46070

000040

FINAL REMEDIAL INVESTIGATION REPORT

FOR

INDUSTRIAL EXCESS LANDFILL
UNIONTOWN, OHIO

JULY 1988

VOLUME I

R E M II

PERFORMANCE OF REMEDIAL RESPONSE ACTIVITIES AT UNCONTROLLED HAZARDOUS WASTE SITES

U.S. EPA CONTRACT NO. 68-01-6939

CDM Federal Programs Corporation
CAMP DRESSER & McKEE INC.
ROY F. WESTON INC.
WOODWARD-CLYDE CONSULTANTS
CLEMENT ASSOCIATES, INC.
ICF INCORPORATED
C.C. JOHNSON & MALHOTRA, P.C.

46070

FINAL REMEDIAL INVESTIGATION REPORT

7/88

FOR

INDUSTRIAL EXCESS LANDFILL
UNIONTOWN, OHIO

JULY 1988

VOLUME I

Company Confidential

Prepared for:

U.S. Environmental Protection Agency
Emergency and Remedial Response Branch
Region V
230 South Dearborn Street
Chicago, Illinois 60604

This document has been prepared for the U.S. Environmental Protection Agency under Contract No. 68-01-6939. The material contained herein is not to be disclosed to, discussed with, or made available to any person or persons without the prior expressed approval of a responsible official of the U.S. Environmental Protection Agency.

Document No.: 157-RI1-RT-GHFM-1

Work Assignment No.: 57-5LW2

15704/29

PERFORMANCE OF REMEDIAL RESPONSE ACTIVITIES AT UNCONTROLLED HAZARDOUS WASTE SITES (REM II)

U.S. EPA CONTRACT NO. 68-01-6939

FINAL REMEDIAL INVESTIGATION REPORT

FOR

INDUSTRIAL EXCESS LANDFILL SITE
UNIONTOWN, OHIO

EPA Work Assignment No.: 57-5LW2

REM II Document No.: 157-RI1-RT-GHFM-1

Prepared by: Sidney F. Paige Date: 6/29/88
Sidney F. Paige, D.Env.
Site Manager

Approved by: John Schroeter Date: 6/29/88
John Schroeter, P.E.
Region V Manager

CDM
environmental engineers, scientists,
planners, & management consultants

CAMP DRESSER & McKEE INC.

200 West Adams Street, Suite 1600
Chicago, Illinois 60606
312 786-1313

June 29, 1988

Mr. Gregg A. Kulma
Acting Regional Project Officer
U.S. Environmental Protection Agency
230 S. Dearborn Street
Chicago, IL 60604

Ms. Julie Mathiesen
Remedial Project Manager
U.S. Environmental Protection Agency
230 S. Dearborn Street
Chicago, IL 60604

Subject:	Final Remedial Investigation Report for the Industrial Excess Landfill Site Uniontown, Ohio
Work Assignment No.:	57-5LW2
EPA Contract No.:	68-01-6939
Document No.:	157-RI1-RT-GHFM-1

Dear Mr. Kulma and Ms. Mathiesen:

Camp Dresser & McKee is pleased to submit Volumes I and II of the Final Remedial Investigation (REM II Document No.: 157-RI1-RT-GHFM-1) for RI/FS activities at the Industrial Excess Landfill Site located in Uniontown, Ohio.

If you have any questions, please contact us.

Very truly yours,

CAMP DRESSER & MCKEE INC.

John Schroeter

John Schroeter, P.E.
Region V Manager

JY:sjr

Enclosures

cc: J. Garforth, Contracting Officer, USEPA
R. Quinn, Project Officer, USEPA
J. Kingscott, Regional Coordinator, USEPA
C. C. Johnson, Jr., President, CCJM
Document Control
Region V Library

C. C. JOHNSON & MALHOTRA, P.C.
ENVIRONMENTAL ENGINEERS

June 29, 1988

Mr. John Schroeter, P.E.
Region V Manager
Camp Dresser & McKee Inc.
200 West Adams Street
Suite 1600
Chicago, IL 60606

Subject: Final Remedial Investigation Report for the RI/FS at Industrial Excess Landfill, Uniontown, Ohio

Work Assignment No.: 57-5LW2

EPA Contract No.: 68-01-6939

Document Control No.: 157-RI1-RT-GHFM-1

Dear Mr. Schroeter:

Enclosed for your review and transmittal to U.S. EPA is the Remedial Investigation Report for the RI/FS being conducted at the Industrial Excess Landfill site located in Uniontown, Ohio. Volume I is the main report and Volume II provides the appendices.

If you have any questions on this matter, please contact me.

Very truly yours,

C. C. JOHNSON & MALHOTRA, P.C.

Sidney F. Paige

Sidney F. Paige, D. Env.
Site Manager

SFP:sjr

Enclosure

cc: File
Document Control
Region V Library

15704B/8

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (cont.)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

1.0 INTRODUCTION

On 26 December 1984, the U.S. Environmental Protection Agency (U.S. EPA) authorized a Remedial Investigation/Feasibility Study (RI/FS) to be conducted at the Industrial Excess Landfill site (IEL) located in Uniontown, Ohio, under EPA Contract No. 68-01-6939: Performance of Remedial Response Activities at Uncontrolled Hazardous Waste Sites (REM II). The RI/FS for the IEL site was initiated by issuance of Work Assignment No. 57-5LW2. The site is ranked No. 159 on the U.S. EPA National Priorities List (NPL) as of July 1987.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), through Executive Order 12316, as revised by the Superfund Amendments and the Reauthorization Act of 1986 (SARA) gives the U.S. EPA the authority and responsibility to respond to the actual or potential release of hazardous substances which pose a substantial threat to human health, or welfare of the environment. Pursuant to Section 105 of CERCLA, the U.S. EPA promulgated revisions to the National Contingency Plan (NCP) on February 12, 1985 to effectuate the response powers and responsibilities created by CERCLA. Subpart F of the NCP, Hazardous Substance Response, establishes methods and criteria for determining the appropriate extent of the response authorized by CERCLA. Subpart F, Section 300.68 of the NCP outlines the procedure for Remedial Investigations (RIs) that are to be undertaken to obtain the necessary data for the evaluation of remedial action alternatives for a given site.

Additional guidance on the details associated with the performance of the RI is provided in U.S. EPA's Guidance on Remedial Investigations under CERCLA, (May 1985). The RI and the Feasibility Study (FS) are designed to be performed concurrently. Therefore, guidance regarding the preparation of the FS needs to be considered along with that for the RI.

The existing guidance document for the FS is U.S. EPA Guidance on Feasibility Studies Under CERCLA, April 1985. In order to provide the reader with an accurate picture of the procedures, purposes, and other pertinent factors associated with the RI/FS process, selected introductory portions of these guidance documents, have been incorporated in this RI report as Appendices A and B. The procedures described in the referenced guidance documents were followed during the Remedial Investigation (RI) of the IEL site.

In accordance with the existing guidance for performance of remedial investigations, the major purpose and emphasis of the RI is site characterization and data collection. The RI is the mechanism for collecting the data needed for the FS. Available guidance indicates that the data collection process should be performed in three levels of detail:

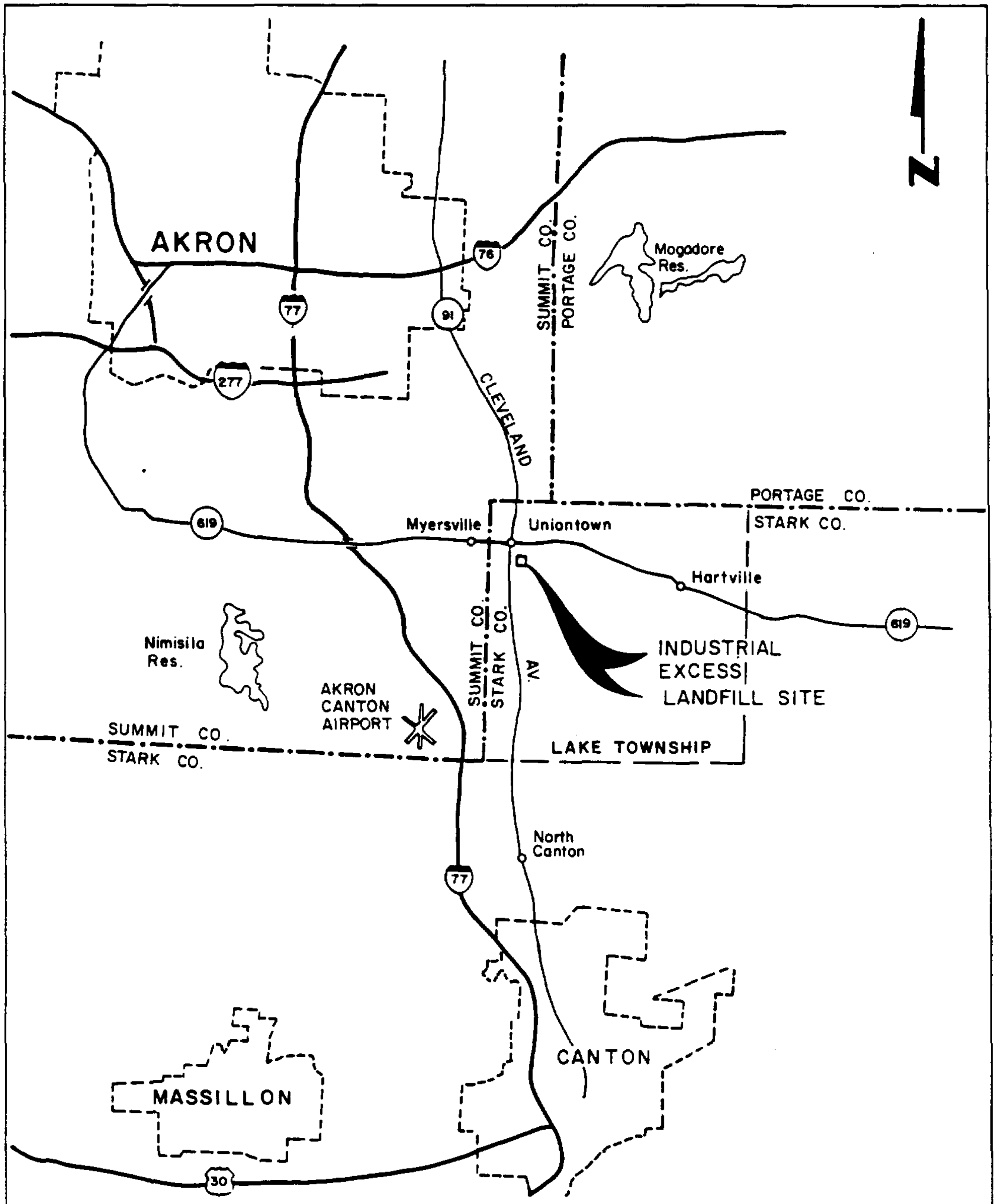
- Level I - Problem Identification and Scoping
- Level II - Problem Quantification
- Level III - Problem Quantification and Detailed Investigation

Not all levels of this phased approach need to be accomplished. The ultimate purpose of the RI process is to obtain the level of information necessary for determination of a remedial response action. The level of remedial investigation detail will thus vary from site to site and the collection of data can cease as soon as the information base is adequate for the selection of a remedial response at the site in question.

1.1 Site Background Information

1.1.1 Site Location

The Industrial Excess Landfill is located in northeastern Ohio, about ten miles southeast of Akron, in Lake Township, Stark County, as shown in Figures 1-1 and 1-2. The landfill is about four-tenths of a mile south of

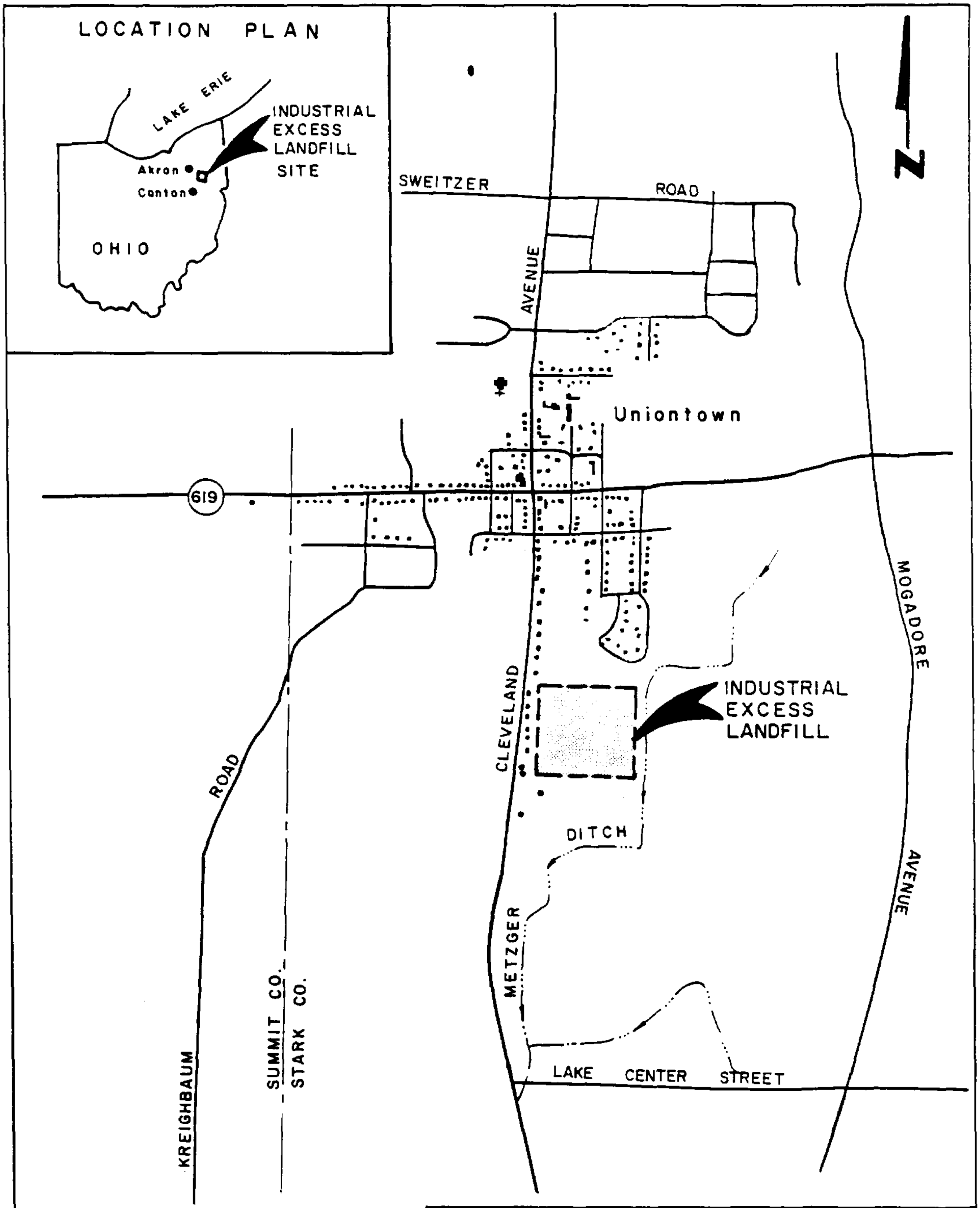


scale approximate
1" : 3.25 miles

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 1-1
REGIONAL LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.



scale approximate
1" : 1,550'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 1 - 2
LOCATION PLAN

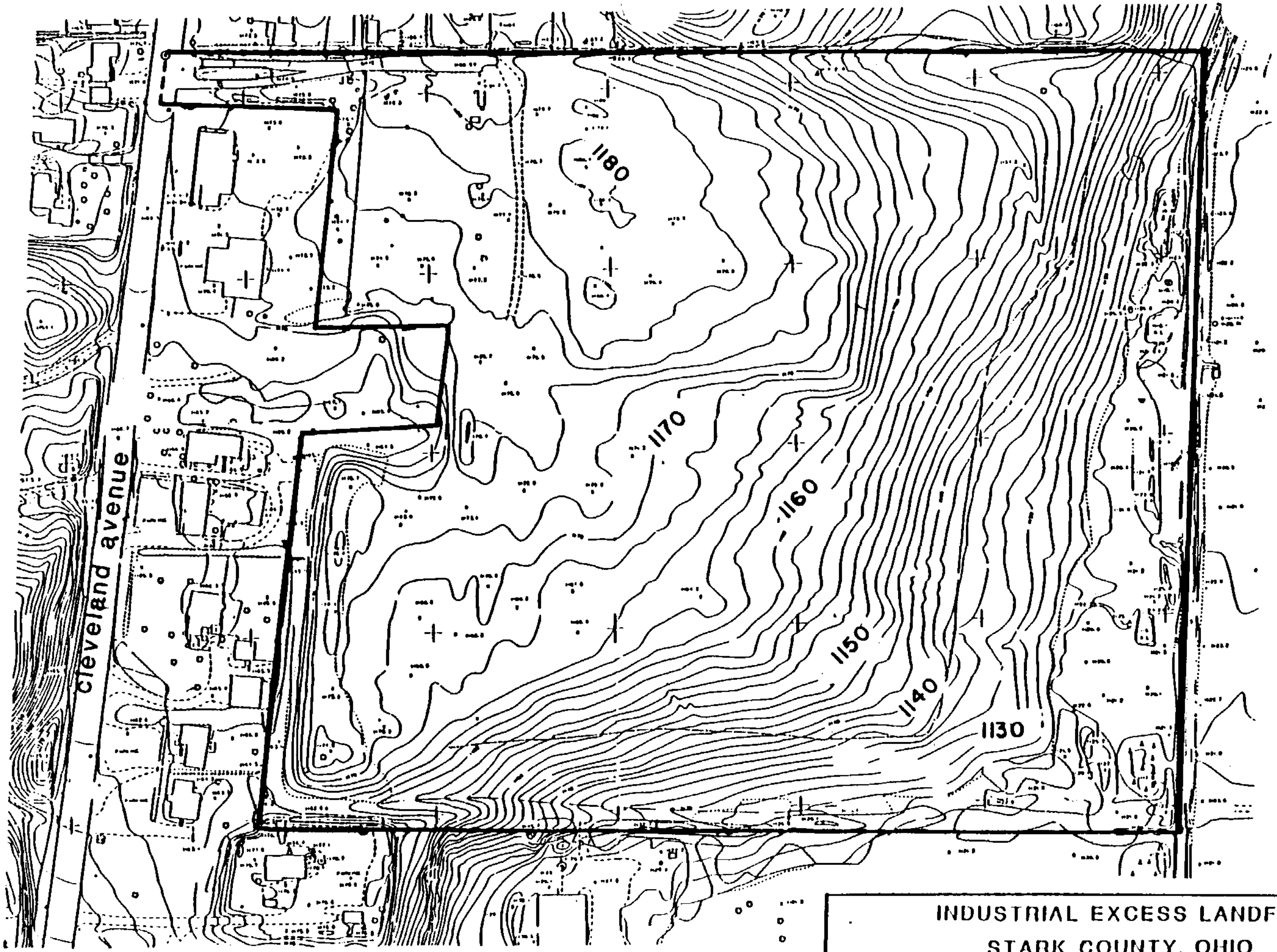
C.C. JOHNSON & MALHOTRA, P.C.

the intersection of Cleveland Avenue and State Route 619 at 12646 Cleveland Avenue, N.W., Uniontown, Ohio.

1.1.2 Site Description

The Industrial Excess Landfill is a closed sanitary landfill located in an area that can be best typified as being rural residential. The 30 acre tract where the landfill is located had previously been the site of a sand and gravel mining operations up until 1966. The excavation, which remained after the end of the sand and gravel operation, was converted into a landfill which received a variety of industrial, commercial, and municipal wastes. In 1980, the site was closed pursuant to a court-ordered consent agreement.

The configuration of the IEL property is presented in Figure 1-3. Dimensions along the eastern and western borders are about 1,100 feet and about 1,200 feet along the northern and southern borders. Available information indicates that approximately 80 to 85 percent of the property area contains buried waste materials. Along the western border, there is a strip of land situated between the landfill and Cleveland Avenue on which there are a number of private residences and assorted commercial structures. The commercial structures include a tire shop, a defunct restaurant (which is now being rented out as office space), and a pole barn which will be used for auctions. The pole barn is located in the parking lot of the restaurant. Of the 6 private residences located along this Cleveland Avenue frontage strip, only four are inhabited. One of the remaining two residences is a seldom used office for a local real estate company. The other has been rented from time-to-time during the RI, but it is currently vacant. The owner of the southern most home along this strip also owns (in partnership with another person) the parcel of land which extends along the southern border of the site.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 1-3
TOPOGRAPHIC SITE MAP
CONTOUR INTERVAL = 2'

C.C. JOHNSON & MALHOTRA, P.C.

scale approximate 1" : 200'

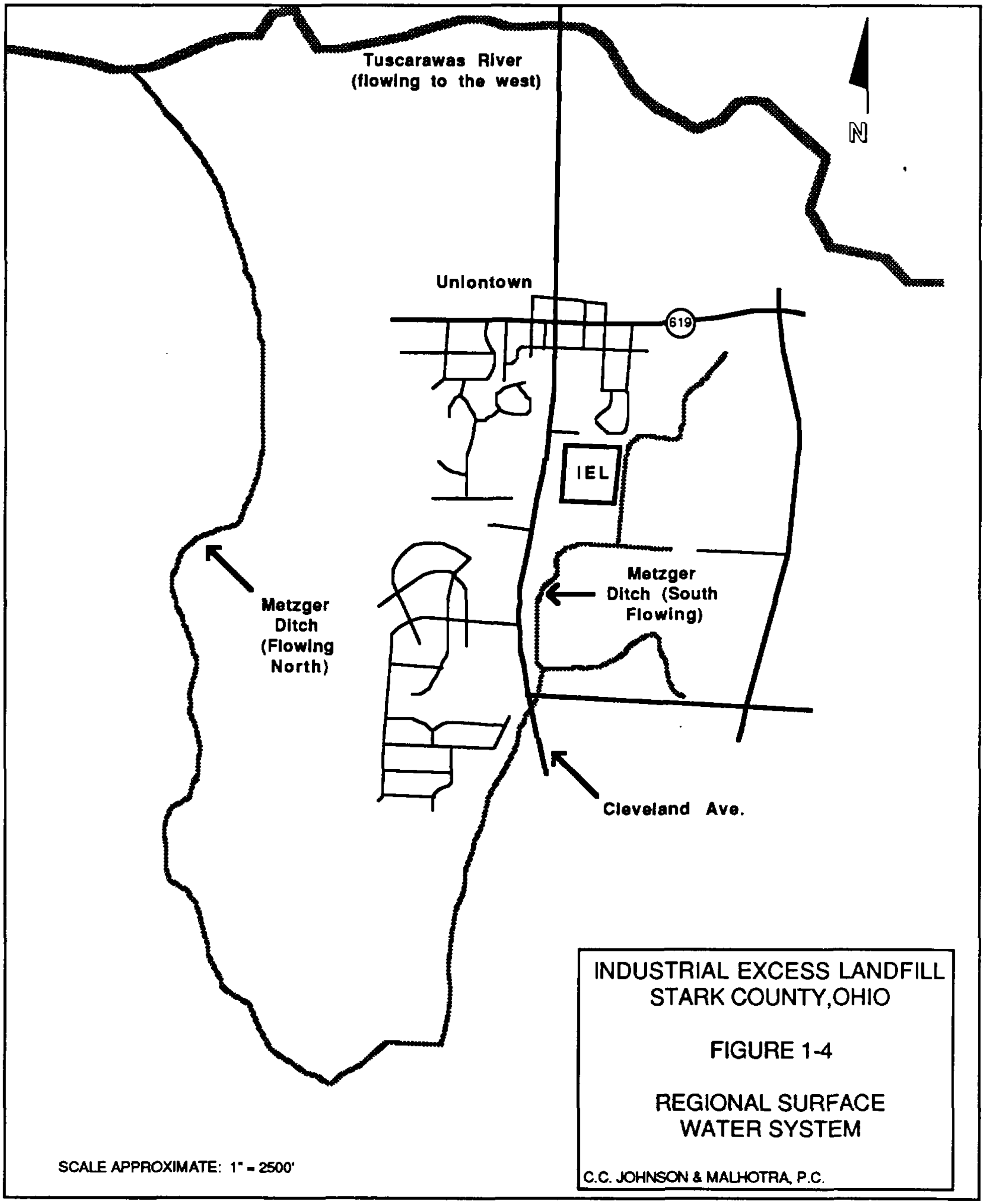
Based on information obtained from an historical aerial photo survey of the site area and discussions/interviews with local residents, the natural state (circa 1942) of the place where the landfill is located was rolling land with a topography sloping gently to the east and south from the north and west.

Substantial quantities of sand and gravel were beneath this rolling topography. The presence of these deposits prompted use of the site for the purpose of sand and gravel mining.

Figure 1-3 shows the current topography of the site. The landfill was graded and sloped so that runoff is generally directed towards Metzger Ditch, a drainage channel located along the eastern boundary of the site. Water in Metzger Ditch flows south, then southwest and then northwest until it ultimately joins the Tuscarawas River (Figure 1-4). On the landfill property, there is approximately 60 feet of elevation difference between the highest spot and the lowest. The highest elevation is in the northwestern portion of the landfill, and the lowest is in the southeastern area and along Metzger Ditch.

Metzger Ditch is the major surface drainage feature (for surface and subsurface water) within the area around the landfill. Storm drains located along the edges of Cleveland Avenue collect into underground pipes and ultimately discharge into Metzger Ditch. Metzger Ditch is maintained by The Stark County Engineering Department. The most recent dredging of the ditch in the area adjacent to the landfill was performed between 1974 and 1976. The dredge spoils from this operation were placed along the east bank of the ditch.

Much of the site is covered with grasses, shrubs and small trees. Generally, the surface soil consists of locally obtained gravel and sand. There are areas on-site where water has collected in small pond-like depressions (Figure 1-5). Along the northeastern and southern edges of the site, there is some erosion, especially on the steeper slopes.

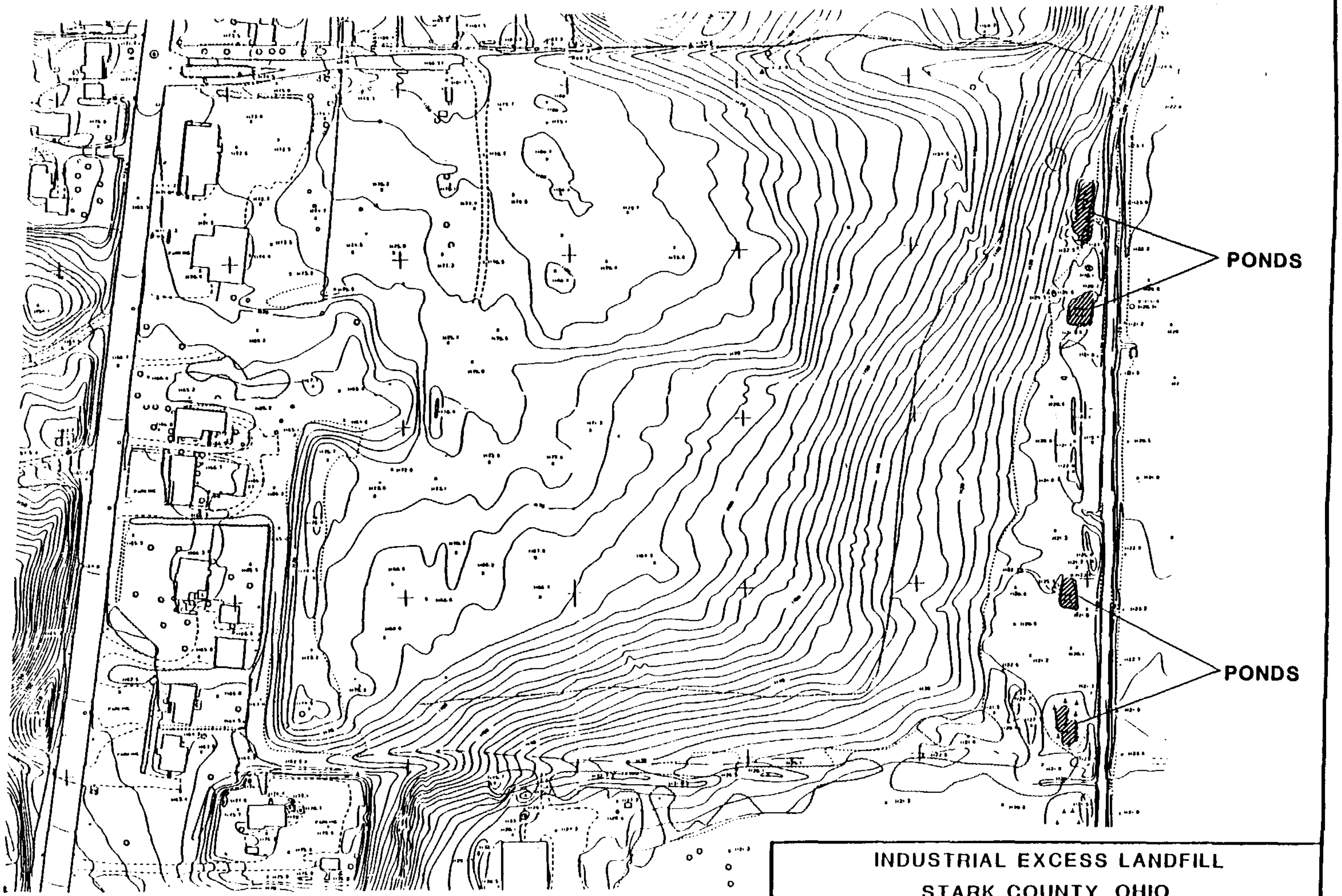


INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 1-4

REGIONAL SURFACE
WATER SYSTEM

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 1-5

ON-SITE PONDS LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.

SCALE APPROXIMATE: 1" to 200'

In an attempt to mitigate high methane levels which had been observed in the soils under adjacent homes, the site's owner, the Industrial Excess Landfill, Inc. (IELI), installed thirteen passive gas wells to intercept methane migrating laterally from the landfill. The generated methane was burned via a flare installed at each well. Most of these gas wells were located along the western portion of the site. A couple were situated along the northwestern portion of the site. Most of these wells were completed in buried waste.

Further testing showed that the passive gas wells were ineffective at intercepting most of the landfill gas. In response to this situation, contractors working for the U.S. EPA installed an active methane venting system (MVS) with gas extraction wells along the entire western edge of the site, along the western half of the northern border of the site and along the western quarter of the southern border of the site. Nested gas monitoring wells were also installed for use in evaluating the system's effectiveness. A central collection blowers and gas flaring facility was constructed in the northwestern portion of the site. (The methane venting system is discussed in detail in Section 6.0).

1.1.3 Site History

Available aerial photography indicates that the IEL site area was in its natural state in 1942. Within the Uniontown community, it was generally thought that coal had been mined at the site prior to the mining of sand and gravel. As a result, there was speculation about a mine shaft being present at the site. As the result of an extensive investigation of this issue, it has been determined conclusively that coal was never mined at the property now occupied by the IEL. This conclusion is based on reviews of available mine records, interviews with the owner of the sand and gravel operation and the opinion of regional geology experts. A detailed discussion of the information supporting this conclusion is presented in Appendix C.

In 1956 the location was used for sand and gravel mining operation using open pit techniques. The facility was known as the Summit Sand and Gravel Pit. The sand and gravel mining activities were terminated in 1961 when the pit depth reached close to or below the water table. The sand and gravel processing method being used would not tolerate feed material which was wet or damp. A bridge was constructed across Metzger Ditch to provide access to small sand and gravel outcrops in a portion of the area east of the landfill which is now a sod farm. This allowed for the temporary continuation of sand and gravel processing operations at the site.

After the cessation of the sand and gravel operation, the owner proposed to convert the property to a trailer park. This proposal was not approved. Further attempts to use the site for tractor trailer storage were also unsuccessful (Sheets, 1988).

The excavated property was ultimately sold to Mr. Charles Kittinger in 1966. Mr. Kittinger used the site for flyash disposal. In January of 1966 Mr. Kittinger requested that the Stark County Board of Health (SCBH) issue a license to operate a landfill at the site. SCBH agreed to allow Mr. Kittinger to operate the site only if the request was approved by the Lake Township Trustees. Initially, the Trustees denied the request, but, in September 1966, they finally granted permission for operation of the landfill.

Mr. Kittinger obtained conditional licenses from the Township Zoning Board to operate the site as a landfill between 1966 and 1968. The site was then referred to by names such as "Kittinger's Landfill", "Kittinger Industrial Landfill" and/or "Industrial Excess Landfill". During this period the landfill accepted an assortment of municipal, commercial, and industrial wastes (containing hazardous substances) of largely undetermined and unknown composition. Residential garbage was excluded, however, there were reports that the general community routinely deposited household wastes just inside the fenced area of the site.

In 1968, Mr. Kittinger was joined by Mr. Hyman Budoff, and together they formed Industrial Excess Landfill, Inc. During this association, day-to-day operation of the landfill was handled by Mr. Kittinger. The association between Mr. Kittinger and Mr. Budoff ended in 1973, after which day-to-day operations were handled by Mr. Gene Laston.

In 1968, Lake Township zoning licenses were issued allowing a variety of solid waste materials to be accepted at the site. A solid waste disposal license was first issued in 1969 by the SCBH and the program was reviewed annually by the Ohio Department of Health from 1968 to 1972, and the Ohio Environmental Protection Agency (Ohio EPA) from 1972 to 1980. It was reported that waste from hospitals, septic tank cleaning firms, and the general public was also accepted at the site. According to reports by Ohio EPA, the landfill received industrial waste primarily from the rubber industry in Akron, Ohio.

Originally, the Ohio EPA estimated that about 780,000 tons of wastes were buried at the site. Based on information obtained from potential responsible parties (PRPs), it is known that they alone have deposited 1,000,000 gallons of wastes at the site. Substantial quantities of chemical and liquid wastes were dumped onto the ground either from 55-gallon drums or from tanker trucks.

According to information provided by a past landfill employee, chemical wastes were reportedly dumped at the rate of 27,000 gallons per week in 1969. Estimates indicate an increase to approximately 70,000 gallons per week during at least a portion of 1972. (Lake Township Trustees Committee, 1984).

Although much of the liquid wastes were listed as latex and oil at the time of disposal, witnesses believed that solvents and volatile industrial chemicals were also disposed at the site. Information obtained from PRP estimates indicate that as many as 60,000 barrels of liquid wastes were dumped on the ground at the site, out of which only 25 percent were thought to be latex. The contents and composition of the remaining 75 percent are unknown.

According to site owners/operators, flyash was received at the site throughout much of its operational life. Liquid waste materials were generally mixed with flyash which served to some extent, as an absorbent, and generally deposited on the ground. As will be discussed in greater detail in Section 3, an evaporation lagoon was also constructed and used for the disposal of liquid wastes.

The Stark County Board of Health (SCBH) ordered the cessation of dumping of chemical (liquid) wastes on January 24, 1972. However, the recollection of community residents indicates that the receipt of liquid wastes may have extended beyond this date. In 1980, due to public concern, and because the facility was reaching its volumetric maximum, the SCBH and Stark County Court of Common Pleas ordered closure of the landfill. A closure plan was developed by a consultant under contract to the owners. The landfill site was then covered and seeded.

Subsequent to the site's closure, concern began to emerge about the migration of methane and other volatile organic compounds from the site. Gas monitoring activities by various organizations revealed high concentrations of methane gas around the IEL site. The concentration of methane at selected locations (including in the soil under the crawl space under one of the private residences and also in boreholes) reached levels which were 100 percent of the Lower Explosive Limit (LEL). This means that the gas-air mixture would burn explosively in the presence of an ignition source. Gas monitoring devices were installed in the homes adjacent to the site. The landfill owner installed 13 passive gas vents with flares at selected locations on the site. The gas vents were positioned along the western and northern areas of the site in an attempt to intercept gases which might have been migrating towards populated areas.

When further monitoring revealed continued high levels of methane near the site, contractors working for the U.S. EPA performed an Emergency Response action and installed the present active methane venting system and gas monitoring well network. Since this system has been on-line, the methane migration potential of the site has been controlled so that the homes along the border have been protected.

1.1.4 Chronology of Events

Presented below is a chronological history addressing facility operations, enforcement activities, and response actions at the IEL site.

Date	Events
1956	The site was the location of a sand and gravel mining operation.
1961	The sand and gravel mining operation ceased. Local residents used the site as a garbage dump.
1964-1966	According to Mr. Charles Kittinger, owner and operator of the site from 1966-1968, flyash was the only material hauled to the site during the 1964-1966 period.
1966	Mr. Charles Kittinger acquired title to the property from Mr. Richard and Ms. Janet Sheets. A County Health Department license was granted to Mr. Charles Kittinger for operation of the landfill. The license limited the materials that could be disposed at the site. Residential garbage was not included as an acceptable waste.

1968 Mr. Charles Kittinger went into business with Mr. Hyman Budoff and Industrial Excess Landfill Inc. was formed.

According to Stark County Health Department (SCHD), liquid latex was carried to the site in tanker trucks or barrels, and disposed into a lagoon. Also, semi-solid latex was brought in drums and was either emptied out of the drums or buried whole. A former employee estimated that approximately 100 barrels a day were disposed at the site.

1969 The Zoning Board renewed the landfill's license for 1970 with the addition of several new waste materials. At the Board meeting, it was reported that oil and grease were brought to the site in drums, emptied and the drums reused. Also about 10,000 to 20,000 gallons per week of liquid oils were disposed at the site.

1970 The Lake Township Trustees requested Stark County Health Department (SCHD) to investigate the cause of a fire that occurred at the site on August 18th.

1971 According to Fire Department records, two fires occurred at the site. One originated from the dumping of barrels containing physically hot materials; the other from an unknown source of ignition.

Complaints were received from nearby residents about a strong odor which originated from two drums of a sulfur-containing liquid which accidentally was broken open at the site.

A resident who worked at General Tire and Rubber Company reported to the zoning inspector that chemical waste from their laboratory was carried to the landfill in barrels. There also were several complaints about lampblack from the landfill blowing into homes as a black dust.

1972 The Zoning Board held several meetings. About 50 residents attended one of the meetings to object to the landfill's operation. Also a petition was circulated to close the landfill.

At another meeting it was reported that a resident witnessed 18 garbage trucks using the landfill. The resident also observed the disposal of drums or barrels. The landfill's attorney who attended the meeting responded, "The drums did not contain liquids but hard rubber and lampblack."

The Stark County Board of Health adopted a resolution to prohibit the dumping of liquid wastes at the site due to the potential for causing contamination of water supplies and due to odors.

The landfill's license was renewed, but with some restrictions, including specification of the types of wastes to be disposed at the site.

1973 Mr. Kittinger terminated his association with Industrial Excess Landfill Inc. Mr. Budoff continued to operate the landfill.

An investigation found that barrels containing solid material were unloaded at the site. No septic tank effluent or chemicals were observed at the site.

1974-1976 There were no records of continued liquid dumping at the site. However, a Fire Department report indicates a fire at the landfill caused by a chemical reaction between dumped materials.

1977-1978 Numerous violations occurred at the site. The township Zoning Board renewed the 1978 license for only five months. The Board denied the following renewal request and ordered all operations to cease.

Industrial Excess Landfill, Inc. filed a suit with the Zoning Board of Appeals. The order to cease operations was suspended pending the final determination of the appeal.

To obtain an operating license, the Industrial Excess Landfill, Inc. signed an agreement with the Stark County Board of Health to correct problems at the landfill.

1979 Poor operating conditions at the site continued, including leakage of an unknown liquid stored on the property.

1980 The Stark County Health Department was informed that the landfill had been closed. The Township Trustees took Industrial Excess Landfill to court to force proper closure of the site. The corporation agreed. However, most of the cover materials were sand and gravel. Numerous outbreaks of leachate were observed. Also observed were elevated methane levels in the filled areas of the landfill. Information also indicated that the methane was migrating off site toward a day care center, two houses and a restaurant.

1984 The U.S. EPA proposed that the IEL site be put on the National Priorities List (NPL). A Work Assignment was issued in December for performance of a RI/FS at the site.

1985 U.S. EPA began RI/FS activities at the IEL site.

1986-87 U.S. EPA Emergency Response Team (EmRT) installed an active Methane Venting System (MVS) at the site.

1987 EmRT installed in-home air strippers to remove vinyl chloride from water supplies of the homes to the west of the landfall.

U.S. EPA chose to study the provision of alternate water as an operable unit for selected homes in the vicinity of the IEL site. A decision to provide alternate water to selected homes was made on September 30, 1987.

1988 PRPs agreed to design the proposed alternate water system and a cooperative agreement was established with the State of Ohio.

1.1.5 Previously Obtained Data and Information

This section provides summaries of environmental studies and various sampling activities performed at the IEL site prior to the start of the RI/FS.

January 1984 - Preliminary Sampling Investigation of Five Residential Wells Near the Industrial Excess Landfill, Uniontown, Ohio.

This study was conducted by Ecology and Environment, Inc. at the request of U.S. EPA. The task was to sample five residential wells situated at various locations around the landfill. The report prepared by the U.S. EPA Field Investigation Team (FIT) summarizes the results. The investigation included the collection of water samples at five residential wells and analysis of these samples for organic and inorganic pollutants.

The results of the organic analysis suggested that there was organic contamination in the water. However, the sampling was not adequate enough for a definitive conclusion. The inorganic analysis results indicated elevated concentrations of iron varying from 380 to 3300 micrograms per liter (ug/l), and manganese 130-330 ug/l in almost all the sampled wells. Boron was detected at 3100 ug/l.

March 27, 1984 - Report on Sampling of Residential Well Water Supplies in the Vicinity of the Industrial Excess Sanitary Landfill, Uniontown, Ohio.

Ohio EPA conducted the study and collected 24 groundwater samples from domestic and commercial wells around the landfill. The samples were analyzed for a standard array of organic and inorganic constituents. The report, submitted by the Ohio EPA, concludes:

1) Water samples analyzed for primary drinking water standards were below the detectable limits. The analysis was for the following contaminants: nitrate, arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver.

2) Among the constituents for which analyses were made, secondary drinking water standards were exceeded for total dissolved solids and chloride. Phenol was also detected. Sulfate and sodium levels were found to be below the secondary limits.

3) Other organic constituents were not detected.

It was concluded from these studies that the majority of the wells sampled had excellent water quality based on most parameters. Elevated total dissolved solids (TDS) and phenol levels were noted and it was suggested that the landfill was the principal source of these parameters. Additional monitoring was recommended to confirm the results.

June 19, 1984 - <u>Report on Intensive Methane Monitoring Survey in and Around Industrial Excess Industrial Area, Uniontown, Stark County.</u>

Ohio EPA conducted an intensive methane monitoring survey at 38 locations in and around the landfill. The results obtained from these surveys indicated very high methane concentrations, except at two of the selected monitoring sites. Methane was checked at six points within the sod farm, and no detectable quantities were found. The southern bog area was also surveyed and no methane was detected. Three septic tanks were investigated as possible methane gas sources and the results were also negative.

November 19, 1984 - <u>Landfill Gas Monitoring at IEL, Uniontown, Ohio: Well Installation and Preliminary Monitoring Results</u>.

This report was submitted by SCS Engineers to Ohio EPA. The objective of the investigation was to determine the extent of gas migration at the landfill site. Field and laboratory analyses were conducted to analyze gas composition.

Field analyses were performed for methane, carbon dioxide, oxygen, and pressure. Laboratory analyses were performed for methane, carbon dioxide, nitrogen and oxygen. From the studies it was concluded that the subsurface gas was probably landfill gas, and its origin was probably the Industrial Excess Landfill.

October 18, 1984 - Charcoal Tube Analysis-IEL.

This report was submitted by Roy F. Weston, Inc. The charcoal tube analysis showed no priority pollutants present (detection limits of 0.1 mg/cubic meter), however the GC/MS identified the major components collected by each tube as hydrocarbons in the C_4 to C_8 range.

- Miscellaneous Investigations

  1. Numerous explosivity surveys of the residential area around the Industrial Excess Landfill were conducted by the Uniontown Volunteer Fire Department and Ohio EPA and confirmed several locations with concentrations of flammable gases.

  2. The Technical Assistance Team (TAT) conducted air sampling on October 4, 5 and 11, 1984 by using an organic vapor analyzer (OVA) which showed high concentrations of organic vapor in the atmosphere, and a combustible gas indicator that confirmed the presence of explosive atmospheres at selected locations.

  3. Ohio EPA and U.S. EPA conducted several rounds of testing of water wells near the site to determine the extent of groundwater contamination. An inspection report of Ohio EPA noted the observation of leachate flowing into Metzger Ditch. The leachate problem was observed by Ohio Health Department on

March 10, 1980. Leachate samples showed extremely high concentrations of certain chemicals including phenol, iron, manganese and ammonia. In another site inspection on December 4, 1980, elevated levels of methylene chloride were found.

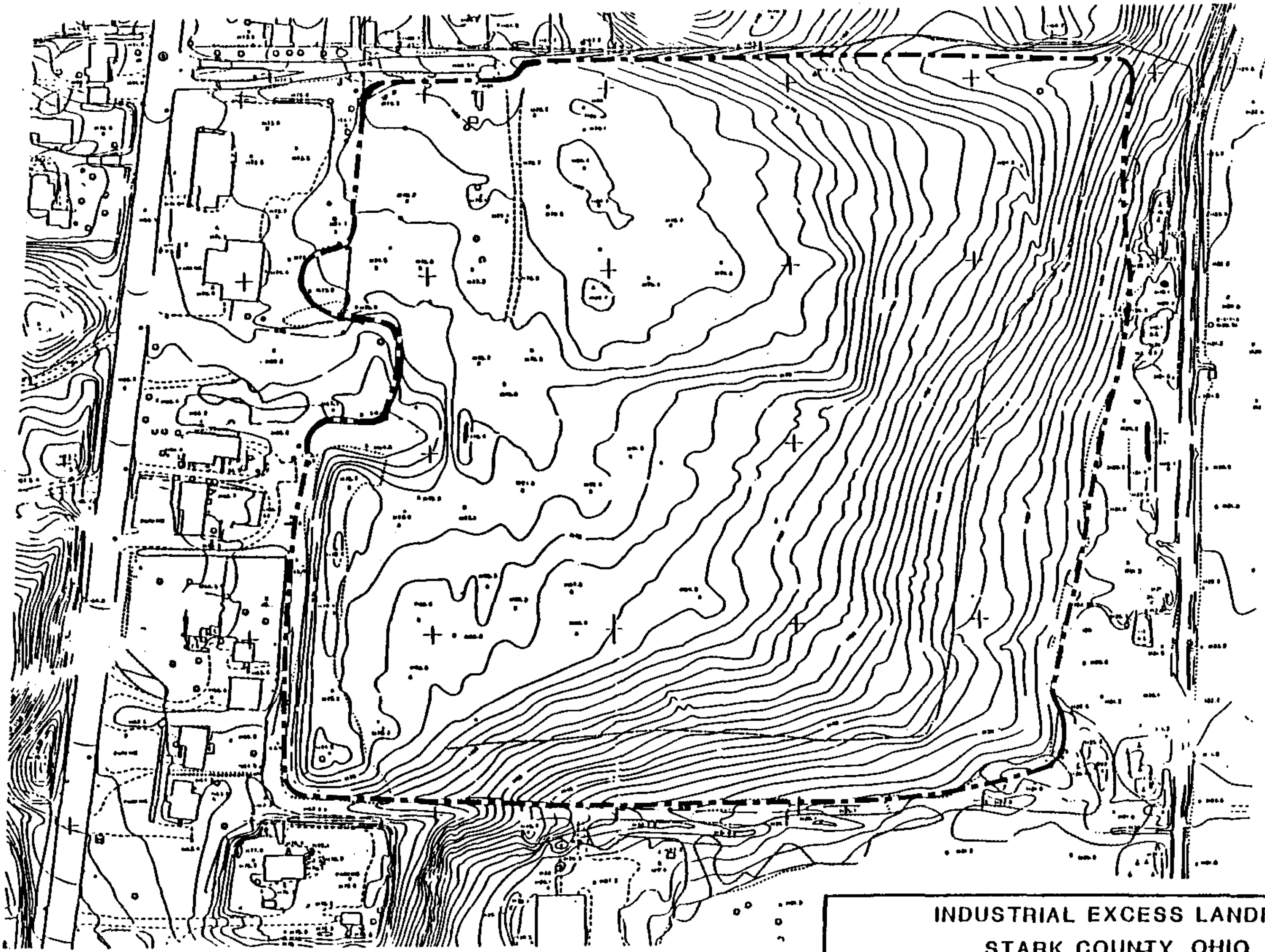
4. In March 1984, tests were conducted by Ohio EPA on leachate coming from the site. High levels of phenol were detected in the seepage. To assess stream impacts from the landfill, Ohio EPA collected samples on June 4, 1984 both from upstream and downstream of the landfill area, and at an identified seep area. The results indicated a violation of Ohio State Water Quality Standards for iron, with values of 3,890 ug/l and 1,340 ug/l at the upstream and downstream site, respectively. No other violations were noted for water quality criteria. The downstream site showed reductions in the levels for most constituents, except for nitrate. Samples from identified seep areas showed elevated levels of COD, phenols, ammonia, and iron, which is typical of leachates.

Other investigative activities conducted at the IEL site will be discussed within the context of this RI Report.

1.2 NATURE AND EXTENT OF THE CONTAMINATION PROBLEM

1.2.1 Known Waste Disposal Areas

During the operation of the IEL site, landfilling of municipal, commercial, and industrial wastes occurred over approximately 80-85 percent of the site property. Many of the industrial wastes deposited in the landfill would be considered hazardous wastes by current criteria. The area of landfilling is shown in Figure 1-6. The IEL site was privately owned and operated until the operation was terminated by court order in 1980. The site then underwent an engineered closure, including grading, placement of cover



LEGEND

-·-—·— APPROXIMATE LIMIT OF WASTE

scale approximate 1" : 200'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 1-6

APPROXIMATE LIMIT OF WASTE

C.C. JOHNSON & MALHOTRA, P.C.

material, seeding and slope stabilization. It was not unusual to find buried waste materials right up to the adjoining property line. During the installation of MVS monitoring wells, buried wastes were also noted at an offsite area behind a commercial building (the tire shop) located close to the northwest corner of the site.

Due to the varying topography at the site, the depth of landfilling ranges from an approximate maximum of 60 feet at the northwest corner of the site to an approximate minimum of several feet along the south and east portions of the site. Areas which did not receive landfilling are those for which the water table is only several feet below the ground surface, especially along the eastern edge of the site.

Along with the landfilling of solid wastes, substantial quantities of liquid waste were dumped onto the ground either from 55-gallon drums or from tanker trucks. These liquids were typically mixed with flyash on the ground. Although great volumes of liquid wastes were listed as latex and oil by the generators, witnesses have described the disposal of, what they believed to have been, solvents and industrial chemicals which were volatile and/or had foul odors. According to a past employee, only those drums which could not be emptied of their contents were landfilled. Others were typically emptied and returned to the generator. While it is possible that liquid filled drums may have been deposited at the landfill, the information provided by the past employee suggests that their occurrence would be rare. Also, the drums which were uncovered during the trenching required for installation of the MVS either contained solid materials or were crushed.

1.2.2 Current Situation

Sampling of private residential and on-site and off-site monitoring wells has shown minor to significant groundwater contamination by volatile and semi-volatile organics and by metals. The most highly contaminated monitoring well contains approximately 400 ppb of assorted Hazardous Substance List (HSL) volatile and semi-volatile organic compounds and another 2,000 ppb of an array of tentatively identified organic compounds (TICs). Compounds of greatest concern found in the monitoring wells include the "known or suspected carcinogens" benzene and 1,2-dichloroethane. Vinyl chloride was found in three private wells downgradient from the landfill. Barium exceeds drinking water standards in two other residential wells. Nickel is present at higher than Ambient Water Quality Criteria levels in 8 downgradient homes. Groundwater contamination is presently confined to the shallow portions of the sand and gravel aquifer.

Groundwater contaminated with volatile and semi-volatile organic compounds and with metals is known to exist at on-site locations and immediately adjacent to the landfill. Based upon monitoring well and residential well sampling, this contamination is known to extend several hundred feet downgradient (west) of the site.

Organic and inorganic contaminated soils and sediments exist at scattered locations on the landfill property. These contaminated solids are closely associated with miscellaneous waste material and buried waste materials. Sampling of soils and sediments indicates that contamination of these media is limited to the area encompassed by the site.

1.2.3 Effects Of Contamination

Contamination has affected private groundwater supplies of residents and businesses on Cleveland Avenue, immediately to the west of the landfill. The contamination includes low levels of vinyl chloride, chloroethane, barium, and nickel, as well as elevated levels of total dissolved solids. Groundwater contamination due to the landfill is presently confined to the sand and gravel aquifer. There is no evidence of landfill-associated substances in the bedrock aquifer. Some of the private residential water supply wells downgradient (west) of the landfill tap this shallow sand and gravel deposit and thus the potential exists for additional residential wells to become contaminated. Furthermore, since the shallow sand and gravel aquifer and underlying bedrock sandstone aquifer are in hydraulic communication, there exists the potential for contamination of wells that tap this deeper aquifer.

The landfill is drained by Metzger Ditch which flows southward along the east side of the landfill and continues southwest beyond the southern boundary of the site. Samples of surface water, sediment, and soil associated with Metzger Ditch indicate that no contamination is presently leaving the landfill by this route.

1.2.4 Mitigation Activities

In response to off-site migration of methane gas and the contamination of water supplies of two residences and one business by vinyl chloride, the following mitigation activities have been implemented:

- U.S. EPA Emergency Response Section has installed an active methane venting system to alleviate the gas migration problem. Extraction wells have been placed along the entire western property line, and portions of the north and south property lines where off-site migration of gas could impact nearby residences.

- U.S. EPA Emergency Response Section has placed in-house air strippers at eight residences and two business along Cleveland Ave. The units treat all incoming water for vinyl chloride contamination.

- In addition, a new fence was installed along the west property line, and a portion of the south property line. This fence was installed after installation of the methane venting system to restrict site access.

1.3 REMEDIAL INVESTIGATION SUMMARY

For any site the primary objectives of the RI/FS are:

- To acquire data necessary to determine the site's exposure potential and identify potential remedial actions;

- To evaluate and develop feasible alternative remedial measures for the site; and

- To recommend effective alternative remedial action(s) from which the final action will be chosen by the U.S. EPA.

1.3.1 Purpose and Objectives of the Remedial Investigation at IEL

On December 26, 1984, the U.S. EPA issued a work assignment requiring that a RI/FS be conducted for the Industrial Excess Landfill.

Remedial Investigation field activities were conducted by the REM II team at the landfill and surrounding areas from August 1985 through February 1988.

The focus of the RI field activities was to assess the extent of existing contamination on and around the site. Specific objectives include:

- Determine the extent of landfilling.

- Determine the nature and extent of groundwater, surface-water, sediment, and soil contamination on and adjacent to the site.
- Assess the extent of off-site migration of contaminants and their impact on potential receptors.
- Determine whether the site poses a hazard to public health, welfare, or the environment.

In order to meet these objectives, field activities included the following tasks and subtasks, as specified in the Work Plan:

Site Boundary Survey

Site Topographical Survey
  a) Establish a Reference Grid
  b) Locate Sampling Points
  c) Monitoring Well Elevations

Geophysical Investigation
  a) EM Survey
  b) Resistivity Survey
  c) Seismic Survey

Air Quality Sampling

Surficial Soils/Sediment Sampling

Well Installation
  a) Slug Tests
  b) Subsurface Soil Sampling
  c) Borehole Logging

Groundwater Sampling

a) Monitoring Well Sampling
b) Residential Well Sampling

Surface Water Sampling

The areal extent of field activities is shown in Figure 1-7. The site was the initial focus of field operations and activities were extended outward to determine the extent of landfill-originated contaminants. Details concerning the extent to which landfill-attributed contamination was observed is described in the appropriate sections of this report. Investigation activities were extended beyond this area to confirm that there was no contamination present. In some cases, selected locations within the study area (shown in Figure 1-7) were used for control purposes, and therefore, were distant from the site.

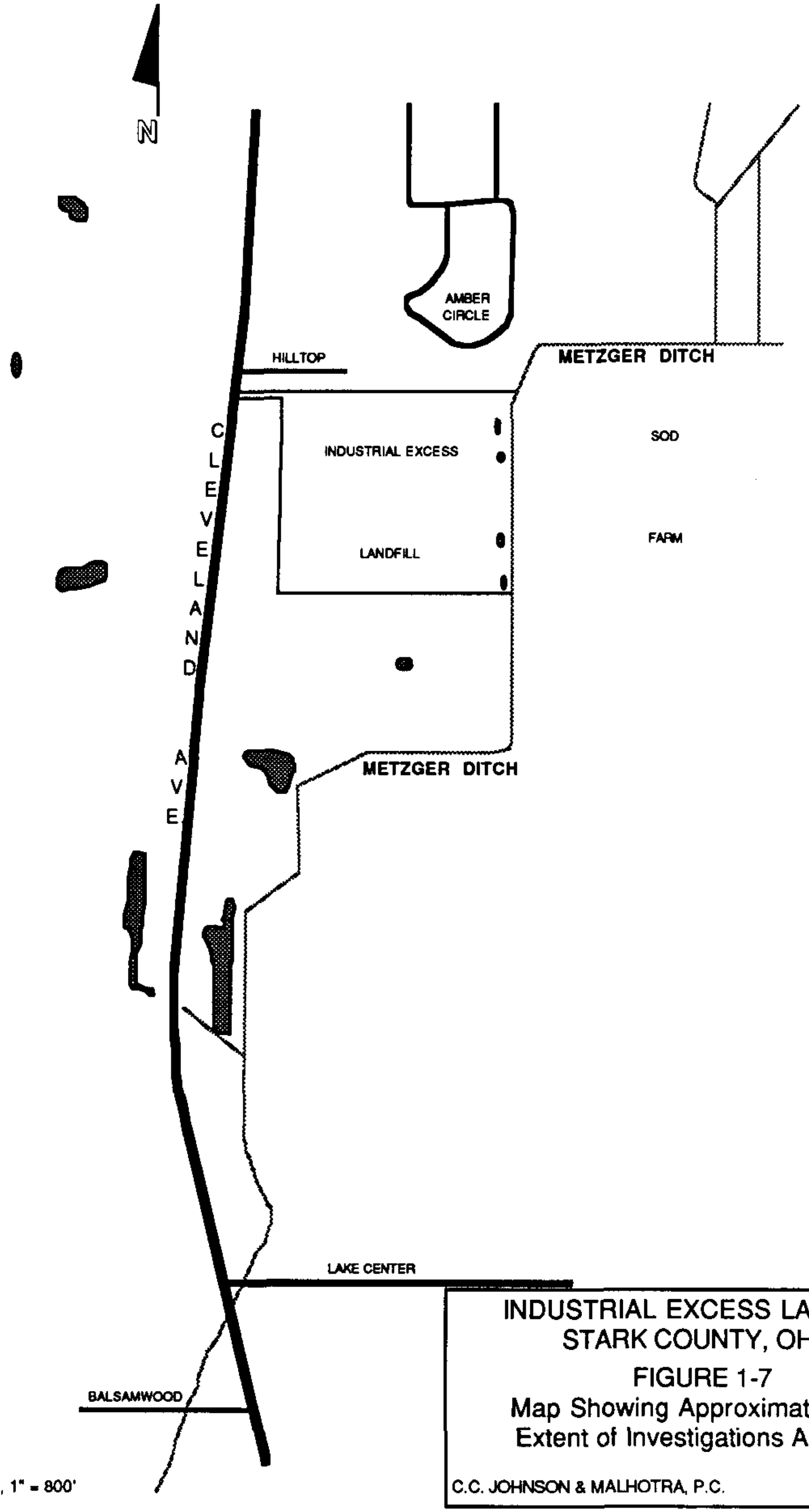
1.3.2 Remedial Investigation Field Procedures

Sampling and sample shipment activities were performed by the REM II team. Other activities were performed by REM II subcontractors under the direction of a CCJM field manager.

The following documents, prepared by CCJM, specified plans and procedures utilized during Remedial Investigation field activities:

- Industrial Excess Landfill Remedial Investigation Work Plan, July 1985 (Document No. 157-WP1-WP-AZWY-4)

- Quality Assurance Project Plan and Sampling and Analysis Plan (QAPP/SAP) for Industrial Excess Landfill, June 1986 (Document No. 157-WP1-OP-CUSS-1).



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 1-7
Map Showing Approximate Areal
Extent of Investigations Activities

C.C. JOHNSON & MALHOTRA, P.C.

- Supplemental QAPP for Groundwater Sampling at Industrial Excess Landfill, April 1986 (Document No. 157-RI1-OP-CLCK-1).

- Invitation for Bids (IFB) to Perform Monitoring Well Installation and Geophysical Testing at Industrial Excess Landfill, November 1985 (Document No. 157-RI1-PS-BUWM-2).

Field Activities associated with the Remedial Investigation were under the guidance of the Health and Safety Plan for Industrial Excess Landfill, February 1986 (Document No. 157-WP1-OP-ATFR-4).

Most activities were conducted at personnel protection level D with the exception of the start of drilling at each of the on-site borehole locations. At these locations, drilling was begun at level C, then downgraded to level D when monitoring instruments indicated background levels in the breathing zone.

1.3.3 Other Field Activities

The following is a listing of other activities which were performed at and around the IEL site during the time that the RI was being conducted:

- In response to the imminent danger to the border homes caused by migrating methane gas, U.S. EPA's Emergency Response (EmRT) and Technical Assistance (TAT) Teams installed an active methane venting system (MVS). This action was initiated after Ohio courts deemed the existing passive system (installed by the site owners) was not effective in protecting the homes adjacent to the site. Periodic monitoring by the EmRt contractors is an ongoing element of this project.

- Investigation of the potential for the existence of an underground fire in the landfill. Performed by EmRt and consisted of infrared detector flyovers, and monitoring of gas temperatures and composition within the Methane Venting System (MVS).

- After analytical data obtained during the RI indicated that unacceptable levels of vinyl chloride were present in the residential wells of selected structures adjacent to the landfill, the decision was made for the EmRT to install in-home air strippers in the border homes.

- On three separate occasions, U.S. EPA's mobile gas chromatograph mass spectrometer was brought to the IEL site area to perform a variety of in-home and environmental air sampling in the Uniontown area. The most recent of these investigation was the most extensive, and was designed to provide supplementary data to the preceding studies. The effort included numerous on-site and off-site soil gas punch probes, gas monitoring well sampling and gas samples at selected water monitoring wells.

- In response to community complaints about explosions in the area, contractors from U.S. EPA installed a seismic monitor at the site to assess whether the complaints could be due to underground explosions at the landfill. A report describing the results obtained from the seismograph is presented as Appendix D. There were no seismic disturbances other than two distant earthquakes. Thus, there was no association between the landfill and local reported disturbances.

- The State of Ohio, via its Ohio Environmental Protection Agency (OEPA) has had an ongoing program of environmental monitoring at the IEL site. These investigations have included the periodic monitoring of wells located at various locations around the site, performing punch probes to determine the methane concentrations in soil around the site, and the sampling of selected environmental media. The most recent effort was performed during February 1988 and included samples of water (surface and residential) and sediment from selected locations in the Uniontown community.

- Due to the residential water contamination of the nearby wells, the decision was made to establish alternate water as an operable unit within the IEL RI/FS. A focused feasibility study was performed and a source of alternate water was selected. The Record of Decision for this operable unit was signed on 30 September 1987.

1.4 OVERVIEW OF RI REPORT

Section 2.0 of the report describes site features including demography, land use, natural resources, and climatology. These descriptions are based on published data for the site area as cited in the text.

Section 3.0 summarizes the wastes and their respective characteristics and behavior. This section addresses waste quantities, locations and containment and their component characteristics.

Section 4.0 provides a summary of the geology and hydrogeology of the site area. Included in this section is a description of the geologic features, the hydrogeologic framework and the groundwater flow patterns. In addition, the section identifies contaminant levels determined in the soil and groundwater contamination investigations.

Section 5.0 addresses the hydrologic investigation conducted at and around the site. Included in this section are discussions of drainage patterns and the investigation and results of the surface water and sediment sampling programs.

Section 6.0 presents the results of the air investigations conducted at and around the site, and in the Uniontown community.

Section 7.0 describes the geophysical investigation that was carried out at the site. This section discusses the techniques used and the results of each of the types of surveys performed.

Section 8.0 is the public health evaluation. This section discusses an evaluation of the public health and environmental concerns posed by the conditions at the site.

2.0 SITE FEATURES INVESTIGATION

During the Remedial Investigation, various site features that were considered germane to the evaluation of the site were examined. These features, including demography, land use, natural resources, and climatology are discussed in the following sections.

2.1 Demography*

Approximately 2,500 to 3,000 people live within one mile of the IEL site. This population is racially rather homogeneous with 99 percent being white and the bulk of these people having German, English, and Irish ancestors. The average age of the population is 29 years (Figure 2-1). Adults living in this community are relatively well educated as illustrated in the table below:

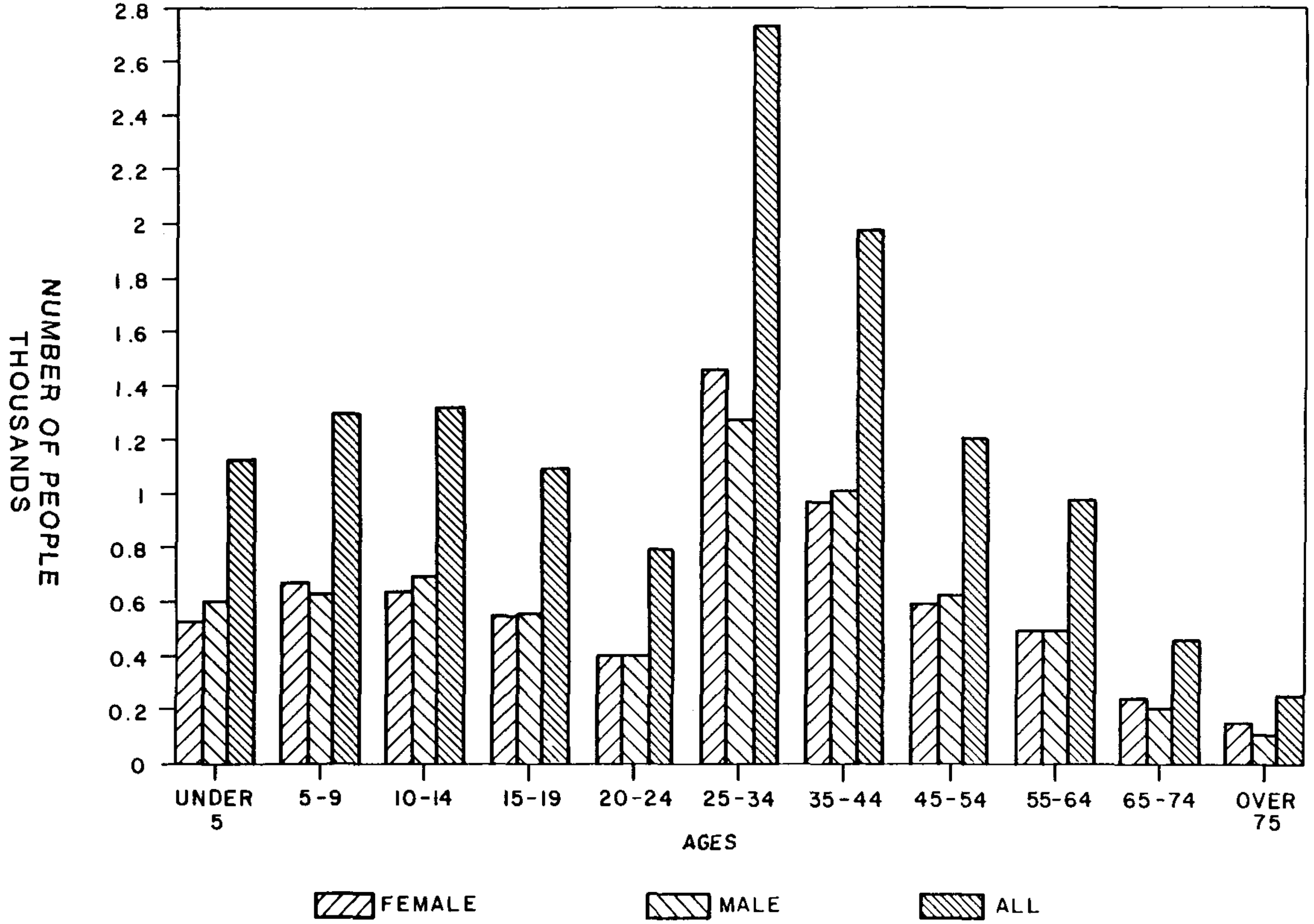
	Amount of Education					High School Graduates
		High School		College		
	0 - 8	1 - 3	4	1 - 3	4 & more	
West Lake Township	9.5%	9.9%	46.3%	15.2%	19.1%	80.6%
Stark County	15.2%	17.5%	44.8%	11.3%	11.3%	67.4%

---

* Data taken from 1980 census and data supplied by Stark County Regional Planning Commission.

URE 2-1

AGE DISTRIBUTION OF RESIDENTS NEAR IEL



This greater-than-average level of education is also reflected in the higher percentage of traditionally "white collar" occupations versus traditionally "blue collar" occupations when comparing western Lake Township workers to workers in all of Stark County (Figure 2-2). Hand-in-hand with the area's higher level of education and higher percentage of traditionally well-rewarded white collar workers is an income distribution which is heavily weighted at the high end (Figure 2-3). This pattern is more pronounced in western Lake Township than in all of Stark County. The median household income for the community near the IEL site is $24,059 and that for all of Stark County is $18,620.

Nearly all (96%) of Western Lake Township workers drive to their jobs. The average one-way driving time is approximately 22 minutes.

A 1985 report of the Stark County Regional Planning Commission (SCRPC, 1985) predicts a decrease in population in the Uniontown area as the population ages. Due to the relative unavailability of developable land, few new families can be added.

2.2 Land Use

The area near IEL is predominantly a residential community that has successfully competed for land formerly devoted to rural and agricultural uses. Homes immediately to the north and west of the landfill were built in the late 1940's to 1950's. Development of subdivisions to the northwest, southwest and south has occurred from the 1950's to the present. Building permits were issued for 29 new homes in the Emerald Hills subdivision to the northeast of IEL from 1981 to 1984 (SCRPC, 1985). New homes are being built at the time of this writing and further subdivision is planned by area land-owners.

FIGURE 2.2

OCCUPATION DISTRIBUTION OF RESIDENTS NEAR IEL

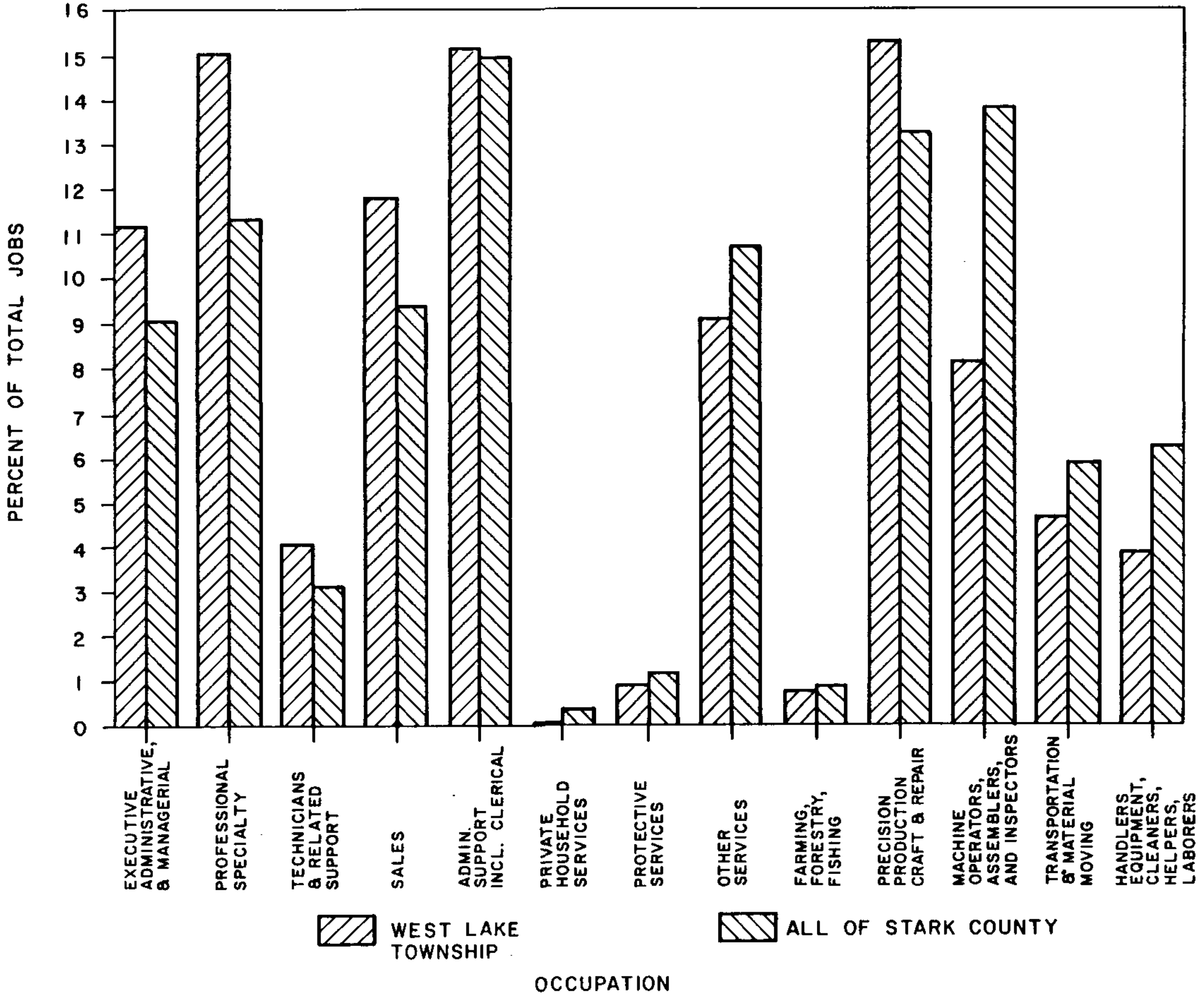
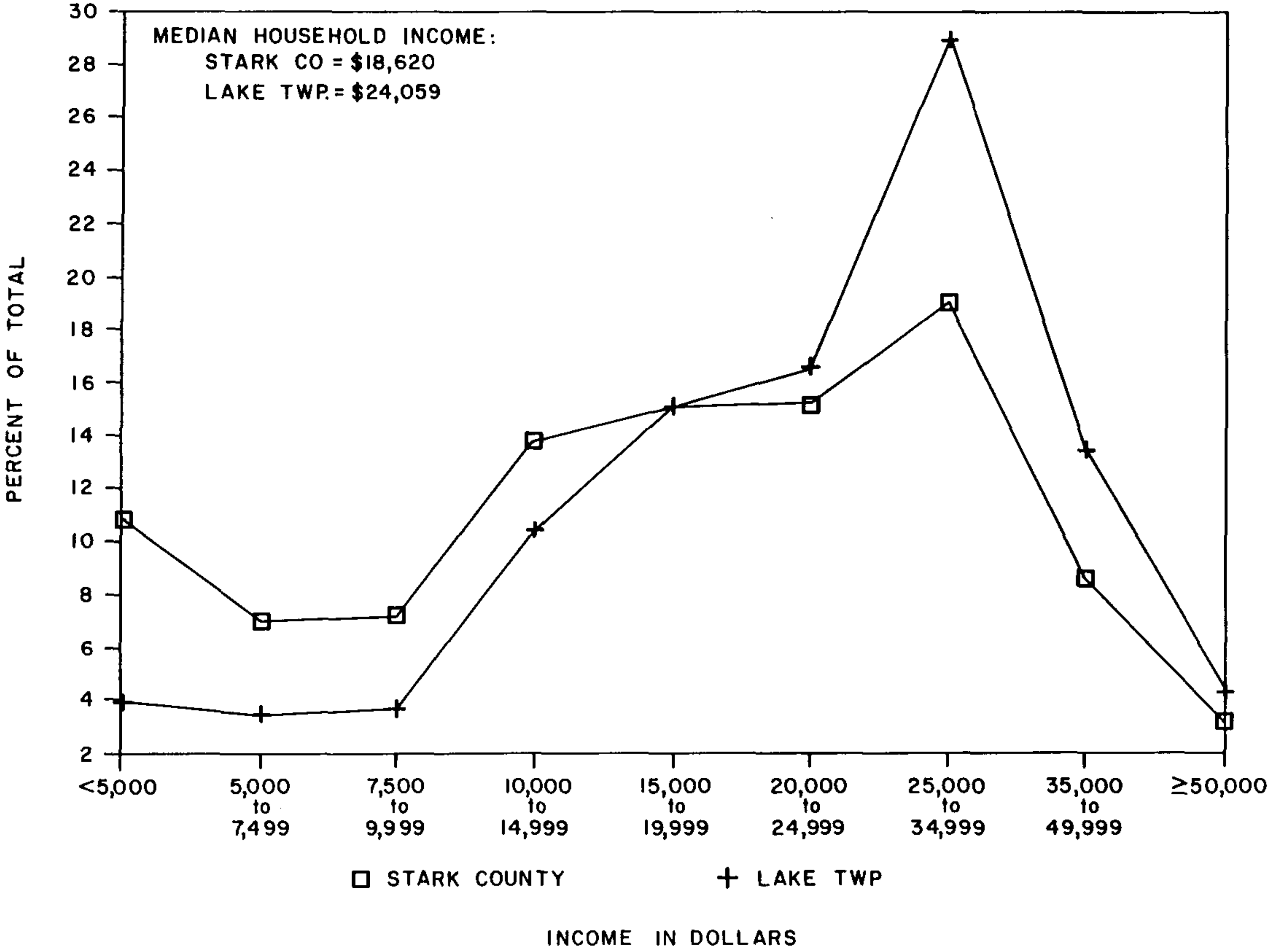


FIGURE 2.3

HOUSEHOLD INCOME DISTRIBUTION FOR RESIDENTS OF IEL AREA



MEDIAN HOUSEHOLD INCOME:
STARK CO = $18,620
LAKE TWP. = $24,059

Agricultural land use in the immediate area of IEL is confined to a sod farm that is located to the east of the landfill. Agriculture in the general area of Uniontown typically is devoted to the production of corn, wheat, soybeans, oats, various pasture and hay crops, and dairy farming. The area located a few miles to the east, near Hartville, possesses organic-rich soils and is noted for the production of vegetable crops including radishes, onions, and lettuce.

Woodland acreage within Stark County is slowly increasing in response to recent abandonment of farmland and the replanting of trees in other areas. The original forest and the trees that are reforesting the county's deforested areas are dominantly beech and maple with lesser numbers of hickory and oak. Woodland in the IEL area occurs in small copses to wooded areas of 30 acres or more.

2.3 Natural Resources

The major natural resources available in the IEL area include arable land, sand and gravel, and oil and natural gas. Agricultural use of land near IEL is described in the above Section concerning Land Use.

The abundance of glacially-derived sand and gravel deposits in the Uniontown area has led to the establishment of a number of gravel pits to exploit these resources. As described in the Section on Site Background Information, IEL was one such gravel pit before it was converted to a landfill. With evolving land use in the area, other sand and gravel pits have mostly been abandoned. A gravel pit on Myersville Road, about 1.2 miles northwest of IEL, is used sporadically.

Drilling records from the Ohio Department of Natural Resources indicate that about a dozen oil and natural gas exploration and production wells have been drilled within a mile of IEL. The target production zone for these wells is the Lower Silurian Clinton Sandstone that lies about 4,500 feet below the surface in this area. Production records from these wells indicate gas production ranging from 50 to 2000 thousand cubic feet per day and oil production from 0 to 97 barrels per day. The majority of these wells continue to produce at the time of this writing.

2.4 Climatology

(Note: The Akron/Canton Airport, located about 5 miles south-southwest of IEL has a first-order weather station from which records were used to help compile this section.)

The climate of the IEL area is mostly typical of the mid-continent of the United States. However, nearby Lake Erie has some moderating effect on cold air masses during late fall and early winter, and it also is partly responsible for heavy snow squalls until the lake freezes over.
Monthly average temperatures and precipitation are shown below:

	Average Temperature	Average Precipitation
January	25.1°F	2.56"
February	27.2°F	2.18"
March	36.7°F	3.37"
April	48.6°F	3.26"
May	58.8°F	3.55"
June	67.8°F	3.27"
July	71.6°F	4.01"
August	70.4°F	3.31"
September	63.8°F	2.96"
October	52.5°F	2.24"
November	41.0°F	2.54"
December	30.3°F	2.65"
Yearly Average:	49.5°F	35.90"

The coldest month is January when temperatures can plunge into the -20's°F. The warmest month is July with highs in the 90's°F not uncommon and low 100's°F occurring rarely. Precipitation is fairly uniformly distributed throughout the year.

Monthly average resultant wind direction, average resultant wind speed, and average wind speed are shown below:

	Resultant Wind* Direction	Resultant Wind Speed	Average Wind Speed
January	250°	8.3 M.P.H.	13.8 M.P.H.
February	240°	5.7 M.P.H.	11.1 M.P.H.
March	240°	3.9 M.P.H.	12.5 M.P.H.
April	240°	5.4 M.P.H.	10.8 M.P.H.
May	230°	1.9 M.P.H.	9.7 M.P.H.
June	270°	2.4 M.P.H.	8.9 M.P.H.
July	230°	2.2 M.P.H.	8.4 M.P.H.
August	260°	1.6 M.P.H.	6.6 M.P.H.
September	220°	2.7 M.P.H.	7.8 M.P.H.
October	170°	1.9 M.P.H.	9.7 M.P.H.
November	160°	1.8 M.P.H.	10.8 M.P.H.
December	230°	9.4 M.P.H.	12.5 M.P.H.
Yearly Average:	228°	--------	10.2 M.P.H.

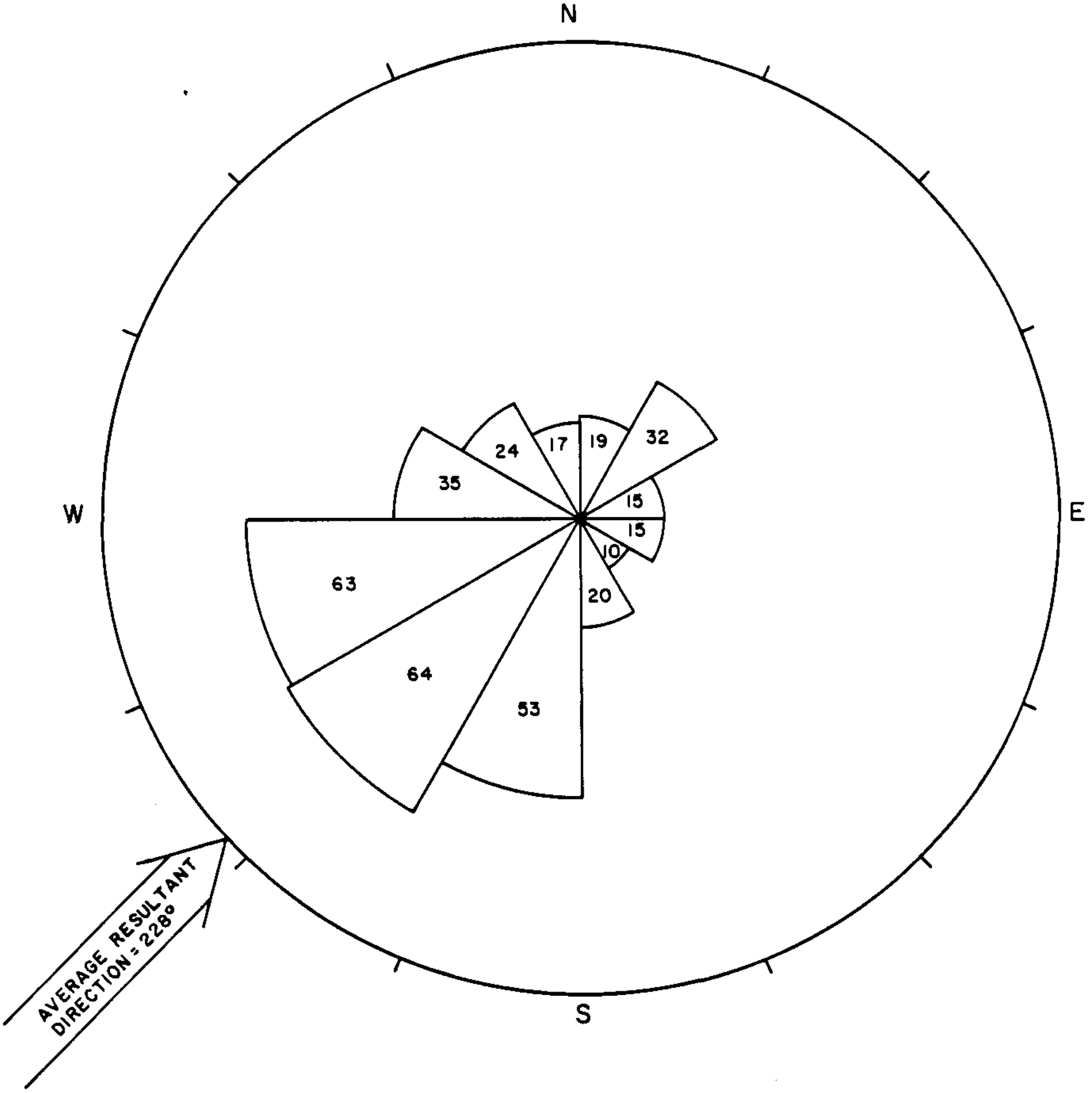
* Direction wind is from, where north is 360°, east is 90°, south is 180°, and west is 270°.

Figure 2-4 illustrates the frequency of daily average resultant wind directions. (Available wind data for 1985 did not include information for August. Therefore, information for August 1984 was used in its place.)

The windiest month at IEL is January while the summer months are relatively calm. As in much of the mid-continent area, the wind blows predominantly from the southwest (Figure 2-4).

FIGURE 2-4

RESULTANT WIND DIRECTIONS FOR AKRON-CANTON AIRPORT, 1985



NUMBERS INDICATE FREQUENCY (DAYS OUT OF THE YEAR) THAT THE DIRECTION WAS THE AVERAGE DIRECTION FROM WHICH THE WIND BLEW.

3.0 HAZARDOUS SUBSTANCES INVESTIGATION

This section presents data concerning the extent of contamination at the IEL site. The information was derived during the investigation at the site. While reference is made to the existing body of information, the focus of this section is to describe the information obtained about on-site waste materials during the performance of the RI.

The section is organized into three main sections. The first provides general information about the wastes present at the site, including particulars such as quantities, location, components, containment and composition. This section will necessarily include information from existing data sources and also information on waste management practices obtained during recent interviews with past owner/operators of the site.

The second section provides a brief overview of the characteristics of the wastes found at the site.

The third section is a discussion of the procedures used for confirming the validity of analytical data. This discussion has been added to this section to provide the reader with a better understanding of the typical procedures associated with the validation of analytical laboratory data, and to provide details of specifics regarding the data handling procedures used at the IEL site.

3.1 Waste Information

3.1.1 Waste Types/Locations and Site Characteristics

Table 3-1 provides a listing of the kinds of wastes which are suspected to have been disposed at the IEL site.

TABLE 3-1

LISTING OF SUSPECTED MATERIALS DISPOSED AT THE INDUSTRIAL EXCESS LANDFILL

<u>Permitted Wastes and Wastes Observed by Knowledgeable Persons and Residents</u>

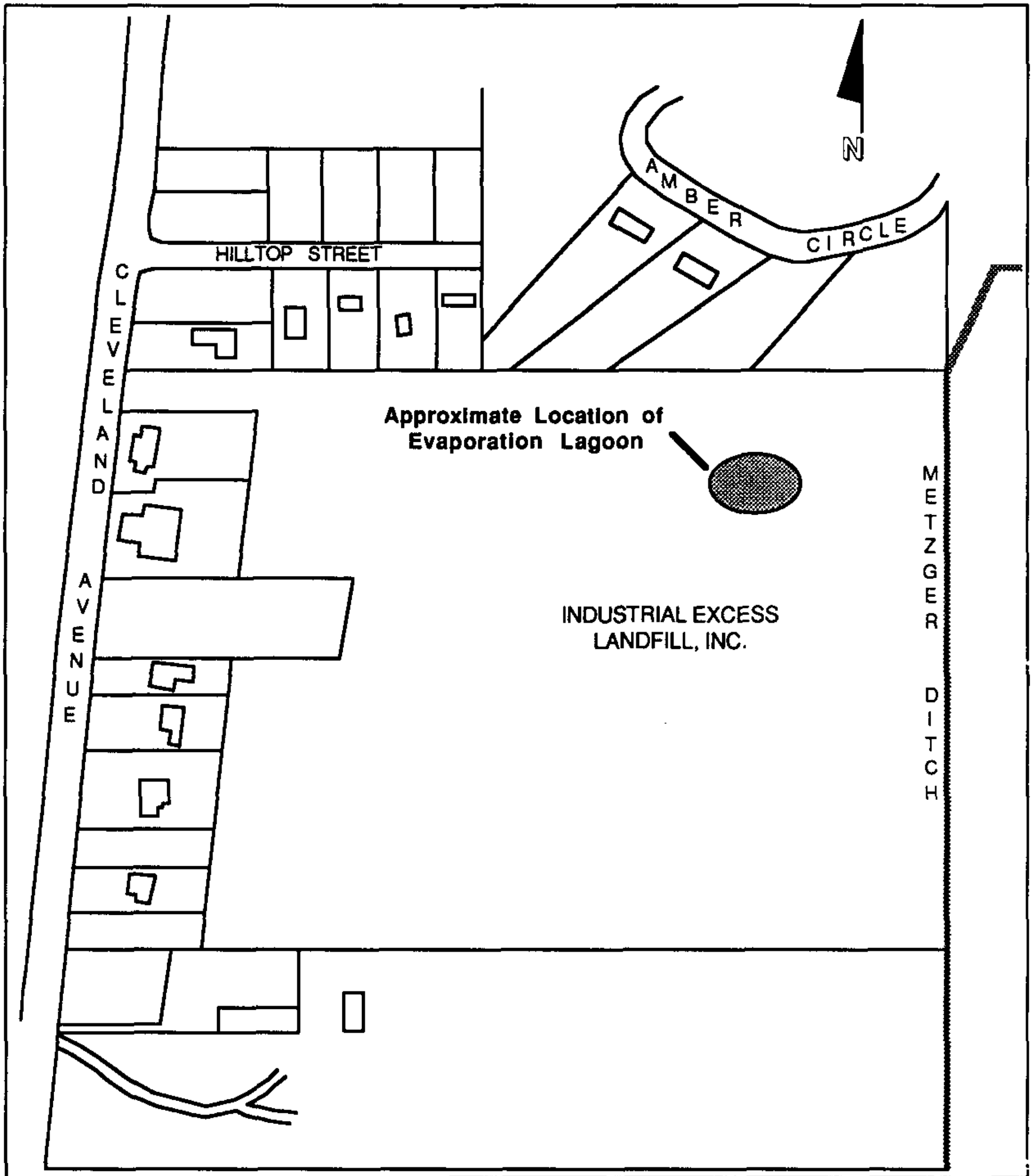
Fly ash
Garbage and household trash
Latex (solid and semi-solid)
"Sulfur liquid"; drummed wastes with odor of rotten eggs
Floor sweepings and other solid industrial wastes in drums
Large salt blocks (from an aluminum foundry)
Paper scrap with "sticky stuff"
Lab chemical wastes
Liquids wastes (described as being capable of causing burn lesions)
Masonry rubble
Paper scrap (solid or liquid)
Lumber scrap
Plastic scraps, rejects and shavings
Rubber
Non-organic oils (slightly acid) and greases
Metallic and glass refuse
Flammable liquids
Sewage (Possibly from septic tanks)
Lamp-black
Hard rubber
"Solid waste from licensed vehicles", (circa 1972)
Liquid solvents

Based on available information, the most predominant wastes (with the potential for producing potentially hazardous contaminants and/or conditions) disposed at the IEL site can be generally put into the following categories:

- Flyash
- Solid and semi-solid latex
- Liquid wastes (including oils, flammable solvents, and non-flammable solvents)
- Garbage, trash, septic tank clean-outs, and other organic matter capable of generating methane.

The flyash was obtained from coal burning facilities located at the Firestone company. This was the first waste brought to the landfill and it was used to begin the filling in of the rather deep depressions that remained after the sand and gravel deposits were removed from the site. Flyash was a waste continually brought in throughout much of IEL's operation history. Thus, one might expect flyash to be distributed throughout the landfill. When brought to the site, the flyash was usually mixed with other incoming wastes. Mixing of the flyash with the lampblack and liquid wastes tended to lessen the fugitive dust problem.

The solid and semi-solid latex materials were placed directly onto the ground. Liquids were mixed with flyash which served to some extent as an absorbent. At the suggestion of the SCHD, a lagoon was constructed to facilitate evaporation of liquid wastes. The approximate location of this lagoon, (according to an interview with Mr. Kittinger and review of site photos), is shown in Figure 3-1. Soil conservation service personnel who were typically involved in the construction of farm ponds were brought in to assist in the construction of the evaporation lagoon. Flyash was mixed



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 3-1

EVAPORATION LAGOON
LOCATION MAP

Scale Approximate, 1" = 280'

C.C. JOHNSON & MALHOTRA, P.C.

with latex liquids and other materials in order to limit the infiltration of liquids deposited in the lagoon. The lagoon apparently operated successfully and evaporated to dryness during one complete cycle. Flyash and other materials were deposited in the bottom of the lagoon to buildup a second impermeable foundation. Liquids were then added to this lagoon to evaporate.

Other liquids and garbage/trash materials were also brought in and deposited directly on the ground. A listing of specific solvents disposed at the site is provided in Table 3-2.

3.1.2 Waste Disposal Practices

As mentioned previously, the first use of the IEL site was as a location for the mining of sand and gravel. Over the 12 years that the sand and gravel facility operated, there was a steady removal of material. Sand and gravel mining operations ceased when the water table was reached. The property was sold to Mr. Kittinger to be used initially as a landfill for flyash.

Based on information obtained from Mr. Kittinger (the first owner/operator of the landfill) and Mr. Sheets (the owner/operator of the sand and gravel operation), the initial location for the deposition of the flyash was in depressions situated in the northwest portion of the landfill. The flyash was deposited directly onto the existing soil material which most likely consisted of sand and gravel. There was no liner or other impermeable material placed in the bottom of the landfill prior to the deposition of the flyash. As mentioned previously, SCHD officials worked with personnel from the local Soil Conservation Service to construct an evaporation lagoon with limited permeability. From discussion with SCHD officials, it was noted that after evaporation, the latex liquids did tend to solidify the soil material that they were mixed with during disposal.

TABLE 3-2

LISTING OF SOLVENTS AND OTHER MATERIALS DISPOSED AT THE IEL SITE

Information obtained from PRPs

- acetone
- benzene
- n-butanol
- n-butyl acetate
- ethanol
- 2-ethoxyethyl acetate
- ethyl acetate
- gasoline
- hexane
- n-heptane
- isopropyl alcohol
- isopropyl acetate
- methanol
- 2-methoxyethanol
- 1,1,1-trichloroethane
- methyl ethyl ketone
- methyl isobutyl ketone
- methylene chloride
- monochlorobenzene
- naptha
- naptha (aliphatic)
- sulfuric acid
- tetrahydrofuran
- toluene
- xylene

3.1.3 Waste Quantities

Waste materials are located underneath approximately 80 to 85 percent of the 30 acre landfill. Observations made during the RI indicates that there is also waste materials buried at an adjacent offsite location (see Section 3.1.4 for further details.) Information obtained as a result of the Potential Responsible Party (PRP) information requests, indicates that a total of 1,000,000 gallons of liquid waste materials had been disposed at the landfill. During some periods, the rate of waste deposition was as much of 11,000 gallons per day. While the total volume of the landfill is approximately 2,000,000 cubic yards (one cubic yard of solid material weighs about one ton), Ohio EPA estimates (based on information in SCHD files) indicated that 780,000 tons of wastes were disposed at the site.

As can be seen from the chronology presented in Section 1, the operation of the IEL site was not without its problems. There were many reports of violations of the prescribed waste management practices and good operating procedures. For example, there were complaints about the lack of daily soil cover, damage to nearby homes from fugitive lampblack and odors, fires, accidents, and a death. The death occurred when two landfill employees were using an unknown liquid (presumably brought to the site for disposal) as a cleaning solvent to remove materials from their hands. The liquid ignited and both persons received serious burns, one later died from his wounds.

As indicated in the chronology presented in Section 1, a number of fires occurred at the site. One of these fires may be of particular importance to developing an understanding of material dynamics at the site. The fire occurred at the evaporation lagoon. The exact date of this fire is not known. The local volunteer fire department responded, but decided that there was nothing that they could do to control the fire and still protect the safety of the fire fighting staff. Therefore, the decision was made to let the fire burn itself out. This fire burned for a number of days, and according to information obtained during interviews with the owners/

operators a large proportion of the waste residues which comprised the lagoon were consumed in the fire.

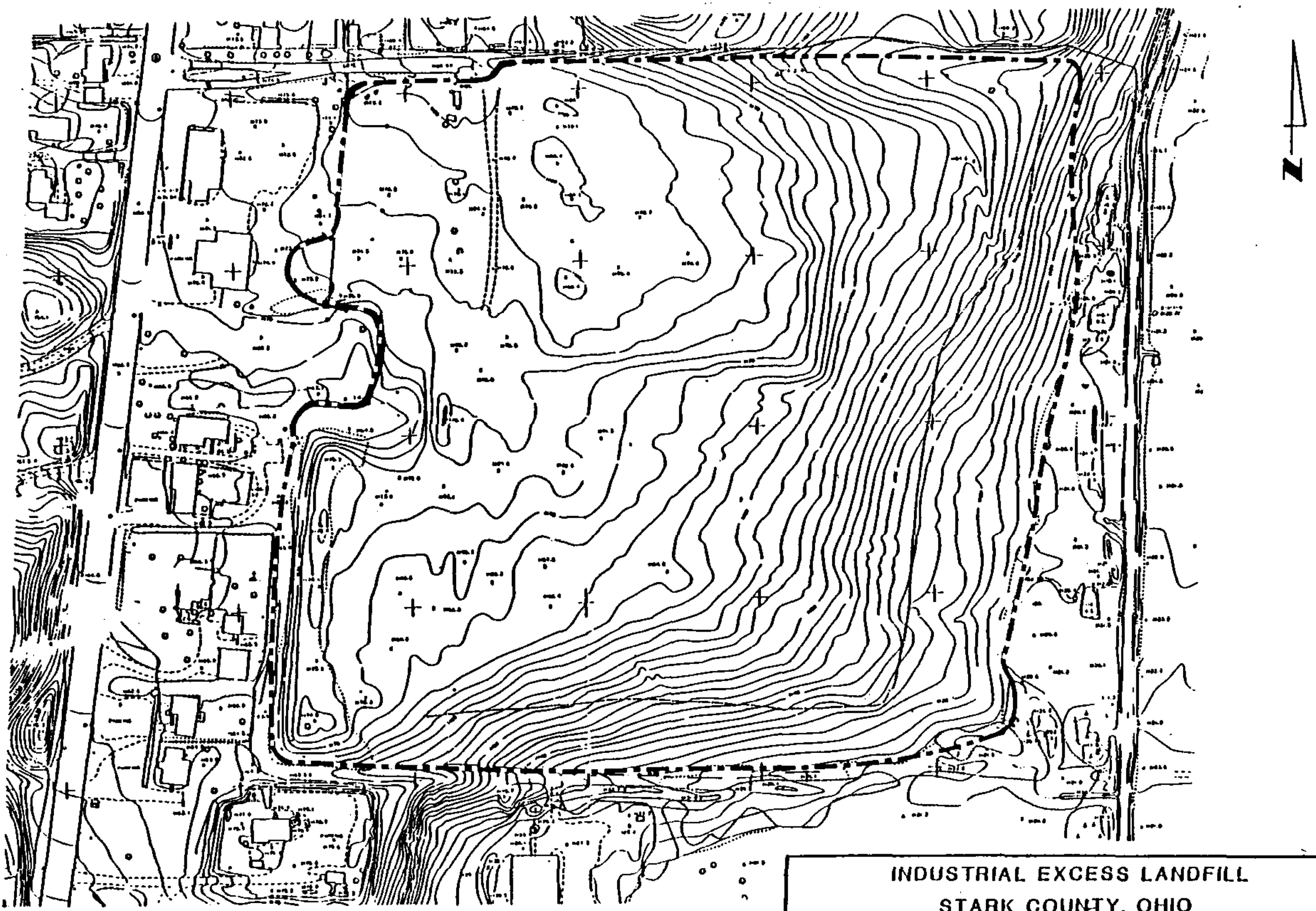
3.1.4 Waste Locations

Figure 3-2 shows the approximate location of the portions of the landfill which are underlain by buried waste materials. It was noticed that waste materials were deposited right up to the property line at some locations, especially along the southern and western boundaries. During some of the activities of U.S. EPA's Emergency Response Team (EmRT), it was also noticed that wastes had been buried off-site in the area behind the Tire Shop (Figure 3-2).

During the performance of the RI/FS at this site, community members strongly suggested that intrusive drilling be performed at the landfill in order to obtain a total characterization of landfill contents. An analysis was performed to determine the overall efficacy of intrusive drilling as a method of characterizing landfill contents. A report was prepared which concluded that intrusive drilling was both an inefficient and ineffective method of characterizing the contents of a 30 acre landfill, and that such an approach was not necessary to select an optimal remedy for this site.

Specifically, it was concluded that:

- The drilling would be dangerous and would further delay the completion of the project.
- A large number of boreholes would have to be drilled in order to obtain the samples necessary to make meaningful conclusions about landfill contents.
- Full characterization of landfill contents is not necessary in order to select a remedy for this site.



LEGEND

-·—-— APPROXIMATE LIMIT OF WASTE

SCALE APPROXIMATE: 1" to 200'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 3-2

APPROXIMATE LIMIT OF WASTE

C.C. JOHNSON & MALHOTRA, P.C.

Three leachate seep areas were observed near the edge of landfilling, on the east, south, and southeast of the site. Flows from these seeps were not continual. Each area exhibited wet or saturated and discolored soil, and dead or stressed vegetation in the immediate area. At times, the seep in the southeast area slowly flowed about 15 feet downslope toward the lower lying area to the east.

A small amount of exposed hospital waste consisting of intravenous tubes and syringes has been observed near the northeast portion of the site. The waste was exposed by the formation of a drainage gully which runs eastward toward Metzger Ditch.

During trenching activities for installation of the methane venting system, a large quantity of waste was exposed. Visual observations of the exposed waste made while performing other RI activities indicate that the majority was miscellaneous residential waste, lumber, and rubber waste. However, a number of drums and hospital waste were also uncovered along the western border of the landfill.

3.2 Waste Characteristics

During the RI, samples of various environmental media were collected and subjected to laboratory analysis. The following is a listing of categories of media sampled during the performance of the RI at this site:

- residential well water,
- monitoring well soils,
- monitoring well water,
- surficial soils,
- ditch and pond sediments,
- ditch and pond water, and
- drums.

As mentioned previously, the detailed results obtained from these analyses were reviewed by chemists and other project personnel to assess the data in relation with the corresponding quality control/quality assurance information which were also generated during the analyses. As a result, it was possible to ascertain what compounds were present, and also those that were considered questionable. CERCLA and other environmental statutes relating to the management of hazardous wastes make specific references to HSL compounds. HSL compounds are defined as such when available toxicological and health data suggests that these substances may pose a hazard to the public.

A listing of the chemicals which have been identified in the various sampled media at the IEL is presented in Tables 3-3 through 3-9. The overall physical and chemical characteristics of the identified HSL substances are of major importance to the type of hazard that these substances will pose for public health and the environment. Detailed information on the characteristics (chemical, physical, toxicological) of individual chemicals identified is provided in Appendix E and as information included in the text of the Appendix to the full Public Health Evaluation (Appendix F).

3.3 Data Validation

In order to assess the impact of the IEL site upon the surrounding environment, samples of air, water and soil have been subjected to chemical analysis. The results of these analyses are presented in Appendix G. These analyses are capable of detecting contaminants at the part per billion (ppb) level. One ppb is equivalent to about 1 ounce of material in 8 million gallons of water. The analysis of environmental samples takes place in an environment (the laboratory) where many of the materials (e.g., solvents) one is searching for are quite common. The possibility of cross-contamination is quite high. In evaluating the data from the IEL environmental samples, several steps were taken to identify laboratory and sampling procedure contamination. These data validation techniques are here described.

TABLE 3-3

ORGANIC CHEMICALS DETECTED IN SURFACE SOILS
INDUSTRIAL EXCESS LANDFILL SITE

	On Site		Near Site & Down Gradient		Off Site (Background)	
Chemical	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection
1,4-Dichlorobenzene	43 (<330)	1/30	---	0/13	---	0/7
2-Butanone	<10-51	2/30	---	0/13	---	0/7
2-Methylnaphthalene	130-15,000	4/30	312-374	0/13	---	0/7
2-Methylphenol	190 (<330)	1/30	---	0/13	---	0/7
4,4-DDE	15-200	3/30	---	0/13	---	0/7
4,4-DDT	<16-170	3/30	<16-4,800	2/12	<16-220	1/7
4-Methyl-2-Pentanone	5 (<10)	1/30	---	0/13	---	0/7
4-Methylphenol	350-3,000	1/30	---	0/13	---	0/7
Acenaphthene	94 (<330)	1/30	---	0/13	---	0/7
Aldrin	<16-53	1/30	---	0/13	---	0/7
Anthracene	240-410	2/30	---	0/13	---	0/7
Benzene	2-9	2/30	---	0/13	---	0/7
Benzo(A) Anthracene	<350-1,100	1/30	---	0/13	---	0/7
Benzo(A) Pyrene	<350-900	1/30	---	0/13	---	0/7
Benzo(B) Fluoranthene	<350-1,400	1/30	---	0/13	---	0/7
Benzo(G,H,I) Perylene	<350-530	1/30	---	0/13	---	0/7
Benzo(K) Fluoranthene	<350-820	1/30	---	0/13	---	0/7
Benzoic Acid	117-122 (<400)	2/30	---	0/13	---	0/7
Bis(2-Ethylhexyl) Phthalate	110-680,000	6/30	585-754	4/13	---	0/7
Butylbenzylphthalate	68-2,100	3/30	---	0/13	12 (<330)	1/7
Chlordane	<25-280	1/30	---	0/13	---	0/7
Chlorobenzene	310	2/30	---	0/13	---	0/7

---

[a] <x = chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parentheses is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 3-3 (Continued)

ORGANIC CHEMICALS DETECTED IN SURFACE SOILS INDUSTRIAL EXCESS LANDFILL SITE

	On Site		Near Site & Down Gradient		Off Site (Background)	
Chemical	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection
Chrysene	<400-4,700	3/30	---	0/13	---	0/7
Di-N-Butyl Phthalate	250 (<330)	1/30	268-2,255	4/13	110-290 (<330)	3/7
Di-N-Octyl Phthalate	330 (<330)	1/30	---	0/13	---	0/7
Dibenzofuran	44 (<330)	1/30	---	0/13	---	0/7
Diethyl Phthalate	46-50 (<330)	2/30	---	0/13	---	0/7
Ethylbenzene	3-980,000	9/30	---	0/13	---	0/7
Fluoranthene	49-12,000	4/30	260-280 (<330)	1/13	93 (<330)	1/7
Fluorene	15-73 (<330)	2/30	---	0/13	---	0/7
Gamma-BHC (Lindane)	<8.0-61	1/30	---	0/13	---	0/7
Indeno(1,2,3-CD) Pyrene	<330-700	1/30	---	0/13	---	0/7
N-Nitrosodiphenylamine	120-4,300	7/30	---	0/13	---	0/7
Naphthalene	30-1,800	4/30	---	0/13	---	0/7
PCBs	59-320	3/30	---	0/13	---	0/7
PCB-1016						
PCB-1232						
PCB-1248						
PCB-1254						
Phenanthrene	210-6,600	5/30	47-291	2/13	---	0/7
Phenol	94-590	2/30	---	0/13	---	0/7
Pyrene	<330-8,400	2/30	80-380	2/13	110 (<330)	1/7
Tetrachloroethene	<5-8	1/30	---	0/13	---	0/7
Toluene	3-20	4/30	<5-810	7/13	---	0/7
Total Xylenes	<5-13,000	8/30	<5-5	1/13	---	0/7
Trichloroethene	<5-16	1/30	<5-8	1/13	---	0/7

---

[a] <x = chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parentheses is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 3-4

INORGANIC CHEMICALS DETECTED IN SURFACE SOILS
INDUSTRIAL EXCESS LANDFILL SITE

	On Site		Near Site & Down Gradient		Off Site (Background)	
Chemical	Range[a] (ppm)	Frequency[b] of Detection	Range[a] (ppm)	Frequency[b] of Detection	Range[a] (ppm)	Frequency[b] of Detection
Aluminum	491-11,100	30/30	1,490-14,600	13/13	4,360-15,700	7/7
Antimony	---	0/30	<7.8-78.6	2/13	---	0/7
Arsenic	3.8-35	27/30	5.1-167	13/13	6.96-34	6/7
Barium	19-547	25/30	64-200	12/13	19-162	7/7
Beryllium	0.28-0.9	11/30	0.2-3.7	8/13	0.4-1.5 (<1.5)	3/7
Cadmium	<1.9-13.3	7/30	<0.67-9.4	8/13	<0.2-5.2	4/7
Calcium	1,510-74,500	30/30	811-38,800	13/13	281-26,100	7/7
Chromium	4.1-53	23/30	<4.4-140	11/13	8-23	6/7
Cobalt	3.8-22	16/30	2.5-20	10/13	7.4-17	3/7
Copper	8.3-55	24/30	<5.6-335	12/13	8.25-36	6/7
Iron	2,100-133,000	29/30	4,700-93,400	13/13	13,400-62,100	7/7
Lead	<2.2-699	27/30	4.6-283	12/13	11-349	7/7
Magnesium	117-7,070	30/30	610-8,720	13/13	983-3,330	7/7
Manganese	29-1,560	29/30	233-1,900	10/13	242-1,540	7/7
Mercury	<0.041-0.23	10/30	<0.1-0.65	5/13	<0.05-0.2	2/7
Nickel	<6.1-48	21/30	7.4-36	11/13	<12-54	3/7
Potassium	<127-2,670	20/30	<166-1,250	9/13	265-1,390	7/7
Selenium	---	0/30	<0.08-1.1	1/13	0.2 (<2.7)	1/7
Silver	1.8-3.5	4/30	<1.3-8.3	3/13	<1.3-3.5	1/7
Sodium	<5.6-3,950	23/30	96-2,770	9/13	74-782	6/7
Thallium	<1.1-2.1	2/30	0.23-0.68	6/13	0.26-0.35 (<1.3)	1/7
Tin	<5.2-50	3/30	NS	---	---	0/7
Vanadium	8.3-30	15/30	7.2-62	10/13	7.6-20 (<23)	6/7
Zinc	<3.5-1,960	29/30	15-362	13/13	46.9-107	7/7
Cyanide	0.95-22.1	5/30	<0.3-42	6/13	<0.36-1.3	1/7

[a] <x = chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parentheses is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

NS = not sampled.

TABLE 3-5

ORGANIC CHEMICALS DETECTED IN MONITOR WELL BORINGS
INDUSTRIAL EXCESS LANDFILL SITE

Chemical	Range of Concentration Detected (mg/kg)	Frequency of Detection
1,1,1-Trichloroethane	3-4 (<5)	1/35
1,4-Dichlorobenzene	270 (<330)	1/35
2-Butanone	<10-2,600	3/35
2-Methylnaphthalene	67-790	3/35
2-Methylphenol	300 (<330)	1/35
4-Methyl-2-Pentanone	<10-610	1/35
4-Methylphenol	320-8,000	2/35
4-Nitrophenol	50 (<1,600)	1/35
Acenaphthene	110 (<300)	1/35
Acetone	<10-1,500	1/35
Anthracene	73 (<330)	1/35
Benzene	1-4 (<5)	4/35
Benzo(A) Anthracene	89-91 (<300)	2/35
Benzo(A) Pyrene	93 (<330)	1/35
Benzo(B) Fluoranthene	120-140 (<300)	2/35
Benzo(G,H,I) Perylene	160-210 (<300)	2/35
Benzo(K) Fluoranthene	110-140 (<300)	2/35
Benzoic Acid	330-2,500	3/35
Bis(2-Ethylhexyl) Phthalate	63-2,800	5/35
Butylbenzylphthalate	77-16,000	6/35
Carbon Disulfide	1-13	4/35
Chlordane	<80-290	1/35
Chrysene	100-160 (<330)	2/35
Di-N-Butyl Phthalate	86-1,600	2/35
Di-N-Octyl Phthalate	120-8,300	2/35
Dibenzofuran	73-150 (<330)	2/35
Diethyl Phthalate	70-410	3/35
Ethylbenzene	0.6-25	14/35
Fluoranthene	93-480	2/35
Fluorene	60 (<330)	1/35
Indeno(1,2,3-CD) Pyrene	55-77 (<330)	2/35
N-Nitrosodiphenylamine	210-580	2/35
Naphthalene	<330-500	2/35
Phenanthrene	38-370	5/35
Phenol	45-2,600	5/35
Pyrene	22-330 (<330)	3/35
Styrene	3-6	3/35
Tetrachloroethene	4-7	3/35
Toluene	3-190	15/35
Total Xylenes	0.7-730	13/35
Trichloroethene	<5-570	2/35

Notes: (1) Samples taken from borings at monitor well 1, 2, 3, 7, 8, 9, 10, 11, 12. Depth of samples range from 5-7 ft. to 160-161 ft.

(2) Frequency of detection is the number of samples in which the compound is detected over the total number of samples analyzed.

TABLE 3-6

INORGANIC CHEMICALS DETECTED IN MONITOR WELL BORINGS INDUSTRIAL EXCESS LANDFILL SITE

Chemical	Range of Concentration Detected (mg/kg)	Frequency of Detection
Alumium	906-12,800	35/35
Arsenic	2.4-50	23/35
Barium	6.1-215	20/35
Beryllium	0.4-1.0	6/35
Cadmium	0.12-9.48	13/35
Calcium	1,120-59,000	35/35
Chromium	1.1-19	25/35
Cobalt	3-23	17/35
Copper	6.4-124	33/35
Iron	4,160-61,900	35/35
Lead	4.7-55	30/35
Magnesium	479-13,500	35/35
Manganese	31-1,130	35/35
Mercury	0.11-0.17	4/35
Nickel	6.2-35	25/35
Potassium	5.8-2,130	28/35
Selenium	0.5-1.4	4/35
Silver	<1.3-3.2	1/35
Sodium	55-1,970	15/35
Thallium	0.6 (<1.0)	1/35
Tin	1.7-13	3/35
Vanadium	3.7-35.0	2/35
Zinc	13-211	35-35

Notes: (1) Samples taken from borings at monitor wells 1, 2, 3, 7, 8, 9, 10, 11, 12. Depth of samples range from 5-7 ft. to 160-161 ft.

(2) Frequency of detection is the number of samples in which the compound is detected over the total number of samples analyzed.

TABLE 3-7

SUMMARY OF RESIDENTIAL WELL SAMPLING RESULTS
HAZARDOUS SUBSTANCE LIST ORGANIC CHEMICALS
IEL

(All concentrations are ug/liter)

	Well Identification Numbers		
Chemical	RW05	RW38	RW39
Vinyl Chloride	7	3.9	2
Chloroethane	2	<1.5	1
Tetrachloroethene	<1	1.3	<1

NOTES:
(1) <x = compound not detected where "x" is the detection limit.
(2) Only those wells and chemicals that showed positive results are listed.
(3) Maximum value from duplicate samples and duplicate sampling rounds is listed.
(4) Detection limit for vinyl chloride is 0.5 ug/liter.

TABLE 3-7 (Continued)

SUMMARY OF RESIDENTIAL WELL SAMPLING RESULTS - INORGANIC CHEMICALS IEL

(All concentrations are ug/liter)

Chemical	Range Concentration Detected	Frequency[3] of Detection
Aluminum	<29-153	5/67
Arsenic	<2-9.1	29/67
Barium	2.1-1,370	67/67
Cadmium	<0.1-0.58	7/67
Calcium	55-460,000	67/67
Chromium	<5-11	3/67
Cobalt	<5-16	3/67
Copper	<4-356	28/67
Iron	<25-13,100	65/67
Lead	<1-239	30/67
Magnesium	76-59,400	67/67
Manganese	<4-489	64/67
Nickel	<7-48	11/67
Potassium	<69-23,400	62/67
Selenium	<2-20	9/67
Silver	<0.4-12	1/67
Sodium	<638-342,000	65/67
Vanadium	<5-22	6/67
Zinc	<8-733	28/67
Cyanide	<2-26	5/67

NOTES:

(1) <x = chemical not detected, where "x" is the detection limit.

(2) Frequency of detection is the number of wells in which the chemical was detected over the total number of wells sampled. In the case of repeat or duplicate samples if a chemical was detected in any of the samples, it is considered as detected in the well.

TABLE 3-8

SUMMARY OF SHALLOW MONITORING WELL SAMPLING RESULTS IEL

(All concentrations are ug/liter)

Chemical	Range[1,2]	Frequency[3] of Detection
Trans-1,2-Dichloroethene	3.8-4.3 (<5)	1/11
1,1-Dichloroethane	<5-25	1/11
1,2-Dichloroethane	<5-10	1/11
Benzene	1.2-10	2/11
Toluene	<0.9-13	1/11
Chlorobenzene	<5-27	1/11
Ethylbenzene	<5-110	1/11
Xylenes	<5-355	1/11
Benzoic Acid	9 (<100)	1/10
1,4-Dichlorobenzene	10-13 (<20)	1/10
Naphthalene	7.9-10 (<20)	1/10
4-Chloro-3-Methylphenol	5.2 (<20)	1/10
2-Methylnaphthalene	2.7-3 (<20)	1/10
Acenaphthene	2 (<20)	1/10
2,4-Dimethylphenol	3 (<10)	1/10
4-Methylphenol	<10-15	1/10
n-Nitrosodiphenylamine	<10-15	1/10
Phenol	3.7 (<10)	1/10

NOTES:

(1) <x = compound not detected where "x" is the detection limit. Where detection limits vary among samples the lowest is listed.
(2) A value or range followed by a number in parantheses indicates an estimated value, where the number in parantheses is the detection limit.
(3) Frequency of detection is the number of positive values detected per the total number of sample locations.

TABLE 3-8 (Continued)

SUMMARY OF SHALLOW MONITORING WELL SAMPLING RESULTS - IEL

(All concentrations are ug/liter)

Chemical	Range[1,2] (Dissolved Metals)	Frequency[3] of Detection
Aluminum	<31	0/10
Arsenic	6 (<10)	1/10
Barium	75-1,430	9/10
Beryllium	<5	0/10
Cadmium	<3.2-21	1/10
Calcium	21,820-279,000	10/10
Chromium	<3.7-7.5	1/10
Cobalt	<20	0/10
Copper	<19	0/10
Iron	<20-78,870	6/10
Lead	<3-11	1/10
Magnesium	5,470-57,200	10/10
Manganese	148-3,060	10/10
Mercury	<0.2	0/10
Nickel	<14-48	3/10
Potassium	1,490-79,200	10/10
Selenium	<3-4.4	1/10
Silver	<5.1-5.8	1/10
Sodium	4,670-360,000	10/10
Tin	<19	0/10
Vanadium	<3.1-17	4/10
Zinc	<6.3-87	3/10

NOTES:

(1) <x = compound not detected where "x" is the detection limit. Where detection limits vary among samples the lowest is listed.
(2) A value or range followed by a number in parantheses indicates an estimated value, where the number in parantheses is the detection limit.
(3) Frequency of detection is the number of positive values detected per the total number of sample locations.

TABLE 3-9

SUMMARY OF DRUM SAMPLING RESULTS - IEL

Organic Chemicals	Detected Range (ug/kg)	Frequency of Detection
1,1,1-Trichloroethane	1200 - 1700	3/24
1,1-Dichloroethane	230	1/24
2-Hexanone	6100	1/24
4-Methyl-2-Pentanone	1000 - 32,000	4/24
Acetone	5100 - 12,000	3/24
Benzene	2200 - 23,000	5/24
Chlorobenzene	1800 - 2300	2/24
Ethylbenzene	3900 - 1.3E7	8/24
Styrene	42,000 - 3,900,000	7/24
Tetrachloroethene	790 - 6200	6/24
Toluene	1000 - 1,100,000	11/24
Xylenes	1400 - 1.2E8	6/24
Trans-1,2-Dichloroethene	8700	1/24
Trichloroethene	1200 - 1400	3/24
1,2-Dichlorobenzene	41,000	1/24
1,4-Dichlorobenzene	11,000 - 15,000	3/24
2-Methylnaphthalene	2.4 - 3,200,000	3/24
2-Methylphenol	8300	1/24
4-Chloro-3-Methylphenol	2200 - 3200	2/24
4-Methylphenol	4900 - 43,000	3/24
Benzoic Acid	34,000	1/24
Bis(2-Chloroethyl)Ether	19,000	1/24
Bis(2-Ethylhexyl)Phthalate	16,000	1/24
Butylbenzyl Phthalate	2400 - 51,000	2/24
Di-N-Butyl Phthalate	8700 - 62,000	2/24
Di-N-Octyl Phthalate	4500 - 65,000	5/24
DiMethyl Phthalate	150,000	1/24
N-Nitrosodiphenylamine	2900 - 32,000	5/24
Naphthalene	2.1 - 2,500,000	5/24
Pentachlorophenol	86,000 - 620,000	2/24
Phenol	6000 - 280,000	7/24
Pyrene	1700 - 5900	2/24

TABLE 3-9
(continued)

SUMMARY OF DRUM SAMPLING RESULTS - IEL

Inorganic Chemicals	Detected Range (mg/kg)	Frequency of Detection
Aluminum	484 - 72,200	21/24
Antimony	28 - 90	3/24
Arsenic	25 - 93	3/24
Barium	132 - 504	6/24
Cadmium	13 - 119	4/24
Calcium	755 - 105,000	20/24
Chromium	26 - 1470	12/24
Copper	48 - 1510	10/24
Cyanide	1.8 - 5.6	3/24
Iron	2200 - 783,000	2/24
Lead	26 - 6040	15/24
Magnesium	755 - 26,300	12/24
Manganese	46 -	16/24
Mercury	.88 - 11	3/24
Molybdenum	52	1/24
Nickel	38 - 139	6/24
Sodium	4850 - 5240	3/24
Thallium	395 - 890	8/24
Tin	1200	1/24
Titanium	665 - 8610	1/24
Vanadium	189	1/24
Zinc	54 - 5430	19/24

3.3.1 U.S. EPA Data Validation and Use of Data Qualifiers

Before the data generated by chemical analysis of environmental samples is made available to the data user, the entire package of raw data, quality control information, and other items generated by the contract laboratory is carefully reviewed and evaluated by the U.S. EPA or their representative to see if the data meets established quality control standards. At that time, data is accepted as is, accepted with qualifications, or rejected as unusable.

During this RI/FS, rejected data is not used for any of the conclusions presented in this report. The data that U.S. EPA accepted or accepted with qualification was further reviewed by the user and some of that data was also rejected as unusable. Details of those rejections are described below.

An understanding of a number of qualifiers applied to the data are important for the following discussions, The "B" qualifier is discussed below. The "estimated" qualifier ("J" for organic samples and square brackets "[ ]" for metals) was widely used for the results from the IEL sampling because chemicals and ions were generally present at very low levels. The meaning of the "J" or "[ ]" estimated qualifier is this: In the sample analyzed, the material noted was present, but at a level below the calibrated detection limit. That is, the so-called "detection limit" for a given substance is actually the lowest level at which the chemist performing the analysis can confidently apply a concentration value. Below this "detection limit", the instrument can still detect and confirm the presence of a given substance, but the quantity of the material is estimated (but is definitely less than the quantifiable "detection limit"). For the purposes of this RI/FS "estimated" data was used throughout (when it, too, passed the evaluation described below).

3.3.2 Background Samples

Being composed of a variety of naturally occurring inorganic minerals, even pristine soils and waters contain many of the inorganic ions found on the Hazardous Substance List (HSL). Moreover, although pristine soils and waters generally should be free of HSL organic compounds, Man's activities have widely dispersed a number of compounds such that they are now ubiquitous in our environment. Thus, in order to evaluate the impact that the IEL site has had upon the soils and waters found on, adjacent, and downstream from IEL, other "background" samples of soils and waters were also collected and analyzed. These background samples are from upstream and upgradient of the site and from areas that are unlikely to have been influenced by runoff or ground-water flow from the site (See Sections 4 and 5).

Results of the background sampling, which are further described in Sections 4 and 5, reveal that none of the surface or groundwater located upstream or upgradient of the landfill contains any hazardous substance list organics. However, as has been found in other studies, background surface soils and sediments in the Uniontown area contain low levels of various types and concentrations of phthalates, polycyclic aromatic hydrocarbons (PAHs) and pesticides. The origin of the pesticides is from the past use of these chemicals, including the very persistent chemical DDT. The phthalates probably originate as "fall-out" from air pollution. They become part of air pollution through the burning of plastics, either privately or at large municipal incinerators. The origin of the PAHs is probably multiple. PAHs, too, are a major component of air pollution, being produced in the burning of coal, from internal combustion engines, and even from cigarette smoke. On a local level, they can be produced by such common events as grass or brush fires. In the Uniontown area, the soils and rocks of the area are also an important source of PAHs. There they may be present as components of coal and coal-related sediments. The extract of a fragment of coal will typically contain a complex mixture of PAHs.

3.3.3 Field Blanks

During collection of water samples (including drinking water, monitoring well water, surface water, and leachates), commercially available distilled and deionized water was placed in sample bottles and sent to the lab with the environmental samples. The results from these field blank samples are then compared to environmental sample results for each group of samples.

3.3.4 Laboratory Blanks

Various blank samples are prepared and analyzed by the CLP laboratories as they run the contracted sample lots. Analytical results from these samples are then compared to results obtained from analysis of environmental samples and field blanks.

3.3.5 Validation of Results and Use of Data Qualifiers

With the above described sample data in hand (from environmental samples, including background samples; field blank samples; and laboratory blank samples) comparisons were made to determine the validity of the results.

Data was rejected for use in this RI based primarily upon three types of findings:

1. Within a set of samples that were collected and analyzed as a single batch of samples (i.e. a "case" or "data package"), laboratory blank samples, prepared and analyzed by the CLP laboratory, were found to contain certain HSL substances. These compounds represent organic materials that are present in the laboratory environment including the air (particularly in the case of the volatile organics), as contaminants in the reagents used by the laboratory, or as contaminants in the analytical equipment which were introduced either in cleaning or as residues from the analysis

of other samples. These same HSL substances are found in the field samples, both normal and background, and at about the same concentration as those found in the laboratory blanks. The results from these samples are flagged with "B" in Appendix G.

2. In other data packages, these same compounds are present in both normal and background samples, and at similar concentrations among these samples. Although the laboratory blanks for these data packages do not contain the compounds, the distribution of these common laboratory contaminants in widely separated samples at similar concentrations strongly suggests that these compounds were introduced by sampling or laboratory procedures and do not reflect the environmental presence of these contaminants. These samples are flagged with "B?" in Appendix G. An excellent example of this type of anomalous contamination is found in the volatile analyses for Case #6296 (Table A1, Appendix G). This case contains the analysis of soil samples S034 through S042, including background samples S037, S038, S040, and S041. A comparison of two samples illustrates the characteristics of laboratory or sampling contamination described above. Sample S041 is a background sample taken about a half mile north of the landfill near the Uniontown firehouse. Sample S042 was taken as a down gradient sample at the Uniontown community park, near the horse-shoe pits. The two samples are separated by about two thirds of a mile. Table 3-10 provides a comparison of the volatile analysis for both of these samples.

   As can be seen, both samples have exactly the same "hits" and at very similar levels. The first three compounds, MEK, acetone, and methylene chloride are also found in the laboratory blanks for this data package. The last three chemicals, toluene, xylenes, and trichloroethene, were not detected in the lab blanks. However, finding all three compounds at nearly the same levels in widely

TABLE 3-10

COMPARISON OF VOLATILE ANALYSIS FOR SELECTED SAMPLES

	Sample No. and Concentration	
Chemical	S041 (Background)	S042 (Downgradient)
2-Butanone (MEK)	16	13
Acetone	52	39
Methylene Chloride	32	71
Toluene	36	27
Total Xylenes	5	2
Trichloroethene	5	7

separated samples provides substantial evidence that sampling and/or laboratory procedures have indeed introduced these chemicals and that they are not reflective of actual contamination of the in-situ soils. Similar reasoning was followed in other situations where background data were available. However, the presence of both background and other samples in the same data package is the exception rather than the rule and evaluation of the data usually relies heavily upon results of laboratory blank analyses.

3. In the case of water samples, field blank data often indicated contamination problems. Since the field blank water could also be contaminated as-is, these data were always compared to sample distribution and background versus non-background results. A good example of the application of this data is found in Case #6296SA where antimony and thallium were found at low levels in numerous samples. However, the field blank data also showed these rather unusual contaminants at similar levels. The data are rejected and assigned a B? qualifier.

Beyond these three main findings, data was rejected for other reasons on a case-by-case basis. For example, the first sampling of residential well RW41 (Case 6577SA) revealed n-nitrosodiphenylamine on the HSL and numerous phthalate TICs. Resampling (Case 7495A) revealed <u>none</u> of those contaminants. The original data was rejected. Other similar situations are discussed where the data is applied (See Sections 4 and 5).

4.0 HYDROGEOLOGIC INVESTIGATION

The results of the hydrogeologic and associated investigations on and around the Industrial Excess Landfill site are presented in this section.

4.1 Investigation Background

Objectives of the hydrogeologic and associated contamination investigations were:

A. To develop an understanding of the regional and local geology and hydrogeology, including the identification of aquifers, aquitards, and confining layers of concern;

B. To develop an understanding of interrelationships between the site geology, surface soils, local groundwater movement, and modes of contaminant transport;

C. To provide quantitative data on site characteristics required to evaluate and potentially implement site specific remediation technologies and alternatives.

The initial steps towards accomplishing the first objective were achieved through the extensive review of existing geologic and hydrogeologic literature. While these existing data were not comprehensive enough to provide the required details pertaining to the specific IEL site, they were useful as supplements to the subsequent field investigations and interpretations. From August 1985 through February 1988, the REM II on-site field investigations and sampling efforts were conducted to provide the additional necessary data. These on-site investigations included drilling, monitoring well installation, geophysical testing, groundwater sampling, surface and subsurface soil sampling, hydrogeologic testing, and water level monitoring. The results of these field investigations are discussed in later sections of this report. Details of field procedures followed to obtain these data are given in the Sampling and Analysis Plan (SAP), which is Appendix B of the Quality Assurance Project Plan (QAPP), Document No. 157-WP1-OP-CUSS-1. Further discussion of the activities performed in connection with the IEL RI/FS are provided by the Work Plan, Document No. 157-WP1-WP-AZWY-4. Additional details on soil sampling and monitoring well installation are provided in Appendixes H and I.

4.2 Description of Geology and Soils

The Industrial Excess Landfill is located in an area of rolling terrain. Elevations range from almost 1,220 feet above Mean Sea Level (M.S.L.) to about 1,100 feet above M.S.L. in the site vicinity. The Uniontown area has a marked hummocky topography. There are irregularly shaped knolls and hills (kames) of gravel, some of which are as high as 80 feet (DeLong and White, 1963). Undrained depressions (kettles) are common in the area.

4.2.1 Geologic Setting

The Industrial Excess Landfill is located in the northern part of Stark County, within the glaciated part of the Appalachian Plateaus Province of Ohio. The land surface in this region has been shaped primarily by the action of the Wisconsinan glaciers that spread southward into Ohio from the Erie basin (White, 1984). A variety of physiographic features produced by glacial action occurs in the region, including ground moraine, end moraine, kames and kettles areas, and generally level to sloping outwash plains. This landscape has been modified by postglacial erosion and deposition, and by the works of man (i.e., excavation and filling).

The thickness of the material deposited by the glaciers varies from about 50 feet to more than 100 feet in the IEL area. The glacial material, consisting primarily of interbedded sand and gravel, with lesser amounts of silt and clay, was deposited along the wasting margins of the ice sheets. These deposits also contain thin layers and masses of sandy till (DeLong and White, 1963). In the Uniontown area, water-bearing glacial sand and gravel serve as an important aquifer for residential water supplies.

The glacial deposits are underlain by consolidated rocks of the Pennsylvanian Pottsville Formation (DeLong and White, 1963; Sedam, 1973; and Walker, 1979). In the area of the IEL, the Pottsville Formation is about 400 feet thick and consists of 250 feet of sandstone with interbedded shale, siltstone, limestone, and coal, underlain by approximately 150 feet of sandstone and conglomerate. More than half of the residential wells surveyed during this RI/FS produce water from sandstones in the middle part of the Pottsville Formation.

4.2.2 Glacial Deposits

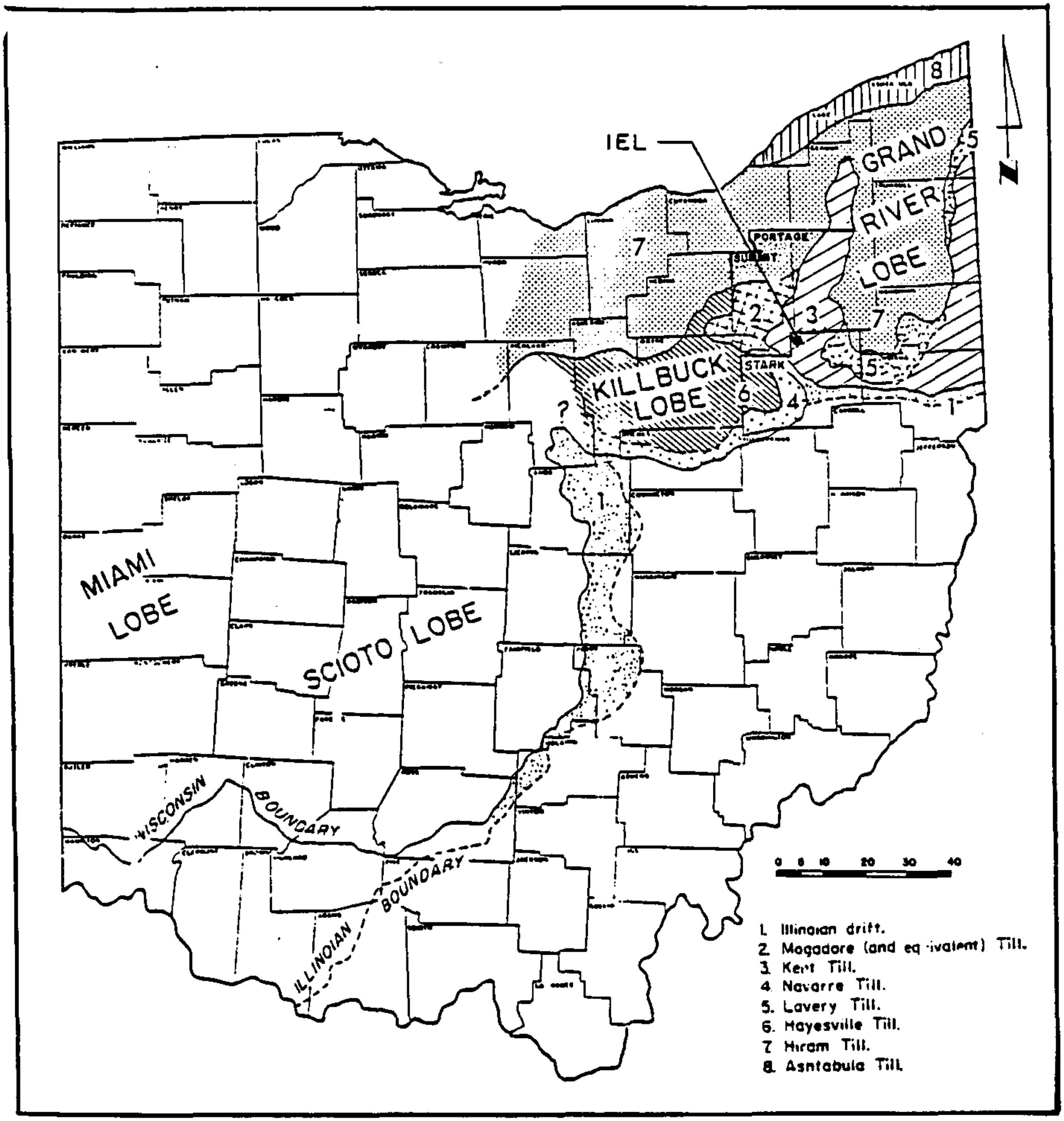
The glacial material that covers the bedrock in the region was deposited during the advances and retreats of a succession of ice sheets in the last glaciation (Wisconsinan). Each ice sheet spread southward from the Erie basin, in a series of lobes controlled by the position of lowland and highland areas (DeLong and White, 1963). The limit of ice advances and the lobes in Ohio are shown in Figure 4-1.

As shown in Figure 4-1, the ice of the Grand River lobe advanced into the eastern part of Stark County from a northeasterly direction, and the ice of the Killbuck lobe advanced into the western part of the county from a northwesterly direction. The two lobes joined along a line trending north from Canton. The IEL site is located within the western part of the Grand River lobe known as the Kent Moraine.

The Kent Moraine is a belt, as much as 10 miles wide, consisting of thick drift with marked hummocky topography. In the Uniontown area, the Kent Moraine is represented by irregularly shaped knolls and hills (kames) of gravel, some of which are as high as 80 feet (DeLong and White, 1963). Undrained depressions (kettles) are common in the area.

Although the kames are composed mainly of sand and gravel, they contain variable amounts of till (DeLong and White, 1963). The tills are generally

FIGURE 4-1



Map showing glacial lobes in Ohio and surface extent of Illinoian drift and Wisconsin rock-stratigraphic units in Killbuck and Grand River lobes. (Modified from Delong and White, 1964) very thin, coarse and sandy, with cobbles and boulders. They are deposits of the several advances of the Wisconsinan ice and generally occur as "pockets" and discontinuous lenses.

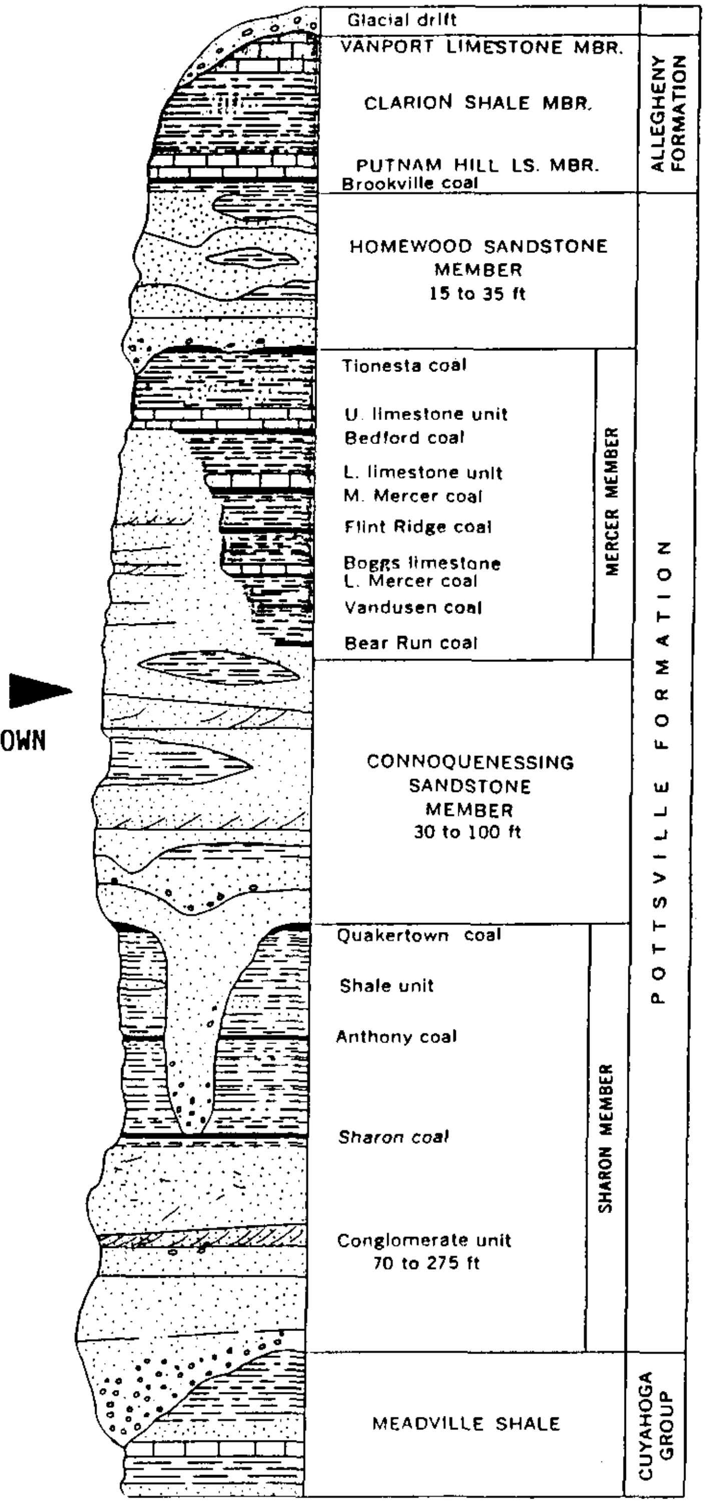
The Kent Till (Late Wisconsinan age) is the surface till along the western margin of the Grand River Lobe. In the Uniontown area, the Kent Till is thin or missing at the surface, or contained within the sand and gravel kame deposits. The Kent Till is a sandy and gravelly till and, in general contains about 45 percent sand, 36 percent silt, and 19 percent clay (DeLong and White, 1963). It contains scattered cobbles and a few large boulders. The Kent Till is moderately dense and crumbly.

An earlier Wisconsinan till, the Mogadore Till, is also associated with the gravel kames of the Kent Moraine and, in northern Stark County, underlies the Kent Till (White, 1984). The Mogadore Till is a sandy, gravelly till in which cobbles and boulders are common. The sand content ranges from 52 to 57 percent, with about 13 to 19 percent clay (White, 1984). The Mogadore Till is typically very hard and well compacted.

The sand and gravel kame material in the Uniontown area provides a locally abundant source of groundwater. This groundwater is present in unconfined, water table conditions. Walker (1979) states that these deposits are capable of yielding water at rates up to 25 to 100 gallons per minute (gpm) from wells up to 150 feet deep. A few wells can yield over 100 gpm.

4.2.3 Bedrock Deposits

The Pottsville Formation is the oldest and stratigraphically lowest of four groups that make up the Pennsylvanian System in Ohio (Sedam, 1973). The stratigraphic members that make up the Pottsville Formation are, in descending order, the Homewood Sandstone Member, the Mercer Member, the Massillon or Connoquenessing Sandstone Member, and the Sharon Member (Figure 4-2). The total thickness of the Pottsville Formation, in the IEL



APPROXIMATE DEPTH OF EROSION IN THE UNIONTOWN AREA.

FIGURE 4-2 STRATIGRAPHIC COLUMN FOR THE POTTSVILLE FORMATION (FROM SEDAM, 1973) area, is about 400 feet. The sandstone members are important bedrock sources of groundwater in northeastern Ohio (Sedam, 1973).

The Homewood Sandstone Member varies from a well-sorted white quartzitic sandstone to a poorly-sorted, tan, micaceous, argillaceous sandstone. Thin-bedded shale is commonly encountered (DeLong and White, 1963). In northeastern Ohio, the Homewood Sandstone occurs as a channel-fill deposit and is only present locally (DeLong and White, 1963). The Homewood Sandstone has been removed by erosion in the IEL area (Figure 4-2).

The Mercer Member, consisting of interbedded shale, sandstone, thin coal seams, clay layers, and thin limestone, has been eroded away in most of the IEL area (Figure 4-2). The thickness of the member is quite variable where present. Wells developed in the water-bearing sandstone layers may yield quantities sufficient to meet domestic requirements (Sedam, 1973).

The Massillon Sandstone is a medium to coarse-grained gray-white sandstone, generally micaceous and also containing some feldspar and clay. In Stark County, the Massillon is a thick sandstone or conglomerate (DeLong and White, 1963) (Figure 4-2). In places, the sandstone fills channels cut into the underlying strata (Sedam, 1973). The thickness of the Massillon approximately ranges from 30 feet to 100 feet. It is one of the more important aquifers of the Pottsville Formation and is the unit from which the great majority of bedrock residential wells in Uniontown draw their water.

The Sharon member is the basal unit of the Pottsville Formation. It is a prominent conglomeratic sandstone that in the IEL area is overlain by shales, siltstones, coals and clay of variable thicknesses (DeLong and White, 1963) (Figure 4-2). The Sharon Conglomerate is a coarse-grained, gray-white to reddish orthoquartzite. It is loosely cemented, and commonly crossbedded and interbedded with coarse, pebbly conglomerate. In places, the conglomerate occurs as channel fillings in the eroded surface of the underlying Mississippian rocks (Sedam, 1973). In the IEL area, the Sharon

Conglomerate unit is about 150 feet thick and is considered to be one of the most productive of the Pottsville Formation aquifers (DeLong and White, 1963; Sedam, 1973).

The pre-glacial topography developed on the bedrock of the Pottsville Formation was characterized by strong relief, steep slopes, and narrow ridges that separated deeply-cut streams. Extensive areas of resistant sandstone controlled the shape of the landscape (DeLong and White, 1963). The pre-glacial landscape of northern Stark County probably closely resembled the present landscape found in the unglaciated southern 1/3 of the county. Glacial erosion has greatly modified the surface of the Pottsville, forming wide bedrock valleys and broad ridges with rounded bedrock hills. The effect of glacial erosion was to remove much of the rock and incorporate it into the advancing ice sheet. This glacial debris constitutes the surface material overlying the bedrock in the area.

Using data from drillers' logs for bedrock residential wells and the data generated from the installation of the bedrock monitoring wells, a map depicting topography on the top of the bedrock in the IEL area was created (Figure 4-3). Although the data is locally sparse (particularly in the area between Cleveland Avenue and Island View where few houses have been built) a number of gross, pre-glacial features are interpreted.

Foremost among these interpreted features is the presence of a bedrock valley that trends from east of IEL, across the study area to the west (Figure 4-3). Lying just north of this probable pre-glacial valley is a prominent bedrock hill that underlies the present hills to the north of IEL. Monitoring well lithology logs (Appendix A) indicate that the higher areas of bedrock are sandstone and the bedrock below the valleys (and below the sandstone) is siltstone and shale. Details of these relationships are discussed in the following section.

4.2.4 Stratigraphy at the Industrial Excess Landfill Site

Using data from lithology logs prepared during drilling of monitoring wells. (Appendix J) and data from the available water well drillers' logs for residential wells near the landfill, three cross sections showing area stratigraphy were prepared. The locations of these cross sections are shown in Figure 4-4A, and the cross sections are presented in Figures 4-4B, 4-5 and 4-6. Figure 4-4B is a north to south cross section along Cleveland Avenue, immediately west of the site. Figures 4-5 and 4-6 are west to east cross sections along the north side of the landfill and along the south side of the landfill, respectively.

One of the major features shown in these illustrations is the irregular bedrock surface. Figure 4-4B cuts across the major bedrock valley that underlies the landfill (See also Figure 4-3). Depth to bedrock in monitoring well MW11D is over 200 feet, but on the northern flank of this valley is a bedrock knoll at well MW02D where depth to bedrock is only 80 feet. The cross sections also show the lateral variability of bedrock lithology. Figure 4-6, the section along the south side of the landfill, depicts fairly continuous sandstone as bedrock with a thin bed of limestone encountered in well MW03D. The northern west to east cross section (Figure 4-5) shows that the upper part of this sandstone (the Massillon Sandstone, see Figure 4-2), contains some interbedded shale. Finally, the deepest wells (MW11D and MW09D, Figures 4-4B and 4-5, respectively) show that underlying this sandstone are siltstones, shales, and very fine sandstones that are probably the upper part of the Sharon Member of the Pottsville Formation (See Figure 4-2).

Within the overlying glacial material, a number of tentative correlations are shown. A layer composed of fine-grained material (including silt and clay with subordinate amounts of sand and gravel; probably a till) may be locally continuous in the area to the north and northwest of the landfill (Figures 4-4B and 4-5). It appears to nearly pinch-out south between RW05 and well MW01D. It may reappear at well

MW10D (Figure 4-4B). At the north side of the site, the layer pinches-out abruptly to the west and east (Figure 4-5). Along the south side of the site, there are no laterally persistent fine-grained layers (Figure 4-6).

4.2.5 Groundwater Flow Patterns

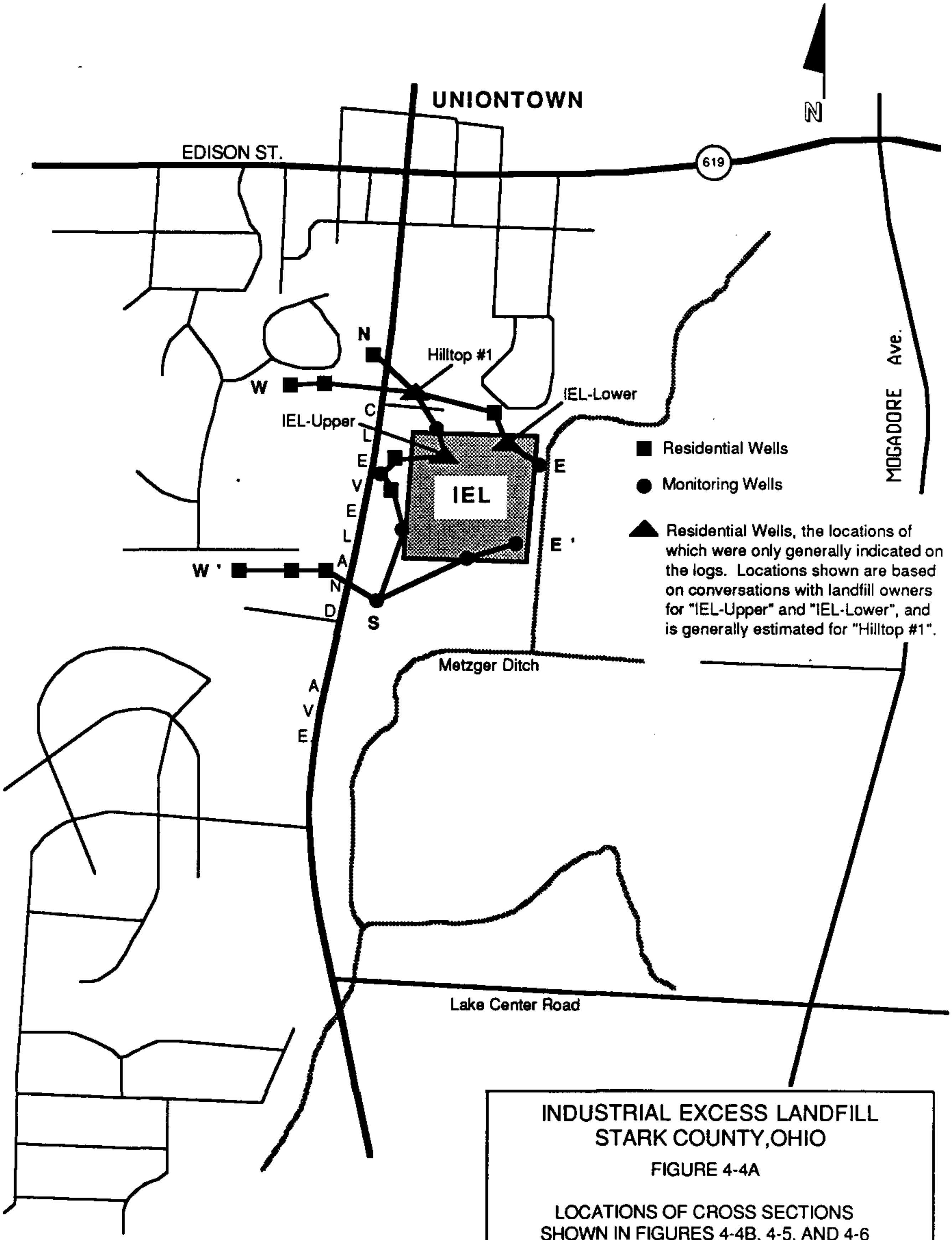
As previously discussed, exploitable groundwater resources are found in two broadly defined aquifers underlying the IEL study area. The uppermost of these units is the glacial sand and gravel aquifer that ranges from 60 feet to about 200 feet in thickness. Underlying these unconsolidated deposits are sandstone, siltstone, shale, coal, and limestone beds that form the bedrock aquifers. To determine the nature and direction of groundwater flow within these two hydrologic units, two approaches were taken. The first approach used existing information to characterize the regional occurrence of groundwater. This information primarily consisted of water levels taken from drillers' logs for many of the sand and gravel, and bedrock residential wells completed in the Uniontown area. Supplementing these data were approximate water table elevations determined from the water levels of surface water bodies as depicted on various available maps. Figure 4-7 illustrates the general features of the regional groundwater system as interpreted from these sources. Not surprisingly, the regional groundwater flow system is strongly controlled by topography. This control is most evident in the sand and gravel aquifer but the gross trends extend to the bedrock aquifer as well. Regionally, the water table elevation is highest in the vicinity of the hills 1 mile east and southeast of the landfill (Figure 4-7) where water levels approach 1150 feet above MSL. About 1 mile west of IEL, the northern extension of Metzger Ditch has a surface elevation of about 975 feet (Figure 4-7). This water level is taken to represent the water table elevation at that point. Superimposed on this westward-declining pattern of water levels is a water-table high that coincides with the northeast-southwest trending ridge upon which much of Uniontown and IEL are built (Figure 4-7). Metzger Ditch (both the portion located east and south of the landfill and the northern extension) appear to be the area groundwater discharge features (Figure 4-7). The terrain to the west of the landfill also has large areas of ponded water and marshy ground which probably act as other important groundwater discharge points (Figure 4-7).

The interpretation of these drilling logs and surface water data is subject to error. The drilling logs are based on observations taken over a 40 year period, at different seasons of the year, and from wells that tap different levels within the aquifers. The surface water elevations of the measuring points are only approximately known. The surface water elevations contain similar probable errors. Still, the gross features of regional groundwater flow depicted by these data agree with flow characteristics expected for this type of environment. However, the available data were deemed inadequate to define groundwater flow in the area of the Industrial Excess Landfill where groundwater is a major potential route of contaminant migration originating from the site. To provide more detailed data about groundwater flow in the immediate area of IEL, and to provide groundwater sampling points of verifiable quality, a system of groundwater monitoring wells was installed in the area surrounding the site (Figure 4-8). This groundwater monitoring system provides the second approach to determining groundwater flow in the IEL area. In order to determine three-dimensional variation of groundwater flow components (including differentiation of recharge and discharge areas) and to provide three-dimensional data concerning contaminant migration, most of these wells were constructed as "nests". That is, a monitoring well nest consists of more than one well at one location and the monitoring wells belonging to the nest are screened at more than one depth. The basic construction of these well nests included three wells: First, there is a "shallow" well that has a screen that straddles the top of the water table. (In all cases in the IEL area, the top of the water table is found within the glacial sand and gravel aquifer.) These shallow wells provide the water levels associated with the top of the water table and, when sampled, provided groundwater samples from the shallowest portion of the groundwater, including any floating material on the top of the saturated zone. Water levels from these shallow wells are most influenced by topography, being at the interface between infiltrating waters in recharge areas (ridges and highlands) and matching closely with the surface water in discharge areas (valleys and kettle holes). Water level measurements from these wells reflect "local" groundwater flow directions. The second well at most monitoring well nests is a "medium" well. This well is also screened in the glacial sand and gravel. However, in this case, the screen is placed at about 35 feet below the top of the water table. This depth was chosen to coincide with the depth of many of the sand and gravel residential wells that are found near the IEL site. Water levels in these medium wells are less influenced by local topography and begin to show the regional directions of groundwater flow. Comparison of water levels between shallow and medium wells helps differentiate recharge areas (areas where water levels in shallow wells are higher than in medium wells and, hence, where groundwater is moving downward), and discharge areas (areas where water levels in shallow wells are lower than in medium wells and hence, where groundwater is moving upward). Moreover, water samples from these medium wells provide data on contaminants that may be traveling in the groundwater below the top of the water table. Finally, the third well at a complete monitoring well nest is screened in the upper part of the bedrock that underlies the monitoring well site. These "deep" monitoring wells provide water level ("head") measurements for the bedrock and provide water quality data for this aquifer that supplies water for more than half of the residential wells in the Uniontown area. The water level measurements are least influenced by topography and are indicative of a more regional groundwater flow system than the shallower wells. Complete monitoring well nests, including shallow, medium, and deep monitoring wells, are located at monitoring well locations 1, 3, 7, 8, 9, 10, and 11 (Figure 4-8). Location 12 has only medium and deep wells. Location 2 has a deep, bedrock well, and a well that is screened in a zone within the glacial material that is 20 feet above the water table but which seasonally has some perched groundwater.

Locations 4, 5, and 6 have only shallow wells. To augment the coverage provided by these monitoring wells, two large diameter irrigation wells, located on the sod farm immediately to the east of IEL, were included in the groundwater monitoring network. These two wells are seldom used and have virtually no effect on local groundwater flow at the landfill, located on the other side of Metzger Ditch. The two wells are screened through the upper 40 feet of the sand and gravel. Due to this long screened interval, water levels from these wells provide a composite value that is somewhat less than a shallow well at that location would show and somewhat more than a medium well at that location would show.

The top of the water table was determined from water level measurements in the 10 shallow depth monitoring wells. These data were combined with water levels in Metzger ditch (a groundwater discharge point) and estimated water levels in ponds adjacent to Metzger ditch. The surface elevation of the ground surface to the southeast of the site (surface elevation of about 1,121.3 feet) constrained the maximum level of groundwater in that area. The water levels in the two sod farm "medium" depth wells and the water level in background medium depth well MW12M were included to provide a minimum water table elevation to the north and east of the site. All these data were combined to produce Figure 4-9 which illustrates the interpreted top of the water table.

Examination of Figure 4-9 indicates that the water table in the IEL area is strongly influenced by the landfill and by the draining effect of Metzger ditch. The water table contours indicate a groundwater mound centered under the landfill. The highest measured point on this mound is monitoring well MW07S, which is just at the southern edge of the waste (Figure 4-9). Another manifestation of this mound is the presence of two leachate seeps on the east side of the landfill at elevations comparable to the water level in MW07S (see Chapter 5). The water level in MW01S, at the west edge of the site (Figure 4-9) is not quite as high as that in MW07S, in spite of



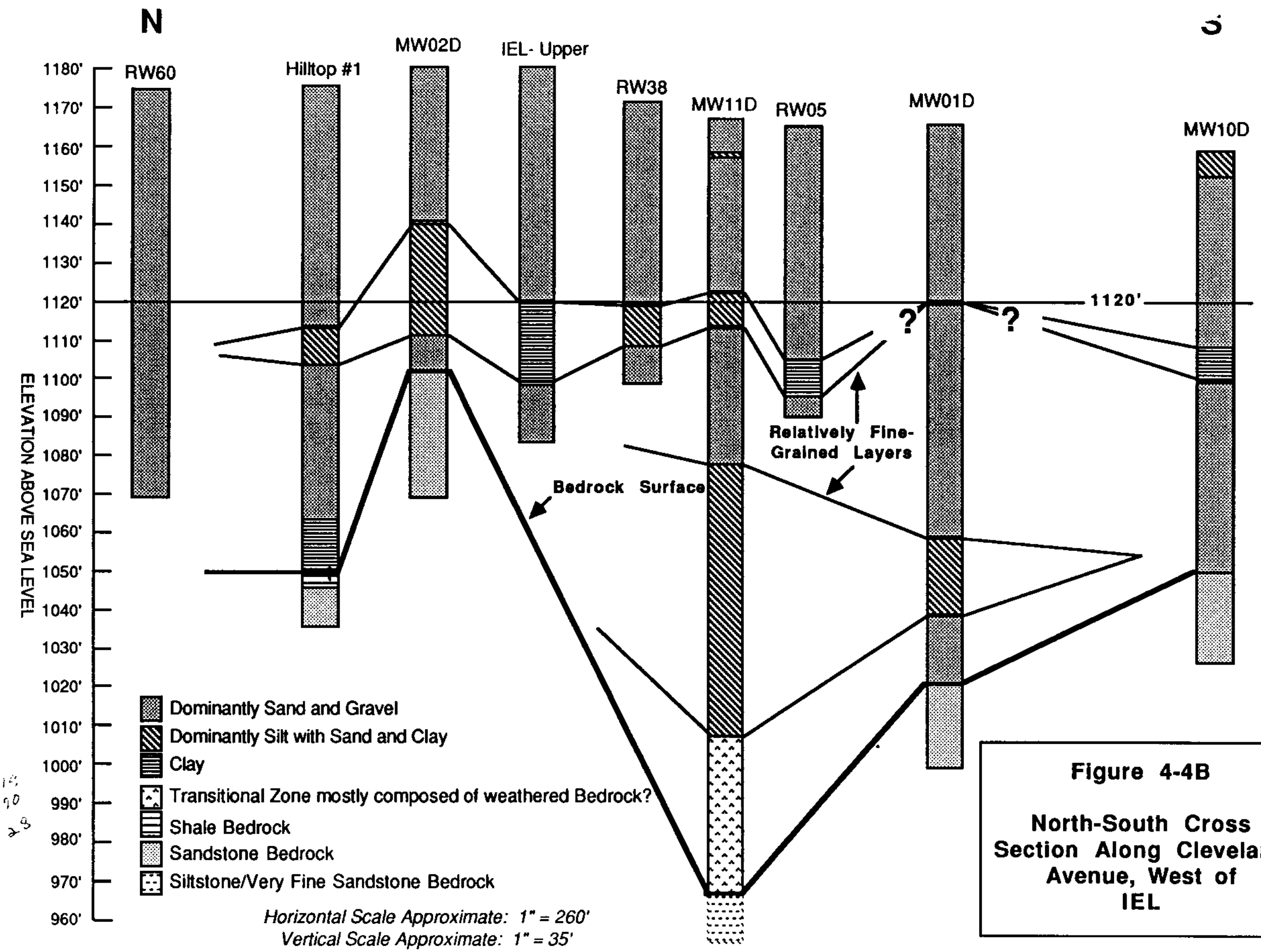
INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-4A

LOCATIONS OF CROSS SECTIONS
SHOWN IN FIGURES 4-4B, 4-5, AND 4-6

C.C. JOHNSON & MALHOTRA, P.C.

Scale Approximate, 1" = 1100'



1118
-990
128

Figure 4-4B

North-South Cross Section Along Cleveland Avenue, West of IEL

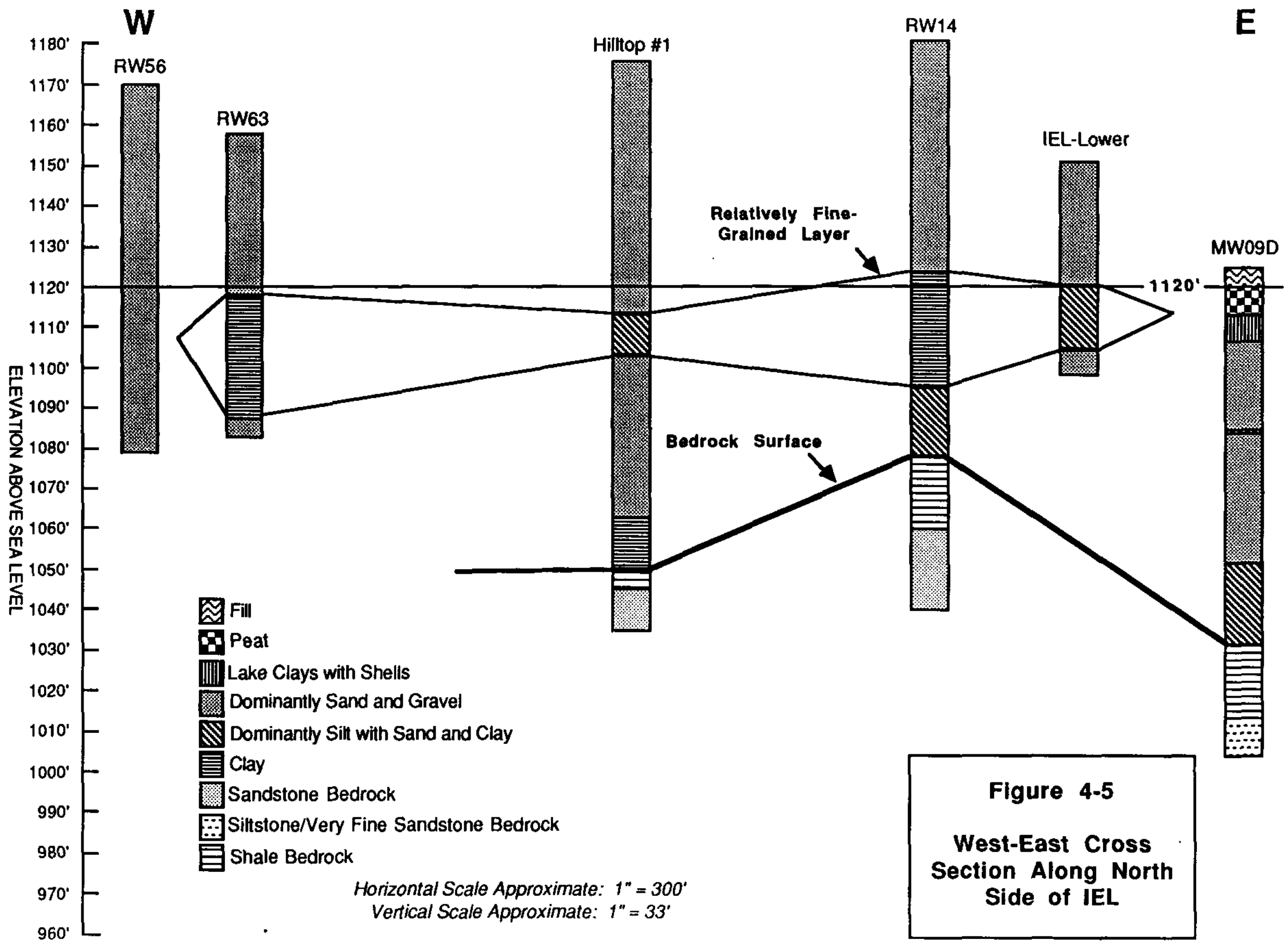
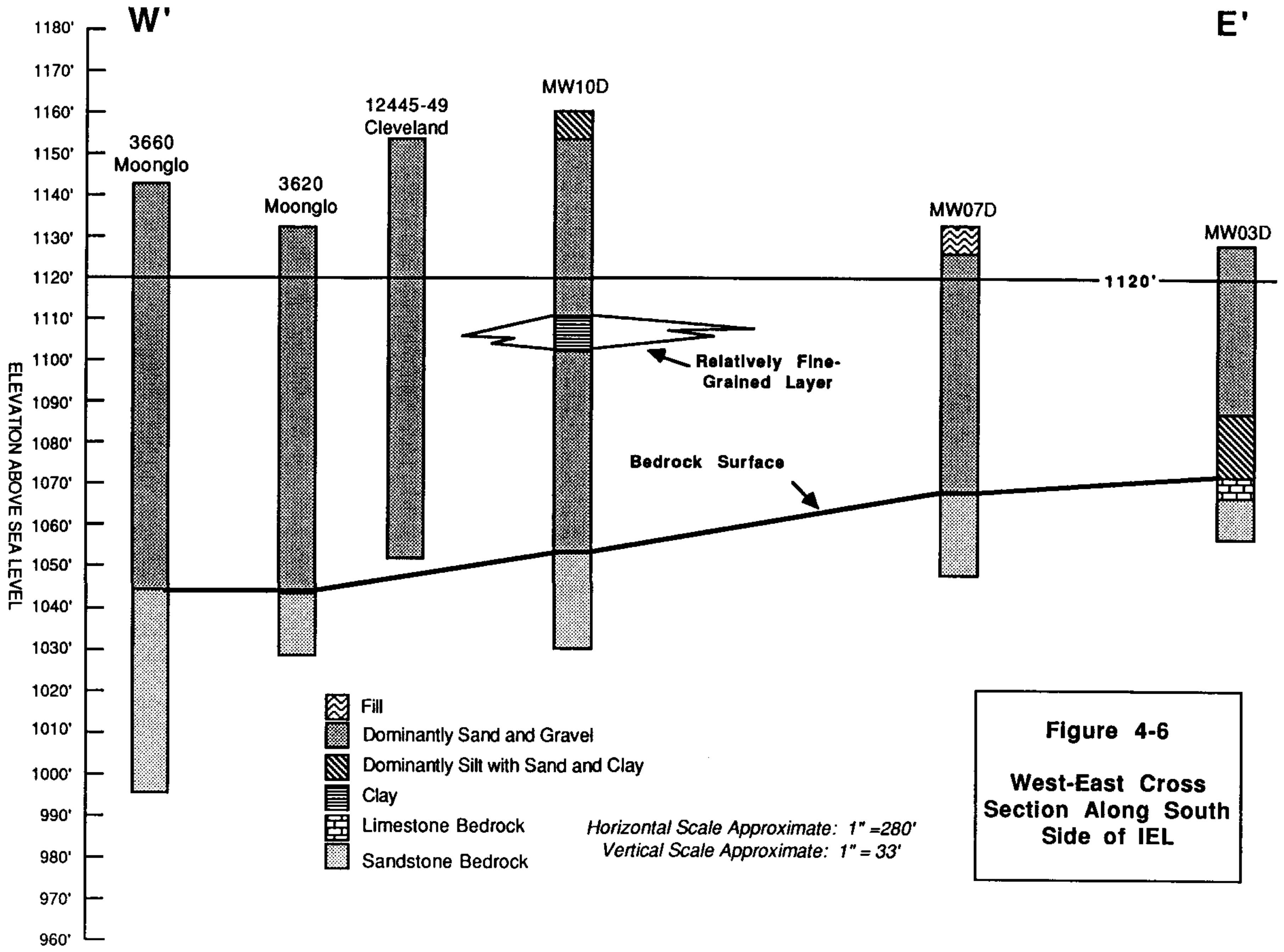


Figure 4-5

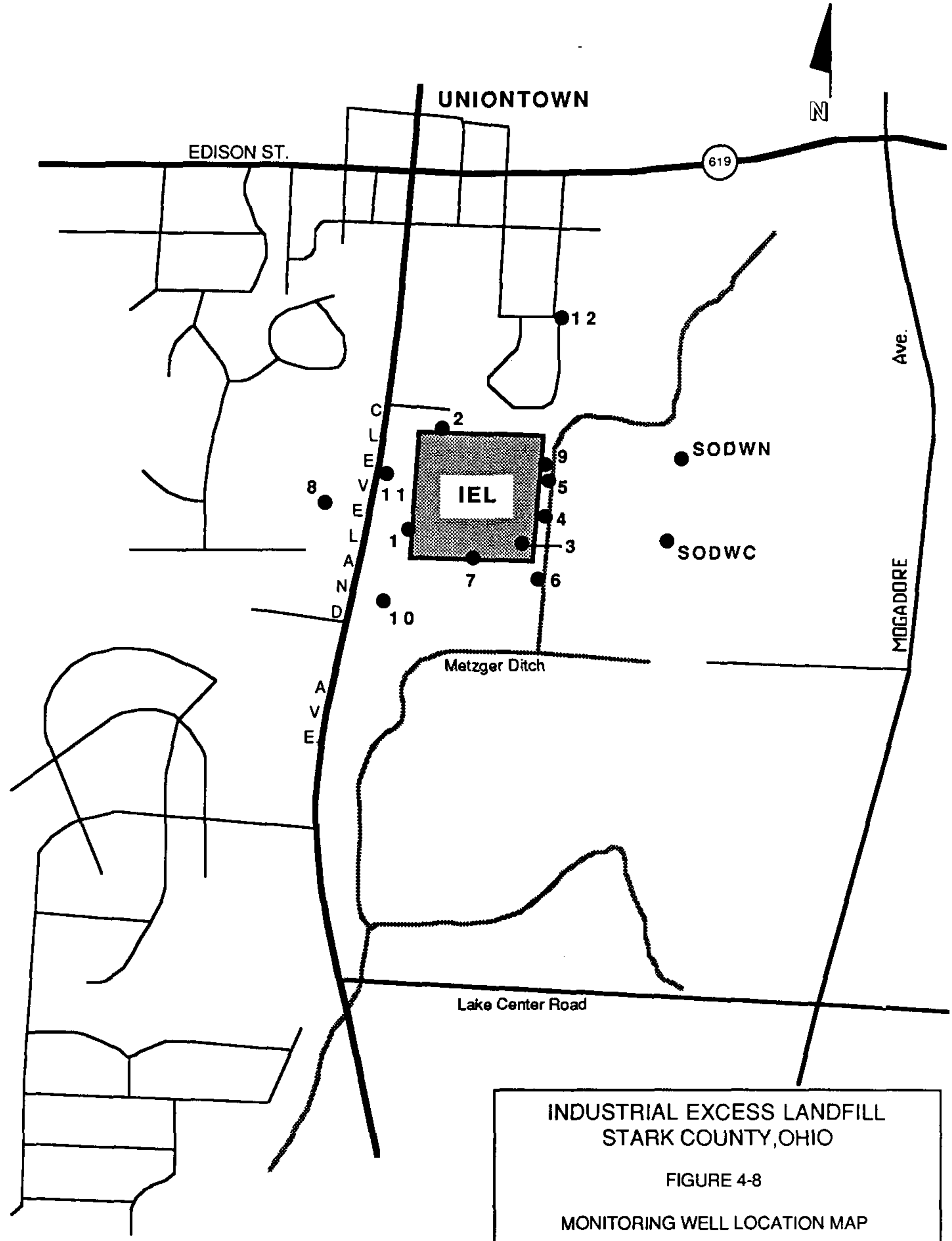
West-East Cross Section Along North Side of IEL



Horizontal Scale Approximate: 1" =280'
Vertical Scale Approximate: 1" = 33'

Figure 4-6

West-East Cross Section Along South Side of IEL



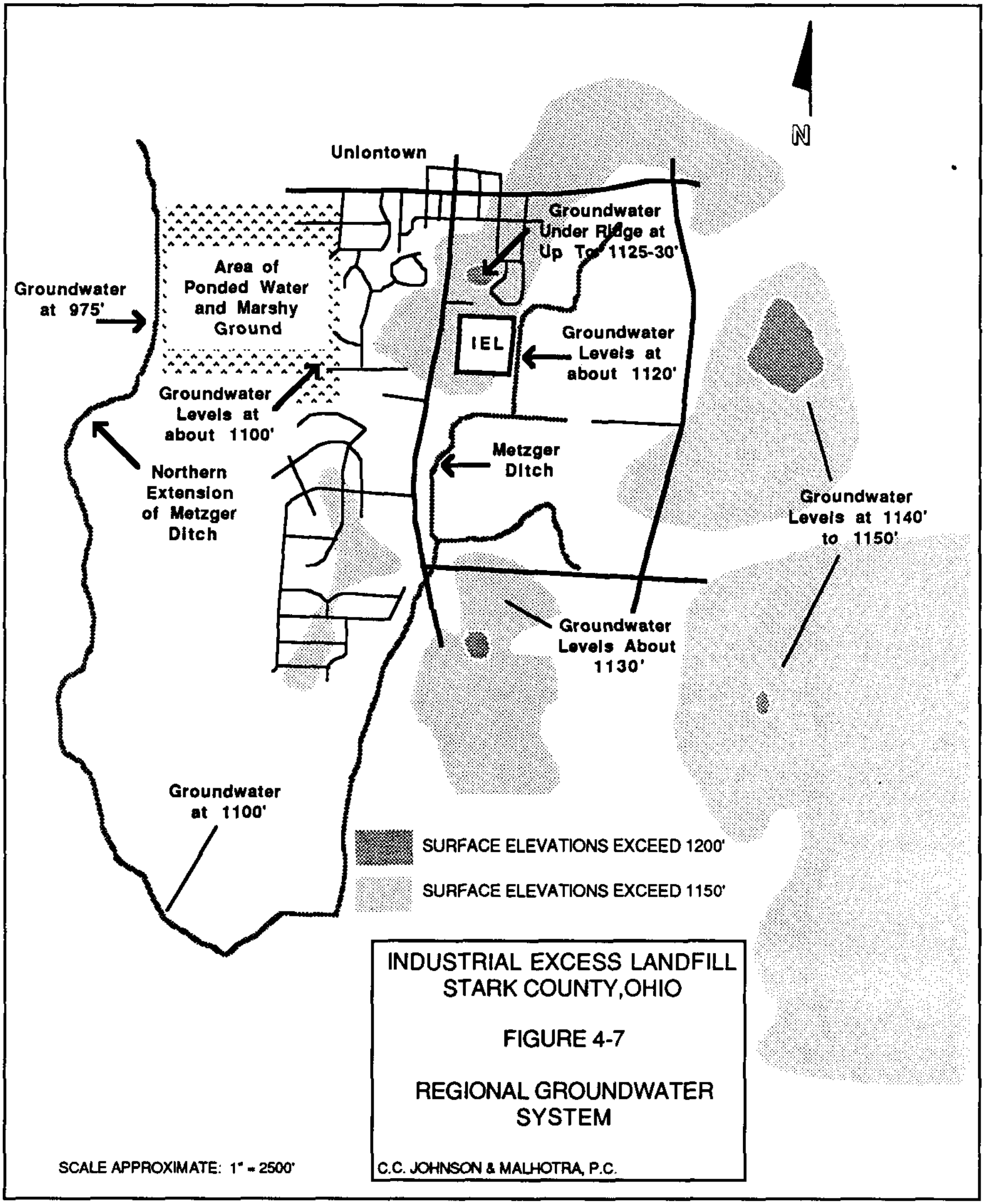
INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-8

MONITORING WELL LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.

Scale Approximate, 1" = 1100'

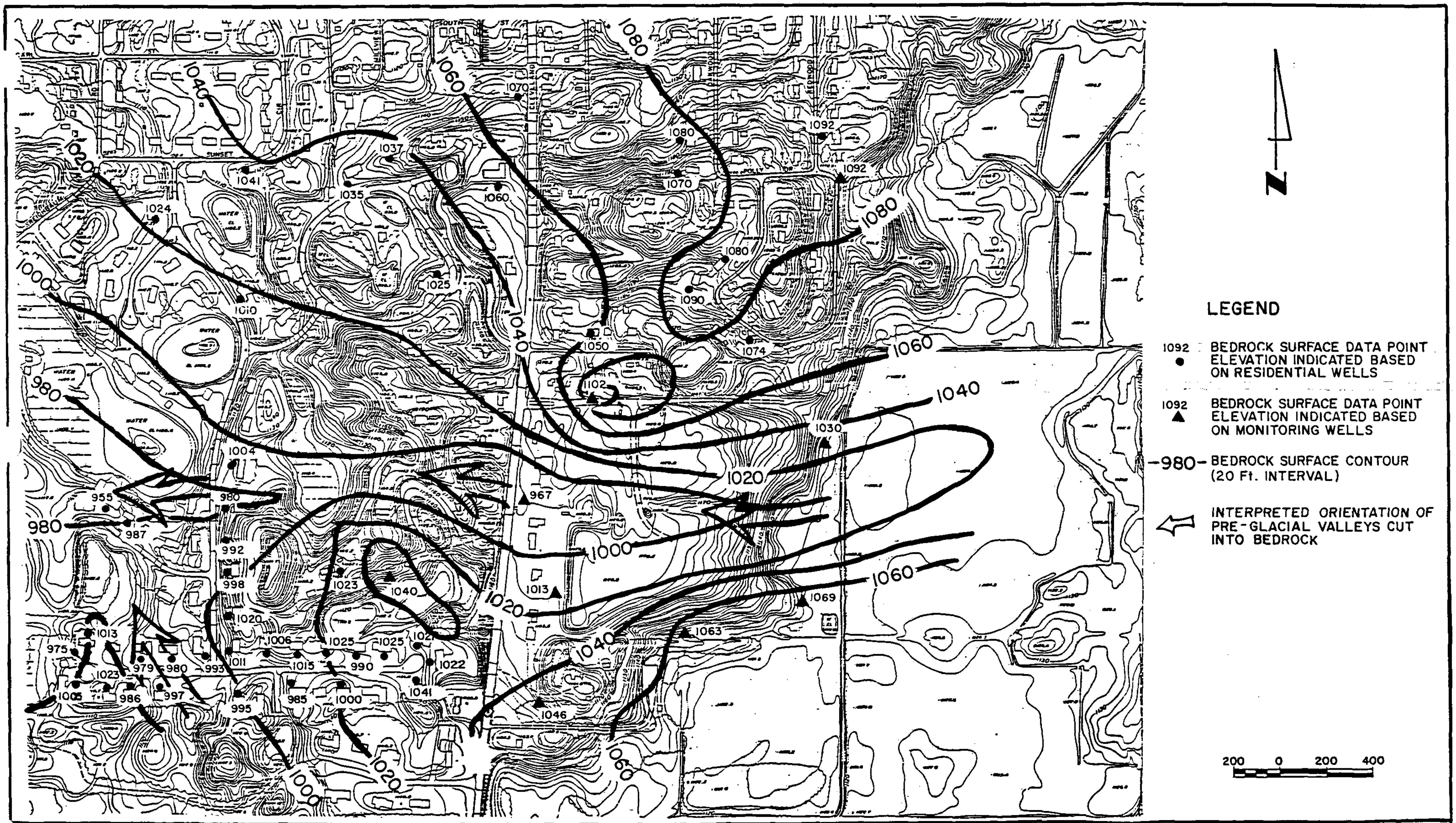


INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

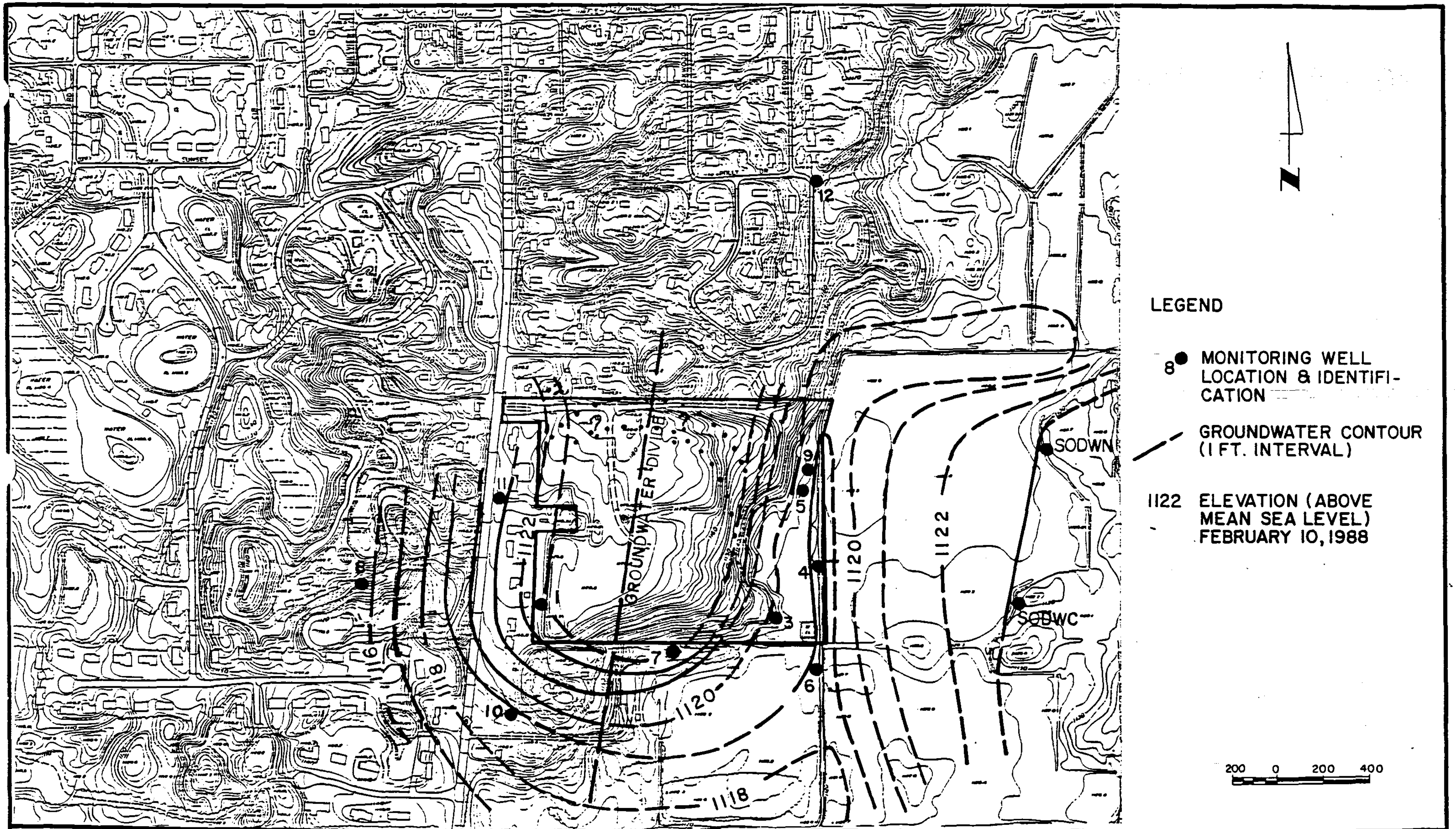
FIGURE 4-7

REGIONAL GROUNDWATER SYSTEM

C.C. JOHNSON & MALHOTRA, P.C.



SCALE 1" = 400'	INDUSTRIAL EXCESS LANDFILL, STARK COUNTY, OHIO	FIGURE
DATE JUNE, 1988	CONTOURS ON TOP OF BEDROCK WITH INTERPRETED ORIENTATION OF PRE-GLACIAL VALLEYS	4-3



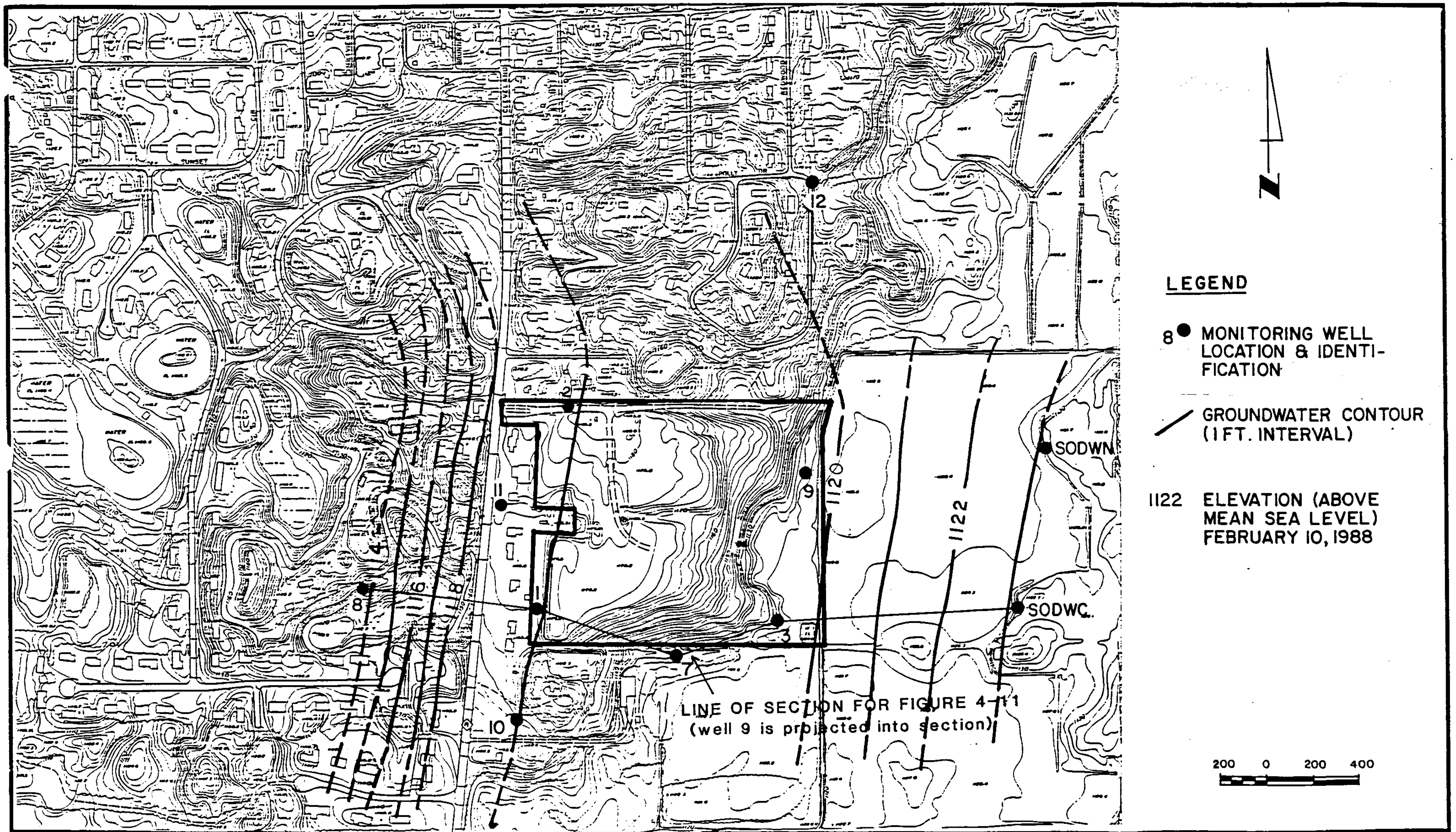
SCALE
1" = 400'

DATE
FEB. 10, 1988

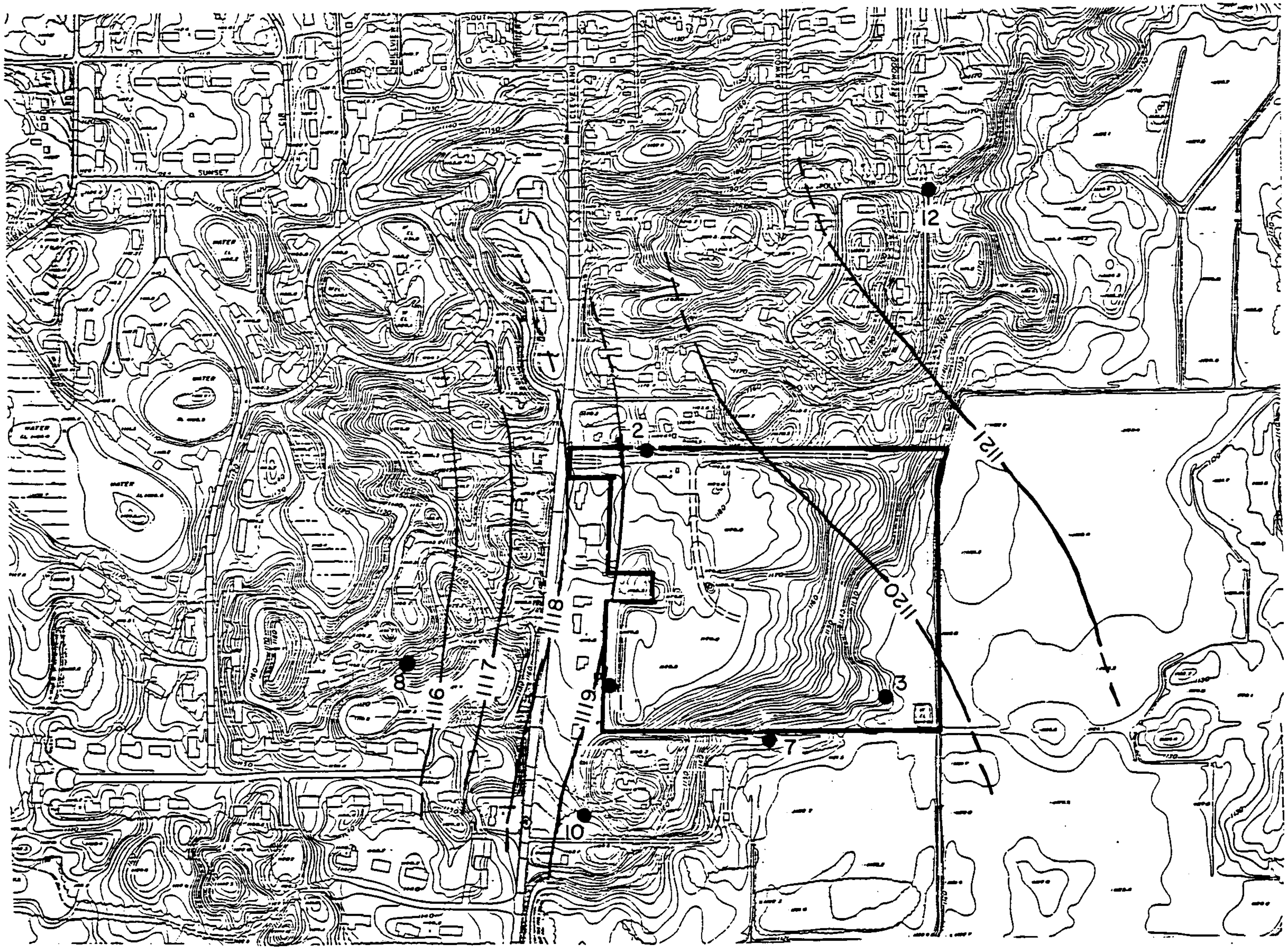
INDUSTRIAL EXCESS LANDFILL, STARK COUNTY, OHIO

GROUNDWATER CONTOURS - SHALLOW DEPTH MONITOR WELL

FIGURE
4-9



SCALE 1" = 400'	INDUSTRIAL EXCESS LANDFILL, STARK COUNTY, OHIO POTENTIOMETRIC SURFACE - MEDIUM DEPTH MONITORING WELL	FIGURE 4-10
DATE FEB. 10, 1988		



LEGEND

● 8 MONITORING WELL LOCATION & IDENTIFICATION

POTENTIOMETRIC CONTOUR (1 FT. INTERVAL)

1128 ELEVATION (ABOVE MEAN SEA LEVEL) MAY 12, 1987

200 0 200 400

SCALE
1" = 400'

DATE
MAY 12, 1988

INDUSTRIAL EXCESS LANDFILL, STARK COUNTY, OHIO

POTENTIOMETRIC SURFACE - BEDROCK MONITORING WELLS

FIGURE
4-12

it being near a higher portion of the landfill. No data are available for water table conditions along the north edge of the site. (This lack of water table data is due to the presence of a locally extensive, dense glacial till that directly overlies bedrock and is itself covered by a relatively thin veneer of sand and gravel [Figure 4-4]. During drilling of monitoring well nest 2, this till was encountered at a depth of about 35 feet and continued to bedrock at about 75 feet [See Appendix J for lithology log from monitoring well #2.] At this location, the water table probably occurs at a depth of 55-60 feet; right in the middle of the dense glacial till. Thus, no water table well was installed at location 2. Instead, a "shallow" well was screened at the top of the glacial till to sample any of the minor perched groundwater that seasonally is present. The other well at location 2 is completed in bedrock below the till.) Without water table elevations for the north edge of the landfill, two different configurations of the water table in that area are possible (Figure 4-9). One configuration (shown with the dashed lines) indicates that the water table associated with the landfill is the southern extension of a groundwater ridge that originates from the topographic ridge north of the site (Figure 4-9). In this interpretation groundwater at the north edge of the site would flow under a low gradient from north to south. The other possible interpretation (shown with dotted lines, Figure 4-9) is that the water table under the landfill is a true mound, with groundwater flowing radially outward from the center of the mound. Whichever configuration is correct, the available data indicate that this mound or ridge quickly dissipates beyond the bounds of the landfill where the natural sand and gravel has higher vertical and horizontal permeability than the filled area. A good example of this dispersal is the observation that monitoring well MW07S, at the edge of the waste, typically has water levels of about 1,124 feet. But only about 120 feet south of this well, dry land surface is at 1,121.3 feet.

Although Figure 4-9 presents a two-dimensional picture of groundwater flow, the actual movement is in three dimensions. A comparison was made of the water levels in water table wells (shallow wells) with water levels in paired medium depth wells (that are screened some 35 feet below the shallow wells). This comparison shows the vertical component to groundwater flow within the sand and gravel (Table 4-1). The data included on Table 4-1 can then be combined with the horizontal gradient data shown in Figure 4-9. These comparisons reveal that along the east side of the site, MW03 wells show only a very slight downward gradient, indicating that most shallow groundwater flow at that location is horizontal and toward Metzger Ditch. Well MW09, the nested monitoring well that is closest to Metzger Ditch shows a moderate upward gradient. This indicates that this well is located in a discharge area. Water level observations to the south (MW07) and west (MW01 and MW11) indicate strong vertically downward gradients from the top of the water table to the medium levels of the sand and gravel. This means that the water table water layer, which is produced from precipitation moving through the permeable soil and also the permeable waste of the landfill, is moving downward as well as horizontally and recharging the medium levels of the aquifer. Precipitation-derived water which has infiltrated through the landfill reaches the groundwater mound and then flows radially down gradient. The final discharge point will depend on the location at which this infiltrated water intercepts the mound. Infiltration into the area to the west of the center of the water table mound moves downward through unsaturated soil (or soil and waste) and joins the water table. There it moves both downward and westward to discharge in the wetlands that lie west of the site or to discharge in the northern extension of Metzger ditch that lies about 1 mile west of the site (Figure 4-7). Water falling on areas to the north or south of the center of the mound also moves downward from the top of the water table as well as moving northward or southward, respectively. However, as described above, the groundwater mound or ridge quickly disperses away from the landfill.

TABLE 4-1: WATER ELEVAT MEASUREMENTS AT IEL

Well #	RISER ELEVATION	SCREENED INTERVAL	6/27/86	8/4/86	9/4/86	1/27/87	5/12/87	6/11/87	1/14/88	2/10/88
1S	1167.12	1118-1127	1123.54	1122.37	1121.91	1124.42	1122.57	1122.40	1122.05	1122.47
1M	1167.48	1085-1095	1118.73	1118.65	1118.14	1118.80	1119.27	1119.06	1118.61	1118.96
1D	1164.50	1002-1010					1119.05	1118.78	1118.65	1118.65
2S	1182.57	1139-1150	1141.40	1141.32	1141.51	1141.77	1142.06			
2D	1182.29	1071-1081	1118.98	1119.33	1118.46	1118.96	1119.43			1118.94
3S	1129.14	1117-1125	1119.48	1119.48	1119.26	1119.65	1119.79	1119.67	1119.94	1119.96
3M	1129.17	1087-1098	1119.39	1119.23	1118.71	1119.44	1119.74	1119.55	1119.10	1119.36
3D	1128.85	1064-1074	1119.14	1119.94	1119.54	1119.80	1119.55	1119.37	1118.92	1119.24
4S	1122.45	1113-1118				1117.55	1118.20	1117.43	1118.96	1118.77
5S	1123.47	1114-1119				1119.18	1118.30	1118.40		1118.85
6S	1122.60	1113-1118				1118.74	1118.83	1118.33		1118.88
7S	1131.38	1116-1127				1124.37	1124.21	1123.37	1123.70	1124.37
7M	1131.40	1089-1101				1119.15	1119.45	1119.25	1118.81	1119.17
7D	1132.15	1047-1054				1119.15	1119.57	1119.36	1118.91	1119.26
8S	1138.71	1108-1120				1115.75	1117.34	1116.59	1115.42	1115.57
8M	1139.01	1080-1087				1114.00	1114.96	1114.52	1113.20	1113.40
8D	1138.43	1020-1030				1114.32	1115.15	1114.71	1113.53	1113.77
9S	1125.54	1110-1122					1118.73	1118.53	1119.36	1119.39
9M	1125.54	1076-1084					1120.03	1119.81		1119.56
9D	1124.84	1005-1019					1115.35	1114.74	1113.37	1113.66
10S	1157.47	1108-1121					1119.43	1119.12	1118.66	1118.95
10M	1155.67	1084-1096					1119.19	1118.99	1119.02	1118.99
10D	1156.22	1031-1039					1119.18	1118.97	1118.62	1119.00
11S	1169.85	1112-1126					1121.27	1121.15	1120.68	1120.79
11M	1169.26	1082-1095					1119.04	1118.79		1118.59
11D	1169.70	953-963					1095.29	1095.64		1095.94
12M	1170.59	1107-1114					1121.59	1121.20	1120.24	1120.26
12D	1170.63	1076-1083					1121.61	1121.21	1120.29	1120.39
SODWC	1127.52	1087-1122						1122.88		1123.10
SODWN	1124.87	1085-1120						1122.82		1123.10

Thus, the groundwater that initially moved northward or southward from the landfill will, in a short distance, be assimilated into the westward regional flow (which is further described below) and will move to the area discharge points west of IEL. Water infiltrating to the east of the center of the mound will move downward and eastward. Some will discharge locally into Metzger Ditch and the rest will be assimilated into the regional flow to the west.

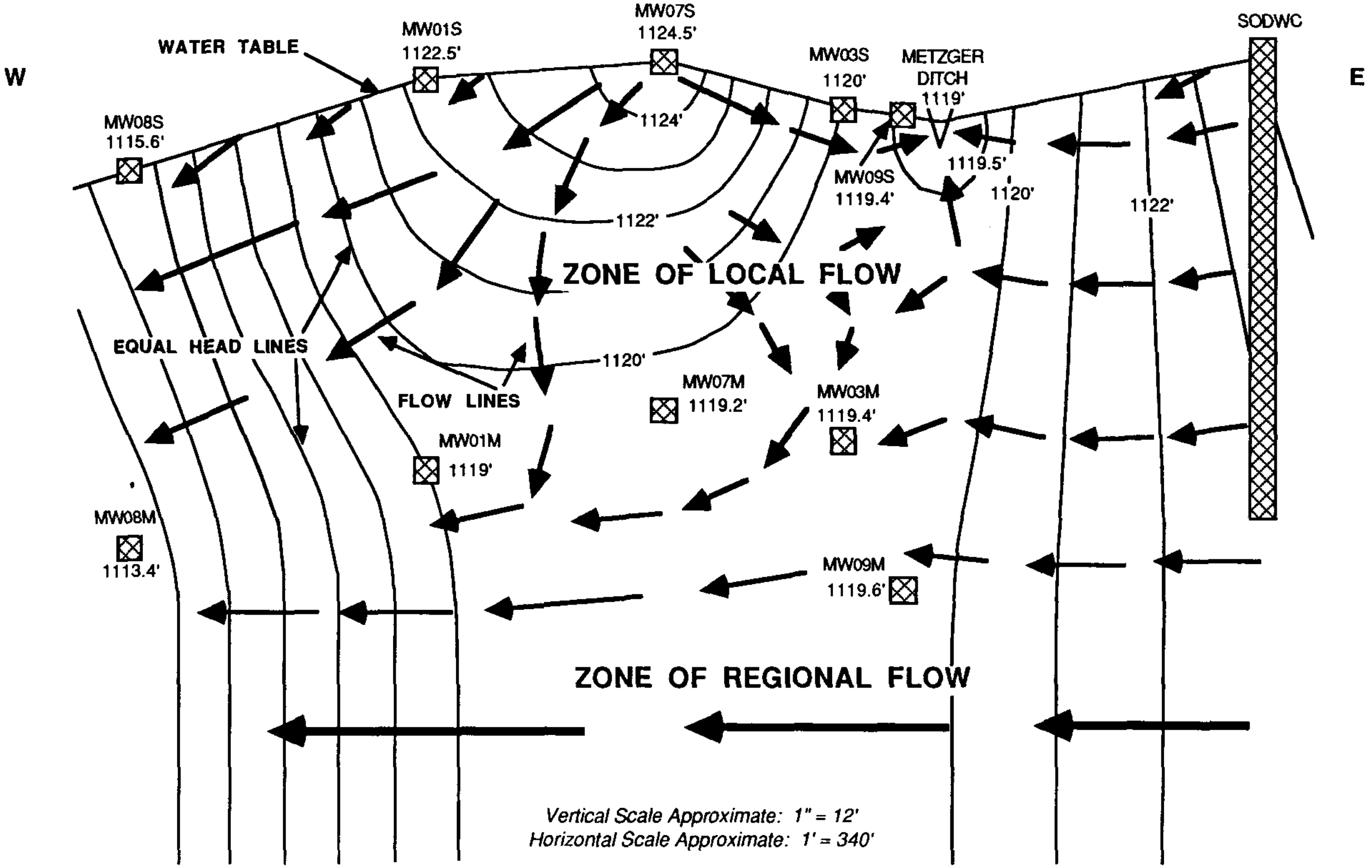
Figure 4-10 depicts the potentiometric surface for groundwater at "medium" elevation levels within the sand and gravel aquifer. The map is based on water levels in all eight medium depth monitoring wells plus the water levels in the two sod farm irrigation wells which are screened in the upper 40 feet of sand and gravel.

The data used to prepare Figure 4-10 can be interpreted in another way. Basically, this alternative explanation extends the groundwater mound or ridge shown by water table elevations in shallow wells to the depth of the medium wells. The consequence of that extension is that groundwater in the medium portion of the sand and gravel aquifer would also flow radially from the landfill area as it does in the water table (shallow) portion of the aquifer. Groundwater sampling of the medium wells does not support that alternative interpretation. It thus appears that the medium monitoring wells, screened at about 35 feet below the water table, tap the regional groundwater flow system wherein groundwater moves from east to west as shown in Figure 4-10. Figure 4-11 is a generalized groundwater flow net that illustrates an east-west cross section through the IEL area. On this figure, the local groundwater system is differentiated from the regional flow system, and potential contaminant migration pathways are illustrated.

As was previously discussed, the bedrock underlying the IEL area has a highly irregular surface formed by pre-glacial erosion and modified by

FIGURE [illegible]-11

GENERALIZED FLOW NET OF GROUNDWATER SYSTEM AT IEL SHOWING LOCAL AND REGIONAL FLOW SYSTEMS AND VARIOUS PATHWAYS OF WATER MOVEMENT



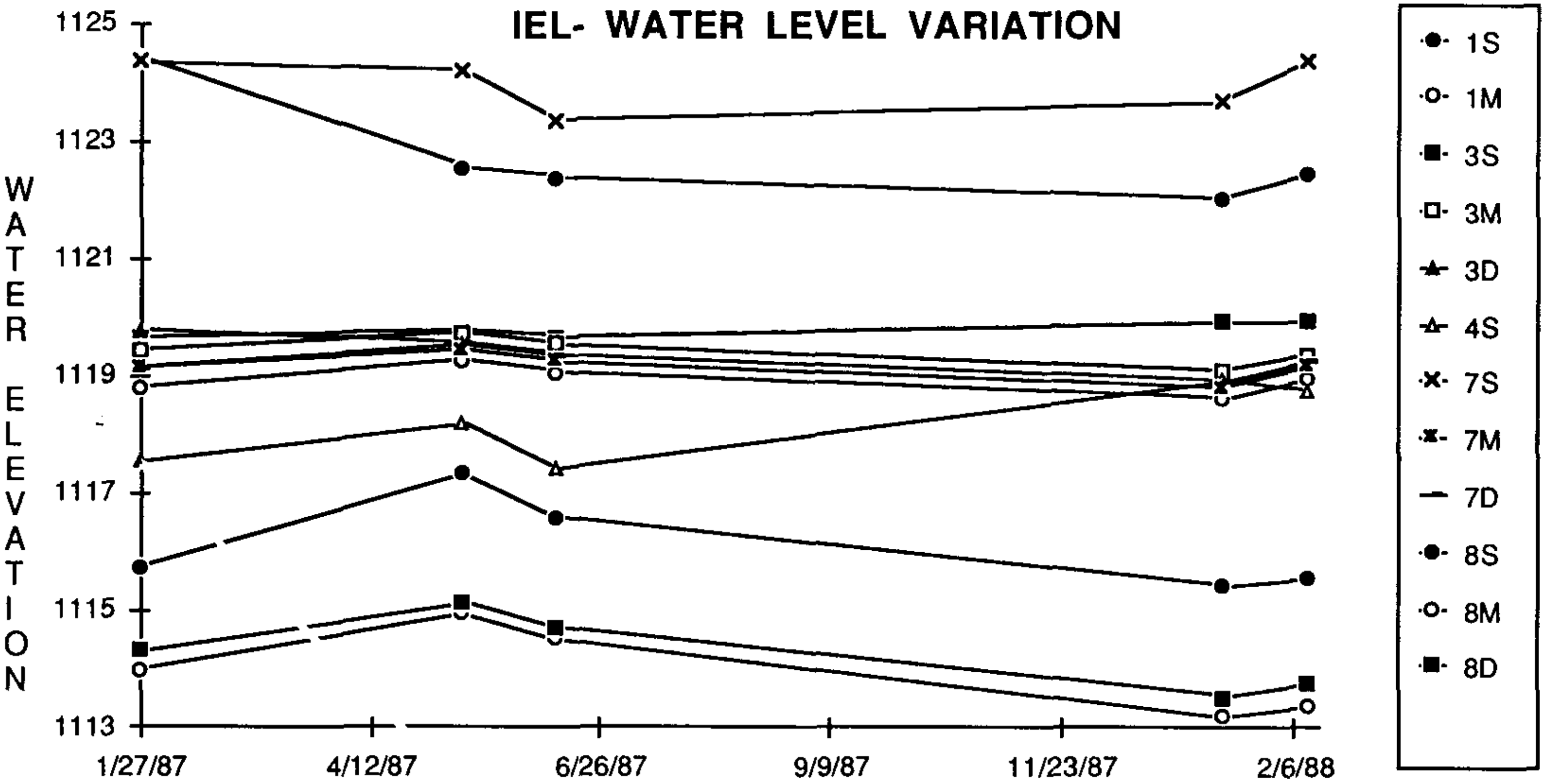
glacial action (Figure 4-3). In general, drilling into bedrock "hills" will encounter the stratigraphically high Massillon sandstone and drilling into bedrock "valleys" (lows) will encounter the underlying siltstone and shale of the Upper Sharon Member (See Figure 4-2). A total of nine monitoring wells were installed into the bedrock, 7 were screened in sandstone that forms the uppermost bedrock at IEL (Massillon Sandstone) and two (MW09D and MW11D), were screened in the underlying siltstone and shale of the Upper Sharon Member. Water levels in the two wells screened in the lower unit are consistently lower than those measured in the overlying sandstone (Table 4-1), probably indicating relative hydraulic isolation from the overlying sandstone and glacial material. Thus, the bedrock potentiometric map (Figure 4-12) is based only on the 7 sandstone wells.

The interpreted potentiometric surface (Figure 4-12) indicates that, like the overlying sand and gravel, groundwater flow in the sandstone aquifer is to the west. Examination of vertical gradients (Table 4-1) reveals that, over time, head values in sandstone bedrock wells are virtually the same as those for their companion medium depth sand and gravel wells. This finding indicates that groundwater flow in the lower portion of the sand and gravel and the immediately underlying sandstone is virtually all horizontal. Bedrock monitoring wells MW09D and MW11D are screened in the upper portion of the Sharon Member of the Pottsville Group. The wells are separated from the overlying sand and gravel aquifer and shallower sandstone aquifer by layers of silts, clays, shales, coals and siltstones of variable thickness. Because of this, it is likely that the wells in the Sharon Member are for the most part hydraulically isolated from the overlying sands and gravels, and sandstone. This condition would explain the large head differences between medium sand and gravel wells and the deep bedrock wells at well nest locations MW09 and MW11.

Based on data presented in Figure 4-13, there does not appear to be sufficient seasonal variations in water levels to alter the basic flow patterns shown on the groundwater maps.

FIGURE 4-13

IEL- WATER LEVEL VARIATION



Summary of Groundwater Flow Patterns

Water table and potentiometric maps show that regional groundwater flow in the sand and gravel, and the hydraulically connected sandstone bedrock, is to the west. In general, the area near IEL is an area of groundwater recharge. Local discharge into Metzger ditch from the sand and gravel does occur. Precipitation falling on the landfill proper moves downward through the permeable cap and waste, and creates contaminated recharge water (leachate). This contaminated groundwater initially moves in all directions away from the groundwater mound associated with the landfill and (with the exception of discharge into Metzger ditch) quickly (within less than 200 feet) joins the regional flow to the west.

4.2.6 Hydraulic Conductivities and Approximate Groundwater Flow Rates*

Slug tests were performed on all medium and deep monitoring wells installed during this RI/FS. The results of all valid tests are summarized in Tables 4-2A and 4-2B.

The results of tests of medium wells completed in the sand and gravel aquifer indicate measured hydraulic conductivities vary from 6.1×10^{-2} to 1.1×10^{-1} ft/min (660 to 1,200 gallons per day per feet^2 [gpd/ft^2]). The average is 7.7×10^{-2} ft/min (830 gpd/ft^2). For deep wells screened in the Massillon Sandstone, the range is 3.5×10^{-3} to 7.2×10^{-2} ft/min (3 to 780 gpd/ft^2) with an average of 3.2×10^{-2} (350 gpd/ft^2). Wells MW09D and MW11D, which are both completed in the upper part of the Sharon Member, yield hydraulic conductivities of 1.5×10^{-2} to 3.6×10^{-3} ft/min (40 to 160 gpd/ft^2).

* The results of these slug tests were originally presented in <u>Focused Feasibility Study for Evaluating Alternative Water Supplies at the Industrial Excess Landfill Site</u> (Document Number 157-RI1-RT-EZGE-1). Reevaluation of the test analyses revealed a systematic error in the calculations. The error has been corrected in the results presented here.

TABLE 4-2A

HYDRAULIC CONDUCTIVITY FOR MEDIUM DEPTH WELLS (SAND AND GRAVEL AQUIFER) AT IEL*

Well Location	No. of Slug Tests	Hydraulic Conductivity Range (ft/min)	Average Hydraulic Conductivity (ft/min)
MW01M	3	5.7×10^{-2} - 6.6×10^{-2}	6.1×10^{-2}
MW03M	3	6.7×10^{-2} - 1.8×10^{-1}	1.1×10^{-1}
MW07M	3	5.6×10^{-2} - 9.1×10^{-2}	6.9×10^{-2}
MW09M	3	2.7×10^{-2} - 1.2×10^{-1}	6.8×10^{-2}
MW10M	1	---	7.5×10^{-2}
MW11M	1	---	7.6×10^{-2}
MW12M	2	6.7×10^{-2} - 9.8×10^{-2}	8.2×10^{-2}

TOTAL AVERAGE = 7.7×10^{-2}

---

* Method used to interpret data is that of Bouwer and Rice, 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Research, Volume 12, No. 3, June, 1976.

TABLE 4-2B

HYDRAULIC CONDUCTIVITY FOR BEDROCK WELLS AT IEL

Well Location	No. of Slug Tests	Hydraulic Conductivity Range (ft/min)	Average Hydraulic Conductivity (ft/min)
MW01D*	4	3.2×10^{-2} - 9.9×10^{-2}	6.0×10^{-2}
MW02D*	1	---	5.1×10^{-2}
MW03D*	4	2.5×10^{-3} - 5.3×10^{-3}	3.5×10^{-3}
MW07D*	2	8.6×10^{-3} - 9.7×10^{-3}	9.2×10^{-3}
MW08D*	2	3.3×10^{-2} - 1.1×10^{-1}	7.2×10^{-2}
MW09D**	2	1.0×10^{-2} - 2.0×10^{-2}	1.5×10^{-2}
MW10D*	1	___	2.2×10^{-2}
MW11D**	2	2.1×10^{-3} - 5.0×10^{-3}	3.6×10^{-3}
MW12D*	3	3.4×10^{-3} - 4.7×10^{-3}	3.9×10^{-3}

Average for Massilon Sandstone wells* = 3.2×10^{-2}

Range for upper Sharon Member wells** = 1.5×10^{-2} to 3.6×10^{-3}

* Method used to interpret data is that of Bouwer and Rice, 1976. "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells." Water Resources Research, Volume 12, No. 3, June, 1976.

** Method used to interpret these data from confined beds is that of Cooper, Bredehoeft, and Papadopulos, 1967. "Response of a Finite-Diameter Well to an Instantaneous Charge of Water." Water Resources Research, Volume 3, No. 1, First Quarter, 1967.

Using the data from these tests, groundwater gradients calculated from the groundwater level maps presented previously (Figures 4-9 through 4-12), and by making assumptions concerning the porosity of the water-bearing sediments at IEL, estimates of average linear groundwater velocity can be made. The equation to calculate this velocity is:

$$\text{Average Linear Velocity} = \frac{\text{Hydraulic Conductivity X Groundwater Gradient}}{\text{Porosity}}$$

Horizontal groundwater gradients in the area of IEL range from about 0.0008 to 0.006. As noted above, hydraulic conductivities in the sand and gravel aquifer range from 6.1×10^{-2} to 1.1×10^{-1} ft/min. Assuming a porosity for the sand and gravel of 30%, the calculated range of horizontal average linear velocities is about 80 to 1,100 feet per year. These values are for the movement of water only. Materials contained in the water will move (or not move) at rates depending on the characteristics of the substance (e.g. sorption coefficient) and characteristics of the aquifer material (e.g. organic carbon content and ion exchange capacity). Data from groundwater sampling in the area of IEL (discussed below in Section 4.5) indicate that, in fact, contaminants from the landfill do not move as fast as the groundwater.

4.3. Area Soils

Most of the soils found in the IEL area have developed in material transported by glacial action. The most extensive soils are those that developed in areas of hummocky topography located to the north, west and southwest of the IEL site. These nearly level to steep soils have been assigned, by the USDA Soil Conservation Service, to the Chili and Conotton Series of soils (Christman and others, 1971).

The Chili and Conotton soils are well-drained soils that formed in silty material underlain by gravelly kames and outwash. These sandy and gravelly soils occur on crests of knolls and on irregular, complex slopes. Large cobbles and boulders may be found locally. High permeability is exhibited by the subsoil and underlying material. Erosion is a problem in the more sloping areas (Christman and others, 1971).

A large, generally level area of organic soils (muck and peat) is located to the east and southeast of the IEL site. Much of this area is occupied by a sod farm, and the normally wet soil has been artificially drained via discharge into Metzger Ditch. Undrained areas are swampy much of the time. These poorly drained organic soils have been assigned to the Carlisle Series of soils (Christman and others, 1971).

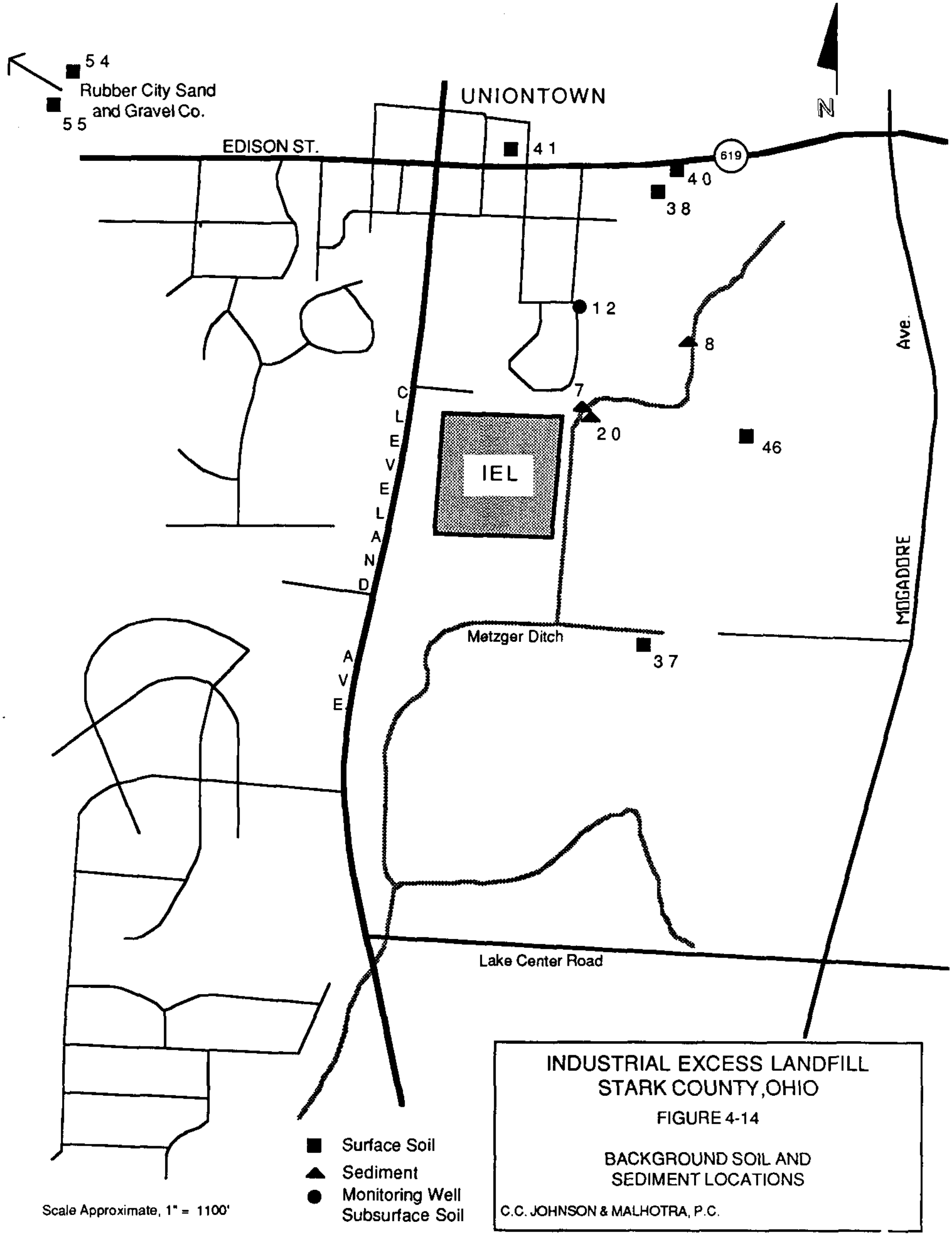
The Carlisle soils are also found in the many depressions (kettles) between the knolls and kames in the areas of hummocky topography near the IEL site. Drainage outlets are generally not available in the areas of kames and the organic soil is saturated most of the time. However, in drained, cultivated areas, this soil is subject to wind erosion and damage by fire (Christman and others, 1971).

4.4 Soil Contamination Study

During the Remedial Investigation at the Industrial Excess Landfill, a total of 50 different surface soil sites were sampled and analyzed for Hazardous Substance List (HSL) compounds and ions. Of these 50 sites, three were later resampled (samples S007, S013, and S025). During the entire sampling effort, 14 duplicate samples were taken to ensure repeatability of results. (Five samples that were originally collected as soil samples [formerly designated S018 to S022] were actually samples of old Metzger Ditch sediment and are discussed in Section 5.3, along with the other sediment samples. Those samples are now designated SDS018 to SDS022.)

In addition to the surface soil samples, 35 separate subsurface soil samples and 11 duplicates were obtained during drilling of the monitoring wells. These soils came from the drilling of all nine nested monitoring wells (wells MW01 to MW03 and MW07 to MW12, Figure 4-8) and from depths ranging from 5 to 166 feet below ground surface. (Subsurface soil samples are designated first by the well they were collected from and then by the depth interval sampled. Thus sample "SOMW01D[25-27]" is from the deep well at location 1 and from a depth of 25-27 feet.) The soils collected in the IEL study area can be divided into three categories based upon where they were collected in relation to the landfill and in relation to surface and groundwater movement from the site. The three categories are background samples, near-site or down-gradient samples, and on-site samples. Background samples are those soils that were collected away from the site and/or up surface and groundwater gradient from the site (Figure 4-14). Background soil samples include samples taken at Rubber City Sand and Gravel Co., 3046 Meyersville Rd., located northwest of Uniontown (samples S054 and S055), samples collected to the north, east, and southeast of the landfill (samples S037, 38, 40, 41, and 46) and samples of soil taken during the drilling of the background monitoring well nest (well MW12).

The "near-site" or down-gradient category of samples were taken in close proximity to the site and hydraulically downgradient of the site. Such soil samples were supposedly not directly affected by the landfilling activities at the site but may or may not have been subsequently contaminated by materials migrating from the landfill (via aerial transport, surface runoff, or groundwater discharge). These "near-site" and down-gradient soils include samples S023, S024, S039, S042, S044, S045, and S047 through S053 (Figures 4-15 and 4-16 and Table 4-3). (Interestingly, samples S047 to S051 were directly affected by the landfill in that the area from which they were collected was part of the landfill during its operation. See additional discussion on this point in Section 4.4.2)

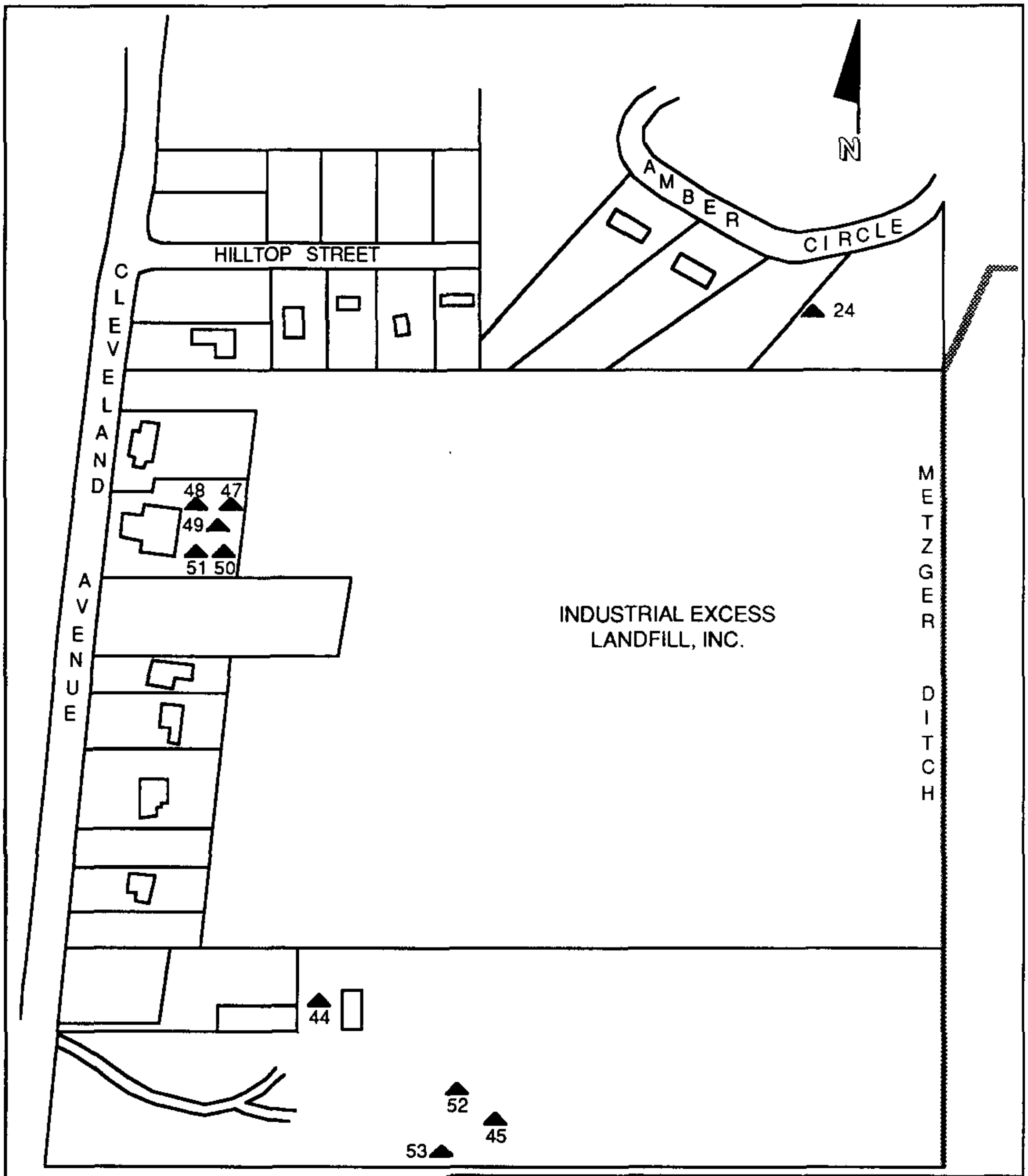


INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-14

BACKGROUND SOIL AND
SEDIMENT LOCATIONS

C.C. JOHNSON & MALHOTRA, P.C.



▲ Surface Soil

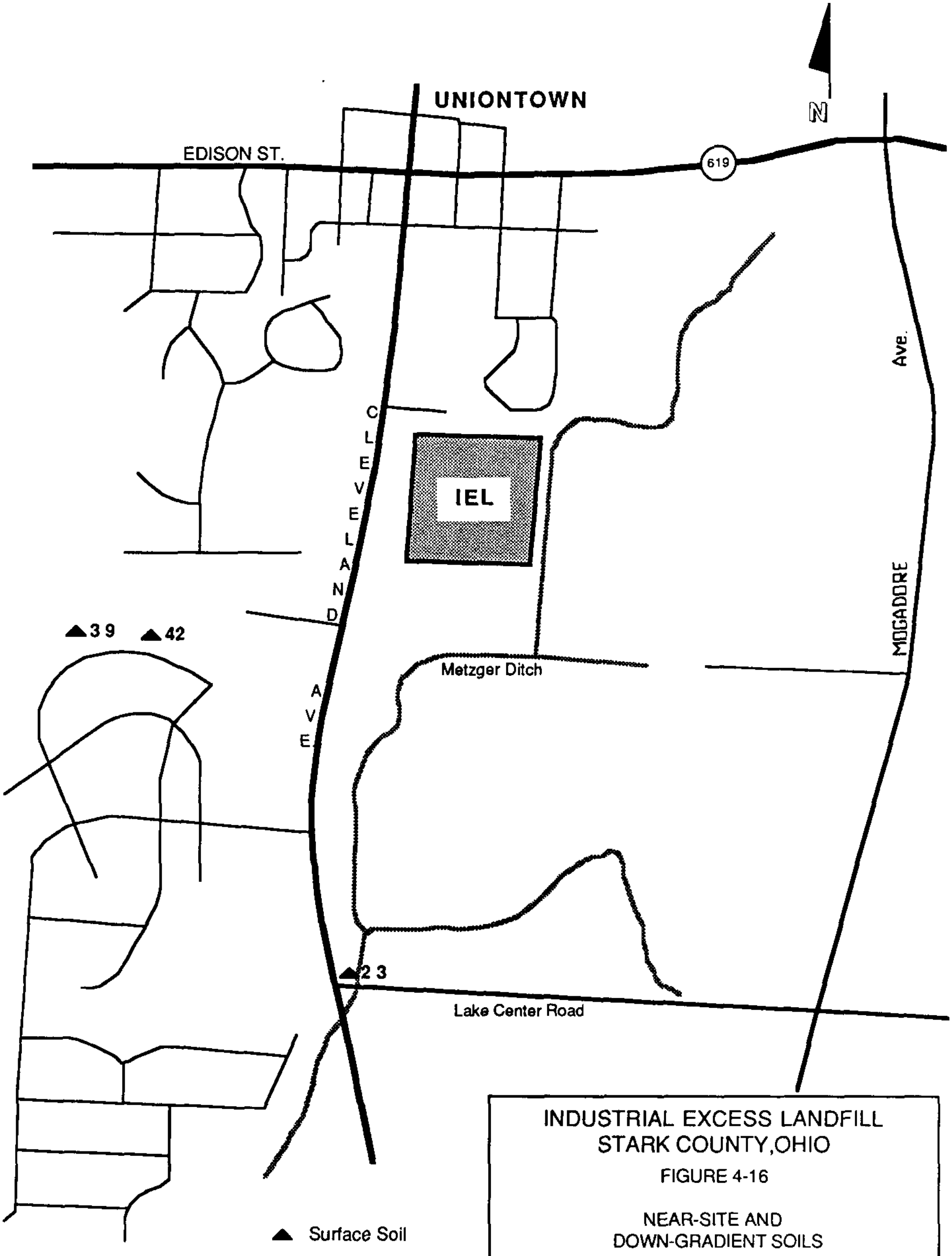
Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 4-15

NEAR-SITE & DOWN GRADIENT SOILS

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-16

NEAR-SITE AND
DOWN-GRADIENT SOILS

C.C. JOHNSON & MALHOTRA, P.C.

TABLE 4-3

NEAR-SITE AND DOWN GRADIENT SOIL SAMPLES - IEL

SURFACE SOIL SAMPLES - GENERAL

S024, S039, S042, S044, S045

SURFACE SOIL SAMPLES - AREA BEHIND UNIONTOWN TIRE THAT MAY HAVE BEEN LANDFILLED

S047, S048, S049, S050, S051

SURFACE SOIL SAMPLE - MIGRATION PATHWAY, METZGER DITCH

S023

SUBSURFACE SOIL SAMPLES - SAMPLES OF PEAT EXCAVATED FROM POND SOUTH OF IEL*

S052, S053

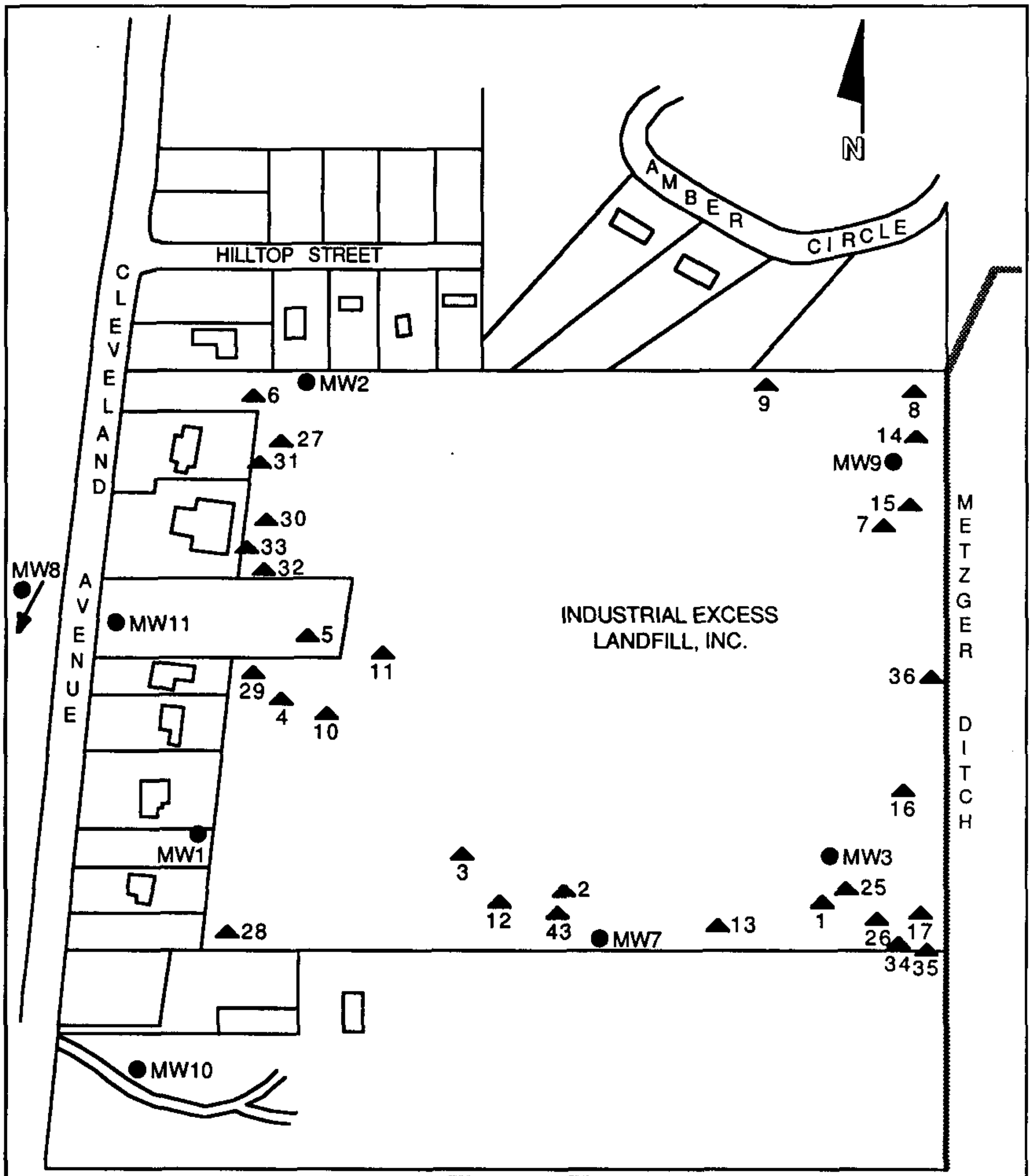
*Sample collected from previously excavated material actual depth of sample is unknown.

Soil samples were also collected from points on the site. These soils included: samples from waste and soil material that was exposed at the surface; waste and soil material that was exposed during trenching activities to install the methane venting system; waste and soil brought to the surface during the drilling of the older, passive methane flares; soils that were obviously stained by leachates or other runoff on the site; and random samples of soil from on the site (Table 4-4 and Figure 4-17). Soils collected on the site include samples S001 through S017, S025 through S036, and S043. Also included in this group of soils are subsurface soil samples from the installation of all monitoring wells except the background well (MW12).

4.4.1 Background Soils and Sediments

A total of 11 samples including 7 surface soils, 3 sediments, and 1 subsurface monitoring well soil were collected to determine background levels of metals and persistent organics in the IEL area (Figure 4-14). The background levels determined from these samples are shown in Table 4-5. These data are used in the following sections to evaluate the impact that the Industrial Excess Landfill may have had on the site itself and the surrounding environment.

The organics detected in background soils and sediments are phthalates, polycylic aromatic hydrocarbons (PAHs), and persistent pesticides (Table 4-5). No organics were detected in the background subsurface soils. Comparisons presented later in this section thus assume that uncontaminated subsurface soil should be free of all organics. Pesticides were found at similar levels in both surface soils and sediments. However, the levels of phthalates in background sediments is 8 times that detected in background soils. Subsequent comparisons of sediments and soils to background levels take into account this difference in phthalate concentration. PAHs were only detected in one surface soil. PAHs in sediments is thus assumed to be zero.



▲ Surface Soil

● Monitoring Well
Subsurface Soil

Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 4-17

ON-SITE SOILS

C.C. JOHNSON & MALHOTRA, P.C.

TABLE 4-4

ON-SITE SOIL SAMPLES - IEL

SURFACE SOIL SAMPLES - GENERAL

S002, S003, S006, S009, S010, S011

SURFACE SOIL SAMPLES - LEACHATE CONTAMINATED SOILS

S001, S007, S013, S025, S026, S043

SURFACE SOIL SAMPLES - MIGRATION PATHWAYS, SURFACE RUNOFF

S008, S012, S034, S035, S036

SUBSURFACE SOIL SAMPLES - NATURAL SOIL LYING BETWEEN LANDFILL AND METZGER DITCH, TAKEN AT DEPTHS OF 1' - 4'.

S014, S015, S016, S017

SUBSURFACE SOIL SAMPLES - SOIL AND WASTE MIXTURES TAKEN FROM AUGER HOLES INTO WASTE AND FROM TRENCHES DUG INTO WASTE ALONG WEST EDGE OF LANDFILL.

S004, S005, S027, S028, S029, S030, S031, S032, S033

SUBSURFACE SOIL SAMPLES - MONITORING WELL SPLIT SPOON SAMPLE, SOIL/WASTE MIXTURE

SOMW07S (6-9)

SUBSURFACE SOIL SAMPLES - MONITORING WELL SPLIT SPOON SAMPLES, NATURAL SOIL

SOMW01D (10-12), SOMW01D (15-17), SOMW01D (20-22), SOMW01D (25-27), SOMW01D (35-37), SOMW01D (50-52), SOMW01D (70-72), SOMW01D (70-75), SOMW01D (83-85), SOMW01D (98-100), SOMW01D (113-115), SOMW01D (123-125), SOMW01D (160-161), SOMW02M (8-10), SOMW02M (50-52), SOMW02M (64-66), SOMW03S (5-7), SOMW03D (8-10) SOMW07S (9-11), SOMW07D (40-42), SOMW07D (50-52), SOMW08S (24-26), SOMW08D (63-65), SOMW09S (5-7), SOMW09D (64-66), SOMW09D (84-86), SOMW10D (25-27), SOMW10D (45-47), SOMW10D (100-102), SOMW11D (39-41), SOMW11D (74-76), SOMW11D (124-126), SOMW11D (164-166)

TABLE 4-5

BACKGROUND LEVELS OF ORGANIC AND INORGANIC COMPONENTS IN SOILS AND SEDIMENTS - IEL

Chemical	Range of Concentration Detected (ppm)	Frequency* of Detection
Bis(2-EthylHexyl)phthalate	.551 - 1.331	2/11
Butylbenzylphtalate	.012	1/11
Di-N-Butyl Phthalate	.110 - 2.344	4/11
Phthalates in Surface Soils	.012 - .290	4/7
Phthalates in Sediments	.551 - 2.344	3/3
(All Phthalates)	.012 - 2.344	7/11
Fluoranthene (soils only)	.093	1/11
Pyrene (soils only)	.110	1/11
(All PAH's) (soils only)	.203	1/11
4,4' - DDE	.048	1/11
4,4' - DDT	.220 - .290	2/11
Beta - BHC	.016	1/11
Endosulfan I	.010	1/11
(All Pesticides)	.220 - .364	2/11
Aluminum	2000 - 15,700	11/11
Arsenic	7 - 34	8/11
Barium	14 - 173	11/11
Beryllium	0.4 - 1.5	4/11
Cadmium (soils only)	2.4 - 5.2	4/11
Calcium	281 - 29,100	11/11
Chromium	3.4 - 23	9/11

*Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 4-5 (Continued)

BACKGROUND LEVELS OF ORGANIC AND INORGANIC COMPONENTS IN SOILS AND SEDIMENTS - IEL

Chemical	Range of Concentration Detected (ppm)	Frequency* of Detection
Cobalt	3.8 - 17	6/11
Copper	8 - 45	10/11
Cyanide	1 - 18	2/11
Iron	11,000 - 62,100	11/11
Lead	10 - 81	10/11
Magnesium	983 - 5820	11/11
Manganese	242 - 1540	10/11
Mercury (soils only)	0.07 - 0.2	2/11
Nickel	7.6 - 54	7/11
Potassium	265 - 1390	9/11
Selenium (soils only)	0.2	1/11
Sodium	74 - 3960	9/11
Thallium (soils only)	0.26 - 0.35	1/11
Vanadium	4.8 - 20	9/11
Zinc	33 - 309	11/11

*Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

Background levels of metals in both soils and sediments are generally comparable (Appendix G). Exceptions are cadmium, mercury, selenium, and thallium which were detected at low levels in soils but were not detected in sediments. Thus, these metals are assumed to have a background level of zero in sediments. All of the other metals detected are used as background levels for sediments, surface soils, and subsurface soils. This approach is considered valid for the following two reasons:

- As mentioned above, detected background levels of metals, with the exceptions noted, are comparable between soils and sediments.

- The surface soils at the IEL site represent excavated material that is, for the most part, unweathered glacial sediment. Thus, it was one of the priorities of background soil sampling to obtain unweathered "soil" from gravel pits and borrow areas in the IEL area (e.g. S046, S054, and S055). Therefore, these background samples, as well as the subsurface soil samples from background monitoring wells MW12, are entirely comparable to subsurface and excavated soil now found as surface soil in the Uniontown area.

Unweathered glacial material, the "parent material" for the in-place soils described in local soil surveys (Christman and others, 1971), can be expected to contain higher levels of trace metals than those found in true, in-place soils in which soil horizons have developed through thousands of years of weathering and in which chemically unstable, naturally occurring minerals, including heavy metal-bearing sulfides, have been selectively removed by solution. This conclusion is borne out by comparison of metals detected in studies of element concentrations in surficial deposits (e.g. Shacklette and Boerngen, 1984, and Logan and Miller, 1983) to the soils studied in this RI/FS. For example, comparison of levels of arsenic, cadmium, and zinc in the Uniontown area background "soils" with levels of the same metals in surficial deposits of the eastern United States indicate that the samples taken in the RI/FS contain higher levels of these metals than one would expect to find in surface soils (Table 4-6). Soil samples analyzed in both Shacklette and Boerngen's (1984) and Logan and Miller's (1983) studies are from the upper 6 inches of soil. Most soils from this RI/FS are taken from depths, or were excavated from depths, that far exceeded 6 inches. Thus, leaching by weathering has not taken place and the soils contain higher levels of trace metals than found in the true surficial soils.

4.4.2 Near-Site and Downgradient Soils

The chemicals detected in soils that are located near or downgradient of IEL are listed in Tables 4-7 and 4-8. For each sample, the detected levels of organics and inorganics were compared to levels found in the background soils and sediments discussed in Section 4.4.1. Table 4-9 is a sample-by-sample listing of near-site soil samples and their chemical components that exceeded background levels by a factor of 1.2. The background level referred to is the maximum level detected in a background sample for that component. The "1.2X" factor is based on examination of duplicate sample results for all chemical data collected at IEL. It was found that data was normally reproducible within plus or minus 20 percent. Thus, data which indicated values greater than 120% of the maximum background value for that chemical or ion were considered as anomalous. This does not mean that the chemicals or ions that exceed 1.2 times the maximum background level are attributable to contamination from IEL. What it does suggest is that it is wise to include this sample in an evaluation of potential contamination patterns that might include IEL as a source of contamination. Beyond this "1.2X" factor, the listing in Table 4-9 also shows samples that exceed maximum background levels for a particular component by factors of at least

TABLE 4-6

RANGE OF ELEMENT CONCENTRATIONS IN SURFICIAL MATERIALS OF THE EASTERN UNITED STATES (EAST OF 96TH MERIDIAN)*

ELEMENT	MEAN**	NORMAL RANGE** (MEAN + 1 s.d.)	EXTREME VALUE** (MEAN + 2 s.d.)
Aluminum	33,000	11,498 - 94,710	189,420
Antimony	0.52	0.22 - 1.24	2.5
Arsenic	4.8	1.9 - 12.3	24.6
Barium	290	123 - 682	1363
Beryllium	0.55	0.22 - 1.39	2.8
Cadmium	---		1 - 4***
Calcium	3400	1104 - 10,472	20,944
Chromium	33	13 - 86	172
Cobalt	5.9	2.3 - 15.2	30
Copper	13	5 - 36	72
Iron	14,000	4,878 - 40,180	80,360
Lead	14	7 - 27	54
Magnesium	2100	592 - 7,455	14,910
Manganese	260	68 - 993	1,986
Mercury	0.081	0.032 - 0.20	0.40
Nickel	11	4 - 29	58
Potassium	12,000	9,000 - 16,000	32,000
Selenium	0.30	0.12 - 0.73	1.46
Silver	---	---	3***
Sodium	2500	549 - 11,375	22,750
Vanadium	43	17 - 108	216
Zinc	40	19 - 84	168

* Data From: Shacklette, H.T. and Boerngen, J.G., 1984, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States: USGS Prof. Paper 1270. 105 p.

** Means and Standard Deviations are geometric for all elements except potassium, which is arithmetic.

*** Values for cadmium and silver are based on very limited data (both were rarely detected). These values are thus considered extreme.

TABLE 4-7

ORGANIC CHEMICALS DETECTED IN SURFACE SOILS
INDUSTRIAL EXCESS LANDFILL SITE

	On Site		Near Site & Down Gradient		Off Site (Background)	
Chemical	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection
1,4-Dichlorobenzene	43 (<330)	1/30	---	0/13	---	0/7
2-Butanone	<10-51	2/30	---	0/13	---	0/7
2-Methylnaphthalene	130-15,000	4/30	312-374	0/13	---	0/7
2-Methylphenol	190 (<330)	1/30	---	0/13	---	0/7
4,4-DDE	15-200	3/30	---	0/13	---	0/7
4,4-DDT	<16-170	3/30	<16-4,800	2/12	<16-220	1/7
4-Methyl-2-Pentanone	5 (<10)	1/30	---	0/13	---	0/7
4-Methylphenol	350-3,000	1/30	---	0/13	---	0/7
Acenaphthene	94 (<330)	1/30	---	0/13	---	0/7
Aldrin	<16-53	1/30	---	0/13	---	0/7
Anthracene	240-410	2/30	---	0/13	---	0/7
Benzene	2-9	2/30	---	0/13	---	0/7
Benzo(A) Anthracene	<350-1,100	1/30	---	0/13	---	0/7
Benzo(A) Pyrene	<350-900	1/30	---	0/13	---	0/7
Benzo(B) Fluoranthene	<350-1,400	1/30	---	0/13	---	0/7
Benzo(G,H,I) Perylene	<350-530	1/30	---	0/13	---	0/7
Benzo(K) Fluoranthene	<350-820	1/30	---	0/13	---	0/7
Benzoic Acid	117-122 (<400)	2/30	---	0/13	---	0/7
Bis(2-Ethylhexyl) Phthalate	110-680,000	6/30	585-754	4/13	---	0/7
Butylbenzylphthalate	68-2,100	3/30	---	0/13	12 (<330)	1/7
Chlordane	<25-280	1/30	---	0/13	---	0/7
Chlorobenzene	310	2/30	---	0/13	---	0/7

---

[a] <x = chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parentheses is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 4-7 (Continued)

ORGANIC CHEMICALS DETECTED IN SURFACE SOILS INDUSTRIAL EXCESS LANDFILL SITE

	On Site		Near Site & Down Gradient		Off Site (Background)	
Chemical	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection	Range[a] (ppb)	Frequency[b] of Detection
Chrysene	<400-4,700	3/30	---	0/13	---	0/7
Di-N-Butyl Phthalate	250 (<330)	1/30	268-2,255	4/13	110-290 (<330)	3/7
Di-N-Octyl Phthalate	330 (<330)	1/30	---	0/13	---	0/7
Dibenzofuran	44 (<330)	1/30	---	0/13	---	0/7
Diethyl Phthalate	46-50 (<330)	2/30	---	0/13	---	0/7
Ethylbenzene	3-980,000	9/30	---	0/13	---	0/7
Fluoranthene	49-12,000	4/30	260-280 (<330)	1/13	93 (<330)	1/7
Fluorene	15-73 (<330)	2/30	---	0/13	---	0/7
Gamma-BHC (Lindane)	<8.0-61	1/30	---	0/13	---	0/7
Indeno(1,2,3-CD) Pyrene	<330-700	1/30	---	0/13	---	0/7
N-Nitrosodiphenylamine	120-4,300	7/30	---	0/13	---	0/7
Naphthalene	30-1,800	4/30	---	0/13	---	0/7
PCBs	59-320	3/30	---	0/13	---	0/7
PCB-1016						
PCB-1232						
PCB-1248						
PCB-1254						
Phenanthrene	210-6,600	5/30	47-291	2/13	---	0/7
Phenol	94-590	2/30	---	0/13	---	0/7
Pyrene	<330-8,400	2/30	80-380	2/13	110 (<330)	1/7
Tetrachloroethene	<5-8	1/30	---	0/13	---	0/7
Toluene	3-20	4/30	<5-810	7/13	---	0/7
Total Xylenes	<5-13,000	8/30	<5-5	1/13	---	0/7
Trichloroethene	<5-16	1/30	<5-8	1/13	---	0/7

---

[a] <x = chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parentheses is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 4-8

INORGANIC CHEMICALS DETECTED IN SURFACE SOILS INDUSTRIAL EXCESS LANDFILL SITE

	On Site		Near Site & Down Gradient		Off Site (Background)	
Chemical	Range[a] (ppm)	Frequency[b] of Detection	Range[a] (ppm)	Frequency[b] of Detection	Range[a] (ppm)	Frequency[b] of Detection
Aluminum	491-11,100	30/30	1,490-14,600	13/13	4,360-15,700	7/7
Antimony	---	0/30	<7.8-78.6	2/13	---	0/7
Arsenic	3.8-35	27/30	5.1-167	13/13	6.96-34	6/7
Barium	19-547	25/30	64-200	12/13	19-162	7/7
Beryllium	0.28-0.9	11/30	0.2-3.7	8/13	0.4-1.5 (<1.5)	3/7
Cadmium	<1.9-13.3	7/30	<0.67-9.4	8/13	<0.2-5.2	4/7
Calcium	1,510-74,500	30/30	811-38,800	13/13	281-26,100	7/7
Chromium	4.1-53	23/30	<4.4-140	11/13	8-23	6/7
Cobalt	3.8-22	16/30	2.5-20	10/13	7.4-17	3/7
Copper	8.3-55	24/30	<5.6-335	12/13	8.25-36	6/7
Iron	2,100-133,000	29/30	4,700-93,400	13/13	13,400-62,100	7/7
Lead	<2.2-699	27/30	4.6-283	12/13	11-349	7/7
Magnesium	117-7,070	30/30	610-8,720	13/13	983-3,330	7/7
Manganese	29-1,560	29/30	233-1,900	10/13	242-1,540	7/7
Mercury	<0.041-0.23	10/30	<0.1-0.65	5/13	<0.05-0.2	2/7
Nickel	<6.1-48	21/30	7.4-36	11/13	<12-54	3/7
Potassium	<127-2,670	20/30	<166-1,250	9/13	265-1,390	7/7
Selenium	---	0/30	<0.08-1.1	1/13	0.2 (<2.7)	1/7
Silver	1.8-3.5	4/30	<1.3-8.3	3/13	<1.3-3.5	1/7
Sodium	<5.6-3.950	23/30	96-2,770	9/13	74-782	6/7
Thallium	<1.1-2.1	2/30	0.23-0.68	6/13	0.26-0.35 (<1.3)	1/7
Tin	<5.2-50	3/30	NS	---	---	0/7
Vanadium	8.3-30	15/30	7.2-62	10/13	7.6-20 (<23)	6/7
Zinc	<3.5-1,960	29/30	15-362	13/13	46.9-107	7/7
Cyanide	0.95-22.1	5/30	<0.3-42	6/13	<0.36-1.3	1/7

---

[a] <x = chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parentheses is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

NS = not sampled.

TABLE 4-9

NEAR-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	(ppm)	Level Above Background*
S023	Bis(2-Ethylhexyl) Phthalate	590		3X
	Di-N-Butyl Phthalate	590		3X
	4,4-DDT	4,800		5X
	Arsenic (Total)		74-167	1.2-3X
	Cadmium (Total)		7.4-9.4	1.2X
	Iron		93,400	1.2X
	Magnesium		8,720	1.2X
	Silver (Total)		4.7-8.3	1.2X
S024	Bis(2-Ethylhexyl) Phthalate	656		3X
	Di-N-Butyl Phthalate	268		3X
S039	Fluoranthene	260-280		1.2-3X
	Pyrene	250-380		1.2-3X
	Antimony (Total)		78.6	5X
	Cadmium (Total)		6.78	1.2X
	Copper (Total)		62.5-335	1.2-5X
	Lead (Total)		220-283	1.2-3X
	Mercury (Total)		0.65	3X
S044	Trichloroethene	8		5X
S045	Di-N-Butyl Phthalate	2,255		5X
	Antimony (Total)		12	5X
	Calcium		38,800	1.2X
	Cyanide (Total)		1.8	1.2X
	Selenium (Total)		1.1	5X
	Thallium (Total)		0.58	1.2X
S047	Toluene	34		5X
	Beryllium (Total)		3.7	1.2X
	Chromium (Total)		93	3X
	Cyanide (Total)		42	5X
	Silver (Total)		4.4	1.2X
	Thallium (Total)		0.49	1.2X
S048	Toluene	60		5X
	2-Methylnaphthalene	312		1.2X
	Beryllium (Total)		2.4	1.2X
	Thallium (Total)		0.68	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-9 (Continued)

NEAR-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
S049	Toluene	34		5X
	2-Methylnaphthalene	374		3X
	Bis(2-Ethylhexyl) Phthalate	754		1.2X
	Phenanthrene	291		3X
	Beryllium (Total)		2.5	1.2X
	Chromium (Total)		140	5X
	Manganese		1,900	1.2X
	Thallium (Total)		0.47	1.2X
	Vanadium		62	3X
S050	Toluene	14		5X
	Bis(2-Ethylhexyl) Phthalate	585		1.2X
	Mercury (Total)		0.33	1.2X
S051	Toluene	106		5X
	2-Methylnaphthalene	341		1.2X
	Beryllium (Total)		2.9	1.2X
	Chromium (Total)		29	1.2X
	Thallium (Total)		0.55	1.2X
S052	Toluene	58		5X
	Total Xylenes	5		5X
	Mercury (Total)		0.5	1.2X
S053	Toluene	32-810		5X
	Arsenic (Total)		61	1.2X
	Mercury (Total)		0.37	1.2X

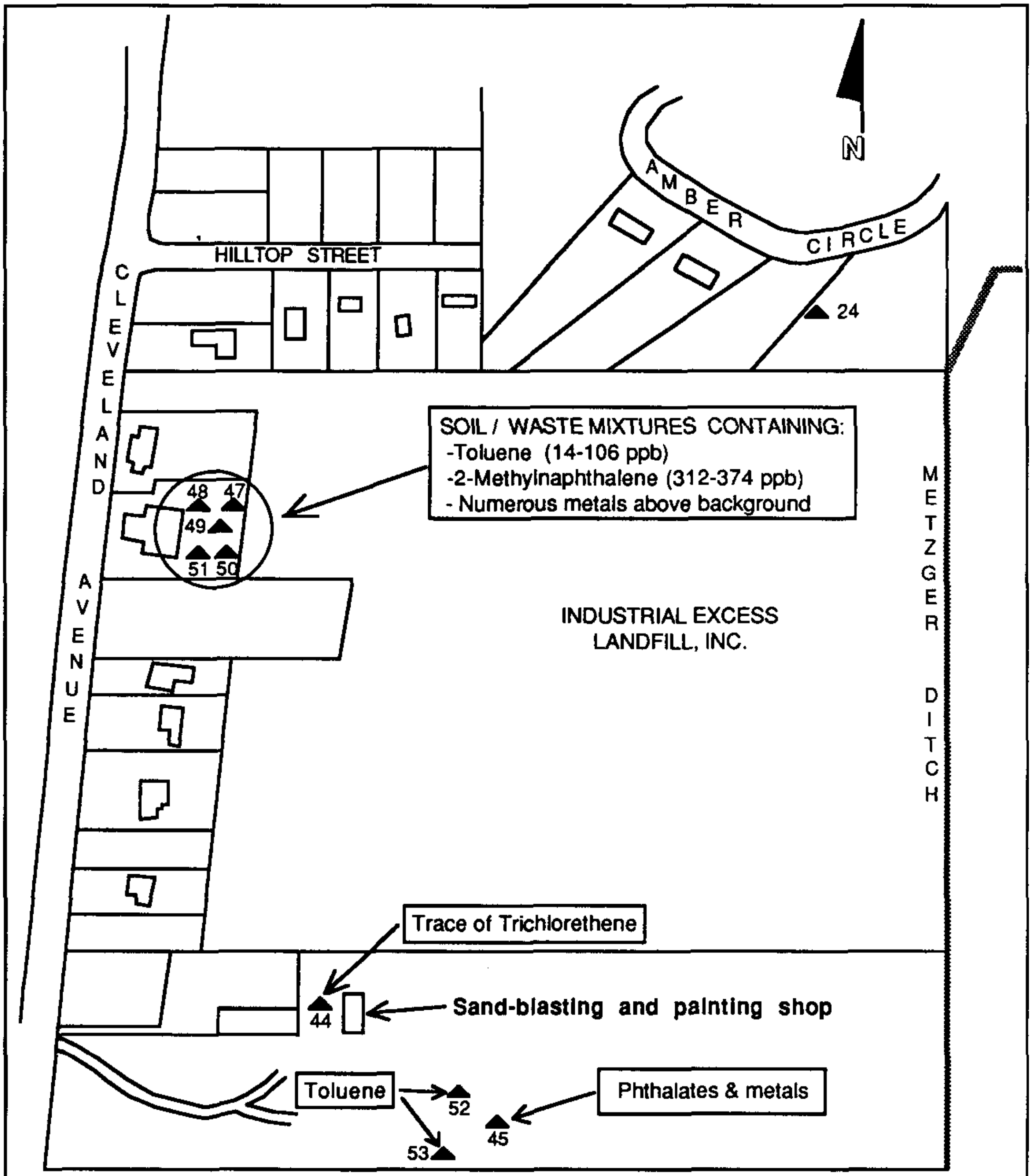
---

*The concentrations listed are above the background concentration by at least the factor shown.

3X and at least 5X. Chemicals or ions that were not detected at all in background samples for a given medium (as discussed in Section 4.4.1 above) automatically are assigned a "5X" factor of exceeding background. For example, trichloroethene was detected at 8 ppb in surface soil S044. No background soil or sediment samples were found to contain any volatile organics, so this detection is automatically flagged as "5X" background. For samples and components for which background levels are available, samples containing 1.2X to 2.999...X background are flagged as "1.2X", samples containing 3.0 to 4.999...X are flagged as "3X, and those exceeding 5X are so flagged.

All but one of the samples contained at least one chemical component exceeding background levels by this 1.2 factor (the exception is S042) (Figures 4-18 and 4-19). The most contaminated samples are those collected behind Uniontown Tire (S047-S051), which are soil/waste mixtures. Three of these five samples contained 2-methylnaphthalene, a chemical also found in soil/waste mixtures just to the east, in the landfill (see Section 4.4.3). Toluene was also prevalent in these contaminated soils/waste mixtures and was also found in two near-site soils to the south of the site (S052 and S053). The origin of volatile organic contamination in soils to the south of the landfill is complicated by the presence of a sand-blasting and painting shop which may represent a local, active source of low-level volatile contamination.

The two samples exhibiting the highest metals concentrations were organic-rich samples collected south of the site adjacent to Metzger Ditch (S023) and in a boggy area to the west-southwest of the landfill (S039) (Figure 4-19). In all, only a few samples contained metals values exceeding background levels by as much as 5X. The specific compounds and the distribution of these exceedances do not reveal any patterns of contaminant migration.



▲ Surface Soil

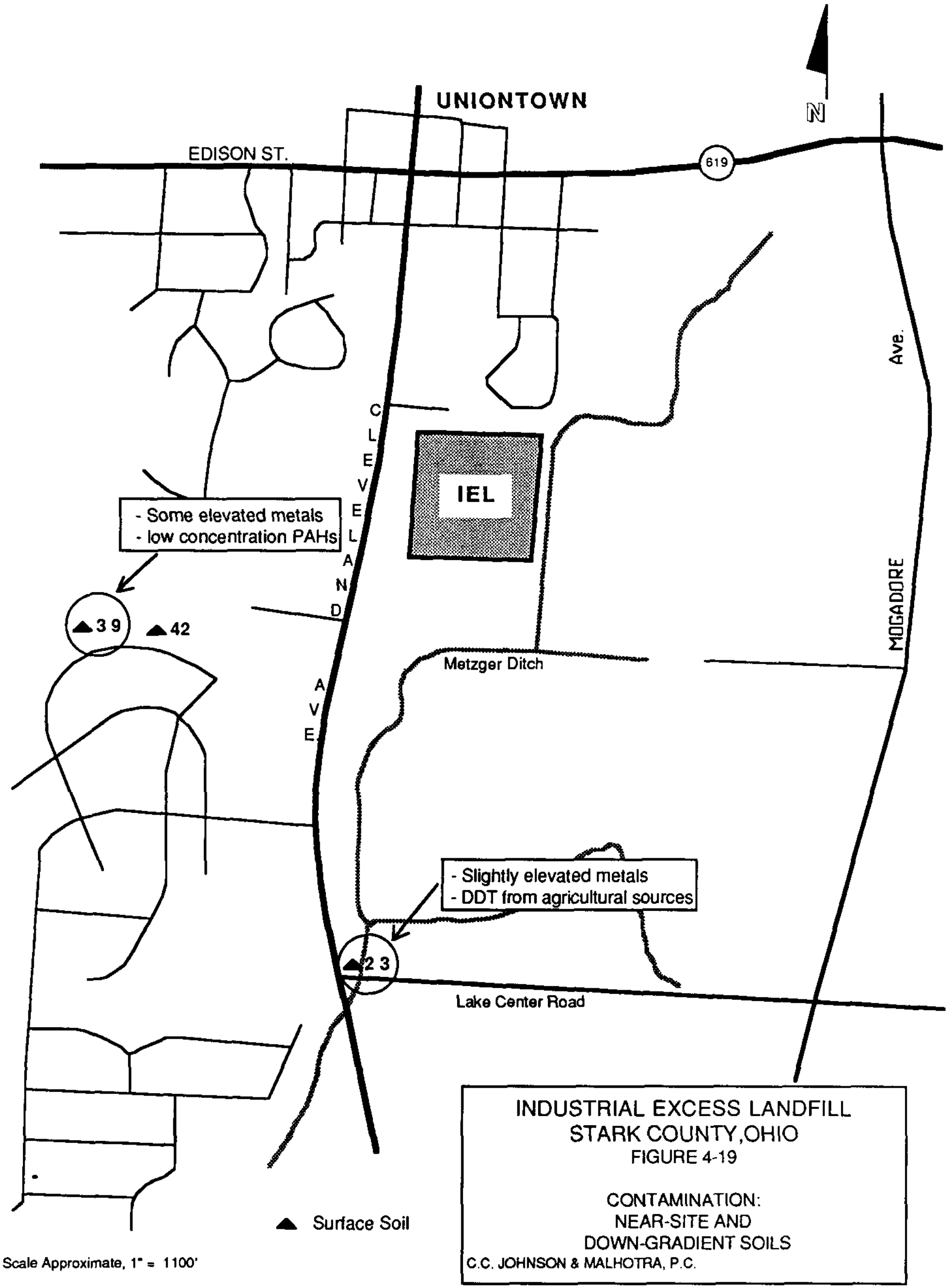
Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 4-18

CONTAMINATION:
NEAR-SITE AND
DOWN-GRADIENT

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 4-19

CONTAMINATION:
NEAR-SITE AND
DOWN-GRADIENT SOILS

C.C. JOHNSON & MALHOTRA, P.C.

If one removes from consideration the landfilled soil/waste mixtures collected behind Uniontown Tire, it is apparent that there are only scattered occurrences of elevated organics and/or metals in near-site and downgradient soil samples. Moreover, the specific compounds and the distribution of these occurrences do not reveal any patterns of contaminant migration from IEL.

4.4.3 On-Site Soils

A complete listing of chemicals detected in on-site soils is presented in Table 4-7, 4-8, 4-10, and 4-11. Table 4-12 provides a sample-by-sample listing of all chemical components that exceed background levels by a factor of more than 1.2 times.

Again, as was described in the above discussion concerning near-site and down-gradient soils, this does not mean that the chemicals or ions that exceed 1.2 times the maximum background level are attributable to contamination from IEL. This factor was only used to narrow down the range of samples included in the evaluation of potential contamination patterns that might include IEL as a source of contamination. Beyond this "1.2X" factor, the listing in Table 4-12 also shows samples that exceed maximum background levels for a particular component by factors of at least 3X and at least 5X. Chemicals or ions that were not detected at all in background samples for a given medium (as discussed in Section 4.4.1 above) automatically are assigned a "5X" factor of exceeding background. For example, benzene was detected at 3 and 4 ppb in subsurface soil SOMW03S(5-7)(a subsurface soil taken in shallow monitoring well MW03S at a depth of 5 to 7 feet). No subsurface soil samples were found to contain any organics, so this detection is automatically flagged as "5X" background. For samples and components for which background levels are available, samples containing 1.2X to 2.999...X background levels are flagged as "1.2X" samples containing 3.0 to 4.999...X are flagged as "3X", and those exceeding 5X are so flagged.

TABLE 4-10

ORGANIC CHEMICALS DETECTED IN MONITOR WELL BORINGS INDUSTRIAL EXCESS LANDFILL SITE

Chemical	Range of[a] Concentration Detected (ppb)	Frequency of[b] Detection
1,1,1-Trichloroethane	3-4(<5)	1/35
1,4-Dichlorobenzene	270(<330)	1/35
2-Butanone	<10-2,600	3/35
2-Methylnaphthalene	67-790	3/35
2-Methylphenol	300(<330)	1/35
4-Methyl-2-pentanone	<10-610	1/35
4-Methylphenol	320-8,000	2/35
4-Nitrophenol	50(<1600)	1/35
Acenaphthene	110(<300)	1/35
Acetone	<10-1,500	1/35
Anthracene	73(<330)	1/35
Benzene	1-4(<5)	4/35
Benzo(A)Anthracene	89-91(<300)	2/35
Benzo(A)Pyrene	93(<330)	1/35
Benzo(B)Fluoranthene	120-140(<300)	2/35
Benzo(G,H,I)Perylene	160-210(<300)	2/35
Benzo(K)Fluoranthene	110-140(<300)	2/35
Benzoic Acid	330-2,500	3/35
Bis(2-Ethylhexyl)Phthalate	63-2,800	5/35
Butylbenzylphthalate	77-16,000	6/35

---

[a] <x = Chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parenthese is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 4-10 (Continued)

ORGANIC CHEMICALS DETECTED IN MONITOR WELL BORINGS INDUSTRIAL EXCESS LANDFILL SITE

Chemical	Range of[a] Concentration Detected (ppb)	Frequency of[b] Detection
Carbon Disulfide	1-13	4/35
Chlordane	<80-290	1/35
Chrysene	100-160(<330)	2/35
Di-N-Butyl phthalate	86-1,600	2/35
Di-N-Octyl phthalate	120-8,300	2/35
Dibenzofuran	73-150(<330)	2/35
Diethyl phthalate	70-410	3/35
Ethylbenzene	0.6-25	14/35
Fluoranthene	93-480	2/35
Fluorene	60(<330)	1/35
Indeno(1,2,3-CD)Pyrene	55-77(<330)	2/35
n-Nitrosodiphenylamine	210-580	2/35
Naphthalene	<330-500	2/35
Phenanthrene	38-370	5/35
Phenol	45-2,600	5/35
Pyrene	22-330(<330)	3/35
Styrene	3-6	3/35
Tetrachloroethene	4-7	3/35
Toluene	3-190	15/35
Total Xylenes	0.7-730	13/35
Trichloroethene	<5-570	2/35

---

[a] <x = Chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parenthese is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 4-11

INORGANIC CHEMICALS DETECTED IN MONITOR WELL BORINGS INDUSTRIAL EXCESS LANDFILL SITE

Chemical	Range of[a] Concentration Detected (mg/kg)	Frequency of[b] Detection
Alumium	906-12,800	35/35
Arsenic	2.4-50	23/35
Barium	6.1-215	20/35
Beryllium	0.4-1.0	6/35
Cadmium	0.12-9.48	13/35
Calcium	1120-59,000	35/35
Chromium	1.1-19	25/35
Cobalt	3-23	17/35
Copper	6.4-124	33/35
Iron	4160-61,900	35/35
Lead	4.7-55	30/35
Magnesium	479-13,500	35/35
Manganese	31-1130	35/35
Mercury	0.11-0.17	4/35
Nickel	6.2-35	25/35
Potassium	5.8-2130	28/35
Selenium	0.5-1.4	4/35
Silver	<1.3-3.2	1/35
Sodium	55-1970	15/35
Thallium	0.6-(<1.0)	1/35
Tin	1.7-13	3/35
Vanadium	3.7-35.0	2/35
Zinc	13-211	35/35

---

[a] <x = Chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parenthese is the detection limit.

[b] = Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 4-12

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
S001	Bis(2-Ethylhexyl) Phthalate	3,900		5X
	N-Nitrosodiphenylamine	1,000		5X
	Barium		473	1.2X
	Calcium		37,100-74,500	1.2X
	Cyanide (Total)		9.35-22.1	5X
	Iron		125,000-133,000	1.2X
	Vanadium		27-29	1.2X
S002	Calcium		43,200	1.2X
	Cyanide (Total)		1.88	1.2X
S003	Cyanide (Total)		2.59	1.2X
S004	Bis(2-Ethylhexyl) Phthalate	680,000		5X
	Cadmium (Total)		7.2	1.2X
	Chromium (Total)		30	1.2X
	Cyanide (Total)		3.78	1.2X
	Lead (Total)		699	5X
	Mercury (Total)		0.2	1.2X
	Tin		23	5X
	Zinc (Total)		512	1.2X
S005	PCB-1248	320		5X
S006	Acenaphthene	94		5X
	Anthracene	240		5X
	Benzo(A)Anthracene	1,100		5X
	Benzo(A)Pyrene	900		5X
	Benzo(B)Fluoranthene	1,400		5X
	Benzo(G,H,I)Perylene	530		5X
	Benzo(K)Fluoranthene	820		5X
	Chrysene	880		5X
	Dibenzofuran	44		5X
	Fluoranthene	2,100		5X
	Fluorene	73		5X
	Ideno(1,2,7-10)Pyrene	700		5X
	Naphthalene	45		5X
	Phenanthrene	990		5X
	Pyrene	1,500		5X
	PCB-1232	71		5X
	PCB-1254	140		5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration		Level Above Background*
		(ppb)	(ppm)	
S007	2-Butanone	33-51		5X
	Benzene	9		5X
	Chlorobenzene	7-10		5X
	Ethylbenzene	8-190		5X
	Total Xylenes	17-36		5X
	1,4-Dichlorobenzene	43		5X
	4-Methylphenol	350-3,000		5X
	Bis(2-Ethylhexyl) Phthalate	710-1,700		1.2-5X
	N-Nitrosodiphenylamine	620-760		5X
	Phenol	94		5X
	PCB-1016	59-73		5X
	Barium		423	1.2X
	Calcium		35,200-47,100	1.2X
	Iron		124,000	1.2X
	Thallium (Total)		1.2-2.1	3-5X
S009	Barium		266	1.2X
S010	Benzoic Acid	117		5X
S011	Benzene	2		5X
	Toluene	3		5X
	Diethyl Phthalate	46		5X
S012	Butylbenzylphthalate	104		5X
S013	Ethylbenzene	35-61		5X
	Toluene	4		5X
	Total Xylenes	13		5X
	Benzoic Acid	122		5X
	Butylbenzylphthalate	68-86		5X
	Diethyl Phthalate	50		5X
	N-Nitrosodiphenylamine	120		5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
S014	Toluene	20		5X
S015	Chromium (Total)		33	1.2X
S025	2-Butanone	22		5X
	Chlorobenzene	3		5X
	Ethylbenzene	3		5X
	Total Xylenes	8		5X
	N-Nitrosodiphenylamine	240-290		5X
	Tin		32	5X
S026	Barium		242	1.2X
	Copper (Total)		55	1.2X
	Potassium		2,670	1.2X
	Vanadium		25	1.2X
S027	Ethylbenzene	62		5X
	Tetrachloroethene	8		5X
	Total Xylenes	36		5X
	2-Methylnaphthalene	510		5X
	Butylbenzylphthalate	2,100		5X
	Fluoranthene	2,500		5X
	Phenanthrene	2,600		5X
	Tin		50	5X
	Zinc (Total)		400	1.2X
S028	Ethylbenzene	7		5X
	Total Xylenes	16		5X
	Anthracene	410		1.2X
	N-Nitrosodiphenylamine	350		5X
S029	4-Methyl-2-Pentanone	5		5X
	Ethylbenzene	11-12		5X
	Toluene	5-15		5X
	Total Xylenes	65-67		5X
	2-Methylnaphthalene	130		1.2X
	2-Methylphenol	190		5X
	Naphthalene	410		3X
	Phenanthrene	210-340		1.2-3X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration		Level Above Background*
		(ppb)	(ppm)	
S030	Ethylbenzene	980,000		5X
	2-Methylnaphthalene	15,000		5X
	Chrysene	4,700		5X
	Fluoranthene	12,000		5X
	N-Nitrosodiphenylamine	4,300		5X
	Phenanthrene	6,600		5X
	Phenol	590		5X
	Pyrene	8,400		5X
	Barium		396	1.2X
	Chromium (Total)		53	1.2X
	Lead (Total)		108	1.2X
	Vanadium	30		1.2X
	Zinc (Total)		1,780	5X
S031	Ethylbenzene	5,300		5X
	Total Xylenes	6,400		5X
	Cobalt		22	1.2X
	Lead (Total)		121	1.2X
	Zinc (Total)		1,960	5X
S033	Ethylbenzene	2,700		5X
	Total Xylenes	13,000		5X
	2-Methylnaphthalene	2,400		5X
	Chrysene	2,200		5X
	N-Nitrosodiphenylamine	2,500		5X
	Naphthalene	1,800		5X
	Phenanthrene	2,900		5X
	Barium		547	3X
	Zinc (Total)		551	1.2X
S034	Bis(2-Ethylhexyl) Phthalate	2,000		5X
	Barium		487	1.2X
	Cadmium (Total)		13.3	1.2X
	Iron		112,000	1.2X
	Potassium		2,140	1.2X
	Vanadium		29.2	1.2X
S035	Mercury (Total)		0.23	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
S036	Barium		236	1.2X
	Cadium (Total)		8.35	1.2X
S043	Trichloroethene	16		5X
	Magnesium		7,070	1.2X
SOMW01D-(10-12)	Ethylbenzene	13		5X
	Total Xylenes	25		5X
	Bis(2-Ethylhexyl) Phthalate	63		1.2X
	Calcium		59,000	1.2X
	Magnesium		13,300	1.2X
SOMW01D-(113-115)	Styrene	6		5X
	Toluene	135		5X
SOMW01D-(123-125)	Toluene	92		5X
	Bis(2-Ethylhexyl) Phthalate	150		1.2X
	Phenol	290		5X
	Selenium (Total)	1.2		5X
	Tin		1.7	5X
SOMW01D-(15-17)	Ethylbenzene	0.9		5X
	Total Xylenes	5		5X
SOMW01D-(160-161)	Toluene	8		5X
SOMW01D-(20-22)	Ethylbenzene	1		5X
	Tetrachloroethene	4		5X
	Total Xylenes	0.7		5X
	Calcium		36,600-46,900	1.2X
	Magnesium		8,340	1.2X
SOMW01D-(25-27)	Ethylbenzene	0.6		5X
	Tetrachloroethene	7		5X
	Total Xylenes	2		5X
	Diethyl Phthalate	70		1.2X
	Calcium		53,700	1.2X
	Magnesium		13,500	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration		Level Above Background*
		(ppb)	(ppm)	
SOMW01D- (35-37)	Benzene	1		5X
	Ethylbenzene	25		5X
	Tetrachloroethene	6		5X
	Total Xylenes	130		5X
	Calcium		41,300	1.2X
	Copper (Total)	124		1.2X
	Magnesium		7,220	1.2X
SOMW01D- (50-52)	Ethylbenzene	1		5X
	Total Xylenes	4		5X
SOMW01D- (70-72)	Toluene	19		5X
	Bis(2-Ethylhexyl) Phthalate	120		1.2X
	Selenium (Total)	1.4		5X
	Tin		13	5X
SOMW01D- (70-75)	Benzene	2		5X
	Ethylbenzene	3		5X
	Toluene	8		5X
	Total Xylenes	9		5X
	Bis(2-Ethylhexyl) Phthalate	2,800		5X
	Di-N-Octyl Phthalate	120		5X
	Calcium		41,800	1.2X
	Magnesium		13,400	1.2X
	Selenium (Total)	0.98		3X
	Thallium (Total)		0.6	1.2X
	Tin		3.1	5X
SOMW01D- (93-85)	Toluene	30		5X
	Calcium		36,900	1.2X
SOMW01D- (98-100)	Carbon Disulfide	4		5X
	Styrene	3		5X
	Toluene	10-27		5X
	Butylbenzylphthalate	94		1.2X
	Diethyl Phthalate	167		1.2X
SOMW01D- (50-52)	Ethylbenzene	11		5X
	Butylbenzylphthalate	770		1.2X
	Arsenic (Total)		50	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*.
SOMW02M- (64-66)	Ethylbenzene	9		5X
	Buthylbenzylphthalate	240		1.2X
SOMW02M- (8-10)	Butylbenzylphthalate	100		1.2X
	Calcium		46,600	1.2X
	Magnesium		10,000	1.2X
SOMW03D- (9-10)	Ethylbenzene	1		5X
	Toluene	10		5X
	Phenol	45		5X
SOMW03S- (5-7)	Benzene	3-4		5X
	Toluene	18-27		5X
	2-Methylphenol	300		5X
	4-Methylphenol	430-8,000		5X
	Benzoic Acid	2,500		5X
	Phenol	200-2,600		5X
	Barium		215	1.2X
SOMW07D- (40-42)	Benzene	1		5X
	Toluene	190		5X
SOMW07D- (50-52)	Toluene	37		5X
	Magnesium		9,830	1.2X
SOMW07S- (6-9)	Total Xylenes	730		5X
	1,4-Dichlorobenzene	270		5X
	2-Methylnaphthalene	180		5X
	4-Methylphenol	320		5X
	4-Nitrophenol	50		5X
	Acenaphthene	110		5X
	Anthracene	73		5X
	Benzo(A)Anthracene	89		5X
	Benzo(A)Pyrene	93		5X
	Benzo(B)Fluoranthene	120		5X
	Benzo(G,H,I)Perylene	210		5X
	Benzo(K)Fluoranthene	110		5X
	Benzoic Acid	330		5X
	Butylbenzylphthalate	16,000		5X
	Chrysene	160		5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
SOMW07S- (6-9) (Cont'd.)	Di-N-Butyl Phthalate	1,600		5X
	Di-N-Octyl Phthalate	8,300		5X
	Dibenzofuran	73		5X
	Fluoranthene	480		5X
	Fluorene	60		5X
	Indeno(1,2,3-CD)Pyrene	57		5X
	N-Nitrosodiphenylamine	580		5X
	Naphthalene	500		5X
	Phenanthrene	370		5X
	Phenol	260		5X
	Pyrene	330		5X
	Benzene	3-4		5X
	Toluene	18-27		5X
	2-Methylphenol	300		5X
	4-Methylphenol	430-8,000		5X
	Benzoic Acid	2,500		5X
	Phenol	220-2,600		5X
	Barium		215	1.2X
SOMW07D- (40-42)	Benzene	1		5X
	Toluene	190		5X
SOMW07D- (50-52)	Toluene	37		5X
	Magnesium		9,830	1.2X
SOMW07S- (6-9)	Total Xylenes	730		5X
	1,4-Dichlorobenzene	270		5X
	2-Methylnaphthalene	180		5X
	4-Methylphenol	320		5X
	4-Nitrophenol	50		5X
	Acenaphthene	110		5X
	Anthracene	73		5X
	Benzo(A)Anthracene	89		5X
	Benzo(A)Pyrene	93		5X
	Benzo(B)Fluoranthene	120		5X
	Benzo(G,H,I)Perylene	210		5X
	Benzo(K)Fluoranthene	110		5X
	Benzoic Acid	330		5X
	Butylbenzylphthalate	16,000		5X
	Chrysene	160		5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration		Level Above Background*
		(ppb)	(ppm)	
SOMW07S-(6-9) (Cont'd.)	Di-N-Butyl Phthalate	1,600		5X
	Di-N-Octyl Phthalate	8,300		5X
	Dibenzofuran	73		5X
	Fluoranthene	480		5X
	Fluorene	60		5X
	Indeno(1,2,3-CD)Pyrene	57		5X
	N-Nitrosodiphenylamine	580		5X
	Naphthalene	500		5X
	Phenanthrene	370		5X
	Phenol	260		5X
	Pyrene	330		5X
SOMW07S-(9-11)	4-Methyl-2-Pentanone	610		5X
	Trichloroethene	570		5X
	Bis(2-Ethylhexyl) Phthalate	150		1.2X
	Phenol	51		5X
SOMW08D-(63-65)	Styrene	3-6		5X
	Toluene	170		5X
	Butylbenzylphthalate	77		1.2X
	Calcium		35,600	1.2X
	Magnesium		8,180	1.2X
SOMW08S-(24-26)	Arsenic (Total)		46.6	1.2X
	Cadmium (Total)		7.29-9.48	1.2X
SOMW09D-(64-66)	Magnesium		8,890	1.2X
SOMW09D-(84-86)	2-Methylnaphthalene	790		5X
	Benzo(A)Anthracene	91		5X
	Benzo(B)Fluoranthene	140		5X
	Benzo(G,H,I)Perylene	160		5X
	Benzo(K)Fluoranthene	140		5X
	Chrysene	100		5X
	Dibenzofuran	150		5X
	Fluoranthene	93		5X
	Indeno(1,2,3-CD)Pyrene	55		5X
	N-Nitrosodiphenylamine	210		5X
	Naphthalene	420		5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-12 (Continued)

ON-SITE SOIL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
SOMW09D-(84-86) (Cont'd.)	Phenathrene	330		5X
	Pyrene	150		5X
	Cobalt		23	1.2X
	Potassium		2,030	1.2X
	Vanadium		29	1.2X
SOMW09S-(5-7)	2-Butanone	1,200-2,600		5X
	Carbon Disulfide	13		5X
	Trichloroethene	28-30		5X
	Cadmium (Total)		6.4	1.2X
	Potassium		1,720-2,130	1.2X
	Vanadium		30-35	1.2X
SOMW10D-(100-102)	Magnesium		8,790	1.2X
SOMW10D-(25-27)	Ethylbenzene	1		5X
	Total Xylenes	4		5X
SOMW11D-(124-126)	2-Butanone	10-14		5X
	Acetone	350-1,500		5X
	Toluene	23-28		5X
	Total Xylenes	6.1-7.3		5X
	Diethyl Phthalate	410		1.2X
	Calcium		37,000	1.2X
	Selenium (Total)		0.5	1.2X
SOMW11D-(164-166)	1,1,1-Trichloroethane	3-4		5X
	2-Butanone	22-33		5X
	Carbon Disulfide	1-2		5X
	Ethylbenzene	4-5		5X
	Toluene	52-70		5X
	Total Xylenes	16-23		5X
	Benzoic Acid	800		5X
	Di-N-Butyl Phthalate	86		1.2X
SOMW11D-(39-41)	Ethylbenzene	2-3		5X
	Total Xylenes	13-15		5X
SOMW11D-(74-76)	Carbon Disulfide	3		5X
	Ethylbenzene	4		5X
	Total Xylenes	18		5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

Comparison of these data with sample type (Table 4-4) shows that the soils composed of soil/waste mixtures and those associated with leachate springs generally contain relatively high levels of contaminants. The types of contaminants present in soil/waste mixtures and leachate-saturated surface soils are similar and include elevated metals with relatively large amounts of volatile organics (including ethylbenzene and xylenes) and various semi-volatiles (including phenolic compounds) (Table 4-12).

Surface soils collected elsewhere on-site including samples of the sand and gravel cover and samples from runoff areas do not display a pattern of contamination (Tables 4-10, 4-11, and 4-12). (Some of these soils, like some of the soil/waste mixtures, contain a complex mixture of PAHs. These chemicals may represent coal-derived material that was incorporated into the sample. See the discussion on Data Evaluation in Section 3.3). Thus, the data indicates that surface soil contamination is limited to the few areas where waste is actually exposed and the very small areas associated with leachate springs.

Subsurface soils collected from monitoring well borings are generally low in contaminants. The exceptions are the soil/waste mixture in sample SOMW07S(6-9) and the soils associated with leachate production, samples SOMW03S(5-7) and SOMW03D(8-10). Metals levels seldom exceed background, and the only semi-volatile compounds detected frequently are phthalates (Table 4-12). However a number of volatile compounds were commonly detected above background levels (Table 4-12). The most common of these volatiles are ethylbenzene, toluene, and xylene which were each detected in 5 to 10 samples. All three of these compounds are known landfill contaminants and their presence in relatively shallow subsurface soil samples is expected. However, another potential source of contamination is also present and this source probably accounts for a portion of these detected volatiles. As described in Appendix I, soil conditions in the area of the landfill dictated the use of mud rotary drilling to install the monitoring wells, particularly the wells that exceeded about 20 feet in depth (the vast majority). To hold the hole open while drilling progressed, commercially available bentonite clay was mixed with water to form the drilling "mud". During the drilling program, several samples of this bentonite were analyzed to determine if there were any contaminants present. Table 4-13 summarizes the volatile organic analyses of these bentonite samples. The results indicate the presence of moderate amounts of various volatiles, all of which were detected in at least one subsurface soil sample. The presence of these contaminants probably explains a few of the volatile hits in subsurface soils. However, the majority of volatile detections in subsurface soils adjacent to the Industrial Excess Landfill appear to indicate the presence of extensive, but low level, contamination by common industrial solvents. Beyond the immediate boundaries of the landfill, at monitoring well nests MW08, MW10, and MW12 (the background monitoring well), volatiles were detected at low levels in one subsurface sample from MW08 (styrene at 3-6 ppb and toluene at 170 ppb in one sample but not in the duplicate) and one sample from MW10 (ethylbenzene at 1 ppb and xylenes at 4 ppb). No volatile organics were detected in the groundwater samples from these well nests and the presence of volatile contamination of subsurface soil at these locations is doubtful. Thus, low level subsurface soil contamination appears to be confined to the immediate landfill area.

4.4.4 Summary of Soil Contamination

The results of the soil contamination study at the Industrial Excess Landfill are:

1. "Soil" samples actually composed of soil/waste mixtures and leachate-saturated surface soils are the most highly contaminated soils associated with IEL. Both types of soil contain elevated levels of metals and also contain relatively large amounts of volatile organics (including ethylbenzene and xylenes) along with various semi-volatiles

TABLE 4-13

VOLATILE CONTAMINANTS DETECTED IN BENTONITE CLAY USED FOR DRILLING PURPOSES AT IEL

SAMPLE	CHEMICAL	CONCENTRATION (ug/kg)
DB	4-Methyl-2-Pentanone	32
	Benzene	2
	Ethylbenzene	17-30
	Toluene	730
	Xylenes	72-140
DB1	Benzene	11
	Xylenes	3

(including phenolic compounds). Many of the soil/waste mixtures analyzed in this RI/FS are not now accessible, because they were taken from monitor well borings or from excavations made on the site to install the methane venting system. The leachate-saturated soils are present in only very small areas.

2. Subsurface soil samples taken during monitoring well installation indicate that some of the subsurface soil directly associated with the landfill probably contains low level volatile organic contamination. Subsurface soil samples taken only a few hundred feet beyond the site boundary (monitoring wells MW08 and MW10) do not contain volatile organic contamination that is attributable to the landfill.

3. Surface soils taken beyond the area where landfilling took place at IEL display scattered occurrences of elevated organics and/or metals. The specific compounds and the distribution of these occurrences do not reveal any patterns of contaminant migration from IEL, but rather may indicate other, local sources of contamination and/or may indicate background chemical data for area soils is incomplete.

4.5 Groundwater Contamination Investigation

To evaluate the extent and nature of possible groundwater contamination in the area of the Industrial Excess Landfill, a two method approach was used. One method was the installation of groundwater monitoring wells in the area of the site. These wells provided groundwater samples that reflected the composition and concentration of contaminants that were leaving the landfill via the ground water. The monitoring wells also provide water level data which were used in determining the direction of groundwater flow. (See Section 4.2.4). The other method involved extensive sampling of the private wells utilized by area residents and businesses. Data generated from this sampling were used to further evaluate the extent of groundwater contamination migration away from the landfill and to assess the quality of residential water supplies. The following discussions describe the results of both the monitoring well and residential well studies.

4.5.1 Monitoring Well Sampling Results

A total of 28 monitoring wells were installed around the Industrial Excess Landfill site. The locations of these wells are shown on Figure 4-8.

Monitoring wells MW 1, 2, 3, 7, 8, 9, 10, 11, and 12 are nested wells that include more than one well screened at various depths, as described below. Wells MW 4, 5, and 6 are single, shallow wells that are located between the landfill and Metzger Ditch. Two large-diameter irrigation wells located immediately to the east of the site were also used as a part of the groundwater monitoring network.

The 28 monitoring wells include 10 shallow wells that were screened to intersect the water table; 8 medium wells that were screened approximately 35 feet below the top of the water table, within the sand and gravel aquifer (at elevations comparable to local residential wells); 9 deep wells that were screened in the upper part of the underlying bedrock aquifer; and one shallow well that taps a limited perched water table in the sand and gravel. A construction detail form for each of the monitoring wells is presented in Appendix J. The two irrigation wells (SODWN and SODWC) are screened in the upper 40 feet of the sand and gravel aquifer. Figure 4-20 provides a schematic rendition of construction details for all the monitoring wells.

Monitoring well nests MW01, MW02, and MW03 were completed in Phase I of the Remedial Investigation. These nests include three deep wells, 2 medium wells, 2 shallow wells, and the well that is screened in the perched water

FIGURE 4-20
MONITORING WELL COMPLETIONS

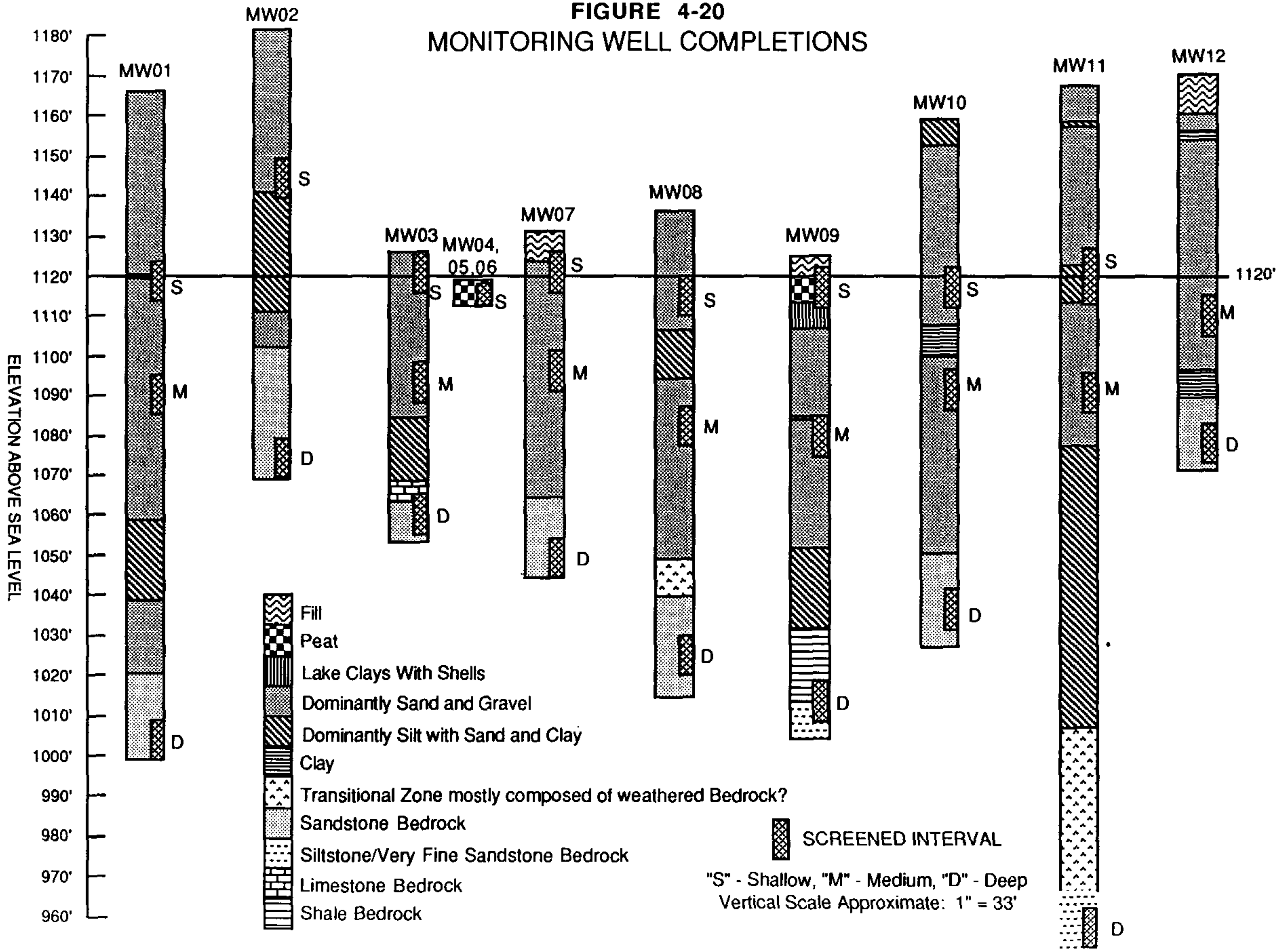


table (MW02S). Groundwater samples were collected from these wells in May, 1986 and analyzed for HSL materials. During Phase II, the other monitoring wells were installed and developed. These new wells as well as the older, Phase I wells were sampled for HSL substances in April, 1987. Nine of the monitoring wells were resampled in May, 1987. The results of these sampling efforts are discussed below.

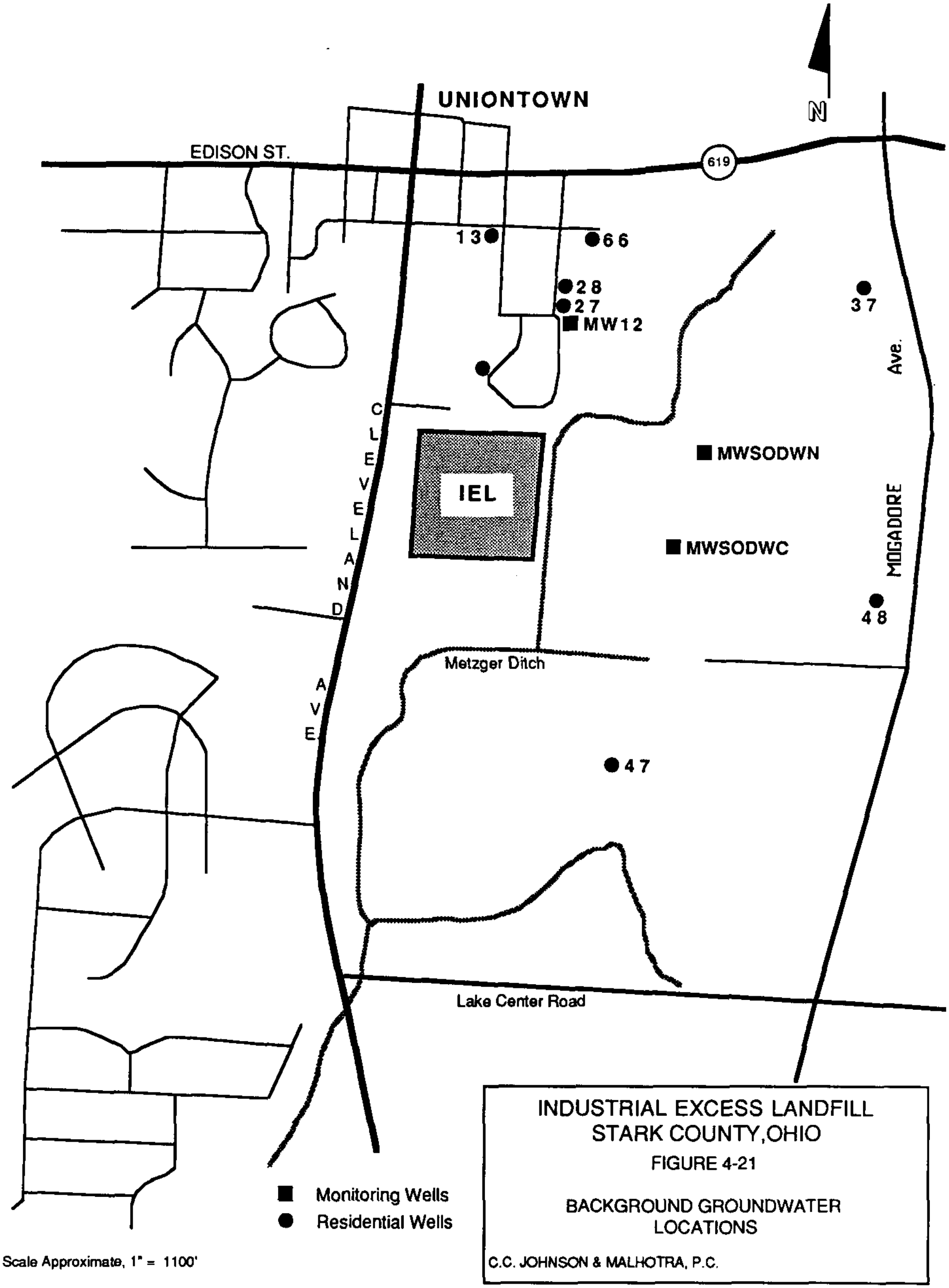
4.5.2 Background Groundwater Waters

A total of 13 samples from 9 residential wells and 4 monitoring wells were collected during the RI to determine background concentrations of HSL substances in the groundwater of the IEL area (Figure 4-21). Organic constituents were not detected in any of these background samples.

The background metals levels appear in Table 4-14. Metals levels are comparable between wells screened in bedrock and those screened in sand and gravel. This finding is in keeping with the interconnected groundwater system described in Section 4.2.4. These data are used in the following sections to assist in the evaluation of the impact Industrial Excess Landfill has had on groundwater in the Uniontown area.

4.5.3 Shallow Monitoring Wells

A total of 11 monitoring wells provided groundwater samples from the upper portion of the water table (Figure 4-22). None of these wells are background wells as described above. The analytical results of these samples are summarized in Table 4-15. Comparison with background data indicates that, in addition to organic contaminants, a number of metals are present at levels at least 1.2 times background. Table 4-16 presents sample-by-sample data for all shallow monitoring wells that contained HSL chemicals at least 1.2 times background levels. Again, as was described in the above discussion concerning soils, this does not mean that the



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 4-21

BACKGROUND GROUNDWATER LOCATIONS

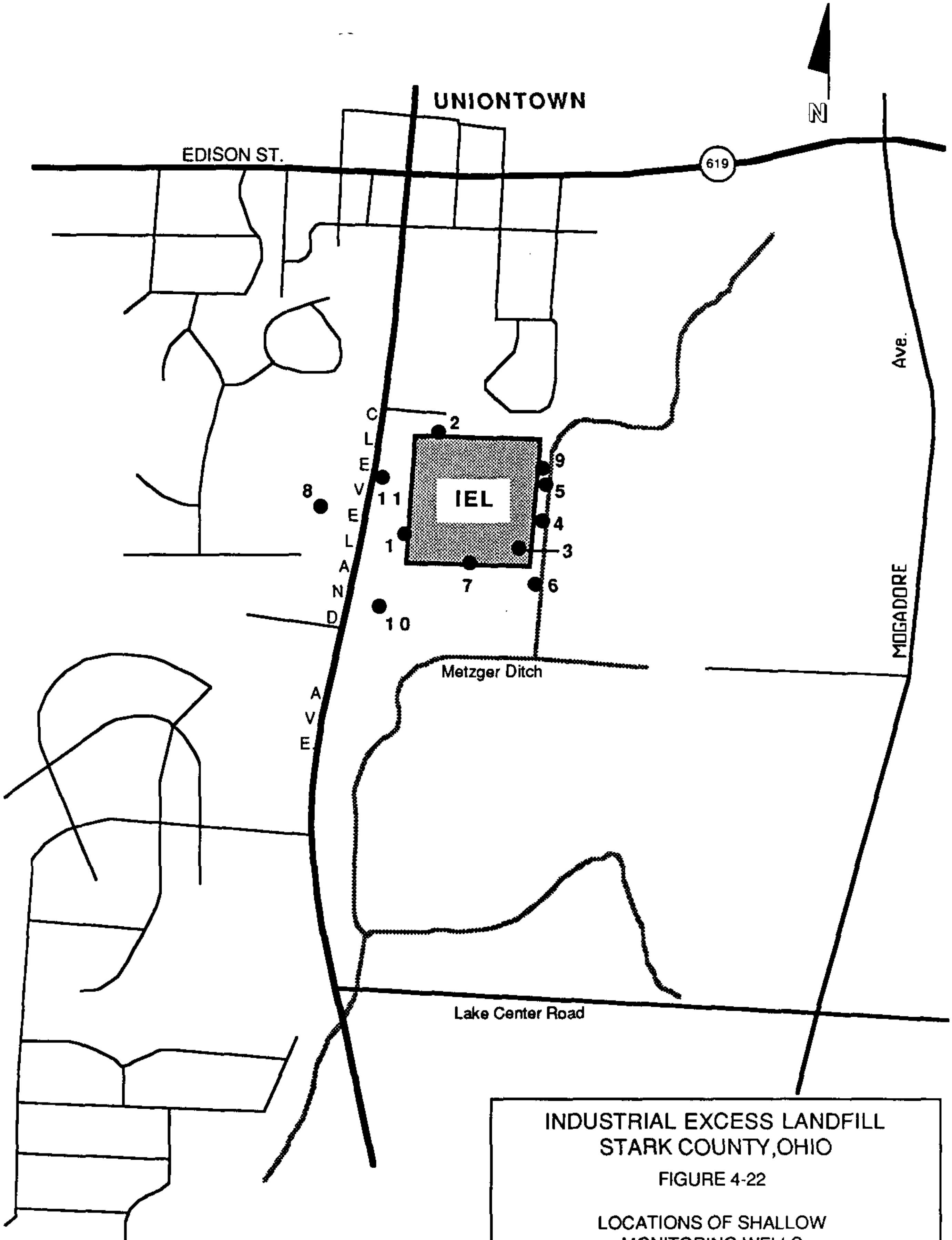
C.C. JOHNSON & MALHOTRA, P.C.

TABLE 4-14

BACKGROUND LEVELS OF INORGANIC COMPONENTS IN GROUNDWATER - IEL

Chemical	Range of Concentration Detected (ppb)	Frequency of Detection
Aluminum	88	1/13
Arsenic	2 - 9.1	2/13
Barium	86 - 394	13/13
Beryllium	2	1/13
Calcium	28,200 - 153,000	13/13
Iron	240 - 2150	13/13
Lead	3	1/13
Magnesium	7450 - 29,500	13/13
Manganese	17 - 465	13/13
Potassium	917 - 4720	12/13
Sodium	2440 - 187,000	13/13
Zinc	9 - 108	5/13

*Frequency of detection is the number of samples in which the chemical was detected over the total number of samples locations.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-22

LOCATIONS OF SHALLOW
MONITORING WELLS

C.C. JOHNSON & MALHOTRA, P.C.

Scale Approximate, 1" = 1100'

TABLE 4-15

SUMMARY OF SHALLOW MONITORING WELL SAMPLING RESULTS IEL

(All concentrations are ppb)

Chemical	Range[1,2]	Frequency[3] of Detection
Trans-1,2-Dichloroethene	3.8-4.3 (<5)	1/11
1,1-Dichloroethane	<5-25	1/11
1,2-Dichloroethane	<5-10	1/11
Benzene	1.2-10	2/11
Toluene	<0.9-13	1/11
Chlorobenzene	<5-27	1/11
Ethylbenzene	<5-110	1/11
Xylenes	<5-355	1/11
Benzoic Acid	9 (<100)	1/10
1,4-Dichlorobenzene	10-13 (<20)	1/10
Naphthalene	7.9-10 (<20)	1/10
4-Chloro-3-Methylphenol	5.2 (<20)	1/10
2-Methylnaphthalene	2.7-3 (<20)	1/10
Acenaphthene	2 (<20)	1/10
2,4-Dimethylphenol	3 (<10)	1/10
4-Methylphenol	<10-15	1/10
n-Nitrosodiphenylamine	<10-15	1/10
Phenol	3.7 (<10)	1/10

NOTES:

(1) <x = compound not detected where "x" is the detection limit. Where detection limits vary among samples the lowest is listed.
(2) A value or range followed by a number in parantheses indicates an estimated value, where the number in parantheses is the detection limit.
(3) Frequency of detection is the number of positive values detected per the total number of sample locations.

TABLE 4-15 (Continued)

SUMMARY OF SHALLOW MONITORING WELL SAMPLING RESULTS - IEL

(All concentrations are ug/liter)

Chemical	Range[1,2] (Dissolved Metals)	Frequency[3] of Detection
Aluminum	<31	0/10
Arsenic	6 (<10)	1/10
Barium	75-1,430	9/10
Beryllium	<5	0/10
Cadmium	<3.2-21	1/10
Calcium	21,820-279,000	10/10
Chromium	<3.7-7.5	1/10
Cobalt	<20	0/10
Copper	<19	0/10
Iron	<20-78,870	6/10
Lead	<3-11	1/10
Magnesium	5,470-57,200	10/10
Manganese	148-3,060	10/10
Mercury	<0.2	0/10
Nickel	<14-48	3/10
Potassium	1,490-79,200	10/10
Selenium	<3-4.4	1/10
Silver	<5.1-5.8	1/10
Sodium	4,670-360,000	10/10
Tin	<19	0/10
Vanadium	<3.1-17	4/10
Zinc	<6.3-87	3/10

NOTES:

(1) <x = compound not detected where "x" is the detection limit. Where detection limits vary among samples the lowest is listed.
(2) A value or range followed by a number in parantheses indicates an estimated value, where the number in parantheses is the detection limit.
(3) Frequency of detection is the number of positive values detected per the total number of sample locations.

TABLE 4-16

SHALLOW MONITORING WELL GROUNDWATER SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
MW01S	1,2-Dichloroethane	6-10	5X
	Trans-1,2-Dichloroethene	3.8-4.3	5X
	Calcium	195,000-218,000	1.2X
	Magnesium	1,070-57,200	1.2-2X
	Manganese	1,690	3X
	Selenium (Total)	4.4	3X
	Silver (Total)	5.8	3X
	Vanadium	9.8-13	3X
MW02S	1,1-Dichloroethane	25	5X
MW03S	Benzene	1.2-6	5X
	4-Chloro-3-Methylphenol	5.2	5X
	Benzoic Acid	9	5X
	Barium	940-1,430	2-3X
	Calcium	195,000-199,000	1.2X
	Iron	18,200-37,400	3X
	Magnesium	49,900-54,300	1.2X
	Manganese	2,690-3,060	3X
	Nickel (Total)	42-48	3X
	Potassium	79,100-79,200	3X
	Sodium	300,000-360,000	1.2X
MW04S	Iron	4,978	1.2X
	Lead (Total)	11	3X
	Manganese	755	1.2X
	Potassium	6,783	1.2X
	Vanadium	4.7	3X
MW05S	Iron	14,340	3X
	Manganese	1,226	2X
	Nickel (Total)	24	3X
	Potassium	25,810	3X
	Vanadium	5.8	3X
MW06S	Potassium	10,500	2X
MW07S	Benzene	9-10	5X
	Chlorobenzene	26-27	5X
	Ethylbenzene	88-110	5X
	Toluene	13	5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-16 (Continued)

SHALLOW MONITORING WELL GROUNDWATER SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
MW07S (Cont'd.)	Total Xylenes	240-355	5X
	1,4-Dichlorobenzene	10-13	5X
	2,4-Dimethylphenol	3	5X
	2-Methylnaphthalene	2.7-3	5X
	4-Methylphenol	15	5X
	Acenaphthene	2	5X
	n-Nitrosodiphenylamine	15	5X
	Naphthalene	7.9-10	5X
	Phenol	3.7	5X
	Cadmium (Total)	21	3X
	Chromium (Total)	6.4-7.5	3X
	Iron	76,200-78,870	3X
	Manganese	1,501-1,750	3X
	Nickel (Total)	31	3X
	Potassium	18,500-26,590	3X
	Vanadium	17	3X
MW09S	Manganese	1,460	3X
MW11S	Calcium	279,000	1.2X
	Magnesium	49,900	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

chemicals or ions that exceed 1.2 times the maximum background level are attributable to contamination from IEL. This factor was only used to narrow down the range of samples included in the evaluation of potential contamination patterns that might include IEL as a source of contamination. Beyond this "1.2X" factor, the listing in Table 4-16 also shows samples that exceed maximum background levels for a particular component by factors of at least 2X and at least 3X. Chemicals or ions that were not detected at all in background groundwater samples (as discussed in Section 4.5.2 above) automatically are flagged with a "3X" factor of exceeding background (for metals) or a "5X" factor (for organics). For example, benzene was detected at 1.2 and 6 ppb and nickel was detected at 42 and 48 ppb in shallow monitoring well MW03S. No background groundwater samples were found to contain any organics and none contained detectable amounts of nickel, so the benzene detection is automatically flagged as "5X" background and the nickel is automatically flagged as "3X" background. For components for which background levels are available, samples containing 1.2X to 1.999...X background are flagged as "1.2X", samples containing to 2.0 to 2.999...X are flagged as "2X", and those exceeding 3X are so flagged.

The most contaminated shallow monitoring wells are those located closest to the actual landfill waste. These wells include MW07S, which is partially completed in waste, and MW03S, MW01S, and MW02S which are completed less than 15 feet from waste. These four wells all contain HSL organics and wells MW01S, MW03S, and MW07S contain elevated levels of several metals (sample volume for well MW02S was too small for metals analyses). The two shallow wells between the landfill and Metzger Ditch (MW04S and MW05S) show elevated levels of five metals each. Monitoring well MW11S contains elevated levels of two metals and wells MW06S and MW09S each contain one metal at greater than background levels. Wells MW08S and MW10S, furthest from the landfill, contain no HSL compounds or ions at above background levels.

Examination of Tentatively Identified Compounds (TICs) from these wells (Table 4-17) provides supporting evidence that indicates that wells MW07S, MW03S, and MW01S are contaminated with a large number of organic compounds.

The results from these samples suggest the following distribution of contamination in the upper portion of the water table aquifer at IEL:

1. Groundwater associated with waste material is contaminated with organics and metals (Sample MW07S, Table 4-15).
2. Organic contamination quickly attenuates away from the waste mass (low organic levels in MW01S, MW02S, and MW03S, and unmeasurable levels in remaining samples).
3. Inorganic contamination is more extensive but also quickly declines with distance from the landfill (no metals above background in samples MW08S and MW10S, the two most distant samples).

4.5.4 Medium Depth Monitoring Wells

Eight medium depth monitoring wells were installed to sample groundwater approximately 35 feet below the top of the water table (at approximately the same elevation as many area residential wells). This sampling was supplemented with samples from the two sod farm irrigation wells (Figure 4-23). The results for non-background wells are summarized in Table 4-18. The sample-by-sample listing of chemicals detected at levels at least 1.2 times above background is shown in Table 4-19. The "Level Above Background" flags were applied following the same method as described above for shallow monitoring wells (Section 4.5.3).

The most striking feature of these data is the marked reduction in organic contamination within only a short depth from the upper portion of the water table aquifer. Only one of the medium depth monitoring wells (MW03M) contained an HSL organic compound (4-chloro-3-methylphenol at 1 ppb). The TIC suite is also sharply diminished with only a few compounds detected (most in well MW03M) (Table 4-20).

TABLE 4-17

TENTATIVELY IDENTIFIED COMPOUNDS "IDENTIFIED" IN SHALLOW MONITORING WELLS

SAMPLES	TENTATIVELY IDENTIFIED COMPOUNDS
MW01S	1,1'-OXYBISETHANE
	1-HEXYL-AZIRIDINE
	2-CYCLOHEXEN-1-OL
	2-METHYL-1-PROPENE
	2-PENTENE
	9-EICOSYNE
	FURAN
MW03S	.BETA.,BETA.-DIMETHYL-BENZENEPROPANOIC ACID
	1,1'-OXYBISETHANE
	1,2-DIETHOXYETHANE
	1,7,7-TRIMETHYL-BICYCLO[2.2.1]HEPTAN-2-ONE
	1-(2-METHOXY-1-METHYLETHOXY)-2-PROPANOL
	1-[1-METHYL-2-(2-PROPENYLOXY)ETHOXY]-2-PROPANOL
	1-[2-(2-METHOXY-1-METHYLETHOXY)-1-METHYL-2-PROPANOL
	2(3H)-BENZOTHIAZOLONE
	2-PROPENYL-CYCLOPENTANE
	4-ACETYL-MORPHOLINE
	4-METHYL-2-PENTANOL
	CYCLOHEPTANOL
	CYCLOHEPTANONE
	CYCLOHEXANE
	DIETHYL ESTER PHOSPHORIC ACID
	HEXADECANOIC ACID
	N'-CYCLOOCTYL-N,N-DIMETHYL-UREA
	N-PHENYL-1H-IMIDAZOLE-4-CARBOXAMIDE
	PROPYL-CYCLOPENTANE
	TETRAHYDROFURAN
	TETRAMETHYL UREA
	TETRAMETHYL-THIOUREA
MW05S	N,N-DIMETHYL-FORMAMIDE
MW07S	(3-CHLOROPHENYL)METHYL-1H-PURIN-6-AMINE
	1,1'-OXYBISETHANE
	1,2,3-TRIMETHYL-BENZENE
	1,2-DIMETHYL-BENZENE
	1,3,3-TRIMETHYL-BICYCLO[2.2.1]HEPTAN-2-ONE
	1,3,5-TRIMETHYL-BENZENE
	1,3-OXATHIOLANE
	1,7,7-TRIMETHYL-BICYCLO[2.2.1]HEPTAN-2-ONE
	1-ETHYL-2-METHYL-BENZENE
	1-ETHYL-3-METHYL-BENZENE
	2(3H)-BENZOTHIAZOLONE
	2-BUTANOL
	2-BUTOXYETHANOL,PHOSPHATE
	2-ETHYL-1,3-DIOXOLONE-4-METHANOL
	2-METHYL-BENZOYL CHLORIDE

TABLE 4-17

SAMPLES	TENTATIVELY IDENTIFIED COMPOUNDS
MW07S	2-METHYL-CYCLOHEXANOL 4,5-DIHYDRO-1,4-DIMETHYL-IH-TETRAZABOROLE 4-(1,1-DIMETHYLETHYL)-PHENOL 4-(ACETYLAMINO)-BENZOIC ACID 4-ACETYL-MORPHOLINE 4-METHYL-1-(METHYLETHYL)-CYCLOHEXANOL DIISOOCTYL ESTER 1,2-BENZENEDICARBOXYLIC ACID HEXADECANOIC ACID N,N'-DIETHYL-THIOUREA TETRAHYDROFURAN

TABLE 4-18

SUMMARY OF DOWNGRADIENT, MEDIUM DEPTH, MONITORING WELLS SAMPLING RESULTS
IEL

(All concentrations are ug/liter)

Chemical	Range[1,2] (Dissolved Metals)	Frequency[3] of Detection
4-Chloro-3-Methylphenol	1 (<20)	1/7
Barium	166-672	7/7
Calcium	72,370-145,000	7/7
Chromium	<1.8-9.2	1/7
Iron	<17-1,651	5/7
Lead	<3-60	3/7
Magnesium	15,950-35,410	7/7
Manganese	141-450	7/7
Nickel	<14-40	3/7
Potassium	558-4,150	7/7
Selenium	<3-6.8	1/7
Silver	<5-7.3	1/7
Sodium	6,180-125,100	7/7
Vanadium	<3.1-8.5	2/7
Zinc	<9-80	4/7

NOTES:

(1) <x = compound not detected where "x" is the detection limit. Where detection limits vary among samples the lowest is listed.
(2) A value or range followed by a number in parantheses indicates an estimated value, where the number in parantheses is the detection limit.
(3) Frequency of detection is the number of positive values detected per the total number of sample locations.

TABLE 4-19

MEDIUM-DEPTH MONITORING WELL GROUNDWATER SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
MW01M	Magnesium	35,410	1.2X
	Nickel (Total)	16	3X
	Selenium (Total)	6.8	3X
MW03M	4-Chloro-3-Methylphenol	1	5X
	Barium	502-672	1.2X
	Copper (Total)	216	3X
	Lead (Total)	60	3X
MW08M	Chromium (Total)	5-9.2	3X
	Nickel (Total)	20	3X
MW09M	Lead (Total)	7.7-8.5	2X
	Silver (Total)	6.7-7.3	3X
	Vanadium	8.2-8.5	3X
MW11M	Lead (Total)	9.1	3X
	Nickel (Total)	40	3X
	Vanadium	6.2	3X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-20

TENTATIVELY IDENTIFIED COMPOUNDS "IDENTIFIED" IN MEDIUM MONITORING WELLS

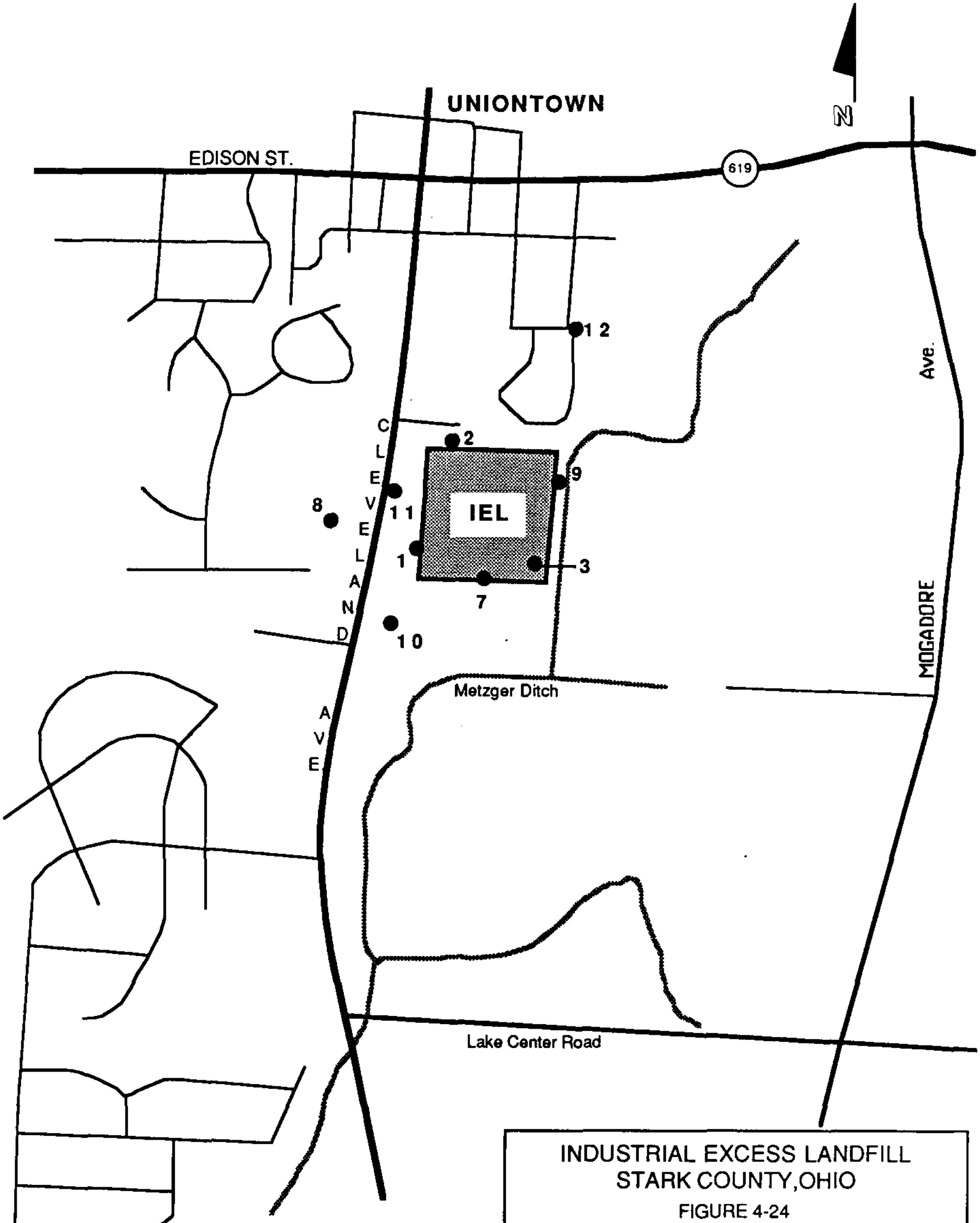
SAMPLES	TENTATIVELY IDENTIFIED COMPOUNDS
MW03M	1-METHYL-2-PYRROLIDINONE 2,4,4-TRIMETHYL-1-PENTENE 2,4--DIMETHYL-1-DECENE 5-METHYL-2-HEXANONE
MW07M	2-PROPOXY-ETHANOL
MW08M	2-CYCLOHEXEN-1-OL 2-PROPOXY-ETHANOL 4-HYDROXY-4-METHYL-2-PENTANONE

The metals that occur at above background levels in these medium wells (Table 4-19) are, for the most part, different than those found at elevated levels in the shallow wells (Table 4-16). This observation strongly suggests that, through some uncertain mechanism, (possibly an ion-exchange reaction, oxidation state change or a pH change), metals that are at high concentrations in and near the waste mass or at the top of the water table (including sodium, potassium, calcium, and magnesium) react with components within the sand and gravel to release other metals (including nickel, lead, silver, copper, and vanadium). These metals are thus found downgradient (both vertically and horizontally) from the landfill.

4.5.5 Deep (Bedrock) Monitoring Wells

Nine deep monitoring wells were completed at various levels in the top of the bedrock underlying the IEL area (Figure 4-24). Seven of these wells were completed in the Massillon sandstone which directly underlies the sand and gravel under much of the Uniontown area. This sandstone is also the source of most residential water in the area. As discussed above, the bedrock surface is very irregular, and thus, the depth of the deep monitoring wells varied according to the buried bedrock topography. Two wells (MW09D, MW11D) penetrated valleys in the bedrock surface where the Massillon Sandstone has been eroded. These wells are screened in the underlying siltstone and shale facies of the Upper Sharon Member (see Figures 4-4 and 4-5). Table 4-21 summarizes the chemical analyses performed on the groundwater obtained from these wells. Table 4-22 is a sample-by-sample listing of chemicals found at levels at least 1.2 times above background. The "Level Above Background" flags were applied following the same method as described above for shallow monitoring wells (Section 4.5.3).

No HSL organic compounds (other than very low levels of phthalates introduced as sampling and/or laboratory contaminants, see Section 3.3 concerning data validation) were detected in any of the samples.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-24

LOCATIONS OF DEEP (BEDROCK)
MONITORING WELLS

C.C. JOHNSON & MALHOTRA, P.C.

Scale Approximate, 1" = 1100'

TABLE 4-21

SUMMARY OF DOWN-GRADIENT, DEEP, MONITORING WELLS SAMPLING RESULTS
IEL

(All concentrations are ppb)

Chemical	Range[1,2] (Dissolved Metals)	Frequency[3] of Detection
Aluminum	<31-139	1/8
Barium	113-306	8/8
Cadmium	<3.2-4.3	1/8
Calcium	45,700-125,400	8/8
Chromium	<1.8-8	1/8
Copper	<11-575	1/8
Iron	<17-598	2/8
Lead	<3-19	2/8
Magnesium	9,335-25,390	8/8
Manganese	39-405	8/8
Potassium	1,047-5,440	8/8
Silver	<5-7.4	1/8
Sodium	6,840-27,100	8/8
Vanadium	<3.1-8.8	1/8
Zinc	<6.3-60	3/8

NOTES:

(1) <x = compound not detected where "x" is the detection limit. Where detection limits vary among samples the lowest is listed.
(2) A value or range followed by a number in parantheses indicates an estimated value, where the number in parantheses is the detection limit.
(3) Frequency of detection is the number of positive values detected per the total number of sample locations.

TABLE 4-22

BEDROCK MONITORING WELL GROUNDWATER SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
MW01D	Butylbenzylphthalate	1	5X
MW02D	Di-N-Octyl Phthalate	1	5X
MW03D	Lead (Total)	19	3X
MW07D	Chromium (Total)	8	3X
	Copper (Total)	575	3X
MW08D	Cadmium (Total)	4.3	3X
MW09D	Lead (Total)	5.9	1.2X
	Silver (Total)	7.4	3X
	Vanadium	8.8	3X
MW10D	Butylbenzylphthalate	6	5X

---

*The concentrations listed are above the background concentration by at least the factor shown.

Examination of the TIC data (Table 4-23) indicates that a very small amount of organic contamination may be present in monitoring wells MW03D and MW07D. As mentioned earlier, these well nests are located directly adjacent to the waste mass.

The metals data (Table 4-21) indicate that a few wells contain above background levels of a number of the same metals as found at above background levels in the medium depth wells (Table 4-18).

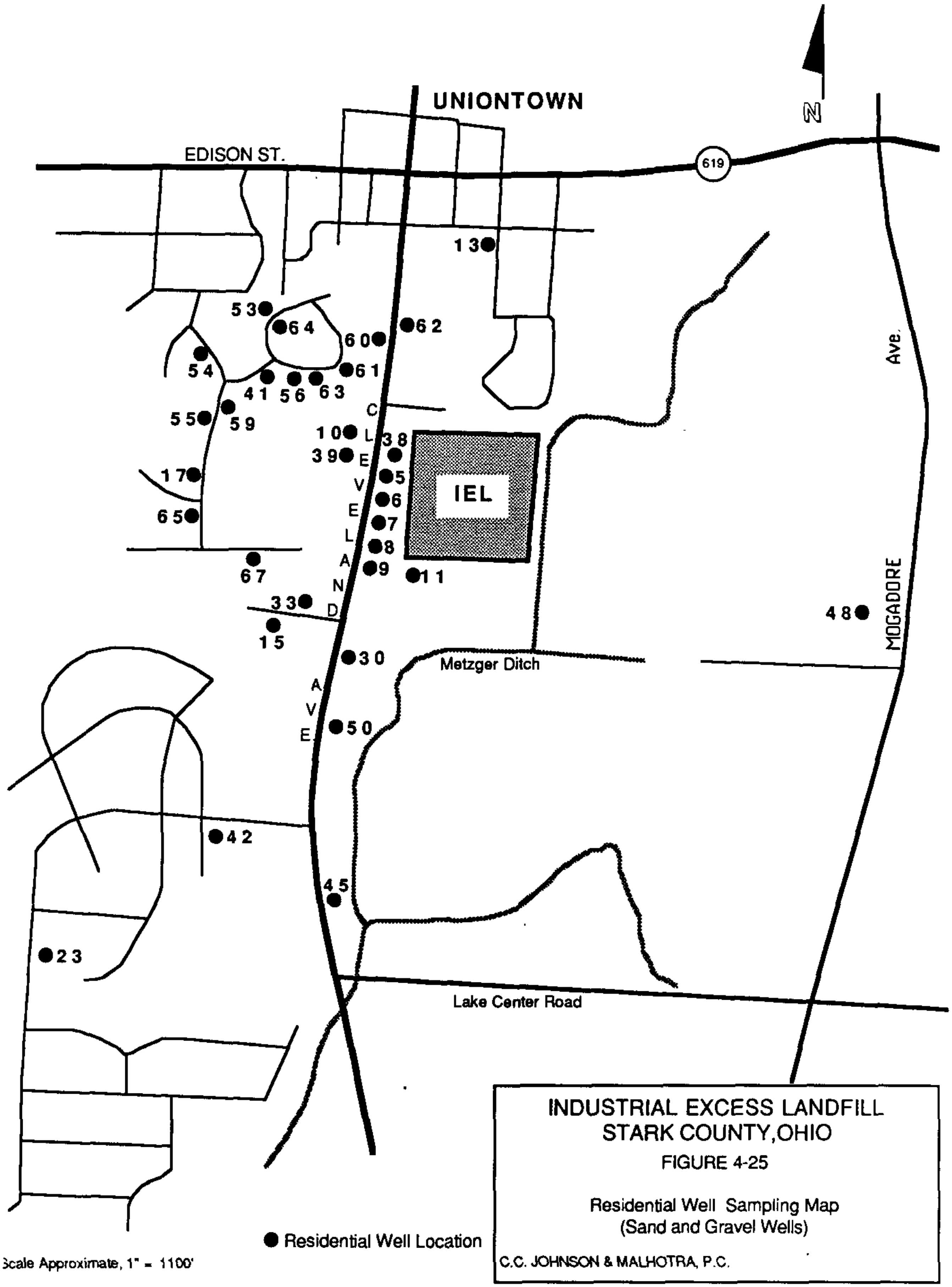
4.5.6 Residential Well Sampling Results

Sixty-seven private wells in the area of the Industrial Excess Landfill were sampled in 5 distinct phases for this Remedial Investigation. The first sampling was in August, 1986 and involved the sampling of 20 homes immediately in the area of the landfill (Samples RW01 through RW20, Figures 4-25 and 4-26) including two duplicates and two field blanks. The samples were analyzed according to the CLP Residential Water Special Analytical Services (including lower detection limits and the inclusion of several additional compounds for identification). In November, 1986, an additional 30 homes were sampled, mainly to the southwest of the site (Samples RW21-50, Figures 4-25, 4-26 and 4-27). This sampling included three duplicate samples and three field blanks. A number of background homes that are up gradient of IEL were also sampled in this effort. The sampling that took place in January of 1987 involved the resampling of 15 of the original 20 homes and the sampling of one new home (RW51). After completion of the monitoring well network around the site in the spring of 1987, the direction of groundwater flow was confirmed to be predominantly from east to west. With this in mind, groundwater samples from 16 additional homes to the west of the site were collected and analyzed (RW52-67, Figures 4-25, 4-26 and 4-27) and five previously sampled homes were resampled. This sampling took place in May, 1987. The following week, 8 homes that had had air strippers installed to deal with the previously identified

TABLE 4-23

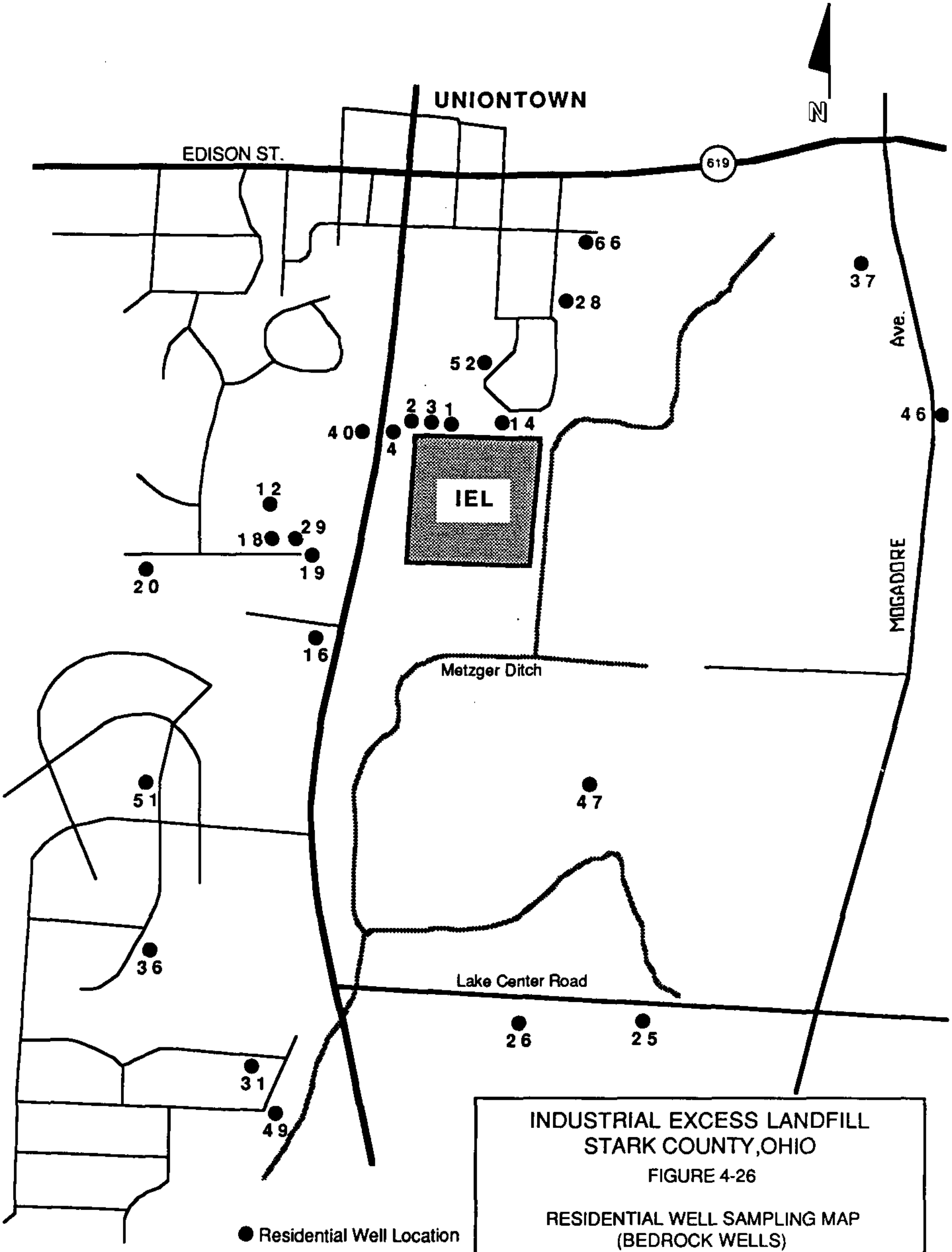
TENTATIVELY IDENTIFIED COMPOUNDS "IDENTIFIED" IN DEEP MONITORING WELLS

SAMPLES	TENTATIVELY IDENTIFIED COMPOUNDS
MW02D	2-CYCLOHEPTEN-1-ONE 4-ETHYL-4H-1,2,4-TRIAZOL-3-AMINE
MW03D	1-METHYL-2-PYRROLIDINONE 2(3H)-BENZOTHIOZOLONE 2-CYCLOHEPTEN-1-ONE 2-PROPOXY-ETHANOL
MW07D	1-METHYL-2-PYRROLIDINONE 2-PROPOXY-ETHANOL 4-HYDROXY-4-METHYL-2-PENTANONE
MW08D	4-HYDROXY-4-METHYL-2-PENTANONE



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 4-25

Residential Well Sampling Map
(Sand and Gravel Wells)



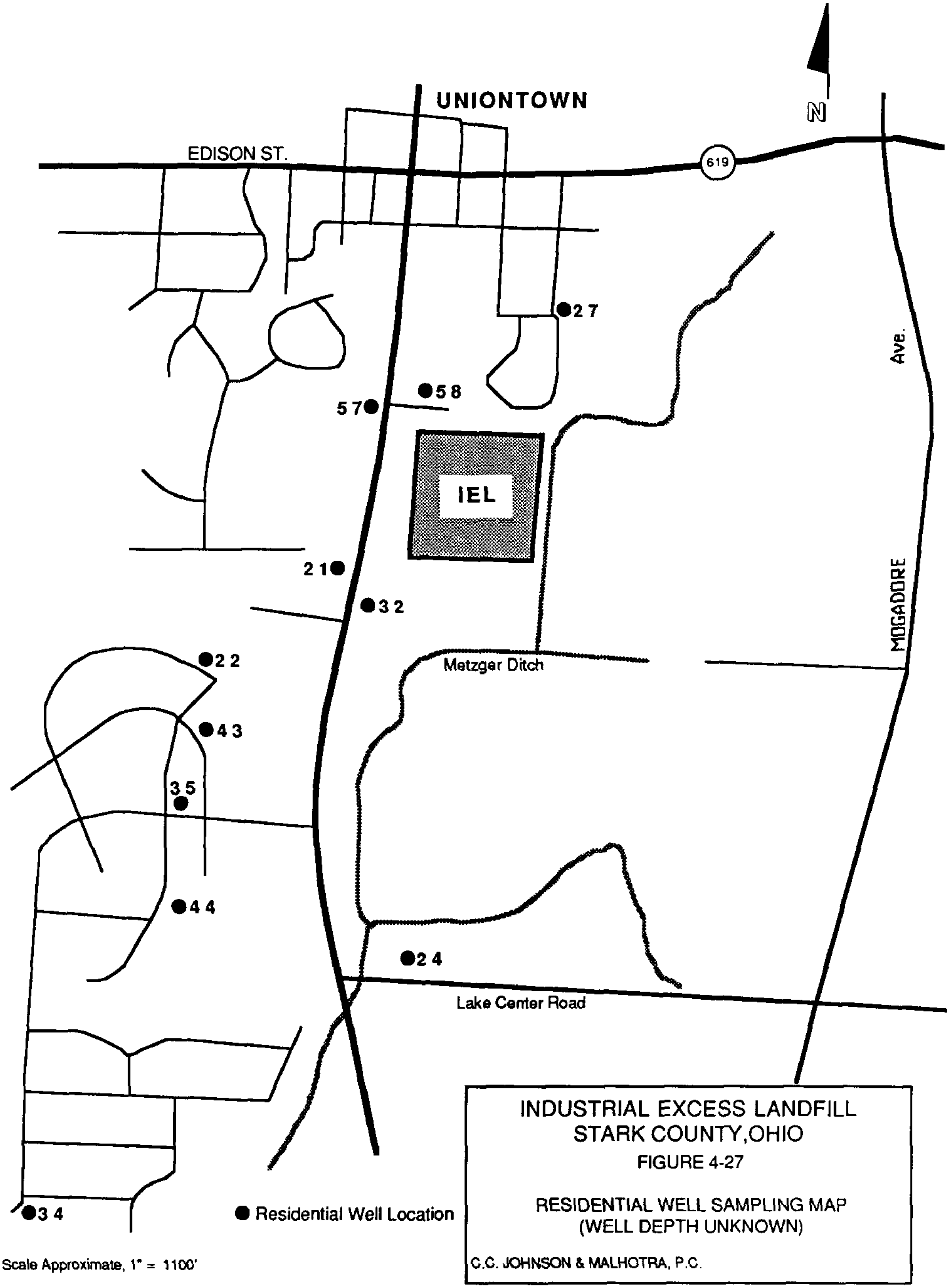
● Residential Well Location

Scale Approximate, 1" = 1100'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 4-26

RESIDENTIAL WELL SAMPLING MAP
(BEDROCK WELLS)

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 4-27

RESIDENTIAL WELL SAMPLING MAP
(WELL DEPTH UNKNOWN)

C.C. JOHNSON & MALHOTRA, P.C.

vinyl chloride problem were sampled both before and after treatment to determine the effectiveness of the treatment. (The data showed that the air strippers <u>are</u> effective.) The results of all of these sampling efforts are summarized in Tables 4-24 and 4-25.

Of the 67 wells sampled, 32 are screened in sand and gravel, 24 are screened in bedrock, and 11 are completed at undetermined depth. Table 4-26 presents completion depths and aquifer type for all wells where data were available. Figures 4-25 to 4-27 show the location of the sand and gravel, bedrock wells, and wells of undetermined depth, respectively.

Tables 4-27 and 4-28 are sample-by-sample listings of sand and gravel, and bedrock and undetermined depth residential well samples, respectively, that contained HSL substances at concentrations at least 1.2 times above background levels. Again, as was described in the above discussion concerning soils, this does not mean that the chemicals or ions that exceed 1.2 times the maximum background level are attributable to contamination from IEL. This factor was only used to narrow down the range of samples included in the evaluation of potential contamination patterns that might include IEL as a source of contamination. Beyond this "1.2X" factor, Tables 4-27 and 4-28 also show samples that exceed maximum background levels for a particular component by factors of at least 2X and at least 3X. Chemicals or ions that were not detected at all in background groundwater samples (as discussed in Section 4.5.2 above) automatically are flagged with a "3X" factor of exceeding background (for metals) or a "5X" factor (for organics). For example, vinyl chloride was detected at 3 and 3.9 ppb and nickel was detected at 26 and 30 ppb in sand and gravel residential well RW38. <u>No</u> background groundwaters were found to contain any organics and none contained detectable amounts of nickel, so the vinyl chloride detection is automatically flagged as "5X" background and nickel is automatically flagged as "3X" background. For components for which background levels are available, samples containing 1.2X to 1.999...X

TABLE 4-24

SUMMARY OF RESIDENTIAL WELL SAMPLING RESULTS - INORGANIC CHEMICALS IEL

(All concentrations are ppb)

Chemical	Range Concentration Detected	Frequency[2] of Detection
Aluminum	<29-153	5/67
Arsenic	<2-9.1	29/67
Barium	2.1-1,370	67/67
Cadmium	<0.1-0.58	7/67
Calcium	55-460,000	67/67
Chromium	<5-11	3/67
Cobalt	<5-16	3/67
Copper	<4-356	28/67
Iron	<25-13,100	65/67
Lead	<1-239	30/67
Magnesium	76-59,400	67/67
Manganese	<4-489	64/67
Nickel	<7-48	11/67
Potassium	<69-23,400	62/67
Selenium	<2-20	9/67
Silver	<0.4-12	1/67
Sodium	<638-342,000	65/67
Vanadium	<5-22	6/67
Zinc	<8-733	28/67
Cyanide	<2-26	5/67

NOTES:

(1) <x = chemical not detected, where "x" is the detection limit.
(2) Frequency of detection is the number of wells in which the chemical was detected over the total number of wells sampled. In the case of repeat or duplicate samples if a chemical was detected in any of the samples, it is considered as detected in the well.

TABLE 4-25

SUMMARY OF RESIDENTIAL WELL SAMPLING RESULTS
HAZARDOUS SUBSTANCE LIST ORGANIC CHEMICALS
IEL

(All concentrations are ppb)

	Well Identification Numbers		
Chemical	RW05	RW38	RW39
Vinyl Chloride	7	3.9	2
Chloroethane	2	<1.5	1
Tetrachloroethene	<1	1.3	<1

NOTES:
(1) <x = compound not detected where "x" is the detection limit.
(2) Only those wells and chemicals that showed positive results are listed.
(3) Maximum value from duplicate samples and duplicate sampling rounds is listed.
(4) Detection limit for vinyl chloride is 0.5 ug/liter.

TABLE 4-26

RESIDENTIAL WELL DEPTHS AND PRODUCING AQUIFERS

SAMPLE NUMBER	WELL DEPTH	AQUIFER*
RW01	?	SANDSTONE?
RW02	?	SANDSTONE?
RW03	?	SANDSTONE?
RW04	?	SANDSTONE?
RW05	75	QS&G
RW06	?	QS&G?
RW07	?	QS&G?
RW08	?	QS&G
RW09	?	QS&G?
RW10	105	QS&G
RW11	?	QS&G?
RW12	138	SANDSTONE
RW13	65	QS&G
RW14	120	SANDSTONE
RW15	41	QS&G
RW16	95	SANDSTONE
RW17	114	QS&G
RW18	150	SHALE
RW19	135	SANDSTONE
RW20	140	SANDSTONE
RW21	?	?
RW22	?	?
RW23	28	QS&G
RW24	?	?
RW25	89	SANDSTONE
RW26	109	SANDSTONE
RW27	?	?
RW28	87	SHALE
RW29	131	SANDSTONE
RW30	51	QS&G
RW31	72	SANDSTONE
RW32	?	?
RW33	41	QS&G
RW34	?	?
RW35	?	?
RW36	67	SANDSTONE
RW37	92	SANDSTONE
RW38	72	QS&G
RW39	85	QS&G
RW40	130	SANDSTONE
RW41	63	QS&G
RW42	32	QS&G
RW43	?	?
RW44	?	?
RW45	28	QS&G
RW46	57	SANDSTONE
RW47	56	SANDSTONE
RW48	30	QS&G
RW49	90	SANDSTONE
RW50	28	QS&G
RW51	86	SANDSTONE
RW52	114	SANDSTONE
RW53	53	QS&G
RW54	94	QS&G
RW55	77	QS&G
RW56	93	QS&G
RW57	?	?
RW58	?	?
RW59	110	QS&G
RW60	106	QS&G
RW61	110	QS&G
RW62	90	QS&G
RW63	75	QS&G
RW64	80	QS&G
RW65	45	QS&G
RW66	88	SANDSTONE?
RW67	76	QS&G

* QS and QG are
Quaternary Sand and Gravel, respectively.
"Sandstone" and "Shale" are
Pennsylvanian Age Bedrock units.

TABLE 4-27

SAND AND GRAVEL RESIDENTIAL WELL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
RW05	Chloroethane	1.8-2	5X
	Vinyl Chloride	3.9-7	5X
	Copper (Total)	7.2-19	3X
	Lead (Total)	4.9	1.2X
	Magnesium	38,000-39,500	1.2X
	Nickel (Total)	9-9.5	3X
	Vanadium	19	3X
RW06	Cadmium (Total)	0.5	3X
	Copper (Total)	253	3X
	Iron	6,690	2X
	Lead (Total)	78	3X
	Magnesium	38,900	1.2X
	Nickel (Total)	9.7	3X
	Selenium (Total)	4.1	3X
RW07	Barium	542-770	1.2X
	Cobalt	7.8	3X
	Copper (Total)	46-89	3X
	Iron	4,430-5,800	1.2X
	Lead (Total)	4.8-6.8	3X
	Magnesium	35,600-47,100	1.2X
	Nickel (Total)	11	3X
	Selenium (Total)	3.7	3X
	Vanadium	19	3X
RW08	Barium	1,080-1,140	2X
	Chromium (Total)	11	3X
	Cobalt	7.4	3X
	Copper (Total	18-44	3X
	Iron	5,670-7,740	1.2-2X
	Lead (Total)	22	3X
	Magnesium	41,400-49,500	1.2X
	Nickel (Total)	9-31	3X
	Potassium	8,150-23,400	1.2-3X
	Selenium (Total)	3.8-4.3	3X
	Vanadium	22	3X
	Zinc (Total)	139-209	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-27 (Continued)

SAND AND GRAVEL RESIDENTIAL WELL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
RW09	Barium	873-1,370	2-3X
	Cadmium (Total)	0.58	3X
	Calcium	191,000-204,000	1.2X
	Chromium (Total)	10	3X
	Copper (Total)	38-41	3X
	Iron	9,180-13,100	2-3X
	Lead (Total)	6-7.3	2X
	Magnesium	45,600-59,400	1.2-2X
	Nickel (Total)	20-32	3X
	Selenium (Total)	2.4	3X
	Zinc (Total)	437-733	3X
RW10	Cadmium (Total)	0.19	3X
	Iron	4,580	1.2X
	Lead (Total)	6.5	2X
	Magnesium	37,700	1.2X
	Nickel (Total)	10	3X
	Selenium (Total)	3.3	3X
	Silver (Total)	12	3X
RW11	Barium	796-886	2X
	Copper (Total)	23-86	3X
	Cyanide (Total)	5.3	3X
	Iron	10,900-12,500	3X
	Magnesium	38,400-41,100	1.2X
	Nickel (Total)	12	3X
RW15	Copper (Total)	13-38	3X
RW23	Calcium	460,000	3X
RW30	Copper (Total)	28	3X
RW33	Magnesium	38,300	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-27 (Continued)

SAND AND GRAVEL RESIDENTIAL WELL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
RW38	Chromium (Total)	11	3X
	Copper (Total)	90	3X
	Iron	4,080-4,920	1.2X
	Lead (Total)	77	3X
	Magnesium	37,100	1.2X
	Nickel (Total)	26-30	3X
	Tetrachloroethene	1.3	5X
	Vinyl Chloride	3-3.9	5X
	Zinc (Total)	193-400	1.2-3X
RW39	Chloroethane	1	5X
	Vinyl Chloride	1.5-2	5X
	Calcium	203,000	1.2X
	Iron	4,980-5,110	1.2X
	Magnesium	41,700-46,900	1.2X
	Lead (Total)	18	3X
RW39	Selenium (Total)	5.45	3X
	Sodium	342,000	1.2X
RW41	Copper (Total)	9.6	3X
	Magnesium	36,700-37,300	1.2X
RW42	Nickel (Total)	27	3X
RW50	Copper (Total)	28	3X
RW53	Copper (Total)	8.4	3X
	Selenium (Total)	4.9	3X
	Vanadium	7.5	3X
RW54	Bromodichloromethane	10	5X
	Chloroform	10	5X
	Dibromochloromethane	7	5X
RW55	Copper (Total)	12	3X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-27 (Continued)

SAND AND GRAVEL RESIDENTIAL WELL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
RW56	Copper (Total)	38	3X
	Magnesium	38,100	1.2X
	Vanadium	7.6	3X
RW59	Copper (Total)	356	3X
RW61	Iron	4,630	1.2X
	Selenium (Total)	2.5	3X
RW62	Copper (Total)	27	3X
	Vanadium	10	3X
RW63	Cadmium (Total)	0.32	3X
	Copper (Total)	11	3X
	Nickel (Total)	48	3X
RW64	Copper (Total)	127	3X
RW65	Copper (Total)	25	3X
RW67	Cadmium (Total)	0.14	3X
	Cobalt	6.3	3X
	Nickel (Total)	18	3X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 4-28

BEDROCK OR UNKNOWN SCREEN DEPTH RESIDENTIAL WELL SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Level Above Background*
RW01	Copper (Total)	5.2	3X
RW02	Zinc (Total)	225	2X
RW03	Copper (Total)	11	3X
RW04	Cadmium (Total)	0.29	3X
	Copper (Total)	23	3X
	Cyanide (Total)	11	3X
RW14	Copper (Total)	24	3X
	Cyanide (Total)	5.1	3X
RW18	Copper (Total)	11	3X
	Cyanide (Total	26	3X
RW19	Cyanide (Total)	2.3	3X
RW40	Copper (Total)	283	3X
	Iron	5,290-5,300	1.2X
	Lead (Total)	239	3X
	Magnesium	41,700	1.2X
RW51	Copper (Total)	22	3X
	Lead (Total	5.1	1.2X
RW21	Cadmium (Total)	0.14	3X
	Copper (Total)	15	3X
	Selenium (Total)	20	3X
RW22	Iron	4,340	1.2X
RW43	Magnesium	38,700	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

background are flagged as "1.2X", samples containing 2.0 to 2.999...X are flagged as "2X", and those exceeding 3X are so flagged.

Tables 4-29 and 4-30 summarize the occurrence of Tentatively Identified Compounds (organics) from these samples.

Only four residential wells contained HSL organic compounds. Three of the four contain contaminants attributed to the landfill. These three are sand and gravel wells contaminated with vinyl chloride (RW05, RW38, and RW39), chloroethane (RW05 and RW39) and tetrachloroethene (RW38) (Figure 4-28). These compounds are all highly mobile. Residential well RW54, a sand and gravel well located west of the landfill, contained 7 to 10 ppb each of these trihalomethanes: bromodichloromethane, chloroform, and dibromochloromethane (Table 4-27). In addition, a number of chlorinated compounds were tentatively identified (Table 4-29). This well has a chlorination system attached which was not completely circumvented during sampling. These various halogenated organics are due to reactions of naturally occurring organics, such as humic and fulvic acids, with the chlorine and attendant trace amounts of bromine. These reaction products are common wherever chlorination is applied to groundwater and can in no way be attributed to the landfill. Examination of the Tentatively Identified Compounds from residential well sampling shows that other volatile compounds (e.g. 1,1'-oxybisethane) or soluble compounds (e.g. tetrahydrofuran) are found in all of the sand and gravel residential wells immediately to the west of the site (Table 4-29 and Figure 4-29). The occurrence of TICs west of Cleveland Avenue is limited to sample RW39 (which also contains HSL organics) and scattered, equivocal samples from both sand and gravel as well as bedrock wells (Figure 4-29 and 4-30). The only TICs that can be attributed to the landfill occur in the homes immediately west, along Cleveland Avenue. These samples contain TICs also identified in monitoring wells located on teh site, including 1,1' oxybisethane, 1,2-diethoxyethane, 2-cyclohexen-1-ol, 4-acetyl-morpholine, diethyl ester phosphoric acid, hexadecanoic acid, tetrahydrofuran, and tetramethyl urea.

TABLE 4-29

TENTATIVELY IDENTIFIED COMPOUNDS "IDENTIFIED" IN SAND AND GRAVEL RESIDENTIAL WELLS

SAMPLES	TENTATIVELY IDENTIFIED COMPOUNDS
RW05S	1,1'-OXYBISETHANE (ETHYL ETHER) 1,2-DIETHOXY-ETHANE 1,3,6-TRIOXOCANE 1-(1,1-DIMETHYLETHYL)-2-METHYL-PROPANOIC ACID 2,2'-[OXYBIS(METHYLENE)]BIS-OXIRANE 2,5-DIMETHYL-2,5-HEXANEDIOL 2-CYCLOHEXEN-1-OL 2-CYCLOHEXEN-1-ONE 4-ACETYL-MORPHOLINE AZACYCLOTRIDECAN-2-ONE DICHLOROFLUOROMETHANE N,N-DI...BENZENECARBOXIMIDAMIDE SULFUR TETRAHYDROFURAN
RW06S	1,1-DIOXIDE-1,2-BENZISOTHIAZOL-3(2H)-ONE 1,3,6-TRIOXOCANE 2-METHYL-CYCLOPENTANOL 3-HYDROXY-3-METHYL-2-BUTANONE 4-ACETYL-MORPHOLINE BROMOHEXANE ISOMER SUBSTITUTED BENZENECARBOXYLIC ACID
RW07S	1,1'-OXYBISETHANE (ETHYL ETHER) SULFUR TETRAHYDROFURAN
RW08S	1,1'-OXYBISETHANE 1,2-DIETHOXY-ETHANE 1-ETHOXYBUTANE 2,4-DIMETHYL-2-PENTANOL 2-BUTOXY-ETHANOL 2-METHOXY-...BENZENEPROPANOL 2-METHYL-2-PROPANOL 4-ACETYLMORPHOLINE 4-BUTOXY-BUTANOIC ACID DIOCTYL ESTER HEXADIOIC ACID METHOXY ETHANE N-ETHYL-MORPHOLINE TETRAETHYL-DIPHOSPHORIC ACID TETRAHYDROFURAN TETRAMETHYLUREA UNKNOWN PHOSPHORIC ACID
RW09S	1,1'-OXYBISETHANE 1,2-DIETHOXY-ETHANE 1-ETHOXYBUTANE

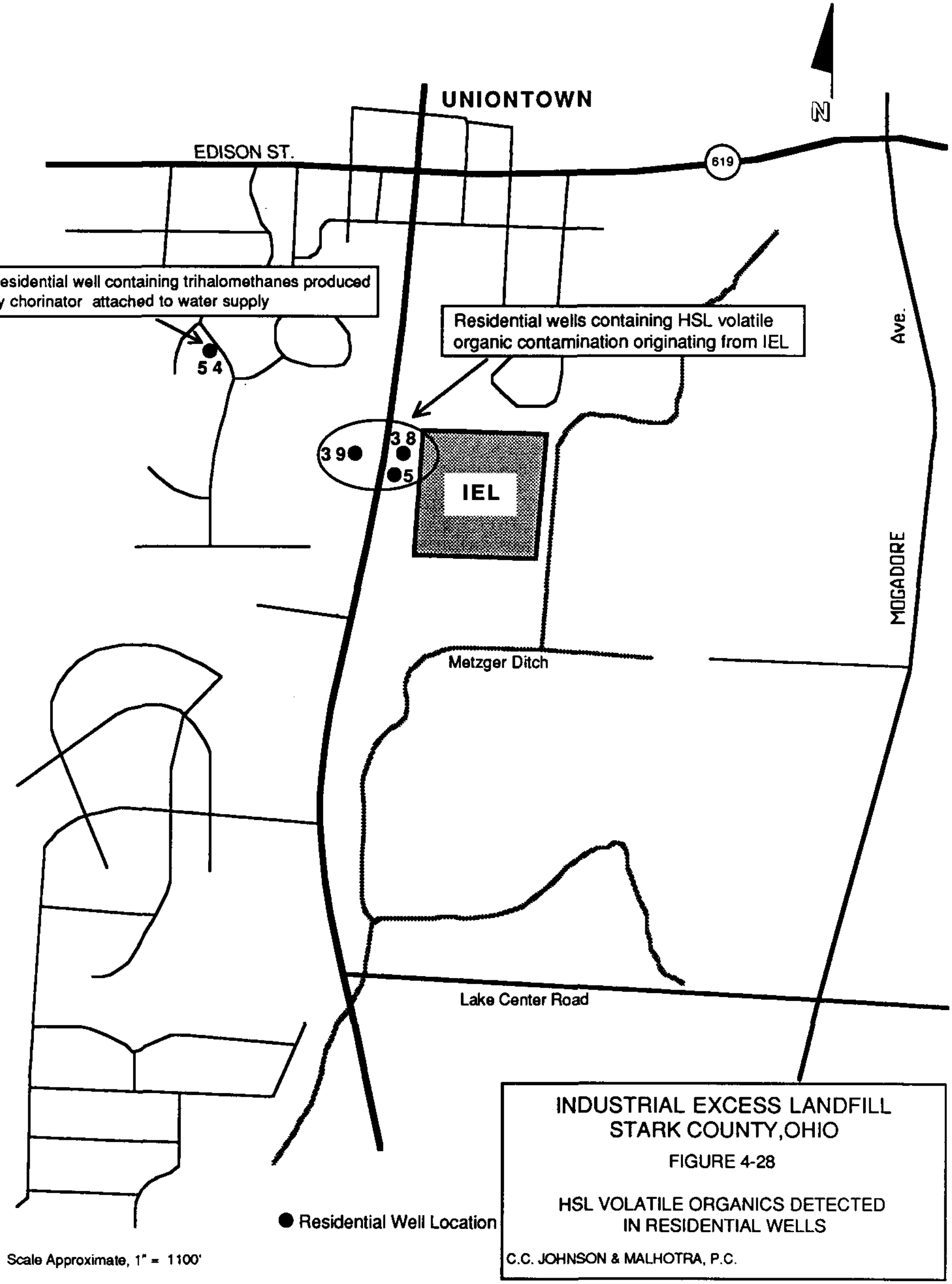
TABLE 4-29

SAMPLES	TENTATIVELY IDENTIFIED COMPOUNDS
RW09S	4-(1,1-DIMETHYL...) BENZOIC ACID
	4-ACETYL-MORPHOLINE
	4-BUTOXY-BUTANOIC ACID
	6-METHOXY-...4,2-CRESOTIC ACID
	AZACYCLOTRIDECAN-2-ONE
	HEXADECANOIC ACID
	METHOXY ACETIC ACID
	METHOXY ETHANE
	O-METHYLOXIME-3-PENTANONE
	SUBSTITUTED BENZENECARBOXYLIC ACID
	SULFUR
	TETRAETHYL-DIPHOSPHORIC ACID
	TETRAHYDROFURAN
	THIAZOLE
	TRIMETHOXY-METHANE
RW11S	1,1'-OXYBISETHANE
	1,2-DIETHOXY-ETHANE
	1,4-DIMETHOXY-2,3,5,6...BENZENE
	1-ETHOXYBUTANE
	1-METHYL-1H-IMIDAZOLE
	2-METHYL-2-PROPANOL
	4-(1,1-DIMETHYL...) BENZOIC ACID
	4-(1,1-DIMETHYLETHYL) BENZOIC ACID
	AZACYCLOTRIDECAN-2-ONE
	DIETHYL ESTER PHOSPHORIC ACID
	HEXADECANOIC ACID
	SULFUR
	TETRAHYDROFURAN
	TETRAMETHYLUREA
RW17S	1-(1,1-DIMETHYLETHYL)-2-METHYL-PROPANOIC ACID
	2,5-DIETHYLTETRAHYDROFURAN
RW38S	1,3,6-TRIOXACANE
	2-CYCLOHEXEN-1-ONE
	TETRAHYDROFURAN
	TETRAMETHYL UREA
RW39S	1-CHLORO-2-ETHENYL-1-METHYL-CYCLOPROPANE
	2-CYCLOHEXEN-1-ONE
	DICHLOROFLUOROMETHANE
RW41S	2,5-DIETHYLTETRAHYDROFURAN
RW54S	2-CYCLOHEXENE-1-OL
	3-CHLORO-CYCLOHEXENE
	4-CHLORO-TRANS-CYCLOHEXANOL
	BROMO CYCLOHEXANOL ISOMER
	CHLORINATED CYCLOHEXANE

TABLE 4-30

TENTATIVELY IDENTIFIED COMPOUNDS "IDENTIFIED" IN BEDROCK OR UNKNOWN DEPTH RESIDENTIAL WELLS

SAMPLES	TENTATIVELY IDENTIFIED COMPOUNDS
RW01D	SULFUR
RW14D	SILOXANE
RW18D	4,4'-THIOBIS[2-(1,1-DIMETHYLETHYL)-5-METHYL]-PHENOL
RW29D	2,5-DIETHYLTETRAHYDROFURAN
RW31D	2-METHYL-BUTANOIC ACID 3-METHYL-2-BUTANONE
RW34D	2-METHYL-...PROPANOIC ACID
RW34D	NONANOIC ACID
RW40D	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE 2-CYCLOHEXEN-1-ONE SULFUR



Residential well containing trihalomethanes produced by chorinator attached to water supply

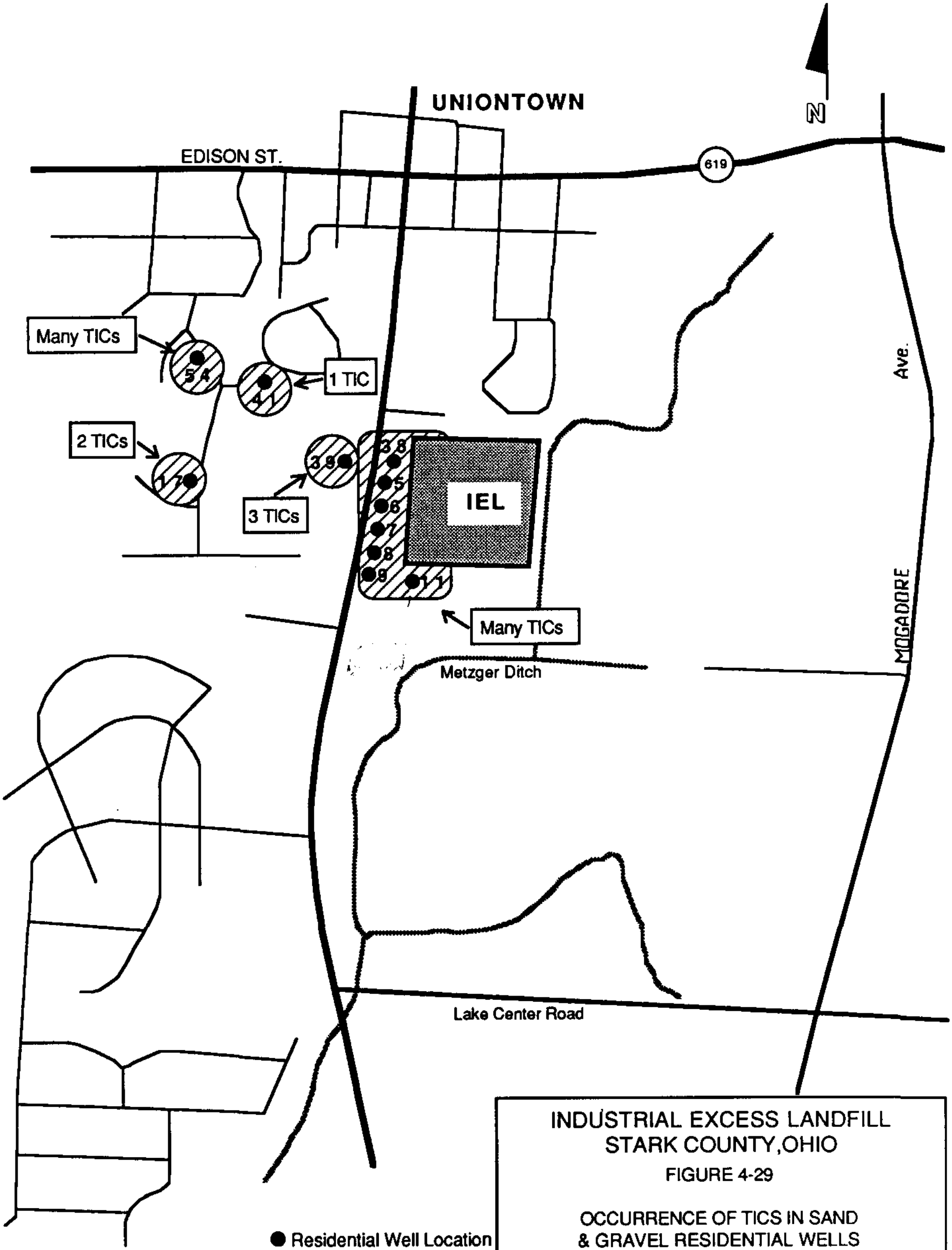
Residential wells containing HSL volatile organic contamination originating from IEL

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-28

HSL VOLATILE ORGANICS DETECTED
IN RESIDENTIAL WELLS

C.C. JOHNSON & MALHOTRA, P.C.



● Residential Well Location

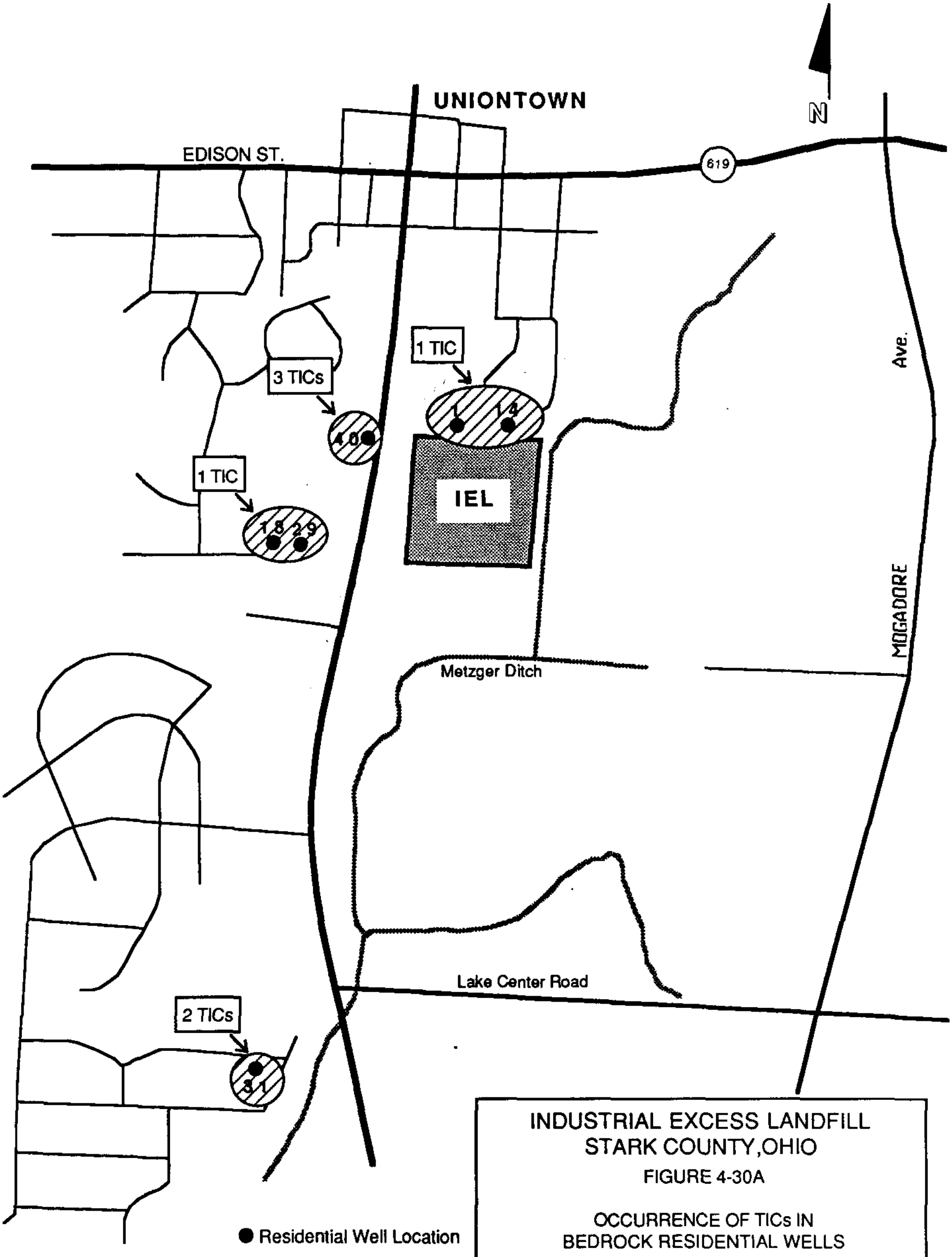
Scale Approximate, 1" = 1100'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-29

OCCURRENCE OF TICS IN SAND
& GRAVEL RESIDENTIAL WELLS

C.C. JOHNSON & MALHOTRA, P.C.



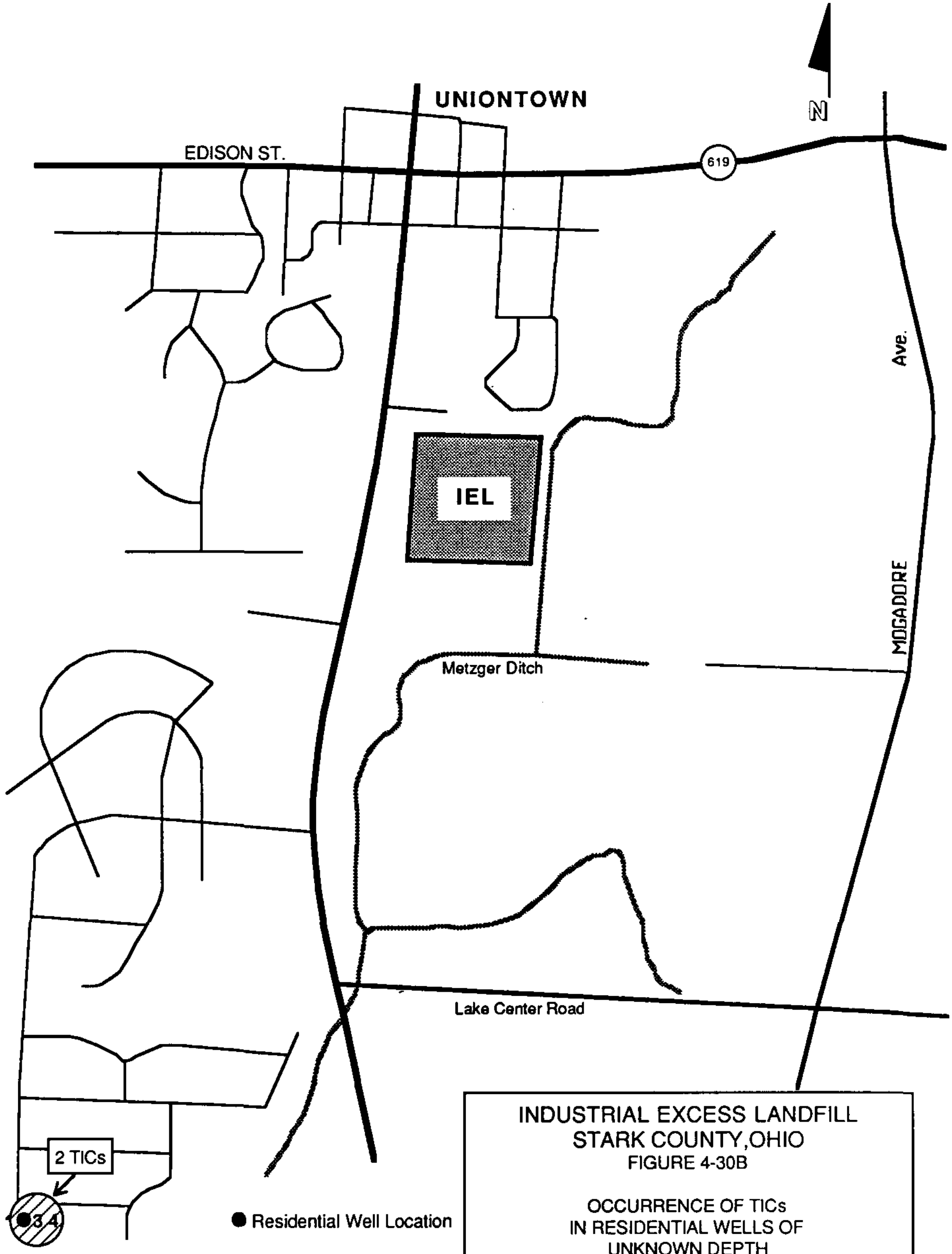
INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-30A

OCCURRENCE OF TICs IN
BEDROCK RESIDENTIAL WELLS

C.C. JOHNSON & MALHOTRA, P.C.

Scale Approximate, 1" = 1100'



Scale Approximate, 1" = 1100'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 4-30B

OCCURRENCE OF TICs
IN RESIDENTIAL WELLS OF
UNKNOWN DEPTH
C.C. JOHNSON & MALHOTRA, P.C.

Metals analyses indicate a pattern similar to that displayed by the organics (Tables 4-27 and 4-28 and Figures 4-31 and 4-32). Moreover, the higher than background levels appear to persist at a somewhat greater distance down gradient from the site (Figures 4-31 and 4-32).

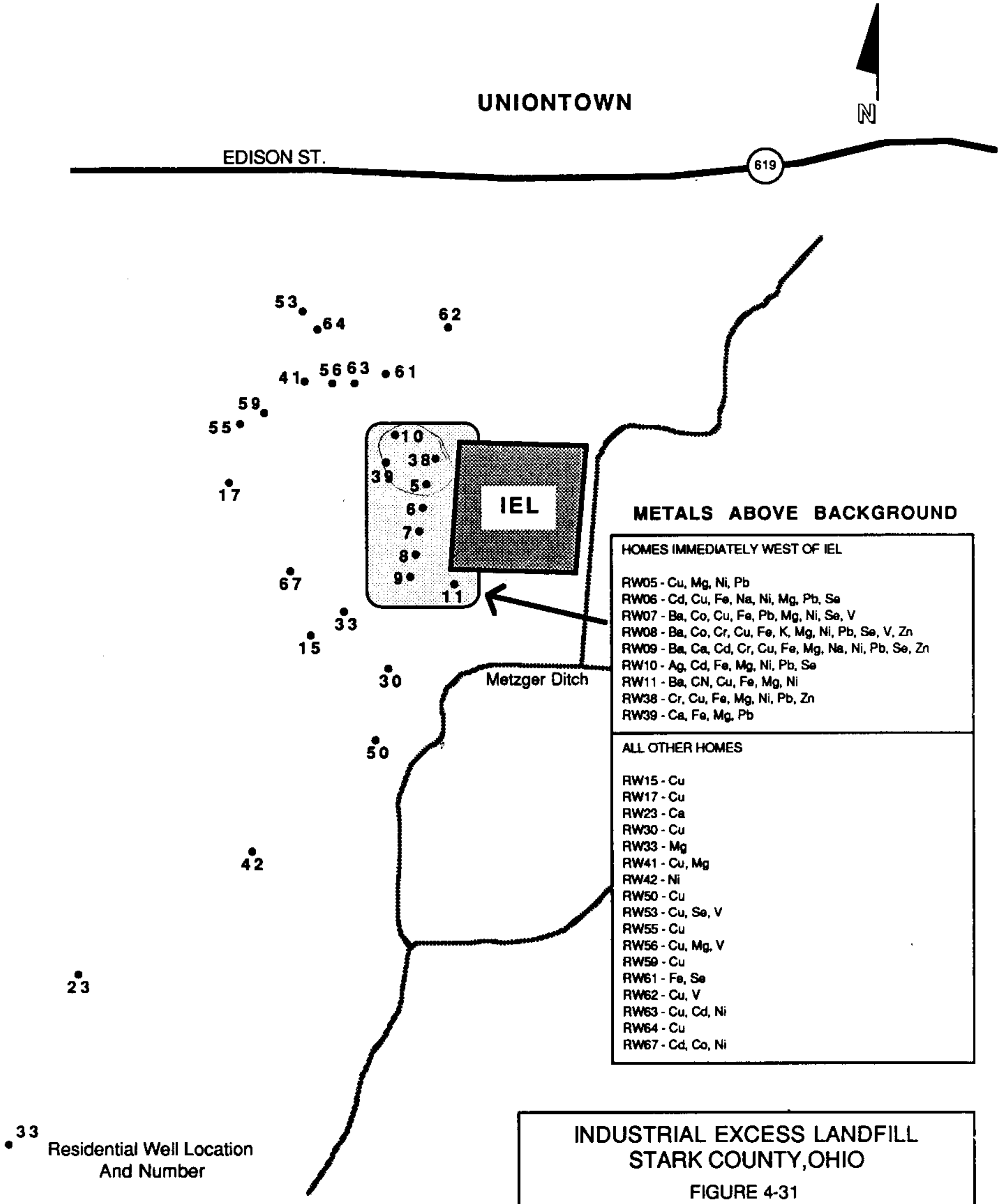
No clear pattern emerges from analysis of individual elevated metals levels away from the site. For example, the occurrence of copper at greater than background is somewhat random and suggests that background data for copper in groundwater in the IEL area may be incomplete. However, the overall theme appears to be high metals immediately adjacent to the landfill, with an area to the west where metals levels are only locally elevated.

In order to get a better view of inorganic contamination extent, groundwater specific conductivity measurements were used to construct a generalized isoconductivity map (Figures 4-33). Data on this map are from both monitoring and residential well sampling. The main feature evident from this display of data is that high specific conductivities are confined to the sand and gravel portion of the aquifer and are confined to the area immediately west of the landfill. Analysis of the conductivity data from bedrock-derived groundwater revealed no pattern of contamination.

4.5.7 Source and Extent of Groundwater Contamination - Summary

An area of groundwater contamination is found below and immediately to the west of the Industrial Excess Landfill (Figure 4-34). This "plume" is defined based on the following criteria derived from examination of both monitoring well and residential well water quality data:

1) The presence of HSL organics
2) The presence of HSL metals at levels above investigation-established background levels
3) The presence of TICs that are landfill derived (this distinction is explained below).



METALS ABOVE BACKGROUND

HOMES IMMEDIATELY WEST OF IEL

RW05 - Cu, Mg, Ni, Pb
RW06 - Cd, Cu, Fe, Na, Ni, Mg, Pb, Se
RW07 - Ba, Co, Cu, Fe, Pb, Mg, Ni, Se, V
RW08 - Ba, Co, Cr, Cu, Fe, K, Mg, Ni, Pb, Se, V, Zn
RW09 - Ba, Ca, Cd, Cr, Cu, Fe, Mg, Na, Ni, Pb, Se, Zn
RW10 - Ag, Cd, Fe, Mg, Ni, Pb, Se
RW11 - Ba, CN, Cu, Fe, Mg, Ni
RW38 - Cr, Cu, Fe, Mg, Ni, Pb, Zn
RW39 - Ca, Fe, Mg, Pb

ALL OTHER HOMES

RW15 - Cu
RW17 - Cu
RW23 - Ca
RW30 - Cu
RW33 - Mg
RW41 - Cu, Mg
RW42 - Ni
RW50 - Cu
RW53 - Cu, Se, V
RW55 - Cu
RW56 - Cu, Mg, V
RW59 - Cu
RW61 - Fe, Se
RW62 - Cu, V
RW63 - Cu, Cd, Ni
RW64 - Cu
RW67 - Cd, Co, Ni

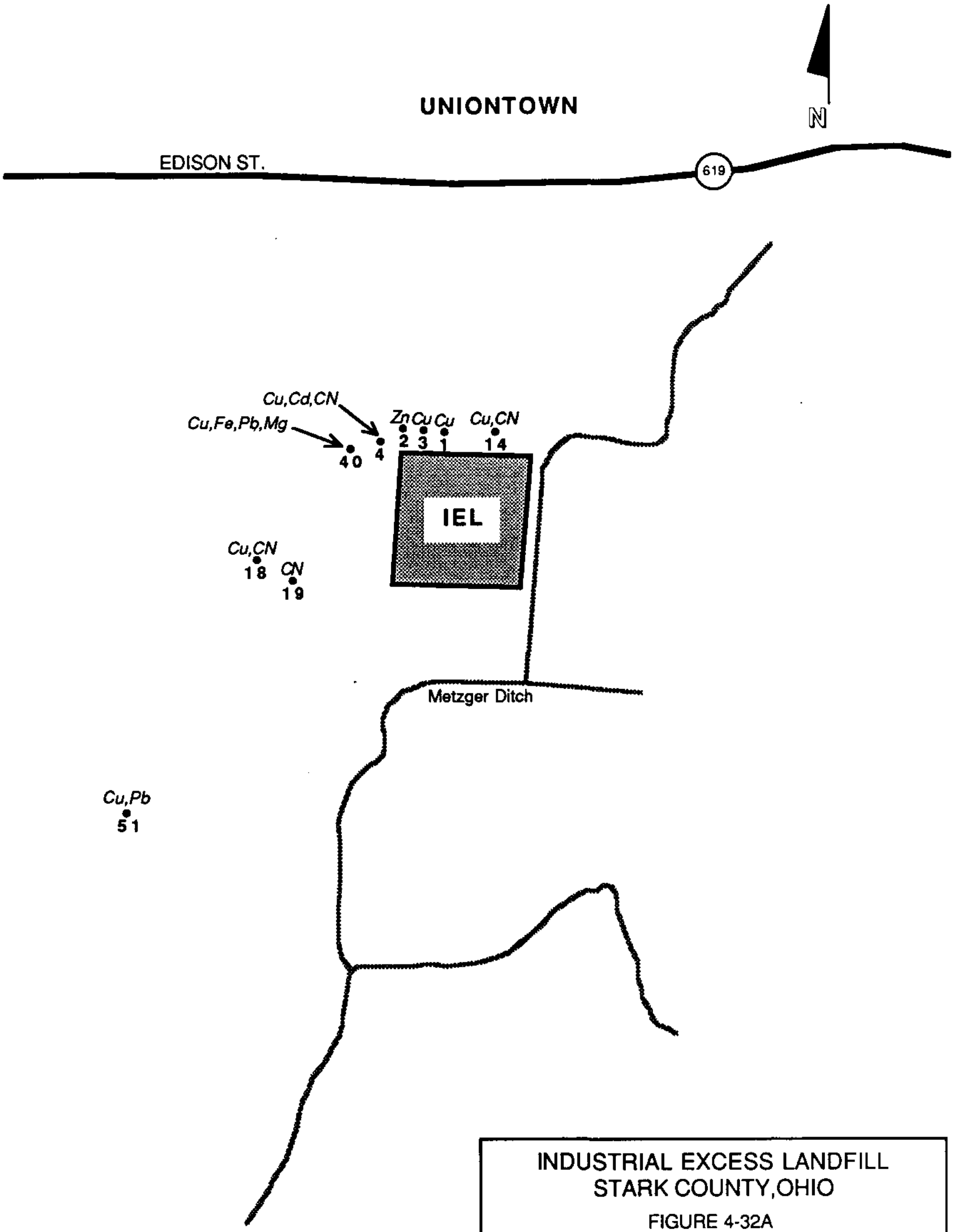
INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-31

METALS DISTRIBUTION IN SAND
& GRAVEL RESIDENTIAL WELLS

C.C. JOHNSON & MALHOTRA, P.C.

Approximate, 1" = 1100'



● Residential Well Location

Cu Metals present above background

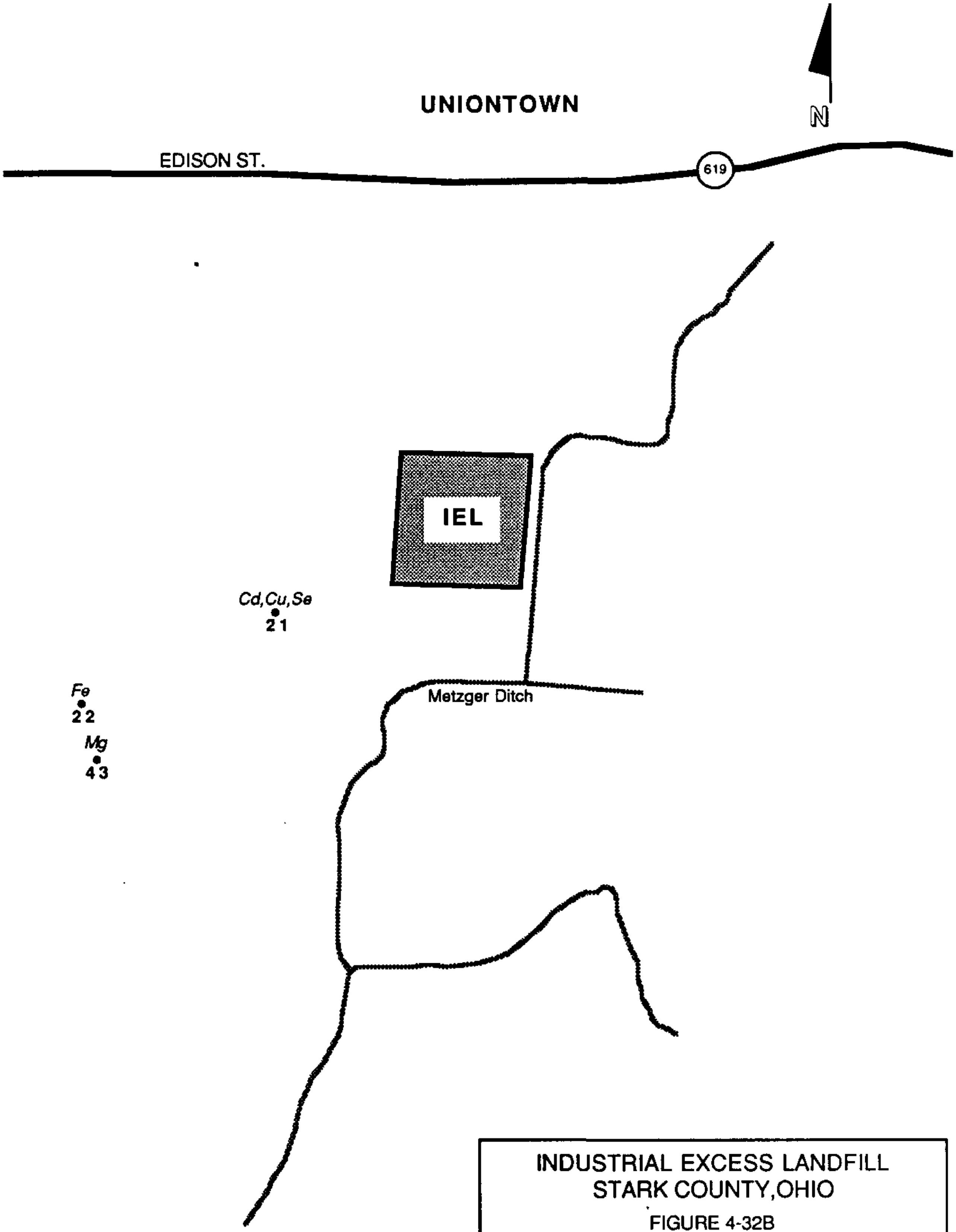
Scale Approximate, 1" = 1100'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-32A

METALS DISTRIBUTION IN
BEDROCK RESIDENTIAL WELLS

C.C. JOHNSON & MALHOTRA, P.C.



- ● Residential Well Location
- *Cu* Metals present above background

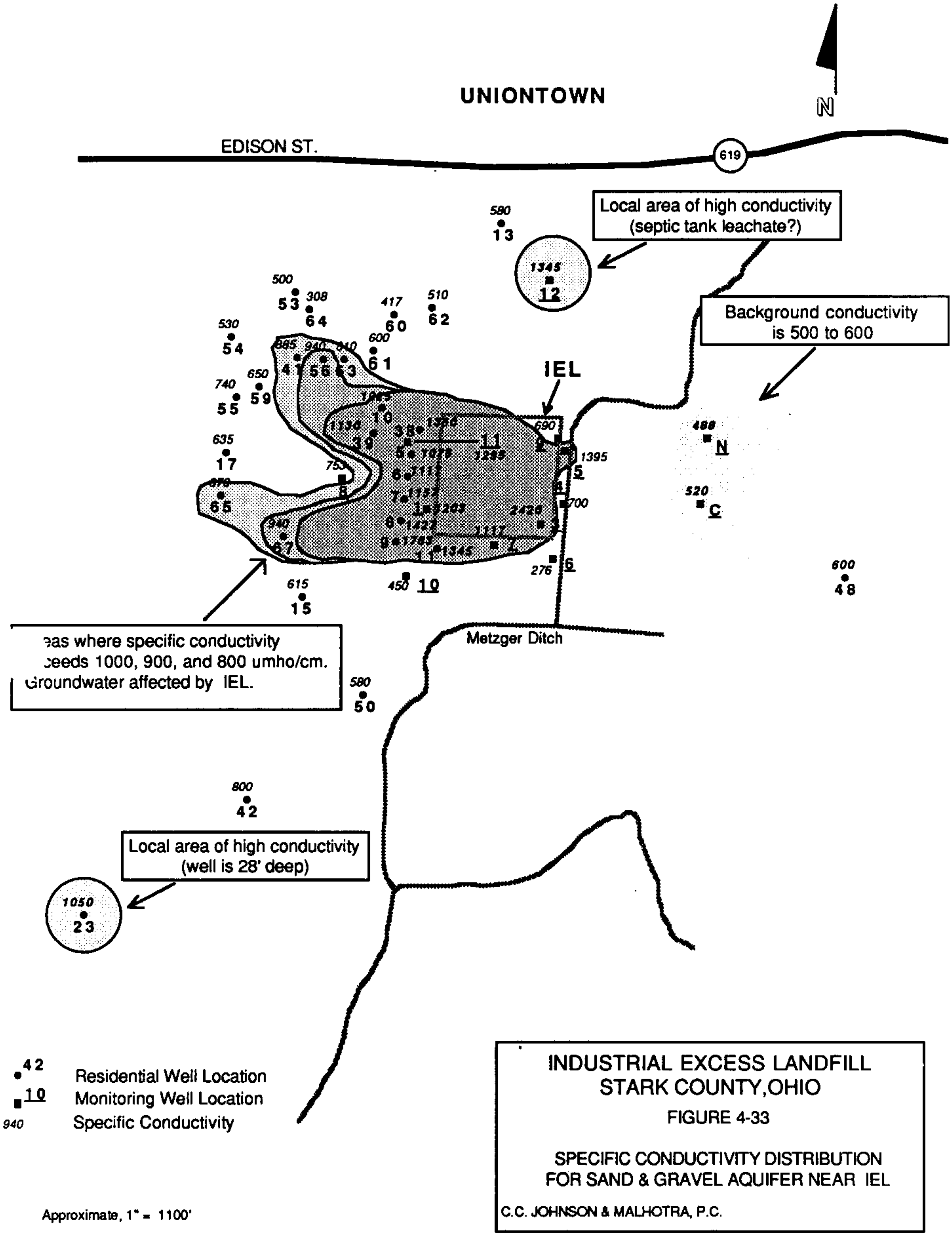
Scale Approximate, 1" = 1100'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-32B

METALS DISTRIBUTION IN RESIDENTIAL
WELLS OF UNKNOWN DEPTH

C.C. JOHNSON & MALHOTRA, P.C.



Local area of high conductivity (septic tank leachate?)

Background conductivity is 500 to 600

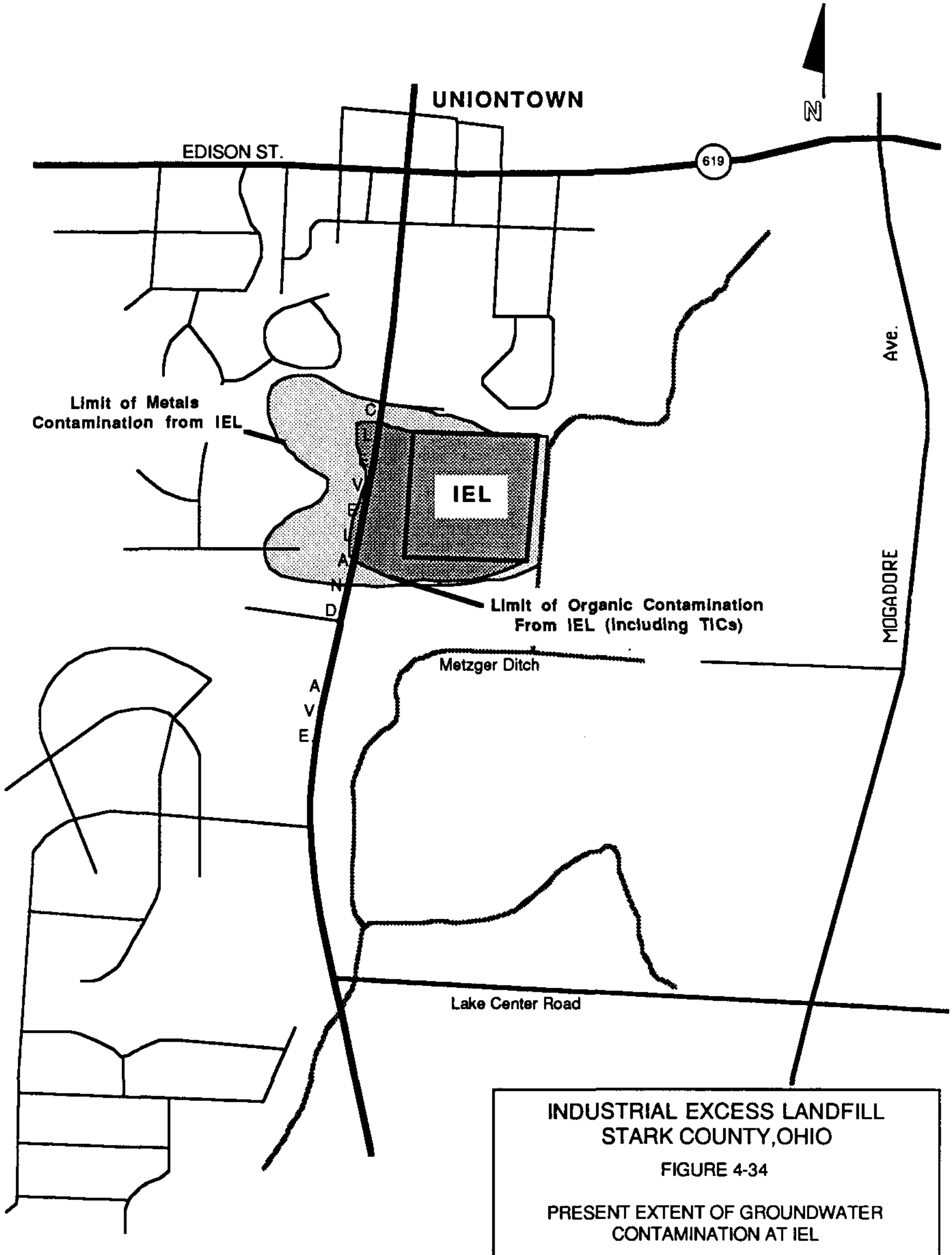
eas where specific conductivity
ceeds 1000, 900, and 800 umho/cm.
Groundwater affected by IEL.

Local area of high conductivity (well is 28' deep)

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 4-33

SPECIFIC CONDUCTIVITY DISTRIBUTION
FOR SAND & GRAVEL AQUIFER NEAR IEL

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 4-34

PRESENT EXTENT OF GROUNDWATER CONTAMINATION AT IEL

C.C. JOHNSON & MALHOTRA, P.C.

Scale Approximate, 1" = 1100'

4) The presence of elevated specific conductivity ("saline" waters).

All four of these criteria were applied to define the area of contamination shown in Figure 4-34. In the Uniontown area, one can find areas of higher-than-normal salinity (see Figure 4-33), or isolated cases of metals at higher than background levels (see Figure 4-31) or even anomalous occurrences of HSL organics (see Appendix G for the complete set of chemical data for residential wells). Furthermore, TICs are commonly reported for groundwater samples. But it is the combination of these four criteria that define the area of contamination shown in Figure 4-34.

In addition to groundwater quality criteria, surface water quality, discussed below in Section 5, was also taken into account for establishing the area of groundwater contamination shown in Figure 4-34. This was particularly true of the area immediately south of IEL where there are few residential or monitoring wells. In that area, the lack of surface water contamination in ponds and in Metzger Ditch, all of which appear to be intimately connected to the groundwater system, confirm that groundwater contamination does not exceed southward beyond the limit shown in Figure 4-34. See Section 5 for a full discussion of surface water sampling results.

The linkage of this contamination to the landfill is clear. The HSL organics, vinyl chloride, chloroethane, and tetrachloroethene are all found in various media on the landfill. The high levels of barium in monitoring wells on the site and in homes immediately to the west is another important link. Further evidence of contamination leaving the landfill via the westward flowing groundwater is found in the analyses for Tentatively Identified Compounds (TICs). TICs are found in nearly all residential well samples but a large number of these are attributable to sample and laboratory contamination. A second class of TICs are those that are unidentified or only identified to a broad class level (e.g. "hydrocarbon")

TABLE 4-31

TENTATIVELY IDENTIFIED COMPOUNDS COMMON TO BOTH MONITORING WELLS AND RESIDENTIAL WELLS

SAMPLES*	TENTATIVELY IDENTIFIED COMPOUNDS	RANGE (PPB)
MW	1,1'-OXYBISETHANE	10-42
RW	1,1'-OXYBISETHANE	4-22
MW	1,2-DIETHOXYETHANE	16
RW	1,2-DIETHOXYETHANE	2-31
MW	2-CYCLOHEXEN-1-OL	6-9
RW	2-CYCLOHEXEN-1-OL	1
MW	4-ACETYL-MORPHOLINE	9-11
RW	4-ACETYL-MORPHOLINE	2-7
MW	DIETHYL ESTER PHOSPHORIC ACID	36
RW	DIETHYL ESTER PHOSPHORIC ACID	3
MW	HEXADECANOIC ACID	14-24
RW	HEXADECANOIC ACID	4-7
MW	TETRAHYDROFURAN	8-18
RW	TETRAHYDROFURAN	3-10
MW	TETRAMETHYL UREA	28
RW	TETRAMETHYL UREA	1-3

* "MW" is Monitoring Well, "RW" is Residential Well

Residential wells containing these compounds are all found between the west edge of the landfill and Cleveland Avenue. The residential wells containing one to six of these compounds are RW05, RW06, RW07, RW08, RW09, RW11, and RW38.

and that are found more or less randomly distributed. These compounds may represent naturally occurring organics (e.g. carbohydrates, fatty acids, and humic substances: see Thurman, 1985) or may reflect local contaminant sources including septic tank leach fields. Although the source of this class of compounds is unknown, their distribution (both upgradient and downgradient of IEL) and chemical nature (not identifiable as industrial-related organic compounds) indicate that they do not derive from contamination at the IEL site. The third class of TICs are those that almost certainly originate from the landfill. All seven of the residential wells along the western boundary of the landfill (RW05, RW06, RW07, RW08, RW09, RW11, and RW38) contain tens of parts per billion of TICs such as tetrahydrofuran, 1,1'-oxybisethane tetramethyl urea, hexadecanoic acid, 1,2-diethoxyethane, and morpholine. These compounds are also tentatively identified in several monitoring wells on the landfill (Table 4-31). All of these compounds are solvents, reagents, or chemical feedstocks of the sort that were dumped at IEL. Their presence on the site and in residential wells to the west (down groundwater gradient) confirm movement of contamination from the landfill to private drinking supplies offsite. These landfill-derived TICs are only found immediately west of the site. TICs identified in other wells are not landfill-derived.

Based upon the evaluation of residential and monitoring well groundwater sample analyses (including TICs) and upon specific conductivity measurements, the following conclusions were drawn concerning the area of groundwater contamination shown in Figure 4-34:

1. Organic and inorganic contamination of the groundwater declines rapidly with increasing lateral distance from the landfill and with increasing depth below the surface of the water table.

2. Organic contamination declines much more rapidly with horizontal and vertical distance from the waste mass than does metals contamination (and specific conductivity).

Only very mobile volatiles (vinyl chloride, chloroethane, tetrachloroethene, 1,1'-oxybisethane) or soluble organics (tetrahydrofuran) are found relatively distant (>100 feet) from the waste mass. Organic contaminants are not detected more than 500 feet from the landfill.

3. Inorganic contaminants attenuate more slowly than organics but are near background levels within 1,000 feet downgradient of the landfill.

5.0 HYDROLOGICAL INVESTIGATION

Objectives of the hydrological and associated contamination investigations were:

A. To develop an understanding of the regional and local geology and hydrology, including the identification of surface water drainage patterns and their relationship to site topography and geology.

B. To develop an understanding of interrelationships among site geology, the local groundwater system, and the surface water system.

C. To evaluate potential modes of contaminant transport through the surface water system, including surface water and sediment sources and fate.

D. To provide quantitative data on site characteristics required to evaluate and potentially implement site specific remediation technologies and alternatives.

From August 1985 through February, 1988, the REM II on-site field investigations and sampling efforts were conducted to provide the data necessary to gain the above objectives. These on-site and near-site activities included site-area reconnaissance, study of potential surface water and sediment contamination migration pathways, and sediment, surface water, and leachate sampling. The results of these field investigations are discussed in the following sections of this report. Details of field procedures followed to obtain these data are given in the Sampling and Analysis Plan (SAP), which is Appendix B of the Quality Assurance Project Plan (QAPP), Document No. 157-WP1-OP-CUSS-1. Further discussion of the activities performed in connection with the IEL RI/FS are provided by the Work Plan, Document No. 157-WP1-WP-AZWY-4.

5.1 Surface Water Features

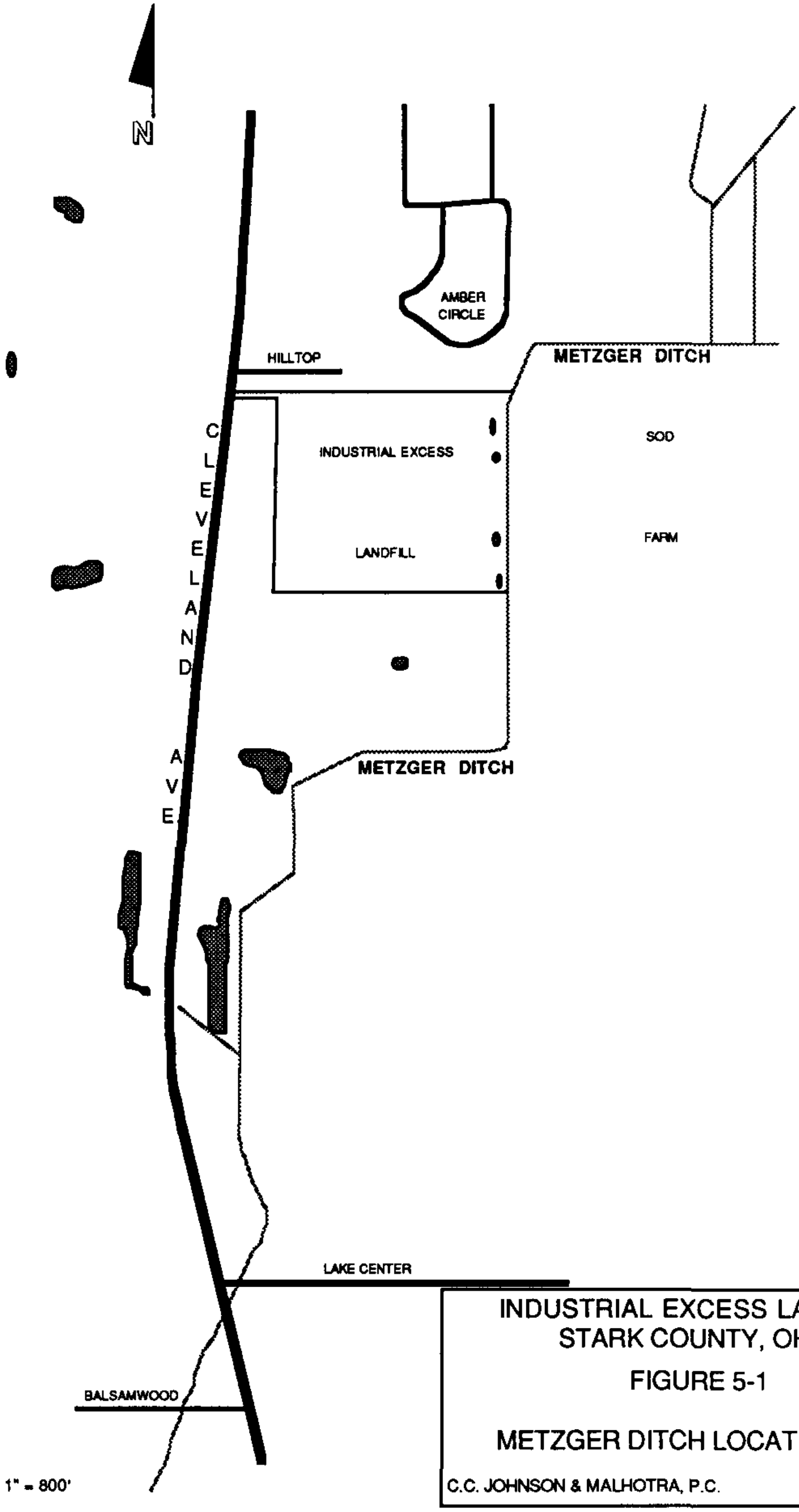
The Industrial Excess Landfill is located in an area of rolling terrain. Elevations range from almost 1220 feet above Mean Sea Level (M.S.L.) to about 1100 feet above M.S.L. in the site vicinity. Some of the lower-lying areas contain standing water which is a reflection of the water table. Other areas are somewhat marshy or consist of peat-type deposits with groundwater very near the surface.

Metzger Ditch (man-made) is the major surface water feature in the site area (See Figure 5-1). The ditch flows southward along the east boundary of the site. The flow continues generally southwest for approximately two and one-half miles until winding northward to meet the Tuscarawas River about two and one-half miles northwest of the site.

Along the eastern, low-lying portion of the site are four man-made ponds. The ponds always contain water, although the water level in the northernmost pond is quite minimal at times. Water in the ponds is a reflection of the groundwater table. Their origin is uncertain. Knowledgeable persons have suggested that they were possibly dug for leachate control, or the soil from the digging was used as fill material in the landfill. Location of the ponds is shown in Figure 5-2.

5.2 Site Drainage

Site drainage is generally to the east for the northern two-thirds of the site. The remaining area drains toward the south property line, where a low-lying, marshy area directs runoff to the east, toward Metzger Ditch. A number of shallow erosional gullies are located primarily along the east and south slopes, where relief is greatest. The on-site drainage pattern is shown in Figure 5-3.



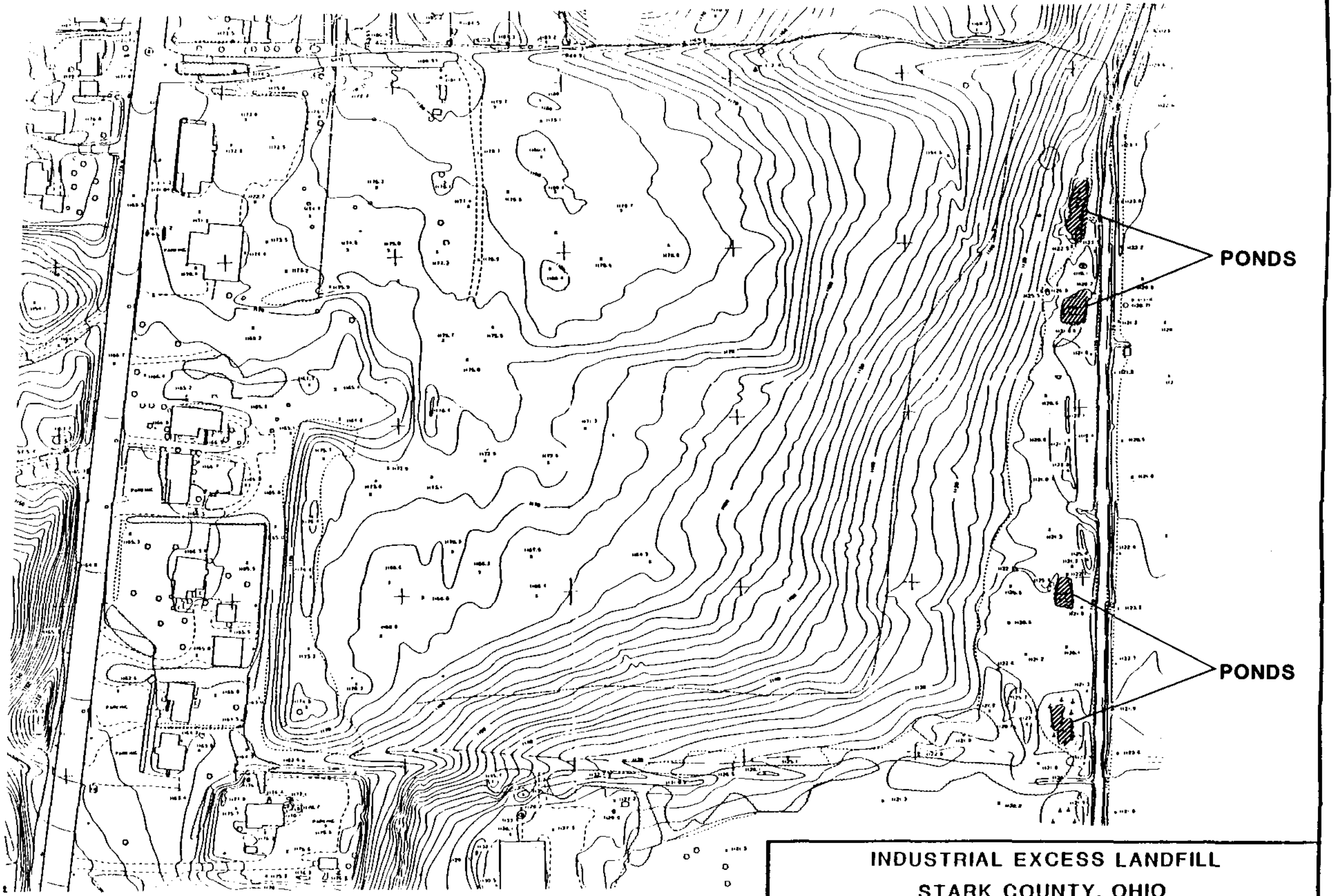
cale Approximate, 1" = 800'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 5-1

METZGER DITCH LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.

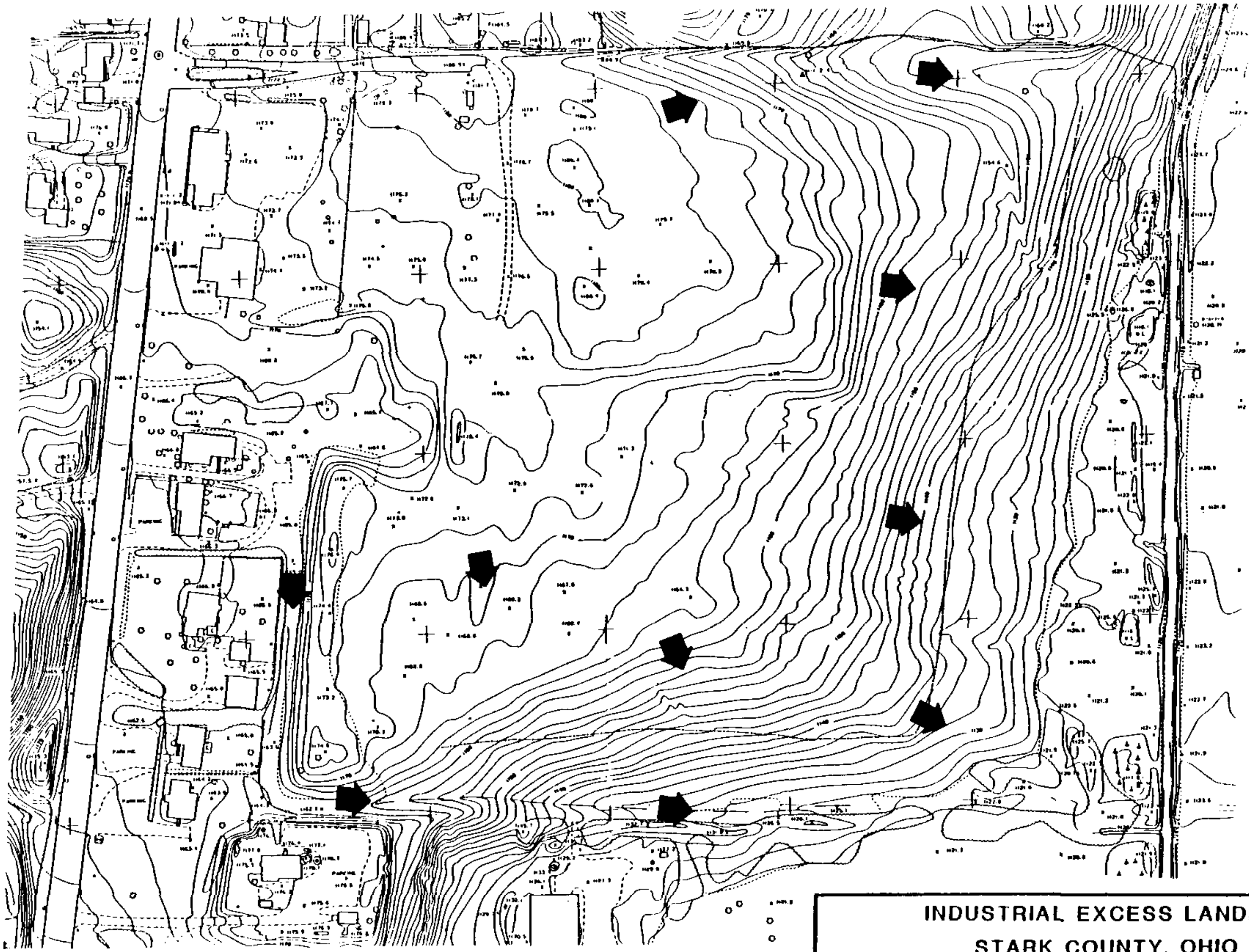


SCALE APPROXIMATE: 1" to 200'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-2

ON-SITE PONDS LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-3

SITE DRAINAGE MAP

C.C. JOHNSON & MALHOTRA, P.C.

SCALE APPROXIMATE: 1" to 200'

In the immediate site area, the main function of Metzger Ditch is to drain farmland to the east and northeast. Fields to the east are underlain by drainage tiles which lead directly to the ditch. The channel is maintained by the county, with the latest dredging taking place in 1976. At that time, dredging was performed for the entire 3.2 miles which lie in Stark County. Spoils were placed on the east side of the ditch for that portion adjacent to the site property.

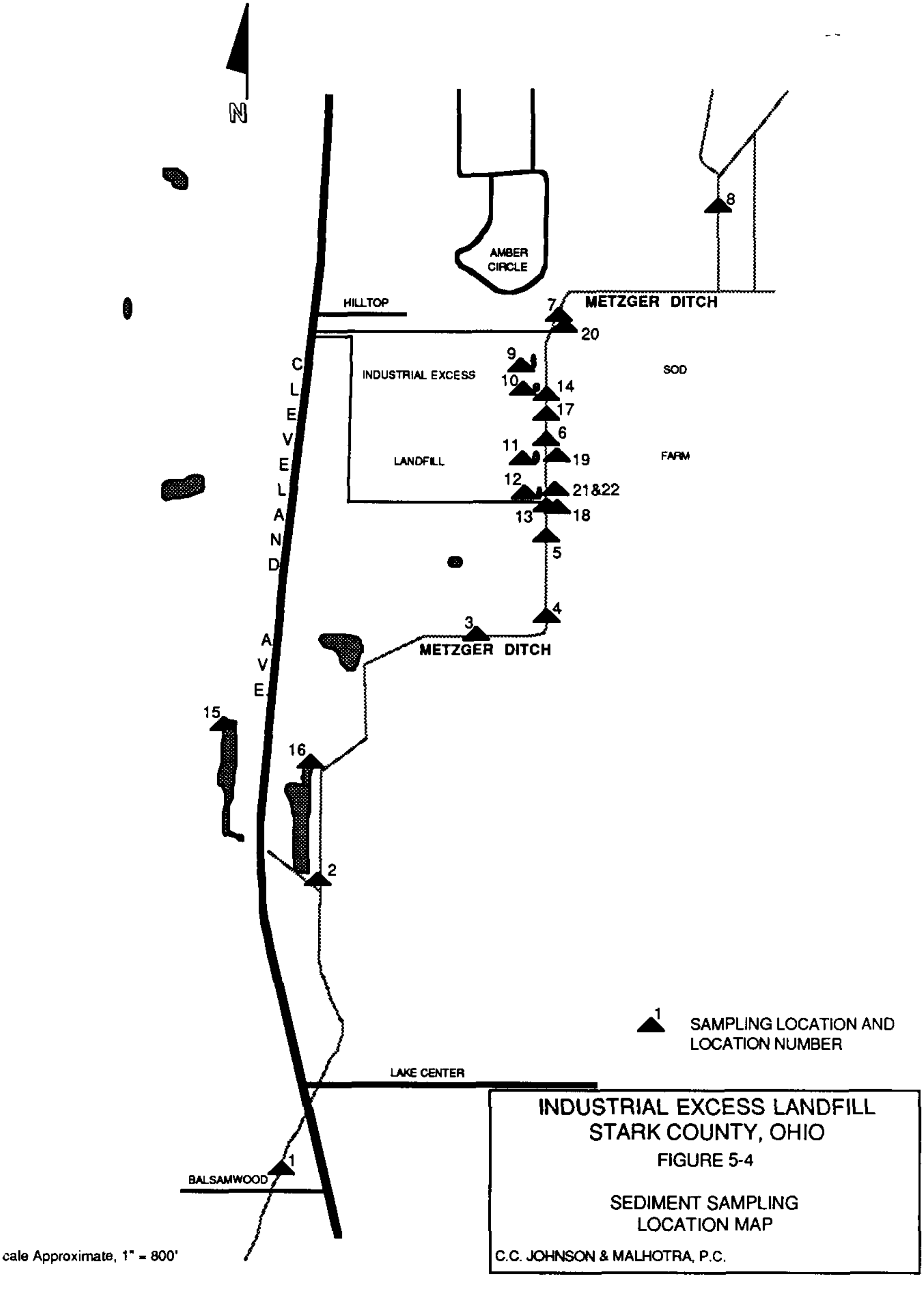
5.3 *Sediment Contamination Investigation*

Sediment samples at 17 different locations were collected during Phase I of the Remedial Investigation with five locations resampled during Phase II (Samples SD01, 05, 06, 07, and 08) (Figure 5-4). Samples were collected in the four on-site ponds, two off-site ponds, and Metzger Ditch. Both off-site ponds are hydraulically connected to the ditch. The pond to the west of Cleveland Avenue is connected by way of a small channel which drains into the ditch. The pond to the east of Cleveland Avenue is separated from the ditch by a bank of soil. However, muskrats have burrowed through the bank and have left a number of tunnels. These allow water to travel to or from the ditch depending upon the water level in the two bodies of water. Ditch samples included six locations downstream of the site, three samples adjacent to site property, and two samples upstream of the site.

As mentioned in Section 5.2, Metzger Ditch was dredged in 1976. To supplement the sediment samples described above, an additional five "soil" samples were taken by hand augering into the old spoils piles (former Metzger Ditch sediment) that had been heaped upon the east bank of the ditch. These samples (SDS018 through SDS022) are also discussed here.

5.3.1 Background Levels in Sediments

During the field investigations at IEL, three background sediment samples were collected and analyzed for HSL compounds (SD07, SD08 and SDS020). In



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-4

SEDIMENT SAMPLING
LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.

cale Approximate, 1" = 800'

addition, 7 surface soils and one background monitoring well subsurface soil were collected and analyzed. The background levels of persistent organics and metals found in these samples are summarized in Table 5-1. Due to the intimate relationship between natural soils and sediments, the total background levels found in both soils and sediments were used, with a few exceptions, to establish levels of contamination in sediments that may have been affected by contaminant migration from the landfill. The exceptions include the following:

- Although metals levels were comparable between background soils and sediments, cyanide was found at a substantially higher level in one sediment that contained it than in the one soil that contained it. These separate levels of cyanide were used in comparing background samples to potentially contaminated samples.
- Levels of total phthalates were consistently higher in sediments in comparison to soils. The soils background level for phthalates was only compared to other soils and the sediment phthalate level was compared to other sediments.
- None of the three background sediments contained detectable levels of polycyclic aromatic hydrocarbons (PAHs). Background level for PAHs in sediments is thus assumed to be zero.
- Background levels of metals in both soils and sediments are generally comparable (Appendix G). Exceptions are cadmium, mercury, selenium, and thallium which were detected at low levels in soils but were not detected in sediments. Thus, these metals are assumed to have a background level of zero in sediments.

5.3.2 Down-Gradient Sediments

Table 5-2 summarizes analytical data obtained from the 19 downgradient sediment samples collected during this investigation. A sample-by-sample listing of chemicals found in these sediments at levels at least 1.2 times

TABLE 5-1

BACKGROUND LEVELS OF ORGANIC AND INORGANIC COMPONENTS IN SOILS AND SEDIMENTS - IEL

Chemical	Range of Concentration Detected (ppm)	Frequency* of Detection
Bis(2-EthylHexyl)phthalate	.551 - 1.331	2/11
Butylbenzylphtalate	.012	1/11
Di-N-Butyl Phthalate	.110 - 2.344	4/11
Phthalates in Surface Soils	.012 - .290	4/7
Phthalates in Sediments	.551 - 2.344	3/3
(All Phthalates)	.012 - 2.344	7/11
Fluoranthene (soils only)	.093	1/11
Pyrene (soils only)	.110	1/11
(All PAH's) (soils only)	.203	1/11
4,4' - DDE	.048	1/11
4,4' - DDT	.220 - .290	2/11
Beta - BHC	.016	1/11
Endosulfan I	.010	1/11
(All Pesticides)	.220 - .364	2/11
Aluminum	2000 - 15,700	11/11
Arsenic	7 - 34	8/11
Barium	14 - 173	11/11
Beryllium	0.4 - 1.5	4/11
Cadmium (soils only)	2.4 - 5.2	4/11
Calcium	281 - 29,100	11/11
Chromium	3.4 - 23	9/11

*Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 5-1 (Continued)

BACKGROUND LEVELS OF ORGANIC AND INORGANIC COMPONENTS IN SOILS AND SEDIMENTS - IEL

Chemical	Range of Concentration Detected (ppm)	Frequency* of Detection
Cobalt	3.8 - 17	6/11
Copper	8 - 45	10/11
Cyanide	1 - 18	2/11
Iron	11,000 - 62,100	11/11
Lead	10 - 81	10/11
Magnesium	983 - 5820	11/11
Manganese	242 - 1540	10/11
Mercury (soils only)	0.07 - 0.2	2/11
Nickel	7.6 - 54	7/11
Potassium	265 - 1390	9/11
Selenium (soils only)	0.2	1/11
Sodium	74 - 3960	9/11
Thallium (soils only)	0.26 - 0.35	1/11
Vanadium	4.8 - 20	9/11
Zinc	33 - 309	11/11

*Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

TABLE 5-2

SUMMARY OF DOWNGRADIENT SEDIMENT SAMPLING RESULTS - IEL

Chemical Organics	Detected Range (ug/kg)	Frequency of Detection
2-Butanone	486	1/19
Toluene	9 - 620	6/19
4-Methylphenol	1,900	1/19
Benzo(A)Anthracene	54 - 63	1/19
Benzo(K)Fluoranthene	182	1/19
Benzoic Acid	430 - 910	2/19
Bis(2-Ethylhexyl) Phthalate	209 - 26,000	8/19
Butybenzylphthalate	44	1/19
Chrysene	59 - 198	2/19
Di-N-Butyl Phthalate	230 - 8,095	11/19
Fluoranthene	120 - 678	5/19
Phenanthrene	85 - 298	2/19
Pyrene	120 - 612	3/19
4,4-DDD	76	1/19
4,4-DDE	12 - 240	5/19
4,4-DDT	50 - 1,800	4/19
Beta-BHC	11 - 110	3/19
Endosulfan I	10	1/19
Heptachlor Epoxide	9	1/19

Chemical Metal	Detected Range (mg/kg)	Frequency of Detection
Aluminum	1,500 - 13,700	19/19
Arsenic	4.9 - 91	14/19
Barium	22 - 308	16/19
Beryllium	0.5 - 0.66	4/19
Cadmium	9.3	1/19
Calcium	4,560 - 176,000	18/19
Chromium (Total)	3.8 - 57	15/19
Cobalt	6 - 28	8/19
Copper (Total)	9.1 - 61	15/19
Cyanide (Total)	1	1/19
Iron	4,420 - 58,400	19/19
Lead (Total)	5.1 - 93	19/19
Magnesium	650 - 8,000	18/19
Manganese	65 - 1,760	19/19
Mercury	0.3 - 0.3	2/19
Nickel	4.9 - 65	16/19
Potassium	184 - 1,230	8/19
Silver	3.2 - 11	4/19
Sodium	217 - 5,630	15/19
Tin	39 - 200	4/19
Vanadium	3.8 - 28	13/19
Zinc	16 - 277	19/19

background (as described in Section 5.3.1) is found in Table 5-3. Again, as was described in previous discussions concerning soils and groundwater, this does not mean that the chemicals or ions that exceed 1.2 times the maximum background level are attributable to contamination from IEL. This factor was only used to narrow down the range of samples included in the evaluation of potential contamination patterns that might include IEL as a source of contamination. Beyond this "1.2X" factor, the listing in Table 5-3 also shows samples that exceed maximum background levels for a particular component by factors of at least 3X and at least 5X. Chemicals or ions that were not detected at all in background samples for a given medium (as discussed in Section 5.3.1 above) automatically are assigned a "5X" factor of exceeding background. For example, toluene was detected at 238 ppb in sediment sample SD05. No sediment samples were found to contain any volatile organics, so this detection is automatically flagged as "5X" background. For samples and components for which background levels are available, samples containing 1.2X to 2.999..X background are flagged as "1.2X" samples containing 3.0 to 4.999...X flagged as "3X", and those exceeding 5X are so flagged.

The data suggest low-level contamination of sediments in Metzger Ditch near the landfill. The contaminants include benzoic acid and 4-methylphenol (Figure 5-5), elevated levels of a few metals (including silver and tin, Figure 5-6) and, equivocally, elevated phthalate levels (Figure 5-7). (The phthalate correlation is confused by the occurrence of a high phthalate level at sample SD02, well downstream of IEL and with no other elevated phthalate sample between it and the site [Figure 5-7]).

The distribution of the remaining contaminants (PAHs, volatiles, and pesticides) does not display a pattern which would indicate the landfill as a source. The one sample with above background levels of pesticides (SDS021) is located near the farmland to the east of the site (Figure 5-8). These

TABLE 5-3

SEDIMENT SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
SD01	Benzo(A)Anthracene	54-63		5X
	Chrysene	59-82		5X
	Fluoranthene	128-220		5X
	Phenanthrene	85-120		5X
	Pyrene	120		5X
SD02	Bis(2-Ethylhexyl) Phthalate	13,115		5X
	Di-N-Butyl Phthalate	2,131		5X
	Chromium (Total)		57	1.2X
	Sodium		5,630	1.2X
SD03	Benzo(K)Fluoranthene	182		5X
	Chrysene	198		5X
	Fluoranthene	678		5X
	Phenanthrene	298		5X
	Pyrene	612		5X
SD04	2-Butanone	486		5X
	Barium		256	1.2X
	Calcium		176,000	5X
	Silver (Total)		11	3X
	Sodium		5,350	1.2X
SD05	Toluene	238		5X
	Bis(2-Ethylhexyl) Phthalate	2,524		1.2X
	Di-N-Butyl Phthalate	1,048		1.2X
SD06	Bis(2-Ethylhexyl) Phthalate	640-26,000		1.2-5X
	Di-N-Butyl Phthalate	387		1.2X
	Fluoranthene	210		5X
	Pyrene	160		5X
SD09	Calcium		95,900	3X
	Magnesium		8,000	1.2X
	Silver (Total)		4.3	1.2X
SD10	Toluene	15		5X
	Bis(2-Ethylhexyl) Phthalate	2,370		1.2X
	Di-N-Butyl Phthalate	1,117		1.2X
	Copper (Total)		61	1.2X
	Magnesium		7,160	1.2X
	Vanadium		29	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

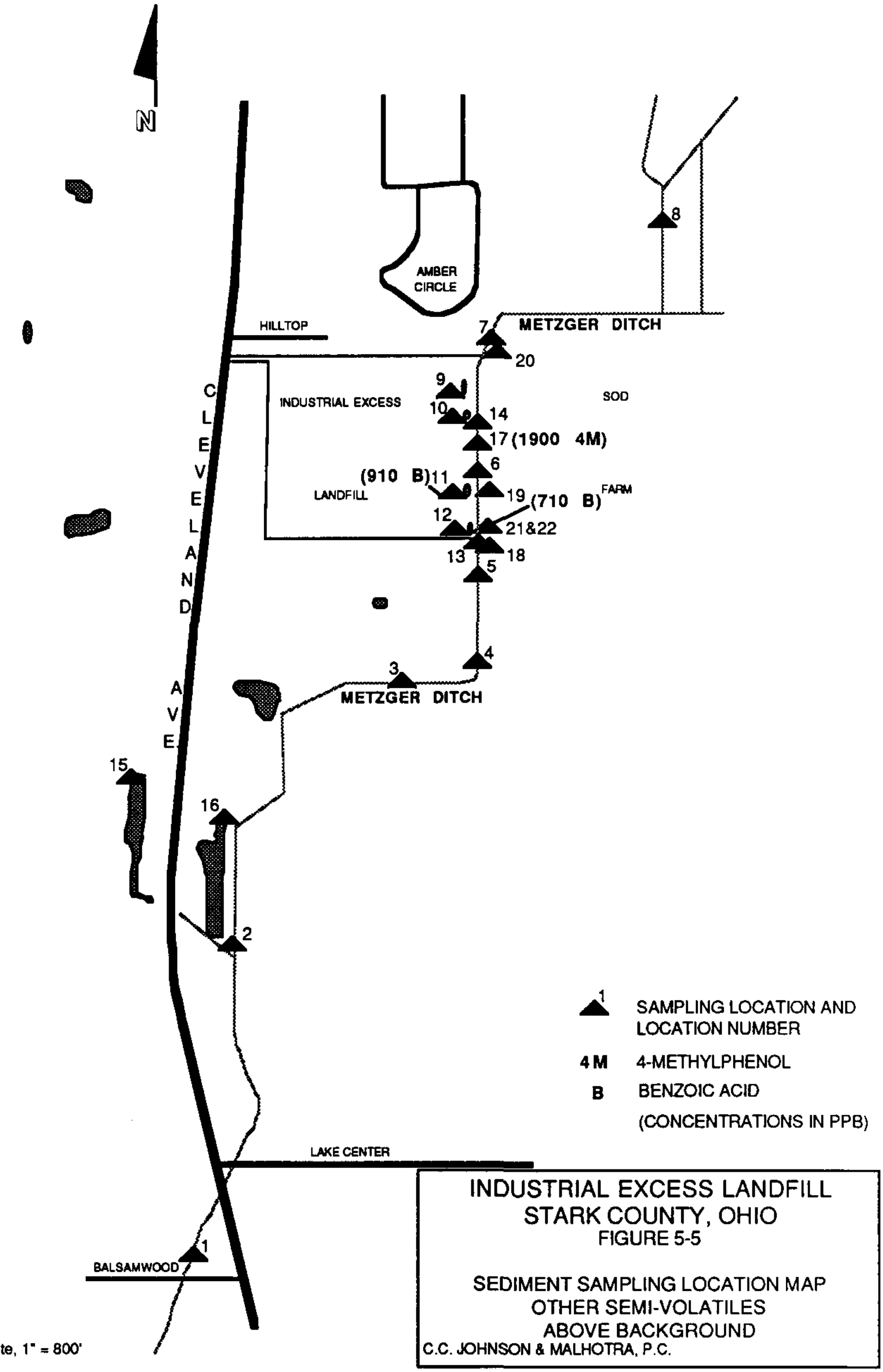
TABLE 5-3 (Continued)

SEDIMENT SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
SD11	Benzoic Acid	430-910		5X
	Calcium		59,100-65,900	1.2X
	Mercury (Total)		0.3	1.2X
	Tin		44-63	5X
SD12	Calcium		53,300	1.2X
	Magnesium		7,500	1.2X
	Tin		39	5X
SD13	Benzoic Acid	710		5X
	Fluoranthene	120		5X
	Barium		308	1.2X
	Cadmium		9.3	1.2X
	Calcium		42,000	1.2X
	Chromium (Total)		36	1.2X
	Cobalt		28	1.2X
	Tin		180	5X
SD14	Tin		200	5X
SD15	Toluene	620		5X
SD16	Toluene	200		5X
	Barium		211	1.2X
	Calcium		135,000	3X
SD17	4-Methylphenol	1,900		5X
SDS018	Toluene	64		5X
	Di-N-Butyl Phthalate	6,200		1.2X
	Arsenic (Total)		91	1.2X
SDS019	Toluene	9		5X
SDS021	4,4-DDE	240		5X
	4,4-DDT	1,800		5X
	Beta-BHC	28		5X
	Fluoranthene	163		5X
	Heptachlor Epoxide	9		5X
SDS022	Di-N-Butyl Phthalate	8,095		3X
	Mercury (Total)		0.3	1.2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

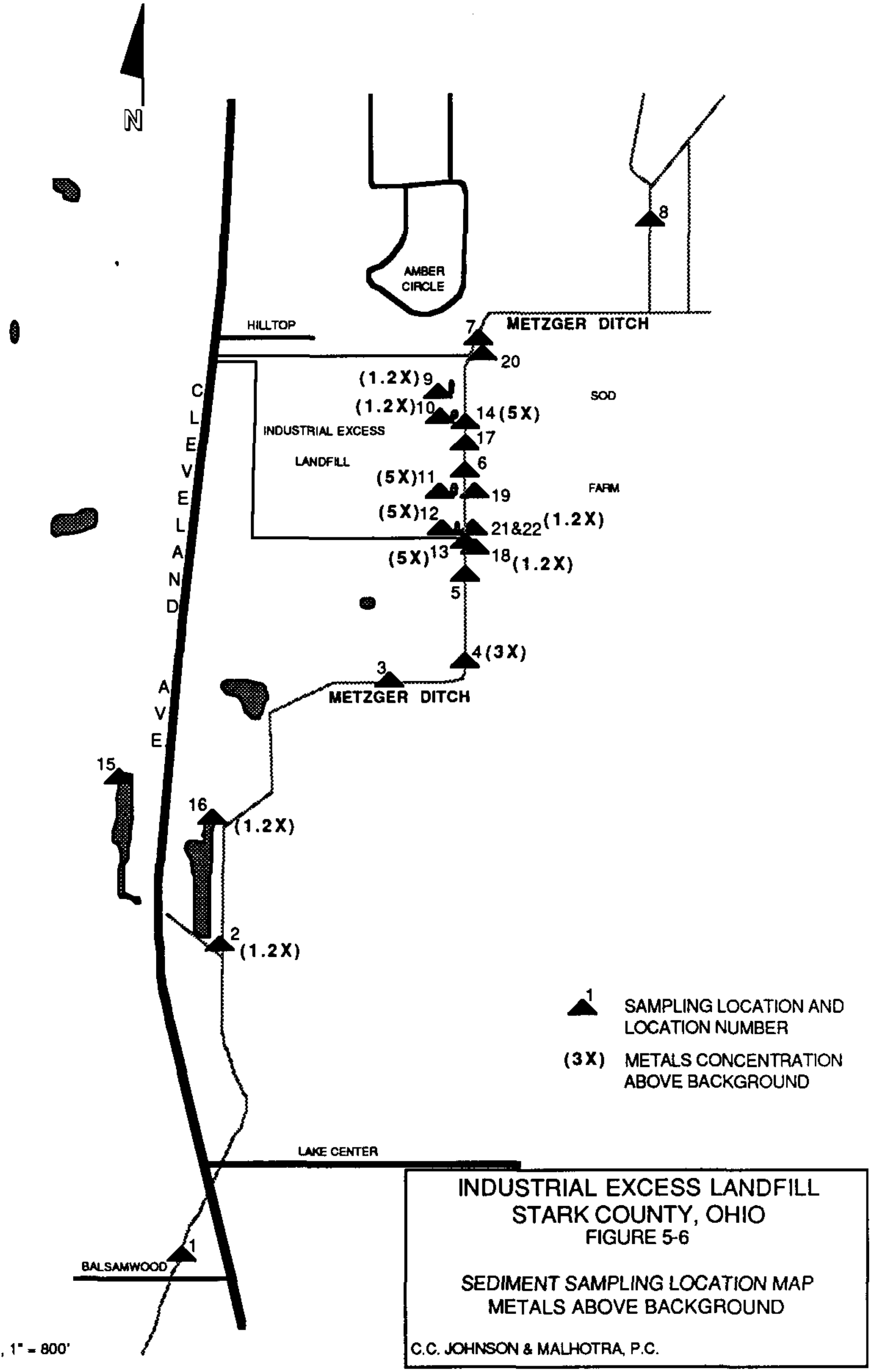


Scale Approximate, 1" = 800'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-5

SEDIMENT SAMPLING LOCATION MAP
OTHER SEMI-VOLATILES
ABOVE BACKGROUND

C.C. JOHNSON & MALHOTRA, P.C.

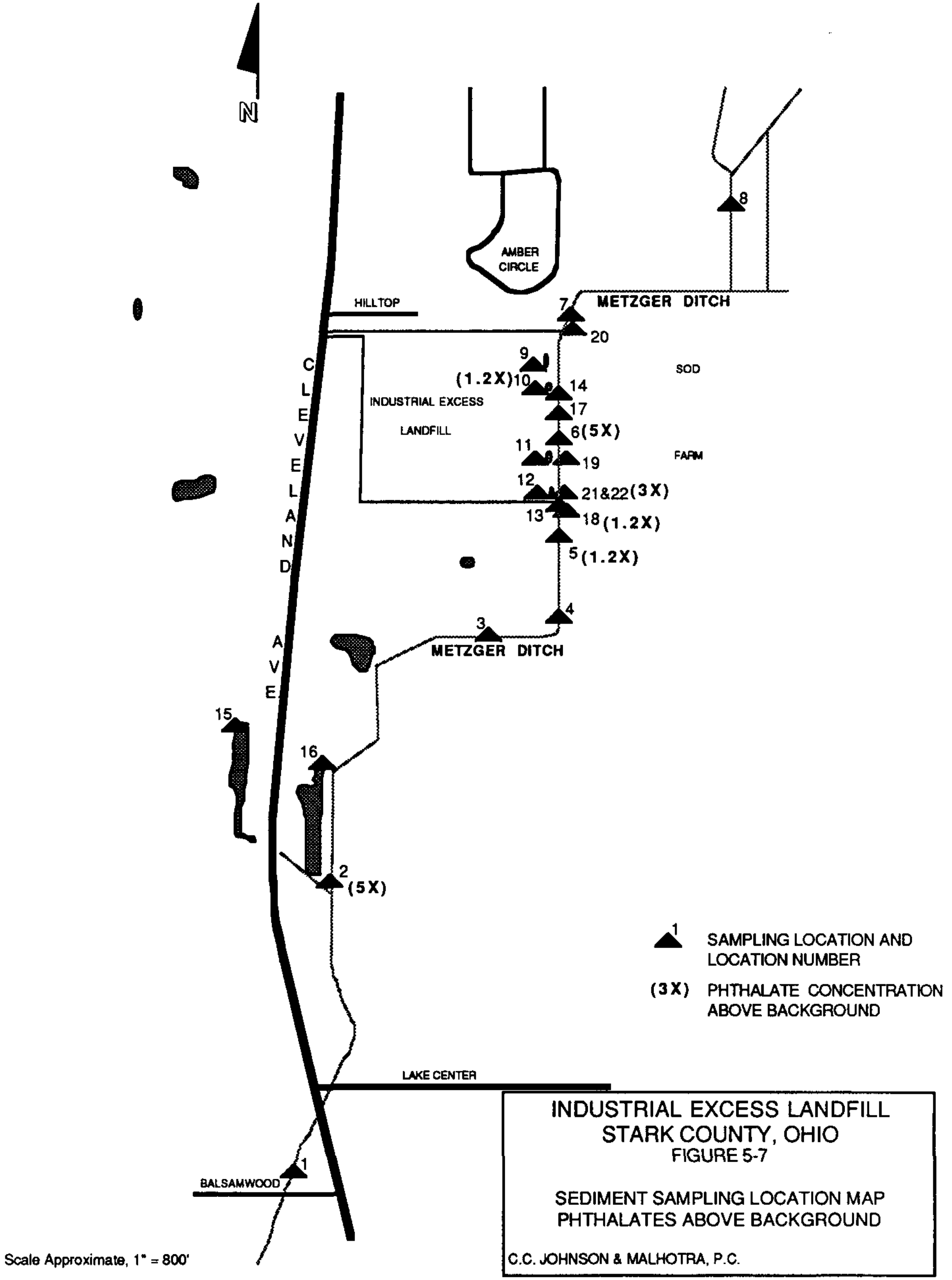


Scale Approximate, 1" = 800'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-6

SEDIMENT SAMPLING LOCATION MAP
METALS ABOVE BACKGROUND

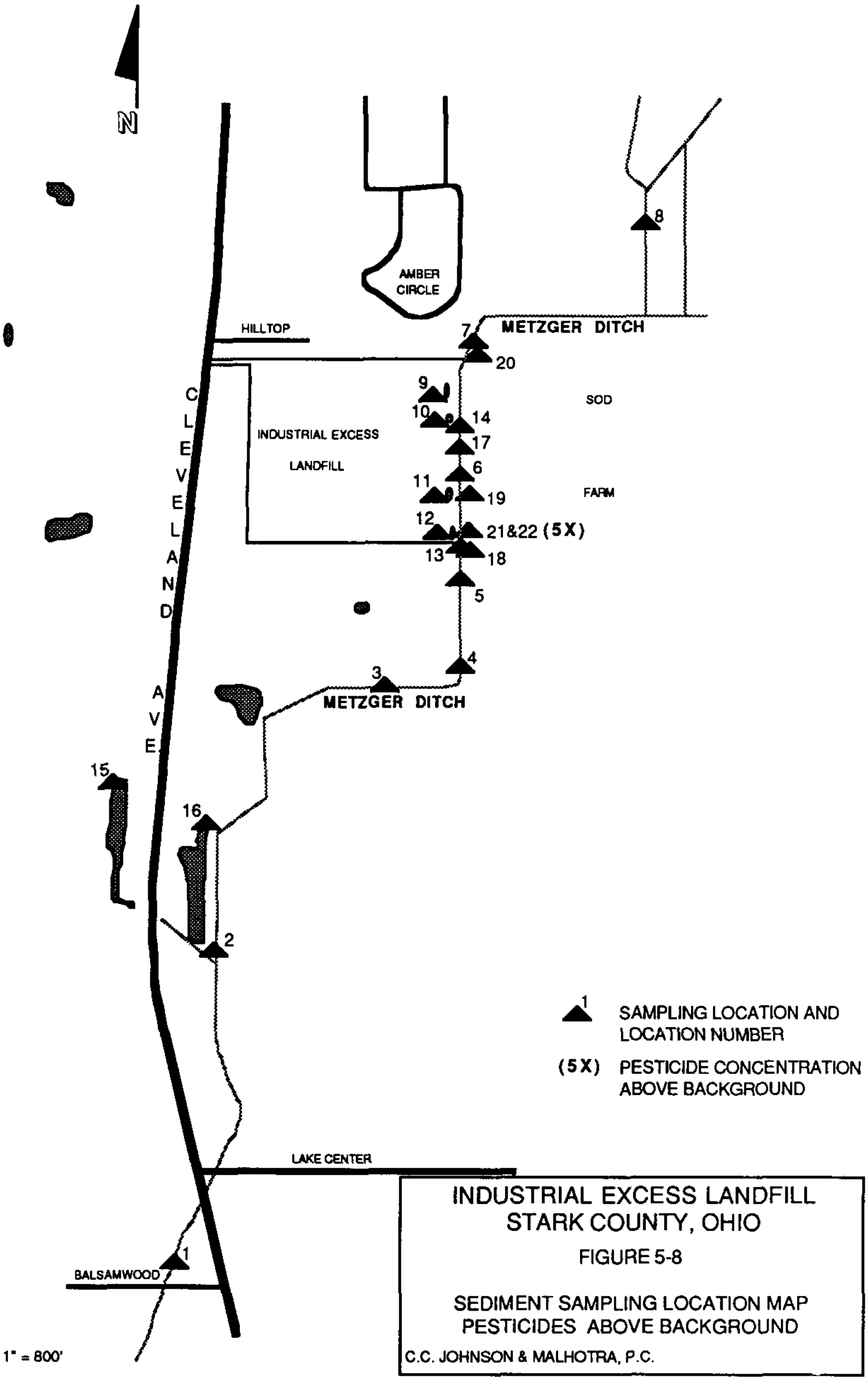
C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-7

SEDIMENT SAMPLING LOCATION MAP
PHTHALATES ABOVE BACKGROUND

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 5-8

SEDIMENT SAMPLING LOCATION MAP
PESTICIDES ABOVE BACKGROUND

C.C. JOHNSON & MALHOTRA, P.C.

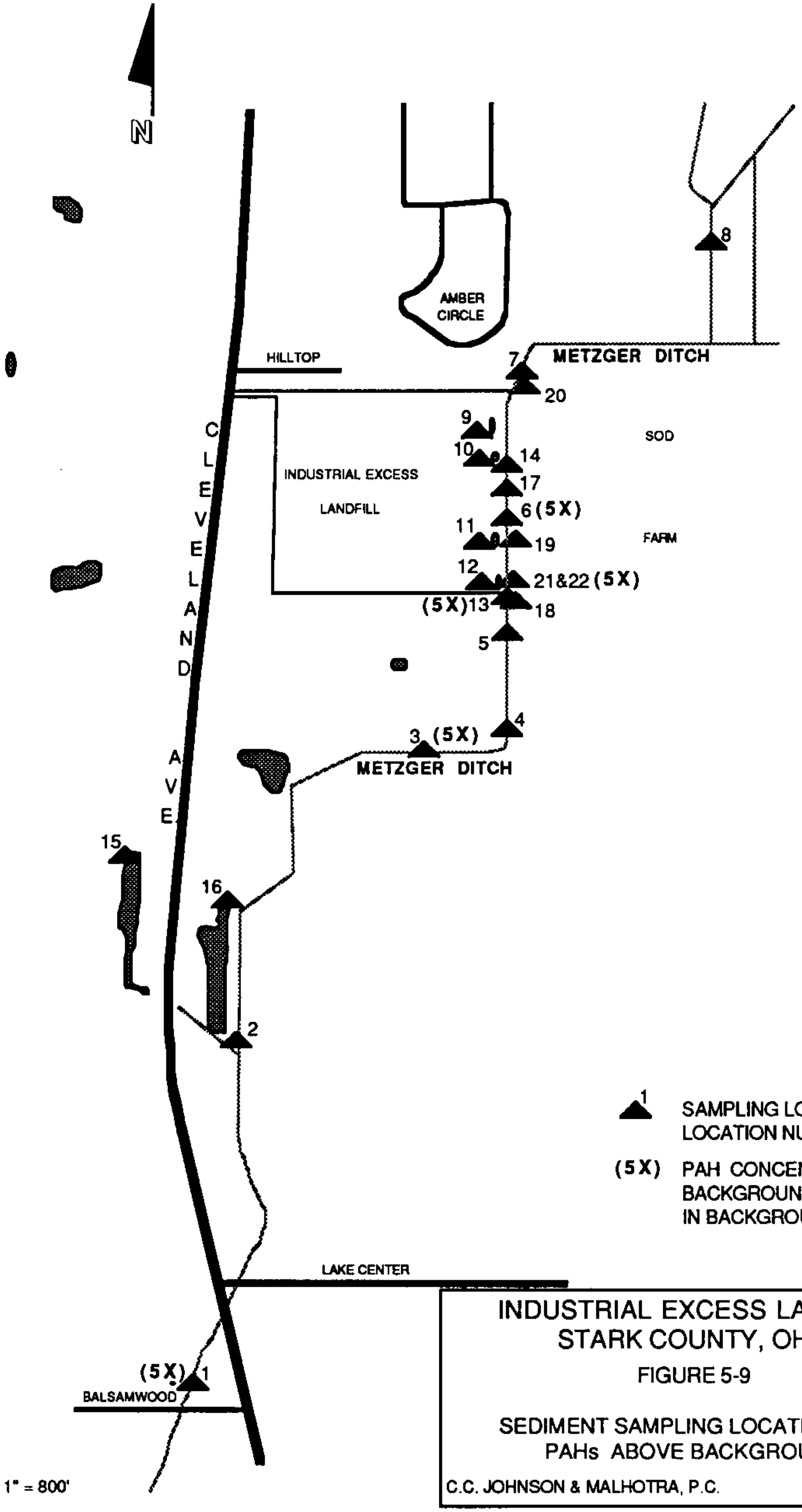
Scale Approximate, 1" = 800'

pesticides probably represent residues from material applied for agricultural purposes. The PAHs detected in far downstream samples SD03 and SD01 (Figure 5-9 and Table 5-3) are at higher levels than found adjacent to the site. This suggests that background data for PAHs in soils and sediments in the IEL area may be incomplete and/or indicates the existence of another contamination source. The detected volatiles include 2-butanone (MEK, sample SD04, 486 ppb) and toluene (samples SD05, SD15, SD16, SDS018, and SDS019, 0 to 620 ppb) (Figure 5-10). In light of the known dumping of these common industrial and commercial chemicals at IEL, these hits appear reasonable. However, associated surface water samples (discussed below in Section 5.4.1) contain neither toluene nor MEK. Moreover, the two highest concentrations of toluene are found in samples SD15 and SD16 which are furthest from the site (about 1/4 mile) and in pond sediment only indirectly linked to drainage from IEL (see prior discussion of surface water features). Therefore, the low-level VOC contamination of sediments near IEL is questionable.

5.4 Surface Water Contamination Investigation

A total of seventeen surface water samples were collected during Phase I activities. Of these seventeen, four samples were collected from on-site ponds, six samples from off-site ponds (two of the ponds were sampled twice using different location numbers for each sample) and eight samples from Metzger Ditch. Five samples were collected in the ditch downstream of the site, one adjacent to the site and two upgradient of the site (Figure 5-11).

In Phase II, an additional four off-site pond locations were sampled and a dug well/spring that feeds one of these ponds was also sampled. All four on-site ponds were resampled, and six ditch locations were resampled. Of these six ditch locations, three were downstream, one was adjacent, and two were upstream of the landfill (Figure 5-11).



Scale Approximate, 1" = 800'

▲1 SAMPLING LOCATION AND LOCATION NUMBER

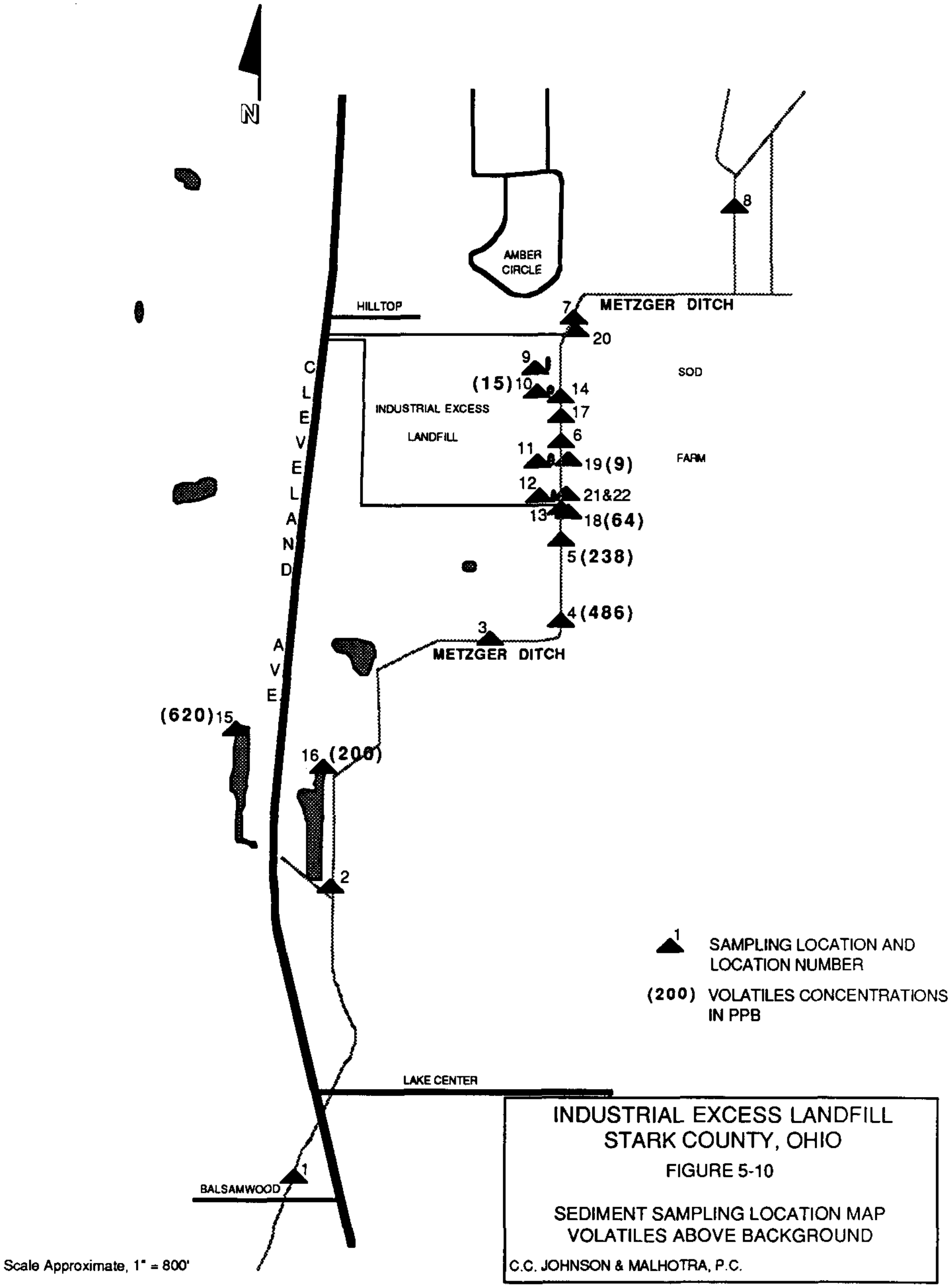
(5X) PAH CONCENTRATION ABOVE BACKGROUND (NO PAHs FOUND IN BACKGROUND SEDIMENTS)

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 5-9

SEDIMENT SAMPLING LOCATION MAP
PAHs ABOVE BACKGROUND

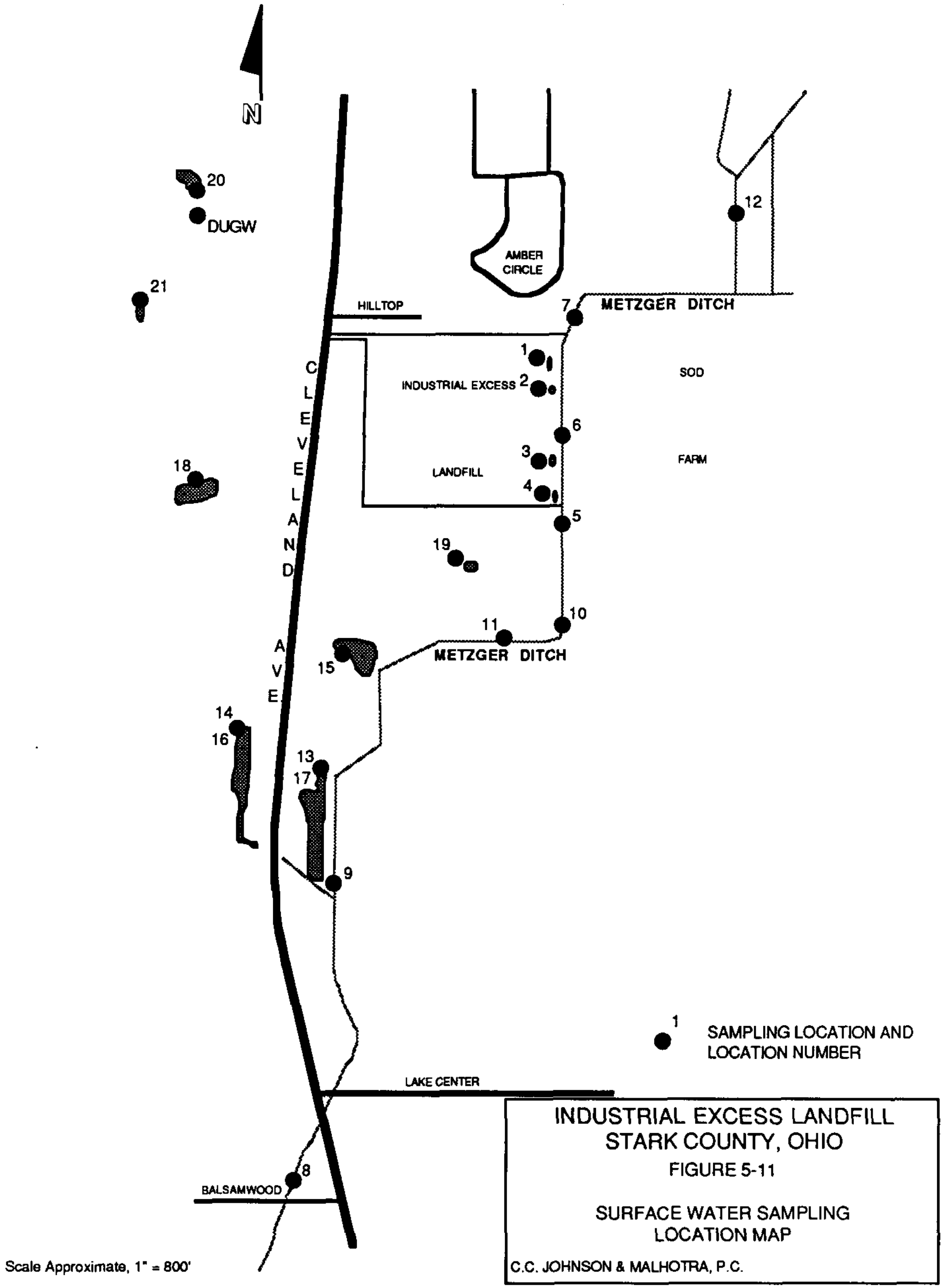
C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-10

SEDIMENT SAMPLING LOCATION MAP
VOLATILES ABOVE BACKGROUND

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-11

SURFACE WATER SAMPLING
LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.

All of the surface water samples were analyzed for HSL inorganic ions and HSL organic compounds. Data from samples that may be affected by contamination from the site are summarized in the following paragraphs and compared to respective levels found in background water samples.

5.4.1 Background Surface Water Samples

Analytical data from background surface water samples are summarized in Table 5-4. Only metals data are shown, as no HSL organics were detected in background samples. These data are here used to evaluate the impact of the Industrial Excess Landfill upon area surface water resources.

5.4.2 Surface Water Down-Gradient of IEL

Table 5-5 presents a summary of all analytical data from surface water samples collected downgradient of IEL. Table 5-6 is a sample-by-sample listing of chemicals detected in these samples at levels at least 1.2 times background. Again, as was described in previous discussions concerning soils, groundwater, and sediments, this does not mean that the chemicals or ions that exceed 1.2 times the maximum background level are attributable to contamination from IEL. This factor was only used to narrow down the range of samples included in the evaluation of potential contamination patterns that might include IEL as a source of contamination. Beyond this "1.2X" factor, the listing in Table 5.6 also shows samples that exceed maximum background levels for a particular component by factors of at least 2X and at least 3X. Chemicals or ions that were not detected at all in background water samples (as illustrated in Section 5.4.1 above) automatically are flagged with a "3X" factor of exceeding background (for metals) or a "5X" factor (for organics). For example, bis(2-ethylhexyl) phthalate was detected at 4 ppb and nickel was detected at 13 ppb in surface water sample SW01. No background surface waters were found to contain any organics and none contained detectable amounts of nickel, so the bis(2-ethylhexyl) phthalate detection is automatically flagged as "5X"

TABLE 5-4

BACKGROUND LEVELS OF INORGANIC COMPONENTS IN SURFACE WATER - IEL

Chemical	Range of Concentration Detected (ppb)	Frequency* of Detection
Aluminum	63 - 310	2/2
Arsenic	2.4	1/2
Barium	66 - 70	2/2
Calcium	94,800 - 114,000	2/2
Iron	1150 - 3240	2/2
Magnesium	18,800 - 25,300	2/2
Manganese	152 - 320	2/2
Potassium	3510	1/2
Sodium	25,800 - 51,900	2/2

* Frequency of detection is the number of samples in which the chemical was detected over the total number of sample locations.

TABLE 5-5

SUMMARY OF SURFACE WATER SAMPLING RESULTS - IEL

Chemical Organics	Detected Range (ug/kg)	Frequency of Detection
4-Methylphenol	4.9	1/20
Benzoic Acid	27	1/20
Bis(2-Ethylhexyl) Phthalate	2.1 - 4	4/20

Chemical Metal	Detected Range (ug/kg)	Frequency of Detection
Aluminum	26 - 636	15/20
Antimony	41 - 225	2/20
Arsenic	5.5 - 51	3/20
Barium	35 - 8,130	20/20
Cadmium	49	1/20
Calcium	11,100 - 302,000	20/20
Chromium	6.1 - 42	2/20
Cobalt	5 - 62	2/20
Copper	10 - 89	4/20
Cyanide	11	1/20
Iron	126 - 820,000	19/20
Lead	2.7 - 68	3/20
Magnesium	1,540 - 69,900	19/20
Manganese	32 - 2,790	19/20
Nickel	12 - 67	4/20
Potassium	606 - 98,600	15/20
Selenium	0.8	1/20
Silver	20 - 65	2/20
Sodium	4,290 - 407,400	18/20
Tin	18	1/20
Vanadium	2.3 - 63	3/20
Zinc	2 - 279	8/20

TABLE 5-6

SURFACE WATER SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration		Level Above Background*
		(ppb)	(ppm)	
SW01	Bis(2-Ethylhexyl) Phthalate	4		5X
	Aluminum	442-2,890		1.2-3X
	Arsenic (Total)	8.6		3X
	Barium	237-470		3X
	Calcium	187,900		1.2X
	Chromium (Total)	6.1		3X
	Iron	16,900-46,300		3X
	Magnesium	35,700-37,200		1.2X
	Manganese	1,070-2,550		3X
	Nickel (Total)	13		3X
	Sodium	95,800-101,000		1.2X
	Potassium	15,700-23,600		3X
	Vanadium	4.3		3X
	Zinc (Total)	29		3X
SW02	Bis(2-Ethylhexyl) Phthalate	3		5X
	Barium	140		2X
	Iron	5,450		1.2X
	Manganese	2,790		3X
	Potassium	7,000-8,160		1.2X
SW03	Bis(2-Ethylhexyl) Phthalate	3		5X
	Barium	723-830		3X
	Calcium	162,800-171,800		1.2X
	Iron	4,130		1.2X
	Magnesium	38,900-42,900		1.2X
	Manganese	422		1.2X
	Potassium	11,600-13,200		3X
	Sodium	86,900-89,700		1.2X
SW04	4-Methylphenol	4.9		5X
	Bis(2-Ethylhexyl) Phthalate	2.1-4		5X
	Aluminum	5,500-6,360		3X
	Antimony (Total)	225		3X
	Arsenic (Total)	34-51		3X
	Barium	320-8,130		3X
	Cadmium (Total)	39-49		3X
	Calcium	173,800-302,000		1.2-2X
	Chromium (Total)	35-42		3X
	Cobalt	59-62		3X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 5-6 (Continued)

SURFACE WATER SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	(ppm)	Level Above Background*
SW04 (Cont'd.)	Copper (Total)	88-89		3X
	Iron	42,200-820,000		3X
	Lead (Total)	14-33		3X
	Magnesium	52,000-69,900		2X
	Manganese	946-1,750		2-3X
	Nickel (Total)	36-67		3X
	Potassium	14,800-98,600		3X
	Silver (Total)	59-65		3X
	Sodium	106,000-407,400		2X-3X
	Vanadium	59-63		3X
	Zinc (Total)	70-279		3X
SW05	Barium	80-90		1.2X
SW08	Barium	105-110		1.2X
SW09	Barium	100		1.2X
SW10	Barium	93-94		1.2X
	Cobalt	5		3X
	Copper (Total)	25		3X
	Nickel (Total)	12		3X
	Zinc (Total)	21		3X
SW13	Barium	85		1.2X
	Cyanide (Total)	11		3X
SW14	Tin	18		3X
SW17	Zinc (Total)	86		3X
SW18	Benzoic Acid	27		5X
	Aluminum	3,520		3X
	Barium	190		2X
	Copper (Total)	26		3X
	Iron	8,160		2X
	Lead (Total)	68		3X
	Manganese	1,000		2X
	Silver (Total)	20		3X
	Zinc (Total)	104		3X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 5-6 (Continued)

SURFACE WATER SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
SW19	Antimony (Total)	41		3X
	Arsenic (Total)	5.5		2X
	Copper (Total)	10		3X
	Lead (Total)	2.7		3X
	Selenium (Total)	0.8		3X
	Vanadium	2.3		3X
	Zinc (Total)	8.2		3X
SW20	Sodium	92200		1.2X
SW21	Barium	103		1.2X
	Manganese	535		1.2X
	Nickel (Total)	17		3X
	Zinc (Total)	96		3X
SWDUGW	Aluminum	470-501		1.2X
	Iron	6,440		1.2X
	Manganese	701		1.2X
	Zinc (Total)	49-61		3X

---

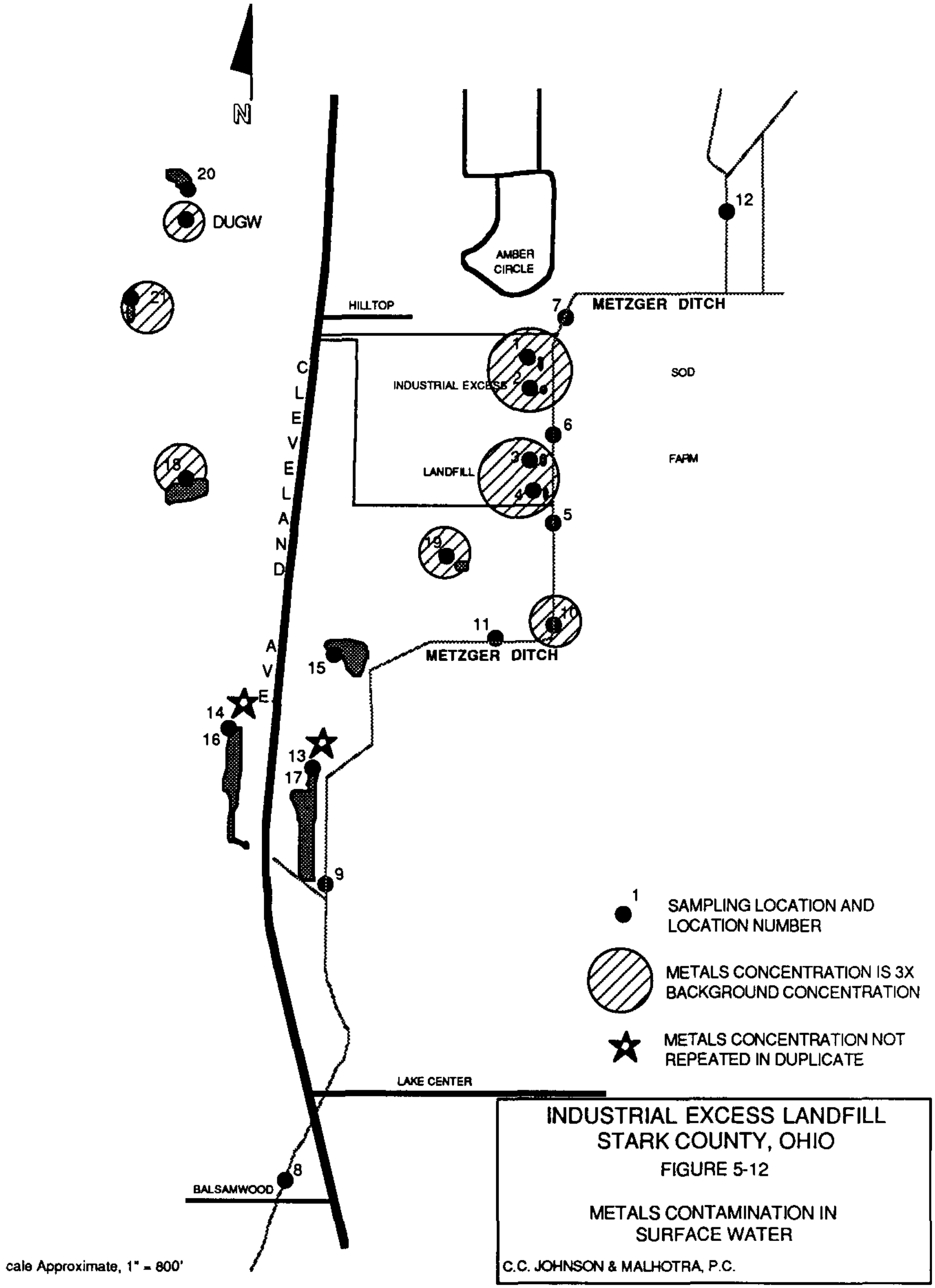
*The concentrations listed are above the background concentration by at least the factor shown.

background and the nickel is automatically flagged as "3X" background. For components for which background levels are available, samples containing 1.2X to 1.999...X background are flagged as "1.2X", samples containing 2.0 to 2.999...X are flagged as "2X", and those exceeding 3X are so flagged.

These data indicate relatively high levels of contamination of the water found in the four on-site ponds (Figure 5-12). The contamination primarily consists of elevated levels of metals. In addition, each pond contains small amounts of bis(2-ethylhexyl)phthalate. The pond at the southeast corner of the site has the highest level of metals contamination and, in addition to containing phthalate, also contains a low level of 4-methylphenol.

Slightly elevated levels of metals in a pond immediately south of the site (SW19, Figure 5-12) and a sample from the ditch down stream from the site (SW10) suggest that low level metals contamination from the landfill may have occurred.

Two ponds directly west of the landfill (SW18 and SW21, Figure 5-12) and the dug well/spring (SWDU6W, Figure 5-12) have elevated levels of some metals (Table 5-6). In addition, sample SW18 had a low concentration of the organic, benzoic acid. These ponds are not connected to the landfill area by surface runoff but are in the area where some groundwater discharge originating from the east can take place (See Section 4.2.5). However, benzoic acid was not detected in monitoring wells or residential wells on the west side of the landfill. Moreover, benzoic acid is a naturally occurring organic found in plant material, including most berries. The small amount detected in sample SW18 is probably naturally occurring. The above background metals in these three samples may indicate very low level groundwater contamination, or they may indicate that background data for surface water is incomplete. In either case, the metals detected in these surface waters are generally at very low levels.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO
FIGURE 5-12

METALS CONTAMINATION IN
SURFACE WATER

C.C. JOHNSON & MALHOTRA, P.C.

5.5 LEACHATE INVESTIGATION

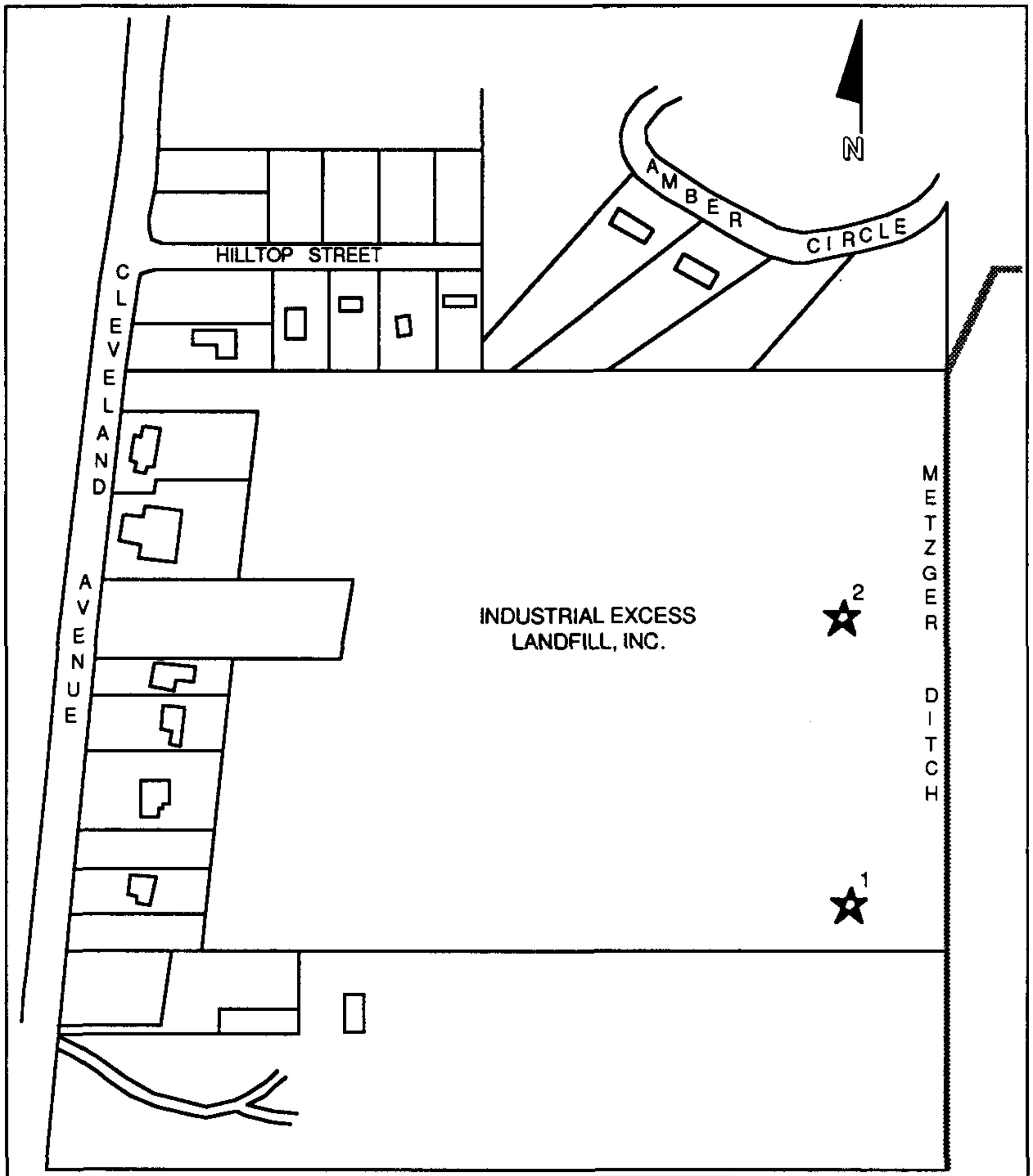
Two samples of leachate (LL01 AND LL02) were collected on site during Phase I, and one was resampled during Phase II (LL01). Soil samples corresponding to leachate seep areas are discussed in Section 4.4. Leachate samples were collected from pooled areas of liquid at the seep location (Figure 5-13). These three leachate samples were analyzed for all HSL substances.

Table 5-7 is a sample-by-sample listing of all chemicals found in these samples at levels substantially above background. The results reveal that these samples are the most highly contaminated water samples obtained during the Remedial Investigation.

5.6 Summary of Surface Water and Sediment Contamination

Based upon the evaluation of the above presented data the following conclusions were drawn:

1. Leachate seeps on the landfill produce water that is highly contaminated with metals, semi-volatile organic compounds, and volatile organics.
2. The four ponds on the site contain sediments and water that are moderately to highly contaminated with metals and contaminated with low levels of organics.
3. Sediments in Metzger Ditch immediately adjacent to the landfill contain low level contamination consisting of metals and a few semi-volatile organic compounds (including 4-methylphenol). Surface water in Metzger Ditch and in the pond immediately south of the site may contain low levels of metals contamination.
4. Higher than background levels of PAHs and phthalates are found in a few sediments downstream of the landfill. However, the distribution of the detected contamination does not suggest contamination from site activities.



★1 LEACHATE SAMPLING LOCATION AND LOCATION NUMBER

Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 5-13

LEACHATE SAMPLING LOCATION MAP

C.C. JOHNSON & MALHOTRA, P.C.

TABLE 5-7

LEACHATE SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration		Level Above Background*
		(ppb)	(ppm)	
LL01	Benzene	17-24		3X
	Chlorobenzene	3-4		3X
	Chloroethane	2-3		3X
	Ethylbenzene	20-94		3X
	Methylene Chloride (Dichloromethane)	40		3X
	Toluene	8		3X
	Total Xylenes	46-100		3X
	2,4-Dimethylphenol	6		3X
	Bis(2-Ethylhexyl) Phthalate	4		3X
	n-Nitrosodiphenylamine	23		3X
	Barium	500-1,710		1.2-3X
	Cadmium (Total)	16		3X
	Calcium	210,800		1.2X
	Chromium (Total)	12		3X
	Cobalt	9.7		3X
	Copper (Total)	24-27		3X
	Iron	79,100-389,000		3X
	Lead (Total)	22		3X
	Magnesium	89,800-90,800		3X
	Manganese	699		1.2X
	Nickel (Total)	36		3X
	Potassium	124,000-128,000		3X
	Silver (Total)	6.4-30		3X
	Sodium	506,000-588,000		2-3X
	Vanadium	6.8-61		3X
	Zinc (Total)	229		2X
LL02	Benzene	41		3X
	Chlorobenzene	6		3X
	Total Xylenes	73		3X
	1,4-Dichlorobenzene	5		3X
	4-Methylphenol	6		3X
	n-Nitrosodiphenylamine	38		3X
	Phenol	9		3X
	Barium	720		1.2X
	Calcium	221,900		1.2X
	Iron	12,222		3X
	Lead (Total)	8		2X
	Magnesium	90,600		3X

---

*The concentrations listed are above the background concentration by at least the factor shown.

TABLE 5-7 (Continued)

LEACHATE SAMPLES CONTAINING ABOVE-BACKGROUND LEVELS OF HSL CHEMICALS

Location	Chemical	Concentration (ppb)	Concentration (ppm)	Level Above Background*
LL02 (Cont'd)	Manganese	747		1.2X
	Potassium	80,800		3X
	Silver (Total)	20		3X
	Sodium	527,000		2X

---

*The concentrations listed are above the background concentration by at least the factor shown.

6.0 AIR INVESTIGATION

The overall purpose of the air investigation portion of the RI is to assess the extent to which the site is introducing gaseous contaminants into the atmosphere, and thereby, exposing nearby receptors. At the IEL site, the air investigation has been comprised of a series of separate studies, performed by a number of different organizations. Each of these efforts was designed to answer specific questions relating to the potential of the site to impact public health and/or the environment via the action of gaseous contaminants. The following is a listing of some of the major questions associated with the potential for gas phase contamination at the IEL site:

- What is the composition of the gases being generated and emitted by the landfill?
- To what extent is there lateral migration of methane (and other volatile contaminants) from the site?
- What is the nature of in-home air quality as it may be related to the types of contaminants emanating from the landfill?
- Is the MVS effective in controlling the migration of explosive levels of methane into the soil beneath the homes adjacent to the site?
- What is the nature of emissions from those areas of the site which are not influenced by the MVS?

The remaining sections describe the efforts performed at the IEL site designed to address these questions. Additional general information on the process associated with landfill gas generation and migration is presented in Appendix K.

6.1 Overview of Air Investigation Activities

The air investigation at the IEL consisted of four major study components: 1) the MVS, 2) the gas monitoring well system, 3) soil gas investigation, and 4) in-home air sampling and analysis. Other efforts included the sampling of the shallow water monitoring wells to determine the possible existence of free liquid, obtaining gas samples from shallow water monitoring wells and obtaining samples from individual extraction wells.

The following paragraphs will provide brief descriptions of each of these studies and the general results obtained. Where necessary, additional descriptive details regarding the system in question will be provided in order for the reader to understand the exact nature of the sampling effort.

6.2 Studies Involving the Methane Venting System

6.2.1 The Methane Venting System

As described in earlier sections of this report, an emergency response action was implemented at the IEL site to control the migration of landfill generated methane. The emergency response action consisted of the installation of an active methane venting system (MVS) which was installed along the western border, and portions of the northern and southern borders of the landfill in order to protect the adjacent homes.

The system consisted of the following major components:

- 12 gas extraction wells,
- An underground header system connecting the extraction wells,
- A series of gas monitoring wells at selected locations around the site,

- A blower house (the termination point for the header and collection point for extracted gases before they are flared), and a
- Flare which is used for the combustion of the gases collected by the system.

Figure 6-1 shows the position of the extraction wells, the blower house, and the header line in relation to the site. Figure 6-2 provides additional detail on the construction of the MVS. (Details concerning the gas monitoring system will be provided in a subsequent subsection.) As shown in Figure 6-2, the originally installed MVS used a candle flare. After some operating experience with this system, the decision was made to use a ground flare instead of the candle flare. The switch to the ground flare would result in:

- Decreased frequency of flame-outs;
- Longer retention times; and
- Higher temperatures.

Figure 6-3 provides a diagram of the ground flare installed at the IEL site. While the candle flare is still present at the site, the ground flare is now used almost exclusively. A valve is in place for use in diverting the flow of landfill gas to the candle flare if necessary.

A chronology describing the recent activities associated with the MVS is provided in Appendix L.

6.2.2 Overview of Sampling Effort at the MVS

The investigation of the MVS was performed in connection with a series of sampling efforts performed by U.S. EPA's Environmental Response Team (EnRT) headquartered in Edison, New Jersey. EnRT's most recent efforts were performed in early 1988, however, there were earlier investigations in 1986

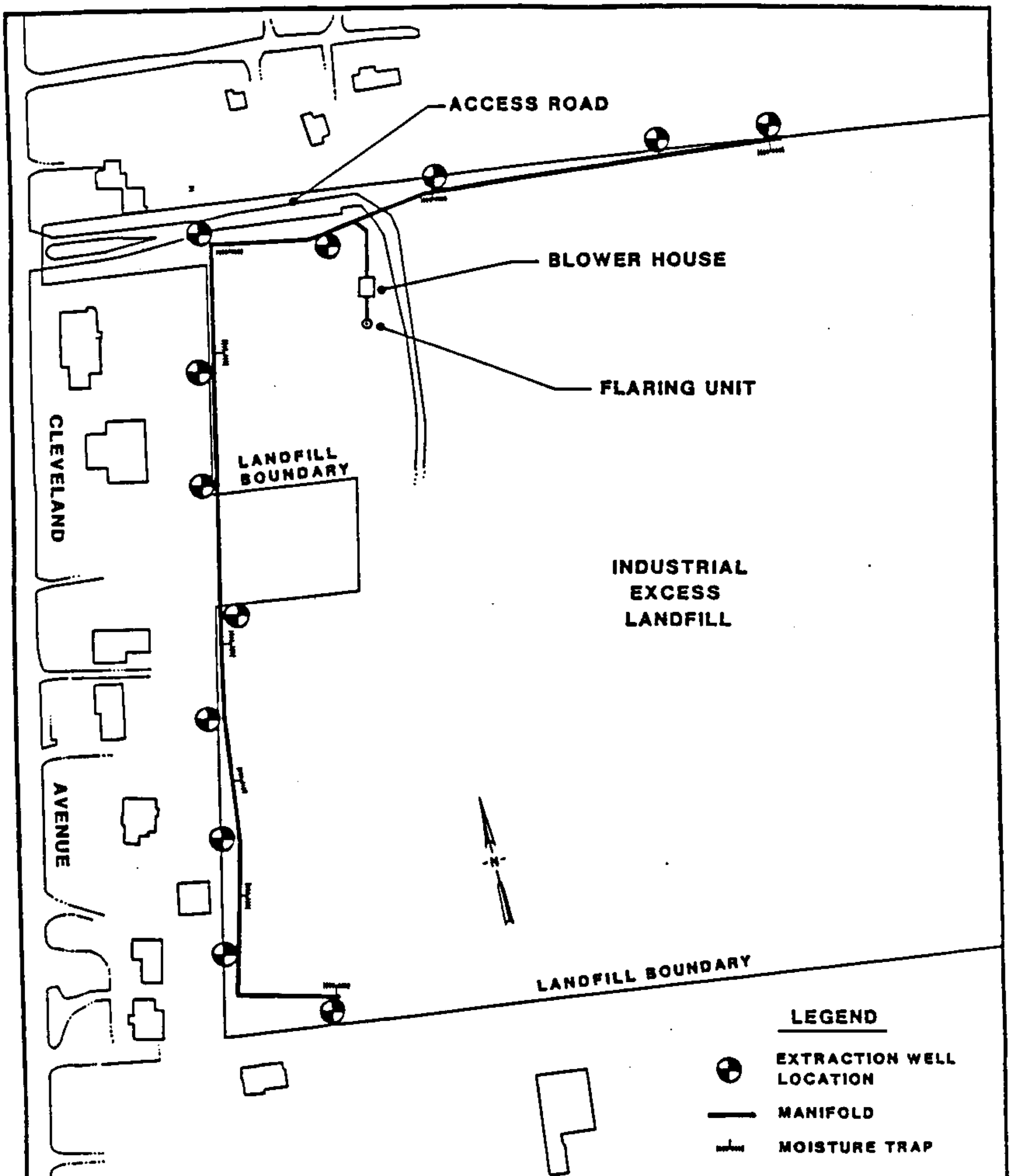


FIGURE 6-1

ACTIVE METHANE VENTING SYSTEM
INDUSTRIAL EXCESS LANDFILL
UNIONTOWN, OHIO

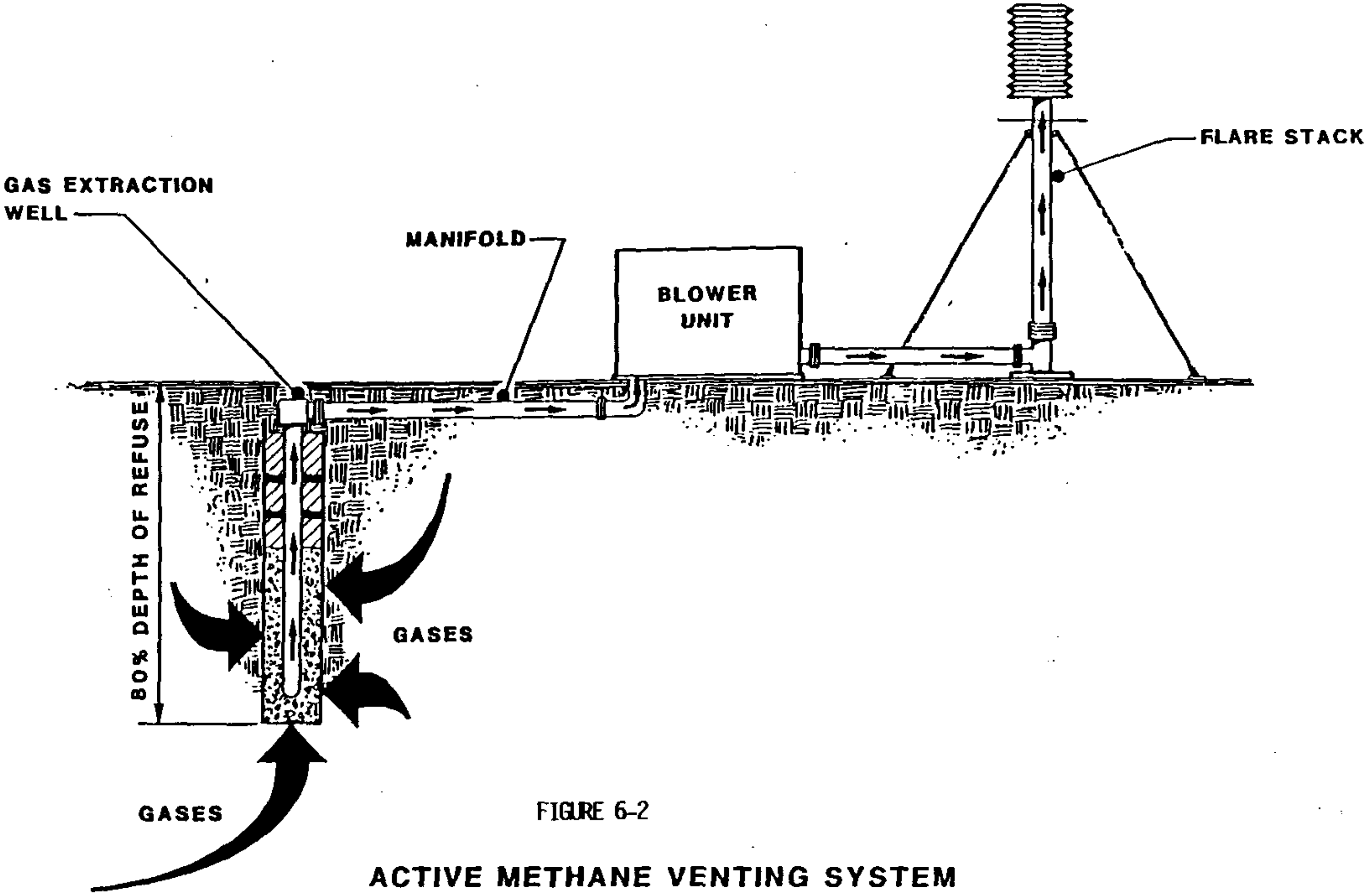
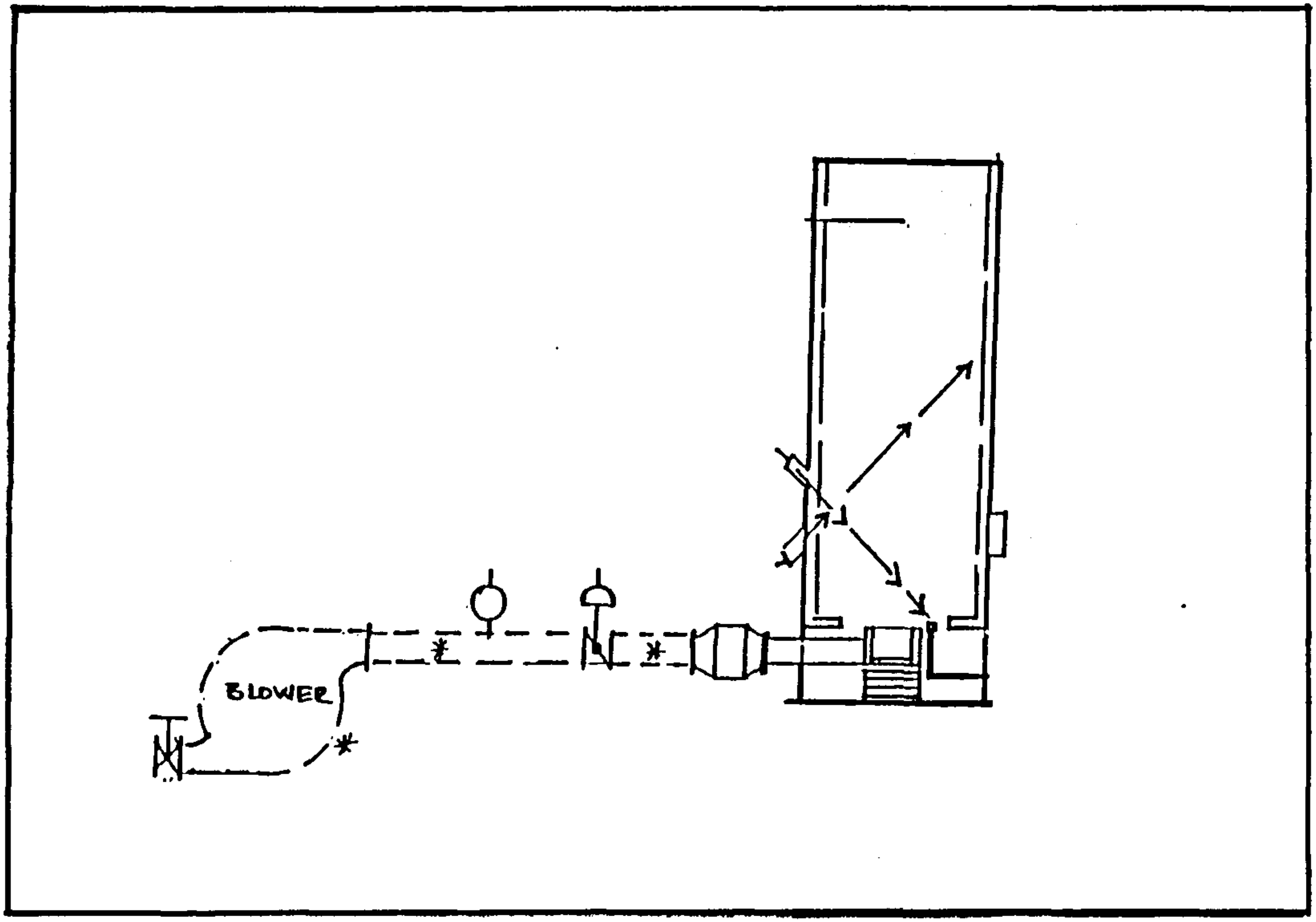


FIGURE 6-2

ACTIVE METHANE VENTING SYSTEM
INDUSTRIAL EXCESS LANDFILL
UNIONTOWN, OHIO

FIGURE 6-3 GROUND FLARE SYSTEM



and 1987. The 1988 investigation was a multi-faceted investigation to characterize different components of the gaseous environment at the IEL site. Of the three investigations, the study performed in 1988 was the most comprehensive.

The general objectives of the 1988 investigation are listed below:

- Characterize the chemical composition of the gases being generated by and emanating from the landfill.
- Develop a list of target compounds being generated by the landfill.
- Characterize the distribution of gaseous constituents in the soil at various locations on and around the landfill.
- Characterize the constituents which may be released from the ground flare operating in conjunction with the methane venting system at the site.
- Use the mobile TAGA unit and other portable gas sampling/ monitoring instruments (including a portable field gas chromatograph) to assess the indoor air quality of homes in the general Uniontown area.

The final report from the 1988 investigation has not been completed as of this writing. However, final data from this effort are available and were used along with information from EmRT's earlier studies at the site and the efforts of other organizations to construct a picture which is representative of current site conditions.

6.2.3 Establishing the List of Target Compounds

Gas samples were taken from the terminus of the header system in the blowerhouse system just before these gases are introduced to the flare. The sampling effort involved taking Tedlar bags samples, Summa canisters (for laboratory-based GC/MS analysis), and field monitoring with HNu and OVA sampling devices. The main purpose of this sampling event was to obtain quantitative and qualitative information on the gases which are being removed from the landfill by the MVS. This information was used to establish a list of target compounds which would be the focus of subsequent phases of EnRT's investigation, namely, the soil gas and in-home analyses.

Table 6-1 provides a listing of the compounds identified in the sample of gases taken from the MVS. Based upon the analyses shown in Table 6-1, a target compound list was established as shown in Table 6-2.

The list of compounds selected for the target compound list is shorter than the total list of compounds detected during the sampling effort. This is by design, because the purpose of a target list is to focus the analytical effort on those contaminants which pose the greatest potential hazard.

The following provides the logic behind the selection and non-selection of the target compounds:

- Choosing from the quantified chlorinated and aromatic compounds, all which were present at levels above 100 ppb were automatically selected. The 100 ppb cutoff point was arbitrarily chosen to limit the target list to the predominant compounds most likely to be migrating offsite at significant concentrations. These compounds would best characterize the potential of soil gas emissions affecting the indoor air quality of adjacent homes.

TABLE 6-1

TARGET COMPOUND LEVELS IN EXTRACTION SYSTEM GAS SAMPLES FROM THE INDUSTRIAL EXCESS METHANE VENTING SYSTEM

Compound	Anal. 1	Anal. 2	Anal. 3
Vinyl Chloride	ND [1]	6.7 ppm	
1,1-Dichloroethylene	>14 ppb [1]		
trans 1,2-Dichloroethene	ND		
1,1-Dichloroethane	630 ppb [2]		
1,2-Dichloroethane	ND		
Benzene	2200 ppb [2]		
Trichloroethylene	280 ppb [2]		
Toluene	1500 ppb [2]		
Tetrachloroethylene	300 ppb [2]		
Ethyl Benzene	1200 ppb [2]		
Xylenes	1860 ppb [2]		
Styrene	65 ppb		
m-Ethyl toluene	73 ppb [3]		
C3 Alkyl Benzene	400 ppb [3]		
Methylene Chloride	Det.		
1,1,1-Trichloroethane	Det.		
Chlorobenzene	Det.		
C5 Hydrocarbons	310 ppb [3]		
C6 Hydrocarbons	14 ppm [3]		
C7 Hydrocarbons	8.9 ppm [3]		
C8 Hydrocarbons	8.0 ppm [3]		
C9 Hydrocarbons	3.3 ppm [3]		
C10 Hydrocarbons	1.9 ppm [3]		

TABLE 6-1 (Continued)

TARGET COMPOUND LEVELS IN EXTRACTION SYSTEM GAS SAMPLES FROM THE INDUSTRIAL EXCESS METHANE VENTING SYSTEM

Compound	Anal. 1	Anal. 2	Anal. 3
Methane		20%	
Ethane		60 ppm	
Propane		4.4 ppm	
Propylene		10 ppm	
Carbon Monoxide		ND (DL = 4 ppm)	
Nitrogen		58%	
Oxygen		2.8%	
Argon		0.63%	
Carbon Dioxide		18.3%	
Hydrogen		ND (DL = 0.005%)	
Phosgene			ND (DL = 100 ppb)
Hydrogen Sulfide			ND (DL = 1 ppm)

Notes: Anal. 1 - GC/MS Analysis of Tenax Portion of collected tubes.
Anal. 2 - Analyses of Summa Canister.
Anal. 3 - Onsite Analyses w/Portable Monitox Sensors.

1/ Either not detected in analysis or reported concentration biased low due to breakthrough of target compound to non-analyzed CMS portion of tube.

2/ Compound signal greater than the range of the instrument calibration.

3/ Reported values are sums of the measured concentrations of individual compounds belonging to the specified.

Det. - Compound detected but not quanitated because of either interferences in its spectra or no calibration curve for the compound.

TABLE 6-2

TARGET COMPOUND LIST FOR THE STUDY OF IEL'S METHANE VENTING SYSTEM

Vinyl chloride,
1,1-Dichloroethylene,
1,1,1-Trichloroethane,
Tetrachloroethylene,
Toluene,
C2 Alkyl Aromatics
  (Ethyl benzene & xylenes),
C3 Alkyl Aromatics
Chlorobenzene

Methylene chloride,
1,1-Dichloroethane,
Trichloroethylene,
Methane,
Benzene
Hexanes

- Sampling results indicated that the results for 1,1-dichloroethylene was probably biased low; therefore, this compound was included.

- Three compounds, (1,1,1-trichloroethane, methylene chloride and chlorobenzene), that were detected, but not quantified, were also included in the list.

- Methane and hexanes were chosen to represent the full spectrum of hydrocarbons. Methane was chosen to represent the offsite migration of low molecular weight hydrocarbons such as methane, ethane, ethylene, acetylene, propane, etc. Methane was present at the highest concentration and is the hydrocarbon least retarded by interactions with the soil matrix. Methane was specifically analyzed for in the soil gas analyses and was screened for using an OVA during the indoor air analyses.

- Hexanes were selected to represent the medium molecular weight hydrocarbons (C5 - C8) for the following two reasons. First, hexanes were the most prominent of the C5 - C8 hydrocarbons detected. Second, the vadose zone mobilities of pentanes and hexanes, both of which are greater than that of C7 and C8 hydrocarbons, are very similar. Hexanes were specifically analyzed for only in the indoor air analyses. The GC/MS confirmation analyses would also look for hexanes if they were among the predominant peaks in the chromatogram.

Some residents have expressed some concern about phosgene as a site contaminant. Phosgene was not detected (at a 100 ppb detection limit) in the sample used to determine the list of target compounds, and was not included on the list of target compounds. Although phosgene has several orders of magnitude greater acute toxicity than the other compounds for which the 100 ppb limit was applied, this cut-off was justified for phosgene because of its chemical inability to migrate at low levels through moist soils. Phosgene, the acid chloride of formic acid, will readily react with water to form hydrochloric acid and formic acid. In the reaction both phosgene and water are consumed in a one-to-two ratio, respectively. In other words, one molecule of phosgene will react with two molecules of water to form one molecule of formic acid and two molecules of hydrogen chloride. Any gas migrating through the vadose zone will be continuously interacting with the moist surfaces on soil particles. A compound which is reactive with water can only migrate through soil by first drying out soil particles by mutual decomposition of the water and itself. Therefore, before a potential would exist for offsite migration of phosgene, there must be more phosgene present at the source than there is water trapped in the soil through which it must migrate. In addition, such a migration would be blocked by the aquifer which contained sufficient water to mutually destroy the phosgene. For phosgene to pass through a groundwater aquifer, it must literally mutually decompose all of the water present at the point of passage. No such levels of phosgene were observed in the soil gas extraction system. Therefore, phosgene will not be considered further as a contaminant which could be migrating offsite to produce an exposure for receptors.

Area residents also expressed some concern about the possible presence of radioactive material at the landfill site. Radiation analyses were performed on the sample taken from the MVS header system. The results of the radiation analysis (as presented in Table 6-3) show that the total radioactivity of the sample was below detection limits. The radon level shown is a measure of the amount of natural radon being extracted from the total soil volume, and does not represent a particularly hazardous situation, nor does it indicate the presence of a radioactive waste source which needs to be considered.

TABLE 6-3

RESULTS FROM VARIOUS RADIATION ANALYSES

Parameter	Level
Total Radioactivity [1]	ND (DL = <.03 mRad/hour)
C-13 Radiation	ND
Tritium Radiation	ND
Iodine-131 Radiation	ND
Radon	516 picocuries/liter

---

[1] Onsite analysis performed using Victoreen GM Meter, Model No. 493-50 (with open probe).

6.3 Stack Emission Samples

The gaseous materials collected by the MVS are burned in the ground flare and the combustion products are released directly into the atmosphere. U.S. EPA's Trace Atmosphere Gas Analyzer (TAGA 6000E) is a mobile tandem mass spectrometer/data system. (A more complete description of this unit is provided in the section on the in-home sampling effort and in Appendix m.)

As a part of the earlier sampling effort, this unit was used for the analysis of emissions from the candle flare originally installed at the IEL site.

On September 9, 1986 TAGA personnel performed gas sampling and analysis from adjacent to and downwind of the candle flare. Samples from downwind were collected at the same height as the plume emanating from the stack. Results are shown in Tables 6-4, 6-5, and 6-6.

The final report on the sampling indicates that the burner was successful in destroying a large portion of the compounds. The lower destruction efficiency of methyl ethyl ketone was probably caused by the formation of this compound from incomplete combustion of hydrocarbons.

Similar sampling of stack emissions were performed at the ground flare during the 1988 investigation. Results of the 1988 sampling effort confirm that the ground flare provides effective destruction of the methane and other gaseous contaminants being extracted from the landfill by the MVS. No detectable levels of target compounds were found at the mouth of the ground flare. Therefore, it is very likely that the levels at the property line will be within safe levels. Furthermore, the 1988 data show the increased effectiveness of the ground flare over that of the earlier candle flare.

TABLE 6-4
LANDFILL STACK* GAS ANALYSES 3/31/86
(Downwind, Gases On, Flare Off)
Uniontown, Ohio

PARAMETER	CONCENTRATION (PPB) I
BENZENE	236
TOLUENE	15
TRICHLOROETHENE	264
METHYL ETHYL KETONE	75
1,1 DICHLOROETHENE	
1,2 DICHLOROETHENE	141
1,1,1, TRICHLOROETHANE	
1,1 DICHLOROETHANE	
1,2 DICHLOROETHANE	2254
VINYL CHLORIDE	
ETHYL BENZENE	367
CHLOROFORM	111
METHYLENE CHLORIDE	
TETRACHLOROETHENE	10
PHOSGENE	12
HYDROCARBONS	P

P - Mass spectra scan shows the presence of Hydrocarbons.

I - Air Monitoring at Landfill Site 5' Downwind from Stack 18' High, Gases on, Flare off.

* - Candle flare.

TABLE 6-5
LANDFILL STACK GAS ANALYSES 3/31/86
(Ambient And Downwind, Gases On; Flare Off)
Uniontown, Ohio

		CONCENTRATION				
PARAMETER	KEY:	J	K	L	M	N
BENZENE		*	*	*	*	*
TOLUENE		*	*	*	*	*
TRICHLOROETHENE		*	*	*	*	*
METHYL ETHYL KETONE		*	*	*	*	*
1,1 DICHLOROETHENE		*	*	*	*	*
1,2 DICHLOROETHENE		*	*	*	*	*
1,1,1 TRICHLOROETHANE		*	*	*	*	*
1,1 DICHLOROETHANE		*	*	*	*	*
1,1 DICHLOROETHANE		*	*	*	*	*
VINYL CHLORIDE		*	*	*	*	*
ETHYL BENZENE		*	*	*	*	*
CHLOROFORM		*	*	*	*	*
METHYLENE CHLORIDE		*	*	*	*	*
TETRACHLOROETHENE		*	*	*	*	*
PHOSGENE		*	*	*	*	*
HYDROCARBONS		P	P	P	P	P

* Below Minimum Quantitation Limit (Table II)

P - Mass spectra scan shows the presence of Hydrocarbons.

Key:
- J Air Monitoring at Landfill Site 40' Downwind from Stack 18' High, Gases on, Flare off.
- K Air Monitoring at Landfill Site 60' Downwind from Stack 18' High, Gases on, Flare off.
- L Air Monitoring - Starting Point 3420 Hilltop Street, Left on Cleveland, Stop at Realty on Cleveland, Gases on, Flare off.
- M Air Monitoring - Starting Point East End of Pine Street. Crossover Cleveland, Stop at Millview, Gases on, Flare off.
- N Air Monitoring - Starting Point Sunset Street Going South, Stop at Moongio Street, Gases on, Flare off.

TABLE 6-6

LANDFILL STACK GAS ANALYSES 3/31/86

(Ambient And Downwind; Gases On; Flare On)

Uniontown, Ohio

		CONCENTRATION (PPB)							
PARAMETER	KEY:	A	B	C	D'	E	F	G	H
BENZENE		*	*	*	*	*	*	*	*
TOLUENE		*	*	*	*	*	*	*	*
TRICHLOROETHENE		*	*	*	*	*	*	*	*
METHYL ETHYL KETONE		*	*	*	*	*	*	*	*
1,1 DICHLOROETHENE		*	*	*	*	*	*	*	*
1,2 DICHLOROETHENE		*	*	*	*	*	*	*	*
1,1,1 TRICHLOROETHANE		*	*	*	*	*	*	*	*
1,1 DICHLOROETHANE		*	*	*	*	*	*	*	*
1,2 DICHLOROETHANE		*	*	*	*	*	*	*	*
VINYL CHLORIDE		*	*	*	*	*	*	*	*
ETHYL BENZENE		*	*	*	*	*	*	*	*
CHLOROFORM		*	*	*	*	*	*	*	*
METHYLENE CHLORIDE		*	*	*	*	*	*	*	*
TETRACHLOROETHENE		*	*	*	*	*	*	*	*
PHOSGENE		*	*	*	*	*	*	*	*
HYDROCARBONS		P	P	P	P	P	P	P	P

---

*Below Minimum Quantitation Limit (Table II)

P - Mass spectra scan shows the presence of Hydrocarbons.

Key: A Air Monitoring at Dutch Cupboard, Gases on, Flare on.
B Air Monitoring at Landfill Site Upwind Ground Air, Gases on, Flare on.
C Air Monitoring at Landfill Site 20' Downwind from Stack, Gases on, Flare on.
D Air Monitoring at Landfill Site 40' Downwind from Stack, Gases on, Flare on.
E Air Monitoring at Landfill Site 60' Downwind from Stack, Gases on, Flare on.
F Air Monitoring at 5' Downwind from Stack, Gases on, Flare on.
G Air Monitoring - Starting Point Broadvista; Northvista going East to West, Gases on, Flare on.
H Air Monitoring - Route 619 Goind West form Oakwood to Kreigbaum going South, Stopped at Raber Road, Gases on, Flare on.

6.4 Studies Involving the Gas Monitoring Well System

6.4.1 The Landfill Gas Monitoring System

The LFG monitoring system installed at the IEL site consists of 15 gas monitoring wells. These wells are installed at the locations depicted by Figure 6-4. As shown in this figure, most of the gas monitoring wells were installed in between the border homes and the landfilled wastes. Originally these wells were designed to provide a means to assess the effectiveness of the MVS in achieving its stated purpose of preventing the movement of explosive levels of methane from the landfill to the nearby homes. Information pertaining to the construction of the individual wells is summarized in the following paragraphs. Additional information, including diagrams showing construction details, are provided in Appendix Monitor.

The gas monitoring wells were designed to intercept different depths of the unsaturated zone.

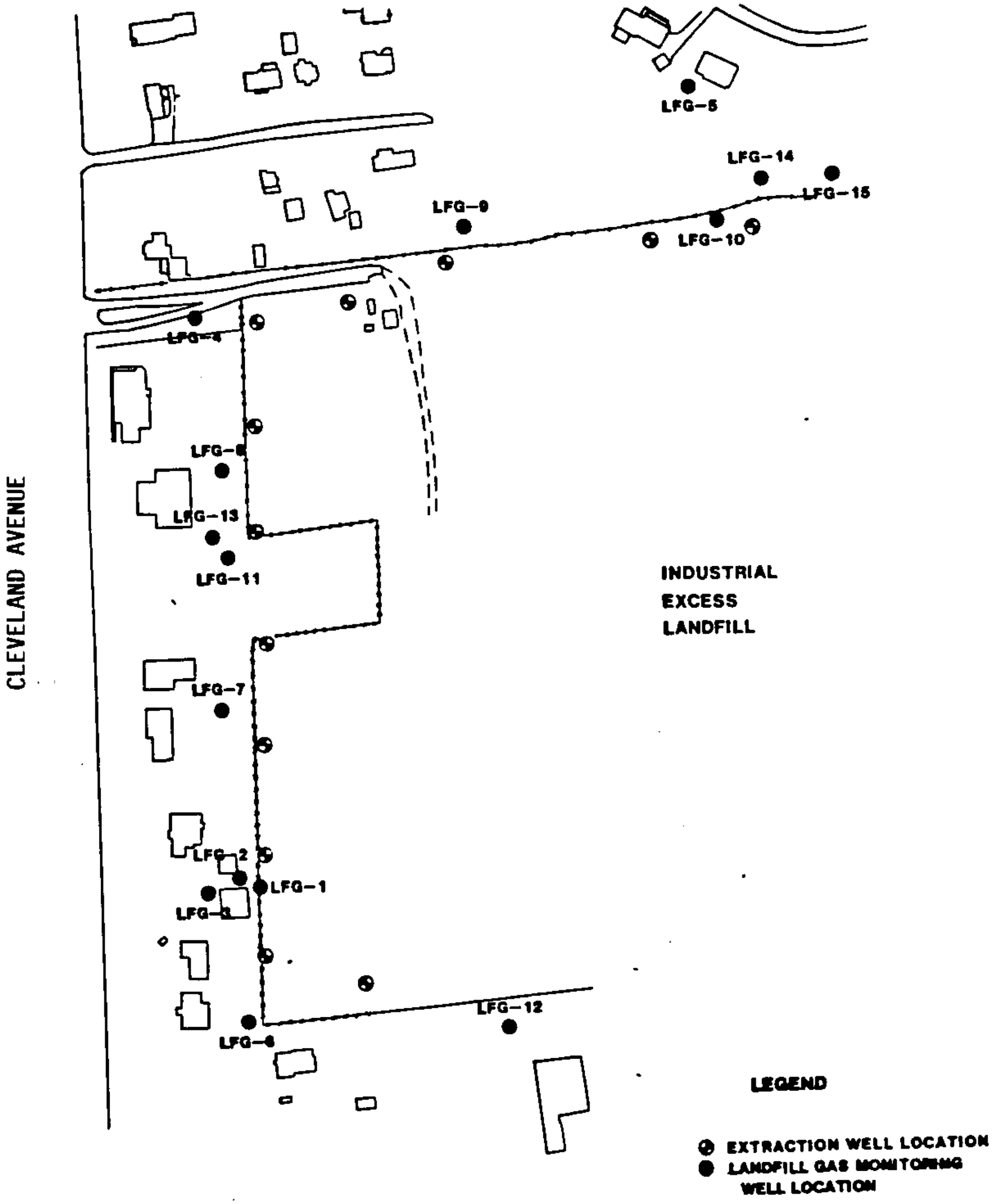
A total of fifteen multi-probe monitoring wells were constructed to measure subsurface methane levels and pressures. The wells are designated as LFG series wells (i.e., LFG-1 thru LFG-15), and their locations are shown in Figure 6-4.

LFG-1, LFG-2, and LFG-3 were constructed in October 1984. LFG-4 and LFG-5 were constructed in December 1985. LFG-6 through LFG-10 were constructed in June 1986. LFG-12 thru LFG-15 were constructed in October 1986.

LFG-1 and LFG-2 have four probes in each well. LFG-3 and LFG-5 have two probes in each well. LFG-4, LFG-6 thru LFG-10, and LFG-13 thru LFG-15 have three probes in each well. LFG-12 has two probes.

Figure 6-4

LANDFILL GAS (LFG) MONITORING WELL LOCATIONS



Probes are clustered in the wells and protected at the surface by steel casings with locking lids.

Five wells are not used to assess the effectiveness of the MVS. These are LFG-1, LFG-7, LFG-8, LFG-10, and LFG-11. These have been excluded from the compliance program due to the following reasons:

- Inaccessibility;
- Location in buried waste;
- Location on landfill property; and,
- Location within a septic tank drain field.

These monitoring wells have not been physically removed from the site because they can provide other fine tuning information and it is not cost-effective to remove an installed well.

Therefore, the following monitoring wells were used and should be employed to determine the ongoing effectiveness of the system:

LFG-2
LFG-3
LFG-4
LFG-5
LFG-6
LFG-9
LFG-12
LFG-13
LFG-14
LFG-15

6.4.2 Gas Monitoring Well Sampling Results

The gas monitoring wells are installed at locations designed to assess the extent to which the MVS is accomplishing its goal of preventing the migration of gases towards the inhabited areas to the west, north and south. These wells are monitored on a regular basis by the U.S. EPA's EmRT contractors and Ohio EPA. Information obtained from the sampling of the identified compliance monitoring wells indicates that the MVS is effective in preventing the lateral migration of gases into the soils under the these homes. Table 6-7 shows typical results obtained during one of the compliance monitoring rounds. The zero methane concentrations at all probe depths indicate that the MVS is effective at removing methane throughout the soil volume. A more extensive set of monitoring well data is presented in Appendix N.

6.5 Soil Gas Investigation

Studies designed to characterize the nature and extent of the migration of gaseous materials in the soil pore spaces have been performed by primarily by two organizations. The Ohio Environmental Protection Agency (Ohio EPA) has been performing periodic monitoring of the soil environment around the IEL site ever since 1984. U.S. EPA's EnRT included a comprehensive study of the soil gas as a part of the investigation performed in early 1988. The following paragraphs describe these studies and the results obtained.

6.5.1 Ohio Environmental Protection Agency Studies

The Ohio EPA began soil gas studies of the area surrounding the IEL site in 1984. Their studies consisted of monitoring three installed gas monitoring wells and performing punch probes at selected location around the landfill. The results from the Ohio EPA studies indicated the presence of explosive levels of methane in the subsurface soil environment prior to the installation of the MVS. Continuing monitoring efforts show that methane levels are typically zero percent of the lower explosive limit (LEL) now that the MVS is operating. The Ohio EPA results are in agreement with the results obtained during RI studies.

A methane percentage of 5 percent corresponds to the LEL. At this concentration, there is enough methane in the air to combine explosively with oxygen when there is an ignition source. Current Ohio EPA monitoring

TABLE 6-7

LFG MIGRATION WELL MONITORING
INDUSTRIAL EXCESS LANDFILL
UNIONTOWN, OHIO

Date: 12/11/86

Time - Start: 11:30 a.m. a.m. p.m.

- Stop: 1:30 p.m. a.m. p.m.

Weather - Temperature: 25 degrees F

Exhauster House Operation:

Status: Static Dynamic

Blowers Active: #1 #2

Flow: N/A cfm

Field Personnel: James Stamm

Instrument	*Type*	*Serial No.*
— Pressure/Vacuum	Dwyer	
— Methane	MSA 60	

Location		Color Code	Depth (ft)	Pressure/ Vacuum (in. H2O)	Methane Content (%)
LFG-2	A	Red	4	0	0
	B	Green	8	0	0
	C	Yellow	17	0	0
	D	Blue	27	0	0
LFG-3	A	Red	4	0	0
	B	Green	8	0	0
LFG-4	A	Red	10	0	0
	B	Green	21	0	0
	C	Yellow	40	0	0
LFG-5	A	Red	10	0	0
	B	Green	23	0	0
LFG-6	A	Red	7	0	0
	B	Green	15	0	0
	C	Yellow	25	0	0
LFG-9	A	Red	7	0	0
	B	Green	15	0	0
	C	Yellow	25	0	0
LFG-12	A	Red	6	0	0
	B	Green	14	0	0
LFG-13	A	Red	7	0	0
	B	Green	15	0	0
	C	Yellow	25	0	0
LFG-14	A	Red	7	0	0
	B	Green	15	0	0
	C	Yellow	25	0	0
LFG-15	A	Red	7	0	0
	B	Green	15	0	0
	C	Yellow	25	0	0

(which includes the 15 well gas monitoring system described in Section 6.3) confirms the zero percent methane readings obtained by EmRT as a part of their periodic monitoring.

An extensive soil gas investigation was performed over the surface and along the edges of the landfill. The purpose of this investigation was to assess:

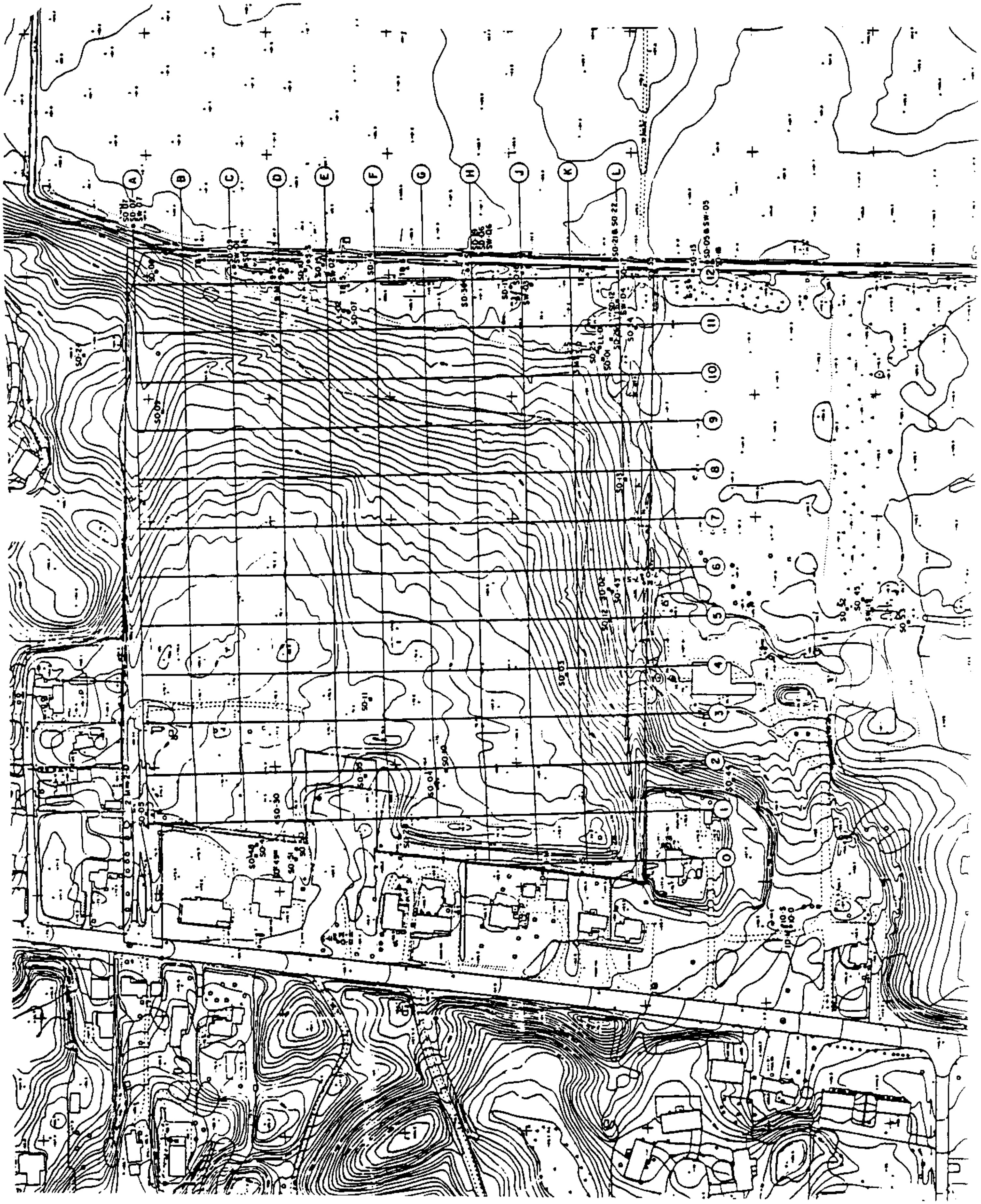
1. The regional distribution of contaminant concentration over the surface of the landfill; and,
2. The extent to which there may be migration of contaminants offsite.

Approximately 75 Tedlar bag samples were taken with a punch probe sampling device capable of obtaining a soil gas sample from 5 feet below the surface. After the sampler was driven into the ground, clay was used to provide a seal around the interface between the probe and the ground's surface. This seal prevents the introduction of ambient air into sample.

The onsite grid used for sampling is shown in Figure 6-5. Subsurface gas samples were taken at selected nodes of the grid lines shown in this figure. The north-south grid lines are numbered "0" (zero) through "12", and the east-west grid lines have alphabetic notations which range from of "A" through "L".

In order to assess the extent to which there may be lateral migration of contaminants, subsurface samples were obtained from offsite locations along lines parallel to the western, northern and southern borders of the IEL site. The sampling along the western border consisted of two sampling transects. The first consisted of the array of gas monitoring wells located along the western boundary (LFG-4, 8, 13, 7, 2, 1, 3 and 6) as

FIGURE 6-5 ONSITE GRID LOCATION MAP



shown in Figure 6-4. A second line of subsurface gas samples were taken in the soils between the homes and Cleveland Avenue along a line which passes through the node produced by the extension of grid lines "A" and "O". The samples were taken at approximately 100 foot intervals north and south of the "AO" node and parallel to Cleveland Avenue.

The northern offsite transect (referred to as the "NE" transect) was performed adjacent to the fence which is situated along much of the site's northern border. The southern transect (referred to as the M transect) is slightly south of and parallel to the "L" transect shown in Figure 6-5.

The data from the punch probe sampling are presented in Tables 6-8 through 6-12. These tables present data from gas monitoring well samples, offsite gas samples (relative to the AO node and the NE and M transects), ambient air samples, headspace samples from selected groundwater monitoring wells, samples from the MVS's gas extraction wells, and samples taken from onsite nodes.

These data provide a comprehensive picture of migrating gaseous contaminants in the subsurface environment of the landfill, along the edge of the landfill and offsite. Samples from gas monitoring wells were taken from the different probe depths (from the upper portions of the vadose zone, down to the water table and into the bedrock, for one probe). Field monitoring was performed using the OVA, field explosimeters (providing readings of in terms of percent of LEL), and results obtained from the field gas chromatographs.

The two major results from this sampling effort are:

- The MVS successfully intercepts gases migrating into the areas the MVS covers. In addition, there is no offsite migration at areas

TABLE 6-8 GAS MONITORING WELL RESULTS (Sorted first by Depth Range and Then by Location)

Results from Soil Gas Analyses Taken at Industrial Excess Landfill,
Uniontown, OH - February 1988
Concentration Data (ppb) From Field Photovac Analyses (Unless Specified Otherwise) *

SAMPLE IDENTIFYING INFORMATION			OVA	On-site Results												Total			*
Sample ID	Sample Description	Sampled Date	Methane PPM	%LEL	Temp.	VINYL CHLORIDE	MeCL (e)	1,1-DCE	1,1-DCA (e)	TCE	1,1,1-TCA (e)	PCE	BENZENE	TOLUENE	m-ETHYL TOLUENE	C2 Alkyl Aromat.	ETHYL BENZENE	m-XYL	STYRENE / o-XYL *
GW1B	Gas Well, 1, Blue, 42'	02/09/88	9200	10	-	i	-	i	-	12.1 i	-	ND	10.5	ND	ND	0	ND	ND	ND *
GW4Y	Gas Well, 4, Yellow, 39 - 40'	02/09/88	5	-	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	32.5	ND	ND	32.5 *
GW6Y	Gas Well, 6, Yellow, 24 - 25'	02/09/88	8	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW2B	Gas Well, MW-2, Blue, 27'	02/09/88	-	0	-	BMDL i	ND	ND	ND	ND	ND	28 e	ND	BMDL	ND	0	ND	ND	ND *
GW1Y	Gas Well, 1, Yellow, 24'	02/09/88	2777	10	-	i	ND	ND e,i	ND	ND	ND	ND-	1	ND	ND	0	ND	ND	ND *
GW7Y	Gas Well, MW-7, Yellow, 24 - 25'	02/09/88	6000	66	-	i	ND	ND e,i	ND	ND	ND	ND	32.4	ND	ND	40	ND	ND	40 *
GW13Y	Gas Well, 13, Yellow, 24 - 25'	02/09/88	11	0	-	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW8Y	Gas Well, 8, Yellow, 24 - 25'	02/09/88	56	0	-	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	ND	0	ND	ND	ND *
GW4G	Gas Well, 4, Green, 20 - 21'	02/09/88	-	0	-	ND	ND	ND	ND	BMDL	ND	10.4	ND	BMDL	ND	0	ND	ND	ND *
GW9Y#2	Gas Well, 9, Yellow, 24 - 25'	02/09/88	18.5 a	0	-	i	ND	ND	ND	ND	ND	ND	ND	4 *	ND	0	ND	ND	ND *
GW10Y	Gas Well, MW-10, Yellow, 24 - 25'	02/09/88	-	0	-	i	ND	ND e,i	ND	ND	ND	ND	98.6	ND	ND	0	ND	ND	ND *
GW14Y	Gas Well, MW-14, Yellow, 24 - 25'	02/09/88	6	0	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND *
GW15Y	Gas Well, 15, Yellow, 24 - 25'	02/09/88	12	0	-	ND	ND	ND	ND	ND	30	ND	ND	ND	ND	0	ND	ND	ND *
GW5G	Gas Well, MW-5, Green, 22 - 23'	02/09/88	6	0	-	i	ND	ND e,i	ND	ND	30	25 e	BMDL	ND	ND	0	ND	BMDL	ND *
GW12R	Gas Well, 12, Red, 13 - 14'	02/09/88	19	0	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND *
GW6G	Gas Well, 6, Green, 14 - 15'	02/09/88	7	0	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND *
GW2Y	Gas Well, MW-2, Yellow, 17'	02/09/88	13	0	-	ND	ND	ND	ND	ND	ND	5	ND	ND	ND	0	ND	ND	ND *
GW1G	Gas Well, 1, Green, 12'	02/09/88	88	10	-	i	ND	ND e,i	ND	ND	ND	13.1	11.2	34.6	ND	0	ND	ND	ND *
GW7G	Gas Well, MW-7, Green, 14 - 15'	02/09/88	1800	50	-	i	ND	ND e,i	ND	ND	ND	ND	BMDL	ND	ND	0	ND	ND	ND *
GW13G	Gas Well, 13, Green, 14 - 15'	02/09/88	7	0	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND *
GW8G	Gas Well, 8, Green, 14 - 15'	02/09/88	3480	0	-	i	ND	ND e	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW4R	Gas Well, 4, Red, 9 - 10'	02/09/88	4	20	-	i	ND	ND e	ND	ND	ND	ND	1	ND	ND	0	ND	ND	ND *
GW9G#2	Gas Well, 9, Green, 14 - 15'	02/09/88	56	0	-	ND	ND	ND	ND	ND	5	ND	1 *	BMDL	ND	111 *	ND	ND	111 * *
GW10G	Gas Well, MW-10, Green, 14 - 15'	02/09/88	* 10 %	110	0	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW14G	Gas Well, MW-14, Green, 14 - 15'	02/09/88	11	0	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND *
GW15G	Gas Well, 15, Green, 14 - 15'	02/09/88	5	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW5O	Gas Well, MW-5, Orange, 9 - 10'	02/09/88	12	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW12G	Gas Well, 12, Green, 5 - 6'	02/09/88	13	0	-	ND	ND	ND	ND	ND	ND	BMDL	ND	ND	ND	0	ND	ND	ND *
GW6R	Gas Well, 6, Red, 6 - 7'	02/09/88	11	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW3R	Gas Well, MW-3, Red, 4'	02/09/88	8	0	0	ND	ND	ND	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND *
GW3G	Gas Well, MW-3, Green, 8'	02/09/88	4	0	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND *
GW2R	Gas Well, MW-2, Red, 4'	02/09/88	8	0	-	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW2G	Gas Well, MW-2, Green, 8'	02/09/88	17	0	-	BMDL i	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND *
GW1R	Gas Well, 1, Red, 5'	02/09/88	-	25	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND *
GW7R	Gas Well, MW-7, Red, 6 - 7'	02/09/88	2300	185	-	i	ND	ND e,i	ND	ND	ND	ND	11	ND	ND	282	ND	89	193 *
GW13R	Gas Well, 13, Red, 6 - 7'	02/09/88	-	0	-	ND	ND	ND	ND	ND	ND	ND	ND	1	ND	0	ND	ND	ND *
GW8R	Gas Well, 8, Red, 6 - 7'	02/09/88	* 4 %	0	-	i	ND	18 i	ND	10 i	ND	ND	67.3	ND	ND	0	ND	ND	ND *
GW9R#1	Gas Well, 9, Red, 6 - 7'	02/09/88	31 a	0	-	ND	ND	ND	ND	ND	ND	ND	BMDL *	BMDL *	ND	0	ND	ND	ND *
GW10R	Gas Well, MW-10, Red, 6 - 7'	02/09/88	-	180	-	360 g	ND	75 e	ND	22 e	ND	8 e	6860	2210	ND	0	ND	ND	ND *

TABLE 6-8
(Cont'd.)

GAS MONITORING WELL RESULTS (Sorted first by Depth Range and Then by Location)

Results from Soil Gas Analyses Taken at Industrial Excess Landfill,
Uniontown, OH - February 1988
Concentration Data (ppb) From Field Photovac Analyses (Unless Specified Otherwise)

SAMPLE IDENTIFYING INFORMATION Sample ID	Sample Description	Sampled Date	OVA Methane PPM	On-site Results %LEL	Temp.	VINYL CHLORIDE	MeCL (e)	1,1-DCE	1,1-DCA (e)	TCE	1,1,1-TCA (e)	PCE	BENZENE	TOLUENE	m-ETHYL TOLUENE	Total C2 Alkyl Aromat.	ETHYL BENZENE	m-XYL	STYRENE / o-XYL
GW14O	Gas Well, MW-14, Orange, 6 - 7'	02/09/88	9	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
GW15R	Gas Well, 15, Red, 6 - 7'	02/09/88	6	0	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND
GW10G	Gas Well, MW-10, Green, 14 - 15'	02/09/88	* 10 %	110	0	i	ND	BMDL i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
GW10R	Gas Well, MW-10, Red, 6 - 7'	02/09/68	-	180	-	360 g	ND	75 e	ND	22 e	ND	8 e	6860	2210	ND	0	ND	ND	ND
GW10Y	Gas Well, MW-10, Yellow, 24 - 25'	02/09/88	-	0	-	i	ND	ND e,i	ND	ND	ND	ND	98.6	ND	ND	0	ND	ND	ND
GW10G	Gas Well, MW-10, Green, 14 - 15'	02/10/88	6700	100	-	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
GW10R	Gas Well, MW-10, Red, 6 - 7'	02/10/88	* 7 %	100	-	i	-	i	-	ND	-	ND	4560	5625	nr	0	ND	ND	nr
GW10Y	Gas Well, MW-10, Yellow, 24 - 25'	02/10/88	1389	100	-	i	ND	27.4 i	ND	ND	ND	ND	104	ND	ND	0	ND	ND	ND
W10GPT00	Well 10, Pump Test, Green, T-0	02/09/88	* 2%	-	-	i	ND	ND e	75	ND	ND	ND	56	ND	ND	0	ND	ND	ND
W10GPT10	Well 10, Pump Test, Green, T-10	02/09/88	8	2	-	i	ND	ND e	ND	ND	ND	ND	ND	ND	nr	0	ND	ND	nr
W10GPT30	Well 10, Pump Test, Green, T-30	02/09/88	-	0	-	ND	-	-	-	ND	-	ND	ND	ND	ND	0	ND	ND	ND
W10RPT00	Well 10, Pump Test, Red, T-0	02/09/88	* 19 %	200	-	i	ND	ND e	110	7 e	ND	5 e	1170	ND	ND	0	ND	ND	ND
W10RPT10	Well 10, Pump Test, Red, T-10	02/09/88	* 13 %	17	-	i	ND	ND e	ND	ND	ND	ND	491	ND	ND	0	ND	ND	ND
W10RPT30	Well 10, Pump Test, Red, T-30	02/09/88	-	0	-	i	ND	ND e	ND	ND e	ND	ND e	-	-	-	-	-	-	-
W10YPT10	Well 10, Pump Test, Yellow, T-10	02/09/88	740	140	-	i	ND	BMDL i	ND	ND	ND	ND	BMDL	ND	ND	0	ND	ND	ND

Notes: Sample abbreviations used: MeCL - Methylene Chloride; DCE - dichloroethylene; DCA - dichloroethane; TCA - trichloroethane;
TCE - Trichloroethylene; PCE - Tetrachloroethylene; Aromat. - Aromatics; XYL - xylene.
ND - Not detected
nr - Sample was not run on a GC which was measuring this parameter.
BMDL - Detected at trace, non-quantifable levels.
"-" - No data; sample either not analyzed (usually because of leak in bag) or on-site data not obtained.
i - Interference from co-eluting hydrocarbons in sample.
g - Reported Results from the GC/MS analyses of tube samples taken from the soil gas bag samples.
e - Reported data from analyses performed by Weston's Loinville lab using a GC w/ electron capture detector.
a - Reported value is an average from replicate samples.
m - Reported value is the maximum obtained from analyses of two replicate samples.
* - Methane Concentration Reported as Percent Volume instead as PPM

TABLE 6-9 RESULTS FROM TRAVERSE ALONG CLEVELAND AVENUE

(Consecutive Numbers Passed Upon 50' Increments)

Uniontown, OH - February 1988
Concentration Data (ppb) From Field Photovac Analyses (Unless Specified Otherwise)

SAMPLE IDENTIFYING INFORMATION				On-site Results															
Sample ID	Sample Description	Sampled Date	OVA Methan PPM	%LEL	Temp.	VINYL CHLORIDE	MeCL (e)	1,1-DCE	1,1-DCA (e)	TCE	1,1,1-TCA (e)	PCE	BENZENE	TOLUENE	m-ETHYL TOLUENE	Total C2 Alkyl Aromat.	ETHYL BENZENE	m-XYL	STYRENE/ O-XYL
AO	At the entrance	02/09/88	-	0	31.6	nr	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
2N	North From AO Next to Cleveland	02/09/88	-	0	-	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
3N	North From AO Next to Cleveland	02/09/88	8.6	0	37.5	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
4N	North From AO Next to Cleveland	02/09/88	-	-	37.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
5N	North From AO Next to Cleveland	02/09/88	-	0	37.5	i	ND	ND e	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
6N	North From AO Next to Cleveland	02/09/88	-	-	37.8	i	ND	ND e	ND	ND	ND	ND	BMDL	13.9	ND	0	ND	ND	ND
7N	North From AO Next to Cleveland	02/09/88	-	0	39.5	i	ND	ND e	ND	ND	ND	ND	BMDL m	BMDL m	ND	0	ND	ND	ND
01A S	South From AO Next to Cleveland	02/09/88	-	0	35.3	i	ND	ND e	ND	ND	ND	ND	10.7	13.8	ND	0	ND	ND	ND
02A S	South From AO Next to Cleveland	02/09/88	-	0	33.2	i	ND	ND e	ND	ND	ND	ND	ND	7	ND	0	ND	ND	ND
03A S	South From AO Next to Cleveland	02/09/88	-	0	33.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
04A S	South From AO Next to Cleveland	02/09/88	-	0	32.3	BMDL i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
05A S	South From AO Next to Cleveland	02/09/88	-	0	35.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
06A S	South From AO Next to Cleveland	02/09/88	-	0	37.4	BMDL i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
07A S	South From AO Next to Cleveland	02/09/88	14	0	37.9	nr	ND	ND e	ND	ND	ND	ND	BMDL	ND	ND	0	ND	ND	ND
08A S	South From AO Next to Cleveland	02/09/88	7	0	35.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
09A S	South From AO Next to Cleveland	02/09/88	8	0	38.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
10A S	South From AO Next to Cleveland	02/09/88	-	0	39.1	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
11A S	South From AO Next to Cleveland	02/09/88	-	0	37.6	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
12A S	South From AO Next to Cleveland	02/09/88	-	0	38.6	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
13A S	South From AO Next to Cleveland	02/09/88	20	0	37.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	BMDL
14AS #1	South From AO Next to Cleveland	02/09/88	8 a	0	35.2	i	ND	ND e	ND	ND	ND	ND	BMDL m	22.5 m	ND	0	ND	ND	ND
15A S	South From AO Next to Cleveland	02/09/88	10	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	CoElute:	BMDL	ND
16A S	South From AO Next to Cleveland	02/09/88	5	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
17A S	South From AO Next to Cleveland	02/09/88	6	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
18A S	South From AO Next to Cleveland	02/09/88	11	7	37.0	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
19A S	South From AO Next to Cleveland	02/09/88	4	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
20A S	South From AO Next to Cleveland	02/09/88	8	0.003	-	ND	ND	ND	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND
21A S	South From AO Next to Cleveland	02/09/88	11	0	-	nr	ND	ND e	ND	ND e	ND	ND e	-	-	-	-	-	-	-
22AS #1	South From AO Next to Cleveland	02/09/88	17 a	0	-	i	ND	ND e	ND	ND	ND	ND	BMDL m	BMDL	ND	0	ND	ND	ND
23A S	South From AO Next to Cleveland	02/09/88	-	0	-	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND

Notes: Sample abbreviations used: MeCL - Methylene Chloride; DCE - dichloroethylene; DCA - dichloroethane; TCA - trichloroethane;
TCE - Trichloroethylene; PCE - Tetrachloroethylene; Aromat. - Aromatics; XYL - xylene.
ND - Not detected
nr - Sample was not run on a GC which was measuring this parameter.
BMDL - Detected at trace, non-quantifable levels.
"-" - No data; sample either not analyzed (usually because of leak in bag) or on-site data not obtained.
i - Interference from co-eluting hydrocarbons in sample.
g - Reported Results from the GC/MS analyses of tube samples taken from the soil gas bag samples.
e - Reported data from analyses performed by Weston's Loinville lab using a GC w/ electron capture detector.
a - Reported value is an average from replicate samples.
m - Reported value is the maximum obtained from analyses of two replicate samples.
Coelute: - signifies that the reported Ethyl Benzene & m-Xylene values were from a GC on which the two compounds coelute.
Therefore the reported value is the total concentration for both compounds.

TABLE 6-10 RESULTS FROM TRAVERSE (WEST TO EAST) ALONG NORTH FENCE
(Consecutive Numbers Passed Upon 50' Increments)

Uniontown, OH - February 1988
Concentration Data (ppb) From Field Photovac Analyses (Unless Specified Otherwise)

SAMPLE IDENTIFYING INFORMATION Sample ID	Sample Description	Sampled Date	OVA Methan PPM	On-site Results %LEL	Temp.	VINYL CHLORIDE	MeCL (e)	1,1-DCE	1,1-DCA (e)	TCE	1,1,1-TCA (e)	PCE	BENZENE	TOLUENE	m-ETHYL TOLUENE	Total C2 Alkyl Aromat.	ETHYL BENZENE	m-XYL	STYRENE/ O-XYL
NE01	East Traverse along North fence	02/09/88	-	0	38.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
NE02	East Traverse along North fence	02/09/88	-	0	39.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
NE03	East Traverse along North fence	02/09/88	14	0	38.6	BMDL i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
NE04	East Traverse along North fence	02/09/88	2500	0	38.3	ND	ND	ND	ND	ND	ND	ND	4	ND	ND	0	ND	ND	ND
NE05	East Traverse along North fence	02/09/88	3	0	39.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
NE06	East Traverse along North fence	02/09/88	18	0	38.7	i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
NE07	East Traverse along North fence	02/09/88	3	0	42.0	ND	ND	ND	ND	ND	ND	ND	14	ND	ND	1	ND	1	ND
NE08	East Traverse along North fence	02/09/88	4	0	41.3	BMDL i	ND	ND e	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
NE09	East Traverse along North fence	02/09/88	* 1 %	>100	43.3	ND	30	ND	ND	ND	47	7 a	ND	ND	ND	0	ND	ND	ND
NE10	East Traverse along North fence	02/09/88	88	0	42.3	i	ND	ND E	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
NE11	East Traverse along North fence	02/09/88	* >25%	>100	-	-	ND	ND e	ND	ND	ND	ND	1450	ND	ND	0	ND	ND	ND
NE13	East Traverse along North fence	02/09/88	-	>100	-	-	ND	ND E	ND	ND	ND	ND	2430	247	nr	0	ND	ND	ND
NE15	East Traverse along North fence	02/09/88	-	20	-	-	ND	ND E	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
NE17	East Traverse along North fence	02/09/88	-	100	-	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
NE19	East Traverse along North fence	02/09/88	-	>100	-	i	ND	ND e,i	ND	ND	ND	ND	340 g	390 g	ND	4160 g	3900 g	260 g	ND
NE21	East Traverse along North fence	02/09/88	1435	20	-	i	ND	ND e,i	ND	ND	ND	ND	11.3	10.4	ND	0	ND	ND	ND
NE23	East Traverse along North fence	02/09/88	-	100	-	i	ND	ND e,i	ND	ND e,i	205 g	ND e	1400 g	1600 g	ND	11150 g	4100 g	5650 g	ND

Notes: Sample abbreviations used: MeCL - Methylene Chloride; DCE - dichloroethylene; DCA - dichloroethane; TCA - trichloroethane;
TCE - Trichloroethylene; PCE - Tetrachloroethylene; Aromat. - Aromatics; XYL - xylene.
ND - Not detected
nr - Sample was not run on a GC which was measuring this parameter.
BMDL - Detected at trace, non-quantifable levels.
"-" - No data; sample either not analyzed (usually because of leak in bag) or on-site data not obtained.
i - Interference from co-eluting hydrocarbons in sample.
g - Reported Results from the GC/MS analyses of tube samples taken from the soil gas bag samples.
e - Reported data from analyses performed by Weston's Loinville lab using a GC w/ electron capture detector.
a - Reported value is an average from replicate samples.
x - Reported value is the maximum obtained from analyses of two replicate samples.
* - Methane Concentration Reported as Percent Volume instead as PPM

TABLE 6-11 RESULTS FROM AMBIENT AIR, HEADSPACE OF SHALLOW GROUNDWATER WELLS, AND HEADSPACE OF GAS EXTRACTION WELL ANALYSES

Results from Soil Gas Analyses Taken at Industrial Excess Landfill,
Uniontown, OH - February 1988
Concentration Data (ppb) From Field Photovac Analyses (Unless Specified Otherwise)

SAMPLE IDENTIFYING INFORMATION Sample ID	Sample Description	Sampled Date	OVA Methan PPM	On-site Results %LEL	Temp.	VINYL CHLORIDE	MeCL (e)	1,1-DCE	1,1-DCA (a)	TCE	1,1,1-TCA (a)	PCE	BENZENE	TOLUENE	m-ETHYL TOLUENE	Total C2 Alkyl Aromat.	ETHYL BENZENE	m-XYL	STYRENE/ O-XYL
	Ambinet Air at Grid Loc. D-4	02/10/88	2000	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
	Ambient Air at Park	02/10/88	10	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	nr	0	ND	nr	nr
	Ambient Air at Grid Loc. G-1	02/10/88	3703	-	-	i	ND	ND e,i	ND	ND	ND	ND	14	17	ND	19.6	ND	19.6	ND
	Ambient Air at Grid Loc. A-6	02/09/88	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
MW-01S	Groundwater Mon. Well	02/10/88	1300	5	-	i	ND	ND e,i	ND	ND	ND	ND	BMDL	ND	ND	0	ND	ND	ND
MW-02S	Groundwater Mon. Well	02/10/88	7	0	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
MW-10S	Groundwater Mon. Well	02/10/88	93	0	-	BMDL i	ND	ND	ND	ND	ND	ND	BMDL	ND	ND	0	ND	ND	ND
MW-11S	Groundwater Mon. Well	02/10/88	8	0	-	i	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
EW01	Extraction Well System	02/10/88	* 28 %	>100	-	i	ND	ND e,i	ND	ND	ND	ND	3280	1730	ND	667	CoElute:	667	ND
EW02	Extraction Well System	02/10/88	* 48 %	-	-	i	ND	ND e,i	ND	410 e	20	790 e	HND	HND	HND	HND	HND	HND	HND
EW03	Extraction Well System	02/10/88	* 24 %	>100	-	i	810	ND e,i	ND	ND	ND	44 e	1120	324	nr	113	CoElute:	113	nr
EW04	Extraction Well System	02/10/88	* 42 %	>100	-	i	570	ND e,i	ND	140 e	ND	130 e	552	222	HND	HND	HND	HND	HND
EW05	Extraction Well System	02/10/88	* 32 %	>100	-	530 g	ND	ND e,i	ND	100 e	ND	53 e	810 g	1300 g	HND	590 g	HND	590 g	HND
EW06	Extraction Well System	02/10/88	* 17 %	>100	-	i	2100	ND e,i	ND	300 e	8	787	2780	1570	HND	HND	HND	HND	HND
EW07	Extraction Well System	02/10/88	* 16 %	>100	-	i	460	ND e,i	ND	34 e	20	21 e	1640	734	HND	HND	HND	HND	HND
EW08	Extraction Well System	02/10/88	33	0	-	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	nr	0	ND	ND	nr
EW09	Extraction Well System	02/10/88	* 32 %	>100	-	790 g	720	ND e,i	ND	120 e	ND	100 e	1800 g	3300 g	HND	2390 g	750 g	1300 g	340 g
EW10	Extraction Well System	02/10/88	* 22 %	>100	-	620 g	850	ND e,i	ND	120 e	65	100 e	3800 g	4200 g	HND	3220 g	1300 g	1500 g	420 g
EW11	Extraction Well System	02/10/88	* 17 %	>100	-	i	1200	ND e,i	ND	34 e	32	67 e	1170	113	ND	71	CoElute:	71	ND
EW12	Extraction Well System	02/10/88	* 16 %	>100	-	i	610	ND e,i	ND	ND	ND	ND	801	HND	HND	HND	HND	HND	HND

Notes: Sample abbreviations used: MeCL - Methylene Chloride; DCE - dichloroethylene; DCA - dichloroethane; TCA - trichloroethane;
TCE - Trichloroethylene; PCE - Tetrachloroethylene; Aromat. - Aromatics; XYL - xylene.
ND - Not detected
HND - Not detected but, because of use of very small injection volumes, the Detection Limit is 10X to 25X larger than a normal ND.
nr - Sample was not run on a GC which was measuring this parameter.
BMDL - Detected at trace, non-quantifable levels.
"-" - No data; sample either not analyzed (usually because of leak in bag) or on-site data not obtained.
i - Interference to Photovac Field Analyses due to co-eluting hydrocarbons in sample.
g - Reported Results from the GC/MS analyses of tube samples taken from the soil gas bag samples.
e - Reported data from analyses performed by Weston's Loinville lab using a GC w/ electron capture detector.
a - Reported value is an average from replicate samples.
m - Reported value is the maximum obtained from analyses of two replicate samples.
* - Methane Concentration Reported as Percent Volume instead as PPM
Reported % concentrations should be considered as estimates only - usefull in describing the relative distribution between sampled points.
Coelute: - signifies that the reported Ethyl Benzene & m-Xylene values were from a GC on which the two compounds coelute.
Therefore the reported value is the total concentration for both compounds.

TABLE 6-12 RESULTS FROM ANALYSES USING THE PRE-EXISTING SAMPLING GRID

Uniontown, OH - February 1988
Concentration Data (ppb) From Field Photovac Analyses (Unless Specified Otherwise)

SAMPLE IDENTIFYING INFORMATION Sample ID	Sample Description	Sampled Date	OVA Methan PPM	On-site Results %LEL	Temp.	VINYL CHLORIDE	MeCL (e)	1,1-DCE	1,1-DCA (e)	TCE	1,1,1-TCA (e)	PCE	BENZENE	TOLUENE	m-ETHYL TOLUENE	Total C2 Alkyl Aromat.	ETHYL BENZENE	m-XYL	STYRENE/ O-XYL
A01	ON SITE GRID POINT	02/10/88	-	0	37.8	ND	-	ND	-	ND	-	ND	ND	ND	nr	0	ND	ND	nr
A03	ON SITE GRID POINT	02/10/88	-	260	37.2	i	ND	ND e,i	ND	ND	ND	15 e	2260	ND	nr	0	ND	nr	nr
A05	ON SITE GRID POINT	02/10/88	-	18	33.2	i	ND	ND e,i	ND	ND	ND	ND	97	ND	nr	0	ND	ND	nr
A07	ON SITE GRID POINT	02/10/88	1296	1	37.8	i	ND	ND e,i	ND	ND	ND	ND	7	ND	nr	0	ND	nr	nr
A09	ON SITE GRID POINT	02/10/88	6481	29	38.2	i	ND	ND e,i	ND	ND	ND	ND	27.5	25.5	ND	992	992	ND	ND
A11	ON SITE GRID POINT	02/10/88	* 10 %	84	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
B02	ON SITE GRID POINT	02/10/88	1296	70	34.1	i	ND	ND e,i	ND	ND	ND	ND	ND	BMDL	ND	0	ND	ND	ND
B04	ON SITE GRID POINT	02/10/88	-	60	33.0	ND	ND	ND e,i	ND	ND	ND	ND	523	4	ND	0	ND	ND	ND
B06	ON SITE GRID POINT	02/10/88	44	0	31.5	i	ND	ND e,i	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
B08	ON SITE GRID POINT	02/10/88	* >50%	>100	31.4	240 g	ND	ND e,i	ND	210 e	120	75 e	6700 g	47000 g	800 g	54600 g	32000 g	14000 g	8600 g
B10	ON SITE GRID POINT	02/10/88	* >50%	>100	33.2	ND	130	ND e;i	210	19 e	17	100 e	ND	ND	ND	0	ND	ND	ND
B12	ON SITE GRID POINT	02/10/88	7407	60	43.7	i	ND	ND e,i	ND	ND	ND	36	135	43.7	240 g	408 g	240 g	130 g	38 g
C01	ON SITE GRID POINT	02/10/88	* 6 %	460	38.0	i	ND	ND e,i	ND	ND	ND	ND	662	84	ND	0	10,860	ND	ND
C03	ON SITE GRID POINT	02/10/88	3888	0	33.5	i	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
C05	ON SITE GRID POINT	02/10/88	* >50%	602	39.6	i	ND	ND e,i	ND	ND	ND	ND	71.9	366	ND	252	252	ND	ND
C07	ON SITE GRID POINT	02/10/88	* 29 %	580	40.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
C09	ON SITE GRID POINT	02/10/88	3666	0	37.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
C11#1	ON SITE GRID POINT	02/10/88	*>50% *	312	41.3	i	ND	ND e,i	ND	ND	ND	ND	93 a	450 a	ND	1018 a	1000 a	35 g,*	ND
D02	ON SITE GRID POINT	02/10/88	* >50%	>100	43.9	i	ND	ND e,i	ND	ND	ND	54 e	25000 i,g	530	HND	23900	22900	860 g	140 g
D04	ON SITE GRID POINT	02/10/88	* 25 %	>100	33.3	i	ND	ND e,i	ND	ND	ND	ND	1120	ND	HND	HND	HND	HND	HND
D06	ON SITE GRID POINT	02/10/88	* 7 %	0	32.1	i	ND	ND e,i	ND	ND	ND	ND	ND	12	ND	260	ND	260	ND
D08#1	ON SITE GRID POINT	02/10/88	* 7% *	>100	33.3	i	ND	ND e,i	ND	ND	ND	ND	296 a	25 g	HND	54 g	26 g	28 g	ND
D10	ON SITE GRID POINT	02/10/88	8703	22	34.4	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	177	CoElute:	177	ND
D12	ON SITE GRID POINT	02/10/88	203	0	33.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
E1	ON SITE GRID POINT	02/10/88	* 19 %	770	39.2	i	ND	ND e,i	ND	ND	ND	ND	2070 g	ND	ND	0	ND	ND	ND
E3	ON SITE GRID POINT	02/10/88	* 23 %	750	34.2	i	ND	ND e,i	ND	ND	ND	ND	12900	ND	859	9958	CoElute:	9958	ND
E5	ON SITE GRID POINT	02/10/88	9000	10	41.4	i	ND	ND e,i	ND	ND	ND	ND	523	7	ND	200	CoElute:	200	ND
E7	ON SITE GRID POINT	02/10/88	* 34 %	550	-	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	6	1054	CoElute:	466	588
E9	ON SITE GRID POINT	02/10/88	2960	32	39.5	i	ND	ND e,i	ND	ND	ND	ND	19.8	13.4	ND	0	ND	ND	ND
E11	ON SITE GRID POINT	02/10/88	* >50%	609	33.0	i	ND	ND e,i	ND	ND	ND	ND	14000 i	ND	ND	5000	5000	ND	ND
F02#1	ON SITE GRID POINT	02/10/88	8700 *	30 *	31.4	i	ND	ND e,i	ND	ND	ND	ND	187 a	BMDL *	ND	0	ND	ND	ND
F04	ON SITE GRID POINT	02/10/88	* >50%	>100	35.4	i	ND	ND e,i	ND	ND	ND	ND	2000	ND	ND	1000	CoElute:	1000	ND
F06	ON SITE GRID POINT	02/10/88	* 9%	>100	35.4	i	ND	ND e,i	ND	ND	ND	ND	1170	1590	HND	2350	1180	1170	HND
F08	ON SITE GRID POINT	02/10/88	* 20 %	>100	37.6	i	16000	ND e,i	ND	34 e	ND	42 e,i	114000	11900	HND	16370	7830	8540	HND
F10	ON SITE GRID POINT	02/10/88	* >50%	>100	38.5	i	ND	ND e,i	ND	11 e	ND	302	35900	1410	HND	39400	39400	HND	HND
G1	ON SITE GRID POINT	02/10/88	* 43% *	>300	39.0	i	ND	ND e,i	ND	11 e,*	ND	24 a,e	1840	1610	ND	12300 a	CoElute:	8000a	4300 a
G3	ON SITE GRID POINT	02/10/88	* 3 %	250	40.6	i	ND	ND e,i	ND	62 e	ND	ND	8930	9835	HND	31000	31000	HND	HND
G5	ON SITE GRID POINT	02/10/88	* 25 %	500	37.1	i	ND	ND e,i	ND	ND	ND	ND	1220	9620	HND	20100	20100	HND	HND
G7	ON SITE GRID POINT	02/10/88	* >50 %	580	37.8	i	ND	ND e,i	96	14 e	14	9 e	16200 i	14400 i	ND	383	CoElute:	214	169
G9	ON SITE GRID POINT	02/10/88	200	0	39.5	i	ND	ND e,i	ND	ND	ND	ND	5340	ND	ND	57.4	ND	ND	57.4
H02	ON SITE GRID POINT	02/10/88	-	0	33.2	i	-	i	-	701	-	ND	210 g	515	1390	209	209	ND	ND
H04	ON SITE GRID POINT	02/10/88	23	>100	34.5	ND	ND	ND	ND	ND	ND	ND	ND	34	ND	91.6	ND	91.6	ND
H06	ON SITE GRID POINT	02/10/88	* >50 %	>100	34.0	i	ND	ND e,i	ND	21 e	ND	ND	1360	ND	ND	110	CoElute:	110	ND
H08	ON SITE GRID POINT	02/10/88	-	>100	32.3	i	ND	ND e,i	ND	ND	ND	ND	2160	152	ND	387	CoElute:	387	ND
H10	ON SITE GRID POINT	02/10/88	* 50 %	>100	30.3	i	ND	ND e,i	ND	ND	ND	ND	1020	475	nr	nr	nr	nr	nr
H12	ON SITE GRID POINT	02/10/88	1333	0	38.2	ND	ND	ND	ND	ND	ND	ND	18.7	10.5	ND	0	ND	ND	ND
J1	ON SITE GRID POINT	02/10/88	* >50 %	>500	39.4	i	ND	ND e,i	ND	ND	ND	ND	1800 i	631 i	ND	0	ND	ND	ND
J3	ON SITE GRID POINT	02/10/88	* >50 %	78	36.8	i	ND	ND e,i	ND	ND	ND	ND	329	ND	ND	13.5	ND	ND	13.5
J5	ON SITE GRID POINT	02/10/88	1333	30	33.6	i	ND	ND e,i	ND	ND	ND	ND	BMDL	BMDL	ND	0	ND	ND	ND
J7	ON SITE GRID POINT	02/10/88	3833	10	35.0	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
J9	ON SITE GRID POINT	02/10/88	-	>600	40.0	i	ND	ND e,i	ND	ND e,i	ND	ND	2030	854	HND	2210	HND	2210	HND
K02	ON SITE GRID POINT	02/10/88	* >50%	>100	37.9	i	1300	ND e,i	ND	50 e	240	100 e	6450	13480	ND	0	ND	ND	ND
K04	ON SITE GRID POINT	02/10/88	-	>100	32.1	i	ND	ND e,i	ND	ND	ND	ND	1750	ND	ND	1050	CoElute:	1050	ND

TABLE 6-12
(Cont'd)

RESULTS FROM ANALYSES USING THE PRE-EXISTING SAMPLING GRID

Uniontown, OH - February 1988
Concentration Data (ppb) From Field Photovac Analyses (Unless Specified Otherwise)

Sample ID	Sample Description	Sampled Date	OVA Methan PPM	On-site Results %LEL	On-site Results Temp.	VINYL CHLORIDE	MeCL (e)	1,1-DCE	1,1-DCA (e)	TCE	1,1,1-TCA (e)	PCE	BENZENE	TOLUENE	m-ETHYL TOLUENE	Total C2 Alkyl Aromat.	ETHYL BENZENE	m-XYL	STYRENE/ O-XYL
K06	ON SITE GRID POINT	02/10/88	* 50 %	0	33.3	i	ND	ND e,i	ND	ND e	ND	ND e	1670	ND	ND	4660	CoElute:	2460	2200
K08	ON SITE GRID POINT	02/10/88	* >50%	>100	-	i	ND	ND e,i	ND	ND	ND	ND	1622 a	265 g,a	ND	6070 g,a	5050 g,a	805 g,a	215 g,a
L1	ON SITE GRID POINT	02/10/88	-	>500	37.1	i	ND	ND e,i	ND	ND	ND	ND	433	ND	ND	7140	CoElute:	7140	BMDL
L3	ON SITE GRID POINT	02/10/88	-	>500	36.0	i	ND	ND e,i	ND	ND	ND	ND	620 g	650 g	ND	3840 g	1500 g	1900 g	440 g
L5	ON SITE GRID POINT	02/10/88	* >50%	>500	37.3	i	ND	ND e,i	ND	ND e	ND	ND	6060	4920	ND	0	ND	ND	ND
L7	ON SITE GRID POINT	02/10/88	1200	18	36.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	nr	0	ND	nr	nr
L9	ON SITE GRID POINT	02/10/88	-	148	39.2	i	ND	ND e,i	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
M00	OFF-SITE GRID POINTS (SOUTH END)	02/10/88	7	0	37.0	i	ND	ND e,i	ND	ND	ND	ND	BMDL	ND	ND	0	ND	ND	ND
M01	OFF-SITE GRID POINTS (SOUTH END)	02/10/88	20	0	30.0	BMDL i	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND
M02	OFF-SITE GRID POINTS (SOUTH END)	02/10/88	* >50%	>100	22.0	i	ND	ND e,i	ND	ND	ND	ND	585 i	ND	ND	2460	CoElute:	2460	ND
M04	OFF-SITE GRID POINTS (SOUTH END)	02/10/88	* 3 %	0	33.1	i	ND	ND e,i	ND	ND	ND	ND	35.3	ND	ND	0	ND	ND	ND
M08	OFF-SITE GRID POINTS (SOUTH END)	02/10/88	8167	0	33.1	i	ND	ND e,i	ND	ND	ND	ND	14.1	ND	ND	0	ND	ND	ND

Notes: Sample abbrevations used: MeCL - Methylene Chloride; DCE - dichloroethylene; DCA - dichloroethane; TCA - trichloroethane;
TCE - Trichloroethylene; PCE - Tetrachloroethylene; Aromat. - Aromatics; XYL - xylene.
ND - Not detected
HND - Not detected but, because of use of very small injection volumes, the Detection Limit is 10X to 25X larger than a normal ND.
nr - Sample was not run on a GC which was measuring this parameter.
BMDL - Detected at trace, non-quantifable levels.
"-" - No data; sample either not analyzed (usually because of leak in bag) or on-site data not obtained.
i - Interference from co-eluting hydrocarbons in sample.
g - Reported Results from the GC/MS analyses of tube samples taken from the soil gas bag samples.
e - Reported data from analyses performed by Weston's Loinville lab using a GC w/ electron capture detector.
a - Reported value is an average from replicate samples.
m - Reported value is the maximum obtained from analyses of two replicate samples.
* - Methane Concentration Reported as Percent Volume instead as PPM
Reported % concentrations should be considered as estimates only - usefull in describing the relative distribution between sampled points.
Coelute: - signifies that the reported Ethyl Benzene & m-Xylene values were from a GC on which the two compounds coelute.
Therefore the reported value is the total concentration for both compounds.

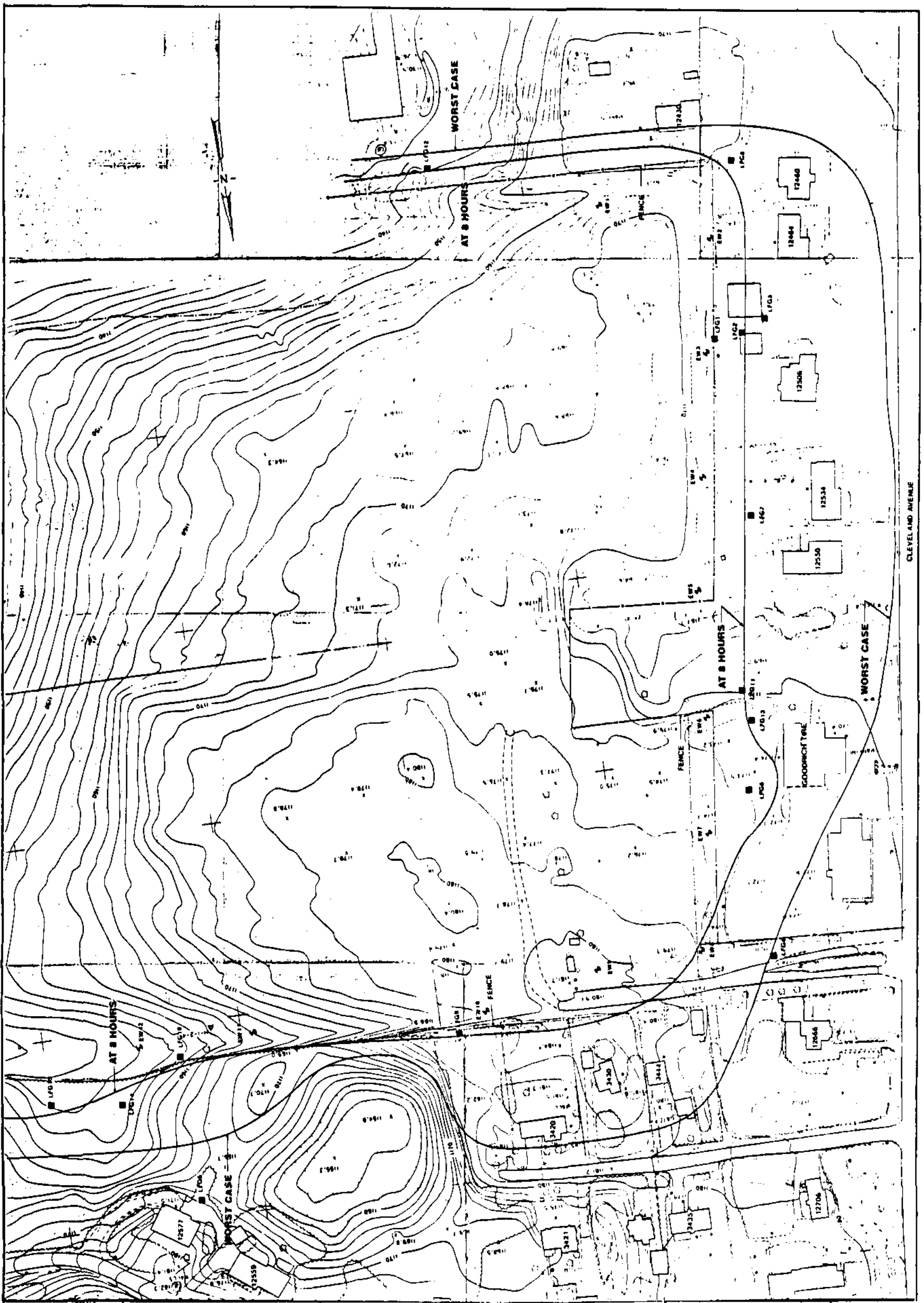
not influenced by MVS, for various topographic and geological reasons. Based on their experience with the MVS, EmRT's contractors prepared a study of the expected worst case gas migration without controls at the IEL site.

- Substantial quantities of gases (including methane, benzene and toluene) are being produced within the central portions of the landfill not being controlled by the MVS. These materials are apparently being emitted through the surface of the site directly into the atmosphere. High concentrations (a maximum of 114,000 ppb of benzene at one location) of these materials were detected within the soil matrix and in the very close proximity to the ground. Substantial drop-off in concentration (due to dilution) is noted at elevations of 5 feet above the ground. No significant ambient concentrations were noted in the breathing zone at offsite locations. Ambient levels observed in the breathing zone on the site are not unlike exposure levels occurring in the vicinity of Cleveland Avenue during rush hour or during the pumping of gasoline.

6.5.2 Worst Case Methane Migration

An assessment was performed by EmRT's contractors to determine the furthest extent of methane migration under worst case conditions. Figure 6-6 provides a diagrammatic representation of the results of this exercise. The "worst case" scenario includes the total the shutdown of the MVS. Lateral methane migration was not expected to be extensive due to the following:

- High water table conditions along the east;
- Topographic and geological conditions at the site; and,
- Pressure and pathway limitations as determined by actual field measurements.



GAS MIGRATION POTENTIAL

INDUSTRIAL EXCESS LANDFILL
UNION TOWN, OHIO

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC
TEL. 606/341-6368
211 GRANDVIEW DRIVE COVINGTON, KENTUCKY 41017

SCALE: 1"=80
DATE: 4-20-87
DRAWN BY: DPG
CHECKED BY: JJW
PROJECT NO 9831301
DRAWING NO

NO.	REVISION	DATE

FIGURE 6-6

The memo describing the results of the worst case migration scenario is presented in Appendix O. The highlights of the rationale for the conclusions regarding the projected maximum extent of methane migration is presented in the following paragraphs.

<u>North Side</u>

1. Area adjacent to Extraction Wells 11 and 12.

    --- Landfill gas has never been detected in LFG-5. This was true even prior to start-up of the gas extraction system, under worst case conditions.

    --- Landfill gas would be expected to be detected in LFG-14 after about 24 hours of uncontrolled migration.

    --- Landfill gas would be expected to be detected in LFG-15 after about 8 hours of uncontrolled migration.

    --- Based on the boring log for LFG-5, the bedrock surface is closer to the ground surface at LFG-5 than at LFG-14 and LEG-15. Bedrock sloping toward the ground surface north of the site gradually confines the unsaturated zone, and should drive subsurface gas to the ground surface. Though landfill gas has been found to move through bedrock at some sites, the deep probe at LFG-5 is in bedrock and has always shown zero percent methane.

2. Natural valley adjacent to the area east of LFG-9 and west of Extraction Well 11.

--- The presence of a natural valley provides a means for landfill gas release to the atmosphere.

--- Landfill gas migration would be expected to be about 50 ft. during worst case conditions.

3. Area adjacent to LFG-9 and northwest corner of landfill.

--- Landfill gas would be expected to be detected in LFG-9 after about 8 hours of uncontrolled migration.

--- The lack of pressure in LFG-9 indicates that diffusion is the main migration mechanism in this area. Landfill gas migration would not be expected to exceed 200 ft. during worst case conditions.

West Side

1. Landfill gas would be expected to be detected in LFG-2 within 8 hours of uncontrolled migration.

2. Landfill gas would be expected to be detected in LFG-13 after 8 hours of uncontrolled migration.

3. Landfill gas would be expected to be detected in LFG-3 and LFG-6 after 48 hours of uncontrolled migration.

4. Landfill gas has never been detected in LFG-4, even during worst case conditions, prior to start-up of the gas extraction system.

5. The lack of pressure in the monitoring wells on the west side indicates that diffusion is the main migration mechanism. Landfill gas migration would not be expected to exceed 200 ft. during worst case conditions.

South Side

1. Area adjacent to Extraction Wells 1 and 2.

--- Migration would be expected to be about 50 ft. during worst case conditions.

2. Area east of Extraction Well 1.

--- The slope adjacent to the landfill in this area provides a natural means of release for landfill gas to the atmosphere.

--- The presence of the water table beneath the base of the gravel slope will limit the migration of gas to the shallow subsurface.

--- Landfill gas would be expected to be detected in LFG-12 after 48 hours.

--- Migration would be expected to be about 50 ft. during worst case conditions.

East Side

1. The drainage ditch probably represents the water table. The presence of the water table at or immediately beneath the ditch would prevent migration of gas under the ditch.

2. The depth of the landfill below existing ground level along the ditch is estimated to be 10 ft. or less.

3. For these two reasons, we would expect gas migration not to proceed east of the ditch even during worst case conditions.

6.6 In-Home Air Sampling

The TAGA mobile laboratory was mobilized to IEL on two occasions in 1986 to perform in-home air sampling. A comprehensive in-home air sampling was also a part of the investigation performed in 1988. Information concerning these samplings are provided in the following paragraphs.

6.6.1 Description of the In-Home Air Sampling Efforts

For the 1986 investigation, operation of the unit was performed by personnel from U.S. EPA's Environmental Response Team (EnRT) and the Enviresponse, Inc. From January 6 through January 9, 1986, 13 homes were sampled and on September 9, 1986, eight homes were sampled.

Samples were collected through a flexible transfer hose from the house directly to the mobile laboratory. Analyses were performed for volatile organic compounds within the mass range of 60-250 atomic mass units. Monitoring was performed at the center of the specific room in the house for 2 minutes, then monitoring was performed along the perimeter. The purpose of this type of monitoring is to indicate a possible single source of target compounds, either through migration from the waste site, or a household product. The Enviresponse report on the analysis indicates that several compounds were found in the basements of individual houses at concentrations above those found in the control house. However, in most cases, the source was identified as household solvent, cleaners and/or paints which were stored in the house.

The report states that overall, the analyses did not provide sufficient information to make a conclusion on the landfill as a possible source of the compounds detected.

The 1988 in-home investigation was performed by U.S. EPA's EnRT in conjunction with personnel operating under Roy F. Weston's Response Engineering and Analytical Contract. In home samples were taken using the TAGA, Tenax/Carbonized Molecular Sieve (Tenax/CMS) adsorption tubes and Summa canisters (for grab samples). Field monitoring devices, (Hnu, OVA and explosimeter), were also used. The Tenax/CMS samples provided the basis for assessing time-integrated concentrations in the home. Analyses were performed for the list of target compounds.

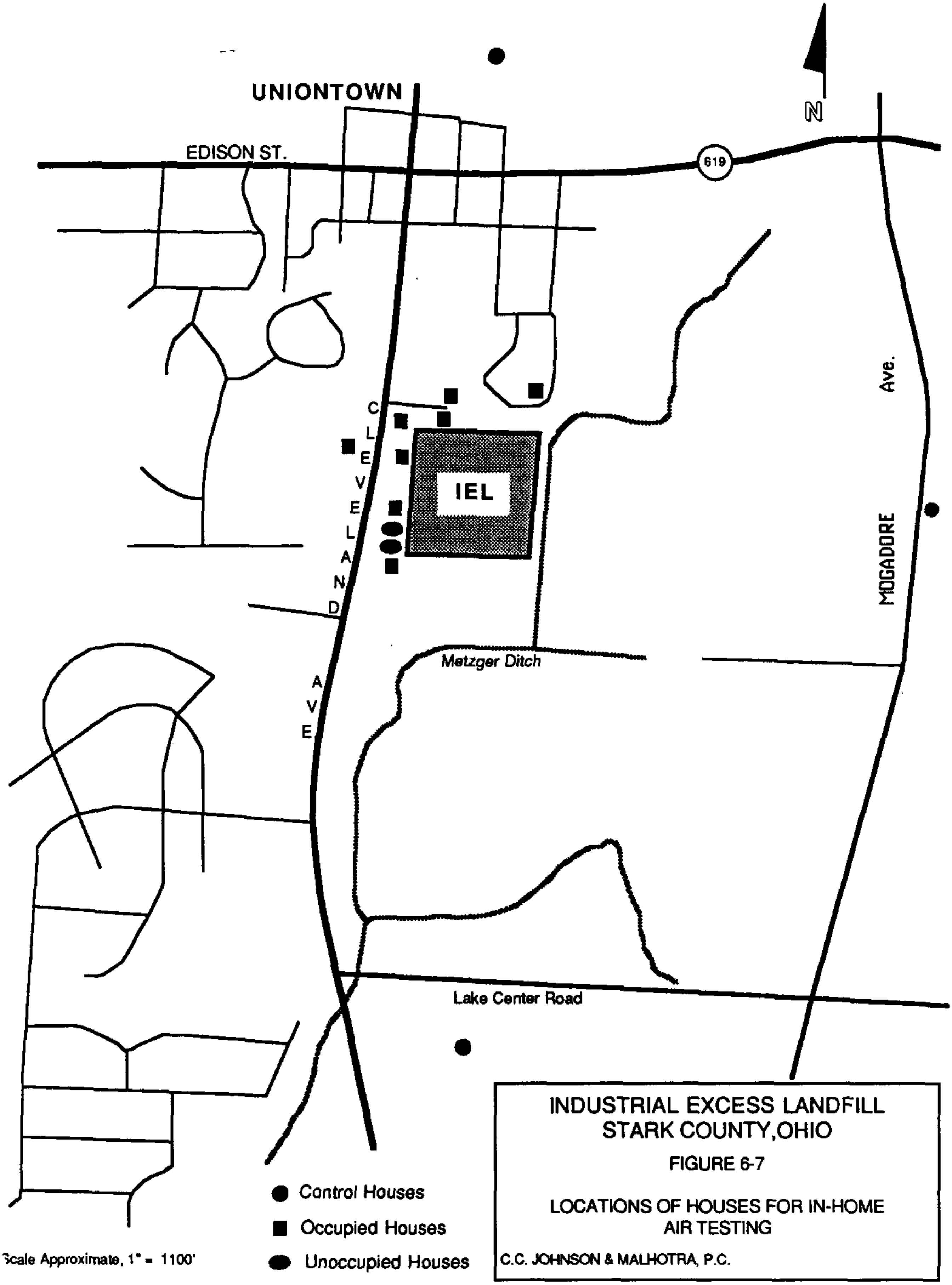
Samples were taken at eight occupied homes, two unoccupied homes and three control homes. The control homes were selected to be approximately 1 mile in each of three directions (north, south, and east) from the site. Figure 6-7 shows the relative locations of the homes sampled with respect to the landfill.

Results from the different phases of the sampling effort are shown in Table 6-13.

6.6.2 Summary of In-Home Air Sampling

A review of the results from the in-home air analyses leads to the following major conclusions:

- o Most of the target compounds were not present at concentrations above the detection limit at most sampling locations in the residences. Where benzene levels were reported in one home, the TAGA was used to trace the source to a chain saw in the basement.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO

FIGURE 6-7

LOCATIONS OF HOUSES FOR IN-HOME AIR TESTING

C.C. JOHNSON & MALHOTRA, P.C.

TABLE 6-13

SUMMARY OF RESULTS FROM INDOOR AIR ANALYSES, UNIONTOWN OHIO, FEBRUARY 1988

(Page 1 of 4)

Compound Analysis Type	Control House #1	Control House #2	Control House #3	Range for Controls	Unoccupied House #1	Unoccupied House #2
1,1,1-Trichloroethane						
TAGA Range	ND (2) - 5 j	ND (1)	ND (1)	ND (1) - 5 j	ND (1)	ND (1)
GC/MS Range	0.4 - 0.8	ND - 0.3	0.09 - 0.1	0.09 - 0.8	ND - <.7 q	ND - 0.3
Summa Data	ND					
1,1-Dichloroethane						
TAGA Range	<7 - <26 i	<1 - <2 i	ND (1) - <3 i	ND(1) - <26 i	ND (1)	ND (1) - <1 i
GC/MS Range	ND	ND	ND	ND	ND	ND
Summa Data	ND					
1,1-Dichloroethene						
TAGA Range	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
GC/MS Range	ND - 0.1	ND	ND	ND - 0.1	ND - <.07 q	ND - <.07 q
Summa Data	ND					
Benzene						
TAGA Range	7 j - 9	1 j - 2 j	ND (1)	ND (1) - 9	ND (4)	ND (2)
GC/MS Range	1.5 - 3.4	1.3 - 1.9	0.2	0.2 - 3.4	<.07 q - 0.4 b	<.07 q - 0.4 b
Summa Data	<10 q					
Chlorobenzene						
TAGA Range	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
GC/MS Range	ND	ND	ND		ND	ND
Summa Data	ND					
C2 Alkyl Aromatics						
TAGA Range	57 j - 77	ND (7)	ND (6)	ND (6) - 77	ND (11)	ND (10)
GC/MS Range	15.9	4.1 - 4.3	2.3 - 7.6	2.3 - 15.9	<.07 - 1.6	0.7 - 1.1
Summa Data	20.8 - 21					
Methylene Chloride						
TAGA Range	ND (3)	ND (2)	ND (2) - 3 j	ND (2) - 3 j	ND (2)	ND (2)
GC/MS Range	0.3 - 1.3	0.6 - 1.6	0.6		0.2 - 0.9	ND - 0.6
Summa Data	ND					

NOTES:

ND - Not Detected; value in parentheses is the reported detection limit.
i - Interference from ethanol; value reported, which has only been partially corrected, should be considered only as maximum potentials.
j - Reported number is less than the TAGA's reported quantitation limit for that analysis.
P - Level detected in the passive sampling tube was greater than the level detected in the actively sampled tube.
b - Maximum level detected in the active sampling tubes was greater than the level detected in the travel blank tube.
q - Reported value was below the GC/MS quantitation limit (reported as BMDL).
a - Ethanol values reported only because of its ability to interfere with the TAGA determinations for 1,1-Dichloroethane (major) and vinyl chloride (slight).

TABLE 6-13 (Continued)

SUMMARY OF RESULTS FROM INDOOR AIR ANALYSES, UNIONTOWN OHIO, 1988

(Page 2 of 4)

Compound Analysis Type	Control House #1	Control House #2	Control House #3	Range for Controls	Unoccupied House #1	Unoccupied House #2
Tetrachloroethylene						
TAGA Range	ND (13)	ND (11)	ND (16)	ND(11)-ND(16)	ND (10)	ND (16)
GC/MS Range	0.1 - 0.3	0.09 - 0.1	0.2 - 0.3	0.09 - 0.3	ND - 0.2	ND - <0.7 q
Summa Data	<10 q					
Trichloroethylene						
TAGA Range	ND (3)	ND (2)	ND (2)	ND(2) - ND(3)	ND (2)	ND (2)
GC/MS Range	ND	ND - <.07 q	ND	ND - <.07 q	ND	ND - 0.09
Summa Data	ND					
Toluene						
TAGA Range	24 - 30	3 j - 4 j	ND (2)	ND (2) - 30	ND (6)	ND (4)
GC/MS Range	8.9 - 10	3.6 - 4.3	0.8 - 1	0.8 - 10	<.07 q - 1.4	0.7 - 1.7
Summa Data	18 - 23					
Vinyl Chloride						
TAGA Range	ND - <1 i	ND (1)	ND (1)	ND - <1 i	ND (1)	ND (1)
GC/MS Range	ND	ND	ND	ND	ND	ND
Summa Data	ND					
Hexanes						
GC/MS Range	0.6 - 4.1	ND	ND	ND - 4.1	ND	ND
Summa Data	ND					
Ethanol (a)						
GC/MS Range	9.7 - 11	ND - 6.8	1.7 - 7.1	ND - 11	ND	0.7 - 3.1
Summa Data	ND - 6.0					

NOTES:

- ND - Not Detected; value in parentheses is the reported detection limit.
- i - Interference from ethanol; value reported, which has only been partially corrected, should be considered only as maximum potentials.
- j - Reported number is less than the TAGA's reported quantitation limit for that analysis.
- P - *Level detected in the passive sampling tube was greater than the level detected in the actively* sampled tube.
- b - Maximum level detected in the active sampling tubes was greater than the level detected in the travel blank tube.
- q - Reported value was below the GC/MS quantitation limit (reported as BMDL).
- a - Ethanol values reported only because of its ability to interfere with the TAGA determinations for 1,1-Dichloroethane (major) and vinyl chloride (slight).

TABLE 6-13 (Continued)

SUMMARY OF RESULTS FROM INDOOR AIR ANALYSES, UNIONTOWN OHIO, FEBR. .8

(Page of 4)

Compound Analysis Type	Occupied House #1	Occupied House #2	Occupied House #3	Occupied House #4	Occupied House #5	Occupied House #6	Garage Occ. #6	Occupied House #7	Occupied House #8
1,1,1-Trichloroethane									
TAGA Range	ND (2)	ND (2) - 3 j	ND (2) - 3 j	ND (2)	ND (1)	ND (1)	ND (1)	ND (1) - 3 j	ND (2)
GC/MS Range	0.1 p - 0.4	0.7 - 1 p	0.1 - 0.4	0.2 - 0.4 p	0.1 - 2.2	0.09 - 0.1		0.3 - 1.8	ND - 0.1
Summa Data	ND					ND			
1,1-Dichloroethane									
TAGA Range	<3i - <4 i	ND(2) - <2 i	ND (5) - <16 i	ND(2) - <2 i	ND(6) - <24 i	<35 i - <95 i	<13 i	<1 i - <18 i	<2 j - <6 j
GC/MS Range	ND	ND	ND	ND	ND	ND		ND	ND
Summa Data	ND					ND			
1,1-Dichloroethene									
TAGA Range	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
GC/MS Range	ND	ND - 0.2	ND	<.07 q - .07	ND	ND		ND	ND - <.07 q
Summa Data	ND					ND			
Benzene									
TAGA Range	ND (2)	ND (2) - 2 j	ND (2) - 2 j	ND (2)	ND (2)	4 j - 14	30	3 j - 6 j	ND (2)
GC/MS Range	0.2 - 0.5 b	0.1 - 0.7 b	0.3 - 0.4 b	0.6 - 1.1 b	0.2 - 0.6 b	2.9 - 4.2		0.4 - 2.9	<.07 q - 0.36
Summa Data	<4.4					4.4 - 5.8			
Chlorobenzene									
TAGA Range	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
GC/MS Range	ND	ND	ND		ND	ND		ND	ND
Summa Data	ND					ND			
C2 Alkyl Aromatics									
TAGA Range	15 j - 22 j	ND (11)	ND (1)	ND (10)	ND (6) - 11 j	45 - 159	361	25 j - 47 j	ND (7)
GC/MS Range	7.5 - 8.7	0.9 - 1.0	3.9 - 6.9	3.1 - 3.5	4.8 - 6.0	21.3 - 24.8		12 - 14	0.9 - 1.1
Summa Data	<13.2 q					30.4 - 47.6			
Methylene Chloride									
TAGA Range	ND (5) - 7 j	ND (5) - 9 j	8 j - 21 j	ND (3)	ND (3)	ND (2) - 4 j	ND (2)	ND (2)	ND (3) - 3 j
GC/MS Range	0.6 - 3.4	2 - 4.5	2.7 - 10	1.3	ND - 4.6	0.2 - 1		1.1 - 5	ND - 0.5
Summa Data	<4.4 q					ND			

NOTES:

ND - Not Detected; value in parentheses is the reported detection limit.
i - Interference from ethanol; value reported, which has only been partially corrected, should be considered only as maximum potentials.
j - Reported number is less than the TAGA's reported quantitation limit for that analysis.
P - Level detected in the passive sampling tube was greater than the level detected in the actively sampled tube.
b - Maximum level detected in the active sampling tubes was greater than the level detected in the travel blank tube.
q - Reported value was below the GC/MS quantitation limit (reported as BMQL).
a - Ethanol values reported only because of its ability to interfere with the TAGA determinations for 1,1-Dichloroethane (major) and vinyl chloride (slight).

TABLE 6-13 (Continued)

SUMMARY OF RESULTS FROM INDOOR AIR ANALYSES, UNIONTOWN OHIO, FEBRU

(Page 4 of 4)

Compound Analysis Type	Occupied House #1	Occupied House #2	Occupied House #3	Occupied House #4	Occupied House #5	Occupied House #6	Garage Occ. #6	Occupied House #7	Occupied House #8
Tetrachloroethylene									
TAGA Range	ND (12)	ND (13)	ND (14)	ND (13)	ND (9)	ND (10)	ND (10)	ND (15)	ND (15)
GC/MS Range	0.4 - 0.5	0.2 - 0.3	0.3 - 0.4	0.4	0.5 - 0.6	0.1 - 0.2		0.2	0.9 - 2.4
Summa Data	ND					ND			
Trichloroethylene									
TAGA Range	ND (2)	ND (2)	ND (2)	ND(2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
GC/MS Range	<.07 q	ND - <.07 q	0.07 - 0.1	0.1 - 0.2	0.1 - 0.2 p	ND		ND	ND - <.07 q
Summa Data	ND					ND			
Toluene									
TAGA Range	5 j - 7 j	ND (3) - 4 j	5 j - 11 j	ND (4) - 4 j	ND (5) - 10 j	106 - 452	984	11 j - 19 j	ND (3) - 4 j
GC/MS Range	3.2 - 3.4	1.4 - 2	5.3 - 8.8	3.4 - 3.6	8 - 8.9	38 - 44		7.6 - 9.2	2.5 - 3.1
Summa Data	<4.4 q					130 - 230			
Vinyl Chloride									
TAGA Range	ND (1) - <1 i	ND (1)	ND (1) - <1 i	ND (1)	ND (1) - <1 i	<1 i - <4 i	<1 i	ND (1)	ND (1)
GC/MS Range	ND	ND - <.07 bq	ND	ND	ND	ND		ND	ND
Summa Data	ND					ND			
Hexanes									
GC/MS Range	0.8 - 1.1	ND	ND	0.8 - 2	ND	ND - 3		0.5 - 1.7	ND
Summa Data	ND					ND			
Ethanol (a)									
GC/MS Range	1 - 11	0.3 - 1	6.3 - 9.1	4.1 - 7.1	1.1 - 12	45 - 210		8.9 - 13	11 - 21
Summa Data	<4.4 q					130 - 240			

NOTES:

ND - Not Detected; value in parentheses is the reported detection limit.
i - Interference from ethanol; value reported, which has only been partially corrected, should be considered only as maximum potentials.
j - Reported number is less than the TAGA's reported quantitation limit for that analysis.
P - Level detected in the passive sampling tube was greater than the level detected in the actively sampled tube.
b - Maximum level detected in the active sampling tubes was greater than the level detected in the travel blank tube.
q - Reported value was below the GC/MS quantitation limit (reported as BMQL).
a - Ethanol values reported only because of its ability to interfere with the TAGA determinations for 1,1-Dichloroethene (major) and vinyl chloride (slight).

- The distribution and concentration levels of compounds found in the occupied homes are comparable to those in the control homes. The levels observed in the unoccupied homes also were lower than concentrations found in either the occupied homes immediately adjacent to the landfill or the control homes. These results suggest that for the homes sampled, domestic sources and other resident activities are the major determinants of indoor air quality (rather than the IEL site).

- There was no evidence that in-home detects were related to gases which had migrated from the landfill.

- Concentrations observed during the in-home testing were generally within the ranges as shown in Table 6-14 which presents data obtained by other researchers describing typical indoor air quality. Excursions beyond these typical ranges were traced to specific sources.

TABLE 6-14

TYPICAL INDOOR CONCENTRATIONS OF SELECTED COMPOUNDS

Compound	Concentration (ppb)	References*	Common Sources
Toluene	3 - 160	1	Petroleum based cleaning solvents, paints and paint removers, spray deodorants, nail base coat and polish, furniture polish; silicon caulking.
	33.7	3	
	14.6	4	
	2.4	5	
Benzene	3 - 16	1	Same sources as toluene with exception of nail base coat and polish; cigarette smokers in household; additional source - particle board.
	9.4	2	
	16.3	3	
	3.1	4	
	4.7	6a, 6d	
	1.4	6e, 6f	
	3.4	6g	
Ethyl Benzene	1 - 9	1	Same sources as benzene with exception of particle board.
	1.5	2, 6a	
	9.3	3	
	1.2	4, 6c	
	1.1	6b	
	1.8	6d	
	0.6	6e, 6h	
	0.4	6f	
	0.5	6g	
Xylenes	3 - 29	1	Same sources as ethyl benzene.
	1.2 - 3.7	2	
	2.0 - 28.8	6	
	28.8	3	
	4.8	4	
Alkanes (petane and lower)	No data in ppb.		Same sources as toluene plus general cleaning solvents, floor waxes, lower molecular weight alkanes also occasionally used as spray propellents.

---

*See end of Table 6-14.

TABLE 6-14 (Continued)

TYPICAL INDOOR CONCENTRATIONS OF SELECTED COMPOUNDS

Compound	Concentration (ppb)	References*	Common Sources
Alkanes (hexane and higher molecular weight hydrocarbons)	1.4 - 122	1	Some glass cleaners, room deodorizers, floor polishes, wood stains, and furniture polish. (Basically pentane and hexane will be found in any substance containing petroleum distillates or kerosene).
Methylene Chloride	372	3	Tar removers and tire patch, paint strippers, some mothballs, car engine cleaners and common spray can propellant.
Trichloroethylene	0.4 - 13	1	General cleaning solvents, metal cleaners, tire patches, and degreasers.
	0.5	2	
	3.5	3	
	0.3	4, 6c	
	0.4	6a	
	0.5	6b	
	0.2	6d, 6g	
	0.1	6e, 6	
	<0.1	6f	
Tetrachloroethane	0.6 - 29	1	Latex paints, residual dry cleaning solvents in clothing, metal degreasers, dewaxing and stripping solvents, upholstery cleaners, general household cleaning solvents.
	0.3 - 1.2	6	
	2.5	3	
	0.6	4	
	0.9	5	
1,1,1-Trichloroethane	1.7	2	General cleaning solvents, dry cleaning solvents, non-caustic drain cleaners, carpet and upholstery cleaners, metal cleaners, auto engine cleaners, and degreaser compounds.
	2.7 - 53	1	
	4.0	3	
	3.1	6a	
	2.2	6b	
	3.3	6c	
	4.8	6d	
	1.3	6e	
	0.8	6f	
	4.8	6g	
	6.8	6h	

---

*See end of Table 6-14

TABLE 6-14 (Continued)

TYPICAL INDOOR CONCENTRATIONS OF SELECTED COMPOUNDS

REFERENCES

1 "Indoor Air and Human Health"; R.B. Gammage & S.V. Kaye, ed.; Lewis Publishers, Inc., 1985; "Volatile Organic Compounds in Indoor Air: An Overview of Sources, Concentrations, and Health Effects", Sterling, D.A; pp. 387-402.

2 Environment International, Vol. 12, 369, 1986; "Total Exposure Assessment Methodology (TEAM) Study: Personal Exposures, Indoor-Outdoor Relationships, and Breath Levels of Volatile Organic Compounds in New Jersey"; Wallace, L.A., et. al. (Concentrations are the reported Geometric Mean of overnight personal air values).

3 "Proceedings of the 3rd International Conference on Indoor Air Quality and Climate"; B. Berglund, T. Lindvall, & J. Sundell, ed.; Liber Tryck AB, Stockholm, 1984; "Integrating 'Real Life' Measurements of Organic Pollution in Indoor and Outdoor Air of Homes in Northern Italy", M. De Bortoli, et. al.; pp. 21-26.

4 "Proceedings of the 3rd International Conference on Indoor Air Quality and Climate"; B. Berglund, T. Lindvall, & J. Sundell, ed.; Liber Tryck AB, Stockholm, 1984; "Volatile Hydrocarbons in Dutch Homes", E. Lebret, et. al.; pp. 169-174.

5 "Proceedings of the 3rd International Conference on Indoor Air Quality and Climate"; B. Berglund, T. Lindvall, & J. Sundell, ed.; Liber Tryck AB, Stockholm, 1984; "Sources and Characterization of Organic Air Contaminants Inside Manufactured Housing", D.K. Monteith, T.H. Stock, & W.E. Seifert, Jr.; pp. 285-290.

6 "The Total Exposure Assessment Methodology (TEAM) Study: Summary and Analysis: Volume 1"; L.A. Wallace, U.S. EPA Report # EPA/600/6-87/002a, June 1987. Concentration data used were median values from Tables 25, 26 & 46. Reference suffices indicate the location and times for the collected data: 6a - New Jersey, Fall 1981; 6b - New Jersey, Summer 1982; 6c - New Jersey, Winter 1983; 6d - Los Angeles, CA, January 1984; 6e - Los Angeles, CA, May, 1984; 6f - Contra Costa County, CA, June 1984; 6g - Greensboro, NC, May 1982; and 6h - Devils Lake, ND, October 1982.

7.0 GEOPHYSICAL INVESTIGATION

Geophysical remote sensing techniques were undertaken at the IEL site in order to gain a better understanding of the relationship between potential groundwater contamination patterns and subsurface geometry. This section provides a description of these studies and a discussion of the interpreted results.

7.1 Investigation Description

Geophysical studies at IEL consisted of two distinct phases of data gathering and interpretation. The first investigative phase had the following goals:

- Determine the horizontal and vertical extent of potential groundwater contamination.
- Determine the depth to bedrock in the area of the landfill.
- Identify potential subsurface pathways of contaminant migration.

Using these data and interpretations, recommendations were made concerning the siting of monitoring wells.

Three different geophysical techniques were utilized in this first phase; terrain conductivity, seismic reflection, and surface resistivity. The procedures used were conventional and widely utilized. A general discussion of these methods can be found in Driscoll, 1986 (p. 170-180). The terrain conductivity and seismic reflection surveys were conducted in October, 1985. The surface resistivity survey took place in December, 1985.

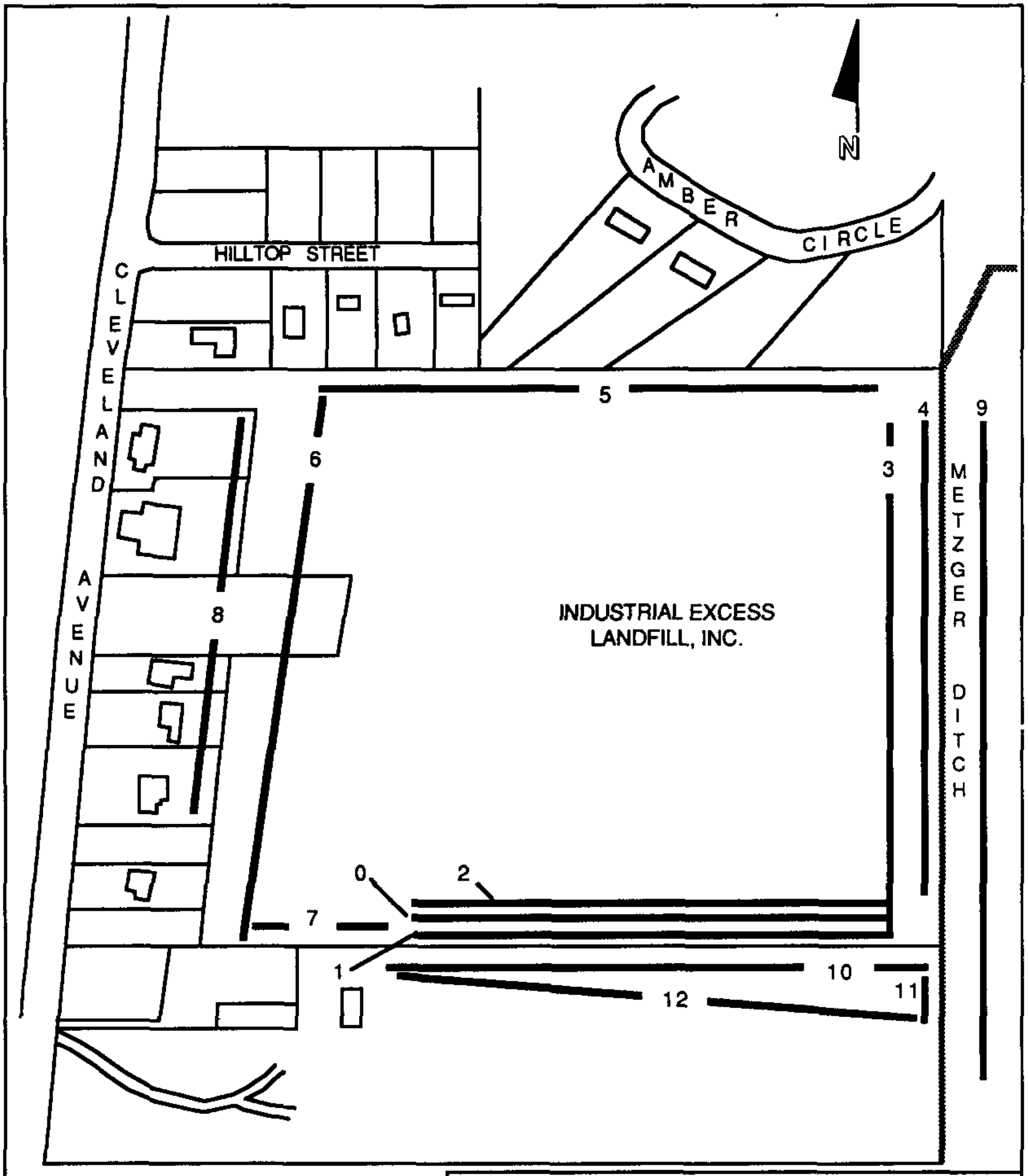
All three types of remote sensing surveys utilized in this first phase were conducted in the immediate area of the landfill. Figures 7-1 through 7-3 illustrate the location of the terrain conductivity lines, seismic reflection points, and surface resistivity points, respectively. Twelve lines of conductivity surveys, eleven seismic reflection measurements, and thirteen resistivity measurements were performed in the first phase.

Three tentative conclusions were derived from combined interpretation of these data:

- Bedrock is generally at a lower elevation at the western edge of the landfill as compared to the eastern edge.
- Shallow groundwater contamination may be present at the eastern and southeastern edge of the landfill. This contamination does not appear on the east side of Metzger Ditch.
- Groundwater contamination may be present at the western edge of the site in the upper portion of the bedrock.

In order to confirm and extend these tentative conclusions, further geophysical remote sensing was undertaken. The goals of this second phase were:

- Define lithologic units along the western and southwestern boundaries of the site, including depth to bedrock.
- Define the aerial extent of the first phase terrain conductivity anomaly (possible deep groundwater contamination) indicated to exist at the western edge of the site.



1

Transect Location and Number

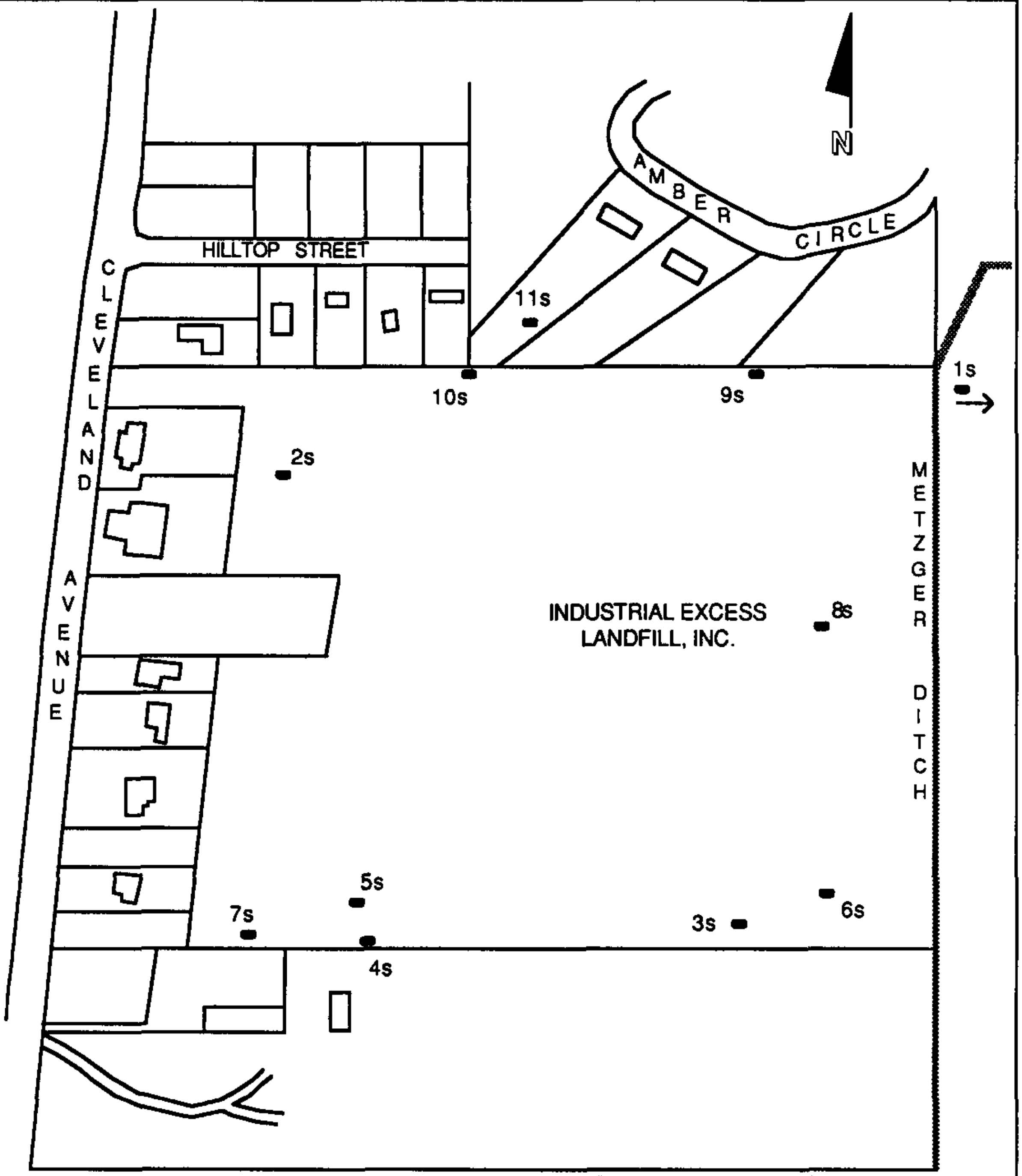
Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 7-1

CONDUCTIVITY SURVEYS
FIRST PHASE

C.C. JOHNSON & MALHOTRA, P.C.



7s ▬
Survey Point and Number

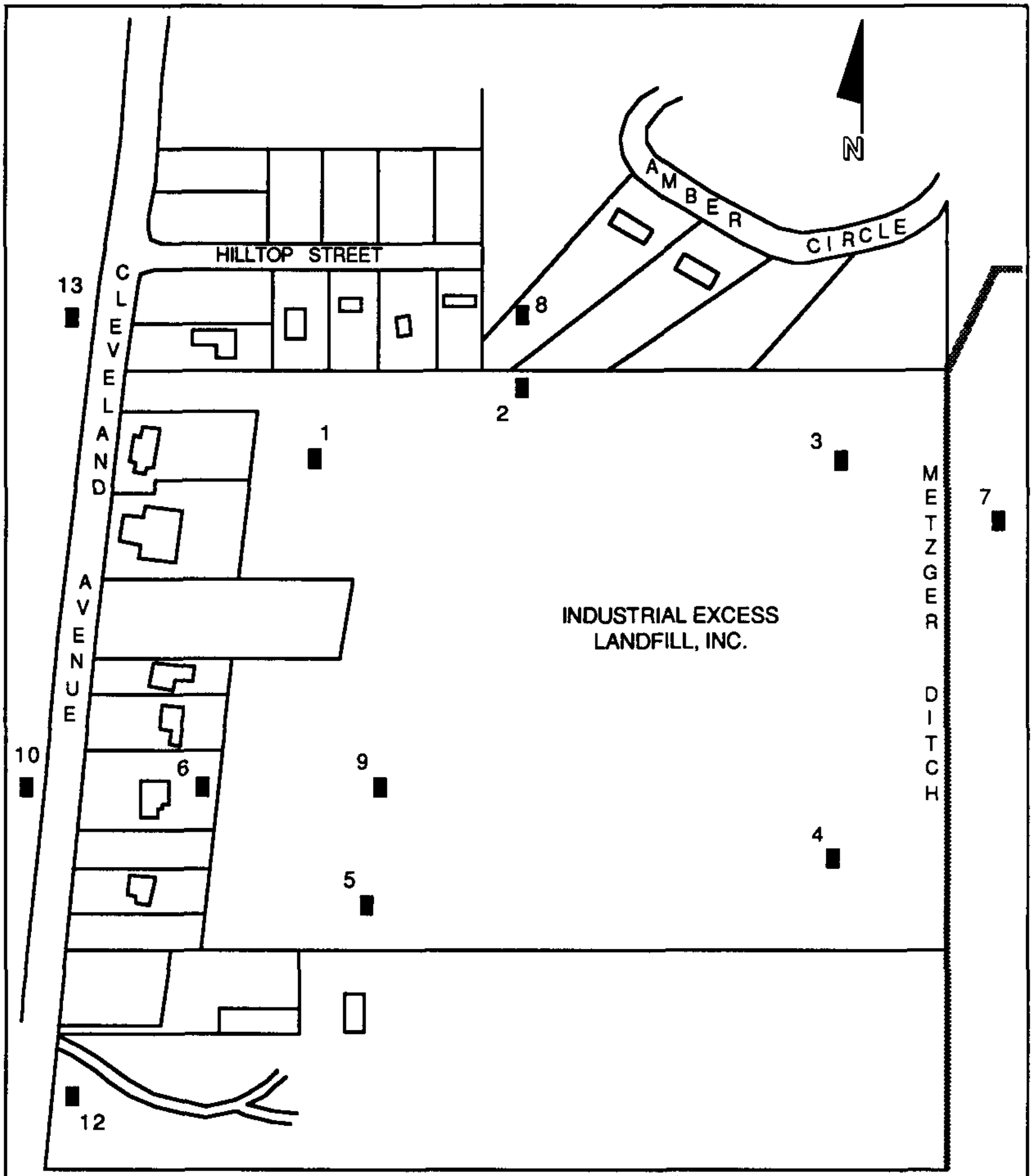
Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 7-2

REFLECTION SEISMIC SURVEYS
FIRST PHASE

C.C. JOHNSON & MALHOTRA, P.C.



4 ■ Survey Point and Number

Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 7-3

RESISTIVITY SURVEYS
FIRST PHASE

C.C. JOHNSON & MALHOTRA, P.C.

This second phase of the geophysical investigation consisted of three additional surface resistivity surveys, three seismic refraction surveys, and two lines of seismic reflection surveys (Figure 7-4 through 7-6). The field work took place in July 1986.

The findings from this final phase of geophysical studies at IEL are:

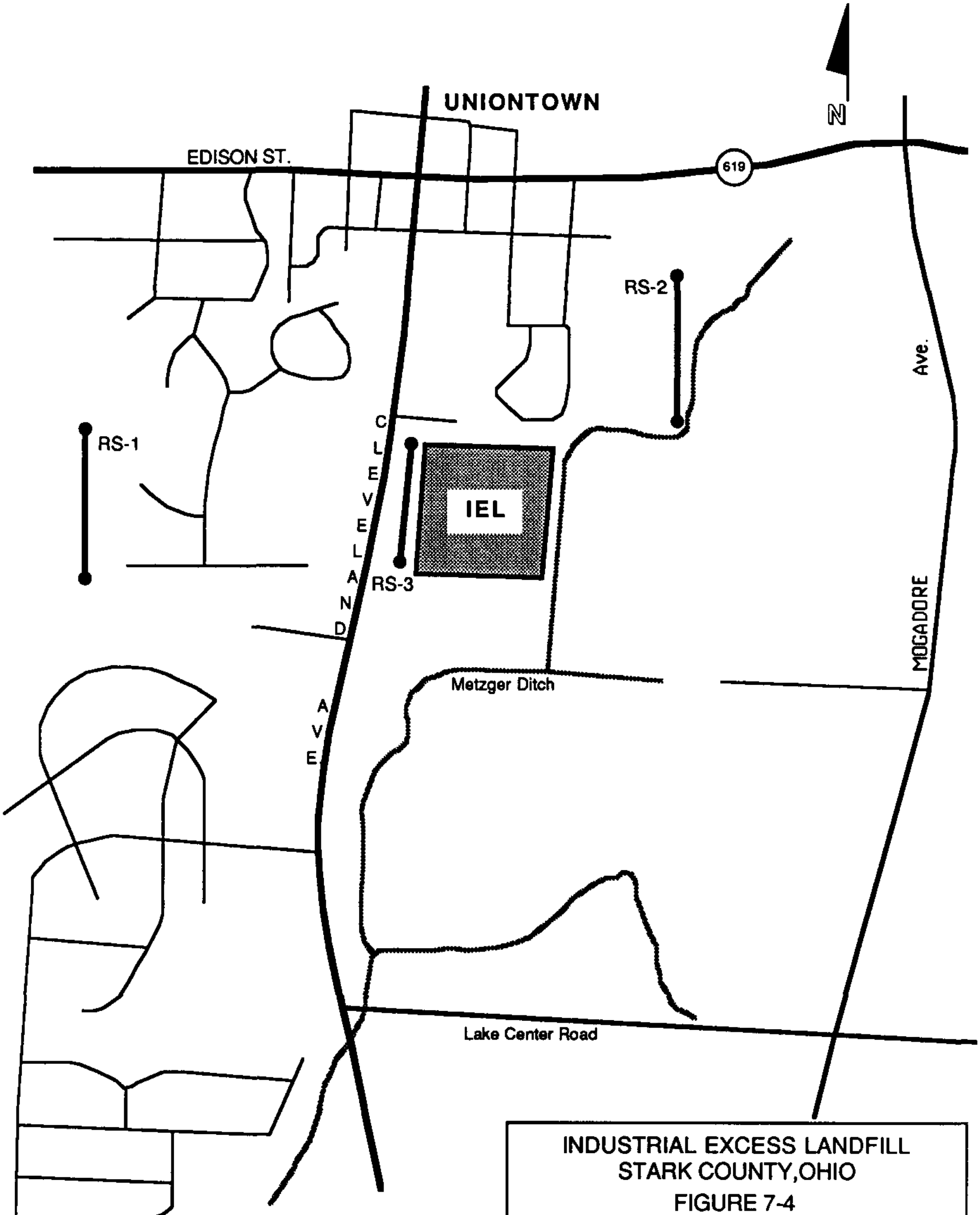
o Based on both the reflection seismic and resistivity surveys (the refractive seismic data were found to be unusable due to site conditions), the depth to bedrock increases from north to south and from east to west in the area of the site.

o The resistivity survey results were inconclusive as regards the presence or absence of contamination in the bedrock groundwater at the western edge of the site.

7.2 Comparison of Geophysical Survey with Monitoring Well Data

The groundwater monitoring wells drilled at the IEL site were located using regional geohydrologic factors and results of the geophysical investigations. Data derived from the installation and sampling of the groundwater monitoring wells is completely discussed in Section 4.0 of this RI report. A comparison of the monitoring well data and that derived from the geophysical survey yields the following general conclusions:

o The depth to bedrock results appear to represent a paleo-valley that is oriented east to west under the landfill. The depth to bedrock indicated by monitoring well installation is somewhat greater than that suggested by geophysical techniques.



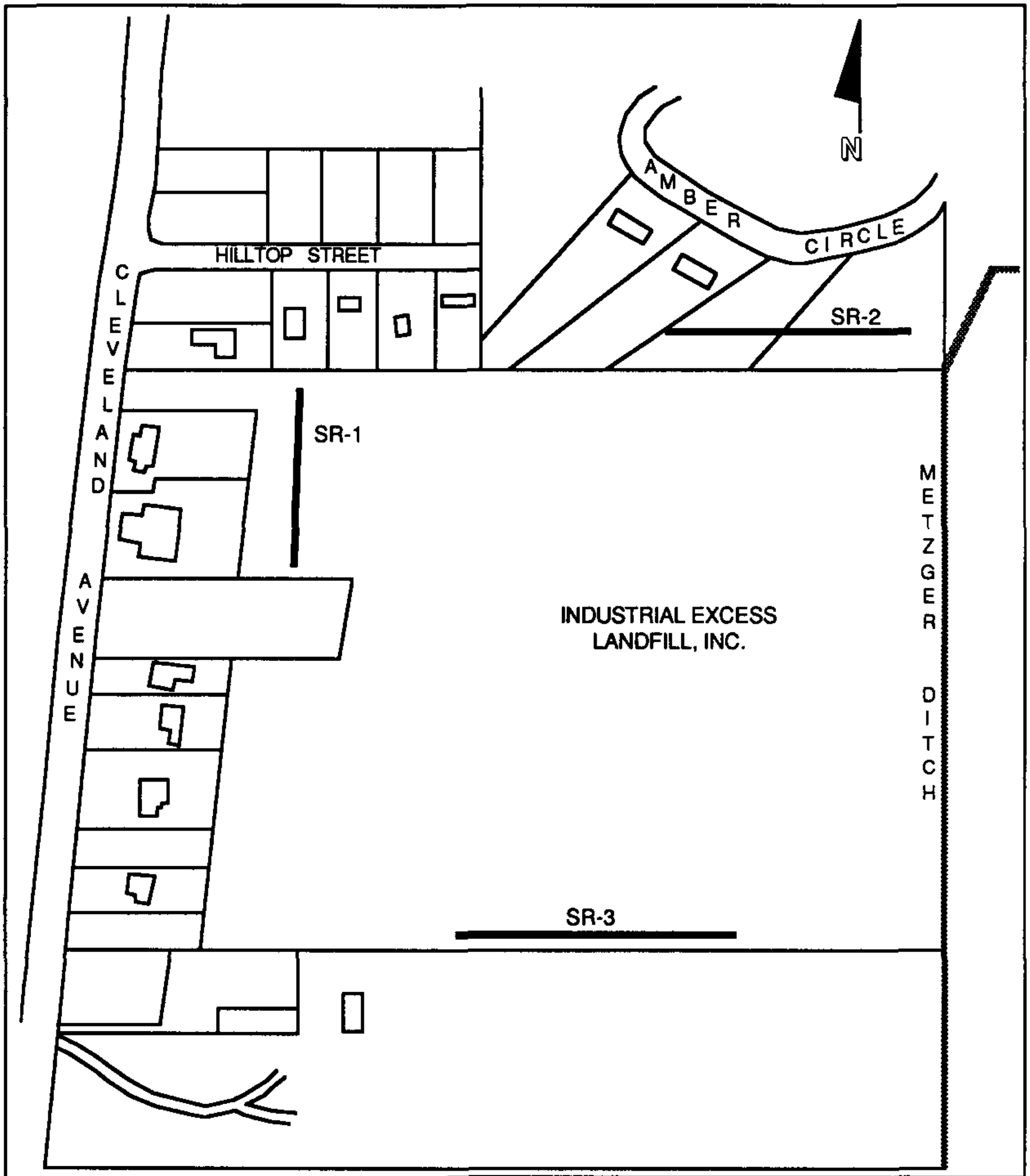
RS-XX
Survey Line and Number

cale Approximate, 1" = 1100'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY,OHIO
FIGURE 7-4

RESISTIVITY SURVEY LOCATIONS
SECOND PHASE

C.C. JOHNSON & MALHOTRA, P.C.



SR-XX

Survey Line and Number

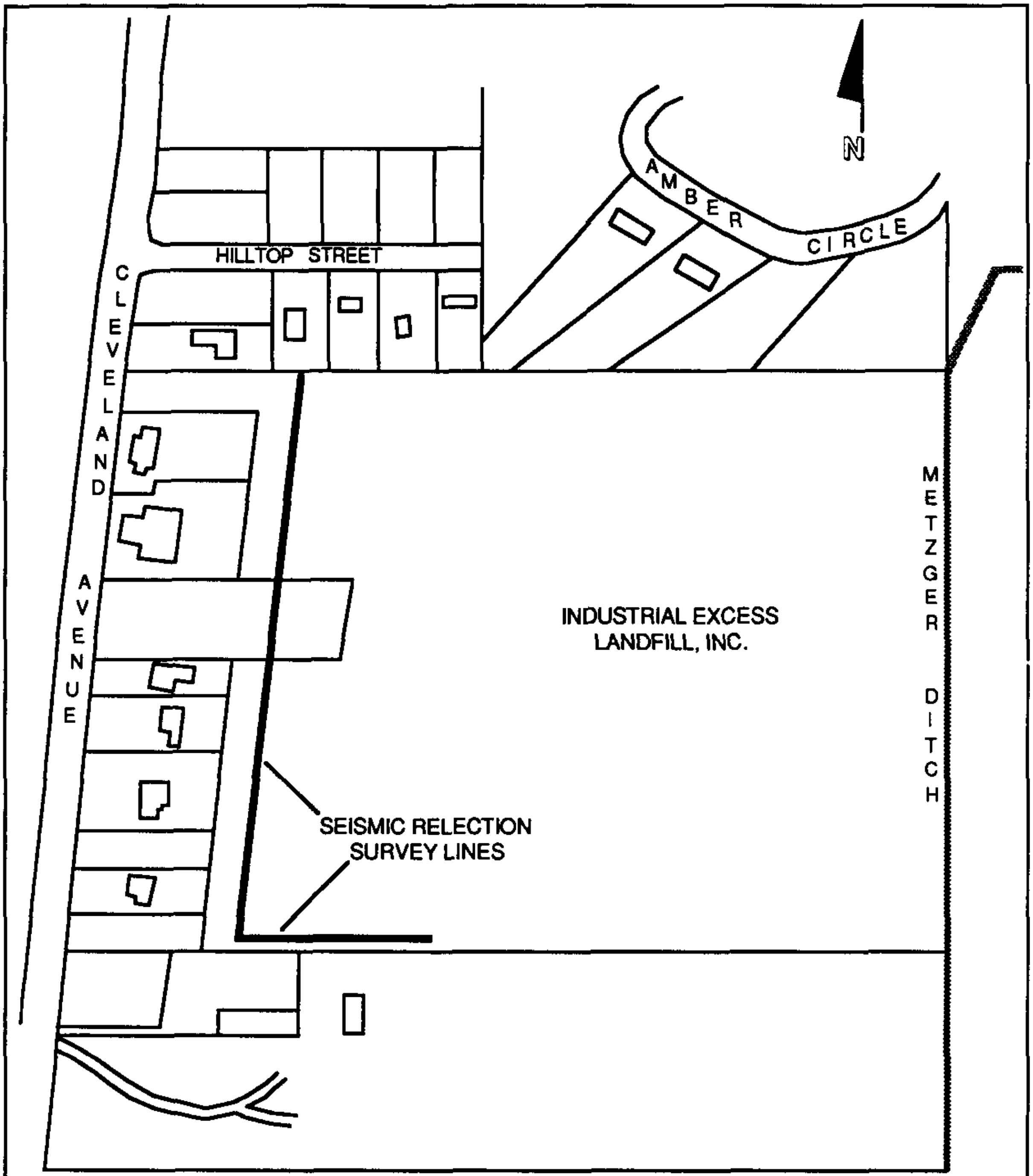
Scale Approximate, 1" = 280'

INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 7-5

SEISMIC REFRACTION
SURVEY LOCATIONS
SECOND PHASE

C.C. JOHNSON & MALHOTRA, P.C.



INDUSTRIAL EXCESS LANDFILL
STARK COUNTY, OHIO

FIGURE 7-6

SEISMIC REFLECTION
SURVEY LOCATION
SECOND PHASE

Scale Approximate, 1" = 280'

C.C. JOHNSON & MALHOTRA, P.C.

- Geophysical investigations confirm the presence of minor shallow groundwater contamination in the southeast corner of the site. (Monitoring wells MW3S and MW3M [located in the southeast corner of the site] both contain low levels of both organic and inorganic contaminants.)

- The shallow groundwater contamination, indicated by geophysical techniques for the eastern edge of the site, is not confirmed by monitoring well samples.

- Residential well data from homes immediately to the west of the landfill do indicate groundwater contamination in the sand and gravel. However, although geophysical data indicated the presence of contamination in the bedrock aquifer, the monitoring well data do not support that conclusion.

8.0 PUBLIC HEALTH EVALUATION

8.1 INTRODUCTION

8.1.1 PURPOSE

The purpose of this Public Health Evaluation (PHE) is to assess the potential impact on public health and environment of the release of hazardous substances from the IEL site. This baseline assessment evaluates the site in the absence of remediation and, therefore, constitutes an evaluation of the no-action alternative.

This study generally follows the guidelines established by U.S. EPA for such assessments under CERCLA (U.S. EPA, 1986a) and Federal guidelines for risk assessments (U.S. EPA, 1986b,c).

Section 8.0 is a summerization of the complete PHE prepared for this site. the complete PHE is presented in Appendix F of this document. The section consists of the as following subsections:

- o <u>Risk Assessment Methodology</u> (Section 8.2). This section discusses the major exposure pathways to be considered at the site. The section also develops the toxicological criteria used to evaluate the levels of contaminants, and the methods used to quantify exposures and risks to both carcinogens and noncarcinogens.

- o <u>Assessment of Residential Wells</u> (Section 8.3). The criteria developed in the previous section are applied to the quantification of risk from contaminants in residential wells.

- o <u>Assessment of Monitoring Wells</u> (Section 8.4). The criteria developed in Section 2 are applied to contaminants detected in monitoring wells.

- Assessment of Tentatively Identified Compounds (TICs) in Residential and Monitoring Wells (Section 8.5). This section contains a review of the data-base research conducted to identify available toxicity information on the TICs. A qualitative assessment of the risk posed by these compounds is also presented.

- Assessment of Surface Soils (Section 8.6). Risks from potential contact with surface soils are quantified.

- Assessment of Air Exposures (Section 8.7). The results of in-home air monitoring and the modeling of gases emanating from the landfill gas venting system are evaluated.

- Assessment of Landfill Borings, Surface Water, and Sediments (Section 8.8). A qualitative assessment of the data resulting from the sampling of these media is presented.

- Risk Assessment Uncertainties (Section 8.9). Major areas of uncertainty in the above risk assessment are discussed.

- Conclusions (Section 8.10). Major conclusions of the previous sections are summarized.

8.1.2 OVERALL APPROACH

The following paragraphs outline the approaches used for the assessment of contaminants in different media. In addition, the approach for assessing the compounds that have only been tentatively identified in samples is given.

Residential Wells, Monitoring Wells, Air, and Surface Soils

The assessment of residential wells, monitoring wells, air, and surface soils follow a three-step procedure:

(1) Data Evaluation. Results of the analysis of samples for the various media are reviewed to determine the number and type of contaminants present and to select those contaminants likely to contribute most to risk for evaluation in the risk assessment.

(2) Standard Comparison. Observed concentrations of chemicals are compared to applicable and relevant and appropriate requirements (ARARs) and other guidance and criteria where available.

(3) Risk Characterization. Risks associated with ingestion, inhalation, or dermal contact with the contaminants in the various media are quantified. Excess lifetime cancer risks are calculated for exposure to carcinogens. Exposures to noncarcinogens are assessed relative to U.S. EPA reference doses.

In the data evaluation stage, different approaches are taken for residetial wells and air samples versus monitoring wells and surface soils. These approaches reflect the different character of the data from these groups and the different requirements of the assessments. For the assessment of groundwater from residential wells and air exposures, it is important to assess the potential current risks to residents. Therefore, the residential wells are dealt with on a well-by-well basis, i.e., the risk assessment is performed for each well based on the type and concentration of contaminants found in the well. This allows for an identification of specific wells where the concentrations of contaminants may pose an unacceptable health risk and, therefore, may warrant an alternate water supply. Similarly in-home air monitoring is dealt with on a home-by-home basis to characterize the potential risks to individual residents. The monitoring wells data, however, are important in evaluating potential future risk because contaminants observed in these wells may migrate from the area of the landfill and thereby pose a future threat to nearby residential wells. As a likely worst-case estimate, the concentrations of contaminants found in the monitoring wells are assessed as a potential future drinking water source. This probably overestimates the actual future risk because some dilution and attenuation of the contaminants may take place as the contaminants migrate from the monitoring wells to the residential wells. The surface soil data are also analyzed as a group rather than as individual samples and described using mean and maximum concentrations. This is in keeping with the site trespassing scenario described in the next section.

The other difference in the evaluation of residential wells and air samples versus monitoring wells and surface soils is in the selection of the contaminants to be characterized. U.S. EPA guidance on PHEs (U.S. EPA, 1986a) states that if more than 10 to 15 chemicals are identified at a site, in order to simplify the risk assessment process, the chemicals may be screened so that indicator chemicals (i.e., chemicals that are most likely to contribute to risk) can be selected for detailed evaluation. Because U.S. EPA guidance also considers the risk from individual contaminants to be additive (see below), evaluating a subset of chemicals may underestimate the actual risk, although the process is adequate in most cases to identify those contaminants that will drive the risk and, therefore, the choice of remedial alternatives. Therefore, indicator chemicals are selected in the evaluation of the monitoring wells and surface soils, because, as sources of contamination, these media are associated with remediation rather than potential current risk. Indicator chemicals were selected using the following criteria:

(1) Comparison to field blanks. Chemicals detected in samples that also appeared at similar concentrations in field blanks were not considered to be representative of site conditions and were eliminated as indicator chemicals.

(2) Inorganic comparison to background levels. Naturally occurring inorganics were compared to background levels from off-site locations and other references. Chemicals not occurring above background were eliminated as indicator chemicals.

(3) Frequency of detection, relative concentration and toxicity. Chemicals occurring with low frequency (generally one hit from a given group of samples), and those occurring at low concentrations relative to human health criteria were considered to pose a nominal risk relative to more frequently detected and more toxic contaminants, and were therefore eliminated as indicator chemicals.

U.S. EPA guidance on PHEs (U.S. EPA, 1986a) gives a methodology for ranking, according to concentration and toxicity, some of the chemicals detected at the IEL site. This methodology was not used because:

(1) The guidance does not provide ranking criteria for some of the chemicals at the IEL site (such as benzoic acid, polynuclear aromatic hydrocarbons, 4-chloro-3-methylphenol, and many inorganics); and,

(2) Once the ranking is completed, subjective criteria, such as listed above are still required to select indicators from the list.

A more conservative approach is taken in the evaluation of residential wells and air samples, in that indicator chemicals are not selected; all chemicals detected are considered as potential contaminants. This provides a means of assessing the potential current risks from a well or home where exposure is currently occurring. This approach may overestimate the risk due to the presence of the landfill since some of the chemicals detected in residential wells are inorganics that may be present at naturally occurring background levels. Definitive information on background levels of inorganics (i.e., levels occurring prior to installation of the landfill) are not available.

However, where the levels detected are believed to be at or near the background levels based on information from upgradient wells or other sources, this is noted in the report. In addition, some of the air contaminants detected may be due to in-home sources since they are common constituents of many household products (See Section 6.0).

Tentatively Identified Compounds

Tentatively identified compounds are compounds not included in routine analyses, but which are detected and identified (by mass spectra if GC/MS analysis is performed) in a particular sample. Their spectra may match those in a mass spectral library, so they are listed with other detected chemicals with an indication that the concentrations given are estimates only. In using these chemicals, it is helpful to know how well the sample spectra match those in the mass spectral library. In many cases, the correlations between sample spectra and library spectra are low and there is little confidence that the chemical is what it is tentatively identified to be. Information on such correlations is not available from this study. Therefore, for the purposes of this assessment, the identity given for the TICs was regarded as true. Our assessment of TICs is necessarily qualitative in nature because of the lack of toxicological information about the compounds in question and the uncertainties associated with the tentative compound identify and concentrations reported presented as a part of the full PHE in Appendix F of this report. The results of a toxicity data base search are reported and, where sufficient information is available, general conclusions are drawn on the potential for adverse health effects.

Landfill Borings, Surface Water and Sediment

Qualitative assessments are presented for the evaluation of contaminants detected in soil borings taken during the installation of the monitoring wells, and surface water and sediments collected from the drainage stream adjacent to the site. The assessments are qualitative partly in recognition of the relative low levels of contaminants detected in these media. Quantitative assessments for these media would require the development of models to predict current and future off-site migration of the contaminants via groundwater movement, surface runoff, and soil erosion. Sufficient information is currently not available for the development of such models. The qualitative assessments made, however, are considered sufficient for identifying potential risks that should be addressed by remedial actions.

8.2 RISK ASSESSMENT METHODOLOGY

This section describes the methodology used to assess contaminants in residential and monitoring wells, air, and surface soils. According to guidelines for preparing public health evaluations as a part of the RI/FS process (U.S. EPA, 1986a), the potential adverse effects on human health should be assessed where possible by first comparing chemical concentrations found at or near the site with applicable or relevant and appropriate requirements (ARARs) that have been developed for the protection of human health or the environment. If suitable ARARs are not available for all of the chemicals and exposure scenarios considered, a quantitative risk characterization must be completed for all chemicals and scenarios. ARARs do not currently exist for all of the chemicals detected in groundwater at the IEL site nor do standards exist for exposure via inhalation of volatiles during showering--a potentially significant pathway in this assessment. No ARARs exist for chemical in soils or sediments. Therefore, a quantitative risk assessment will also be performed as part of this assessment.

8.2.1 COMPARISON WITH STANDARDS AND CRITERIA

Under SARA, U.S. EPA is required to consider maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) develop under the Safe Drinking Water Act, federal ambient water quality criteria (AWQC), and state water standards to be potential ARARs for evaluating groundwater exposures at Superfund sites. In addition, the National Ambient Air Quality Standards (NAAQS) promulgated under the Clean Air Act are ARARs with respect to air exposures and are used in this assessment.

8.2.2 METHODOLOGY FOR QUANTITATIVE RISK CHARACTERIZATION

Identification of Exposure Pathways

Exposure pathways describe the mechanisms by which humans or biota may come in contact with (be exposed to) contaminants. An exposure pathway will depend on the physical and chemical properties of the contaminants, current or potential future uses of the site, and site characteristics such as geology, hydrology, soil properties and climate. U.S. EPA guidance on Superfund risk assessments (U.S. EPA, 1986a) defines an exposure pathway as consisting of the following elements:

(1) A source and mechanism of chemical release to the environment;

(2) An environmental transport medium for the released chemical (e.g., air, groundwater);

(3) A point of potential human or biota contact with the contaminated medium (referred to as an exposure point); and,

(4) A route of exposure at the exposure point (e.g., ingestion, inhalation, or dermal contact).

For the purposes of this assessment, the sources of contamination at the IEL site are the wastes disposed in the landfill and its associated groundwater and air contamination. The following paragraphs address release and transport mechanisms, potentially exposed populations, and exposure routes relative to each of the potential exposure media-surface water, groundwater, soil, and air.

Surface Water. Surface water, leachate, and sediments have been sampled at onsite and downgradient locations. Surface water is not used as a drinking water source, or for recreation. Therefore, the primary exposure pathway of concern is the potential for release of contaminants from leachate or surface runoff to adversely affect aquatic life in the larger streams that receive runoff from the site.

Groundwater. Groundwater is the primary source of drinking water in the vicinity of the landfill. Most of the wells in the area are bedrock wells, but some tap the shallow aquifers. Contaminants may have leached or may leach in the future from wastes within the landfill and reach current or future wells. The residential wells have been sampled and are important current exposure points. Monitoring wells around the landfill provide additional information on potential future exposures in the event that leaching from the site continues.

Soil. Potential exposure pathways for soil involve scenarios whereby trespassers, children playing onsite, or nearby residents who engage in gardening or other outdoor activities come in contact with contaminated surface soils. Exposure occurs through absorption of chemicals through the skin and incidental soil ingestion.

Air. Exposure via air may occur primarily from two sources: generation of windblown dust, and migration of landfill gas. Given the current cover on the site, significant quantities of wind blown dust are not expected to be generated. This is not considered a significant exposure pathway and is not considered in the assessment. Nearby residents may be exposed to landfill gas via subsurface migration and entry of the gas into basements. Measurements of gas in the basements are used to assess this pathway. The air investigation indicates that this is not a current exposure pathway.

Exposure Assessment

Once exposure pathways have been identified, the next step is to identify appropriate exposure scenarios. For the assessment of groundwater in the residential and monitoring wells, two exposure scenarios are considered. Under the first scenario a 2-year exposure period is assumed. This was chosen to correspond to an interim period between the sampling of wells and the installation of any new water source that may be required. This scenario can thus be used to asses any potential risks due to exposure to groundwater in this interim period. The second scenario represents a complete "no action" alternative risk assessment. This scenario assumes that no remedial actions will ever be taken at the site. Use of groundwater is assessed over a lifetime exposure period assuming that current concentrations are sustained for a lifetime.

Two separate routes of exposure are considered under both the 2-year and lifetime exposure scenarios. The first route is ingestion: It is assumed per U.S. EPA standard assumptions (U.S. EPA, 1986a) that adults consume 2 liters of water per day and children consume 1 liter per day. The second route of exposure is the inhalation of volatile contaminants released from water during showering. A model developed by Foster and Chrostowski (1987) is used to estimate the concentrations of volatiles in air during showering. The model is based on the two-film resistance theory of mass transfer. The governing equations and major assumptions for the model are explained in detail in Appendix A of the complete PHE which can be found in Appendix F of this RI Report.

Other routes of exposure may also be relevant to the use of groundwater as a domestic water supply, such as dermal contact while bathing or swimming, inhalation during lawn-sprinkling, and garden-watering and subsequent uptake by vegetables. However, individuals are normally only exposed via these routes for relatively short periods. These routes are, therefore, considered less significant than drinking water ingestion and shower inhalation, which are likely to occur on a daily basis. They are, therefore, not quantified in this assessment.

A site trespassing scenario is used to evaluate the contaminants detected in surface soils. Because the site is not completely fenced and homes are located adjacent to the landfill, local children and adults have access to the site. Exposure may occur through incidental ingestion of soil by children who engage in mouthing activities and by adults who may eat, drink, or smoke during or following contact with soils. Direct absorption of contaminants from soil through the skin is also considered.

Two scenarios are considered in the evaluation of chemicals detected in air. The first approach evaluates exposures using the levels of chemicals detected in individual homes during the EmRT's investigation. The second approach uses the concentrations of chemicals predicted by the dispersion modeling performed by U.S. EPA Region V Air Management Division. The modeling predicts annual average concentrations of contaminants at locations downwind from the landfill gas flare. The assessment assumes that the landfill flare is operating 90 percent of the time and achieves and 80 percent destruction efficiency.

To perform the risk characterization, the concentrations of chemicals in groundwater and soils are converted to chronic daily intakes (CDIs). A CDI is an average daily dose (expressed in units of mg of ingested contaminants per kg of body weight of the exposed individual per day exposed--mg/kg/day) received over the assumed exposure period. For chemicals exhibiting potential carcinogenic effects, the dose is prorated over an average 70-year lifetime. For chemicals exhibiting noncarcinogenic effects, the CDI is averaged over the period of exposure only. The equations used to calculate CDIs, along with other assumptions about ingestion rates, inhalation rates, and average body weights, and other parameters are provided in Appendix A of the complete PHE which can be found in Appendix F of this RI Report. Details on the methodology used for assessing toxicity are also presented in the full PHE.

8.3 ASSESSMENT OF RESIDENTIAL WELLS

8.3.1 DATA EVALUATION

Sixty-seven residential wells near the IEL site have been sampled for Hazardous Substance List compounds. Sampling occurred in August and November 1986, and January and May 1987. Twenty-four wells have been sampled twice. Fifteen organic and nineteen inorganic chemicals were detected in residential wells. From among the organics detected, acetone, methylene chloride, bis(2-ethylhexyl)phthalate, di-octylphthalate, phenol, chloromethane, benzoic acid and 2-butanone were also detected in field and/or laboratory blank samples at similar levels. The source of these chemicals is, therefore, not considered to be well water, and these chemicals will not be considered further in the risk assessment. In addition, acrylonitrile, which was detected in the sample from well RW25 is also considered to be a laboratory contaminant based on the assessment of the U.S. EPA Contract Laboratory reviewer.

Two chemicals, pentachlorophenol and pyrene, were detected only in wells upgradient of the landfill and therefore are not considered to be site-related and will not be considered further in this risk assessment. The chemical n-Nitrosodiphenylamine was detected in a single duplicate sample of RW05 and was not detected in any of several other duplicates or in resamples of the well at different times. Therefore, the single detected value is not considered to represent site-related contamination in RW05 and this chemical will not be considered further in this assessment. The three remaining organic chemicals (chloroethane, tetrachloroethene, and vinyl chloride) are considered to represent residential well attributed to the landfill contamination and will be addressed in the risk assessment. Table 8-1 lists the wells in which these compounds were detected and the concentrations found.

The range of concentrations and frequency of detection of the inorganic chemicals detected in residential wells are listed in Table 8-2. For purposes of comparison, background levels of these chemicals, obtained from several sources, are listed in Table 8-3. A statistical comparison between upgradient and downgradient residential wells cannot be used to determine background levels because of the variability in well depths. However, a visible comparison suggests that cadmium, cobalt, copper, nickel, selenium, silver, and vanadium, although infrequently detected in residential wells, may be indicative of contamination since these chemicals were not detected in background sources. It should be noted that detection limits in background were in some cases higher than levels detected in downgradient wells. Thus, background levels for these metals are not well established. Therefore, isolated occurrences of cadmium, cobalt, copper, nickel, selenium, silver, or vanadium could well indicate background levels of these metals or may indicate local contamination sources. As discussed in Section 4.5.6, the occurrence of several or more of these metals in one well is characteristic of contamination found along the west side of the landfill. Elevated levels of barium, calcium, iron, potassium, sodium and zinc detected in some residential wells may also indicate contamination. Levels of aluminum, arsenic, lead, magnesium, manganese and cyanide appear to be within background ranges. However, as noted earlier, all chemicals detected in residential wells will be evaluated.

TABLE 8-1

SUMMARY OR RESIDENTIAL WELL SAMPLING RESULTS
HAZARDOUS SUBSTANCE LIST ORGANIC CHEMICALS
INDUSTRIAL EXCESS SITE

REM II
(all concentrations are ug/l)

	Well		
Chemical	RW05	RW38	RW39
Vinyl Chloride	7	3.9	2
Chloroethane	2	<1.5	1
Tetrachloroethene	<1	1.3	<1

NOTES:
(1) <x = compound not detected where 'x' is the detection limit.

(2) Only those samples that showed positive results are listed.

(3) Maximum value from duplicate samples is listed.

(4) Detection limit for vinyl chloride is 0.5 ug/liter.

TABLE 8-2

SUMMARY OF RESIDENTIAL WELL SAMPLING RESULTS
INORGANIC CHEMICALS
INDUSTRIAL EXCESS SITE

REM II
(all concentrations are ug/l)

Chemical	Range of Concentration Detected	Frequency of Detection
Alumiumum	<29-153	5/67
Arsenic	<2-9.1	29/67
Barium	2.1-1,370	67/67
Cadmium	<0.1-0.58	7/67
Calcium	55-460,000	67/67
Chromium	<5-11	3/67
Cobalt	<5-16	3/67
Copper	<4-356	28/67
Iron	<25-13,100	65/67
Lead	<1-239	30/67
Magnesium	76-59,400	67/67
Manganese	<4-489	64/67
Nickel	<7-48	11/67
Potassium	<69-23,400	62/67
Selenium	<2-20	9/67
Silver	<0.4-12	1/67
Sodium	<638-342,000	65/67
Vanadium	<5-22	6/67
Zinc	<8-733	28/67
Cyanide	<2-26	5/67

NOTES:
(1) <x - chemical not detected, where 'x' is the detection limit.
(2) Frequency of detection is the number of wells in which the chemical was detected per the total number of wells sampled. In the case of repeat or duplicate samples if a chemical was detected in any of the samples, it is considered as detected in the well.

TABLE 8-3

TYPICAL BACKGROUND CONCENTRATIONS OF INORGANICS
INDUSTRIAL EXCESS LANDFILL SITE
REM II

(All concentrations are ug/liter)

Chemical	EPA	Franklin County Ohio	Monitor Well 12 (Upgradient) (Filtered Samples) except cyanide	Upgradient Residential Wells
Aluminum	-	-	<139	<29-88
Arsenic	10	1	<1.8	<2-9.1
Barium	200	-	126-394	86-289
Cadmium	5	<1	<3.2	<0.2
Calcium	48,000	71,000-140,000	88,000-153,000	28,200-114,000
Chromium	202	<1	<1.8	<9
Cobalt	-	-	<13	<16
Copper	20	-	<19	<10
Iron	200	580-2,000	<273-1,650	240-2150
Lead	10	1-4	<3.1	<1.3
Magnesium	14,000	23,000-51,000	17,700-29,500	7,450-25,300
Manganese	40	69-720	175-465	<4-210
Mercury	0.5	<0.1-0.1	<0.2	<0.2
Nickel	-	<1-9	<19	<21
Potassium	-	2,500-15,000	917-4,650	<778-4720
Selenium	-	-	<1.3	<3
Silver	10	-	<0.4	<8
Sodium	-	43,000-389,000	10,900-187,000	<638-63,100
Vanadium	-	-	<18	<10
Zinc	-	10-82	<6.3	<8-108
Cyanide	-	<0.01	<10	<10

<x = chemical not detected, where 'x' is the detection limit.

- not analyzed for.

NOTE: Upgradient Residential Wells: RW 13, 27, 28, 37, 46, 47, 48, 52, 66.

Sources: EPA: Environmental Criteria and Assessment Office 1986; Franklin County: USGS 1982.

8.3.2 COMPARISON TO STANDARDS

Table 8-4 presents the comparison to applicable or relevant and appropriate requirements (ARARs) for the contaminants detected in residential wells. The table lists the range of concentrations detected as given in Tables 8-1 and 8-2. The ARARs listed in the table are the Safe Drinking Water Act MCLs and MCLGs and the Clean Water Act AWQC adjusted for drinking water exposure only. For public water supply systems, MCLs are legally enforceable drinking water standards. They are based principally on health criteria, but also take into account the technological and economic feasibility of removing the contaminant from the water supply. MCLGs are based entirely on health considerations and are therefore always less than or equal to MCLs. MCLGs for noncarcinogens represent the concentration of a contaminant in drinking water that is considered unlikely to pose a health hazard for lifetime exposures. MCLGs for carcinogens are set at zero reflecting the belief that any exposure to carcinogens may induce a carcinogenic response in the exposed individual.

Federal AWQCs are estimates of ambient surface water concentrations that are developed to be protective of adverse health effects in humans. For carcinogens,the criteria listed in Table 8-4 correspond to a 10^{-6} excess lifetime cancer risk from exposure via drinking. AWQCs are non-enforceable guidelines which many states have adopted as enforceable water quality standards. The AWQC are applicable for assessment of groundwater exposure if adjusted to account for drinking water ingestion only (i.e., the risk from the consumption of fish from ambient waters is not considered). U.S. EPA Office of Drinking Water Health Advisories (HA) are also listed in the table. These are not ARARs, but they provide some guidance for short-term exposures and exposures to children. The HAs are nonregulatory advisories that are provided as guidance to drinking water suppliers for various chemicals that may be encountered in a water system. The HAs include a margin of safety to protect sensitive members of the population. In cases where sufficient data are available, HAs have been developed for 1-day,

TABLE 8-4
RESIDENTIAL WELLS
COMPARISON TO APPLICABLE AND RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR) AND OTHER GUIDANCE AND CRITERIA
INDUSTRIAL EXCESS SITE
REM II

(all concentrations are ug/l)

		Standard or Criterion								
					Drinking Water Health Advisories					
							Longer-Term			
Chemical	Range of Concentration	MCL	MCLG	AWQC	One-Day (Child)	Ten-Day (Child)	(Child)	(Adult)	Lifetime (Noncar-cinogens)	Reference Concentrations (Carcinogens)
Tetrachloroethene	<1-1.3	-	0 (p)	0.88 (c)	2,000	2,000	1,400	5,000	10	0.7
Vinyl Chloride	2-7	2	0	2 (c)	2,600	2,600	13	46	NA	0.015
Chloroethane	1-2	-	-	-	-	-	-	-	-	-
Aluminum	<29-153	-	-	-	-	-	-	-	-	-
Arsenic	<2-9.1	50	50 (p)	0.025 (c)	50	50	50	50	50	0.023
Barium	2.1-1,370	1,000	1,500 (p)	-	-	-	-	-	1,800	NA
Cadmium	<0.1-0.58	10	5 (p)	10	43	8	5	18	18	NA
Calcium	55-460,000	-	-	-	-	-	-	-	-	-
Chromium	<5-11	50	120	50 (h)	1,400	1,400	240	840	120	NA
Cobalt	<5-16	-	-	-	-	-	-	-	-	-
Copper	<4-356	1,000 (s)	1,300 (p)	1,000 (o)	-	-	-	-	-	-
Iron	<25-13,100	300 (s)	-	-	-	-	-	-	-	-
Lead	<1-15.5	50 (20p)	-	50	-	-	10	10	10	0.031
Magnesium	76-59,400		-	-	-	-	-	-	-	-
Manganese	<4-489	50 (s)	-	-	-	-	-	-	-	-
Nickel	<7-48	-	-	15.4	-	-	-	-	-	-
Selenium	<2-4.5	10	45 (p)	10	-	-	-	-	-	-
Potasium	<69-23,400	-	-	-	-	-	-	-	-	-
Silver	<0.4-12	50	-	50	-	-	-	-	-	-
Sodium	638-342,000	-	-	-	-	-	-	-	-	-
Vanadium	<5-22	-	-	-	-	-	-	-	-	-
Zinc	<8-733	5,000 (s)	-	5,000 (o)	-	-	-	-	-	-
Cyanide	<2-26	-	-	200	220	220	220	750	750	NA

All standards are as reported in EPA 1986a

MCL = Safe Drinking Water Act Maximum Contaminant Level.
MCLG = Safe Drinking Water Act Maximum Contaminant Level Goal.
AWQC = Clean Water Act Ambient Water Quality Criterion adjusted for drinking water only.
p = Proposed
c = Corresponds to 10^{-6} excess lifetime cancer risk.
o = Based on organoleptic criteria.
s = Secondary MCL, based primarily on organoleptic or aesthetic criteria.
h = for hexavalent chromium.
NA = Not applicable.
- = No standard or criterion available.

10-day, and longer-term (several months to several years-exposure in addition to lifetime exposures (EPA 1986a).

A well-by-well comparison to ARARs and guidance levels reveals the following:

- The MCL, MCLG and AWQC for vinyl chloride are exceeded in wells RW38 and RW05. The concentration of vinyl chloride in well 39 equals the MCL and AWQC, and exceeds the MCLG.

- The MCLG of zero, the AWQC and the HA Reference Concentration for tetrachloroethene are exceeded in RW38.

- The AWQC and the HA Reference Concentration for arsenic are exceeded in wells RW02, 05, 06, 07, 08, 10, 13, 14, 15, 18, 19, 20, 21, 32, 35, 39, 40, 41, 44, 45, 50, 56, 60, and 66 although concentrations in all residential wells are below the MCL. The arsenic levels however may be naturally occurring, based on the previous discussion of background levels.

- The MCL for barium is exceeded in well RW09.

- The Secondary MCL for iron (based on organoleptic, i.e., not health based criteria) is exceeded in all of the wells <u>except</u> RW23, RW33, and RW43. The iron is naturally occurring and not considered to be attributed to the landfill.

- The lead concentration in RW40 exceeds the longer-term and lifetime HAs.

- The Secondary MCL for manganese is exceeded in all wells except RW06, RW23, RW33, RW43, RW46, RW52, RW64, and RW65. The manganese is naturally occurring and not considered to be attributed to the landfill.

- The AWQC for nickel is exceeded in wells RW09, RW38, RW42, and RW63. The detection limit of 20 ug/l reported for many of the wells is not adequate to assess the AWQC of 1.54 ug/l.

- Concentrations of cadmium, chromium, copper, selenium, silver, zinc, and cyanide do not exceed any ARARs or HAs.

- No ARARs or HAs are available for chloroethane, cobalt, aluminum, calcium, magnesium, potassium, sodium, or vanadium.

The following conclusions are noted:

2-Year Exposure Period: Children

- Total excess upper-bound lifetime cancer risks range from $9x10^{-6}$ at well RW02 to $7x10^{-5}$ at well RW05. In the majority of wells, the total lifetime excess cancer risk is attributable to arsenic which may be present at background levels. (None of the arsenic levels exceed the MCL.) For example, in RW13 and RW66 both upgradient wells, the excess lifetime cancer risk is $2x10^{-5}$ in wells RW05, RW38, and RW39.

- Excess upper-bound lifetime cancer risks attributable to vinyl chloride range from $1x10^{-5}$ to $5x10^{-5}$ in wells RW05, RW38, and RW39.

- The excess lifetime cancer risk attributable to tetrachloroethene in RW38 is $4x10^{-6}$.

- Global hazard indices exceed one for 23 of the 67 wells. However, hazard indices grouped by critical effects exceed one only for wells RW07, RW08, RW09, RW11, and RW40. For wells RW07, RW08, RW09, and RW11, the combined concentrations of barium and zinc cause in HI to exceed one. For well RW40, the combined concentrations of lead and manganese cause the HI to exceed one. Data indicate that these constituents are not landfill related.

2-Year Exposure Period: Adults

- Total excess upper-bound lifetime cancer risks range from $3x10^{-6}$ to $2x10^{-5}$. Most of the risk is attributable to arsenic which may be present in all wells at background levels. (None of the arsenic levels exceed the MCL.) The excess lifetime cancer risks attributable to arsenic in two upgradient wells, RW13 and RW66, are $5x10^{-6}$ and $1x10^{-5}$, respectively.

- Excess upper-bound lifetime cancer risks attributable to vinyl chloride range from $1x10^{-5}$ to $4x10^{-6}$ in wells RW05, RW38, and RW39.

- The excess lifetime cancer risk attributable to tetrachloroethene in well RW38 in $4x10^{-8}$.

- No global hazard indices exceed one for any residential wells.

Lifetime Exposure

- Total excess upper-bound lifetime cancer risks range from $9x10^{-5}$ to $7x10^{-4}$. In the majority of wells, the total lifetime excess cancer risk is attributable to arsenic which may be present at background levels. (None of the arsenic levels exceed the MCL.) The excess lifetime cancer risk attributable to arsenic in two upgradient residential wells, RW13 and RW66, is $2x10^{-4}$ and $4x10^{-4}$, respectively.

- Excess upper-bound lifetime cancer risks attributable to vinyl chloride range from 1×10^{-4} to 5×10^{-4} for wells RW05, RW38, and RW39.

- No global hazard indices exceed one for any residential wells.

Based on this analysis, near-term (2 years) consumption of groundwater by children from residential wells may result in a risk greater than a 10^{-6} excess upper-bound lifetime cancer risk. Consumption of groundwater from wells RW07, RW08, RW09, RW11, and RW40 may result in a hazard index for a critical effect group exceeding one. The U.S. EPA's acceptable risk range is 10^{-4} to 10^{-7}. The 10^{-6} risk level is used as the goal. Based on similar criteria, long-term (lifetime) exposure to groundwater from residential wells may result in exposures exceeding the previously cited target levels. Although the presence of arsenic in residential wells results in an excess upper-bound lifetime cancer risk greater than 10^{-6}, it should be noted that the arsenic is naturally occurring and not related to the landfill, nor do the levels exceed the MCL or MCLG.

8.4 ASSESSMENT OF MONITORING WELLS

8.4.1 DATA EVALUATION

Eleven monitoring well clusters have been established around the landfill perimeter. An additional well cluster is located upgradient, north of the site. Each cluster (excepting the upgradient cluster) consists of a shallow, medium, and deep well. Sampling results are grouped according to these well depths.

Shallow Wells

Discounting the volatile chemicals that were noted as possible field or laboratory contaminants, 18 organic and 16 inorganic chemicals were detected in the shallow monitoring wells. Concentration ranges, geometric means[1] and frequency of detection for these chemicals are listed in Table 8-5. From among the organics, for reasons given below, the following chemicals have been selected for evaluation in the risk assessment: 1,1-dichloroethane, 1,2-dichloroethane, 1,4-dichlorobenzene, benzene, toluene, chlorobenzene, ethylbenzene, and xylenes at the concentrations detected in these wells. U.S. EPA has not established critical toxicity values such as reference doses for benzoic acid, 2-methylnaphthalene, 4-chloro-3-methylphenol, or acenaphthene. Therefore, these compounds are not included in the risk assessment. Naphthalene, 2,4-dimethylphenol, 4-methylphenol, N-nitrosodiphenylamine, and trans-1,2-dichloroethene were detected in single samples and at low levels and can be anticipated to represent toxicologically insignificant risks at the levels measured. From among the inorganics, barium, chromium, lead, and nickel are selected as likely to contribute most to risk in light of their known health risks at low exposure levels. Calcium, iron, magnesium, potassium and sodium are eliminated from further consideration based on a lack of standards or reference doses. Arsenic, cadmium, selenium, and silver were detected infrequently (1/10 samples) and at relatively low concentrations (based on the the calculated geometric mean values) and would, therefore, not be expected to contribute significantly to risk. The remaining inorganic chemicals (manganese, silver, vanadium, and zinc) are considered to have low toxicity relative to the concentrations detected and therefore, are not selected for further quantitative evaluation. It should be noted that no background sample is available for shallow groundwater.

Medium Depth Wells

One organic chemical (4-chloro-3-methylphenol) and fourteen inorganic chemicals were detected in the medium depth wells (excluding suspected field or laboratory contaminants). Concentration ranges, geometric means and frequencies of detection are listed in Table 8-6. Concentrations

Table 8-5

SUMMARY OF SHALLOW MONITORING WELL SAMPLING RESULTS
INDUSTRIAL EXCESS SITE
REM II

(All concentrations are ug/liter)

Chemical	Range	Geometric Mean	Frequency Of Detection
trans-1,2-Dichloroethene	3.8-4.3	2.6	1/11
1,1-Dichloroethane	<5-25	3.1	1/11
1,2-Dichloroethane	<5-10	2.7	1/11
Benzene	1.2-10	2.8	2/11
Toluene	<0.9-13	1.2	1/11
Chlorobenzene	<5-27	3.1	1/11
Ethylbenzene	<5-110	3.4	1/11
Xylenes	<5-355	3.9	1/11
Benzoic Acid	9(<100)	46	1/10
1,4-Dichlorobenzene	10-13(<20)	9.9	1/10
Naphthalene	7.9-10(<20)	9.7	1/10
4-chloro-3-methylphenol	5.2(<20)	9.1	1/10
2-methylnaphthalene	2.7-3(<20)	8.9	1/10
Acenaphthene	2(<20)	9.3	1/10
2,4-Dimethylphenol	3(<10)	NR	1/10
4-Methylphenol	<10-15	10	1/10
N-nitrosodiphenylamine	<10-15	3.4	1/10
Phenol	3.7(<10)	9.3	1/10
Arsenic	6(<10)	4.8	1/10
Barium	75-1430	188	9/10
Cadmium	<3.2-21	2	1/10
Calcium	21820-279000	118100	1/10
Chromium	<3.7-7.5	3.8	1/10
Iron	<20-78870	888	6/10
Lead	<3-11	3.1	1/10
Magnesium	5470-57200	24400	10/10
Manganese	148-3060	717	10/10
Nickel	<14-48	12.8	3/10
Potassium	1490-79200	6120	10/10
Selenium	<3-4.4	2.6	1/10
Silver	<5.1-5.8	4	1/10
Sodium	4670-360000	44300	10/10
Vanadium	<3.1-64.7	7.8	4/10
Zinc	<6.3-87	6.8	3/10

NOTES:

(1) <x = chemical not detected where 'x' is the detection limit. Where detection limits vary among samples the lowest is listed.
(2) A value or range followed by a number in parantheses indicates an estimated value, where the number in parantheses is the detection limit.
(3) NR = value not reported, since geometric mean is greater than the maximum detected value.
(4) Frequency of detection is the number of positive values detected per the total number of sample locations.

TABLE 8-6

SUMMARY OF MEDIUM DEPTH MONITORING WELLS SAMPLING RESULTS INDUSTRIAL EXCESS SITE

REM II
(all concentrations are ug/l)

	Downgradient Wells			Upgradient Well (MW12M)
Chemical	Range	Geometric Mean	Frequency of Detection	
4-chloro-3-methylphenol	1(<20)	NR	1/7	<20
Barium	166-672	263	7/7	394
Calcium	72,370-145,000	103,000	7/7	153,000
Chromium	<1.8-9.2	2.6	1/7	<1.8
Iron	<17-1,651	117	5/7	1,650
Lead	<3-60	3.7	3/7	<3.1
Magnesium	15,950-35,410	23,600	7/7	29,500
Manganese	141-450	218	7/7	465
Nickel	<14-40	12.9	3/7	<19
Potassium	558-4,150	1,430	7/7	4,650
Selenum	<3-6.8	2.4	1/7	<1.3
Silver	<5-7.3	3.6	1/7	<0.4
Sodium	6,180-125,100	29,800	7/7	187,000
Vanadium	<3.1-8.5	4.6	2/7	<18
Zinc	<9-80	11.8	4/7	<6.3

NOTES

(1) <x = chemical not detected where 'x' is the detection limit. Where detection limits vary among samples the lowest is listed.

(2) Frequency of detection is the number of positive values detected per the total number of sample locations.

(3) Downgradient wells: Nos. 1, 3, 7, 8, 9, 10, 11. Upgradient well: No./12.

detected in the upgradient well (12M) are also listed. 4-chloro-3-methylphenol was detected in only one well. No toxicity criteria are available for this chemical, but based upon the available data, 4-chloro-3-methylphenol is not expected to contribute significantly to risk at the concentrations detected in the monitoring well. Therefore, this chemical will not be considered further in this risk assessment. None of the inorganic chemicals appear to be present at elevated concentrations relative to the upgradient well or to other sources of background levels as listed in Table 8-3. Therefore, the medium depth wells are not considered further in the risk assessment.

Deep Monitoring Wells

Two organic and fifteen inorganic chemicals were detected in the deep monitoring wells. Concentration ranges, geometric means, and frequencies of detection are listed in Table 8-7. The two organic chemicals were detected once or twice out of the eight samples. These chemicals are eliminated from known health risks at low exposure levels. Calcium, iron, magnesium, potassium and sodium are eliminated from further consideration based on a lack of standards or reference doses. Arsenic, cadmium, selenium, and silver were detected infrequently (1/10 samples) and at relatively low concentrations (based on the calculated geometric mean values) and would therefore not be expected to contribute significantly to risk. The remaining inorganic chemicals (manganese, silver, vanadium, and zinc) are considered to have low toxicity relative to the concentrations detected and therefore, are not selected for further quantitative evaluation. It should be noted that no background sample is available for shallow groundwater.

deep?

8.4.2 COMPARISON TO STANDARDS

The comparison of concentration of indicator chemicals detected in the shallow monitoring wells with ARARs and other criteria is presented in

TABLE 8-7

SUMMARY OF DEEP MONITORING WELLS SAMPLING RESULTS
INDUSTRIAL EXCESS SITE

REM II
(all concentrations are ug/l)

	Downgradient Wells			Upgradient Well (MW12D)
Chemical	Range	Geometric Mean	Frequency of Detection	
Butylbenzylphalate	1-6(<20)	NR	2/8	<20
Di-n-octylphthalate	1(z20)	NR	1/8	<20
Aluminum	<31-139	42.1	1/8	<139
Barium	113-306	179	8/8	126
Cadmium	<3.2-4.3	2.1	1/8	<3.2
Calcium	45,700-125,400	76,000	8/8	88,000
Chromium	<1.8-8	3.5	1/8	<1.8
Copper	<11-575	9.4	1/8	<19
Iron	<17-598	56.3	2/8	<273
Lead	<3-19	2.8	2/8	<3.1
Magnesium	9,335-25,390	16,200	8/8	17,700
Manganese	39-405	125	8/8	175
Potassium	1,047-5,440	1,840	8/8	1,610
Silver	<5-7.4	4.2	1/8	<0.4
Sodium	6,840-27,100	13,600	8/8	10,900
Vanadium	<3.1-8.8	5.9	1/8	<18
Zinc	z6.3-60	6.8	3/8	<6.3

Table 8-8. The table lists the mean and maximum concentrations detected and the corresponding MCL, MCLG, AWQC and HA. (See Section 3.3.2 of the complete PHE which is located in Appendix F of this RI Report for a discussion of the development of these standards.) The comparison reveals the following:

- The MCLG and AWQC for 1, 2-dichloroethane are exceeded by the mean and maximum concentrations in shallow groundwater. The MCL is exceeded only by the maximum concentration.
- The MCLG, AWQC and HA reference concentration for benzene are exceeded by the mean and maximum concentrations in shallow groundwater. The MCL is exceeded only by the maximum concentration.
- The MCL for barium is exceeded by the maximum concentration.
- The longer-term HA and the lifetime HA for lead are exceeded by the maximum concentration.
- The AWQC for nickel is exceeded by the maximum concentration.
- Concentrations of toluene, chlorobenzene, ethylbenzene, xylenes, and 1,4-dichlorobenzene do not exceed ARARs or Health Advisories.
- No standards are available for 1,1-dichloroethane.

8.4.3 QUANTITATIVE RISK ASSESSMENT

The quantitative risk characterization evaluates the potential for adverse health effects from a hypothetical lifetime exposure scenario in which groundwater containing the levels of contaminants detected in the monitoring wells is used as a drinking water source. Exposure is assumed to

TABLE 8-8

MONITORING WELLS
COMPARISON TO APPLICABLE AND RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR) AND OTHER STANDARDS AND CRITERIA
INDUSTRIAL EXCESS SITE
REM II

(All concentrations are ug/l)

	Concentration in Monitoring Well (a)		Standard or Criterion			Drinking Water Health Advisories					
Chemical	Geometric Mean	Maximum	MCL	MCLG	AWQC	One-Day (Child)	Ten-Day (Child)	Longer-Term (Child)	Longer-Term (Adult)	Lifetime (Noncarcinogens)	Reference Concentrations (Carcinogens)
1,1-Dichloroethane	3.1	25	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	2.7	10	5	0	0.94 (c)	740	740	740	2,600	NA	NA
Benzene	2.8	10	5	0	0.67 (c)	233	233	NA	NA	NA	0.35
Toluene	1.2	13	-	2,000 (p)	15,000	18,000	6,000	-	-	10,800	NA
Chlorobenzene	3.1	27	-	-	488	1,800	1,800	9,000	30,000	3,150	NA
Ethylbenzene	3.4	110	-	-	2,400	21,000	2,100	-	-	3,400	NA
Xylenes	3.9	355	-	440 (p)	-	12,000	7,800	7,800	27,300	2,200	NA
1,4-Dichlorobenzene	9.9	13	75	75	470	10,700	10,700	10,700	37,500	3,750	NA
Barium	188	1,430	1,000	1,500 (p)	-	-	-	-	-	1,800	NA
Chromium	3.8	7.5	50	120 (p)	50	1,400	1,400	240	840	170	NA
Lead	3.1	11	50	20 (p)	50	-	-	10	10	10	NA
Nickel	128	48	-	-	15.4	-	1,000	-	-	350	NA

(a) Values given are for shallow monitoring wells.

All standards are as reported in EPA 1986a

MCL = Safe Drinking Water Act Maximum Contaminant Level.
MCLG = Safe Drinking Water Act Maximum Contaminant Level Goal.
AWQC = Clean Water Act Ambient Water Quality Criterion adjusted for drinking water only.
p = Proposed
c = Corresponds to 10E-6 excess lifetime cancer risk.
o = Based on organoleptic criteria.
NR = Not reported because mean is greater than maximum detected value.
NA = Not applicable.
\- = No standard available.

include both ingestion and inhalation of volatile chemicals while showering. The carcinogenic and noncarcinogenic risks associated with the mean and maximum concentrations detected in the shallow monitoring wells are summarized in Tables 8-9 and 8-10 respectively. The following conclusions are noted:

- Total excess lifetime cancer risks are 4×10^{-5} based on the maximum *concentrations and* 1×10^{-5} *based on the mean concentration of chemicals* detected in shallow wells. The risks are attributable to 1,2-dichloroethane and benzene.
- The global hazard index exceeds one under the maximum case. However, no hazard indices for the critical effects groups exceed one.

Based on this assessment, long-term (lifetime) consumption of groundwater containing the levels of contaminants detected in shallow monitoring wells may result in a risk greater than a 10^{-6} excess upper-bound cancer risk. The U.S. EPA's acceptable risk range is 10^{-4} to 10^{-7}. The 10^{-6} risk level is used as the goal. The risks are associated with 1,2-dichloroethane and benzene. Because some dilution or attenuation of contaminants may take place as the contaminants migrate from the landfill towards the residential wells, and because the closest redients will be receiving an alternate water supply, this assessment may overestimate~~s~~ actual future risks to nearby residents.

8.5 TOXICOLOGY SUMMARY OF THE TENTATIVELY IDENTIFIED COMPOUNDS (TICs)

A toxicity information search was conducted on all of the compounds tentatively identified (TICs) in groundwater and residential well water. The National Library of Medicine's Hazardous Substances Data Bank (HSDB) was the primary database searched. The HSDB contains data on more than 4,100

TABLE 8-9

SHALLOW MONITORING WELLS
RISKS DUE TO NONCARCINOGENS
LIFETIME EXPOSURE
INDUSTRIAL EXCESS LANDFILL SITE
RDM II

Chemical	Ingestion of Groundwater				Inhalation of Volatile Chemicals During Showering	
	Average Exposure Case		Plausible Maximum Exposure Case			
	Concentration (ug/l)	CDI/RfD	Concentration (ug/l)	CDI/RfD	Concentration (ug/l)	CDI/RfD
1,1-Dichloroethane	3.1	$7x10^{-4}$	25	$6x10^{-3}$	25	$3x10^{-3}$
Toluene	1.2	$1x10^{-4}$	13	$1x10^{-3}$	13	$3x10^{-5}$
Chlorobenzene	3.1	$3x10^{-3}$	27	$3x10^{-2}$	27	$6x10^{-4}$
Ethylbenzene	3.4	$1x10^{-3}$	110	$3x10^{-2}$	110	$4x10^{-3}$
Xylenes	3.9	$6x10^{-5}$	355	$5x10^{-3}$	355	$3x10^{-2}$
1,4-Dichlorobenzene	9.9	$3x10^{-3}$	13	$3x10^{-3}$	-	-
Barium	188	$1x10^{-1}$	1,430	$7x10^{-1}$	-	-
Chromium	3.8	$2x10^{-2}$	7.5	$4x10^{-2}$	-	-
Lead	3.1	$6x10^{-2}$	11	$2x10^{-1}$	-	-
Nickel	12.8	$4x10^{-2}$	48	$2x10^{-1}$	-	-

Hazard Indices:	Average Exposure Case	Plausible Maximum Exposure Case	Inhalation During Showering
Global	<1 (0.2)	<1 (1.2)	<1 (0.04)
Group A	-	0.06	-
Group B	-	0.7	-
Group C	-	2?	-
Group D	-	0.005	-
Group E	-	0.2	-
Group F	-	0.2	-
Group G	-	0.04	-

Group A: 1,1-dichloroethane, chlorobenzene, ethylbenzene, 1,4-dichlorobenzene
Group B: toluene, barium
Group C: (No chemicals in this group selected as indicator chemicals for shallow monitoring wells)
Group D: xylene
Group E: nickel
Group F: lead
Group G: chromium

TABLE 8-10

SHALLOW MONITORING WELLS
EXCESS LIFETIME CANCER RISK
LIFETIME EXPOSURE
INDUSTRIAL EXCESS LANDFILL SITE
REM II

	Concentration		Excess Lifetime Cancer Risk					
			Ingestion		Inhalation		Total	
Chemical	Mean (ug/l)	Maximum (ug/l)	Mean	Maximum	Mean	Maximum	Mean	Maximum
1,2-Dichloroethane	2.7	10	7E-6	3E-5	1E-7	5E-7	7E-6	3E-5
Benzene	2.8	10	4E-6	1E-5	2E-7	8E-7	4E-6	1E-5
Total	-	-	-	-	-	-	1E-5	4E-5

chemical substances that are known or potential toxicity and to which substantial populations are exposed. It is a factual, nonbibliographic, "dossier-type" data base. The data contained in the HSDB are derived from a core set of standard texts and monographs and is augmented with information from government documents, technical reports, and primary journal literature. The HSDB is a fully peer-reviewed data base that is maintained and updated quarterly in the National Library of Medicine's Toxicology Data Network. Ten classes of information comprise a chemical profile. These classes are the following: substance identification information; manufacturing/use information; information on chemical and physical properties; safety and handling information; toxicity/biomedical effects; pharmacology; environmental fate/exposure potential information; exposure standards and regulations; monitoring and analytical methods; and additional references.

The great majority of the TICs tentatively identified by name in the RI have not been even minimally characterized for their acute or chronic health effects. The absence of information on the TICs may be due to the incomplete analytical characterization of some of the materials listed as "tentatively identified: (e.g., "cyclic substituted for hydrocarbon" as opposed to a specific chemical identification); the incompleteness of the HSDB regarding the particular chemicals at this site; or the absence of any toxicity information on these chemicals in the available literature.

The complete list of TICs detected at the IEL site are presented in Appendix D of the full PHE report (located in Appendix F of this RI Report). The TICs for which limited toxicity data have been reported and the health effects associated with exposure to each TIC are presented in Table 8-11.

TABLE 8-11

TOXICITY INFORMATION SUMMARY OF THE TENTATIVELY IDENTIFIED COMPOUNDS

	Health Effects Reported													
Compound	Carcinogenic	Embryotoxic	Fetotoxic	Teratogenic	Central Nervous System	Behavioral	Hepatotoxic	Nephrotoxic	Cardiac	Pulmonary	Blood/ Vascular Effects	Dermal	Visual	Growth Inhibition
1,2-Diethoxyethane . . .					A					H				
N,N'-Dimethylformamide .		A		A	A		A	A						
1,3,5-Trimethylbenzene .					H									
Tetrahydrofuran					H	H								
Tetramethylurea				A										
Trichlorofluoromethane .					H				H	H				
Dichlorofluoromethane . .					H				H	H				
1,1,2-*Trichloro*-1,2,2-Trifluoromethane . . .					H				H	H				
sec-Butyl alcohol					H									
Tetraethyl pyrophosphate					H									
4-Hydroxy-4-methyl-2-pentanone					H		H	H			H	H		
N-Ethylmorpholine													H	
2,4,4-Trimethyl-1-pentene												A		
N,N'-Diethylthiourea . .	A											H		
1-Methyl-2-pyrrolidinone.			A	A										
4-(1,1-Dimethylethyl)-5 *methylphenol*	A													A
p-tert-Butylbenzoic acid.							A					H		
Azacyclotridecan-2-one .					A									
Cyclohexane					H		A	A				H		
Pentane					H							H		
Hexahydro-2H-azepin-2-one		A			H		A	A			A	H		A

TABLE 8-11 (Cont'd.)

TOXICITY INFORMATION SUMMARY OF THE TENTATIVELY IDENTIFIED COMPOUNDS

Compound	*Health Effects Reported* Carcinogenic	Embryotoxic	Fetotoxic	Teratogenic	Central Nervous System	Behavioral	Hepatotoxic	Nephrotoxic	Cardiac	Pulmonary	Blood/ Vascular Effects	Dermal	Visual	Growth Inhibition
2-Butoxy-1-ethanol					H		H	H		H	H		H	A
Sulfur.										H	A	H	H	
Nonanoic.												H		
Trimethoxymethane												H	H	
4-Methyl-2-pentanol . . .												A	H	
Cyclohexanol.					A						A		A	
Cycloheptanone.										H		H		
Furan					H					A	A	A		
1,2-Diethoxyethane. . . .					H			H			H		H	
2-Butoxyethanol phosphate					A									
2-Methyl-1-propene. . . .					A									
5-Methyl-2-hexanone . . .												A		
1,1-dioxide-1,2-benzisothiazol-3(2H)-one	A													A
2,2'-[oxybis(methylene)] bis-oxirane.	A				A					A		H	A	
Benzoic acid												H		

H = data obtained from observations in human acute exposure settings.

A = data obtained from observations in laboratory animals.

8.6 ASSESSMENT OF SURFACE SOILS

8.6.1 DATA ANALYSIS

Surface soils on and near the IEL site have been sampled at fifty locations. Thirty sample locations are on the landfill, thirteen locations are on properties adjacent to the landfill and seven are at off-site background locations. Samples were analyzed for Toxic Compound List compounds. Forty-one organic and twenty-five inorganic chemicals were detected. Tables 8-12 and 8-13 list the organic and inorganic chemicals detected, respectively. The tables list the range of concentrations detected, the geometric mean value, and the frequency of detection (i.e., the number of samples in which the chemical was detected over the total number of samples analyzed.)

The greatest number of organic chemicals were detected in the onsite samples (41). However, many of these chemicals were detected infrequently, and nineteen were detected in only one sample. In the near-site samples, 3 of the 10 chemicals detected were detected only once. Because one sample represents a very small area of the site, an individual is unlikely to be exposed to a chemical detected in only one sample under the trespassing scenario outlined below. Consequently, these chemicals are unlikely to contribute to the site risk and are therefore eliminated from further consideration in this risk assessment.

Of the remaining organic chemicals, U.S. EPA has not established toxicity criteria for benzoic acid, 2-methylnaphthalene or butylbenzyl phthalate, therefore the risks from these compounds will not be assessed. Phenol, diethylphthalate, and chlorobenzene were each detected in only 2 onsite samples. Based on U.S. EPA's reference doses, these compounds are considered to have low toxicity. They are, therefore, eliminated from consideration based on a combined low frequency of detection and low toxicity. Several polycyclic aromatic hydrocarbons (PAHs) were detected in surface soils.

TABLE 8-12

ORGANIC CHEMICALS DETECTED IN SURFACE SOILS
INDUSTRIAL EXCESS LANDFILL SITE, REM II

Chemical	On Site			Near Site & Down Gradient			Off Site (Background)		
	Range (a) (ug/kg)	Geometric Mean (b) (ug/kg)	Frequency of Detection (c)	Range (a) (ug/kg)	Geometric Mean (b) (ug/kg)	Frequency of Detection (c)	Range (a) (ug/kg)	Geometric Mean (b) (ug/kg)	Frequency of Detection (c)
1,4-Dichlorobenzene	43(<330)	NR	1/30	-	-	0/13	-	-	0/7
2-Butanone	<10-51	6	2/30	-	-	0/13	-	-	0/7
2-Methylnaphthalene	130-15,000	217	4/30	312-374	195	3/13	-	-	0/7
2-Methylphenol	190(<330)	166	1/30	-	-	0/13	-	-	0/7
4,4-DDE	15-200	10	3/30	-	-	0/13	-	-	0/7
4,4-DDT	<16-170	10	3/30	<16-4,800	18	2/13	<16-220	13	1/7
4-Methyl-2-Pentanone	5(<10)	5	1/30	-	-	0/13	-	-	0/7
4-Methylphenol	<330-3,000	166	1/30	-	-	0/13	-	-	0/7
Acenaphthene	94(<330)	162	1/30	-	-	0/13	-	-	0/7
Aldrin	<16-53	9	1/30	-	-	0/13	-	-	0/7
Anthracene	240-410	172	2/30	-	-	0/13	-	-	0/7
Benzene	2-9	3	2/30	-	-	0/13	-	-	0/7
Benzo(a)anthracene	<350-1,100	186	1/30	-	-	0/13	-	-	0/7
Benzo(a)pyrene	<350-900	188	1/30	-	-	0/13	-	-	0/7
Benzo(b)fluoranthene	<350-1,400	188	1/30	-	-	0/13	-	-	0/7
Benzo(g,h,i)perylene	<350-530	182	1/30	-	-	0/13	-	-	0/7
Benzo(k)fluoranthene	<350-820	184	1/30	-	-	0/13	-	-	0/7
Benzoic acid	117-122(<400)	NR	2/30	-	-	0/13	-	-	0/7
Bis(2-ethylhexyl)phthalate	110-680,000	400	9/30	585-754	250	4/13	-	-	0/7
Butylbenzylphthalate	68-2,100	172	3/30	-	-	0/13	12(<330)	NR	1/7
Chlordane	<25-280	14	1/30	-	-	0/13	-	-	0/7
Chlorobenzene	3-10	3	2/30	-	-	0/13	-	-	0/7
Chrysene	<400-4,700	213	3/30	-	-	0/13	-	-	0/7
Di-N-Butyl phthalate	250(<330)	167	1/30	268-2,255	241	4/13	110-290(<330)	181	3/7
Di-N-Octyl phthalate	330 (<330)	169	1/30	-	-	0/13	-	-	0/7
Dibenzofuran	44(<330)	NR	1/30	-	-	0/13	-	-	0/7
Diethyl phthalate	46-50(<330)	NR	2/30	-	-	0/13	-	-	0/7
Ethylbenzene	3-980,000	9	9/30	-	-	0/13	-	-	0/7
Fluoranthene	49-12,000	218	4/30	260-280(<330)	171	1/13	93(<330)	NR	1/7
Fluorene	15-73(<330)	156	2/30	-	-	0/13	-	-	0/7
Gamma-BHC (Lindane)	<8.0-61	4	1/30	-	-	0/13	-	-	0/7
Indeno(1,2,3-cd)pyrene	<330-700	160	1/30	-	-	0/13	-	-	0/7
N-Nitrosodiphenylamine	120-4,300	235	7/30	-	-	0/13	-	-	0/7
Naphthalene	30-1,800	174	3/30	-	-	0/13	-	-	0/7
PCBs	59-320	46	3/30	-	-	0/13	-	-	0/7
Phenanthrene	210-6,600	245	5/30	47-291	156	2/13	-	-	0/7
Phenol	94-590	171	2/30	-	-	0/13	-	-	0/7
Pyrene	<330-8,400	202	2/30	80-380	166	2/13	110(<330)	NR	1/7
Tetrachloroethene	<5-8	3	1/30	-	-	0/13	-	-	0/7
Toluene	3-20	3	5/30	<5-810	13	7/13	-	-	0/7
Total Xylenes	<5-13,000	7	8/30	<5-5	3	1/13	-	-	0/7
Trichloroethene	<5-16	3	1/30	<5-8	3	1/13	-	-	0/7

(a) <x = chemical not detected, where "x" is the detection limit. A number or range followed by a number in parentheses indicates detected values below the detection limit where the number in parentheses is the detection limit.
(b) Geometric means are calculated using one half the detection limit for samples in which the compound is not detected.
(c) Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.
NR = not reported. Geometric mean is greater than the maximum detected value due to estimated values below the detection limit.

TABLE 8-13

INORGANIC CHEMICALS DETECTED IN SURFACE SOILS
INDUSTRIAL EXCESS LANDFILL SITE, REM II

	On Site			*Residences Near Site*			*Off Site*		
Chemical	*Range (a)* (mg/kg)	Geometric Mean (b) (mg/kg)	Frequency of Detection (c)	Range (a) (mg/kg)	Geometric Mean (b) (mg/kg)	Frequency of Detection (c)	Range (a) (mug/kg)	Geometric Mean (b) (mug/kg)	Frequency of Detection (c)
Aluminum	491-11,100	3,810	30/30	1,490-14,600	6,350	13/13	4,360-15,700	8,630	7/7
Antimony	--	--	0/30	<7.8-78.6	15.0	2/13	--	--	0/7
Arsenic	3.8-35	10.8	27/30	5.1-167	22.5	13/13	6.96-34	12.5	6/7
Barium	19-547	83.3	25/30	64-200	101	12/13	19-162	69.9	7/7
Beryllium	0.28-0.9	NR	11/30	0.2-3.7	1.21	8/13	0.4-1.5(<1.5)	1.26	3/7
Cadmium	<1.9-13.3	3.18	7/30	<0.67-9.4	1.77	8/13	<0.2-5.2	2.65	4/7
Calcium	1,510-74,500	13,200	30/30	811-38,800	4,640	13/13	281-26,100	1,650	7/7
Chromium	4.1-53	10.9	23/30	<4.4-140	15.0	11/13	8-23	12.7	6/7
Cobalt	3.8-22	8.81	16/30	2.5-20	9.29	10/13	7.4-17	16.2	3/7
Copper	8.3-55	18.0	24/30	<5.6-335	24.8	12/13	8.25-36	15.1	6/7
Iron	2,100-133,000	21,600	29/30	4,700-93,400	25,500	13/13	13,400-62,100	21,900	7/7
Lead	<2.2-699	19.5	27/30	4.6-283	26.6	12/13	11-349	35.5	7/7
Magnesium	117-7,070	2,090	30/30	610-8,720	1,410	13/13	983-3,330	1,610	7/7
Manganese	29-1,560	405	29/30	233-1,900	584	10/13	242-1,540	595	7/7
Mercury	<0.041-0.23	0.1	10/30	<0.1-0.65	0.16	5/13	<0.05-0.2	0.07	2/7
Nickel	<6.1-48	18.9	21/30	7.4-36	20.8	11/13	<12-54	22.0	3/7
Potassium	<127-2,670	642	20/30	<166-1,250	571	9/13	265-1,390	692	7/7
Selenium	--	--	0/30	<0.08-1.1	0.5	1/13	0.2(<2.7)	NR	1/7
Silver	1.8-3.5	1.83	4/30	<1.3-8.3	2.47	3/13	<1.3-3.5	1.09	1/7
Sodium	<5.6-3,950	366	23/30	96-2,770	240	9/13	74-782	396	6/7
Thallium	<1.1-2.1	NR	2/30	<0.23-0.68	NR	6/13	0.26-0.35(<1.3)	NR	1/7
Tin	<5.2-50	15	3/30	NS	NS	--	--	--	0/7
Vanadium	8.3-30	18.2	15/30	7.2-62	15.3	10/13	7.6-20(<23)	13.6	6/7
Zinc	<3.5-1,960	93.9	29/30	15-362	70.3	13/13	46.9-107	71.7	7/7
Cyanide	0.95-22.1	1.09	5/30	0.3-42	0.89	6/13	<0.36-1.3	NR	1/7

(a) <x = chemical not detected, where "x" is the detection limit. *A number or range followed by a number in parentheses indicates* detected values below the detection limit where the number in parentheses is the detection limit.

(b) Geometric means are calculated *using one half the detection limit for samples in which the compound is not detected.*

(c) Frequency of detection is the number of samples in which the chemical was detected over the total number of samples analyzed.

NR = not reported. Geometric mean is greater than the maximum detected value due to estimated values below the detection limit.
NS = not sampled.

For risk assessment purpose PAHs are normally divided into carcinogenic and noncarcinogenic compounds. Carcinogenic PAHs (CPAHs) are those for which there is sufficient evidence of carcinogenity in animals as classified by the International Agency for Research on Cancer (IARC). In general, little toxicological information is available on the noncarcinogenic PAHs and toxicity criteria have not been established for these compounds. Potential health risks from the CPAHs are likely to outweigh additional risks from noncarcinogenic PAHs. Therefore the four noncarcinogenic PAHs detected at the onsite or near-site areas (fluoranthene, fluorene, phenanthrene and pyrene) are eliminated from further assessment. The CPAHs detected at the site are chrysene an anthracene. Common risk assessment practice is to sum the concentrations of all carcinogenic PAHs and assess the sum as a single indicator chemical based on the toxicity of one of its members, benzo(a)pyrene.

Two pesticides (4,4'-DDE and 4,4'-DDT) and PCBs were detected in more than one surface soil sample. These compounds are all ubiquitous in the environment and may be indicative of background concentrations given that there is no history of pesticide or PCB disposal at this site. For example, 4,4'-DDT was detected in one off-site surface soil sample. From among these chemicals, 4,4'-DDE and 4,4'-DDT were detected at relatively high maximum concentrations. No toxicological criteria have been established for 4,4'-DDD, therefore only 4,4'-DDT is retained for assessment; although it is recognized that the concentrations may represent background conditions. PCBs are also retained for assessment due to their relatively high toxicity.

In summary, the organic chemicals in surface soils retained for assessment are, 2-butanone (onsite), benzene (onsite), toluene (onsite/near site), ethylbenzene (onsite), xylene (onsite), n-nitrosodiphenylamine (onsite), di-n-butylphthalate (near site), bis (2-ethylhexyl)phthalate (onsite/near site), 4,4'-DDT (onsite/near site), PCBs (onsite) and CPAHs (onsite).

Risks associated with indicator chemicals occurring in both onsite and near-site areas are assessed by selecting the highest mean and maximum concentrations for evaluation.

Table 8-13 summarizes the range, geometric mean and frequency of detection for inorganic chemicals for the onsite, near-site and off-site groups. As the Table indicates, all chemicals detected in onsite or near-site samples, with the exception of antimony and tin, also were detected in background (off site) samples. For the purpose of this assessment, a chemical was considered to be elevated above background if the maximum concentration detected at the site exceeds by more than an approximate factor of 2, the maximum background concentration. A factor of 2 is believed to be conservative because background concentrations of some naturally occurring metals have been observed to vary over one order of magnitude. As can be seen from Table 8-13, of the inorganic chemicals detected, 16 chemicals from onsite samples and 12 chemicals from near-site samples are at concentrations considered to be in the range of background concentrations, using the criteria described above. Of the remaining chemicals, no toxicity criteria are available for calcium sodium or tin (onsite) or magnesium, sodium or tin (near site) and therefore these chemicals will not be considered further in this assessment. Indicator chemicals of onsite soils are therefore barium, cyanide and zinc. Indicator chemicals for near site soils are antimony, arsenic, chromium, copper, cyanide, mercury, selenium, silver, vanadium, and zinc. Risks associated with exposure to cyanide and zinc are evaluated using onsite concentrations (which are greater than concentrations at near-site locations).

8.6.2 COMPARISON TO STANDARDS

No federal or state applicable or relevant or appropriate requirements (ARARs) exist for contaminants in soil. A quantitative risk assessment for soil exposures is presented in the next section.

8.6.3 QUANTITATIVE RISK ASSESSMENT

To assess the potential risks from surface soils it is assumed that both children (ages 6 to 11) and adults will trespass on the unfenced site and adjacent properties. Exposures to contaminated soils may occur from incidental ingestion of soil by children who engage in mouthing activities or by children or adults who eat, drink, or smoke during or following contact with soils. Exposure may also occur via direct contact and subsequent absorption of contaminants through the skin. Absorption is assumed to occur only for the more highly lipid soluble compounds such as PCBs, PAHs, and 4,4'DDT. In order to provide a range to the risk characterization, two exposure cases are considered--an average case using geometric mean soil concentrations and average exposure assumptions, and a plausible maximum case using maximum soil concentrations and upper-bound exposure assumptions. As with the previous risk characterizations, soil concentrations are converted to chronic daily intakes (CDIs) using assumptions about soil ingestion rates, soil contact rates, adsorption factors, frequency of exposure and average body weight. Appendix A of the PHE report (presented in its entirety in Appendix F of this RI Report), lists the assumptions used in estimating CDIs. The CDIs are then assessed relative to cancer potency factors and reference doses to characterize risk.

Tables 8-14 and 8-15 summarize the risks associated with carcinogens and non-carcinogens, respectively from contact with surface soils. The tables indicate that upper-bound excess lifetime cancer risks for children exposed for 5 years are $2x10^{-6}$ for the plausible maximum case and $1x10^{-8}$ for the average case. For adults, the upper-bound excess lifetime cancer risks are $3x10^{-5}$ for the plausible maximum case and $1x10^{-6}$ for the average case. Hazard indices are less than one for all exposure cases. As noted in previous sections, the 10^{-6} risk level is generally considered by U.S. EPA to be an acceptable level. This level is exceeded under the plausible maximum case for both children and adults. The risk in all cases is attributable to carcinogenic PAHs. This assessment may overestimate potential risks associated with CPAHs attributable to the Industrial Excess

TABLE 8-14

UPPERBOUND EXCESS LIFETIME CANCER RISKS
TRESPASSING SCENARIO
INDUSTRIAL EXCESS LANDFILL SITE
REM II

	Concentration in Surface soil		Upperbound Excess Lifetime Cancer Risk			
			Children		Adults	
Chemical	Geometric Mean (mg/kg)	Maximum (mg/kg)	Average Case	Plausible Maximum Case	Average Case	Plausible Maximum Case
Arsenic	0.023	0.167	$1x10^{-10}$	$8x10^{-9}$	$3x10^{-9}$	$1x10^{-7}$
Carcinogenic PAHs	0.34	5.1	$1x10^{-8}$	$2x10^{-6}$	$1x10^{-6}$	$3x10^{-5}$
PCBs	0.05	0.32	$6x10^{-10}$	$6x10^{-8}$	$6x10^{-8}$	$7x10^{-7}$
4,4'-DDT	0.018	4.8	$2x10^{-11}$	$8x10^{-8}$	$3x10^{-9}$	$1x10^{-6}$
Benzene	0.003	0.009	$8x10^{-13}$	$2x10^{-11}$	$8x10^{-12}$	$8x10^{-11}$
n-Nitrosodiphenylamine	.24	4.30	$5x10^{-12}$	$7x10^{-10}$	$5x10^{-11}$	$4x10^{-9}$
Bis(2-ethyl hexyl)phthalate	0.400	680	$1x10^{-12}$	$2x10^{-8}$	$1x10^{-11}$	$9x10^{-8}$
TOTAL	--	--	$1x10^{-8}$	$2x10^{-6}$	$1x10^{-6}$	$3x10^{-5}$

TABLE 8-15

RISKS DUE TO NONCARCINOGENS
TRESPASSING SCENARIO
INDUSTRIAL EXCESS LANDFILL SITE
REM II

	Concentration in Surface Soil		CDI:RfD			
			Children		Adults	
Chemical	Geometric Mean[a] (mg/kg)	Maximum (mg/kg)	Average Case	Plausible Maximum Case	Average Case	Plausible Maximum Case
Toluene	0.013	0.810	$4x10^{-9}$	$3x10^{-6}$	$2x10^{-9}$	$5x10^{-7}$
Ethylbenzene	0.009	980	$1x10^{-8}$	$1x10^{-2}$	$4x10^{-9}$	$2x10^{-3}$
Xylene	0.007	13	$8x10^{-8}$	$1x10^{-3}$	$3x10^{-8}$	$2x10^{-4}$
Di-n-butylphthalate	0.241	2.26	$3x10^{-7}$	$2x10^{-5}$	$1x10^{-7}$	$4x10^{-6}$
2-Butanone	0.006	0.051	$1x10^{-8}$	$1x10^{-6}$	$6x10^{-9}$	$2x10^{-7}$
Barium	83.3	547	$2x10^{-4}$	$1x10^{-2}$	$8x10^{-4}$	$2x10^{-3}$
Antimony	15	78.6	$4x10^{-3}$	$2x10^{-1}$	$2x10^{-3}$	$9x10^{-2}$
Cyanide	1.1	22.1	$6x10^{-6}$	$1x10^{-3}$	$3x10^{-6}$	$5x10^{-4}$
Chromium	15	140	$3x10^{-4}$	$3x10^{-2}$	$1x10^{-4}$	$1x10^{-2}$
Copper	24.8	335	$7x10^{-5}$	$1x10^{-2}$	$3x10^{-5}$	$4x10^{-3}$
Mercury	0.16	0.65	$1x10^{-5}$	$5x10^{-4}$	$5x10^{-6}$	$2x10^{-4}$
Selenium	0.5	1.1	$2x10^{-5}$	$4x10^{-4}$	$8x10^{-6}$	$2x10^{-4}$
Silver	2.47	8.3	$9x10^{-5}$	$3x10^{-3}$	$4x10^{-5}$	$1x10^{-3}$
Vanadium	15.3	62	$8x10^{-5}$	$3x10^{-3}$	$4x10^{-5}$	$2x10^{-3}$
Zinc	93.9	1,960	$5x10^{-5}$	$1x10^{-2}$	$2x10^{-5}$	$5x10^{-3}$
Hazard Index	--	--	$5x10^{-3}$	$3x10^{-1}$	$3x10^{-3}$	$1x10^{-1}$

[a] Maximum value used where data were insufficient to calculate a geometric mean.

Landfill site, because these chemicals may be naturally occurring background constituents. Although no CPAHs were detected in site-related background samples, PAHs are generally ubiquitous in the environment because they are produced by combustion of organic matter. Brown and Associates (1983) noted an urban background level of 100 mg/kg for PAHs in soil. This value is one to two orders of magnitude higher than those observed in onsite soil samples.

8.7 ASSESSMENT OF AIR EXPOSURE

8.7.1 DATA ANALYSIS

Air sampling at and near the Industrial Excess Landfill site has been performed on five occasions between March 1985 and September 1986. In March 1985 the (Roy F. Weston's personnel under contract to U.S. EPA) sampled at one upwind and four downwind locations for eight-hour periods using Gillian air pumps and triple stage silicon gel, Tenax and activated carbon tubes. Several volatile compounds were detected, however, the results did not conclusively show that the downwind concentrations were greater than the upwind concentrations. From December 1985 to March 1986 the TAT sampled during the installation of the gas manifold system at the landfill using an organic vapor analyzer (OVA), photoionization detector (Hnu), explosimeter, Gillian pumps with Tenax tubes and long-term Draeger tubes. Levels of volatile organics above background were detected, primarily within gas wells and trench excavations.

U.S. EPA's Emergency Response Team (EmRT) sampled thirteen houses near the landfill (including two control houses) and gas from the landfill vents between January 6 and 9, 1986. Samples were collected and analyzed using a mobile laboratory capable of detecting volatile organics within a mass range of 60 to 250 amu. Samples were collected in both basement and upstairs areas. Chemicals detected included 1,1,1-trichloroethane, methyl ethyl ketone, ethylbenzene, toluene, methylene chloride, 1,1-dichloroethylene, 1,2-dichloroethylene and petroleum hydrocarbons. 1,1,1-Trichloroethane, methylene chloride, toluene and petroleum hydrocarbons were also detected in the control houses. The levels detected ranged from <1 ppb to 110 ppb. The landfill gas contained all of the compounds listed above, plus trichloroethene, tetrachloroethylene, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, and vinyl chloride. Concentrations of individual chemicals in the landfill gas ranged from 0.05 ppm to 220 ppm.

In March 1986 the ERT mobile laboratory returned and monitored air quality at 56 outdoor locations on and around the landfill. Samples were taken both with the landfill flares on and off. Volatiles were detected at concentrations from 10-20 ppb at distances from 5 feet away from the flare stack with the flare off, but no compounds were detected with the flare on. Samples of the gas from the landfill venting system were also analyzed. They revealed the presence of several volatiles with concentrations in the 100 ppm range. These analyses were used by U.S. EPA Region V Air Management Division as input to air dispersion models (U.S. EPA, 1986d). The Air Management Division used U.S. EPA's PTPLU and MPTER models to predict maximum eight-hour average concentrations and average annual concentrations within an 800 meter radius of the site. The maximum (of the five year modeling period) annual average concentrations are listed in Table 8-16. These concentrations assume that the flare remains off. Table 8-16 also lists concentrations of the same chemicals assuming that the flare is on and that the flare obtains an 80 percent destruction efficiency. These concentrations represent conservative estimates based on the most recent sampling of the landfill gas and appropriate U.S. EPA recommended models and will therefore be used in the risk assessment presented in the following sections.

The next air sampling occurred in September 1986 when the ERT mobile laboratory sampled in seven houses near the landfill and one control house (U.S. EPA, 1987). Samples from several rooms in each house were analyzed in an

TABLE 8-16

OUTDOOR AIR CONCENTRATIONS
INDUSTRIAL EXCESS LANDFILL SITE
REM II

Chemical	Maximum Annual Concentration With Flare Off[a] (mg/m^3)	 With Flare On[b] (mg/m^3)
Benzene	5.37×10^{-4}	1.07×10^{-4}
Toluene	7.76×10^{-4}	1.55×10^{-4}
Trichloroethylene	2.8×10^{-5}	5.6×10^{-6}
Methyl ethyl ketone	1.03×10^{-4}	2.06×10^{-5}
1,1-Dichloroethylene	1.0×10^{-3}	2.0×10^{-4}
1,2-Dichloroethylene	1.0×10^{-3}	2.0×10^{-4}
1,1,1-Trichloroethane	1.39×10^{-3}	2.78×10^{-4}
1,1-Dichloroethane	3.5×10^{-3}	7.0×10^{-4}
1,2-Dichloroethane	3.5×10^{-3}	7.0×10^{-4}
Vinyl chloride	2.23×10^{-3}	4.46×10^{-4}
Ethyl benzene	1.53×10^{-3}	3.06×10^{-4}
Chloroform	2.17×10^{-4}	4.34×10^{-5}
Methylene chloride	1.17×10^{-4}	2.34×10^{-5}

[a] Values are taken from dispersion modeling performed by EPA Region V, Air Management Division. Concentration is the maximum year of the 5-year period modeled.

[b] Based on EPA modeled values, assuming 80% efficiency of the flair.

effort to isolate sources of the chemical detected. In most cases, where a chemical was detected, the concentrations did not vary significantly from location to location within the house, suggesting that the landfill gases, which would be more likely to accumulate at the point of entry into the house--basement areas--might not be contributing to the detected concentrations. Household chemicals stored in basements and kitchens were suggested as possible sources. As a conservative approach, the chemicals and concentrations detected in each of the homes will be used in the following risk assessment. This will provide an assessment of the potential risk to the individuals in these homes, however it may overestimate the risk attributable to the landfill since some of the chemicals may be due to sources within the homes. Table 8-17 presents the maximum concentration of each chemical detected in the eight homes monitored. In most cases, the differences in the concentrations of a given chemical measured in different rooms were within the 18-to-43 percent precision and accuracy limits reported for the data. Therefore, the maximum concentration is used in the risk assessment as a representative value.

8.7.2 COMPARISON TO STANDARDS

With the exceptions of hydrocarbons, U.S. EPA has not established National Ambient Air Quality Standards (NAAQS) for the volatile organics detected in the landfill gas or in homes near the landfill. The 3-hour average NAAQS for hydrocarbons is 0.160 mg/m^3. The combined levels of hexane and pentane measured in each of the seven homes and the control house exceed this level. As noted in Table A, the hexane/pentane concentrations range from 0.241 mg/m^3 to 0.841 mg/m^3. U.S. EPA noted in its assessment of the in-house measurements that the hexane and pentane concentrations could be due to oil heating systems within the houses, from automotive omissions from Cleveland Avenue.

TABLE 8-17
INDOOR AIR CONCENTRATION
INDUSTRIAL EXCESS LANDFILL SITE
REM II

Location	Chemical	Maximum Concentration Detected in Home Survey ppb	Maximum Concentration Detected in Home Survey mg/m^3
Amber Circle	Methylene chloride/chloroform	7	[a]0.034
	Toluene	8	0.030
	Methyl ethyl ketone	24	0.070
	Ethylbenzene/xylene	5	0.022
	Hexane	3	0.011
	1,1-Dichloroethane	14	0.057
	Pentane	78	0.229
Hilltop	Toluene	9	0.030
	Methyl ethyl ketone	17	0.050
	Ethyl benzene/xylene	4	0.017
	Hexane	4	0.014
	1,1-Dichloroethane	10	0.040
	Pentane	76	0.223
Cleveland	Methylene chloride/chloroform	21	0.102
	Toluene	7	0.030
	1,1,1-Trichloroethane	2	0.011
	Methyl ethyl ketone	20	0.060
	Ethyl benzene/xylene	7	0.030
	Hexane	3	[b]0.011
	1,1-Dichloroethane	6	0.024
	Pentane	89	0.203

TABLE 8-17(Cont'd.)
INDOOR AIR CONCENTRATION
INDUSTRIAL EXCESS LANDFILL SITE
REM II

Location	Chemical	Maximum Concentration Detected in Home Survey ppb	mg/m^3
Basswood (Control House)	Benzene	4	0.013
	Methylene chloride/chloroform	7	0.034
	Toluene	16	0.060
	1,1,1-Trichloroethane	5	0.027
	Methyl ethyl ketone	26	0.080
	Ethyl benzene/xylene	11	0.048
	Hexane	6	0.021
	1,1-Dichloroethane	64	0.259
	Pentane	137	0.403
Cleveland	Toluene	13	0.049
	Methyl ethyl ketone	116	0.340
	Ethyl benzene/xylene	8	0.035
	Hexane	5	0.018
	1,1-Dichloroethane	53	0.214
	Pentane	129	0.379
Cleveland	Benzene	3	^{c}0.0096
	Methylene chloride/chloroform	8	0.039
	Toluene	63	0.240
	Methyl ethyl ketone	31	0.240
	Ethyl benzene/xylene	20	0.087

TABLE 8-17 (Cont'd.)
INDOOR AIR CONCENTRATION
INDUSTRIAL EXCESS LANDFILL SITE
REM II

Location	Chemical	Maximum Concentration Detected in Home Survey	
		ppb	mg/m^3
	Hexane	11	0.039
	1,1-Dichloroethane	20	0.081
	Pentane	163	0.479
Cleveland	Methylene chloride/chloroform	18	0.087
	Toluene	11	0.041
	Methyl ethyl ketone	8	0.240
	Ethyl benzene/xylene	4	0.017
	Pentane	169	0.497
Cleveland	Benzene	7	0.022
	Methylene chloride/chloroform	21	0.102
	Vinyl chloride/1,2-dichloroethane	2	[d]0.005
	Toluene	110	0.410
	1,1,1-Trichloroethane	2	0.011
	Methyl ethyl ketone	70	0.210
	Ethyl benzene/xylene	18	0.078
	Hexane	12	0.042
	1,1-Dichloroethane	88	0.356
	Pentane	272	0.799

TABLE 8-17 (Cont'd.)
INDOOR AIR CONCENTRATION
INDUSTRIAL EXCESS LANDFILL SITE
REM II

---

[a] Not detected downstairs.

[b] Detected in back bedroom only.

[c] Detected in bedroom and cellar, not living room or family room.

[d] Not detected in basement of crawl space.

NOTE: Analytical technique unable to distinguish between chemicals in the following groups: methylene chloride/chloroform, ethylbenzene/xylene, and vinyl chloride/1,2-dichloroethane.

8.7.3 QUANTITATIVE RISK ASSESSMENT

The results of quantitative risk are presented in Tables 8-18 and 8-19. Table 8-18 presents the risks based on exposure to chemicals at the maximum annual concentrations predicted at locations downwind of the site by the modeling performed by U.S. EPA Region V by Air Management Division plus ICF-Clements' assumptions about the operation of the flare. It is assumed that the landfill gas flare is operating 90% of the time and that the flare is 80 percent efficient. Two exposure scenarios are considered. The first estimates the risks to children during the five year period from ages 6 to 11. The second scenario is based on a seventy year lifetime exposure to adults. A detailed explanation of the estimation of chronic daily intakes (CDIs) from these exposures, along with assumptions about breathing rates, body weights and contaminant adsorption are contained in Appendix A of the full PHE. Table 8-18 indicates that the upperbound excess lifetime cancer risks are 3×10^{-6} for children and 6×10^{-6} for adults. Hazard indices for exposure to noncarcinogens are less than one for both adults and children. These estimates probably overestimate actual risk in that concentrations for the maximum annual average of the five year modeled period are used. Concentrations would be expected to be below this level during the entire period of exposure. Further, residents will not be exposed to the maximum concentrations, but some lower level depending on their relative downwind distance from the site. Residents who spend some time away from home, such as school or work, will also receive less exposure.

Table 8-19 presents the risks based on the levels of chemicals detected by the in-home surveys. The control house is also included in the table for comparative purposes. Similar assumptions about period of exposure, breathing rates, and body weights as listed above for the modeled ambient concentrations are used to calculate chronic daily intakes and risks for the in-home concentrations. It is assumed that for a maximally exposed individual, the concentrations are representative of continuous (24-hr)

TABLE 8-18

RISKS FROM AIR EXPOSURE BASED ON EPA ESTIMATED ANNUAL AVERAGE AIR CONCENTRATIONS INDUSTRIAL EXCESS LANDFILL SITE REM II

A. Carcinogens

Compound	Concentration (mg/m^3)	Upper-Bound Excess Lifetime Cancer Risk	
		Children	Adults
Benzene	$1.5x10^{-4}$	$2x10^{-8}$	$6x10^{-8}$
Trichloroethylene	$7.8x10^{-6}$	$2x10^{-10}$	$6x10^{-10}$
1,1-Dichloroethylene	$2.8x10^{-4}$	$2x10^{-6}$	$5x10^{-6}$
1,2-Dichloroethane	$9.8x10^{-4}$	$5x10^{-7}$	$2x10^{-6}$
Vinyl chloride	$6.2x10^{-4}$	$8x10^{-8}$	$3x10^{-7}$
Chloroform	$6.1x10^{-5}$	$3x10^{-7}$	$4x10^{-7}$
Methylene chloride	$3.3x10^{-5}$	$2x10^{-9}$	$8x10^{-9}$
Total	--	$3x10^{-6}$	$6x10^{-6}$

B. Noncarcinogens

Compound	Concentration (mg/m^3)	CDI:RfD Ratio	
		Children	Adults
Toluene	$2.2x10^{-4}$	$2.4x10^{-5}$	$4.2x10^{-5}$
Methyl ethyl ketone	$2.9x10^{-5}$	$2.2x10^{-5}$	$3.8x10^{-5}$
1,2-Dichloroethylene	$2.8x10^{-4}$	$1.2x10^{-5}$	$2.0x10^{-3}$
1,1,1-Dichloroethane	$3.9x10^{-4}$	$1.0x10^{-5}$	$1.8x10^{-5}$
1,1-Dichloroethane	$9.8x10^{-4}$	$1.2x10^{-3}$	$5.7x10^{-4}$
Ethylbenzene	$4.3x10^{-4}$	$1.6x10^{-4}$	$2.8x10^{-4}$
Hazard index	--	$2.6x10^{-3}$	$2.9x10^{-3}$

TABLE 8-19

RISKS FROM AIR EXPOSURE BASED ON CONCENTRATIONS MEASURED IN HOMES NEAR THE LANDFILL
INDUSTRIAL EXCESS LANDFILL SITE
REM II

Compound[a]	Concentration (mg/m^3)	Upper-Bound Excess Lifetime Cancer Risk: Children	Upper-Bound Excess Lifetime Cancer Risk: Adults	CDI:RfD Ratio: Children	CDI:RfD Ratio: Adults
12559 AMBER CIRCLE					
Chloroform/methylene chloride	0.034/0.024	$7x10^{-5}/2x10^{-6}$	$4x10^{-3}/1x10^{-4}$	--	--
Toluene	0.030	--	--	$3.3x10^{-3}$	$5.7x10^{-3}$
Methyl ethyl ketone	0.070	--	--	$5.3x10^{-2}$	$9.1x10^{-2}$
Ethylbenzene/xylene	0.022/0.022	--	--	$8.4x10^{-3}/9.2x10^{-3}$	$1.4x10^{-2}/1.6x10^{-2}$
1,1-Dichloroethane	0.057	--	--	$6.8x10^{-2}$	$1.2x10^{-1}$
Hazard index	--	--	--	0.13/0.16	0.23/0.23
3444 HILLTOP					
Toluene	0.030	--	--	$3.3x10^{-3}$	$5.7x10^{-3}$
Methyl ethyl ketone	0.050	--	--	$3.8x10^{-2}$	$6.5x10^{-2}$
Ethylbenzene/xylene	0.017/0.017	--	--	$6.5x10^{-3}/7.1x10^{-3}$	$1.1x10^{-2}/1.2x10^{-2}$
1,1-Dichloroethane	0.040	--	--	$4.7x10^{-2}$	$8.2x10^{-2}$
Hazard index	--	--	--	0.10/0.10	0.16/0.16
12506 CLEVELAND					
Chloroform/Methylene chloride	0.102/0.072	$2x10^{-4}/5x10^{-6}$	$1x10^{-2}/4x10^{-4}$	--	--
Toluene	0.030	--	--	$3.3x10^{-3}$	$5.7x10^{-3}$
1,1,1-Trichloroethane	0.011	--	--	$2.9x10^{-4}$	$5.0x10^{-4}$
Methyl ethyl ketone	0.060	--	--	$4.5x10^{-2}$	$7.8x10^{-2}$
Ethylbenzene/xylene	0.030/0.030	--	--	$1.1x10^{-2}/1.2x10^{-2}$	$2.0x10^{-2}/2.1x10^{-2}$
1,1-Dichloroethane	0.024	--	--	$2.9x10^{-2}$	$4.9x10^{-2}$
Hazard index	--	--	--	0.09/0.09	0.15/0.15

TABLE 8-19 (Cont'd.)

Compound[a]	Concentration (mg/m^3)	Upper-Bound Excess Lifetime Cancer Risk		CDI:RfD Ratio	
		Children	Adults	Children	Adults
		12018 BASSWOOD (CONTROL HOUSE)			
Benzene	0.013	$2x10^{-6}$	$1x10^{-4}$	--	--
Chloroform/methylene chloride	0.034/0.024	$7x10^{-5}/2x10^{-6}$	$4x10^{-3}/1x10^{-4}$	--	--
	Total	--	$7x10^{-5}/3x10^{-6}$	$4x10^{-3}/2x10^{-4}$	--
Toluene	0.060	--	--	$6.7x10^{-3}$	$1.1x10^{-2}$
1,1,1,-Trichloroethane	0.027	--	--	$7.1x10^{-4}$	$1.2x10^{-3}$
Methyl ethyl ketone	0.080	--	--	$6.1x10^{-2}$	$1.0x10^{-1}$
Ethylbenzene/xylene	0.048/0.048	--	--	$1.8x10^{-2}/2.0x10^{-2}$	$3.2x10^{-2}/3.4x10^{-2}$
1,1-Dichloroethane	0.259	--	--	$3.1x10^{-1}$	$5.3x10^{-1}$
Hazard index	--	--	--	0.40/0.40	0.67/0.68
		12666 CLEVELAND			
Toluene	0.049	--	--	$5.4x10^{-3}$	$9.3x10^{-3}$
Methyl ethyl ketone	0.340	--	--	$2.6x10^{-1}$	$4.4x10^{-1}$
Ethylbenzene/xylene	0.035/0.035	--	--	$1.3x10^{-2}/1.5x10^{-2}$	$2.3x10^{-2}/2.5x10^{-2}$
1,1-Dichloroethane	0.214	--	--	$2.5x10^{-1}$	$4.4x10^{-1}$
Hazard index	--	--	--	0.58/0.53	0.91/0.91
		12430 CLEVELAND			
Benzene	0.0096	$1x10^{-6}$	$7x10^{-5}$	--	--
Chloroform/methylene chloride	0.039/0.028	$8x10^{-5}/2x10^{-6}$	$5x10^{-3}/7x10^{-4}$		
Total	--	$8x10^{-5}/3x10^{-6}$	$5x10^{-3}/7x10^{-4}$	--	--
Toluene	0.240	--	--	$2.7x10^{-2}$	$4.6x10^{-2}$
Methyl ethyl ketone	0.090	--	--	$6.8x10^{-2}$	$1.2x10^{-1}$
Ethylbenzene/xylene	0.087/0.087	--	--	$3.3x10^{-2}/3.6x10^{-2}$	$5.7x10^{-2}/6.2x10^{-2}$
1,1-Dichloroethane	0.081	--	--	$9.6x10^{-2}$	$1.7x10^{-1}$
Hazard index	--	--	--	0.22/0.23	0.39/0.40

TABLE 8-19 (Cont'd.)

Compound[a]	Concentration (mg/m^3)	Upper-Bound Excess Lifetime Cancer Risk		CDI:RfD Ratio	
		Children	Adults	Children	Adults
12460 CLEVELAND					
Chloroform/methylene chloride	0.087/0.062	$2\times10^{-4}/5\times10^{-6}$	$1\times10^{-2}/2\times10^{-4}$	--	--
Toluene	0.041	--	--	4.6×10^{-3}	7.8×10^{-3}
Methyl ethyl ketone	0.240	--	--	1.8×10^{-1}	3.1×10^{-1}
Ethylbenzene/xylene	0.017/0.017	--	--	$6.5\times10^{-3}/7.1\times10^{-3}$	$1.1\times10^{-2}/1.2\times10^{-2}$
Hazard index	--	--	--	0.19/0.19	0.33/0.30
12550 CLEVELAND					
Benzene	0.022	3×10^{-6}	2×10^{-4}	--	--
Chloroform/methylene chloride	0.102/0.073	$2\times10^{-4}/5\times10^{-6}$	$1\times10^{-2}/4\times10^{-4}$	--	--
Vinyl chloride/1,2-dichloroethane	0.005/0.008	$6\times10^{-7}/1\times10^{-6}$	$4\times10^{-5}/9\times10^{-5}$	--	--
Total	--	2×10	$^{-4}/1\times10^{-5}$	$1\times10^{-2}/6\times10^{-4}$	--
--					
Toluene	0.410	--	--	4.6×10^{-2}	7.8×10^{-2}
1,1,1-Trichloroethane	0.011	--	--	2.9×10^{-4}	5.0×10^{-4}
Methyl ethyl ketone	0.210	--	--	1.6×10^{-1}	2.7×10^{-1}
Ethylbenzene/xylene	0.078/0.078	--	--	$3.0\times10^{-2}/3.2\times10^{-2}$	$5.1\times10^{-2}/5.6\times10^{-2}$
1,1-Dichloroethane	0.356	--	--	4.2×10^{-1}	7.3×10^{-1}
Hazard index	--	--	--	0.66/0.66	[b] 1.1/1.1

[a] The analytical technique used to detect volatiles is unable to distinguish between the following pairs of chemicals: chloroform/methylene chloride, ethylbenzene/xylene, and vinyl chloride/1,2-dichloroethane. Concentrations and risks are presented for both cases.

[b] Hazard indices by critical effect group: Group A (1,1,1-trichloroethane, 1,1-dichloroethane, ethylbenzene) = 0.78; Group B (toluene) = 0.08; Group D (xylene) = 0.06; and Group G (methyl ethyl ketone) = 0.27.

exposures. This is based on recent studies which indicate that homemakers spend 95 percent of their time indoors (Quackenboss et al. 1986). Table 8-19 indicates that upper bound excess lifetime cancer risks range from $2x10^{-4}$ to $3x10^{-6}$ for children and $1x10^{-2}$ to $1x10^{-4}$ for adults. The risk is attributable to chloroform, methylene chloride, benzene, and in one case vinyl chloride and 1,2-dichloroethane. The analytical technique use to detect chemicals in the houses was not able to distinguish between the following pairs of chemicals: chloroform/methylene chloride, ethylbenzene/xylene, and vinyl chloride/1,2-dichloroethane (in the presence of methane). Therefore, two sets of risk calculations are presented assuming that the concentrations detected represent one or the other of the chemicals in the pair. Risks are greater assuming chloroform rather than methylene chloride and 1,2-dichloroethane rather than vinyl chloride. The risks from ethylbenzene versus xylene are roughly equivalent.

Hazard indices are less than one for all cases except one where the hazard index for exposure to adults is 1.1. None of the hazard indices for the critical effects groups, however, exceed one.

Based on this analysis, exposure to chemicals in air from the landfill flare and from levels measured in homes near the landfill may exceed an upperbound excess lifetime cancer risk of 10^{-6}. As stated in previous sections the 10^{-6} risk level is generally considered by U.S. EPA to be an acceptable level. U.S. EPA considers the $1x10^{-4}$ to $1x10^{-7}$ risk range as being acceptable, depending upon the site. A level of 10^{-6} is the target risk level.

As stated above, the extent to which the observed in-home levels are attributable to the landfill versus other sources within the homes cannot be determined because of the questionable representativeness of the control house.

8.8 ASSESSMENT OF MONITORING WELL BORINGS, SURFACE WATER AND SEDIMENT

8.8.1 MONITORING WELL BORINGS

Soil samples were collected at depths ranging from 5 feet to 161 feet during the drilling of the monitoring wells that surround the landfill. The samples were analyzed for Hazardous Substance List compounds. Table 8-20 and 8-21 summarized the results of the analyses for inorganic and organic chemicals, respectively. The tables present the range of concentrations detected and the frequency of detection. Since the samples are from numerous well locations and numerous depths, mean values are not considered representative of site conditions and are therefore not presented. Except for four chemicals, the range of concentrations listed in Table 8-20 for the inorganics are within the ranges detected for background surface soils as presented in previous sections. The maximum detected concentrations of copper, magnesium, sodium, and tin in the well borings are slightly elevated above the range of concentrations considered background for these chemicals. However, these chemicals are relatively immobile in soils and are not likely to leach into groundwater in great quantities. Small amounts of these substances may reach groundwater but the potential for toxic effects from use of groundwater is small due to the relatively low toxicity of the chemicals.

Table 8-21 lists 41 organic compounds detected in the soil samples (excluding those chemicals which were detected in field and laboratory blanks). Organics in subsurface soils may pose a risk at this site based on their potential to leach or desorb from the soil and contaminate groundwater. The potential for desorption is related to the soil-water partitioning characteristics of the chemicals, as reflected by the log of the octanol-water partition coefficient (log K_{ow}) and the organic carbon content of the soils. Higher log K_{ow} values and higher solid organic carbon content indicate a higher tendency for the chemical to adhere to the soil and therefore

TABLE 8-20

INORGANIC CHEMICALS DETECTED IN MONITOR WELL BORINGS
INDUSTRIAL EXCESS LANDFILL SITE
REM II

Chemical	Range of Concentration Detected (ug/kg)	Frequency of Detection
Aluminum	906-12,800	35/35
Arsenic	2.4-50	23/35
Barium	6.1-215	20/35
Beryllium	0.4-1.0	6/35
Cadmium	0.12-9.48	13/35
Calcium	1120-59,000	35/35
Chromium	1.1-19	25/35
Cobalt	3-23	17/35
Copper	6.4-124	33/35
Iron	4160-61,900	35/35
Lead	4.7-55	30/35
Magnesium	479-13,500	35/35
Manganese	31-1130	35/35
Mercury	0.11-0.17	4/35
Nickel	6.2-35	23/35
Potassium	5.8-2130	28/35
Selenium	0.5-1.4	4/35
Silver	<1.3-3.2	1/35
Sodium	55-1970	15/35
Thallium	0.6 (<1.0)	1/35
Tin	1.7-13	3/35
Vanadium	3.7-35.0	21/35
Zinc	13-211	35/35

Notes: (1) Samples taken from borings at Monitor wells 1, 2, 3, 7, 8, 9, 10, 11, 12. Depth of samples range from 5-7 ft. to 160-161 ft.

(2) Frequency of detection is the number of samples in which the compound is detected over the total number of samples analyzed.

TABLE 8-21

ORGANIC CHEMICALS DETECTED IN MONITOR WELL BORINGS

Chemical	Range (ug/kg)	Frequency
1,1,1-Trichloroethane	3-4(<5)	1/35
1,4-Dichlorobenzene	270(<330)	1/35
Methyl ethyl ketone	<10-2,600	3/35
2-Methylnaphthalene	67-790	3/35
2-Methylphenol	300(<330)	1/35
4-Methyl-2-Pentanone	<10-610	1/35
4-Methylphenol	320-8,000	2/35
4-Nitrophenol	50(<1,600)	1/35
Acenaphthene	110(<330)	1/35
Acetone	<10-1,500	1/35
Anthracene	73(<330)	1/35
Benzene	1-4<5)	4/35
Benzo(a)anthracene	89-91(<330)	2/35
Benzo(a)pyrene	93(<330)	1/35
Benzo(b)fluoranthene	120-140(<330)	2/35
Benzo(g,h,i)perylene	160-210(<330)	2/35
Benzo(k)fluoranthene	110-140(<330)	2/35
Benzoic acid	330-2,500	3/35
Bis(2-ethylhexyl)phthalate	63-2,800	5/35
Butylbenzylphthalate	77-16,000	6/35
Carbon disulfide	1-13	4/35
Chlordane	<80-290	1/35
Chrysene	100-160(<330)	2/35
Di-N-butyl phthalate	86-1,600	2/35
Di-N-octyl phthalate	120-8,300	2/35
Dibenzofuran	73-150(<330)	2/35
Diethyl phthalate	70-410	3/35
Ethylbenzene	0.6-25	14/35
Fluoranthene	93-480	2/35
Fluorene	60(<330)	1/35
Indeno(1,2,3-cd)pyrene	55-57(<330)	2/35
N-nitrosodiphenylamine	210-580	2/35
Naphthalene	<330-500	2/35
Phenanthrene	38-370	5/35
Phenol	45-2,600	5/35
Pyrene	22-330(<330)	3/35
Styrene	3-6	3/35
Tetrachloroethene	4-7	3/35
Toluene	3-190	15/35
Total xylenes	0.7-730	13/35
Trichloroethene	<5-570	2/35

a lower potential for future groundwater contamination. Site specific data on the organic carbon content of soils are not available; however, in the sandy soils found at the site, the organic carbon content would be expected to be relatively low. Of the forty-one organic chemicals detected in subsurface soils, the PAHs and two of the phthalate esters bis(2-ethylhexyl) and butylbenzylphthalate) have log K_{ow} values greater than 4.0 (Callahan et al. 1979, Hincheel 1983, Radding et al. 1976, Verscheuren 1983, Finlayson-Pitts and Pitts 1986, Russell and McDuffie 1986, Wolf et al. 1980, and McDuffie, et al. 1984). These compounds would not be expected to desorb from the soils in significant quantities and would not be expected to contribute to future groundwater contamination. The remaining compounds have log K_{ow} values ranging from 0.26 (methyl ethyl ketone) to greater than 3.0 (e.g., ethylbenzene, xylene, di-n-butyl phthalate, chlordane (U.S. EPA, 1986a). Many of these chemicals, however, were detected at relatively low concentrations in soil (<10 ug/kg) and were detected infrequently at the site (3 or less detections out of 32 samples). Consequently these compounds would not be expected to have a significant overall impact on groundwater quality. Toluene, ethylbenzene, xylene, and butylbenzyl phthalate were detected with relatively high frequency, at relatively high concentrations, and have low log K_{ow} values. Based on this combination of data, these compounds would be expected to have an impact on future groundwater quality. No toxicological criteria has been established for butylbenzyl phthalate. Toluene, ethylbenzene, and xylene are of relatively low toxicity based on reference doses presented in previous sections of the report. Therefore, the potential future risk to groundwater from subsurface solid encountered in the monitoring wells is considered to be minimal.

8.8.2 SURFACE WATER, LEACHATE, AND SEDIMENTS

Surface water, leachate and sediments have been sampled at twenty locations including onsite ponds and seeps, and upgradient, onsite, and downgradient along the creek that receives surface runoff from the site. Samples have been analyzed for Hazardous Substance List chemicals. Tables 8-22 and 8-23 list representative samples of onsite, upgradient and downgradient surface water, leachate and sediment locations. Surface water is not believed to be used as a source of drinking water in the area; therefore, the exposure pathway of concern is the potential for effects on aquatic life in the larger streams that receive discharge from the creek that drains the site. Table 8-22 and 8-23 indicate that, in general, concentrations of both organic and inorganic chemicals are higher in onsite versus downgradient or upgradient surface water samples. In addition, the number of chemicals detected onsite is greater than upgradient or downgradient. Sediment samples show a similar pattern with the notable exception of several semi-volatile compounds detected in sample SD01. This suggests that contaminants may be leaching from the site, but that the impact may not be observable at off-site locations possibly due to the effects of dilution from runoff from other areas, evaporation of volatiles or attenuation of contaminants in sediments. Table 8-3 presents the U.S. EPA Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life or the lowest-observed-effect level (LOEL) for aquatic life if sufficient data are not available to develop a criterion. These criteria can be compared to the surface water concentrations to provide a means of assessing the potential impacts of the site on aquatic life. The table indicates that the criteria for cadmium, copper, chromium, silver, and zinc are exceeded by onsite surface water concentrations. (Standard detection limits are not sufficient for the evaluation of the criteria for cadmium, copper, and silver.)

The contaminants present in onsite surface water and leachate would be subject to additional dilution and attenuation by sediments as they migrate off site in surface water runoff. In the case of chromium, copper, and zinc, a dilution factor of three would be sufficient to reduce the concentration below the AWQC or LOEL. A dilution factor of 20 and 30 would be required to reduce the concentration to below the criteria or LOEL for

TABLE 8-22

REPRESENTATIVE SURFACE WATER CONCENTRATIONS
INDUSTRIAL EXCESS LANDFILL SITE
REM II

(all concentrations are ug/l)

Chemical	On-Site			Upgradient		Downgradient		Ambient Water Quality Criteria for the Protection of Freshwater Aquatic Life (c) (24-hr average except as noted)
	LL02 (Leachate)	SW04 (b)	LL01 (a) (Leachate)	SW07 (a)	SW12 (a)	SW08 (b)	SW13 (a)	
Choroethane	<10	<10	2	<10	<10	<10	<10	-
Benzene	41	<5	20	<5	<5	<5	<5	5,300 (d)
Toluene	<5	<5	5	<5	<5	<5	<5	17,500 (d)
Chlorobenzene	6	<5	3	<5	<5	<5	<5	50 (f)
Ethylbenzene	<5	<5	43	<5	<5	<5	<5	-
Xylene	73	<5	68	<5	<5	<5	<5	-
Bis(2-ethylhexyl)phthalate	<10	3.7	4	<10	<10	<10	<10	-
Phenol	9	<10	<10	<10	<10	<10	<10	2,560 (f)
1,4-Dichlorobenzene	5	<10	<10	<10	<10	<10	<10	763 (f)
4-Methylphenol	6	5	<10	<10	<10	<10	<10	-
n-Nitrosodiphenylamine	38	<10	23	<10	<10	<10	<10	-
2,4-Dimethylphenol	<10	<10	6	<10	<10	<10	<10	2,120 (d)
Aluminum	69	3,035	<6,400	74	36	<160	104	-
Antimony	<25	76	<60	<60	<60	<60	<60	1,600 (d)
Arsenic	<2	21	<10	<2	3	<10	<10	48 (d)
Barium	720	320	925	69	39	107	85	-
Cadmium	<5	30.2	16	<5	<5	<5	<4	1.1 (e)
Calcium	222,000	243,800	188,200	111,000	104,000	116,000	81,700	-
Chromium	<10	19.4	12(<20)	<10	<10	<10	<4	11
Cobalt	<38	41	9.7(<38)	<38	<38	<38	<5	-
Copper	<17	40.5	25	<17	<17	<17	<17	12 (e)
Iron	12,200	293,600	175,400	1,940	2,000	392	623	-
Magnesium	90,600	57,500	90,300	24,300	<21,700	25,000	16,750	-
Manganese	747	1,250	666	184	318	113	86	-
Nickel	<31	35	23(<31)	<31	<31	<31	<7	160 (e)
Potassium	80,800	29,000	126,000	<4,800	2,720	<4,800	4,015	-
Silver	20	27	14	<10	<10	<10	<3	0.12 (f)
Sodium	527,000	167,500	545,500	<27,010	43,040	<26,000	20,450	-
Vanadium	<35	40	6.4	<35	<35	<35	<4	-
Zinc	110	169	160	<17	<17	<17	4.3	110 (e)

(a) Average of two samples.
(b) Average of three samples.
(c) Federal Register March 15, 1979; July 25, 1979; October 1, 1979; November 28, 1980.
(d) Acute toxicity lowest-observed-effect level (EPA 1986a).
(e) Assumes a water hardness of 100 mg/l CaCo(3).
(f) Chronic toxicity lowest-observed-effect-level (EPA 1986e).
<x = Chemical not detected where 'x' is the detection limit.

TABLE 8-23

REPRESENTATIVE SEDIMENT CONCENTRATIONS
INDUSTRIAL EXCESS LANDFILL SITE
(all concentrations are ug/kg)

	On-Site		Upgradient		Downgradient	
Chemical	SD11 (a)	SD13	SD07(a)	SD08(a)	SD01(a)	SD04
Benzoic acid	670	710	<2,842	<8,081	<2,062	<8,939
Bis(2-ethyl hexyl)phthalate	<610	<2,300	326	1,087	827	<1,844
Di-n-butyl phthalate	<330	230	<586	<1,667	<425	1,899
Butyl benzyl phthalate	<350	<1,300	<586	<1,667	157	<1,844
Phenanthrene	<350	<1,300	<586	<1,667	103	<1,844
Fluoranthrene	<720	120	<586	<1,667	174	<1,844
Benzo(a)anthracene	<190	1,400	<586	<1,667	59	<1,844
Chrysene	<190	<700	<586	<1,667	71	<1,844
Aluminum	2,805	11,300	6,680	5,410	8,950	3,510
Arsenic	4	<5	11	<28	12	19
Barium	58	308	121	139	60	256
Beryllium	<0.5	<0.5	0.73	<1.1	0.51	<1.1
Cadmium	<0.5	9.3	<3.8	<11	<2.9	<11
Calcium	62,500	42,000	12,900	29,100	10,500	176,000
Chromium	14	36	10	17	12	16
Cobalt	9	28	9.4	15	11	<14
Copper	11	37	25	45	23	33
Iron	16,500	32,600	23,400	36,400	27,300	25,600
Lead	29	93	19	39	25	17
Magnesium	5,220	4,100	4,110	4,050	2,880	4,430
Manganese	431	937	344	408	448	571
Nickel	9	65	16	30	19	41
Potassium	557	1,230	<2,050	<6,030	<1,600	<6,030
Silver	<0.5	<0.5	<2.8	<8.3	3.9	11
Sodium	432	1,540	1,000	3,960	790	5,350
Vanadium	8.7	13	16	17	15	12
Zinc	78	165	88	204	88	96

(a) Average of two samples.

<x = chemical not detected where 'x' is the detection limit.

cadmium and silver, respectively. There is therefore a potential for off-site migration of cadmium and silver to result in adverse impacts on aquatic life.

8.9 RISK ASSESSMENT UNCERTAINTIES

The procedure used to assess potential human health risks in this evaluation are subject to a wide variety of uncertainties. In general, there are four main sources of uncertainty in this assessment:

- Environmental chemistry sampling and analysis, "Exposure parameter estimation,
- Toxicological data, and
- Errors through combinations of the above

Environmental chemistry sampling and analysis error can stem from the error inherent in the procedures, from a failure to take an adequate number of samples to arrive at sufficient areal resolution, from mistakes on the part of the sampler, or from the heterogeneity of the matrix being sampled.

A significant area of uncertainty relates to the tentatively identiified compounds. The assessment is based on the identifications provided by the laboratory; however, these should not be considered as reliable as the identification of Hazardous Substance List compounds.

There are inherent uncertainties in determining the exposure parameters that are combined with toxicological information to assess risk. Of particular note in this assessment are assumptions about average body weight, average daily water consumption, and average inhalation rates, which may underestimate or overestimate exposure depending on the actual characteistics of exposed populations. In addition, the model used to assess exposure via showering contains numerous assumptions about mass transfer kinetics, shower characteristics (droplet diameter and drop time), and shower duration and frequency, which has been recently validated through laboratory experiments and is believed to be reasonably accurate. In general, conservative assumptions used throughout the assessment to account for uncertainties.

Toxicological data error is also a major source of uncertainty in this risk assessment. As noted in its Guidelines for Carcinogenic Risk Assessment (U.S. EPA, 1986c):

> There are major uncertainies in extrapolating both from animals to humans and from high to low doses. There are important species differences in uptake, metabolism, and organ distibution of carcinogens, as well as species and strain differences in target site susceptibility. Human population are variable with respect to geometric constitution, diet, occupation and home environment, activity patterns, and other cultural factors.

Cancer potency factors used in this assessment are upper-bound estimates of risk. Actual risks are not likely to be higher than thes estimates but could be considerably lower.

The toxicity factors of arsenic is currently the subject of considerable controversy. This is reflected in this report by the difference in the results of the risk assessment based on a standards comparisonn and the assessment based on the CAG carcinogenic potency factor. Although the MCL is based on technical and economic as well as health considerations, U.S. EPA has recently proposed the same 50 mg/liter level as the maximum contaminant level goal (MCLG) for arsenic. MCLGs are nonenforceable health-based goals, which are set such that, with an adequate margin of safety, no known or anticipated health effects will occur. MCLGs for potential carcinogens are normally set at zero, reflecting the belief that any exposure to a potential carcinogen results in an increased excess lifetime cancer risk. U.S. EPA's proposed MCLG of 50 mg/liter was based on the recommendation of the National Academy of Science, which found that arsenic may be a essential nutritional element and that the drinking water criteria provides a sufficient margin of safety for protecion against adverse health effects. As explained in Appendix B of the full PHE, the carcinogenic potency factor used in this risk assessment was derived from a study of 37 villages in Taiwan where arsenic was detected in well water. That study has been critized on the grounds that its applicability to different exposure conditions may be limited. However, it is generally in agreement with recent epidemiologic data from other sources. The relationship found between arsenic exposure and skin cancer seen in the Taiwanese studies has not found in epidemiologic studies conducted in the United States,. However it has been noted that these studies lacked sufficient power to definitely detect this relationship. It is important to note that with the given carcinogenic potency factor, even background levels of arsenic in groundwater at the Industrial Excess Landfill site may pose a greater than 10^{-6} excess lifetime cancer risk under some of the exposure cases.

8.10 CONCLUSION

This assessment has evaluated levels of contaminants detected in residential wells, monitoring wells, tentatively identifed compounds in groundwater, leachate, surface water, soils, air and sediments near the Industrial Excess Landfill site. Residential wells have been assessed on a well-by-well basis, with the assessment including all chemicals for which toxicity values are available. Similarily, air sampling has been evaluated on a home-by-home basis. Monitoring wells and surface soils evaluations have been based on the average and maximum concentrations of selected contaminants as a likely worst-case possible future exposure scenario. A toxicity data base search was conducted for tentatively identified compounds (TICs), and the limited available information on these compounds has been used in a qualitative assessment. Monitor well borings, surface water, leachate, and sediment data have been qualitatively reviewed. The following conclusions are noted:

- Near term (2) years consumption of groundwater from residential wells RW05, RW38, RW39, RW07, RW08, RW09, RW40, and RW11 may result in unacceptable health risks for children, where an unacceptable risk is defined as a greater than 10^{-6} excess lifetime cancer risk or a hazard index for a critical effect group exceeding 1. Based on similar criteria, long-term (lifetime) consumption of groundwater from wells RW05, RW38, and RW39 may result in unacceptable health risk. Although the presence of arsenic in several wells results in an excess lifetime cancer risk greater than 10^{-6}, the concentration of arsenic are well below the MCL or MCLG. (See Section 8.9, "Risk Assessment Uncertainties," for a discussion of the current controversy surrounding the toxicity of arsenic.)

- Based on the previous definition, unacceptable adverse health risks may be associated with long-term (lifetime) consumption of groundwater containing the level of contaminants detected in the shallow monitoring wells. The risks are associated with 1,2,-dichloroethane, benzene, barium, and lead. Since some dilution or attenuation of contaminants may take place as the contaminants migrate from the landfill towards the residential wells, this assessment may overestimate actual future risks to nearby residents.

- Levels of TICs detected in residential and monitoring wells are well below levels associated with acute and subacute toxic effects. However, it is possible that the TICs as a mixture may augment the toxic effects of each chemical individually.

- Under the assumed trespassing scenario, the upper-bound excess lifetime cancer risks associated with soil contact exceed the 10^{-6} level for children and adults under the plausible, maximum case, but not for the average case. For noncarcinogenic effects, hazard indices under the trespassing scenario are all less than one.

- Upperbound excess lifetime cancer risk from exposure to contaminants in air, based on the modeling of emissions from the landfill flare to the nearest house are marginally above 10^{-6} level for both children and adults. The exposure is based on U.S. EPAs modeling and ICF-Clements assumption that the flare operates 90 percent of the time and is 80 percent efficient. The assessment probably overestimates risk since a five-year maximum value air concentration is used, and because no adjustment is made for time spent away from the landfill, such as at school or work.

- Levels of air contaminants detected in residences near the landfill exceed the 10^{-6} upperbound excess lifetime cancer risk level. The extent to which the chemicals detected in the homes are due to the landfill as opposed to in-home sources, such as solvents, cleaners, or heating systems cannot be adequately assessed because of the unusually high concentrations detected in the control house.

- The future potential impact on groundwater from subsurface soils encountered in the monitoring well borings is considered to be minimal. This is due to the relatively low concentrations and frequencies of detection of most of the chemicals. Although toluene, ethylbenzene, and zylene may be expected to leach into groundwater over time, the toxicities of these compounds are low, and the consequent potential risk is expected to be minimal.

- There is a potential for adverse effects on aquatic life in streams that receive runoff from the site, based on the concentrations of cadmium and silver detected in onsite surface water and leachate in comparison to the Ambient Water Quality Criteria for the protection of freshwater aquatic life or lowest-observed-effect levels for aquatic toxicity.

SECTION 9.0 REFERENCES/BIBLIOGRAPHY

Brown, K.W. and Associates,Inc., 1983. Background Levels of Polynuclear Armomatic Hydrocarbons. July 1983

Callahan, M.A. Slimak, M.W., Gabel, N.W., Max C.P., Fowler, G.F., Freed, J.R., Jennings,P., Dirfee, R.L., Whitmore, F.C., Maestri, B., Mahey, W.R., Holt, B.R., and Gould, C. 1979. Water-related envrionmental fate of 129 Priority Pollutants. 2 volumes. Office of Water Planning and Standards, U.S. Environmental Protection Agency, Washington, D.C. EPA 4409/4-79-029a,b

Delong, R.M., Geologic May of Stark County, Ohio, Ohio Department of Natural Resources, Division of Geological Survey, 1963.

Delong, R.M. and White, G.W. 1964. Geology of Stark County, Ohio. Ohio Geological Survey Bulletin 61, 209 p., 2 maps.

Environmental Protection Agency (EPA). 1986a. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response, Washington, D.C. EPA 540/1-86-060

Environmental Protection Agency (EPA). 1986b. Guidelines for the health risk assessment of chemical mixtures. Fed. Reg. 51:34014-34025

Environmental Protection Agency (EPA). 1986c. Guidelines for carcinogen risk assessment. Fed. Reg. 51:33992-34003

Environmental Protection Agency (EPA). 1986d. Development of Risk Assessment Methodology for Municipal Sludge Landfilling. March 1986. ECAO-CIN-485

Foster, S.A. and Chrostowski, P.C. 1987. Integrated Household Exposure Model for Use of Tap Water Contaminated with Volatile Organic Chemicals. Presented at the 79th Air Pollution Control Association Annual Meeting, Minneapolis, Minnesota. June 1986. Paper 86-12-3

Gifford, G. Status Report: Industrial Excess Landfill, December 1984.

Goldthwait, R.P., White, G.W., and Forsyth, J.L. 1961. Glacial Map of Ohio. U.S. Geological Survey Miscellaneous Geologic Investigations Map I-316.

Groenewold, G.H., Hydrogeologic and Other Considerations Related to the Selection of Sanitary-Landfill Sites in Ohio, Information Circular No. 41, Ohio State Department of Natural Resources, Division of Geological Survey, 1974. Other publications of interest cited in this reference include:

> Christman, R.L., Waters, D.D., and Bauder, J.R., 1971, Soil Survey of Stark County, Ohio: U.S. Department of Agriculture Soil Conservation Service.

REFERENCES/BIBLIOGRAPHY
(continued)

DeLong, R.M., and White, G.W., 1963, Geology of Stark County: Ohio Geological Survey Bulletin 61.

Harker, D.H., and Bernhagen, R.J., 1943, Water Supply in Stark County: Report to Ohio Water Supply Board.

Schaefer, E.J., White, G.W., and Van Tuyl, D.W, 1946, The Groundwater Resources of the Glacial Deposits in the Vicinity of Canton, Ohio: Ohio Water Resources Board Bull. 3, 60 p.

Stark County Regional Planning Commission, 1969, Sanitary Landfill Location Study: 84 p.

Local Climatological Data: Annual Summary with Comparative Data, 1981, and National Oceanic Atmospheric Administration.

McDuffie, B., Russell, D.J., and Natishar, J.J. 1984. Potential for migration into Groundwater. Proc. Triangle Conf. on Environ. Tech. Marcch 6-8, Duke University 1984

Quackenboss, J.J., Spengler, J.D., Manarek, M.S., Letz, R., and Duffy, C.D. 1986. Personal Exposure to Nitrogen Dioxide: Relationship to Indoor/Outdoor Air Quality and Activity Patterns. Environ. Sci. Technol. 20:8. August 1986

Radding, S.B., LIU, D.H., Johnson, H.L., and Mill, J. 1977. Review of the Environmental Fate of Selected Chemicals. Office of Toxic Substances, U.S. Environmental Protection Agency, Washington, D.C. EPA 560/5-77-003

Sedam, A.C. 1973. Hydrogeology of the Pottsville Formation in Northeastern Ohio. U.S. Geological Survey Hydrologic Investigations Atlas HA-494, 2 sheets.

Russell, D.J., and McDuffie, B. 1986. Chemodynamic Properties and Phthalate Esters: Partitioning and Soil Migration. Chemosphere 15:1003-1021

Statement under Oath of Kenny Catlette, May 31, 1984.

Stark County Regional Planning Commission, 1985. Report, 1985.

Techlaw, Inc., Draft Report: Industrial Excess Landfill, November 1, 1984.

Verschueren, K. 1983. Handbook of Environmental Data on Organic Chemicals. Van aNostrand Reinhold Co., New York, New York

REFERENCES/BIBLIOGRAPHY
(continued)

Walker, A.C. 1979. Ground-water Resources of Stark County. Ohio Department of Natural Resources, Division of Water, (Map).

White, G.W. 1984. Glacial Geology of Summit County, Ohio. Ohio Geological Survey Report of Investigations No. 123, 25 p., 1 map.

Weston - Spill Prevention and Emergency Response Technical Assistance Team, Region V, Emergency Action Plan for Industrial Excess Landfill; Uniontown, Ohio, December, 1994.

13135 Lee Jackson Memorial Highway
Suite 200
Fairfax, Virginia 22033
(703) 968-0900