Cross Grad	08/20/88	IT	BMDL	89 J	20	BJ								
29	Ob-Early Warn	08/20/88	IT	BMDL		13	BJ								
29	Ob-Early Warn	01/[illegible]/89	Lord	ND	ND			ND		ND	ND	ND	ND		
30	Ob-Early Warn	08/2[illegible]		BMDL		19	BJ								
30	Ob-Early Warn	01/06/89	Lord	ND	ND			ND		ND	ND	ND	ND		
31	Ob-Early Warn	08/20/88	IT	BMDL		21	BJ								
35B	Ob-Early Warn	12/21/88	Lord	ND	24 B			ND		ND	ND	ND	ND		
35B	Ob-Early Warn	01/05/89	IT	BMDL		6.3 J									
35B	Ob-Early Warn	06/22/89	Lord	ND	ND			ND							
21B	Ob-Perimeter	10/29/88	IT	45 B										5 J	
21B	Ob-Perimeter	01/13/89	Lord	17 B	17 B		37			ND	ND	6	ND		
22B	Ob-Perimeter	10/29/88	IT	ND										14 J	
22B	Ob-Perimeter	01/13/89	Lord	ND	ND		ND			ND	ND	ND	ND		
23B	Ob-Perimeter	08/13/88	IT	ND		26	BJ		4 BJ						
23B	Ob-Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND		
24B	Ob-Perimeter	08/13/88	IT	ND		17	BJ								
24B	Ob-Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND		
27B	Ob-Perimeter	10/29/88	IT	BMDL		40 J								48 J	
27B	Ob-Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND		
32B	Ob-Perimeter	10/29/88	IT	BMDL											
32B	Ob-Perimeter	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND		
37B	Ob-Perimeter	12/21/88	Lord	13 B	10 B		4 BJ			ND	ND	ND	ND		
37B	Ob-Perimeter	01/05/89	IT	ND		14 J									
37B	Ob-Perimeter	01/06/89	Lord	ND	ND										
1A	Ob-Plume	01/23/89	Lord	ND	250 B		23 B			ND	ND	ND	ND		
1A	Ob-Plume	02/14/89	Lord	690 B	40 B		420								
1A	Ob-Plume	02/21/89	Lord	270 B	26 B		10			ND	ND	ND	ND		
1	Ob-Plume	07/01/88	IT	37000 B		1000 J	11000 J								
1	Ob-Plume	01/23/89	Lord	930 B	56 B		11000 B			32 B	ND	ND	ND		
1	Ob-Plume	02/14/89	Lord	5800 B	360 B		180000								
1	Ob-Plume	02/21/89	Lord	960 B	5 BJ		4700			ND	ND	ND	ND		
4A	Ob-Plume	01/23/89	Lord	ND	430 B		3 BJ			ND	ND	ND	ND		
4A	Ob-Plume	02/14/89	Lord	ND	270 B		BMDL								
4A	Ob-Plume	02/21/89	Lord	ND	ND		ND			ND	ND	ND	ND		
26B	Ob-Plume	01/23/89	Lord	26 B	11 B		5 BJ			ND	ND	ND	ND		
26B	Ob-Plume	02/14/89	Lord	530 B	140 B		BMDL								
26B	Ob-Plume	02/21/89	Lord	ND	6 BJ		ND			ND	ND	ND	ND		
11	Ob-Plume	01/23/89	Lord	ND	10 B		ND			ND	ND	ND	ND		
11	Ob-Plume	02/14/89	Lord	ND	ND		1000								
33	Ob-Plume	02/21/89	Lord	1100 B	37 B	16	28			ND	ND	ND	ND		
34B	Ob-Plume	12/21/88	Lord	11 B	9 BJ		ND			ND	ND	ND	ND		

TABLE 5-2
INTERMEDIATE ZONE WELLS

WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro-1,2-trifluoro-ethane	4-Methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1-Dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	150 Propanol	Total of Unknown Compounds
148	On Plume	01/05/89	IT	ND		5 7 1									
148	On Plume	01/13/89	Lord	ND	ND		ND			ND	ND	ND	ND		
148	On Plume	01/23/89	Lord	ND	ND		ND			ND	ND	ND	ND		
148	On Plume	02/14/89	Lord	ND	ND		trace								
148	On Plume	01/05/89	IT	ND											35 B T
148	On Plume	01/23/89	Lord	ND	trace		trace								
148	On Plume	02/14/89	Lord	ND	ND		33								
248	On Upgrad	07/01/88	IT	10 B											
248	On Upgrad	08/13/88	IT	ND		16 BJ									
248	On Upgrad	01/13/89	Lord	ND	5 BJ		ND			ND	ND	ND	ND		

Notes 1 ND indicates compound not detected at or above the detection limit
2 trace indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

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TABLE 5-3
DEEP ZONE WELLS

WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shoup Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon tetra-chloride	Chloro-benzene	Chloro-dibromo-methane	Chloro-ethane	2-Chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro ethane	1,2-Dichloro ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl benzene
21C	DA-Cross Grad	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND		2 BJ	ND	ND	ND	ND	ND	ND
21C	DA-Cross Grad	01/06/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
24C	DA-Cross Grad	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND		2 BJ	ND	ND	ND	ND	ND	ND
24C	DA-Cross Grad	01/06/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
24C	DA-Cross Grad	08/13/88	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
24C	DA-Cross Grad	01/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
4R	DA-Perimeter	12/21/88	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
4R	DA-Perimeter	01/05/89	IT	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
4R	DA-Perimeter	01/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
4R	DA-Perimeter	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND
4R	DA-Perimeter	02/14/89	Lord	ND	ND	ND	ND	ND		ND	ND	12			ND	ND	ND	ND	ND	ND
7A	DA-Upgrad	08/20/88	IT	ND	ND	ND	ND	ND			ND	BMQL		21 J	ND	ND	ND	ND	ND	ND
21C	DA-Upgrad	10/27/88	IT	BMQL	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
21C	DA-Upgrad	01/23/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
22C	DA-Upgrad	10/27/88	IT	ND	ND	ND	ND	ND			ND	ND		51 J	ND	ND	ND	ND	ND	ND
22C	DA-Upgrad	01/13/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND
27C	DA-Upgrad	10/27/88	IT	ND	ND	ND	ND	ND			ND	ND		17 J	ND	ND	ND	ND	ND	ND
27C	DA-Upgrad	01/06/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND		ND	ND

Notes
1 ND indicates compound not detected at or above the detection limit.
2 BMQL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3 B indicates that compound was found in a blank.

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TABLE 5-3
DEEP ZONE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Ford/Shoppe Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene Chloride		1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane		Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	Methyl Ethyl Ketone	Methyl Iso Butyl Ketone
23C	On-Cross Grad	08/13/88	IT			15	B	ND	ND	ND	ND	ND	ND	ND	33	T	ND				ND	ND
23C	On-Cross Grad	01/06/89	Lord	ND		29	B	ND	ND	ND	ND	ND		ND	16	B	ND					
24C	On-Cross Grad	08/13/88	IT			17	B	ND	ND	BMDL	ND	ND	ND	ND	18	T	ND				ND	ND
25C	On-Cross Grad	01/06/89	Lord	ND		45	B	ND	ND	ND	ND	ND		ND	10	B	ND					
26C	On-Cross Grad	08/13/88	IT			6	B	ND	ND	ND	ND	ND	ND	ND			ND				ND	ND
26C	On-Cross Grad	01/13/89	Lord	ND		37	B	ND	ND	ND	ND	ND		ND		ND	ND					
6B	On-Perimeter	12/21/88	Lord	ND		57	B	ND	ND	ND	ND	ND		6	BJ	ND	ND					
6B	On-Perimeter	01/05/89	IT			8	B	ND	ND	ND	ND	ND	ND	ND			ND				ND	BMDL
6B	On-Perimeter	01/13/89	Lord	ND		61	B	ND	ND	ND	ND	ND		ND		ND	ND					
6B	On-Perimeter	01/23/89	Lord	ND	ND	50	B	ND	ND	ND	ND	ND	ND	ND		BMDL	ND	ND		ND	ND	ND
6B	On-Perimeter	02/14/89	Lord		ND			ND	ND	ND	ND	ND	ND	ND		BMDL	ND				ND	BMDL
7A	On-Upgrad	08/20/88	IT			31	B	ND	ND	ND	ND	ND	ND	ND			ND				ND	ND
21C	On-Upgrad	10/29/88	IT			37	B	ND	ND	ND	ND	ND	ND	ND			ND				ND	ND
21C	On-Upgrad	01/23/89	Lord	ND		23	B	ND	ND	ND	ND	ND		ND	7	BJ	ND					
22C	On-Upgrad	10/29/88	IT			33	B	ND	ND	ND	ND	ND	ND	ND			ND				ND	ND
22C	On-Upgrad	01/13/89	Lord	ND		140	B	ND	ND	ND	ND	ND		ND	8	BJ	>					
27C	On-Upgrad	10/29/88	IT			8	B	ND	ND	ND	ND	ND	2D	ND			ND				ND	ND
27C	On-Upgrad	01/06/89	Lord	ND		31	B	ND	ND	ND	ND	ND		ND	5	BJ	ND					

Notes 1 ND indicates compound not detected at or above the detection limit.
2 BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3 B indicates that compound was found in a blank.

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TABLE 5-3
DEEP ZONE WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Ford/Simmo Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2 Tri-chloro-trifluoro-ethane	1,2-4-methyl-2-pentanol	Dichloro-difluoro-methane	Dichloro fluoro-methane	1,1-dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	Iso propanol	Total of Unknown Compounds	
23C	Ob-Cross Grad	08/13/88	IT	27		18	BI		2	BI						
23C	Ob-Cross Grad	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND			
24C	Ob-Cross Grad	08/13/88	IT	60		21	BI		2	BI						
24C	Ob-Cross Grad	01/06/89	Lord	ND	ND		ND			ND	ND	ND	ND			
25C	Ob-Cross Grad	08/13/88	IT	ND		12	BI									
25C	Ob-Cross Grad	01/13/89	Lord	ND 5		BJ		BMBL		ND	ND	ND	ND			
6B	Ob-Perimeter	12/21/88	Lord	12 B	ND			ND		ND	ND	ND	ND			
6B	Ob-Perimeter	01/05/89	IT	ND		11	1									
6B	Ob-Perimeter	01/13/89	Lord	ND 5		BJ		ND		ND	ND	ND	ND			
6B	Ob-Perimeter	01/23/89	Lord	12 B	ND											
6B	Ob-Perimeter	02/14/89	Lord	ND	ND			BMBL								
7A	Ob-Upgrad	08/20/88	IT	BMBL		10	BI		21	1						
21C	Ob-Upgrad	10/29/88	IT	13 B											5	1
21C	Ob-Upgrad	01/23/89	Lord	ND 7		BJ		BMBL		ND	ND	ND	ND			
22C	Ob-Upgrad	10/29/88	IT	BMBL					51	1					9	1
22C	Ob-Upgrad	01/13/89	Lord	ND	ND			ND		ND	ND	ND	ND			
27C	Ob-Upgrad	10/29/88	IT	16 B		30	1		17	1					5	1
27C	Ob-Upgrad	01/06/89	Lord	ND	ND			BMBL		ND	ND	ND	ND			

Notes 1 ND indicates compound not detected at or above the detection limit
2 BMBL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3 B indicates that compound was found in a blank.

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TABLE 5-4
RESIDENTIAL WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Ford/Siepe Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon Tetra-chloride	Chloro-benzene	Chloro-dibromo-methane	Chloro-ethane	2 Chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl Benzene
Ratto	Dom Res	02/02/87	Ford	ND			ND					ND			ND		ND			
Ratto	Dom Res	04/13/87	Ford	ND			ND					ND			ND		ND			
Ratto	Dom Res	01/19/88	Microbac			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Ratto	Dom Res	06/28/89	Ford	ND	ND	ND	ND	[illegible]		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Ratto	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Carey	Dom Res	11/11/86	Ford	ND			ND					ND			ND		ND			
Carey	Dom Res	04/13/87	Ford	ND			ND					ND			ND		ND			
Carey	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Clark	Dom Res	11/11/86	Ford	ND			ND					ND			ND		ND			
Clark	Dom Res	04/13/87	Ford	ND			ND					ND			ND		ND			
Clark	Dom Res	01/05/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Clark	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Clark	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Tiley	Dom Res	11/11/86	Ford	ND			ND					ND			ND		ND			
Tiley	Dom Res	04/13/87	Ford	ND			ND					ND			ND		ND			
Tiley	Dom Res	01/05/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tiley	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Tiley	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Gilbert	Dom Res	02/02/87	Ford	ND			ND					ND			ND		ND			
Gilbert	Dom Res	04/13/87	Ford	ND			ND					ND			ND		ND			
Gilbert	Dom Res	01/05/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gilbert	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Grattier	Dom Res	01/26/84	Ford																	
Kimmer	Dom Res	02/02/87	Ford	ND			ND					ND			ND		ND			
Kimmer	Dom Res	04/13/87	Ford	ND			ND					ND			ND		ND			
Kimmer	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Kramer	Dom Res	11/11/86	Ford	ND			ND					ND			ND		ND			
Kramer	Dom Res	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kramer	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Kramer	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Wells	Dom Res	07/22/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wells	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wells	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Perry, C	Dom Res	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perry, C	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Perry, C	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Perry, R	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Perry, R	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Pistolak	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Pistolak	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Pistolak	Dom Res	11/11/86	Ford	ND			ND					ND			ND		ND			
Pistolak	Dom Res	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sabin	Dom Res	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sabin	Dom Res	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Sabin	Dom Res	06/28/89	Ford	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Siepe	Dom Res	01/19/88	Microbac			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 5-4
RESIDENTIAL WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Ford/Simpe Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon Tetra-chloride	Chloro Benzene	Chloro-dibromo-methane	Chloro-ethane	2-chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl Benzene
Shrpe	Ck Rns	07/22/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Shrpe	Ck Rns	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Shrpe	Ck Rns	06/28/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
Stewart	Ck Rns	11/11/86	Lord	ND			ND					ND			ND		ND			
Stewart	Ck Rns	01/09/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Stewart	Ck Rns	06/28/89	Microbac	ND		ND	ND	ND		ND		ND			ND	ND	ND	ND	ND	ND
Stewart	Ck Rns	06/28/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
West Ridge	Ck Rns	01/09/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
West Ridge	Ck Rns	06/28/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND	ND		ND	ND	ND	ND	ND	ND

Notes: 1 ND indicates compound not detected at or above the detection limit.
2 Data indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

07/07/89

TABLE 5-4
RESIDENTIAL WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (GROUP 2 of 3)
(ppb)

Todd/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene chloride	1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	Trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro benzene	Methyl Ethyl Ketone	Methyl Iso Butyl Ketone
Barto	Ba RMS	02/02/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Barto	Ba RMS	04/13/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Barto	Ba RMS	01/19/88	Microbac			ND	ND			ND	ND	ND	ND		ND				ND	ND
Barto	Ba RMS	06/28/89	Lord			18 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Barto	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND					
Carey	Ba RMS	11/11/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND	ND	ND	ND		
Carey	Ba RMS	04/13/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Carey	Ba RMS	06/28/89	Lord			21.1 B	ND	ND	ND	ND	ND	ND	ND	ND	ND				ND	ND
Clark	Ba RMS	11/11/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND					
Clark	Ba RMS	04/13/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Clark	Ba RMS	01/09/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Clark	Ba RMS	06/29/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Clark	Ba RMS	06/28/89	Lord			20.3 B	ND	ND	ND	ND	ND	ND	ND	ND	ND					
Frey	Ba RMS	11/11/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Frey	Ba RMS	04/13/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Frey	Ba RMS	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Frey	Ba RMS	06/29/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Frey	Ba RMS	06/28/89	Lord			19.9 B	ND	ND	ND	ND	ND	ND	ND	ND	ND					
Gilbert	Ba RMS	02/02/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Gilbert	Ba RMS	04/13/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Gilbert	Ba RMS	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Gilbert	Ba RMS	06/28/89	Lord			18.6 B	ND	ND	ND	ND	ND	ND	ND	ND	ND					
Grattier	Ba RMS	01/24/84	Lord																	
Kimmar	Ba RMS	02/02/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Kimmar	Ba RMS	04/13/87	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Kimmar	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND		
Kramer	Ba RMS	11/11/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Kramer	Ba RMS	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Kramer	Ba RMS	06/28/89	Lord			18.7 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Kramer	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Mello	Ba RMS	07/22/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Mello	Ba RMS	06/28/89	Lord			17.6 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Mello	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND		
Perry, C	Ba RMS	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Perry, C	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND		
Perry, C	Ba RMS	06/28/89	Lord			17.7 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Perry, R	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND		ND					
Perry, R	Ba RMS	06/28/89	Lord			17.8 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Pistelak	Ba RMS	06/28/89	Lord			17.8 B	ND	ND	ND	ND	ND	ND	ND	ND	ND					
Pistelak	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND		ND					
Pistelak	Ba RMS	11/11/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND	ND	ND	ND		
Pistelak	Ba RMS	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Shein	Ba RMS	01/06/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Shein	Ba RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Shein	Ba RMS	06/28/89	Lord			18.5 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Shope	Ba RMS	01/19/88	Microbac			ND	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND		

TABLE 5-4
RESIDENTIAL WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene Chloride	Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	Trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4 Dichloro-benzene	Methyl Ethyl Ketone	Methyl Iso Butyl Ketone
Shope	OW-RMS	07/22/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Shope	OW-RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND		
Shope	OW-RMS	06/28/89	Lord			17.6 B	ND	ND	ND	ND	ND	ND	ND	ND	ND					
Stewart	OW-RMS	11/11/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
Stewart	OW-RMS	01/09/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Stewart	OW-RMS	06/28/89	Microbac			ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND		
Stewart	OW-RMS	06/28/89	Lord			20.1 B	ND	ND	ND	ND	ND	ND	ND	ND	ND					
West Ridge	OW-RMS	01/09/89	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
West Ridge	OW-RMS	06/28/89	Lord			33.2 B	ND	ND	ND	ND	ND	ND	ND	ND	ND					

Notes 1 ND indicates compound not detected at or above the detection limit.
2 BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3 B indicates that compound was found in a blank.

07/07/89

TABLE 5-4
RESIDENTIAL WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample number	Sample location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro 1,2-trifluoro-ethane	4-Methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1-Dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	ISO propanol	Total of Unknown Compounds
Barto	Dr Bms	02/02/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Barto	Dr Bms	04/13/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Barto	Dr Bms	01/19/88	Microbac												
Barto	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Barto	Dr Bms	06/28/89	Microbac		ND										
Carey	Dr Bms	11/11/86	Lord	ND	ND		ND				ND	ND	ND	ND	
Carey	Dr Bms	04/13/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Carey	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Clark	Dr Bms	11/11/86	Lord	ND	ND		ND				ND	ND	ND	ND	
Clark	Dr Bms	04/13/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Clark	Dr Bms	01/09/89	Microbac												
Clark	Dr Bms	06/28/89	Microbac		ND										
Clark	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Frey	Dr Bms	11/11/86	Lord	ND	ND		ND				ND	ND	ND	ND	
Frey	Dr Bms	04/13/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Frey	Dr Bms	01/06/89	Microbac												
Frey	Dr Bms	06/28/89	Microbac		ND										
Frey	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Gilbert	Dr Bms	02/02/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Gilbert	Dr Bms	04/13/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Gilbert	Dr Bms	01/06/89	Microbac												
Gilbert	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Grattice	Dr Bms	01/26/84	Lord												
Kimmel	Dr Bms	02/02/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Kimmel	Dr Bms	04/13/87	Lord	ND	ND		ND				ND	ND	ND	ND	
Kimmel	Dr Bms	06/28/89	Microbac		ND										
Kramm	Dr Bms	11/11/86	Lord	ND	ND		ND				ND	ND	ND	ND	
Kramm	Dr Bms	01/06/89	Microbac												
Kramm	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Kramm	Dr Bms	06/28/89	Microbac		ND										
Mello	Dr Bms	07/22/88	Microbac												
Mello	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Mello	Dr Bms	06/28/89	Microbac		ND										
Myers C	Dr Bms	01/06/89	Microbac												
Myers C	Dr Bms	06/28/89	Microbac		ND										
Myers C	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Myers R	Dr Bms	06/28/89	Microbac		ND										
Myers R	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Mystipak	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Mystipak	Dr Bms	06/28/89	Microbac		ND										
Mystipak	Dr Bms	11/11/86	Lord	ND	ND		ND				ND	ND	ND	ND	
Mystipak	Dr Bms	01/06/89	Microbac												
Sabin	Dr Bms	01/06/89	Microbac												
Sabin	Dr Bms	06/28/89	Microbac		ND										
Sabin	Dr Bms	06/28/89	Lord	ND	ND		ND				ND	ND			
Shope	Dr Bms	01/19/88	Microbac												

TABLE 5-4
RESIDENTIAL WELLS
WATER QUALITY DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Ford/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro 1,2-trifluoro-ethane	4-Methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro fluoro-methane	1,1-Dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	Iso Propanol	Total of Unknown Compounds
Shope	OB-RES	07/22/88	Microbac												
Shope	OB-RES	04/28/89	Microbac		ND										
Shope	OB-RES	04/28/89	Lord	ND	ND		ND				ND	ND			
Stewart	OB-RES	11/11/86	Lord	ND	ND		ND				ND	ND	ND	ND	
Stewart	OB-RES	01/09/89	Microbac												
Stewart	OB-RES	04/28/89	Microbac		ND										
Stewart	OB-RES	04/28/89	Lord	ND	ND		ND				ND	ND			
West Ridge	OB-RES	01/09/89	Microbac												
West Ridge	OB-RES	04/28/89	Lord	ND	ND		ND				ND	ND			

Notes: 1 ND indicates compound not detected at or above the detection limit.
2 (ND) indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

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TABLE 5-5
WATER TABLE WELLS
WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (GROUP 1 of 3)
(ppb)

Lord/Shope Slip
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Di-n-Butyl-Phthalate	Di-n-Octyl-Phthalate	bis-(2-Ethyl-hexyl) Phthalate	Diethyl-Phthalate	Butyl Benzyl Phthalate	1,3-Dichloro-Benzene	1,4-Dichloro-Benzene	Benzoic Acid	Phenol	N-Nitroso Di-n-Propyl-amine	1,2,4-Trichloro-Benzene	4-Chloro-3-methyl phenol	Acenaph-thene	N-Nitroso-diphenyl-amine	2-Nitro phenol
5A1	Ck Cross Grad	08/20/88	IT	ND	ND	47 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8A1	Ck Cross Grad	08/20/88	IT	ND	ND	34 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35A	Ck Early Warn	12/21/88	IT	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35A	Ck Early Warn	01/05/89	Lord	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20A	Ck Perimeter	10/29/88	IT	BWK	ND	14 B	ND	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND
21A	Ck Perimeter	10/29/88	IT	BWK	ND	20 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22A	Ck Perimeter	10/29/88	IT	ND	ND	23 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23A	Ck Perimeter	08/13/88	IT	ND	ND	11 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24A	Ck Perimeter	08/13/88	IT	BWK	ND	10 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
25A1	Ck Perimeter	08/13/88	IT	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	BWK	ND
27A	Ck Perimeter	10/29/88	IT	ND	ND	29 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
32A	Ck Perimeter	10/29/88	IT	ND	ND	20 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37A	Ck Perimeter	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37A	Ck Perimeter	01/05/89	IT	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37A	Ck Perimeter	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1R1	Ck Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1R1	Ck Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3R1	Ck Plume	07/01/88	IT	64	ND	36 B	ND	ND	ND	ND	BWK	ND	BWK	ND	ND	ND	ND	ND
3R1	Ck Plume	01/23/89	Lord	ND 24		49 B	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3R1	Ck Plume	02/14/89	Lord	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3R1	Ck Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4R1	Ck Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4R1	Ck Plume	02/14/89	Lord	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4R1	Ck Plume	02/21/89	Lord	ND	140	520 B	ND	140	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5R1	Ck Plume	12/21/88	Lord	18	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5R1	Ck Plume	01/05/89	IT	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36A	Ck Plume	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36A	Ck Plume	12/21/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36A	Ck Plume	01/23/89	Lord	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36A	Ck Plume	02/14/89	Lord	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
39A	Ck Plume	12/21/88	Lord	ND	ND	17 B	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
39A	Ck Plume	01/05/89	IT	BWK	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
39A	Ck Plume	01/23/89	Lord	ND	BWK	31 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
39A	Ck Plume	02/14/89	Lord	ND	ND	BWK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2RA	Ck Upgrad	07/01/88	IT	ND	BWK	34 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2RA	Ck Upgrad	08/13/88	IT	ND	ND	10 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: 1 ND indicates compound not detected at or above the detection limit
2 BWK indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank

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TABLE 5-5
WATER TABLE WELLS

WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample number	Sample location	Sample date	Lab	2,4-Dinitro-toluene	Penta-chloro-phenol	Pyrene	2,6-Dinitro-toluene	2-methyl Naph-thalene	Benzo (a) Anthra-cene	Chrysene	Benzo (b) Fluor-anthene	Anthra-cene	Benzo (a) Pyrene	Benzo (k) Fluor-anthene	Benzo (ghi) Perylene	Fluor-anthene	Indeno (1,2,3-cd) Pyrene	Phen-anthrene
5R1	Ob Cross Grad	08/30/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8R1	Ob Cross Grad	08/30/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35A	Ob Early Warn	12/21/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35A	Ob Early Warn	01/05/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20A	Ob Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21A	Ob Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22A	Ob Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23A	Ob Perimeter	08/13/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23A	Ob Perimeter	08/13/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
25R1	Ob Perimeter	08/13/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27A	Ob Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
32I	Ob Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37A	Ob Perimeter	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37A	Ob Perimeter	01/05/89	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37A	Ob Perimeter	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1R1	Ob Pilot	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1R1	Ob Pilot	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3R1	Ob Pilot	07/01/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	52	ND	ND	ND	ND
3R1	Ob Pilot	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND	ND	ND
3R1	Ob Pilot	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND
3R1	Ob Pilot	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND
4R1	Ob Pilot	01/23/89	Lord	ND	ND	ND	ND			ND	ND	ND	ND		ND	ND	ND	ND
4R1	Ob Pilot	02/14/89	Lord	ND	ND	ND	ND		ND	ND	ND	ND	ND		ND	ND	ND	ND
4R1	Ob Pilot	02/21/89	Lord	ND	ND	ND	ND			ND	ND	ND	ND		ND	ND	ND	ND
9R1	Ob Pilot	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9R1	Ob Pilot	01/05/89	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34A	Ob Pilot	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34A	Ob Pilot	12/21/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34A	Ob Pilot	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34A	Ob Pilot	02/14/89	Lord	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34A	Ob Pilot	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35A	Ob Pilot	01/05/89	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35A	Ob Pilot	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4B	ND	ND	ND	ND
35A	Ob Pilot	02/14/89	Lord	ND	ND	ND	ND		ND	ND	ND	ND	ND		ND	ND	ND	ND
24A	Ob Upgrad	07/01/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24A	Ob Upgrad	08/13/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: 1 ND indicates compound not detected at or above the detection limit
2 Even indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank

TABLE 5-5
WATER TABLE WELLS

WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Lord/Shore Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	1,2-Benzenedi-carboxylic acid	Hexanoic Acid	2,3-Dimethyl heptane	TENTATIVELY IDENTIFIED: Conc. of Unknown Compounds	Number of Unknown Compounds	Conc. of Known Compounds	Number of Known Compounds
5W1	On Cross Grad	08/20/88	IT				99 J	2	292	B1 3
8W1	On Cross Grad	08/20/88	IT				16 J	1	30	J 2
15A	On Early Warn	12/21/88	IT							
35A	On Early Warn	01/05/89	Lord							
20A	On Perimeter	10/29/88	IT				124 J	8		
21A	On Perimeter	10/29/88	IT				397 J	7		
22A	On Perimeter	10/29/88	IT				26 J	5	31	J 1
23A	On Perimeter	08/13/88	IT				13 J	1		
24A	On Perimeter	08/13/88	IT							
25W1	On Perimeter	08/13/88	IT							
27A	On Perimeter	10/29/88	IT				10 J	1		
32A	On Perimeter	10/29/88	IT				6 J	1		
37A	On Perimeter	12/21/88	Lord							
37A	On Perimeter	01/05/89	IT				20.1 J	1		
37A	On Perimeter	01/23/89	Lord						100	1
1W1	On Plume	01/23/89	Lord				31	1	129	2
1W1	On Plume	02/21/89	Lord						104	3
3W1	On Plume	07/01/88	IT	ND			324 J	6		
3W1	On Plume	01/23/89	Lord				50	1	156	4
3W1	On Plume	02/14/89	Lord						100	1
3W1	On Plume	02/21/89	Lord							
4W1	On Plume	01/23/89	Lord						168	2
4W1	On Plume	02/14/89	Lord							
4W1	On Plume	02/21/89	Lord						269	5
9W1	On Plume	12/21/88	Lord							
9W1	On Plume	01/05/89	IT							
36A	On Plume	12/21/88	Lord							
36A	On Plume	12/21/88	IT							
36A	On Plume	01/23/89	Lord						142	2
36A	On Plume	02/14/89	Lord							
39A	On Plume	[illegible]/21/88	Lord							
39A	On Plume	01/05/89	IT							
39A	On Plume	01/23/89	Lord						102.2	2
39A	On Plume	02/14/89	Lord							
26A	On Upgrad	07/01/88	IT	ND	19 J		24 J	4	30	J 2
[illegible]	On Upgrad	08/13/88	IT				20 J	2		

Notes
1 ND indicates compound not detected at or above the detection limit
2 BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank

TABLE 5-6
INTERMEDIATE ZONE WELLS
WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (GROUP 1 OF 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Di-n-Butyl-Phthalate	Di-n-Octyl-Phthalate	Bis-(2-Ethyl-hexyl) Phthalate		Diethyl-Phthalate	Butyl Benzyl Phthalate	1,3-Dichloro-Benzene	1,4-Dichloro-Benzene	Benzoic Acid	Phenol	N-Nitroso Di-n-Propyl-amine	1,2,4-Trichloro-Benzene	4-Chloro-3-methyl phenol	Acenaph-thene	2-Nitroso-diphenyl-amine	4-Nitro phenol
5	Ol-Cross Grad	08/20/88	IT	BMDL	ND	13	B	ND	ND	17	BMDL	ND	BMDL	ND	ND	ND	ND	BMDL	ND
5A	Ol-Cross Grad	08/20/88	IT	ND	ND	10	B	ND	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND
5B	Ol-Cross Grad	08/20/88	IT	ND	ND	20	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	Ol-Cross Grad	08/20/88	IT	ND	ND	BMDL		ND	ND	BMDL	ND	ND	BMDL	ND	ND	ND	ND	ND	ND
8	Ol-Cross Grad	08/20/88	IT	ND	ND	15	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8A	Ol-Cross Grad	08/20/88	IT	ND	ND	27	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	Ol-Early Warn	08/20/88	IT	BMDL	ND	30		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	Ol-Early Warn	08/20/88	IT	BMDL	ND	22	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31	Ol-Early Warn	08/20/88	IT	BMDL	ND	18	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35B	Ol-Early Warn	12/21/88	Lord	21	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35B	Ol-Early Warn	12/21/88	IT	BMDL	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21B	Ol-Perimeter	10/29/88	IT	BMDL	ND	15	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22A	Ol-Perimeter	10/29/88	IT	ND	ND	18	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23B	Ol-Perimeter	08/13/88	IT	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND
24B	Ol-Perimeter	08/13/88	IT	BMDL	ND	BMDL		ND	ND	BMDL	ND	ND	BMDL	ND	ND	ND	ND	ND	ND
27B	Ol-Perimeter	10/29/88	IT	ND	ND	44	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
32B	Ol-Perimeter	10/29/88	IT	ND	ND	23	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37B	Ol-Perimeter	01/05/89	IT	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37B	Ol-Perimeter	01/16/89	Lord	BMDL	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37B	Ol-Perimeter	01/23/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1A	Ol-Plume	01/23/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1A	Ol-Plume	02/14/89	Lord	ND	BMDL	47	B	ND	ND	ND	ND	BMDL	ND	ND	ND	ND	ND	ND	ND
1A	Ol-Plume	02/14/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1A	Ol-Plume	02/21/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	Ol-Plume	07/01/88	IT	ND	ND	19	B	ND	ND	BMDL	ND	310	ND	ND	ND	ND	ND	ND	ND
3	Ol-Plume	01/23/89	Lord	BMDL	ND	BMDL		ND	ND	ND	ND	2800	ND	ND	ND	ND	ND	ND	ND
3	Ol-Plume	02/14/89	Lord	ND	ND	ND		ND	ND	ND	ND	4300	ND	ND	ND	ND	ND	ND	ND
3	Ol-Plume	02/21/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	1100	ND	ND	ND	ND	ND	ND	ND
4A	Ol-Plume	01/23/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4A	Ol-Plume	02/14/89	Lord	ND	ND	510	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4A	Ol-Plume	02/21/89	Lord	ND	ND	BMDL		ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20B	Ol-Plume	01/23/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20B	Ol-Plume	02/14/89	Lord	ND	BMDL	170	B	ND	ND	ND	ND	ND	BMDL	ND	ND	ND	ND	ND	ND
20B	Ol-Plume	02/21/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	BMDL	ND	ND	BMDL	ND	ND	ND
34	Ol-Plume	01/23/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34	Ol-Plume	02/14/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34	Ol-Plume	02/21/89	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34B	Ol-Plume	12/21/88	Lord	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34B	Ol-Plume	12/21/88	IT	BMDL	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34B	Ol-Plume	01/23/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34B	Ol-Plume	02/14/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34B	Ol-Plume	12/21/88	Lord	ND	BMDL	ND		ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34B	Ol-Plume	01/05/89	IT	BMDL	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35B	Ol-Plume	01/23/89	Lord	ND	BMDL	72	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35B	Ol-Plume	02/14/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 5-6
INTERMEDIATE ZONE WELLS
WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Di-n-Butyl-Phthalate	Di-n-Octyl-Phthalate	Bis-(2-Ethyl-hexyl) Phthalate	Diethyl-Phthalate	Butyl Benzyl Phthalate	1,3-Dichloro-Benzene	1,4-Dichloro-Benzene	Benzoic Acid	Phenol	N-Nitroso Di-n-Propyl-amine	1,2,4-Trichloro-Benzene	4-Chloro-3-methyl phenol	Acenaph-thene	n-Nitroso-diphenyl-amine	4-Nitro phenol
248	Ov-Upgrad	07/01/88	IT	BMDL	6 B	87 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
248	Ov-Upgrad	08/13/88	IT	ND	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
1. ND indicates compound not detected at or above the detection limit.
2. BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3. B indicates that compound was found in a blank.

07/07/89

TABLE 5-6
INTERMEDIATE ZONE WELLS
WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	2,4-Dinitro-toluene	Penta-chloro-phenol	Pyrene	2,6-Dinitro-toluene	2-Methyl Naph-thalene	Benzo (a) Anthra-cene	Chrysene	Benzo (b) Fluor-anthene	Anthra-cene	Benzo (a) Pyrene	Benzo (k) Fluor-anthene	Benzo (ghi) Perylene	Fluor-anthene	Indeno-(1,2,3-cd) Pyrene	Phen-anthrene
5	Gr-Cross Grad	08/20/88	IT	ND	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5R	Gr-Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5R	Gr-Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	Gr-Cross Grad	08/20/88	IT	ND	ND	ND	ND	[illegible]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7 R	Gr-Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	Gr-Cross Grad	08/20/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	Gr-Early Warn	08/20/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31	Gr-Early Warn	08/20/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35R	Gr-Early Warn	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35R	Gr-Early Warn	12/21/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21R	Gr-Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22R	Gr-Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23R	Gr-Perimeter	08/13/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24R	Gr-Perimeter	08/13/88	IT	ND	ND	ND	ND	[illegible]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27R	Gr-Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
32R	Gr-Perimeter	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37R	Gr-Perimeter	01/05/89	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37R	Gr-Perimeter	01/19/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37R	Gr-Perimeter	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1A	Gr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1A	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1A	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1A	Gr-Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND	ND	ND
3	Gr-Plume	07/01/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	Gr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	57	ND	ND	ND	ND
3	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	51	ND	ND	ND	ND
3	Gr-Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	52	ND	ND	ND	ND
4	Gr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	Gr-Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20R	Gr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20R	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20R	Gr-Plume	02/21/89	Lord	ND	[illegible]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34	Gr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34	Gr-Plume	02/21/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38R	Gr-Plume	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38R	Gr-Plume	12/21/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38R	Gr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38R	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38R	Gr-Plume	12/21/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38R	Gr-Plume	01/05/89	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38R	Gr-Plume	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	55	ND	ND	ND	ND
38R	Gr-Plume	02/14/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 5-6
INTERMEDIATE ZONE WELLS

WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (GROUP 2 of 3)
(ppb)

Ford/Shenn Site
Girard Twp., Pennsylvania

Sample number	Sample location	Sample date	Lab	2,4-Dinitro-toluene	Penta-chloro-phenol	Pyrene	2,6-Dinitro-toluene	2-Methyl Naph-thalene	Benzo (a) Anthra-cene	Chrysene	Benzo (b) Fluor-anthene	Anthra-cene	Benzo (a) Pyrene	Benzo (k) Fluor-anthene	Benzo (ghi) Perylene	Fluor-anthene	Indeno-(1,2,3-cd) Pyrene	Phen-anthrene
248	Original	07/01/88	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
248	Original	08/13/88	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: 1 ND indicates compound not detected at or above the detection limit
2 PWR indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

07/07/89

TABLE 5-6
INTERMEDIATE ZONE WELLS
WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Lord/Shore Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	1,2-Benzenedi-carboxylic acid	Hexanoic Acid	2,3-Dimethyl Heptane	TENTATIVELY IDENTIFIED: Conc. of Unknown Compounds	Number of Unknown Compounds	Conc. of Known Compounds	Number of Known Compounds
5	OR Cross Grad	08/20/88	IT				189 J	6	357	14
5A	OR Cross Grad	08/20/88	IT				138 J	3	17	12
5B	OR Cross Grad	08/20/88	IT						22	11
7	OR Cross Grad	08/20/88	IT				84 J	4	184	11
8	OR Cross Grad	08/20/88	IT				10 J	1	31	B12
8A	OR Cross Grad	08/20/88	IT				40 J	2	17	B1
29	OR Early Warn	08/20/88	IT				242 J	9	17 J	1
30	OR Early Warn	08/20/88	IT				37 J	3	27	12
31	OR Early Warn	08/20/88	IT				17 J	1	542	13
35B	OR Early Warn	12/21/88	Lord							
35B	OR Early Warn	12/21/88	IT				87 J	4		
21B	OR Perimeter	10/29/88	IT				142 J	8		
22B	OR Perimeter	10/29/88	IT						16 J	1
23B	OR Perimeter	08/13/88	IT				9 J	1		
24B	OR Perimeter	08/13/88	IT				6	1		
27B	OR Perimeter	10/29/88	IT				20 J	4		
32B	OR Perimeter	10/29/88	IT				2 J	1		
37B	OR Perimeter	01/05/89	IT				51.4	2		
37B	OR Perimeter	01/16/89	Lord							
37B	OR Perimeter	01/23/89	Lord						157	2
1A	OR Plume	01/23/89	Lord						250	3
1A	OR Plume	02/14/89	Lord						175.23	4
1A	OR Plume	02/14/89	Lord							
1A	OR Plume	02/21/89	Lord							
3	OR Plume	07/01/88	IT				1549 J	6	7832	19
3	OR Plume	01/23/89	Lord						194.75	7
3	OR Plume	02/14/89	Lord						183.7	6
3	OR Plume	02/21/89	Lord						179.95	7
4A	OR Plume	01/23/89	Lord						125	3
4A	OR Plume	02/14/89	Lord						111	2
4A	OR Plume	02/21/89	Lord							
20B	OR Plume	01/23/89	Lord						130	2
20B	OR Plume	02/14/89	Lord						116	2
20B	OR Plume	02/21/89	Lord						113	2
34	OR Plume	01/23/89	Lord						152	4
34	OR Plume	02/14/89	Lord						147	2
34	OR Plume	02/21/89	Lord						100	1
34B	OR Plume	12/21/88	Lord							
34B	OR Plume	12/21/88	IT							
34B	OR Plume	01/23/89	Lord						100	1
34B	OR Plume	02/14/89	Lord						157	2
39B	OR Plume	12/21/88	Lord							
39B	OR Plume	01/05/89	IT				37	12		
39B	OR Plume	01/23/89	Lord						100	1
39B	OR Plume	02/14/89	Lord							

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TABLE 5-6
INTERMEDIATE ZONE WELLS

WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Ford/Shipe Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	1,2-Benzenedicarboxylic acid	Hexanoic Acid	2,3-Dimethylheptane	----------TENTATIVELY IDENTIFIED---------- Conc. of Unknown Compounds	Number of Unknown Compounds	Conc. of Known Compounds	Number of Known Compounds
2KB	Ov-Upgrad	07/01/88	11	ND			425	7 6	11	7 1
2KB	Ov-Upgrad	08/13/88	11				35	1 2		

Notes
1 ND indicates compound not detected at or above the detection limit
2 Rank indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

TABLE 5-7
DEEP ZONE WELLS
WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (GROUP 1 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Di-n-Butyl-Phthalate	Di-n-Octyl-Phthalate	Bis-(2-Ethyl-hexyl) Phthalate		Diethyl-Phthalate	Butyl Benzyl Phthalate	1,3-Dichloro-Benzene	1,4-Dichloro-Benzene	Benzoic Acid	Phenol	N-Nitroso Di-n-Propyl-amine	1,2,4-Trichloro-Benzene	4-Chloro-3-Methyl phenol	Acenaph-thene	n-Nitroso-diphenyl-amine	4-Nitro phenol
23C	Ow-Cross Grad	08/13/88	11	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24C	Ow-Cross Grad	08/13/88	11	BMDL	ND	25	B	ND	ND	BMDL	ND	ND	BMDL	ND	ND	ND	ND	ND	ND
26C	Ow-Cross Grad	08/13/88	11	BMDL	ND	BMDL		ND	ND	21	BMDL	ND	BMDL	ND	ND	ND	ND	ND	ND
6A	Ow-Perimeter	01/03/89	11	BMDL	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6A	Ow-Perimeter	01/03/89	Lord	4%	27	94		BMDL	17			ND	ND			ND	ND		
6A	Ow-Perimeter	01/23/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6A	Ow-Perimeter	01/23/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6A	Ow-Perimeter	02/14/89	Lord	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7A	Ow-Upgrad	08/20/88	11	BMDL	ND	20	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21C	Ow-Upgrad	10/29/88	11	ND	ND	BMDL		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22C	Ow-Upgrad	10/29/88	11	ND	ND	29	B	ND	ND	BMDL	ND	ND	BMDL	ND	ND	ND	ND	ND	ND
27C	Ow-Upgrad	10/29/88	11	ND	ND	22	B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
1. ND indicates compound not detected at or above the detection limit.
2. BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3. B indicates that compound was found in a blank.

07/07/89

TABLE 5-7
DEEP ZONE WELLS

WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (GROUP 2 OF 3)
(ppb)

Ford/Shippe Slip
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	2,4-Dinitro-toluene	Penta-chloro-phenol	Pyrene	2,6-Dinitro-toluene	2-Methyl Naph-thalene	Benzo (a) Anthra-cene	Chrysene	Benzo (b) Fluor-anthene	Anthra-cene	Benzo (a) Pyrene	Benzo (k) Fluor-anthene	Benzo (ghi) Perylene	Fluor-anthene	Indeno-(1,2,3-cd) Pyrene	Phen-anthrene
23C	Ox Cross Grad	08/13/88	11	ND	ND	ND	17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24C	Ox Cross Grad	08/13/88	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
26C	Ox Cross Grad	08/13/88	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6B	Ox Perimeter	01/03/89	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6B	Ox Perimeter	01/03/89	Lord		ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6B	Ox Perimeter	01/23/89	Lord	ND	ND	ND	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND
6B	Ox Perimeter	01/23/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6B	Ox Perimeter	02/14/89	Lord	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7A	Ox Upgrad	08/20/88	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21C	Ox Upgrad	10/29/88	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22C	Ox Upgrad	10/29/88	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27C	Ox Upgrad	10/29/88	11	ND	ND	ND	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

NOTES
1 ND indicates compound not detected at or above the detection limit.
2 Bold indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank

07/07/89

TABLE 5-7
DEEP ZONE WELLS
WATER QUALITY DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Ford/Siegel Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	1,2-Benzenedicarboxylic acid	Hexanoic Acid	2,3-Dimethylheptane	Tentatively Identified: Conc. of Unknown Compounds	Tentatively Identified: Number of Unknown Compounds	Tentatively Identified: Conc. of Known Compounds	Tentatively Identified: Number of Known Compounds
21C	GW-Cross Grad	08/13/88	IT				26 J	3		
24C	GW-Cross Grad	08/13/88	IT				39 J	2		
24C	GW-Cross Grad	08/13/88	IT				7 J	1		
4B	GW Perimeter	01/03/89	IT				33 J	1		
4B	GW Perimeter	01/03/89	Lord						134.1	3
6B	GW Perimeter	01/23/89	Lord						180	1
6B	GW Perimeter	01/23/89	Lord						190	1
6B	GW Perimeter	02/14/89	Lord						354	2
7A	GW-Upgrad	08/20/88	IT				42 J	2	8	11
21C	GW Upgrad	10/29/88	IT				11 J	2		
22C	GW-Upgrad	10/29/88	IT				485 J	9		
27C	GW Upgrad	10/29/88	IT				43 J	6		

Notes: 1 ND indicates compound not detected at or above the detection limit
2 With indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

TABLE 5-8
BACKGROUND METALS DATA SET
WATER TABLE ZONE

Non-detects were set to one-half of the detection limit
Statistics are for log transformed data

BACKGROUND SET: 26A

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	11	11	11	11	11
Number above DL:	1	11	7	9	4
Geometric Mean:	2.578	66.180	3.714	6.710	5.376
Mean of Logs:	0.947	4.192	1.312	1.904	1.682
Std. Dev. of Logs:	0.101	0.458	0.868	0.786	1.070

DATA SET: 29

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	3	3	3	3	3
Number above DL:	1	3	2	3	1
Geometric Mean:	1.842	237.83	1.857	7.650	5.724
Mean of Logs:	0.611	5.472	0.619	2.035	1.745
Std. Dev. of Logs:	0.529	0.223	0.258	0.682	1.435
SIGNIFICANCE:					
T-Test -- Equal Var.:	0.0485	0.000623	0.208	0.798	0.934
Mann-Whitney Test:	0.125	0.0127	0.111	0.640	0.856
Test of Proportions:	NA	NA	NA	NA	0.923

DATA SET: 30

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	3	3	3	3	3
Number above DL:	2	3	2	3	3
Geometric Mean:	3.420	347.04	1.854	9.983	27.441
Mean of Logs:	1.230	5.849	0.617	2.301	3.312
Std. Dev. of Logs:	0.271	0.400	0.266	0.910	0.354
SIGNIFICANCE:					
T-Test -- Equal Var.:	0.0109	0.000104	0.207	0.465	0.0262
Mann-Whitney Test:	0.0299	0.0127	0.130	0.755	0.0199
Test of Proportions:	NA	NA	NA	NA	0.0507

DATA SET: 31

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	3	3	3	3	3
Number above DL:	2	3	1	3	2
Geometric Mean:	2.154	537.35	3.063	11.302	8.837
Mean of Logs:	0.768	6.287	1.120	2.425	2.179
Std. Dev. of Logs:	0.705	0.114	0.352	0.581	1.141
SIGNIFICANCE:					
T-Test -- Equal Var.:	0.380	0.000006	0.720	0.310	0.494
Mann-Whitney Test:	1.000	0.0127	1.000	0.350	0.546
Test of Proportions:	NA	NA	NA	NA	0.347

TABLE 5-9
BACKGROUND METALS DATA SET
INTERMEDIATE ZONE

Non-detects were set to one-half of the detection limit
Statistics are for log transformed data

BACKGROUND SET: 26B

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	11	11	11	11	11
Number above DL:	1	11	8	9	8
Geometric Mean:	2.500	31.735	2.444	8.396	12.003
Mean of Logs:	0.916	3.457	0.894	2.128	2.485
Std. Dev. of Logs:	0.000000	0.492	0.261	0.730	1.022

DATA SET: 29

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	3	3	3	3	3
Number above DL:	1	3	2	3	1
Geometric Mean:	1.842	237.83	1.857	7.650	5.724
Mean of Logs:	0.611	5.472	0.619	2.035	1.745
Std. Dev. of Logs:	0.529	0.223	0.258	0.682	1.435
SIGNIFICANCE:					
T-Test -- Equal Var.:	0.0507	0.000021	0.131	0.847	0.322
Mann-Whitney Test:	0.0817	0.0126	0.180	0.938	0.689
Test of Proportions:	NA	NA	NA	NA	NA

DATA SET: 30

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	3	3	3	3	3
Number above DL:	2	3	2	3	3
Geometric Mean:	3.420	347.04	1.854	9.983	27.441
Mean of Logs:	1.230	5.849	0.617	2.301	3.312
Std. Dev. of Logs:	0.271	0.400	0.266	0.910	0.354
SIGNIFICANCE:					
T-Test -- Equal Var.:	0.000957	0.000006	0.132	0.734	0.203
Mann-Whitney Test:	0.00714	0.0126	0.156	0.876	0.115
Test of Proportions:	NA	NA	NA	NA	NA

DATA SET: 31

	Arsenic	Barium	Cadmium	Chromium	Lead
Number of Samples:	3	3	3	3	3
Number above DL:	2	3	1	3	2
Geometric Mean:	2.154	537.35	3.063	11.302	8.837
Mean of Logs:	0.768	6.287	1.120	2.425	2.179
Std. Dev. of Logs:	0.705	0.114	0.352	0.611	0.141
SIGNIFICANCE:					
T-Test -- Equal Var.:	0.443	0.000001	0.237	0.531	0.660
Mann-Whitney Test:	0.898	0.0126	0.425	0.436	0.526
Test of Proportions:	NA	NA	NA	NA	NA

TABLE 5-10

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN WATER TABLE ZONE

WELL OR GROUP OF WELLS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
BACKGROUND WELLS: (26A-29-30-31)	28.8	2.49	141	2.93	7.85	6.39	12.3	7.47	<0.20	17.7	7.88	65.5
NW PERIMETER WELLS:												
20A	(<50.0)	<5.00	36.5	2.04	12.5	(<10.0)	(<10.0)	10.7	(<0.20)	(<30.0)	(<10.0)	(27.9)
21A	(<50.0)	<5.00	66.9	3.39	8.16	(<10.0)	(<10.0)	10.5	(<0.20)	(<30.0)	(<10.0)	(14.6)
22A	(<50.0)	2.96	55.2	1.72	10.1	(<10.0)	(<10.0)	6.96	(<0.20)	(<30.0)	(<10.0)	(27.8)
23A	(<50.0)	2.96	57.9	2.73	11.2	(<10.0)	(<10.0)	8.21	(2.00)	(<30.0)	(<10.0)	(20.8)
24A	(<50.0)	2.96	102	2.97	11.4	(<10.0)	(<10.0)	4.65	(3.00)	(<30.0)	(<10.0)	(22.1)
25WI	(<50.0)	3.41	54.3	2.88	9.17	(<10.0)	(<10.0)	10.1	(<0.20)	(<30.0)	(10.2)	(138)
NW PERIMETER COMBINED:	<50.0	2.88	59.1	2.57	10.3	<10.0	<10.0	8.25	0.29	<30.0	5.63	29.9)
NE PERIMETER WELLS:												
27A	(<50.0)	<5.00	72.5	1.94	6.36	(<10.0)	(<10.0)	14.6	(<0.20)	(<30.0)	(<10.0)	(19.5)
32A	(<50.0)	<5.00	175	2.39	9.93	(<10.0)	(<10.0)	12.8	(<0.20)	(<30.0)	(<10.0)	(13.9)
37A	<50.0	<5.00	<5.00	3.54	10.5	<10.0	<10.0	<5.00	0.14	15.5	<10.0	15.0
NE PERIMETER COMBINED:	<50.0	<5.00	52.6	2.37	8.40	<10.0	<10.0	9.75	0.12	15.2	<10.0	15.7
CROSS-GRADIENT WELLS:												
5WI	(<50.0)	7.00 **	109	2.32	22.1 *	(35.7)	(37.2)	12.5	(<0.20)	(118)	(60.8)	(390)
5R	(<50.0)	3.32	51.4	3.48	13.2	(<10.0)	(60.0)	67.5 ***	(<0.20)	(<30.0)	(12.5)	(1170)
7WI	(<50.0)	(24.0)	(204)	(<5.00)	(111)	(70.9)	(153)	(70.1)	(<0.20)	(129)	(97.4)	(907)
8WI	(<50.0)	5.70 ***	124	2.18	20.1 **	(17.2)	(31.8)	11.2	(<0.20)	(50.7)	(31.8)	(334)

Notes:
*** -- Significantly higher than background at 1% level.
** -- Significantly higher than background at 5% level.
* -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
-- -- No samples taken
(...) -- Value based on one sample; significance level not evaluated.

TABLE 5-10

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN WATER TABLE ZONE

WELL OR GROUP OF WELLS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
CROSS-GRADIENT COMBINED:	<50.0	5.93 ***	98.4	2.55	21.5 ***	21.6 **	57.4 ***	22.3 **	<0.20	58.3 **	39.2 ***	509 *
PLUME WELLS:												
1WT	<50.0	<5.00	514 ***	3.54	<10.0	8.46	<10.0	3.34	0.19 *	17.5	9.71	10.4
3WT	31.2	3.77 *	13.1	3.32	17.1 *	11.6	11.2	4.14	0.17	21.5	10.9	50.6
4WT	<50.0	3.10	6.04	3.11	7.07	8.01	6.89	5.05	0.18	13.6	7.89	22.8
36A	<50.0	<5.00	<5.00	<5.00	<10.0	<10.0	<10.0	5.85	<0.20	<30.0	<10.0	11.4
39A	<50.0	<5.00	<5.00	<5.00	7.75	<10.0	<10.0	4.09	<0.20	<30.0	<10.0	30.3
PIEPER RD. RESIDENTIAL WELLS:												
Barlo	--	<5.00	<5.00	<5.00	4.69	--	--	4.22	--	--	--	--
Perry, C.	--	(2.90)	(95.0)	(3.00)	(6.00)	--	--	(<5.00)	--	--	--	--
Perry, R.	--	(<5.00)	(34.0)	(<5.00)	(3.00)	--	--	(<5.00)	--	--	--	--
Sawin	--	(<5.00)	(57.0)	(<5.00)	(<10.0)	--	--	(<5.00)	--	--	--	--
Shope	--	(4.60)	(87.0)	(1.00)	(6.00)	--	--	(33.0)	--	--	--	--
PIEPER RD. RESIDENTIAL COMBINED:	--	2.79	15.8	2.21	4.76	--	--	4.52	--	--	--	--
ROUTE 20 RESIDENTIAL WELLS:												
Carey	--	<5.00	160	2.57	6.80	--	--	21.2	--	--	--	--
Clark	--	2.56	36.3	1.84	4.75	--	--	4.44	--	--	--	--
Frey	--	2.50	84.3	2.66	6.36	--	--	9.58	--	--	--	--
Gilbert	--	<5.00	236	3.27	5.67	--	--	12.6	--	--	--	--

Notes:
*** -- Significantly higher than background at 1% level.
** -- Significantly higher than background at 5% level.
* -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
-- -- No samples taken.
(...) -- Value based on one sample; significance level not evaluated.

TABLE 5-10

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN WATER TABLE ZONE

WELL OR GROUP OF WELLS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
Kinnear	--	<5.00	54.8	2.71	7.47	--	--	24.0	--	--	--	--
Kramer	--	<5.00	39.5	1.58	5.06	--	--	5.00	--	--	--	--
Pustulak	--	<5.00	8.37	1.58	3.10	--	--	7.42	--	--	--	--
Stewart	--	<5.00	47.6	4.18	4.58	--	--	6.71	--	--	--	--
West Ridge	--	(<5.00)	(55.0)	(2.00)	(5.00)	--	--	(<5.00)	--	--	--	--
ROUTE 20 RESIDENTIAL COMBINED:	--	2.51	60.2	2.41	5.32	--	--	8.70	--	--	--	--

Notes:
*** -- Significantly higher than background at 1% level.
** -- Significantly higher than background at 5% level.
* -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
-- -- No samples taken
(...) -- Value based on one sample; significance level not evaluated.

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TABLE 5-11

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN INTERMEDIATE ZONE

WELL OR GROUP OF WELLS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
BACKGROUND WELLS:												
(26B-29-30-31)	28.8	2.45	93.9	2.33	8.89	6.39	16.5	11.6	<0.20	17.7	7.88	129
NW PERIMETER WELLS:												
21B	(<50.0)	3.34	213	2.62	10.3	(10.3)	(<10.0)	17.1	(<0.20)	(<30.0)	(18.4)	(82.4)
22B	(<50.0)	3.02	112	4.13 -	14.2	(14.5)	(10.7)	10.8	(<0.20)	(37.7)	(24.5)	(95.6)
23B	(<50.0)	3.81 --	281	2.30	9.05	(<10.0)	(<10.0)	25.3 -	(<0.20)	(<30.0)	(<10.0)	(20.3)
24B	(<50.0)	2.96	91.0	2.24	7.93	(<10.0)	(<10.0)	6.89	(2.00)	(<30.0)	(<10.0)	(20.6)
NW PERIMETER COMBINED:	<50.0	3.26 --	157	2.73	10.1	7.82	6.05	13.4	0.21	18.9	10.3	42.6
NE PERIMETER WELLS:												
27B	(<50.0)	4.95 -	220	2.27	7.62	(<10.0)	(<10.0)	16.0	(<0.20)	(<30.0)	(10.8	(48.5)
32B	(<50.0)	5.54 ---	134	2.80	8.78	(19.8)	(10.2)	30.2 --	(0.30)	(45.6)	(31.8	(127)
37B	<50.0	<5.00	360	<5.00	<10.0	<10.0	<10.0	<5.00	0.20	<30.0	<10.0	9.22
NE PERIMETER COMBINED:	<50.0	4.52 --	199 -	2.52	7.41	7.05	5.98	14.2	0.19 -	19.8	9.63	26.9
CROSS-GRADIENT WELLS:												
5	(<50.0)	3.32 -	31.4	1.84	15.4	(<10.0)	(38.7)	26.8	(<0.20)	(<30.0)	(<10.0)	(415)
5A	(<50.0)	6.46 ---	89.7	2.80	11.9	(<10.0)	(43.4)	64.7 ---	(<0.20)	(<30.0)	(<10.0)	(478)
7	(<50.0)	(<5.00)	(39.9)	(<5.00)	(<10.0)	(<10.0)	(16.3)	(5.00)	(<0.20)	(<30.0)	(<10.0)	(299)
8	(<50.0)	2.74	104	2.92	8.96	(<10.0)	(58.4)	23.2	(0.40)	(<30.0)	(10.7)	(1210)
8A	(<50.0)	7.70 ---	48.3	2.92	13.5	(<10.0)	(37.1)	26.5	(<0.20)	(38.1)	(<10.0)	(974)

Notes:
--- -- Significantly higher than background at 1% level.
-- -- Significantly higher than background at 5% level.
- -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
-- -- No samples taken
(...) -- Value based on one sample; significance level not evaluated.

TABLE 5-11

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN INTERMEDIATE ZONE

WELL OR GROUP OF WELLS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
CROSS-GRADIENT CONTINED:	<50.0	4.58 ***	56.7	2.54	11.6	<10.0	35.9	28.3 **	0.13	18.1	5.82	587
PLUME WELLS:												
1A	<50.0	10.2 **	1164 ***	4.47 **	19.4 *	22.4 **	115 *	21.8	0.26 **	36.8	33.1 *	4061 ***
3	31.9	<5.00	5817 ***	4.02 **	9.03	8.19	365 ***	7.76	0.12	<30.0	11.5	1519 **
4A	<50.0	<5.00	17.0	3.11	11.0	8.01	36.4	11.6	0.19	13.6	8.56	983 **
20B	<50.0	<5.00	4131 ***	5.53 ***	10.6	<10.0	<10.0	10.9	0.44 **	13.1	<10.0	12.0
28	--	3.50	97.3	2.47	11.0	--	--	12.2	--	--	--	--
33	--	2.61	613 ***	2.21	12.6	--	--	27.1 **	--	--	--	--
34	<50.0	<5.00	1328 ***	<5.00	10.3	<10.0	7.37	4.40	0.13	<30.0	<10.0	12.5
36B	<50.0	<5.00	22.4	<5.00	<10.0	7.07	<10.0	<5.00	0.20	<30.0	<10.0	9.75
39B	<50.0	<5.00	1474 ***	<5.00	63.6 ***	7.42	<10.0	25.4	<0.20	61.2 *	19.0	106

Notes:
*** -- Significantly higher than background at 1% level.
** -- Significantly higher than background at 5% level.
* -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
-- -- No samples taken
(...) -- Value based on one sample; significance level not evaluated.

If the page is filmed in this frame it is not as readable as desired. Letter is due to substandard color or condition of the original page.

TABLE 5-12

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN DEEP ZONE

WELL OR GROUP OF WELLS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
BACKGROUND WELLS: (7A-21C-22C-27C)	<50.0	2.82	175	3.87	10.3	6.24	11.0	9.95	<0.20	<30.0	10.1	40.0
PERIMETER WELLS: 68	<50.0	<5.00	318	<5.00	<10.0	<10.0	<10.0	<5.00	0.20	<30.0	<10.0	12.4
CROSS GRADIENT WELLS: 23C	(<50.0)	4.82 ***	773 **	2.55	10.8	(<10.0)	(<10.0)	6.22	(3.00)	(<30.0)	(<10.0)	(54.5)
24C	(<50.0)	3.68	190	2.24	10.5	(<10.0)	(32.9)	9.21	(4.00)	(70.4)	(18.9)	(148)
26C	(<50.0)	5.10 ***	184	2.01	6.52	(<10.0)	(<10.0)	18.7	(<0.20)	(<30.0)	(<10.0)	(41.6)
CROSS-GRADIENT COMBINED:	<50.0	4.68 ***	255	2.17	8.10	<10.0	9.37	12.5	1.06 *	25.1	7.79	69.5

Notes:
*** -- Significantly higher than background at 1% level.
** -- Significantly higher than background at 5% level.
* -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
-- -- No samples taken
(...) -- Value based on one sample: significance level not evaluated.

Section 6

6.0 SURFACE WATER QUALITY

Samples have been collected from the two small streams located somewhat more distant from the site (Figure 3-4). Other miscellaneous samples have been collected from the surface "seeps" and the various drainage swales and springs, as indicated on Sheet 1 of 21.

Multiple water and bottom sediment samples have been collected from the two small streams at the six stations designated SW-1 through SW-6. In addition, a seventh station, SW-7, was also sampled less frequently. The pre-1988 surface water samples collected were analyzed for all of the Category A, B, C, D parameters (Table 3-1). The sediment samples were analyzed only for TVO, THVO and metals (Table 3-1). More recently, samples collected from these locations have been subjected to analysis for the TCL parameters, as presented on Tables 6-1 through 6-7.

The surface "seeps" have been sampled periodically from 1983 to 1986 at times when sufficient water has been available to be collected. These samples have been analyzed only for pH, Specific Conductivity and TVO. These data are presented on Table 6-8. In addition, a limited number of recently collected seep samples have been analyzed for the TCL parameters, as presented on Tables 6-9 and 6-10.

6.1 STREAM DATA

Stream samples have been collected from seven stations as previously described. Two of these stations, SW-1 and SW-2, represent background locations with respect to the site. Three sample stations SW-5, SW-6, and SW-7 are located in the small stream located closest to the site and are the most likely of any to be affected by the site.

6.1.1 Volatile Organic Compounds

None of the surface water samples indicated the presence of any volatile organic compounds except for one sample collected from background station SW-1 located at the Lexington Road culvert. This sample contained low levels of tetrachloroethane, benzene, and 1,1-dichloroethene (Table 6-1).

Volatile organic compounds were slightly more prevalent in the sediment samples. The background station, SW-1, indicated benzene, toluene, and 2-butanol at concentrations of 20, 16, and 170 ppb, respectively. These compounds are indicative of the presence of petroleum compounds, as noted below. Non-recurrent levels of volatile organics were detected in several of the small stream samples. 2-butanol was detected once at SW-5 at 45.6 ppb and carbon disulfide was observed in SW-7 at 18 ppb.

The presence of methylene chloride, trichlorofluoromethane, and acetone are believed to represent inadvertent laboratory contamination.

6.1.2 Semivolatile Organic Compounds

Semivolatile organic compounds are more widespread in the surface water samples than are the volatiles. A number of polynuclear aromatics (PNAs) were detected at levels too low to quantify in the background station SW-1. All other surface water samples were free of semivolatiles with the exception of one collected from SW-6 on December 2, 1988. This sample contained a number of semivolatiles at concentrations ranging up to 270 ppb. All other water samples collected from SW-6 were free of semivolatile constituents (Table 6-2).

None of the sediment samples contained semivolatile compounds above the detection limit except for three samples collected from background station SW-1. Samples from this station contained significant levels of a number of PNA compounds. The presence of the PNAs, the volatile organics, and the proximity of this station, SW-1, to the road would suggest that this station has been contaminated by petroleum products from the road.

6.1.3 Metals

Metals data for water and sediment samples collected from the seven stream stations are presented on Table 6-3. Statistical analyses have been performed on these samples as per the methodology described previously.

The surface water metals data are characterized by a high percentage of data recorded as non-detectable (ND). Table 6-4 gives, for each metal, the number of samples above the detection limit and the total number of samples for each station. Six metals, antimony, cadmium, cobalt, mercury, nickel, and vanadium, have no measurements above the detection limit and can be eliminated from further consideration. Two other metals, arsenic and copper, show only a single detection of 13.7 ppb and 12.5 ppb, respectively, each of which were at station SW-6. There is not sufficient data to generate any statistical inferences, but the fact that station SW-6 is very close to the downgradient end of the landfill, is suggestive of site-derived influence.

The remaining four metals, barium, chromium, lead, and zinc, have between 16 percent and 44 percent of total samples (5 to 14 measurements) above the detection limit. This is too low a detection rate for parametric tests, but is enough for non-parametric tests, including the Mann-Whitney and the test of proportions. The latter test is more reliable, but requires that the data be combined into two sets: background data (SW-1 and SW-2) and test data (stations SW-3 through SW-7). The results of the test of proportions are given in Table 6-5; only zinc has a significantly higher proportion of detects in the test data at the 5 percent level. The results of applying all tests to the surface water data are given in Appendix G.

Table 6-6 gives estimated geometric mean concentrations for each metal at the background stations (SW-1 and SW-2 combined), at each downstream station, for SW-7 combined (SW-7 is combined with SW-6), and for all downstream stations (SW-3 through SW-7) combined. The measurements below the detection limit have been set to one-half the detection limit when calculating the mean values. The table also shows the locations where the downstream concentrations were significantly higher then background: zinc at stations SW-6 and SW-7 combined, and at SW-3.

The geometric mean concentrations for metals in stream sediments are given in Table 6-7 at the various stations. Data from stations SW-1 and SW-2 have been combined to give one background set and data from stations SW-6 and SW-7 have also been combined. The data were log-transformed before analysis and non-detects were set to one-half the detection limit. The table also

indicates that barium and arsenic are present at several locations at significantly higher concentrations than background samples. Barium is significant at stations SW-3, and SW-6 with geometric means of 61,100 ppb and 76,900 ppb, respectively, compared to a background mean of 39,100 ppb. Arsenic at location SW-3 and SW-5 had geometric means of 9220 ppb and 12,400 ppb, respectively, compared to a background mean of 4700 ppb. The basis for these conclusions is discussed below.

Of the twelve metals, two can be eliminated from statistical consideration immediately: antimony which has no measurements above the detection limit, and mercury which has data from only two downstream samples. In order to investigate the differences in concentrations of the remaining ten metals at the various locations, the data from each downstream test station (SW-3, SW-4, SW-5, SW-6, and SW-7) were individually compared to data from the combined background stations (SW-1 and SW-2). Both parametric (Student's t) and non-parametric (Mann-Whitney) tests were used. The tests are one-sided since we are interested in cases where the downstream locations have higher concentrations. For all three metals there was reasonable agreement between the non-parametric Mann-Whitney and the Student's t with a log-normal distribution. The results of these tests are given in Appendix G.

Barium shows elevated concentrations at stations SW-3, SW-6, and SW-7, which are significant at the one percent level. Concentrations at locations 4 and 5, are not significantly elevated, even at the five percent level.

Arsenic also has higher concentrations at station SW-3, but not at station SW-4, which is further downstream. The situation for stations SW-5 through SW-7 on the smaller stream, is less clear. There is evidence of significantly higher concentrations at about the one percent level at station SW-5, but no such evidence at stations SW-6 and SW-7, which are upstream and closer to the landfill than station SW-5.

In summary, most of the metals data for the stream water samples indicated no detection of most metals, with the exception of barium, chromium, lead, and zinc. Only zinc showed any significant differences in downstream samples, with a geometric mean value of 9.4 ppb for the combined group of samples.

More data are available for the sediment samples. Two metals are significantly above background in the sediments. Barium is significant at SW-3, SW-6, and SW-7, with geometric mean concentrations ranging to 76,900 ppb. Arsenic may be elevated at stations SW-3, SW-5, SW-6, and SW-7 with geometric means ranging to 12,400 ppb. These data can be qualitatively compared to naturally-occurring levels of metals in the soils. Five soil samples collected at various depths from two soil borings, at background locations represented by W-37 and PZ-38, were analyzed for metals (Table 6-11). Barium and arsenic levels were observed in a sample from W-37 at 85,800 ppb and 12,200 ppb, respectively, which is not dissimilar to the maximum means as observed in the stream sediments.

6.2 MISCELLANEOUS DATA

6.2.1 Seep Samples

Water quality samples have been collected from five "seep" areas including a former excavation termed the "New Pond". All available data from these samples indicates the presence of volatile organic compounds, based principally upon the TVO analysis. The presence of volatile organics is consistent with the observed water quality data in the water table wells located at the landfill perimeter. This is not surprising as the water collected from the "seeps" originates from the shallow water table.

Most of the "seeps" contain water only during the wet periods of the year. An exception is the "NE Seep" which contains sufficient water for sampling during most months of the year. The data for the "NE Seep" indicates apparent seasonal variation in the TVO concentration with the highest levels occurring in the wetter periods of the spring. These higher levels probably correspond to periods when greater volumes of water are exposed at the surface and at a time when temperatures are relatively low thus allowing less volatilization of the contaminants. Similar but less marked trends are noted for data from the other "seeps".

The compound specific analysis of a water and sediment sample collected from the "NE Seep" on July 29, 1988 resulted in no positive identification of

specific compounds except for several that were found in the blank or were tentatively identified. TCL volatiles and metals were run on a subsequent water sample collected on May 9, 1989. The results are variable, but indicate levels of trans-1,2-dichloroethene and vinyl chloride on the May 1989 sample at 120 and 56 ppb, respectively. A sample collected from the SE Seep on the same date contained trans-1,2-dichloroethene and trichloroethene at 130 and 33 ppb, respectively.

In the analysis for metals, arsenic, barium, and zinc were detected in most or all of the samples from the "seeps" with concentrations ranging as high as 30 ppb, 329 ppb, and 250 ppb, respectively. Lead and mercury were detected in two of the four samples, with maximum concentrations of 50 ppb and 23 ppb, respectively. Copper and vanadium were detected only in the July 26, 1988 sample from the "NE Seep", with concentrations of 32 ppb and 22 ppb, respectively. In comparison with the range of concentrations seen in background wells in the shallow water table, arsenic, mercury, and perhaps zinc concentrations appear somewhat elevated, but barium concentrations are within the expected range.

6.2.2 Other Samples

A number of miscellaneous surface water samples have been collected in the vicinity of the site. These include stormwater runoff samples from two landfill cap swales, a wet "spring" area north of the landfill near well W-39, discharges from a tile system draining the field north of the site, and the swale running parallel to the northern property line.

The "Spring" located north of the landfill has been observed to contain only a BMDL level of vinyl chloride. Water from this spring represents the discharge of the low level groundwater plume from the Water Table Zone. Barium was detected in the spring water at a concentration of 76 ppb, well within the background range for the shallow water table.

Stormwater flowing off of the landfill has been sampled. These samples have been collected from the swales on the north and west sides of the landfill. These swales drain to the northwest from which a sample was collected nearby

well W-11. Very low levels of volatile organics were observed from the samples collected from the landfill swales in May 1989. This is represented by the north swale which contained trans-1,2-dichloroethene and trichloroethene at 19 and 8 ppb, respectively. Samples collected from these swales in 1986 were not found to contain volatiles. The downstream swale near well W-11 was free of volatiles on May 9, 1989. The highest metals concentrations on May 9, 1989 were found in the north swale where barium, lead, and zinc were detected at 202 ppb, 15 ppb, and 141 ppb, respectively. These concentrations are within the normal range of background concentrations in the shallow water table.

Standing water is often observed in the woods located west of the site during the wet periods of the year. This likely represents the presence of the water table surface at the immediate ground surface. A sample was collected from this "Wet Woods" the results of which were free of volatile organics and showed only background levels of metals.

TABLE 6-1
STREAM WATER and SEDIMENT DATA
VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Ford/Shaw Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon tetra-chloride	Chloro-benzene	Chloro-dibromo-methane	Chloro ethane	2-chloro-ethyl vinyl ether	Chloroform	Dichloro bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl benzene
1	SW-Water	09/12/86	Lord	ND			ND					ND			ND		ND			
1	SW-Water	11/23/88	Free-Col	ND		ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
1	SW-Water	12/02/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Water	12/07/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Water	01/25/89	Lord	6	ND	ND	ND	ND		ND	ND	ND			ND	ND	10	ND	ND	ND
2	SW-Water	09/12/86	Lord	ND			ND					ND			ND		ND			
2	SW-Water	11/23/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Water	12/02/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Water	12/07/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
3	SW-Water	09/12/86	Lord	ND			ND					ND			ND		ND			
3	SW-Water	11/23/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	12/02/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	12/07/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
4	SW-Water	09/12/86	Lord	ND			ND					ND			ND		ND			
4	SW-Water	11/23/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	12/02/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	12/07/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
5	SW-Water	09/12/86	Lord	ND			ND					ND			ND		ND			
5	SW-Water	11/23/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	12/02/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	12/07/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
6	SW-Water	09/12/86	Lord	ND			ND					ND			ND		ND			
6	SW-Water	11/23/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	12/02/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	12/07/88	Free-Col	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
7	SW-Water	12/02/86	Lord	ND			ND					ND			ND		ND			
7	SW-Water	10/29/88	11	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
1	SW-Sed	10/30/86	Lord	ND			ND					ND			ND		ND			
1	SW-Sed	11/23/88	Microbac	20	ND	ND	ND	ND	ND	ND		ND			ND	ND	ND	ND	ND	ND
1	SW-Sed	12/02/88	Microbac	ND		ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
1	SW-Sed	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Sed	10/30/86	Lord	ND			ND					ND			ND		ND			
2	SW-Sed	11/23/88	Microbac	ND	ND	ND	ND	ND	ND	ND		ND			ND	ND	ND	ND	ND	ND
2	SW-Sed	12/02/88	Microbac		ND															
2	SW-Sed	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Sed	10/30/86	Lord	ND			ND					ND			ND		ND			
3	SW-Sed	10/29/88	11	ND	ND	ND	ND	ND			ND	ND			ND	ND	ND	ND	ND	ND
3	SW-Sed	11/23/88	Microbac	ND	ND	ND	ND	ND	ND	ND		ND			ND	ND	ND	ND	ND	ND
3	SW-Sed	12/02/88	Microbac	ND		ND	ND		ND	ND	ND	ND			ND	ND	ND	ND	ND	ND
3	SW-Sed	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Sed	10/30/86	Lord	ND			ND					ND			ND		ND			

TABLE 6-1
STREAM WATER and SEDIMENT DATA

VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Ford/Shipe Site
Girard Twp., Pennsylvania

Sample Number	Sample Duration	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon Tetrachloride	Chloro benzene	Chloro dibromo-methane	Chloro-ethane	2-chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl benzene
4	SB Snd	11/23/88	Microbac	ND	ND	ND	ND	ND	ND	ND		ND			ND	ND	ND	ND	ND	ND
4	SB Snd	12/02/88	Microbac	ND		ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
4	SB Snd	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SB Snd	10/10/89	Ford	ND			ND					ND			ND		ND			
5	SB Snd	11/23/88	Microbac	ND	ND	ND	ND	ND	ND	ND		ND			ND	ND	ND	ND	ND	ND
5	SB Snd	12/02/88	Microbac	ND		ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
5	SB Snd	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SB Snd	10/10/89	Ford	ND			ND					ND			ND		ND			
6	SB Snd	11/23/88	Microbac	ND	ND	ND	ND	ND	ND	ND		ND			ND	ND	ND	ND	ND	ND
6	SB Snd	12/02/88	Microbac	ND		ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
6	SB Snd	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	SB Snd	10/29/88	IT	ND	1B	ND	ND	1B			ND	ND			ND	ND	ND	ND	ND	ND

Notes 1 ND indicates compound not detected at or above the detection limit.
2 (###) indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3 B indicates that compound was found in a blank.

07/07/89

TABLE 6-1
STREAM WATER and SEDIMENT DATA
VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Lord/Stone Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene Chloride	1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	Methyl Ethyl Xylene	Methyl Iso-butyl Xylene
1	SW Water	09/12/84	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
1	SW Water	11/23/88	Free-Col			55	ND		ND		ND	ND	ND	ND	ND	ND	ND	ND		
1	SW Water	12/02/88	Free-Col	ND	ND	81	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
1	SW Water	12/07/88	Free-Col	ND	ND	80	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
1	SW-Water	01/25/89	Lord			52 B	ND	ND	5	ND	ND	ND	ND	BMDL	ND				ND	ND
2	SW Water	09/12/84	Lord		ND	ND		ND	ND	ND	ND		ND		ND				ND	ND
2	SW Water	11/23/88	Free-Col	ND	ND	49		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
2	SW Water	12/02/88	Free-Col	ND	ND	91		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
2	SW-Water	12/07/88	Free-Col	ND	ND	25		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
2	SW-Water	01/25/89	Lord			57 B		ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
3	SW Water	09/12/84	Lord		ND	ND			ND	ND	ND		ND		ND				ND	ND
3	SW Water	11/23/88	Free-Col	ND	ND	35		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
3	SW Water	12/02/88	Free-Col	ND	ND	70		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
3	SW-Water	12/07/88	Free-Col	ND	ND	89		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
3	SW-Water	01/25/89	Lord			55 B		ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
4	SW Water	09/12/84	Lord		ND	ND			ND	ND	ND		ND		ND				ND	ND
4	SW Water	11/23/88	Free-Col	ND	ND	58		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
4	SW Water	12/02/88	Free-Col	ND	ND	87		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
4	SW Water	12/07/88	Free-Col	ND	ND	63		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
4	SW-Water	01/25/89	Lord			45 B		ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
5	SW Water	09/12/84	Lord		ND	ND			ND	ND	ND		ND		ND				ND	ND
5	SW Water	11/23/88	Free-Col	ND	ND	150		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
5	SW Water	12/02/88	Free-Col	ND	ND	81		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
5	SW Water	12/07/88	Free-Col	ND	ND	45		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
5	SW-Water	01/25/89	Lord			47 B		ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
6	SW Water	09/12/84	Lord		ND	ND			ND	ND	ND		ND		ND				ND	ND
6	SW Water	11/23/88	Free-Col	ND	ND	97		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
6	SW Water	12/02/88	Free-Col	ND	ND	130		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
6	SW-Water	12/07/88	Free-Col	ND	ND	100		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND		
6	SW-Water	01/25/89	Lord			46 B		ND	ND	ND	ND	ND	ND	BMDL	ND				ND	ND
7	SW Water	12/02/88	Lord		ND	ND			ND	ND	14.5		ND		ND				ND	ND
7	SW-Water	10/29/88	TT			5 B		ND	ND	ND		ND	ND		ND				ND	ND
1	SW Sed	10/30/84	Lord		ND	ND			ND	ND	ND		ND		ND					
1	SW Sed	11/23/88	Microbac				ND		ND	34		ND	ND		ND	ND	ND	ND		
1	SW Sed	12/02/88	Microbac			ND	ND			ND		ND	ND		ND	ND	ND	ND		
1	SW-Sed	12/07/88	Microbac	ND		ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW Sed	10/30/84	Lord		ND	ND			ND	ND	ND		ND		ND					
2	SW Sed	11/23/88	Microbac			ND	ND		ND	ND		ND	ND		ND	ND	ND	ND		
2	SW Sed	12/02/88	Microbac																	
2	SW Sed	12/07/88	Microbac	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW Sed	10/30/84	Lord		ND	ND			ND	ND	ND		ND		ND					
3	SW Sed	10/29/88	TT			BMDL	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND
3	SW-Sed	11/23/88	Microbac			ND	ND	ND	ND		ND	ND	ND		ND	ND	ND	ND		
3	SW-Sed	12/02/88	Microbac			ND	ND		ND		ND	ND	ND	ND	ND	ND	ND	ND		
3	SW Sed	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW Sed	10/30/84	Lord		ND	ND			ND	ND	ND		ND		ND					

TABLE 6-1
STREAM WATER and SEDIMENT DATA
VOLATILE ORGANIC COMPOUNDS (GROUP 2 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Methyl-bromide	Methyl-chloride	Methylene Chloride	1,1,2,2-Tetra-chloro-ethane	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro-ethene	1,1,1-Trichloro-ethane	1,1,2-Trichloro-ethane	Trichloro-ethene	Trichloro-fluoro-methane	Vinyl Chloride	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	Methyl Ethyl Ketone	Methyl Iso-butyl Ketone
4	SW-Snd	11/23/88	Microbac			ND	ND	ND	ND		ND	ND	ND		ND	ND	ND	ND		
4	SW-Snd	12/02/88	Microbac			ND	ND		ND		ND	ND	ND	ND	ND	ND	ND	ND		
4	SW-Snd	12/07/88	Microbac	ND	ND	53 -	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Snd	10/10/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND					
5	SW-Snd	11/23/88	Microbac			ND	ND	ND	ND		ND	ND	ND		ND	ND	ND	ND		
5	SW-Snd	12/02/88	Microbac			ND	ND		ND		ND	ND	ND	ND	ND	ND	ND	ND		
5	SW-Snd	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Snd	10/10/86	Lord		ND	ND		ND	ND	ND	ND		ND		ND					
6	SW-Snd	11/23/88	Microbac			ND	ND	ND	ND		ND	ND	ND		ND	ND	ND	ND		
6	SW-Snd	12/02/88	Microbac			ND	ND		ND		ND	ND	ND	ND	ND	ND	ND	ND		
6	SW-Snd	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	SW-Snd	10/29/88	IT			15 B	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND

Notes: 1. ND indicates compound not detected at or above the detection limit. 07/07/89
2 Bold indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3 B indicates that compound was found in a blank.

TABLE 6-1
STREAM WATER and SEDIMENT DATA
VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ug/L)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro-1,2-trifluoro-ethane	4-Methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1-Dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	ISO propanol	Total of UNKNOWN Compounds
1	SW-Water	09/12/86	Lord	ND	ND		ND				ND	ND	ND	ND	
1	SW-Water	11/23/88	Free-Col						ND						
1	SW-Water	12/02/88	Free-Col						ND						
1	SW-Water	12/07/88	Free-Col						ND						
1	SW-Water	01/25/89	Lord	ND	BWX		ND								
2	SW-Water	09/12/86	Lord	ND	ND		ND				ND	ND	ND	ND	
2	SW-Water	11/23/88	Free-Col						ND						
2	SW-Water	12/02/88	Free-Col						ND						
2	SW-Water	12/07/88	Free-Col						ND						
2	SW-Water	01/25/89	Lord	ND	BWX		ND								
3	SW-Water	09/12/86	Lord	ND	ND		ND				ND	ND	ND	ND	
3	SW-Water	11/23/88	Free-Col						ND						
3	SW-Water	12/02/88	Free-Col						ND						
3	SW-Water	12/07/88	Free-Col						ND						
3	SW-Water	01/25/89	Lord	11 B	BWX		ND								
4	SW-Water	09/12/86	Lord	ND	ND		ND				ND	ND	ND	ND	
4	SW-Water	11/23/88	Free-Col						ND						
4	SW-Water	12/02/88	Free-Col						ND						
4	SW-Water	12/07/88	Free-Col						ND						
4	SW-Water	01/25/89	Lord	11 B	ND		ND								
5	SW-Water	09/12/86	Lord	ND	ND		ND				ND	ND	ND	ND	
5	SW-Water	11/23/88	Free-Col						ND						
5	SW-Water	12/02/88	Free-Col						ND						
5	SW-Water	12/07/88	Free-Col						ND						
5	SW-Water	01/25/89	Lord	ND	ND		ND								
6	SW-Water	09/12/86	Lord	ND	ND		ND				ND	ND	ND	ND	
6	SW-Water	11/23/88	Free-Col						ND						
6	SW-Water	12/02/88	Free-Col						ND						
6	SW-Water	12/07/88	Free-Col						ND						
6	SW-Water	01/25/89	Lord	ND	ND		ND								
7	SW-Water	12/02/88	Lord	ND	ND		ND				ND	ND	ND	ND	
7	SW-Water	10/29/86	IT	19 B											
1	SW-Sed	10/10/86	Lord	190			ND					ND	150		
1	SW-Sed	11/23/88	Microbac	200			ND					ND	170		
1	SW-Sed	12/02/88	Microbac	64											
1	SW-Sed	12/07/88	Microbac	ND	ND										
2	SW-Sed	10/10/86	Lord	310			ND					ND	ND		
2	SW-Sed	11/23/88	Microbac	ND			ND					ND	ND		
2	SW-Sed	12/02/88	Microbac	15			ND						ND		
2	SW-Sed	12/07/88	Microbac	ND	ND										
-	SW-Sed	10/10/86	Lord	290			ND					ND	ND		
3	SW-Sed	10/29/86	IT	25 B		25	81								
3	SW-Sed	11/23/88	Microbac	ND			ND					ND	ND		
3	SW-Sed	12/02/88	Microbac	12											
3	SW-Sed	12/07/88	Microbac	ND	ND										
4	SW-Sed	10/10/86	Lord	290			ND					ND	ND		

TABLE 6-1
STREAM WATER and SEDIMENT DATA

VOLATILE ORGANIC COMPOUNDS (GROUP 3 OF 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro-1,2-trifluoro ethane	4 methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1 Dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	150 propanol	Total of UNKNOWN compounds
4	Sb-Sed	11/23/88	Microbac	ND			ND					ND	ND		
4	Sb-Sed	12/02/88	Microbac	27											
4	Sb-Sed	12/07/88	Microbac	ND	ND										
5	Sb-Sed	10/10/86	Lord	170			ND					ND	ND		
5	Sb-Sed	11/23/88	Microbac	ND			ND					ND	ND		
5	Sb-Sed	12/02/88	Microbac	90									45 A		
5	Sb-Sed	12/07/88	Microbac	ND	ND										
6	Sb-Sed	10/10/86	Lord	ND			ND					ND	ND		
6	Sb-Sed	11/23/88	Microbac	ND			ND					ND	ND		
6	Sb-Sed	12/02/88	Microbac	35											
6	Sb-Sed	12/07/88	Microbac	ND	ND										
7	Sb-Sed	10/29/88	IT	BMDL		27	BT								

Notes: 1. ND indicates compound not detected at or above the detection limit.
2. BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3. B indicates that compound was found in a blank.

07/07/89

TABLE 6-2
STREAM WATER and SEDIMENT DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Di-n-Butyl-Phthalate	Di-n-Octyl-Phthalate	bis-(2 Ethyl-hexyl) Phthalate	Diethyl-Phthalate	Butyl Benzyl Phthalate	1,3-Dichloro-Benzene	1,4-Dichloro Benzene	Benzoic Acid	Phenol	N-Nitroso Di-n-Propyl-amine	1,2,4-Trichloro Benzene	4-Chloro-3-Methyl phenol	Acenaph-thene	N-Nitroso-diphenyl-amine	4-Nitro phenol
1	SW-Water	11/23/88	Lord	18 B	ND	BMDL	ND		ND	ND	ND		ND	ND	ND	ND	ND	ND
1	SW-Water	12/02/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Water	12/07/88	Lord	37	40	ND	ND	43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Water	11/23/88	Lord	28 B	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW Water	12/02/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	11/23/88	II	BMDL	ND	21 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND
3	SW-Water	12/02/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW Water	12/16/88	Lord	BMDL	ND	BMDL	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW Water	11/23/88	Lord	22 B	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	12/02/88	Lord	37	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW Water	12/16/88	Lord	ND	ND	BMDL	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW Water	01/25/89	Lord	ND	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	12/02/88	Lord	28	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	12/16/88	Lord	87 B	BMDL	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	12/02/88	Lord	130	ND	BMDL	ND	ND	110	110	ND	29	57	130	85	ND	ND	ND
6	SW Water	12/16/88	Lord	69 B	BMDL	BMDL	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW Water	01/25/89	Lord	ND	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	SW Water	10/29/88	II	ND	ND	11 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NI Seep	SW Water	07/26/88	II	ND	ND	12 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND
1	SW Sed	11/23/88	Microbac			ND	ND	ND			ND	ND			ND	ND		
1	SW-Sed	12/02/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND
1	SW-Sed	12/07/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND
1	SW-Sed	01/25/89	Lord	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	ND
2	SW-Sed	11/23/88	Microbac			ND	ND	ND			ND	ND			ND	ND		
2	SW-Sed	12/02/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND
2	SW Sed	12/07/88	Microbac	ND	ND	930	ND		ND	ND			ND	ND	ND	ND	ND	ND
2	SW Sed	01/25/89	Lord	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW Sed	10/29/88	II	BMDL	ND	530 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW Sed	11/23/88	Microbac			ND	ND	ND			ND	ND			ND	ND		
3	SW Sed	12/02/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND
3	SW Sed	12/07/88	Microbac	ND	ND	480	ND		ND	ND			ND	ND	ND	ND	ND	ND
3	SW Sed	01/25/89	Lord	BMDL	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW Sed	11/23/88	Microbac			ND	ND	ND			ND	ND			ND	ND		
4	SW Sed	12/02/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND
4	SW Sed	12/07/88	Microbac	ND	ND	420	ND		ND	ND			ND	ND	ND	ND	ND	ND
4	SW-Sed	01/25/89	Lord	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW Sed	11/23/88	Microbac			ND	ND	ND			ND	ND			ND	ND		
5	SW Sed	12/02/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND

TABLE 6-2
STREAM WATER and SEDIMENT DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Di-n-Butyl-Phthalate	Di-n-Octyl-Phthalate	bis-(2-Ethylhexyl)-Phthalate	Diethyl-Phthalate	Butyl Benzyl Phthalate	1,3-Dichloro-Benzene	1,4-Dichloro-Benzene	Benzoic Acid	Phenol	N-Nitroso-Di-n-Propyl-amine	1,2,4-Trichloro Benzene	4-Chloro-3-Methyl phenol	Acenaph-thene	n-Nitroso-diphenyl-amine	4-Nitro phenol
5	Sw-Sed	12/07/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND
5	Sw-Sed	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	Sw-Sed	11/23/88	Microbac			ND	ND	ND			ND	ND			ND	ND		
6	Sw-Sed	12/02/88	Microbac	ND	ND	ND	ND		ND	ND			ND	ND	ND	ND	ND	ND
6	Sw-Sed	12/07/88	Microbac	ND	ND	380	ND		ND	ND			ND	ND	ND	ND	ND	ND
6	Sw-Sed	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	Sw-Sed	10/29/88	IT	BMDL	ND	670 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6(Sed)	Sw-Sed	07/26/88	IT	ND	ND	BMDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

NOTES
1. ND indicates compound not detected at or above the detection limit
2. BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3. B indicates that compound was found in a blank.

07/07/89

TABLE 6-2
STREAM WATER and SEDIMENT DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Lord/Stope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	2,4-Dinitro-toluene	Penta-chloro-phenol	Pyrene	2,6-Dinitro-toluene	2-Methyl Naph-thalene	Benzo (a) Anthra-cene	Chrysene	Benzo (b) Fluor-anthene	Anthra-cene	Benzo (a) Pyrene	Benzo (k) Fluor-anthene	Benzo (ghi) Perylene	Fluor-anthene	Indeno-(1,2,3-cd) Pyrene	Phen-anthrene
1	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	BMDL	BMDL	BMDL	ND	ND	ND	ND	ND	ND	ND
1	SW-Water	12/02/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Water	12/07/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Water	12/02/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	11/23/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	12/02/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	12/16/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	12/02/88	Lord	ND	ND	ND	ND	ND	BMDL	BMDL	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	12/16/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	12/02/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	12/16/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	11/23/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	12/02/88	Lord	120	90	270	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	12/16/88	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Water	01/25/89	Lord	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	SW-Water	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W SWD	SW-Water	07/26/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Sed	11/23/88	microbac		ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1	SW-Sed	12/02/88	microbac	ND	ND	3200	ND		1800	1900	1500	390	1700	1740	1000	2800	1100	2400
1	SW-Sed	12/07/88	microbac	ND	ND	5800	ND		3100	3000	5000	750	3100	5000	3500	3400	3500	3900
1	SW-Sed	01/25/89	Lord	ND	ND	BMDL	ND		BMDL	BMDL	BMDL	ND	ND	ND	ND	ND	ND	ND
2	SW-Sed	11/23/88	microbac		ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Sed	12/02/88	microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Sed	12/07/88	microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	SW-Sed	01/25/89	Lord	ND	ND	ND	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Sed	10/29/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Sed	11/23/88	microbac		ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Sed	12/02/88	microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Sed	12/07/88	microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	SW-Sed	01/25/89	Lord	ND	ND	BMDL	ND		BMDL	BMDL	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Sed	11/23/88	microbac		ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Sed	12/02/88	microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Sed	12/07/88	microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	SW-Sed	01/25/89	Lord	ND	ND	ND	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Sed	11/23/88	microbac		ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Sed	12/02/88	microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 6-2
STREAM WATER and SEDIMENT DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 2 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	2,4-Dinitro-toluene	Penta-chloro-phenol	Pyrene	2,6-Dinitro-toluene	2-methyl Naph-thalene	Benzo (a) Anthra-cene	Chrysene	Benzo (b) Fluor-anthene	Anthra-cene	Benzo (k) Benzo (a) Pyrene	Fluor-anthene	Benzo (ghi) Perylene	Fluor-anthene	Ideno-(1,2,3-cd) Pyrene	Phen-anthrene
5	SW-Sed	12/07/88	Microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	SW-Sed	01/25/89	Lord	ND	ND	ND	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Sed	11/23/88	Microbac		ND			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Sed	12/02/88	Microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Sed	12/07/88	Microbac	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	SW-Sed	01/25/89	Lord	ND	ND	ND	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND
7	SW-Sed	10/29/88	?3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HE SWD	SW-Sed	07/26/88	IT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
1. ND indicates compound not detected at or above the detection limit.
2. BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3. B indicates that compound was found in a blank.

07/07/89

TABLE 6-2
STREAM WATER and SEDIMENT DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	1,2-Benzenedicarboxylic acid	Hexanoic Acid	2,3-Dimethyl Heptane	Tentatively Identified: Conc. of Unknown Compounds	Tentatively Identified: Number of Unknown Compounds	Tentatively Identified: Conc. of Unknown Compounds	Tentatively Identified: Number of Unknown Compounds
1	SW-Water	11/23/88	Lord						244	T 6
1	SW-Water	12/02/88	Lord						213	T 4
1	SW-Water	12/07/88	Lord						160.7	4
1	SW-Water	01/25/89	Lord						139	2
2	SW-Water	11/23/88	Lord				9.5	T 1	261	T 8
2	SW-Water	12/02/88	Lord						211	T 4
2	SW-Water	01/25/89	Lord						100.33	3
3	SW-Water	11/23/88	Lord						284	T 4
3	SW-Water	11/23/88	IT				1448	T 8		
3	SW-Water	12/02/88	Lord				18	T1	131	T 2
3	SW-Water	12/16/88	Lord						246	T 4
3	SW-Water	01/25/89	Lord						100	1
4	SW-Water	11/23/88	Lord						319	T 5
4	SW-Water	12/02/88	Lord							
4	SW-Water	12/16/88	Lord						93	T 2
4	SW-Water	01/25/89	Lord						197	2
5	SW-Water	11/23/88	Lord				9	1	348	7
5	SW-Water	12/02/88	Lord						136	2
5	SW-Water	12/16/88	Lord						17	T 1
5	SW-Water	01/25/89	Lord						100	1
6	SW-Water	11/23/88	Lord				100	1	72	2
6	SW-Water	12/02/88	Lord							
6	SW-Water	12/16/88	Lord							
6	SW-Water	01/25/89	Lord						100	1
7	SW-Water	10/29/88	IT				152	6		
RE Seep	SW-Water	07/26/88	IT	ND					91	T2
1	SW-Sed	11/23/88	Microbac							
1	SW-Sed	12/02/88	Microbac							
1	SW-Sed	12/07/88	Microbac							
1	SW-Sed	01/25/89	Lord						104.4	2
2	SW-Sed	11/23/88	Microbac							
2	SW-Sed	12/02/88	Microbac							
2	SW-Sed	12/07/88	Microbac							
2	SW-Sed	01/25/89	Lord							
3	SW-Sed	10/29/88	IT				124390	4	1930	T2
3	SW-Sed	11/23/88	Microbac							
3	SW-Sed	12/02/88	Microbac							
3	SW-Sed	12/07/88	Microbac							
3	SW-Sed	01/25/89	Lord						100.25	2
4	SW-Sed	11/23/88	Microbac							
4	SW-Sed	12/02/88	Microbac							
4	SW-Sed	12/07/88	Microbac							
4	SW-Sed	01/25/89	Lord						100	1
5	SW-Sed	11/23/88	Microbac							
5	SW-Sed	12/02/88	Microbac							

TABLE 6-2
STREAM WATER and SEDIMENT DATA
SEMI-VOLATILE ORGANIC COMPOUNDS (Group 3 of 3)
(ppb)

Ford/Shoop Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	1,2-Benzenedicarboxylic Acid	Hexanoic Acid	2,3-Dianthylnaphthalene	---------TENTATIVELY IDENTIFIED--------- Conc. of Unknown Compounds	Number of Unknown Compounds	Conc. of Unknown Compounds	Number of Unknown Components
5	SW-Sed	12/07/88	Microchem							
5	SW-Sed	01/25/89	Lord						300	1
6	SW-Sed	11/21/88	Microchem							
6	SW-Sed	12/02/88	Microchem							
6	SW-Sed	12/07/88	Microchem							
6	SW-Sed	01/25/89	Lord						109	3
7	SW-Sed	10/29/88	IT				2500	2	124440	5
NE Swmp	SW-Sed	07/26/88	IT	ND		3700	1			

Notes: 1 ND indicates compound not detected at or above the detection limit.
2 Bmbk indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

TABLE 6-3
STREAM WATER and SEDIMENT DATA

METALS/OTHER (1 of 2)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury
1	SW-water	09/12/86	Lord/Micro			ND	48		ND		1.2				12			
1	SW-water	11/22/88	Microbac	ND	ND	ND	ND	ND	ND	33100	ND	ND	ND	116	ND	7370	56	
1	SW-water	12/02/88	Microbac	483	ND	ND	ND	ND	ND	34800	11	ND	ND	719	ND	8150	204	
1	SW-water	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	34300	ND	ND	ND	ND	ND	7520	60	
1	SW-water	01/26/89	IT	ND	ND	ND	43.5	B ND	ND	46100	ND	ND	ND	113	ND	8760	117	
2	SW-water	09/12/86	Lord/Micro			ND	50		ND		3.3				14			
2	SW-water	11/22/88	Microbac	ND	ND	ND	ND	ND	ND	39100	24	ND	ND	ND	17.6	8760	16	
2	SW-water	12/02/88	Microbac	ND	ND	ND	ND	ND	ND	42700	ND	ND	ND	ND	17.6	9320	35	
2	SW-water	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	38300	ND	ND	ND	ND	ND	8420	17	
2	SW-water	01/26/89	IT	ND	ND	ND	53.4	B ND	ND	54600	ND	ND	ND	124	ND	10800	43.7	
3	SW-water	09/12/86	Lord/Micro			ND	62		ND		ND				ND			
3	SW-water	10/29/88	IT	202		ND	56	B ND	ND	50600	ND	ND	ND	257	ND	9250	61.2	ND
3	SW-water	11/22/88	Microbac	ND	ND	ND	ND	ND	ND	37100	ND	ND	ND	197	ND	8030	57	
3	SW-water	12/02/88	Microbac	ND	ND	ND	ND	ND	ND	41900	11	ND	ND	141	ND	8980	49	
3	SW-water	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	37700	ND	ND	ND	ND	ND	7910	39	
3	SW-water	01/26/89	IT	ND	ND	ND	54.9	B ND	ND	54800	ND	ND	ND	146	ND	10200	69.9	
4	SW-water	09/12/86	Lord/Micro			ND	95		ND		2.5				20			
4	SW-water	11/22/88	Microbac	ND	ND	ND	ND	ND	ND	42800	ND	ND	ND	199	6	9230	50	
4	SW-water	12/02/88	Microbac	ND	ND	ND	ND	ND	ND	47800	ND	ND	ND	134	ND	10400	42	
4	SW-water	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	45500	17	ND	ND	ND	ND	9730	42	
4	SW-water	01/26/89	IT	ND	ND	ND	81.6	B ND	ND	63400	ND	ND	ND	176	ND	11800	59.7	
5	SW-water	09/12/86	Lord/Micro			ND	70		ND		2.2				25			
5	SW-water	11/22/88	Microbac	ND	ND	ND	ND	ND	ND	33000	ND	ND	ND	ND	5.94	6340	ND	
5	SW-water	12/02/88	Microbac	ND	ND	ND	ND	ND	ND	30900	ND	ND	ND	ND	ND	6030	ND	
5	SW-water	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	29700	ND	ND	ND	ND	ND	5490	ND	
5	SW-water	01/26/89	IT	372	ND	ND	49	B ND	ND	40100	ND	ND	ND	378	15	7040	92.8	
6	SW-water	09/12/86	Lord/Micro			13.7	102		ND		4.2				16			
6	SW-water	11/22/88	Microbac	ND	ND	ND	ND	ND	ND	28100	ND	ND	ND	128	ND	5740	ND	
6	SW-water	12/02/88	Microbac	ND	ND	ND	ND	ND	ND	27200	ND	ND	ND	ND	ND	5550	ND	
6	SW-water	12/07/88	Microbac	ND	ND	ND	ND	ND	ND	27100	ND	ND	ND	ND	ND	5460	ND	
6	SW-water	01/26/89	IT	1830		ND	64.5	B ND	ND	34300	ND	ND	12.5	B1970	ND	6900	148	
7	SW-water	10/29/88	IT	102	B ND	ND	60.9	B ND	ND	47000	14.3	ND	ND	152	ND	8490	78	ND
M 5490	SW-water	07/26/88	IT	15100	ND	29.6	329	ND	ND	8500	32	ND	32	41700	50.4	3290	B 1330	ND
M 5490	SW-water	07/26/88	IT	729	ND	8	B 278	ND	ND	90200	ND	ND	ND	6720	ND	13800	3030	.3
1	SW-Sed	10/10/86	Lord/Micro			3400	20400		333		3400				6400			
1	SW-Sed	11/23/88	Microbac	8480000	ND	ND	42400	700	ND	577000	11300	7300	20400	19900000	9400	11900000	339000	
1	SW-Sed	12/02/88	Microbac	10067000	ND	ND	43700	400	ND	1413000	10500	7900	23000	20800000	19500	2707000	344000	
1	SW-Sed	12/07/88	Microbac	10200000	ND	ND	43000	490	840	2015000	10500	8800	22500	20900000	21000	2760000	327000	
1	SW-Sed	01/26/89	IT	7170000	ND	6499	32500	B ND	1200	12600000	13700	8800	B25100	15900000	12300	6870000	348000	
2	SW-Sed	10/10/86	Lord/Micro			4100	32100		450		5400				11300			
2	SW-Sed	11/23/88	Microbac	8500000	ND	ND	58400	300	700	2800000	9200	8200	8000	20800000	23500	3530000	606000	
2	SW-Sed	12/02/88	Microbac	6480000	ND	3720	42100	300	700	3460000	9700	6800	7500	17490000	7120	2120000	414000	
2	SW-Sed	12/07/88	Microbac	6618000	ND	10400	41100	200	600	7500000	10000	5500	6490	16800000	12600	4360000	431000	
2	SW-Sed	01/26/89	IT	6430000	ND	8800	48400	B ND	ND	2160000	13800	10700	B17200	21600000	11700	2860000	654000	
3	SW-Sed	10/10/86	Lord/Micro			3107	39400		449		4700				9300			
3	SW-Sed	10/29/88	IT	6930000	ND	12180	53500	ND	1700	1200000	11400	8400	B 17800	15600000	13300	1990000	467000	110

TABLE 6-3
STREAM WATER and SEDIMENT DATA

METALS/OTHER (2 of 2)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Cyanide	pH	Specific Cond. (umho/cm)	Total Dissolved Solids	Chloride	Sulfate	Chemical Oxygen Demand
1	SW-WATER	09/12/86	Lord/Micro										7.4	264	180	17	25	33.5
1	SW-WATER	11/22/88	Microbac	ND	2090	ND	ND	10200	ND	ND	ND							
1	SW-WATER	12/02/88	Microbac	ND	1720	ND	18	11900	ND	ND	ND							
1	SW-WATER	12/07/88	Microbac	ND	1650	ND	ND	13400	ND	ND	ND							
1	SW-WATER	01/26/89	IT	ND	1700 B	ND	ND	13300	ND	ND	ND							
2	SW-WATER	09/12/86	Lord/Micro										8	323	223	16	48	3.2
2	SW-WATER	11/22/88	Microbac	ND	2140	ND	ND	7410		ND	ND							
2	SW-WATER	12/02/88	Microbac	ND	1430	ND	ND	7670	ND	ND	ND							
2	SW-WATER	12/07/88	Microbac	ND	1490	ND	ND	8880	ND	ND	ND							
2	SW-WATER	01/26/89	IT	ND	1420 B	ND	ND	8720	ND	ND	ND							
3	SW-WATER	09/12/86	Lord/Micro										7.7	308	210	15	47	8.6
3	SW-WATER	10/29/88	IT	ND	2320 B	ND	ND	5040	ND	ND	137	ND						
3	SW-WATER	11/22/88	Microbac	ND	1810	ND	ND	5190	ND	ND	ND							
3	SW-WATER	12/02/88	Microbac	ND	1490	ND	ND	6050	ND	ND	ND							
3	SW-WATER	12/07/88	Microbac	ND	1420	ND	ND	6720	ND	ND	ND							
3	SW-WATER	01/26/89	IT	ND	1510 B	ND	ND	6760	ND	ND	10.3 B							
4	SW-WATER	09/12/86	Lord/Micro										8	350	240	17	53	3.2
4	SW-WATER	11/22/88	Microbac	ND	1640	ND	ND	5310	ND	ND	ND							
4	SW-WATER	12/02/88	Microbac	ND	1350	ND	ND	6240	ND	ND	ND							
4	SW-WATER	12/07/88	Microbac	ND	1400	ND	ND	6500	ND	ND	ND							
4	SW-WATER	01/26/89	IT	ND	1300 B	ND	ND	6450	ND	ND	ND							
5	SW-WATER	09/12/86	Lord/Micro										7.3	290	200	6.8	38	0.0029
5	SW-WATER	11/22/88	Microbac	ND	749	ND	ND	3040	ND	ND	ND							
5	SW-WATER	12/02/88	Microbac	ND	623	ND	ND	2510	ND	ND	ND							
5	SW-WATER	12/07/88	Microbac	ND	649	ND	ND	2510	ND	ND	ND							
5	SW-WATER	01/26/89	IT	ND	637 B	ND	ND	2840 B	ND	ND	11 B							
6	SW-WATER	09/12/86	Lord/Micro										7.2	217	150	4.6	39	26
6	SW-WATER	11/22/88	Microbac	ND	563	ND	ND	2640	ND	ND	ND							
6	SW-WATER	12/02/88	Microbac	ND	528	ND	ND	2380	ND	ND	ND							
6	SW-WATER	12/07/88	Microbac	ND	530	ND	ND	2530	ND	ND	ND							
6	SW-WATER	01/26/89	IT	ND	613 B	ND	ND	2870 B	ND	ND	193							
7	SW-WATER	10/29/88	IT	ND	924 B	ND	ND	2140 B	ND	ND	92.6	ND						
M Samp	SW-WATER	07/26/88	IT	ND	1100 B	ND	ND	ND	ND	22.2	213	ND						
M Samp	SW-WATER	07/26/88	IT	ND	1720 B	ND	ND	4900	ND	ND	250	ND						
1	SW-SED	09/10/86	Lord/Micro															
1	SW-SED	11/23/88	Microbac	20800	554000	ND	2200	67200	1300	10100	28900							
1	SW-SED	12/07/88	Microbac	20000	731000	ND	ND	151000	ND	14000	90000							
1	SW-SED	12/07/88	Microbac	20500	798000	ND	ND	164000	ND	13700	84200							
1	SW-SED	01/26/89	IT	15800	573000 B	ND	ND	ND	ND	13800	72300							
2	SW-SED	09/10/86	Lord/Micro															
2	SW-SED	11/23/88	Microbac	19100	675000	ND	1600	92700	ND	11300	74500							
2	SW-SED	12/07/88	Microbac	13700	490000	ND	ND	103000	ND	12400	56500							
2	SW-SED	12/07/88	Microbac	12700	641000	ND	1200	125000	ND	11800	57300							
2	SW-SED	01/26/89	IT	14300	446000 B	ND	ND	ND	ND	16200	135000							
3	SW-SED	09/10/86	Lord/Micro															
3	SW-SED	10/29/88	IT	19400	560000 B	ND	ND	ND	ND	14600	68400	ND						

TABLE 6-3
STREAM WATER and SEDIMENT DATA

METALS/OTHER (2 of 2)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Cyanide	pH	Specific Cond. (umho/cm)	Total Dissolved Solids	Chloride	Sulfate	Chemical oxygen demand
3	SW-Sed	11/23/88	Microbac	17000	640000	ND	ND	74200	ND	8400	51400							
3	SW-Sed	12/02/88	Microbac	16900	567000	ND	3500	94000	ND	12400	70200							
3	SW-Sed	12/07/88	Microbac	18700	528000	ND	ND	879000	ND	13000	66500							
3	SW-Sed	01/26/89	IT	13400	573000 B	ND	ND	ND	ND	15500	67500							
4	SW-Sed	10/10/86	Lord/Micro															
4	SW-Sed	11/22/88	Microbac	11300	622000	ND	1700	81500	ND	8900	54000							
4	SW-Sed	12/02/88	Microbac	22400	680000	ND	2700	103000	ND	12200	87000							
4	SW-Sed	12/07/88	Microbac	16400	590000	ND	1300	88500	ND	1200	58700							
4	SW-Sed	01/26/89	IT	18900	486000 B	ND	ND	ND	ND	21000	84000							
5	SW-Sed	10/10/86	Lord/Micro															
5	SW-Sed	11/22/88	Microbac	19900	733000	ND	ND	142000	ND	17600	94100							
5	SW-Sed	12/02/88	Microbac	16500	653000	ND	1200	95100	ND	13300	74200							
5	SW-Sed	12/07/88	Microbac	30800	546000	ND	ND	119000	ND	15000	81400							
5	SW-Sed	01/26/89	IT	14000	416000 B	ND	ND	ND	ND	17200	69400							
6	SW-Sed	10/10/86	Lord/Micro															
6	SW-Sed	11/22/88	Microbac	15900	529000	ND	2200	81100	ND	18200	85900							
6	SW-Sed	12/02/88	Microbac	18700	748000	ND	ND	115000	ND	22300	107000							
6	SW-Sed	12/07/88	Microbac	30200	483000	ND	ND	84500	ND	17600	78100							
6	SW-Sed	01/26/89	IT	ND	274000 B	ND	ND	ND	ND	10800	850400							
7	SW-Sed	10/29/88	IT	15000	404000 B	ND	ND	ND	ND	11900	852900	ND						
Elkpond	SW-Misc	04/01/86	Lord/Micro										7.39	200	174	4.89	30	4.45
Elk-1	SW-Misc	04/01/86	Lord/Micro										7.89	200	288	6.52	52	8.91
Elk-2	SW-Misc	04/01/86	Lord/Micro										7.67	200	356	17.93	80	4.45

NOTES: 1. ND indicates compound not detected at or above the detection limit.
2. B indicates that compound was found in a blank.

05/24/89

If the page filmed in this frame is not readable, it is due to substandard color or condition of the original page.

AR301890

TABLE 6-5

TEST OF PROPORTIONS APPLIED TO SURFACE WATERS DATA

METAL	Barium	Chromium	Lead	Zinc
SIGNIFICANCE LEVEL	0.39	0.76	0.76	0.049

If the page filmed in this frame is not as readable as this label, it is due to substandard color or condition of the original page.

TABLE 6-6

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN SURFACE WATERS

STATION OR GROUP OF STATIONS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
BACKGROUND (SW-1 + SW-2):	<50.0	<5.00	8.19	<5.00	5.26	<10.0	<10.0	5.13	--	<30.0	<10.0	<10.0
DOWNSTREAM STATIONS:												
SW-3	<50.0	<5.00	12.0	<5.00	5.70	<10.0	<10.0	<5.00	(<0.20)	<30.0	<10.0	11.2 -
SW-4	<50.0	<5.00	10.4	<5.00	5.56	<10.0	<10.0	4.51	--	<30.0	<10.0	<10.0
SW-5	<50.0	<5.00	8.83	<5.00	4.24	<10.0	<10.0	6.74	--	<30.0	<10.0	6.09
SW-6	<50.0	3.51	10.1	<5.00	4.83	<10.0	6.29	3.62	--	<30.0	<10.0	12.5
SW-7	(<50.0)	(<5.00)	(60.9)	(<5.00)	(14.3)	(<10.0)	(<10.0)	(<5.00)	(<0.20)	(<30.0)	(<10.0)	(92.6)
SW-6 & SW-7 COMBINED:	<50.0	3.32	13.6	<5.00	5.79	<10.0	6.01	3.41	<0.20	<30.0	<10.0	18.6 **
DOWNSTREAM STATIONS COMBINED:	<50.0	2.70	11.2	<5.00	5.32	<10.0	5.26	3.90	<0.20	<30.0	<10.0	9.42 -

Notes:
--- -- Significantly higher than background at 1% level.
** -- Significantly higher than background at 5% level.
- -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
- -- No samples taken
(...) -- Value based on one sample; significance level not evaluated.

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TABLE 6-7

GEOMETRIC MEAN CONCENTRATIONS OF METALS IN STREAM SEDIMENTS

STATION OR GROUP OF STATIONS	MEAN CONCENTRATIONS (ppb) Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Vanadium	Zinc
BACKGROUND (SW 1 + SW 2):	<50.0	4710	39100	121	9080	7820	14300	12400	--	16800	17100	78300
DOWNSTREAM STATIONS												
SW-3	<50.0	9220 **	61100 ***	47.6	9360	8010	15400	9720	(110)	17000	12500	64400
SW-4	<50.0	5460	50500	74.6	9330	8940	17900	6730	--	16900	7230	69400
SW-5	<50.0	12400 ***	61100	22.7	10100	8760	15500	15200	--	17600	15700	79300
SW-6	<50.0	7020	76900 ***	283	8400	6470	7150	11900	--	3080	16700	77600
SW-7	(<50.0)	(5600)	(56600)	(1600)	(9800)	(6800)	(6700)	(11300)	(<0.20)	(15000)	(11900)	(529000)
SW-6 + SW-7 COMBINED:	<50.0	6760	73100 ***	377	8620	6540	6950	11800	(<0.20)	4230	15600	71800
DOWNSTREAM STATIONS COMBINED:	<50.0	8040 **	61400 ***	78.4	9300	7810	12800	10400	3.32	11600	12400	70700

Notes:
*** -- Significantly higher than background at 1% level.
** -- Significantly higher than background at 5% level.
* -- Possibly significantly higher than background at 5% level.
<... -- All measurements are less than the detection limit. Value given is detection limit.
-- -- No samples taken
(...) -- Value based on one sample; significance level not evaluated.

TABLE 6-8
WATER QUALITY DATA
MISCELLANEOUS SURFACE WATER
INDICATORS\METALS
(reported in ppm, except TVO & THVO which are ppb)

Lord\Shope Site
Girard Twp., Pennsylvania

Location	Date	pH	Spec Cond	TVO(A)
NE Seep	Oct-86	6.3	450.0	10.9
New Pond	Jun-83			26.6
New Pond	Aug-83			35.6
New Pond	Sep-83			26.2
New Pond	Oct-83			32.2
New Pond	Mar-84			29.8
New Pond	Apr-84			40.0
New Pond	May-84			21.3
New Pond	Jun-84			45.6
New Pond	Jul-84	8.7	200.0	40.0
New Pond	Aug-84	9.0	290.0	31.9
New Pond	Sep-84	7.6	150.0	23.9
New Pond	Oct-84	7.4	200.0	29.3
New Pond	Nov-84	7.0	560.0	47.0
New Pond	Dec-84	6.7	340.0	43.6
New Pond	Mar-85	7.0	610.0	27.4
New Pond	Apr-85	6.8	675.0	13.8
New Pond	May-85	6.7	640.0	
SE Seep	May-84			662.5
SE Seep	Jun-84			406.8
SE Seep	Jul-84	8.3	490.0	90.0
SE Seep	Mar-85	7.8	510.0	692.2
SE Seep	Apr-85	6.9	530.0	1351.5
SE Seep	May-85	6.5	420.0	285.4
SE Seep	Nov-85	6.4	1080.0	36.4
SE Seep	Dec-85	6.7	625.0	1594.9
SE Seep	Mar-86	6.2	230.0	1291.0
SE Seep	Jun-86	6.4	380.0	62.3
SW Seep	Nov-85	6.4	540.0	45.7
MISCELLANEOUS SURFACE WATER				
Swale LF	02-Dec-86			ND
Swale LF	02-Dec-86			ND
Swale SW GC	02-Dec-86			ND
Spring	02-Dec-86			ND
6" Pipe	19-Dec-86			ND
8" Pipe	19-Dec-86			ND

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TABLE 6-9
MISCELLANEOUS SURFACE WATER

VOLATILE ORGANIC COMPOUNDS (Group 1 of 3)
(ppb)

Lord/Shane Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Benzene	Carbon Disulfide	Bromoform	Carbon tetra-chloride	Chloro-benzene	Chloro-dibromo-methane	Chloro-ethane	2-Chloro-ethyl vinyl ether	Chloroform	Dichloro-bromo-methane	Dichloro-difluoro-methane	1,1-Dichloro-ethane	1,2-Dichloro-ethane	1,1-Dichloro-ethene	1,2-Dichloro-propane	trans-1,3-Dichloro-propene	Ethyl benzene
NC Seep	SW-water	11/14/85	Lord																	
NE Seep	SW-water	07/26/88	IT	ND	ND	ND	ND	ND			ND	ND	81	1	ND	ND	ND	ND	ND	ND
NE Seep	SW-water	05/09/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
SE Seep	SW-water	05/09/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
Spring	SW-water	12/02/86	Lord	ND			ND					ND			ND		ND			
Spring	SW-water	05/09/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
Swale N Tr	SW-water	12/02/86	Lord	ND			ND					ND			ND		ND			
Swale N Tr	SW-water	05/09/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
Swale W Tr	SW-water	12/02/86	Lord	ND			ND					ND			ND		ND			
Swale W Tr	SW-water	05/09/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			12	ND	ND	ND	ND	ND
Swale @ Tr	SW-water	05/09/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
Wet Woods	SW-water	05/09/89	Lord	ND	ND	ND	ND	ND		ND	ND	ND			ND	ND	ND	ND	ND	ND
NE Seep	SW-Sed	07/26/88	IT	ND	ND	ND	ND	ND			ND	ND	-46	BT	ND	ND	ND	ND	ND	BMDL
6" Pipe	SW-misc	12/19/86	Lord	ND			ND					ND			ND		ND			
8" Pipe	SW-misc	12/19/86	Lord	ND			ND					ND			ND		ND			
Eight#1	SW-misc	08/13/86	Lord	ND			ND					ND			ND		ND			
Eight#2	SW-misc	08/13/86	Lord	ND			ND					ND			ND		ND			
Elm	SW-misc	12/19/86	Lord	ND			ND					ND			ND		ND			
Elmwood	SW-misc	04/01/86	Lord	ND			ND					ND			ND		ND			
Elmwood	SW-misc	12/19/86	Lord	ND			ND					ND			ND		ND			
Elm-1	SW-misc	04/01/86	Lord	ND			ND					ND			ND		ND			
Elm-2	SW-misc	04/01/86	Lord	ND			ND					ND			ND		ND			
Elm-3	SW-misc	04/01/86	Lord	ND			ND					ND			ND		ND			
Sink#1	SW-misc	08/13/86	Lord	ND			ND					ND			ND		ND			
Sink#2	SW-misc	08/13/86	Lord	ND			ND					ND			ND		ND			

NOTES:
1. ND indicates compound not detected at or above the detection limit.
2. BMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation.
3. B indicates that compound was found in a blank.

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TABLE 6-9
MISCELLANEOUS SURFACE WATER
VOLATILE ORGANIC COMPOUNDS (GROUP 3 OF 3)
(ppb)

Ford/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Acetone	Tetra-hydro-furan	1,1,2-Tri-chloro-1,2-trifluoro-Ethane	4-Methyl-2-Pentanol	Dichloro-difluoro-methane	Dichloro-fluoro-methane	1,1-Dichloro-ethylene	Cyclo-hexanone	Xylene	2-Butanol	Iso propanol	Total of Unknown Compounds
W Seep	Sw-Water	11/14/85	Ford												
W Seep	Sw-Water	07/24/88	IT	17 B		10	B1								
W Seep	Sw-Water	05/09/89	Ford	ND	ND		ND								
SE Seep	Sw-Water	05/09/89	Ford	ND	ND		ND								
Spring	Sw-Water	12/02/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Spring	Sw-Water	05/09/89	Ford	ND	ND		ND								
Swale N LF	Sw-Water	12/02/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Swale N LF	Sw-Water	05/09/89	Ford	ND	ND		ND								
Swale W LF	Sw-Water	12/02/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Swale W LF	Sw-Water	05/09/89	Ford	ND	ND		ND								
Swale @ 31	Sw-Water	05/09/89	Ford	ND	ND		ND								
Wet Woods	Sw-Water	05/09/89	Ford	ND	ND		ND								
W Seep	Sw-Sed	07/24/88	IT	ND		97	B1								
E Pipe	Sw-Misc	12/19/86	Ford	ND	ND		ND				ND	ND	ND	ND	
E Pipe	Sw-Misc	12/19/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Eight#1	Sw-Misc	08/13/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Eight#2	Sw-Misc	08/13/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Elw	Sw-Misc	12/19/86	Ford	ND	ND		ND				ND	ND	ND	ND	
ElwPond	Sw-Misc	04/01/86	Ford	ND	ND		ND				ND	ND	ND	ND	
ElwPond	Sw-Misc	12/19/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Elw-1	Sw-Misc	04/01/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Elw-2	Sw-Misc	04/01/86	Ford	ND	ND		ND				ND	7 05	ND	5.8	
Elw-3	Sw-Misc	04/01/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Sump1	Sw-Misc	08/13/86	Ford	ND	ND		ND				ND	ND	ND	ND	
Sump2	Sw-Misc	08/13/86	Ford	ND	ND		ND				ND	ND	ND	ND	

Notes: 1 ND indicates compound not detected at or above the detection limit
2 PMDL indicates compound is present but at a level below the detection limit which is too low for accurate or precise quantitation
3 B indicates that compound was found in a blank.

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TABLE 6-10
MISCELLANEOUS SURFACE WATER

METALS/OTHER (1 of 2)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury
NE Seep	Sw-water	07/26/88	IT	729	ND	8 B	278	ND	ND	90200	ND	ND	ND	6720	ND	13800	3010	.3
NE Seep	Sw-water	07/26/88	IT	15100	ND	29.6	329	ND	ND	8500	B 32	ND	32	41700	50.4	3790 B	1330	ND
NE Seep	Sw-water	05/09/89	Microbac	280	ND	23	268	ND	ND	73000	ND	ND	ND	15400	ND	12500	3920	23
SE Seep	Sw-water	05/09/89	Microbac	2390	ND	ND	252	ND	ND	103000	ND	ND	ND	5230	B	12100	2340	ND
Spring	Sw-water	05/09/89	Microbac	340	ND	ND	74	ND	ND	48000	ND	ND	ND	235	ND	ND	23	ND
Swale N	Sw-water	05/09/89	Microbac	11300	ND	ND	202	ND	6	87000	ND	ND	36	21700	15	14400	5160	ND
Swale W	Sw-water	05/09/89	Microbac	370	ND	ND	43	ND	ND	100000	ND	ND	ND	559	ND	15500	132	ND
Swale @ TP	Sw-water	05/09/89	Microbac	1610	ND	ND	57	ND	6	30100	ND	ND	ND	1550	ND	5720	37	ND
Wetlands W	Sw-water	05/09/89	Microbac	640	ND	ND	62	ND	ND	47400	ND	ND	ND	1360	ND	9650	290	ND

Notes: 1 ND indicates compound not detected at or above the detection limit.
2 B indicates that compound was found in a blank.

05/24/89

TABLE 6-10
MISCELLANEOUS SURFACE WATER

METALS/other (2 of 2)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Cyanide	pH	Specific Cond. (umho/cm)	Total Dissolved Solids	Chloride	Sulfate	Chemical Oxygen Demand
NE Seep	Surface Water	07/26/88	IT	ND	1720 B	ND	ND	4900	ND	ND	250	ND						
NE Seep	Surface Water	07/26/88	IT	ND	1100 B	ND	ND	ND	ND	22.2	213	ND						
NE Seep	Surface Water	05/09/89	Microbac	ND	1750	ND	ND	4920	ND	ND	26							
SE Seep	Surface Water	05/09/89	Microbac	ND	5580	ND	ND	3280	ND	ND	65							
Spring	Surface Water	05/09/89	Microbac	ND	2900	ND	ND	3380	ND	ND	ND							
Swale N	Surface Water	05/09/89	Microbac	ND	2950	50	ND	4750	ND	ND	141							
Swale S	Surface Water	05/09/89	Microbac	ND	1730	50	ND	5200	ND	ND	ND							
Swale @ 11	Surface Water	05/09/89	Microbac	ND	3640	50	ND	2320	ND	ND	85							
Wetlands W	Surface Water	05/09/89	Microbac	ND	3500	ND	ND	4840	ND	ND	ND							

Notes 1. ND indicates compound not detected at or above the detection limit.
2. B indicates that compound was found in a blank.

05/24/89

TABLE 6-11
BACKGROUND SOIL DATA
METALS/OTHER (1 of 2)
(ppb)

Enid/Sippo Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury
38-1	Soil 2'	11/08/88	Ecklidar	6090000	ND	7950	ND	ND	ND		5800		22300		10400			ND
37-2	Soil 7'	11/17/88	Ecklidar	7660000	ND	12200	85800	ND	ND		7500		29000		9380			ND
38-4	Soil 17'	11/08/88	Ecklidar	5780000	ND	7280	27600	ND	ND		7500		34900		11000			ND
37-14	Soil 43'	11/17/88	Ecklidar	5940000	ND	8650	43500	ND	ND		6400		24800		9030			ND
38-13	Soil 62'	11/08/88	Ecklidar	5940000	ND	6980	30200	ND	ND		6400		24000		9800			ND

Notes: 1. ND indicates compound not detected at or above the detection limit.
2. B indicates that compound was found in a blank.

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TABLE 6-11
BACKGROUND SOIL DATA
METALS/OTHER (2 of 3)
(ppb)

Lord/Shope Site
Girard Twp., Pennsylvania

Sample Number	Sample Location	Sample Date	Lab	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Cyanide	pH	Specific Cond (umhos/cm)	Total Dissolved Solids	Chloride	Sulfate	Chemical Oxygen Demand
38-1	Soil 2'	11/08/88	Eckfldev	14500		ND	ND	65			68700							
37-2	Soil 7'	11/17/88	Eckfldev	20200		ND	ND	170			84200							
38-4	Soil 17'	11/08/88	Eckfldev	14500		ND	ND	155			73000							
37-14	Soil 43'	11/17/88	Eckfldev	20200		ND	ND	135			60200							
38-13	Soil 62'	11/08/88	Eckfldev	18300		ND	ND	125			58100							

Notes 1. ND indicates compound not detected at or above the detection limit.
2. B indicates that compound was found in a blank.

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SECTION 7

7.0 AIR QUALITY SURVEY

An ambient air quality survey was conducted in the area on and around the landfill. The survey was initially conducted on October 15, 1984 using an HNU-Model PI-101 photoionizer detector (PID) with a 10.2 eV lamp. Readings were measured at several upwind, background locations and then at 100-foot intervals on and around the landfill with probe held approximately three feet above the ground surface. The air quality study was repeated twice on June 26, 1989. The second survey was performed in the same manner as for the October 15, 1984 survey, except that two PID meters were used, one with a 10.2 eV lamp and one with an 11.7 eV lamp, in order to enhance detectability of certain volatile organics.

The locations of each reading have been plotted on Figure 7-1. The PID data and associated climatological data at the time of each measurement is summarized on Table 7-1. All readings indicated non-detectable or background levels of volatile organic compounds in the breathing zone, at a level three feet above the ground surface. With the probe held immediately above the ground surface, no detection was noted within the 10.2 eV PID on any of the surveys. However, ground surface readings with the 11.7 eV PID indicated low level readings at the "NE Seep" and in the area southeast of the landfill near well W-5 at levels ranging up to 2.0 ppm. (HNU units referenced to benzene).

The sensitivity of the PID meter to volatile organics has been shown to vary with both the compound to be detected and the lamp used. The photoionization sensitivities, as reported by the manufacturer, for the primary volatile organic compounds that have been detected in groundwater plume are listed on Table 7-2. Of the 13 major plume compounds, nine have sensitivities above 4.5 ppm. This means each of these compounds will have an instrument response of at least 45 percent of the observed reading. It should be noted that the compounds of particular concern, vinyl chloride and benzene, exhibit a strong instrument response of 50 and 100 percent, respectively. Four compounds are not listed and no firm conclusions can be drawn about their detectability; however, their similarity to compounds that are listed suggests that they should be reasonably detectable.

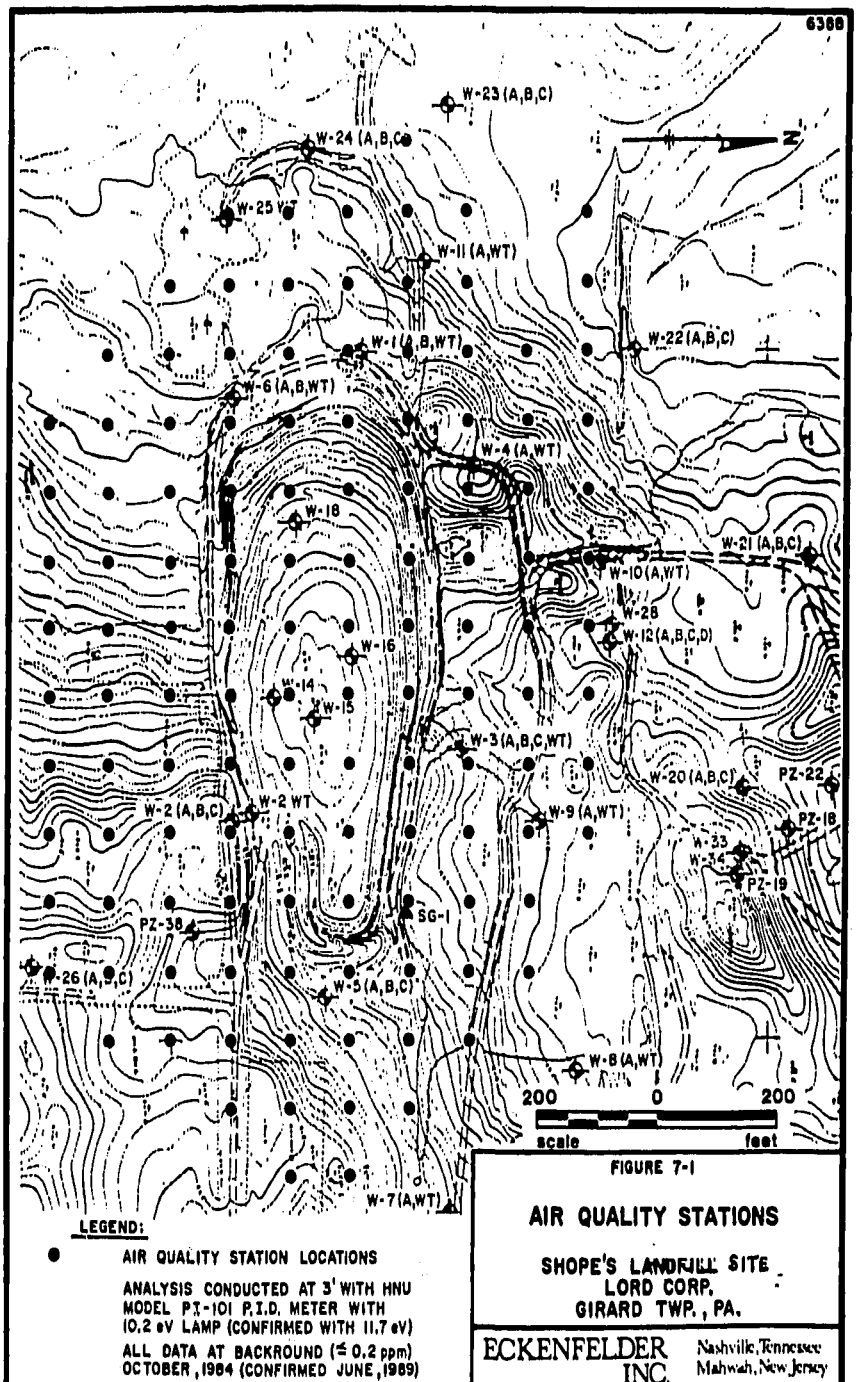

TABLE 7-1

SUMMARY OF AMBIENT AIR MONITORING

Date	Time	Weather Conditions			PID[1] Response in Breathing Zone[2]	
		Temp (F)	Relative Humidity	Wind	10.2 eV	11.7 eV
15-Oct-84	01:30 PM - 04:30 PM	62°	78%	NNE, 9 mph	ND	--
26-Jun-89	08:30 AM - 10:30 AM	73°	57%	N, 7 mph	ND	ND[3]
26-Jun-89	12:30 PM - 02:30 PM	84°	58%	N, 7 mph	ND	ND[4]

Notes:

1. PID meters utilized are HNU Systems, Inc. models PI-101 (10.2 eV) and HW-101 (11.7 eV). Detection Limit is 0.2 ppm.

2. Breathing zone refers to measurements made at a level approximately three feet above ground surface.

3. At ground surface, positive PID detections were observed in two areas at noted time with the 11.7 eV lamp only:
   2.0 ppm - NE Seep
   1.0 ppm - vicinity of well W-5

4. At ground surface, positive PID detection was observed in one area at noted time with the 11.7 eV lamp only:
   1.0 ppm - NE Seep

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TABLE 7-2

SENSITIVITY OF PID METER TO
GROUNDWATER PLUME VOLATILE ORGANIC COMPOUNDS

COMPOUND	PHOTOIONIZATION SENSITIVITY [1.]	
	10.2 eV Lamp	11.7 eV Lamp
benzene	10.0	12.2
methyl ethyl ketone (MEK)	5.7	6.3
4-methyl-2-pentanol	NL	NL
methyl isobutyl ketone (MIBK)	5.7	10.6
vinyl chloride	5.0	NL
trans-1,2-dichloroethene	NL	NL
tetrahydrofuran (THF)	6.0	7.9
tetrachloroethene	NL	NL
trichloroethene	8.9	NL
acetone	6.3	5.7
cyclohexanone	5.1	NL
2-butanol	NL	NL
isopropanol	1.0	4.5

Notes:

1. Reading (ppm) when measuring 10.0 ppm of the particular gas with the HNU Systems, Inc. Model PI 101 PID meter calibrated for benzene, based on data provided by the manufacturer.

2. "NL" indicates photoionization sensitivity data not listed by the manufacturer.

In summary, no volatile organics have been detected in the breathing zone at any area on or around the site. Only low levels of volatiles have been detected at the ground surface and only in areas previously shown to contain volatile organics in the surficial soils. These data have been based upon the use of the combined use of 10.2 eV and 11.7 eV PID meters which have been shown to provide good response to the parameters of concern.

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Note: *On March 1, 1989, AWARE Incorporated became ECKENFELDER INC.

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