NORTHEAST AREA SUMMARY REPORT

FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Prepared For:

Revitalizing Auto Communities Environmental Response Trust (RACER)

DISCLAIMER:
SOME FORMATTING CHANGES MAY HAVE OCCURRED WHEN THE ORIGINAL DOCUMENT WAS PRINTED TO PDF; HOWEVER, THE ORIGINAL CONTENT REMAINS UNCHANGED.

Prepared by:
Conestoga-Rovers & Associates

14496 Sheldon Road, Suite 200
Plymouth, Michigan 48170

Office: (734) 453-5123
Fax: (734) 453-5021

web: http://www.CRAworld.com

JUNE 2012
REF. NO. 017358 (22)

NORTHEAST AREA SUMMARY REPORT

FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Prepared For:

Revitalizing Auto Communities Environmental Response Trust (RACER)

JUNE 2012
REF. NO. 017358 (22)
This report is printed on recycled paper

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	GENERAL	1
1.2	REPORT ORGANIZATION	2
2.0	SITE SETTING	3
2.1	SITE LAND USE	3
2.2	GEOLOGY	3
2.3	HYDROGEOLOGY	3
2.4	GROUNDWATER USE	3
3.0	ENVIRONMENTAL INVESTIGATIONS AND ACTIONS	5
3.1	SCREENING CRITERIA	5
3.2	HISTORICAL ACTIVITIES	5
3.2.1	SUBSURFACE SOIL STUDY	5
3.2.2	SOIL EXCAVATION	6
3.2.3	GROUNDWATER MONITORING PROGRAM	7
3.2.4	TEST PIT SAMPLE	8
3.2.5	CONCLUSIONS	8
3.3	CURRENT ACTIVITIES	9
3.3.1	SOIL RESULTS	9
3.3.2	GROUNDWATER RESULTS	10
3.3.4	CONCLUSIONS	10
4.0	CONCLUSIONS AND RECOMMENDATIONS	11
5.0	REFERENCES	12

LIST OF FIGURES
(Following Text)

FIGURE 1.1 SITE LOCATION

FIGURE 1.2 SITE PLAN

FIGURE 2.1 GROUNDWATER CONTOUR - APRIL 26, 2012

FIGURE 3.1 HISTORICAL AND CURRENT INVESTIGATIONS

LIST OF TABLES
(Following Text)

TABLE 3.1 SOIL SCREENING CRITERIA

TABLE 3.2 GROUNDWATER SCREENING CRITERIA

TABLE 3.3 SOIL ANALYTICAL RESULTS (1988)

TABLE 3.4 GROUNDWATER ANALYTICAL RESULTS (1989 -1990)

TABLE 3.5 GROUNDWATER ANALYTICAL RESULTS (2004 – 2012)

TABLE 3.6 SOIL ANALYTICAL RESULTS (2012)

LIST OF APPENDICES
(Following Text)

APPENDIX A STRATIGRAPHIC LOGS

APPENDIX B HISTORICAL REPORTS

LIST OF ACRONYMS

AOI	Area of Interest
bgs	Below ground surface
CRA	Conestoga-Rovers & Associates
EDR	Environment Data Resources Inc.
ft	Feet
ft^2	Square feet
GM	General Motors Corporation
GM LLC	General Motors LLC
GME	General Motors Environmental Science Department
MBSS	Michigan Background Soil Survey
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg/kg	Milligram/kilogram
mg/L	Milligram/liter
MLC	Motors Liquidation Company
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
Plant	Willow Run Plant
RACER	Revitalizing Auto Communities Environmental Response Trust
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Site	Former Willow Run Plant
SVOCs	Semi-Volatile Organic Compounds
U.S. EPA	United States Environmental Protection Agency
µg/L	Microgram/liter
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) has prepared this report to summarize the historical and current conditions for a portion of the former General Motors Corporation (GM) Willow Run Plant (Plant) located at 2930 Ecorse Road in Ypsilanti, Michigan (United States Environmental Protection Agency [U.S. EPA] ID MID 980 587 893) (Site). The portion this report focuses on is the Northeast corner of the property, north of the Plant building, currently consisting of vacant land or parking lot. For the purposes of this report, this area will be referred to as the Northeast Area. The Site location and the Northeast Area are shown on Figures 1.1 and 1.2.

As a result of GM's recent bankruptcy, certain operating assets of GM were sold on July 10, 2009 to a newly formed company which is now known as General Motors LLC (GM LLC). Existing, non-conforming assets remained the property of GM, which was renamed Motors Liquidation Company (MLC). On October 20, 2010, MLC entered into a settlement agreement with federal and state governmental authorities regarding MLC's environmental obligations at its owned real property, including this Site (Settlement Agreement). On March 3, 2011, this Settlement Agreement was approved by the United States Bankruptcy Court for the Southern District of New York as part of MLC's Chapter 11 Plan of Liquidation. According to the terms of the Settlement Agreement, MLC transferred its interests in this Site to the Revitalizing Auto Communities Environmental Response Trust (RACER) on March 31, 2011, the effective date of MLC's Chapter 11 Plan of Liquidation. As such, the Site is now operated by RACER and this summary of the current and historical conditions in the Northeast Area has been prepared on RACER's behalf.

1.1 GENERAL

The Site is located at Ecorse and Wiard Roads in Ypsilanti, Michigan as shown on Figure 1.1. The Site consists of approximately 315 acres of land and is surrounded by industrial, commercial, and residential development. Operations began at the Site in 1941 and currently consist of 4.8 million square feet of manufacturing area having housed various process operations over the years. These operations have primarily included machining, cleaning, painting and assembly of metal parts and products.

Although the Northeast Area was never used for manufacturing; the Current Conditions Report (CRA, 2011) for the Site identified one Area of Interest (AOI) within the area. AOI 12, the North Yard, is an outdoor area, approximately 800 by 200 ft, and was used for approximately 30 years to store various pieces of production machinery and

equipment. Some of the machinery was not properly drained and it is likely that operating fluids (e.g. organic and inorganic oils) leaked into the soil.

This report has been prepared to summarize historical and current conditions in the Northeast Area in support of transferring a portion of this area to the Willow Run Airport. The approximate area that is expected to be transferred is shown on Figure 1.2.

1.2 REPORT ORGANIZATION

This report is organized as follows:

- Section 1.0 – Introduction
- Section 2.0 – Site Setting
- Section 3.0 – Environmental Investigations and Actions
- Section 4.0 – Conclusions and Recommendations
- Section 5.0 – References

2.0 SITE SETTING

2.1 SITE LAND USE

The Site is zoned for Industrial use. The areas to the north, northeast, west-northwest, and south of the Site are zoned Industrial. The property closest to the Northeast Area, the Willow Run Airport, is zoned Airport.

2.2 GEOLOGY

The Site geology and hydrogeology described in Sections 2.2 and 2.3 are defined based on a review of the stratigraphic and instrumentation logs from historical investigations.

The geology for the eastern portion of the Site consists of two units. A poorly graded sand extends from the surface to approximately 15 feet (ft) below ground surface (bgs), thickening to the east. This sand is underlain by a clay unit that appears to be the regionally extensive clay unit. Stratigraphic logs from the Northeast Area are presented in Appendix A. The Current Conditions Report (CRA, 2011), includes several cross-sections across the site detailing the Site geology.

2.3 HYDROGEOLOGY

The saturated zone for the eastern portion of the Site consists of a poorly graded sand that extends to approximately 15 ft bgs as described in Section 2.2. The depth to groundwater for the eastern portion of the Site varies from approximately 4 to 8 ft bgs beneath the Plant and in the Northeast Area is shallower. The saturated thickness increases from approximately 5 ft beneath the Plant to 10 ft at the eastern property boundary.

A Groundwater contour map was generated from groundwater levels collected on April 26, 2012 (Figure 2.1). The April 2012 groundwater contour map is generally consistent with historical groundwater contour maps. Groundwater generally flows to the southeast.

2.4 GROUNDWATER USE

The Ypsilanti Community Utilities Authority provides potable water to the Site and adjacent properties.

According to Site personnel, no water supply or irrigation wells are currently present on the Site. No evidence of any water supply or irrigation wells was observed by CRA during the Site inspection. Numerous monitoring wells, which were installed during ongoing and historical subsurface investigations, are present at the Site.

As discussed in The Current Conditions Report (CRA, 2011), well information provided in an Environment Data Resources Inc. (EDR) report indicates that there are three wells located on the west side of the Site and are identified as household wells. It is unknown if these wells are drinking water wells or are monitoring wells. The wells were installed October 30, 1984, February 2, 1985, and October 30, 1985, and are 15 ft deep.

3.0 ENVIRONMENTAL INVESTIGATIONS AND ACTIONS

3.1 SCREENING CRITERIA

The soil and groundwater results were compared to Michigan Part 201 generic cleanup criteria developed by the Michigan Department of Environmental Quality (MDEQ) under the authority of the Natural Resources and Environmental Protection Act (1994 PA 451, as amended), and published under Remediation and Redevelopment Operational Memorandum No. 1, Part 201 Generic Cleanup Criteria/Part 213 Risk Based Cleanup Levels, as updated March 25, 2011 by the Remediation Division. Due to the proximity to a property boundary, the results were compared to both residential and non residential cleanup criteria. Tables 3.1 and 3.2 present the soil and groundwater screening criteria, respectively.

3.2 HISTORICAL ACTIVITIES

An August 6, 1987 letter from Charles San Juan of the Michigan Department of Natural Resources (MDNR) summarized the findings of a site inspection, including observation of leaking, pooling, and staining of soils related to hydraulic oil and other lubricating liquids draining from stored machinery.

As a result, Hydramatic and the General Motors Environmental Science Department (GME) conducted an investigation and remediation program of the Northeast Area from 1987 to 1990. This included an investigation of a grid of surficial soil between 1 and 4 ft bgs, a limited excavation of the surficial soil (1 to 2 ft) in two discreet areas and the installation of 3 monitoring wells followed by a groundwater monitoring program. The investigation and excavation areas are included on Figure 3.1. Historical reports detailing these investigations are included in Appendix B.

3.2.1 SUBSURFACE SOIL STUDY

To determine the extent of contamination in the Northeast Area, GM conducted a subsurface soil study, using a phased approach, which was completed in April 1988. The following four phases were to be implemented sequentially and the implementation of each phase depended on finding contamination in all the preceding phases:

- Phase 1: Organic and Inorganic constituents in the surface material
- Phase 2: Constituents and characterization of the unsaturated zone

- Phase 3: Constituents and characterization of the saturated zone
- Phase 4: Delineation of vapor phase constituents

In Phase 1, completed surface soil sampling was used to define the lateral extent of contamination. A total of 42 soil samples, from 0 to 12 inches, were collected and analyzed for Polychlorinated Biphenyls (PCBs) (Aroclors 1221, 1248, 1254, 1260), heavy metals (chromium, lead, cadmium, zinc, nickel and iron) and total hydrocarbons. Analytical results are included in Table 3.3 and are compared against the current screening criteria described in Section 3.1.

The results demonstrated that the foreign constituents measured in the soil were mostly concentrated horizontally in an approximately 100 by 200 foot central region of the yard. The maximum concentrations of hydrocarbons and PCBs in the surface soils were 14,000 milligram/kilogram (mg/kg) and 4 mg/kg, respectively. Other parts of the storage area generally had lower concentrations, mostly background levels.

Chromium was the only constituent analyzed for that exceeds current screening criteria. These chromium detections exceed chromium VI criteria but do not exceed chromium III screening levels. Based on chromium speciation recently completed (Spring 2012) on a Site-wide basis, chromium VI is not prevalent at the Site and, therefore chromium III criteria should be used.

In Phase 2, 21 soil cores were collected using a specially designed coring device to adequately define the vertical spread of contaminants. The results showed that, in all areas, the unsaturated soil zone below the upper 22 inches was not impacted. Therefore, an investigation of the deeper perched aquifer system (Phase 3), which would have began at about 6 ft bgs, was unnecessary. Since no vapor-phase organics were detected in the soil samples, delineation of vapor contaminants (Phase 4) was unnecessary. GME concluded that retardation processes such as adsorption, cation exchange, and low contaminant solubility, prevented contaminant migration beyond the storage area or into the aquifer. Furthermore, environmental regulations at the time of the investigation did not require cleanup action. Therefore, the investigation concluded that no remedial action was necessary in the area.

3.2.2 SOIL EXCAVATION

Due to the low concentrations and limited vertical migration of the contaminants and their insignificant potential for future migration, as discussed in the previous section, the area could have been left in its then current state. However, plant management decided

to excavate the surface soil in PCB-containing areas, prior to grading the site. With the agreement of the MDNR, an area of about 27,000 square feet (ft^2), which included the central zone of higher contaminant concentrations, was excavated to a depth of 2 ft bgs. Another more lightly affected area about 5,000 ft^2 was excavated to 1 foot bgs. The approximate 32,000 ft^2 of soil was excavated and disposed of as nonhazardous waste. The limited extent of the excavation was completed only because of the precise delineation of the shallow contaminated zone demonstrated by the phased soil-coring investigated at the site. This excavation was completed in August 1988 and the approximate areas are shown on Figure 3.1.

3.2.3 GROUNDWATER MONITORING PROGRAM

As part of the Northeast Area remediation program, a quarterly groundwater monitoring program was implemented for a 2-year period beginning in March 1989. The primary objective of the study was to sample and analyze shallow groundwater in the Northeast Area for organic chemicals and inorganic constituents. Analytical results are summarized in Table 3.4 and are compared against the screening criteria described in Section 3.1.

Three monitoring wells (MW-301, MW-302 and MW-303, renamed CRA-266M, CRA-265M and CRA-264M, respectively) were installed on February 14, 1989. The locations of the monitoring wells are shown on Figure 3.1. Eight quarterly groundwater sampling events were conducted in March 1989, June 1989, September 1989, December 1989, March 1990, July 1990, September 1990 and December 1990. In each monitoring event, groundwater samples were collected from the three monitoring wells and analyzed for dissolved metals (chromium, lead, cadmium, zinc, nickel and iron), purgeable halocarbons, purgeable aromatic hydrocarbons, and PCBs.

The groundwater data generally indicated that metals were present at levels not uncommon for shallow groundwater in Michigan. Iron was detected in all samples at CRA-264M and CRA-265M and two samples at CRA-266M at concentrations that exceed the current residential and non-residential drinking water criteria. These concentrations are expected to be related to background or naturally occurring metals concentrations in groundwater. All other metals were generally undetected. Copper and lead were detected once at concentrations that exceeded screening criteria at CRA-266M; however, it is unlikely that these isolated detections were Site-related.

Site-related organic chemicals (including PCBs) were generally not identified during the monitoring period. However, in December 1989, PCB Aroclor 1248 was detected in

CRA-264M at extremely low concentrations of 0.0031 milligram/liter (mg/L) and 0.0060 mg/L (duplicate sample). In March 1990, the concentration of Aroclor 1248 decreased to 0.00077 mg/L in CRA-264M. No PCBs were found in CRA-264M during subsequent sampling events. During the subsurface soil study, low concentrations of PCBs were found in shallow soils in two discrete areas of the site, but no PCBs above the limit of detection (0.2 mg/kg) were found in soil samples from the CRA-264M area. Also, PCBs are highly insoluble in water and tend to be found in the environment either adsorbed to soil particles or in soil. The historical reports indicate that the groundwater sample from this well was very silty. Therefore, it is likely that the PCBs observed in groundwater samples from CRA-264M were not indicative of actual groundwater conditions.

3.2.4 TEST PIT SAMPLE

A groundwater sample was collected from a test pit in the Northeast Area in November 2004 during a Site utility investigation. The sample was analyzed for dissolved metals, PCBs, Semi-Volatile Organic Compounds (SVOCs) and Volatile Organic Compounds (VOCs). Table 3.5 summarizes the results of the groundwater samples compared against the screening criteria described in Section 3.1. The location of the test pit sample is shown on Figure 3.1.

No VOCs, SVOCs, or PCBs were detected at concentrations above the screening criteria. Various metals were detected above screening criteria. Mercury was detected at 0.056 microgram/liter (µg/L) which exceeds the groundwater surface water interface (GSI) criteria of 0.0013 µg/L. Detections of aluminum, 1.3 mg/L, and iron, 1.6 mg/L, exceeded both the residential and non-residential drinking water criteria. The vanadium concentration of 0.0046 mg/L exceeded the residential drinking water criteria of 0.0045 mg/L.

3.2.5 CONCLUSIONS

The results of the historical study indicate that the fluids and oils from the stored machinery in the North Yard were confined within the upper 24 inches of soil. The areas of soil with greatest impact were removed by excavation and subsequent groundwater monitoring indicated that past activities in this area have not impacted the groundwater quality.

3.3 CURRENT ACTIVITIES

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) is currently being completed at the Site. This report discusses a subset of the RFI Work Plan activities that were completed to facilitate a property transfer with neighboring Willow Run Airport. The investigation included the collection of soil samples from 11 soil borings, the installation of 8 monitoring wells (CRA-705M, CRA-706M, CRA-709M, CRA-710M, CRA-828M, CRA-829M, CRA-833M, CRA-834M), development of the wells and the collection of groundwater samples from the 8 new wells and 2 existing wells. The work was completed between January 17, 2012 and February 7, 2012. Monitoring well and soil boring locations are shown on Figure 3.1. At the time this field work was completed, the area to be included in the property transfer was unclear, so a large area was investigated. The two most upgradient wells (CRA 705M and CRA-706M) were installed as background wells for evaluating background concentrations of metals at the Site.

Continuous soil samples were collected from each location to record soil stratigraphy and to screen for organic vapors using a photoionization detector (PID). The stratigraphic and instrumentation logs are presented in Appendix A. Soil samples were collected for laboratory analysis from 0 to 2 ft bgs, the interval 2 ft above the water table, and from a maximum of one additional interval that is deemed significantly impacted in the field (elevated PID readings, odors, staining, etc.). Soil and groundwater samples were collected for laboratory analysis for VOCs, SVOCs, PCBs, and metals.

3.3.1 SOIL RESULTS

No additional soils samples were required due to elevated PID readings, odors, staining, etc. Table 3.6 summarizes the results of the soil samples compared against the screening criteria described in Section 3.1. No VOCs, SVOCs, or PCBs were detected at concentrations above the screening criteria. Various metals were detected above screening criteria.

Arsenic, iron, manganese, magnesium, and selenium were detected in at least one sample at concentrations above the screening criteria. These concentrations are likely the result of background levels of metals in soils.

In 2005 the MDEQ updated the document "*Michigan Background Soil Survey*" (MBSS). The MBSS is a compilation of soil sampling data that represents what is assumed to be naturally occurring background concentrations of metals in Michigan soils. The data

and statistical summaries in the MBSS are used for comparison purposes only and are meant to provide a resource for information regarding the concentrations of naturally occurring metals in various soil types and geographic areas of Michigan. The concentrations detected fall within the typical data range for these metals in Michigan as documented in the MBSS.

3.3.2 GROUNDWATER RESULTS

The groundwater in the Northeast Area is fairly shallow. Water levels in the wells range from approximately 1.5 to 4 ft bgs. The general groundwater flow direction in this area is to the southeast (Figure 2.1).

Table 3.5 summarizes the results of the groundwater samples compared against the screening criteria described in Section 3.1. No VOCs, SVOCs, or PCBs were detected at concentrations above the screening criteria. Various metals were detected above screening criteria.

Arsenic, chromium, copper, lead, and vanadium were only detected at concentrations that exceed screening criteria in one sample collected from CRA-710M on January 23, 2012. The sample collected from this well was very turbid (667 NTU). A subsequent sample was collected from this well on April 12, 2012 and analyzed for metals. The turbidity of this sample was 0.95 NTU. The only metal detected above screening criteria was manganese. This confirms that the elevated concentrations of metals detected in the January sample are related to the particulates in the groundwater, rather than actual groundwater conditions. This well is located west of the probable new property boundary and is expected to remain RACER property.

Aluminum, iron, and manganese were detected in all or almost all samples above drinking water and or groundwater surface water interface criteria. These concentrations are expected to be related to background or naturally occurring metals concentrations in groundwater. As part of the overall Site investigation, a background metals concentration in groundwater analysis is being completed.

3.3.4 CONCLUSIONS

The analytical results from the investigation indicate that the soil and groundwater are not impacted by organic parameters (i.e., VOCs, SVOCs, and PCBs) and that the detected metals are likely attributable to naturally occurring background concentrations.

4.0 CONCLUSIONS AND RECOMMENDATIONS

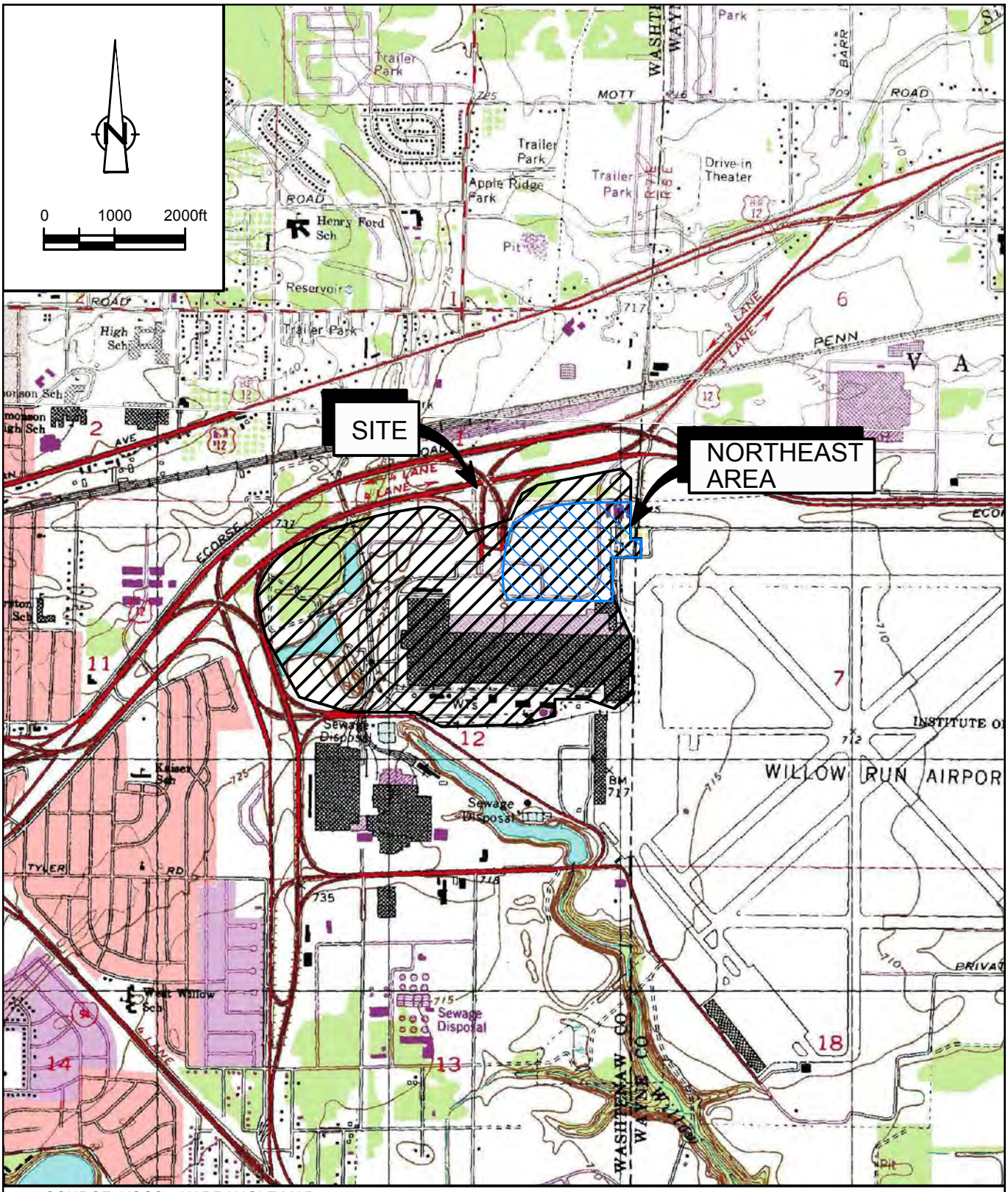
This report summarizes the historical and current conditions of the Northeast Area of the former Willow Run Plant. The analytical results of the historical and current investigations indicate that the soil and groundwater are not impacted by organic parameters (i.e., VOCs, SVOCs, and PCBs) and that the detected metals are likely attributable to naturally occurring background concentrations.

Based on the information provided in this report, it is anticipated that a no further action request will be submitted for the Northeast Area.

5.0 REFERENCES

CRA. 2011. Current Conditions Report, Former General Motors Powertrain Willow Run, Ypsilanti, Michigan, July 2011.

FIGURES



SOURCE: USGS 7.5 QUADRANGLE MAP
EAST YPSILANTI, MICHIGAN
DATE: 1996
EAST DENTON, MICHIGAN
DATE: 1969 REVISED: 1980

YPSILANTI

NOTE:
SITE BOUNDARY IS ESTIMATED

figure 1.1

SITE LOCATION
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
Ypsilanti, Michigan

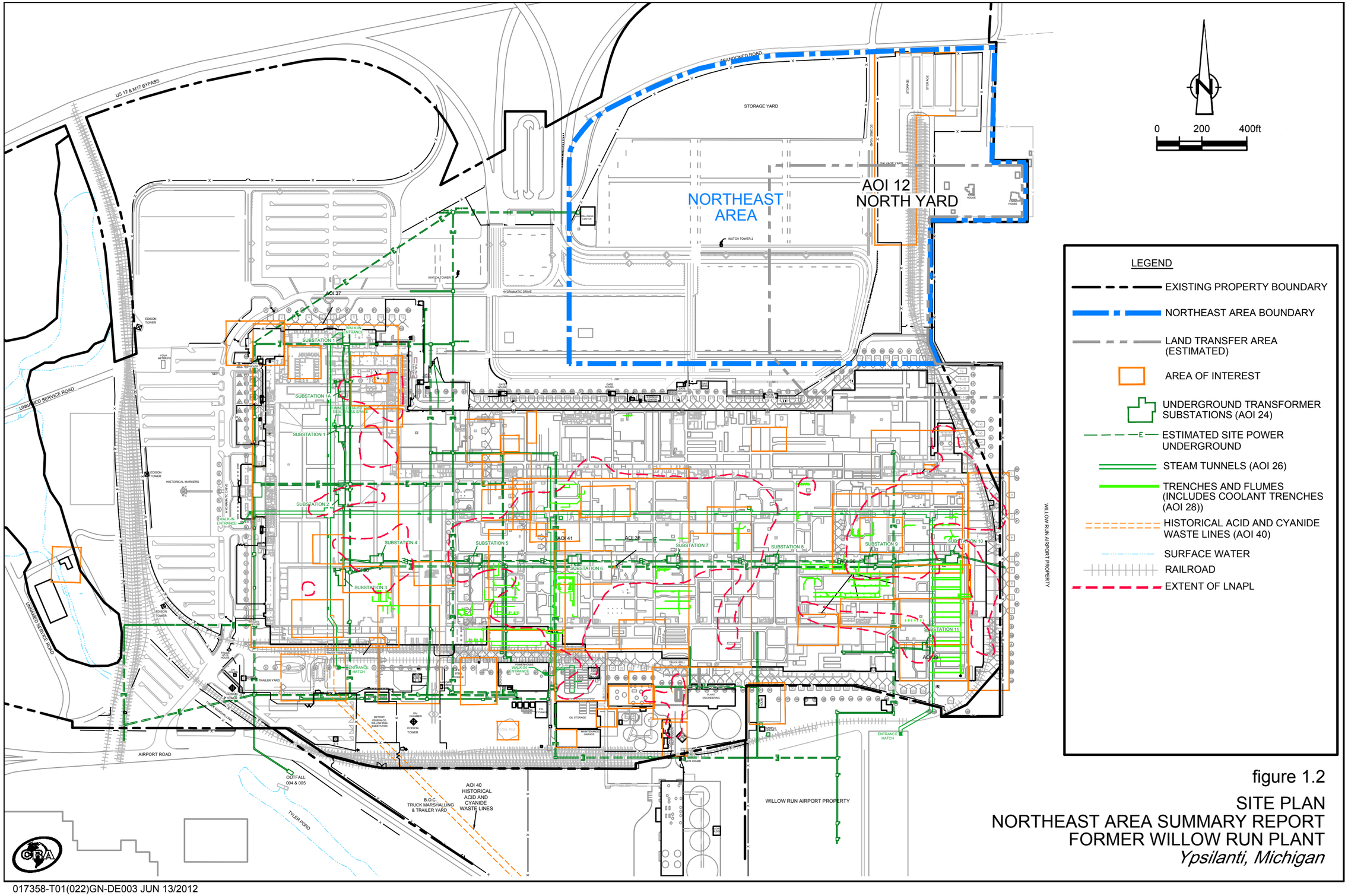


figure 1.2

SITE PLAN
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
Ypsilanti, Michigan

017358-T01(022)GN-DE003 JUN 13/2012

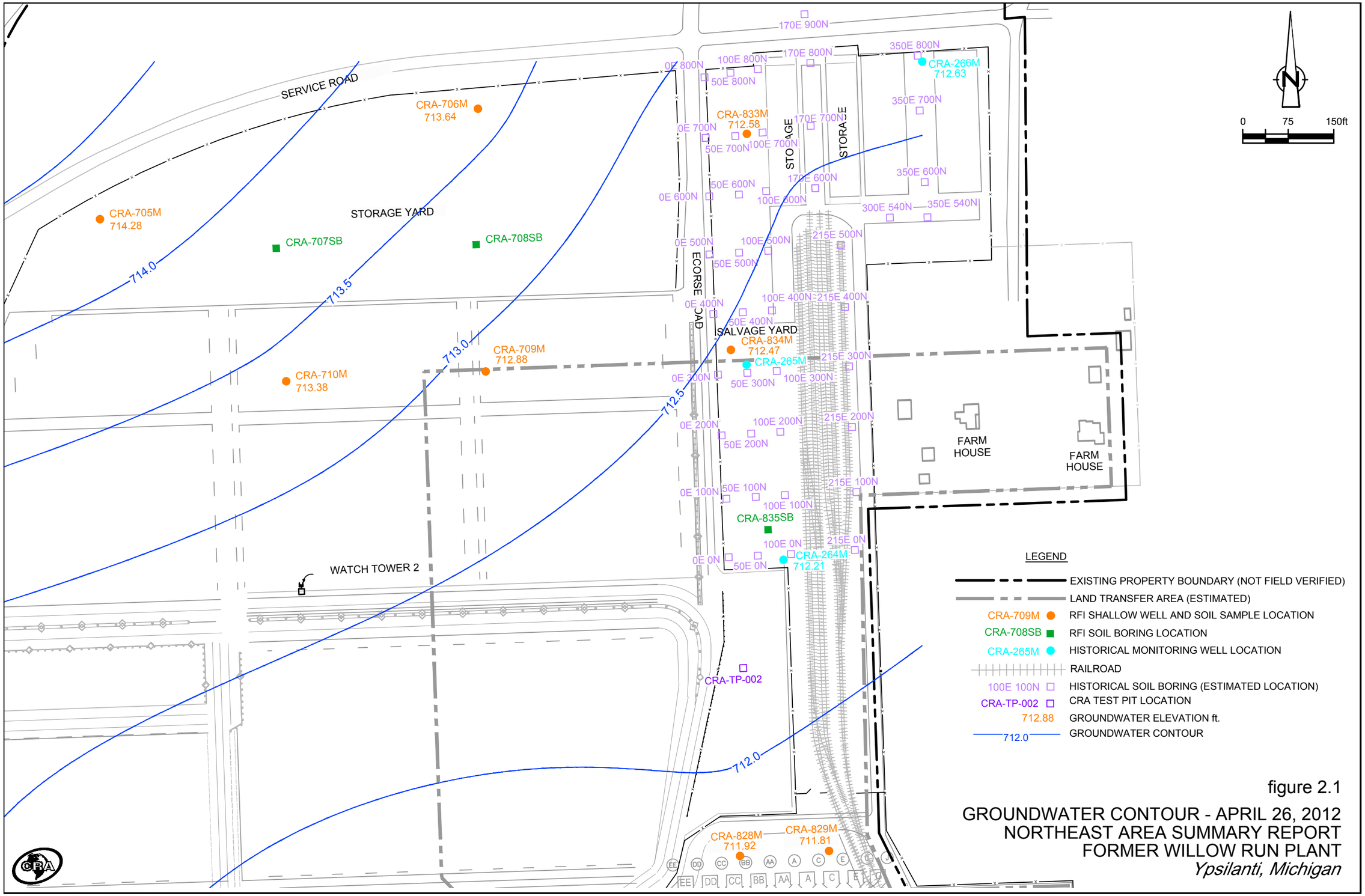


figure 2.1

GROUNDWATER CONTOUR - APRIL 26, 2012
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
Ypsilanti, Michigan

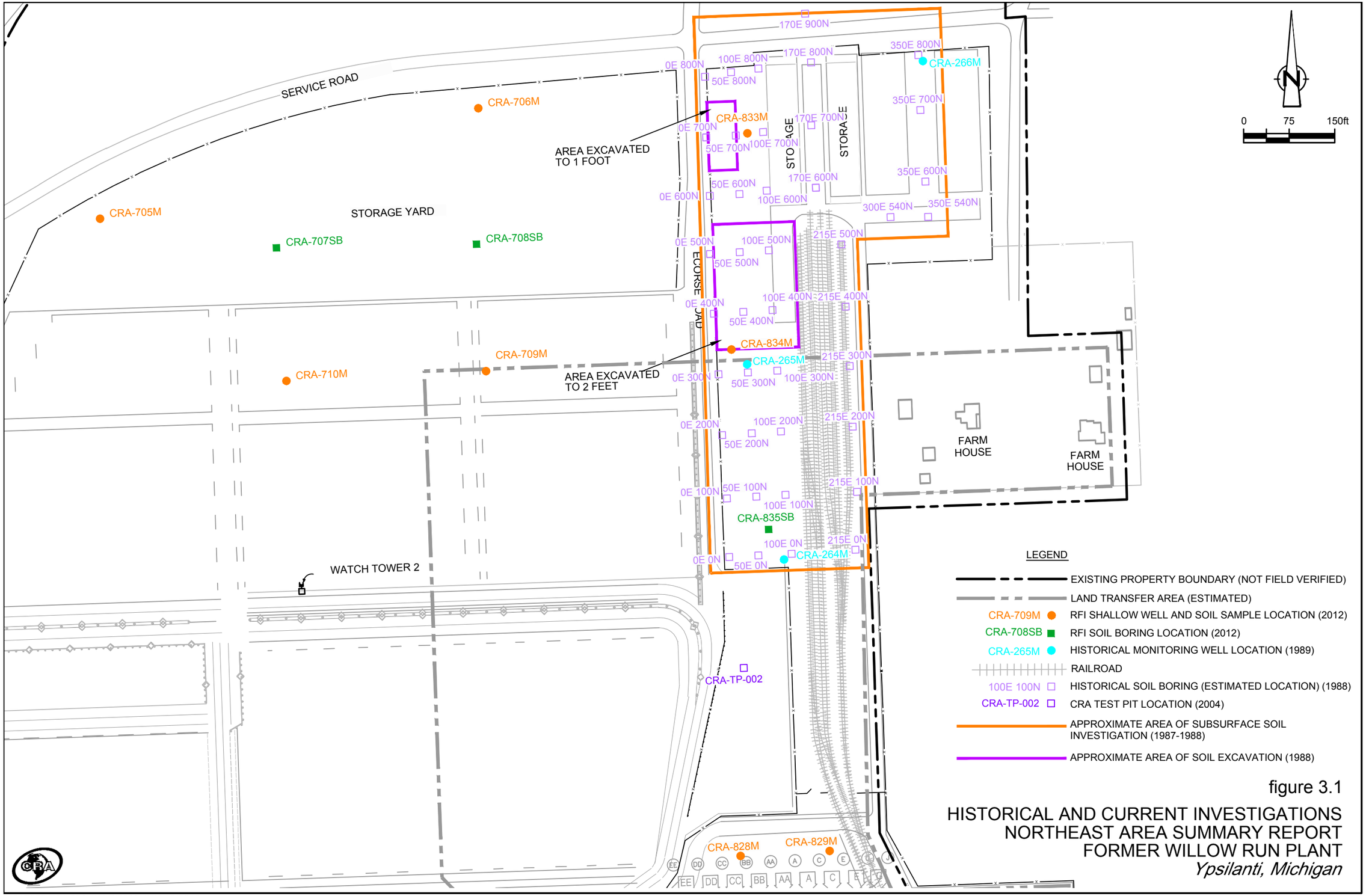


figure 3.1

HISTORICAL AND CURRENT INVESTIGATIONS NORTHEAST AREA SUMMARY REPORT FORMER WILLOW RUN PLANT

Ypsilanti, Michigan

017358-T01(022)GN-DE006 JUN 13/2012

TABLES

TABLE 3.1

SOIL SCREENING CRITERIA
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location Sample Identification Sample Date Sample Type Sample Depth	Statewide Default Background	Drinking Water Protection	Non-Residential Drinking Water Protection	Groundwater Surface Water Interface Protection	Groundwater Contact Protection	Soil Volatilization to Indoor Air Inhalation	Non-Residential Soil Volatilization to Indoor Air Inhalation	Infinite Source Volatile Soil Inhalation	Non-Residential Infinite Source Volatile Soil Inhalation	Finite VSIC for 5 Meter Source Thickness	Non-Residential Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Non-Residential Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation	Non-Residential Particulate Soil Inhalation	Direct Contact	Non-Residential Direct Contact	Soil Saturation Concentration Screening
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
Inorganics (mg/kg)																		
Aluminum	6900	1	1	NA	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	50000	370000	NA
Antimony	NA	4.3	4.3	94	49000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	13000	5900	180	670	NA
Arsenic	5.8	4.6	4.6	4.6	2000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	720	910	7.6	37	NA
Barium	75	1300	1300	1200	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	330000	150000	37000	130000	NA
Beryllium	NA	51	51	950	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	1300	590	410	1600	NA
Cadmium	1.2	6	6	7.30	230000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	1700	2200	550	2100	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	18	30	30	3.3	140000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	260	240	2500	9200	NA
Chromium III (trivalent)	18	1000000	1000000	6600000	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	330000	150000	790000	1000000	NA
Chromium VI (hexavalent)	NA	30	30	3.3	140000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	260	240	2500	9200	NA
Cobalt	6.8	0.8	2	2	48000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	13000	5900	2600	9000	NA
Copper	32	5800	5800	170	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	130000	59000	20000	73000	NA
Iron	12000	6	6	NA	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	160000	580000	NA
Lead	21	700	700	7700	ID	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	100000	44000	400	900	NA
Magnesium	NA	8000	22000	NA	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	6700000	2900000	1000000	1000000	NA
Manganese	440	1	1	130	180000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	3300	1500	25000	90000	NA
Mercury	0.13	1.7	1.7	0.05	47	48	89	52	62	52	62	52	62	20000	8800	160	580	NA
Nickel	20	100	100	170	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	13000	16000	40000	150000	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.41	4	4	0.4	78000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	130000	59000	2600	9600	NA
Silver	1	4.5	13	0.1	200000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	6700	2900	2500	9000	NA
Sodium	NA	2500	7000	NA	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	1000000	1000000	NA
Thallium	NA	2.3	2.3	4.2	15000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	13000	5900	35	130	NA
Vanadium	NA	72	990	190	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	750	5500	NA
Zinc	47	2400	5000	380	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	170000	630000	NA
PCBs (mg/kg)																		
Aroclor-1016 (PCB-1016)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1221 (PCB-1221)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232 (PCB-1232)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242 (PCB-1242)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248 (PCB-1248)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254 (PCB-1254)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260 (PCB-1260)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	NA	NLL	NLL	NLL	NLL	3000	16000	240	810	7900	28000	7900	28000	5200	6500	4	16	NA
Semi-Volatile Organic Compounds (mg/kg)																		
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	39	110	NA	9100	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	23000000	10000000	23000	73000	NA
2,4,6-Trichlorophenol	NA	2.4	9.4	0.33	200	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	1000000	1300000	710	3300	NA
2,4-Dichlorophenol	NA	1.5	4.2	0.33	960	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	5100000	2300000	660	1800	1800
2,4-Dimethylphenol	NA	7.4	20	7.6	10000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	4700000	2100000	11000	36000	NA
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	0.43	0.64	NA	170	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	16000	20000	48	220	NA
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	620	1800	NA	2300	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	56000	180000	NA
2-Chlorophenol	NA	0.9	2.6	0.36	1900	430	800	960	1100	960	1100	960	1100	1200000	530000	1400	4500	19000
2-Methylnaphthalene	NA	57	170	4.2	5500	2700	4900	1500	1800	1500	1800	1500	1800	670000	290000	8100	26000	NA
2-Methylphenol	NA	7.4	20	1	16000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	6700000	2900000	11000	36000	NA
2-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	NA	0.4	1.2	ID	1600	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	630	2000	NA
3&4-Methylphenol	NA	7.4	20	1	16000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	6700000	2900000	11000	36000	NA
3,3'-Dichlorobenzidine	NA	2	2	2	4.6	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	6500	8200	6.6	30	NA
3-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	NA	0.83	0.83	NA	190	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	79	260	NA
4-Bromophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	5.8	16	0.28	3000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	4500	15000	NA
4-Chloroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	NA	300	880	8.7	970	190000	350000	81000	97000	81000	97000	81000	97000	14000000	6200000	41000	130000	NA
Acenaphthylene	NA	5.9	17	ID	440	1600	3000	2200	2700	2200	2700	2200	2700	2300000	1000000	1600	5200	NA
Acetophenone	NA	30	88	ID	1100	1100	1100	44000	52000	44000	52000	44000	52000	33000000	14000000	1100	1100	1100
Anthracene	NA	41	41	ID	41	1000000	1000000	1400000	1600000	1400000	1600000	1400000	1600000	67000000	29000000	230000	730000	NA
Atrazine	NA	0.06	0.06	0.15	110	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	71	330	NA
Benzaldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	20	80	NA
Benzo(a)pyrene	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	1500	1900	2	8	NA

TABLE 3.1

SOIL SCREENING CRITERIA
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location Sample Identification Sample Date Sample Type Sample Depth	Statewide Default Background	Drinking Water Protection	Non-Residential Drinking Water Protection	Groundwater Surface Water Interface Protection	Groundwater Contact Protection	Soil Volatilization to Indoor Air Inhalation	Non-Residential Soil Volatilization to Indoor Air Inhalation	Infinite Source Volatile Soil Inhalation	Non-Residential Infinite Source Volatile Soil Inhalation	Finite VSIC for 5 Meter Source Thickness	Non-Residential Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Non-Residential Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation	Non-Residential Particulate Soil Inhalation	Direct Contact	Non-Residential Direct Contact	Soil Saturation Concentration Screening
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
Benzo(b)fluoranthene	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	20	80	NA
Benzo(g,h,i)perylene	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	800000	350000	2500	7000	NA
Benzo(k)fluoranthene	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	200	800	NA
Biphenyl (1,1-Biphenyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	NA	0.10	0.17	0.1	110	8.3	44	3.8	13	3.8	13	3.8	13	9400	12000	13	58	2200
bis(2-Ethylhexyl)phthalate (DEHP)	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	700000	890000	2800	10000	10000
Butyl benzylphthalate (BBP)	NA	310	310	120	310	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	47000000	21000000	310	310	310
Caprolactam	NA	120	340	NA	1000000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	670000	290000	53000	310000	NA
Carbazole	NA	9.4	39	1.1	820	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	62000	78000	530	2400	NA
Chrysene	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	2000	8000	NA
Dibenz(a,h)anthracene	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	2	8	NA
Dibenzofuran	NA	ID	ID	1.7	ID	2000	3600	130	160	130	160	130	160	6700	2900	ID	ID	NA
Diethyl phthalate	NA	110	320	2.2	740	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	3300000	1500000	740	740	740
Dimethyl phthalate	NA	790	790	NA	790	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	3300000	1500000	790	790	790
Di-n-butylphthalate (DBP)	NA	760	760	11	760	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	3300000	1500000	760	760	760
Di-n-octyl phthalate (DnOP)	NA	100000	140000	ID	140000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	31000000	14000000	6900	20000	140000
Fluoranthene	NA	730	730	5.5	730	1000000	1000000	740000	890000	740000	880000	740000	880000	9300000	4100000	46000	130000	NA
Fluorene	NA	390	890	5.3	890	580000	1000000	130000	150000	130000	150000	130000	150000	9300000	4100000	27000	87000	NA
Hexachlorobenzene	NA	1.8	1.8	0.35	8.2	41	220	17	56	17	56	17	56	6800	8500	8.9	37	NA
Hexachlorobutadiene	NA	26	72	0.091	350	130	350	130	460	130	460	130	460	140000	180000	100	350	350
Hexachlorocyclopentadiene	NA	320	320	ID	720	30	56	50	60	50	60	50	60	13000	5900	720	720	720
Hexachloroethane	NA	0.43	1.2	1.8	110	40	79	550	660	930	1400	930	1400	230000	100000	230	730	NA
Indeno(1,2,3-cd)pyrene	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	ID	ID	20	80	NA
Isophorone	NA	15	62	26	2400	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	12000000	8200000	2400	2400	2400
Naphthalene	NA	35	100	0.73	2100	250	470	300	350	300	350	300	350	200000	88000	16000	52000	NA
Nitrobenzene	NA	0.33	0.33	3.6	220	91	170	54	64	54	64	54	64	47000	21000	100	340	490
N-Nitrosodi-n-propylamine	NA	0.33	0.33	NA	7.2	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	1600	2000	1.2	5.4	1500
N-Nitrosodiphenylamine	NA	5.4	22	NA	700	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	2200000	2800000	1700	7800	NA
Pentachlorophenol	NA	0.022	0.022	27	4.3	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	100000	130000	90	320	NA
Phenanthrene	NA	56	160	2.1	1100	2800	5100	160	190	160	190	160	190	6700	2900	1600	5200	NA
Phenol	NA	88	260	9	12000	NLV	NLV	NLV	NLV	NLV	NLV	NLV	NLV	40000000	18000000	12000	12000	12000
Pyrene	NA	480	480	ID	480	1000000	1000000	650000	780000	650000	780000	650000	780000	6700000	2900000	29000	84000	NA
Volatile Organic Compounds (mg/kg)																		
1,1,1-Trichloroethane	NA	4	4	1.8	460	250	460	3800	4500	12000	15000	28000	31000	67000000	29000000	460	460	460
1,1,2,2-Tetrachloroethane	NA	0.17	0.7	1.6	94	4.3	23	10	34	10	34	14	34	54000	68000	53	240	870
1,1,2-Trichloroethane	NA	0.1	0.1	6.6	420	4.6	24	17	57	21	57	44	120	190000	250000	180	840	920
1,1-Dichloroethane	NA	18	50	15	890	230	430	2100	2500	5900	6000	14000	14000	33000000	15000000	890	890	890
1,1-Dichloroethene	NA	0.14	0.14	2.6	220	0.062	0.33	1.1	3.7	5.3	15	13	37	62000	78000	200	570	570
1,2,4-Trichlorobenzene	NA	4.2	4.2	5.9	1100	1100	1100	28000	34000	28000	34000	28000	34000	25000000	11000000	990	1100	1100
1,2-Dibromo-3-chloropropane (DBCP)	NA	0.01	0.01	ID	1.2	1.2	1.2	13	15	13	15	13	15	13000	5900	1.2	1.2	1.2
1,2-Dibromoethane (Ethylene dibromide)	NA	0.02	0.02	0.11	0.5	0.67	3.6	1.7	5.8	1.7	5.8	3.3	9.8	14000	18000	0.092	0.43	890
1,2-Dichlorobenzene	NA	14	14	0.28	210	210	210	39000	46000	39000	46000	52000	55000	100000000	44000000	210	210	210
1,2-Dichloroethane	NA	0.1	0.1	7.2	380	2.1	11	6.2	21	11	33	26	74	120000	150000	91	420	1200
1,2-Dichloropropane	NA	0.1	0.1	4.6	320	4	7.4	25	30	50	51	110	120	270000	120000	140	550	550
1,3-Dichlorobenzene	NA	0.17	0.48	0.68	51	26	48	79	94	79	94	110	110	200000	8800	170	170	170
1,4-Dichlorobenzene	NA	1.7	1.7	0.36	140	19	100	77	260	77	260	110	340	450000	570000	400	1900	NA
2-Butanone (Methyl ethyl ketone) (MEK)	NA	260	760	44	27000	27000	27000	29000	35000	29000	35000	35000	36000	67000000	29000000	27000	27000	27000
2-Hexanone	NA	20	58	ID	2500	990	1800	1100	1300	1100	1300	1400	1500	2700000	1200000	2500	2500	2500
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	NA	36	100	ID	2700	2700	2700	45000	53000	45000	53000	67000	70000	140000000	60000000	2700	2700	2700
Acetone	NA	15	42	34	110000	110000	110000	130000	160000	130000	160000	190000	200000	390000000	170000000	23000	73000	110000
Benzene	NA	0.1	0.1	4	220	1.6	8.4	13	45	34	99	79	230	380000	470000	180	400	400
Bromodichloromethane	NA	1.6	1.6	ID	280	1.2	6.4	9.1	31	9.7	31	19	57	84000	110000	110	490	1500
Bromoform	NA	1.6	1.6	ID	870	150	770	900	3100	900	3100	900	3100	2800000	3600000	820	870	870
Bromomethane (Methyl bromide)	NA	0.2	0.58	0.7	1400	0.86	1.6	11	13	57	57	140	140	330000	150000	320	1000	2200
Carbon disulfide	NA	16	46	ID	280	76	140	1300	1600	7900	8000	19000	19000	47000000	21000000	280	280	280
Carbon tetrachloride	NA	0.1	0.1	0.9	92	0.19	0.99	3.5	12	12	34	28	79	130000	170000	96	390	390
Chlorobenzene	NA	2	2	0.5	260	120	220	770	920	990	1100	2100	2100	4700000	2100000	260	260	260
Chloroethane	NA	8.6	34	22	950	950	950	30000	36000	120000	120000	280000	280000	670000000	290000000	950	950	950
Chloroform (Trichloromethane)	NA	1.6	1.6	7	1500	7.2	38	45	150	120	340	270	790	1300000	1600000	1200	1500	1500
Chloromethane (Methyl chloride)	NA	5.2	22	ID	1100	2.3	10	40	120	410	1000	1000	2500	4900000	2600000	1100	1100	1100
cis-1,2-Dichloroethene	NA	1.4	1.4	12	640	22	41	180	210	420	430	990	1000	2300000	1000000	640	640	640
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	NA	1.6	1.6	ID	360	3.9	21	24	80	24	80	33	98	130000	160000	110	500	610
Dichlorodifluoromethane (CFC-12)	NA	95	270	ID	1000	900	1700	53000	63000	550000	550000	1400000	1400000	3300000000	1500000000	1000	1000	1000
Ethylbenzene	NA	1.5	1.5	0.36	140	87	140	720	2400	1000	3100	2200	6500	10000000	13000000	140	140	140
Isopropyl benzene	NA	91	260	3.2	390	390	390	1700	2000	1700	2000	2800	3000	5800000	2600000	390	390	390
Methyl acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl tert butyl ether (MTBE)	NA	0.8	0.8	140	5900	5900	5900	25000	30000	39000	41000	87000	89000	200000000	88000000	1500	5900	5900
Methylene chloride	NA	0.1	0.1	30	2300	45	240	210	700	590	1700	1400	4000	6600000	8300000	1300	2300	2300

TABLE 3.1

SOIL SCREENING CRITERIA
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location Sample Identification Sample Date Sample Type Sample Depth	Statewide Default Background a	Drinking Water Protection b	Non-Residential Drinking Water Protection c	Groundwater Surface Water Interface Protection d	Groundwater Contact Protection e	Soil Volatilization to Indoor Air Inhalation f	Non-Residential Soil Volatilization to Indoor Air Inhalation g	Infinite Source Volatile Soil Inhalation h	Non-Residential Infinite Source Volatile Soil Inhalation i	Finite VSIC for 5 Meter Source Thickness j	Non-Residential Finite VSIC for 5 Meter Source Thickness k	Finite VSIC for 2 Meter Source Thickness l	Non-Residential Finite VSIC for 2 Meter Source Thickness m	Particulate Soil Inhalation n	Non-Residential Particulate Soil Inhalation o	Direct Contact p	Non-Residential Direct Contact q	Soil Saturation Concentration Screening r
Styrene	NA	2.7	2.7	2.1	270	250	520	970	3300	970	3300	1400	4200	5500000	6900000	400	520	520
Tetrachloroethene	NA	0.1	0.1	1.2	88	11	60	180	600	480	1400	1100	3300	5400000	6800000	88	88	88
Toluene	NA	16	16	5.4	250	250	250	2800	3300	5100	36000	12000	36000	27000000	12000000	250	250	250
trans-1,2-Dichloroethene	NA	2	2	30	1400	23	43	280	330	830	840	2000	2000	4700000	2100000	1400	1400	1400
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	NA	0.1	0.1	4	440	7.1	37	78	260	170	440	390	1100	1800000	2300000	500	500	500
Trichlorofluoromethane (CFC-11)	NA	52	150	NA	560	560	560	92000	110000	630000	140000000	1500000	140000000	3800000000	1700000000	560	560	560
Trifluorotrichloroethane (Freon 113)	NA	550	550	1.7	550	550	550	180000	210000	880000	890000	2100000	2100000	5100000000	2300000000	550	550	550
Vinyl chloride	NA	0.04	0.04	0.26	20	0.27	2.8	4.2	29	30	170	73	420	350000	890000	3.8	34	490
Xylenes (total)	NA	5.6	5.6	0.82	150	150	150	46000	54000	61000	65000	130000	130000	290000000	130000000	150	150	150

Notes
Michigan Part 201 generic clean up criteria (updated March 25, 2011)

ID Insufficient data to develop criterion
NLL Hazardous substance is not likely to leach under most soil conditions.
NLV Hazardous substance is not likely to volatilize under most conditions
NA Criterion or value is not available
VSIC Volatile Soil Inhalation Criteria

TABLE 3.2

GROUNDWATER SCREENING CRITERIA
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

	Residential Drinking Water	Non-Residential Drinking Water	Groundwater Surface Water Interface	Residential Groundwater Volatilization to Indoor Air Inhalation	Non-Residential Groundwater Volatilization to Indoor Air Inhalation	Groundwater Contact	Water Solubility	Flammability and Explosivity Screening Levels	Acute Inhalation Screening Levels
	a	b	c	d	e	f	g	h	i
Inorganics (mg/L)									
Aluminum	0.05	0.05	NA	NLV	NLV	64000	NA	ID	ID
Antimony	0.006	0.006	0.13	NLV	NLV	68	NA	ID	ID
Arsenic	0.01	0.01	0.01	NLV	NLV	4.3	NA	ID	ID
Barium	2	2	1.87	NLV	NLV	14000	NA	ID	ID
Beryllium	0.004	0.004	0.075	NLV	NLV	290	NA	ID	ID
Cadmium	0.005	0.005	0.006	NLV	NLV	190	NA	ID	ID
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	0.1	0.1	0.011	NLV	NLV	460	NA	ID	ID
Chromium III (trivalent)	0.1	0.1	0.23	NLV	NLV	290000	NA	ID	ID
Chromium VI (hexavalent)	0.1	0.1	0.011	NLV	NLV	460	NA	ID	ID
Cobalt	0.04	0.1	0.1	NLV	NLV	2400	NA	ID	ID
Copper	1	1	0.029	NLV	NLV	7400	NA	ID	ID
Cyanide (total)	0.2	0.2	0.0052	NLV	NLV	57	NA	ID	ID
Iron	0.3	0.3	NA	NLV	NLV	58000	NA	ID	ID
Lead	0.004	0.004	0.044	NLV	NLV	ID	NA	ID	ID
Magnesium	400	1100	NA	NLV	NLV	1000000	NA	ID	ID
Manganese	0.05	0.05	6.40	NLV	NLV	9100	NA	ID	ID
Mercury	0.002	0.002	0.0000013	0.056	0.056	0.056	0.056	ID	ID
Nickel	0.1	0.1	0.16	NLV	NLV	74000	NA	ID	ID
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.05	0.05	0.005	NLV	NLV	970	NA	ID	ID
Silver	0.034	0.098	0.0002	NLV	NLV	1500	NA	ID	ID
Sodium	120	350	NA	NLV	NLV	1000000	NA	ID	ID
Thallium	0.002	0.002	0.0037	NLV	NLV	13	NA	ID	ID
Vanadium	0.0045	0.062	0.012	NLV	NLV	970	NA	ID	ID
Zinc	2.4	5	0.38	NLV	NLV	110000	NA	ID	ID
Aluminum (dissolved)	0.05	0.05	NA	NLV	NLV	64000	NA	ID	ID
Antimony (dissolved)	0.006	0.006	0.13	NLV	NLV	68	NA	ID	ID
Arsenic (dissolved)	0.01	0.01	0.01	NLV	NLV	4.3	NA	ID	ID
Barium (dissolved)	2	2	1.87	NLV	NLV	14000	NA	ID	ID
Beryllium (dissolved)	0.004	0.004	0.075	NLV	NLV	290	NA	ID	ID
Cadmium (dissolved)	0.005	0.005	0.006	NLV	NLV	190	NA	ID	ID
Chromium (dissolved)	0.1	0.1	0.011	NLV	NLV	460	NA	ID	ID
Cobalt (dissolved)	0.04	0.1	0.1	NLV	NLV	2400	NA	ID	ID
Copper (dissolved)	1	1	0.029	NLV	NLV	7400	NA	ID	ID
Iron (dissolved)	0.3	0.3	NA	NLV	NLV	58000	NA	ID	ID
Lead (dissolved)	0.004	0.004	0.044	NLV	NLV	ID	NA	ID	ID
Manganese (dissolved)	0.05	0.05	6.40	NLV	NLV	9100	NA	ID	ID
Mercury (dissolved)	0.002	0.002	0.0000013	0.056	0.056	0.056	0.056	ID	ID
Nickel (dissolved)	0.1	0.1	0.16	NLV	NLV	74000	NA	ID	ID
Selenium (dissolved)	0.05	0.05	0.005	NLV	NLV	970	NA	ID	ID
Silver (dissolved)	0.034	0.098	0.0002	NLV	NLV	1500	NA	ID	ID
Thallium (dissolved)	0.002	0.002	0.0037	NLV	NLV	13	NA	ID	ID
Vanadium (dissolved)	0.0045	0.062	0.012	NLV	NLV	970	NA	ID	ID
Zinc (dissolved)	2.4	5	0.38	NLV	NLV	110000	NA	ID	ID
PCBs (mg/L)									
Aroclor-1016 (PCB-1016)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1221 (PCB-1221)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1232 (PCB-1232)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1242 (PCB-1242)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1248 (PCB-1248)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254 (PCB-1254)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260 (PCB-1260)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.0005	0.0005	0.0002	0.045	0.045	0.0033	0.0447	ID	ID
Semi-Volatile Organic Compounds (mg/L)									
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	0.73	2.1	NA	NLV	NLV	170	1200	ID	ID
2,4,6-Trichlorophenol	0.12	0.47	0.005	NLV	NLV	10	800	ID	ID
2,4-Dichlorophenol	0.073	0.21	0.011	NLV	NLV	48	4500	ID	ID
2,4-Dimethylphenol	0.37	1	0.38	NLV	NLV	520	7870	ID	ID
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	0.0077	0.032	NA	NLV	NLV	8.6	270	ID	ID
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	1.8	5.2	NA	ID	ID	6.7	6.74	ID	ID
2-Chlorophenol	0.045	0.13	0.018	ID	ID	94	22000	ID	ID
2-Methylnaphthalene	0.26	0.75	0.019	25	25	25	24.6	ID	ID
2-Methylphenol	0.37	1	0.03	NLV	NLV	810	28000	NA	ID
2-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	0.02	0.058	ID	NLV	NLV	79	2500	ID	ID
3&4-Methylphenol	0.37	1	0.03	NLV	NLV	810	28000	NA	ID
3,3'-Dichlorobenzidine	0.0011	0.0043	0.0003	NLV	NLV	0.18	3.11	ID	ID
3-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	0.02	0.02	NA	NLV	NLV	9.5	200	ID	ID
4-Bromophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	0.15	0.42	0.0074	NLV	NLV	79	3900	ID	ID
4-Chloroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol	0.37	1	0.03	NLV	NLV	810	28000		ID
4-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	1.3	3.8	0.038	4.2	4.2	4.2	4.24	ID	ID
Acenaphthylene	0.052	0.15	ID	3.9	3.9	3.9	3.93	ID	ID
Acetophenone	1.5	4.4	NA	6100	6100	6100	6100	ID	ID
Anthracene	0.043	0.043	ID	0.043	0.043	0.043	0.0434	ID	ID
Atrazine	0.003	0.003	0.0073	NLV	NLV	5.4	70	ID	ID
Benzaldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	0.0021	0.0085	ID	NLV	NLV	0.0094	0.0094	ID	ID
Benzo(a)pyrene	0.005	0.005	ID	NLV	NLV	0.001	0.00162	ID	ID
Benzo(b)fluoranthene	0.0015	0.0015	ID	ID	ID	0.0015	0.0015	ID	ID
Benzo(g,h,i)perylene	0.001	0.001	NA	NLV	NLV	0.001	0.00026	ID	ID
Benzo(k)fluoranthene	0.001	0.001	NA	NLV	NLV	0.001	0.0008	ID	ID
Biphenyl (1,1-Biphenyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	0.002	0.0083	0.001	38	210	5.7	17200	17000	17000
bis(2-Ethylhexyl)phthalate (DEHP)	0.006	0.006	0.025	NLV	NLV	0.32	0.34	NA	0.34
Butyl benzylphthalate (BBP)	1.2	2.7	0.067	NLV	NLV	2.7	2.69	ID	ID
Caprolactam	5.8	17	NA	NLV	NLV	390000	5250000	NA	1000000
Carbazole	0.085	0.35	0.01	NLV	NLV	7.4	7.48	ID	ID
Chrysene	0.0016	0.0016	ID	ID	ID	0.0016	0.0016	ID	ID
Dibenz(a,h)anthracene	0.002	0.002	ID	NLV	NLV	0.002	0.00249	ID	ID
Dibenzofuran	ID	ID	0.004	10	10	ID	10	ID	ID
Diethyl phthalate	5.5	16	0.11	NLV	NLV	1100	1080	NA	ID
Dimethyl phthalate	73	210	NA	NLV	NLV	4200	4190	NA	ID
Di-n-butylphthalate (DBP)	0.88	2.5	0.0097	NLV	NLV	11	11.2	NA	ID
Di-n-octyl phthalate (DnOP)	0.13	0.38	ID	NLV	NLV	0.4	3	ID	ID
Fluoranthene	0.21	0.21	0.0016	0.21	0.21	0.21	0.206	ID	ID
Fluorene	0.88	2	0.012	2	2	2	1.98	ID	ID
Hexachlorobenzene	0.001	0.001	0.0002	0.44	3	0.0046	6.2	ID	ID
Hexachlorobutadiene	0.015	0.042	0.000053	1.6	3.2	0.4	3.23	ID	ID
Hexachlorocyclopentadiene	0.05	0.05	ID	0.13	0.42	1.6	1.8	ID	ID
Hexachloroethane	0.0073	0.021	0.0067	27	50	1.9	50	ID	ID
Indeno(1,2,3-cd)pyrene	0.002	0.002	ID	NLV	NLV	0.002	0.000022	ID	ID
Isophorone	0.77	3.1	1.3	NLV	NLV	990	12000	NA	12000
Naphthalene	0.52	1.5	0.011	31	31	31	31	NA	31
Nitrobenzene	0.0034	0.0096	0.18	280	550	11	2090	NA	ID
N-Nitrosodi-n-propylamine	0.005	0.005	NA	NLV	NLV	0.36	9890	ID	ID
N-Nitrosodiphenylamine	0.27	1.1	NA	NLV	NLV	35	35.1	ID	ID
Pentachlorophenol	0.001	0.001	0.0028	NLV	NLV	0.2	1850	ID	ID
Phenanthrene	0.052	0.15	0.002	1	1	1	1	ID	ID
Phenol	4.4	13	0.45	NLV	NLV	29000	82800	NA	ID
Pyrene	0.14	0.14	ID	0.14	0.14	0.14	0.135	ID	ID
Volatile Organic Compounds (mg/L)									

TABLE 3.2

GROUNDWATER SCREENING CRITERIA
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

1,1,1-Trichloroethane	0.2	0.2	0.089	660	1300	1300	1330	ID	1300
1,1,2,2-Tetrachloroethane	0.0085	0.035	0.078	12	77	4.7	2970	ID	ID
1,1,2-Trichloroethane	0.005	0.005	0.33	17	110	21	4420	NA	ID
1,1-Dichloroethane	0.88	2.5	0.74	1000	2300	2400	5060	380	ID
1,1-Dichloroethene	0.007	0.007	0.13	0.2	1.3	11	2250	97	140
1,2,4-Trichlorobenzene	0.07	0.07	0.099	300	300	19	300	NA	300
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.0002	NA	1.2	1.2	0.39	1.23	NA	ID
1,2-Dibromoethane (Ethylene dibromide)	0.00005	0.00005	0.0057	2.4	15	0.025	4200	ID	ID
1,2-Dichlorobenzene	0.6	0.6	0.013	160	160	160	156	NA	160
1,2-Dichloroethane	0.005	0.005	0.36	9.6	59	19	8520	2500	ID
1,2-Dichloropropane	0.005	0.005	0.23	16	36	16	2800	550	2800
1,3-Dichlorobenzene	0.0066	0.019	0.028	18	41	2	111	ID	ID
1,4-Dichlorobenzene	0.075	0.075	0.017	16	74	6.4	73.8	NA	ID
2-Butanone (Methyl ethyl ketone) (MEK)	13	38	2.2	240000	240000	240000	240000	ID	240000
2-Hexanone	1	2.9	ID	4200	8700	5200	16000	NA	ID
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	1.8	5.2	ID	20000	20000	13000	20000	ID	20000
Acetone	0.73	2.1	1.7	1000000	1000000	31000	1000000	15000	1000000
Benzene	0.005	0.005	0.2	5.6	35	11	1750	68	67
Bromodichloromethane	0.08	0.08	ID	4.8	37	14	6740	ID	ID
Bromoform	0.08	0.08	ID	470	3100	140	3100	ID	ID
Bromomethane (Methyl bromide)	0.01	0.029	0.035	4	9	70	14500	ID	ID
Carbon disulfide	0.8	2.3	ID	250	550	1200	1190	13	ID
Carbon tetrachloride	0.005	0.005	0.045	0.37	2.4	4.6	793	ID	96
Chlorobenzene	0.1	0.1	0.025	210	470	86	472	160	ID
Chloroethane	0.43	1.7	1.1	5700	5700	440	5740	110	ID
Chloroform (Trichloromethane)	0.08	0.08	0.35	28	180	150	7920	ID	ID
Chloromethane (Methyl chloride)	0.26	1.1	ID	8.6	45	490	6340	36	210
cis-1,2-Dichloroethene	0.07	0.07	0.62	93	210	200	3500	530	ID
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	0.08	0.08	ID	14	110	18	2600	ID	ID
Dichlorodifluoromethane (CFC-12)	1.7	4.8	ID	220	300	300	300	ID	ID
Ethylbenzene	0.074	0.074	0.018	110	170	170	169	43	170
Isopropyl benzene	0.8	2.3	0.028	56	56	56	56	29	ID
Methyl acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl tert butyl ether (MTBE)	0.04	0.04	7.1	47000	47000	610	46800	ID	ID
Methylene chloride	0.005	0.005	1.5	220	1400	220	17000	ID	ID
Styrene	0.1	0.1	0.08	170	310	9.7	310	140	310
Tetrachloroethene	0.005	0.005	0.06	25	170	12	200	ID	200
Toluene	0.79	0.79	0.27	530	530	530	526	61	ID
trans-1,2-Dichloroethene	0.1	0.1	1.5	85	200	220	6300	230	ID
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	0.005	0.005	0.2	15	97	22	1100	ID	1100
Trichlorofluoromethane (CFC-11)	2.6	7.3	NA	1100	1100	1100	1100	ID	1100
Trifluorotrichloroethane (Freon 113)	170	170	0.032	170	170	170	170	ID	170
Vinyl chloride	0.002	0.002	0.013	1.1	13	1	2760	33	ID
Xylenes (total)	0.28	0.28	0.041	190	190	190	186	70	190

Notes
Michigan Part 201 generic clean up criteria (updated March 25, 2011)

ID Insufficient data to develop criterion
NLV Hazardous substance is not likely to volatilize under most conditions
NA Criterion or value is not available

TABLE 3.3

SOIL ANALYTICAL RESULTS - 1988
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location	*0E0N*	*0E100N*	*0E200N*	*0E300N*	*0E400N*	*0E500N*	*0E600N*	*0E700N*	*0E800N*	*100E0N*	*100E100N*	*100E200N*	*100E300N*	*100E400N*	*100E500N*	*100E600N*	*100E700N*	*100E800N*	*170E600N*	*170E700N*	*170E800N*
Sample Identification	*0E0N*	*0E100N*	*0E200N*	*0E300N*	*0E400N*	*0E500N*	*0E600N*	*0E700N*	*0E800N*	*100E0N*	*100E100N*	*100E200N*	*100E300N*	*100E400N*	*100E500N*	*100E600N*	*100E700N*	*100E800N*	*170E600N*	*170E700N*	*170E800N*
Sample Date	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*
Sample Type																					
Sample Depth	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*
AOI	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*
Metals (mg/kg)																					
Cadmium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.2	2.7	1 U	1 U	1 U	1 U	1 U	1.6	1 U	1 U	1 U	1 U	1 U	1 U
Chromium	4.8	4.8	4.3	8.5	3.3	3.6	**19[d]**	12	8.3	4.8	6.5	15	4.3	**74[bcd]**	12	5.6	3.9	5.8	--	--	--
Iron	0.0039	0.005	0.0049	0.0071	0.0044	0.0055	0.0076	0.013	--	0.0039	0.0045	0.0063	0.006	0.022	0.0098	0.0083	0.0071	0.0028	--	--	0.0085
Lead	15	8.8	7.4	8.1	2.5	7.6	8.8	12	38	6.7	4.5	54	7.9	65	33	8.1	5.4	7.1	--	--	--
Nickel	7.8	5.4	5.8	7.4	4.3	5.4	5.2	19	8.2	5.7	6.5	6.6	6.6	25	11	7.2	2.2	9.7	--	--	--
Zinc	23	21	19	25	18	18	20	33	48	19	17	34	20	62	66	25	15	23	--	--	--
PCBs (mg/kg)																					
Total PCBs	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.3	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	4	3.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Petrl Prod (mg/kg)																					
Total Petroleum Hydrocarbons	300	200	300	100	50 U	200	2500	600	1500	100	100	50 U	800	14000	13000	--	--	100	309	1469	239

Sample Location	*170E900N*	*215E0N*	*215E100N*	*215E200N*	*215E300N*	*215E400N*	*215E500N*	*300E540N*	*350E540N*	*350E600N*	*350E700N*	*350E800N*	*50E0N*	*50E100N*	*50E200N*	*50E300N*	*50E400N*	*50E500N*	*50E600N*	*50E700N*	*50E800N*
Sample Identification	*170E900N*	*215E0N*	*215E100N*	*215E200N*	*215E300N*	*215E400N*	*215E500N*	*300E540N*	*350E540N*	*350E600N*	*350E700N*	*350E800N*	*50E0N*	*50E100N*	*50E200N*	*50E300N*	*50E400N*	*50E500N*	*50E600N*	*50E700N*	*50E800N*
Sample Date	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*	*1/1/1988*
Sample Type																					
Sample Depth	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*	*(0-1) ft BGS*
AOI	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*	*AOI:12*
Metals (mg/kg)																					
Cadmium	1 U	1.6	1.2	1 U	1 U	1.1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.1	1 U	1 U	5.6	1 U	1 U	1 U	1 U
Chromium	--	14	11	6.7	5.1	8.6	7.6	--	--	--	--	--	5.8	6.3	5.3	5.5	**38[bcd]**	7.8	5.8	6.9	1.5
Iron	--	0.015	0.0097	0.0064	0.003	0.015	0.0071	--	--	--	--	--	0.0056	0.0097	0.0054	0.0051	0.034	0.01	0.012	0.009	0.0087
Lead	--	9.9	5	2.1	3.6	8.3	5.3	--	--	--	--	--	7.7	6.1	6.3	5.1	210	16	12	8.5	7.8
Nickel	--	18	13	7.4	5.5	12	11	--	--	--	--	--	8	11	5.5	5.5	3.4	11	7	11	3.6
Zinc	--	35	27	20	12	26	23	--	--	--	--	--	23	16	16	13	140	40	22	27	10
PCBs (mg/kg)																					
Total PCBs	0.2 U	0.4	0.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.9	0.2 U	0.2 U	0.2 U	0.2 U
Petrl Prod (mg/kg)																					
Total Petroleum Hydrocarbons	50 U	7000	14000	1900	50 U	2600	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	200	50 U	5300	2400	80	100	50

Notes:

[b] Drinking Water Protection Criteria
[c] Non-Residential Drinking Water Protection Criteria
[d] Groundwater Surface Water Interface Criteria
U Not present at or above the associated value
-- Parameter not analyzed

TABLE 3.4

GROUNDWATER ANALYTICAL RESULTS - 1989 -1990
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

AOI	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12
Sample Location	CRA-266M	CRA-266M	CRA-266M	CRA-266M	CRA-266M	CRA-266M	CRA-266M	CRA-266M	CRA-266M	CRA-266M	CRA-265M	CRA-265M	CRA-265M	CRA-265M	CRA-265M	CRA-265M
Sample Identification	MW301	MW301	MW301	MW301	MW301	MW301	MW301	MW301	MW301	MW301	MW302	MW302	MW302	MW302	MW302	MW302
Sample Date	3/1/1989	3/1/1989	6/1/1989	6/1/1989	9/1/1989	12/1/1989	3/1/1990	7/1/1990	9/1/1990	12/1/1990	3/1/1989	6/1/1989	9/1/1989	9/1/1989	12/1/1989	3/1/1990
Sample Type		Duplicate		Duplicate										Duplicate		
Inorganics (mg/L)																
Cadmium (dissolved)	--	--	U	U	U	U	U	U	U	U	--	U	U	U	U	U
Chromium (dissolved)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Copper (dissolved)	U	U	U	**0.04**[c]	U	U	--	U	U	U	U	U	0.02	0.02	U	--
Iron (dissolved)	U	U	0.03	0.04	0.16	U	U	**0.31**[ab]	**5.1**[ab]	0.03	**2.8**[ab]	**2**[ab]	**5.9**[ab]	**5.9**[ab]	**8.9**[ab]	**5.1**[ab]
Lead (dissolved)	U	U	U	U	U	U	U	U	**0.02**[ab]	U	U	U	U	U	U	U
Nickel (dissolved)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Zinc (dissolved)	U	U	U	U	0.03	U	U	U	U	U	U	U	0.03	0.02	U	U
PCBs (mg/L)																
Aroclor-1248 (PCB-1248)	--	--	--	--	--	U	U	U	U	U	--	--	--	--	U	U
Volatile Organic Compounds (mg/L)																
1,1,1-Trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Bromodichloromethane	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Chloroform (Trichloromethane)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

AOI	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12	AOI:12
Sample Location	CRA-265M	CRA-265M	CRA-265M	CRA-265M	CRA-265M	CRA-264M	CRA-264M	CRA-264M	CRA-264M	CRA-264M	CRA-264M	CRA-264M	CRA-264M	CRA-264M	CRA-264M	CRA-264M
Sample Identification	MW302	MW302	MW302	MW302	MW302	MW303	MW303	MW303	MW303	MW303	MW303	MW303	MW303	MW303	MW-303	MW303
Sample Date	3/1/1990	7/1/1990	9/1/1990	12/1/1990	12/1/1990	3/1/1989	6/1/1989	9/1/1989	12/1/1989	12/1/1989	3/1/1990	7/1/1990	7/1/1990	9/1/1990	9/1/1990	12/1/1990
Sample Type	Duplicate				Duplicate					Duplicate			Duplicate		Duplicate	
Inorganics (mg/L)																
Cadmium (dissolved)	U	U	U	U	U	--	U	U	U	U	U	U	U	U	U	U
Chromium (dissolved)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Copper (dissolved)	--	U	U	U	U	U	U	U	U	U	--	U	U	U	U	U
Iron (dissolved)	**4.9**[ab]	**5.3**[ab]	**4.7**[ab]	**4.3**[ab]	**12**[ab]	**8.1**[ab]	**2**[ab]	**7.9**[ab]	**7.2**[ab]	**7.3**[ab]	**7.5**[ab]	**11**[ab]	**10**[ab]	**4.7**[ab]	**10**[ab]	**3.7**[ab]
Lead (dissolved)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Nickel (dissolved)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Zinc (dissolved)	U	0.11	U	U	U	U	U	0.03	U	U	U	U	U	U	U	U
PCBs (mg/L)																
Aroclor-1248 (PCB-1248)	U	U	U	U	U	--	--	--	**0.0031**[abc]	**0.006**[abcf]	**0.00077**[abc]	U	U	U	U	U
Volatile Organic Compounds (mg/L)																
1,1,1-Trichloroethane	U	U	U	U	U	U	0.002	U	U	U	U	U	U	U	U	U
Bromodichloromethane	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Chloroform (Trichloromethane)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

Notes:

[a] Residential Drinking Water Criteria
[b] Non-Residential Drinking Water Criteria
[c] Groundwater Surface Water Interface Criteria
[f] Groundwater Contact Criteria
U Not present at or above the associated value
-- Parameter not analyzed

TABLE 3.5

GROUNDWATER ANALYTICAL RESULTS - 2004 - 2012
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location	*CRA-TP-002*	*CRA-264M*	*CRA-264M*	*CRA-266M*	*CRA-705M*	*CRA-706M*	*CRA-709M*	*CRA-710M*	*CRA-710M*	*CRA-710M*	*CRA-828M*	*CRA-828M*	*CRA-829M*	*CRA-829M*	*CRA-833M*	*CRA-834M*
Sample Identification	*GW-17358-110304-DCR-756*	*GW-17358-012312-DR-027*	*GW-17358-012312-DR-028*	*GW-17358-012312-DR-029*	*GW-17358-012412-DR-031*	*GW-17358-012412-DR-030*	*GW-17358-012312-DR-026*	*GW-17358-012312-DR-025*	*GW-017358-020712-SK-038*	*GW-17358-041212-DR-1000*	*GW-17358-012312-DR-023*	*GW-017358-020712-SK-036*	*GW-17358-012312-DR-024*	*GW-017358-020712-SK-037*	*GW-17358-012412-DR-032*	*GW-17358-012412-DR-033*
Sample Date	*11/3/2004*	*1/23/2012*	*1/23/2012*	*1/23/2012*	*1/24/2012*	*1/24/2012*	*1/23/2012*	*1/23/2012*	*2/7/2012*	*4/12/2012 **	*1/23/2012*	*2/7/2012*	*1/23/2012*	*2/7/2012*	*1/24/2012*	*1/24/2012*
Sample Type			*Duplicate*													
Inorganics (mg/L)																
Aluminum	--	0.027 J	0.02 J	0.042 J	**0.42[ab]**	**0.44[ab]**	**0.33[ab]**	**35[ab]**	--	0.031 J	**1.4[ab]**	--	**0.35[ab]**	--	**0.43[ab]**	**0.1[ab]**
Antimony	--	0.00014 J	0.00013 J	0.00019 J	0.00056 J	0.0004 J	0.00029 J	0.0022	--	0.00042 J	0.00042 J	--	0.0002 J	--	0.00028 J	0.00084 J
Arsenic	--	0.00088 J	0.00081 J	0.0045 J	0.0011 J	0.0011 J	0.0026 J	**0.017[abc]**	--	0.002 J	0.0016 J	--	0.0012 J	--	0.0038 J	0.003 J
Barium	--	0.058 J	0.064 J	0.023 J	0.047 J	0.066 J	0.14	0.29	--	0.072 J	0.079 J	--	0.075 J	--	0.11	0.062 J
Beryllium	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002	--	0.001 U	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Cadmium	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 J	--	0.001 U	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Calcium	--	--	--	--	85	92	--	--	--	--	--	--	--	--	--	--
Chromium	--	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	**0.021[c]**	--	0.01 U	0.0021 J	--	0.01 U	--	0.01 U	0.01 U
Chromium III (trivalent)	--	--	--	--	0.01 U	--	0.01 U	--	--	--	--	--	--	--	--	--
Chromium VI (hexavalent)	--	--	--	--	0.01 UJ	--	0.01 U	--	--	--	--	--	--	--	--	--
Cobalt	--	0.0004 J	0.0004 J	0.00017 J	0.00057 J	0.00061 J	0.0019 J	0.0071 J	--	0.00059 J	0.0012 J	--	0.00099 J	--	0.00047 J	0.00055 J
Copper	--	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	**0.033[c]**	--	0.00042 J	0.004 U	--	0.004 U	--	0.004 U	0.004 U
Cyanide (total)	0.005 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	--	**0.54[ab]**	**0.54[ab]**	0.15 J	**0.45[ab]**	**0.6[ab]**	**0.84[ab]**	**24[ab]**	--	0.2 U	**1.1[ab]**	--	**0.46[ab]**	--	**0.76[ab]**	0.15 J
Lead	--	0.003 U	0.003 U	0.003 U	0.00032 J	0.00043 J	0.00036 J	**0.027[ab]**	--	0.003 U	0.00069 J	--	0.00032 J	--	0.00035 J	0.00033 J
Magnesium	--	--	--	--	16	18	--	--	--	--	--	--	--	--	--	--
Manganese	--	**0.2[ab]**	**0.2[ab]**	**0.06[ab]**	**0.059[ab]**	**0.11[ab]**	**0.28[ab]**	**0.25[ab]**	--	**0.18 B[ab]**	**0.1[ab]**	--	**0.23[ab]**	--	**0.19[ab]**	**0.051[ab]**
Mercury	--	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	--	0.04 U	0.04 U	--	0.04 U	--	0.04 U	0.04 U
Nickel	--	0.0012 J	0.0012 J	0.0016 J	0.0026 J	0.0024 J	0.0026 J	0.02	--	0.002 J	0.011 J	--	0.0021 J	--	0.0014 J	0.0029 J
Potassium	--	--	--	--	1.2 J	1.4 J	--	--	--	--	--	--	--	--	--	--
Selenium	--	0.0014 J	0.00097 J	0.005 U	0.0011 J	0.005 U	0.005 U	0.0046 J	--	0.005 U	0.0008 J	--	0.005 U	--	0.005 U	0.005 U
Silver	--	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	--	0.0002 U	0.0002 U	--	0.0002 U	--	0.0002 U	0.0002 U
Sodium	--	--	--	--	34	40	--	--	--	--	--	--	--	--	--	--
Thallium	--	0.00016 J	0.00014 J	0.002 U	0.00054 J	0.002 U	0.00018 J	0.00061 J	--	0.00069 J	0.00069 J	--	0.00036 J	--	0.00017 J	0.002 U
Vanadium	--	0.004 U	0.004 U	0.004 U	0.0013 J	0.0014 J	0.001 J	**0.047[ac]**	--	0.004 U	0.0033 J	--	0.0011 J	--	0.0012 J	0.0015 J
Zinc	--	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.081	--	0.05 U	0.05 U	--	0.05 U	--	0.05 U	0.05 U
Aluminum (dissolved)	**1.3[ab]**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Antimony (dissolved)	0.00093 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic (dissolved)	0.01 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Barium (dissolved)	0.025 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium (dissolved)	0.001 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium (dissolved)	0.0005 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium (dissolved)	0.0028 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cobalt (dissolved)	0.0057 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Copper (dissolved)	0.005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron (dissolved)	**1.6[ab]**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead (dissolved)	0.003 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese (dissolved)	0.036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury (dissolved)	**0.000056 J[c]**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel (dissolved)	0.0026 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium (dissolved)	0.002 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver (dissolved)	0.0005 UJ	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium (dissolved)	0.001 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium (dissolved)	**0.0046 J[a]**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc (dissolved)	0.0089 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs (mg/L)																
Aroclor-1016 (PCB-1016)	0.0002 U	0.00011 U	0.0001 U	0.000099 U	0.0001 U	0.0001 U	0.000095 U	--	0.000095 U	--	--	0.000095 U	--	0.000095 U	0.0001 U	0.0001 U
Aroclor-1221 (PCB-1221)	0.0002 U	0.00011 U	0.0001 U	0.000099 U	0.0001 U	0.0001 U	0.000095 U	--	0.000095 U	--	--	0.000095 U	--	0.000095 U	0.0001 U	0.0001 U
Aroclor-1232 (PCB-1232)	0.0004 U	0.00011 U	0.0001 U	0.000099 U	0.0001 U	0.0001 U	0.000095 U	--	0.000095 U	--	--	0.000095 U	--	0.000095 U	0.0001 U	0.0001 U
Aroclor-1242 (PCB-1242)	0.0002 U	0.00011 U	0.0001 U	0.000099 U	0.0001 U	0.0001 U	0.000095 U	--	0.000095 U	--	--	0.000095 U	--	0.000095 U	0.0001 U	0.0001 U
Aroclor-1248 (PCB-1248)	0.0002 U	0.00011 U	0.0001 U	0.000099 U	0.0001 U	0.0001 U	0.000095 U	--	0.000095 U	--	--	0.000095 U	--	0.000095 U	0.0001 U	0.0001 U
Aroclor-1254 (PCB-1254)	0.0002 U	0.00011 U	0.0001 U	0.000099 U	0.0001 U	0.0001 U	0.000095 U	--	0.000095 U	--	--	0.000095 U	--	0.000095 U	0.0001 U	0.0001 U
Aroclor-1260 (PCB-1260)	0.0002 U	0.00011 U	0.0001 U	0.000099 U	0.0001 U	0.0001 U	0.000095 U	--	0.000095 U	--	--	0.000095 U	--	0.000095 U	0.0001 U	0.0001 U
Total PCBs	ND	ND	ND	ND	ND	ND	ND	--	ND	--	--	ND	--	ND	ND	ND

TABLE 3.5

GROUNDWATER ANALYTICAL RESULTS - 2004 - 2012
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location	*CRA-TP-002*	*CRA-264M*	*CRA-264M*	*CRA-266M*	*CRA-705M*	*CRA-706M*	*CRA-709M*	*CRA-710M*	*CRA-710M*	*CRA-710M*	*CRA-828M*	*CRA-828M*	*CRA-829M*	*CRA-829M*	*CRA-833M*	*CRA-834M*
Sample Identification	*GW-17358-110304-DCR-756*	*GW-17358-012312-DR-027*	*GW-17358-012312-DR-028*	*GW-17358-012312-DR-029*	*GW-17358-012412-DR-031*	*GW-17358-012412-DR-030*	*GW-17358-012312-DR-026*	*GW-17358-012312-DR-025*	*GW-017358-020712-SK-038*	*GW-17358-041212-DR-1000*	*GW-17358-012312-DR-023*	*GW-017358-020712-SK-036*	*GW-17358-012312-DR-024*	*GW-017358-020712-SK-037*	*GW-17358-012412-DR-032*	*GW-17358-012412-DR-033*
Sample Date	*11/3/2004*	*1/23/2012*	*1/23/2012*	*1/23/2012*	*1/24/2012*	*1/24/2012*	*1/23/2012*	*1/23/2012*	*2/7/2012*	*4/12/2012 **	*1/23/2012*	*2/7/2012*	*1/23/2012*	*2/7/2012*	*1/24/2012*	*1/24/2012*
Sample Type			*Duplicate*													
Semi-Volatile Organic Compounds (mg/L)																
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2,4,5-Trichlorophenol	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2,4,6-Trichlorophenol	0.004 U	0.0043 U	0.0043 U	0.0042 U	0.004 U	0.0041 U	0.0042 U	0.0041 U	--	--	0.0041 U	--	0.0041 U	--	0.004 U	0.0038 U
2,4-Dichlorophenol	0.01 U	0.011 U	0.011 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.0099 U	0.0095 U
2,4-Dimethylphenol	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2,4-Dinitrophenol	0.02 U	0.022 U	0.021 U	0.021 U	0.02 U	0.02 U	0.021 U	0.02 U	--	--	0.02 U	--	0.021 U	--	0.02 U	0.019 U
2,4-Dinitrotoluene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2,6-Dinitrotoluene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2-Chloronaphthalene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2-Chlorophenol	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2-Methylnaphthalene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2-Methylphenol	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
2-Nitroaniline	0.02 U	0.022 U	0.021 U	0.021 U	0.02 U	0.02 U	0.021 U	0.02 U	--	--	0.02 U	--	0.021 U	--	0.02 U	0.019 U
2-Nitrophenol	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
3&4-Methylphenol	--	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
3,3'-Dichlorobenzidine	0.004 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
3-Nitroaniline	0.02 U	0.022 U	0.021 U	0.021 U	0.02 U	0.02 U	0.021 U	0.02 U	--	--	0.02 U	--	0.021 U	--	0.02 U	0.019 U
4,6-Dinitro-2-methylphenol	0.02 U	0.022 U	0.021 U	0.021 U	0.02 U	0.02 U	0.021 U	0.02 U	--	--	0.02 U	--	0.021 U	--	0.02 U	0.019 U
4-Bromophenyl phenyl ether	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
4-Chloro-3-methylphenol	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
4-Chloroaniline	0.02 U	0.011 U	0.011 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.0099 U	0.0095 U
4-Chlorophenyl phenyl ether	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
4-Methylphenol	0.005 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	0.02 U	0.022 U	0.021 U	0.021 U	0.02 U	0.02 U	0.021 U	0.02 U	--	--	0.02 U	--	0.021 U	--	0.02 U	0.019 U
4-Nitrophenol	0.02 U	0.022 U	0.021 U	0.021 U	0.02 U	0.02 U	0.021 U	0.02 U	--	--	0.02 U	--	0.021 U	--	0.02 U	0.019 U
Acenaphthene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Acenaphthylene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Acetophenone	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Anthracene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Atrazine	0.005 U	0.0032 U	0.0032 U	0.0031 U	0.003 U	0.0031 U	0.0031 U	0.0031 U	--	--	0.0031 U	--	0.0031 U	--	0.003 U	0.0029 U
Benzaldehyde	0.01 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Benzo(a)anthracene	0.004 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Benzo(a)pyrene	0.004 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Benzo(b)fluoranthene	0.004 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Benzo(g,h,i)perylene	0.005 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Benzo(k)fluoranthene	0.005 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Biphenyl (1,1-Biphenyl)	0.01 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
bis(2-Chloroethoxy)methane	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
bis(2-Chloroethyl)ether	0.004 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
bis(2-Ethylhexyl)phthalate (DEHP)	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Butyl benzylphthalate (BBP)	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Caprolactam	0.01 U	0.011 U	0.011 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.0099 U	0.0095 U
Carbazole	0.01 U	0.011 U	0.011 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.0099 U	0.0095 U
Chrysene	0.005 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Dibenz(a,h)anthracene	0.004 U	0.0022 U	0.0021 U	0.0021 U	0.002 U	0.002 U	0.0021 U	0.002 U	--	--	0.002 U	--	0.0021 U	--	0.002 U	0.0019 U
Dibenzofuran	0.005 U	0.0043 U	0.0043 U	0.0042 U	0.004 U	0.0041 U	0.0042 U	0.0041 U	--	--	0.0041 U	--	0.0041 U	--	0.004 U	0.0038 U
Diethyl phthalate	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Dimethyl phthalate	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Di-n-butylphthalate (DBP)	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Di-n-octyl phthalate (DnOP)	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Fluoranthene	0.005 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Fluorene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Hexachlorobenzene	0.005 U	0.00022 U	0.00021 U	0.00021 U	0.0002 U	0.0002 U	0.00021 U	0.0002 U	--	--	0.0002 U	--	0.00021 U	--	0.0002 U	0.00019 U
Hexachlorobutadiene	0.005 U	0.0011 U	0.0011 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.00099 U	0.00095 U
Hexachlorocyclopentadiene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Hexachloroethane	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Indeno(1,2,3-cd)pyrene	0.004 U	0.0022 U	0.0021 U	0.0021 U	0.002 UJ	0.002 U	0.0021 U	0.002 U	--	--	0.002 U	--	0.0021 U	--	0.002 U	0.0019 U
Isophorone	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Naphthalene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Nitrobenzene	0.004 U	0.0032 U	0.0032 U	0.0031 U	0.003 U	0.0031 U	0.0031 U	0.0031 U	--	--	0.0031 U	--	0.0031 U	--	0.003 U	0.0029 U
N-Nitrosodi-n-propylamine	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
N-Nitrosodiphenylamine	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Pentachlorophenol	0.02 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Phenanthrene	0.005 U	0.0022 U	0.0021 U	0.0021 U	0.002 U	0.002 U	0.0021 U	0.002 U	--	--	0.002 U	--	0.0021 U	--	0.002 U	0.0019 U
Phenol	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U
Pyrene	0.005 U	0.0054 U	0.0053 U	0.0052 U	0.005 U	0.0051 U	0.0052 U	0.0051 U	--	--	0.0051 U	--	0.0052 U	--	0.005 U	0.0048 U

TABLE 3.5

GROUNDWATER ANALYTICAL RESULTS - 2004 - 2012
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location	*CRA-TP-002*	*CRA-264M*	*CRA-264M*	*CRA-266M*	*CRA-705M*	*CRA-706M*	*CRA-709M*	*CRA-710M*	*CRA-710M*	*CRA-710M*	*CRA-828M*	*CRA-828M*	*CRA-829M*	*CRA-829M*	*CRA-833M*	*CRA-834M*
Sample Identification	*GW-17358-110304-DCR-756*	*GW-17358-012312-DR-027*	*GW-17358-012312-DR-028*	*GW-17358-012312-DR-029*	*GW-17358-012412-DR-031*	*GW-17358-012412-DR-030*	*GW-17358-012312-DR-026*	*GW-17358-012312-DR-025*	*GW-017358-020712-SK-038*	*GW-17358-041212-DR-1000*	*GW-17358-012312-DR-023*	*GW-017358-020712-SK-036*	*GW-17358-012312-DR-024*	*GW-017358-020712-SK-037*	*GW-17358-012412-DR-032*	*GW-17358-012412-DR-033*
Sample Date	*11/3/2004*	*1/23/2012*	*1/23/2012*	*1/23/2012*	*1/24/2012*	*1/24/2012*	*1/23/2012*	*1/23/2012*	*2/7/2012*	*4/12/2012 **	*1/23/2012*	*2/7/2012*	*1/23/2012*	*2/7/2012*	*1/24/2012*	*1/24/2012*
Sample Type			*Duplicate*													
Volatile Organic Compounds (mg/L)																
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,1,2,2-Tetrachloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,1,2-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,1-Dichloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,2,4-Trichlorobenzene	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,2-Dibromo-3-chloropropane (DBCP)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,2-Dibromoethane (Ethylene dibromide)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,2-Dichlorobenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,2-Dichloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,2-Dichloropropane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,3-Dichlorobenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
1,4-Dichlorobenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
2-Butanone (Methyl ethyl ketone) (MEK)	0.025 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.00057 J	--	--	0.01 U	--	0.01 U	--	0.01 U	0.01 U
2-Hexanone	0.05 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.01 U	0.01 U
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	0.05 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.01 U	0.01 U
Acetone	0.025 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.01 U	0.01 U
Benzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Bromodichloromethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Bromoform	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Bromomethane (Methyl bromide)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Carbon disulfide	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	--	--	0.005 U	--	0.005 U	--	0.005 U	0.005 U
Carbon tetrachloride	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Chlorobenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Chloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Chloromethane (Methyl chloride)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
cis-1,3-Dichloropropene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Cyclohexane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Dibromochloromethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Dichlorodifluoromethane (CFC-12)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Isopropyl benzene	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Methyl acetate	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	--	0.01 U	--	0.01 U	--	0.01 U	0.01 U
Methyl cyclohexane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Methyl tert butyl ether (MTBE)	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	--	--	0.005 U	--	0.005 U	--	0.005 U	0.005 U
Methylene chloride	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	--	--	0.005 U	--	0.005 U	--	0.005 U	0.005 U
Styrene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
trans-1,3-Dichloropropene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Trichlorofluoromethane (CFC-11)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Trifluorotrichloroethane (Freon 113)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	--	0.001 U	--	0.001 U	0.001 U
Xylenes (total)	0.003 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	--	--	0.002 U	--	0.002 U	--	0.002 U	0.002 U

Notes:

[a] Residential Drinking Water Criteria
[b] Non-Residential Drinking Water Criteria
[c] Groundwater Surface Water Interface Criteria
B Compound wad detected in the blank and sample
J Estimated concentration.
ND Non detect
U Not present at or above the associated value
UJ Estimated reporting limit
* Data validation has not been completed on this sample.
-- Parameter not analyzed.

TABLE 3.6

SOIL ANALYTICAL RESULTS - 2012
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location	CRA-705M	CRA-705M	CRA-705M	CRA-706M	CRA-707SB	CRA-707SB	CRA-708SB	CRA-708SB	CRA-709M	CRA-709M	CRA-710M	CRA-710M	CRA-828M	CRA-828M	CRA-829M	CRA-829M	CRA-833M	CRA-833M	CRA-834M	CRA-834M	CRA-835-SB	CRA-835-SB
Sample Identification	SO-17358-011812-DR-009	SO-17358-011812-DR-010	SO-17358-011812-DR-011	SO-17358-011812-DR-012	SO-17358-011812-DR-015	SO-17358-011812-DR-016	SO-17358-011812-DR-013	SO-17358-011812-DR-014	SO-17358-011712-DR-005	SO-17358-011712-DR-006	SO-17358-011812-DR-007	SO-17358-011812-DR-008	SO-17358-011712-DR-003	SO-17358-011712-DR-004	SO-17358-011712-DR-001	SO-17358-011712-DR-002	SO-17358-011912-DR-021	SO-17358-011912-DR-022	SO-17358-011812-DR-017	SO-17358-011812-DR-018	SO-17358-011912-DR-019	SO-17358-011912-DR-020
Sample Date	1/18/2012	1/18/2012	1/18/2012	1/18/2012	1/18/2012	1/18/2012	1/18/2012	1/18/2012	1/17/2012	1/17/2012	1/18/2012	1/18/2012	1/17/2012	1/17/2012	1/17/2012	1/17/2012	1/19/2012	1/19/2012	1/18/2012	1/18/2012	1/19/2012	1/19/2012
Sample Depth	(0-2) ft BGS	(0-2) ft BGS	(2-3) ft BGS	(0-2) ft BGS	(0-2) ft BGS	(2-3) ft BGS	(0-2) ft BGS	(2-3) ft BGS	(0-2) ft BGS	(2-4) ft BGS	(0-2) ft BGS	(2-4) ft BGS	(0-2) ft BGS	(2-4) ft BGS	(0-2) ft BGS	(2.5-4.5) ft BGS	(0-2) ft BGS	(3-5) ft BGS	(0-2) ft BGS	(3-5) ft BGS	(0-2) ft BGS	(2-4) ft BGS
Sample Type		Duplicate																				
Inorganics (mg/kg)																						
Aluminum	4400	4300	2400	3300	4300	3200	6600	2700	2700	4600	4900	2300	4500	2100	1900	3100	3500	5300	3400	2900	3900	4100
Antimony	0.057 J	0.048 J	0.045 J	0.067 J	0.21 J	0.081 J	0.042 J	0.046 J	0.18 J	0.031 J	0.066 J	0.12 J	0.038 J	0.056 J	0.039 J	0.084 J	0.063 J	0.049 J	0.07 J	0.071 J	0.042 J	0.037 J
Arsenic	4.9	5.3	3.4	4.2	4.5	**8.7**[bcdp]	**6.8**[bcd]	**5.9**[bcd]	**5.9**[bcd]	4.1	**6.2**[bcd]	**6.8**[bcd]	3.8	2.9	3.5	3.4	3.7	**7.5**[bcd]	3.7	**7.7**[bcdp]	3.1	3
Barium	17	16	6.9	13	31	12	72	29	19	20	41	7.3	17	8.1	7.3	11	19	80	31	47	19	16
Beryllium	0.12 J	0.054 J	0.16 U	0.17 U	0.07 J	0.066 J	0.22	0.16 U	0.071 J	0.17 U	0.13 J	0.12 U	0.047 J	0.17 U	0.13 U	0.15 U	0.15 U	0.083 J	0.16 U	0.07 J	0.17 U	0.16 U
Cadmium	0.049 J	0.046 J	0.042 J	0.084 J	0.69	0.081 U	0.36	0.064 J	0.082	0.085 U	0.11	0.029 J	0.075 U	0.086 U	0.068	0.075	0.075 J	0.079 U	0.1	0.15	0.087 U	0.082 U
Calcium	52000 J	38000 J	95000 J	6900 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	8.7	9.8	8.2	7.9	14	8.6	12	5.8	6.3	9.3	9.2	6.2	10	4.6	4.2	8.5	7.7	11	9.6	6.6	6.5	9.7
Chromium III (trivalent)	8	9.3	8.2	--	13	7.9	--	--	5.5	8.9	8.3	5.7	9.5	3.9	4.2	8.1	7.3	10	--	--	--	--
Chromium VI (hexavalent)	0.63 J	0.42 J	0.87 U	--	1.9	0.75 J	--	--	0.76 J	0.38 J	0.9	0.53 J	0.74 J	0.65 J	0.85 U	0.35 J	0.45 J	0.85 J	--	--	--	--
Cobalt	2.8	3.1	2.3	2.9	3.9	3.2	6.3	2.4	2.2	3	3.6	3.2	3.2	3.4	1.7	3.9	3	3.8	3.3	6.3	1.6	2.7
Copper	9.6	10	8	6.8	26	9.3	7.8	5.8	8.8	4.4	8	9.1	8.8	13	5.8	15	7.1	5.6	18	7.7	2.8	3.3
Iron	9300	10000	6600	9400	**13000**[bc]	**14000**[bc]	**15000**[bc]	9900	7100	10000	11000	12000	9100	7500	5200	8100	7600	**16000**[bc]	7700	12000	7000	8600
Lead	5.1	5.8	3.5	5.4	26	6	7.6	2.7	6.1	5.8	6.7	3.1	4.1	3.1	2.4	4.5	5.5	5.5	14	4.9	4.5	4.7
Magnesium	**14000**[b]	**10000**[b]	**14000**[b]	2200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	230 J	220 J	180 J	110 J	330 J	160 J	**600 J**[bcd]	440 J	220 J	95 J	360 J	110 J	66 J	170 J	200 J	210 J	180 J	300 J	190 J	**710 J**[bcd]	54 J	59 J
Mercury	0.015 J	0.044 U	0.039 U	0.044 U	0.027 J	0.037 U	0.042	0.04 U	0.026 J	0.016 J	0.024 J	0.034 U	0.027 J	0.026 J	0.04 U	0.02 J	0.041 U	0.027 J	0.026 J	0.035 U	0.041 U	0.043 U
Nickel	9.4	9.9	7.2	8.2	13	7.8	11	10	6.5	7.5	8.3	5.9	9	6.6	5	13	7.6	9.4	8.2	9.7	4.2	7
Potassium	430 J	360	350 J	260 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	**0.67**[d]	**0.59**[d]	0.37	**0.52**[d]	**0.47**[d]	**0.54**[d]	**1.1**[d]	0.4	**0.44**[d]	**0.62**[d]	**0.71**[d]	**0.44**[d]	**0.71**[d]	0.35	0.34	**0.7**[d]	**0.48**[d]	**0.63**[d]	**0.48**[d]	**0.73**[d]	0.36	**0.44**[d]
Silver	0.089 U	0.065 U	0.08 U	0.087 U	0.022 J	0.081 U	0.025 J	0.081 U	0.022 J	0.085 U	0.018 J	0.061 U	0.075 U	0.086 U	0.067 U	0.074 U	0.076 U	0.025 J	0.033 J	0.078 U	0.087 U	0.082 U
Sodium	89 U	65 U	80 U	87 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	0.13	0.11	0.079 J	0.12	0.1	0.07 J	0.1	0.091	0.074	0.095	0.082	0.061 U	0.075 U	0.24	0.11	0.14	0.11	0.083	0.088	0.075 J	0.11	0.13
Vanadium	12	13	8.5	13	13	17	19	8.8	9	14	14	15	13	12	6.8	9.8	11	18	9.7	17	13	13
Zinc	26	24	19	22	47	27	32	14	18	32	27	17	19	18	12	27	19	32	26	19	12	18
PCBs (mg/kg)																						
Aroclor-1016 (PCB-1016)	0.037 U	0.037 U	0.036 U	0.037 U	0.035 U	0.036 U	0.038 U	0.037 U	0.036 U	0.036 U	0.037 U	0.037 U	0.036 U	0.036 U	0.035 U	0.035 U	0.036 U	0.038 U	0.037 U	0.035 U	0.036 U	0.037 U
Aroclor-1221 (PCB-1221)	0.037 U	0.037 U	0.036 U	0.037 U	0.035 U	0.036 U	0.038 U	0.037 U	0.036 U	0.036 U	0.037 U	0.037 U	0.036 U	0.036 U	0.035 U	0.035 U	0.036 U	0.038 U	0.037 U	0.035 U	0.036 U	0.037 U
Aroclor-1232 (PCB-1232)	0.037 U	0.037 U	0.036 U	0.037 U	0.035 U	0.036 U	0.038 U	0.037 U	0.036 U	0.036 U	0.037 U	0.037 U	0.036 U	0.036 U	0.035 U	0.035 U	0.036 U	0.038 U	0.037 U	0.035 U	0.036 U	0.037 U
Aroclor-1242 (PCB-1242)	0.037 U	0.037 U	0.036 U	0.037 U	0.035 U	0.036 U	0.038 U	0.037 U	0.036 U	0.036 U	0.037 U	0.037 U	0.036 U	0.036 U	0.035 U	0.035 U	0.036 U	0.038 U	0.037 U	0.035 U	0.036 U	0.037 U
Aroclor-1248 (PCB-1248)	0.037 U	0.037 U	0.036 U	0.037 U	0.035 U	0.036 U	0.038 U	0.037 U	0.036 U	0.036 U	0.037 U	0.037 U	0.036 U	0.036 U	0.035 U	0.035 U	0.036 U	0.038 U	0.037 U	0.035 U	0.036 U	0.037 U
Aroclor-1254 (PCB-1254)	0.037 U	0.037 U	0.036 U	0.037 U	0.035 U	0.036 U	0.038 U	0.037 U	0.036 U	0.036 U	0.037 U	0.037 U	0.036 U	0.036 U	0.035 U	0.035 U	0.036 U	0.038 U	0.037 U	0.035 U	0.036 U	0.037 U
Aroclor-1260 (PCB-1260)	0.037 U	0.037 U	0.036 U	0.037 U	0.035 U	0.036 U	0.038 U	0.037 U	0.036 U	0.036 U	0.037 U	0.037 U	0.036 U	0.036 U	0.035 U	0.035 U	0.036 U	0.038 U	0.079	0.035 U	0.036 U	0.037 U
Total PCBs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.079	ND	ND	ND
Semi-Volatile Organic Compounds (mg/kg)																						
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2,4,5-Trichlorophenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2,4,6-Trichlorophenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2,4-Dichlorophenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2,4-Dimethylphenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2,4-Dinitrophenol	0.17 U	0.17 U	0.16 U	0.17 U	0.63 U	0.16 U	0.17 U	0.17 U	0.65 U	0.17 U	0.17 U	0.17 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.17 U	0.42 U	0.16 U	0.41 U	0.17 U
2,4-Dinitrotoluene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2,6-Dinitrotoluene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2-Chloronaphthalene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2-Chlorophenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2-Methylnaphthalene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.042 J	0.28 U	0.73 U	0.29 U
2-Methylphenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
2-Nitroaniline	0.22 U	0.22 U	0.22 U	0.23 U	0.85 U	0.22 U	0.23 U	0.22 U	0.86 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.21 U	0.22 U	0.23 U	0.56 U	0.21 U	0.55 U	0.22 U
2-Nitrophenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
3&4-Methylphenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
3,3'-Dichlorobenzidine	1.8 U	1.8 U	1.7 U	1.8 U	6.8 U	1.7 U	1.8 U	1.8 U	6.9 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.9 U	4.5 U	1.7 U	4.4 U	1.8 U
3-Nitroaniline	0.22 U	0.22 U	0.22 U	0.23 U	0.85 U	0.22 U	0.23 U	0.22 U	0.86 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.21 U	0.22 U	0.23 U	0.56 U	0.21 U	0.55 U	0.22 U
4,6-Dinitro-2-methylphenol	0.17 U	0.17 U	0.16 U	0.17 U	0.63 U	0.16 U	0.17 U	0.17 U	0.65 U	0.17 U	0.17 U	0.17 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.17 U	0.42 U	0.16 U	0.41 U	0.17 U
4-Bromophenyl phenyl ether	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
4-Chloro-3-methylphenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
4-Chloroaniline	0.22 U	0.22 U	0.22 U	0.23 U	0.85 U	0.22 U	0.23 U	0.22 U	0.86 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.21 U	0.22 U	0.23 U	0.56 U	0.21 U	0.55 U	0.22 U
4-Chlorophenyl phenyl ether	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
4-Nitroaniline	0.22 U	0.22 U	0.22 U	0.23 U	0.85 U	0.22 U	0.23 U	0.22 U	0.86 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.21 U	0.22 U	0.23 U	0.56 U	0.21 U	0.55 U	0.22 U
4-Nitrophenol	0.37 U	0.37 U	0.36 U	0.37 U	1.4 U	0.36 U	0.38 U	0.37 U	1.4 U	0.37 U	0.37 U	0.37 U	0.36 U	0.36 U	0.35 U	0.35 U	0.36 U	0.38 U	0.92 U	0.35 U	0.91 U	0.37 U
Acenaphthene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.043 J	0.28 U	0.73 U	0.29 U
Acenaphthylene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Acetophenone	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Anthracene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.13 J	0.28 U	0.73 U	0.29 U
Atrazine	0.045 U	0.044 U	0.043 U	0.045 U	0.17 U	0.044 U	0.046 U	0.045 U	0.17 U	0.044 U	0.045 U	0.045 U	0.044 U	0.044 U	0.043 U	0.043 U	0.043 U	0.046 U	0.11 U	0.043 U	0.11 U	0.044 U

TABLE 3.6

SOIL ANALYTICAL RESULTS - 2012
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location	*CRA-705M*	*CRA-705M*	*CRA-705M*	*CRA-706M*	*CRA-707SB*	*CRA-707SB*	*CRA-708SB*	*CRA-708SB*	*CRA-709M*	*CRA-709M*	*CRA-710M*	*CRA-710M*	*CRA-828M*	*CRA-828M*	*CRA-829M*	*CRA-829M*	*CRA-833M*	*CRA-833M*	*CRA-834M*	*CRA-834M*	*CRA-835-SB*	*CRA-835-SB*
Sample Identification	*SO-17358-011812-DR-009*	*SO-17358-011812-DR-010*	*SO-17358-011812-DR-011*	*SO-17358-011812-DR-012*	*SO-17358-011812-DR-015*	*SO-17358-011812-DR-016*	*SO-17358-011812-DR-013*	*SO-17358-011812-DR-014*	*SO-17358-011712-DR-005*	*SO-17358-011712-DR-006*	*SO-17358-011812-DR-007*	*SO-17358-011812-DR-008*	*SO-17358-011712-DR-003*	*SO-17358-011712-DR-004*	*SO-17358-011712-DR-001*	*SO-17358-011712-DR-002*	*SO-17358-011912-DR-021*	*SO-17358-011912-DR-022*	*SO-17358-011812-DR-017*	*SO-17358-011812-DR-018*	*SO-17358-011912-DR-019*	*SO-17358-011912-DR-020*
Sample Date	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/17/2012*	*1/17/2012*	*1/18/2012*	*1/18/2012*	*1/17/2012*	*1/17/2012*	*1/17/2012*	*1/17/2012*	*1/19/2012*	*1/19/2012*	*1/18/2012*	*1/18/2012*	*1/19/2012*	*1/19/2012*
Sample Depth	*(0-2) ft BGS*	*(0-2) ft BGS*	*(2-3) ft BGS*	*(0-2) ft BGS*	*(0-2) ft BGS*	*(2-3) ft BGS*	*(0-2) ft BGS*	*(2-3) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*	*(0-2) ft BGS*	*(2.5-4.5) ft BGS*	*(0-2) ft BGS*	*(3-5) ft BGS*	*(0-2) ft BGS*	*(3-5) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*
Sample Type		*Duplicate*																				
Benzaldehyde	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Benzo(a)anthracene	0.3 U	0.29 U	0.29 U	0.3 U	0.038 J	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.024 J	0.31 U	0.39 J	0.28 U	0.73 U	0.29 U
Benzo(a)pyrene	0.3 U	0.29 U	0.29 U	0.3 U	0.048 J	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.025 J	0.31 U	0.4 J	0.28 U	0.73 U	0.29 U
Benzo(b)fluoranthene	0.3 U	0.29 U	0.29 U	0.3 U	0.068 J	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.046 J	0.0085 J	0.5 J	0.28 U	0.025 J	0.29 U
Benzo(g,h,i)perylene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.024 J	0.31 U	0.37 J	0.28 U	0.73 U	0.29 U
Benzo(k)fluoranthene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.015 J	0.31 U	0.23 J	0.28 U	0.73 U	0.29 U
Biphenyl (1,1-Biphenyl)	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
bis(2-Chloroethoxy)methane	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
bis(2-Chloroethyl)ether	0.09 U	0.089 U	0.087 U	0.09 U	0.34 U	0.087 U	0.092 U	0.089 U	0.34 U	0.089 U	0.089 U	0.09 U	0.087 U	0.087 U	0.085 U	0.085 U	0.086 U	0.093 U	0.22 U	0.086 U	0.22 U	0.089 U
bis(2-Ethylhexyl)phthalate (DEHP)	0.047 J	0.052 J	0.039 J	0.037 J	0.096 J	0.031 J	0.025 J	0.032 J	1.1 U	0.29 U	0.053 J	0.029 J	0.041 J	0.29 U	0.034 J	0.041 J	0.29 U	0.31 U	0.086 J	0.038 J	0.73 U	0.29 U
Butyl benzylphthalate (BBP)	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Caprolactam	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Carbazole	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.083 J	0.28 U	0.73 U	0.29 U
Chrysene	0.3 U	0.29 U	0.29 U	0.3 U	0.049 J	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.028 J	0.31 U	0.4 J	0.28 U	0.73 U	0.29 U
Dibenz(a,h)anthracene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.054 J	0.28 U	0.73 U	0.29 U
Dibenzofuran	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.031 J	0.28 U	0.73 U	0.29 U
Diethyl phthalate	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Dimethyl phthalate	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Di-n-butylphthalate (DBP)	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Di-n-octyl phthalate (DnOP)	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Fluoranthene	0.3 U	0.29 U	0.29 U	0.3 U	0.061 J	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.028 J	0.31 U	0.89	0.28 U	0.01 J	0.29 U
Fluorene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.04 J	0.28 U	0.73 U	0.29 U
Hexachlorobenzene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Hexachlorobutadiene	0.045 U	0.044 U	0.043 U	0.045 U	0.17 U	0.044 U	0.046 U	0.045 U	0.17 U	0.044 U	0.045 U	0.045 U	0.044 U	0.044 U	0.043 U	0.043 U	0.043 U	0.046 U	0.11 U	0.043 U	0.11 U	0.044 U
Hexachlorocyclopentadiene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Hexachloroethane	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Indeno(1,2,3-cd)pyrene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.019 J	0.31 U	0.26 J	0.28 U	0.73 U	0.29 U
Isophorone	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Naphthalene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.033 J	0.28 U	0.73 U	0.29 U
Nitrobenzene	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
N-Nitrosodi-n-propylamine	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
N-Nitrosodiphenylamine	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Pentachlorophenol	0.17 U	0.17 U	0.16 U	0.17 U	0.63 U	0.16 U	0.17 U	0.17 U	0.65 U	0.17 U	0.17 U	0.17 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.17 U	0.42 U	0.16 U	0.41 U	0.17 U
Phenanthrene	0.3 U	0.0083 J	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.52 J	0.28 U	0.73 U	0.29 U
Phenol	0.3 U	0.29 U	0.29 U	0.3 U	1.1 U	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.29 U	0.31 U	0.74 U	0.28 U	0.73 U	0.29 U
Pyrene	0.3 U	0.0077 J	0.29 U	0.3 U	0.072 J	0.29 U	0.3 U	0.29 U	1.1 U	0.29 U	0.29 U	0.3 U	0.29 U	0.29 U	0.28 U	0.28 U	0.029 J	0.31 U	0.67 J	0.28 U	0.0094 J	0.29 U
Volatile Organic Compounds (mg/kg)																						
1,1,1-Trichloroethane	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
1,1,2,2-Tetrachloroethane	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
1,1,2-Trichloroethane	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
1,1-Dichloroethane	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
1,1-Dichloroethene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
1,2,4-Trichlorobenzene	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.014 J	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
1,2-Dibromo-3-chloropropane (DBCP)	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
1,2-Dibromoethane (Ethylene dibromide)	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
1,2-Dichlorobenzene	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
1,2-Dichloroethane	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
1,2-Dichloropropane	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
1,3-Dichlorobenzene	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
1,4-Dichlorobenzene	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
2-Butanone (Methyl ethyl ketone) (MEK)	0.67 U	0.66 U	0.65 U	0.74 U	0.63 U	0.64 U	0.75 U	0.65 U	0.65 U	0.66 U	0.67 U	0.64 U	0.61 U	0.62 U	0.65 U	0.64 U	0.71 U	0.64 U	0.67 U	0.6 U	0.68 U	0.67 U
2-Hexanone	2.2 U	2.2 U	2.2 U	2.5 U	2.1 U	2.1 U	2.5 U	2.2 U	2.2 U	2.2 U	2.2 U	2.1 U	2 U	2.1 U	2.2 U	2.1 U	2.4 U	2.1 U	2.2 U	2 U	2.3 U	2.2 U
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	2.2 U	2.2 U	2.2 U	2.5 U	2.1 U	2.1 U	2.5 U	2.2 U	2.2 U	2.2 U	2.2 U	2.1 U	2 U	2.1 U	2.2 U	2.1 U	2.4 U	2.1 U	2.2 U	2 U	2.3 U	2.2 U
Acetone	0.67 U	0.66 U	0.65 U	0.74 U	0.63 U	0.64 U	0.75 U	0.65 U	0.65 U	0.66 U	0.67 U	0.64 U	0.61 U	0.62 U	0.65 U	0.64 U	0.71 U	0.64 U	0.67 U	0.6 U	0.68 U	0.67 U
Benzene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Bromodichloromethane	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
Bromoform	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
Bromomethane (Methyl bromide)	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
Carbon disulfide	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
Carbon tetrachloride	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Chlorobenzene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Chloroethane	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
Chloroform (Trichloromethane)	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Chloromethane (Methyl chloride)	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
cis-1,2-Dichloroethene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
cis-1,3-Dichloropropene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Cyclohexane	1.1 U	1.1 U	1 U	1.2 U	1 U	1 U	1.2 U	1 U	1 U	1.1 U	1.1 U	1 U	0.97 U	0.99 U	1 U	1 U	1.1 U	1 U	1.1 U	0.96 U	1.1 U	1.1 U
Dibromochloromethane	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Dichlorodifluoromethane (CFC-12)	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
Ethylbenzene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U

TABLE 3.6

SOIL ANALYTICAL RESULTS - 2012
NORTHEAST AREA SUMMARY REPORT
FORMER WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Sample Location	*CRA-705M*	*CRA-705M*	*CRA-705M*	*CRA-706M*	*CRA-707SB*	*CRA-707SB*	*CRA-708SB*	*CRA-708SB*	*CRA-709M*	*CRA-709M*	*CRA-710M*	*CRA-710M*	*CRA-828M*	*CRA-828M*	*CRA-829M*	*CRA-829M*	*CRA-833M*	*CRA-833M*	*CRA-834M*	*CRA-834M*	*CRA-835-SB*	*CRA-835-SB*
Sample Identification	*SO-17358-011812-DR-009*	*SO-17358-011812-DR-010*	*SO-17358-011812-DR-011*	*SO-17358-011812-DR-012*	*SO-17358-011812-DR-015*	*SO-17358-011812-DR-016*	*SO-17358-011812-DR-013*	*SO-17358-011812-DR-014*	*SO-17358-011712-DR-005*	*SO-17358-011712-DR-006*	*SO-17358-011812-DR-007*	*SO-17358-011812-DR-008*	*SO-17358-011712-DR-003*	*SO-17358-011712-DR-004*	*SO-17358-011712-DR-001*	*SO-17358-011712-DR-002*	*SO-17358-011912-DR-021*	*SO-17358-011912-DR-022*	*SO-17358-011812-DR-017*	*SO-17358-011812-DR-018*	*SO-17358-011912-DR-019*	*SO-17358-011912-DR-020*
Sample Date	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/18/2012*	*1/17/2012*	*1/17/2012*	*1/18/2012*	*1/18/2012*	*1/17/2012*	*1/17/2012*	*1/17/2012*	*1/17/2012*	*1/19/2012*	*1/19/2012*	*1/18/2012*	*1/18/2012*	*1/19/2012*	*1/19/2012*
Sample Depth	*(0-2) ft BGS*	*(0-2) ft BGS*	*(2-3) ft BGS*	*(0-2) ft BGS*	*(0-2) ft BGS*	*(2-3) ft BGS*	*(0-2) ft BGS*	*(2-3) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*	*(0-2) ft BGS*	*(2.5-4.5) ft BGS*	*(0-2) ft BGS*	*(3-5) ft BGS*	*(0-2) ft BGS*	*(3-5) ft BGS*	*(0-2) ft BGS*	*(2-4) ft BGS*
Sample Type		*Duplicate*																				
Isopropyl benzene	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
Methyl acetate	1.1 U	1.1 U	1 U	1.2 U	1 U	1 U	1.2 U	1 U	1 U	1.1 U	1.1 U	1 U	0.97 U	0.99 U	1 U	1 U	1.1 U	0.42 J	0.089 J	0.96 U	1.1 U	1.1 U
Methyl cyclohexane	1.1 U	1.1 U	1 U	1.2 U	1 U	1 U	1.2 U	1 U	1 U	1.1 U	1.1 U	1 U	0.97 U	0.99 U	1 U	1 U	1.1 U	1 U	1.1 U	0.96 U	1.1 U	1.1 U
Methyl tert butyl ether (MTBE)	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
Methylene chloride	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
Styrene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Tetrachloroethene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Toluene	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
trans-1,2-Dichloroethene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
trans-1,3-Dichloropropene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Trichloroethene	0.045 U	0.044 U	0.044 U	0.049 U	0.042 U	0.043 U	0.05 U	0.044 U	0.043 U	0.044 U	0.045 U	0.043 U	0.041 U	0.041 U	0.043 U	0.043 U	0.048 U	0.043 U	0.045 U	0.04 U	0.045 U	0.045 U
Trichlorofluoromethane (CFC-11)	0.09 U	0.088 U	0.087 U	0.098 U	0.084 U	0.086 U	0.1 U	0.087 U	0.086 U	0.088 U	0.089 U	0.086 U	0.081 U	0.082 U	0.087 U	0.086 U	0.095 U	0.085 U	0.089 U	0.08 U	0.091 U	0.089 U
Trifluorotrichloroethane (Freon 113)	0.22 U	0.22 U	0.22 U	0.25 U	0.21 U	0.21 U	0.25 U	0.22 U	0.22 U	0.22 U	0.22 U	0.21 U	0.2 U	0.21 U	0.22 U	0.21 U	0.24 U	0.21 U	0.22 U	0.2 U	0.23 U	0.22 U
Vinyl chloride	0.036 U	0.035 U	0.035 U	0.039 U	0.034 U	0.034 U	0.04 U	0.035 U	0.034 U	0.035 U	0.036 U	0.034 U	0.032 U	0.033 U	0.035 U	0.034 U	0.038 U	0.034 U	0.036 U	0.032 U	0.036 U	0.036 U
Xylenes (total)	0.13 U	0.13 U	0.13 U	0.15 U	0.13 U	0.13 U	0.15 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.12 U	0.12 U	0.13 U	0.13 U	0.14 U	0.13 U	0.13 U	0.12 U	0.14 U	0.13 U
Total Petroleum Hydrocarbons (mg/kg)																						
Total Petroleum Hydrocarbons	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

[b] Drinking Water Protection Criteria
[c] Non-Residential Drinking Water Protection Criteria
[d] Groundwater Surface Water Interface Criteria
[p] Direct Contact Criteria
J Estimated concentration
ND Non detect
U Not present at or above the associated value
-- Parameter not analyzed

APPENDIX A

STRATIGRAPHIC LOGS

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

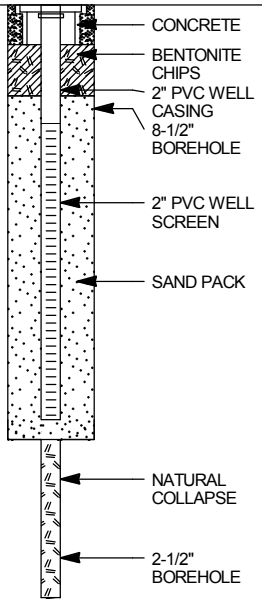
HOLE DESIGNATION: CRA-705M
DATE COMPLETED: January 18, 2012
DRILLING METHOD: DIRECT PUSH / HSA
FIELD PERSONNEL: D. RIVERS

NORTHING: 273015.69
EASTING: 13344440.13

TOP OF CASING 716.84
GROUND SURFACE 716.84
TOP OF RISER 716.20

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft
0	ASPHALT	716.64
2	SC-CLAYEY SAND (FILL), with silt, trace fine gravel, compact, fine to coarse grained, poorly graded, brown and yellow brown, moist	714.34
4	SP-SAND, with fine gravel, compact, fine to coarse grained, poorly graded, brown and light brown, moist - wet at 3.5ft BGS - trace fine gravel at 4.5ft BGS - trace fine grained, medium to coarse grained, gray at 6.0ft BGS	
6	- fine to coarse grained at 6.4ft BGS	
8	- fine grained, brown gray at 8.8ft BGS - fine to coarse grained at 9.1ft BGS	
10	- with fine gravel at 9.6ft BGS	706.74
12	CL-SILTY CLAY, firm, low plasticity, gray, moist	
14		
16	END OF BOREHOLE @ 15.0ft BGS	701.84
18		
20		
22		
24		
26		
28		
30		
32		
34		

MONITORING WELL



WELL DETAILS
Screened interval:
713.84 to 706.34ft
3.00 to 10.50ft BGS
Length: 7.5ft
Diameter: 2in
Slot Size: 0.010
Material: PVC
Seal:
715.84 to 714.54ft
1.00 to 2.30ft BGS
Material: BENTONITE CHIPS
Sand Pack:
714.54 to 705.84ft
2.30 to 11.00ft BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE	PID (ppm)
1DP 0-2' -009/ 010				0.0
2-3' -011 2DP				0.0
3DP				0.0
4DP				0.0
5DP				0.0
6DP				0.0
7DP				0.0
8DP				0.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS

OVERBURDEN LOG 017358-RACER.GPJ CRA_CORP.GDT 6/12/12

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

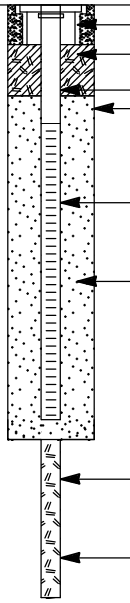
HOLE DESIGNATION: CRA-706M
DATE COMPLETED: January 18, 2012
DRILLING METHOD: DIRECT PUSH / HSA
FIELD PERSONNEL: D. RIVERS

NORTHING: 273197.54
EASTING: 13345062.49

TOP OF CASING 715.73
GROUND SURFACE 715.72
TOP OF RISER 715.16

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft
0	ASPHALT	715.52
2	SP-SAND (FILL), trace silt and fine gravel, compact, fine to medium grained, poorly graded, dark brown, moist - no gravel, orange brown at 0.8ft BGS - fine to coarse grained, brown, moist to wet (native) at 2.5ft BGS - wet at 3.5ft BGS	
4	- with fine gravel at 4.2ft BGS	710.52
6	SW-SAND, trace fine gravel, compact, fine to coarse grained, well graded, brown gray, wet	708.52
8	SP-SAND, trace silt, compact, fine to coarse grained, poorly graded, gray, wet	706.52
10	SM-SILTY SAND, compact, fine grained, poorly graded, gray, wet	705.72
12	CL-SILTY CLAY, firm, low plasticity, gray, moist	
14		
16	END OF BOREHOLE @ 15.0ft BGS	700.72
18		
20		
22		
24		
26		
28		
30		
32		
34		

MONITORING WELL



WELL DETAILS
Screened interval:
712.72 to 705.22ft
3.00 to 10.50ft BGS
Length: 7.5ft
Diameter: 2in
Slot Size: 0.010
Material: PVC
Seal:
714.72 to 713.42ft
1.00 to 2.30ft BGS
Material: BENTONITE CHIPS
Sand Pack:
713.42 to 704.72ft
2.30 to 11.00ft BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE	PID (ppm)
1DP 0-2' -012				0.0
2DP				0.0
3DP				0.0
4DP				0.0
5DP				0.0
6DP				0.0
7DP				0.0
8DP				0.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (1DP)

OVERBURDEN LOG 017358-RACER.GPJ CRA_CORP.GDT 6/12/12

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

HOLE DESIGNATION: CRA-707SB
DATE COMPLETED: January 18, 2012
DRILLING METHOD: DIRECT PUSH
FIELD PERSONNEL: D. RIVERS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	NORTHING: 272967.94 EASTING: 13344730.42 GROUND SURFACE	716.50						
0	ASPHALT	716.30	BACKFILLED WITH BENTONITE CHIPS	1DP 0-2' -015				0.0
2	SC-CLAYEY SAND (FILL), with silt, trace fine gravel, compact, fine to coarse grained, poorly graded, brown and yellow brown, moist	714.50	2-1/2" BOREHOLE	2-3' -016 2DP				0.0
4	SP-SAND, trace silt and fine gravel, compact, fine to coarse grained, poorly graded, brown and orange brown, moist to wet - wet at 3.5ft BGS	711.50		3DP				0.0
6	END OF BOREHOLE @ 5.0ft BGS							
8								
10								
12								
14								
16								
18								
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (1DP)

OVERBURDEN LOG 017358-RACER.GPJ CRA_CORP.GDT 6/12/12

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

HOLE DESIGNATION: CRA-708SB
DATE COMPLETED: January 18, 2012
DRILLING METHOD: DIRECT PUSH
FIELD PERSONNEL: D. RIVERS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	NORTHING: 272973.78 EASTING: 13345059.61 GROUND SURFACE	715.96						
0	ASPHALT	715.66	BACKFILLED WITH BENTONITE CHIPS	1DP 0-2' -013				0.0
2	SC-CLAYEY SAND (FILL), with silt, trace fine gravel, compact, fine to coarse grained, poorly graded, brown and yellow brown, moist	713.96	2-1/2" BOREHOLE	2-3' -024 2DP				0.0
4	SP-SAND, trace silt, compact, fine grained, poorly graded, orange brown, moist - moist to wet at 3.0ft BGS - wet at 3.5ft BGS			3DP				0.0
6	- trace fine gravel, fine to coarse grained, brown gray at 3.8ft BGS	710.96						
8	END OF BOREHOLE @ 5.0ft BGS							
10								
12								
14								
16								
18								
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval)

OVERBURDEN LOG 017358-RACER.GPJ CRA_CORP.GDT 6/12/12

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

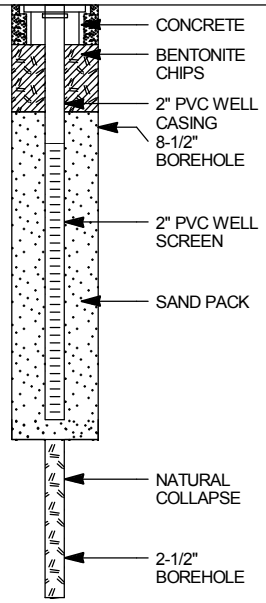
HOLE DESIGNATION: CRA-709M
DATE COMPLETED: January 17, 2012
DRILLING METHOD: DIRECT PUSH / HSA
FIELD PERSONNEL: D. RIVERS

NORTHING: 272764.99
EASTING: 13345075.21

TOP OF CASING 716.08
GROUND SURFACE 716.08
TOP OF RISER 715.73

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft
0	ASPHALT	715.78
2	SM/CL-SAND, SILT AND CLAY (FILL), trace fine gravel, compact, non plastic, fine to coarse sand, brown, gray and light brown, moist	714.28
4	SP-SAND, trace silt, compact, fine grained, poorly graded, brown gray, moist - orange brown at 2.2ft BGS - trace fine gravel, fine to coarse grained, brown at 2.7ft BGS	710.58
6	- brown gray, wet at 4.8ft BGS - 0.1' silty clay seam, firm, low plasticity, gray, moist at 5.2ft BGS	710.38 708.98
8	GP-SANDY GRAVEL, compact, fine gravel, coarse sand, round to subrounded, brown gray, wet	
10	SW-SAND, compact, fine to coarse grained, well graded, gray, wet	706.08
12	SP-SAND, trace silt, compact, fine to coarse grained, poorly graded, gray, wet CL-SILTY CLAY, firm, low plasticity, gray, moist	
14		
16	END OF BOREHOLE @ 15.0ft BGS	701.08
18		
20		
22		
24		
26		
28		
30		
32		
34		

MONITORING WELL



WELL DETAILS
Screened interval:
712.58 to 705.58ft
3.50 to 10.50ft BGS
Length: 7ft
Diameter: 2in
Slot Size: 0.010
Material: PVC
Seal:
715.08 to 713.38ft
1.00 to 2.70ft BGS
Material: BENTONITE CHIPS
Sand Pack:
713.38 to 705.08ft
2.70 to 11.00ft BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE	PID (ppm)
1DP 0-2' -005				0.0
2DP 2-4' -006				0.0
3DP				0.0
4DP				0.0
5DP				0.0
6DP				0.0
7DP				0.0
8DP				0.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

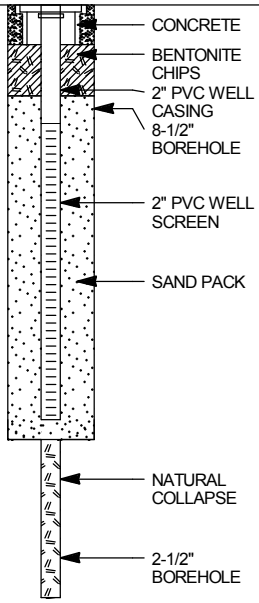
HOLE DESIGNATION: CRA-710M
DATE COMPLETED: January 18, 2012
DRILLING METHOD: DIRECT PUSH / HSA
FIELD PERSONNEL: D. RIVERS

NORTHING: 272748.91
EASTING: 13344746.55

TOP OF CASING 716.52
GROUND SURFACE 716.51
TOP OF RISER 715.92

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft
0	ASPHALT	716.21
	CL-CLAY (FILL), with silt and fine sand, trace fine gravel, firm, low plasticity, brown, moist	
2	SP-SAND, trace silt, compact, fine grained, poorly graded, orange brown, moist	714.01
4	- brown gray at 3.5ft BGS	
	- fine to coarse grained, moist to wet at 4.0ft BGS	
6	- trace fine gravel, wet at 4.5ft BGS	
8	- no gravel, fine grained, increase in silt content at 8.7ft BGS	707.11
10	SM-SILTY SAND, compact, fine grained, poorly graded, gray, wet	706.51
	CL-SILTY CLAY, firm, low plasticity, gray, moist	
12		
14		
	END OF BOREHOLE @ 15.0ft BGS	701.51
16		
18		
20		
22		
24		
26		
28		
30		
32		
34		

MONITORING WELL



WELL DETAILS
Screened interval:
713.51 to 706.01ft
3.00 to 10.50ft BGS
Length: 7.5ft
Diameter: 2in
Slot Size: 0.010
Material: PVC
Seal:
715.51 to 714.21ft
1.00 to 2.30ft BGS
Material: BENTONITE CHIPS
Sand Pack:
714.21 to 705.51ft
2.30 to 11.00ft BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE	PID (ppm)
1DP 0-2' -007				0.0
2DP 2-4' -008				0.0
3DP				0.0
4DP				0.0
5DP				0.0
6DP				0.0
7DP				0.0
8DP				0.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS

OVERBURDEN LOG 017358-RACER.GPJ CRA_CORP.GDT 6/12/12

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

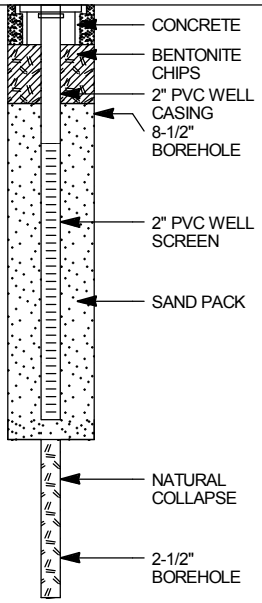
HOLE DESIGNATION: CRA-828M
DATE COMPLETED: January 17, 2012
DRILLING METHOD: DIRECT PUSH / HSA
FIELD PERSONNEL: D. RIVERS

NORTHING: 271967.07
EASTING: 13345494.03

	ELEV. ft
GROUND SURFACE	716.11
TOP OF CASING	716.08
TOP OF RISER	715.70

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft
0	CONCRETE	715.41
2	SP-SAND (FILL), trace silt, compact, fine grained, poorly graded, orange brown, moist - trace fine gravel, fine to coarse grained, light brown at 2.0ft BGS - no gravel, fine grained,, brown at 3.2ft BGS	
4	- moist to wet at 4.5ft BGS	
6	SP-SAND, trace silt, fine to coarse grained, poorly graded, brown gray, wet - fine to medium grained at 6.0ft BGS	711.11
8		
10	- fine grained, gray at 9.5ft BGS	
12	CL-SILTY CLAY, firm, low plasticity, gray, moist	706.31
14		
16	END OF BOREHOLE @ 15.0ft BGS	701.11
18		
20		
22		
24		
26		
28		
30		
32		
34		

MONITORING WELL



WELL DETAILS
Screened interval:
712.61 to 705.61ft
3.50 to 10.50ft BGS
Length: 7ft
Diameter: 2in
Slot Size: 0.010
Material: PVC
Seal:
715.11 to 713.61ft
1.00 to 2.50ft BGS
Material: BENTONITE CHIPS
Sand Pack:
713.61 to 705.11ft
2.50 to 11.00ft BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE	PID (ppm)
1DP 0-2' -003				0.0
2DP 2-4' -004				0.0
3DP				0.0
4DP				0.0
5DP				0.0
6DP				0.0
7DP				0.0
8DP				0.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval)

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

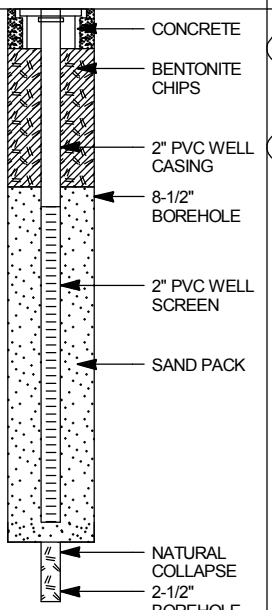
PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

HOLE DESIGNATION: CRA-829M
DATE COMPLETED: January 17, 2012
DRILLING METHOD: DIRECT PUSH / HSA
FIELD PERSONNEL: D. RIVERS

NORTHING: 271975.16
EASTING: 13345640.61

TOP OF CASING 716.26
GROUND SURFACE 716.15
TOP OF RISER 715.81

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft
0	CONCRETE	715.65
	CL-SILTY CLAY (FILL), with fine sand, trace fine gravel, firm, low plasticity, brown, moist	715.05
2	SP-SAND (FILL), trace silt and fine gravel, compact, fine to coarse grained, poorly graded, orange brown, moist	
4	- with fine gravel at 2.5ft BGS	711.65
	CL-SILTY CLAY (FILL), trace fine sand to fine gravel, firm, low plasticity, brown gray, moist	710.85
6	SP-SAND, trace silt and fine gravel, compact, fine to coarse grained, poorly graded, brown, wet	
8	- 0.2' fine gravel seam at 6.3ft BGS	
10	- no gravel, fine to medium grained, brown gray at 10.5ft BGS	
12		703.65
	CL-SILTY CLAY, firm, low plasticity, gray, moist	
14		701.15
	END OF BOREHOLE @ 15.0ft BGS	
16		
18		
20		
22		
24		
26		
28		
30		
32		
34		



WELL DETAILS
Screened interval:
711.15 to 703.15ft
5.00 to 13.00ft BGS
Length: 8ft
Diameter: 2in
Slot Size: 0.010
Material: PVC
Seal:
715.15 to 711.65ft
1.00 to 4.50ft BGS
Material: BENTONITE CHIPS
Sand Pack:
711.65 to 702.65ft
4.50 to 13.50ft BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE	PID (ppm)
1DP 0-2' -001				0.0
2DP 2.5-4.5' -002				0.0
3DP				0.0
4DP				0.0
5DP				0.0
6DP				0.0
7DP				0.0
8DP				0.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

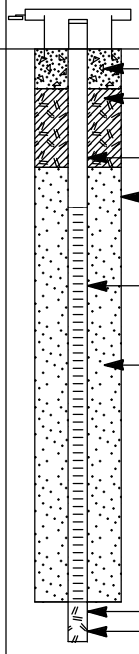
HOLE DESIGNATION: CRA-833M
DATE COMPLETED: January 19, 2012
DRILLING METHOD: DIRECT PUSH / HSA
FIELD PERSONNEL: D. RIVERS

NORTHING: 273156.32
EASTING: 13345505.26

TOP OF CASING 720.07
TOP OF RISER 719.81
GROUND SURFACE 717.01

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft
0	MIX of CONCRETE AND ASPHALT DEBRIS, with sand, silt and clay	716.01
2	SP-SAND (FILL), trace silt and fine gravel, compact, fine to coarse grained, poorly graded, brown, moist	714.51
4	SM/CL-SAND AND CLAY (FILL), with silt, compact, nonplastic, fine sand, dark brown, moist	
	- yellow brown and greenish brown at 4.0ft BGS	711.91
6	SP-SAND, with fine gravel, trace silt, compact, fine to coarse grained, poorly graded, brown gray, wet	
8		
	- trace fine gravel at 9.2ft BGS	
10		
12		
14	CL-SILTY CLAY, firm, low plasticity, gray, moist	703.51
	END OF BOREHOLE @ 15.0ft BGS	702.01
16		
18		
20		
22		
24		
26		
28		
30		
32		
34		

MONITORING WELL



WELL DETAILS
Screened interval:
713.01 to 703.01ft
4.00 to 14.00ft BGS
Length: 10ft
Diameter: 2in
Slot Size: 0.010
Material: PVC
Seal:
716.01 to 714.01ft
1.00 to 3.00ft BGS
Material: BENTONITE CHIPS
Sand Pack:
714.01 to 703.01ft
3.00 to 14.00ft BGS
Material: SAND

SAMPLE NUMBER	INTERVAL	REC (%)	'N' VALUE	PID (ppm)
1DP 0-2' -021				0.0
2DP				0.0
3-5' -022				
3DP				0.0
4DP				0.0
5DP				0.0
6DP				0.0
7DP				0.0
8DP				0.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS (oval)

OVERBURDEN LOG 017358-RACER.GPJ CRA_CORP.GDT 6/12/12

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: RACER-WILLOW RUN
PROJECT NUMBER: 017358-T01
CLIENT: RACER
LOCATION: YPSILANTI, MI

HOLE DESIGNATION: CRA-835SB
DATE COMPLETED: January 19, 2012
DRILLING METHOD: DIRECT PUSH
FIELD PERSONNEL: D. RIVERS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. ft	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	NORTHING: 272504.31 EASTING: 13345540.31 GROUND SURFACE	716.61						
0	ASPHALT AND GRAVEL (FILL)	716.11	BACKFILLED WITH BENTONITE CHIPS	1DP 0-2'-019				0.0
2	SP-SAND (FILL), trace silt and fine gravel, compact, fine to coarse grained, poorly graded, dark brown, moist - brown at 1.0ft BGS - no gravel, with silt, fine grained at 2.0ft BGS - trace silt (native), brown and orange brown at 2.5ft BGS - trace fine gravel, fine to coarse grained, moist to wet at 4.1ft BGS - wet at 4.8ft BGS		2-1/2" BOREHOLE	2DP 2-4'-020				0.0
4				3DP				0.0
6		711.61						
8	END OF BOREHOLE @ 5.0ft BGS							
10								
12								
14								
16								
18								
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ( )

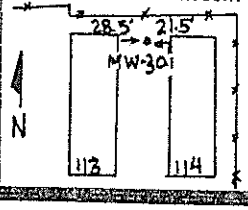
OVERBURDEN LOG 017358-RACER.GPJ CRA_CORP.GDT 6/12/12

CRA-264M

BORING LOG / MONITORING WELL DIAGRAM

C-E ENVIRONMENTAL, INC.

PROJECT NO.: 5883-00	PROJECT NAME: HYDRA-MATIC WILLOW RUN	BORING/WELL DESIGNATION: MW-303	BORING/WELL LOCATION:
DRILLING CONTRACTOR: P.S.I.	DRILLING METHOD: HOLLOW STEM AUGER	BOREHOLE SIZE: 8 IN.	BOREHOLE DEPTH: 13.5 FT.
DATE STARTED: 2/14/89	DATE COMPLETED: 2/14/89	GROUND ELEV.: 102.02 FT.	MEASURING POINT ELEV: 100.02 FT.
RIG: CME-55	DRILLER: P. LIBBY	HELPER: M. BOND	LOGGED BY: C KIELTY



DEPTH (FT.)	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNTS(N)	P.I. METER (ppm)	COMMENTS	WELL DATA
0	ASPHALT DEBRIS; SAND & GRAVEL (FILL)	N/A	N/A	N/A	BG	WELL FINISHED ABOVE GRADE W/A LOCKABLE PROTECTIVE CASING	
	SAND - orange-brown, medium grained, moist, some fine gravel.					CEMENT	
2.5						BENTONITE SEAL	
5.0	SAND - gray-brown, fine-medium grained, moist, some silt.					TWO-INCH SCHEDULE 40 FLUSH-THREADED PVC WELL CASING	
7.5						SAND FILTER PACK	
	SAND - gray, medium grained, wet, some silt.						
10.0	(groundwater encountered @ approx. 9 feet)					TWO-INCH 10-SLOT PVC WELL SCREEN	
12.5	CLAY - gray, moist, some silt.						
	END OF BORING AT 13.5 FEET						
15.0							

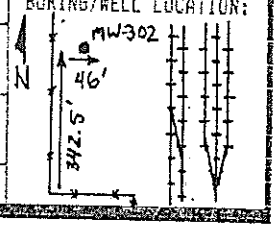
NOTES: BG - BACKGROUND
N/A - NOT APPLICABLE
SAMPLES LOGGED FROM CUTTINGS

CRA-265M

BORING LOG / MONITORING WELL DIAGRAM

C-E ENVIRONMENTAL, INC.

PROJECT NO.: 5883-00	PROJECT NAME: HYDRA-MATIC WILLOW RUN	BORING/WELL DESIGNATION: MW-302	BORING/WELL LOCATION:
DRILLING CONTRACTOR: P.S.I.	DRILLING METHOD: HOLLOW STEM AUGER	BOREHOLE SIZE: 8 IN.	BOREHOLE DEPTH: 13 FT.
DATE STARTED: 2/14/89	DATE COMPLETED: 2/14/89	GROUND ELEV.: 102.63 FT.	MEASURING POINT ELEV: 100.13 FT.
RIG: CME-55	DRILLER: P. LIBBY	HELPER: M. BOND	LOGGED BY: C KIELTY



DEPTH (FT.)	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNTS(N)	P.I. METER	COMMENTS	WELL DATA
0	ASPHALT DEBRIS SAND & GRAVEL (FILL)	N/A	N/A	N/A	BG (ppm)	WELL FINISHED ABOVE GRADE W/A LOCKABLE PROTECTIVE CASING CEMENT BENTONITE SEAL TWO-INCH SCHEDULE 40 FLUSH-THREADED PVC WELL CASING	XX XXX
2.5	SAND - orange-brown, medium grained, moist, some fine gravel.						
5.0						SAND FILTER PACK	
	SAND - gray-brown, wet, trace fine gravel and silt. (groundwater encountered @ approx. 6-feet)						
7.5						TWO-INCH 10-SLOT PVC WELL SCREEN	
10.0							
	CLAY - gray, moist, some silt.						
12.5							
	END OF BORING AT 13 FEET						
15.0							

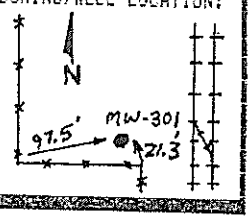
NOTES: BG - BACKGROUND
N/A - NOT APPLICABLE
SAMPLES LOGGED FROM CUTTINGS

CRA-266M

BORING LOG / MONITORING WELL DIAGRAM

C-E ENVIRONMENTAL, INC.

PROJECT NO.: 5883-00	PROJECT NAME: HYDRA-MATIC WILLOW RUN		BORING/WELL DESIGNATION: MW-301	BORING/WELL LOCATION:
DRILLING CONTRACTOR: P.S.I.	DRILLING METHOD: HOLLOW STEM AUGER	BOREHOLE SIZE: 8 IN.	BOREHOLE DEPTH: 11 FT.	
DATE STARTED: 2/14/89	DATE COMPLETED: 2/14/89	GROUND ELEV.: 99.79 FT.	MEASURING POINT ELEV: 97.79 FT.	WELL DEPTH: 10.0 FT.
RIG: CME-55	DRILLER: P. LIBBY	HELPER: M. BOND	LOGGED BY: C KIELTY	



DEPTH (FT.)	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNTS(N)	P.I. METER (ppm)	COMMENTS	WELL DATA
0	SAND (FILL)	N/A	N/A	N/A	BG	WELL FINISHED ABOVE GRADE W/A LOCKABLE PROTECTIVE CASING	
	SAND - orange-brown, medium grained, moist.					CEMENT	
						BENTONITE SEAL	
2.5	(groundwater encountered @ approx. 3 feet)					TWO-INCH SCHEDULE 40 FLUSH-THREADED PVC WELL CASING	
5.0	SAND - gray-brown, wet, trace silt.					SAND FILTER PACK	
7.5						TWO-INCH 10-SLOT PVC WELL SCREEN	
10.0	CLAY - gray, moist, some silt.						
	END OF BORING AT 11 FEET						
12.5							
15.0							

NOTES: BG - BACKGROUND
N/A - NOT APPLICABLE
SAMPLES LOGGED FROM CUTTINGS

APPENDIX B

HISTORICAL REPORTS

9803-147

HYDRA-MATIC

Division of General Motors Corporation Ypsilanti, Michigan 48198-6198

437
9/88
ENV033:Binder/147 - Soil & Groundwater Invest North Yard & ATF

September 30, 1988

Mr. Charles F. San Juan
Geologist
Environmental Response Division
Jackson State Office Building
301 E. Louis Glick Hwy.
Jackson, Michigan 49201

Subject: North Yard and ATF Spill Areas

Dear Mr. San Juan:

The purpose of this letter is to transmit information pertaining to the North Yard and ATF hydrogeological work. The enclosed submittals will provide supporting documentation for the previous presentations given to MDNR regarding the above stated Subject. Included are outlines of GMRL's field research activities and work plans that were mutually agreed upon, findings of the investigations and discussion on remedial strategies. This documentation is intended to provide the framework for the forthcoming technical reports that will be submitted to MDNR by December 1988 for the ATF spill area, and by February 1989 for the North Yard.

Hydra-Matic trusts that this submittal will supplement the information package that MDNR currently has in its files. Furthermore, Hydra-Matic is confident that this submittal, along with the forthcoming technical reports, will sufficiently detail the North Yard and ATF hydrogeological work plans thus far. If you have any questions regarding this matter, please contact the undersigned at (313) 481-7232.

Sincerely,

Christopher F Winkeljohn

Christopher F. Winkeljohn
Environmental Engineering

Enclosures

SOIL AND GROUNDWATER INVESTIGATION
HYDRA-MATIC WILLOW RUN PLANT
MACHINE STORAGE AREA

WORK PLAN 1
FOR
SITE CHARACTERIZATION AND DELINEATION
OF CONTAMINATED ZONES

ENVIRONMENTAL SCIENCE DEPARTMENT
GENERAL MOTORS RESEARCH LABORATORIES
WARREN, MICHIGAN 48090-9055

NOVEMBER 1987

A region of the north-east corner of the Hydra-matic Willow Run property is suspected of being contaminated by organic and inorganic constituents from old machinery formerly stored on the site. In this presentation titled "Soil and Groundwater Investigation Hydra-matic Willow Run Plant...Machine Storage Area" we will outline a proposal to characterize the site and delineate the zones of contamination. The contents of this proposal is referred to as WORK PLAN 1.

The proposal was developed by a team of environmental professionals from the General Motors Research Laboratories (GMRL) and Hydra-matic. The team includes Abdul S. Abdul (Ph.D, contaminant hydrogeology, Thomas L. Gibson (Ph.D, organic chemistry), and Chris Winkeljohn (BSc., environmental engineering). This team will supervise the implementation of Work Plan 1. Soil coring and drilling will be carried out by Professional Services Industries, Inc. Michigan Testing Engineers Division, Detroit MI., while chemical analyses will be done by Environmental Control Technology Corporation (ENCOTEC), Ann Arbor, Michigan.

SUMMARY

- A REGION ON THE NORTH SIDE OF THE HYDRA-MATIC WILLOW RUN PLANT IS SUSPECTED OF BEING CONTAMINATED BY CONSTITUENTS FROM OLD MACHINERY FORMERLY STORED ON THE SITE

- THIS WORK PLAN OUTLINES THE ACTIONS HYDRA-MATIC INTENDS TO TAKE, IN COLLABORATION WITH EV AND EAS, TO INVESTIGATE THE EXTENT OF SOIL AND GROUNDWATER CONTAMINATION AT THE SITE AND TO CHARACTERIZE THE SITE

- THE INVESTIGATION WILL PROGRESS IN FOUR STAGES
  (1) CONTAMINATION OF SURFACE MATERIALS
  (2) CONTAMINATION AND CHARACTERIZATION OF THE UNSATURATED ZONE
  (3) CONTAMINATION AND CHARACTERIZATION OF THE SATURATED ZONE
  (4) DELINEATION OF VAPOR PHASE CONTAMINATION

- INVESTIGATION WILL COMMENCE 11/87 AND WILL PROGRESS THROUGH 12/88

- IN EACH STAGE METHOD DEVELOPMENT AND BETTER UNDERSTANDING OF PROCESSES MAY BE NEEDED

Here is a summary of the presentation. The third main point in this summary list indicates the proposed investigative approach that we plan to inplement at the site. By this approach the investigation is divided into four main stages. First the lateral extent of contamination of the surface material (0 to 12 inch) will be assessed. If the surface material is contaminated then the investigation will progress through the unsaturated zone, otherwise the investigation will not progress to deeper regions of the subsurface. Again, if the unsaturated zone is investigated and found to be contaminated then this will trigger investigation of the saturated zone and then of vapor phase contamination. The details of these proposed investigations are included in this presentation.

The investigation will commence 11/87 and is expected to be completed by 12/88.

The site to be investigated is about 200 by 800 feet. Inspection of the site location map on the next page should give a general perspective of where the site is on the Hydra-matic property. Potential contaminants at the site include; oils, PCBs, and metals.

PROBLEM BACKBROUND

* PAST PRACTICE OF STORING USED MACHINERY ON A 200 BY 800 FT SURFACE PLOT
* PLOT IS IMMEDIATELY NORTH OF THE NORTH-EAST CORNER OF THE HYDRAMATIC PLANT
* SOME OF THE MACHINERY WAS NOT COMPLETELY DRAINED OF OPERATING FLUIDS:
    * OILS - CONTAIN LOW LEVELS OF PCBs
    * OTHER ORGANICS MAY BE PRESENT
    * SOLUTIONS MAY CONTAIN METALS

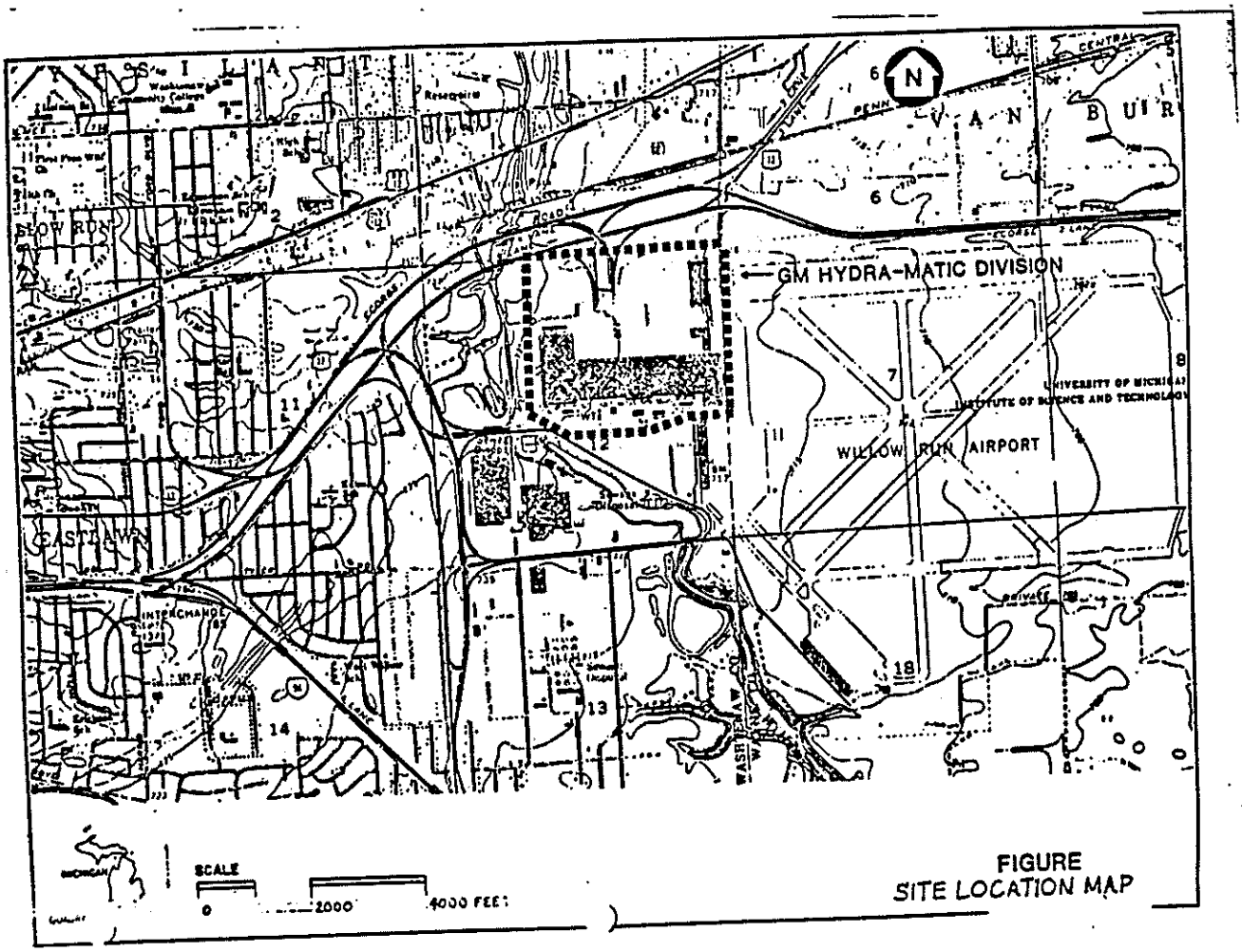


FIGURE
SITE LOCATION MAP

Based on data collected from other regions of the Hydra-matic property, the surficial deposits are continuous and of mainly medium to fine lacustrine materials. Also, the water table of a perched aquifer is 6 to 7 feet below the surface and flow is mainly towards the south to southwest. The perched aquifer is not used for potable water and there is no aquifer or surface water at risk.

SITE BACKGROUND

- THE UNCONSOLIDATED SURFACIAL DEPOSIT IS CONTINUOUS AND OF MAINLY MEDIUM TO FINE LACUSTRINE MATERIALS
- THE WATER TABLE IS 6 TO 7 FEET BELOW THE SURFACE AND FLOW IS MAINLY TOWARDS THE SOUTH/SOUTHWEST
- THE UNCONFINED AQUIFER IS NOT USED FOR POTABLE WATER AND THERE IS NO AQUIFER OR SURFACE WATER AT RISK
- THE SITE IS DRAINED BY THE HURON RIVER WHICH RUNS NW TO SE ON THE SOUTH SIDE OF THE SITE

The specific objectives of WORK PLAN 1 are to delineate the zones of contamination, describe the site geology and hydrology (if necessary), and assess the problem in each contaminated zone.

Who put that there twice?

OBJECTIVES OF WORK PLAN 1

* DELINEATE THE ZONES OF CONTAMINATION
* DESCRIBE THE SITE GEOLOGY AND HYDROLOGY
* ASSESS THE PROBLEM

The tasks included in phase 1 for delineating the extent of surface contamination are presented in this and the next two pages. We propose to divide the site into a 100 by 100 feet grid (see figure on next page). Twenty five soil samples from the surface to a depth of 12 inches will be taken at the 25 grid points by using a 3 inch I.D split-spoon sampler. The lower 3 inch of the soil core (from 9 to 12 inch depth) will be analyzed by Encotec for PCB Aroclors 1221, 1248, 1254, and 1260, for total heavy metals (Cr, Pb, Cd, Zn, Ni, and Fe), and for total hydrocarbons.

Based on the results of these 25 samples we will assess the needs for increasing the sampling density and extending the sampling area to adequately define the extent of surface contamination.

After the extent of surface contamination is established we plan to assess the needs for excavation and disposal of the surface material.

PHASES OF WORK PLAN 1

* PHASE 1
  * DELINEATION OF SURFACE CONTAMINATION
    * 3 BY 3 INCH SOIL CORES FROM 9 TO 12 INCH DEPTH
    * 100 BY 100 FT GRID: 25 SOIL SAMPLES
    * SOIL EXTRACTS WILL BE ANALYZED FOR:
      (A) PCBs:
        (1) AROCLOR 1221
        (2) AROCLOR 1248
        (3) AROCLOR 1254
        (4) AROCLOR 1260

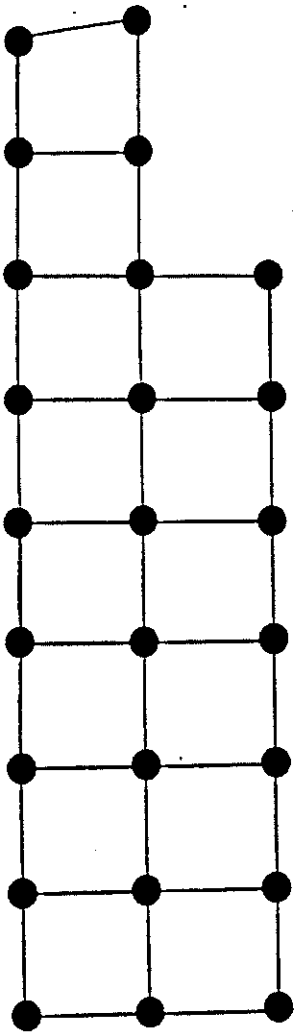
      (B) HEAVY METALS:
        Cr, Pb, Cd, Zn, Ni, Fe

      (C) TOTAL HYDROCARBONS

  * INCREASE DENSITY OF SAMPLING
  * EXTEND SAMPLING AREA

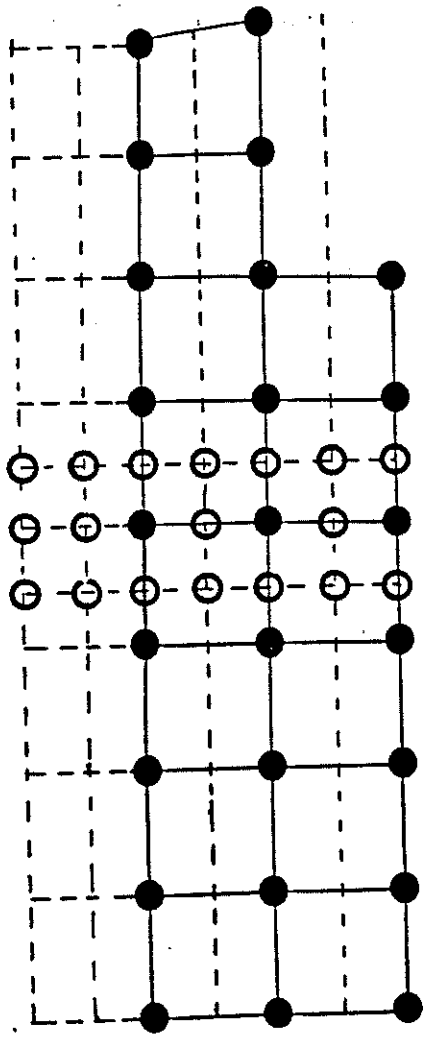
  * ASSESS REMOVAL OF SURFACE SOURCES

This diagram shows the 200 by 800 ft site divided into a 100 by 100 ft grid. The 25 sampling locations are shown as circles.



CORING AND SAMPLING LOCATIONS

This diagram illustrates how the sampling density and site area could be increased should it be necessary to define the contaminated area in more detail.



CORING AND SAMPLING LOCATIONS

Tables 1 and 2 outline the analytical program that Encotec will follow to detect and quantify organic and inorganic constituents in soil and water samples. The analyte , analytical method, and practical quantification limits (PQL) are identified for both soil and water samples.

TABLE 1. ANALYTICAL PROGRAM FOR ORGANICS IN SOIL AND WATER SAMPLES
GM Hydra-Matic Plant, Willow Run, Michigan

	SOIL CORES		LIQUIDS	
ANALYTE	METHOD	PQL (mg/kg)	METHOD	PQL (mg/kg)
VOCs			MDNR SCAN 1-2	.005-.100
PCBs	EPA 8080	1.0	EPA 8080	.02
HYDROCARBONS Lube oil Hydraulic fluid Cleaning solution Fuels	GRAVIMETRY/GC-FID	1-10	GC/FID	.02-.2

Notes:

1. PQLs are highly matrix dependent. Typical values are presented here; actual limits are determined at time of analysis.

2. Soil results will be on a dry weight basis.

TABLE 2. ANALYTICAL PROGRAM FOR INORGANICS IN SOIL AND WATER SAMPLES
GM Hydra-Matic Plant, Willow Run, Michigan

		SOIL CORES		LIQUIDS
ANALYTE	METHOD	PQL (mg/kg)		PQL (mg/kg)
Cadmium	EPA 3050/ICP & 6010	0.5-2.0		0.01-0.04
Chromium	"	"		"
Nickel	"	"		"
Zinc	"	"		"
Iron	"	"		"
Barium	"	"		"
Copper	"	"		"
Arsenic	7061	0.10	7061	0.002
Lead	7420	1.00	7420	0.02
Mercury	7471	0.01	7470	0.0002

Notes:

1. PQLs are highly matrix dependent. Typical values are presented here; actual limits are determined at time of analysis.

2. Soil results will be on a dry weight basis.

3. ICP - inductively coupled plasma method

Phase 2 of the project will address investigation of the unsaturated zone. Recall that Phase 2 will be implemented only if the surface material is contaminated.

In Phase 2, we plan to determine the vertical and lateral spread of contamination and describe the geologic material in the unsaturated zone. Soil cores will be used in these analyses. Also, depending on the degree of saturation of the unsaturated zone and the level of soil contamination we will consider the need for characterizing the pore water chemistry.

- PHASE 2: INVESTIGATE THE UNSATURATED ZONE
  - DETERMINE VERTICAL AND LATERAL SPREAD OF CONTAMINANTS FROM SURFACE
    - INCREMENTAL CORING
  - CHARACTERIZATION OF UNSATURATED ZONE
    - INCREMENTAL CORING
  - CHARACTERIZATION OF PORE WATER CHEMISTRY
    - PORE WATER EXTRACTS

Phase 3 of the project will address investigation of the saturated zone. Recall that Phase 3 will be implemented only if the unsaturated zone is comtaminated down to the water table.

In Phase 3, we plan to determine the vertical and lateral spread of contamination and characterize the site geology and hydrology. Soil cores, monitoring wells, and field and lab measurements will be used in these analyses.

- PHASE 3: INVESTIGATE SATURATED ZONE
  - DETERMINE VERTICAL AND LATERAL SPREAD OF CONTAMINANTS
    - CORES
    - MONITORING WELLS
    - FIELD AND LAB MEASUREMENTS
    - CHEMICAL ANALYTICAL PROGRAM
  - CHARACTERIZATION OF SITE GEOLOGY
    - CORES
    - LABORATORY MEASUREMENTS
  - CHARACTERIZATION OF SITE HYDROLOGY
    - MONITORING WELLS
    - FIELD AND LAB MEASUREMENTS

If the unsaturated zone is contaminated down to the water table and if volatile organic constituents are found in the unsaturated zone then we plan to investigate the spread of VOCs in the soil air. This investigation will involve sampling the air from the vadose zone and analyzing the samples for VOCs.

* PHASE 4:

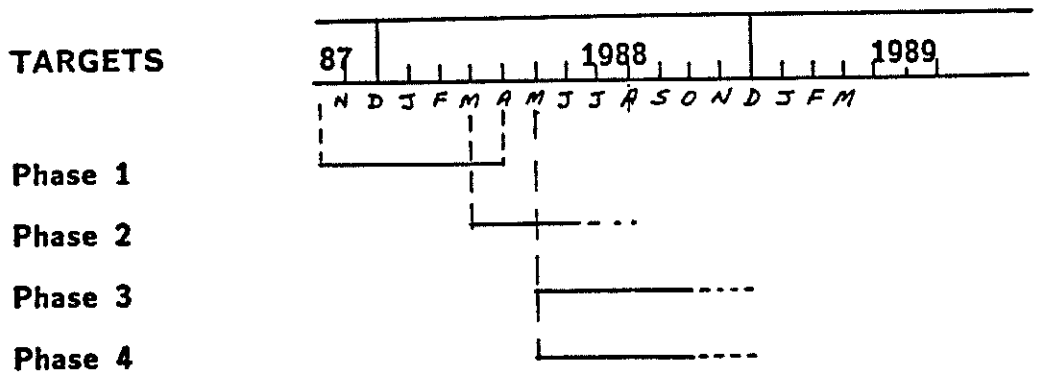
  * ASSESS THE NEED FOR MONITORING VAPOR IN THE VADOSE ZONE

  * IF NEEDED, DESIGN AND IMPLEMENT A MONITORING SCHEME

  * MULTIBUNDLE TUBES IN THE VADOSE ZONE

Here is a proposed schedule for initiating the four phases of the project. We expect the investigation to be completed by December 1988.

HYDRA-MATIC MACHINE STORAGE SITE SCHEDULE (WORK PLAN 1)



MACHINE STORAGE AREA

NORTH YARD

HYDRA-MATIC WILLOW RUN PLANT

HYDROGEOLOGIC STUDIES

MAY 1988

In November 1987 a work plan (WORK PLAN 1) was presented to MDNR for site investigation and delineation of the contaminated zones at a former machine storage yard on the Hydra-matic Willow Run Plant property. This presentation addresses the implementation of WORK PLAN 1.

The presentation will be given in two parts. In the first part, the results from the implementation of WORK PLAN 1 will be presented, while in the second part these results will be used to assess the present extent of surface and subsurface contamination at the site and concerns about future migration of contaminants from the site.

This map gives a general perspective of the location of the Hydra-matic property.

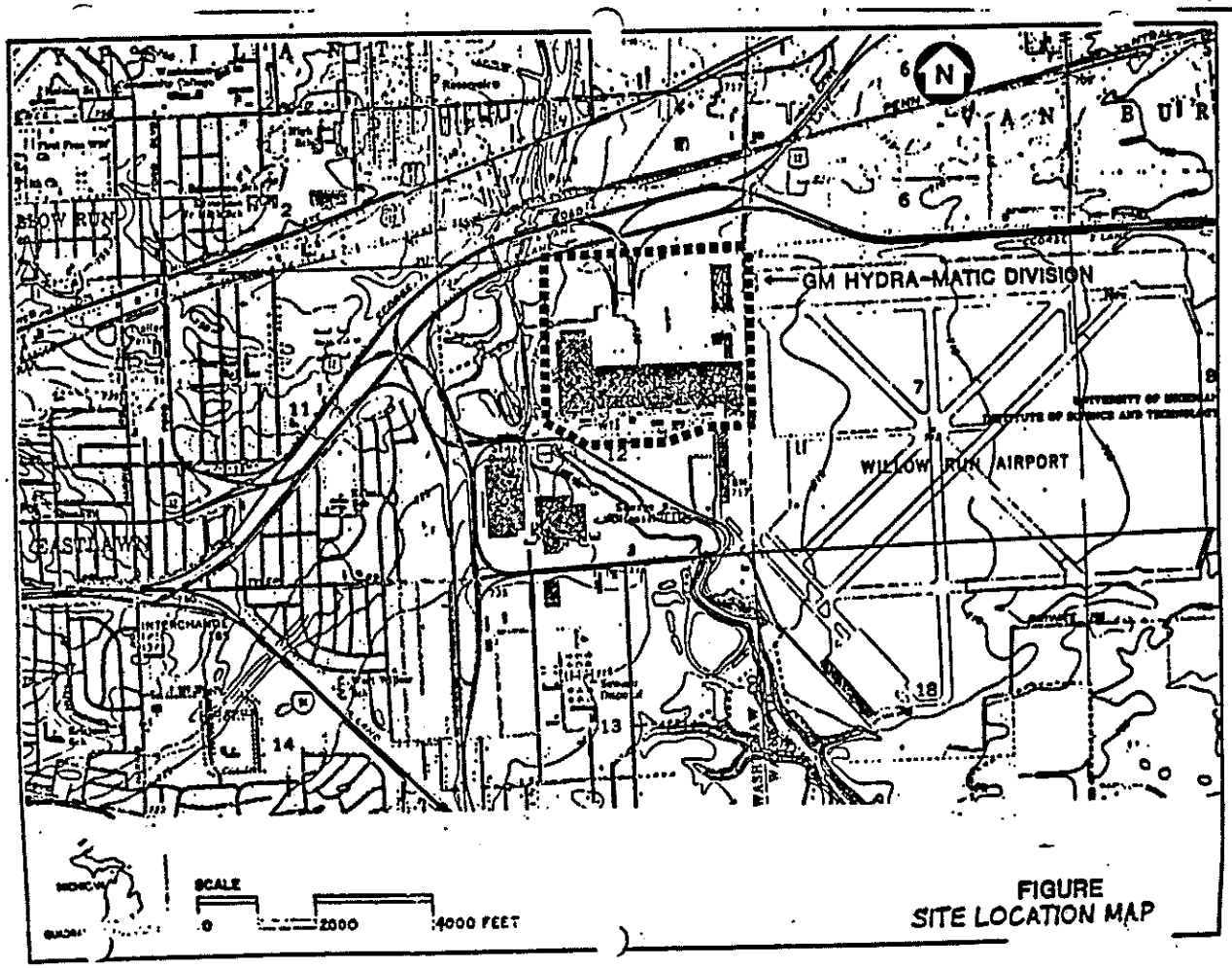


FIGURE
SITE LOCATION MAP

Here, we are reminded of the investigative approach we planned to implement at the site. By this approach, the investigation is divided into four main stages. First the lateral extent of contamination of the surface material (0 to 12 inch) will be assessed. If the surface material is contaminated then the investigation will progress through the unsaturated zone, otherwise the investigation will not progress to deeper regions of the subsurface. Again, if the unsaturated zone is investigated and found to be contaminated down to the water table this will trigger investigation of the saturated zone and then of vapor phase contamination.

PHASES OF INVESTIGATION

- **The investigation has progressed in four stages**

  Phase (1) Organic and inorganic constituents in the surface materials

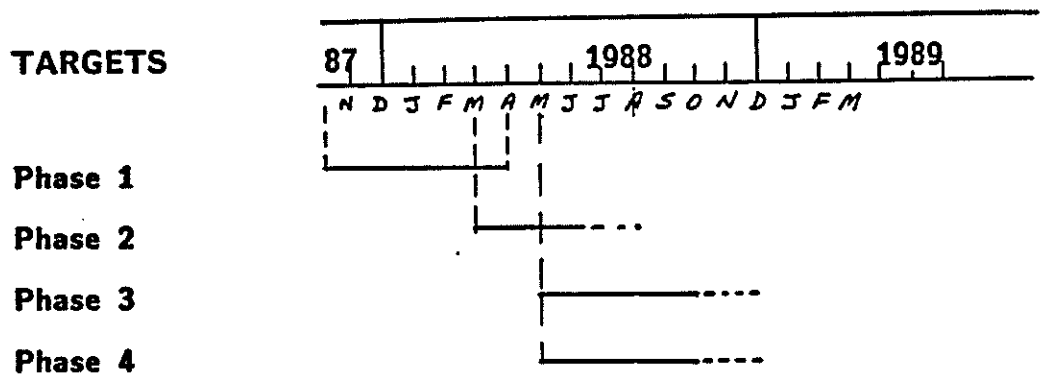
  Phase (2) Constituents and characterization of the unsaturated zone

  Phase (3) Constituents and characterization of the saturated zone

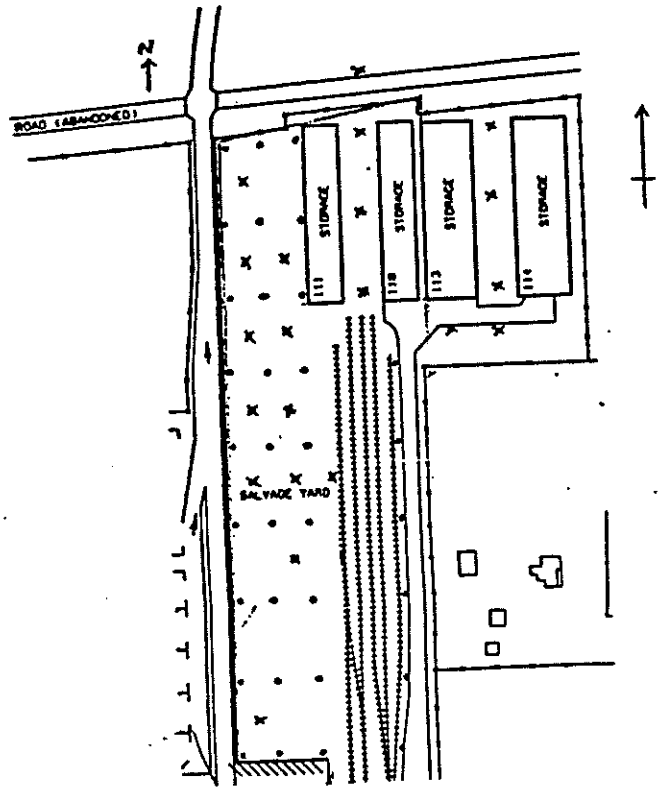
  Phase (4) Delineation of vapor phase constituents

This schedule for implementing the four phases was presented in WORK PLAN 1.

HYDRA-MATIC MACHINE STORAGE SITE SCHEDULE (WORK PLAN 1)



This diagram shows the locations where soil cores were taken during phase 1 (surface investigation) and phase 2 (unsaturated zone investigation). The circles and the Xs (with a few exceptions) show the coring locations during phase 1, while the Xs show the coring locations during phase 2. Forty two locations were cored, from 0 to 12 inches, during phase 1 and 21 locations were cored to 4 ft during phase 2.



The specific objective of phase 1 was to delineate the extent of surface contamination. A total of 42 soil samples, from 0 to 12 inches, were taken by a split-spoon sampler mounted on a drill rig. The soil sampling was carried out by Professional Services Industries, Inc., Detroit MI. These samples were analyzed by ENCOTEC for PCBs (Aroclors 1221, 1248, 1254, and 1260), heavy metals (Cr, Pb, Cd, Zn, Ni, and Fe), and total hydrocarbons. The results from these analyses are included in this presentation.

PHASE 1

- **Delineation of surface contamination**
  - **Soil cores from surface to 12 inch depth (PSI)**
  - **35 soil samples**
  - **Soil extracts will be analyzed for:**
    - **(A) PCBs:**
      - **(1) Aroclor 1221**
      - **(2) Aroclor 1248**
      - **(3) Aroclor 1254** **(ENCOTEC)**
      - **(4) Aroclor 1260**
    - **(B) Heavy metals:**
      Cr, Pb, Cd, Zn, Ni, Fe
    - **(C) Total hydrocarbons**

Here is a summary of the analytical procedures ENCOTEC followed to detect total hydrocarbon, PCBs, and heavy metals in the soil samples. As a screening step to determine if the soil was contaminated with oil, some soil samples were also extracted with freon at the General Motors Research Laboratories (GMRL).

ANALYTICAL PROCEDURES

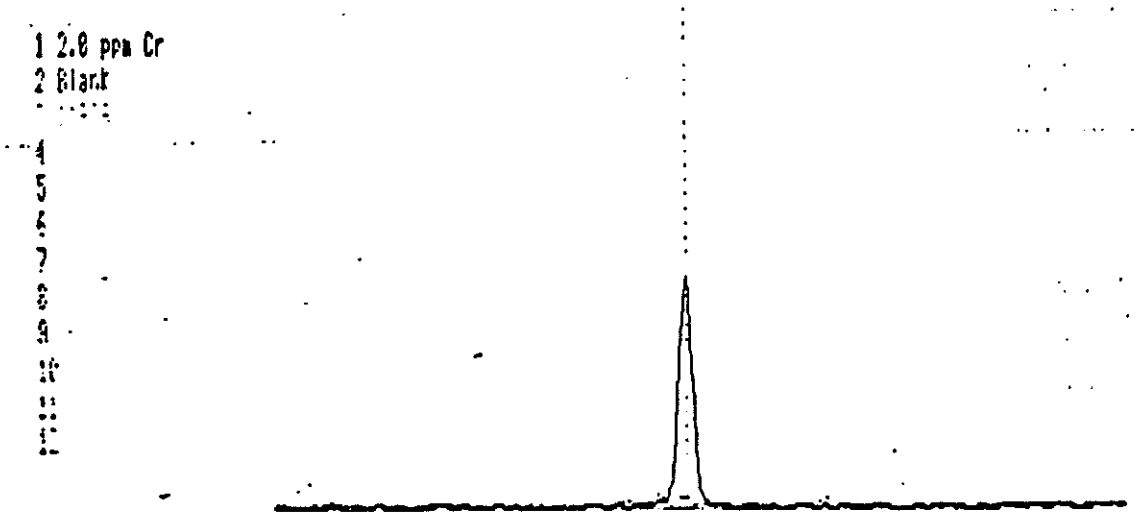
Freon extractables - oil and grease, ATF
- Extraction
- Solvent evaporation - 100°C
- Weigh residue

Total Hydrocarbon
- Extraction - CH_2Cl_2
- GC - FID

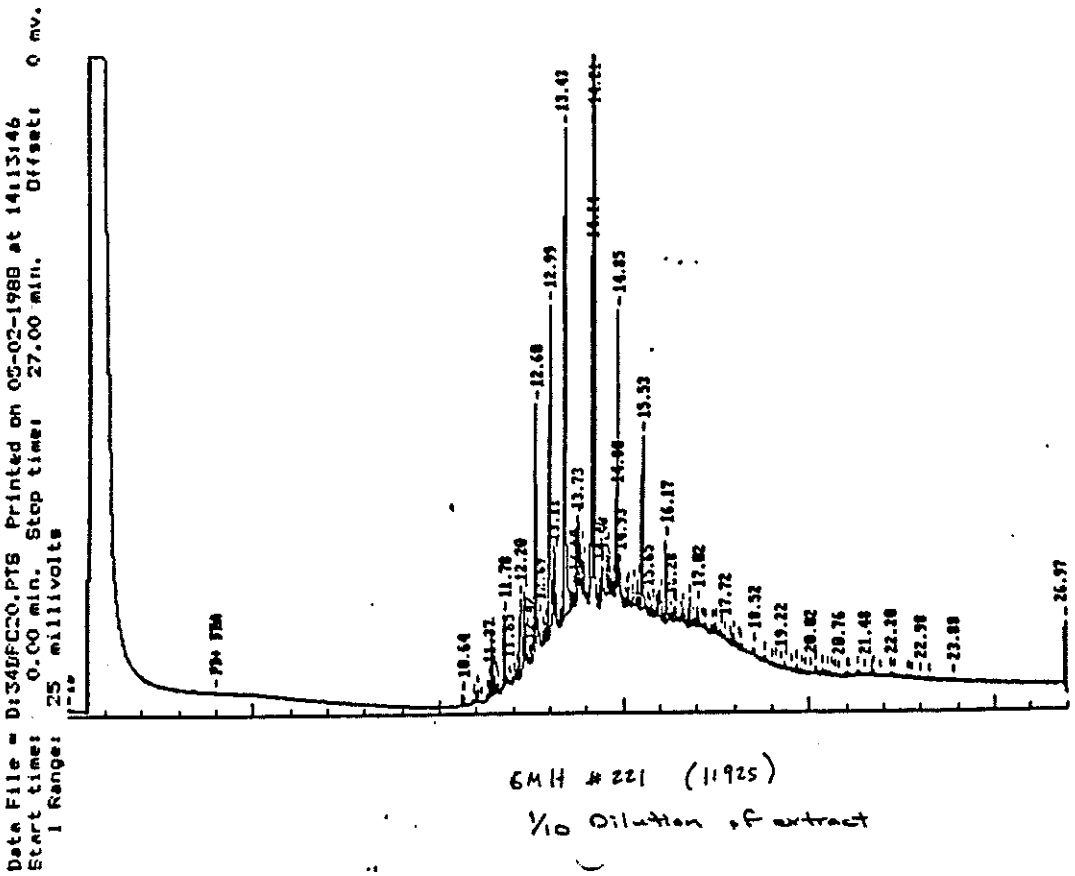
PCB'S - EPA 8080
- Extraction
- GC - EC

Heavy Metals - EPA 3050, 6010, 7420
- Total conc.
- HNO_3 Digestion
- Inductively coupled plasma

This figure shows a typical spectrum for chromium. The spectra for the other metals were similar. The spectra were used to detect the metals and to determine their concentrations in the soil samples.

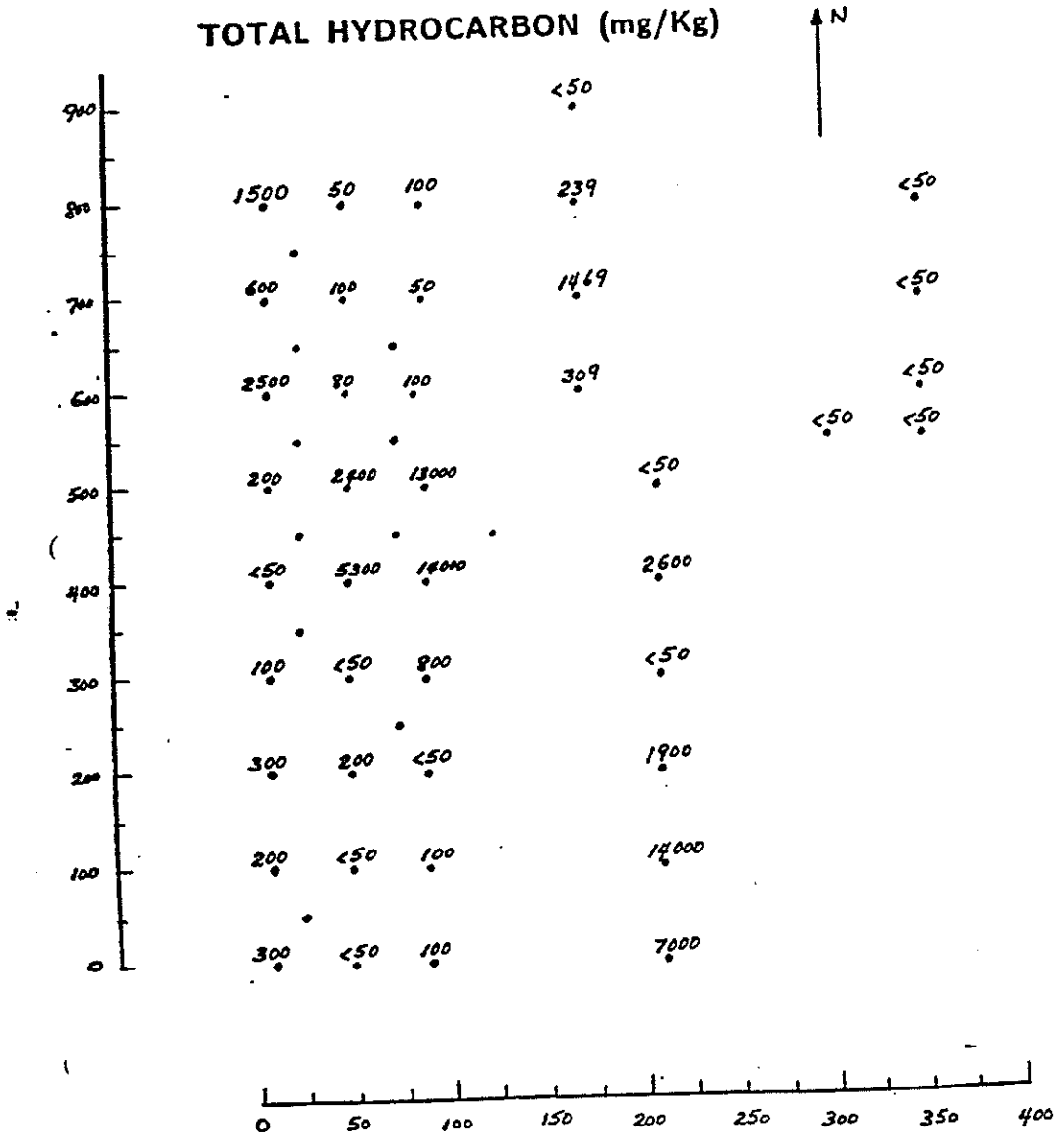


This figure shows a typical chromatogram for the total hydrocarbons in the soil samples. The chromatograms were used to determine the total concentrations of hydrocarbons in the soil samples.

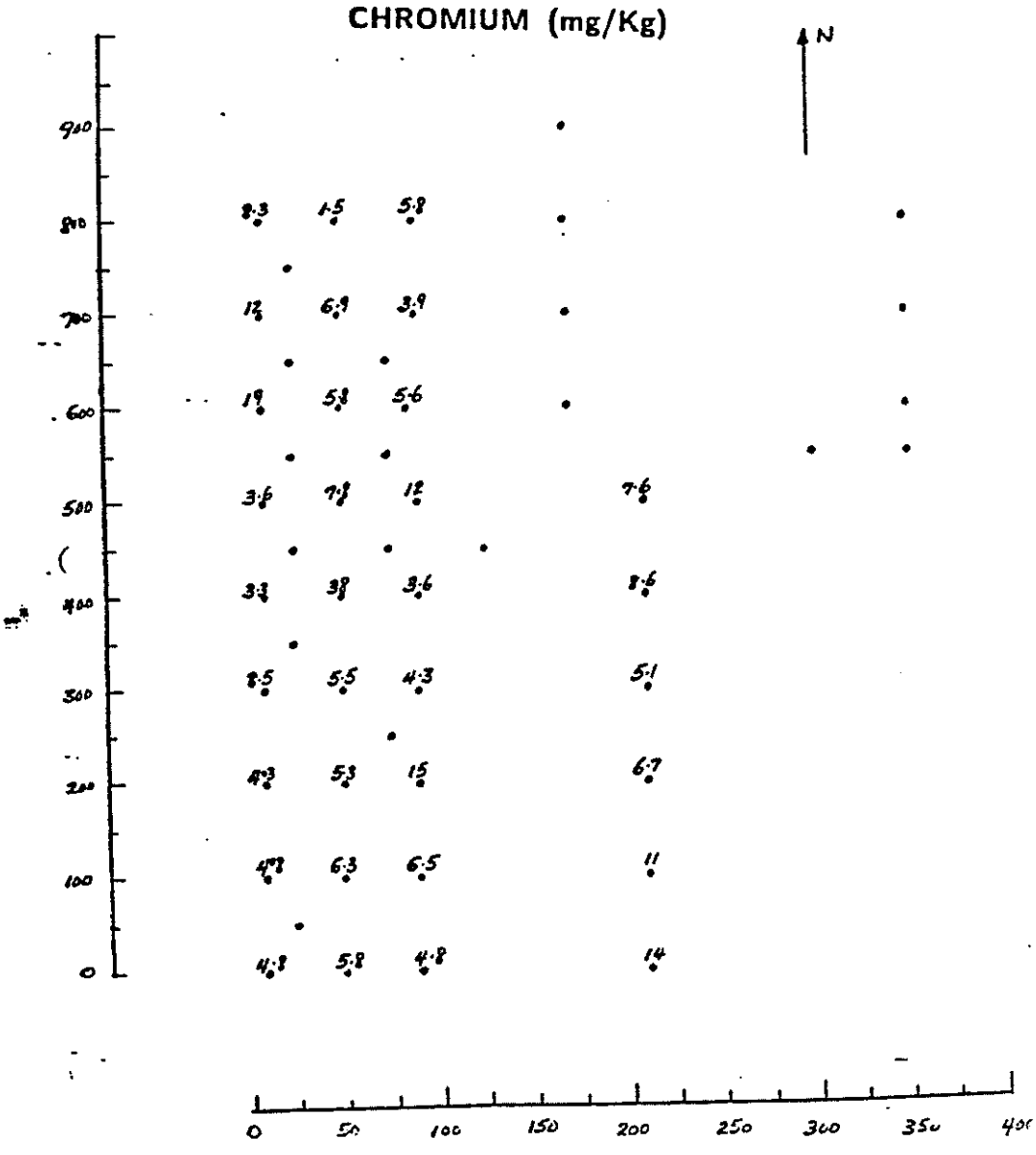


The concentrations of total hydrocarbons (mg hydrocarbon/Kg of soil) in the surface samples are shown in this diagram. The x and y axes can be used to find the sample location with respect to the south-west corner of the site, which has the coordinate 0,0.

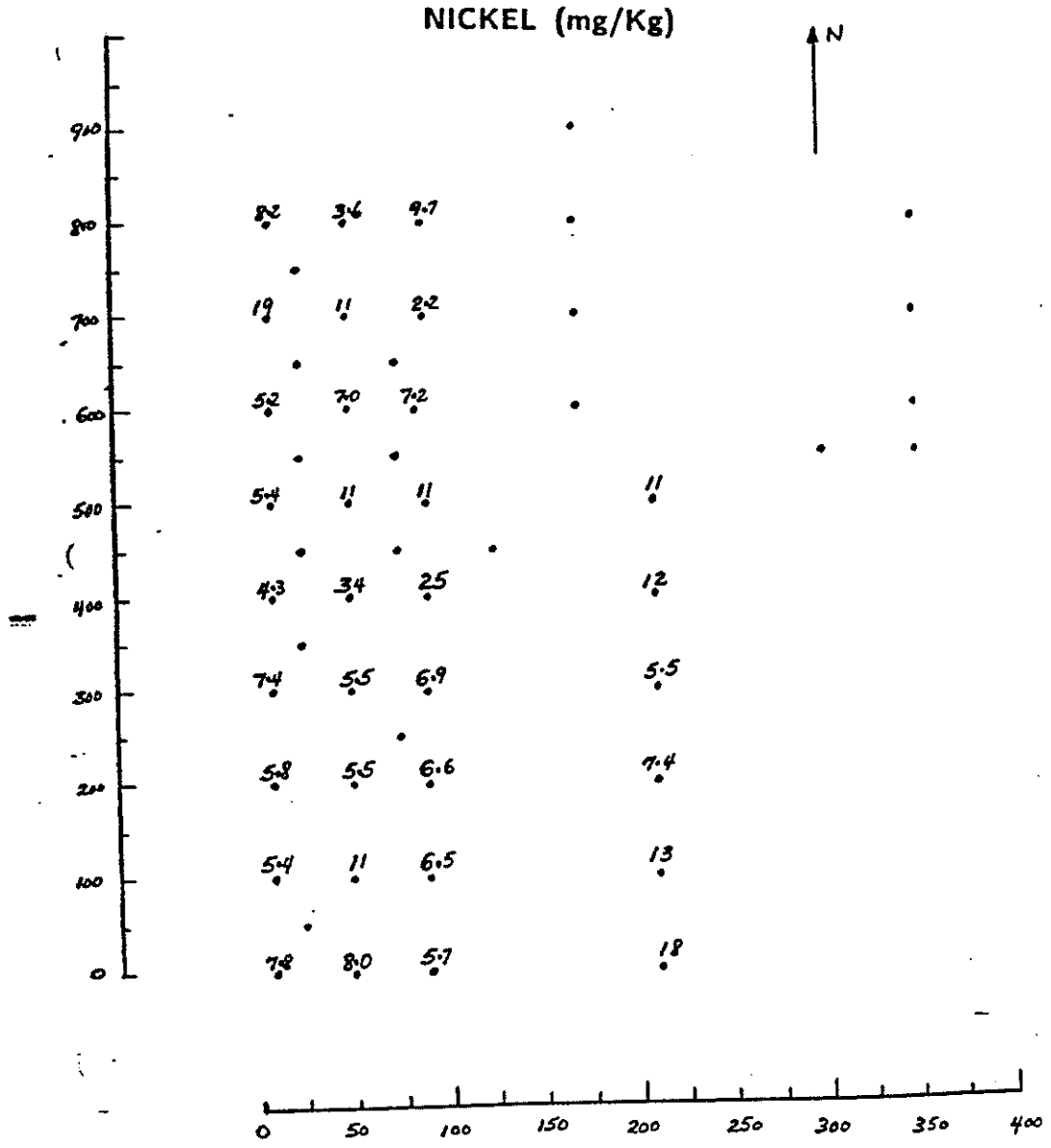
The concentrations of total hydrocarbon range from below detection (< 50 mg/Kg) to 14,000 mg/Kg.



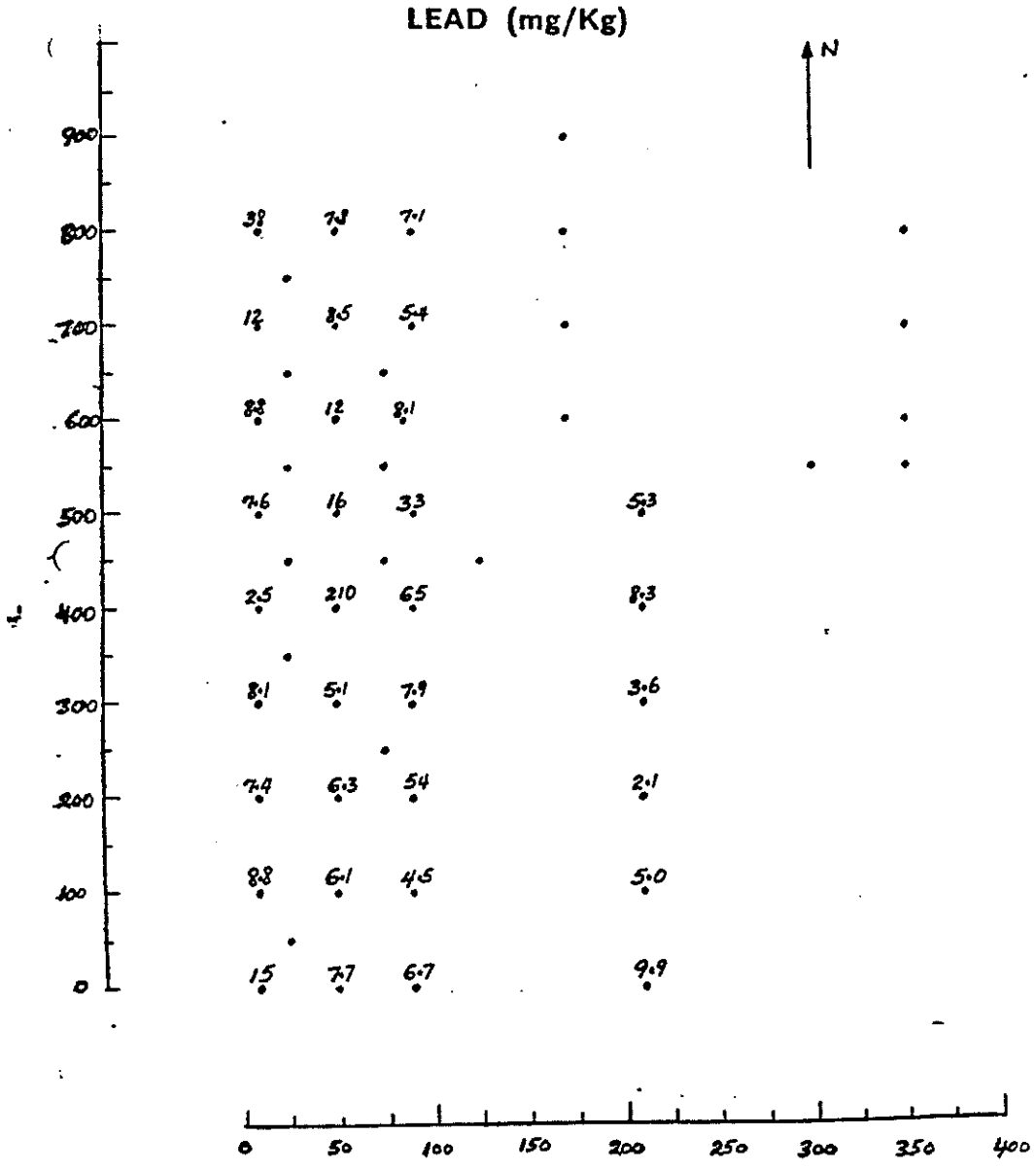
This diagram shows the concentrations (mg/Kg) of chromium in the surface samples. These concentrations of total chromium range from 1.5 to 38 mg/Kg



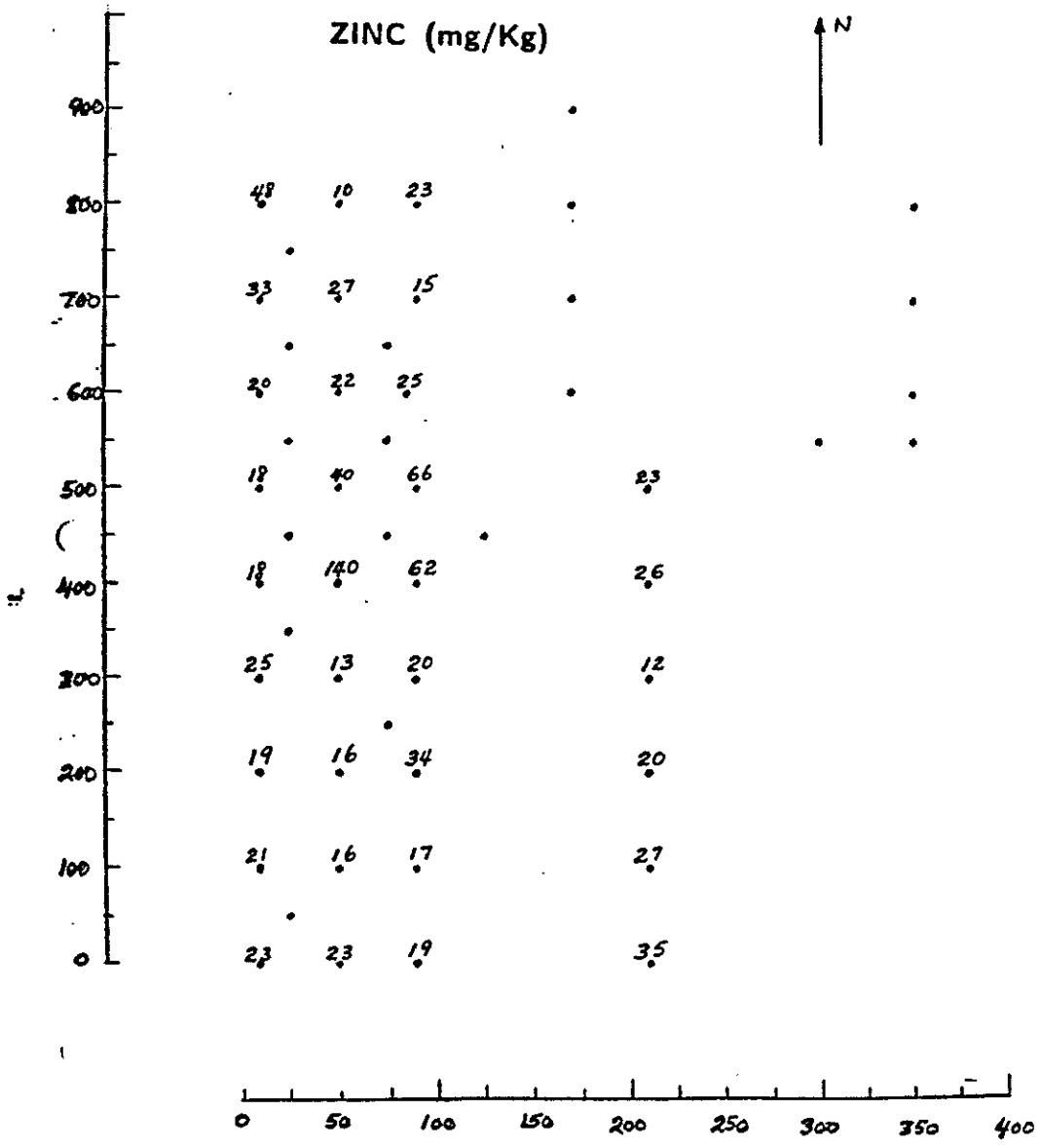
This diagram shows the concentrations (mg/Kg) of nickel in the surface samples. These concentrations of total nickel range from 2.2 to 34 mg/kg.



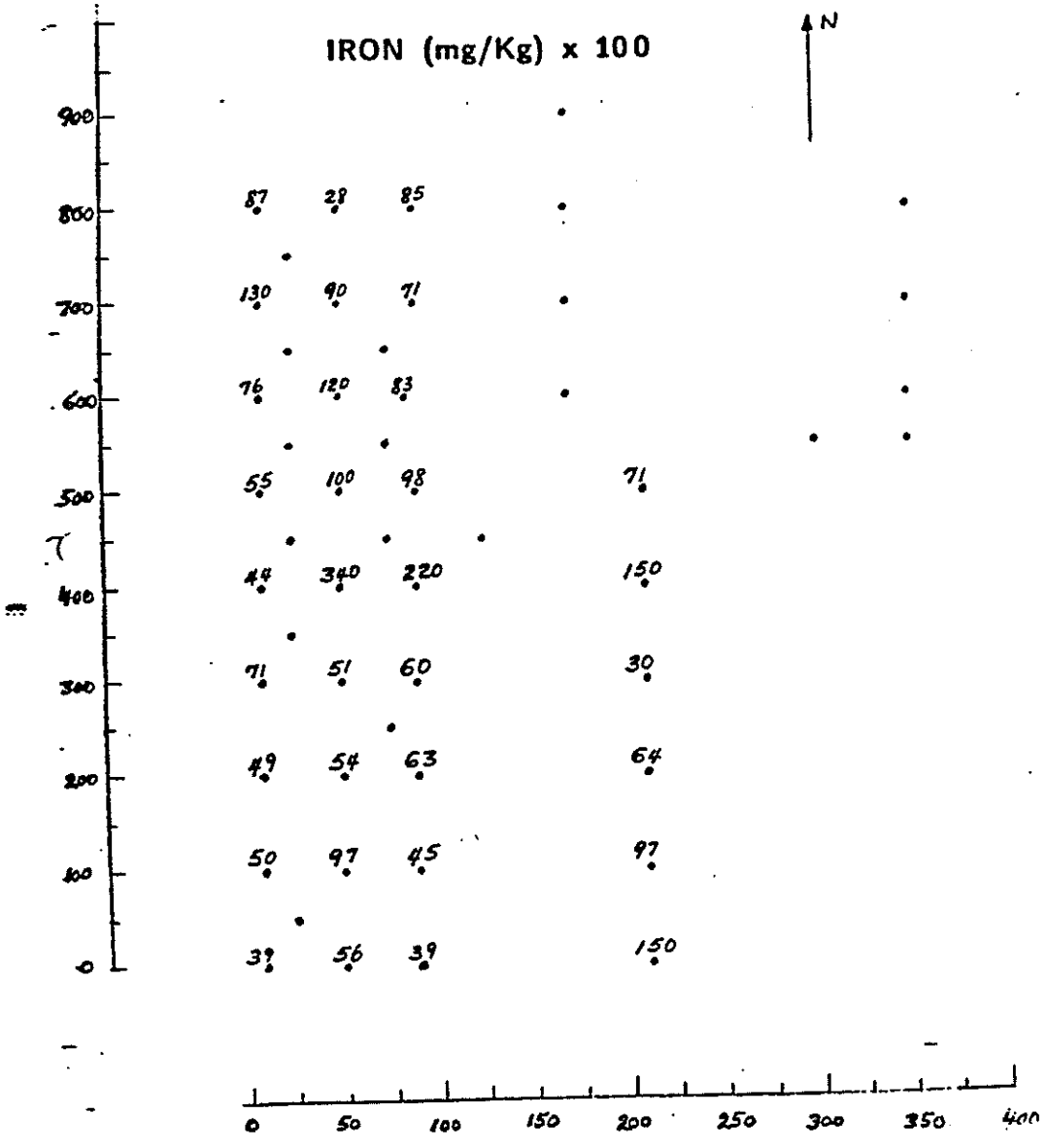
This diagram shows the concentration (mg/Kg) of lead in the surface samples. These concentrations of total lead range from 2.1 to 210 mg/kg.



This diagram shows the concentration (mg/Kg) of zinc in the surface samples. These concentrations of total zinc range from 10 to 140 mg/Kg.

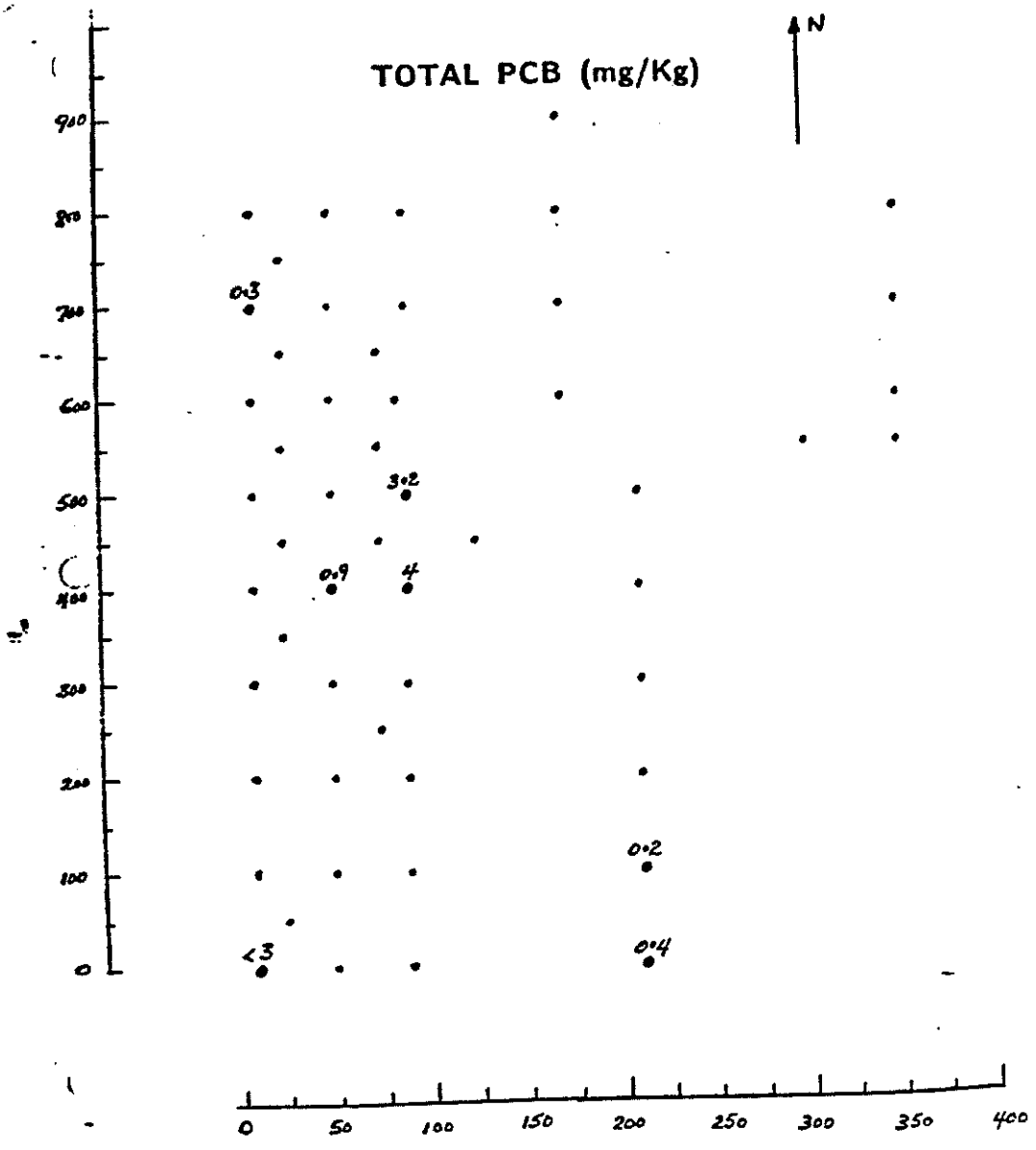


This diagram shows the concentration (mg/Kg) of iron in the surface samples. These concentrations of total iron range from 2800 to 34000 mg/Kg.



This diagram shows the concentration (mg/Kg) of PCBs in the surface samples. These concentrations are the sums of the four Aroclors (1221, 1248, 1254, 1260), each of which has a detection limit of 0.2 mg/kg. PCBs were found in seven surface samples and the concentrations range from 0.2 to 4 mg/Kg.

Based on either the concentrations of total hydrocarbons, of the metals, or of the PCBs, the region of highest contamination is bounded by the following coordinates: (50,400), (50,500), (100,400), (100,500).



Because contamination was found in the surface samples, Phase 2 of the investigation was implemented. The specific objectives of Phase 2 was to determine the vertical and lateral spread of contaminants in the unsaturated zone and to characterize the unsaturated zone. The results from this phase of the investigation is included in this presentation.

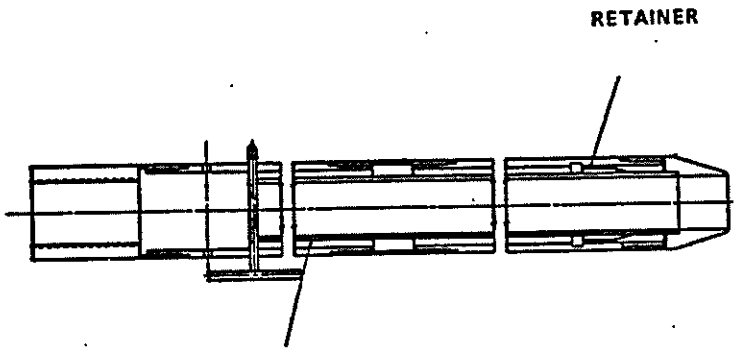
PHASE 2: INVESTIGATE THE UNSATURATED ZONE

- **Determine vertical and lateral spread of contaminants from surface**

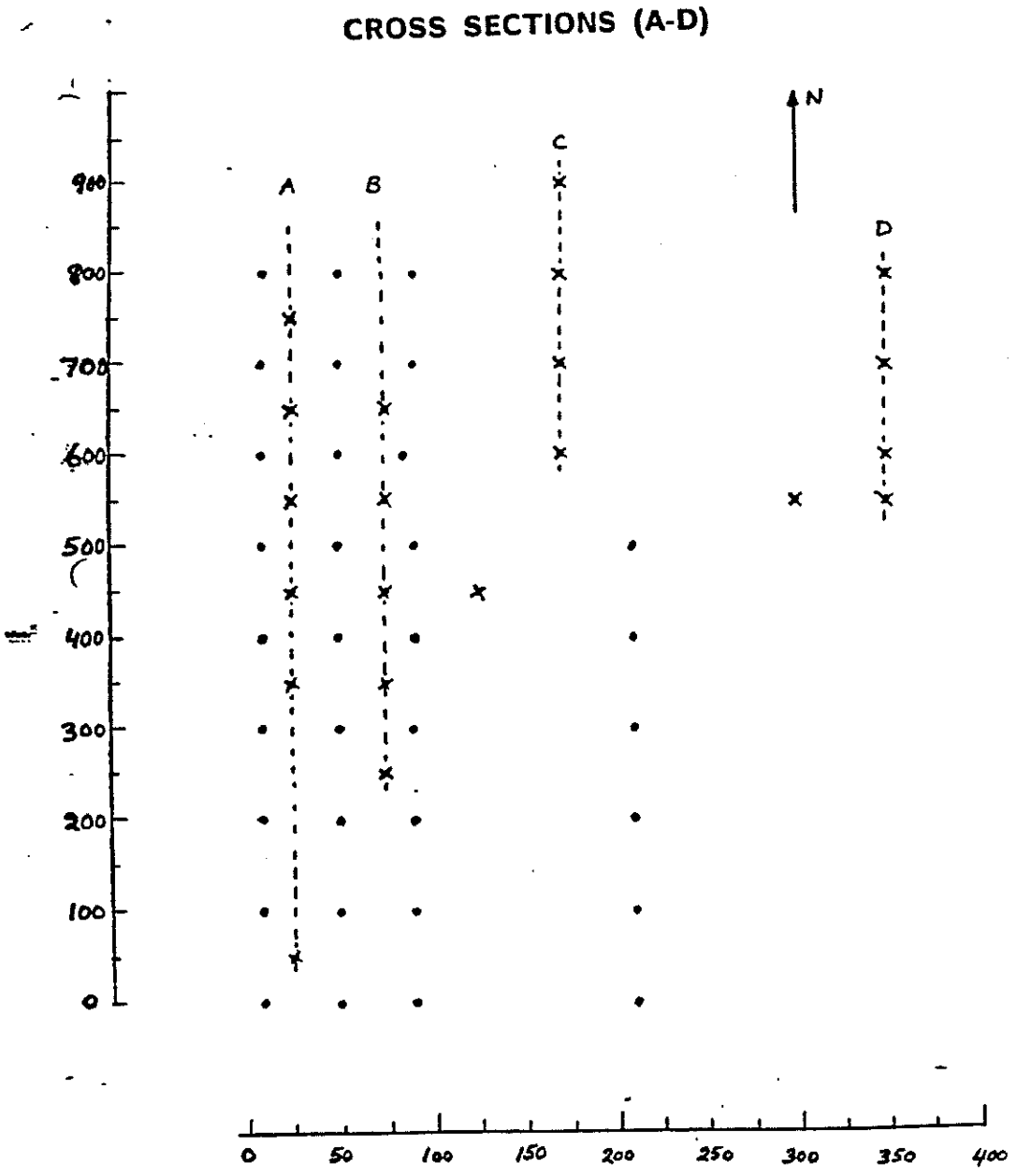
- **Characterization of unsaturated zone**

In phase 2, twenty one soil cores were taken from 1 ft to 4 ft depth by using an undisturbed soil sampler. A schematic of the soil sampler, which was designed and built at GMRL, is shown below. Each soil core was collected in a 1.75 inch I.D. aluminum tube, which was subsequently split along its length to expose the soil. Each soil core was divided into 5 inch sections. Each section was extracted with freon and the concentration of freon extractables measured. Selected cores were analyzed for metals.

UNDISTURBED SOIL CORER



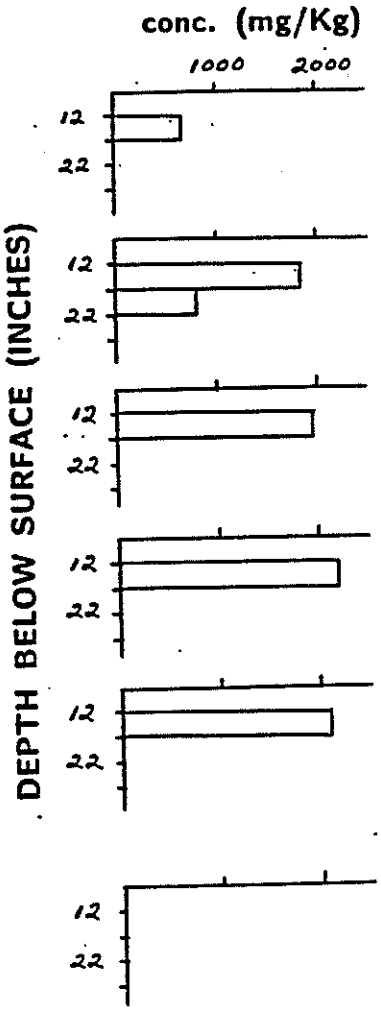
The coring locations during phase 2 are shown by the Xs. The results for freon extractables, which include the total hydrocarbons, will be presented along the four cross-sections (A, B, C, and D) shown in this diagram.



These plots going down the page are for coring locations along cross-section A, going from north to south. The results indicate that in most cases the freon extractables are above a depth of 17 inches and in no case below 22 inches. These concentrations are lower than the total hydrocarbon concentrations found in the surface samples.

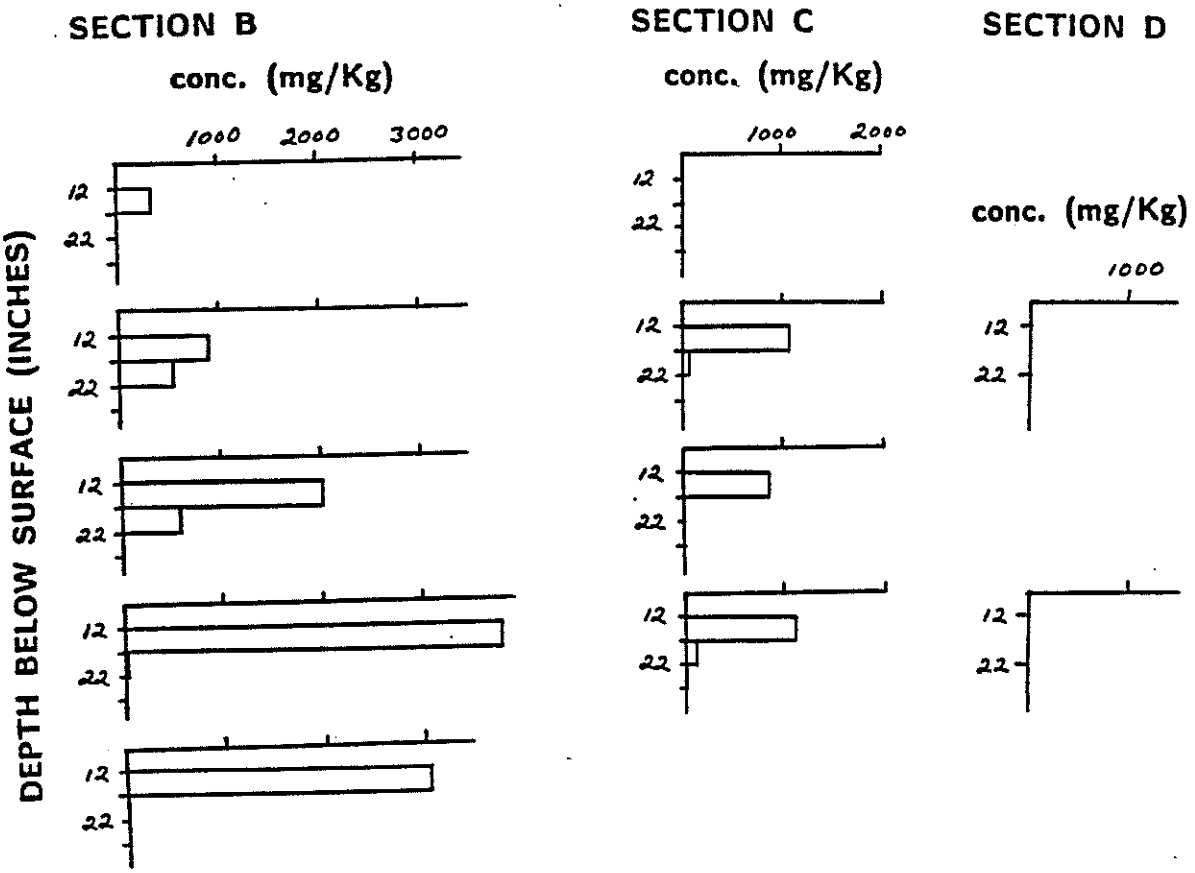
FREON EXTRACTABLES - VERTICAL DISTRIBUTION

SECTION A

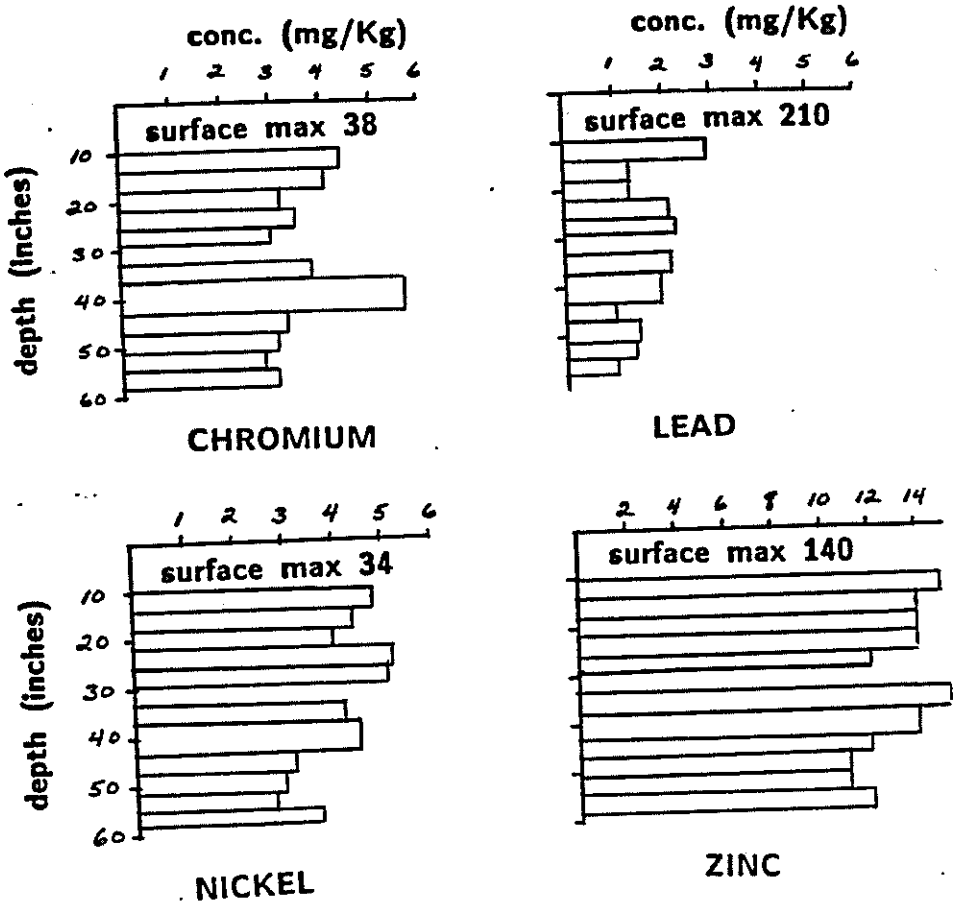


These results are similar to those for cross-section A.

FREON EXTRACTABLES



These plots show the results for the vertical distributions of total chromium, lead, nickel, and zinc. The soil core was taken at cordinate (50,400), where the highest levels of surface contamination was found. The concentrations are given in mg/Kg and the surface concentrations are indicated in the plots. These results show that the concentrations of these metals in the soil, beneath the location of highest surface contamination, are much lower than the surface concentrations. In fact, as will be subsequently shown, these subsurface concentrations are similar to background levels.



VERTICAL DISTRIBUTIONS

METALS

As was the case for the metals, no PCB was found in the subsurface material taken from beneath areas of known surface contamination by PCBs.

PCBs

Vertical spread - undisturbed cores

- **No PCB s (<0.2 mg/Kg) below 10 inches**
- **Region with surface PCBs**

The results indicated that the lateral distributions of metals, PCBs, and total hydrocarbon-oil constituents in the surface materials are mainly confined to a 100 x 200 ft area in the center region of the site. Also, the bulk of these constituents are contained above 12 inch depth and they do not extend below 22 inch depth.

The distribution of the contaminants is adequately delineated and there is no need for further site investigation. In the second part of this presentation, which follows next, we will address the needs for site remediation.

SUMMARY

- Highly consistent patterns for metal, PCB, and hydrocarbon-oil constituents
- Lateral distribution - mainly concentrated in a central region - 100 x 200 ft
- Vertical spread -
  Bulk above 12 inch depth
  None below 17-22 inch depth

Of 33 sampling locations, PCBs were detected at 7 and their concentrations ranged from undetectable to 4 mg/Kg. Only at three locations was the concentration of PCBs greater than 1 ppm. By the requirements of a Federal spill cleanup policy (Federal Register Vol. 52, No. 63), and based on the current concentrations of PCBs in the soil there is no need for site remediation.

TOTAL PCBs

RESULTS

- Of 33 sampling locations, PCBs were detected at 7
- Range: 0 to 4 (mg/Kg)
- Three locations had higher than 1 ppm PCBs

Federal Register (Vol. 52, No. 63) PCB Spill Cleanup Policy

- Requirement for decontaminating spills in restricted access areas
  - 'Soil contaminated by spill will be cleaned to 25 ppm (mg/Kg) PCBs by weight.'
- Requirement for decontaminating spills in nonrestricted access areas
  - 'Soil contaminated by a spill will be decontaminated to 10 ppm (mg/Kg) PCBs by weight provided the soil is excavated to a minimum depth of 10 inches. The excavated soil will be replaced with clean soil, i.e., containing less than 1 ppm (mg/Kg) PCBs.'

Next, we will show that the PCBs left in place will not migrate through the unsaturated zone to the underlying perched water table. The migration of PCBs through soils will depend on the extent to which they are adsorbed by the soils or on the k_d of the PCBs. The first two equations can be used to calculate the value of k_d from the octanol-water partition coefficient (Kow) of the PCB and the organic carbon content (foc) of the soil. For the Hydra-matic site, a value for K_d of 240 was calculated.

Based on this value of K_d, if 1 cm of soil is contaminated with 4 ppm PCB, infiltrating water in equilibrium with the soil will have an aqueous concentration of 17 ppb PCB. This aqueous concentration of 17 ppb PCB will be reduced to 71 ppt as the water comes to equilibrium with another cm of soil. Because of the strong adsorption of PCBs on the soil, water leaving the contaminated surface soil will be readily cleansed soon after it leaves the surface.

MIGRATION OF PCBs

$$\log koc = 1.04 \log Kow - 0.88 \quad (r = 0.95)$$

$$k_d = foc \cdot koc$$

For: $\log kow = 5.62$
$\log koc = 4.38$
$foc = 0.01$

$$k_d = 240$$

4 ppm PCBs on soil.....17 ppb in infiltrating water

which will be immediately adsorbed.....71 ppt.....

The mobility of metals through soils is significantly dependent on the cation exchange capacity (CEC) of the soil. Typically, in the neutral pH environments of surface soils, where the CEC range from 5 to 10 meq/100 g of soil, the mobility of metals is not expected to be significant. This expectation is corroborated with the results, in that the metals are confined to the upper 12 inches of the subsurface.

MIGRATION OF HEAVY METALS

- **Significant fraction of the site material is smaller than 125 um**
- **Typically the CEC for soil ranged from 5 to 10 meq/100 g of soil**
- **The ion exchange of these metals with the soil could explain why they are contained in the thin upper layer.**

This table summarizes the results for the six metals found at the site and includes Michigan average values for sand and clay, and typical averages for Pennsylvania and Tennessee soils. From a comparison of the results with the reference values it is concluded that the subsurface levels of these metals are similar to expected background levels. Also, of the surface concentrations only those of lead, cadmium, and perhaps zinc are outside the reference ranges. These will be addressed next.

HEAVY METALS

Metals	North Yard Maximum Conc. Surface (mg/Kg Soil)	Subsur.	Michigan Avg. Sand (mg/Kg Soil)	Clay	Pennsylvania Soil (mg/Kg Soil)	Tennessee Soil (mg/Kg Soil)
Cr	38	5.7	3-4	9-25	66-100	26-74
Ni	34	5.2	3-10	25-34	25-45	6-17
Pb	210	2.9	9-14	13-23	25-32	5-19
Cd	5.6	<1	1-1.4	1-1.6	---	---
Zn	140	16	---	41-51	81-115	25-168
Fe	34000	5000	---	---	37000-56000	13000-47000

These results are EP Toxicity measurements for the most contaminated surface soil. These results indicate that non of the six metals found in the surface soil is leachable by the influx of precipitation. Further, the EP Toxicity results are within RCRA and Drinking Water Standards. Based on these results, there is no need for site remediation.

EP TOXICITY RESULTS

Parameter	Units	S-2 11/11/87 EP TOX 9193	S-3 11/11/87 EP TOX 9194	2-4 11/11/87 EP TOX 9195		RCRA STDS	Drinking Water STDS	
Cadmium	mg/l	0.01	0.01	<0.005		1.0	0.01	
Chromium	mg/l	<0.03	<0.03	<0.03		5.0	0.05	
Iron	mg/l	4.1	5.5	0.33		—	—	
Lead	mg/l	0.05	0.06	<0.02		5.0	0.05	
Nickel	mg/l	<0.05	0.07	<0.05		—	—	
Zinc	mg/l	0.08	0.25	0.02		500	5.0	

As oils drain through soils, a residual fraction is left behind trapped in the soil pore space. This residual fraction typically occupies about 20 % of the pore space (20 % saturation). Laboratory measurements with the Hydra-matic soil indicated a residual volume of about 22 percent. A residual oil volume of 20 % is equivalent to 48,600 mg of oil per Kg of soil from the site. Also, the residual fraction is not mobile; that is, it cannot drain under the influence of gravity.

The maximum concentration of total hydrocarbons in the surface soil was 14,000 mg/Kg. This level of contamination is equivalent to 5.8 % saturation. For comparison, 200 mg/Kg total hydrocarbon is equivalent to 0.08 % saturation, and it will take 11,000 gal of oil to satisfy the residual volume of a soil layer 200 ft by 100 ft by 1 ft.

Since the surface soil is significantly below residual oil saturation, the results suggest that there was no significant pool of oil on the surface, and the contamination was likely caused by small spills or leaks from the machines.

Since infiltrating water has not washed the low level of oil from the surface soil, this low residual volume of oil is considered quite stable in the surface material and does not warrant any remedial action.

TOTAL HYDROCARBONS

RESULTS

* **Maximum.....14,000 mg/Kg of surface soil**
* **Residual hydrocarbon saturation from infiltration and drainage**

ρ_b = 1.4 g/cc

η = 0.4

θ_r = 20 % of pores

= 48,600 mg/kg

* **Hydrocarbon at this concentration will be immobile**
* **14,000 mg/Kg.....5.8% saturation**
* **200 mg/Kg..... 0.08% saturation**
* **To bring a 200 ft by 100 ft by 1 ft layer of soil to residual**

11,000 gal of oil

* **These results suggest that there was no significant pool of oil on the surface.....and small spills or leaks from machines cannot fill the residual capacity of the surface soil.**

CONCLUSIONS

(1) THE CONSTITUENTS AT THE NORTH YARD DO NOT POSE RISKS TO THE SOIL AND GROUNDWATER ENVIRONMENTS AT THE SITE

(2) THESE CONSTITUENTS ARE CONTAINED IN LOCALIZED AREAS AND IN THE UPPER 22 INCHES OF THE SURFACE MATERIAL. THE RESULTS INDICATE THAT THESE CONSTITUENTS WILL NOT MIGRATE TO DEEPER ZONES AT THE SITE. THEREFORE, FURTHER SPREADING AND FUTURE RISKS ARE NOT LIKELY.

* A PERCHED AQUIFER EXIST BENEATH THE SITE WHICH IS NOT USED AS POTABLE WATER (BY ACT 307 NOT A RESOURCE)

* NO WATER RESOURCE OR LOCAL WELL IS AT RISK

* SURFACE RUNOFF FROM THE SITE ARE COLLECTED, TREATED, AND DISCHARGED UNDER PERMIT

HYDRA-MATIC'S PROPOSAL FOR ADDITIONAL WORK AT THE NORTH YARD

GMRL's results and conclusions establish that no remedial work is needed at the North Yard. However, in the interest of improving and monitoring the subsurface condition at the North Yard, Hydra-Matic proposes to implement the following:

Soil Excavation

Soil will be excavated to 2 feet below grade at a radius of 50 feet from coring locations that had PCB concentrations above 1 ppm.

Soil will be excavated to 1 foot below grade at a radius of 50 feet from coring locations that had detectable PCB concentrations below 1 ppm.

Soil Sampling

For those areas within the North Yard that will not be excavated, three randomly-located soil core samples will be taken semiannually to monitor the natural biodegradation of the residual oil in the surface soil. These cores will extend 2 feet beneath the surface. The soil samples will be analyzed for total hydrocarbons per Workplan 1. At the end of a two year period, the analytical results will be reviewed to determine the need for an ongoing sampling program.

Groundwater Monitoring

Although GMRL has analytically established that soils in the North Yard are not contributing organic or inorganic constituents to groundwater, Hydra-Matic proposes to monitor the groundwater in this area as an additional measure of ensuring that groundwater quality in the perched aquifer is not adversely impacted by historical activities at the North Yard. To accomplish this, three groundwater monitoring wells are proposed. Hydra-Matic will retain a hydrogeological consultant to develop the work plan for the well installation and to develop the sampling program. The work plan proposal will be submitted to MDNR by January 1989.

9803-046

437
7/88

ENV033:Binder # 046
ATF Work on North Yard

Environmental Activities Staff
General Motors Corporation
General Motors Technical Center
30400 Mound Road
Warren, Michigan 48090-9015

Date: November 18, 1988

Subject: Documentation of work on ATF and North Yard

From: Steve Song

To: Chris Winkeljohn

Earlier this week I received a copy of the September 30, 1988 letter from Hydra-matic to the MDNR concerning the submittal of documentation on the remedial investigation conducted by GMR on the ATF Spill and North Yard at Hydra-matic, Ypsilanti.

Per our conversation, I am forwarding to you two suggested report formats for the documentation. The attached formats are from the Draft Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, March 1988, OSWER Directive 9355.3-01. Although the guidance document, on the whole, is designed to provide an understanding of the RI/FS process under the Superfund program, it contains much information that is relevant to "less rigorous" remedial investigations and feasibility studies. I believe that the report formats I have excerpted are examples of such information.

As you review these formats, I think you'll find that the items outlined are fairly consistent with what I had previously suggested as being necessary, although there are some sections in these formats that appear to be more rigorous than what is required for our immediate purpose. Specifically, these sections are: Section 6 of the RI Report Format, and Sections 3 and 4 of the FS Report Format. Inasmuch as GMR has already conducted both the "RI" and the "FS", it would be appropriate to combine the two formats to generate one report.

Please let me know if you would like to discuss this matter in more detail.

Attachments

cc: Phil Gerwert

Let's Get It Together
SAFETY BELTS SAVE LIVES

Table 3-13
SUGGESTED RI REPORT FORMAT

Executive Summary

1. Introduction
   - 1.1 Purpose of Report
   - 1.2 Site Background
     - 1.2.1 Site Description
     - 1.2.2 Site History
     - 1.2.3 Previous Investigations
   - 1.3 Report Organization

2. Study Area Investigation
   - 2.1 Includes field activities associated with site characterization. These may include physical and chemical monitoring of some, but not necessarily all, of the following:
     - 2.1.1 Surface Features (topographic mapping, etc.) (natural and manmade features)
     - 2.1.2 Contaminant Source Investigations
     - 2.1.3 Meteorological Investigations
     - 2.1.4 Surface-Water and Sediment Investigations
     - 2.1.5 Geological Investigations
     - 2.1.6 Soil and Vadose Zone Investigations
     - 2.1.7 Ground-Water Investigations
     - 2.1.8 Human Population Surveys
     - 2.1.9 Ecological Investigations
   - 2.2 If technical memoranda documenting field activities were prepared, they may be included in an appendix and summarized in this report chapter.

3. Physical Characteristics of the Study Area
   - 3.1 Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all, of the following:
     - 3.1.1 Surface Features
     - 3.1.2 Meteorology
     - 3.1.3 Surface-Water Hydrology
     - 3.1.4 Geology
     - 3.1.5 Soils
     - 3.1.6 Hydrogeology
     - 3.1.7 Demography and Land Use
     - 3.1.8 Ecology

Table 7-7

SUGGESTED FS REPORT FORMAT

Executive Summary

1 Introduction
- 1.1 Purpose and Organization of Report
- 1.2 Background Information (Summarized from RI Report)
  - 1.2.1 Site Description
  - 1.2.2 Site History
  - 1.2.3 Nature and Extent of Contamination
  - 1.2.4 Contaminant Fate and Transport
  - 1.2.5 Baseline Risk Assessment

2 Identification and Screening of Technologies
- 2.1 Introduction
- 2.2 Remedial Action Objectives--
  Presents the development of remedial action objectives for each medium of interest (i.e., ground water, soil, surface water, air, etc.). For each medium, the following should be discussed:
  - Contaminants of interest
  - Allowable exposure based on risk assessment
  - Allowable exposure based on ARARs
  - Development of remedial action objectives
- 2.3 General Response Actions--
  For each medium of interest, describes the estimation of areas or volumes to which treatment, containment, or exposure technologies may be applied.
- 2.4 Identification and Screening of Technology Types and Process Options--For each medium of interest, describes:
  - 2.4.1 Identification and Screening of Technologies
  - 2.4.2 Evaluation of Technologies and Selection of Representative Technologies

3 Development and Screening of Alternatives
- 3.1 Development of Alternatives--
  Describes rationale for combination of technologies/media into alternatives. Note: This discussion may be by medium or for the site as a whole.
- 3.2 Screening of Alternatives
  - 3.2.1 Introduction
  - 3.2.2 Alternative 1
    - Description
    - Evaluation
      - Effectiveness
      - Implementability
      - Cost

Subject: Work Plan 2 for ATF

1. Page 2: How will we know when the ATF is removed?
2. What about pockets of ATF that remain?
3. Page 3: Extrapolation of plume beyond wells just east of the storm sewer needs to be addressed or taken out since it appears that the plume is entering the sewer and we do not have any data to support this.
4. Page 7: How did you arrive at the size of the drawdown cones and why are they different sizes.
5. Why are the regions of the plume outside of the drawdown cones not being addressed.

Subject: Work Plan 1 for the North Yard

1. Page 1: Change to Chris Winkeljohn (BSc., chemical engineering)
2. Page 2: The word 'implement' in the third line is misspelled
3. Page 3: Last line of text to read "Potential contaminants at the site are: Include .
4. Why would we expect to find PCB's at the site? This needs to be addressed in the text.
5. Attention must be given to the fact that HydraMatic's procedure called for draining machinery before taking

them out to the NOrth Yard, and that only residual oils, with rainwater were spilled onto the ground.

Research

6. Page 5: What does "at risk" mean? Why is do you say that there is no surface water at risk when Willow Creek and Tyler Pond are 1/2 mile south of the plant?

7. Page 7: Second paragraph; What, specifically, will tell you when to increase the sampling density.

8. Why only these aroclors and heavy metals. This must be addressed in the text.

9. Page 11 Specifically, what conditions will tell you when pore water chemistry must be looked at and why?

Subject: Work plan 2 for the North Yard

1. Page 5: Work Plan 1 called for 25 soil cores. How did you get to 42 cores.

2. Page 6: What did the results from the GMR screening extractions performed on the soil samples tell you? What is the screening criteria.

3. Page 8: How did you get from this chromatogram to actual ppm. What is a normal or background level.

4. Page 9: What did the results from phase 1 tell you and how did you come up with the phase 2 coring locations and the number of cores to be taken?

5.Pg.11-15 Where is the data for the rest of the sampling

locations? Where is the data for Cd as called for in check plans 1 and 2?

6. Page 16 If PCB was not detected at any other locations, then this must be indicated on the diagram.

7. Page 22 For the Vertical Distributions of Metals slide not show values for Cd and Fe?

8. Page 25 The Federal regulations called out here are not applicable here since the spillage occurred prior to the promulgation of this reg. and is therefore not covered.

Inter-Organization

Environmental Activities Staff
General Motors Corporation
General Motors Technical Center
30400 Mound Road
Warren, Michigan 48090-9015

Date: September 15, 1988

Subject: ATF Project at Hydra-matic, Ypsilanti

From: Steve Song

To: Ron Williams

Your group's presentation of its work on the above referenced project last Friday at EAS is much appreciated. I hope the exchange of information and perspectives was as useful for your group as it was enlightening for us. I look forward to further exchanges of this type.

Problems in contaminant identification, plume delineation, and remediation are of much interest to all of us. Basic research in these areas is of value to not only GM but the environmental management community in general. GMRL's effort to carry this research into the field is commendable as is its attempt to translate the results from basic research into innovative solutions of real-life problems at Hydra-matic, Ypsilanti.

Combining field research with practical real-world problem solving does, unfortunately, raise concerns. Unless very clear distinctions are made between which activities are motivated by research objectives and which are appropriate for practical problem solving, ample opportunities will be presented for those who are either unfamiliar with the work or inexperienced in this field to loose sight of the research and practical problem solving applications. The resulting potential confusion could present obvious significant difficulties in future investigations where the scope of work is constrained by practicality and cost-effectiveness. This mutual concern has been voiced previously and was articulated again last Friday.

To forestall potential problems of this nature, I trust you'll agree that it is imperative that the documentation of GMRL's work on the above referenced project firmly establishes all explicit and/or implicit research related objectives within the more obvious overall objective and clearly distinguishes between what was research and what was practical problem solving.

Let's Get It Together
SAFETY BELTS SAVE LIVES

By letter dated August 16, 1988 from Don Schafer to Charles San Juan, Hydra-matic indicated that detailed documentation of the above referenced project, compiled by GMRL, will be submitted to the MDNR by October 3, 1988. I believe that it would be appropriate to have a draft of the documentation ready for review by September 19, 1988.

cc: Don Schafer, Hydra-matic
Chris Winklejohn, Hydra-matic
Nick Gallopoulos, GMRL
Phil Gerwert, GM EAS
Don Schiemann, GM Legal

E.C. JORDAN CO. ENGINEERS & SCIENTISTS

SAMPLING PLAN

HYDROGEOLOGIC INVESTIGATIONS AT FIVE SEPARATE AREAS

HYDRA-MATIC WILLOW RUN PLANT

Prepared for:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
Ypsilanti, Michigan

SAMPLING PLAN

HYDROGEOLOGIC INVESTIGATIONS
AT FIVE SEPARATE AREAS

HYDRA-MATIC WILLOW RUN PLANT

Prepared for:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
Ypsilanti, Michigan

Prepared by:

E.C. JORDAN CO.
FARMINGTON HILLS, MICHIGAN

Job No. 5883-00

January 1989

TABLE OF CONTENTS

SECTION	TITLE	PAGE NO.
1.0	INTRODUCTION	1
1.1	BUILDING #19 TANK FARM	1
1.2	POWERHOUSE TANK FARM	1
1.3	NORTH YARD	4
1.4	BAY Q-24	4
1.5	TRANSMISSION SUBTEST AREA	4
2.0	PHASE I ACTIVITIES	6
2.1	BUILDING #19 TANK FARM	6
2.2	POWERHOUSE TANK FARM	6
2.3	NORTH YARD	9
2.4	BAY Q-24	9
2.5	TRANSMISSION SUBTEST AREA	9
3.0	FIELD PROCEDURES	14
3.1	SOIL BORINGS AND SOIL SAMPLING	14
3.2	GROUNDWATER MONITORING WELLS	14
3.3	GROUNDWATER SAMPLING	15
4.0	ANALYTICAL PROGRAM	16

APPENDICES

APPENDIX A - FIELD SAMPLING FORMS

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1-1	LOCATION OF THE GM HYDRA-MATIC PLANT.....	2
1-2	LOCATIONS OF THE FIVE AREAS OF INVESTIGATION.....	3
2-1	PROPOSED WELL LOCATIONS - BUILDING #19 TANK FARM.....	7
2-2	PROPOSED WELL LOCATIONS - POWERHOUSE TANK FARM.....	7
2-3	PROPOSED WELL LOCATIONS - NORTH YARD.....	10
2-4	PROPOSED WELL AND SOIL BORING LOCATIONS - BAY Q-24...	11
2-5	PROPOSED WELL LOCATIONS - TRANSMISSION SUBTEST AREA..	13

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
4-1	SAMPLE SUMMARY TABLE.....	17
4-2	DNR SCAN 1 COMPOUNDS.....	18
4-3	DNR SCAN 2 COMPOUNDS.....	19
4-4	SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS.....	20

1.0 INTRODUCTION

The General Motors (GM) Hydra-matic Willow Run plant is located in Ypsilanti, Michigan, within Washtenaw County (see Figure 1-1). In 1953, GM purchased the facility from the Ford Motor Company to house its transmission manufacturing operations. Hydra-matic currently produces automatic transmissions for automobiles and trucks. The major production operations include machining, stamping, heat treating and assembly.

Hydra-matic has identified five areas of potential environmental contamination at their plant which they wish to investigate (see Figure 1-2). These five areas are as follows:

- Building #19 Tank Farm
- Powerhouse Tank Farm
- North Yard
- Bay Q-24; Main Manufacturing Building
- Transmission Subtest Area

In each area, a preliminary Phase I investigation will be conducted to collect information on groundwater and/or soil to assess environmental impacts due to various potential contaminant sources. Additional phases of data collection may be required at one or more of the five areas to adequately assess site conditions. If environmental impacts are identified, remedial actions will be evaluated and implemented, as appropriate, during subsequent phases not covered by this sampling plan.

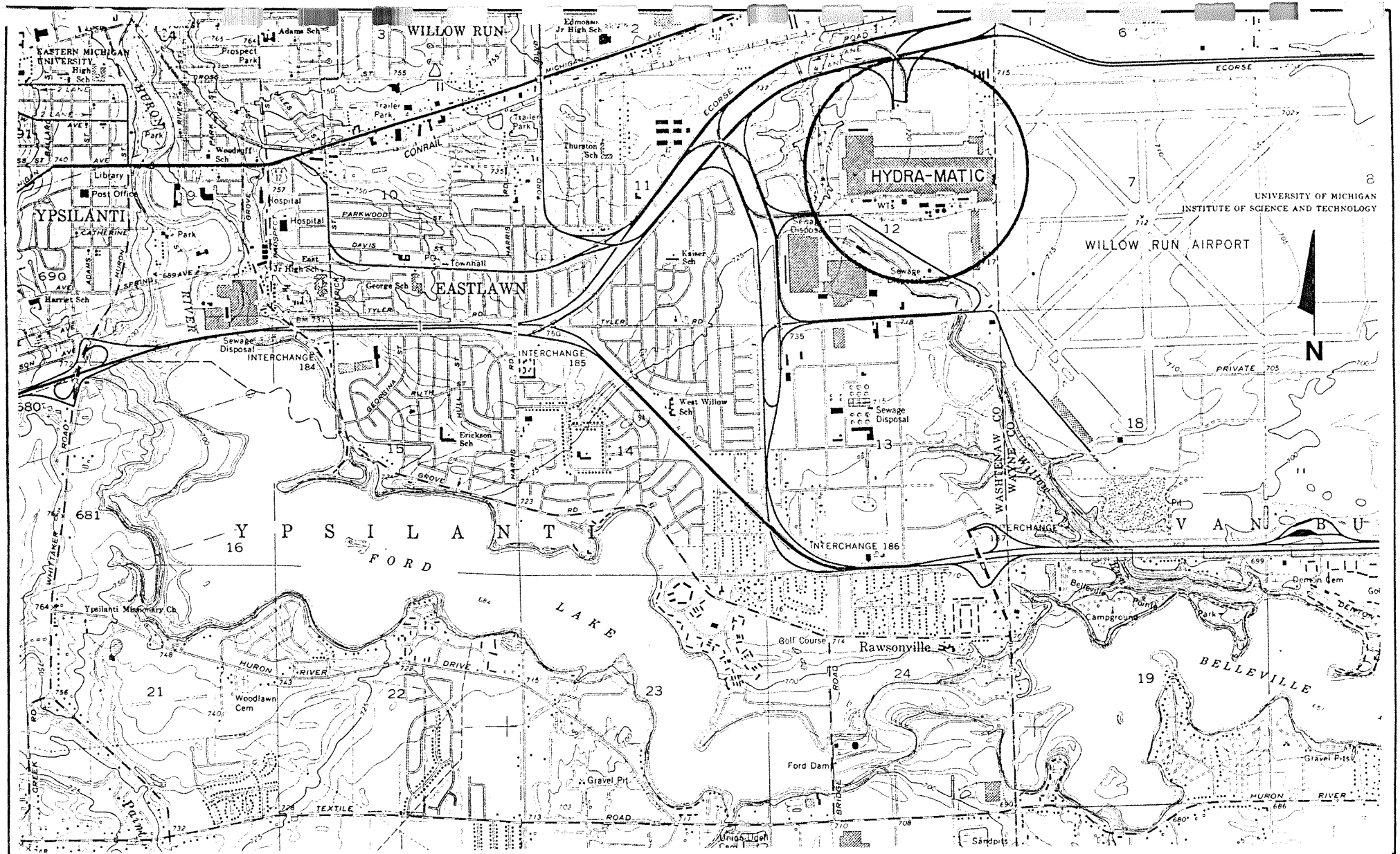
This sampling plan includes three sections after the introduction. Section 2.0 summarizes the Phase I activities to be completed in each area; Section 3.0 describes field procedures and sampling methodologies; and Section 4.0 presents the analytical program. The following paragraphs describe each area of investigation.

1.1 BUILDING #19 TANK FARM

Hydra-matic recently performed a leak check on an existing 15,000-gallon underground gasoline storage tank located south of the main manufacturing building between Building #17 and Building #19. The results of this test indicated that the tank will not maintain a constant level when full. Hydra-matic suspects that soil and/or groundwater contamination may have occurred as a result of this condition. Groundwater monitoring wells will be installed, and soil and groundwater samples will be collected and analyzed, to see if soil or groundwater in this area has been contaminated due to the underground tank.

1.2 POWERHOUSE TANK FARM

Hydra-matic is currently constructing a vaulted tank farm directly within the boundaries of the existing Powerhouse Tank Farm, located south of the main manufacturing building. As part of this construction project, the existing



QUADRANGLE LOCATION

0 1500 3000 6000 FEET

TAKEN FROM U.S.G.S. YPSILANTI EAST, MICH. 7.5' QUADRANGLE MAP.

FIGURE 1-1
LOCATION OF THE
GM HYDRA-MATIC PLANT
WILLOW RUN, MICHIGAN

EC JORDAN CO

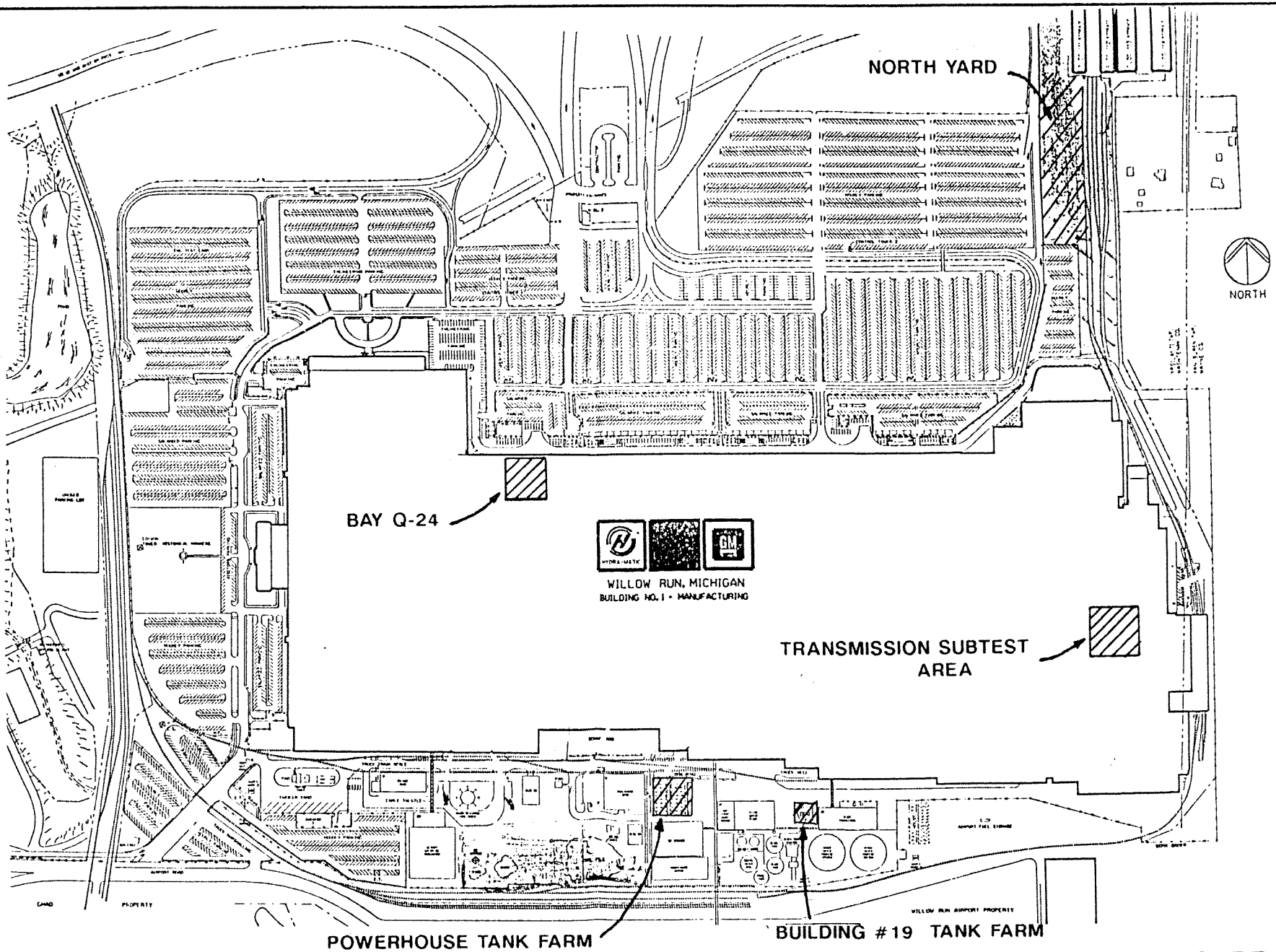


FIGURE 1-2
LOCATIONS OF THE FIVE AREAS OF INVESTIGATION
HYDRA-MATIC HYDROGEOLOGIC INVESTIGATIONS

E.C. JORDAN CO.

underground storage tanks are scheduled for removal. These tanks were installed in 1942 with the original facility. Since that time, these tanks have been used to store fuel oils, gasoline, a wide range of petroleum oils, and waste oils from the wastewater treatment plant.

During the excavation phase of the tank farm construction project, transmission fluid was detected in a groundwater pumping well that is being used to dewater the construction site. The underground storage tanks are the suspected source of this contamination. The Phase I investigation of this potential problem includes the installation of groundwater monitoring wells, the collection of soil and groundwater samples, and the analysis of those samples.

1.3 NORTH YARD

The North Yard is located on the northeast corner of Hydra-matic's property. This area was used to store production machinery and equipment that had been taken out of service. The equipment was stored directly on the soil surface, and residual metal-working fluids and various oils that remained in the equipment leaked into the soil.

To determine the extent of contamination in the North Yard, GM conducted a subsurface soil study. The results indicated that the contaminants were confined to the upper 24 inches of soil; this material was removed from the site. A groundwater monitoring well network will be installed during this phase to evaluate groundwater quality in the area.

1.4 BAY Q-24

Bay Q-24 is located in the main manufacturing building. Hydra-matic recently discovered a leak in a 5-gallon sump that is used to collect soluble oil coolant from a production machine pad. This soluble oil was found to be leaking into a void between the top of the sump and the concrete floor. Leaking occurred only when the sump was full. Based on available information, Hydra-matic has estimated that 1,000 gallons of coolant (3% oil, 97% water) leaked into the soil over a 4-year period. During Phase I, soil borings will be conducted, groundwater monitoring wells will be installed, and soil and groundwater samples will be collected and analyzed.

1.5 TRANSMISSION SUBTEST AREA

The Transmission Subtest Area is located in the northeast section of the main manufacturing building. This area consisted mainly of hydraulically operated test machines for several transmission components. Most of the equipment is currently being removed as part of a new product program.

During a previous hydrogeologic study at an adjacent area, an oil plume was discovered beneath the Transmission Subtest Area, and 14 wells were installed to delineate the plume and to locate its source. Due to various constraints, however, the plume boundaries have not yet been completely defined. The Phase

I investigation in the Transmission Subtest Area will consist of the installation of temporary monitoring wells to locate the oil plume boundaries and to develop an updated oil-thickness contour map.

2.0 PHASE I ACTIVITIES

The following paragraphs describe Phase I investigation activities proposed for each of the five areas. These activities may be altered in the field depending upon the conditions encountered.

2.1 BUILDING #19 TANK FARM

Field activities at the Building #19 Tank Farm will include groundwater monitoring well installation, groundwater sampling and analysis, soil sampling and analysis, and static water level measurements.

Four 15-foot-deep groundwater monitoring wells will be installed at the Building #19 Tank Farm at the approximate locations shown in Figure 2-1. The wells will be constructed to straddle the water table and to also screen the entire saturated zone. Each well will be finished at grade.

A total of 16 soil samples (plus two duplicates) will be collected from split-spoon samples and analyzed for benzene, toluene, and xylene (BTX). After measuring static water levels and checking for floating product, groundwater samples will be collected from each well. These four samples, plus one blank and one duplicate, will be analyzed for BTX.

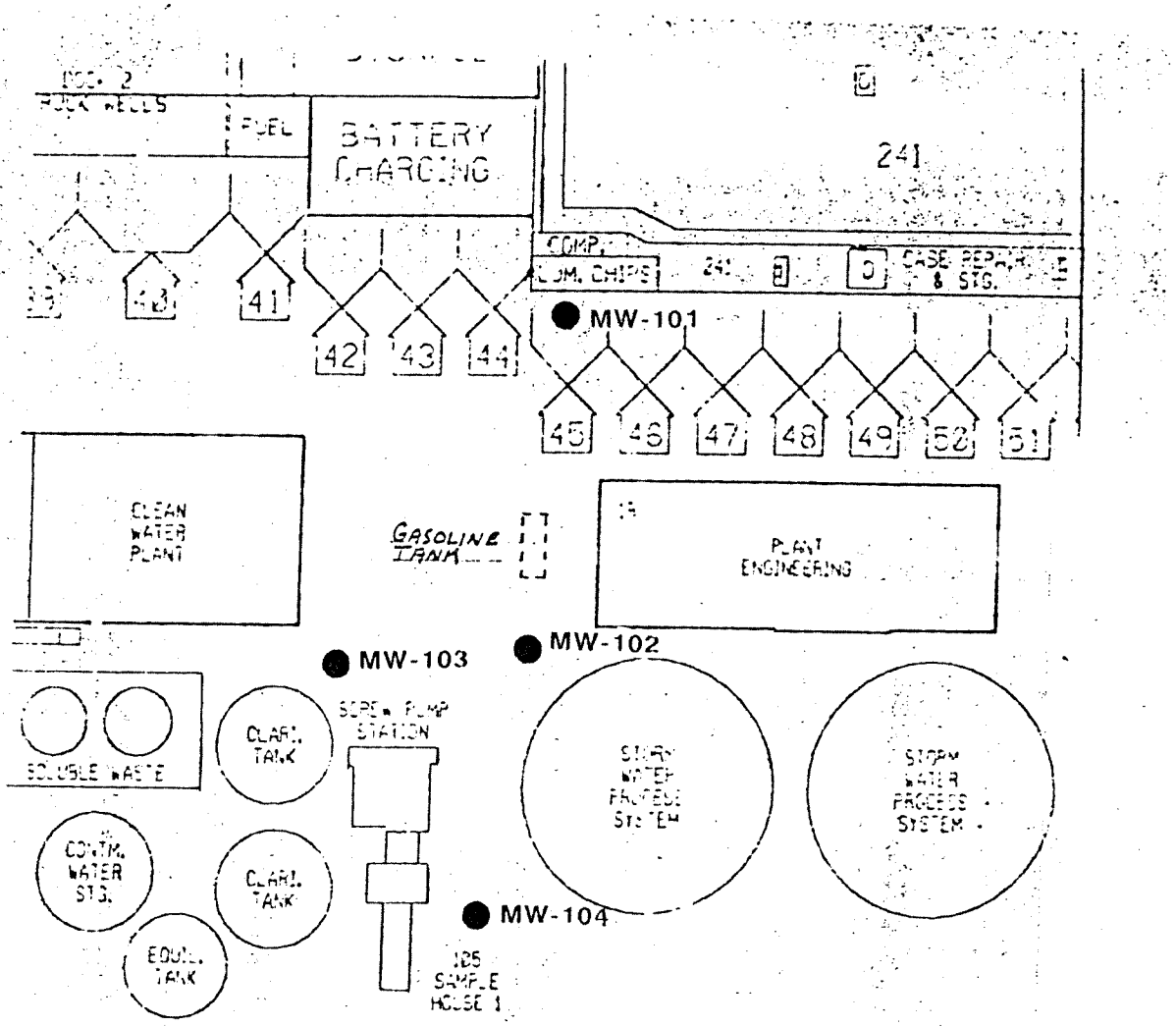
2.2 POWERHOUSE TANK FARM

Field activities at the Powerhouse Tank Farm will include groundwater monitoring well installation, groundwater sampling and analysis, and soil sampling and analysis.

Three 25-foot-deep groundwater monitoring wells will be installed at the Powerhouse Tank Farm at the approximate locations shown in Figure 2-2. The wells will be constructed so that the entire saturated zone is screened. Wells MW-1 and MW-2 will be finished at grade with a locking inner well cover and a water box cemented in place. Wells MW-3 will be finished above grade with a locking well protector cemented in place.

A total of 18 soil samples (plus two duplicates) will be collected from split-spoon samplers and analyzed for BTX and total hydrocarbons. Six samples will be selected from each 25-foot-deep boring.

After measuring static water levels and checking for floating product, groundwater samples will be collected from each well. These three samples, plus one blank and one duplicate, will be analyzed for BTX and total hydrocarbons. If oil is found on top of the water table, the samples will also be analyzed for polychlorinated biphenyls (PCBs).

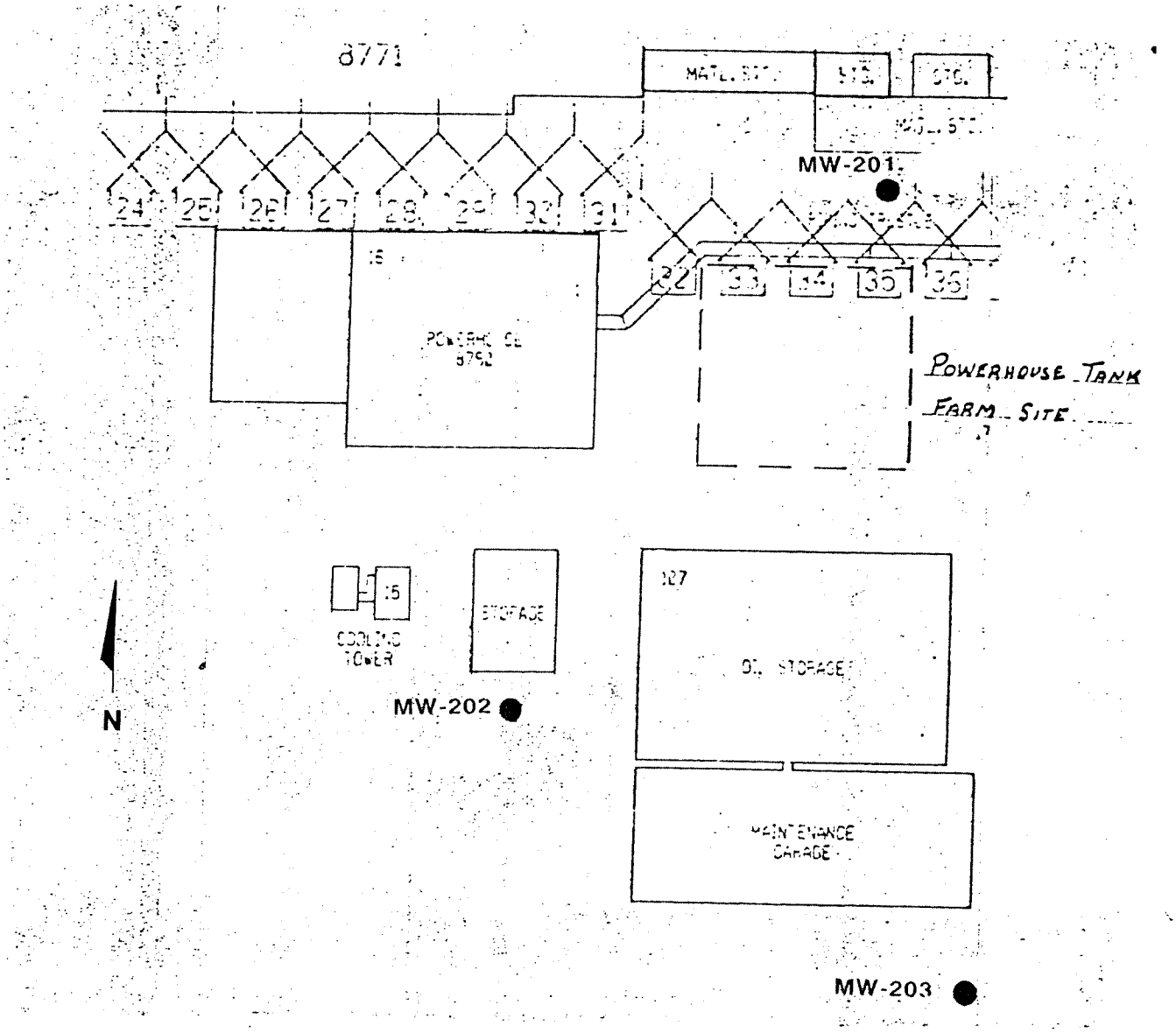


KEY

● MONITORING WELL

FIGURE 2-1
PROPOSED WELL LOCATIONS
BUILDING # 19 TANK FARM
HYDRA-MATIC HYDROGEOLOGIC INVESTIGATIONS

GM DRAWING # HWR-G1



KEY

● MONITORING WELL

FIGURE 2-2
PROPOSED WELL LOCATIONS
POWERHOUSE TANK FARM
HYDRA-MATIC HYDROGEOLOGIC INVESTIGATIONS

GM DRAWING # HWR-TF-1

2.3 NORTH YARD

Field activities for the North Yard investigation will include groundwater monitoring well installation, and groundwater sampling and analysis.

Three 15-foot-deep groundwater monitoring wells will be installed in the North Yard at the approximate locations shown in Figure 2-3. The wells will be constructed so that the entire saturated zone is screened. Each well will be finished above grade with a locking well protector cemented in place. Soil samples will not be collected during drilling.

After measuring static water levels, groundwater samples will be collected from each well. These three samples, plus one blank and one duplicate, will be analyzed for dissolved metals (Cd, Cr, Fe, Ni, Pb, and Zn), purgeable halocarbons (DNR Scan 1), and purgeable aromatic hydrocarbons (DNR Scan 2). If an oil layer is found on top of the water table, the samples will also be analyzed for PCBs.

Following this initial sampling event, a two-year quarterly groundwater sampling program (eight sampling events) will be implemented. This program will include the collection of groundwater samples from all three wells (plus one blank and one duplicate). The samples will be analyzed for the parameters listed above.

2.4 BAY Q-24

Field activities at Bay Q-24 will include groundwater monitoring well installation, groundwater sampling and analysis, and soil sampling and analysis.

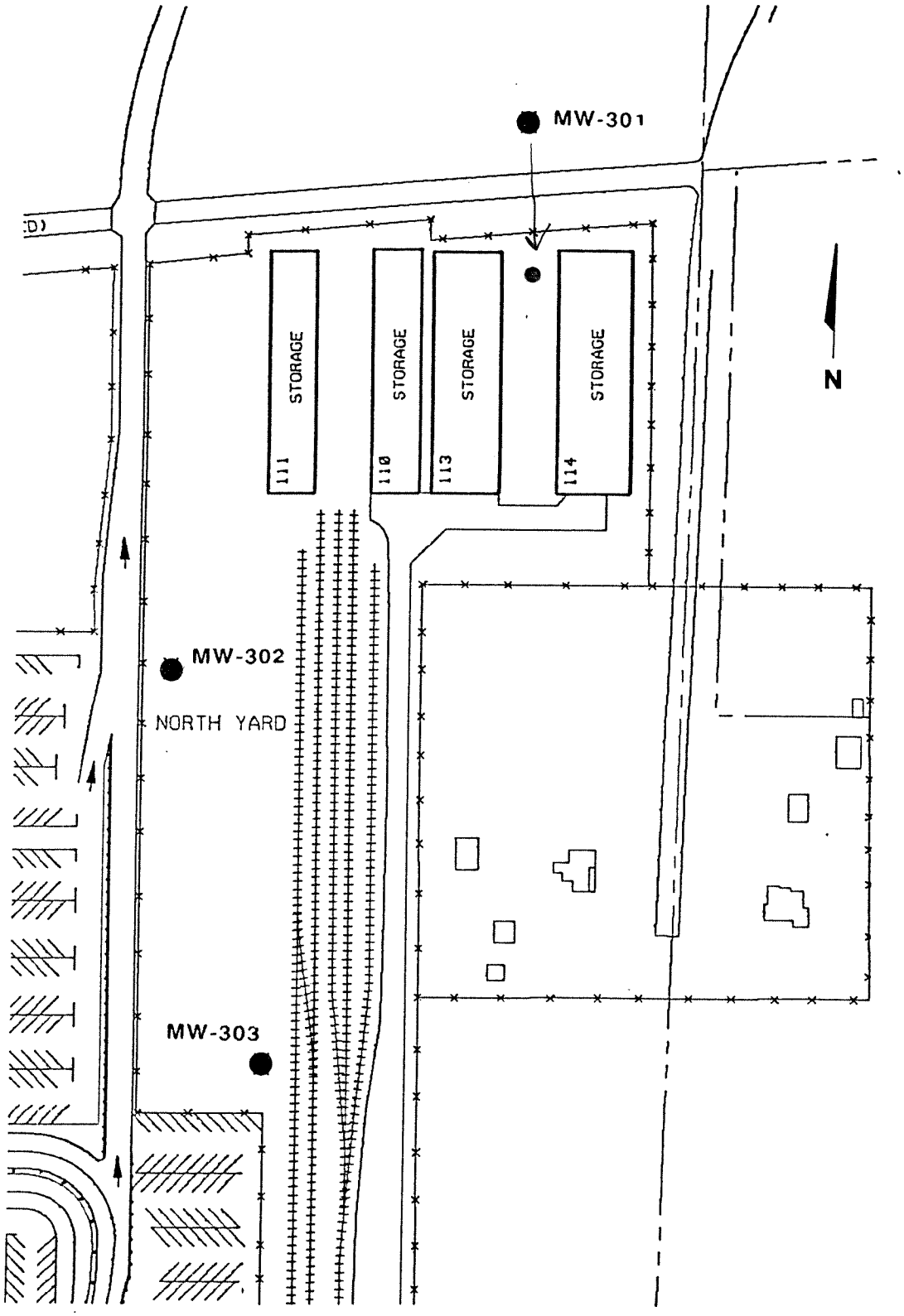
Two 15-foot-deep soil borings will be drilled, and three 15-foot-deep groundwater monitoring wells will be installed at Bay Q-24. Approximate locations are shown in Figure 2-4. The wells will be constructed so that the entire saturated zone is screened. Each well will be finished at grade with a locking inner well cover and a water box cemented in place.

A total of 20 soil samples (plus two duplicates) will be analyzed for total hydrocarbons and four metals (Cr, Cu, Pb, and Zn). Four samples will be selected from each of the five borings. The soil borings without monitoring well installations will be grouted upon completion.

After measuring static water levels and checking for floating product, groundwater samples will be collected from each well. These three samples, plus one blank and one duplicate, will be analyzed for total hydrocarbons and four dissolved metals (Cr, Cu, Pb, and Zn).

2.5 TRANSMISSION SUBTEST AREA

Field activities in the Transmission Subtest Area investigation will include groundwater monitoring well installation, oil-thickness measurements, and well abandonment.



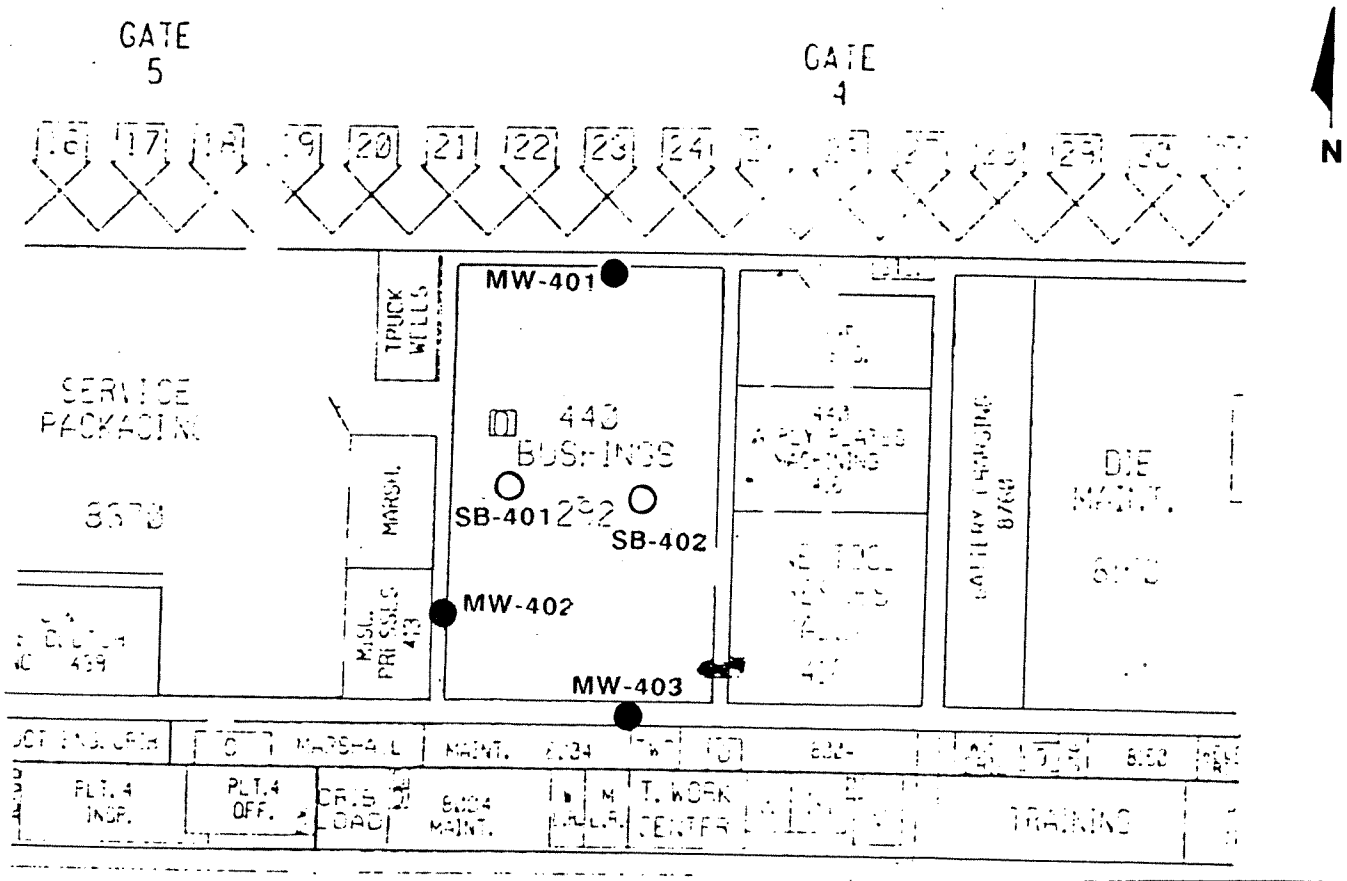
KEY

● MONITORING WELL

FIGURE 2-3
PROPOSED WELL LOCATIONS
NORTH YARD AREA
HYDRA-MATIC HYDROGEOLOGIC INVESTIGATIONS

GM DRAWING # HWR-NY-1

ECJORDANCO



KEY

● MONITORING WELL

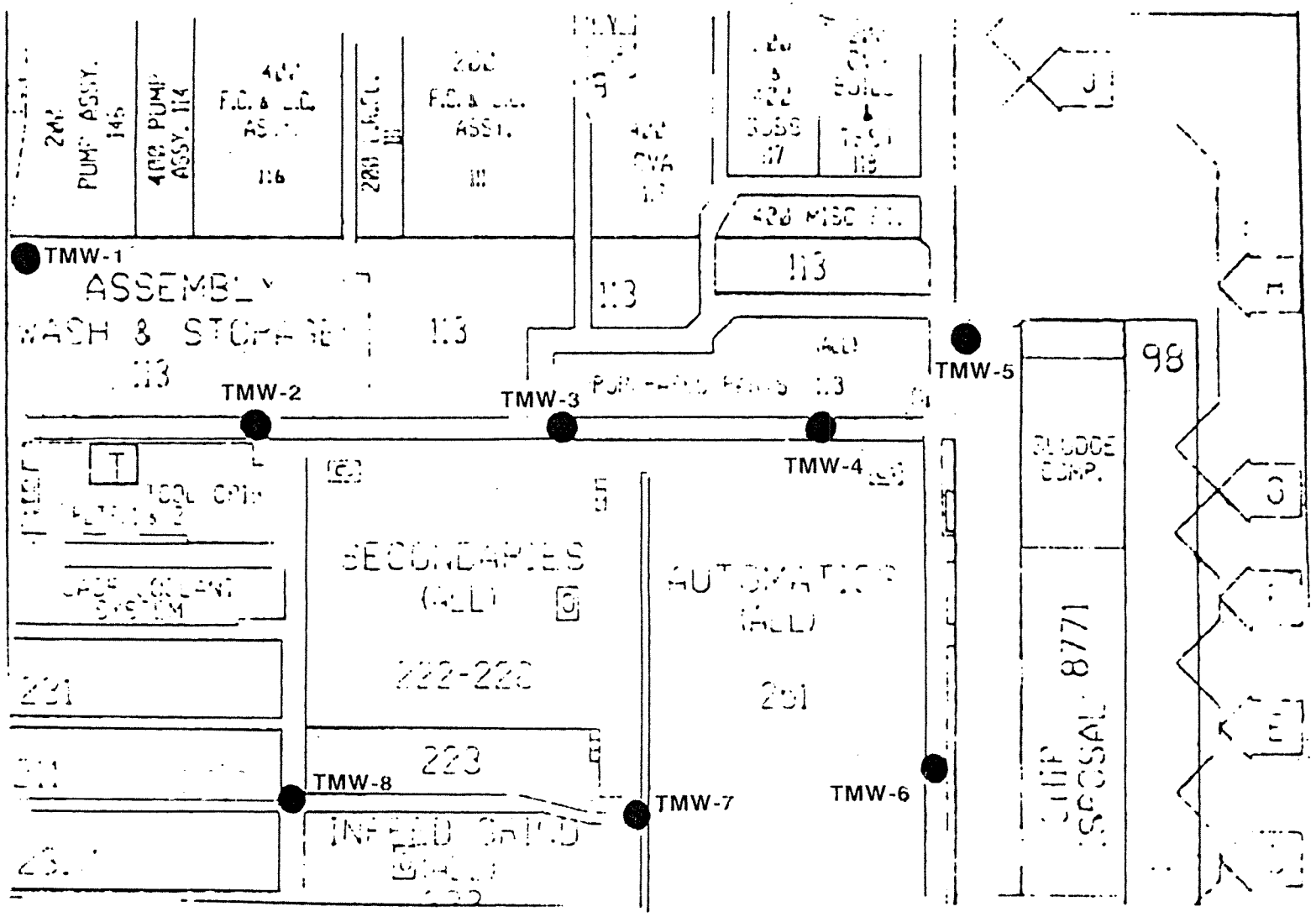
○ SOIL BORING

FIGURE 2-4
PROPOSED WELL AND SOIL BORING LOCATIONS
BAY Q-24
HYDRA-MATIC HYDROGEOLOGIC INVESTIGATIONS

GM DRAWING # HWR-Q24

Eight 15-foot-deep temporary groundwater monitoring wells will be installed in the Transmission Subtest Area at the approximate locations shown in Figure 2-5. The wells will be constructed so that the well screen straddles the water table. Because these wells are temporary, each well will be finished at grade by using the minimum amount of protection required for that location without jeopardizing the well. Soil samples will not be collected during drilling.

After well development, the thickness of oil existing on top of the water table will be measured in each well. After the measurements have been collected, each well will be abandoned by grouting.



KEY

● MONITORING WELL

GM DRAWING # HWR-SA2

FIGURE 2-5
PROPOSED WELL LOCATIONS
TRANSMISSION SUBTEST AREA
HYDRA-MATIC HYDROGEOLOGIC INVESTIGATIONS

ECJORDANCO

3.0 FIELD PROCEDURES

The following paragraphs describe the field procedures that Jordan will follow during each Phase I investigation at the Hydra-matic plant. Procedures for soil sampling, groundwater monitoring well installation, and groundwater sampling are described below. Jordan's subcontractor, Professional Service Industries, Inc. (PSI) will conduct all subsurface explorations.

3.1 SOIL BORINGS AND SOIL SAMPLING

Soil boring will be completed with truck-mounted CME-45 drilling rig using hollow-stem augers. Soil samples will be collected continuously in split-spoon samplers. Each split-spoon will be screened for the presence of volatile organic chemicals with a photoionization (PI) meter immediately upon opening the split-spoon. The soil sample will then be placed in the appropriate jars and visually observed and described by the onsite geologist.

A minimum of three grab samples from each split-spoon sampler will be composited to form one representative sample. The composite samples will be homogenized by mixing representative portions of each discrete soil sample in a stainless steel bowl. Samples for benzene, toluene and xylene (BTX) analysis will not be mixed because to do so could result in a loss of volatile organic chemicals from the sample. These samples will be composited by selecting portions of the sample from several discrete points in the sample interval and placing them directly into the sample container. After mixing, the samples will be transferred to the appropriate sample containers, labeled, and placed on ice in coolers until delivery to the laboratory.

Labels will include sample designation (e.g., SB-1), sampling interval (e.g., 5-10 feet), time and data of sampling, samplers initials, and Jordan's job number. Soil descriptions, groundwater observations, PI meter reading and other perrtinent informatin will be documented on Soil Boring Long/Monitoring Well Diagram forms (see Appendix A).

To reduce the potential for cross-contamination during drilling, down-hole drilling equipment will be steam-cleaned at the drilling location after the completion of each boring. During soil sampling, the split-spoon sampler will be decontaminated with trisodium phosphate (TSP) and water. Soil borings without monitoring wells will be grouted upon completion.

3.2 GROUNDWATER MONITORING WELLS

Groundwater monitoring wells will be constructed of 2-inch ID, flush-threaded, schedule 40, PVC riser pipe and 2-inch ID, 10-slot, 10-foot-long, PVC well screens. The screens will be sand-packed and the remaining annular space grouted to the surface. Most wells will be completed at grade with a locking inner well cover and a water box cemented in place, although some will be completed above grade with a locking well protector cemented in place.

After installation, each well will be developed to remove fine-grained sediment from the well and the aquifer material near the screen. This will be accomplished by bailing, or by the air-lift technique using an air compressor equipped with a hydrocarbon filter on the outlet. Groundwater will be removed from the well until the water appears to be free of fine-grained sediment.

After installation, the top of casing of each well will be surveyed to an accuracy of ± 0.01 foot. In addition, the relative location of each well and soil boring will be measured from existing reference points to an accuracy of ± 1.0 foot.

Well construction details will be documented on Jordan's Soil Boring Log/Monitoring Well Diagram form (see Appendix A). Information such as well materials, screen depth, grout type, etc., will be included on this form.

3.3 GROUNDWATER SAMPLING

After allowing the wells to stabilize following installation, groundwater samples will be collected. Prior to evacuation, static water levels and well depths will be measured to the nearest 0.01 foot. The wells will be evacuated by bailing or pumping three well volumes of groundwater (or until the well goes dry). While evacuating, pH, temperature, and specific conductance will be measured a minimum of three times (or until parameters stabilize) to check that stagnant water has been removed from the well. Samples will be collected using a stainless steel bailer fitted with a bottom-emptying device or a stainless steel submersible pump suitable for sampling groundwater that may contain organic compounds. If a bailer is used, new cord will be attached to the bailer before each well is sampled. Care will be taken to avoid contact between the bailer (and bailer cord) and the ground.

Water samples to be analyzed for metals will be field-filtered, preserved to a pH of less than 2 with nitric acid, and placed in the appropriate sample container. After processing and labeling, the samples will be kept in coolers with ice until delivery to the laboratory. Labels will include sample location (e.g., MW-1), date and time of sampling, sampler initials, type of analyses required, Jordan's job number, preservation, and information on whether or not the sample was filtered. Each sample will be documented on Jordan's groundwater field sample data record (see Appendix A).

The bailer or sampling pump will be decontaminated between samples with TSP and water followed by a distilled water rinse. Decontamination procedures will be checked by submitting sampler blanks for analysis. A sampler blank is a distilled water sample handled and processed in the same manner as a groundwater sample (i.e., it is poured into the bailer and into sample bottles, filtered, preserved, etc.).

4.0 ANALYTICAL PROGRAM

The analytical program for the Phase I investigations includes the analysis of soil and groundwater for various organic and inorganic parameters. Table 4-1 summarizes the number and types of samples to be collected in each area and the analytical methods to be used. Quality control samples will consist of the field duplicates and blanks listed on Table 4-1.

Table 4-4 shows sample container and preservation requirements for the analyses to be performed. Appropriate containers will be provided by Environmental Control Technology (ENCOTEC), the laboratory which will perform the analyses.

An example chain-of-custody record is included in Appendix A. This form includes information such as project number, project name, station number, date and time of sampling, type of sample (i.e., composite or grab sample), station location, number of containers, and media. At the bottom of the form, there are boxes for relinquishing and receiving signatures plus date and time. These forms will be initiated by Jordan when samples are collected.

Also included in Appendix A is Jordan's analysis request form. This form is submitted with each shipment of samples to assure that the proper analyses are performed.

TABLE 4-1
SAMPLE SUMMARY TABLE
HYDRA-MATIC WILLOW RUN PLANT
YPSILANTI, MICHIGAN

LOCATION SAMPLE TYPE ANALYSIS(METHOD #)	FIELD SAMPLES	FIELD DUPLICATES	SAMPLER BLANKS	TOTAL SAMPLES
BUILDING #19 TANK FARM				
Soil Samples				
Benzene, toluene, and xylene (5030/8020)	16	2	0	18
Groundwater Samples				
Benzene, toluene, and xylene (5030/8020)	4	1	1	6
POWERHOUSE TANK FARM				
Soil Samples				
Benzene, toluene, and xylene (5030/8020)	18	2	0	20
Total Hydrocarbons (GC) (ASTM 3328)	18	2	0	20
Groundwater Samples				
Benzene, toluene, and xylene (5030/8020)	3	1	1	5
Total Hydrocarbons (GC) (ASTM 3328)	3	1	1	5
* PCBs (3510/8080)	3	1	1	5
NORTH YARD				
Groundwater Samples				
DNR Scan 1 (Table 4-2)	3	1	1	5
DNR Scan 2 (Table 4-3)	3	1	1	5
Dissolved Metals	3	1	1	5
Cd (1310/6010)				
Cr (1310/6010)				
Fe (3010/7380)				
Ni (1310/6010)				
Pb (3010/7420)				
Zn (1310/6010)				
* PCBs (3510/8080)	3	1	1	5
BAY Q-24				
Soil Samples				
Total Hydrocarbons (GC) (ASTM 3328)	20	2	0	22
Total metals	20	2	0	22
Cu (1310/6010)				
Cr (1310/6010)				
Pb (3050/7420)				
Zn (1310/6010)				
Groundwater Samples				
Total Hydrocarbons (GC) (ASTM 3328)	3	1	1	5
Dissolved metals	3	1	1	5
Cu (1310/6010)				
Cr (1310/6010)				
Pb (3010/7420)				
Zn (1310/6010)				
TRANSMISSION SUBTEST AREA				
No analytical work to be done				

*Will be analyzed only if oil is found on top of the water table.

TABLE 4-2
DNR SCAN 1 COMPOUNDS
HYDRA-MATIC WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chloroform
Dibromochloromethane
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,3-Dichloropropene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene

TABLE 4-3
DNR SCAN 2 COMPOUNDS
HYDRA-MATIC WILLOW RUN PLANT
YPSILANTI, MICHIGAN

Benzene
Ethylbenzene
Styrene
Toluene
Total Xylenes

TABLE 4-4
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS
HYDRA-MATIC WILLOW RUN PLANT
YPSILANTI, MICHIGAN

	Concentration	Container	Sample Size	Preservation	Maximum Holding Time
WATER					
Benzene, toluene, xylene	Low	Glass, Teflon-lined septum	2 x 40 mL	Cool to 4 C	7 days
Polychlorinated Byphenyls (PCBs)	Low	Glass, amber	1 L	Cool to 4 C	7 days to extraction, 40 days after extraction
Metals (dissolved)	Low	Polyethylene	1 L	HNO3 to pH<2	6 months
DNR Scans 1 and 2	Low	Glass, Teflon-lined septum	2 x 40 mL	Cool to 4 C	7 days
Total Hydrocarbons (GC)	Low/medium	Glass, Teflon-lined septum	1 L	Cool to 4 C	7 days to extraction, 40 days after extraction
SOILS/SOLIDS					
Benzene, toluene, xylene	Low	Wide-mouth glass, Teflon-lined cap	2 x 2 oz.	Cool to 4 C	10 days to extraction, 40 days after extraction
Metals (total)	Low/medium	Wide-mouth glass	4 oz.	Cool to 4 C	6 months
Total Hydrocarbons (GC)	Low/medium	Wide-mouth glass	4 oz.	Cool to 4 C	10 days to extraction, 40 days after extraction

Notes:

1. Holding times are from date of sample collection.

APPENDIX A

FIELD SAMPLING FORMS

SOIL BORING LOG / MONITORING WELL DIAGRAM

E.C. JORDAN CO.

PROJECT NO.:	PROJECT NAME:		BORING/WELL DESIGNATION:		BORING/WELL LOCATION:
DRILLING CONTRACTOR:		DRILLING METHOD:	BOREHOLE SIZE: IN.	BOREHOLE DEPTH: FT.	
DATE STARTED:	DATE COMPLETED:	GROUND ELEV.: FT.	MEASURING POINT ELEV: FT.	WELL DEPTH: FT.	
RIG:	DRILLER:	HELPER:	LOGGED BY:		

DEPTH (FT.)	SOIL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNTS(N)	P.I. METER (ppm)	COMMENTS	WELL DATA
0							
5							
10							
15							
20							
25							
30							
35							

NOTES:

EC JORDAN CO

PAGE _____ OF _____

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT _____ JOB NO _____

STATION NO/LOCATION _____ DATE _____

SKETCH ON BACK YES ☐ NO ☐ PHOTOGRAPHS YES ☐ NO ☐ ROLL NO/EXPOSURE NO _____

FIELD DATA

TIME: START _____ AIR TEMP _____

END _____ WEATHER _____

WATER DEPTH _____ ☐ TOP WELL ☐ TOP CASING WELL DEPTH _____ WELL DIAM. _____ WELL MATERIAL _____

WELL STICK-UP _____ WELL/CASING _____ EQUIPMENT USED!

_____ FT. WATER X _____ {2" / 4" / 6"} X _____ CASING VOLUME = _____ VOL. PURGE _____

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE VOA LEVEL (PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ _____ GAL	@ _____ GAL	@ _____ GAL	@ _____ GAL
TEMP _____ °C	TEMP _____ °C	TEMP _____ °C	TEMP _____ °C
SP. COND _____ @25°C	SP. COND _____ @25°C	SP. COND _____ @25°C	SP. COND _____ @25°C
pH _____	pH _____	pH _____	pH _____
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED

REMARKS/OBSERVATIONS _____

SAMPLER _____

PAGE ___ OF ___

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME

SAMPLERS (SIGNATURE)

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS	SAMPLE TYPE												REMARKS INDICATE SOIL/WATER/AIR SEDIMENT/SLUDGE

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED FOR DISPOSAL BY: (SIGNATURE)	DATE / TIME	REMARKS

E.C. JORDAN CO.

ANALYSIS REQUEST FORM

CLIENT INFORMATION: NAME _____

COMPANY _____

MAILING ADDRESS _____

_____

PURCHASE ORDER/JOB NUMBER _____

WHERE TO SEND REPORT: ☐ DIRECTLY TO CLIENT

☐ ECJ - NAME _____

ANALYSES REQUESTED BY: _____
TECHNICAL PROJECT MANAGER

APPROVED BY: _____
PROJECT MANAGER

DATE RECEIVED _____
LAB LOCATION _____
RESULTS DUE _____
CLIENT I.D. NO. _____

☐ SOLID WASTE DATA FILE
☐ DATA DOCUMENTATION REQUIRED
☐ ENTERED IN COMPUTER

TYPE OF SAMPLE _____
LIST ANY HAZARDS _____

☐ SPECIAL PROCEDURE

☐ FILTERED IN FIELD ☐ NON-FILTERED

ADDITIONAL INFORMATION OR SPECIAL PROCEDURES:

SAMPLE IDENTIFICATION	LAB NUMBERS	DATE SAMPLED	SAMPLED BY	ANALYSES REQUIRED

1003
2/89
ENV033:Binder # 047 Soil
Contaminated Machine Storage Area

9803-047

RESEARCH REPORT

EV-333

INVESTIGATION OF SOIL CONTAMINATION IN A MACHINE STORAGE AREA AT THE HYDRA-MATIC PLANT IN YPSILANTI, MICHIGAN

Thomas L. Gibson
Abdul S. Abdul

Environmental Science Department

February 20, 1989

GM
General Motors
Research Laboratories
Warren, Michigan 48090

GM RESTRICTED ..... SEE TITLE PAGE FOR DISTRIBUTION LIMITS

GMR 247C
Rev. 3-78

RESEARCH REPORT NO. ● EV-333

Title ● INVESTIGATION OF SOIL CONTAMINATION IN A MACHINE STORAGE AREA AT THE HYDRA-MATIC PLANT IN YPSILANTI, MICHIGAN

Date ● February 20, 1989

Reported by ● Thomas L. Gibson
Thomas L. Gibson 313-986-1615
8-226-1615

Abdul S. Abdul
Abdul S. Abdul

Approved by ● Nick Gallopoulos
N. E. Gallopoulos, Head
Environmental Science Department

General Motors Research Laboratories
Warren, Michigan 48090

GM RESTRICTED:

Title ■ May □ May Not Be Announced Within GMR
Title ■ May □ May Not Be Announced Within GM

PURPOSE

An outdoor area at the Hydra-matic Willow Run Plant in Ypsilanti, Michigan, was used for approximately 30 years to store machinery after removal from the plant. Oily fluids leaking or washed by precipitation from these hydraulic and metal-cutting machines contaminated the ground surface with organic and inorganic constituents. From the surface, these contaminants could spread downward through pores in the sandy unsaturated zone to the underlying soil and groundwater aquifer. Hydra-matic, with the agreement of the Michigan Department of Natural Resources, decided to implement a plan designed by the authors of this report to define the potential contamination problems. The purpose of this report is to present the results of investigations carried out during 1988, which showed that the contaminants that had leaked from stored machines did not pose any significant risk to the underlying soil and aquifer.

SUMMARY

An 800 by 200 foot storage yard for disused machinery at the Hydra-matic Willow Run plant was contaminated by oily fluids that leaked from the machines. The fluids were known to contain hydrocarbons, heavy metals, and polychlorinated biphenyls (PCBs). A phased approach was used to investigate contamination at the site. The following four phases were to be implemented sequentially, and the implementation of each phase depended on finding contamination in all the preceeding phases: phase 1, delineation of the areas with surface contamination; phase 2, delineation of the vertical spread of contaminants into the unsaturated soil zone;

phase 3, delineation of contamination in the shallow aquifer; and phase 4, delineation of vapor contamination. Only phases 1 and 2 proved to be necessary.

In phase 1, surface soil sampling was used to define the lateral extent of contamination. In phase 2, soil coring was used to determine the vertical spread of contaminants into the subsurface beneath the surface contaminated areas. Soil cores were taken by driving a specially designed coring device (the GMR sampler) to a depth of 4 feet using a truck-mounted drill rig. Surface and subsurface soil samples from each location were analyzed for oily hydrocarbons, heavy metals, and PCBs to determine the extent of contamination. These results demonstrated that the foreign constituents measured in the soil were most concentrated horizontally in an approximately 100 by 200 foot central region of the yard and were contained vertically within the upper 22 inches of soil. Other areas in and around the storage yard generally had lower concentrations, many of them equal to background levels. The results adequately defined the lateral and vertical extent of the contamination, showing that, in all areas, the unsaturated soil zone below the upper 22 inches was not contaminated. Therefore, phase 3, the investigation of the deeper perched aquifer system, which starts about 6 feet below the surface, was unneccesary. Furthermore, since no vapor-phase organics were detected in the surface or subsurface samples taken in phases 1 and 2, phase 4, involving determination of vapor contamination, was unnecessary.

Neither the hydrocarbon, heavy metal nor PCB contaminants had migrated from near the surface, probably because of retardation processes such as adsorption, cation exchange, and low contaminant solubiliy. Estimates of the effects of these processes indicated that they could prevent migration even in the central region of the site where surface concentrations were

maximum. Thus, the concern about contaminant migration beyond the storage area or into the aquifer was adequately addressed by the investigation.

Because of the low levels of PCBs (maximum 4 mg/kg of soil) and metals (usually close to soil background concentrations) and the immobility of all the contaminants, current regulations did not require cleanup action. Therefore, the GMR investigation concluded that site closure was possible without further action. However, Hydra-matic plant management decided to excavate to a depth of 1-2 feet in and near the central zone of the yard to remove PCB-contaminated surface soil. The shallow and limited extent of the excavation was based on the use of the GMR soil core sampler in place of the commonly-used standard split spoon method. The standard split spoon method, could cause cross-contamination of the subsurface samples by contaminated surface material, resulting in overestimating the depth of the contamination. Because of the precise delineation of the contaminated zones achieved with the GMR sampler and the phased investigative approach, there were savings in cleanup costs at the site.

CONCLUSION

This investigation showed that contamination by stored machinery at the Hydra-matic site was minimal, requiring no clean-up action under current environmental regulations.

INTRODUCTION

An outdoor area (about 800 by 200 feet), north of the General Motors Hydra-matic Plant at Ypsilanti, Michigan, was used for approximately 30 years to store machinery removed from the plant. A site map is shown in Figure 1. In some cases, the machinery, including hydraulic presses and metal cutting machines, was incompletely drained, and leaking fluids could have contaminated the surface soil with their organic and inorganic constituents. Further, in the unlikely event of a large spill or leak the contamination could have migrated through the sandy subsurface material to a shallow perched aquifer. After agreeing with the Michigan Department of Natural Resources to address the potential problem, Hydra-matic requested the help of the Environmental Science Department to plan and carry out the investigation.

To approach the problem definition systematically and rationally, available data were gathered to characterize the local hydrogeology and the potential contaminants. Hydrogeologic data from a nearby site indicated that the subsurface is comprised mainly of fine to medium sand and a shallow perched aquifer extends from a depth of about 6 feet to a dense clay layer at a depth of about 13 feet (Abdul et al., 1988a). Analysis of fluids sampled from pieces of machinery had shown the presence of oily hydrocarbons, heavy metals, and very low levels of PCBs.

From theoretical considerations and from the available data about the site and potential contaminants, it appeared possible that contamination would be contained near the surface sources, and migration laterally and below the surface might be restricted. A large volume of oil can be retained in the pores of a sandy matrix as residual saturation (approximately 16 gallons/yd^3, Abdul, 1988). The presence of small amounts

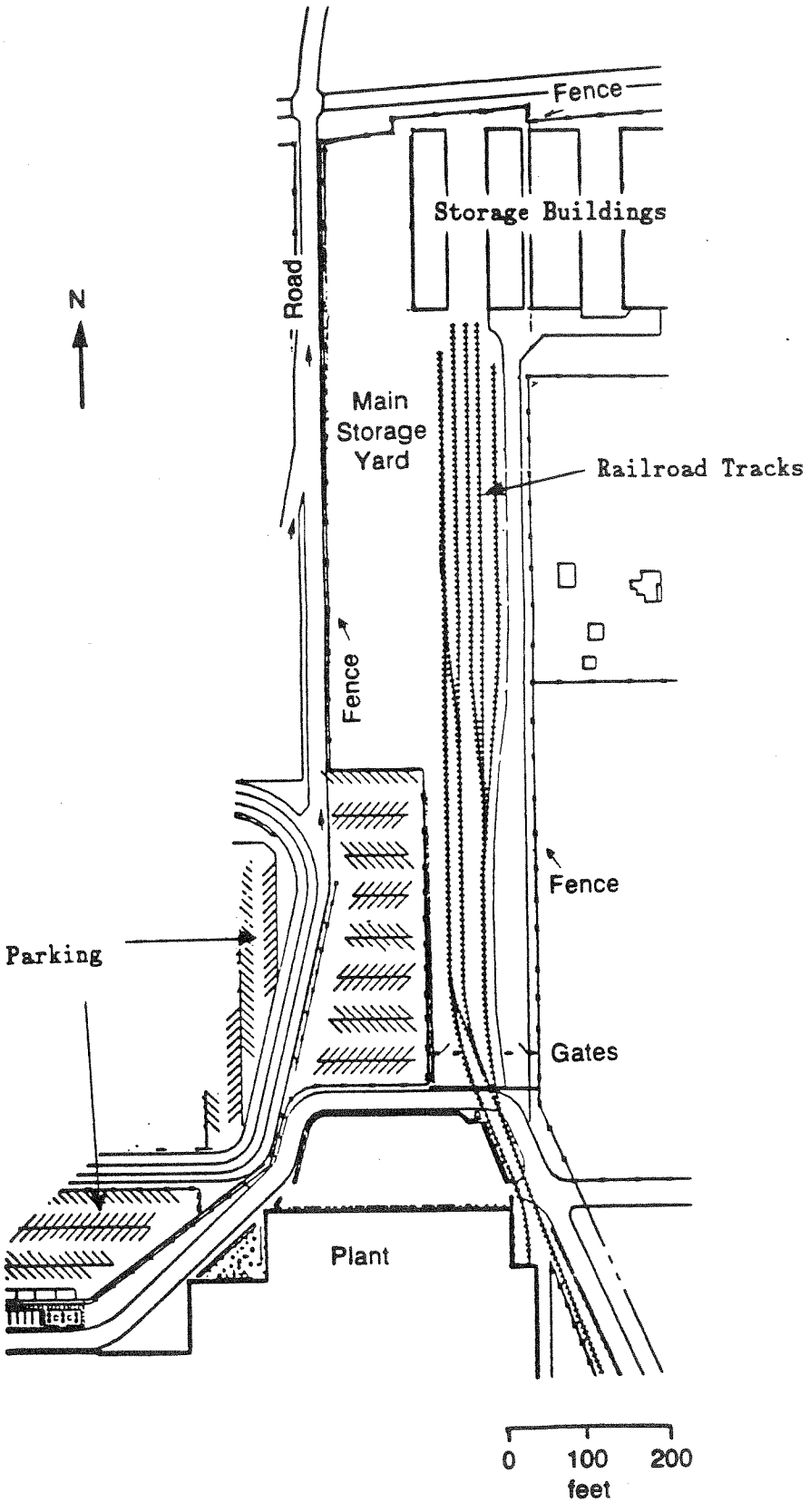


Figure 1. Map of the machine storage area at the Willow Run Hydra-matic Plant.

of clay, having a high cation exchange capacity, could tie up metal ions (Grimshaw, 1971), and PCBs are known to be strongly adsorbed and retarded by hydrophobic adsorption processes in sandy aquifer material (Abdul and Gibson, 1986; Abdul et al., 1987). Thus, extensive and costly investigations deep into the subsurface might be unnecessary at this site. In fact, coring and drilling through contaminated surface material to some arbitrary depth below the water table are common practice at contaminated sites, and should be avoided if possible because this can spread the contamination downward into otherwise clean layers.

APPROACH

To systematically assess the problem, the investigation was divided into the following four phases: phase 1- delineating the extent of surface contamination; phase 2- delineating the spread of contamination downward into the unsaturated zone and characterizing the geologic material in this zone; phase 3- delineating contamination in the perched aquifer and describing the hydrology and geology of this aquifer; and phase 4- delineating the extent of vapor contamination. It was decided that the implementation of any phase was to be based on the results of the preceeding phases. By this decision, phase 2 was to be implemented only if comtamination was found in the surface material, phase 3 was to be implemented only if contamination was found throughout the unsaturated zone, and phase 4 was to be implemented if volatile organic compounds were found in surface and subsurface materials.

Since the contaminants were released at the surface, it was appropriate in the first phase of investigation to sample and analyze only surface material. This was done by taking shallow soil samples from the

surface to a depth of 12 inches at locations 100 feet apart north to south and 50 feet apart east to west (Figure 2). Since this sampling scheme would cover the machine storage yard (800 by 200 ft), the concentrations of organic and inorganic constituents revealed by chemical analysis could be used to look for patterns of contamination in the surface material. By this method, we could judge where to concentrate our greatest efforts in delineating the lateral spread of the contaminants.

Because machinery was stored infrequently in other areas, adjacent to the yard, as well (Figure 2), it was decided to also investigate those areas. The same phased investigative approach was followed and samples were typically taken at intervals of about 100 feet.

After assessing the distribution of the contaminants in the surface material, deeper coring was planned in phase 2 of the investigation to determine the vertical distribution of the contaminants in the unsaturated zone down to the shallow water table. The GMR soil core sampler, used to take the samples, was designed specifically to take soil cores for delineating zones of subsurface contamination (Gibson and Abdul, 1989). With this device, it is possible to obtain soil cores through the shallow unsaturated soil zone without cross contamination by surface material, which the standard split spoon sampler (ASTM, 1988), most commonly used for soil sampling, is not designed to do.

Liquid or dissolved-phase contaminants in the unsaturated zone would spread mostly downward under the influence of gravity. The tendency of oils to leave behind residual contamination in the pore spaces between soil particles and the strong adsorption of hydrophobic contaminants by the soil would ensure that there could be no contamination below a surface location unless the same constituents were also found in the surface samples. Spread

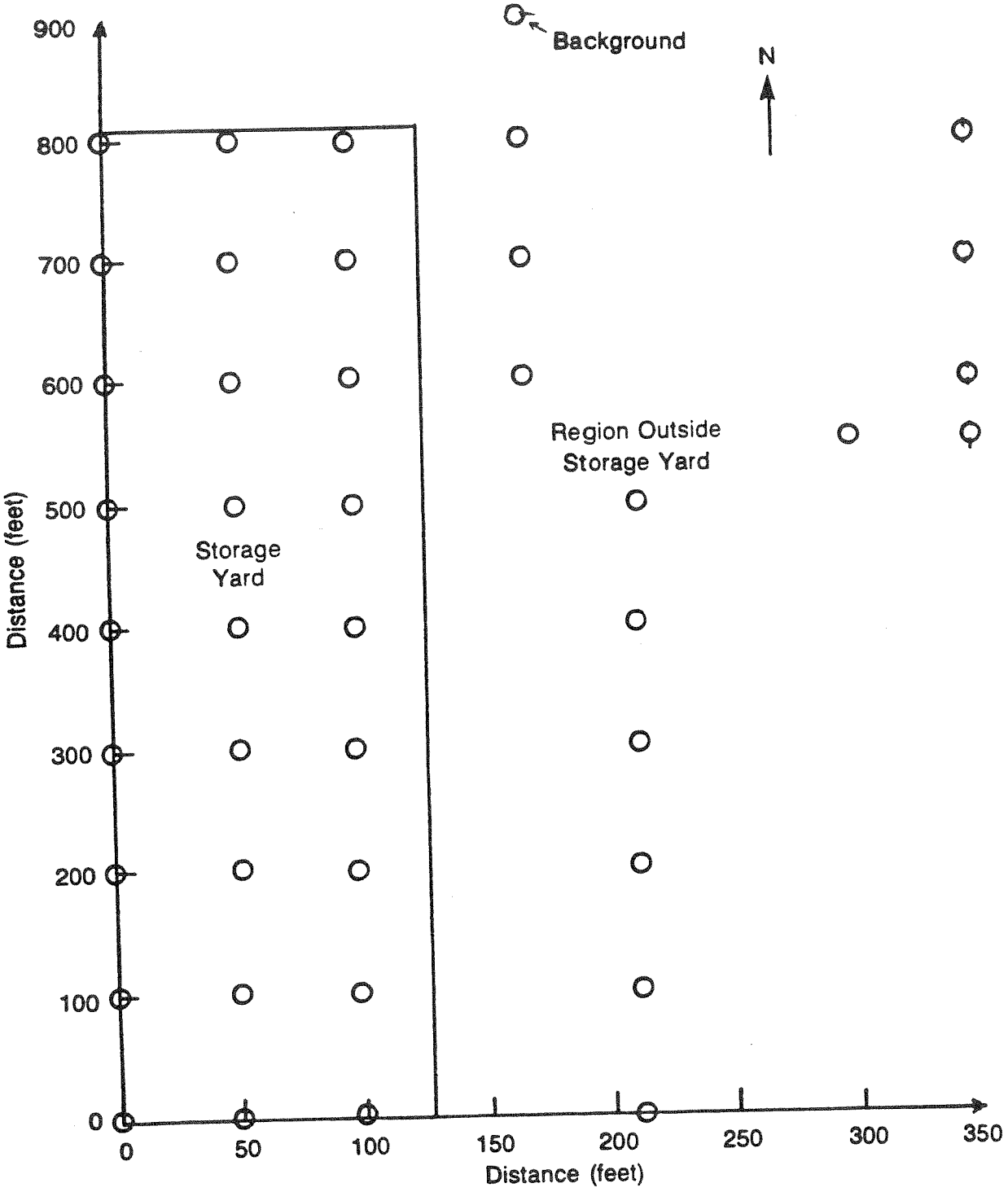


Figure 2. The surface material sampling grid at the machine storage area: Sampling locations (○).

of constituents by diffusion could likewise not contaminate underlying zones without leaving evidence of contamination in surface material. Thus, if contaminants are not present at the water table it is not necessary to implement phase 3 to look for comtamination of the aquifer.

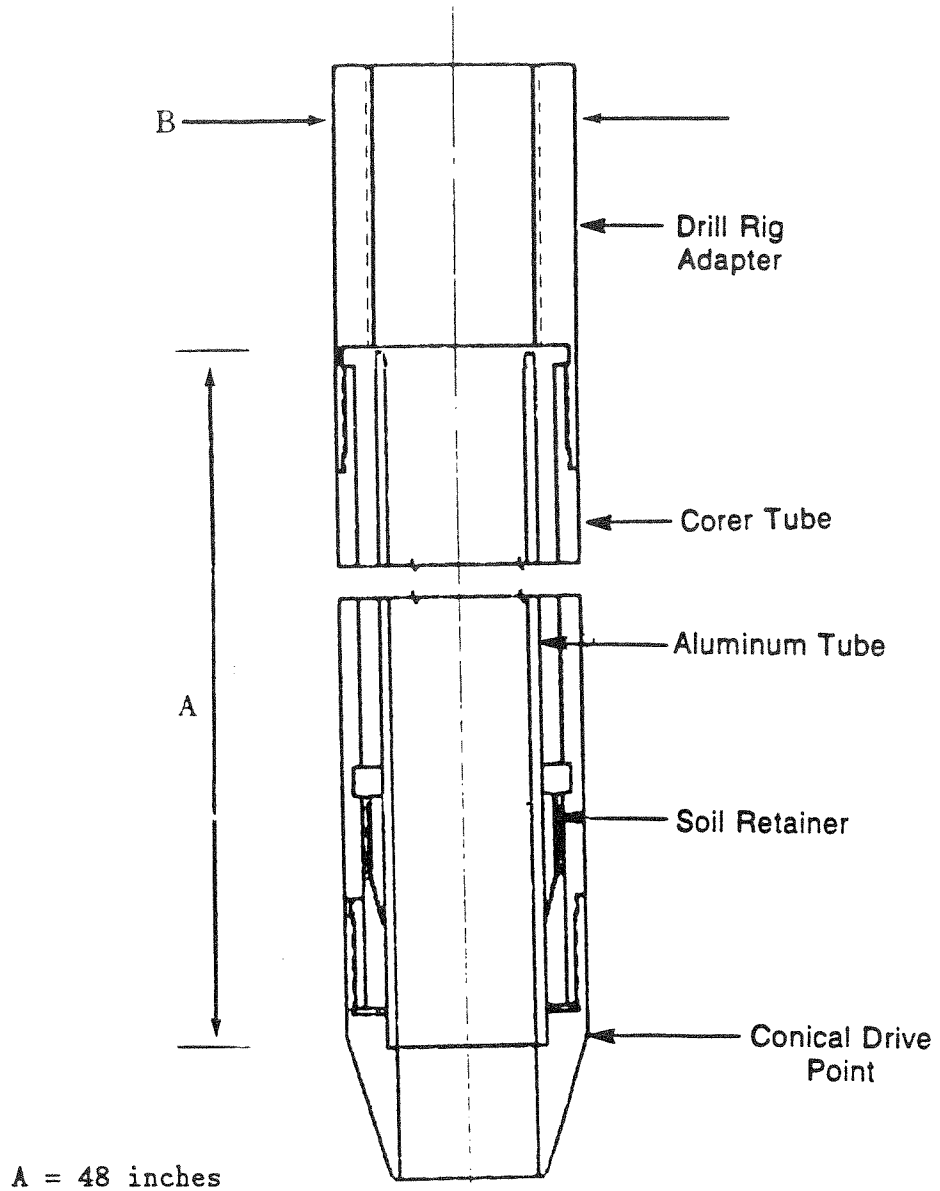
METHODS

Surface Material Samples

The split-spoon or split-barrel sampler (SSP), used to obtain grab samples of surface material from the surface to a depth of 12 inches, was that described in ASTM method D 1586 - 84, Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM, 1988). This device consisted of a steel sampler barrel, 3.0 inches O.D. and 2.4 inches I.D. by 24 inches long, which splits longitudinally, to be easily opened for inspection in the field. The split spoon was driven vertically into the ground by a truck-mounted drill rig. Each soil core, once taken out of the ground, was visually inspected and then mixed to provide a homogeneous grab sample.

Subsurface Material Samples

The GMR soil sampler used to core the unsaturated zone consists of three main parts: (1) an outer stainless steel corer tube (Figure 3), with a drill rig adapter, to mount the corer on a standard drill rod of a truck mounted rig, and a conical drive point, that can be driven into the ground; (2) an inner tube for collecting the soil made from 2.0-inch OD aluminum pipe; and (3) a metal soil retainer held in a recessed area in the bottom end of the corer tube, so that the aluminum tube extends through the retainer holding it open during soil coring (Figure 2). After the corer was driven into the ground, the leaves of the retainer could be made to



A = 48 inches

B = 3.00 inches

Figure 3. The GMR soil core sampler.

close by backing out the aluminum tube about one inch, thus preventing the soil from falling out (Figure 4).

To break through the uppermost layer of compacted surface material and old pavement and to reduce stresses on the sampler, a hollow-stem auger (10 inch OD by 6.5 inch ID) was first used to bore out the upper 12 inches of material. At the machine storage site, coring to a depth of 48 inches proved sufficient to delineate the shallow contaminated zone. After coring, the borehole was backfilled with bentonite clay. The drilling was performed by Professional Services Industries, Inc., Michigan Testing Engineers Division.

Vapor Phase Organics

A Model TIPI hand-held photoionization detector (Photovac, Inc.) was used to measure organic vapor concentrations in the surface and subsurface soil during the investigation. The TIPI can detect a minimum of 0.1 ppm hydrocarbon vapor by volume in air. Before use, the detector was calibrated with a standard gas mixture of isobutylene in air following the manufacturer's directions.

Total Hydrocarbons

Soil samples were first extracted with methylene chloride using a soxhlet apparatus. Total hydrocarbons were measured in the extracts by gas chromatography using a 30-m DB-5 capillary column and flame ionization detection, and by comparing the integrated area under the peaks with that obtained using Fuel Oil #6 as reference (modified Method 601, USEPA, 1986). A typical chromatogram is shown in Figure 5. These analyses were done under contract by Encotec, Inc., Ann Arbor, MI.

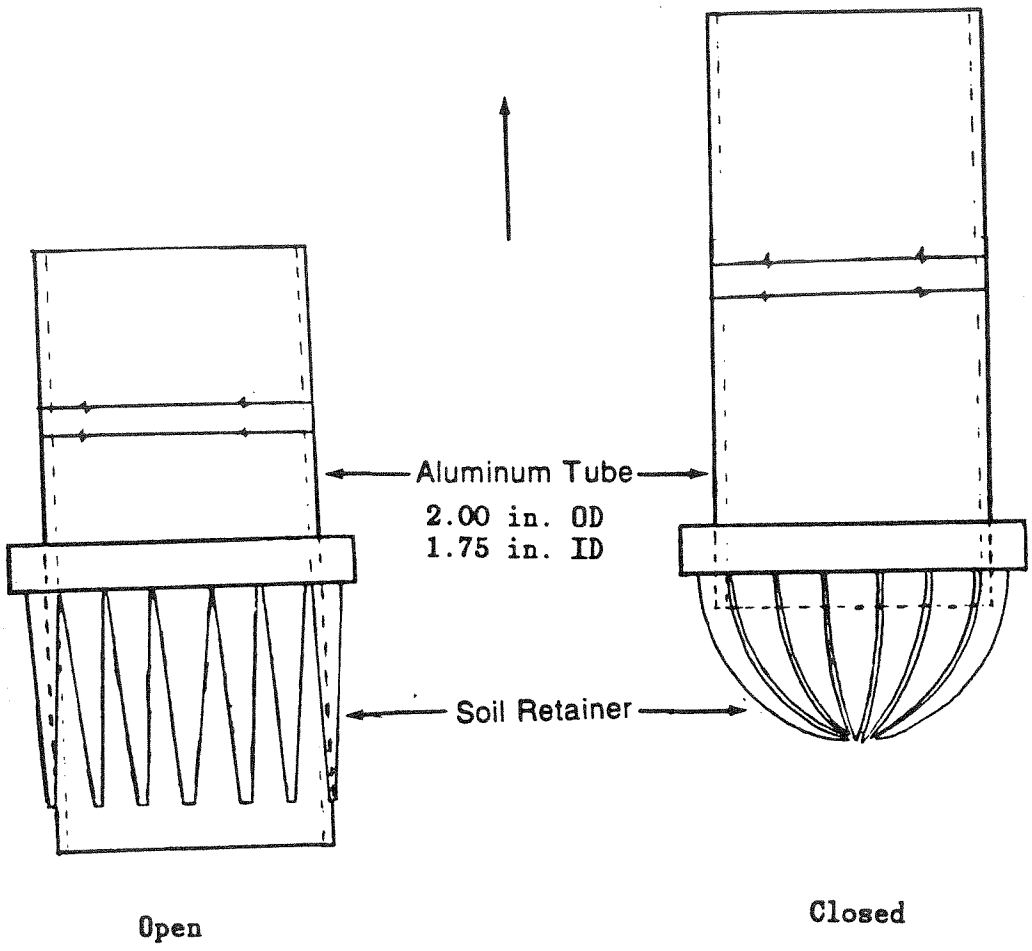


Figure 4. Operation of the soil retainer. Manually withdrawing the aluminum tube about one inch closes the retainer, holding the soil sample in the tube.

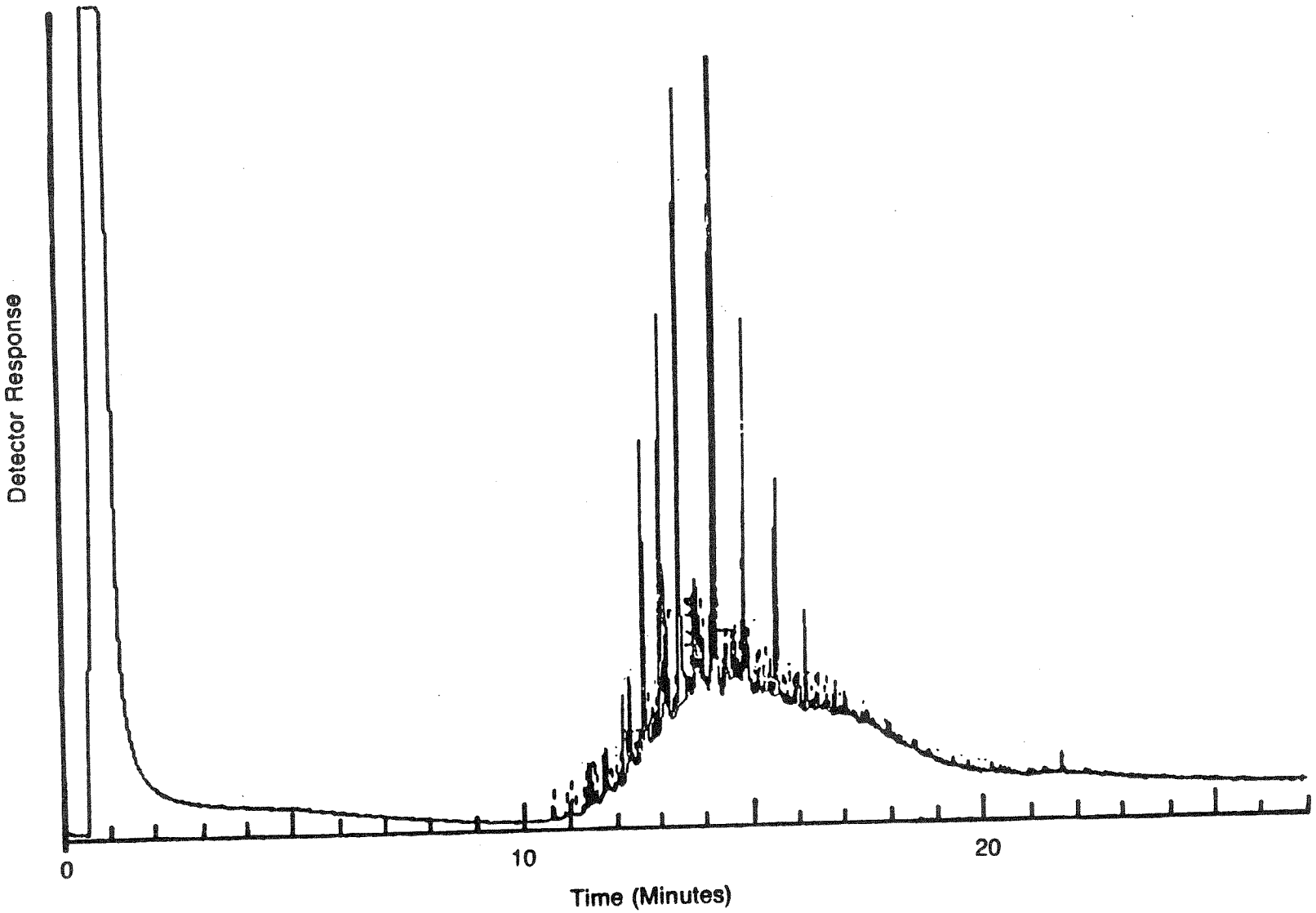


Figure 5. Typical gas chromatogram of the total hydrocarbon in a soil extract from the machine storage area (flame ionization detector). Concentration was determined from the integrated area under the peaks.

Freon Extractables

Soil samples were analyzed for total grease and oil by a procedure based on the partition-gravimetric and extraction methods described in Standard Methods for the Examination of Water and Wastewater (1985) and Method 418.1 (USEPA, 1979). Oil and grease are defined by the conditions used in the method, as any material extracted by the solvent and not volatilized when the solvent is removed. Using this method, the total Freon-extractable organic materials were measured by extracting each soil sample (approximately 100 g) with four 50-mL portions of 1,1,2-trichloro-1,2,2-trifluoroethane (Freon-113) with vigorous stirring for 5 min each. Freon was evaporated from the combined extracts by heating on a steam bath, and the residue was weighed.

Polychlorinated Biphenyls (PCBs)

PCBs were determined as Aroclors 1016, 1221, 1232, 1248, 1254, and 1260 by gas chomatography with electron capture detection in methylene chloride extracts of the soil samples , according to EPA Method 8080 (USEPA, 1986). The analyses were carried out under contract by Encotec, Inc., Ann Arbor, MI, and the results are reported as total PCBs.

Heavy Metals

The total concentrations of heavy metals, including chromium, nickel, lead, zinc, cadmium, and iron, were measured in the soil samples, after nitric acid digestion, by the inductively coupled plasma method, following EPA Methods 3050, 6010, and 7420 (USEPA, 1986). Examples of spectra for each of the metals are shown in Figure 6. Extraction Procedure (EP) toxicity tests (RCRA Method 1310, USEPA, 1986) were also performed on selected samples from the most contaminated surface material to determine

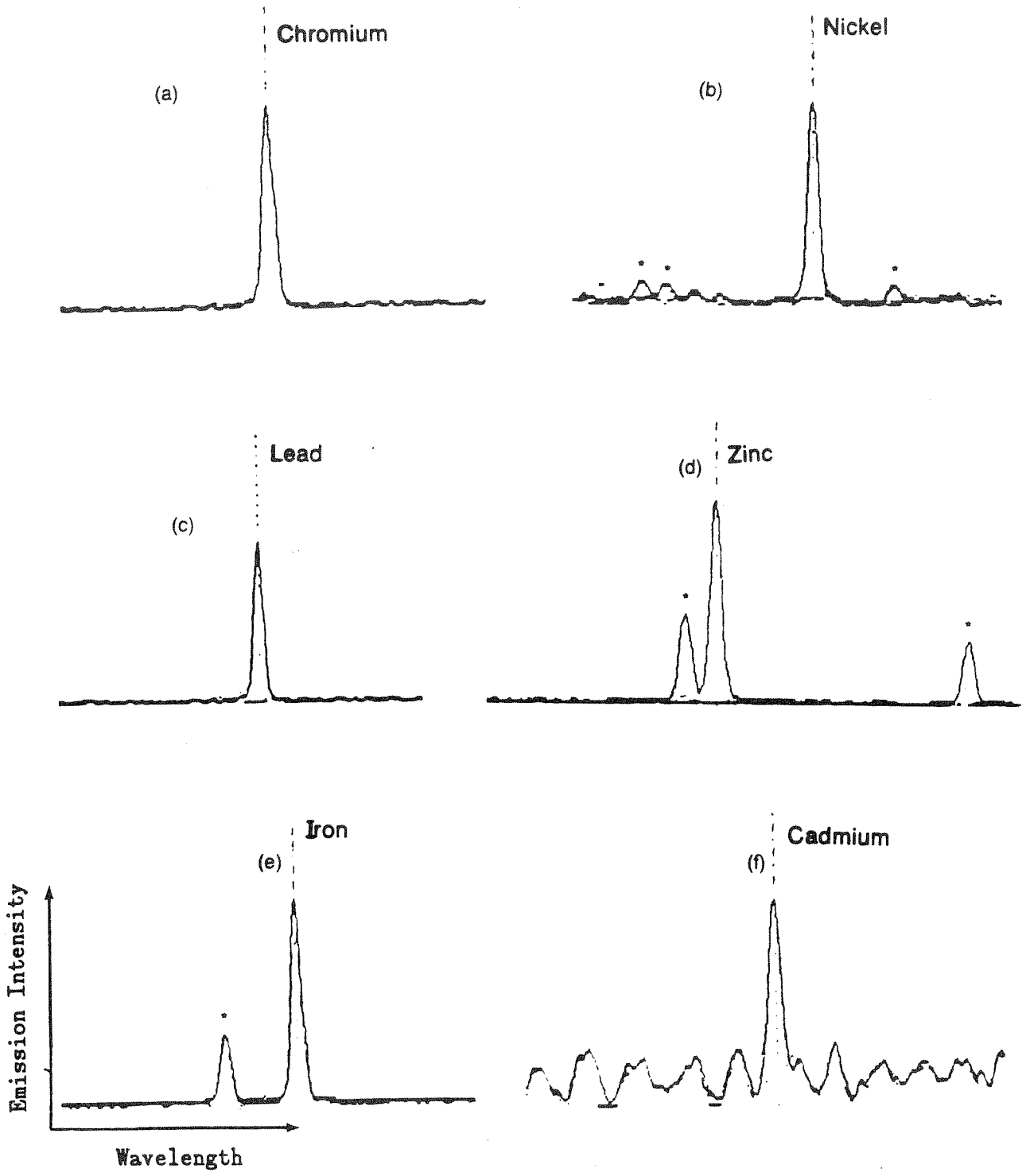


Figure 6. Typical inductively coupled plasma (ICP) spectra of heavy metals measured in soil samples from the machine storage area.
Metal, wavelength: (a) chromium, 205.552 nm; (b) nickel, 231.604 nm; (c) lead, 220.353; (d) zinc, 206.200 nm; (e) iron, 259.940 nm; and (f) cadmium, 214.438 nm. Other noninterfering metals (*).

the leachability of the metals under acidic conditions (pH about 5.0). The samples were treated with acetic acid, overnight in a rotary extractor. These analyses were carried out by Encotec, Inc., Ann Arbor, MI.

RESULTS

Contaminant Distribution in the Surface Material

The sampling grid for surface material is shown in Figure 2. This figure indicates two areas of interest: the storage yard and the area on the east side of the yard where machinery was less frequently stored. The area of primary interest is the storage yard. To identify any point on this grid, the x-(west-east) and y-(south-north) coordinates will be used, starting from the origin at the southwest corner of the site. For example, a surface sample taken 100 feet east and 400 feet north of the origin, will be labeled location (100, 400). The soil was sampled from the surface to a depth of 12 inches, and a homogenized subsample was analyzed for hydrocarbons, heavy metals, and PCBs.

Total Hydrocarbons: The total hydrocarbon concentrations in mg per kg of surface soil are shown in Figure 7 for 27 sampling locations within the storage yard and for 15 locations outside the yard. The concentrations of total hydrocarbons ranged from below the detection limit of 50 mg/kg to 14000 mg/kg. The area with the highest hydrocarbon concentration was in a central zone (shown as a hatched area in Figure 7) of the storage yard. In addition, seven locations outside the central zone, including five outside the storage yard to the east, had concentrations of hydrocarbons greater than 1000 mg/kg. Locations surrounding the central zone mostly had hydrocarbon levels of less than 300 mg/kg.

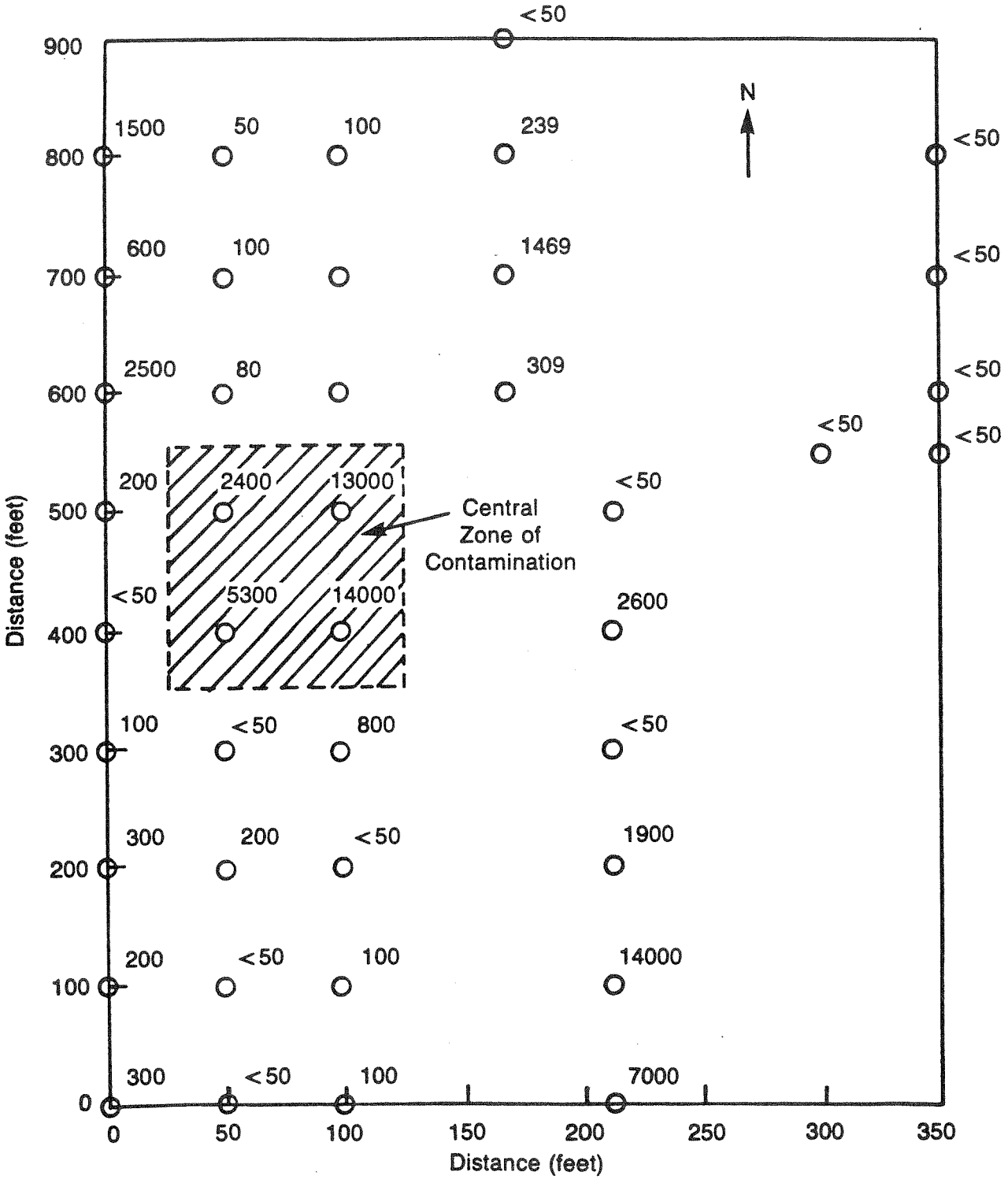


Figure 7. Concentrations of total hydrocarbons (mg/kg of soil) in surface samples from the machine storage yard. Sampling locations (○).

Heavy Metals: Figures 8 through 13 show the concentrations of individual metals in mg per kg of surface soil at 27 locations within the yard and 6 locations outside the yard. Chromium concentrations in the samples ranged from 1.5 to 74 mg/kg, nickel from 2.2 to 34 mg/kg, lead from 2.1 to 210 mg/kg, zinc from 10 to 140 mg/kg, iron from 2800 to 34000 mg/kg, and cadmium from <1 to 5.6 mg/kg. Chromium, nickel, lead, cadmiun, iron, and zinc were all found in highest concentrations in the central zone of the storage area. Concentrations about 4-20 times less than these maximum levels were found at most locations in the peripheral regions. The significance of these levels in relation to background soil concentrations will be discussed in a subsequent section.

Polychlorinated Biphenyls (PCBs): Samples from 27 surface locations in the storage yard and 6 locations outside the yard to the east were analyzed for PCBs. PCBs were found in low concentrations (4 mg/kg or less) at 4 locations in the storage yard and 2 outside (Figure 14). Again the higher concentrations were clustered in the central zone of the yard, where hydrocarbons and metals were also highest.

Contaminant Distribution in the Unsaturated Zone

Since hydrocarbons, heavy metals, and PCBs were found in surface samples, the second phase of investigation was implemented. The main objective of phase 2 was to delineate the vertical spread of contaminants beneath the upper 12 inches of surface material through the unsaturated zone toward the water table. The locations for sampling in the second phase were selected on the basis of the previously determined distribution of contaminants in the surface material. Eleven soil cores were taken

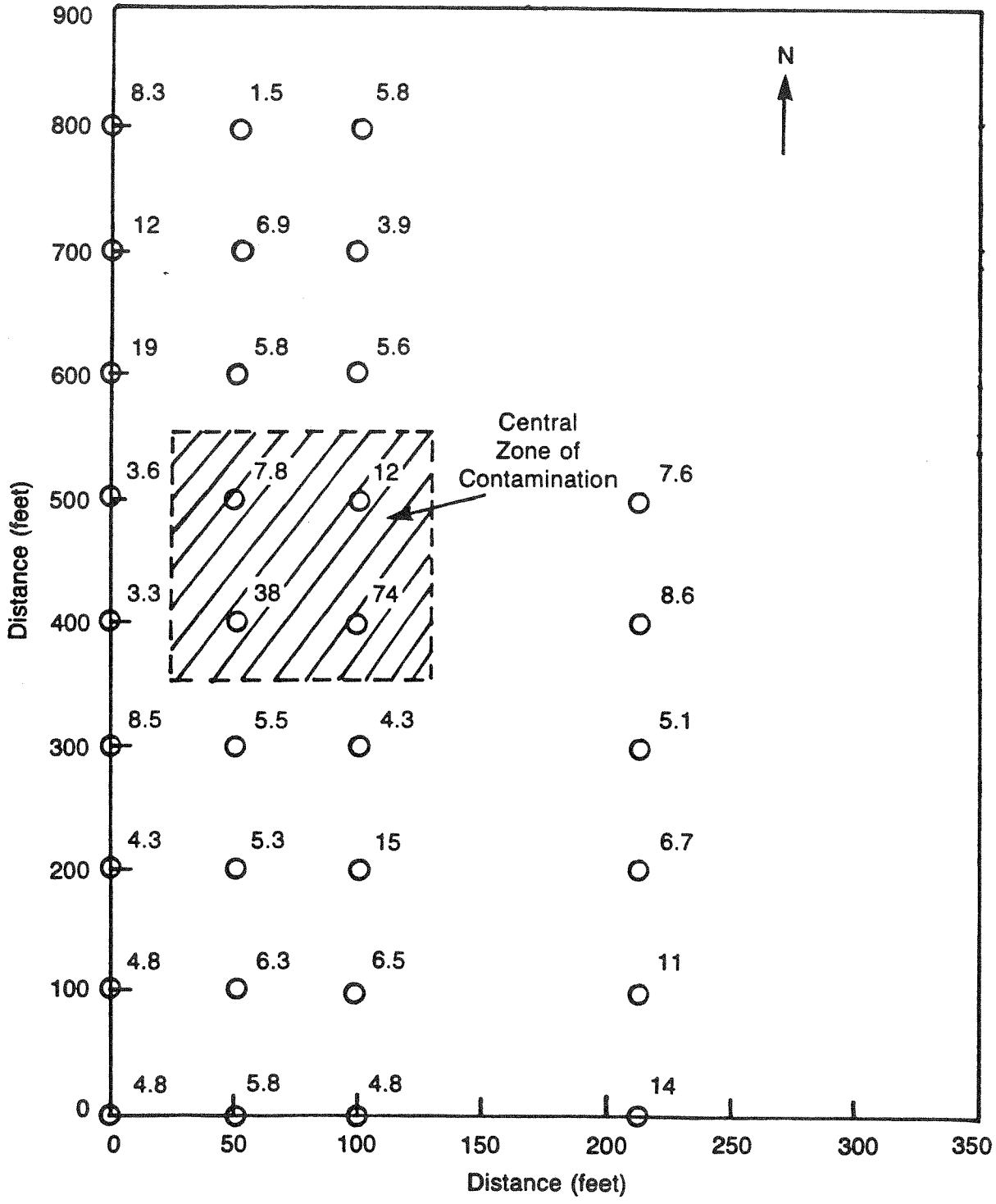


Figure 8. Concentrations of chromium (mg/kg) in surface samples. Sampling locations (○).

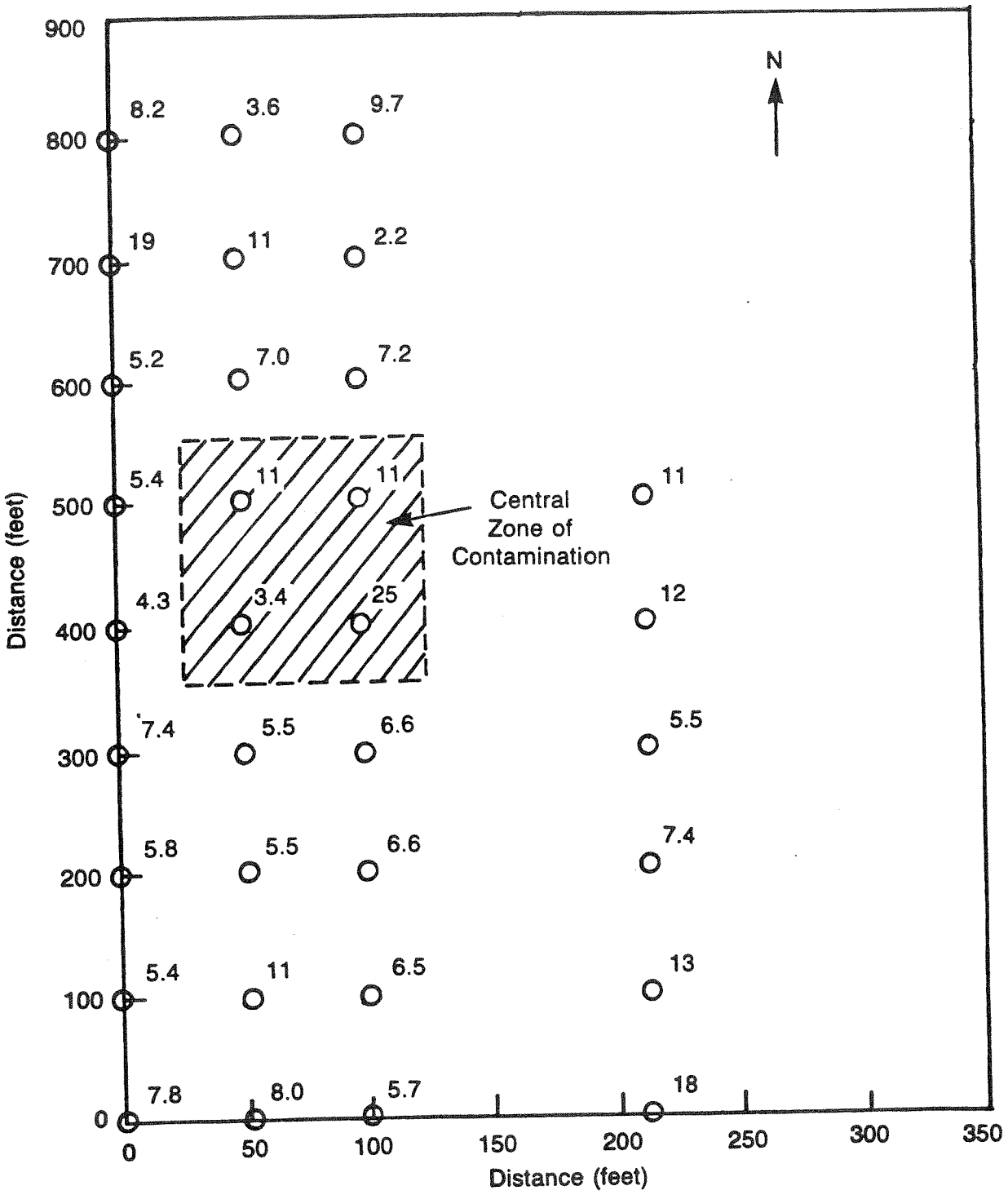


Figure 9. Concentrations of nickel (mg/kg) in surface samples. Sampling locations (○).

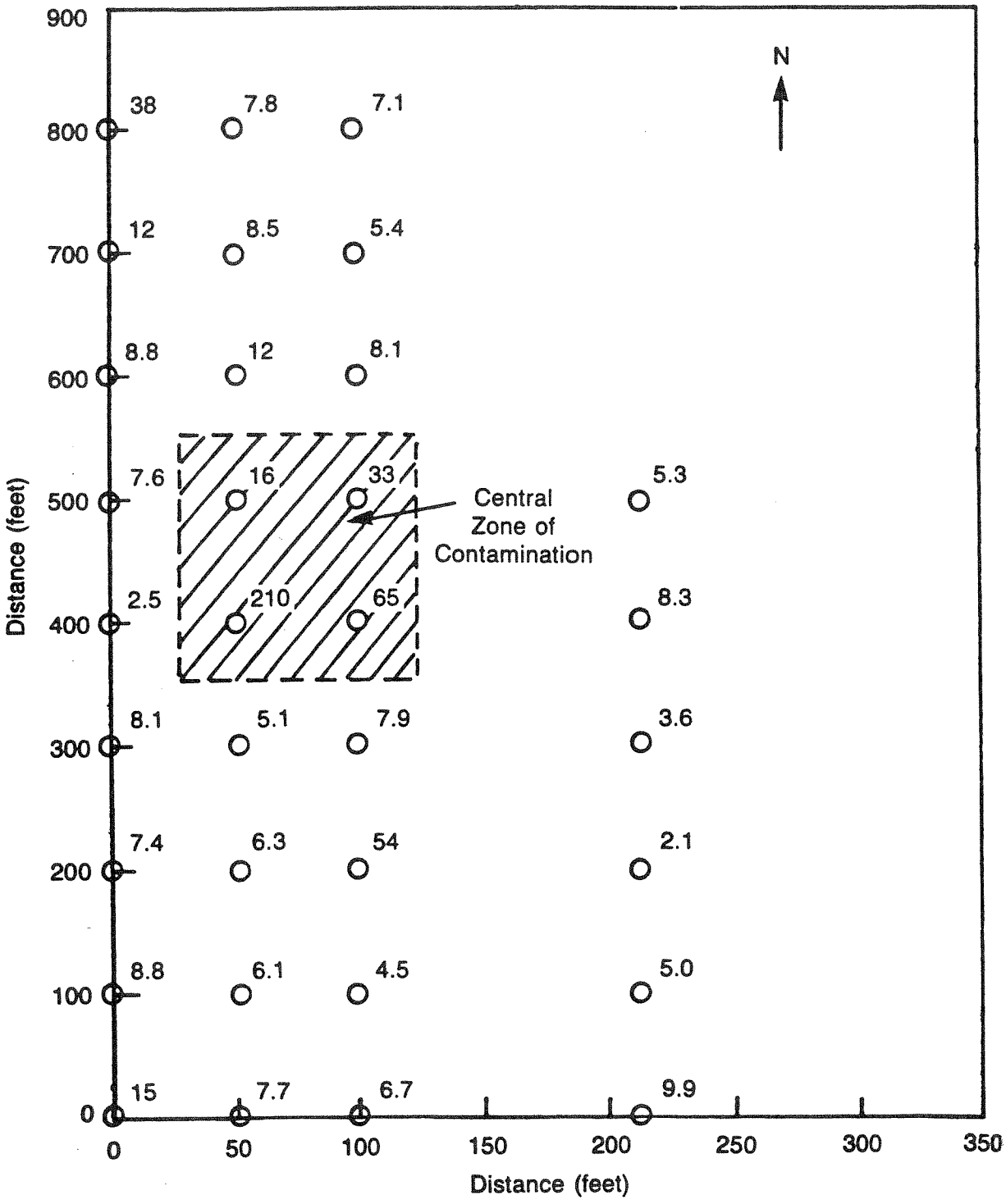


Figure 10. Concentrations of lead (mg/kg) in surface samples. Sampling locations (○).

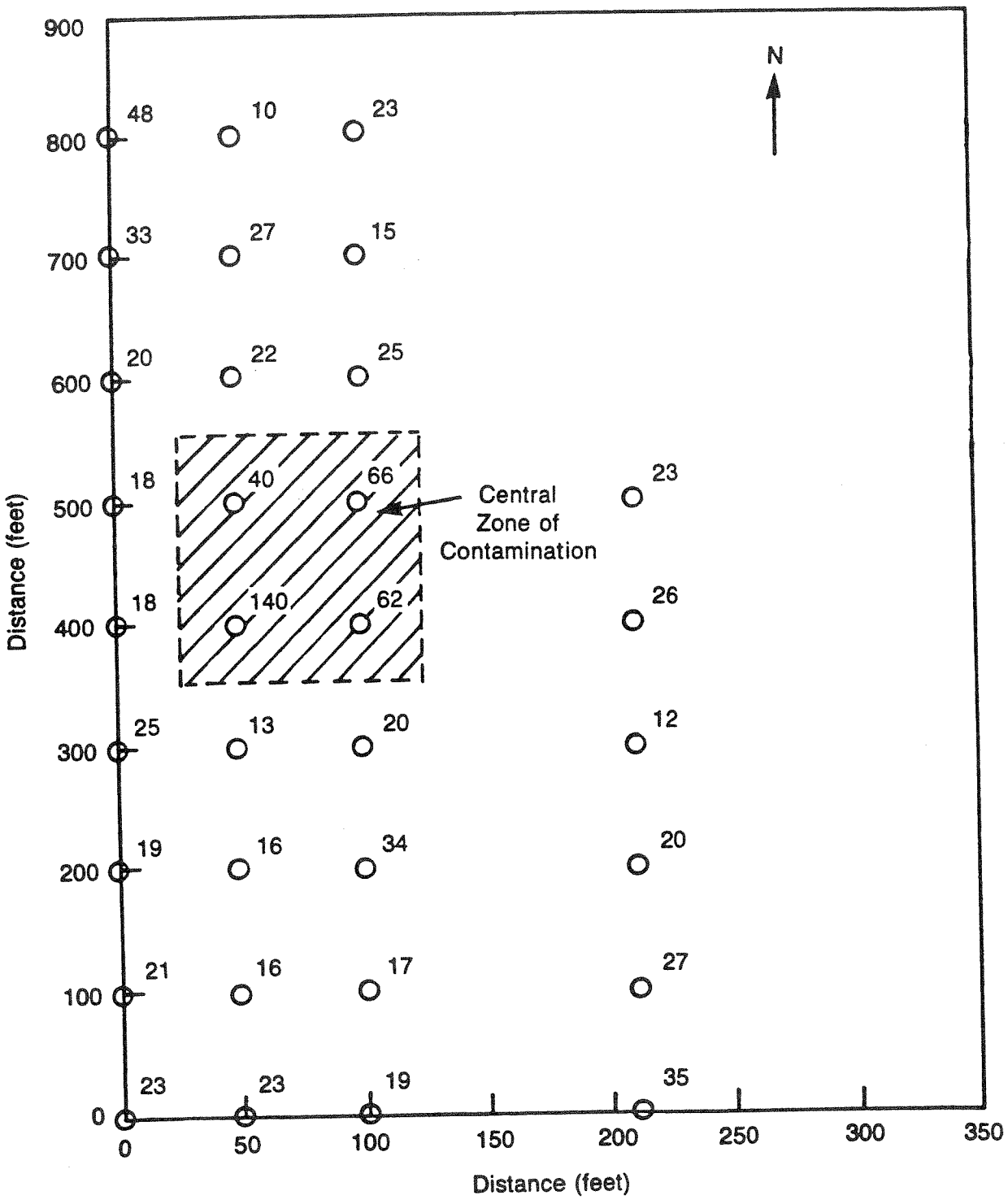


Figure 11. Concentrations of zinc (mg/kg) in surface samples. Sampling location (○).

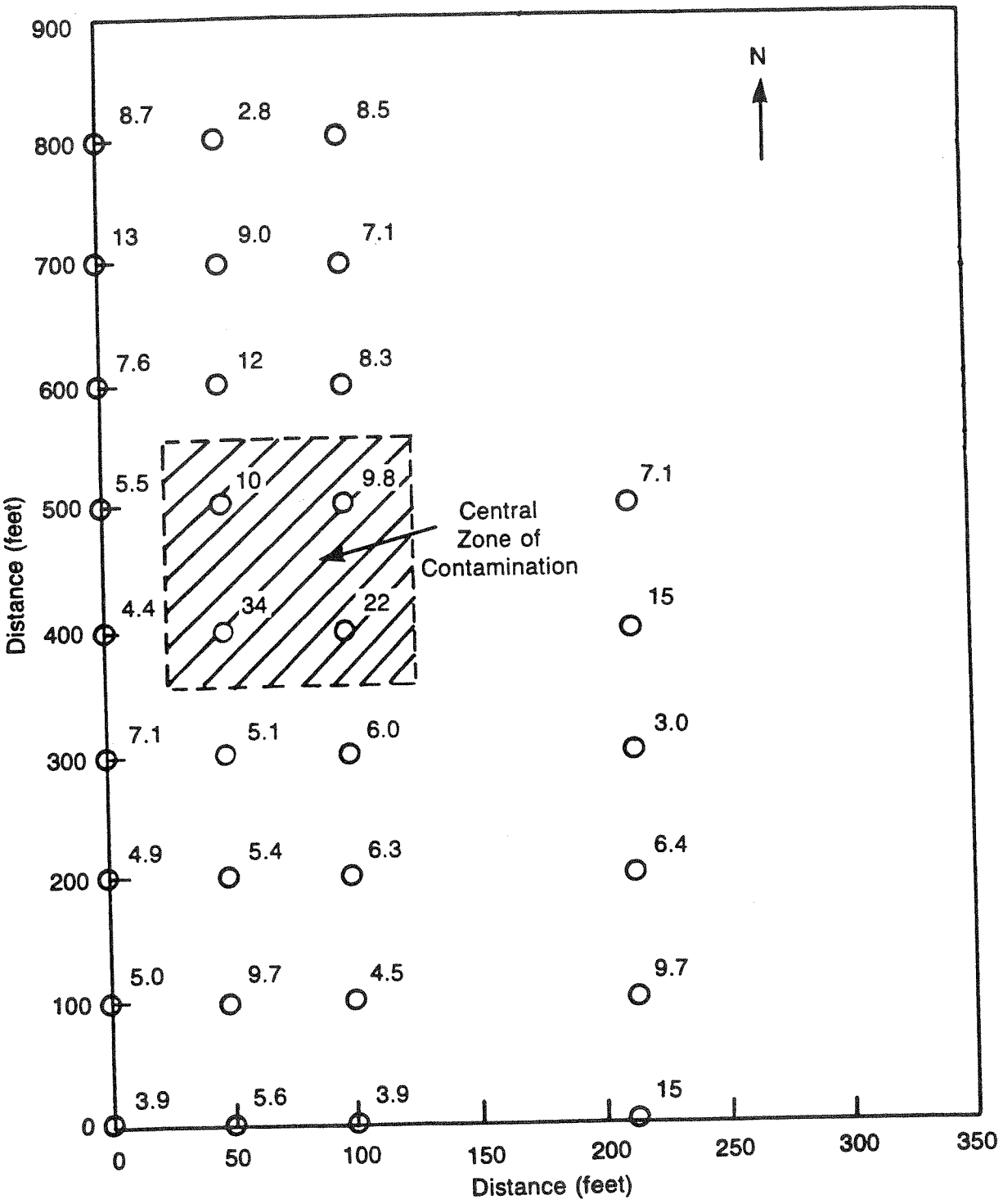


Figure 12. Concentrations of iron (mg/kg x 10^{-3}) in surface samples.

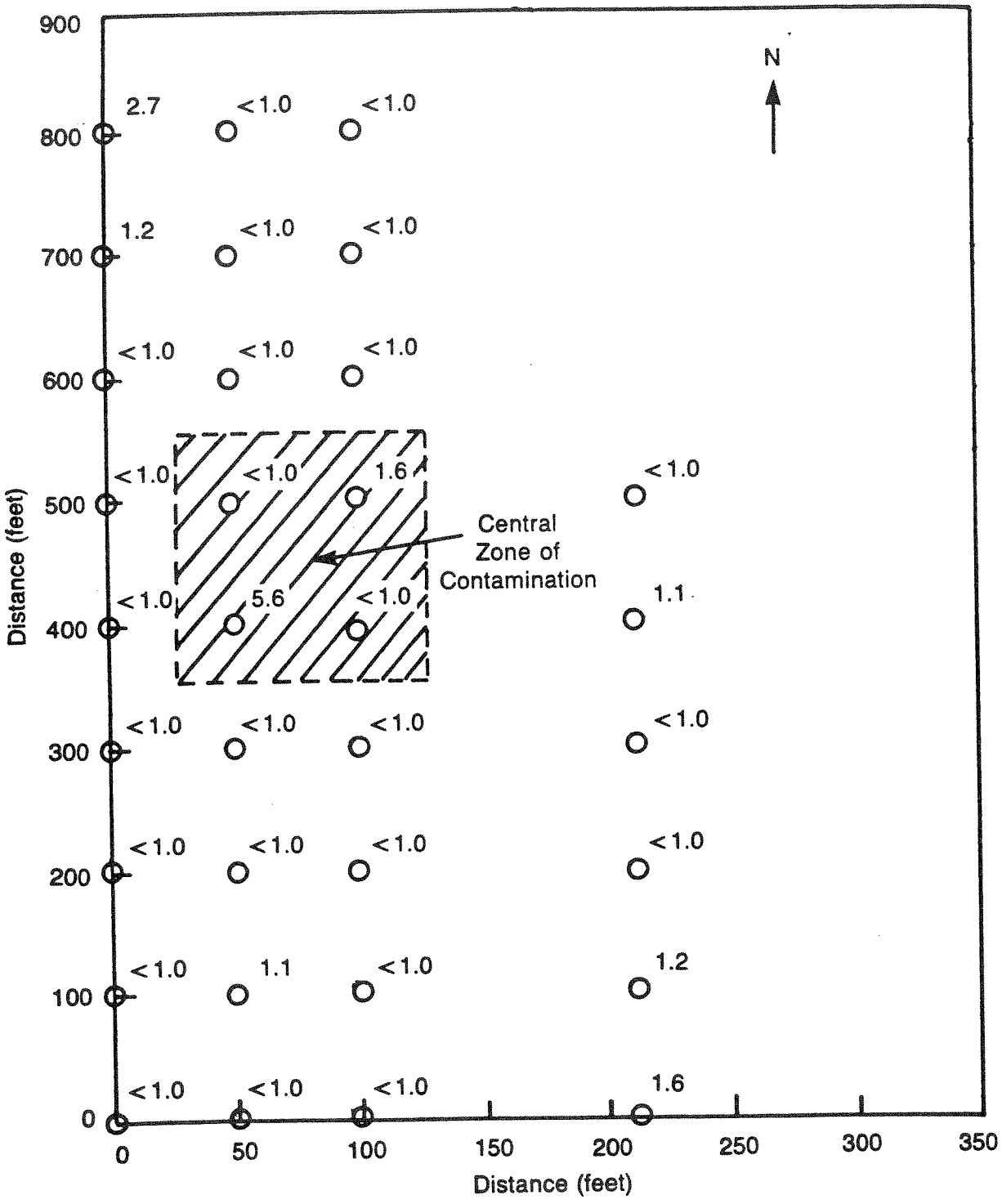


Figure 13. Concentrations of cadmium (mg/kg) in surface samples. Sampling locations (○).

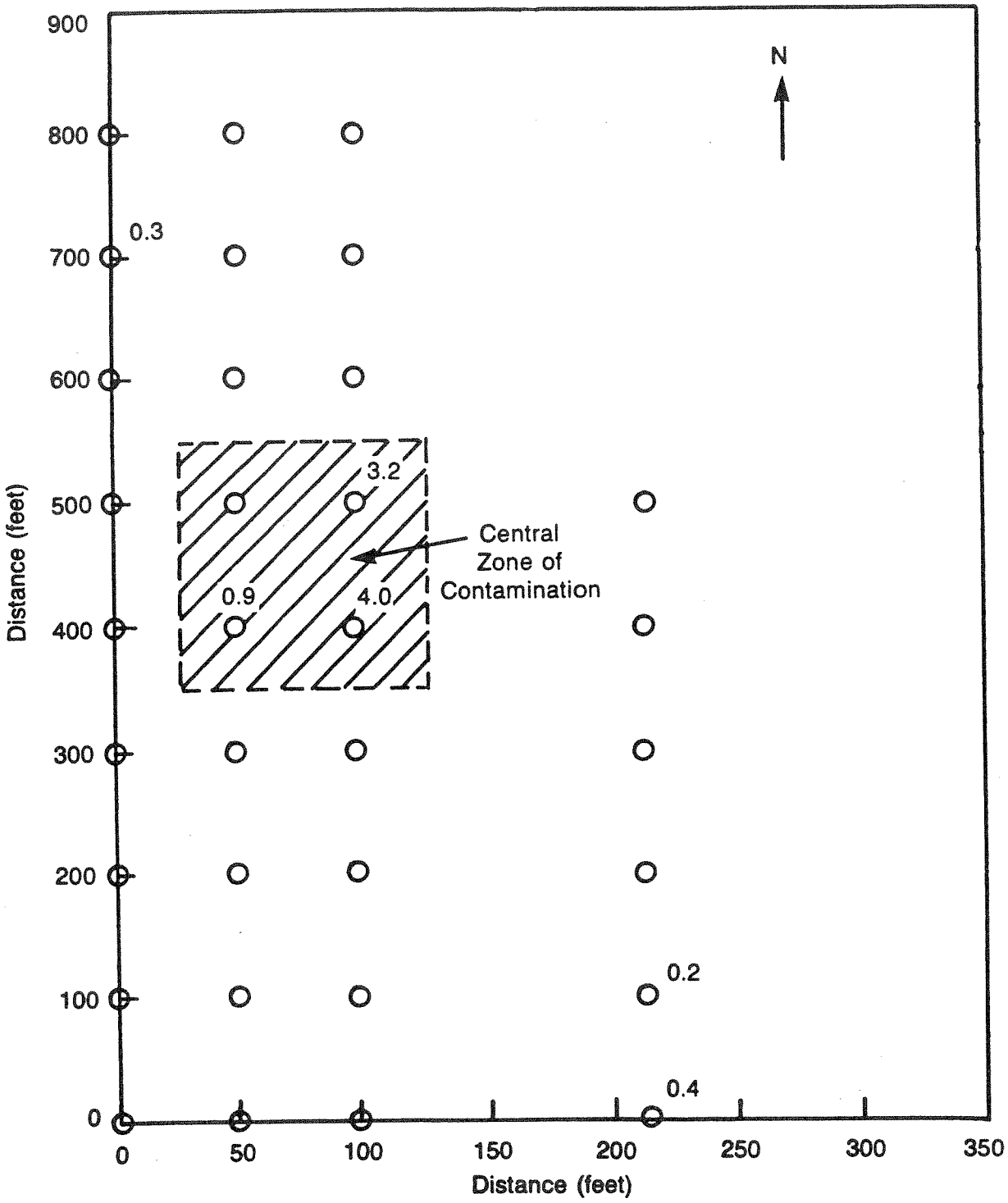


Figure 14. Concentrations of polychlorinated biphenyls (PCBs) (mg/kg) in the surface samples. The concentrations at the unlabeled sampling locations were less than the detection limit (0.2 mg/kg).

along two north-south cross-sections in the storage yard, while 10 soil cores were taken outside the yard (see Figure 15) Typically, the soil cores were taken from a depth of 1 to 4 feet using the GMR soil sampler.

Each subsurface soil core was collected in a 1.75-inch ID aluminum tube, which was then sealed at each end and taken to the laboratory for careful study. There, the tubes were split lengthwise to expose the soil core, which was examined and divided into 5-inch sections. Visual soil characteristics were recorded, and each section was extracted with Freon to determine the concentration of Freon-extractable organics. Two cores from the central zone (*locations in Figure 15) were also analyzed for metals and PCBs.

Freon Extractables: The results for Freon extractables along two north-south sections (A and B) within the storage yard and one north-south section outside the yard (C) are shown in Figure 16. The concentrations of Freon extractables range from less than 50 mg/kg to about 4000 mg/kg of soil. The vertical spread of measureable Freon extractables (>50 mg/kg) was confined to the upper 22 inches of the subsurface. The maximum concentration was found in a soil sample at a depth from 12 to 17 inches at one of the locations (75, 350) adjacent to a surface location (100, 400) with the highest total hydrocarbon level (14,000 mg/kg).

Heavy Metals: To determine the vertical spread of metals at the site, chromium, lead, nickel, cadmium, iron, and zinc were measured in soil cores at locations (75, 350) and (75, 450) in the central zone where the highest levels of surface contamination were found. The results from both locations are similar. Figure 17 shows the concentrations of chromimum, lead, nickel, and zinc at various depths of location (75, 450). The

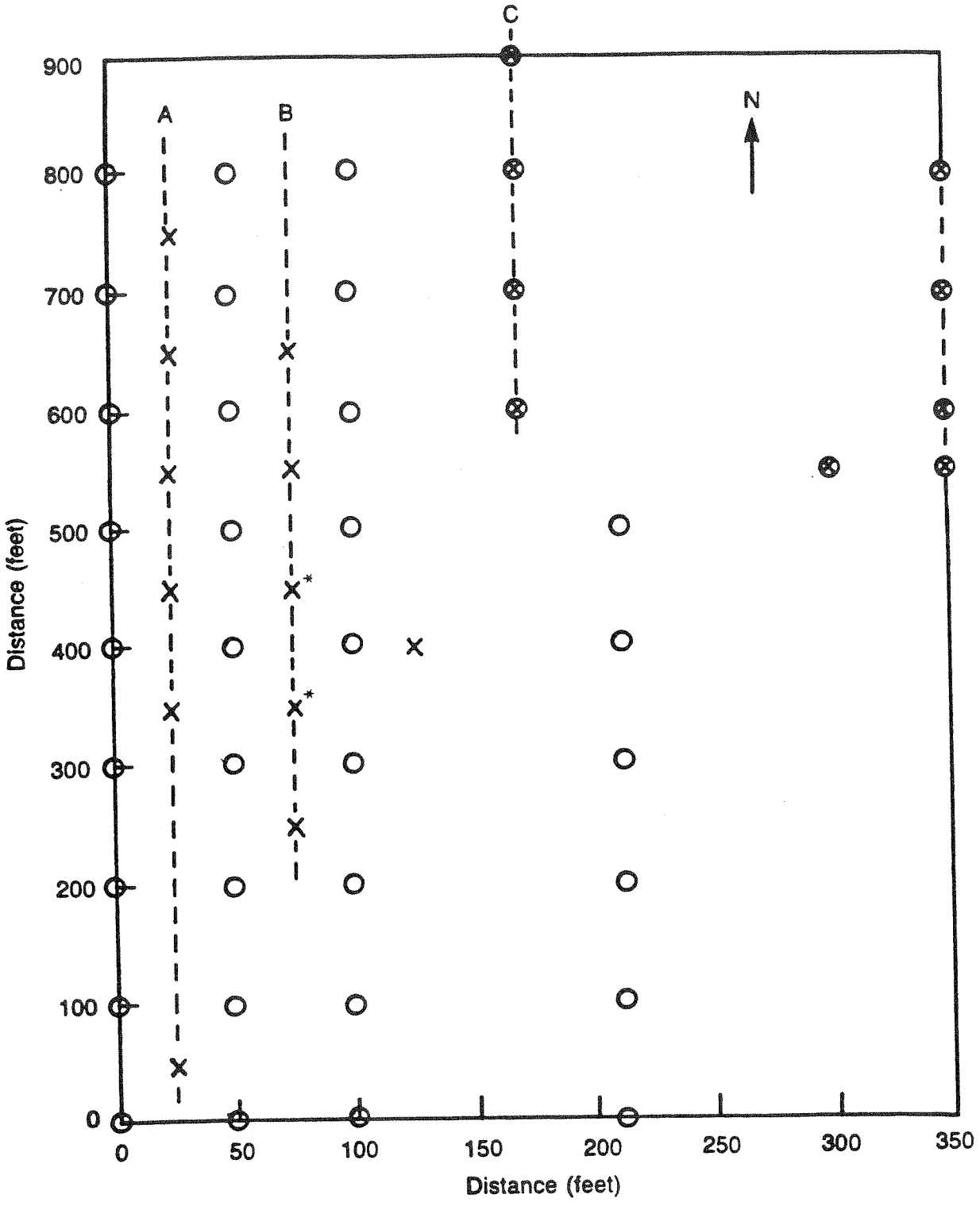


Figure 15. Phase 2 coring locations (X) used to investigate the subsurface zone (GMR soil core sampler). North-south cross-sections; A, B, C. Two coring locations for vertical distributions of metals, PCBs, and particle sizes (*).

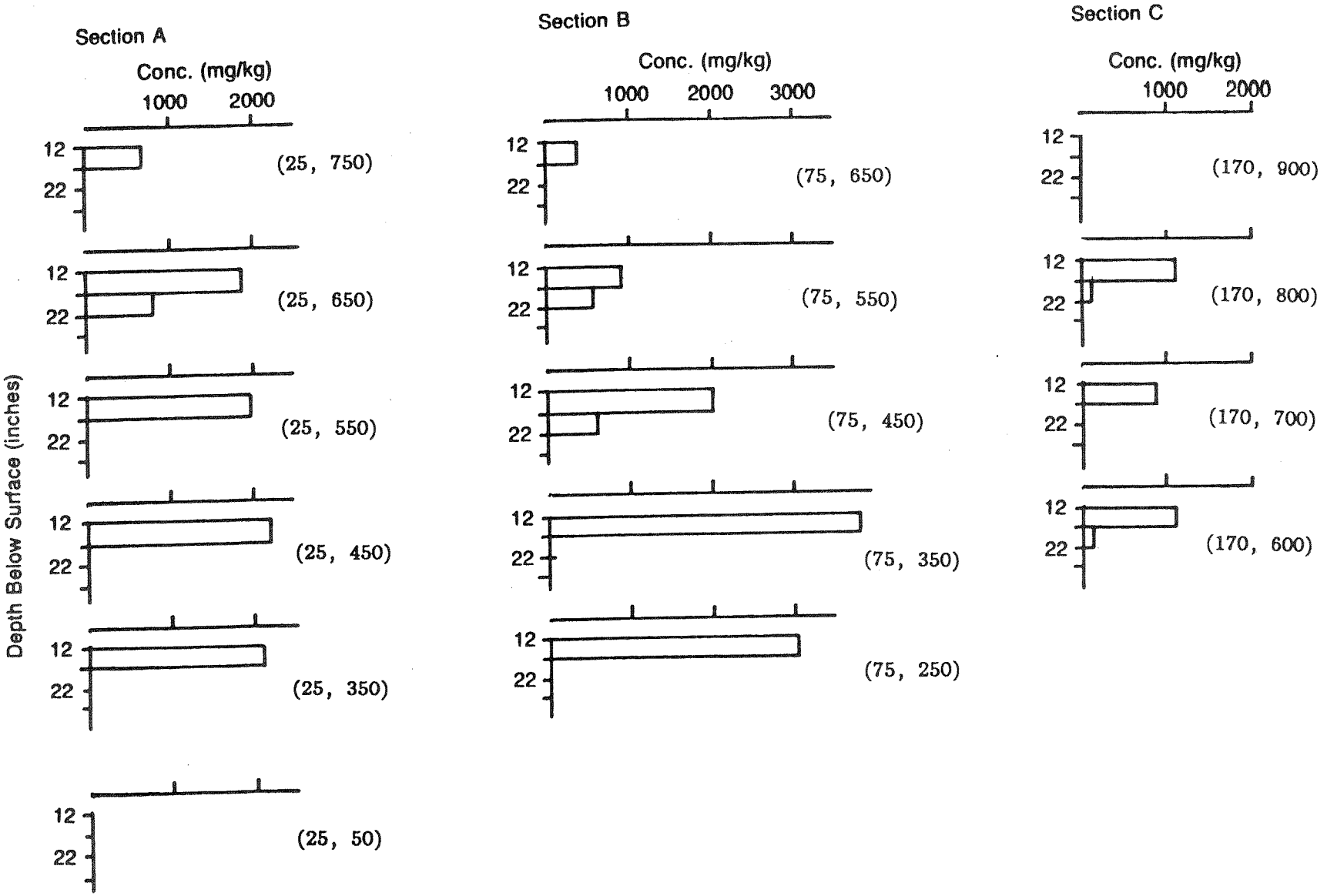


Figure 16. The vertical distribution of Freon extractables in the subsurface zone. Each bar graph corresponds to a soil core from one of the locations on north-south cross-sections shown in the previous figure. Coordinates are given in feet from the SW corner of the yard. The concentrations were measured in 5-in. core segments.

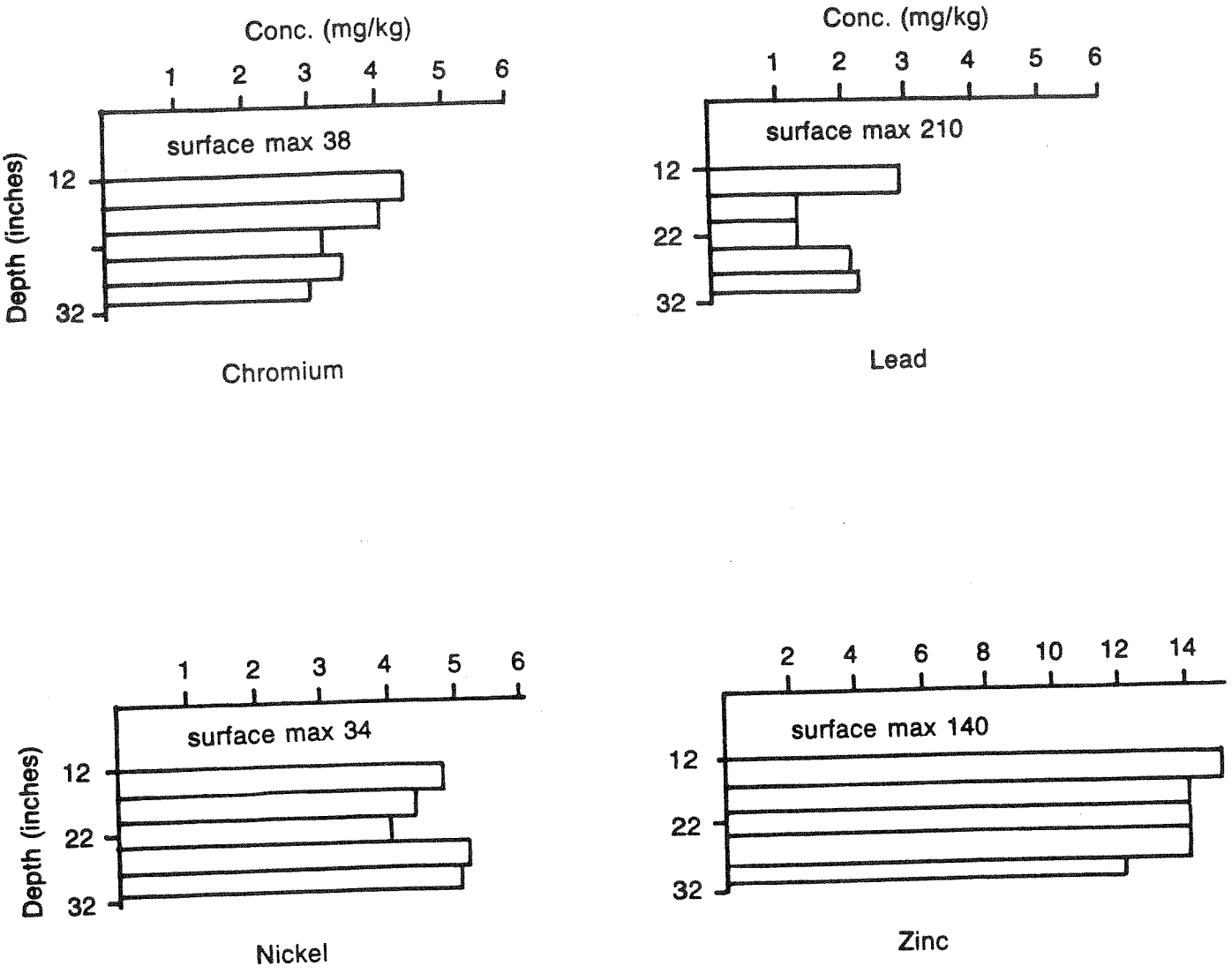


Figure 17. The vertical distribution of heavy metals in the subsurface zone at coring location (75,450).

results show that the concentrations below a depth of 12 inches are always much less than the adjacent surface concentrations. Moreover, the vertical profiles show only slight changes from depths of 1 to 4 feet, suggesting that the concentrations may be background. The results for cadimum and iron are similar to those for the other four metals.

Polychlorinated Biphenyls (PCBs): The two soil cores analyzed for metals were also analyzed for PCBs. PCBs could not be detected (<0.2 mg/kg) in any of the samples taken from below the surface (12 inches).

Vapor Phase Organics

No volatile organic compounds (VOCs) were detected by the portable photoionization detector. Samples of soil from the surface to a depth of 4 feet were tested during the surface sampling and coring investigation.

Site Characterization

The site material was first characterized by visual inspection of the surface soil samples and subsurface soil cores. Several distinct subsurface soil layers were observed in all regions of the machine storage area with only minor variations in their depth and thickness. Like the other areas at the plant, the shallow subsurface material at the site consisted mainly of sand and some gravel with less than 1% of clay and silt. The upper 12 inches of surface material in the storage yard was coarse sand, gravel and stones. However, areas outside the yard are typically covered with grass and have natural soil.

The particle size distribution of subsurface materials from locations (75, 350) and (75, 450) at the storage yard was investigated more precisely by fractionating soil core samples from various depths. The masses of

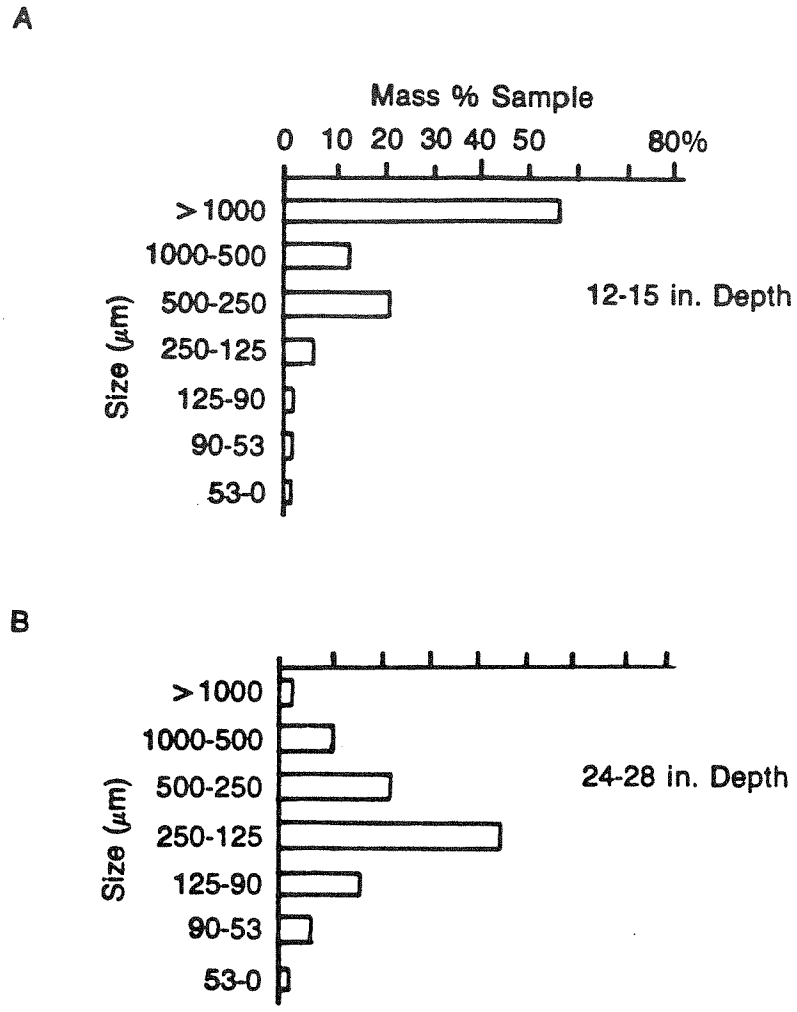


Figure 18. Particle size distribution in subsurface samples from the machine storage yard at coring location (75, 450). (A) The sample nearest the surface zone, containing fine gravel. (B) Fine-medium sand most typical of the subsurface material.

seven size fractions (>1000, 1000-500, 500-250, 250-125, 125-90, 90-53, and 53-0 μm) were determined by first sieving a section of soil core through a series of standard size steel meshes and then weighing each size fraction. Although the core segments contained varying distributions of particle sizes, the subsurface material was predominantly fine and medium sand with considerable gravel mainly near the surface. The results from the two cores are similar; therefore, two typical particle size distributions in core segments from location (75, 450) are shown in Figure 18: (A) material nearest the surface containing substantial amounts of fine gravel and (B) sandy material from a depth below 2 feet. The mean particle size of the sandy material was typically about 200 μm.

The hydraulic conductivity of water through two soil samples from the lower region of the unsaturated zone was measured in the laboratory by the falling head method (Freeze and Cherry, 1979). In these measurements, about 50 g of soil was added to a glass column that was fitted at the base with a fritted-glass plate and connected at the top to an upright burette. While water from the burette flowed through the sand, the change in water head in the burette and the flow rate were measured. The saturated hydraulic conductivity (k_s) was calculated by using Equation (1) (Freeze and Cherry, 1979):

$$k_s = (aL/A\delta t)\ln(h_i/h_t) \qquad (1)$$

where, L is the thickness of the soil column, δt is the time interval, h_i is initial head of fluid in the burette, h_t is the head of fluid in the burette after time δt, and a and A are the cross-sectional areas of the burette and soil column, respectively. From these tests the average saturated hydraulic conductivity of the soil to water was 5×10^{-3} cm/sec.

The organic carbon content of a sample of sandy material from the deeper region of the unsaturated zone was measured using a carbon analyser (Abdul et al, 1987) and was approximately 0.5 percent.

DISCUSSION

Based on the distributions and concentrations of contaminants measured at the site, it was possible to assess the problem and to determine what cleanup steps were needed, if any.

Polychlorinated Biphenyls (PCBs): Of 27 sampling locations in the storage yard and 6 outside the yard, PCBs were detected at only six locations. The total PCB levels ranged from undetectable to 4 mg/kg and exceeded 1 mg/kg at only two locations, both being in the certral zone of the storage yard. At this time, there are no regulations which apply directly to low level soil contamination by small oil leaks over a long period. Federal spill cleanup policy (Federal Register, 1987) applies only to spills of oils with more than 50 ppm PCBs, occurring after 1987. However, the concentrations of PCBs found at the time of the site investigation can at least be compared to the levels that the policy requires after site cleanup. The machine storage yard represented a fenced, restricted access area. According to the policy, when a spill has occurred in a restricted-access area, it is necessary to clean the contaminated plot to a soil PCB concentration of 25 ppm (mg/kg) by weight. The stricter requirements for decontaminating spills in nonrestricted-access areas would also not remove PCBs to the 4 ppm (mg/kg) level. At such places, contaminated soil should be decontaminated to 10 ppm (mg/kg) PCBs by weight. At the machine storage yard the levels of PCBs are less

than the levels to be left behind after cleanup of either the restricted or nonrestricted areas.

Moreover, the low level PCBs, if left in place at the storage site could not migrate through the unsaturated zone to the underlying perched water table (below a depth of 6 feet). The migaration of PCBs, due to leaching by rainfall, through soils is retarded by the strong adsorption of PCBs on soil particles. Adsorption is determined by the K_d, i.e. the adsorption coefficients of the compounds. K_d defines the concentration of contaminant in water (C_w) in equilibrium with contaminant adsorbed on soil (C_s) according to equation 2.

$$C_s = K_d \times C_w \qquad (2)$$

The value of K_d can be estimated from the octanol-water partition coefficient (Kow) and the organic carbon content of the soil (Foc) using equations 3 and 4 (Abdul et al., 1987).

$$K_d = Foc \times Koc \qquad (3)$$

$$\log Koc = 1.04 \log Kow - 0.88 \qquad (4)$$

For the machine storage site, where the Foc of the surface material is about 0.5% and for PCBs whose Kow is about 4×10^5, a value of $K_d = 442$ was calculated. Based on this value of K_d, infiltrating water in equilibrium with surface soil having 4 mg/kg PCBs could remove an aqueous concentration of just 9.0×10^{-3} mg/L. As soon as these dissolved PCBs contacted clean soil, however, perhaps one centimeter deeper, the aqueous concentration of 9.0×10^{-3} mg/L would be reduced to 20.5×10^{-6} mg/L at equilibrium,

according to the same equations. Thus, water percolating down from the contaminated surface soil would be readily cleansed when it had migrated a very short distance.

Heavy Metals: The mobility of metals through soils is dependent on the cation exchange capacity (CEC) of the soil. The CEC is defined as the quantity of exchangeable cations in milliequivalents per 100 g of soil that can adsorb on the negatively charged particles (clay minerals). Typically in the approximately neutral environment of surface soils at the site (pH 6-7), where the CEC is expected to range from 5 to 10 meq/100 g of soil, the mobility of metals is insignificant (Abdul et al., 1988b; Grimshaw, 1971). The cation exchange of metals, including chromium, nickel, lead, cadimum, iron, and zinc, with soil cations such as Ca^{+2} and Mg^{+2} can explain why they were contained in the thin upper layer above 12 inches at the contaminated site. Table 1 summarizes the results of measuring these six metals at the machine storage yard in the surface and subsurface layers and compares their concentrations with average background values found in Michigan (MDNR, 1988), and in Pennsylvania and Tennessee (EPRI, 1986). From a comparison of the results at the site with the reference values, it apppears that the subsurface concentrations of these metals represented background levels, and even the surface concentrations exceeded the reference ranges only for lead, cadmium and perhaps zinc.

The results of measurements of heavy metals in the leachate from the most contaminated surface soil (EP Toxicity test) are given in Table 2. These results indicate that none of the six metals in the surface soil was leached under the conditions of the test, which uses acetic acid to lower the pH to 5. Thus, the influx of even acid precipitation could not cause significant migration of the metals. Further, the concentrations of the

Table 1. Heavy metal concentrations in soils from the machine storage area and typical background averages.

Metal	Storage Yard Maximum conc.[1] Surface (mg/kg soil)	Subsurf. (mg/kg soil)	Michigan avg.[2] Sand (mg/kg soil)	Clay (mg/kg soil)	Pennsylvania[3] Soils (mg/kg soil)	Tennessee[3] Soils (mg/kg soil)
Chromium	74	5.7	3-4	9-25	66-100	26-74
Nickel	34	5.2	3-10	25-34	25-45	6-17
Lead	210	2.9	9-14	13-23	25-32	5-19
Zinc	140	16	--	41-51	81-115	25-168
Iron	34000	5000	--	--	37000-56000	13000-47000
Cadmium	5.6	<1	1-1.4	1-1.6	--	--

[1]Total metal concentration in soil sample measured by the inductively coupled plasma method after nitric acid digestion.

[2]MDNR (1988).

[3]EPRI (1986).

Table 2. Metal leaching measurements for the most contaminated surface soil at the machine storage yard.

Metal	Concentration (mg/kg)[1] Soil sample locations (50, 400)	(100, 400)	(200, 100)	RCRA[2] stds	Drinking[3] water stds
Chromium	<0.03	<0.03	<0.03	5.0	0.05
Nickel	<0.05	0.07	<0.05	--	--
Lead	0.05	0.06	<0.02	5.0	0.05
Zinc	0.08	0.25	0.02	500	5.0
Iron	4.1	5.5	0.33	--	--
Cadmium	0.01	0.01	<0.005	1.0	0.01

[1]Metal concentration in leachate after overnight extraction (pH 5) following the EP Tox Test, RCRA Method 1310 (USEPA, 1986).

[2]Title 40, CFR, Sec. 141.

[3]Title 40, CFR, Sec. 261.24.

metals in the acidic leachate were within the RCRA and Federal Drinking Water Standards (Title 40, CFR). Based on these results, like those for PCBs, there was no need for site remediation due to contamination by metals.

Total Hydrocarbons - Freon Extractables: When oily hydrocarbon mixtures, such as the Freon extractable material or total hydrocarbons measured at the machine storage yard, drain through soils, they leave behind a residual fraction trapped in the pore spaces between soil grains. The residual oil is not continuous and cannot migrate under the influence of gravity (Abdul, 1988). This residual fraction could occupy about 22% of the pore volume as determined by laboratory measurements on the soil at the Hydra-matic site. A residual oil volume of 22% is equivalent to 50,000 mg of oil per kg of soil (57 mL oil/kg of soil). Even this relatively low, immobile concentration of oil is much higher than the levels found in the surface soil at the most contaminated locations in the storage yard. The maximum concentration of total hydrocarbon found at the site (at location 100, 400) was only 14,000 mg/kg of soil. This level of contamination is equivalent to 5.8% saturation of the pore spaces. As an example, based on similar theoretical considerations, it would take about 11,000 gallons of oil to fill the residual volume of a soil layer 200 ft by 100 ft by 1 ft. Since the surface layer (1 ft) had much less oil than that required for residual saturation, the results suggested that there had never been a massive spill of oils to form a surface pool to cause significant migration through the unsaturated zone. Instead, the minor drips and spills from the disused machinery could not saturate the surface region in the yard. The lower levels of hydrocarbon contamination (about 200 mg/kg) typical of much of the yard were equivalent to less than 0.1% pore saturation and would be

even less able to migrate under the influence of processes such as rainwater percolation.

No evidence of contamination by volatile organic compounds (VOCs) was found during coring at the machine storage yard and regions outside the yard when the surface and subsurface soil were tested using a portable photoionization detector, able to detect <1 ppm organic vapor in air. Since residual VOCs were not found in the soil, easily dissolved and vaporized organic contaminants such as gasoline were unlikely to have been present. The absence of both volatile and oily contaminants in the lower subsurface zone further demonstrated that contamination did not spread in any form beyond the upper 22 inches of the site.

SITE CLOSURE

Because of the low concentrations and limited vertical migration of the contaminants, and their insignificant potential for future migration, the site could have been left in its then current state. However, Hydramatic plant management decided to excavate the surface soil in PCB-containing areas, prior to grading the site. With the agreement of the Michigan Department of Natural Resources, an area of about 27,000 ft^2 including the central zone of higher contaminant concentrations in the storage yard, was excavated to a depth of 2 ft (Figure 19). Another more lightly affected area, about 5,000 ft^2, was excavated to 1 ft. The soil was excavated and disposed of, as nonhazardous waste, at a total cost of $72,000. This excavated soil represented only a small part of the surface and subsurface material in the machine storage area. The limited extent of the excavation was possible only because of the precise delineation of the shallow contaminated zone demonstrated by the phased soil-coring

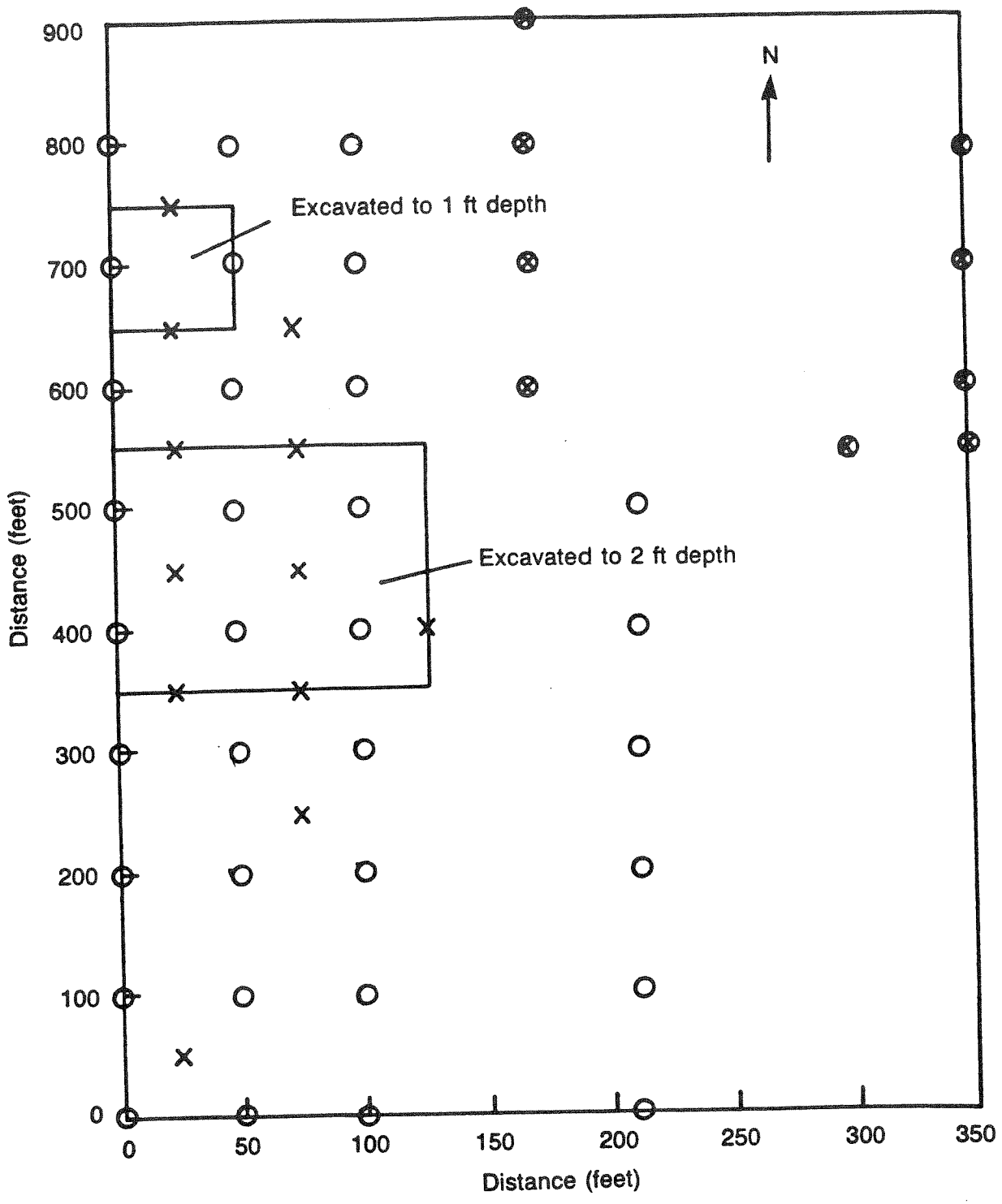


Figure 19. Areas excavated at the machine storage yard (1988).

investigation at the site. The limited excavation represented a saving compared to the greater cost of excavating the same areas down to the water table at 6 feet. This deeper excavation would have involved about four times more material at a total cost of about $270,000 for excavation, transportation, and disposal as nonhazardous waste. The cleanup cost would have reached about $2 million if the same volume of excavated soil had been declared a hazardous waste, as commonly happens at sites with higher contaminant concentrations.

In fact, using the wrong methods of investigation could have overestimated the amount of contaminated soil, thus leading to greater disposal costs for hazardous or nonhazardous waste. The standard device, most commonly used to sample subsurface material, is the split spoon sampler. In field tests of the GMR sampler and split spoon sampler at the storage yard, the GMR sampler showed contamination only in the upper portion of the soil core down to a depth of 22 inches, but the split spoon sampler showed cross-contamination by surface material in samples taken as deep as 6 feet (Gibson and Abdul, 1989). Thus, the contamination would have appeared to extend much deeper based on erroneous results if the split spoon method had been used to investigate the unsaturated zone at the site.

REFERENCES

Abdul, A.S., Migration of Petroleum Products Through Sandy Hydrogeologic Systems, Ground Water Monitoring Review 8(4), 1988.

Abdul, A.S. and Gibson, T.L., Adsorption-Desorption of Polycyclic Aromatic Hydrocarbons by Two Hydrogeologic Materials, Hazardous Waste and Hazardous Materials, 3(2), 125-138, 1986.

Abdul, A.S., Gibson, T.L., and Rai, D.N., Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water, Hazardous Waste and Hazardous Materials, 4(3), 211, 1987.

Abdul, A.S., Gibson, T.L., and Kia, S.F., Contamination of Soil and Groundwater by Automatic Transmission Fluid: Site Description and Problem Assessment, GMR Report EV-328, 1988a.

Abdul, A.S., Gibson, T.L., and Rai, D.N., Laboratory Studies of the Flow of Some Organic Solvents and Their Aqueous Solutions Through Bentonite and Kaolin Clays, GMR Report EV-327, 1988b.

ASTM D 1586-84, Standard Method for Penetration Test and Split-Barrel Sampling of Soils, Annual Book of ASTM Standards, Vol. 04.08, pp. 216-219, 1988.

USEPA, Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, 1979.

USEPA, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, November 1986.

EPRI, Physiochemical Measurements of Soil at Solid-Waste Disposal Sites, EPRI EA-4417, Project 2485-3, Final Report, 1986.

Federal Register, PCB Spill Cleanup Policy, Vol. 52, No. 63, 1987.

Freeze, R.A. and Cherry, J.A., Groundwater, Prentice-Hall Inc., Englewood Cliffs, NJ, 1979.

Gibson, T.L. and Abdul, A.S., The Design and Testing of a Device to Take Soil Cores from Shallow Unsaturated Zones, GMR Report, in review, 1989.

Grimshaw, R.W., The Chemistry and Physics of Clays, London, Ernest Benn LTD., London, 1971.

Michigan Department of Natural Resources, WMD/MDNR Draft Guidance, "How Clean is Clean?" May, 1988.

Standard Methods for the Examination of Water and Wastewater. 16th Edition, APHA., AWWA., WPCF, 1985.

Title 40, Code of Federal Regulations, Section 141, Interim Primary Drinking Water Standards.

Title 40, Code of Federal Regulations, Section 261.24, RCRA Hazardous Waste Standards.

DISTRIBUTION LIST

Research Laboratories

Biomedical Science
C. C. Green
J. S. Siak

Executive
C. S. Tuesday

Technical Information (3)

AC Spark Plug

D. R. Fredericks
E. Lane*

Allison Gas Turbine (Indianapolis)

P. P. Cook
P. A. Eddy
S. M. Hudson*
M. S. Johnson*

Argonaut

J. G. Meenahan
R. J. Tessier
H. S. VanDusen
K. T. Ravani

Buick-Oldsmobile-Cadillac Group

G. Bosak
R. J. Phillips
(Facil. Eng.-BOC Hqtrs.)

Chevrolet-Pontiac-GM of Canada Group

W. T. McKeel
E. J. Piasecki
R. Sobczynski

Delco Moraine (Dayton, OH)

E. J. Gansen*
M. A. Koth
J. Miller*
T. J. Schneider

*Research Contact or Principal Engineering Executive

Environmental Activities Staff

A. A. Aguwa
G. J. Barnes
D. L. Boyd*

J. P. Chu
D. J. Eden
P. Gerwert
J. M. Heuss
N. C. Kachman
R. L. Klimisch
J. M. Mullins
S. S. Song

Fisher Guide

Anderson, IN
W. G. McMahan*

Columbus, OH
R. L. Williams

Warren, MI
P. R. Kienle
D. L. Martinec
J. K. Waller, Troy*

Hydra-matic (Ypsilanti, MI)

L. Hachigian
M. King-Blandford*
A. H. Rasegan*
D. H. Schafer
M. A. Smith
C. Trudell
C. F. Winkeljohn

Legal Staff

P. J. McCarroll

Patent Section

G. A. Grove

Service Parts Operation (Flint)

D. V. Bosch
D. Gatlin

Technical Center Facilities Section

J. J. Bieda
T. J. Lang

C-E ENVIRONMENTAL, INC.

HYDROGEOLOGIC INVESTIGATION at the NORTH YARD

FINAL REPORT

Prepared for

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
Ypsilanti, Michigan

July 1989

COMBUSTION ENGINEERING

HYDROGEOLOGIC INVESTIGATION
AT THE
NORTH YARD

FINAL REPORT

Prepared For:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
YPSILANTI, MICHIGAN

Prepared By:

C-E ENVIRONMENTAL, INC./E.C. JORDAN CO.
Farmington Hills, Michigan

Job No. 5883-00

July 1989

TABLE OF CONTENTS

SECTION NO.	TITLE	PAGE NO.
1.0	INTRODUCTION	1
2.0	PROJECT OBJECTIVES	4
3.0	FIELD INVESTIGATION	5
	3.1 MONITORING WELL INSTALLATION	5
	3.2 SURVEYING	7
	3.3 GROUNDWATER SAMPLING	8
4.0	RESULTS AND DISCUSSIONS	10
	4.1 HYDROGEOLOGY	10
	4.2 GROUNDWATER QUALITY	13
5.0	CONCLUSIONS AND RECOMMENDATIONS	15

APPENDIX A - BORING LOGS
APPENDIX B - GROUNDWATER SAMPLING FIELD DATA RECORDS
APPENDIX C - ANALYTICAL RESULTS

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1-1	LOCATION OF THE GM HYDRA-MATIC PLANT.....	2
1-2	INVESTIGATION LOCATION MAP.....	3
3-1	MONITORING WELL LOCATIONS.....	6
4-1	GROUNDWATER ELEVATION.....	11

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
4-1	STATIC WATER ELEVATIONS - MARCH, 1989.....	12
4-2	ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER.....	14

1.0 INTRODUCTION

The General Motors (GM) Hydra-matic Willow Run plant is located in Ypsilanti, Michigan, within Washtenaw County (see Figure 1-1). In 1953, GM purchased the facility to house its transmission manufacturing operations. Hydra-matic currently produces automatic transmissions for automobiles and trucks. The major production operations include machining, stamping, heat treating, and assembly. The facility is located adjacent to the Willow Run Airport in close proximity to the GMC Willow Run Assembly plant. The majority of plant property is covered by buildings, pavement, and other structures.

The focus of this study was the North Yard which is located in the northeast corner of Hydra-matic's property (see Figure 1-2). This area was used to store production machinery and equipment that had been taken out of service. The equipment was stored directly on the soil surface and, as a result, residual metal-working fluids and various oils leaked from the equipment and into the soil.

To determine the extent of contamination in the North Yard, GM conducted a subsurface soil study which was completed in April 1988. The results indicated that the fluids and oils from the machinery were confined to the upper 24 inches of soil. This material was subsequently removed from the site in August 1988.

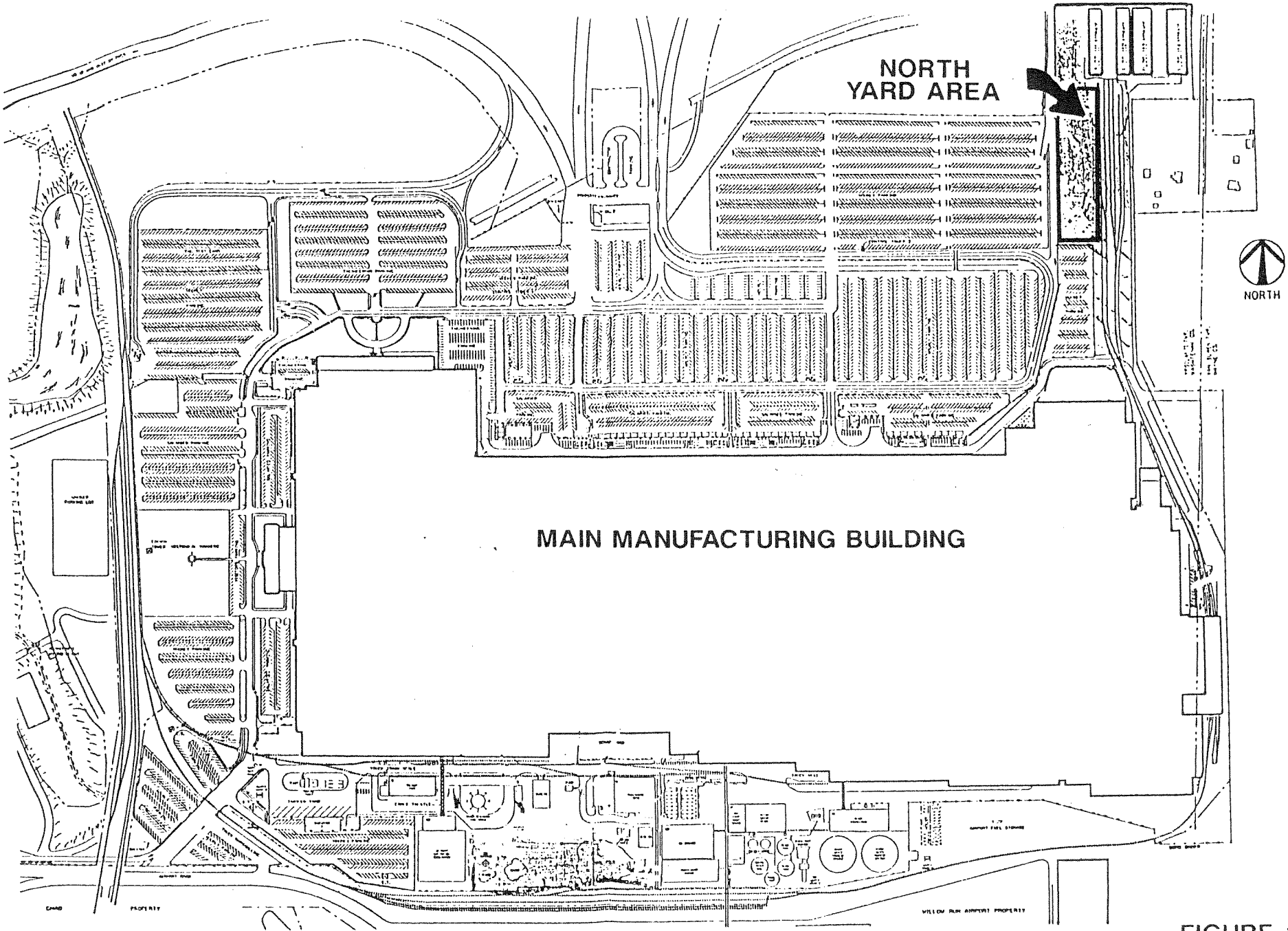
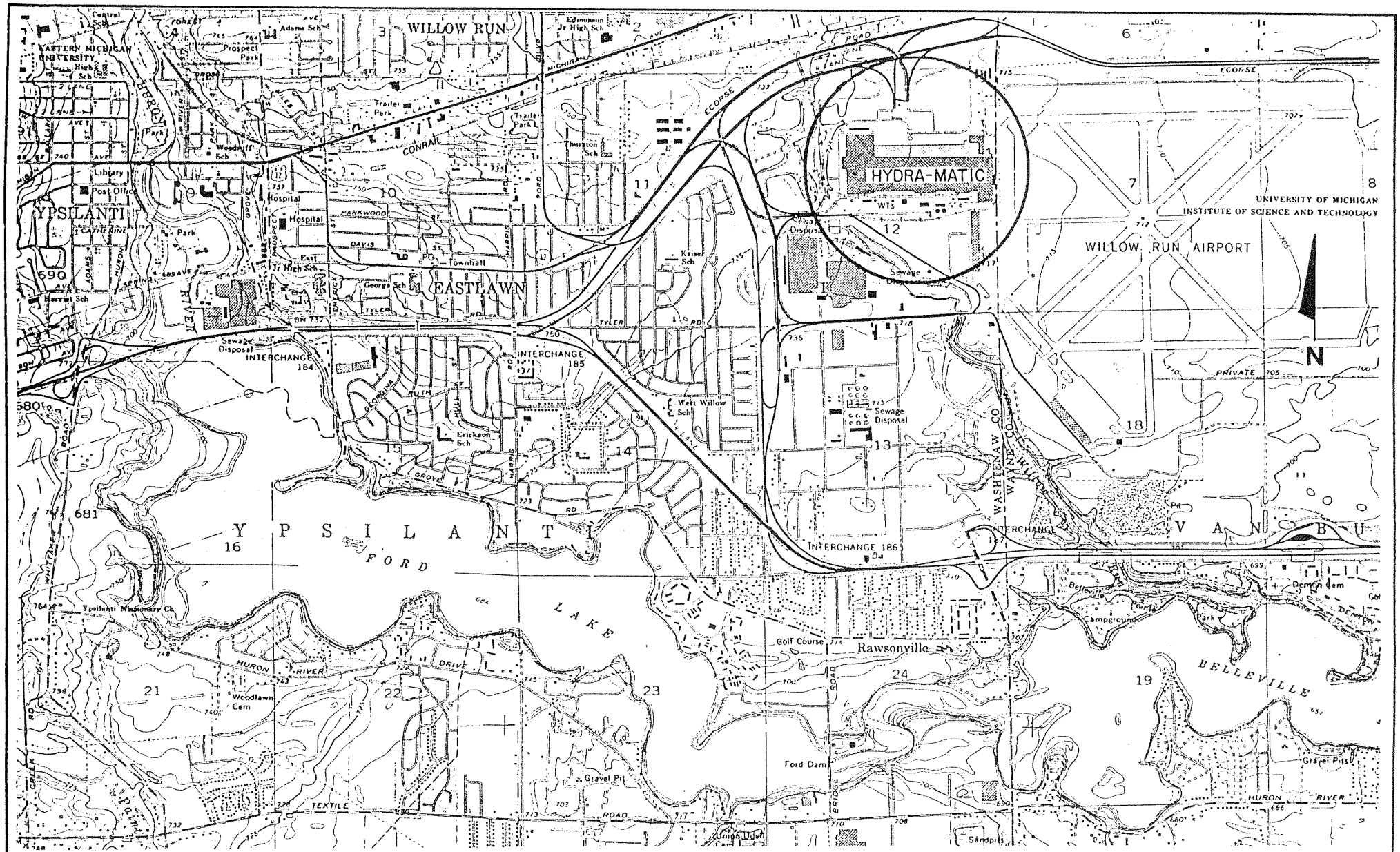


FIGURE 1-2
INVESTIGATION LOCATION MAP
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

E.C. JORDAN CO.



QUADRANGLE LOCATION

0 1500 3000 6000 FEET

FIGURE 1-1
LOCATION OF THE GM HYDRA-MATIC PLANT YPSILANTI, MICHIGAN

TAKEN FROM U.S.G.S. YPSILANTI EAST, MICH. 7.5' QUADRANGLE MAP.

EC JORDAN CO

2.0 PROJECT OBJECTIVES

The primary objective of this study was to sample and analyze shallow groundwater in the North Yard area for organic chemicals and inorganic consitituents. This objective was achieved by conducting the following tasks:

- Installation of three groundwater monitoring wells;
- Collection of three groundwater samples for chemical analysis; and
- Survey of monitoring well elevations and locations.

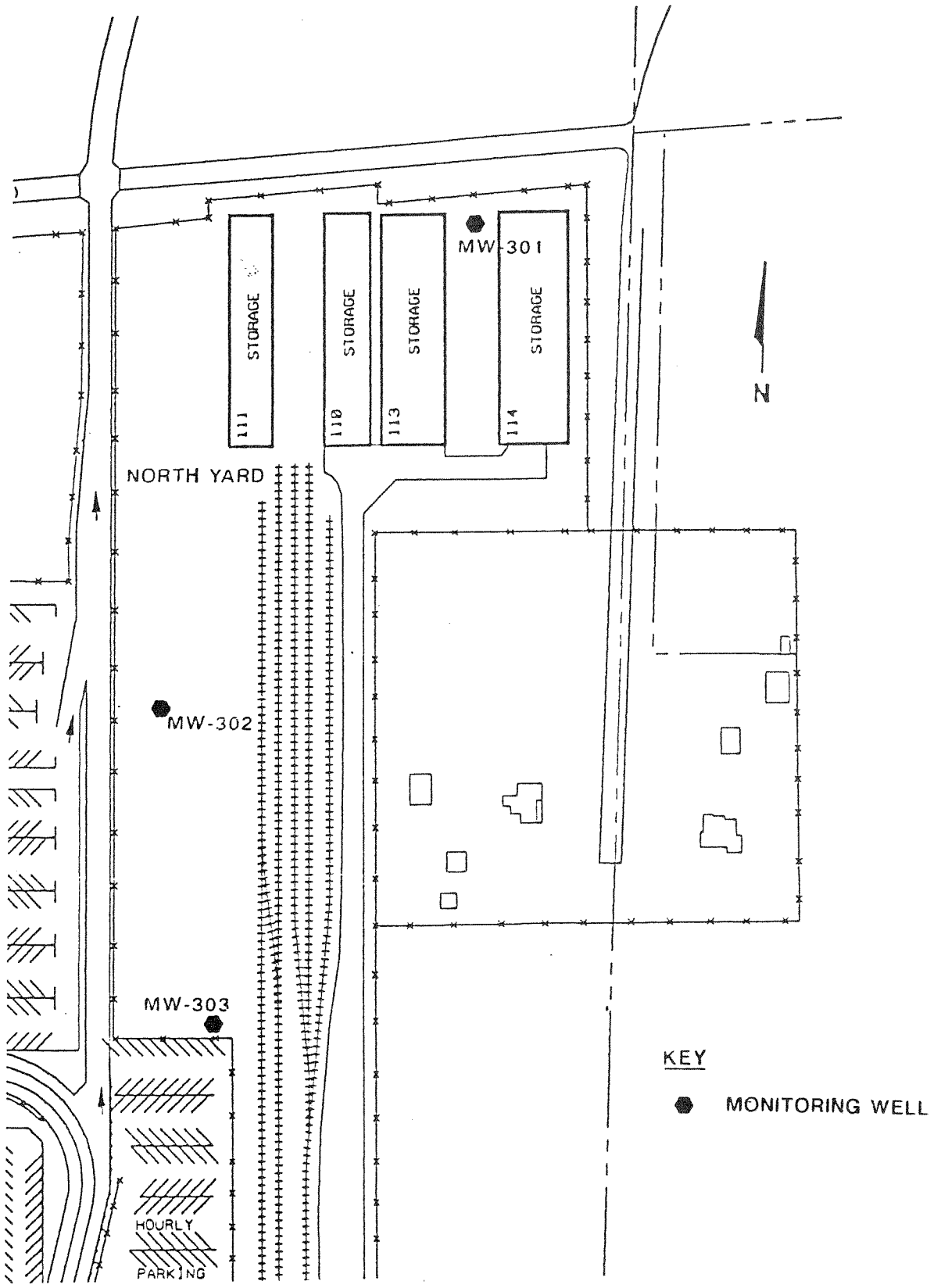
3.0 FIELD INVESTIGATION

The groundwater investigation in the North Yard was conducted by E.C. Jordan Co. (Jordan) from February 14 through March 22, 1989. Analytical services were provided by Environmental Control Technology Corporation (ENCOTEC), Ann Arbor, Michigan. Drilling services were provided by Professional Services Industries (PSI), Redford, Michigan.

3.1 MONITORING WELL INSTALLATION

Three monitoring wells, MW-301, MW-302, and MW-303, were installed on February 14, 1989, to provide piezometric and groundwater quality data (see Figure 3-1). The borings were completed by PSI with a truck-mounted CME-55 drilling rig using 6.25-inch ID hollow-stem augers. Soil samples were not collected. The borings were advanced until a dense silty clay was encountered at approximately 10 to 13 feet below the ground surface. Each borehole was logged visually from soil cuttings. To reduce the potential for cross-contamination during drilling, down-hole drilling equipment was steam-cleaned after the completion of each boring.

The wells were constructed of 2-inch ID, flush-threaded, PVC casing and 2-inch ID, 10-slot, PVC well screens ranging in length from 7 to 10 feet. Well screens were set on top of the dense silty clay at depths ranging from 10 to 13 feet. The wells were constructed so that the entire saturated zone was



SCALE

0 100 200 400 FEET

FIGURE 3-1
MONITORING WELL LOCATIONS
NORTH YARD
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

GM DRAWING # HWR-NY-1

E.C. JORDAN CO.

screened. The annular space around the screen was packed with silica sand from the bottom of the screen to approximately 2 feet above the top of the screen, and the remaining annular space was sealed with bentonite pellets. Each well was finished above grade with a lockable well protector cemented in place. Boring/monitoring well logs with construction diagrams are included in Appendix A.

After installation, each well was developed to remove fine-grained sediment from the well and the aquifer material near the screen. This was accomplished by bailing and/or pumping with a submersible pump until the groundwater appeared to be free of fine-grained sediment.

3.2 SURVEYING

The vertical elevations and horizontal positions of the monitoring wells were surveyed by Jordan. Elevations were measured at the top of each well casing to an accuracy of $\pm$ 0.01 foot. In addition, the relative location of each well was measured from existing reference points to an accuracy of $\pm$ 1.0 foot.

3.3 GROUNDWATER SAMPLING

Groundwater samples were collected from the three wells on March 22, 1989. Each sample was analyzed for dissolved metals (Cd, Cr, Fe, Ni, Pb, and Zn), purgeable halocarbons (DNR Scan 1), and purgeable aromatic hydrocarbons (DNR Scan 2). Samples were also to be analyzed for polychlorinated biphenyls (PCBs) if an oil layer was found on top of the water table. Oil was not evident during well development or purging; therefore, none of the groundwater samples were analyzed for PCBs.

Prior to sampling, the static water level and depth of each well was measured from the top of the well casing. The volume of water standing inside the well casing was calculated, and three well volumes were evacuated from the well using a submersible pump equipped with teflon tubing. Groundwater temperature, pH, and specific conductance were recorded and monitored until these parameters stabilized. Stabilization of these parameters indicated that stagnant water had been removed from the well casing so that a representative groundwater sample could be taken. These parameters were recorded on the Groundwater Field Data Sampling Records contained in Appendix B.

After evacuating each well, groundwater samples were collected with the submersible pump. Samples to be analyzed for dissolved metals were pressure-filtered with nitrogen in a 2.4-liter barrel filter using a membrane filter with a 0.45-micron pore size. The samples were filtered directly into laboratory prepared bottles, pre-preserved with nitirc acid. Between samples, the

filter assembly was rinsed with a dilute nitric acid solution followed by distilled water. The membrane filter was replaced between samples. After processing and labeling, all samples were kept on ice in coolers until delivery to the laboratory.

The submersible pump was decontaminated with trisodium phosphate (TSP) and distilled water solution, followed by a distilled water rinse. The decontamination procedures were checked by submitting a distilled water sampler blank (MW-350) to the laboratory for analysis. The sampler blank was handled and processed in the same manner as the groundwater samples (i.e., run through the submersible pump, pressure-filtered for metals analysis, placed in the appropriate laboratory bottles, etc.). In addition to the sampler blank, one duplicate sample, MW-351 (a duplicate of MW-301), and one trip blank were also submitted for analysis. The sampler blank and the duplicate sample were analyzed for dissolved metals and DNR Scans 1 and 2. The trip blank was only analyzed for volatile organic chemicals (i.e., DNR Scans 1 and 2).

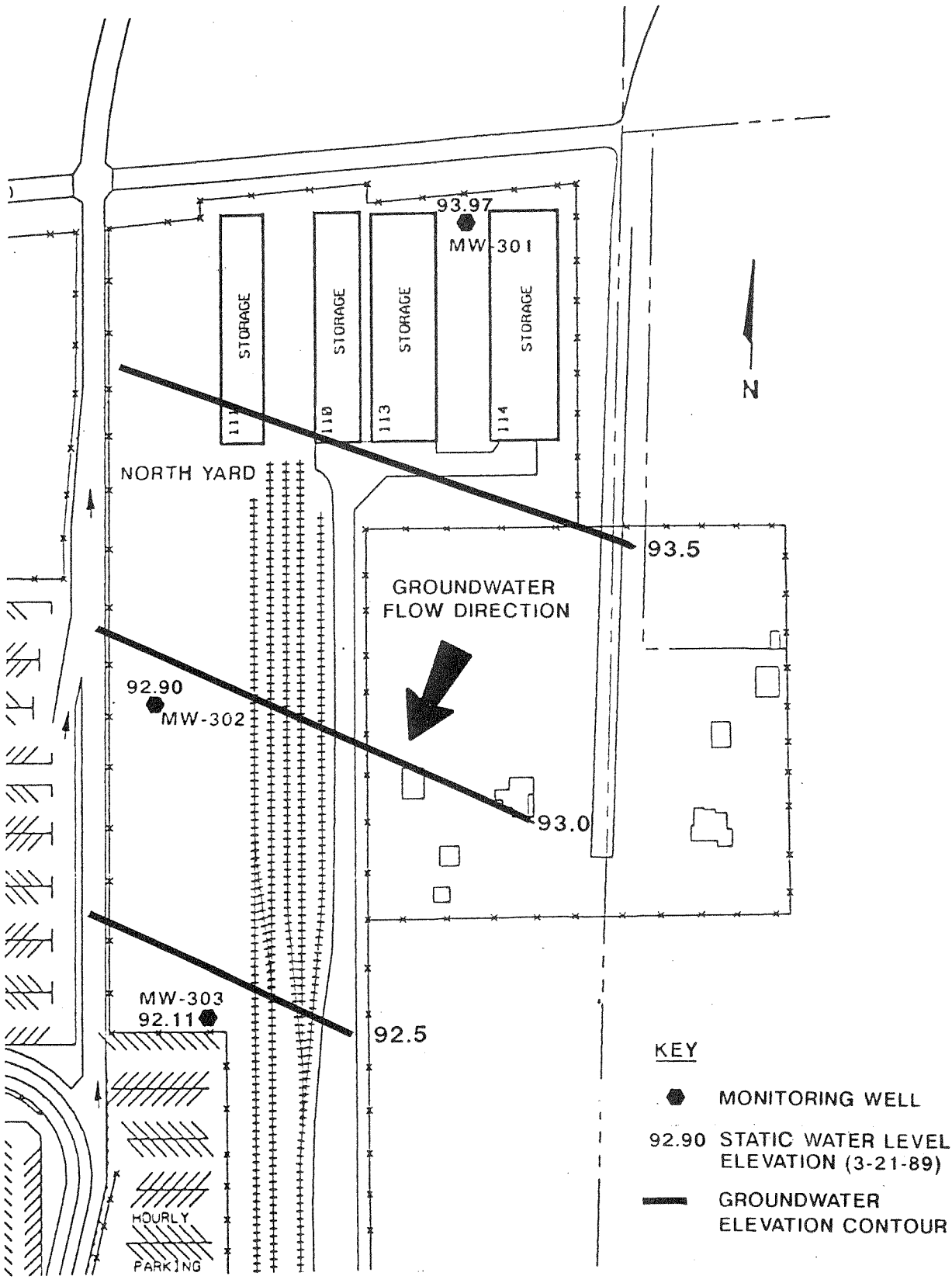
4.0 RESULTS AND DISCUSSION

4.1 HYDROGEOLOGY

The Hydra-matic plant is located in the Huron River drainage basin which empties into Lake Erie near the mouth of the Detroit River. The geology is characterized by approximately 140 feet of unconsolidated glacial deposits which overlie the Mississippian Antrim Shale. Locally, the surficial geologic materials are primarily fine-grained lacustrine sands, silts and clays of moderate to low permeability.

Based upon observations made during drilling, the geologic materials at the GM site consist of poorly sorted fine to medium-grained sand with silt to a depth of approximately 12 feet. At approximately 12 feet, a dense silty clay till was encountered.

Groundwater was encountered in the North Yard at depths ranging from approximately 3 to 8 feet below ground surface. Elevational data and static water level measurements (obtained on March 21, 1989) are included in Table 4-1, and Figure 4-1 illustrates the groundwater flow direction. The average horizontal hydraulic gradient was calculated at approximately 0.0019 feet/foot with groundwater flowing generally to the southwest.



SCALE

0 100 200 400 FEET

FIGURE 4-1
GROUNDWATER ELEVATION AND FLOW DIRECTION MAP
NORTH YARD
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

GM DRAWING # HWR-NY-1

EC JORDAN CO

TABLE 4-1

STATIC WATER ELEVATIONS - MARCH, 1989
NORTH YARD
GM HYDRA-MATIC, YPSILANTI, MI

WELL DESIGNATION	TOP OF CASING ELEVATION	DEPTH TO WATER	STATIC WATER LEVEL
MW-301	97.79	3.82	93.97
MW-302	100.13	7.23	92.90
MW-303	100.02	7.61	92.41

Notes:

1. All measurements are relative and expressed in feet.

4.2 GROUNDWATER QUALITY

Floating product was not observed at any of the well locations during drilling or groundwater sampling. Groundwater evacuated prior to sampling was described as silty to clear and without noticeable odor with the exception of MW-302 which had a slight sulfur odor.

The results of the chemical analysis of groundwater are summarized in Table 4-2, and laboratory analysis reports from ENCOTEC are contained in Appendix C. Organic chemicals were not detected in groundwater from any of the wells located in the study area. The duplicate sample, MW-351, and the sampler blank, MW-350, and the trip blank, were also free of organic chemicals.

The results of the inorganic groundwater analysis indicated that iron was the only metal present in groundwater from the North Yard at concentrations above the detection limits. Iron was detected in MW-302 at 2.8 mg/L, and in MW-303 at 8.1 mg/L. All other metals were undetected.

TABLE 4-2 ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER
NORTH YARD
GM HYDRA-MATIC, YPSILANTI, MI

Compound	Detection Limit (mg/L)	MW-350 SAMPLER BLANK	MW-301	MW-351 DUP OF MW-301	MW-302	MW-303	TRIP BLANK 3
Bromodichloromethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Bromoform	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Bromomethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Carbon Tetrachloride	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chlorobenzene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chloroethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Dibromochloromethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Dichlorodifluoromethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,2-Dichloroethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,2-Dichloropropane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,3-Dichloropropene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,3-Dichloropropene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Methylene Chloride	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,2,2-Tetrachloroethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Tetrachloroethene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,2-Trichloroethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Trichlorofluoromethane	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl Chloride	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Benzene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Styrene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,2-Xylene	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,3-Xylene and 1,4-Xylene	0.002	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Dissolved Chromium	0.03	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	NA
Dissolved Copper	0.02	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	NA
Dissolved Iron	0.05	0.05 U	0.05 U	0.05 U	2.8	8.1	NA
Dissolved Lead	0.02	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	NA
Dissolved Nickel	0.02	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	NA
Dissolved Zinc	0.02	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	NA

Notes:
1. All concentrations in mg/L.
2. U - Compound was analyzed for but not detected.
3. NA - Not analyzed.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the information collected during this investigation, it appears that the oils and fluids contained in production machinery and equipment stored in the North Yard area have not contributed organic chemicals to groundwater. Although the levels of dissolved iron found in MW-302 and MW-303 are above background, such concentrations are commonly found in Michigan groundwater.

To confirm the analytical results of this sampling event, Jordan recommends that another full round of groundwater samples be taken and similarly analyzed. Jordan understands that Hydra-matic has agreed to monitor groundwater in the North Yard area for a period of two years. The sampling event described in this report constitutes the first quarterly sampling of this program.

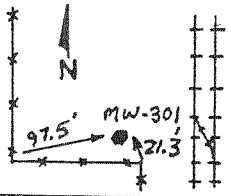
APPENDIX A

BORING LOGS

BORING LOG / MONITORING WELL DIAGRAM

C-E ENVIRONMENTAL, INC.

PROJECT NO.: 5883-00	PROJECT NAME: HYDRA-MATIC WILLOW RUN	BORING/WELL DESIGNATION: MW-301	BORING/WELL LOCATION:
DRILLING CONTRACTOR: P.S.I.	DRILLING METHOD: HOLLOW STEM AUGER	BOREHOLE SIZE: 8 IN.	BOREHOLE DEPTH: 11 FT.
DATE STARTED: 2/14/89	DATE COMPLETED: 2/14/89	GROUND ELEV.: 99.79 FT.	MEASURING POINT ELEV: 97.79 FT.
WELL DEPTH: 10.0 FT.			
RIG: CME-55	DRILLER: P. LIBBY	HELPER: M. BOND	LOGGED BY: C KIELTY



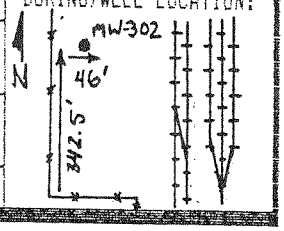
DEPTH (FT.)	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNTS(N)	P.I. METER	COMMENTS	WELL DATA
0					(ppm)		
	SAND (FILL)	N/A	N/A	N/A	BG	WELL FINISHED ABOVE GRADE W/A LOCKABLE PROTECTIVE CASING	XXX XXX XXX XXX XXX
	SAND - orange-brown, medium grained, moist.					CEMENT	XX XXX
						BENTONITE SEAL	// ///
2.5						TWO-INCH SCHEDULE 40 FLUSH-THREADED PVC WELL CASING	... ...
	(groundwater encountered @ approx. 3 feet)						... == ...
5.0						SAND FILTER PACK	... == ...
	SAND - gray-brown, wet, trace silt.						... == ...
7.5						TWO-INCH 10-SLOT PVC WELL SCREEN	... == ...
10.0	CLAY - gray, moist, some silt.						... == ...
	END OF BORING AT 11 FEET						.....
12.5							
15.0							

NOTES: BG - BACKGROUND
N/A - NOT APPLICABLE
SAMPLES LOGGED FROM CUTTINGS

BORING LOG / MONITORING WELL DIAGRAM

C-E ENVIRONMENTAL, INC.

PROJECT NO.: 5883-00	PROJECT NAME: HYDRA-MATIC WILLOW RUN	BORING/WELL DESIGNATION: MW-302	BORING/WELL LOCATION:
DRILLING CONTRACTOR: P.S.I.	DRILLING METHOD: HOLLOW STEM AUGER	BOREHOLE SIZE: 8 IN.	BOREHOLE DEPTH: 13 FT.
DATE STARTED: 2/14/89	DATE COMPLETED: 2/14/89	GROUND ELEV.: 102.63 FT.	MEASURING POINT ELEV: 100.13 FT.
WELL DEPTH: 12.5 FT.			
RIG: CME-55	DRILLER: P. LIBBY	HELPER: M. BOND	LOGGED BY: C KIELTY



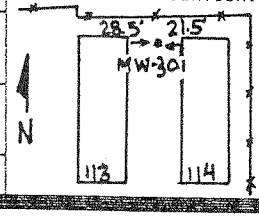
DEPTH (FT.)	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNTS(N)	P.I. METER	COMMENTS	WELL DATA
0	ASPHALT DEBRIS SAND & GRAVEL (FILL)	N/A	N/A	N/A	BG (ppm)	WELL FINISHED ABOVE GRADE W/A LOCKABLE PROTECTIVE CASING CEMENT BENTONITE SEAL TWO-INCH SCHEDULE 40 FLUSH-THREADED PVC WELL CASING	
2.5	SAND - orange-brown, medium grained, moist, some fine gravel.						
5.0						SAND FILTER PACK	
	SAND - gray-brown, wet, trace fine gravel and silt. (groundwater encountered @ approx. 6-feet)						
7.5						TWO-INCH 10-SLOT PVC WELL SCREEN	
10.0							
12.5	CLAY - gray, moist, some silt.						
	END OF BORING AT 13 FEET						
15.0							

NOTES: BG - BACKGROUND
N/A - NOT APPLICABLE
SAMPLES LOGGED FROM CUTTINGS

BORING LOG / MONITORING WELL DIAGRAM

C-E ENVIRONMENTAL, INC.

PROJECT NO.: 5883-00	PROJECT NAME: HYDRA-MATIC WILLOW RUN	BORING/WELL DESIGNATION: MW-303	BORING/WELL LOCATION:
DRILLING CONTRACTOR: P.S.I.	DRILLING METHOD: HOLLOW STEM AUGER	BOREHOLE SIZE: 8 IN.	BOREHOLE DEPTH: 13.5 FT.
DATE STARTED: 2/14/89	DATE COMPLETED: 2/14/89	GROUND ELEV.: 102.02 FT.	MEASURING POINT ELEV: 100.02 FT.
WELL DEPTH: 13 FT.			
RIG: CME-55	DRILLER: P. LIBBY	HELPER: M. BOND	LOGGED BY: C KIELTY



DEPTH (FT.)	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNTS(N)	P.I. METER	COMMENTS	WELL DATA
0					(ppm)		
	ASPHALT DEBRIS; SAND & GRAVEL (FILL)	N/A	N/A	N/A	BG	WELL FINISHED ABOVE GRADE W/A LOCKABLE PROTECTIVE CASING	
	SAND - orange-brown, medium grained, moist, some fine gravel.					CEMENT	
2.5						BENTONITE SEAL	
						TWO-INCH SCHEDULE 40 FLUSH-THREADED PVC WELL CASING	
5.0	SAND - gray-brown, fine-medium grained, moist, some silt.						
7.5						SAND FILTER PACK	
	SAND - gray, medium grained, wet, some silt.						
10.0	(groundwater encountered @ approx. 9 feet)					TWO-INCH 10-SLOT PVC WELL SCREEN	
12.5	CLAY - gray, moist, some silt.						
	END OF BORING AT 13.5 FEET						
15.0							

NOTES: BG - BACKGROUND
N/A - NOT APPLICABLE
SAMPLES LOGGED FROM CUTTINGS

APPENDIX B

GROUNDWATER SAMPLING FIELD DATA RECORDS

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD YPSI JOB NO 5883-00

STATION NO/LOCATION MW-301 DATE 3/22/89

SKETCH ON BACK ☐ YES ☒ NO PHOTOGRAPHS ☐ YES ☒ NO ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH 3.82 ☐ TOP WELL ☒ TOP CASING WELL DEPTH 12' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK X	KECK X
QED ___	QED ___
SSBAIL ___	SSBAIL ___
OTHER ___	OTHER ___

PURGE TIME START 0935 END _____

SAMPLE TIME START _____ END 1000

WEATHER Sunny

9 FT. WATER X .163 (2"=.163gal/ft, 4"=.653gal/ft, 6"=1.47gal/ft) X 3 CASING VOLUME = 4.5 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL (PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL
TEMP 3.3 °C	TEMP 3.0 °C	TEMP 3.0 °C	TEMP 2.7 °C
SP. COND 188 @25°C	SP. COND 194 @25°C	SP. COND 200 @25°C	SP. COND 200 @25°C
pH 7.5	pH 7.5	pH 7.4	pH 7.3
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
DNR SCANS 1&2	80ml	glass	NO	—	
Dissolved Metals	1l	plastic	yes	HNO_3 pre	

REMARKS/OBSERVATIONS Water cloudy (silty) Will pump to develop more. Cleared up well.

SAMPLER DHB/CSK

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD YPSI JOB NO 5883-00

STATION NO/LOCATION MW-302 DATE 3/22/89

SKETCH ON BACK YES ☐ NO ☒ PHOTOGRAPHS YES ☐ NO ☒ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH 7.23 ☐ TOP WELL ☒ TOP CASING WELL DEPTH 15' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

	PURGE	SAMPLE
KECK	X	X
QED		
SSBAIL		
OTHER		

PURGE TIME START 1005 END _____

SAMPLE TIME START _____ END 1020

WEATHER Sunny

8 FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = 4 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL (PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL
TEMP 5.1 °C	TEMP 5.2 °C	TEMP 5.4 °C	TEMP _____ °C
SP. COND 879 @25°C	SP. COND 981 @25°C	SP. COND 1020 @25°C	SP. COND _____ @25°C
pH 7.0	pH 7.0	pH _____	pH _____
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
DNR Scans 1+2	80ml	glass	No	—	
Diss. metals	1l	plastic	yes	HNO3 pre	

REMARKS/OBSERVATIONS Water Slightly Silty to → Clear "Sulfur" smell

SAMPLER DHB/CSK

EC JORDAN CO. North Yard

PAGE 1 OF 1

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD YPSI JOB NO 5883-00

STATION NO/LOCATION MW-303 DATE 3/22/89

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☑ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH 7.61 ☐ TOP WELL ☑ TOP CASING WELL DEPTH 15' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK X	KECK X
QED ___	QED ___
SSBAIL ___	SSBAIL ___
OTHER ___	OTHER ___

PURGE TIME START 1046 END _____

SAMPLE TIME START _____ END 1100

WEATHER Sunny

8 FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = 4 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION / HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL
TEMP 5.3 °C	TEMP 5.2 °C	TEMP 5.1 °C	TEMP 5.1 °C
SP. COND 673 @25°C	SP. COND 689 @25°C	SP. COND 692 @25°C	SP. COND 686 @25°C
pH 6.9	pH 6.9	pH 6.9	pH 6.9
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
DNR SCAN 1Z	80ml	glass	no	—	
Dissolved Metals	1l	plastic	yes	HNO3 pre	

REMARKS/OBSERVATIONS Water Slightly Cloudy → clear

SAMPLER DHB/CSK

EC JORDAN CO North Yard

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD YPSI JOB NO 5883-00

STATION NO/LOCATION MW-[redacted]350, DATE 3/22/89

SKETCH ON BACK YES ☐ NO ☒ PHOTOGRAPHS YES ☐ NO ☒ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH — ☐ TOP WELL ☒ TOP CASING WELL DEPTH — WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED	PURGE	SAMPLE
KECK	✓	✓
QED		
SSBAIL		
OTHER		

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 0930

WEATHER Sunny

____FT. WATER X .163 (2"=.163gal/ft, 4"=.653gal/ft, 6"=1.47gal/ft) X 3 CASING VOLUME = ____GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ ____ GAL	@ ____ GAL	@ ____ GAL	@ ____ GAL
TEMP ____ °C	TEMP ____ °C	TEMP ____ °C	TEMP ____ °C
SP. COND ____ @25°C	SP. COND ____ @25°C	SP. COND ____ @25°C	SP. COND ____ @25°C
pH ____	pH ____	pH ____	pH ____
Eh ____	Eh ____	Eh ____	Eh ____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
DNR Scans 1+2	8ml	glass	No	NO —	
Dissolved Metals	1l	plastic	Yes	Yes pre	

REMARKS/OBSERVATIONS Blank taken @ start of day w/ Keck

SAMPLER DHB/CSK

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD YPSI JOB NO 5883-00

STATION NO/LOCATION MW-351 DATE 3/22/89

SKETCH ON BACK YES ☐ NO ☒ PHOTOGRAPHS YES ☐ NO ☒ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH — ☐ TOP WELL ☒ TOP CASING WELL DEPTH — WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP — WELL/CASING —

EQUIPMENT USED

PURGE	SAMPLE
KECK X	KECK X
QED	QED
SSBAIL	SSBAIL
OTHER	OTHER

PURGE TIME START — END —

SAMPLE TIME START — END —

WEATHER Sunny

— FT. WATER X .163 (2"=.163gal/ft, 4"=.653gal/ft, (6"=1.47gal/ft) X 3 CASING VOLUME = — GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT —

SAMPLE LOCATION —

HEADSPACE —

SAMPLE PURGE DATA

@ — GAL	@ — GAL	@ — GAL	@ — GAL
TEMP — °C	TEMP — °C	TEMP — °C	TEMP — °C
SP. COND — @25°C	SP. COND — @25°C	SP. COND — @25°C	SP. COND — @25°C
pH —	pH —	pH —	pH —
Eh —	Eh —	Eh —	Eh —

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
DNR Scans 1+2	80ml	glass	NO	—	
Dissolved metals	1 l	plastic	yes	HNO3 pre	

REMARKS/OBSERVATIONS Duplicate of MW-301 (Keck)

SAMPLER DHB/CSK

APPENDIX C

ANALYTICAL RESULTS

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: E. C. Jordan
PROJECT NO.: 40650
SAMPLE TYPE: Dissolved Metals - Water
REPORT DATE: April, 1989

SAMPLE NAME		MW-350	MW-301	MW-351	MW-302	MW-303
SAMPLE DATE		3/22/89	3/22/89	3/22/89	3/22/89	3/22/89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		29669	29670	29671	29672	29673
Chromium	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Copper	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	mg/L	<0.05	<0.05	<0.05	2.8	8.1
Lead	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: April 20, 1989

Sample: MW-350
ENCOTEC Number: 29664
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
Dichlorodifluoromethane	75-71-8	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: April 20, 1989

Sample: MW-350
ENCOTEC Number: 29664
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Styrene	100-42-5	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: April 20, 1989

Sample: MW-301
ENCOTEC Number: 29665
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
Dichlorodifluoromethane	75-71-8	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: April 20, 1989

Sample: MW-301
ENCOTEC Number: 29665
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Styrene	100-42-5	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: April 20, 1989

Sample: MW-351
ENCOTEC Number: 29666
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Styrene	100-42-5	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: April 20, 1989

Sample: MW-302
ENCOTEC Number: 29667
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
Dichlorodifluoromethane	75-71-8	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: April 20, 1989

Sample: MW-302
ENCOTEC Number: 29667
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Styrene	100-42-5	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: April 20, 1989

Sample: MW-303
ENCOTEC Number: 29668
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
Dichlorodifluoromethane	75-71-8	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: April 20, 1989

Sample: MW-303
ENCOTEC Number: 29668
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Styrene	100-42-5	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: April 20, 1989

Sample: Trip Blank #3
ENCOTEC Number: 29674
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
Dichlorodifluoromethane	75-71-8	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E. C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: April 20, 1989

Sample: Trip Blank
ENCOTEC Number: 29674
Sample Date: 3/22/89
Date Received: 3/22/89
Date Extracted: N/A
Date Analyzed: 4/7/89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Styrene	100-42-5	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

July 1990 Sampling

DATA SUMMARY SHEET

PROJECT: ABB Environmental

PROJECT NO.: 40650

SAMPLE TYPE: Water

REPORT DATE: August, 1990

SAMPLE NAME		MW 301	MW 302	MW 303	MW 350	MW 351
SAMPLE DATE		7-20-90	7-20-90	7-20-90	7-20-90	7-20-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		55832	55833	55834	55835	55836
Cadmium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/L	<0.02	<0.02	<0.02	0.14	<0.02
Iron	mg/L	0.31	5.3	11	<0.05	10
Lead	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	<0.02	0.11	<0.02	0.14	<0.02

C-E ENVIRONMENTAL, INC.

GROUNDWATER MONITORING REPORT DECEMBER 1989, MARCH 1990, AND JULY 1990

NORTH YARD

Prepared For:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
GM Hydra-Matic, Ypsilanti, Michigan

October 1990

Job No. 5883-00

COMBUSTION ENGINEERING

GROUNDWATER MONITORING REPORT
DECEMBER 1989, MARCH 1990, AND JULY 1990

NORTH YARD

Prepared For:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
GM Hydra-Matic, Ypsilanti, Michigan

Prepared By:

C-E ENVIRONMENTAL INC.
Farmington Hills, Michigan

October 1990

5883-00

TABLE OF CONTENTS

SECTION NO.	TITLE	PAGE NO.
1.0	INTRODUCTION	1
2.0	SCHEDULE	1
3.0	PERSONNEL	1
4.0	SAMPLING LOCATIONS	1
5.0	FIELD PROCEDURES	1
6.0	SAMPLE HANDLING	5
7.0	QUALITY CONTROL SAMPLES	5
8.0	RESULTS	5
8.1	GROUNDWATER FLOW	5
8.2	QUALITY CONTROL SAMPLES	6
8.3	GROUNDWATER QUALITY	6

APPENDIX A - GROUNDWATER SAMPLE DATA RECORDS - DECEMBER 1989
APPENDIX B - GROUNDWATER SAMPLE DATA RECORDS - MARCH 1990
APPENDIX C - GROUNDWATER SAMPLE DATA RECORDS - JULY 1990
APPENDIX D - ANALYTICAL METHODS
APPENDIX E - LABORATORY ANALYTICAL REPORTS - DECEMBER 1989
APPENDIX F - LABORATORY ANALYTICAL REPORTS - MARCH 1990
APPENDIX G - LABORATORY ANALYTICAL REPORTS - JULY 1990

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1	LOCATION OF THE GM HYDRA-MATIC WILLOW RUN PLANT	2
2	INVESTIGATION LOCATION MAP	3
3	MONITORING WELL LOCATIONS	4
4	MONITORING WELL LOCATIONS AND WATER LEVEL MEASUREMENTS	7

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1	SUMMARY OF WATER LEVELS AND GROUNDWATER FLOW DIRECTIONS OBSERVED DURING 1989 AND 1990	6
2	ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER AT THE NORTH YARD	8

1.0 INTRODUCTION

The General Motors (GM) Hydra-matic Willow Run Plant is located in Ypsilanti, Michigan, within Washtenaw County (see Figure 1). The North Yard, previously used to store production machinery and equipment, is located in the northeast corner of Hydra-matic's property (see Figure 2). The equipment was stored directly on the ground; as a result, residual metal-working fluids and various oils leaked from the equipment and into the soil.

GM conducted a subsurface soil study in April 1988 to determine the extent of contamination in the North Yard. The results indicated that the fluids and oils from the machinery were confined to the upper 24 inches of soil. This material was removed from the site in August 1988.

As part of the North Yard remediation program, Hydra-matic implemented a quarterly groundwater monitoring program for a two year period beginning in 1989[1]. In February 1989, C-E Environmental, Inc. (formerly E.C. Jordan Co.) installed three groundwater monitoring wells in the North Yard. Groundwater samples were collected in March 1989, June 1989, September 1989, December 1989, March 1990, and July 1990. All samples were analyzed for selected dissolved metals, purgeable halocarbons (DNR Scan 1), and purgeable aromatic hydrocarbons (DNR Scan 2). In addition, samples collected in December 1989, March 1990, and July 1990 were analyzed for polychlorinated biphenyls (PCBs). The results of the first three sampling events were reported previously. This report documents the last three groundwater sampling events which occurred in December 1990, March 1990, and July 1990.

2.0 SCHEDULE

The fourth groundwater sampling event was conducted on December 28, 1989, the fifth on March 27, 1990, and the sixth on July 20, 1990.

3.0 PERSONNEL

C-E Environmental staff collected groundwater samples during each sampling event. Groundwater samples in December 1989 and March 1990 were collected by C. Kielty and T. Winebrenner. C. Kielty and C. Cantwell collected the samples in July, 1990.

4.0 SAMPLING LOCATIONS

Figure 3 shows the locations of the three monitoring wells in the North Yard.

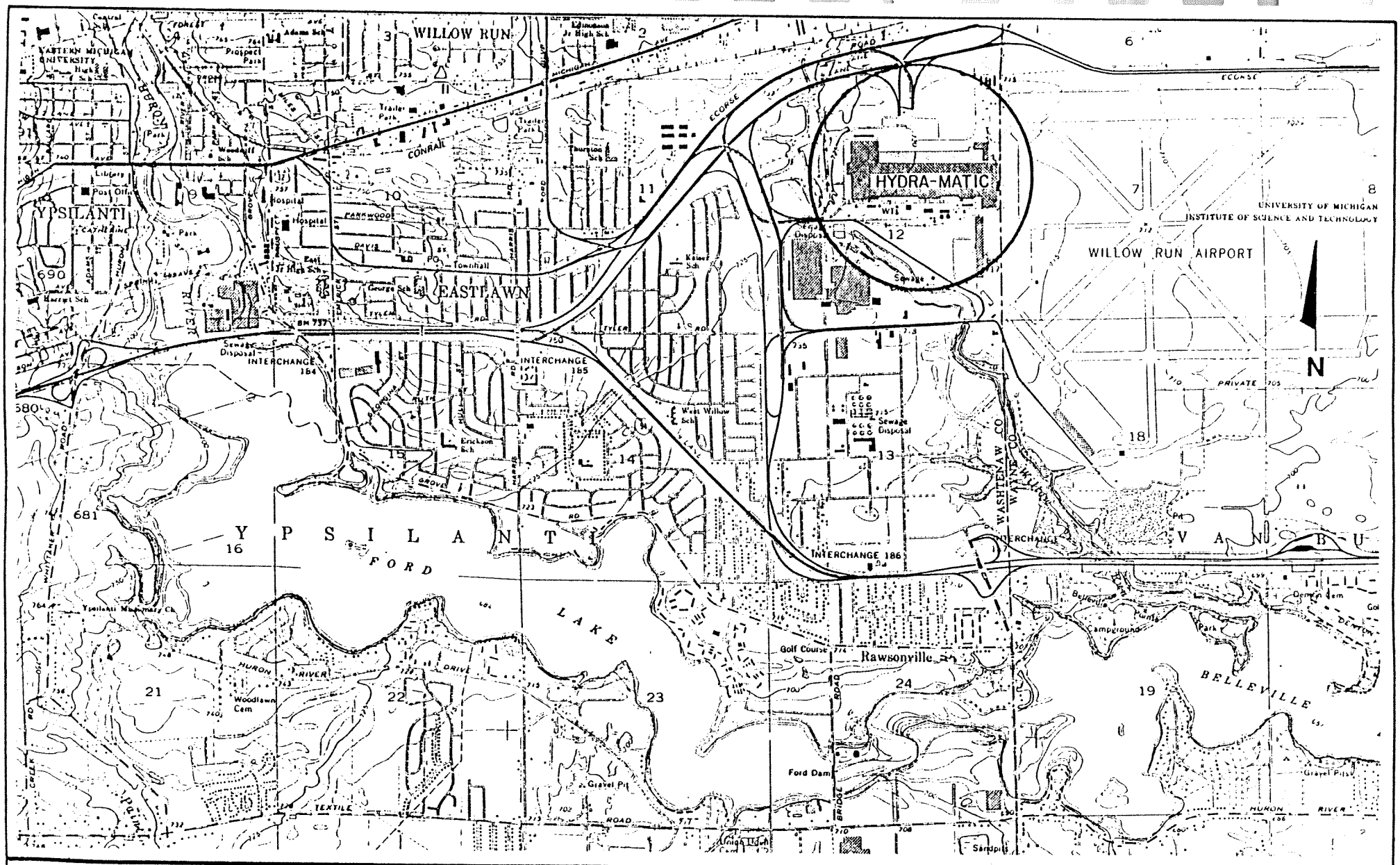
5.0 FIELD PROCEDURES

Field procedures for each sampling event were identical. Prior to sampling, the water level and depth of each well was measured from the top of the well casing. The volume of water standing inside the well casing was calculated, and three well volumes were evacuated from the well using a Teflon or stainless-steel bailer.

Groundwater temperature, pH, and specific conductance were recorded three times during evacuation. Stabilization of these parameters indicated that stagnant water had been removed from the well casing so that a representative groundwater sample could be taken. These parameters were recorded on the Groundwater Sampling Records contained in Appendices A, B, and C, for December 1989, March 1990, and July 1990, respectively.

---

[1]For additional information, see: "Hydrogeologic Investigation at the North Yard," July 1989. Prepared for General Motors Corporation, Hydra-matic Division, by C-E Environmental, Inc.



TAKEN FROM U.S.G.S. YPSILANTI EAST, MICH. 7.5' QUADRANGLE MAP.

FIGURE 1
LOCATION OF THE GM HYDRA-MATIC PLANT YPSILANTI, MICHIGAN

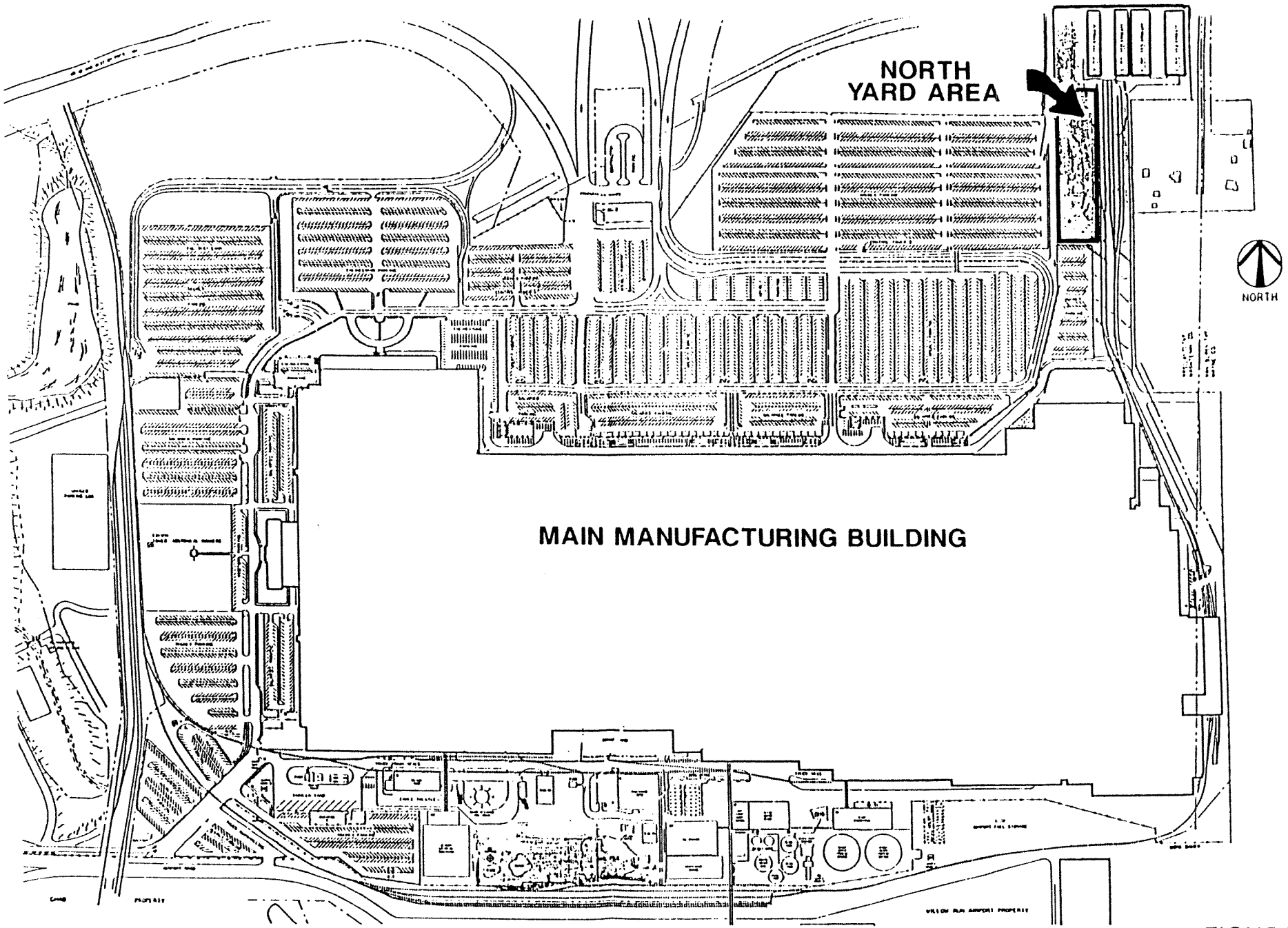
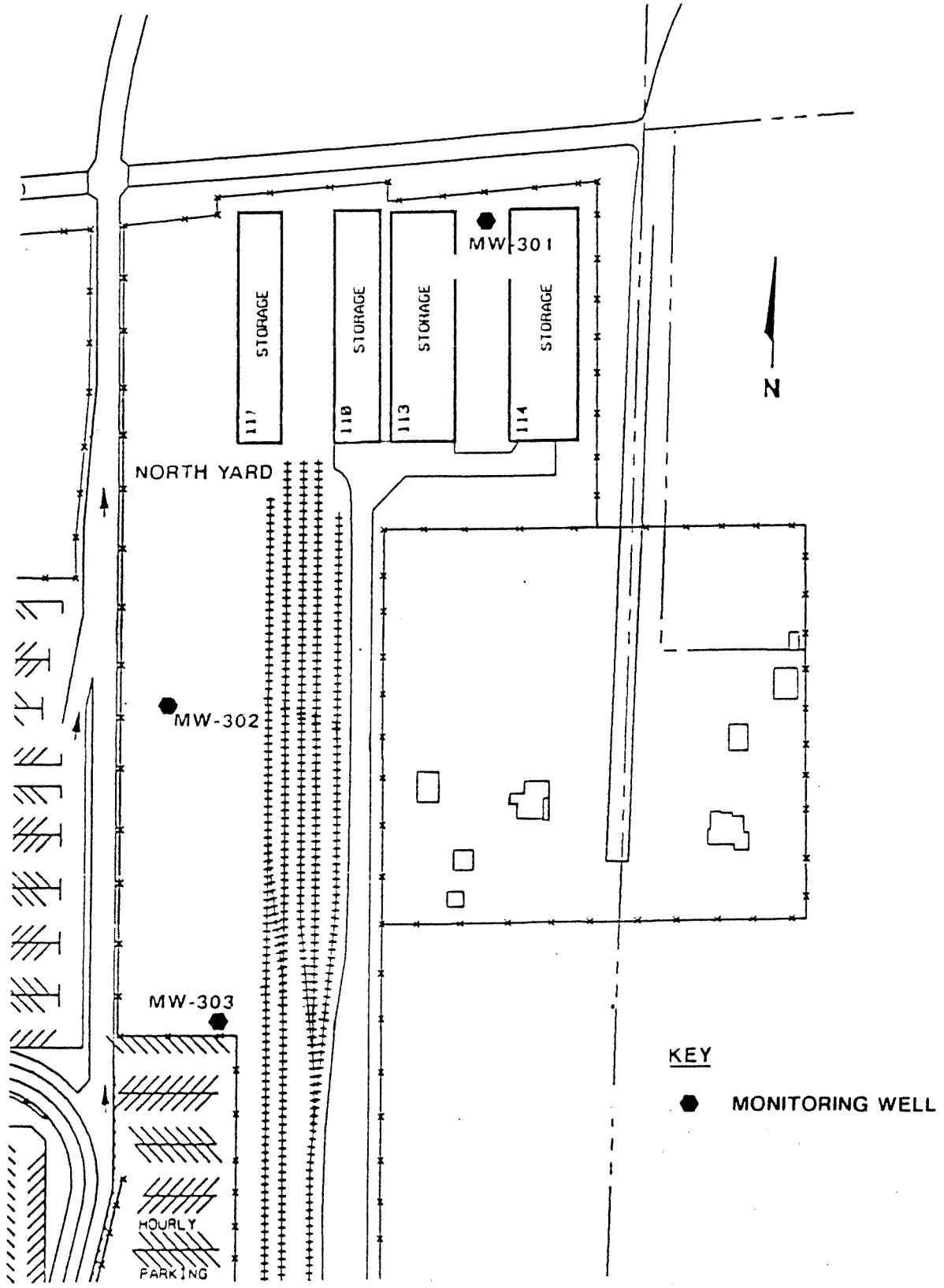


FIGURE 2
INVESTIGATION LOCATION MAP
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

C-E Environmental, Inc.



SCALE

0 100 200 400 FEET

FIGURE 3
MONITORING WELL LOCATIONS
NORTH YARD
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

GM DRAWING # HWR-NY-1

C-E ENVIRONMENTAL, INC.

After evacuating each well, groundwater samples were collected with a Teflon or stainless-steel bailer. Samples to be analyzed for dissolved metals were pressure-filtered with nitrogen in a 2.4-liter Geotech polycarbonate barrel filter using a membrane filter with a 0.45-micron pore size. The samples were filtered directly into laboratory prepared bottles that were pre-preserved with nitric acid. Between samples, the filter assembly was rinsed with a dilute nitric acid solution followed by distilled water. The membrane was replaced between samples. After processing and labeling, all samples were kept on ice in coolers until delivery to the laboratory.

The bailer was decontaminated with a solution of trisodium phosphate and distilled water, followed by a final distilled water rinse.

6.0 SAMPLE HANDLING

After processing and labeling, a chain-of-custody record and an analytical request form was completed. The samples were then transported to Environmental Control Technology Corporation (ENCOTEC), Ann Arbor, Michigan, for analysis of selected dissolved metals (cadmium, chromium, copper, iron, lead, nickel, and zinc), purgeable halocarbons (DNR Scan 1), and purgeable aromatic hydrocarbons (DNR Scan 2). In addition, at the request of the MDNR, the samples collected in December 1989 were also analyzed for Hazardous Substance List (HSL) pesticides and polychlorinated biphenyls (PCBs). March and July 1990 samples were analyzed for PCBs only. The analytical methods used and lists of organic analytes are presented in Appendix D.

7.0 QUALITY CONTROL SAMPLES

For quality control purposes, one blind duplicate sample and one sampler blank (taken prior to sampling) were collected during each sampling effort. Similar to the groundwater samples, each quality control sample was analyzed for dissolved metals and organic chemicals. A blind duplicate sample is a duplicate sample labeled in a manner such that the laboratory is unaware that it is a duplicate. The purpose of a duplicate sample is to check the homogeneity of the sample in addition to the precision of the laboratory. A sampler blank is a sample of distilled water that is handled in the same manner as a groundwater sample - it is poured into the sampling equipment, filtered, preserved, placed into laboratory-prepared bottles, etc. The purpose of a sampler blank is to check the effectiveness of the decontamination procedures.

8.0 RESULTS

8.1 GROUNDWATER FLOW

Table 1 and Figure 4 summarize water level measurements and groundwater flow directions observed in the North Yard during the six sampling events conducted thusfar. The groundwater flow directions were determined by using the triagulation method.

TABLE 1
Summary of Water Levels and Groundwater Flow Directions
Observed in the North Yard During 1989 and 1990

	3/89	6/89	9/89	12/89	3/90	7/90
MW-301	93.97	93.03	92.45	92.09	93.50	91.94
MW-302	92.90	93.20	92.89	92.33	93.15	92.70
MW-303	92.41	92.75	92.63	92.11	92.80	92.48
Direction of Flow	S	SE	ESE	ESE	SSE	SE

In general, groundwater beneath the North Yard moves in a southeasterly direction with an average hydraulic gradient of 1.7 x 10-3 feet per foot. Previous studies have shown that groundwater in other locations at the Willow Run Plant generally flows toward the southwest. Due to local variations in hydrogeologic conditions, the small variations in flow direction exhibited in the North Yard are not unexpected, especially in an industrial plant setting where recharge from preciptiation is often prevented in some areas and concentrated in others. The relatively low gradient is also conducive to local and seasonal variations in groundwater flow direction.

8.2 Quality Control Samples

The analytical data generated during December 1989, March 1990, and July 1990 have been compiled with data from all previous sampling events and summarized in Table 2. Laboratory analytical reports for December 1989, March 1990, and July 1990 are contained in Appendicies E, F, and G, respectively.

Zinc was detected in all sampler blanks, but its presence did not effect the data interpretation in any way. It is likely that the zinc was present in the distilled water used to decontaminate the sampling equipment. All duplicate samples exhibited good correlation with the original samples.

8.3 GROUNDWATER QUALITY

Similar to previous sampling events, iron was the only potentially site-related metal observed in groundwater above the limits of detection during December 1989, March 1990, and July 1990. In December 1990, iron was found in wells MW-302 and MW-303 at 8.9 mg/L and 7.2 mg/L, respectively. In March 1990, iron was detected in MW-302 and MW-303 at 5.1 mg/L and 7.5 mg/L, respectively. Iron was not detected in well MW-301 in March or December. In July 1990, iron was found all three monitoring wells at concentrations of 0.31, 5.3 and 11 mg/L in MW-301, MW-302 and MW-303, respectively. In general, these concentrations are comparable to those observed during previous sampling events, and they are not unusual or unexpected in shallow groundwater in Michigan.

Also similar to the previous groundwater sampling efforts, no site-related organic chemicals were found in December 1989, March 1990, and July 1990 with the exception of the PCB compound Aroclor 1248. In

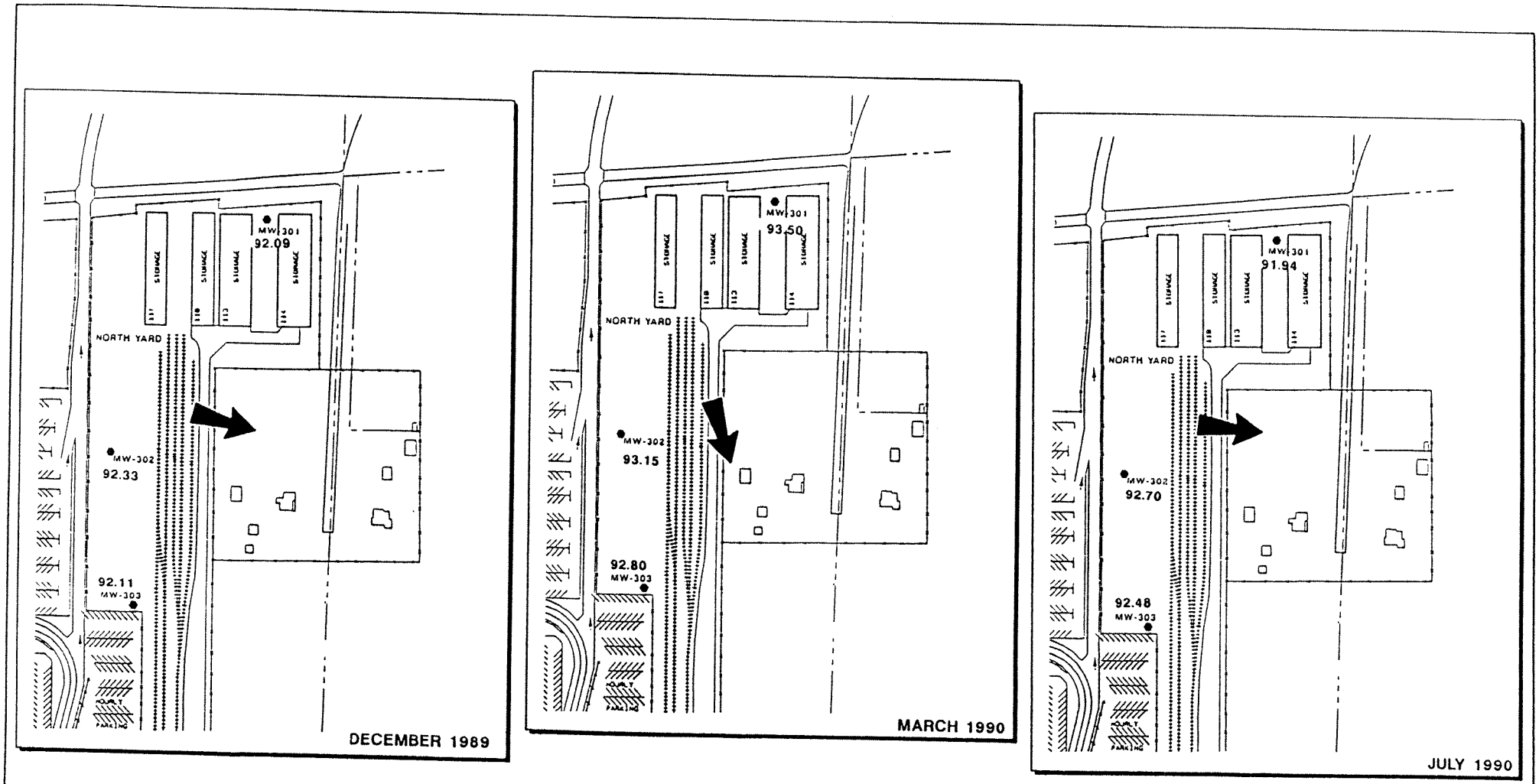


FIGURE 4

MONITORING WELL LOCATIONS
AND WATER LEVEL MEASUREMENTS

C-E ENVIRONMENTAL, INC.

TABLE 2

ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER AT THE NORTH YARD
GM HYDRA-MATIC, YPSILANTI, MICHIGAN

Date	Well No.	Cd	Cr	Cu	Fe	Pb	Ni	Zn	1,1,1-TCA	BDCM	CHLOROFORM	PCB-1248
July 1990	MW-301	U	U	U	0.31	U	U	U	U	U	U	U
	MW-302	U	U	U	5.3	U	U	0.11	U	U	U	U
	MW-303	U	U	U	11	U	U	U	U	U	U	U
	MW-351 (Dup of MW-303)	U	U	U	10	U	U	U	U	U	U	U
	MW-350 (Sampler Blank)	U	U	0.14	U	U	U	0.15	U	U	U	U
March 1990	MW-301	U	U	NA	U	U	U	U	U	U	U	U
	MW-302	U	U	NA	5.1	U	U	U	U	U	U	U
	MW-360 (Dup of MW-302)	U	U	NA	4.9	U	U	U	U	U	U	U
	MW-303	U	U	NA	7.5	U	U	U	U	U	U	0.00077
	MW-350 (Sampler Blank)	U	U	NA	U	U	U	0.03	U	U	U	U
December 1989	MW-301	U	U	U	U	U	U	U	U	U	U	U
	MW-302	U	U	U	8.9	U	U	U	U	U	U	U
	MW-303	U	U	U	7.2	U	U	U	U	U	U	0.0031
	MW-360 (Dup of MW-303)	U	U	U	7.3	U	U	U	U	U	U	0.0060
	MW-350 (Sampler Blank)	U	U	0.03	U	U	U	0.09	U	U	U	U
September 1989	MW-301	U	U	U	0.16	U	U	0.03	U	U	U	NA
	MW-302	U	U	0.02	5.9	U	U	0.03	U	U	U	NA
	MW-360 (Dup of MW-302)	U	U	0.02	5.9	U	U	0.02	U	U	U	NA
	MW-303	U	U	U	7.9	U	U	0.03	U	U	U	NA
	MW-350 (Sampler Blank)	U	U	0.51	0.06	0.03	U	0.32	U	U	0.003	NA
June 1989	MW-301	U	U	U	0.03	U	U	U	U	U	U	NA
	MW-351 (Dup of MW-301)	U	U	0.04	0.04	U	U	U	U	U	U	NA
	MW-302	U	U	U	2.0	U	U	U	U	U	U	NA
	MW-303	U	U	U	2.0	U	U	U	0.002	U	U	NA
	MW-350 (Sampler Blank)	U	U	0.02	U	U	U	U	U	0.001	0.005	NA
March 1989	MW-301	NA	U	U	U	U	U	U	U	U	U	NA
	MW-351 (Dup of MW-301)	NA	U	U	U	U	U	U	U	U	U	NA
	MW-302	NA	U	U	2.8	U	U	U	U	U	U	NA
	MW-303	NA	U	U	8.1	U	U	U	U	U	U	NA
	MW-350 (Sampler Blank)	NA	U	U	U	U	U	U	U	U	U	NA

NOTES:
1. All concentrations in mg/L.
2. U - Compound was analyzed but not detected.
3. NA - Not analyzed.
4. BDCM - Bromodichloromethane
5. 1,1,1-TCA - 1,1,1-Trichloroethane
6. Each sample was analyzed for DNR Scans 1 and 2 and HSL PCBs (EPA method 8080) unless otherwise noted; only the compounds detected are shown on this table.

December, this compound was detected in MW-303 and its duplicate (MW-360) at extremely low concentrations of 0.0031 mg/L and 0.0060 mg/L, respectively. In March, the concentration of Aroclor 1248 decreased to 0.00077 ug/L in MW-303. No PCBs were found in MW-303 during the July sampling event.

As mentioned previously, Hydra-matic conducted a subsurface soil study[2] in the North Yard in April 1988 to assess soil impacts due to oil leaks from machinery stored in the area. During the study, low concentrations of PCBs ($\leq$ 4 mg/kg) were found in shallow soils in two discrete areas of the site, but no PCBs above the limit of detection (0.2 mg/kg) were found in soil samples from the MW-303 area.

The presence of PCBs in groundwater at MW-303 was unexpected for several reasons. First, no PCBs were detected in soil samples from the MW-303 area, and at other areas of the site, PCBs were found only to a depth of 12 inches (MW-303 is 15 feet deep). Secondly, Aroclor 1248 is highly insoluble in water and tends to be found in the environment either adsorbed to soil particles or in oils. No oil was found in MW-303 or in any of the other wells in the North Yard.

The low concentration of Aroclor 1248 in MW-303 was most likely due to soil particles contaminated with very low levels of PCBs that were carried down to the screened interval during drilling. Although PCBs were undetected in soils around MW-303, it is possible that PCBs at concentrations below the limit of detection (0.2 mg/kg) were present in this area. If small amounts of these soils were carried downward during drilling, it is possible that very low PCB concentrations could be detected in groundwater if the samples were turbid. Indeed, the groundwater sampling record for MW-303 (see Appendices A and B) reported that water in this well was very silty.

In summary, it is likely that the PCBs observed in groundwater samples from MW-303 were actually not in groundwater, but instead were adsorbed to suspended soil particles. The PCBs at this depth were probably inadvertently introduced into the well during drilling. In any event, the fact that the concentration of Aroclor 1248 decreased during March (and was not evident in July) indicates that the small amount of PCBs smeared across the face of the borehole were removed during previous groundwater purging and sampling activities. Groundwater samples should be analyzed for PCBs during the next sampling event to confirm this conclusion.

---

[2]"Investigation of Soil Contamination in a Machine Storage Area at the Hydra-matic Plant in Ypsilanti, Michigan," GM Research, March 30, 1989.

APPENDIX A

GROUNDWATER SAMPLE DATA RECORDS
DECEMBER 1989

EC JORDAN CO.

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT Em Hmd YPSI - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-350 DATE 12/28/89

SKETCH ON BACK YES ☐ NO ☒ PHOTOGRAPHS YES ☐ NO ☒ ROLL NO/EXPOSURE NO _____

WELL DATA

WATER DEPTH — ☐ TOP WELL ☐ TOP CASING WELL DEPTH — WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK	KECK
QED	QED
SSBAIL	SSBAIL
OTHER	OTHER X teflon

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1215

WEATHER C

____ FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = _____ GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☒ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ ____ GAL	@ ____ GAL	@ ____ GAL	@ ____ GAL
TEMP ____ °C	TEMP ____ °C	TEMP ____ °C	TEMP ____ °C
SP. COND ____ @25°C	SP. COND ____ @25°C	SP. COND ____ @25°C	SP. COND ____ @25°C
pH ____	pH ____	pH ____	pH ____
Eh ____	Eh ____	Eh ____	Eh ____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80 ml	glass	No	No / No	VOA
	1l	plastic	Yes	HNO3 / 5 ml	Dissolved Metals
	2l	glass	No	— / —	PCB's

REMARKS/OBSERVATIONS Blank taken @ start of day through teflon bailer.

SAMPLER CK

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT Gm Amo YPSI - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-301 DATE 12/28/89

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☐ ROLL NO/EXPOSURE NO /

WELL DATA 4.74 4.76

WATER DEPTH 5.70 ☐ TOP WELL ☐ TOP CASING WELL DEPTH 12' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED	PURGE	SAMPLE
KECK	___	___
QED	___	___
SSBAIL	___	___
OTHER	X	X teflon

PURGE TIME START _____ END _____

SAMPLE TIME START 1230 END _____

WEATHER _____

7 FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = 3.5 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☑ IN BOTTLE

VOA LEVEL (PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ _____ GAL
TEMP 6.3 °C	TEMP 6.6 °C	TEMP 5.6 °C	TEMP _____ °C
SP. COND 109 @25°C	SP. COND 127 @25°C	SP. COND 133 @25°C	SP. COND _____ @25°C
pH 7.11	pH 6.90	pH 6.98	pH _____
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	N/A	VOA
	1l	plastic	Yes	HNO3 2ml	Diss. Metals
	2l	glass	No	—	PCB's

REMARKS/OBSERVATIONS Water slightly silty

SAMPLER BL

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT ~~Sharpe~~ - 4PSE - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-302 DATE 12/28/89

SKETCH ON BACK YES ☐ NO ☒ PHOTOGRAPHS YES ☐ NO ☒ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH ~~7.80~~ ☐ TOP WELL ☐ TOP CASING WELL DEPTH 15' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK ____	KECK ____
QED ____	QED ____
SSBAIL ____	SSBAIL ____
OTHER X	OTHER X teflon

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1245

WEATHER _____

7.2 FT. WATER X .163 (4"=.653gal/ft) (6"=1.47gal/ft) @=.163gal/ft) X 3 CASING VOLUME = 3.6 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____

SAMPLE LOCATION _____

HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ ____ GAL
TEMP 6.9 °C	TEMP 7.2 °C	TEMP 6.1 °C	TEMP ____ °C
SP. COND 501 @25°C	SP. COND 530 @25°C	SP. COND 480 @25°C	SP. COND ____ @25°C
pH 6.32	pH 6.31	pH 6.40	pH ____
Eh ____	Eh ____	Eh ____	Eh ____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	No / No	VOA
	1l	plastic	yes	HNO_3 2ml	Diss. Metals
	2l	glass	No	—	PCB's

REMARKS/OBSERVATIONS water silty

SAMPLER CSK

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT Lm AMD YPSI – North Yard JOB NO 5883-00

STATION NO/LOCATION MW-303 DATE 12/28/89

SKETCH ON BACK YES ☐ NO ☒ PHOTOGRAPHS YES ☐ NO ☒ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH 7.91 ☐ TOP WELL ☐ TOP CASING WELL DEPTH 15' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED	PURGE	SAMPLE
KECK		
QED		
SSBAIL		
OTHER	X	X teflon

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1300

WEATHER _____

7.1 FT. WATER X 163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = 3.5 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☒ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ _____ GAL
TEMP 6.1 °C	TEMP 5.9 °C	TEMP 6.6 °C	TEMP _____ °C
SP. COND 360 @25°C	SP. COND 337 @25°C	SP. COND 350 @25°C	SP. COND _____ @25°C
pH 6.40	pH 6.37	pH 6.35	pH _____
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	—	VOA
	1l	plastic	yes	HNO3 2ml	Diss. Metals
	2l	glass	No	—	PCB's

REMARKS/OBSERVATIONS Water very silty

SAMPLER CK

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM AMD YPSI - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-360 DATE 12/28/89

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☒ ROLL NO/EXPOSURE NO _____

WELL DATA

WATER DEPTH _____ ☐ TOP WELL ☐ TOP CASING WELL DEPTH _____ WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK	KECK
QED	QED
SSBAIL	SSBAIL
OTHER ✓	OTHER ✓

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END _____

WEATHER _____

_____ FT. WATER X .163 (2"=.163gal/ft, 4"=.653gal/ft, 6"=1.47gal/ft) X 3 CASING VOLUME = _____ GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ _____ GAL	@ _____ GAL	@ _____ GAL	@ _____ GAL
TEMP _____ °C	TEMP _____ °C	TEMP _____ °C	TEMP _____ °C
SP. COND _____ @25°C	SP. COND _____ @25°C	SP. COND _____ @25°C	SP. COND _____ @25°C
pH _____	pH _____	pH _____	pH _____
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80 ml	glass	No	—	VOA
	1l	plastic	yes	HNO3 2ml	Diss. Metals
	2l	glass	No	—	PCB's

REMARKS/OBSERVATIONS Duplicate Sample of MW-303

SAMPLER _____

APPENDIX B

GROUNDWATER SAMPLE DATA RECORDS
MARCH 1990

EC JORDAN CO

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-350 DATE 3/27/90

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☑ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH _____ ☐ TOP WELL ☑ TOP CASING WELL DEPTH _____ WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

	PURGE	SAMPLE
KECK		
QED		
SSBAIL	X	X
OTHER		

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1220

WEATHER Sunny

_____ FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = _____ GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ ____ GAL	@ ____ GAL	@ ____ GAL	@ ____ GAL
TEMP ____ °C	TEMP ____ °C	TEMP ____ °C	TEMP ____ °C
SP. COND ____ @25°C	SP. COND ____ @25°C	SP. COND ____ @25°C	SP. COND ____ @25°C
pH ____	pH ____	pH ____	pH ____
Eh ____	Eh ____	Eh ____	Eh ____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	—	VOA
	1l	Nalgene	Yes	HNO_3 2ml	Diss. Metals
	2l	Amberglass	No	—	PCBs

REMARKS/OBSERVATIONS Blank taken @ start of sampling day through SS bailer.

SAMPLER CSK/TM

EC JORDAN CO.

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-301 DATE 3/27/90

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☑ ROLL NO/EXPOSURE NO —

WELL DATA 3.31 .98 2.33

WATER DEPTH 4.29 ☐ TOP WELL ☑ TOP CASING WELL DEPTH 12' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK ____	KECK ____
QED ____	QED ____
SSBAIL X	SSBAIL X
OTHER ____	OTHER ____

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1245

WEATHER Sunny

8 FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = 4 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL
TEMP 7.8 °C	TEMP 6.0 °C	TEMP 5.9 °C	TEMP 5.9 °C
SP. COND 340 @25°C	SP. COND 310 @25°C	SP. COND 308 @25°C	SP. COND 308 @25°C
pH 6.9	pH 6.9	pH 6.9	pH 6.9
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	—	VOA
	1l	Nalgene	Yes	HNO_3 2ml	Diss. Metals
	2l	Amberglass	No	—	PCBs

REMARKS/OBSERVATIONS Water Silty

SAMPLER CSK/Ted

EC JORDAN CO.

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-302 DATE 3/27/90

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☑ ROLL NO/EXPOSURE NO —

WELL DATA 6.00

WATER DEPTH ~~6.98~~ 6.98 ☐ TOP WELL ☑ TOP CASING WELL DEPTH 15' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK	KECK
QED	QED
SSBAIL X	SSBAIL X
OTHER	OTHER

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1315

WEATHER Sunny

8 FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = 4 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL(PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL
TEMP 8.9 °C	TEMP 7.0 °C	TEMP 7.0 °C	TEMP 6.9 °C
SP. COND 1600 @25°C	SP. COND 1300 @25°C	SP. COND 1300 @25°C	SP. COND 1300 @25°C
pH 6.65	pH 6.5	pH 6.55	pH 6.55
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	— —	VOA
	1l	Nalgene	Yes	HNO_3 2ml	Diss. Metals
	2l	Amberglass	No	— —	PCBs

REMARKS/OBSERVATIONS Water mostly clear

SAMPLER CSK/Ind

EC JORDAN CO.

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-303 DATE 3/27/90

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☑ ROLL NO/EXPOSURE NO —

WELL DATA 6.94 1.98

WATER DEPTH 7.92 ☐ TOP WELL ☑ TOP CASING WELL DEPTH 15' WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK	KECK
QED	QED
SSBAIL X	SSBAIL X
OTHER	OTHER

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1345

WEATHER Sunny

8 FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = 4 GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL (PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL
TEMP 7.0 °C	TEMP 6.3 °C	TEMP 6.2 °C	TEMP 6.2 °C
SP. COND 890 @25°C	SP. COND 855 @25°C	SP. COND 850 @25°C	SP. COND 850 @25°C
pH 6.6	pH 6.65	pH 6.7	pH 6.7
Eh _____	Eh _____	Eh _____	Eh _____

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	—	VOA
	1l	Nalgene	Yes	HNO_3 2ml	Diss. Metals
	2l	Amberglass	No	—	PCBs

REMARKS/OBSERVATIONS Water Turbid

SAMPLER CSK/MD

EC JORDAN CO

PAGE 1 OF 1

GROUNDWATER FIELD SAMPLE DATA RECORD

PROJECT GM HMD - North Yard JOB NO 5883-00

STATION NO/LOCATION MW-360 DATE 3/27/90

SKETCH ON BACK YES ☐ NO ☑ PHOTOGRAPHS YES ☐ NO ☑ ROLL NO/EXPOSURE NO —

WELL DATA

WATER DEPTH _____ ☐ TOP WELL ☑ TOP CASING WELL DEPTH _____ WELL DIAM. 2" WELL MATERIAL PVC

WELL STICK-UP _____ WELL/CASING _____

EQUIPMENT USED

PURGE	SAMPLE
KECK	KECK
QED	QED
SSBAIL X	SSBAIL X
OTHER	OTHER

PURGE TIME START / END /

SAMPLE TIME START / END /

WEATHER Sunny

/ FT. WATER X .163 (2"=.163gal/ft) (4"=.653gal/ft) (6"=1.47gal/ft) X 3 CASING VOLUME = / GAL PURGED

FIELD DATA

FIELD DATA COLLECTION ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL (PPM) AMBIENT _____ SAMPLE LOCATION _____ HEADSPACE _____

SAMPLE PURGE DATA

@ GAL	@ GAL	@ GAL	@ GAL
TEMP °C	TEMP °C	TEMP °C	TEMP °C
SP. COND @25°C	SP. COND @25°C	SP. COND @25°C	SP. COND @25°C
pH	pH	pH	pH
Eh	Eh	Eh	Eh

BOTTLE ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED
	80ml	glass	No	—	VOA
	1l	Nalgene	Yes	HNO_3 2ml	Diss. Metals
	2l	Amberglass	No	—	PCBs

REMARKS/OBSERVATIONS Duplicate sample of MW-302

SAMPLER CSK/Ind

APPENDIX C

GROUNDWATER SAMPLE DATA RECORDS
JULY 1990

GROUNDWATER SAMPLE RECORD

SITE: Gm HMD YPSI - North Yard JOB NO. 5883-00 DATE: 7/20/90

SAMPLER BLANK

SAMPLE LOCATION MW-350 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH _____FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH _____FT
MONITORING:
AMBIENT AIR ___/___PPM
WELL MOUTH ___/___PPM

HISTORICAL WELL DEPTH _____FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____FT

PURGE DATA

HEIGHT OF WATER COLUMN _____FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] ____ GAL/FT (____IN)
X 10 3 CASING VOLUMES = GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 1130

	@ ___ GAL	@ ___ GAL	@ ___ GAL	@ ___ GAL	@ ___ GAL
PURGE VOLUME					
TEMP, DEG C					
pH, UNITS					
SPECIFIC CONDUCTIVITY, umhos/cm					

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID	DECON FLUIDS USED	WATER LEVEL EQUIP.USED
[X]	[ ] PERISTALTIC PUMP	_____	[ ] ETHYL ALCOHOL	[ ] ELECTRIC COND. PROBE
[ ]	[ ] SUBMERSIBLE PUMP	_____	[ ] DEIONIZED WATER	[X] FLOAT ACTIVATED
[ ]	[X] BAILER (PVC/SS/TEFLON)	_____	[ ] HNO3/D.I. WATER	[ ] KECK INTERFACE PROBE
[ ]	[ ] PVC/SILICON TUBING		[ ] POTABLE WATER	[ ] OTHER
[ ]	[X] TEFLON/SILICON TUBING		[X] TSP SOLUTION	
[ ]	[ ] AIR LIFT		[ ] NONE	NUMBER OF FILTER PAPERS USED ____
[ ]	[ ] WATERRA	_____	[ ] _____	
	[ ] IN-LINE FILTER			
	[ ] PRESS/VAC FILTER			
[ ]	[ ] _____	_____		

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	DNR SCAN 1&2	8020	80ml	glass	No	No
_____	Dissolved metals	Cd Cr Fe Ni Pb Zn	1l	plastic	Yes	Yes/2ml
_____	PCBs	8080	1l	amber glass	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES

Sampler Blank taken @ start of Day

SIGNATURE Jerry D. Kelly

SIGNATURE/FUNCTION: _____

GROUNDWATER SAMPLE RECORD

SITE: GM HMD YPSI - North Yard JOB NO. 5883-00 DATE: 7/20/90

SAMPLE LOCATION MW-301 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH 12' FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH 7.81 + .90 = 5.85 FT
MONITORING:
AMBIENT AIR ___/___ PPM
WELL MOUTH ___/___ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 6.5 FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] ____ GAL/FT (____ IN)
1.8 x 3 CASING VOLUMES = 3.25 GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 1145

	@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL	@ ___ GAL
PURGE VOLUME					
TEMP, DEG C	16.7	16.6	16.4	16.4	
pH, UNITS	7.1	7.3	7.3	7.3	
SPECIFIC CONDUCTIVITY, umhos/cm	880	680	675	675	

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID	DECON FLUIDS USED	WATER LEVEL EQUIP.USED
[X]	[ ] PERISTALTIC PUMP	_____	[ ] ETHYL ALCOHOL	[ ] ELECTRIC COND. PROBE
[ ]	[ ] SUBMERSIBLE PUMP	_____	[ ] DEIONIZED WATER	[X] FLOAT ACTIVATED
[ ]	[X] BAILER (PVC/SS/TEFLON)	_____	[ ] HNO3/D.I. WATER	[ ] KECK INTERFACE PROBE
[ ]	[ ] PVC/SILICON TUBING		[ ] POTABLE WATER	[ ] OTHER
[ ]	[X] ~~TEFLON/SILICON TUBING~~		[X] TSP SOLUTION	
[ ]	[ ] AIR LIFT		[ ] NONE	NUMBER OF FILTER PAPERS USED ____
[ ]	[ ] WATERRA	_____	[ ] _____	
	[ ] IN-LINE FILTER			
	[ ] PRESS/VAC FILTER			
[ ]	[ ] _____	_____		

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	DNR SCAN 1 & 2	8020	80 ml	glass	No	No
_____	Dissolved metals	Cd Cr Fe Ni Pb Zn	1 l	plastic	Yes	Yes/2ml
_____	PCBs	8080	1 l	amber glass	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES Water Clear

SIGNATURE _____

SIGNATURE/FUNCTION: _____

90303.WP
REVISED 3/90

GROUNDWATER SAMPLE RECORD

SITE: Gn HMD YPSI - North Yard JOB NO. 5883-00 DATE: 7/20/90

SAMPLE LOCATION MW-302 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH 15 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH 6.93 / 7.43 FT
MONITORING:
AMBIENT AIR ___/___ PPM
WELL MOUTH ___/___ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 7.16 FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] ____ GAL/FT (____ IN)
X (3) CASING VOLUMES = GALLONS TO BE PURGED 3.8 (10)
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 1205

PURGE VOLUME	a 1 GAL	a 2 GAL	a 3 GAL	a 4 GAL	a ___ GAL
TEMP, DEG C	17.0	17.2	17.2	17.1	
pH, UNITS	7.0	7.0	7.0	7.0	
SPECIFIC CONDUCTIVITY, umhos/cm	1860	1740	1800	1800	

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID
[X]	[ ] PERISTALTIC PUMP	_____
[ ]	[ ] SUBMERSIBLE PUMP	_____
[ ]	[X] BAILER (PVC/SS/TEFLON)	_____
[ ]	[ ] PVC/SILICON TUBING	
[ ]	[X] ~~TEFLON/SILICON TUBING~~	
[ ]	[ ] AIR LIFT	
[ ]	[ ] WATERRA	_____
	[ ] IN-LINE FILTER	
	[ ] PRESS/VAC FILTER	
[ ]	[ ] _____	_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[ ] _____

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	DNR SCAN 1 & 2	8020	80 ml	glass	No	No
_____	Dissolved Metals	Cd Cr Fe Ni Pb Zn	1 l	plastic	Yes	Yes/2 ml
_____	PCBs	8080	1 l	amber glass	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES Water Clear

SIGNATURE Amy S. Kelly

SIGNATURE/FUNCTION: _____

90303.WP
REVISED 3/90

GROUNDWATER SAMPLE RECORD

SITE: GM HMD YPSI - North Yard JOB NO. 5883-00 DATE: 7/20/90

SAMPLE LOCATION MW-303 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH 15 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____

WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____

WATER DEPTH 6.56 + .98 = 7.54 FT

MONITORING:
AMBIENT AIR ___/___ PPM
WELL MOUTH ___/___ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____

WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____

PROTECTIVE CASING STICK-UP (FROM GROUND) _____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 7.5 FT

[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] ____ GAL/FT (____ IN)

10 X 3 CASING VOLUMES = GALLONS TO BE PURGED 3.8 x 3 = 12

PURGE TIME START _____ END _____

SAMPLE TIME START 1235 END _____

	a 3 GAL	a 6 GAL	a 9 GAL	a 12 GAL	a ___ GAL
TEMP, DEG C	17.5	17.6	17.2	17.3	
pH, UNITS	7.0	7.1	7.0	7.0	
SPECIFIC CONDUCTIVITY, umhos/cm	1175	1135	1100	1100	

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID
[X]	[ ] PERISTALTIC PUMP	_____
[ ]	[ ] SUBMERSIBLE PUMP	_____
[ ]	[X] BAILER (PVC/SS/TEFLON)	_____
[ ]	[ ] PVC/SILICON TUBING	
[ ]	[X] ~~TEFLON/SILICON TUBING~~	
[ ]	[ ] AIR LIFT	
[ ]	[ ] WATERRA	_____
	[ ] IN-LINE FILTER	
	[ ] PRESS/VAC FILTER	
[ ]	[ ] _____	_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[ ] _____

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	DNR SCAN 1&2	8020	80 ml	glass	No	No
_____	Dissolved metals	Cd Cr Fe Ni Pb Zn	1 l	plastic	Yes	Yes/2 ml
_____	PCBs	8080	1 l	amber glass	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES

⇒ Purge 10 well volumes
Water Clear

SIGNATURE _____

SIGNATURE/FUNCTION: _____

GROUNDWATER SAMPLE RECORD

SITE: Gn HMD YPSI - North Yard JOB NO. 5883-00 DATE: 7/20/90

SAMPLE LOCATION MW-351 LAB NUMBER Dup of 303

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH _____FT

[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____

WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____

WATER DEPTH _____FT

MONITORING:
AMBIENT AIR ____/____PPM
WELL MOUTH ____/____PPM

HISTORICAL WELL DEPTH _____FT

[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____

WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____

PROTECTIVE CASING STICK-UP (FROM GROUND)
_____FT

PURGE DATA

HEIGHT OF WATER COLUMN _____FT

[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] ____ GAL/FT (____IN)

X 10 3 CASING VOLUMES = GALLONS TO BE PURGED

PURGE TIME START_____ END_____

SAMPLE TIME START_____ END_____

	@ ___ GAL	@ ___ GAL	@ ___ GAL	@ ___ GAL	@ ___ GAL
PURGE VOLUME					
TEMP, DEG C					
pH, UNITS					
SPECIFIC CONDUCTIVITY, umhos/cm					

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID	DECON FLUIDS USED	WATER LEVEL EQUIP.USED
[X]	[ ] PERISTALTIC PUMP		[ ] ETHYL ALCOHOL	[ ] ELECTRIC COND. PROBE
[ ]	[ ] SUBMERSIBLE PUMP		[ ] DEIONIZED WATER	[X] FLOAT ACTIVATED
[ ]	[X] BAILER (PVC/SS/TEFLON)		[ ] HNO3/D.I. WATER	[ ] KECK INTERFACE PROBE
[ ]	[ ] PVC/SILICON TUBING		[ ] POTABLE WATER	[ ] OTHER
[ ]	[X] TEFLON/SILICON TUBING		[X] TSP SOLUTION	
[ ]	[ ] AIR LIFT		[ ] NONE	NUMBER OF FILTER PAPERS USED ____
[ ]	[ ] WATERRA		[ ] _____	
	[ ] IN-LINE FILTER			
	[ ] PRESS/VAC FILTER			
[ ]	[ ] _____			

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
	DNR SCAN 1 & 2	8020	80 ml	glass	No	No
	Dissolved metals	Cd Cr Fe Ni Pb Zn	1 l	plastic	Yes	Yes/2 ml
	PCBs	8080	1 l	amber glass	No	No

NOTES

Duplicate sample of MW-303

SIGNATURE _____

SIGNATURE/FUNCTION: _____

APPENDIX D

ANALYTICAL METHODS

ANALYTICAL PROGRAM
QUARTERLY GROUNDWATER MONITORING PROGRAM

NORTH YARD
GM HYDRA-MATIC

PARAMETER	METHOD NUMBER
Dissolved Metals:	
Cadmium	1310/6010
Chromium	1310/6010
Iron	3010/7380
Nickel	1310/6010
Lead	3010/7420
Zinc	1310/6010
DNR Scan 1 Compounds:	8020
Bromodichloromethane	
Bromoform	
Carbon tetrachloride	
Chlorobenzene	
Chloroform	
Dibromochloromethane	
Dichlorodifluoromethane	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1-Dichloroethene	
cis-1,2-Dichloroethene	
trans-1,2-Dichloroethene	
1,3-Dichloropropene	
1,1,2,2-Tetrachloroethane	
Tetrachloroethene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethene	
DNR Scan 2 Compounds:	8020
Benzene	
Ethylbenzene	
Styrene	
Toluene	
Total Xylenes	
HSL Pesticides and PCBs:	8080
Aldrin	
Alpha-BHC	
Beta-BHC	
Delta-BHC	
Gamma-BHC (Lindane)	
Chlordane	
4-4'-DDD	
4-4'-DDE	
4-4'-DDT	
Dieldrin	
Alpha-Endosulfan	
Beta-Endosulfan	
Endosulfan Sulfate	
Endrin	
Endrin Ketone	
Heptachlor	
Heptachlor Epoxide	
Methoxychlor	
Toxaphene	
PCB-1016	
PCB-1221	
PCB-1232	
PCB-1242	
PCB-1248	
PCB-1254	
PCB-1260	

APPENDIX E

LABORATORY ANALYTICAL REPORTS
DECEMBER 1989

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: EC Jordan
PROJECT NO.: 40650
SAMPLE TYPE: Water
REPORT DATE: January, 1990

SAMPLE NAME		MW-350	MW-360	MW-301	MW-302	MW-303
SAMPLE DATE		12-28-89	12-28-89	12-28-89	12-28-89	12-28-89
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		45346	45347	45348	45349	45350
Cadmium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/L	0.03	<0.02	<0.02	<0.02	<0.02
Iron	mg/L	<0.02	7.3	<0.02	8.9	7.2
Lead	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	0.09	<0.02	<0.02	<0.02	<0.02

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: February 8, 1990

Sample: MW 301
ENCOTEC Number: 45343
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: February 8, 1990

Sample: MW-301
ENCOTEC Number: 45343
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
(313) 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: EPA 8080
Report Date: February 8, 1990

Sample: MW 301
ENCOTEC Number: 45343
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: 1-4-90
Date Analyzed: 1-22-90

U = Analyte not detected
B = Analyte present in method blank

HAZARDOUS SUBSTANCE LIST PESTICIDES	CAS #	UNITS	CONC.	DETECTION LIMIT
Aldrin	309-00-2	ug/L	U	0.05
Alpha-BHC	319-84-6	ug/L	U	0.05
Beta-BHC	319-85-7	ug/L	U	0.05
Delta-BHC	319-86-8	ug/L	U	0.05
Gamma-BHC (Lindane)	58-89-9	ug/L	U	0.05
Chlordane	57-74-9	ug/L	U	0.50
4,4'-DDD	72-54-8	ug/L	U	0.10
4,4'-DDE	72-55-9	ug/L	U	0.10
4,4'-DDT	50-29-3	ug/L	U	0.10
Dieldrin	60-57-1	ug/L	U	0.10
Alpha-Endosulfan	959-98-8	ug/L	U	0.05
Beta-Endosulfan	33213-65-9	ug/L	U	0.10
Endosulfan Sulfate	1031-07-08	ug/L	U	0.10
Endrin	72-20-8	ug/L	U	0.10
Endrin Ketone	53494-70-5	ug/L	U	0.10
Heptachlor	76-44-8	ug/L	U	0.05
Heptachlor Epoxide	1024-57-3	ug/L	U	0.05
Methoxychlor	72-43-5	ug/L	U	0.50
Toxaphene	80001-35-2	ug/L	U	1.0
PCB-1016	12674-11-2	ug/L	U	0.50
PCB-1221	11104-28-2	ug/L	U	0.50
PCB-1232	11141-16-5	ug/L	U	0.50
PCB-1242	53469-21-9	ug/L	U	0.50
PCB-1248	12572-29-6	ug/L	U	0.50
PCB-1254	11097-69-1	ug/L	U	1.0
PCB-1260	11096-82-5	ug/L	U	1.0

Quality Assurance Data

Surrogate Spike	Percent Recovery	QC Set
Dibutylchlorendate	73	4PW90

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: February 8, 1990

Sample: MW 302
ENCOTEC Number: 45344
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: February 8, 1990

Sample: MW-302
ENCOTEC Number: 45344
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
(313) 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: EPA 8080
Report Date: February 8, 1990

Sample: MW 302
ENCOTEC Number: 45344
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: 1-4-90
Date Analyzed: 1-22-90

U = Analyte not detected
B = Analyte present in method blank

HAZARDOUS SUBSTANCE LIST PESTICIDES	CAS #	UNITS	CONC.	DETECTION LIMIT
Aldrin	309-00-2	ug/L	U	0.05
Alpha-BHC	319-84-6	ug/L	U	0.05
Beta-BHC	319-85-7	ug/L	U	0.05
Delta-BHC	319-86-8	ug/L	U	0.05
Gamma-BHC (Lindane)	58-89-9	ug/L	U	0.05
Chlordane	57-74-9	ug/L	U	0.50
4,4'-DDD	72-54-8	ug/L	U	0.10
4,4'-DDE	72-55-9	ug/L	U	0.10
4,4'-DDT	50-29-3	ug/L	U	0.10
Dieldrin	60-57-1	ug/L	U	0.10
Alpha-Endosulfan	959-98-8	ug/L	U	0.05
Beta-Endosulfan	33213-65-9	ug/L	U	0.10
Endosulfan Sulfate	1031-07-08	ug/L	U	0.10
Endrin	72-20-8	ug/L	U	0.10
Endrin Ketone	53494-70-5	ug/L	U	0.10
Heptachlor	76-44-8	ug/L	U	0.05
Heptachlor Epoxide	1024-57-3	ug/L	U	0.05
Methoxychlor	72-43-5	ug/L	U	0.50
Toxaphene	80001-35-2	ug/L	U	1.0
PCB-1016	12674-11-2	ug/L	U	0.50
PCB-1221	11104-28-2	ug/L	U	0.50
PCB-1232	11141-16-5	ug/L	U	0.50
PCB-1242	53469-21-9	ug/L	U	0.50
PCB-1248	12572-29-6	ug/L	U	0.50
PCB-1254	11097-69-1	ug/L	U	1.0
PCB-1260	11096-82-5	ug/L	U	1.0

Quality Assurance Data

Surrogate Spike	Percent Recovery	QC Set
Dibutylchlorendate	84	4PW90

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: February 8, 1990

Sample: MW 303
ENCOTEC Number: 45345
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: February 8, 1990

Sample: MW-303
ENCOTEC Number: 45345
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
(313) 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: EPA 8080
Report Date: February 8, 1990

Sample: MW 303
ENCOTEC Number: 45345
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: 1-4-90
Date Analyzed: 1-22-90

U = Analyte not detected
B = Analyte present in method blank

HAZARDOUS SUBSTANCE LIST PESTICIDES	CAS #	UNITS	CONC.	DETECTION LIMIT
Aldrin	309-00-2	ug/L	U	0.05
Alpha-BHC	319-84-6	ug/L	U	0.05
Beta-BHC	319-85-7	ug/L	U	0.05
Delta-BHC	319-86-8	ug/L	U	0.05
Gamma-BHC (Lindane)	58-89-9	ug/L	U	0.05
Chlordane	57-74-9	ug/L	U	0.50
4,4'-DDD	72-54-8	ug/L	U	0.10
4,4'-DDE	72-55-9	ug/L	U	0.10
4,4'-DDT	50-29-3	ug/L	U	0.10
Dieldrin	60-57-1	ug/L	U	0.10
Alpha-Endosulfan	959-98-8	ug/L	U	0.05
Beta-Endosulfan	33213-65-9	ug/L	U	0.10
Endosulfan Sulfate	1031-07-08	ug/L	U	0.10
Endrin	72-20-8	ug/L	U	0.10
Endrin Ketone	53494-70-5	ug/L	U	0.10
Heptachlor	76-44-8	ug/L	U	0.05
Heptachlor Epoxide	1024-57-3	ug/L	U	0.05
Methoxychlor	72-43-5	ug/L	U	0.50
Toxaphene	80001-35-2	ug/L	U	1.0
PCB-1016	12674-11-2	ug/L	U	0.50
PCB-1221	11104-28-2	ug/L	U	0.50
PCB-1232	11141-16-5	ug/L	U	0.50
PCB-1242	53469-21-9	ug/L	U	0.50
PCB-1248	12572-29-6	ug/L	3.1	0.50
PCB-1254	11097-69-1	ug/L	U	1.0
PCB-1260	11096-82-5	ug/L	U	1.0

Quality Assurance Data

Surrogate Spike	Percent Recovery	QC Set
Dibutylchlorendate	75	4PW90

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: February 8, 1990

Sample: MW 360 Dup of MW-303
ENCOTEC Number: 45342
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: February 8, 1990

Sample: MW-360 Dup of MW-303
ENCOTEC Number: 45342
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
(313) 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: EPA 8080
Report Date: February 8, 1990

Sample: MW 360 Dup
ENCOTEC Number: 45342
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: 1-4-90
Date Analyzed: 1-22-90

U = Analyte not detected
B = Analyte present in method blank

HAZARDOUS SUBSTANCE LIST PESTICIDES	CAS #	UNITS	CONC.	DETECTION LIMIT
Aldrin	309-00-2	ug/L	U	0.05
Alpha-BHC	319-84-6	ug/L	U	0.05
Beta-BHC	319-85-7	ug/L	U	0.05
Delta-BHC	319-86-8	ug/L	U	0.05
Gamma-BHC (Lindane)	58-89-9	ug/L	U	0.05
Chlordane	57-74-9	ug/L	U	0.50
4,4'-DDD	72-54-8	ug/L	U	0.10
4,4'-DDE	72-55-9	ug/L	U	0.10
4,4'-DDT	50-29-3	ug/L	U	0.10
Dieldrin	60-57-1	ug/L	U	0.10
Alpha-Endosulfan	959-98-8	ug/L	U	0.05
Beta-Endosulfan	33213-65-9	ug/L	U	0.10
Endosulfan Sulfate	1031-07-08	ug/L	U	0.10
Endrin	72-20-8	ug/L	U	0.10
Endrin Ketone	53494-70-5	ug/L	U	0.10
Heptachlor	76-44-8	ug/L	U	0.05
Heptachlor Epoxide	1024-57-3	ug/L	U	0.05
Methoxychlor	72-43-5	ug/L	U	0.50
Toxaphene	80001-35-2	ug/L	U	1.0
PCB-1016	12674-11-2	ug/L	U	0.50
PCB-1221	11104-28-2	ug/L	U	0.50
PCB-1232	11141-16-5	ug/L	U	0.50
PCB-1242	53469-21-9	ug/L	U	0.50
PCB-1248	12572-29-6	ug/L	6.0	0.50
PCB-1254	11097-69-1	ug/L	U	1.0
PCB-1260	11096-82-5	ug/L	U	1.0

Quality Assurance Data

Surrogate Spike	Percent Recovery	QC Set
Dibutylchlorendate	70	4PW90

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: February 8, 1990

Sample: MW 350 – Blank
ENCOTEC Number: 45341
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: February 8, 1990

Sample: MW-350 Blank
ENCOTEC Number: 45341
Sample Date: 12/28/89
Date Received: 12/28/89
Date Extracted: NA
Date Analyzed: 1/2/90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
(313) 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: EPA 8080
Report Date: February 8, 1990

Sample: MW 350 Blank
ENCOTEC Number: 45341
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: 1-4-90
Date Analyzed: 1-22-90

U = Analyte not detected
B = Analyte present in method blank

HAZARDOUS SUBSTANCE LIST PESTICIDES	CAS #	UNITS	CONC.	DETECTION LIMIT
Aldrin	309-00-2	ug/L	U	0.05
Alpha-BHC	319-84-6	ug/L	U	0.05
Beta-BHC	319-85-7	ug/L	U	0.05
Delta-BHC	319-86-8	ug/L	U	0.05
Gamma-BHC (Lindane)	58-89-9	ug/L	U	0.05
Chlordane	57-74-9	ug/L	U	0.50
4,4'-DDD	72-54-8	ug/L	U	0.10
4,4'-DDE	72-55-9	ug/L	U	0.10
4,4'-DDT	50-29-3	ug/L	U	0.10
Dieldrin	60-57-1	ug/L	U	0.10
Alpha-Endosulfan	959-98-8	ug/L	U	0.05
Beta-Endosulfan	33213-65-9	ug/L	U	0.10
Endosulfan Sulfate	1031-07-08	ug/L	U	0.10
Endrin	72-20-8	ug/L	U	0.10
Endrin Ketone	53494-70-5	ug/L	U	0.10
Heptachlor	76-44-8	ug/L	U	0.05
Heptachlor Epoxide	1024-57-3	ug/L	U	0.05
Methoxychlor	72-43-5	ug/L	U	0.50
Toxaphene	80001-35-2	ug/L	U	1.0
PCB-1016	12674-11-2	ug/L	U	0.50
PCB-1221	11104-28-2	ug/L	U	0.50
PCB-1232	11141-16-5	ug/L	U	0.50
PCB-1242	53469-21-9	ug/L	U	0.50
PCB-1248	12572-29-6	ug/L	U	0.50
PCB-1254	11097-69-1	ug/L	U	1.0
PCB-1260	11096-82-5	ug/L	U	1.0

Quality Assurance Data

Surrogate Spike	Percent Recovery	QC Set
Dibutylchlorendate	81	4PW90

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: February 8, 1990

Sample: Trip Blank
ENCOTEC Number: 45351
Sample Date: 12-28-89
Date Received: 12-28-89
Date Extracted: NA
Date Analyzed: 1-2-89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: February 8, 1990

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 1-2-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: February 8, 1990

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 1-2-89

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
(313) 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: E.C. Jordan
Project Number: 40650
Method: EPA 8080
Report Date: February 8, 1990

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: 1-4-90
Date Analyzed: 1-22-90

U = Analyte not detected
B = Analyte present in method blank

HAZARDOUS SUBSTANCE LIST PESTICIDES	CAS #	UNITS	CONC.	DETECTION LIMIT
Aldrin	309-00-2	ug/L	U	0.05
Alpha-BHC	319-84-6	ug/L	U	0.05
Beta-BHC	319-85-7	ug/L	U	0.05
Delta-BHC	319-86-8	ug/L	U	0.05
Gamma-BHC (Lindane)	58-89-9	ug/L	U	0.05
Chlordane	57-74-9	ug/L	U	0.50
4,4'-DDD	72-54-8	ug/L	U	0.10
4,4'-DDE	72-55-9	ug/L	U	0.10
4,4'-DDT	50-29-3	ug/L	U	0.10
Dieldrin	60-57-1	ug/L	U	0.10
Alpha-Endosulfan	959-98-8	ug/L	U	0.05
Beta-Endosulfan	33213-65-9	ug/L	U	0.10
Endosulfan Sulfate	1031-07-08	ug/L	U	0.10
Endrin	72-20-8	ug/L	U	0.10
Endrin Ketone	53494-70-5	ug/L	U	0.10
Heptachlor	76-44-8	ug/L	U	0.05
Heptachlor Epoxide	1024-57-3	ug/L	U	0.05
Methoxychlor	72-43-5	ug/L	U	0.50
Toxaphene	80001-35-2	ug/L	U	1.0
PCB-1016	12674-11-2	ug/L	U	0.50
PCB-1221	11104-28-2	ug/L	U	0.50
PCB-1232	11141-16-5	ug/L	U	0.50
PCB-1242	53469-21-9	ug/L	U	0.50
PCB-1248	12572-29-6	ug/L	U	0.50
PCB-1254	11097-69-1	ug/L	U	1.0
PCB-1260	11096-82-5	ug/L	U	1.0

Quality Assurance Data

Surrogate Spike	Percent Recovery	QC Set
Dibutylchlorendate	86	3PW90

APPENDIX F

LABORATORY ANALYTICAL REPORTS
MARCH 1990

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: C. E. Environmental PROJECT NO.: 40650

SAMPLE TYPE: Filtrate REPORT DATE: May, 1990

SAMPLE NAME		MW 350	MW 360	MW 301	MW 302	MW 303
SAMPLE DATE		3-27-90	3-27-90	3-27-90	3-27-90	3-27-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		49771	49772	49773	49774	49775
Cadmium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	mg/L	<0.02	4.9	<0.02	5.1	7.5
Lead	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	0.03	<0.02	<0.02	<0.02	<0.02

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: C. E. Environmental
PROJECT NO.: 40650
SAMPLE TYPE: Water
REPORT DATE: May, 1990

SAMPLE NAME		MW 350	MW 360	MW 301	MW 302	MW 303
SAMPLE DATE		3-27-90	3-27-90	3-27-90	3-27-90	3-27-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		49766	49767	49768	49768 69	49770
Aroclor 1016	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	ug/L	<0.1	<0.1	<0.1	<0.1	0.77
Aroclor 1254	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: MW301
ENCOTEC Number: 49763
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: MW301
ENCOTEC Number: 49768
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: MW302
ENCOTEC Number: 49769
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: MW302
ENCOTEC Number: 49769
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: MW360 Dup of MW-302
ENCOTEC Number: 49767
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: MW360 Comp B /10302
ENCOTEC Number: 49767
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: MW303
ENCOTEC Number: 49770
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: MW303
ENCOTEC Number: 49770
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: MW350 - Blank
ENCOTEC Number: 49766
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: MW350 - [illegible]
ENCOTEC Number: 49766
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: Trip Blank
ENCOTEC Number: 49776
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: Trip Blank
ENCOTEC Number: 49776
Sample Date: 3-27-90
Date Received: 3-27-90
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: Method Blank (B036V15)
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	0.001	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	0.002	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: Method Blank (A036V15)
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 4-3-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	0.002	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: May 11, 1990

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 4-4-90

U = Analyte not detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	0.001	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	0.001	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: C.E. Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: May 11, 1990

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 4-4-90

U = Analyzed, Not Detected
B = Analyte present in method blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	0.002	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

APPENDIX G

LABORATORY ANALYTICAL REPORTS
JULY 1990

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: ABB Environmental
PROJECT NO.: 40650
SAMPLE TYPE: Water
REPORT DATE: August, 1990

SAMPLE NAME		MW 301	MW 302	MW 303	MW 350	MW 351
SAMPLE DATE		7-20-90	7-20-90	7-20-90	7-20-90	7-20-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		55832	55833	55834	55835	55836
Cadmium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/L	<0.02	<0.02	<0.02	0.14	<0.02
Iron	mg/L	0.31	5.3	11	<0.02	10
Lead	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	<0.02	0.11	<0.02	0.15	<0.02

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: ABB Environmental
PROJECT NO.: 40650
SAMPLE TYPE: Water
REPORT DATE: August, 1990

SAMPLE NAME		MW 301	MW 302	MW 303	MW 350	MW 351
SAMPLE DATE		7-20-90	7-20-90	7-20-90	7-20-90	7-20-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		55832	55833	55834	55835	55836
Aroclor 1016	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	ug/L	<0.2	<0.2	<0.2	<0.2	<0.2
Aroclor 1260	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1

0002

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: August 10, 1990

Sample: MW 301
ENCOTEC Number: 55832
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.002
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: AAB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: August 10, 1990

Sample: MW 301
ENCOTEC Number: 55832
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.002
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: August 10, 1990

Sample: MW 302
ENCOTEC Number: 55833
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.002
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: AAB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: August 10, 1990

Sample: MW 302
ENCOTEC Number: 55833
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.002
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: August 10, 1990

Sample: MW 303
ENCOTEC Number: 55834
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.002
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: AAB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: August 10, 1990

Sample: MW 303
ENCOTEC Number: 55834
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.002
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: August 10, 1990

Sample: MW 351
ENCOTEC Number: 55836
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.002
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: AAB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: August 10, 1990

Sample: MW 351-
ENCOTEC Number: 55836
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: August 10, 1990

Sample: MW 350
ENCOTEC Number: 55835
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.003
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: AAB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: August 10, 1990

Sample: MW 350
ENCOTEC Number: 55835
Sample Date: 7-20-90
Date Received: 7-20-90
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.002
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichlorgethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: August 10, 1990

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	0.001	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: AAB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: August 10, 1990

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 7-30-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

C-E ENVIRONMENTAL, INC.

GROUNDWATER MONITORING REPORT SEPTEMBER 1990

NORTH YARD

Prepared For:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
GM Hydra-Matic, Ypsilanti, Michigan

December 1990

Job No. 5883-00

COMBUSTION ENGINEERING

GROUNDWATER MONITORING REPORT
SEPTEMBER 1990

NORTH YARD

Prepared For:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
Ypsilanti, Michigan

Prepared By:

C-E ENVIRONMENTAL INC.
Farmington Hills, Michigan

December 1990

5883-00

TABLE OF CONTENTS

SECTION NO.	TITLE	PAGE NO.
1.0	INTRODUCTION	1
2.0	SCHEDULE	1
3.0	PERSONNEL	1
4.0	SAMPLING LOCATIONS	1
5.0	FIELD PROCEDURES	1
6.0	SAMPLE HANDLING	5
7.0	QUALITY CONTROL SAMPLES	5
8.0	RESULTS	5
	8.1 GROUNDWATER FLOW	5
	8.2 QUALITY CONTROL SAMPLES	5
	8.3 GROUNDWATER QUALITY	5

APPENDIX A - GROUNDWATER SAMPLE DATA RECORDS
APPENDIX B - ANALYTICAL METHODS
APPENDIX C - LABORATORY ANALYTICAL REPORTS

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1	LOCATION OF THE GM HYDRA-MATIC WILLOW RUN PLANT	2
2	INVESTIGATION LOCATION MAP	3
3	MONITORING WELL LOCATIONS	4
4	MONITORING WELL LOCATIONS AND WATER LEVEL MEASUREMENTS	6

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1	SUMMARY OF WATER LEVELS AND GROUNDWATER FLOW DIRECTIONS	7
2	ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER AT THE NORTH YARD - SEPTEMBER 1990	8

1.0 INTRODUCTION

The General Motors (GM) Hydra-matic Willow Run Plant is located in Ypsilanti, Michigan, within Washtenaw County (see Figure 1). The North Yard, previously used to store production machinery and equipment, is located in the northeast corner of Hydra-matic's property (see Figure 2). The equipment was stored directly on the ground; as a result, residual metal-working fluids and various oils leaked from the equipment into the soil.

GM conducted a subsurface soil study in April 1988 to determine the extent of contamination in the North Yard. The results indicated that the fluids and oils which had leaked from the machinery were confined to the upper 24 inches of soil. This material was removed from the site in August 1988.

As part of the North Yard remediation program, Hydra-matic chose to implement a quarterly groundwater monitoring program for a two year period beginning in 1989[1]. In February 1989, C-E Environmental, Inc. intalled three groundwater monitoring wells in the North Yard. Groundwater samples were collected in March 1989, June 1989, September 1989, December 1989, March 1990, July 1990, and September 1990. All samples were analyzed for selected dissolved metals, purgeable halocarbons (DNR Scan 1), and purgeable aromatic hydrocarbons (DNR Scan 2). In addition, samples collected in December 1989, March 1990, July 1990, and September 1990 were analyzed for polychlorinated biphenyls (PCBs). The results of the first six sampling events were reported previously. This report documents the sampling event which occurred in September 1990.

2.0 SCHEDULE

The seventh groundwater sampling event was conducted on September 19, 1990.

3.0 PERSONNEL

Groundwater samples were collected by C. Kielty of C-E Environmental.

4.0 SAMPLING LOCATIONS

Figure 3 shows the locations of the three monitoring wells in the North Yard.

5.0 FIELD PROCEDURES

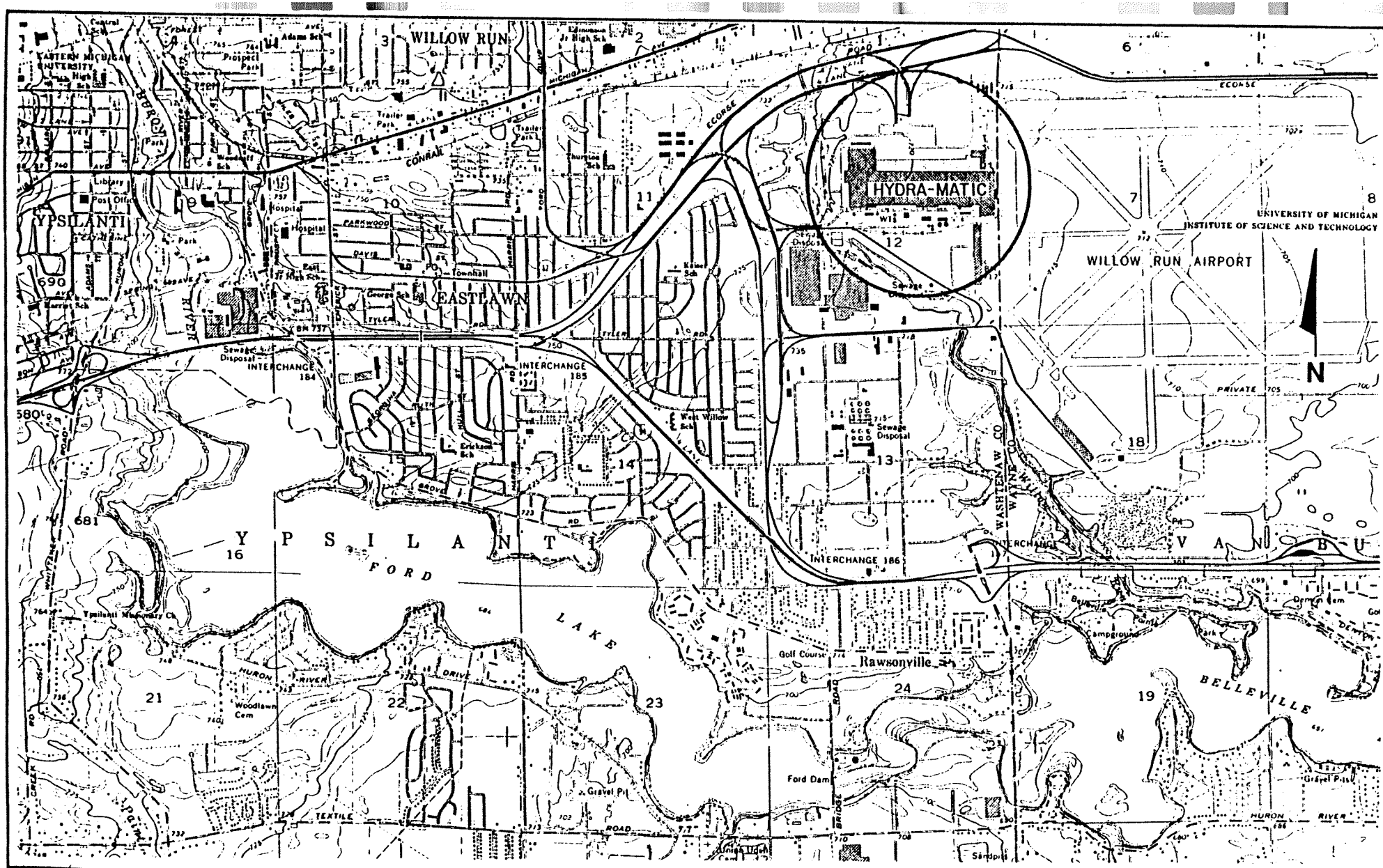
Prior to sampling, the water level and depth of each well was measured from the top of the well casing. The volume of water standing inside the well casing was calculated, and three well volumes were evacuated from the well using a peristaltic pump and disposable tygon tubing. New tygon tubing was used for each well.

Groundwater temperature, pH, and specific conductance were recorded three times during evacuation. Stabilization of these parameters indicated that stagnant water had been removed from the well casing so that a representative groundwater sample could be taken. These parameters were recorded on the Groundwater Sampling Records contained in Appendix A.

After evacuating each well, groundwater samples being analyzed for organic parameters were collected with a Teflon bailer. Samples to be analyzed for dissolved metals were filtered directly through a 45-micron pore size, in-line, disposable filter into laboratory prepared bottles that were pre-preserved with nitric acid. The

---

[1]For additional information, see: "Hydrogeologic Investigation at the North Yard," July 1989. Prepared for General Motors Corporation, Hydra-matic Division, by C-E Environmental, Inc.



TAKEN FROM U.S.G.S. YPSILANTI EAST, MICH. 7.5' QUADRANGLE MAP.

FIGURE 1
LOCATION OF THE GM HYDRA-MATIC PLANT YPSILANTI, MICHIGAN

C-E ENVIRONMENTAL, INC.

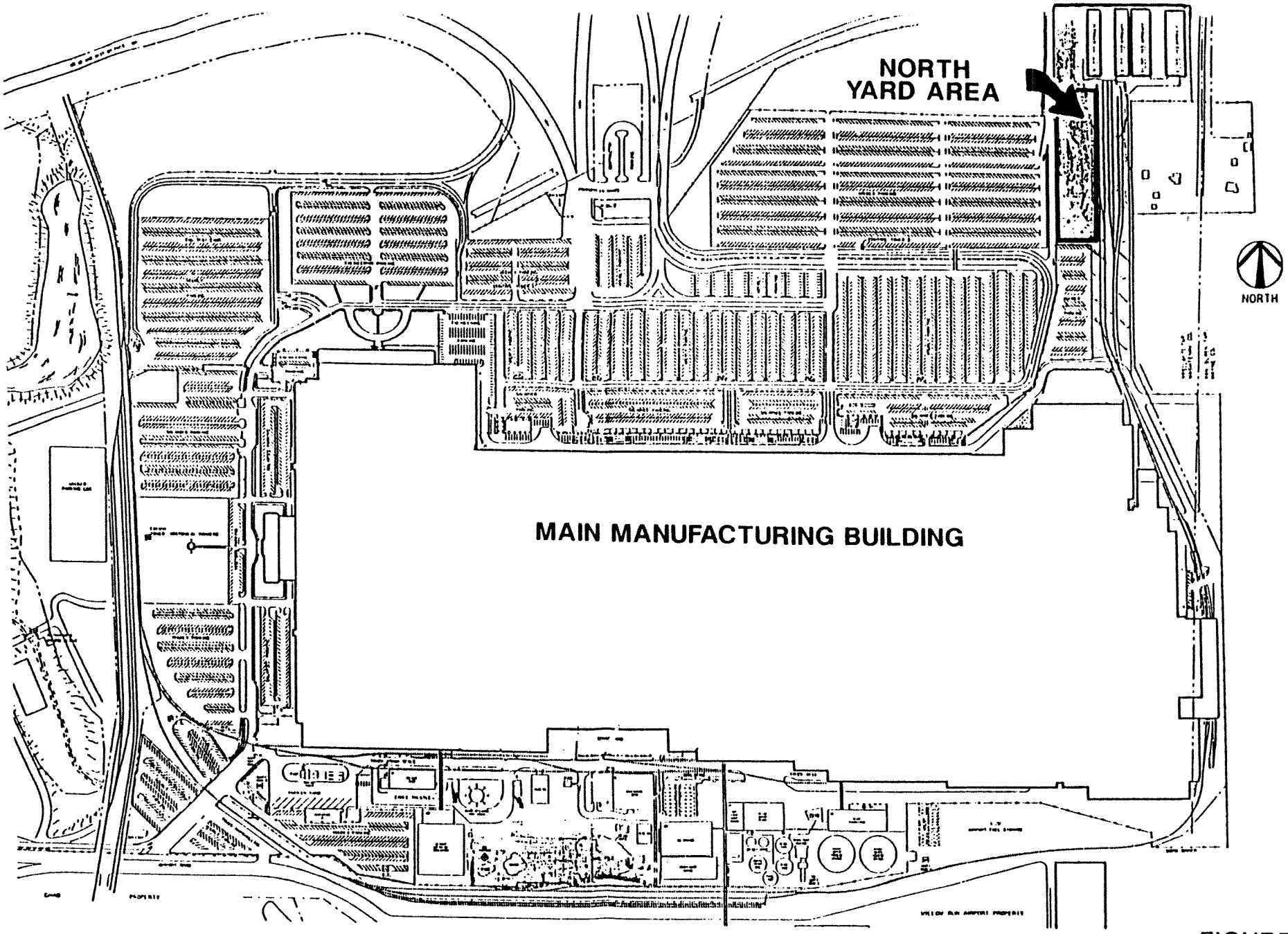
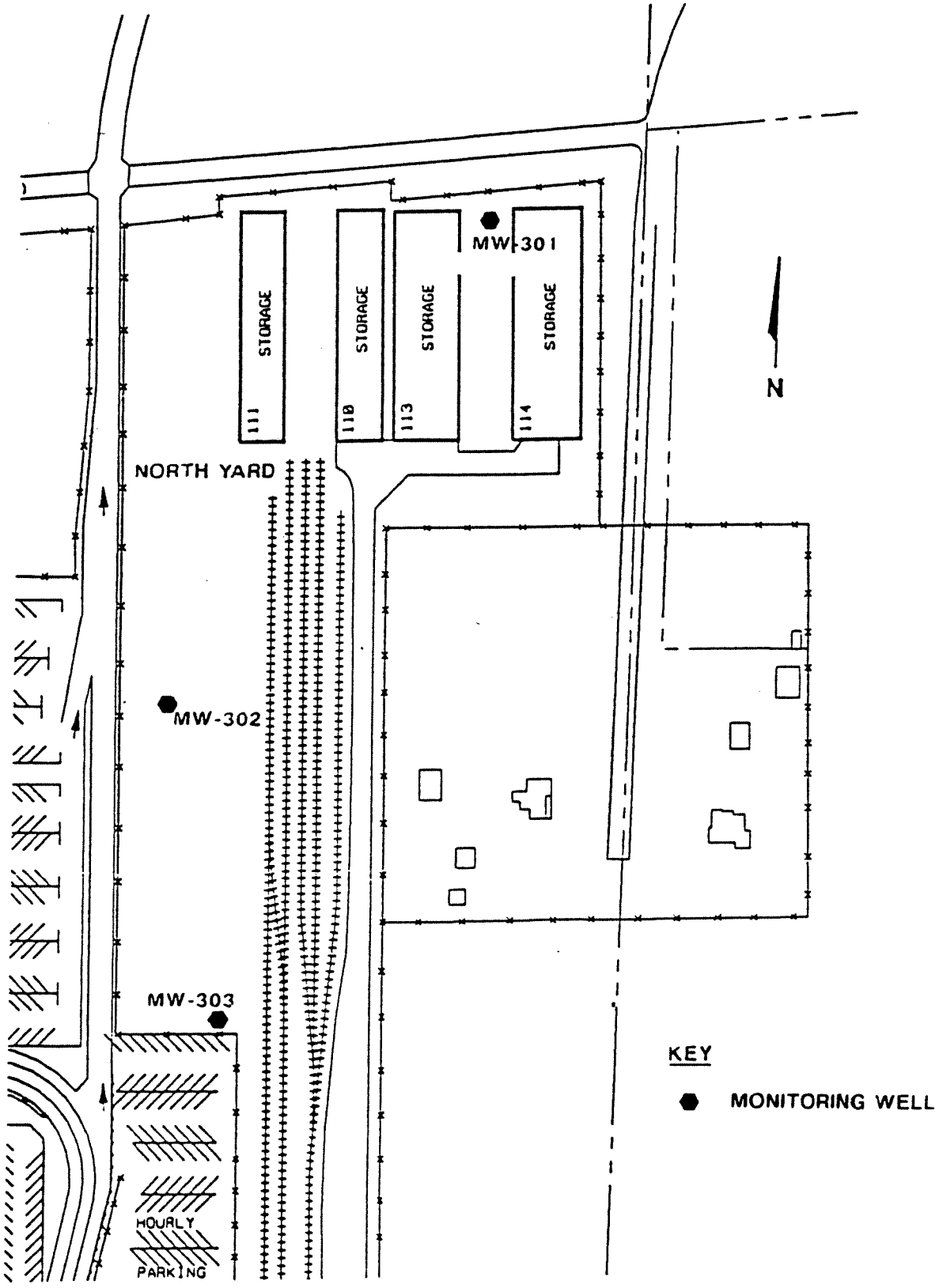


FIGURE 2
INVESTIGATION LOCATION MAP
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

C-E ENVIRONMENTAL, INC.



SCALE

0 100 200 400 FEET

FIGURE 3
MONITORING WELL LOCATIONS
NORTH YARD
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

GM DRAWING # HWR-NY-1

C-E Environmental, Inc.

filter was replaced after each sample. After processing and labeling, all samples were kept on ice in coolers until delivery to the laboratory.

The bailer was decontaminated with a solution of trisodium phosphate and distilled water, followed by a final distilled water rinse.

6.0 SAMPLE HANDLING

After processing and labeling, a chain-of-custody record and an analytical request form was completed. The samples were then transported to Environmental Control Technology Corporation (ENCOTEC), of Ann Arbor, Michigan, for analysis of selected dissolved metals (cadmium, chromium, copper, iron, lead, nickel, and zinc), purgeable halocarbons (DNR Scan 1), purgeable aromatic hydrocarbons (DNR Scan 2), and PCBs. The analytical methods used and lists of organic analytes are presented in Appendix B.

7.0 QUALITY CONTROL SAMPLES

For quality control purposes, one blind duplicate sample (MW-351, a duplicate of MW-303) and one sampler blank (MW-350, taken prior to sampling) were collected during this sampling effort. Similar to the groundwater samples, each quality control sample was analyzed for dissolved metals and organic chemicals.

A blind duplicate sample is a duplicate sample labeled in a manner such that the laboratory is unaware that it is a duplicate. The purpose of a duplicate sample is to check the homogeneity of the sample in addition to the precision of the laboratory. A sampler blank is a sample of distilled water that is handled in the same manner as a groundwater sample -it is poured into the sampling equipment, filtered, preserved, placed into laboratory-prepared bottles, etc. The purpose of a sampler blank is to check the effectiveness of the decontamination procedures.

8.0 RESULTS

8.1 GROUNDWATER FLOW

As shown on Figure 4, groundwater in the North Yard appeared to be moving toward the southwest in September 1990. Table 1 summarizes water level measurements and groundwater flow directions observed in the North Yard during the seven sampling events conducted thus far.

8.2 QUALITY CONTROL SAMPLES

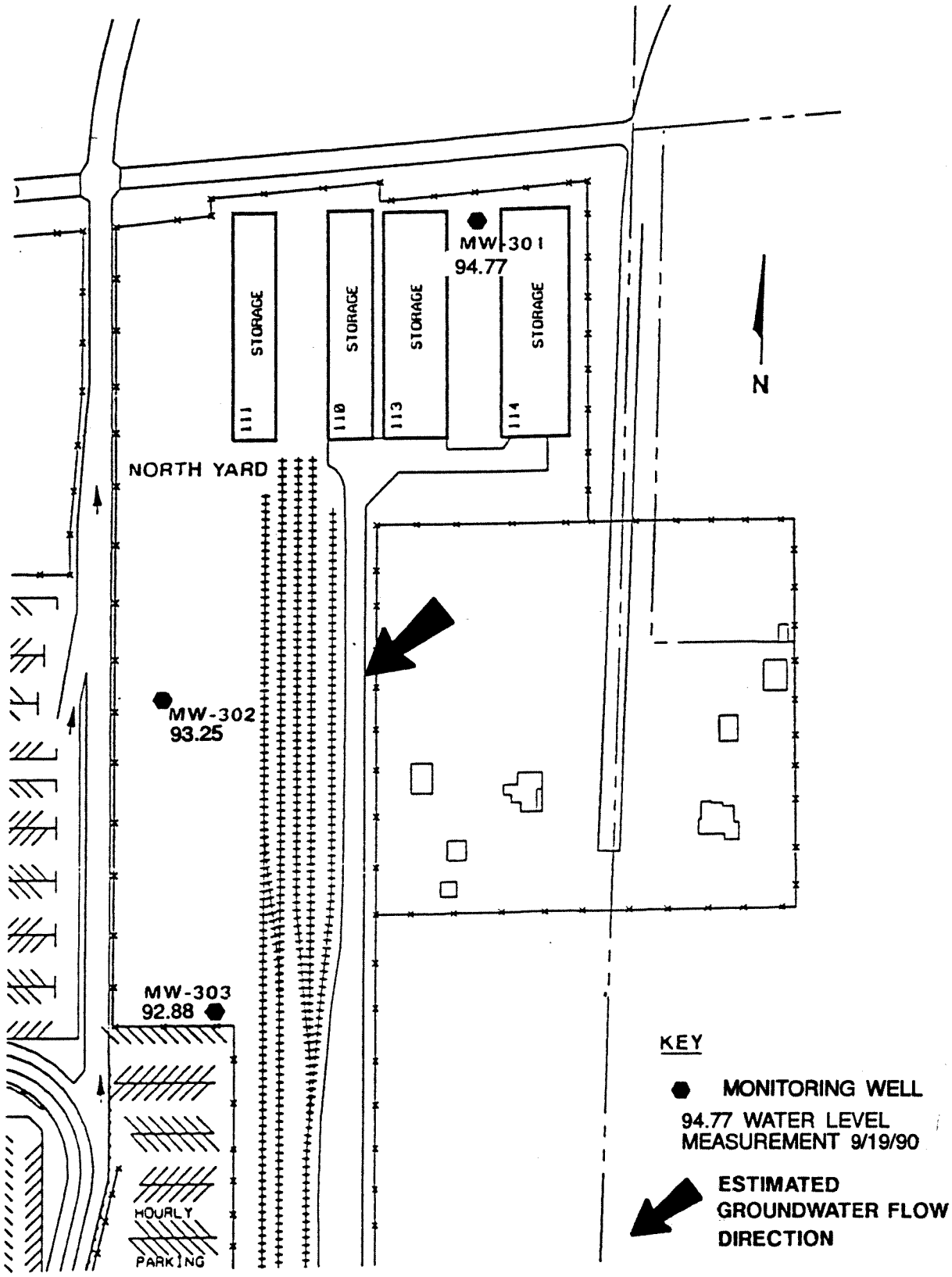
Table 2 presents the analytical data for September 1990, as well as the data collected during all previous sampling events. Laboratory analytical reports for September 1990 are contained in Appendix C.

The sampler blank (MW-350) contained 0.30 milligrams per liter (mg/L) of iron, 0.02 mg/L of lead, and 0.002 mg/L of chloroform. Sample MW-303 showed excellent correlation with its duplicate sample MW-303, indicating good quality control.

8.3 GROUNDWATER QUALITY

As shown on Table 2, iron was detected in all three wells at concentrations ranging from 4.7 to 10 mg/L. These concentrations are similar to those detected during previous sampling events. In addition to iron, lead was detected in MW-301 at 0.02 mg/L, but lead was also detected in the sampler blank at the same concentration. Because of this fact, and because lead has never been detected at the site during previous sampling events, it is unlikely that lead is site-related.

No site-related organic chemicals were found in September 1990.



SCALE

0 100 200 400 FEET

FIGURE 4
MONITORING WELL LOCATIONS
AND STATIC WATER LEVELS
SEPTEMBER 1990
NORTH YARD
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

GM DRAWING # HWR-NY-1

C-E Environmental, Inc.

TABLE 1
Summary of Water Levels and Groundwater Flow Directions
Observed in the North Yard During 1989 and 1990

	3/89	6/89	9/89	12/89	3/90	7/90	9/90
MW-301	93.97	93.03	92.45	92.09	93.50	91.94	94.77
MW-302	92.90	93.20	92.89	92.33	93.15	92.70	93.25
MW-303	92.41	92.75	92.63	92.11	92.80	92.48	92.88
FLOW DIRECTION	S	SE	ESE	ESE	SSE	SE	SW

TABLE 2 ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER AT THE NORTH YARD
GM HYDRA-MATIC, YPSILANTI, MICHIGAN

Date	Well No.	Cd	Cr	Cu	Fe	Pb	Ni	Zn	1,1,1-TCA	BDCM	CHLOROFO	PCB-1248
September 1990	MW-301	U	U	U	5.1	0.02	U	U	U	U	U	U
	MW-302	U	U	U	4.7	U	U	U	U	U	U	U
	MW-303	U	U	U	4.7	U	U	U	U	U	U	U
	MW-351 (Dup of MW-303)	U	U	U	10	U	U	U	U	U	U	U
	MW-350 (Sampler Blank)	U	U	U	0.30	0.02	U	U	U	U	0.002	U
July 1990	MW-301	U	U	U	0.31	U	U	U	U	U	U	U
	MW-302	U	U	U	5.3	U	U	0.11	U	U	U	U
	MW-303	U	U	U	11	U	U	U	U	U	U	U
	MW-351 (Dup of MW-303)	U	U	U	10	U	U	U	U	U	U	U
	MW-350 (Sampler Blank)	U	U	0.14	U	U	U	0.15	U	U	U	U
March 1990	MW-301	U	U	NA	U	U	U	U	U	U	U	U
	MW-302	U	U	NA	5.1	U	U	U	U	U	U	U
	MW-360 (Dup of MW-302)	U	U	NA	4.9	U	U	U	U	U	U	U
	MW-303	U	U	NA	7.5	U	U	U	U	U	U	0.00077
	MW-350 (Sampler Blank)	U	U	NA	U	U	U	0.03	U	U	U	U
December 1989	MW-301	U	U	U	U	U	U	U	U	U	U	U
	MW-302	U	U	U	8.9	U	U	U	U	U	U	U
	MW-303	U	U	U	7.2	U	U	U	U	U	U	0.0031
	MW-360 (Dup of MW-303)	U	U	U	7.3	U	U	U	U	U	U	0.0060
	MW-350 (Sampler Blank)	U	U	0.03	U	U	U	0.09	U	U	U	U
September 1989	MW-301	U	U	U	0.16	U	U	0.03	U	U	U	NA
	MW-302	U	U	0.02	5.9	U	U	0.03	U	U	U	NA
	MW-360 (Dup of MW-302)	U	U	0.02	5.9	U	U	0.02	U	U	U	NA
	MW-303	U	U	U	7.9	U	U	0.03	U	U	U	NA
	MW-350 (Sampler Blank)	U	U	0.51	0.06	0.03	U	0.32	U	U	0.003	NA
June 1989	MW-301	U	U	U	0.03	U	U	U	U	U	U	NA
	MW-351 (Dup of MW-301)	U	U	0.04	0.04	U	U	U	U	U	U	NA
	MW-302	U	U	U	2.0	U	U	U	U	U	U	NA
	MW-303	U	U	U	2.0	U	U	U	0.002	U	U	NA
	MW-350 (Sampler Blank)	U	U	0.02	U	U	U	U	U	0.001	0.005	NA
March 1989	MW-301	NA	U	U	U	U	U	U	U	U	U	NA
	MW-351 (Dup of MW-301)	NA	U	U	U	U	U	U	U	U	U	NA
	MW-302	NA	U	U	2.8	U	U	U	U	U	U	NA
	MW-303	NA	U	U	8.1	U	U	U	U	U	U	NA
	MW-350 (Sampler Blank)	NA	U	U	U	U	U	U	U	U	U	NA

NOTES:

1. All concentrations in mg/L.
2. U - Compound was analyzed but not detected.
3. NA - Not analyzed.
4. BDCM - Bromodichloromethane
5. 1,1,1-TCA - 1,1,1-Trichloroethane
6. Each sample was analyzed for DNR Scans 1 and 2 and HSL PCBs (EPA method 8080) unless otherwise noted; only the compounds detected are shown on this table.

APPENDIX A

GROUNDWATER SAMPLE DATA RECORDS

GROUNDWATER SAMPLE RECORD

SITE: Gm Hmd 4PSI - North Yard JOB NO. 5883-00 DATE: 9/19/90

Sampler Blank

SAMPLE LOCATION MW-350 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH _____FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH _____FT
MONITORING:
AMBIENT AIR _____PPM
WELL MOUTH _____PPM

HISTORICAL WELL DEPTH _____FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____FT

PURGE DATA

[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (____IN)

HEIGHT OF WATER COLUMN _____FT X ____ CASING VOLUMES = GALLONS TO BE PURGED

PURGE TIME START _____ END _____

SAMPLE TIME START _____ END 1020

	@ ____ GAL	@ ____ GAL	@ ____ GAL	@ ____ GAL	@ ____ GAL
PURGE VOLUME					
TEMP, DEG C					
pH, UNITS					
SPECIFIC CONDUCTIVITY, umhos/cm					

EQUIPMENT DOCUMENTATION

PURGING
[X]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

SAMPLING
[X] PERISTALTIC PUMP Metals
[ ] SUBMERSIBLE PUMP
[X] BAILER (PVC/SS/TEFLON) VOA
[ ] PVC/SILICON TUBING + PCBs
[ ] TEFLON/SILICON TUBING
[ ] AIR LIFT
[ ] WATERRA
[ ] IN-LINE FILTER
[ ] PRESS/VAC FILTER
[ ] _____

EQUIPMENT ID
_____
_____
_____
_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[X] DISTILLED

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____
QED FILTERS

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	DNR SCAN 1 & 2	8010 8020	40 ml	glass	No	No
_____	Dissolved metals	Cd Cr Cu Fe Pb Ni Zn	1l	PE	Yes	Yes/2ml
_____	PCBs only	8080	1l	A-glass	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES Sampler Blank Taken at start of day.

SIGNATURE Craig S Kelly

SIGNATURE/FUNCTION: _____

GROUNDWATER SAMPLE RECORD

SITE: Gm Hmd 4PSI - North Yard JOB NO. 5883-00 DATE: 9/19/90

SAMPLE LOCATION MW-301 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH 12 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH 3.02 FT (2.04x.98)
MONITORING:
AMBIENT AIR 0 PPM
WELL MOUTH 0 PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND) _____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 0 FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (____ IN)
X 3 CASING VOLUMES = 4.5 GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 1035

PURGE VOLUME	@ 1 GAL	@ 2.5 GAL	@ 3.5 GAL	@ 5 GAL	@ ___ GAL
TEMP, DEG C	16.0	16.1	15.7	15.8	
pH, UNITS	7.0	7.6	7.5	7.5	
SPECIFIC CONDUCTIVITY, umhos/cm	530	500	435	433	

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID
[X]	[X] PERISTALTIC PUMP Metals	
[ ]	[ ] SUBMERSIBLE PUMP	
[ ]	[X] BAILER (PVC/SS/TEFLON) VOA & PCBs	
[ ]	[ ] PVC/SILICON TUBING	
[ ]	[ ] TEFLON/SILICON TUBING	
[ ]	[ ] AIR LIFT	
[ ]	[ ] WATERRA	
	[ ] IN-LINE FILTER	
	[ ] PRESS/VAC FILTER	
[ ]	[ ] _____	

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[X] DISTILLED

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED 1
QED FILTERS

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
	DNR SCAN 1&2	8010 8020	80 ml	glass	No	No
	Dissolved metals	Cd Cr Cu Fe Pb Ni Zn	1l	PE	Yes	Yes/2ml
	PCBs only	8080	2l	A-glass	No	No

NOTES

Water Slightly Cloudy to clear @ 1.5 gallons

SIGNATURE Craig & Kathy

SIGNATURE/FUNCTION: _____

GROUNDWATER SAMPLE RECORD

SITE: Gm HMD YPSI - North Yard JOB NO. 5883-00 DATE: 9/19/90

SAMPLE LOCATION MW-302 LAB NUMBER _____

WATER LEVEL/WELL DATA

5.90+.98

MEASURED WELL DEPTH 15 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH 6.88 FT
MONITORING:
AMBIENT AIR / PPM
WELL MOUTH / PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND) _____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 9 FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (____ IN)
X 3 CASING VOLUMES = GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 1120

	@ 1.5 GAL	@ 2.5 GAL	@ 3.5 GAL	@ 5 GAL	@ ___ GAL
PURGE VOLUME					
TEMP, DEG C	17.0	16.9	16.7	16.7	
pH, UNITS	7.4	7.4	7.4	7.4	
SPECIFIC CONDUCTIVITY, umhos/cm	1030	890	940	942	

EQUIPMENT DOCUMENTATION

PURGING
[X]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

SAMPLING
[X] PERISTALTIC PUMP Metals
[ ] SUBMERSIBLE PUMP
[X] BAILER (PVC/SS/TEFLON) VOA & PCBs
[ ] PVC/SILICON TUBING
[ ] TEFLON/SILICON TUBING
[ ] AIR LIFT
[ ] WATERRA
[ ] IN-LINE FILTER
[ ] PRESS/VAC FILTER
[ ] [ ] _____

EQUIPMENT ID
_____
_____
_____
_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[X] DISTILLED

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____
QED FILTERS

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
	DNR SCAN 1&2	8010 8020	80 ml	glass	No	No
	Dissolved metals	Cd Cr Cu Fe Pb Ni Zn	1l	PE	Yes	Yes/2ml
	PCBs only	8080	2l	A-glass	No	No

NOTES

Water Clear ; Slight Sulfur odor

SIGNATURE Craig S Kutty

SIGNATURE/FUNCTION: _____

GROUNDWATER SAMPLE RECORD

SITE: Gm Hmd 4PSI - North Yard JOB NO. 5883-00 DATE: 9/19/90

SAMPLE LOCATION MW-303 LAB NUMBER _____

WATER LEVEL/WELL DATA

6.16+.98

MEASURED WELL DEPTH 15 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH 7.14 FT
MONITORING:
AMBIENT AIR 1 PPM
WELL MOUTH _____ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND) _____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 8 FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (_____ IN)
X 10+ CASING VOLUMES = 15 GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 1215

	@ 3 GAL	@ 6 GAL	@ 9 GAL	@ 12.5 GAL	@ 15 GAL
TEMP, DEG C	17.5	17.4	17.1	17.0	17.0
pH, UNITS	7.3	7.3	7.2	7.2	7.2
SPECIFIC CONDUCTIVITY, umhos/cm	685	650	654	649	650

EQUIPMENT DOCUMENTATION

PURGING
[X]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

SAMPLING
[X] PERISTALTIC PUMP Metals
[ ] SUBMERSIBLE PUMP
[X] BAILER (PVC/SS/TEFLON) VOA
[ ] PVC/SILICON TUBING + PCBs
[ ] TEFLON/SILICON TUBING
[ ] AIR LIFT
[ ] WATERRA
[ ] IN-LINE FILTER
[ ] PRESS/VAC FILTER
[ ] [ ] _____

EQUIPMENT ID
_____
_____
_____
_____
_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[X] DISTILLED

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____
QED FILTERS

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	DNR SCAN 1 & 2	8010 8020	80 ml	glass	No	No
_____	Dissolved metals	Cd Cr Cu Fe Pb Ni Zn	1 l	PE	Yes	Yes/2ml
_____	PCBs only	8080	2 l	A-glass	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES

⇒ Purged 10 well volumes = 15 gallons
Water Clear ; Slight Sulfur odor

SIGNATURE Craig & Kathy

SIGNATURE/FUNCTION: _____

90303.WP
REVISED 3/90

ABB ENVIRONMENTAL SERVICES, INC.

GROUNDWATER SAMPLE RECORD

SITE: Gm HMD 4PSI - North Yard JOB NO. 5883-00 DATE: 9/19/90

Dup of MW-303

SAMPLE LOCATION MW-351 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH _____FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[ ] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH _____FT
MONITORING:
AMBIENT AIR _____PPM
WELL MOUTH _____PPM

HISTORICAL WELL DEPTH _____FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[ ] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____FT

PURGE DATA

HEIGHT OF WATER COLUMN _____FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (_____IN)
X _____ CASING VOLUMES = GALLONS TO BE PURGED
PURGE TIME START_____ END_____
SAMPLE TIME START_____ END_____

	@ ____ GAL	@ ____ GAL	@ ____ GAL	@ ____ GAL	@ ____ GAL
PURGE VOLUME					
TEMP, DEG C					
pH, UNITS					
SPECIFIC CONDUCTIVITY, umhos/cm					

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID	DECON FLUIDS USED	WATER LEVEL EQUIP.USED
[X]	[X] PERISTALTIC PUMP Metals	_____	[ ] ETHYL ALCOHOL	[ ] ELECTRIC COND. PROBE
[ ]	[ ] SUBMERSIBLE PUMP	_____	[ ] DEIONIZED WATER	[X] FLOAT ACTIVATED
[ ]	[X] BAILER (PVC/SS/TEFLON) VOA	_____	[ ] HNO3/D.I. WATER	[ ] KECK INTERFACE PROBE
[ ]	[ ] PVC/SILICON TUBING + PCBs		[ ] POTABLE WATER	[ ] OTHER
[ ]	[ ] TEFLON/SILICON TUBING		[X] TSP SOLUTION	
[ ]	[ ] AIR LIFT		[ ] NONE	NUMBER OF FILTER PAPERS USED ____
[ ]	[ ] WATERRA	_____	[X] DISTILLED	QED FILTERS
	[ ] IN-LINE FILTER			
	[ ] PRESS/VAC FILTER			
[ ]	[ ] _____	_____		

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	DNR SCAN 1&2	8010 8020	80 ml	glass	No	No
_____	Dissolved metals	Cd Cr Cu Fe Pb Ni Zn	1l	PE	Yes	Yes/2ml
_____	PCBs only	8080	1l	A-glass	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES

Duplicate Sample of MW-303

SIGNATURE Craig S Kelly

SIGNATURE/FUNCTION: _____

APPENDIX B

ANALYTICAL METHODS

ANALYTICAL PROGRAM
QUARTERLY GROUNDWATER MONITORING PROGRAM

NORTH YARD
GM HYDRA-MATIC

PARAMETER	METHOD NUMBER
Dissolved Metals:	
Cadmium	1310/6010
Chromium	1310/6010
Iron	3010/7380
Nickel	1310/6010
Lead	3010/7420
Zinc	1310/6010
DNR Scan 1 Compounds:	8020
Bromodichloromethane	
Bromoform	
Carbon tetrachloride	
Chlorobenzene	
Chloroform	
Dibromochloromethane	
Dichlorodifluoromethane	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1-Dichloroethene	
cis-1,2-Dichloroethene	
trans-1,2-Dichloroethene	
1,3-Dichloropropene	
1,1,2,2-Tetrachloroethane	
Tetrachloroethene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethene	
DNR Scan 2 Compounds:	8020
Benzene	
Ethylbenzene	
Styrene	
Toluene	
Total Xylenes	
HSL Pesticides and PCBs:	8080
Aldrin	
Alpha-BHC	
Beta-BHC	
Delta-BHC	
Gamma-BHC (Lindane)	
Chlordane	
4-4'-DDD	
4-4'-DDE	
4-4'-DDT	
Dieldrin	
Alpha-Endosulfan	
Beta-Endosulfan	
Endosulfan Sulfate	
Endrin	
Endrin Ketone	
Heptachlor	
Heptachlor Epoxide	
Methoxychlor	
Toxaphene	
PCB-1016	
PCB-1221	
PCB-1232	
PCB-1242	
PCB-1248	
PCB-1254	
PCB-1260	

APPENDIX C

LABORATORY ANALYTICAL REPORTS

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: ABB Environmental
SAMPLE TYPE: Filtrate
PROJECT NO.: 40650
REPORT DATE: October , 1990

SAMPLE NAME		MW 350	MW 301	MW 302	MW 303	MW 351
SAMPLE DATE		9-19-90	9-19-90	9-19-90	9-19-90	9-19-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		59837	59838	59839	59840	59841
Cadmium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	mg/L	0.30	5.1	4.7	11	10
Lead	mg/L	0.02	0.02	<0.02	< 0.02	<0.02
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: ABB Environmental
PROJECT NO.: 40650
SAMPLE TYPE: Water
REPORT DATE: November, 1990

SAMPLE NAME		MW-350	MW-301	MW-302	MW-303	MW-351
SAMPLE DATE		9-19-90	9-19-90	9-19-90	9-19-90	9-19-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		59832	59833	59834	59835	59836
Aroclor 1016	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
					001	

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389
ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: October 24, 1990

Sample: MW 350
ENCOTEC Number: 59832
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-01-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	0.002	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: October 24, 1990

Sample: MW 301
ENCOTEC Number: 59833
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-01-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: October 24, 1990

Sample: MW 302
ENCOTEC Number: 59834
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-01-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: October 24, 1990

Sample: MW 303
ENCOTEC Number: 59835
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-01-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.005
Bromoform	75-25-2	mg/L	U	0.005
Bromomethane	74-83-9	mg/L	U	0.005
Carbon Tetrachloride	56-23-5	mg/L	U	0.005
Chlorobenzene	108-90-7	mg/L	U	0.005
Chloroethane	75-00-3	mg/L	U	0.005
Chloroform	67-66-3	mg/L	U	0.005
Dibromochloromethane	124-48-1	mg/L	U	0.005
1,1-Dichloroethane	75-34-3	mg/L	U	0.005
1,2-Dichloroethane	107-06-2	mg/L	U	0.005
1,1-Dichloroethene	75-35-4	mg/L	U	0.005
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.005
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.005
1,2-Dichloropropane	78-87-5	mg/L	U	0.005
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.005
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.005
Methylene Chloride	75-09-2	mg/L	U	0.005
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.005
Tetrachloroethene	127-18-4	mg/L	U	0.005
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.005
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.005
Trichloroethene	79-01-6	mg/L	U	0.005
Trichlorofluoromethane	75-69-4	mg/L	U	0.005
Vinyl Chloride	75-01-4	mg/L	U	0.005

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

Detection Limits Raised Due to Sample Foaming.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: October 24, 1990

Sample: MW 351
ENCOTEC Number: 59836
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-01-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.005
Bromoform	75-25-2	mg/L	U	0.005
Bromomethane	74-83-9	mg/L	U	0.005
Carbon Tetrachloride	56-23-5	mg/L	U	0.005
Chlorobenzene	108-90-7	mg/L	U	0.005
Chloroethane	75-00-3	mg/L	U	0.005
Chloroform	67-66-3	mg/L	U	0.005
Dibromochloromethane	124-48-1	mg/L	U	0.005
1,1-Dichloroethane	75-34-3	mg/L	U	0.005
1,2-Dichloroethane	107-06-2	mg/L	U	0.005
1,1-Dichloroethene	75-35-4	mg/L	U	0.005
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.005
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.005
1,2-Dichloropropane	78-87-5	mg/L	U	0.005
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.005
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.005
Methylene Chloride	75-09-2	mg/L	U	0.005
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.005
Tetrachloroethene	127-18-4	mg/L	U	0.005
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.005
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.005
Trichloroethene	79-01-6	mg/L	U	0.005
Trichlorofluoromethane	75-69-4	mg/L	U	0.005
Vinyl Chloride	75-01-4	mg/L	U	0.005

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

Detection Limits Raised Due to Sample Foaming.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389
ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: October 24, 1990

Sample: Method Blank
ENCOTEC Number: N/A
Sample Date: N/A
Date Received: N/A
Date Extracted: N/A
Date Analyzed: 10-01-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: October 24, 1990

Sample: MW 350
ENCOTEC Number: 58932
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-1-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: October 24, 1990

Sample: MW 301
ENCOTEC Number: 58933
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-1-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: October 24, 1990

Sample: MW 302
ENCOTEC Number: 58934
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-1-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: October 24, 1990

Sample: Method Blank
ENCOTEC Number: N/A
Sample Date: N/A
Date Received: N/A
Date Extracted: N/A
Date Analyzed: 10-1-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: October 24, 1990

Sample: MW 303
ENCOTEC Number: 59835
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-1-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.005
Ethylbenzene	100-41-4	mg/L	U	0.005
Toluene	108-88-3	mg/L	U	0.005
1,2-Xylene	95-47-6	mg/L	U	0.005
1,3-Xylene*	108-38-3	mg/L	U	0.01
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

Detection Limits Raised Due to Sample Foaming.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: October 24, 1990

Sample: MW 351
ENCOTEC Number: 59836
Sample Date: 9-19-90
Date Received: 9-19-90
Date Extracted: N/A
Date Analyzed: 10-1-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.005
Ethylbenzene	100-41-4	mg/L	U	0.005
Toluene	108-88-3	mg/L	U	0.005
1,2-Xylene	95-47-6	mg/L	U	0.005
1,3-Xylene*	108-38-3	mg/L	U	0.01
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

Detection Limits Raised Due to Sample Foaming.

C-E ENVIRONMENTAL, INC.

GROUNDWATER MONITORING REPORT
DECEMBER 1990

NORTH YARD

Prepared For:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
GM Hydra-Matic, Ypsilanti, Michigan

JANUARY 1991

JOB NO. 5883-00

COMBUSTION ENGINEERING

GROUNDWATER MONITORING REPORT
DECEMBER 1990

NORTH YARD

Prepared For:

GENERAL MOTORS CORPORATION
HYDRA-MATIC DIVISION
Ypsilanti, Michigan

Prepared By:

C-E ENVIRONMENTAL INC.
Farmington Hills, Michigan

JANUARY 1991

PROJECT NO. 5883-00

TABLE OF CONTENTS

SECTION NO.	TITLE	PAGE NO.
1.0	INTRODUCTION	1
2.0	SCHEDULE	1
3.0	PERSONNEL	1
4.0	SAMPLING LOCATIONS	1
5.0	FIELD PROCEDURES	1
6.0	SAMPLE HANDLING	5
7.0	QUALITY CONTROL SAMPLES	5
8.0	RESULTS	5
	8.1 Groundwater Flow	5
	8.2 Quality Control Samples	5
	8.3 Groundwater Quality	5

APPENDIX A - GROUNDWATER SAMPLE DATA RECORDS
APPENDIX B - ANALYTICAL METHODS
APPENDIX C - LABORATORY ANALYTICAL REPORTS

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1	LOCATION OF THE GM HYDRA-MATIC WILLOW RUN PLANT	2
2	INVESTIGATION LOCATION MAP	3
3	MONITORING WELL LOCATIONS	4
4	GROUNDWATER LEVEL MEASUREMENTS	6

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1	SUMMARY OF WATER LEVELS AND GROUNDWATER FLOW DIRECTIONS	7
2	ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER AT THE NORTH YARD	8

1.0 INTRODUCTION

The General Motors (GM) Hydra-matic Willow Run Plant is located in Ypsilanti, Michigan, within Washtenaw County (see Figure 1). The North Yard, previously used to store production machinery and equipment, is located in the northeast corner of Hydra-matic's property (see Figure 2). The equipment was stored directly on the ground; as a result, residual metal-working fluids and various oils leaked from the equipment into the soil.

GM conducted a subsurface soil study in April 1988 to determine the extent of contamination in the North Yard. The results indicated that the fluids and oils which had leaked from the machinery were confined to the upper 24 inches of soil. This material was removed from the site in August 1988.

As part of the North Yard remediation program, Hydra-matic chose to implement a quarterly groundwater monitoring program for a two year period beginning in 1989[1]. In February 1989, C-E Environmental, Inc. installed three groundwater monitoring wells in the North Yard. Groundwater samples were collected from these wells in March 1989, June 1989, September 1989, December 1989, March 1990, July 1990, September 1990, and December 1990. All samples were analyzed for selected dissolved metals, purgeable halocarbons (DNR Scan 1), and purgeable aromatic hydrocarbons (DNR Scan 2). In addition, samples collected in December 1989, March 1990, July 1990, September 1990, and December 1990 were analyzed for polychlorinated biphenyls (PCBs). The results of the first seven sampling events were reported previously. This report documents the sampling event which occurred in December 1990.

2.0 SCHEDULE

The eighth quarterly groundwater sampling event was conducted on December 21, 1990.

3.0 PERSONNEL

Groundwater samples were collected by C. Kielty and M. DeLong of C-E Environmental.

4.0 SAMPLING LOCATIONS

Figure 3 shows the locations of the three monitoring wells in the North Yard.

5.0 FIELD PROCEDURES

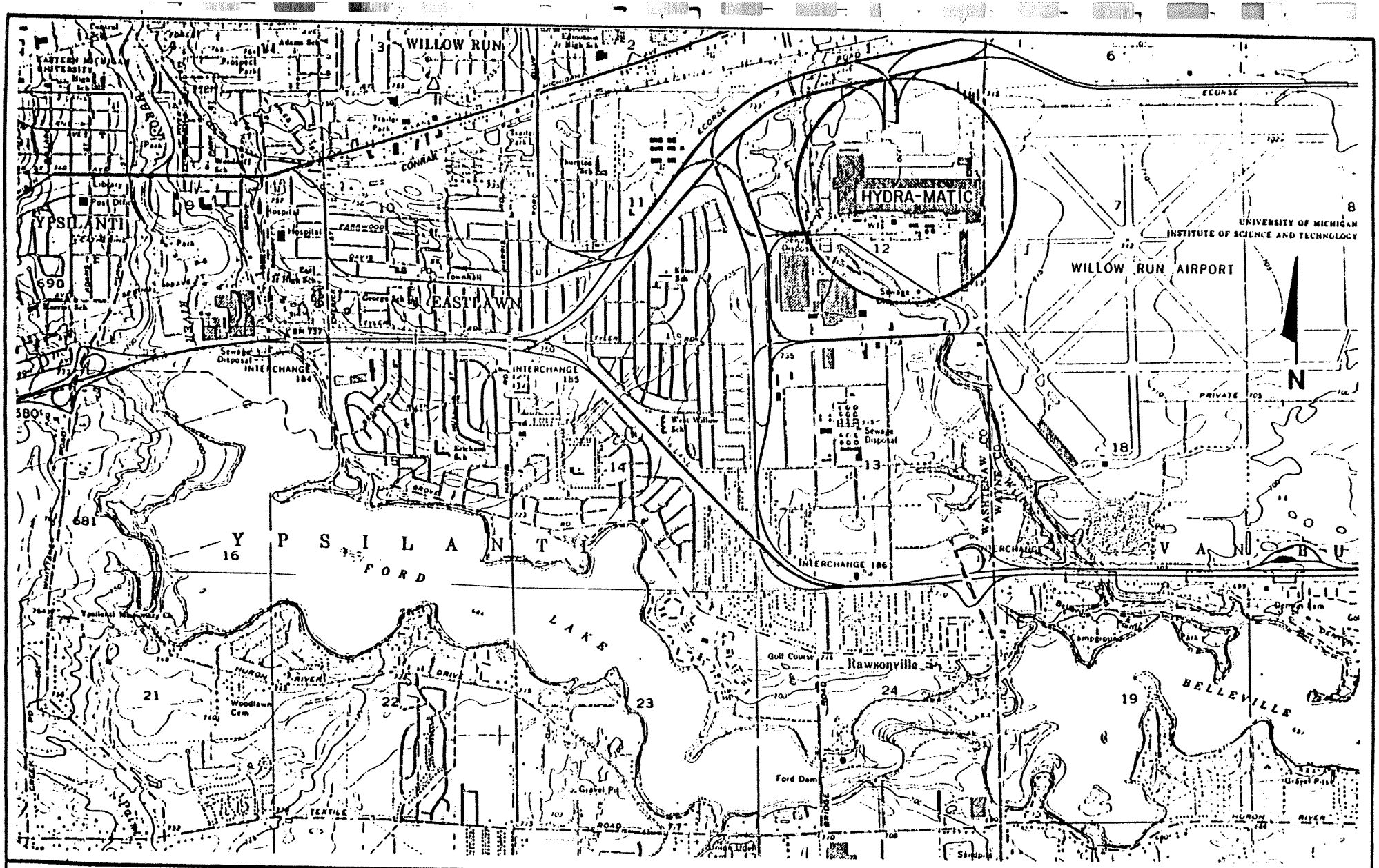
Prior to sampling, the water level and depth of each well was measured from the top of the well casing. The volume of water standing inside the well casing was calculated, and three well volumes were evacuated from the well using a peristaltic pump and disposable tygon tubing. New tygon tubing was used for each well.

Groundwater temperature, pH, and specific conductance were recorded three times during evacuation. Stabilization of these parameters indicated that stagnant water had been removed from the well casing so that a representative groundwater sample could be taken. These parameters were recorded on the Groundwater Sample Records contained in Appendix A.

After evacuating each well, groundwater samples to be analyzed for organic parameters were collected with a Teflon bailer. Samples to be analyzed for dissolved metals were filtered directly through a 0.45-micron pore size, in-line, disposable filter into laboratory prepared bottles that were pre-preserved with nitric acid. The

---

[1]For additional information, see: "Hydrogeologic Investigation at the North Yard," July 1989. Prepared for General Motors Corporation, Hydra-matic Division, by C-E Environmental, Inc.



TAKEN FROM U.S.G.S. YPSILANTI EAST, MICH. 7.5' QUADRANGLE MAP.

FIGURE 1
LOCATION OF THE
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

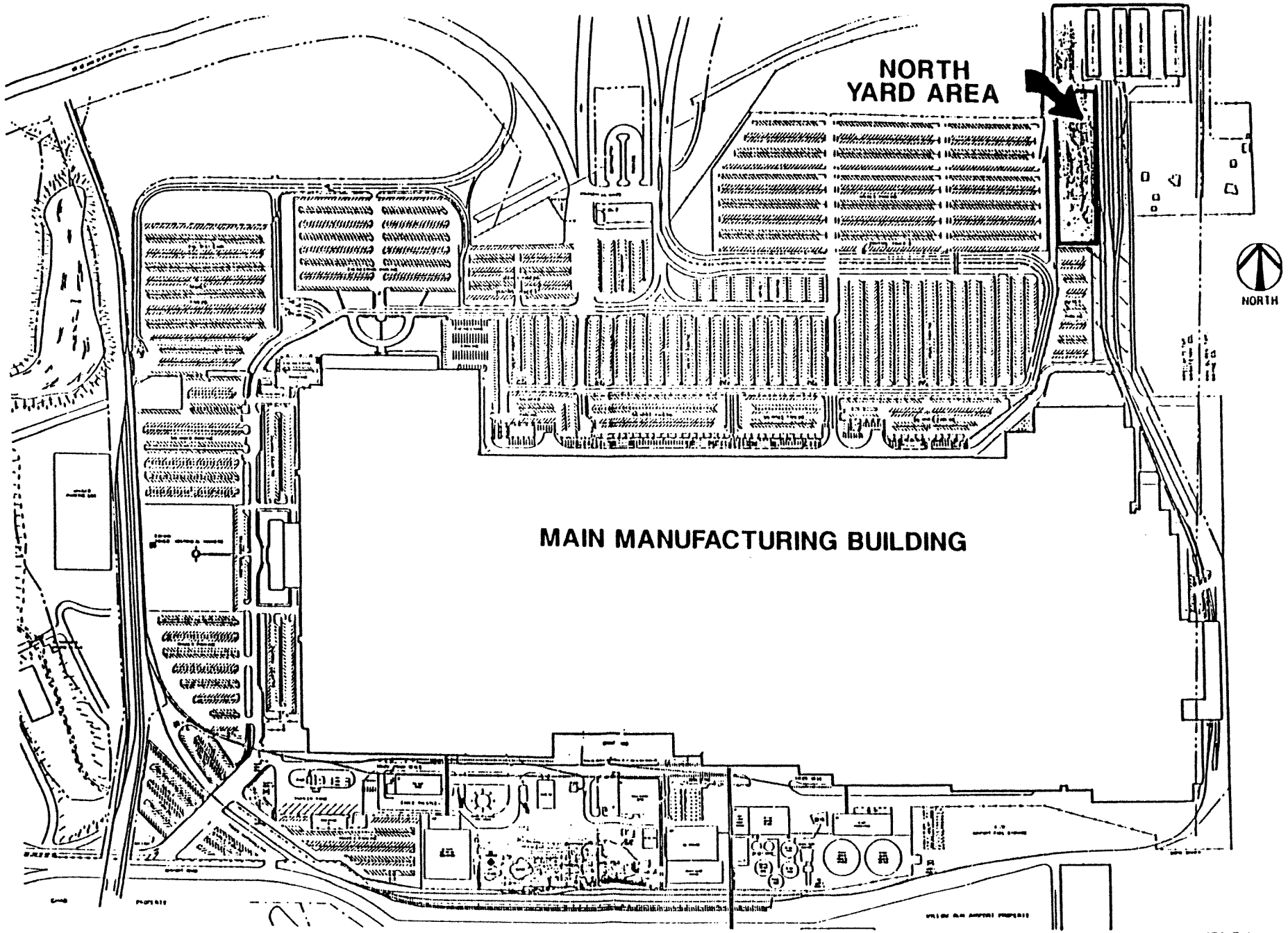
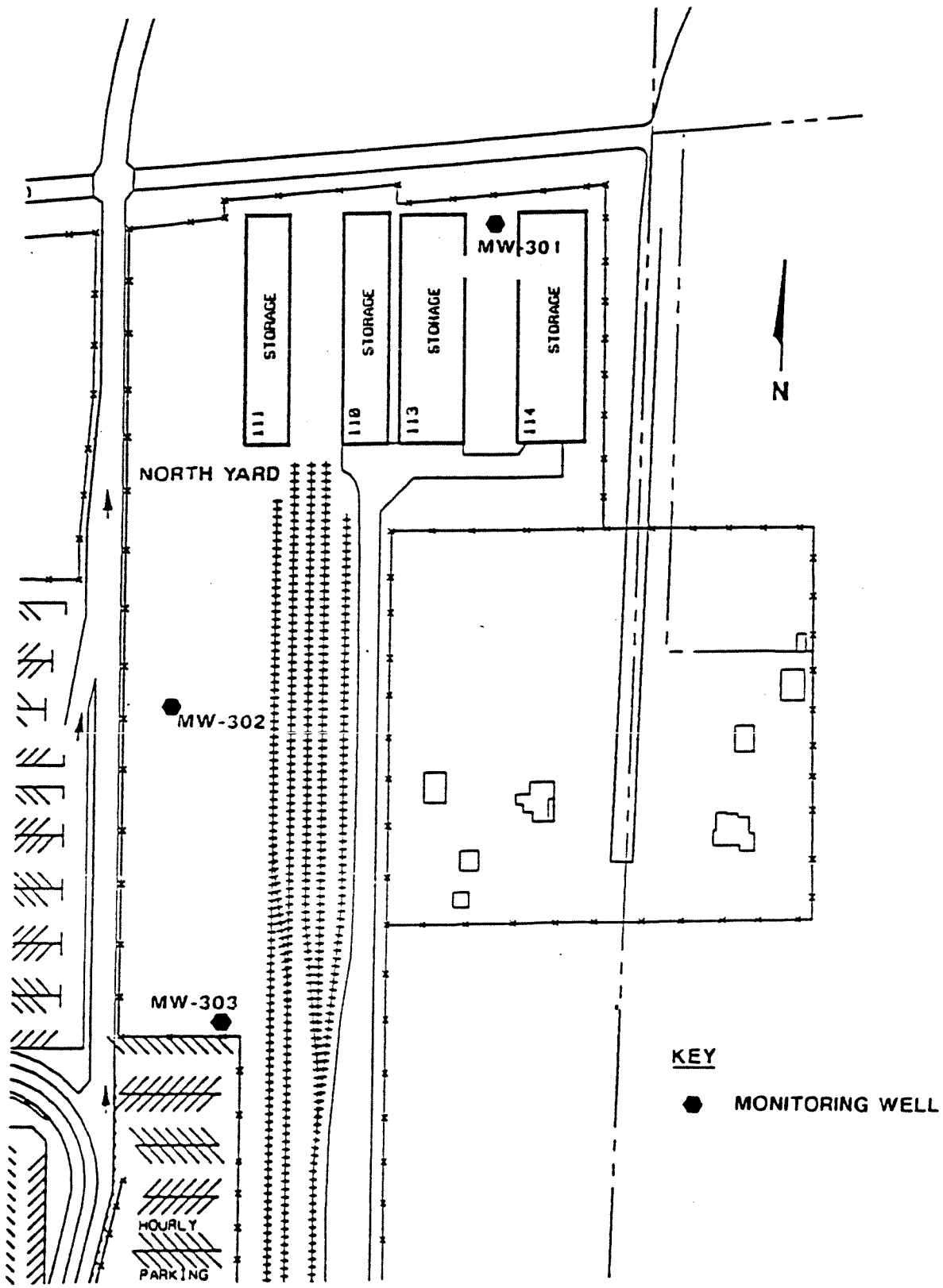


FIGURE 2
INVESTIGATION LOCATION MAP
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

C-E ENVIRONMENTAL, INC.



SCALE

0 100 200 400 FEET

FIGURE 3
MONITORING WELL LOCATIONS
NORTH YARD
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

GM DRAWING # HWR-NY-1

C-E Environmental, Inc.

filter was replaced after each sample. After processing and labeling, all samples were kept on ice in coolers until delivered to the laboratory.

The bailer was decontaminated with a solution of trisodium phosphate and distilled water, followed by a final distilled water rinse.

6.0 SAMPLE HANDLING

After processing and labeling, a chain-of-custody record and an analytical request form were completed. The samples were then transported to Environmental Control Technology Corporation (ENCOTEC), of Ann Arbor, Michigan, for analysis of selected dissolved metals (cadmium, chromium, copper, iron, lead, nickel, and zinc), purgeable halocarbons (DNR Scan 1), purgeable aromatic hydrocarbons (DNR Scan 2), and PCBs. The analytical methods used and lists of organic analytes are presented in Appendix B.

7.0 QUALITY CONTROL SAMPLES

For quality control purposes, one blind duplicate sample (MW-351, a duplicate of MW-302) and one sampler blank (MW-350, taken prior to sampling) were collected during this sampling effort. A blind duplicate sample is a duplicate sample labeled in a manner such that the laboratory is unaware that it is a duplicate. The purpose of a duplicate sample is to check the homogeneity of the sample in addition to the precision of the laboratory. A sampler blank is a sample of distilled water that is handled in the same manner as a groundwater sample -it is poured into the sampling equipment, filtered, preserved, placed into laboratory-prepared bottles, etc. The purpose of a sampler blank is to check the effectiveness of the decontamination procedures.

Each quality control sample was analyzed for the same dissolved metals and organic chemicals as the groundwater samples.

8.0 RESULTS

8.1 Groundwater Flow

As shown on Figure 4, groundwater in the North Yard appeared to be moving toward the south-southeast in December 1990. Table 1 summarizes water level measurements and groundwater flow directions observed in the North Yard during the eight sampling events conducted to date.

8.2 Quality Control Samples

Table 2 presents the analytical data for December 1990, as well as the data collected during all previous sampling events. Laboratory analytical reports for December 1990 are contained in Appendix C.

The sampler blank (MW-350) contained 0.002 milligrams per liter (mg/L) of chloroform, a common contaminant found in jugs of distilled water. Sample MW-302 showed excellent correlation with its duplicate sample MW-351, indicating good quality control.

8.3 Groundwater Quality

As shown in Table 2, dissolved iron was detected in all three wells at concentrations ranging from 0.03 to 12 mg/L. These concentrations are similar to those detected during previous sampling events, and are not uncommon for shallow groundwater in Michigan.

No site-related organic chemicals were found in groundwater samples collected from the North Yard in December, 1990.

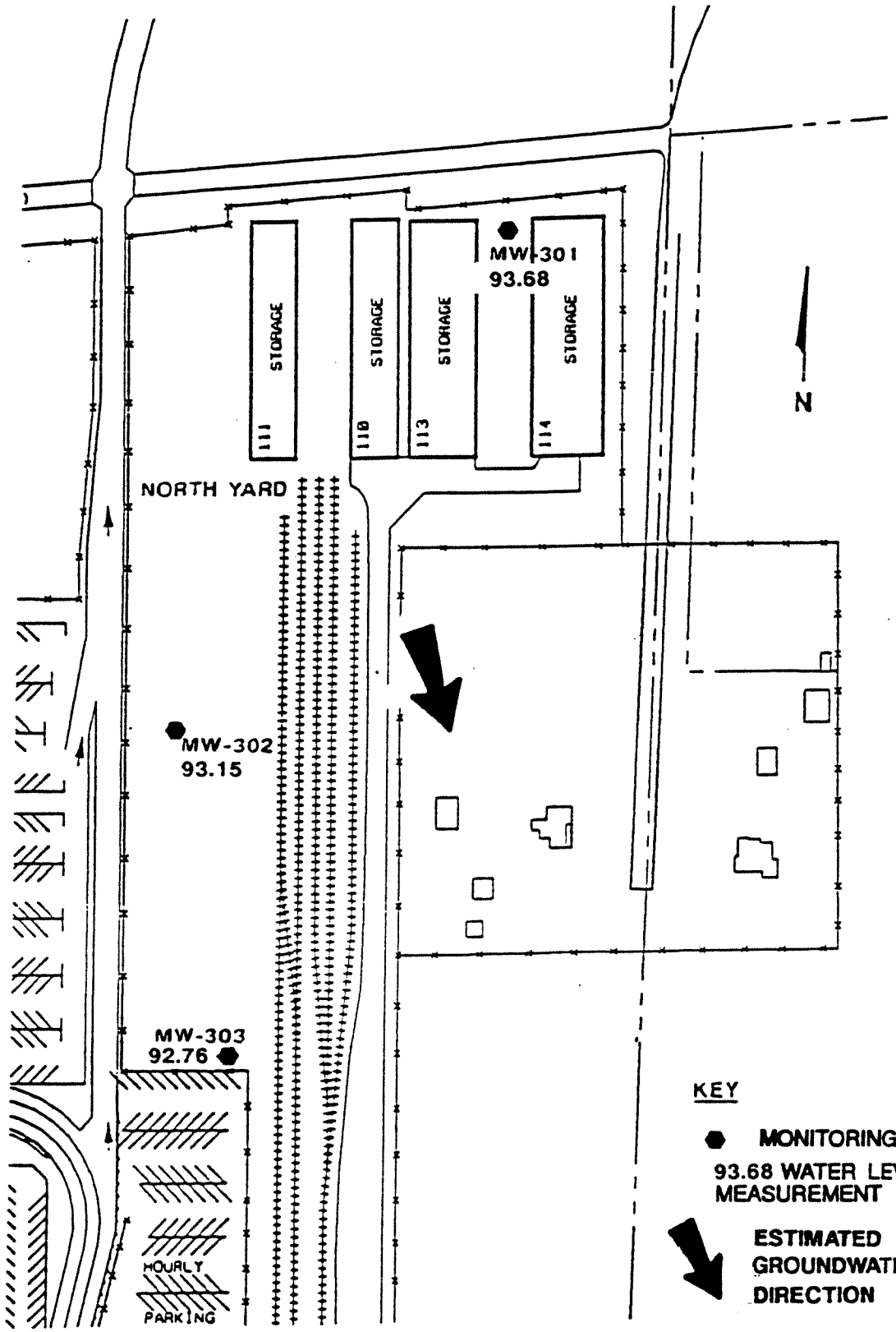


FIGURE 4
GROUNDWATER LEVEL MEASUREMENTS
DECEMBER 1990
NORTH YARD
GM HYDRA-MATIC PLANT
YPSILANTI, MICHIGAN

GM DRAWING # HWR-NY-1

C-E Environmental, Inc.

TABLE 1
Summary of Water Levels and Groundwater Flow Directions
Observed in the North Yard During 1989 and 1990

MONTH/YEAR	MONITORING WELL			GENERAL GROUNDWATER FLOW DIRECTION
	MW-301	MW-302	MW-303	
3/89	93.97	92.90	92.41	S
6/89	93.03	93.20	92.75	SE
9/89	92.45	92.89	92.63	ESE
12/89	92.09	92.33	92.11	ESE
3/90	93.50	93.15	92.80	SSE
7/90	91.94	92.70	92.48	SE
9/90	94.77	93.25	92.88	SW
12/90	93.68	93.15	92.76	SSE

Notes:

1. All elevations in feet. Referenced to temporary benchmark designated eleveation 100.00.

TABLE 2

ORGANIC AND INORGANIC CHEMICALS IN GROUNDWATER AT THE NORTH YARD
GM HYDRA-MATIC, YPSILANTI, MICHIGAN

Date	Well No.	Cd	Cr	Cu	Fe	Pb	Ni	Zn	1,1,1-TCA	BDCM	CHLOROFORM	PCB-1248
December 1990	MW-301	U	U	U	0.03	U	U	U	U	U	U	U
	MW-302	U	U	U	4.3	U	U	U	U	U	U	U
	MW-351 (Dup of MW-302)	U	U	U	12	U	U	U	U	U	U	U
	MW-303	U	U	U	3.7	U	U	U	U	U	U	U
	MW-350 (Sampler Blank)	U	U	U	U	U	U	U	U	U	0.002	U
September 1990	MW-301	U	U	U	5.1	0.02	U	U	U	U	U	U
	MW-302	U	U	U	4.7	U	U	U	U	U	U	U
	MW-303	U	U	U	4.7	U	U	U	U	U	U	U
	MW-351 (Dup of MW-303)	U	U	U	10	U	U	U	U	U	U	U
	MW-350 (Sampler Blank)	U	U	U	0.30	0.02	U	U	U	U	0.002	U
July 1990	MW-301	U	U	U	0.31	U	U	U	U	U	U	U
	MW-302	U	U	U	5.3	U	U	0.11	U	U	U	U
	MW-303	U	U	U	11	U	U	U	U	U	U	U
	MW-351 (Dup of MW-303)	U	U	U	10	U	U	U	U	U	U	U
	MW-350 (Sampler Blank)	U	U	0.14	U	U	U	0.15	U	U	U	U
March 1990	MW-301	U	U	NA	U	U	U	U	U	U	U	U
	MW-302	U	U	NA	5.1	U	U	U	U	U	U	U
	MW-360 (Dup of MW-302)	U	U	NA	4.9	U	U	U	U	U	U	U
	MW-303	U	U	NA	7.5	U	U	U	U	U	U	0.00077
	MW-350 (Sampler Blank)	U	U	NA	U	U	U	0.03	U	U	U	U
December 1989	MW-301	U	U	U	U	U	U	U	U	U	U	U
	MW-302	U	U	U	8.9	U	U	U	U	U	U	U
	MW-303	U	U	U	7.2	U	U	U	U	U	U	0.0031
	MW-360 (Dup of MW-303)	U	U	U	7.3	U	U	U	U	U	U	0.0060
	MW-350 (Sampler Blank)	U	U	0.03	U	U	U	0.09	U	U	U	U
September 1989	MW-301	U	U	U	0.16	U	U	0.03	U	U	U	NA
	MW-302	U	U	0.02	5.9	U	U	0.03	U	U	U	NA
	MW-360 (Dup of MW-302)	U	U	0.02	5.9	U	U	0.02	U	U	U	NA
	MW-303	U	U	U	7.9	U	U	0.03	U	U	U	NA
	MW-350 (Sampler Blank)	U	U	0.51	0.06	0.03	U	0.32	U	U	0.003	NA
June 1989	MW-301	U	U	U	0.03	U	U	U	U	U	U	NA
	MW-351 (Dup of MW-301)	U	U	0.04	0.04	U	U	U	U	U	U	NA
	MW-302	U	U	U	2.0	U	U	U	U	U	U	NA
	MW-303	U	U	U	2.0	U	U	U	0.002	U	U	NA
	MW-350 (Sampler Blank)	U	U	0.02	U	U	U	U	U	0.001	0.005	NA
March 1989	MW-301	NA	U	U	U	U	U	U	U	U	U	NA
	MW-351 (Dup of MW-301)	NA	U	U	U	U	U	U	U	U	U	NA
	MW-302	NA	U	U	2.8	U	U	U	U	U	U	NA
	MW-303	NA	U	U	8.1	U	U	U	U	U	U	NA
	MW-350 (Sampler Blank)	NA	U	U	U	U	U	U	U	U	U	NA

NOTES:

1. All concentrations in mg/L.
2. U - Compound was analyzed but not detected.
3. NA - Not analyzed.
4. BDCM - Bromodichloromethane
5. 1,1,1-TCA - 1,1,1-Trichloroethane
6. Each sample was analyzed for DNR Scans 1 and 2 and HSL PCBs (EPA method 8080) unless otherwise noted; only the compounds detected are shown on this table.
7. All metals are dissolved fraction.

APPENDIX A

GROUNDWATER SAMPLE RECORDS

GROUNDWATER SAMPLE RECORD

SITE: Fmc Hmo YPSI - North Yard JOB NO. 5883-00 DATE: 12/21/90

Sampler Blank

SAMPLE LOCATION MW-350 LAB NUMBER _____

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH ~~_____~~ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL DIAM.
[ ] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH _____ FT
MONITORING:
AMBIENT AIR _____ PPM
WELL MOUTH _____ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[ ] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____ FT

PURGE DATA

HEIGHT OF WATER COLUMN _____ FT
[ ] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (_____ IN)
X ___ CASING VOLUMES = GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 0915

	@ ___ GAL	@ ___ GAL	@ ___ GAL	@ ___ GAL	@ ___ GAL
PURGE VOLUME					
TEMP, DEG C					
pH, UNITS					
SPECIFIC CONDUCTIVITY, umhos/cm					

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID
[ ]	[X] PERISTALTIC PUMP	_____
[ ]	[ ] SUBMERSIBLE PUMP	_____
[ ]	[X] BAILER (PVC/SS/TEFLON)	_____
[ ]	[ ] PVC/SILICON TUBING	
[ ]	[ ] TEFLON/SILICON TUBING	
[ ]	[ ] AIR LIFT	
[ ]	[ ] WATERRA	_____
	[ ] IN-LINE FILTER	
	[ ] PRESS/VAC FILTER	
[ ]	[ ] _____	_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[ ] TSP SOLUTION
[ ] NONE
[ ] _____

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[ ] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	VOA	Scan 42	80ml	_____	No	No
_____	Diss. Metals	6010	1l	_____	Yes	HNO3/2ml
_____	PCBs	8080	2l	_____	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES Blank taken through peristaltic/filter - metals, and teflon bailer - VOA, PCBs @ start of day

SIGNATURE Lisa S Kelly/Michael DeLong

SIGNATURE/FUNCTION: _____

90303.WP
REVISED 3/90

GROUNDWATER SAMPLE RECORD

SITE: Gm HMD YBI - North Yard JOB NO. 5883-CO DATE: 12/21/90

SAMPLE LOCATION MW-301 LAB NUMBER

WATER LEVEL/WELL DATA

3.13 + .98

MEASURED WELL DEPTH 12 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH 4.11 FT
MONITORING:
AMBIENT AIR _____ PPM
WELL MOUTH _____ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 8 FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] ____ GAL/FT (____ IN)
x 3 CASING VOLUMES = 4 GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 0945

	@ 1 GAL	@ 2 GAL	@ 3 GAL	@ 4 GAL	@ ___ GAL
PURGE VOLUME					
TEMP, DEG C	9.0	8.3	7.9	7.9	
pH, UNITS	7.1	7.1	7.1	7.1	
SPECIFIC CONDUCTIVITY, umhos/cm	850	690	670	671	

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID	DECON FLUIDS USED	WATER LEVEL EQUIP.USED
[X]	[X] PERISTALTIC PUMP		[ ] ETHYL ALCOHOL	[ ] ELECTRIC COND. PROBE
[ ]	[ ] SUBMERSIBLE PUMP		[ ] DEIONIZED WATER	[X] FLOAT ACTIVATED
[ ]	[X] BAILER (PVC/SS/TEFLON)		[ ] HNO3/D.I. WATER	[ ] KECK INTERFACE PROBE
[ ]	[ ] PVC/SILICON TUBING		[ ] POTABLE WATER	[ ] OTHER
[ ]	[ ] TEFLON/SILICON TUBING		[X] TSP SOLUTION	
[ ]	[ ] AIR LIFT		[ ] NONE	NUMBER OF IN-LINE FILTERS/PAPERS USED 1
[ ]	[ ] WATERRA		[ ] _____	
	[ ] IN-LINE FILTER			
	[ ] PRESS/VAC FILTER			
[ ]	[ ] _____			

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
	VOA		80ml		No	No
	DISSOLVED METALS		1l		yes	HNO3/2ml
	PCB's		80 oz		No	No

NOTES

Water Clear @ 2 gallons
Sample slightly cloudy

SIGNATURE Craig S. Kielty / Michael DeLong

SIGNATURE/FUNCTION:

ABB ENVIRONMENTAL SERVICES, INC.

90303.WP
REVISED 3/90

GROUNDWATER SAMPLE RECORD

SITE: Sm #MD WMSI - North Yard JOB NO. 5883-00 DATE: 12/21/90

SAMPLE LOCATION MW-302 LAB NUMBER _____

WATER LEVEL/WELL DATA

6.00 + .98

MEASURED WELL DEPTH 15 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____

WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____

WATER DEPTH 6.98 FT

MONITORING:
AMBIENT AIR _____ PPM
WELL MOUTH _____ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____

WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____

PROTECTIVE CASING STICK-UP (FROM GROUND)
_____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 8 FT

[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] ____ GAL/FT (____ IN)

X 3 CASING VOLUMES = GALLONS TO BE PURGED 4

PURGE TIME START _____ END _____

SAMPLE TIME START 1500 END 1500

	@ 1 GAL	2 GAL	@ 3 GAL	@ 4 GAL	@ ___ GAL
PURGE VOLUME					
TEMP, DEG C	8.2	7.9	7.8	7.8	
pH, UNITS	7.1	7.2	7.2	7.2	
SPECIFIC CONDUCTIVITY, umhos/cm	1650	1525	1625	1625	

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID
[X]	[X] PERISTALTIC PUMP	_____
[ ]	[ ] SUBMERSIBLE PUMP	_____
[ ]	[X] BAILER (PVC/SS/TEFLON)	_____
[ ]	[ ] PVC/SILICON TUBING	
[ ]	[X] TEFLON/SILICON TUBING	
[ ]	[ ] AIR LIFT	
[ ]	[ ] WATERRA	_____
	[ ] IN-LINE FILTER	
	[ ] PRESS/VAC FILTER	
[ ]	[ ] _____	_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[ ] _____

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	VOA	Scan 42	80ml	_____	No	No
_____	D. Metals	6010	1l	_____	Yes	HNO3
_____	PCBs	8080	2l	_____	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES

Water Clear;
PCB + VOA sample
Slightly Cloudy

SIGNATURE Craig S. Kelly Michael J. DeLong

SIGNATURE/FUNCTION: _____

90303.WP
REVISED 3/90

ABB ENVIRONMENTAL SERVICES, INC.

Page ___ of ___

GROUNDWATER SAMPLE RECORD

SITE: Sm And YBI - North Yard JOB NO. 5893-00 DATE: 12/21/90

SAMPLE LOCATION MW-303 LAB NUMBER _____

WATER LEVEL/WELL DATA

6.28.18

MEASURED WELL DEPTH 15 FT
[ ] TOP OF WELL
[X] TOP OF CASING
[ ] _____
WELL DIAM.
[X] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH 7.26 FT
MONITORING:
AMBIENT AIR _____ PPM
WELL MOUTH _____ PPM

HISTORICAL WELL DEPTH _____ FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[X] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND) _____ FT

PURGE DATA

HEIGHT OF WATER COLUMN 8 FT
[X] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (____ IN)
X 3 CASING VOLUMES = 4 GALLONS TO BE PURGED
PURGE TIME START _____ END _____
SAMPLE TIME START _____ END 1015

	a 1 GAL	a 2 GAL	a 3 GAL	a 4 GAL	a ___ GAL
PURGE VOLUME					
TEMP, DEG C	9.0	8.5	8.2	8.2	
pH, UNITS	6.8	6.9	6.9	6.9	
SPECIFIC CONDUCTIVITY, umhos/cm	1390	1375	1351	1352	

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID
[X]	[X] PERISTALTIC PUMP	_____
[ ]	[ ] SUBMERSIBLE PUMP	_____
[ ]	[X] BAILER (PVC/SS/TEFLON)	_____
[ ]	[ ] PVC/SILICON TUBING	
[ ]	[ ] TEFLON/SILICON TUBING	
[ ]	[ ] AIR LIFT	
[ ]	[ ] WATERRA	_____
	[ ] IN-LINE FILTER	
	[ ] PRESS/VAC FILTER	
[ ]	[ ] _____	_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[X] TSP SOLUTION
[ ] NONE
[ ] _____

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[X] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	VOA	Scan 1&2	80ml	_____	No	No
_____	D. Metals	6010	1l	_____	Yes	HNO3/1ml
_____	PCBs	8080	2l	_____	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES

Water Clear
VOA & PCB Sample Slightly Cloudy

SIGNATURE [signature] / Michael DeLong

SIGNATURE/FUNCTION: _____

90303.WP
REVISED 3/90

ABB ENVIRONMENTAL SERVICES, INC.

GROUNDWATER SAMPLE RECORD

SITE: Sm Hmo Yasi - North Yard JOB NO. 5883-00 DATE: 12/21/90

SAMPLE LOCATION MW-351 LAB NUMBER Dup of 302

WATER LEVEL/WELL DATA

MEASURED WELL DEPTH _____FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL DIAM.
[ ] 2 INCH
[ ] 4 INCH
[ ] 6 INCH
[ ] _____
WATER DEPTH _____FT
MONITORING:
AMBIENT AIR _____PPM
WELL MOUTH _____PPM

HISTORICAL WELL DEPTH _____FT
[ ] TOP OF WELL
[ ] TOP OF CASING
[ ] _____
WELL MATERIAL:
[ ] PVC
[ ] SS
[ ] _____
PROTECTIVE CASING STICK-UP (FROM GROUND)
_____FT

PURGE DATA

HEIGHT OF WATER COLUMN _____FT
[ ] .16 GAL/FT (2 IN)
[ ] .65 GAL/FT (4 IN)
[ ] 1.5 GAL/FT (6 IN)
[ ] _____ GAL/FT (_____IN)
X ___ CASING VOLUMES = GALLONS TO BE PURGED
PURGE TIME START_____ END_____
SAMPLE TIME START_____ END_____

	a ___ GAL	a ___ GAL	a ___ GAL	a ___ GAL	a ___ GAL
PURGE VOLUME					
TEMP, DEG C					
pH, UNITS					
SPECIFIC CONDUCTIVITY, umhos/cm					

EQUIPMENT DOCUMENTATION

PURGING	SAMPLING	EQUIPMENT ID
~~[ ]~~	~~[ ]~~ PERISTALTIC PUMP	_____
[ ]	[ ] SUBMERSIBLE PUMP	_____
[ ]	~~[ ]~~ BAILER (PVC/SS/TEFLON)	_____
[ ]	[ ] PVC/SILICON TUBING	
[ ]	[ ] TEFLON/SILICON TUBING	
[ ]	[ ] AIR LIFT	
[ ]	[ ] WATERRA	_____
	[ ] IN-LINE FILTER	
	[ ] PRESS/VAC FILTER	
[ ]	[ ] _____	_____

DECON FLUIDS USED
[ ] ETHYL ALCOHOL
[ ] DEIONIZED WATER
[ ] HNO3/D.I. WATER
[ ] POTABLE WATER
[ ] TSP SOLUTION
[ ] NONE
[ ] _____

WATER LEVEL EQUIP.USED
[ ] ELECTRIC COND. PROBE
[ ] FLOAT ACTIVATED
[ ] KECK INTERFACE PROBE
[ ] OTHER

NUMBER OF FILTER PAPERS USED ____

SAMPLES COLLECTED

BOTTLE ID	ANALYSIS REQUESTED	METHOD NUMBER	VOLUME	JAR TYPE	FILTERED	PRESERVATIVE/ VOLUME
_____	VOA	Scan 12	80ml	_____	No	No
_____	D. Metals	6010	1l	_____	Yes	HNO3 Kml
_____	PCBs	8080	2l	_____	No	No
_____	_____	_____	_____	_____	_____	_____

NOTES

Duplicate sample of MW-302

SIGNATURE Michael DeLong
SIGNATURE/FUNCTION: _____

90303.WP
REVISED 3/90

ABB ENVIRONMENTAL SERVICES, INC.

APPENDIX B

ANALYTICAL METHODS

ANALYTICAL PROGRAM
QUARTERLY GROUNDWATER MONITORING PROGRAM

NORTH YARD
GM HYDRA-MATIC

PARAMETER	METHOD NUMBER
Dissolved Metals:	
Cadmium	1310/6010
Chromium	1310/6010
Iron	3010/7380
Nickel	1310/6010
Lead	3010/7420
Zinc	1310/6010
DNR Scan 1 Compounds:	8020
Bromodichloromethane	
Bromoform	
Carbon tetrachloride	
Chlorobenzene	
Chloroform	
Dibromochloromethane	
Dichlorodifluoromethane	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1-Dichloroethene	
cis-1,2-Dichloroethene	
trans-1,2-Dichloroethene	
1,3-Dichloropropene	
1,1,2,2-Tetrachloroethane	
Tetrachloroethene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethene	
DNR Scan 2 Compounds:	8020
Benzene	
Ethylbenzene	
Styrene	
Toluene	
Total Xylenes	
HSL Pesticides and PCBs:	8080
Aldrin	
Alpha-BHC	
Beta-BHC	
Delta-BHC	
Gamma-BHC (Lindane)	
Chlordane	
4-4'-DDD	
4-4'-DDE	
4-4'-DDT	
Dieldrin	
Alpha-Endosulfan	
Beta-Endosulfan	
Endosulfan Sulfate	
Endrin	
Endrin Ketone	
Heptachlor	
Heptachlor Epoxide	
Methoxychlor	
Toxaphene	
PCB-1016	
PCB-1221	
PCB-1232	
PCB-1242	
PCB-1248	
PCB-1254	
PCB-1260	

APPENDIX C

LABORATORY ANALYTICAL REPORTS

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: ABB Environmental
PROJECT NO.: 40650
SAMPLE TYPE: Filtrate
REPORT DATE: January, 1991

SAMPLE NAME		MW-301	MW-302	MW-303	MW-350	MW-351
SAMPLE DATE		12-21-90	12-21-90	12-21-90	12-21-90	12-21-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		66031	66032	66033	66034	66035
Cadmium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	mg/L	0.03	4.3	12	<0.02	3.7
Lead	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
						01

ENCOTEC
3985 RESEARCH PARK DR.
ANN ARBOR, MI 48108
(313) 761-1389

DATA SUMMARY SHEET

PROJECT: ABB Environmental
PROJECT NO.: 40650
SAMPLE TYPE: Water
REPORT DATE: January, 1991

SAMPLE NAME		MW-301	MW-302	MW-303	MW-350	MW-351
SAMPLE DATE		12-21-90	12-21-90	12-21-90	12-21-90	12-21-90
PARAMETER	UNITS	ENCOTEC SAMPLE I.D. NUMBER				
		66026	66027	66028	66029	66030
Aroclor 1016	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate Recovery		84%	88%	90%	87%	91%
Analysis Date:						
Analyst: J. Hoag						
						02

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: January 21, 1991

Sample: MW-301
ENCOTEC Number: 66026
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: January 21, 1991

Sample: MW-301
ENCOTEC Number: 66026
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.002
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: January 21, 1991

Sample: MW-302
ENCOTEC Number: 66027
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: January 21, 1991

Sample: MW-302
ENCOTEC Number: 66027
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: January 21, 1991

Sample: MW-303
ENCOTEC Number: 66028
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: January 21, 1991

Sample: MW-303
ENCOTEC Number: 66028
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: January 21, 1991

Sample: MW-350
ENCOTEC Number: 66029
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	0.002	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: January 21, 1991

Sample: MW-350
ENCOTEC Number: 66029
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: January 21, 1991

Sample: MW-351
ENCOTEC Number: 66030
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: January 21, 1991

Sample: MW-351
ENCOTEC Number: 66030
Sample Date: 12-21-90
Date Received: 12-21-90
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389
ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 1
Report Date: January 21, 1991

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyte not detected
B = Analyte present in method blank
J = Present at level less than detection limit

VOLATILE ORGANICS	CAS #	UNITS	CONC.	DETECTION LIMIT
Bromodichloromethane	75-27-4	mg/L	U	0.001
Bromoform	75-25-2	mg/L	U	0.001
Bromomethane	74-83-9	mg/L	U	0.001
Carbon Tetrachloride	56-23-5	mg/L	U	0.001
Chlorobenzene	108-90-7	mg/L	U	0.001
Chloroethane	75-00-3	mg/L	U	0.001
Chloroform	67-66-3	mg/L	U	0.001
Dibromochloromethane	124-48-1	mg/L	U	0.001
1,1-Dichloroethane	75-34-3	mg/L	U	0.001
1,2-Dichloroethane	107-06-2	mg/L	U	0.001
1,1-Dichloroethene	75-35-4	mg/L	U	0.001
cis-1,2-Dichloroethene*	540-59-0	mg/L	U	0.001
trans-1,2,-Dichloroethene*	156-60-5	mg/L	U	0.001
1,2-Dichloropropane	78-87-5	mg/L	U	0.001
cis-1,3-Dichloropropene	10061-01-5	mg/L	U	0.001
trans-1,3-Dichloropropene	10061-02-6	mg/L	U	0.001
Methylene Chloride	75-09-2	mg/L	U	0.001
1,1,2,2-Tetrachloroethane	79-34-5	mg/L	U	0.001
Tetrachloroethene	127-18-4	mg/L	U	0.001
1,1,1-Trichloroethane	71-55-6	mg/L	U	0.001
1,1,2-Trichloroethane	79-00-5	mg/L	U	0.001
Trichloroethene	79-01-6	mg/L	U	0.001
Trichlorofluoromethane	75-69-4	mg/L	U	0.001
Vinyl Chloride	75-01-4	mg/L	U	0.001

*Reported separately. Some data may report the cis- and trans- isomers together under trans-1,2-dichloroethene.

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
3985 Research Park Drive * Ann Arbor, MI 48108
313 / 761-1389

ORGANIC ANALYSIS DATA SUMMARY SHEET

Project Name: ABB Environmental
Project Number: 40650
Method: Mich DNR Scan 2
Report Date: January 21, 1991

Sample: Method Blank
ENCOTEC Number: NA
Sample Date: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 12-28-90

U = Analyzed, Not Detected
J = Present at Level Less Than Detection Limit
B = Present in Method Blank

VOLATILE ORGANICS	CAS #	Units	Conc.	Detection Limit
Benzene	71-43-2	mg/L	U	0.001
Ethylbenzene	100-41-4	mg/L	U	0.001
Toluene	108-88-3	mg/L	U	0.001
1,2-Xylene	95-47-6	mg/L	U	0.001
1,3-Xylene*	108-38-3	mg/L	U	0.002
1,4-Xylene*	106-42-3			

*Reported together under 1,3-Xylene

AOI 4
Physical File

HYDRA-MATIC

Division of General Motors Corporation Ypsilanti, Michigan 48198-6198

August 15, 1989

AUG 17 1989

Mr. Charles F. San Juan
Geologist
Environmental Response Division
Michigan Department of Natural Resources
Jackson State Office Building
301 E. Louis Glick Hwy.
Jackson, Michigan 49201

Dear Mr. San Juan:

This letter is being issued to confirm the items that we discussed during our meeting on August 7, 1989. During the meeting, you were provided the final reports for five initial hydrogeological investigations that have been completed, along with proposals for 'Phase II' investigative work for three of these areas. In addition, we would like to highlight the following agreements that were made during our meeting.

1. Powerhouse Tank Farm Area

   The results and conclusions from the hydrogeological study demonstrate that the oil contamination noticed in the excavation has not significantly moved from this area, and that any residual oil contamination that does exist will be contained and eventually removed by the permanent groundwater collection (underdrain) system below the concrete tank vault floor. Also, the bulk of the contaminated soil was removed and properly disposed of as part of the construction project. As such, further hydrogeological work is not necessary in this area.

2. North Yard

   The analytical results from the first round of groundwater sampling indicate that the past activities in this area have not impacted groundwater quality. During our discussion, we agreed that PCB analysis would be performed on one set of samples during the course of the analytical program. In addition, the monitoring data will be reviewed at the end of one year to determine the need for proceeding with the monitoring program.

3. Building #19 Tank Farm, Subtest Area and Bay Q-24 Area

We will proceed with the Phase II investigative work as proposed to you during our meeting. Upon receipt, we would like to discuss the results, conclusions and recommendations from these investigations with MDNR to formulate remedial measures as needed.

4. Drum Handling Area

The one year sampling program has been completed. Enclosed with this letter you will find the last data set. Due to the nature of the problem in this area, the sampling program will be extended for a period of one year. At the end of that year, Hydra-matic would like to meet with MDNR to discuss the data base generated by the monitoring program. This information will aid in the development of remedial strategies as needed.

I will be contacting you in November of this year to schedule another status meeting to discuss our progress on the proposed work plans. If you have any questions or concerns regarding this matter or would like more information on the ongoing remedial activities at this facility, please contact myself at (313) 481-7232.

Sincerely,

Chris Winkeljohn
Environmental Engineering

Enclosure

437 ENV003:Binder # 039 Tank 2 Summary
3/93 Hydro Elevations (1 of 3)

9803-039

Investigation of Soil Contamination in a Machine Storage Area at the Hydra-matic Plant in Ypsilanti, Michigan

Thomas L. Gibson and Abdul S. Abdul

Environmental Science Department
General Motors Research Laboratories
Warren, Michigan 48090-9055

For submission to the
Michigan Department of Natural Resources

ABSTRACT

An outdoor storage yard for disused machinery at the Hydra-matic plant in Ypsilanti, Michigan was contaminated by residual fluids that leaked from the machines. Hydra-matic, with the agreement of the Michigan Department of Natural Resources, decided to implement a plan designed by the authors of this report to define the potential contamination. A phased investigation was carried out during 1988 to delineate contamination at the site.

In phase 1, surface soil sampling was used to define the lateral extent of contamination. The results demonstrated that the foreign constituents measured in the soil were most concentrated horizontally in an approximately 100 by 200 foot central region of the yard. Maximum concentrations of contaminants in surface soil in the central region were, hydrocarbons, 14,000 mg/kg; chromium, 74 mg/kg; nickel, 34 mg/kg; lead, 210 mg/kg; zinc, 140 mg/kg; cadmium, 5.6 mg/kg; iron, 34,000 mg/kg; and total PCBs, 4 mg/kg. Other parts of the storage area generally had lower concentrations, mostly background levels. In phase 2, soil cores were taken using a specially designed coring device (the GMR sampler) to adequately define the vertical spread of contaminants. The results showed that, in all areas, the unsaturated soil zone below the upper 22 inches was not contaminated. Therefore, investigation of the deeper perched aquifer system (phase 3), which starts about 6 feet below the surface, was unneccesary. Since no vapor-phase organics were detected in the soil samples, delineation of vapor contamination (phase 4) was unnecessary.

Retardation processes such as adsorption, cation exchange, and low contaminant solubility, prevented contaminant migration beyond the storage area or into the aquifer. Furthermore, current environmental regulations did not require cleanup action. Therefore, the GMR investigation concluded that no remedial action was necessary at this site.

INTRODUCTION

An outdoor area (about 800 by 200 feet), north of the General Motors Hydra-matic Plant at Ypsilanti, Michigan, was used for approximately 30 years to store machinery removed from the plant. A site map is shown in Figure 1. In some cases, the machinery, including hydraulic presses and metal cutting machines, was incompletely drained, and leaking fluids could have contaminated the surface soil with their organic and inorganic constituents. Further, in the unlikely event of a large spill or leak the contamination could have migrated through the sandy subsurface material to a shallow perched aquifer. After agreeing with the Michigan Department of Natural Resources to address the situation, Hydra-matic requested the help of the Environmental Science Department to plan and carry out the investigation.

To approach the problem definition systematically and rationally, available data were gathered to characterize the local hydrogeology and the potential contaminants. Hydrogeologic data from a nearby site indicated that the subsurface is comprised mainly of fine to medium sand and a shallow perched aquifer extends from a depth of about 6 feet to a dense clay layer at a depth of about 13 feet (Abdul et al., 1988a). Analysis of fluids sampled from pieces of machinery had shown the presence of oily hydrocarbons, heavy metals, and very low levels of PCBs.

From theoretical considerations and from the available data about the site and the potential contaminants, it appeared possible that contamination would be contained near the surface sources, and migration laterally and below the surface might be restricted. A large volume of oil can be retained in the pores of a sandy matrix as residual saturation (approximately 16 gallons/yd^3, Abdul, 1988). The presence of small amounts

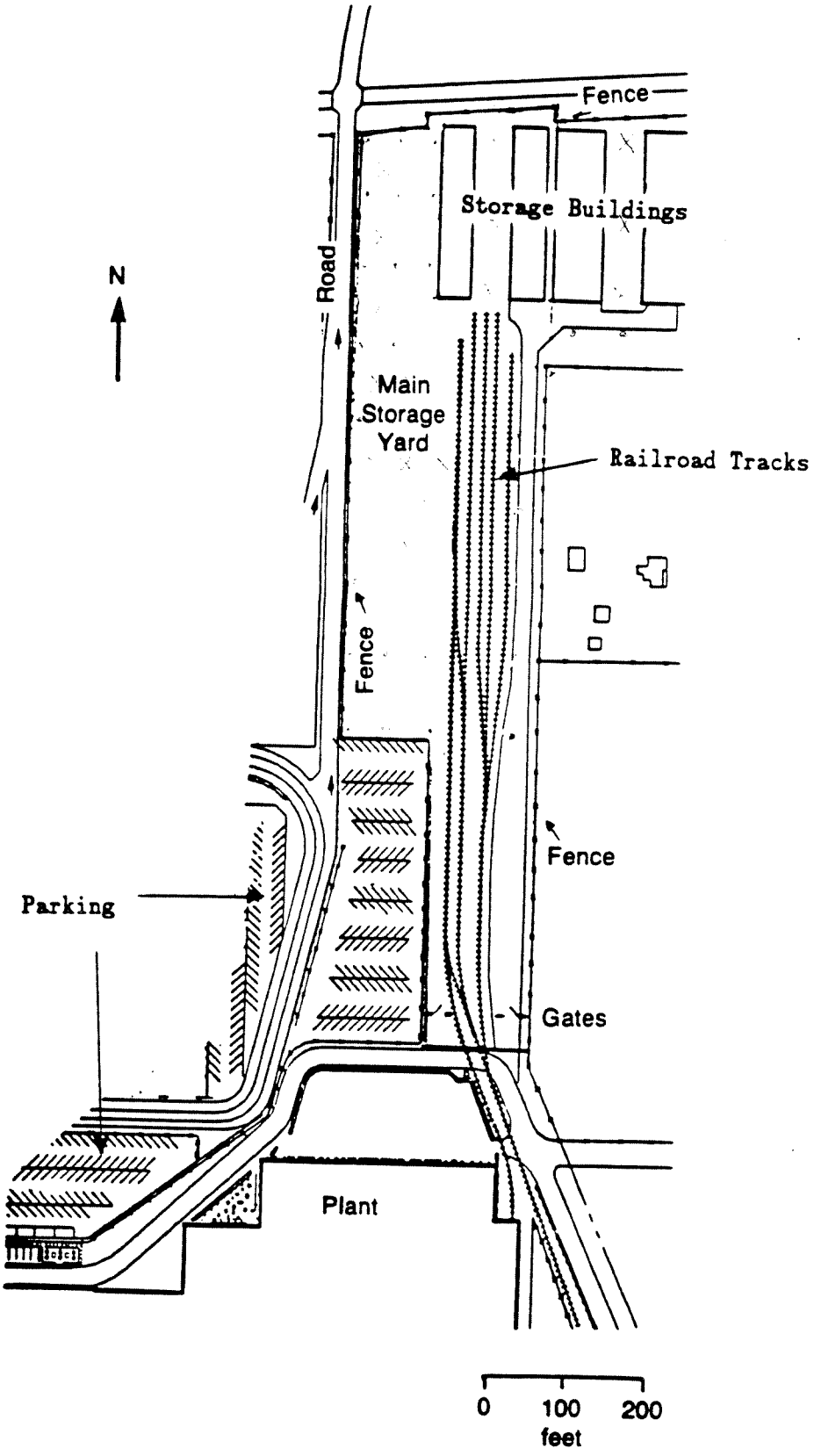


Figure 1. Map of the machine storage area at the Willow Run Hydra-matic Plant.

of clay, having a high cation exchange capacity, could tie up metal ions (Grimshaw, 1971), and the migration of PCBs is known to be strongly retarded by hydrophobic adsorption on sandy aquifer material (Abdul and Gibson, 1986; Abdul et al., 1987). Thus, extensive and costly investigations deep into the subsurface might be unnecessary at this site. Coring and drilling through contaminated surface material to some arbitrary depth below the water table should be avoided if possible because this can spread the contaminants downward into otherwise clean layers.

APPROACH

To systematically assess the problem, the investigation was divided into the following four phases: phase 1- delineating the extent of surface contamination; phase 2- delineating the spread of contamination downward into the unsaturated zone and characterizing the geologic material in this zone; phase 3- delineating contamination in the perched aquifer and describing the hydrology and geology of this aquifer; and phase 4- delineating the extent of vapor contamination. It was decided that the implementation of any phase was to be based on the results of the preceeding phases. By this decision, phase 2 was to be implemented only if comtamination was found in the surface material, phase 3 was to be implemented only if contamination was found throughout the unsaturated zone, and phase 4 was to be implemented if volatile organic compounds were found in surface and subsurface materials.

Since the contaminants were released at the surface, it was appropriate in the first phase of investigation to sample and analyze only surface material. This was done by taking shallow soil samples from the surface to a depth of 12 inches at locations 100 feet apart north to south

and 50 feet apart east to west (Figure 2). Since this sampling scheme would cover the machine storage yard (800 by 200 ft), the concentrations of organic and inorganic constituents revealed by chemical analysis could be used to look for patterns of contamination in the surface material. By this method, we could judge where to concentrate our greatest efforts in delineating the lateral spread of the contaminants.

Because machinery was stored infrequently in other areas, adjacent to the yard, as well (Figure 2), it was decided to also investigate those areas. The same phased investigative approach was followed and samples were typically taken at intervals of about 100 feet.

After assessing the distribution of the contaminants in the surface material, deeper coring was planned in phase 2 of the investigation to determine the vertical distribution of the contaminants in the unsaturated zone down to the shallow water table. The GMR soil core sampler, used to take the samples, was designed specifically to take soil cores for delineating zones of subsurface contamination (Gibson and Abdul, 1989). With this device, it is possible to obtain soil cores through the shallow unsaturated soil zone without cross contamination by surface material, which the standard split spoon sampler (ASTM, 1988), most commonly used for soil sampling, is not designed to do.

Liquid or dissolved-phase contaminants in the unsaturated zone would spread mostly downward under the influence of gravity. The tendency of oils to leave behind residual contamination in the pore spaces between soil particles and the strong adsorption of hydrophobic contaminants by the soil would ensure that there could be no contamination below a surface location unless the same constituents were also found in the surface samples. Spread of constituents by diffusion could likewise not contaminate underlying

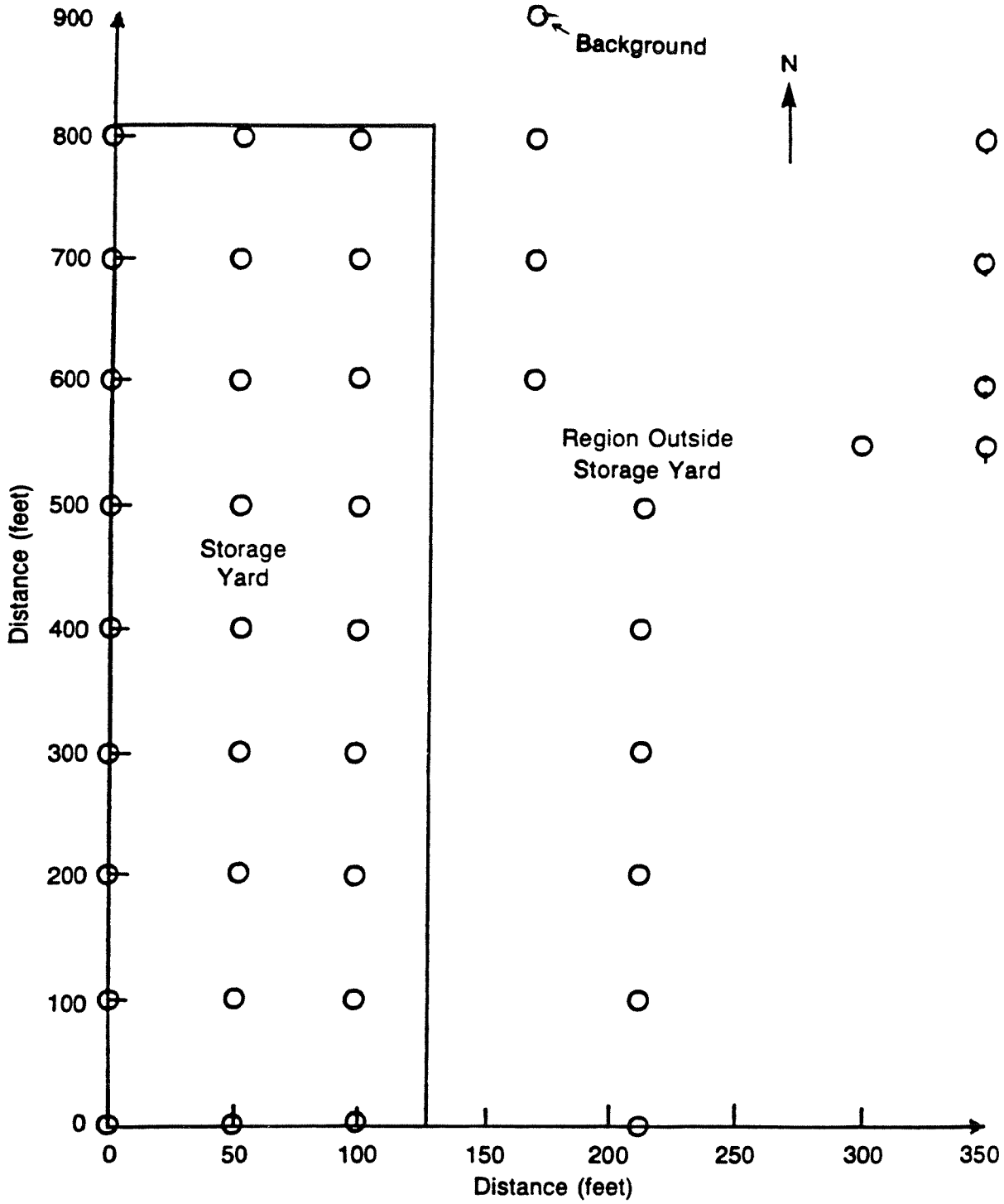


Figure 2. The surface material sampling grid at the machine storage area: Sampling locations (O).

zones without leaving evidence of contamination in surface material. Thus, if contaminants are not present at the water table it is not necessary to implement phase 3 to look for comtamination of the aquifer.

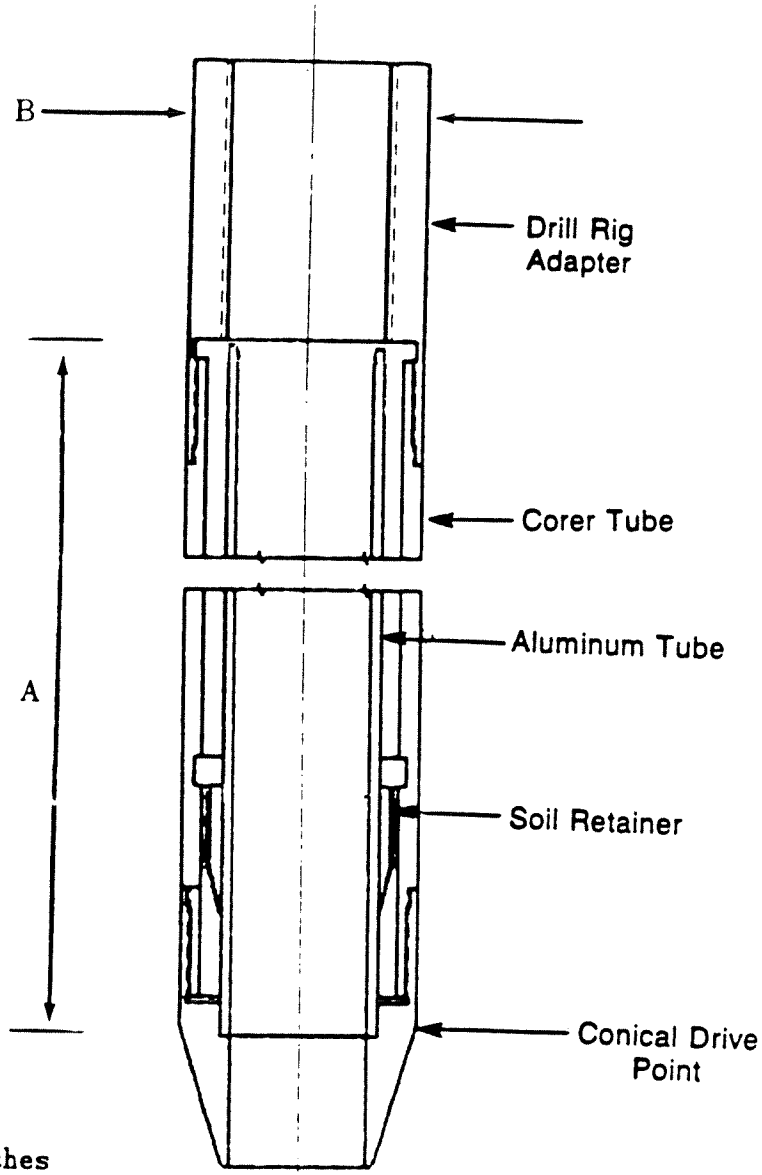
METHODS

Surface Material Samples

The split-spoon or split-barrel sampler (SSP), used to obtain grab samples of surface material from the surface to a depth of 12 inches, was that described in ASTM method D 1586 - 84, Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM, 1988). This device consisted of a steel sampler barrel, 3.0 inches O.D. and 2.4 inches I.D. by 24 inches long, which splits longitudinally, to be easily opened for inspection in the field. The split spoon was driven vertically into the ground by a truck-mounted drill rig. Each soil core, once taken out of the ground, was visually inspected and then mixed to provide a homogeneous grab sample.

Subsurface Material Samples

The GMR soil sampler used to core the unsaturated zone consists of three main parts: (1) an outer stainless steel corer tube (Figure 3), with a drill rig adapter, to mount the corer on a standard drill rod of a truck mounted rig, and a conical drive point, that can be driven into the ground; (2) an inner tube for collecting the soil made from 2.0-inch OD aluminum pipe; and (3) a metal soil retainer held in a recessed area in the bottom end of the corer tube, so that the aluminum tube extends through the retainer holding it open during soil coring (Figure 2). After the corer was driven into the ground, the leaves of the retainer could be made to



A = 48 inches

B = 3.00 inches

Figure 3. The GMR soil core sampler.

close by backing out the aluminum tube about one inch, thus preventing the soil from falling out (Figure 4).

To break through the uppermost layer of compacted surface material and old pavement and to reduce stresses on the sampler, a hollow-stem auger (10 inch OD by 6.5 inch ID) was first used to bore out the upper 12 inches of material. At the machine storage site, coring to a depth of 48 inches proved sufficient to delineate the shallow contaminated zone. After coring, the borehole was backfilled with bentonite clay. The drilling was performed by Professional Services Industries, Inc., Michigan Testing Engineers Division.

Vapor Phase Organics

A Model TIPI hand-held photoionization detector (Photovac, Inc.) was used to measure organic vapor concentrations in the surface and subsurface soil during the investigation. The TIPI can detect a minimum of 0.1 ppm hydrocarbon vapor by volume in air. Before use, the detector was calibrated with a standard gas mixture of isobutylene in air following the manufacturer's directions.

Total Hydrocarbons

Soil samples were first extracted with methylene chloride using a soxhlet apparatus. Total hydrocarbons were measured in the extracts by gas chromatography using a 30-m DB-5 capillary column and flame ionization detection, and by comparing the integrated area under the peaks with that obtained using Fuel Oil #6 as reference (modified Method 601, USEPA, 1986). A typical chromatogram is shown in Figure 5. These analyses were done under contract by Encotec, Inc., Ann Arbor, MI.

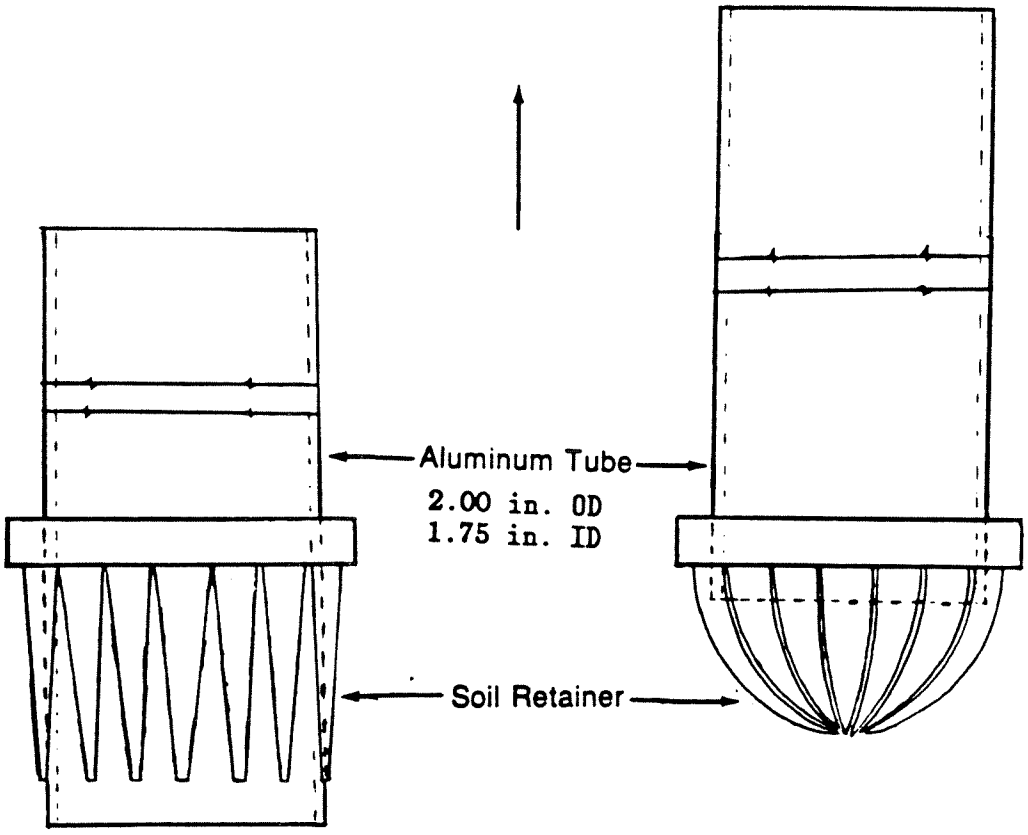


Figure 4. Operation of the soil retainer. Manually withdrawing the aluminum tube about one inch closes the retainer, holding the soil sample in the tube.

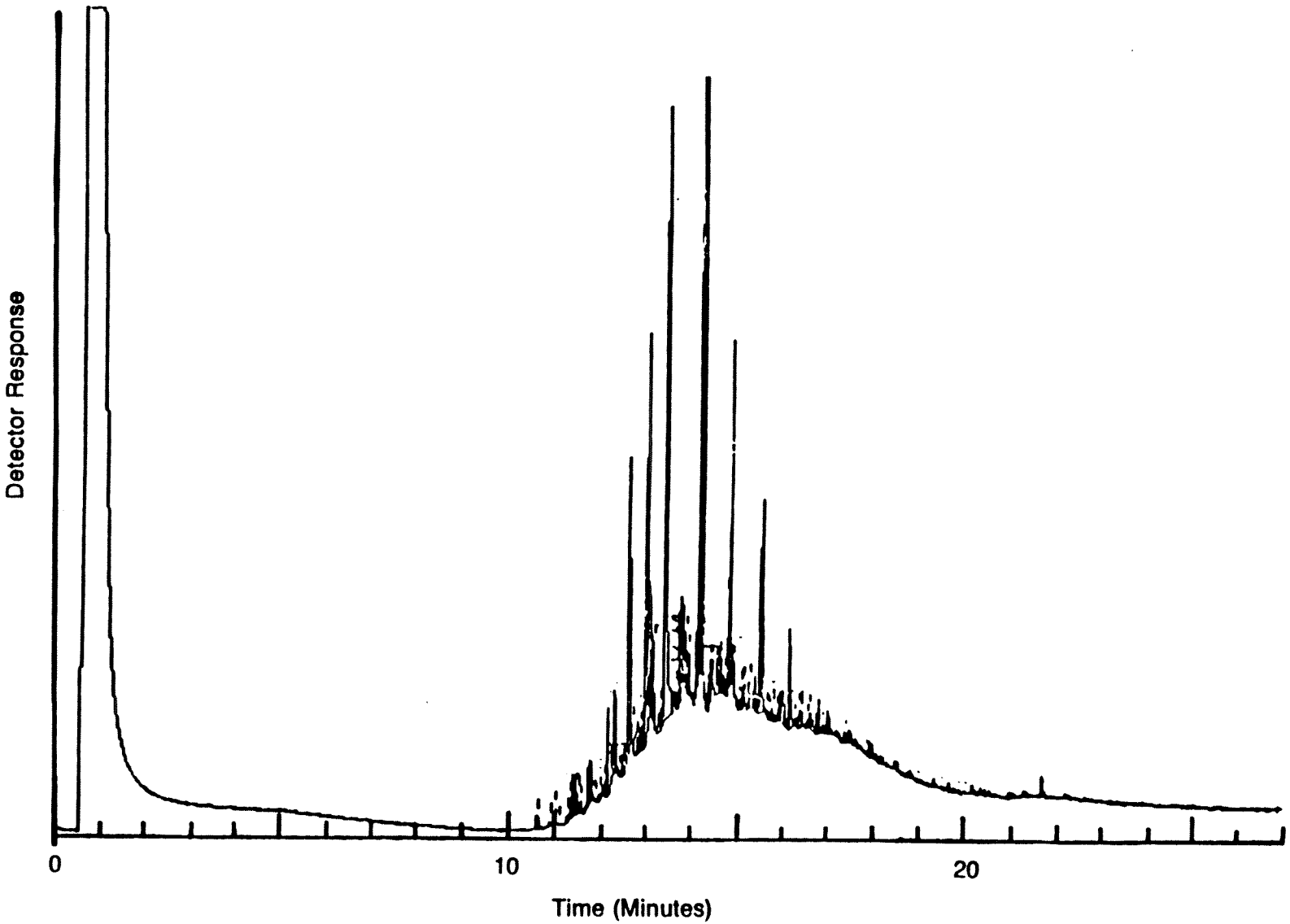


Figure 5. Typical gas chromatogram of the total hydrocarbon in a soil extract from the machine storage area (flame ionization detector). Concentration was determined from the integrated area under the peaks.

Freon Extractables

Soil samples were analyzed for total grease and oil by a procedure based on the partition-gravimetric and extraction methods described in Standard Methods for the Examination of Water and Wastewater (1985) and Method 418.1 (USEPA, 1979). Oil and grease are defined by the conditions used in the method, as any material extracted by the solvent and not volatilized when the solvent is removed. Using this method, the total Freon-extractable organic materials were measured by extracting each soil sample (approximately 100 g) with four 50-mL portions of 1,1,2-trichloro-1,2,2-trifluoroethane (Freon-113) with vigorous stirring for 5 min each. Freon was evaporated from the combined extracts by heating on a steam bath, and the residue was weighed.

Polychlorinated Biphenyls (PCBs)

PCBs were determined as Aroclors 1016, 1221, 1232, 1248, 1254, and 1260 by gas chomatography with electron capture detection in methylene chloride extracts of the soil samples , according to EPA Method 8080 (USEPA, 1986). The analyses were carried out under contract by Encotec, Inc., Ann Arbor, MI, and the results are reported as total PCBs.

Heavy Metals

The total concentrations of heavy metals, including chromium, nickel, lead, zinc, cadmium, and iron, were measured in the soil samples, after nitric acid digestion, by the inductively coupled plasma method, following EPA Methods 3050, 6010, and 7420 (USEPA, 1986). Examples of spectra for each of the metals are shown in Figure 6. Extraction Procedure (EP) toxicity tests (RCRA Method 1310, USEPA, 1986) were also performed on selected samples from the most contaminated surface material to determine

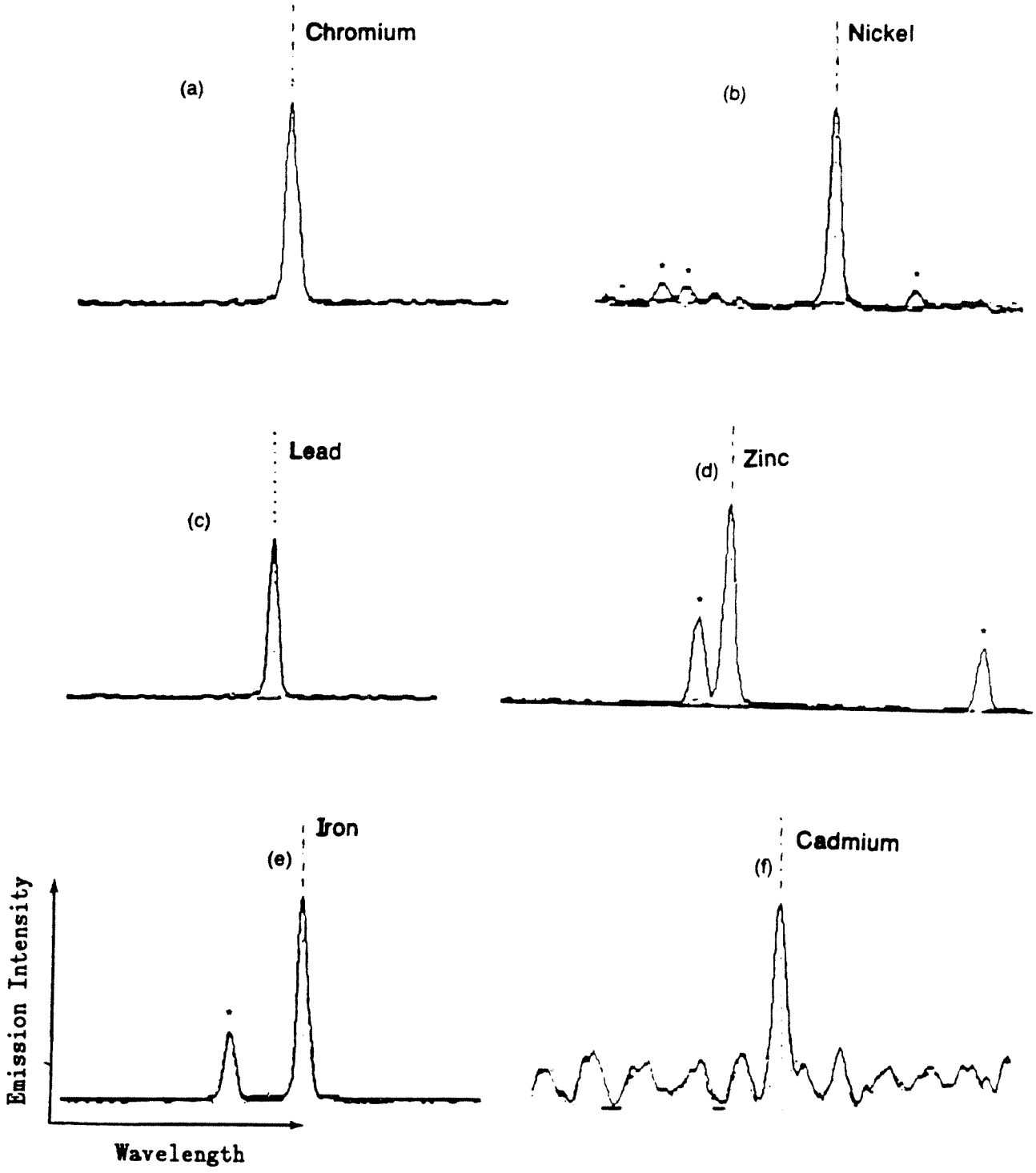


Figure 6. Typical inductively coupled plasma (ICP) spectra of heavy metals measured in soil samples from the machine storage area.
Metal, wavelength: (a) chromium, 205.552 nm; (b) nickel, 231.604 nm; (c) lead, 220.353; (d) zinc, 206.200 nm; (e) iron, 259.940 nm; and (f) cadmium, 214.438 nm. Other noninterfering metals (*).

the leachability of the metals under acidic conditions (pH about 5.0). The samples were treated with acetic acid, overnight in a rotary extractor. These analyses were carried out by Encotec, Inc., Ann Arbor, MI.

RESULTS

Contaminant Distribution in the Surface Material

The sampling grid for surface material is shown in Figure 2. This figure indicates two areas of interest: the storage yard and the area on the east side of the yard where machinery was less frequently stored. The area of primary interest is the storage yard. To identify any point on this grid, the x-(west-east) and y-(south-north) coordinates will be used, starting from the origin at the southwest corner of the site. For example, a surface sample taken 100 feet east and 400 feet north of the origin, will be labeled location (100, 400). The soil was sampled from the surface to a depth of 12 inches, and a homogenized subsample was analyzed for hydrocarbons, heavy metals, and PCBs.

Total Hydrocarbons: The total hydrocarbon concentrations in mg per kg of surface soil are shown in Figure 7 for 27 sampling locations within the storage yard and for 15 locations outside the yard. The concentrations of total hydrocarbons ranged from below the detection limit of 50 mg/kg to 14000 mg/kg. The area with the highest hydrocarbon concentration was in a central zone (shown as a hatched area in Figure 7) of the storage yard. In addition, seven locations outside the central zone, including five outside the storage yard to the east, had concentrations of hydrocarbons greater than 1000 mg/kg. Locations surrounding the central zone mostly had hydrocarbon levels of less than 300 mg/kg.

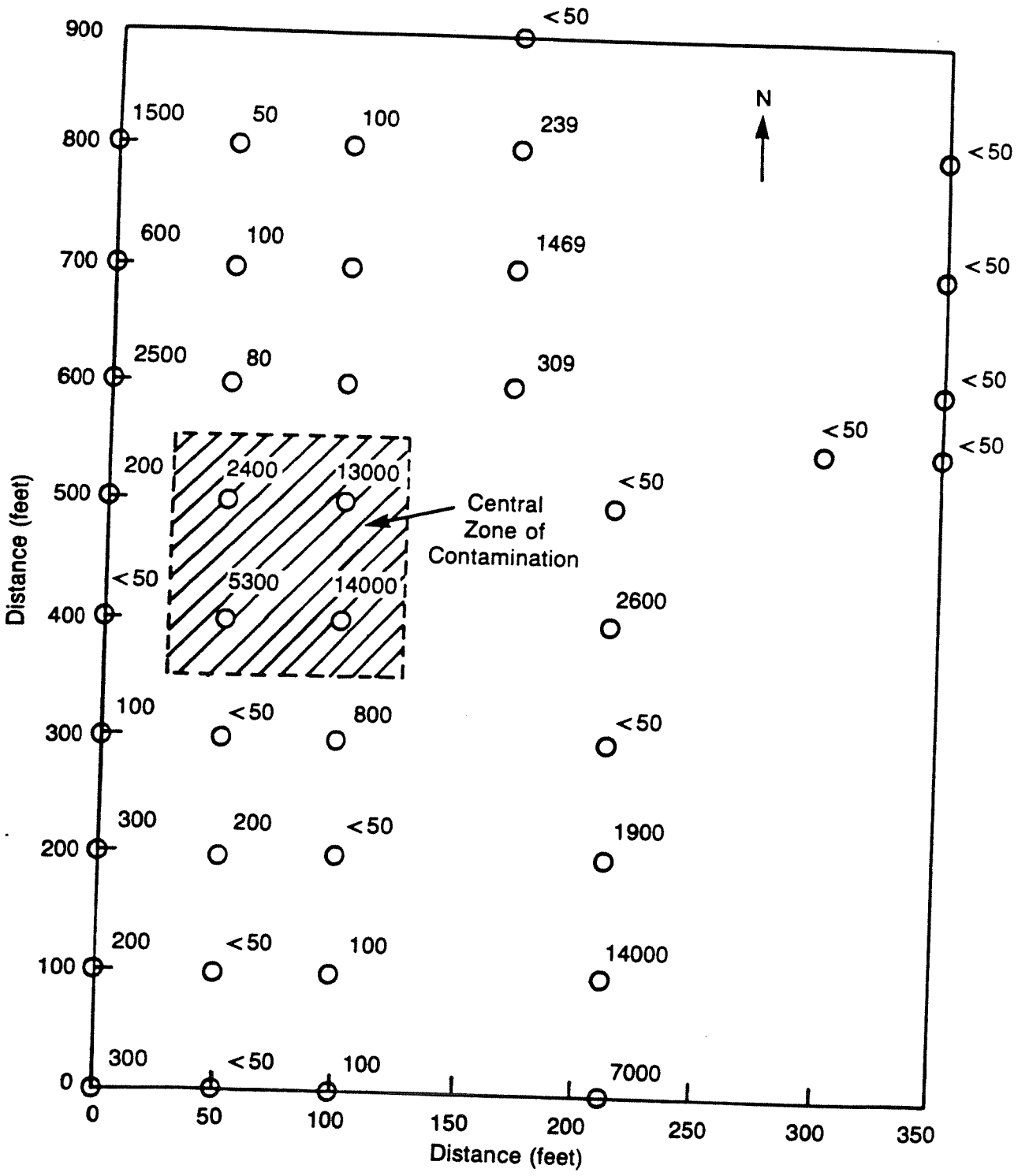


Figure 7. Concentrations of total hydrocarbons (mg/kg of soil) in surface samples from the machine storage yard. Sampling locations (○).

Heavy Metals: Figures 8 through 13 show the concentrations of individual metals in mg per kg of surface soil at 27 locations within the yard and 6 locations outside the yard. Chromium concentrations in the samples ranged from 1.5 to 74 mg/kg, nickel from 2.2 to 34 mg/kg, lead from 2.1 to 210 mg/kg, zinc from 10 to 140 mg/kg, iron from 2800 to 34000 mg/kg, and cadmium from <1 to 5.6 mg/kg. Chromium, nickel, lead, cadmiun, iron, and zinc were all found in highest concentrations in the central zone of the storage area. Concentrations about 4-20 times less than these maximum levels were found at most locations in the peripheral regions. The significance of these levels in relation to background soil concentrations will be discussed in a subsequent section.

Polychlorinated Biphenyls (PCBs): Samples from 27 surface locations in the storage yard and 6 locations outside the yard to the east were analyzed for PCBs. PCBs were found in low concentrations (4 mg/kg or less) at 4 locations in the storage yard and 2 outside (Figure 14). Again the higher concentrations were clustered in the central zone of the yard, where hydrocarbons and metals were also highest.

Contaminant Distribution in the Unsaturated Zone

Since hydrocarbons, heavy metals, and PCBs were found in surface samples, the second phase of investigation was implemented. The main objective of phase 2 was to delineate the vertical spread of contaminants beneath the upper 12 inches of surface material through the unsaturated zone toward the water table. The locations for sampling in the second phase were selected on the basis of the previously determined distribution of contaminants in the surface material. Eleven soil cores were taken

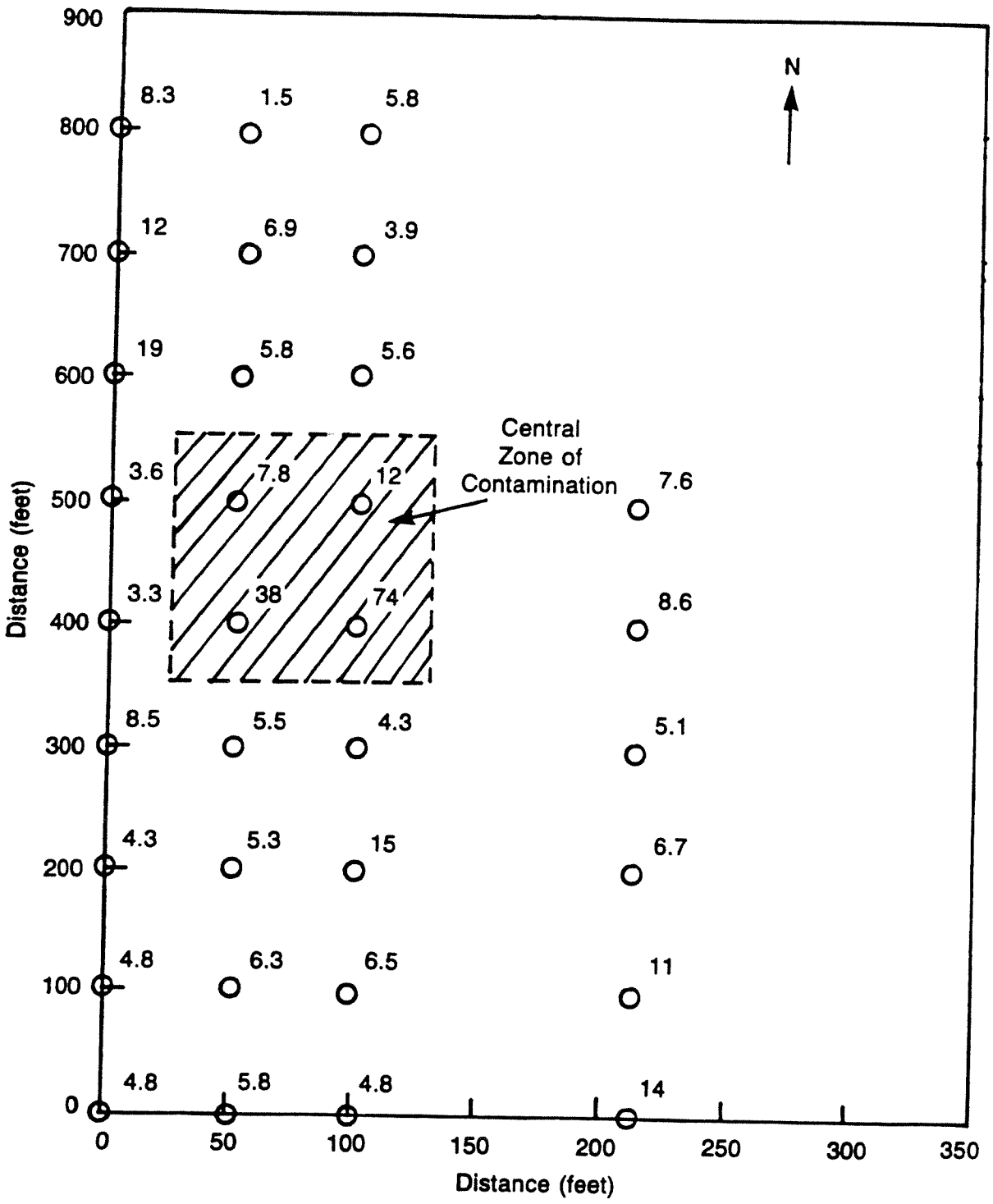


Figure 8. Concentrations of chromium (mg/kg) in surface samples. Sampling locations (○).

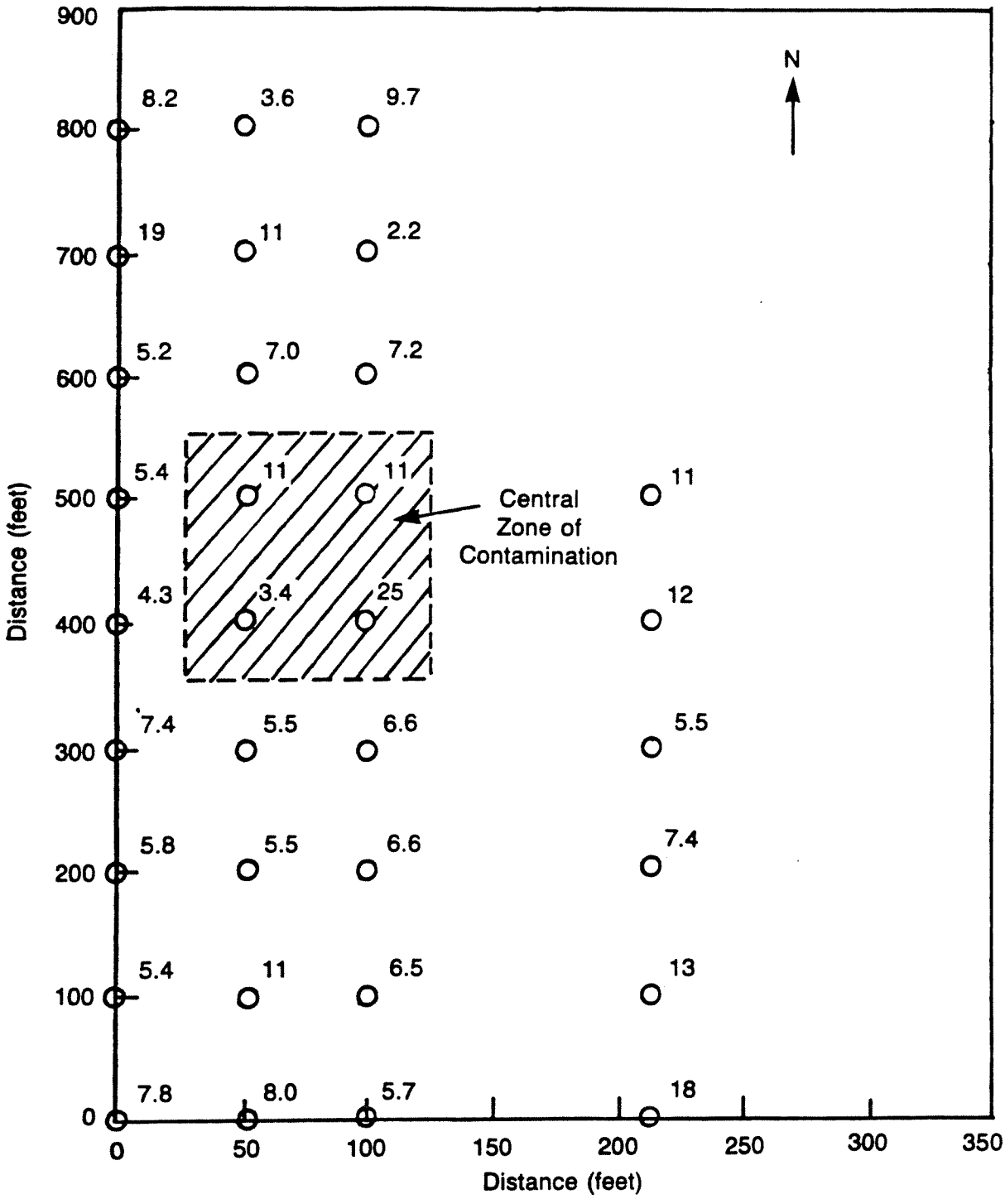


Figure 9. Concentrations of nickel (mg/kg) in surface samples. Sampling locations (○).

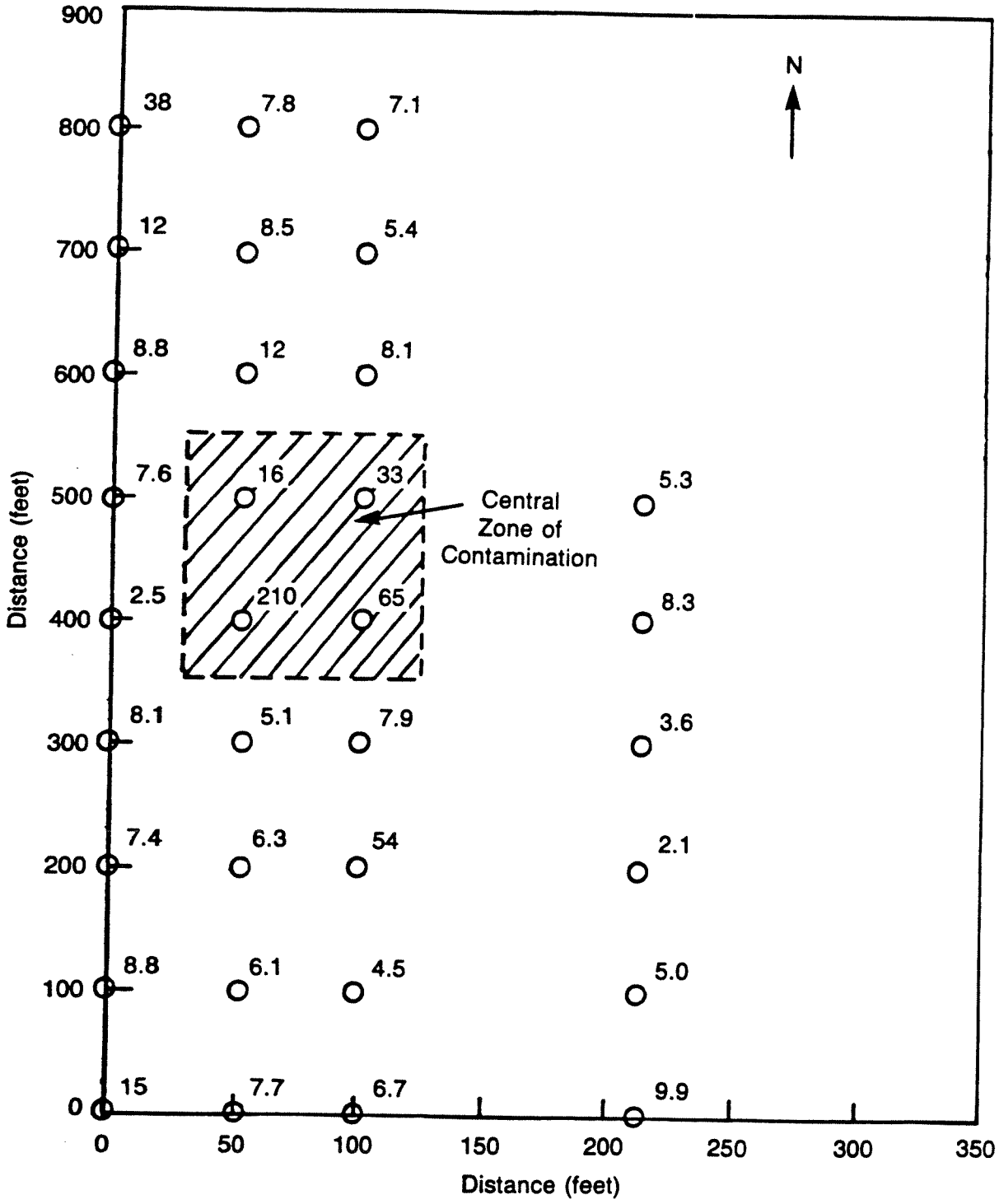


Figure 10. Concentrations of lead (mg/kg) in surface samples. Sampling locations (O).

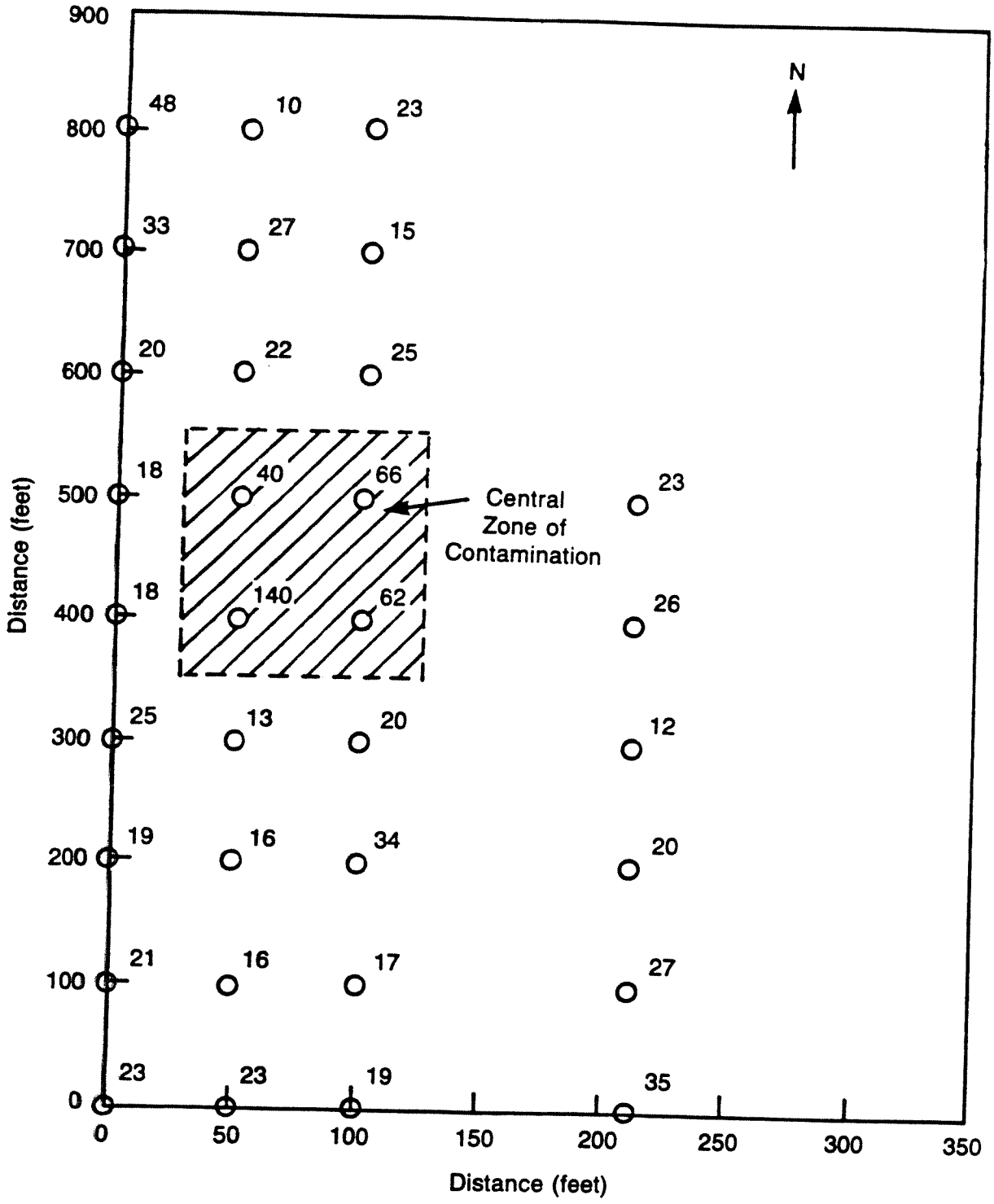


Figure 11. Concentrations of zinc (mg/kg) in surface samples. Sampling location (O).

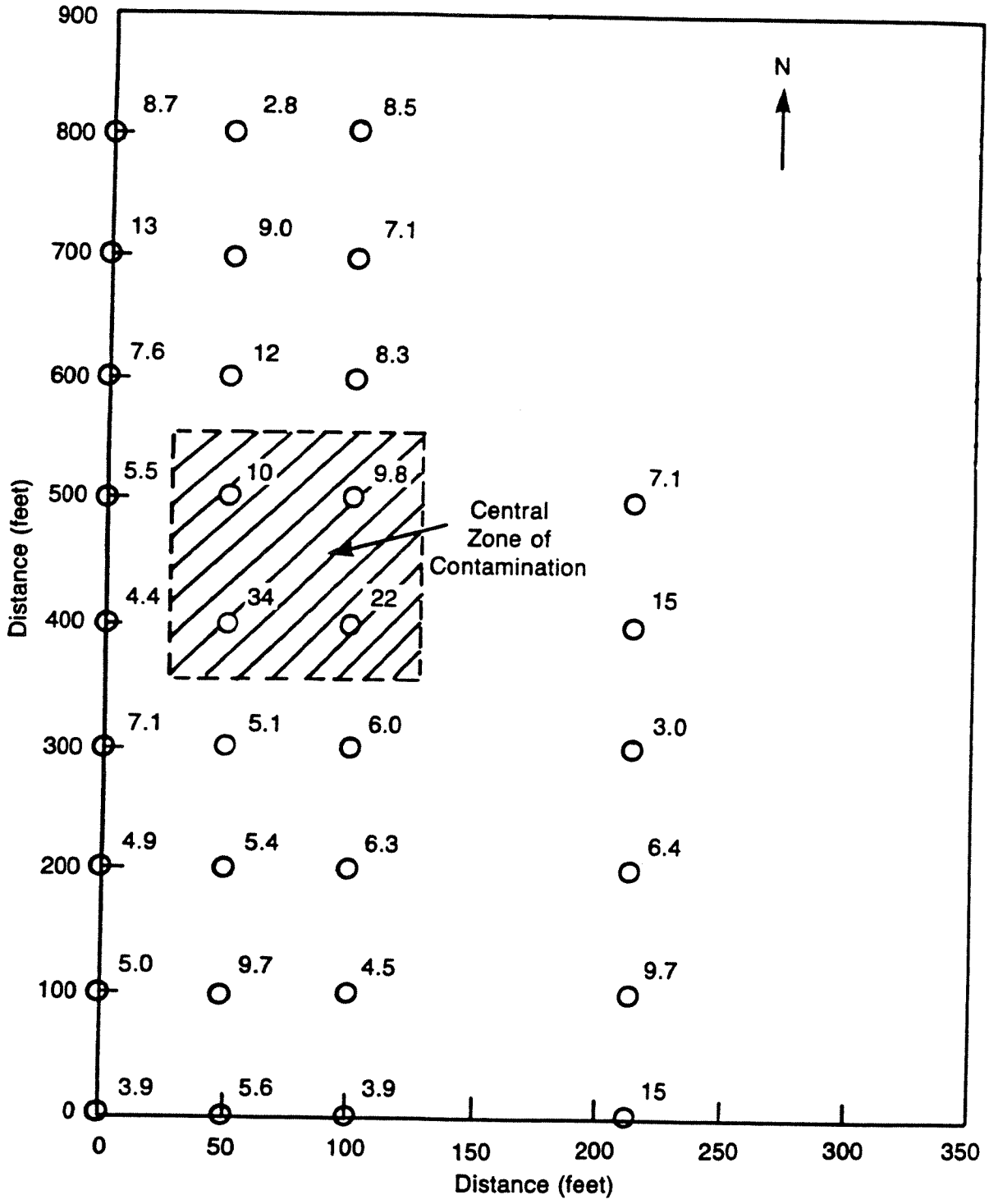


Figure 12. Concentrations of iron (mg/kg x 10^{-3}) in surface samples.

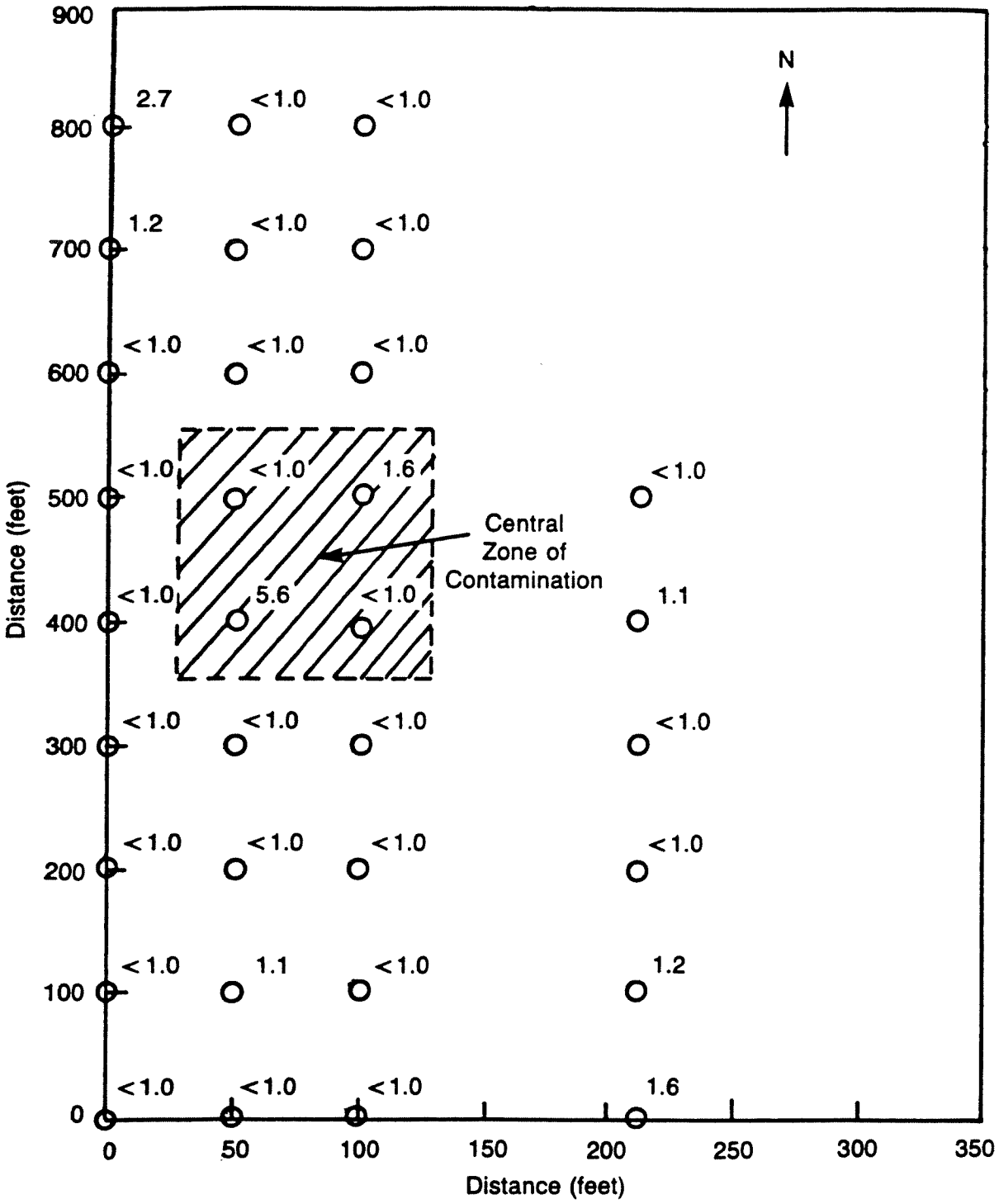


Figure 13. Concentrations of cadmium (mg/kg) in surface samples. Sampling locations (O).

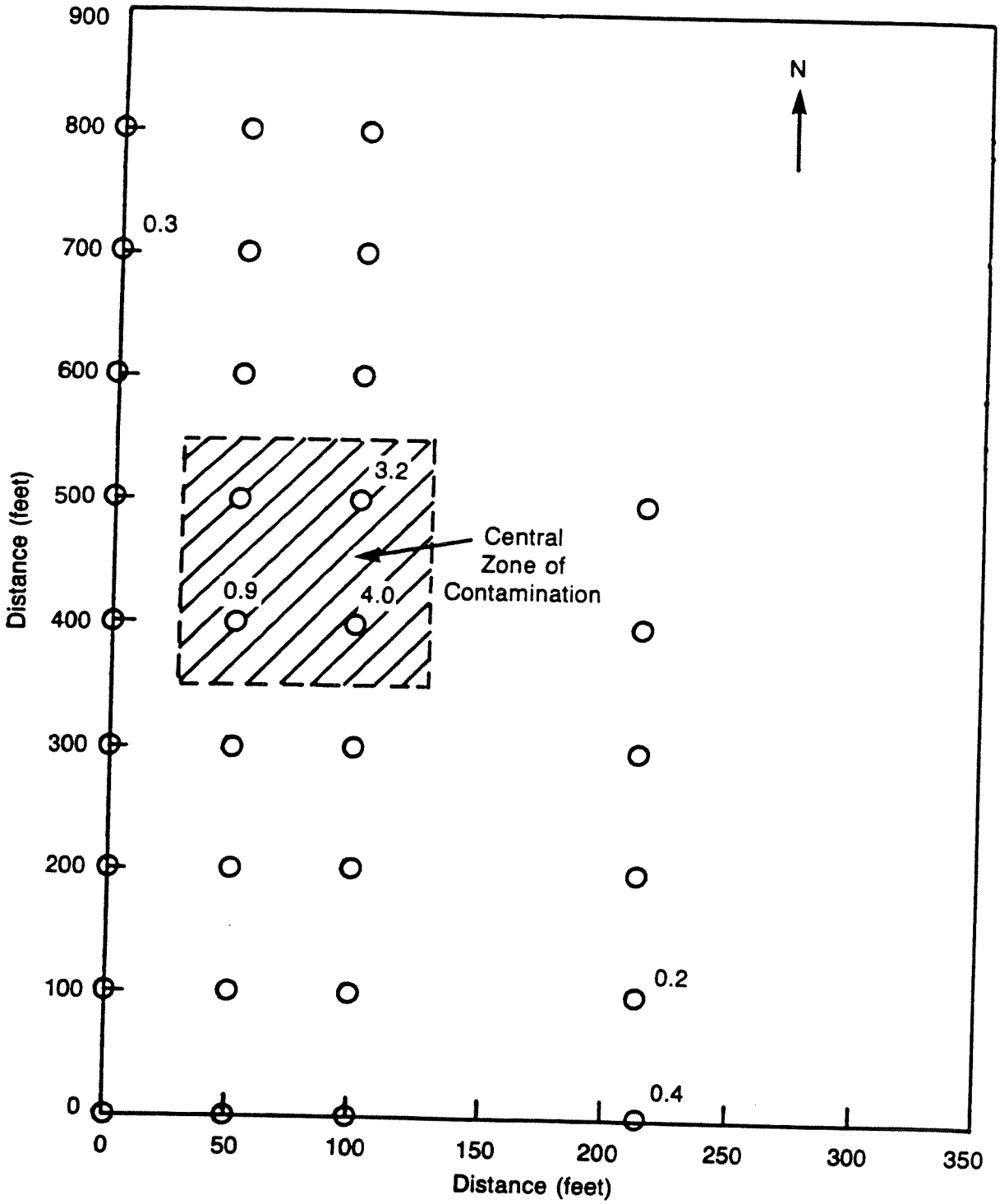


Figure 14. Concentrations of polychlorinated biphenyls (PCBs) (mg/kg) in the surface samples. The concentrations at the unlabeled sampling locations were less than the detection limit (0.2 mg/kg).

along two north-south cross-sections in the storage yard, while 10 soil cores were taken outside the yard (see Figure 15) Typically, the soil cores were taken from a depth of 1 to 4 feet using the GMR soil sampler.

Each subsurface soil core was collected in a 1.75-inch ID aluminum tube, which was then sealed at each end and taken to the laboratory for careful study. There, the tubes were split lengthwise to expose the soil core, which was examined and divided into 5-inch sections. Visual soil characteristics were recorded, and each section was extracted with Freon to determine the concentration of Freon-extractable organics. Two cores from the central zone (*locations in Figure 15) were also analyzed for metals and PCBs.

Freon Extractables: The results for Freon extractables along two north-south sections (A and B) within the storage yard and one north-south section outside the yard (C) are shown in Figure 16. The concentrations of Freon extractables range from less than 50 mg/kg to about 4000 mg/kg of soil. The vertical spread of measureable Freon extractables (>50 mg/kg) was confined to the upper 22 inches of the subsurface. The maximum concentration was found in a soil sample at a depth from 12 to 17 inches at one of the locations (75, 350) adjacent to a surface location (100, 400) with the highest total hydrocarbon level (14,000 mg/kg).

Heavy Metals: To determine the vertical spread of metals at the site, chromium, lead, nickel, cadmium, iron, and zinc were measured in soil cores at locations (75, 350) and (75, 450) in the central zone where the highest levels of surface contamination were found. The results from both locations are similar. Figure 17 shows the concentrations of chromimum, lead, nickel, and zinc at various depths of location (75, 450). The

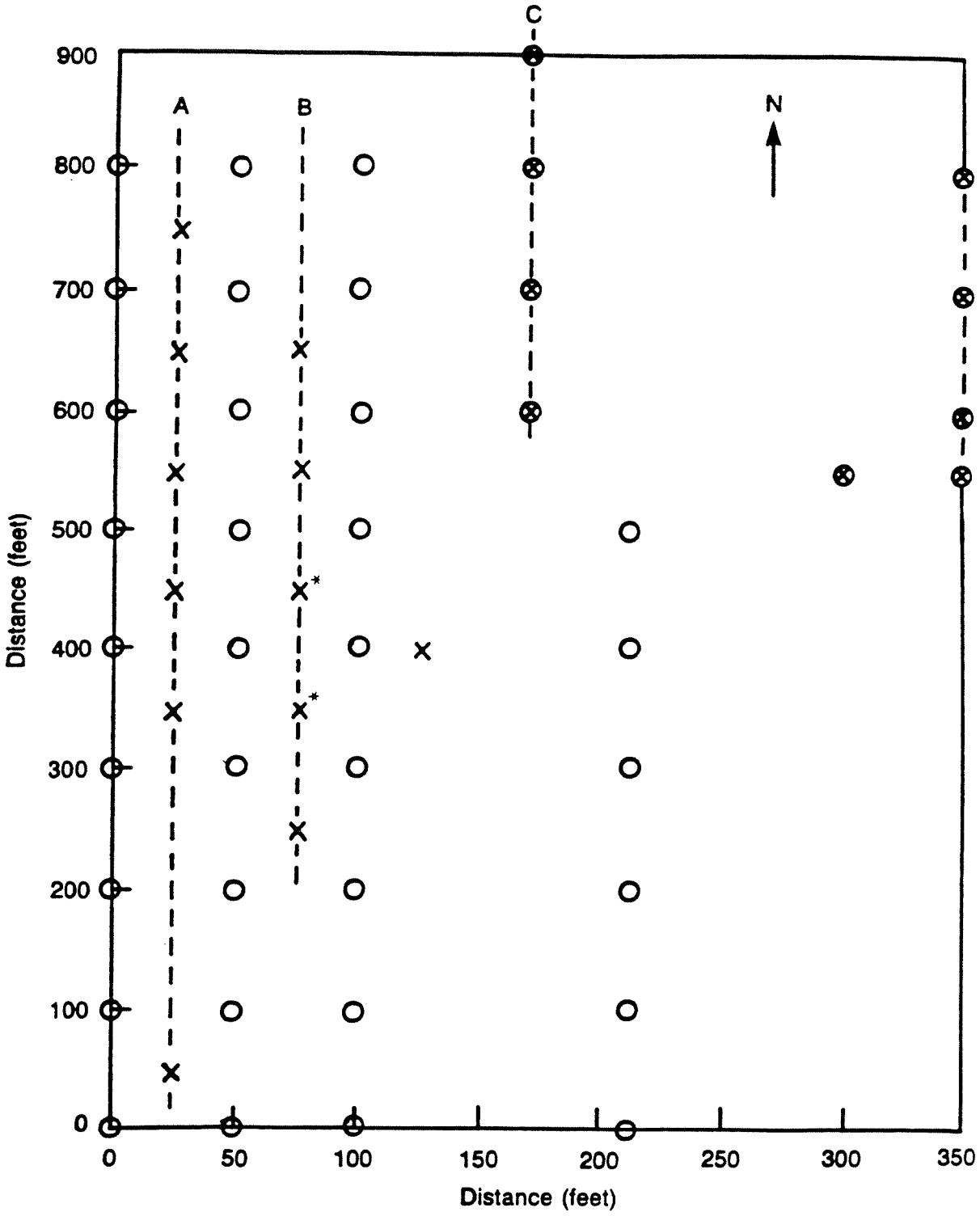


Figure 15. Phase 2 coring locations (X) used to investigate the subsurface zone (GMR soil core sampler). North-south cross-sections; A, B, C. Two coring locations for vertical distributions of metals, PCBs, and particle sizes (*).

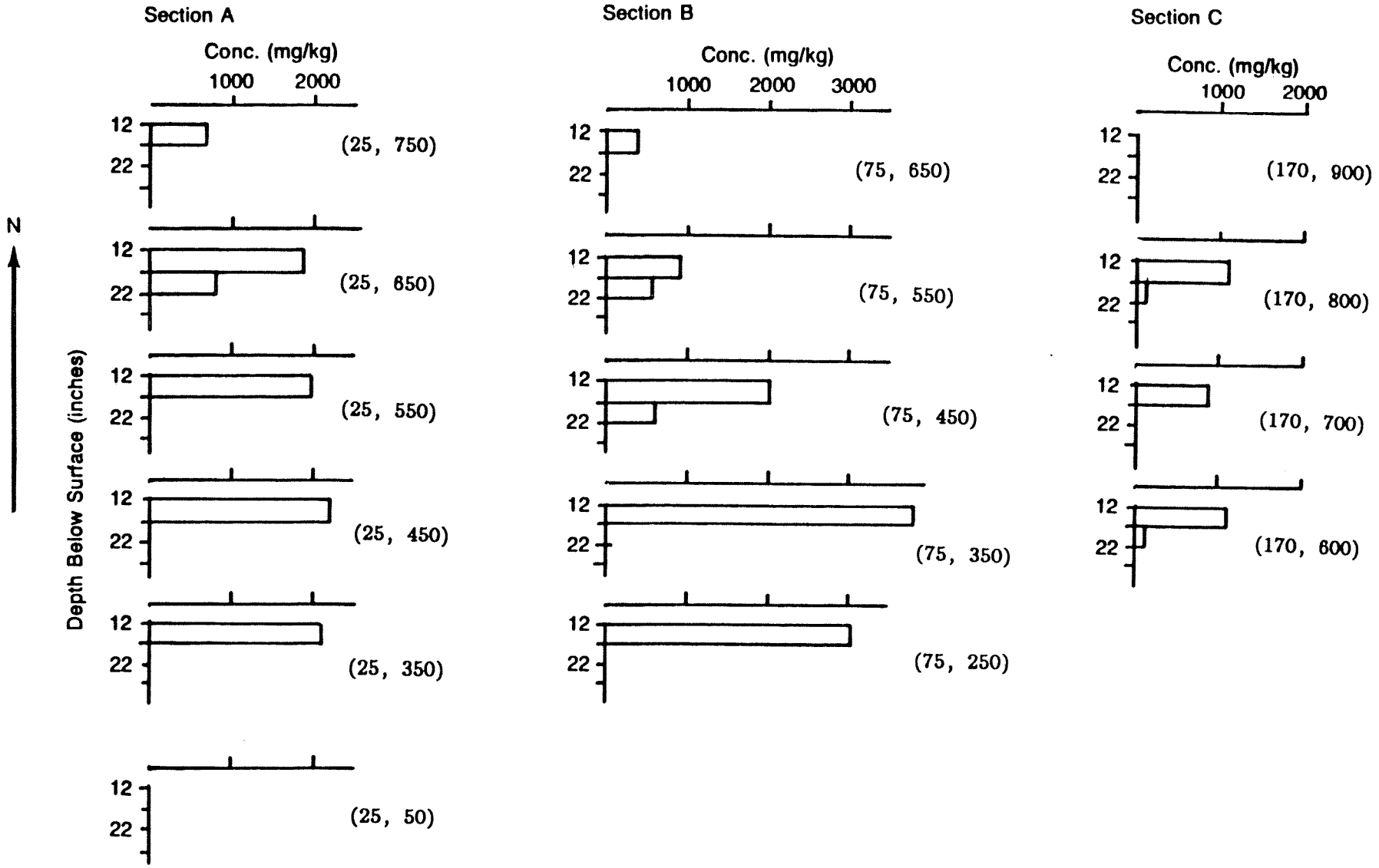


Figure 16. The vertical distribution of Freon extractables in the subsurface zone. Each bar graph corresponds to a soil core from one of the locations on north-south cross-sections shown in the previous figure. Coordinates are given in feet from the SW corner of the yard. The concentrations were measured in 5-in. core segments.

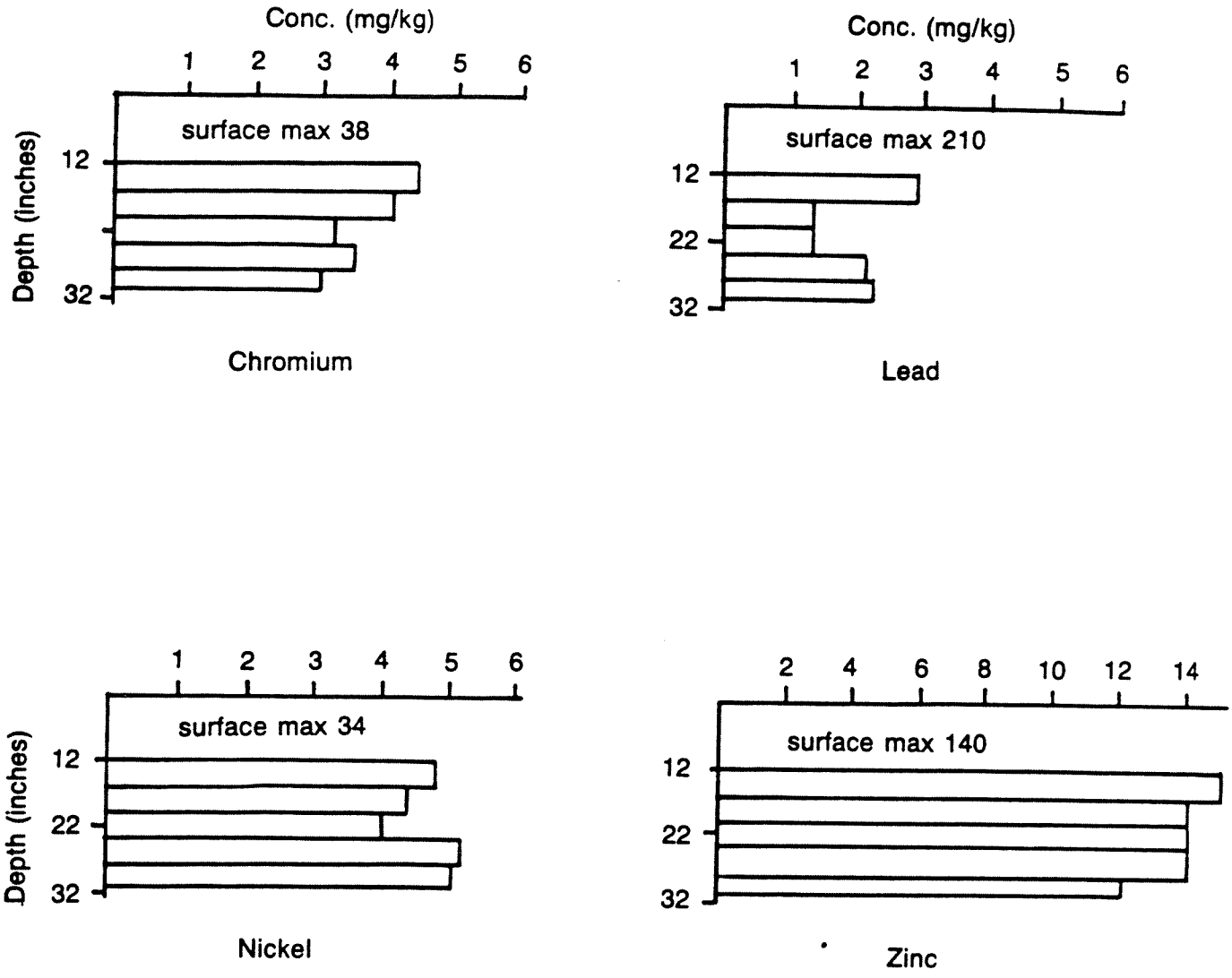


Figure 17. The vertical distribution of heavy metals in the subsurface zone at coring location (75,450).

results show that the concentrations below a depth of 12 inches are always much less than the adjacent surface concentrations. Moreover, the vertical profiles show only slight changes from depths of 1 to 4 feet, suggesting that the concentrations may be background. The results for cadimum and iron are similar to those for the other four metals.

Polychlorinated Biphenyls (PCBs): The two soil cores analyzed for metals were also analyzed for PCBs. PCBs could not be detected (<0.2 mg/kg) in any of the samples taken from below the surface (12 inches).

Vapor Phase Organics

No volatile organic compounds (VOCs) were detected by the portable photoionization detector. Samples of soil from the surface to a depth of 4 feet were tested during the surface sampling and coring investigation.

Site Characterization

The site material was first characterized by visual inspection of the surface soil samples and subsurface soil cores. Several distinct subsurface soil layers were observed in all regions of the machine storage area with only minor variations in their depth and thickness. Like the other areas at the plant, the shallow subsurface material at the site consisted mainly of sand and some gravel with less than 1% of clay and silt. The upper 12 inches of surface material in the storage yard was coarse sand, gravel and stones. However, areas outside the yard are typically covered with grass and have natural soil.

The particle size distribution of subsurface materials from locations (75, 350) and (75, 450) at the storage yard was investigated more precisely by fractionating soil core samples from various depths. The masses of

seven size fractions (>1000, 1000-500, 500-250, 250-125, 125-90, 90-53, and 53-0 μm) were determined by first sieving a section of soil core through a series of standard size steel meshes and then weighing each size fraction. Although the core segments contained varying distributions of particle sizes, the subsurface material was predominantly fine and medium sand with considerable gravel mainly near the surface. The results from the two cores are similar; therefore, two typical particle size distributions in core segments from location (75, 450) are shown in Figure 18: (A) material nearest the surface containing substantial amounts of fine gravel and (B) sandy material from a depth below 2 feet. The mean particle size of the sandy material was typically about 200 μm.

The hydraulic conductivity of water through two soil samples from the lower region of the unsaturated zone was measured in the laboratory by the falling head method (Freeze and Cherry, 1979). In these measurements, about 50 g of soil was added to a glass column that was fitted at the base with a fritted-glass plate and connected at the top to an upright burette. While water from the burette flowed through the sand, the change in water head in the burette and the flow rate were measured. The saturated hydraulic conductivity (k_s) was calculated by using Equation (1) (Freeze and Cherry, 1979):

$$k_s = (aL/A\delta t)\ln(h_i/h_t) \qquad (1)$$

where, L is the thickness of the soil column, δt is the time interval, h_i is initial head of fluid in the burette, h_t is the head of fluid in the burette after time δt, and a and A are the cross-sectional areas of the burette and soil column, respectively. From these tests the average saturated hydraulic conductivity of the soil to water was 5×10^{-3} cm/sec.

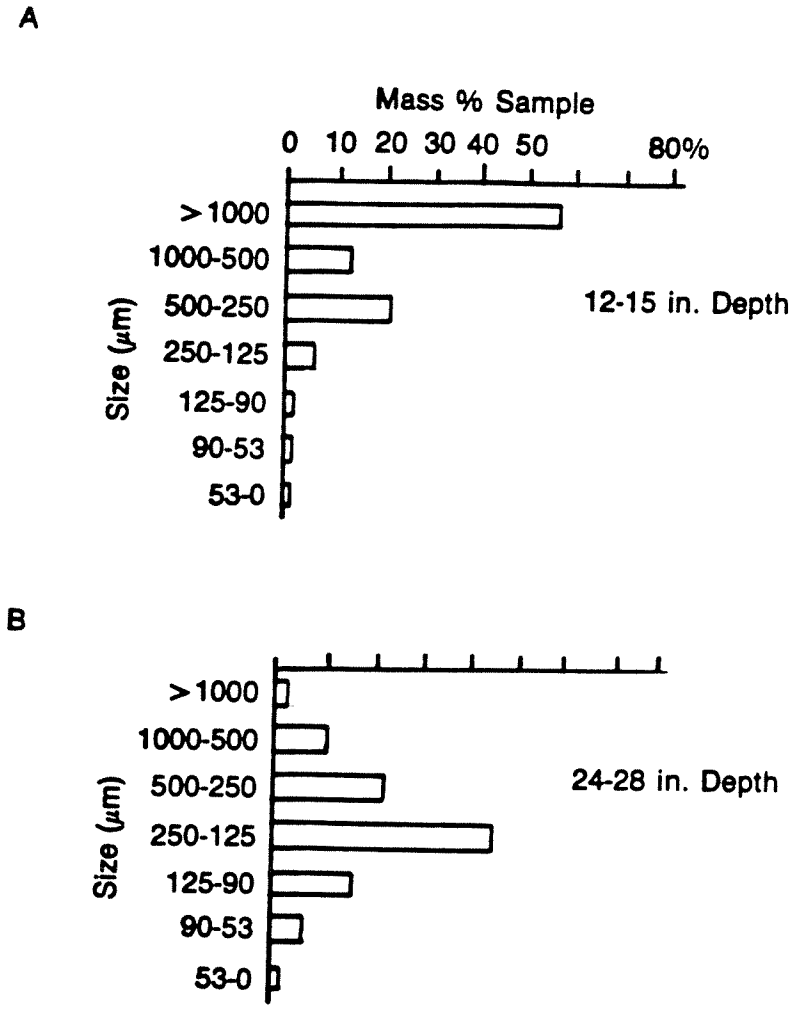


Figure 18. Particle size distribution in subsurface samples from the machine storage yard at coring location (75, 450). (A) The sample nearest the surface zone, containing fine gravel. (B) Fine-medium sand most typical of the subsurface material.

The organic carbon content of a sample of sandy material from the deeper region of the unsaturated zone was measured using a carbon analyser (Abdul et al, 1987) and was approximately 0.5 percent.

DISCUSSION

Based on the distributions and concentrations of contaminants measured at the site, it was possible to assess the situation and to determine what clean-up steps were needed, if any.

Polychlorinated Biphenyls (PCBs): Of 27 sampling locations in the storage yard and 6 outside the yard, PCBs were detected at only six locations. The total PCB levels ranged from undetectable to 4 mg/kg and exceeded 1 mg/kg at only two locations, both being in the certral zone of the storage yard. At this time, there are no regulations which apply directly to low level soil contamination by small oil leaks over a long period. Federal spill cleanup policy (Federal Register, 1987) applies only to spills of oils with more than 50 ppm PCBs, occurring after 1987. However, the concentrations of PCBs found at the time of the site investigation can at least be compared to the levels that the policy requires after site cleanup. The machine storage yard represented a fenced, restricted access area. According to the policy, when a spill has occurred in a restricted-access area, it is necessary to clean the contaminated plot to a soil PCB concentration of 25 ppm (mg/kg) by weight. The stricter requirements for decontaminating spills in nonrestricted-access areas would also not remove PCBs to the 4 ppm (mg/kg) level. At such places, contaminated soil should be decontaminated to 10 ppm (mg/kg)

PCBs by weight. At the machine storage yard the levels of PCBs are less than the levels to be left behind after cleanup of either the restricted or nonrestricted areas.

Moreover, the low level PCBs, if left in place at the storage site could not migrate through the unsaturated zone to the underlying perched water table (below a depth of 6 feet). The migaration of PCBs, due to leaching by rainfall, through soils is retarded by the strong adsorption of PCBs on soil particles. Adsorption is determined by the K_d, i.e. the adsorption coefficients of the compounds. K_d defines the concentration of contaminant in water (C_w) in equilibrium with contaminant adsorbed on soil (C_s) according to equation 2.

$$C_s = K_d \times C_w \qquad (2)$$

The value of K_d can be estimated from the octanol-water partition coefficient (Kow) and the organic carbon content of the soil (Foc) using equations 3 and 4 (Abdul et al., 1987).

$$K_d = Foc \times Koc \qquad (3)$$

$$\log Koc = 1.04 \log Kow - 0.88 \qquad (4)$$

For the machine storage site, where the Foc of the surface material is about 0.5% and for PCBs whose Kow is about 4×10^5, a value of $K_d = 442$ was calculated. Based on this value of K_d, infiltrating water in equilibrium with surface soil having 4 mg/kg PCBs could remove an aqueous concentration of just 9.0×10^{-3} mg/L. As soon as these dissolved PCBs contacted clean soil, however, perhaps one centimeter deeper, the aqueous concentration of

9.0×10^{-3} mg/L would be reduced to 20.5×10^{-6} mg/L at equilibrium, according to the same equations. Thus, water percolating down from the contaminated surface soil would be readily cleansed when it had migrated a very short distance.

Heavy Metals: The mobility of metals through soils is dependent on the cation exchange capacity (CEC) of the soil. The CEC is defined as the quantity of exchangeable cations in milliequivalents per 100 g of soil that can adsorb on the negatively charged particles (clay minerals). Typically in the approximately neutral environment of surface soils at the site (pH 6-7), where the CEC is expected to range from 5 to 10 meq/100 g of soil, the mobility of metals is insignificant (Abdul et al., 1988b; Grimshaw, 1971). The cation exchange of metals, including chromium, nickel, lead, cadimum, iron, and zinc, with soil cations such as Ca^{+2} and Mg^{+2} can explain why they were contained in the thin upper layer above 12 inches at the contaminated site. Table 1 summarizes the results of measuring these six metals at the machine storage yard in the surface and subsurface layers and compares their concentrations with average background values found in Michigan (MDNR, 1988), and in Pennsylvania and Tennessee (EPRI, 1986). From a comparison of the results at the site with the reference values, it apppears that the subsurface concentrations of these metals represented background levels, and even the surface concentrations exceeded the reference ranges only for lead, cadmium and perhaps zinc.

The results of measurements of heavy metals in the leachate from the most contaminated surface soil (EP Toxicity test) are given in Table 2. These results indicate that none of the six metals in the surface soil was leached under the conditions of the test, which uses acetic acid to lower the pH to 5. Thus, the influx of even acid precipitation could not cause

Table 1. Heavy metal concentrations in soils from the machine storage area and typical background averages.

Metal	Storage Yard Maximum conc.[1] Surface (mg/kg soil)	Subsurf. (mg/kg soil)	Michigan avg.[2] Sand (mg/kg soil)	Clay (mg/kg soil)	Pennsylvania[3] Soils (mg/kg soil)	Tennessee[3] Soils (mg/kg soil)
Chromium	74	5.7	3-4	9-25	66-100	26-74
Nickel	34	5.2	3-10	25-34	25-45	6-17
Lead	210	2.9	9-14	13-23	25-32	5-19
Zinc	140	16	--	41-51	81-115	25-168
Iron	34000	5000	--	--	37000-56000	13000-47000
Cadmium	5.6	<1	1-1.4	1-1.6	--	--

[1]Total metal concentration in soil sample measured by the inductively coupled plasma method after nitric acid digestion.

[2]MDNR (1988).

[3]EPRI (1986).

Table 2. Metal leaching measurements for the most contaminated surface soil at the machine storage yard.

Metal	Concentration (mg/kg) Soil sample locations[1] (50, 400)	(100, 400)	(200, 100)	RCRA[2] stds	Drinking[3] water stds
Chromium	<0.03	<0.03	<0.03	5.0	0.05
Nickel	<0.05	0.07	<0.05	--	--
Lead	0.05	0.06	<0.02	5.0	0.05
Zinc	0.08	0.25	0.02	500	5.0
Iron	4.1	5.5	0.33	--	--
Cadmium	0.01	0.01	<0.005	1.0	0.01

[1]Metal concentration in leachate after overnight extraction (pH 5) following the EP Tox Test, RCRA Method 1310 (USEPA, 1986).

[2]Title 40, CFR, Sec. 261.24.; MDNR (1985).

[3]Title 40, CFR, Sec. 141 and 143.

significant migration of the metals. Further, the concentrations of the metals in the acidic leachate were within the RCRA and Federal Drinking Water Standards. Based on these results, like those for PCBs, there was no need for site remediation due to contamination by metals.

Total Hydrocarbons - Freon Extractables: When oily hydrocarbon mixtures, such as the Freon extractable material or total hydrocarbons measured at the machine storage yard, drain through soils, they leave behind a residual fraction trapped in the pore spaces between soil grains. The residual oil is not continuous and cannot migrate under the influence of gravity (Abdul, 1988). This residual fraction could occupy about 22% of the pore volume as determined by laboratory measurements on the soil at the Hydra-matic site. A residual oil volume of 22% is equivalent to 50,000 mg of oil per kg of soil (57 mL oil/kg of soil). Even this relatively low, immobile concentration of oil is much higher than the levels found in the surface soil at the most contaminated locations in the storage yard. The maximum concentration of total hydrocarbon found at the site (at location 100, 400) was only 14,000 mg/kg of soil. This level of contamination is equivalent to 5.8% saturation of the pore spaces. As an example, based on similar theoretical considerations, it would take about 11,000 gallons of oil to fill the residual volume of a soil layer 200 ft by 100 ft by 1 ft. Since the surface layer (1 ft) had much less oil than that required for residual saturation, the results suggested that there had never been a massive spill of oils to form a surface pool to cause significant migration through the unsaturated zone. Instead, the minor drips and spills from the disused machinery could not saturate the surface region in the yard. The lower levels of hydrocarbon contamination (about 200 mg/kg) typical of much of the yard were equivalent to less than 0.1% pore saturation and would be

even less able to migrate under the influence of processes such as rainwater percolation.

No evidence of contamination by volatile organic compounds (VOCs) was found during coring at the machine storage yard and regions outside the yard when the surface and subsurface soil were tested using a portable photoionization detector, able to detect <1 ppm organic vapor in air. Since residual VOCs were not found in the soil, easily dissolved and vaporized organic contaminants such as gasoline were unlikely to have been present. The absence of both volatile and oily contaminants in the lower subsurface zone further demonstrated that contamination did not spread in any form beyond the upper 22 inches of the site.

CONCLUDING REMARKS

Because of the low concentrations and limited vertical migration of the contaminants, and their insignificant potential for future migration, the site could have been left in its then current state. However, Hydramatic plant management decided to excavate the surface soil in PCB-containing areas, prior to grading the site. With the agreement of the Michigan Department of Natural Resources, an area of about 27,000 ft^2 including the central zone of higher contaminant concentrations in the storage yard, was excavated to a depth of 2 ft (Figure 19). Another more lightly affected area, about 5,000 ft^2, was excavated to 1 ft. The excavated soil, about 60,000 ft^3, disposed of as nonhazardous waste, represented only a small part of the surface and subsurface material in the machine storage area. If the same areas had been excavated down to the water table, at a depth of six feet, about four times as much soil would have been involved. The limited extent of the actual excavation was

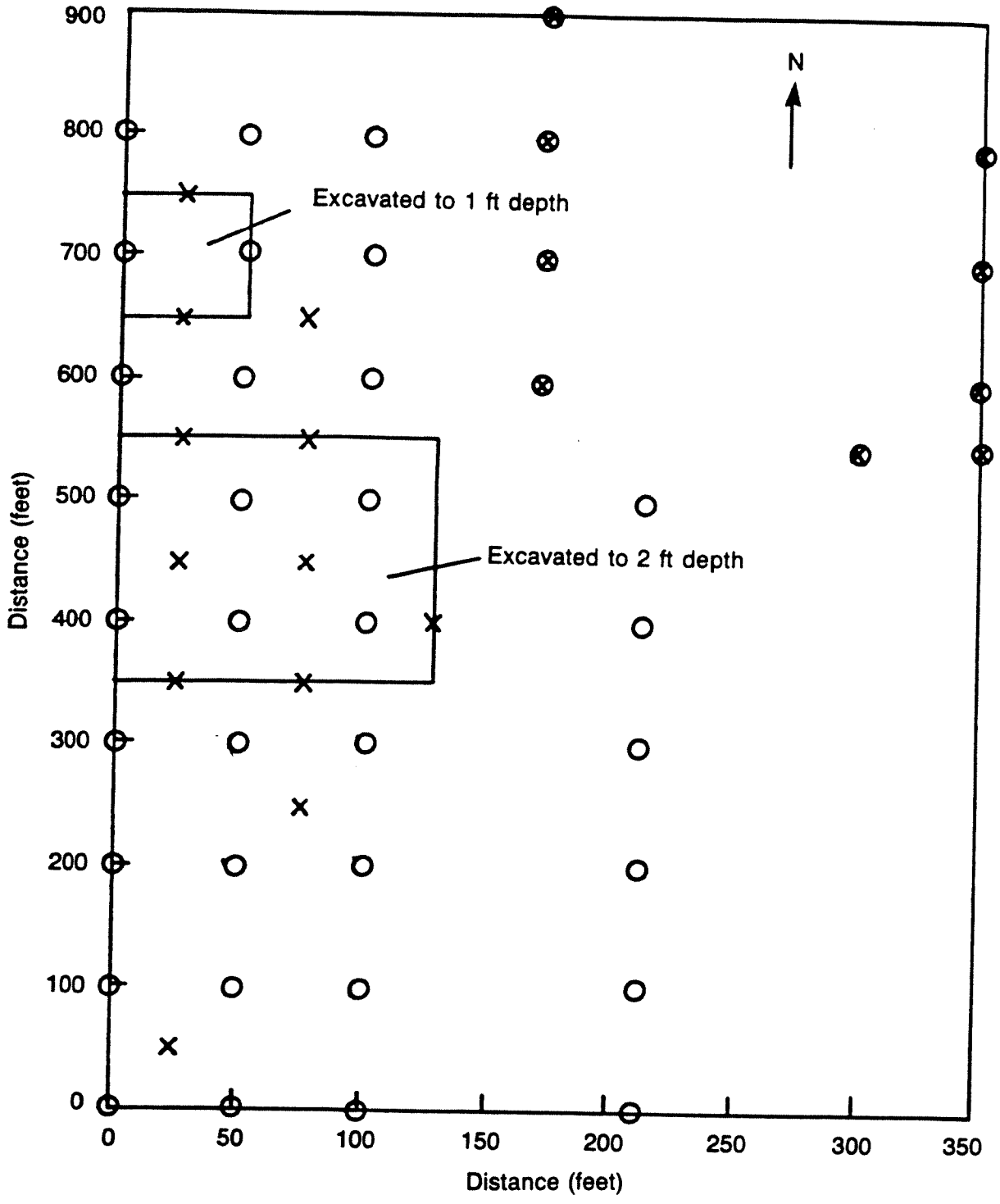


Figure 19. Areas excavated at the machine storage yard (1988).

possible only because of the precise delineation of the shallow contaminated zone demonstrated by the phased soil-coring investigation at the site.

Using the wrong methods of investigation could have overestimated the soil contamination. The standard device, most commonly used to sample subsurface material, is the split spoon sampler. In field tests of the GMR sampler and split spoon sampler at the storage yard, the GMR sampler showed contamination only in the upper portion of the soil core down to a depth of 22 inches, but the split spoon sampler showed cross-contamination by surface material in samples taken as deep as 6 feet (Gibson and Abdul, 1989). Thus, the contamination would have appeared to extend much deeper based on erroneous results if the split-spoon method had been used to investigate the unsaturated zone at this site.

REFERENCES

Abdul, A.S., Migration of Petroleum Products Through Sandy Hydrogeologic Systems, Ground Water Monitoring Review 8(4), 1988.

Abdul, A.S. and Gibson, T.L., Adsorption-Desorption of Polycyclic Aromatic Hydrocarbons by Two Hydrogeologic Materials, Hazardous Waste and Hazardous Materials, 3(2), 125-138, 1986.

Abdul, A.S., Gibson, T.L., and Rai, D.N., Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water, Hazardous Waste and Hazardous Materials, 4(3), 211, 1987.

Abdul, A.S., Gibson, T.L., and Kia, S.F., Contamination of Soil and Groundwater by Automatic Transmission Fluid: Site Description and Problem Assessment, GM Research Publication GMR-6540, 1988a.

Abdul, A.S., Gibson, T.L., and Rai, D.N., Laboratory Studies of the Flow of Some Organic Solvents and Their Aqueous Solutions Through Bentonite and Kaolin Clays, in submittal to Ground Water, 1988b.

ASTM D 1586-84, Standard Method for Penetration Test and Split-Barrel Sampling of Soils, Annual Book of ASTM Standards, Vol. 04.08, pp. 216-219, 1988.

USEPA, Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, 1979.

USEPA, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, November 1986.

EPRI, Physiochemical Measurements of Soil at Solid-Waste Disposal Sites, EPRI EA-4417, Project 2485-3, Final Report, 1986.

Federal Register, PCB Spill Cleanup Policy, Vol. 52, No. 63, 1987.

Freeze, R.A. and Cherry, J.A., Groundwater, Prentice-Hall Inc., Englewood Cliffs, NJ, 1979.

Gibson, T.L. and Abdul, A.S., The Design and Testing of a Device to Take Soil Cores from Shallow Unsaturated Zones, report in review, 1989.

Grimshaw, R.W., The Chemistry and Physics of Clays, London, Ernest Benn LTD., London, 1971.

Michigan Department of Natural Resources, Hazardous Waste Management Rules, Section R299.9217, Table 201, December, 1985.

Michigan Department of Natural Resources, WMD/MDNR Draft Guidance, "How Clean is Clean?", May, 1988.

Standard Methods for the Examination of Water and Wastewater. 16th Edition, APHA., AWWA., WPCF, 1985.

Title 40, Code of Federal Regulations, Sections 141 and 143, Interim Primary Drinking Water Standards.

Title 40, Code of Federal Regulations, Section 261.24, RCRA Hazardous Waste Standards.