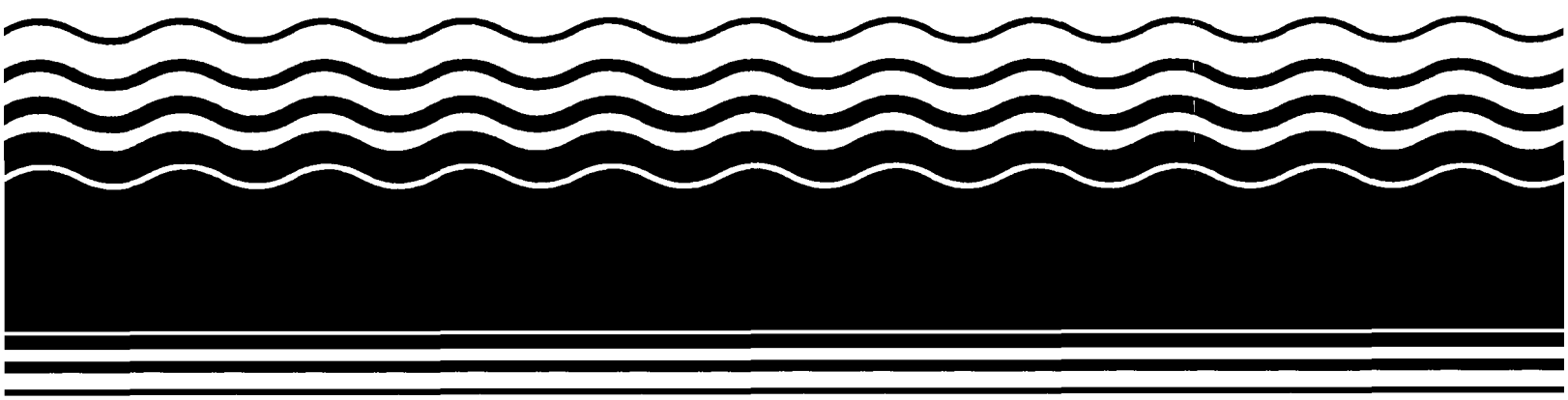
PB97-964102
EPA/541/R-97/029
November 1997

EPA Superfund Record of Decision:

Organic Chemicals, Inc.,
Operable Unit 2,
Grandville, MI
2/5/1997



RECORD OF DECISION

SELECTED REMEDIAL ALTERNATIVE
FOR THE
ORGANIC CHEMICALS, INC. SITE
GRANDVILLE, MICHIGAN

Statement of Basis and Purpose

This decision document presents the selected remedial action for the Organic Chemicals Inc., site in Grandville, Michigan, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The State of Michigan concurs with the selected remedy.

Assessment of the Site

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

Description of the Selected Remedy

This ROD addresses the second Operable Unit (OU), or discrete action at the Site. The first OU was an interim action to contain the contaminated groundwater plume. The second OU is the final action at the site and will address the low level (groundwater) and principal threats at the site (contaminated soil). The selected remedy consists of the following components:

- Continued operation and maintenance of the existing ground-water extraction system in the upper ground-water system to the USEPA Maximum Contaminant Limits at an Alternate Point of Compliance determined through institutional controls. Maintain the groundwater extraction and treatment system until the MCLs are attained throughout the contaminated plume.

- Excavation of approximately 6,000 cubic yards of contaminated soil and on-site remediation by solidification/stabilization.

Statutory Determinations

The two operable units, which deal with the contaminated soil, and contaminated ground water, are protective of human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and are cost-effective. However, because treatment of the principal threat of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principle element.

Because these remedies will result in hazardous substances on-site above health based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

State Concurrence

The State of Michigan concurs with the selected remedy. The Letter of Concurrence is attached to this Record of Decision.

Wm. E. Muno

William E. Muno
Division Director

2/5/97

Date

STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY

HOLLISTER BUILDING, PO BOX 30473, LANSING MI 48909-7973

INTERNET: http://www.deq.state.mi.us

RUSSELL J. HARDING, Director

January 17, 1997

RECEIVED
JAN 23 1997
SUPERFUND DIVISION
OFFICE OF THE DIRECT

Mr. William E. Muno, S-6J
Director, Superfund Division
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Dear Mr. Muno:

SUBJECT: Record of Decision (ROD) for the Organic Chemicals, Inc. (OCI) Superfund Site, Grandville, Michigan

The Michigan Department of Environmental Quality (MDEQ) is pleased to concur with the ROD for the OCI Superfund site.

Please provide a copy to the MDEQ once it has been signed. If you have any questions, please feel free to contact Mr. Ardon Toland, Chief, Superfund Section, Environmental Response Division, at 517-373-8815, or you may contact me.

Sincerely,

Russell J. Harding
Director
517-373-7917

cc: Mr. Valdas V. Adamkus, EPA
Mr. Alan J. Howard, MDEQ
Mr. Ardon Toland, MDEQ
Dr. George Carpenter, MDEQ
Mr. William Harmon, MDEQ

Decision Summary for the Record
of Decision
Organic Chemicals, Inc. Site
Grandville, Michigan

I. Site Name, Location, and Description

The Organic Chemicals Inc. (OCI) property is located at 3291 Chicago Drive, S.W., in the city of Grandville, Kent County, Michigan (the "Site"). The OCI property, approximately 5 acres, is fenced, with several buildings, structures, and storage tanks occupying the Site (Figures 1 and 2) which extends over several properties. The Chesapeake and Ohio Railroad, which runs southeast of the facility and along the north side of Chicago Drive, has an elevated railbed acting as a barrier to surface drainage. A drainage ditch exists on the west side of the OCI Site. There is no visible surface drainage linking the Site and the Grand River, which is located approximately 0.95 miles north. Two gravel quarries have been identified near the OCI Site. One quarry is located 0.3 miles northwest, and the other quarry is 0.2 miles northeast of the Site. Both quarries are inactive and filled with water.

The OCI property has several buildings and structures occupying the property. The chemical manufacturing operation, which is housed in two buildings along the western boundary of the property, produced small quantities of specialized industrial chemicals and pharmaceutical intermediates. The solvent recovery operation is housed in several buildings along the southeastern portion of the property. Other structures include a warehouse, several drum and storage tank areas, an office building, a boiler facility and a waste water pretreatment facility. OCI stopped operations in May 1991, because of financial problems and the inability to obtain a Resource Conservation and Recovery Act (RCRA) Part B permit. OCI completed RCRA closure of the equipment and tanks in 1992.

Two railroad sidings parallel the southern and eastern OCI property boundaries (Figure 2). Along the sidings are the remnants of a series of aboveground storage tank facilities. Although the tanks no longer exist, the concrete footings and underground piping connections remain.

The OCI property is bordered by Packaging Corporation of America on the east, by the former Haven-Busch Co. on the west, and by Grand Rapids Gravel Co. on the north and these properties are also part of the OCI Site. The property directly north and northwest of OCI has a lower ground surface elevation due to earlier sand and gravel mining activities. Residential areas are approximately 200 feet southeast of the Site and 1700 feet to the southwest.

II. Site History and Enforcement Activities

A. Site History

The OCI Site is situated approximately 0.95 miles southeast of the Grand River. The Site was previously used for petroleum refining from 1941 to 1945, and transport and storage operations from 1945 to 1966. A succession of petroleum-related industries leased the land prior to its purchase by Spartan Chemicals. Anne R. Herald, owner of the property from approximately 1900 to 1942, issued an oil and gas lease for the entire property to Gerald J. Wagner on December 7, 1937. Mr. Wagner then leased the premises for oil and gas exploration to various third parties. During tenure of these leaseholds, two oil production wells were drilled onsite. One was a dry hole and the other was never completed or maintained. Attempts made to identify the exact locations of these wells by reviewing existing data were unsuccessful.

All oil and gas exploration leases were summarily voided by Ms. Herald on February 7, 1941. Other petroleum industry operations including a refinery commenced onsite in the early 1940's. Total Pipeline Corporation, a petroleum transporter, leased an oil and gasoline warehouse and tank facility onsite during this period. Its facilities were then taken over by its parent company, Total Petroleum, Inc., which operated onsite through 1964. Leonard Fuels purchased the Site in 1964 and sold the property to Total Realty in 1966. In 1968, Spartan Chemical Company acquired the Site property for the solvent reclamation and chemical manufacturing operations of its subsidiary, Organic Chemicals Company (now Organic Chemicals, Inc.). Organic Chemicals, Inc. (OCI) has operated on the Site since 1968. In 1979, OCI became the owner of the premises by conveyance of deed from Spartan Chemical Company.

Historical aerial photographs, taken from 1960 through 1978, show changes to the physical facilities of the OCI Site. In a 1960 photograph, three large vertical tanks with two sumps for containing spills were present along the northwestern portion of the former refinery. By 1967, these tanks were no longer present. In 1973, the terrain on the western portion of the former refinery was being regraded and leveled. The ground was visibly scarred from earth moving activity. In this same year there was a seepage lagoon on the OCI property which appeared to contain liquid waste. Two new buildings and six additional vertical storage tanks had been added to the facility in 1973. A 1978 aerial photograph indicates that the west portion of the former refinery was abandoned. This area was owned by Haven-Busch, Co. and was being used as an open storage yard for this steel fabrication company. Haven-Busch, Co. has since closed both their corporate office and their steel fabrication plant and has been sold to Padnos Iron and Metal.

In March 1976, a water well was drilled on the OCI property. The well was 165 feet deep and was used to provide plant production and cooling water. Because of various problems with the performance of the well, it was abandoned and the plant returned to the use of water supplied by the city of Grandville.

A chemical fire occurred onsite on October 11, 1976, damaging part of the OCI facilities. The cause of the blaze was reported as being started by a spark from a metal drum dragged across a floor. The spark ignited barrels of solvents stored nearby. According to retired Grandville Fire Chief Osterink, the fire was contained in the building and prevented from spreading to other storage tanks outside.

A chemical spill at the Site in November, 1979, was reported to the Michigan Department of Environmental Quality (MDEQ) by OCI. On November 3, 1979, 2,200 gallons of lacquer thinner were spilled by an operator onto the ground onsite. Some of the spilled lacquer thinner was recovered and disposed of in the onsite seepage lagoon.

The OCI Site was classified, on April 14, 1980, as a potential hazardous waste site by the United States Environmental Protection Agency (EPA). The Site was listed on the National Priority List on September 8, 1983. The EPA summarized the problem in its Potential Hazardous Waste Site log as "known groundwater contamination by organic solvents." Between 1968 and 1980, company records indicate that OCI discharged its process waste and cooling water, which included F001-F005 hazardous wastes into the onsite seepage lagoon. In June 1980, OCI ceased discharge of wastewater to the seepage lagoon. In 1980, the company installed a wastewater pretreatment facility with discharge to the City of Grandville Sanitary Sewer system. The pretreatment facility included two 9,000 gallon sedimentation tanks and a 30,000 gallon aeration basin with pH adjustment.

In September 1981, seepage lagoon sludges were excavated and transferred to railroad cars. The total removed soil filled approximately seven railroad cars. These sludges were disposed of at Chem-Met Services, Inc. in Wyandotte, Michigan.

A Preliminary Assessment (PA) for the Site was completed by EPA in 1983. The PA documented potential groundwater contamination from the solvent-contaminated seepage lagoon. Soils beneath this pond were also found to be contaminated. A potential for drinking water contamination and endangerment of flora and fauna in nearby potential wetlands was indicated in the PA.

In September 1986, MDEQ Law Enforcement Division personnel responded to a complaint of alleged illegal disposal of hazardous wastes at the facility. Reportedly, OCI personnel were disposing of sludges and other residues generated from the solvent recovery operations by placing these materials into drums and rolloff containers along with their normal nonhazardous solid waste materials. Analyses taken from solid waste storage units (rolloffs and 55 gallon drums) located at the Site revealed the presence of various contaminants including methylene chloride, toluene, ethylbenzene, xylenes and arochlor 1242 polychlorinated bi-phenyls(PCBs). Analyses of soil samples taken from the vicinity of the solid waste storage units revealed the presence of methylene chloride, toluene, xylenes, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, chloroform, 1,1-dichloroethene, 1,2-dichloroethene, and Aroclor 1242 (PCBs).

As a result of this investigation, OCI was cited by the EPA on December 3, 1986, to be in violation of RCRA. Among the violations cited were: (1) the unreported generation of hazardous waste from a drum cutting operation; (2) the routine transport of hazardous waste from the Site by unauthorized agents; (3) failure to prepare hazardous waste manifests, and (4) shipment of hazardous waste to unauthorized facilities. Based on these findings, the EPA levied fines of $22,500 on OCI.

During August/September 1987, OCI conducted a voluntary investigation in cooperation with MDEQ. Approximately 150 buried drums were discovered and removed from the southwest corner of the OCI warehouse building. Some of these drums contained sludge and liquid residues. Groundwater samples taken at that time from Prein & Newhof's monitoring well, B-11, indicated the presence of 1,1-dichloroethene, 1,1-dichloroethane, cis-1,2-dichloroethene, dibromochloromethane, toluene, ethylbenzene, and xylenes. Monitoring well B-11 was located south and slightly west of the warehouse building. The drum burial area was excavated down to approximately 17 feet below grade. Soil samples from the bottom of the excavation indicated methylene chloride (13 ug/kg) and tetrachloroethene (2.7 ug/kg) contamination.

B. Previous Investigations

In November 1979, the MDEQ requested that OCI perform a hydrogeological study to investigate suspected groundwater contamination. This study, conducted in four phases, was completed in October 1981. It concluded that the groundwater flow in the upper groundwater system at the Site was northwesterly towards the Grand River. Soil borings identified a sand and gravel aquifer existed over a clay layer. The elevation of the top of the clay layer was found to vary throughout the area. It was deepest below the area of the former seepage pond. The elevation of the top of the clay layer was found to be shallowest 1,000 feet west of the OCI property. This clay mound west of the Site re-directs the westward movement of groundwater to flow around the mound.

Twenty-four monitoring wells were installed during this study. Analysis of monitoring wells north and west of the former seepage pond revealed the following contaminants: methylene chloride, toluene, 1,1-dichloroethene, trans 1,2-dichloroethene, 1,2-dichloroethane, trichloroethene, benzene, chlorobenzene, ethylbenzene, pentachlorophenol, xylene, acetone, 1-propanol, 4-methyl-2 pentanone, trifluoromethylbenzene, naphthalenes, and various aliphatic hydrocarbons.

Analyses of surface soil samples taken from the OCI facility revealed the presence of methylene chloride, toluene, xylenes, 1,1,2-trichloroethane, trichloroethene, tetrachloroethene, chloroform, 1,1-dichoroethene, 1,2-dichloroethene and Aroclor 1242 (PCB).

The investigation also attempted to determine the rate of groundwater flow. Using soil samples obtained during the different phases of the investigation and the hydraulic gradient

determined from groundwater elevations, the rate of groundwater flow was estimated by the Kozeny-Carmen Equation. Due to the various soil strata encountered, which have various amounts of fines in the gravel, it was extremely difficult to accurately determine the rate of groundwater flow. The calculations indicated that the groundwater flow rate may vary from approximately 0.3 feet per day to as high as 1.5 feet per day or possibly higher in localized areas of extremely high permeability.

In the fall of 1988, EPA and the ARCS V project team conducted preliminary field investigation (PFI) activities with the objective of further characterizing the OCI Site. A description of PFI activities can be found in the PFI Quality Assurance Project Plan (QAPP). The information gathered during the PFI was incorporated in the planning and implementation of the Phase I Remedial Investigation (RI) activities. Analytical results obtained during the PFI study are presented in Appendix C of the Focused Feasibility Study (FFS).

C. CERCLA Enforcement

On March 30, 1988, a letter was sent to both OCI and Spartan Chemical pursuant to Section 122(a) of CERCLA informing them that work pursuant to 104(a) of CERCLA would be undertaken by EPA because OCI and Spartan lacked the financial capability to perform an RI/FS. On April 9, 1991, a General Notice letter was sent to OCI and Spartan; also on April 9, 1991, a General Notice Letter and Information Request was sent to 182 Potentially Responsible Parties (PRPs) who were customers of OCI and are considered generators of hazardous waste at OCI, pursuant to Section 107(a)(3) of CERCLA. On January 6, 1992, a Unilateral Administrative Order was sent to the 182 PRPs pursuant to Section 106 of CERCLA. On September 21, 1992, a De Minimis Administrative Order on Consent was executed with 100 PRPs providing for payment of past costs in the amount of $1,384,714. The settlement was pursuant to Section 122(g)(4) of CERCLA. On June 5, 1995, a General Notice Letter and Information Request was sent to 5 PRPs, pursuant to Section 107(a)(3) of CERCLA, who had contracted with OCI for the manufacture of chemicals.

III. Highlights of Community Participation

A Community Relations Plan was finalized for the OCI Site in February 1989. This document lists contacts and interested parties throughout the government and the local community. It also established communication pathways to ensure timely dissemination of pertinent information. A fact sheet outlining the RI sampling program was distributed in May of 1989. An RI public availability session was held on May 10, 1989. A second fact sheet was distributed in January of 1991, outlining this interim action for the upper ground-water system. The FFS was finalized on July 17, 1991. The Proposed Plan for the interim action at the OCI Site was released to the public on July 18, 1991. The Proposed Plan for the final action at the OCI Site was released on July 12, 1996. All of these documents, including the analytical data upon which this decision was based, were made available in both the Administrative Record and the information repository maintained at the Grandville Public

Library at 3141 Wilson Avenue in Grandville. The notice of availability of these documents was published in the Grand Rapids Press (Grandville Edition) on July 11, 1996, and the Grand Valley Advance on July 16, 1996.

A public comment period was held from July 22 through August 20, 1991, for the interim action and the comment period for the final action was held from July 15 through August 28, 1996. A public meeting was held on August 6, 1991, to present the result of the FFS and the preferred alternative as presented in the Proposed Plan for the interim action. The ROD was signed on September 30, 1991. A public meeting was held on July 16, 1996, to present the results of the Phase II Remedial Investigation, Final Feasibility Study (FS) and the preferred alternative as presented in the Proposed Plan for the final action. All significant comments which were received by EPA prior to the end of the second public comment period, including those expressed verbally at the second public meeting, are addressed in the Responsiveness Summary, which is attached to this Record of Decision.

IV. Scope of Response Action

EPA had organized this project into two response actions. The first response action was an interim action to address contamination in the upper ground-water system (UGS) by stopping the contaminant plume migration. The final action will remediate the ground water to comply with Maximum Contaminant Limits (MCLs), and the soil contamination to be protective in an industrial setting.

The soil which is the principle threat at the Site will be addressed by excavation of approximately 6,000 cubic yards of the contaminated soil and on-site treatment by solidification/stabilization. Contamination associated with past oil related activities at the Site are being addressed by MDEQ under the State voluntary cleanup program.

V. Site Characteristics

The primary contaminants at the Site are associated with the past operation of the seepage pit by OCI, chemical spills at the Site and past oil related activities. These areas are: the former seepage lagoon, the former lacquer thinner spill Site and petroleum sludge lagoons. The total organic compounds in soil exceeds 2,747,000, 85,600 and 149,000 ug/kg, respectively, at these areas. (Figure 3) These contaminants include elevated levels of chlorinated solvents and benzene, ethylbenzene, toluene, and xylene (BETX) compounds. Lower concentrations of other volatile and semi-volatile organic compounds were also detected. The nature and extent of contamination is presented in the FFS and Phase II RI report and summarized in the following sections.

A. Hydrogeologic Characteristics and Groundwater Contamination

Shallow groundwater at the OCI Site occurs in the saturated unconfined deposits of sand and gravel, which range in thickness from 4 to 30 feet. There are no known residential wells

that draw water from these deposits. The sand and gravel deposits are underlain by clay throughout the Site except at SB-10 (Figures 4 through 8) and SB-16, which encountered shale directly below the sand and gravel deposits. See Figure 9 for the location of soil borings. The thickness of the clay varies from 0 feet at SB-10 to 35.5 feet at MW-20. The sand and gravel aquifer will be referred to as the upper groundwater system (UGS). The Michigan formation underlies the clay unit and consists of interbedded gypsum, limestone and shale with occasional sandstone lenses. The Marshall Sandstone formation underlies the Michigan formation and is the source of groundwater for private and industrial wells and is a Class I aquifer. Residential areas are located to the southeast and southwest of the Site. The groundwater systems which lie beneath the clay will be referred to as the lower groundwater system (LGS).

Ground water flow in the unconsolidated deposits is to the northwest towards the Grand River. Ground water flow in the LGS also appears to move in a westerly, northwesterly direction across the Site.

The LGS is a confined and locally unconfined (where the clay unit is not present). The hydraulic conductivity for the LGS range from 1.86×10^{-6} cm/sec to 2.09×10^{-3} cm/sec. The hydraulic conductivity in UGS monitoring wells screened in coarse grained sediments (predominantly sand and/or gravel) range from 2.86×10^{-4} centimeters per second (cm/sec) to 5.14×10^{-2} cm/sec. Monitoring well MW-9 is an exception to this range with a hydraulic conductivity of 6.97×10^{-5} cm/sec; however, MW-9 is screened across the sand and gravel unit to clay unit interface.

B. Phase I Groundwater Monitoring

Two rounds of groundwater samples were collected from 25 of the 26 monitoring wells installed during the Phase I field investigation (Figure 10). The results of this sampling are documented in the previous ROD for the Site and presented in Figures 11 and 12.

C. Phase II RI Groundwater Monitoring

Two rounds of groundwater samples were collected from the Phase I and II monitoring wells during June 9 through 16, 1993, and September 20 through 25, 1993 (Figure 10). These samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, PCBs, metals, and cyanide. Figures 13 and 14 summarize this information.

C.1 Volatile Organic Compounds

The highest VOC concentrations detected during groundwater sampling rounds 1 and 2 occurred at the following monitoring wells: MW-1 (round 2: 2,523 µg/L) and MW-27 (round 2: 2,623 µg/L). The principal contaminants detected at MW-1 were 1,2-dichloroethene (565 µg/L), trichloroethene (195 µg/L), benzene (155 µg/L), toluene (660 µg/L), chlorobenzene

(205 μg/L), ethylbenzene (310 μg/L), and xylene (345 μg/L). The principal contaminants detected at MW-27 were 1,1,2-trichloroethane (18 μg/L), benzene (36 μg/L), toluene (170 μg/L), chlorobenzene (99 μg/L), ethylbenzene (400 μg/L), and xylene (1,900 μg/L). These wells are associated with the former seepage lagoon and former oil refinery.

VOC tentatively identified compounds (TICs) ranged from 0 to 2,124 μg/kg. Four locations had TICs greater than 1,000 μg/kg: MW-27 (1,354 μg/L; round 1), MW-28 (1,092 μg/L; round 1), MW-29 (2,124 μg/L; round 1), and MW-31 (1,148 μg/L; round 1).

C.2 Semivolatile Organic Compounds

The highest concentrations of total SVOCs were detected at the following monitoring wells: MW-1 (413 μg/L; round 2), MW-20 160 μg/L; round 1), MW-28 (100 μg/L; round 1), and MW-31 (78 μg/L; round 1). Monitoring wells MW-1 and MW-28 are associated with the former seepage lagoon and former oil refinery. Compounds detected in samples collected from monitoring wells MW-20 and MW-31 contained a common laboratory contaminant (i.e., bis-2-ethylhexylphthalate) or were qualified "B" because they also were found in corresponding rinsate blanks.

Principal contaminants detected at MW-1 were naphthalene, 2-methylnaphthalene, N-nitrosodiphenylamine, and carbazole. The principal contaminants detected at MW-28 were naphthalene and 2-methylnaphthalene.

C.3 Pesticides/PCBs

The following pesticides and PCBs were detected in groundwater samples collected from MW-1 and MW-8: MW-1 (round 2: aldrin, 0.033 μg/l; endrin ketone, 0.11 μg/L; Arochlor 1248, 2.0 μg/L) and MW-8 (round 1: Arochlor 1242 at 1.6 μg/L). These compounds were not detected in other rounds of sampling or in these wells before the Phase II RI.

C.4 Metals and Cyanide

Inorganic elements were detected at varying degrees at all monitoring wells (Figures 13 and 14). To evaluate the data, inorganic concentrations detected in rounds 1 and 2 of MW-17 groundwater samples were assumed to represent naturally occurring background levels in the UGS. Similarly, inorganic concentrations detected in the round 1 and 2 MW-20 groundwater samples were assumed to represent naturally occurring background levels in the LGS. These wells are located approximately 500 feet upgradient of the Site in a residential setting. Table 1 lists the background concentrations for UGS and LGS wells encountered during the Phase II investigation. The analytical data was used to determine those locations that exceeded five times background concentrations. Table 2 presents the results of this determination.

Eleven inorganic contaminants were detected in concentrations significantly above background (i.e., greater than five times): arsenic, barium, calcium, chromium, copper, iron, magnesium, manganese, potassium, sodium, and zinc (Table 2).

D. Comparison Between 1989 and 1993 Groundwater Analytical Results

Comparison between the Phase I (1989) and the Phase II (1993) groundwater analytical results show some important trends in the data: decreased contaminant concentrations at MW-1 and MW-2, increased contaminant concentrations at MW-4 and MW-27, and a general decrease in VOCs and SVOCs in outlying monitoring wells (i.e., MW-3, MW-5, MW-6, MW-8, MW-9, and MW-11).

Groundwater VOC and SVOC concentrations at MW-1 and MW-2 apparently decreased between 1989 and 1993. Average VOC concentrations at MW-1 and MW-2 during 1989 sampling were 29,684 and 53,523 μg/L, respectively. Whereas, average VOC concentrations at MW-1 and MW-2 during 1993 sampling were 1,398 and 135 μg/L, respectively; a decrease in concentration of approximately 95 and 99 percent, respectively occurred. Similarly, average SVOC concentrations at MW-1 and MW-2 during 1989 sampling were 1,569 and 805 μg/L, respectively. Whereas, average SVOC concentrations at MW-1 and MW-2 during 1993 sampling were 287 and 6 μg/L, respectively, a decrease in concentration of approximately 82 and 99 percent, respectively occurred.

Groundwater VOC and SVOC concentrations at MW-4 and MW-27 (a Phase II well nest) apparently increased between 1989 and 1993. Average VOC and SVOC concentrations at MW-4 during 1989 sampling were 142 and 12 μg/L, respectively. Whereas, average VOC and SVOC concentrations at MW-4 and MW-27 during 1993 sampling were 1,371 and 27 μg/L, respectively.

Contaminant isopleths were drawn to visualize changes between 1989 and 1993 groundwater conditions (Figure 12 and 14). The following conclusions can be drawn from evaluation of these contours: 1) apparently, the aerial extent of the 100 μg/L plume has increased between 1989 and 1993; 2) apparently, the aerial extent of the 1,000 μg/L plume has decreased between 1989 and 1993; and 3) the center of the plume seems to have shifted to the west of the OCI Site.

E. Phase II Residential Well Analytical Results

Three residential well samples were collected for analysis of VOCs during the Phase II RI: PW-2, PW-3, and PW-5. No VOCs were detected in PW-3. The following VOCs were detected in PW-2: acetone (14 μg/L), carbon disulfide (1 μg/L), chloroethane (0.3 μg/L), chloromethane (13 μg/L), 1,2-dichloroethane (17 μg/L), and 1,2-dichloropropane (0.4 μg/L). In PW-5, toluene was detected at a concentration of 0.1 μg/L.

PW-2 analytical results are anomalous because no other bedrock wells screened in the Marshall Sandstone (i.e., MW-41, MW-42, PW-2, and PW-5) contained such high concentrations of chlorinated organics. Furthermore, no VOCs were detected in PW-2 during Phase I RI sampling. In addition, although PW-3 is located just 300 feet away from PW-2, the sample and duplicate sample collected from PW-3 contained no detectable VOC concentrations.

F. Surface Soil Analytical Results

A total of 142 surface soil samples were collected at OCI during the Phase II investigation. See Figure V. Eight samples were collected at monitoring well locations; 33 samples were collected at soil boring locations; and 101 samples were collected at surface soil locations. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, and cyanide. Table 4-13 in the Phase II RI presents the organic and inorganic compounds detected in surface soil samples.

F.1 VOCs

Three surface soil samples (SS-96, SS-104, and SS-107) had the highest concentrations of total VOCs (greater than 10,000 µg/kg). Soil at these locations contained elevated levels of xylene (25,000, 73,000, and 360 µg/kg, respectively), toluene (6500, 74,000, 170 µg/kg, respectively) and tetrachloroethene (1,400, 4,700, and 3,000 kg, respectively). In addition, SS-96 and SS-104 had high concentrations of ethylbenzene (1300 and 25,000 kg, respectively), and SS-107 had a high concentration of 1,2-dichloroethene (13,000 µg/kg). Both SS-104 and SS-107 are located in former tanker loading areas and are on or adjacent to the main driveway of the Site. SS-96 is situated in the northeastern corner of the former lacquer thinner spill area, immediately south of the northern tank farm. SS-96 and SS-107 were the only two surface soil samples that had VOC TICs greater than 10,000 (12,250 and 12,640 µg/kg, respectively); all other surface soil VOC TICs ranged from 0-6000 µg/kg.

F.2 SVOCs

SS-51, SS-95, and SS-105 contained the highest levels of total SVOCs (greater than 100,000 µg/kg). The compound containing the highest concentration at all three locations was bis(2-Ethylhexyl) phthalate (66,000, 220,000, and 150,000 µg/kg, respectively). SS-95 and SS-105 are located within the former lacquer thinner spill area, and SS-51 is located on the Site, just outside of the staging area. SS-51 is situated on level ground at the bottom of a hill from the OCI buildings. Because of the elevated concentrations at SS-58, SS-59, and SS-60, which are near SS-51, it is believed this level ground is affected by surface runoff.

In addition to the three locations mentioned above, 23 out of the 52 sample locations within the Site fenced area contained high levels of total SVOCs (greater than 10,000 µg/kg). These high concentration surface soil locations are in areas associated with considerable Site activity or with surface runoff from high Site activity locations (e.g. the depression that runs

along the western edge of OCI and the low ground north of the boiler house and aeration basin).

Nine surface soil samples contained SVOC TIC concentrations greater than 1,000,000 μg/kg; seven of these are located within the Site fenced area (SS-51, SS-58, SS-68, SS-69, SS-93, SS-95, and SS-97). Their concentrations range from 1,303,800 to 3,269,100 μg/kg. SS-110 is located east of the Site along the railroad siding and has an SVOC TIC concentration of 1,656,400 μg/kg. SS-30 was located on the hill adjacent to PCA rail siding and has an SVOC TIC concentration of 2,430,300 μg/kg. Twelve surface soil samples contained greater than 100,000 μg/kg SVOC TICs; 11 of these samples were taken in the areas of high activity in the Site fenced area. The twelfth surface soil sample (SS-98) was located along the railroad siding east of the Site.

F.3 Pesticides/PCBs

Surface soil pesticide levels outside of the Site were less than 140 μg/kg. Within the fenced area, pesticide levels ranged from 0-6616 μg/kg. The five highest pesticide concentrations were detected at SS-68 (1,163.4 μg/kg), SS-84 (1,113.1 μg/kg), SS-93 (2,232.5 μg/kg), SS-97 (6,616.1 μg/kg), and SS-103 (4,275 μg/kg).

PCBs in the surface soil samples were found predominantly within the Site. Concentrations in this area ranged from 43 to 74,000 μg/kg, with the seven highest concentrations located at SS-60 (17,000 μg/kg), SS-61 (30,490 μg/kg), SS-81 (74,000 μg/kg), SS-86 (14,000 μg/kg), SS-93 (32,000 μg/kg), SS-103 (45,000 μg/kg), and SS-104 (13,000 μg/kg). In general, samples outside of the OCI Site contained low PCB concentrations (< 100 μg/kg). The one exception is SB-22 (345 μg/kg), which is located approximately 1,500 feet northwest of the Site.

F.4 Metals and Cyanide.

Inorganic elements were detected at varying degrees at all locations. The highest surface soil inorganic contamination encountered occurred at the Site during the Phase II investigation, and in particular, at the former lacquer thinner spill area.

The highest concentrations of inorganic analytes were found at the former lacquer spill area. In this area, four analytes were found to be significantly higher than background concentrations: cadmium, chromium, cyanide, and lead. Cadmium was found in excess of 50 times the background level of 0.21 μg/kg at SS-31 (33.6 mg/kg), SS-32 (41.4 mg/kg), SS-33 (35.7 mg/kg), SS-40 (44.8 mg/kg), and SS-96 (11.9 mg/kg), and greater than five times background at SS-45 (2.2 mg/kg). Chromium was found in excess of 50 times the background level of 19.84 mg/kg at SS-31 (1490 mg/kg), SS-32 (1590 mg/kg), SS-33 (1540 mg/kg), and SS-105 (1180 mg/kg), and greater than five times background at SS-40 (629 mg/kg) and SS-95 (835 mg/kg). Cyanide was found in excess of 50 times the background level of 0.33 mg/kg at locations SS-31 (113 mg/kg), SS-32 (136 mg/kg), SS-33 (120 mg/kg),

and SS-105 (95.8 mg/kg). Lead was found in excess of 500 times the background level of 13.99 mg/kg at SS-31 (13,100 mg/kg), SS-32 (10,600 mg/kg), and SS-105 (8460 mg/kg).

G. Additional Studies

The following additional studies were performed to supplement the data obtained during the Phase II RI:

- Cone Penetrometer Study
- Dense Non-Aqueous Phase Liquid (DNAPL) Investigation
- Phase II RI Non-Aqueous Phase Liquid (NAPL) and Headspace Results

G.1 Cone Penetrometer Study

The EPA tasked the U.S. Army Corps of Engineers (USACE), Earthquake Engineering and Geosciences Division, Waterways Experiment Station, to perform an investigation at OCI "to evaluate and demonstrate the ability of the Site Characterization and Analysis Penetrometer System at the Site." Appendix M presents the USACE investigation report; the following paragraphs summarize the report.

The investigation was conducted in July 1992. 49 cone penetrometer penetrations were completed along a 300 x 300 foot grid. The USACE estimated that petroleum contamination greater than 100 ppm total recoverable petroleum hydrocarbons was present in two distinct plumes, as presented in Figure 16. The first plume extended from the Site property, west approximately 800 feet, and north approximately 2,000 feet. The second plume extended approximately 400 feet radially from the sludge waste pit. The sludge waste pit is approximately 2,500 feet north of the Site. The report indicates the easterly extent of the first plume was not defined conclusively during the cone penetrometer investigation; the first plume likely extends further east than is shown in Figure 16.

G.2 DNAPL Investigation

Six DNAPL wells were located and constructed at OCI. See Figure 17. No DNAPL has been detected in these wells to date. Although not conclusive, it appears that DNAPL is not present at OCI.

G.3 Phase II RI NAPL and Headspace Study

During the drilling of Phase II RI soil borings, headspace analyses and non-aqueous phase liquid (NAPL) shake tests were performed at two-foot intervals for each boring. The headspace test was performed by placing approximately 100 ml of soil into a 250 ml glass jar. The glass jar was covered with aluminum foil, sealed, and set aside for 5 to 10 minutes. After the prescribed period of time, the lid of the jar was opened, the aluminum foil was

punctured simultaneously with the tips of a photoionization detector and a flame-ionization detector, and the instrument readings were recorded.

The NAPL shake test was performed in a manner similar to that described in Cohen, et al. (1992). Approximately 100 ml of soil was placed in a 250-ml glass jar, containing approximately 50 ml of distilled water and 1 gram of SUDAN IV (a hydrophobic dye). After sealing the jar, the mixture was shaken vigorously and inspected for changes. If NAPL was present in the soil sample, then the dye would dissolve within the NAPL and appear bright red. If no NAPL was present in the sample, then the dye would not dissolve into the solution, and no color change would occur. Appendix F of the Phase II RI presents the head space and NAPL test results.

Headspace readings, using an FID, were observed to be greater than 1,000 ppm at the following locations: SB-12, SB-25, SB-26, SB-29, SB-30, SB-32, SB-35, SB-41, SB-43, MW-35, MW-38, D-4, and D-6. Eleven soil and liquid sample locations indicated the presence of NAPL: SB-12, SB-14, SB-25, SB-26, SB-30, SB-42, SB-44, D-2, D-3, MW-33, and MW-38. These locations correspond to those associated with OCI operations, former oil refinery operations, or waste disposal sites from the former oil refinery.

H. Contaminant Fate and Transport

This section describes the fate and transport of the constituents detected at Organic Chemicals, Inc. (OCI), based on Site history, knowledge of surface and subsurface media gained during the Phase I and II remedial investigation (RI) field investigations, and analytical results. The purpose of this section is to evaluate qualitatively potential pathways of contaminant migration, as well as to describe the environmental behavior of Site contaminants.

This section is divided into two parts: potential migration routes and contaminant persistence and migration. Potential migration routes will be evaluated to determine routes that could transmit contaminants to receptors. Contaminants associated with pertinent migration routes will be evaluated based on their persistence in the environment and factors affecting contaminant migration.

H.1 Potential Routes of Migration

This section discusses the following potential routes or pathways of contaminant migration: air, surface water, soil exposure, and groundwater.

H.1.a Air Pathway

The release of hazardous substances to the air appears to be a minor potential contaminant migration route because no work activities are performed onsite and the onsite water treatment facility is no longer in operation. There are neither open pits nor industrial

operations which emit fugitive dust at OCI. No other sources of contaminant transport to the air pathway exist on the Site; therefore, the air pathway for contaminant transport is considered insignificant.

H.1.b Surface Water Pathway

The release of hazardous substances to surface water appears to be a minor potential contaminant migration route. A small intermittent ditch, Roy's Creek, runs from the quarry, southeast of the Site, 1,250 feet northwest to a point west of the Wyoming publicly-owned treatment works (POTW), and north of Packaging Corporation of America. Roy's Creek then runs west for approximately 1,000 feet before turning north for 2,500 feet, where it discharges into the Grand River.

Based on the contaminant plumes presented in Figures 12 and 14, Roy's Creek does not appear to be a discharge point of groundwater contaminated above 100 μg/L. The nearest monitoring wells upgradient from the intermittent creek, MW-11 and MW-29, had the following groundwater total VOC analytical results: Round 1: 400 and 8 μg/L, and Round 2: 0 and 0 μg/L, respectively. The 400 μg/L result for MW-11 during round 1 sampling was attributed primarily to chloromethane (i.e., 390 μg/L). This contaminant was not detected at MW-11 during the second round of Phase II sampling or the first or second rounds of Phase I sampling. Therefore, contaminant transport by the surface water pathway was considered insignificant. However, without the collection of surface water or sediment analytical data, and a subsequent risk analysis on that data, this pathway cannot be completely ruled out.

H.1.c Soil Exposure Pathway

The release of hazardous substances through exposure to Site soils appears to be a potential contaminant migration route. Evaluation of the surface soil data determined that high levels of carcinogenic polynuclear aromatic hydrocarbons (PAHs), lead, polychlorinated biphenyls (PCBs), and dioxin/furans were present at the OCI Site. These contaminants may cause undue risk to trespassers and future onsite workers.

H.1.d Groundwater Pathway

The release of hazardous substances through exposure to lower groundwater system (LGS) groundwater may be a potential contaminant migration route. Levels of chlorinated hydrocarbons and petroleum products are present in the upper groundwater system (UGS), and to a much lesser extent, in the LGS. The UGS groundwater pathway is currently being addressed by the existing groundwater treatment system. Private wells located near the Site are screened in the LGS, specifically the Marshall Formation (i.e., sandstone).

H.2 Contaminant Persistence and Migration

The contaminants associated with the soil exposure and groundwater migration pathways were evaluated based on their persistence in the environment and factors affecting contaminant migration. Table 3 presents physical and chemical constants associated with these contaminants [e.g., aqueous solubility, vapor pressure, Henry's law constant, organic carbon partition coefficient (Koc), octanol-water partition coefficient (K_{ow}) and density].

The aqueous solubility represents the maximum concentration of a compound that will dissolve in water at ambient temperature and pressure. Vapor pressure is the pressure exerted by a chemical vapor in equilibrium with its solid or liquid form at a given temperature. Henry's law constant provides a measure of the extent of chemical partitioning between air and water at equilibrium. The organic carbon partition coefficient, Koc, is a measure of the tendency for organic compounds to adsorb to soil or sediment. The octanol-water partition coefficient, Kow, is an indicator of hydrophobicity or the tendency of a compound to avoid the aqueous phase. Density is the mass of a compound divided by its volume.

H.2.a Soil Exposure Pathway

The contaminants associated with the soil exposure pathway are carcinogenic PAHs, lead, PCBs, and dioxin/furans. Based on the data presented in Table , these compounds would tend to adsorb to soil particles because of their high Koc and tend not to transfer to water- or air-phases because of their low water solubilities and vapor pressures. Because lead can be found in numerous forms, each having its own unique physical characteristics, data for lead was not presented in Table 3. A determination of the species of lead was not performed as a part of either the Phase I or Phase II RIs; therefore, this subsection does not discuss lead migration.

H.2.b Groundwater Exposure Pathway

Contaminants associated with the groundwater exposure pathway are chlorinated hydrocarbons, aromatics, and PAHs. Because of the differences in physical characteristics of these contaminants, this subsection discusses chlorinated hydrocarbons and aromatics separately from PAHs.

Water solubility and K_{ow} are important physical characteristics that affect contaminant transport in groundwater. Based on the data presented in Table 3, chlorinated hydrocarbons and aromatics generally have moderate water solubilities (greater than 10,000 mg/L) and low K_{ow} values (less than 100); therefore, chlorinated hydrocarbons and aromatics would tend to be susceptible to the groundwater transport pathway.

Based on the data presented in Table 3, PAHs generally have low water solubilities (less than 1 mg/L) and moderate to high K_{ow} values; therefore, PAHs would tend not to be susceptible to the groundwater transport pathway.

VI. Summary of Site Risks

The following groundwater exposure scenario was evaluated quantitatively in the FFS: a future ingestion of drinking water for adults only and potential for current ingestion of drinking water from the private wells. Due to the limited scope of the FFS and the unlikelihood of future residential land use, only one exposure pathway was chosen to evaluate potential future adverse health risks associated with exposure to contaminated groundwater. This scenario assumes that contaminated ground water will migrate to the LGS where it would be a potable water source.
A quantitative assessment of baseline risk for human health at OCI, evaluates potential exposures and subsequent risks for current trespassers and future occupants of OCI. This assessment addressed risks associated with exposure to chemicals present in soils at the Site, as well as the area of investigation (AOI). For the risk assessment, the AOI was defined as that area at OCI excluding both the Site and the area near the petroleum sludge lagoon (i.e., the area represented by soil samples collected from the following locations: SB-12, SB-14, MW-16, MW-32, and MW-33).

A. Toxicity Assessment Summary

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors assure that the RfDs will not underestimate the potential for adverse non carcinogenic effects to occur. Table 6-7 gives RfDs and slope factors.

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$ or 1E-6). An excess lifetime cancer risk of $1x10^{-6}$ indicates that, as a plausible upper bound, an individual has a one in a million chance of developing cancer as a result of Site-related exposure to a carcinogen over a 70-year lifetime under the specific conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminants reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single media or across media.

Excess cancer risk estimates were calculated for exposures to carcinogenic indicator chemicals by adding together the product of the chronic daily intakes (CDI) and cancer potency factor for all carcinogenic indicator chemicals and intake routes for a given human receptor. Hazard indices were calculated for exposures to non-carcinogenic indicator chemicals by summing the ratios of CDIs to acceptable daily intakes (reference doses) for all chemicals and intake routes for a given human receptor.

B. Risk Summary

B.1 Carcinogenic Risk

The future exposure scenario included residential groundwater use. Only exposure to groundwater was assessed under the future residential scenario. A chronic hazard index of 17.6 was estimated for potential future residential use of groundwater. This indicated a potential noncarcinogenic health risk for this hypothetical scenario. Trichloroethene in groundwater accounted for approximately 79 percent of this noncarcinogenic risk. Both toluene and N-nitrosodiphenylamine accounted for approximately 11 percent of the risk.

Excess cancer risk for potential future residential groundwater use was estimated at $3x10^{-3}$. Vinyl chloride ($8x10^{-4}$), trichloroethene ($8x10^{-4}$), 1,1-dichloroethene ($3x10^{-4}$), and arsenic($3x10^{-4}$) accounted for the majority of this excess cancer risk.

The above risk assessment was performed in the FFS. No risk assessment was performed in the Phase II RI for the shallow aquifer because the interim ROD concluded that the groundwater may pose an imminent and substantial endangerment to public health, welfare or the environment. Implementation of the interim ROD selected remedy has begun to stop further migration of the contaminant plume, achieving significant risk reduction while a final solution was developed.

The Site current trespasser scenario yielded an excess lifetime cancer risk of 2×10^{-4}. Risk is due to exposure to the following compounds: benzo(a)pyrene, dibenzo(a,h)anthracene, 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD) (on a total equivalent basis), and PCB (Aroclor 1248). The Site future worker scenario yielded an excess lifetime cancer risk of 3×10^{-4}. Risk is due largely to exposure to the following compounds: benzo(a)pyrene, beryllium, bis(2-ethylhexyl)phthalate, chromium(VI), dieldrin, 2,3,7,8-TCDD (on a total equivalent basis), and PCB (Aroclor 1248). In both the Site current and future scenarios, risk was found to exceed the acceptable range of 10^{-6} to 10^{-4}.

The excess lifetime cancer risk for the Area of Investigation (AOI), MW-41, and MW-42 future residential exposure scenarios was evaluated. The excess lifetime cancer risk for these scenarios was, 5×10^{-5}, 1×10^{-4}, and 2×10^{-5}, respectively. Only the MW-41 scenario was outside of the acceptable range of carcinogenic risk. Arsenic was responsible for the excess risk in this scenario equal to 1×10^{-4}.

B.2 Non-carcinogenic Risk

The Site current trespasser HI and the Site future worker were 0.2, and 0.8 respectively, these risk numbers are below the level for increased concern of non-carcinogenic effects. The HI for the AOI future resident was 0.7, this risk is below the level for increased concern of non-carcinogenic effects. The HIs for the MW-41 and MW-42 scenarios (the two Marshall sandstone well scenarios) were 2 and 0.4, respectively. The HI in MW-41 is due largely to the manganese and arsenic water concentrations.

B.3 Qualitative Ecological Risk Assessment Results (QERA)

A HI less than 1.0 indicates the ecological chemicals of potential concern are below levels of ecological concern. The hazard indices for the open water wetland, the forested wetland, the scrub-shrub wetland, and the old field terrestrial habitats were 0.07, 0.14, 0.17, and 0.17, respectively. Therefore, habitats and species at OCI do not appear to be subjected to significant ecological risk from OCI contamination. Figure 18 shows the sample locations used to determine the HI. Tables 5 and 6 show the intake values used to calculate the HIs.

B.4 Assessment of Human Health and Environmental Risks Presented by the Site

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

VII. Description of Alternatives

Two alternatives were developed for the final groundwater action and nine were developed for the final source action. The alternatives developed for these actions are:

- Alternative 1: No Action

- Alternative 2: Institutional Controls

All of the following alternatives include the groundwater final alternative which consists of continued operation of the existing groundwater system and will be referred to as Alternative 10.

- Alternative 3: Contaminated Soil Containment by Concrete Capping and Surface Controls

- Alternative 4: Offsite Disposal of Contaminated Soil

- Alternative 5: Onsite Ex Situ Treatment of Contaminated Soil by Soil Washing

- Alternative 6: Onsite Ex Situ Treatment of Contaminated Soil by Solidification/Stabilization

- Alternative 7: Treatment of Organic-Contaminated Soil by Onsite Thermal Treatment and Containment of Residual and Inorganic-Contaminated Soil by Capping

- Alternative 8: Treatment of Organic-Contaminated Soil by Onsite Thermal Treatment and Landfill Disposal of Residual and Inorganic-Contaminated Soil

- Alternative 9: Treatment of Organic-Contaminated Soil by Onsite Thermal Treatment and Treatment of Residual and Inorganic-Contaminated Soil by Solidification/Stabilization

- Alternative 10: Continued Operation and Maintenance of the Existing Granular Activated Carbon Groundwater Treatment System

A. Alternative 1: No Action

Alternative 1 is the no action alternative, required by the National Contingency Plan and Superfund Amendments and Reauthorization Act regulations. This alternative serves as a baseline for comparison with other alternatives for the soil and groundwater alternatives.

The capital and present worth cost for this alternative is $0.

B. Alternative 2: Institutional Controls

Alternative 2 is a limited action alternative that includes implementation of institutional controls to prevent direct contact with or ingestion of contaminated soil. A 6-foot security fence with three strands of barbed wire would be installed in contaminated areas of the Site

not currently fenced to reduce the opportunity for exposure. This alternative would include addressing areas south of the staging area and along the abandoned railroad siding. Warning signs would be displayed on fences to alert the public of potential hazards. Future uses would also be limited by deed restrictions.

The capital cost and O&M cost for this alternative are $47,569 and $7,000 respectively. The present worth cost for this alternative is $155,176.

C. Alternative 3: Contaminated Soil Containment by Concrete Capping and Surface Controls

Alternative 3 involves capping contaminated soil areas with concrete. The concrete cap was selected as representative of forms of containment that reduce potential contact with contaminated soils and surface water infiltration into groundwater of de minimis volatile organic soil contaminants that are major groundwater contaminants. The major soil contaminants of concern at the Site are not expected to leach to groundwater. Drainage controls would be provided to control surface water runoff. A 6-foot security fence with three strands of barbed wire would be installed in contaminated Site areas not currently fenced, as described in Alternative 2. Deed restrictions would be placed on the Site to limit future land use (i.e., subsurface excavations below the concrete cap). For cost estimating purposes, it is assumed a pre-design investigation will be performed to confirm the extent of soil contamination.

The capital cost and O&M cost for this alternative are $2,137,691, and $12,000 respectively. The present worth cost for this alternative is $2,322,161

D. Alternative 4: Offsite Disposal of Contaminated Soil

Alternative 4 includes excavation, removal and transportation of contaminated soil from the OCI Site to an approved landfill. Appendix B in the Phase II RI shows 5,561 cubic yards of soil must be disposed of at a Resource Conservation and Recovery Act (RCRA) Part B-permitted landfill and 22 cubic yards at a Toxic Substances Control Act (TSCA) permitted landfill. An additional 457 cubic yards of soil may be disposed of at a local solid waste landfill. The total estimated soil to be remediated is 6040 cubic yards. See Figure 19. Following excavation and disposal of contaminated soil, the OCI Site will be backfilled with clean soil and revegetated. Following disposal of contaminated soil, the Site would be considered safe for industrial use. Fence restrictions will be required because groundwater remediation will be operating long after the soil cleanup is complete. For cost estimating purposes, it is assumed that a pre-design investigation will be performed to confirm the extent of soil contamination. In addition, it is assumed the offsite disposal facility will require analytical testing to be performed at a consistent rate (i.e., one test per 100 cubic yards) during the offsite transfer of contaminated soil.

The capital cost and O&M cost for this alternative are $2,363,032, and $7,000 respectively. The present worth cost for this alternative is $2,470,640.

E. Alternative 5: Onsite Ex Situ Treatment of Contaminated Soil by Soil Washing

Alternative 5 includes excavation and onsite treatment by soil washing. Excavated contaminated soil will be placed in waste piles with an impermeable base and cover. Contaminated soil is screened to remove coarse rock and debris. For cost estimating purposes, it is assumed 1 percent of the total volume of soil to be treated will consist of cobbles and other large debris, too large to be accepted into the treatment unit. These materials will be disposed of offsite as solid waste.
Chemical additives, such as surfactants, acids, bases, and chelants, are added to the soil to produce a slurry feed, which flows to an attrition scrubbing machine. Mechanical and fluid shear stresses are applied to the slurry feed through the use of screens, separators, and cyclones. After these steps, the following output streams are created: coarse clean fraction, contaminated fine fraction, and contaminated process water.

Soil monitoring will be implemented to confirm the treatment process reduced contaminant levels below cleanup goals. The coarse clean fraction is expected to be used as backfill. All excavated areas will have a vegetative cover. The contaminated fine fraction, assumed to be 10 percent of treated volume, will require disposal in a RCRA-permitted landfill. For cost estimating purposes, it is assumed 10 percent of the treated soil volume will fail to meet cleanup goals and be disposed of offsite as solid waste. Contaminated process water would be treated and returned to the plant for re-use.

Following disposal of contaminated soil, the Site would be considered safe for industrial use. Fence restrictions will be required because groundwater remediation will be operating long after the soil cleanup is complete. Before implementation of this alternative, it is assumed a treatability study would be required to determine the necessary chemical additives to treat the soil to below cleanup goals. For cost estimating purposes, it is assumed a pre-design investigation will be performed to confirm the extent of soil contamination. In addition, it is assumed the offsite disposal facility will require analytical testing to be performed at a consistent rate (i.e., one test per 100 cubic yards) during the offsite transfer of contaminated soil.

The capital cost and O&M cost for this alternative are $2,270,401, and $7,000 respectively. The present worth cost for this alternative is $2,378,009.

F. Alternative 6: Onsite Ex Situ Treatment of Contaminated Soil by Solidification/Stabilization

Alternative 6 includes excavation and onsite treatment of contaminated soil by solidification/stabilization and subsequent onsite disposal of stabilized soil. Excavated contaminated soil would be placed in waste piles with an impermeable base and cover. Contaminated soil is screened to remove coarse rock and debris and combined with pozzalanic ingredients (including fly ash and cement binding reagents) and water in a pug mill. For cost estimating purposes, it is assumed 1 percent of the total volume of soil to be treated will

consist of cobbles and other large debris, too large to be accepted into the treatment unit. These materials will be disposed of offsite as solid waste.

Wet slurry is returned to excavated areas to cure. Stabilized material would exhibit engineering characteristics similar to those of a low load bearing concrete mixture (i.e., 25-50 psi). It is estimated the net volumetric expansion of stabilized soil would be 25 percent. For cost estimating purposes, it is assumed 10 percent of treated soil will fail the Toxicity Characteristic Leaching Procedure (TCLP) and be disposed of offsite as RCRA hazardous waste.

Following treatment and curing of stabilized soil, a vegetative cover would be applied to the stabilized mass to protect future workers from dermal contact with treated soil. The Site would be considered safe for industrial use. Deed restrictions to limit future excavation of stabilized soils would be required. Fence restrictions will be required because groundwater remediation will be operating long after the soil cleanup is complete. Before treatment, a mix evaluation would be performed to determine the most effective mix ratio of soil, pozzalanic ingredients, and water.

For cost estimating purposes, it is assumed that a pre-design investigation will be performed to confirm the extent of soil contamination. In addition, it is assumed the offsite disposal facility will require analytical testing to be performed at a consistent rate (i.e., one test per 100 cubic yards) during the offsite transfer of contaminated soil.

The capital cost and O&M cost for this alternative are $1,596,399, and $7,000 respectively. The present worth cost for this alternative is $1,704,007.

G. Alternative 7: Treatment of Organic-Contaminated Soil by Onsite Thermal Treatment and Containment of Residual and Inorganic-Contaminated Soil by Capping

Alternative 7 includes excavation and thermal treatment of contaminated soil followed by onsite containment of residual by capping. Before implementation of this alternative, soil would be segregated into three groups. Group 1 (Figure 20) soils contain organic contaminants above their respective cleanup goals. Group 2 (Figure 21) soils contain inorganic contaminants above their respective cleanup goals. Group 3 (Figure 22) soils contain both organic and inorganic contaminants above their respective cleanup goals. Group 1 and 3 soils would be thermally treated and contained. Group 2 soils would not be thermally treated, but would be contained. Estimated volumes of Group 1, 2, and 3 soils are 126; 1,306; and 4,609 cubic yards, respectively.

Excavated contaminated soil would be placed in waste piles with an impermeable base and cover. Contaminated soils to be thermally treated would be screened to remove coarse rock and debris. For cost estimating purposes, it is assumed 1 percent of the total volume of soil to be treated will consist of cobbles and other large debris, too large to be accepted into the treatment unit. These materials will be disposed of offsite as solid waste. Screened soil

would be fed into a mobile thermal treatment unit (including either fluidized bed, thermal desorption, or circulating bed technologies) to treat Group 1 and 3 soils. After thermal treatment, the residual (ash and soil) would be tested for contaminants to verify inorganic contamination and that residuals were below organic contaminant cleanup goals. Residuals above organic contaminant cleanup goals would be retreated.

For cost estimating purposes, it is assumed 10 percent of the treated soil would be disposed of offsite as RCRA hazardous waste. The remaining Group 1 and 3 soils would be placed in areas inside a security fence and contained along with Group 2 soils with a concrete cap. Drainage controls would be provided to control surface water runoff. Deed restrictions would be placed on the Site to limit future land use (i.e., subsurface excavations below the concrete cap). Before treatment, a trial burn would be performed to determine thermal treatment effectiveness.

For cost estimating purposes, it is assumed a pre-design investigation will be performed to confirm the extent of soil contamination. In addition, it is assumed the offsite disposal facility will require analytical testing to be performed at a consistent rate (i.e., one test per 100 cubic yards) during the offsite transfer of contaminated soil.

The capital cost and O&M cost for this alternative are $8,786,474, and $12,000 respectively. The present worth cost for this alternative is $8,970,944.

H. Alternative 8: Treatment of Organic-Contaminated Soil by Onsite Thermal Treatment and Landfill Disposal of Residual and Inorganic-Contaminated Soil

Alternative 8 includes onsite thermal treatment of organic-contaminated soil and landfill disposal of the thermal treatment residual and inorganic-contaminated soil. Before implementation of this alternative, soil would be segregated into three groups, as discussed in Alternative 7. Excavated contaminated soil would be placed in waste piles with an impermeable base and cover. Contaminated soils to be thermally treated would be handled as described in Alternative 7. After thermal treatment, the inorganic contaminated residual (ash and soil) would be tested to verify inorganic contamination and that residuals were below organic contaminant cleanup goals. Residuals above organic contaminant cleanup goals would be retreated.

Residuals below organic and inorganic contaminant cleanup goals would be backfilled onsite. Residuals having inorganic concentrations above contaminant cleanup goals and Group 2 soils would be tested to determine whether they are RCRA hazardous. RCRA hazardous soils would be transported offsite to a RCRA Part B-permitted landfill. Non-RCRA hazardous soils would be transported offsite to a local solid waste landfill. Clean soil would be backfilled into excavated areas and revegetated to bring areas back to grade. Following treatment of contaminated soil, the Site would be considered safe for industrial use. Fence restrictions will be required because groundwater remediation will be operating long after the

soil cleanup is complete. Before treatment, a trial burn would be performed to determine thermal treatment effectiveness.

For cost estimating purposes, it is assumed a pre-design investigation will be performed to confirm the extent of soil contamination. In addition, it is assumed the offsite disposal facility will require analytical testing to be performed at a consistent rate (i.e., one test per 100 cubic yards) during the offsite transfer of contaminated soil.

The capital cost and O&M cost for this alternative are $8,583,301, and $7,000 respectively. The present worth cost for this alternative is $8,690,907.

I. Alternative 9: Treatment of Organic-Contaminated Soil by Onsite Thermal Treatment and Treatment of Residual and Inorganic-Contaminated Soil by Solidification/Stabilization

Alternative 9 includes onsite thermal treatment of organic-contaminated soil and solidification/stabilization of the thermal treatment residual and inorganic-contaminated soil. Before implementation of this alternative, soil would be segregated into three groups, as discussed in Alternative 7. Excavated contaminated soil would be placed in waste piles with an impermeable base and cover. Contaminated soils to be thermally treated would be handled as described in Alternative 7. After thermal treatment, the inorganic contaminated residual (ash and soil) would be tested to verify inorganic contamination and that residuals were below organic contaminant cleanup goals. Residuals above organic contaminant cleanup goals would be retreated. Residuals below organic and inorganic contaminant cleanup goals would be backfilled onsite. Residuals having inorganic concentrations above contaminant cleanup goals and Group 2 soils would undergo a solidification/stabilization process as described in Alternative 6. Stabilized material would exhibit engineering characteristics similar to those of a low load bearing concrete mixture (i.e., 25-50 psi). It is estimated the net volumetric expansion of the stabilized soil would be 25 percent.

Following solidification/stabilization of contaminated soil, the stabilized mass would be analyzed for TCLP. For cost estimating purposes, it assumed 10 percent of the stabilized material fails TCLP and would be disposed of offsite as RCRA hazardous. A vegetative cover would be applied to the remaining stabilized material to protect future workers from dermal contact with treated soil. The Site would be considered safe for industrial use. Deed restrictions to limit future excavation of stabilized soils would be required. Fence restrictions will be required because groundwater remediation will be operating long after the soil cleanup is complete.

Before treatment, a mix evaluation would be performed to determine the most effective mix ratio of soil, pozzalanic ingredients, and water; a trial burn would be performed to determine the effectiveness of thermal treatment. For cost estimating purposes, it is assumed a pre-design investigation will be performed to confirm the extent of soil contamination. In addition, it is assumed the offsite disposal facility will require analytical testing to be

performed at a consistent rate (i.e., one test per 100 cubic yards) during the offsite transfer of contaminated soil.

The capital cost and O&M cost for this alternative are $7,930,993, and $7,000 respectively. The present worth cost for this alternative is $8,038,601.

J. Alternative 10 - Operate and maintain a ground water extraction and treatment system to contain the contaminated plume within OCI property boundaries and prevent the migration of contaminants to sensitive receptors like the LGS. Groundwater is currently being extracted and treated by the granular activated carbon system to comply with NPDES discharge limitations with discharge to Roy's Creek.

A ground water extraction and treatment system will be operated until MCLs are achieved at the point of compliance. The point of compliance is throughout the contaminant plume. Enforceable land use restrictions or other institutional controls will be required for the Site to prevent unacceptable risk from exposures to hazardous substances in the groundwater. Exposure controls will remain in effect until MCLs and other pertinent Part 201 criteria are achieved throughout the contaminated plume. A monitoring plan that meets the substantive requirements of Part 201 of the Michigan Natural Resources and Environmental Protection Act, Act 451 of 1994, ("Part 201") will be developed and implemented to ensure the effectiveness of the remedial action.

An alternate point of compliance (APC) may be established by the EPA in consultation with the MDEQ if the likelihood of exposure to the aquifer is demonstated to be remote, and enforceable land use restrictions or other institutional controls are in place to prevent unacceptable risk from exposures to hazardous substances in the groundwater. The APC must be protective of human health and the environment, as well as consistent with the NCP and all applicable or relevant and appropriate state requirements, including Part 201. If the EPA establishes an APC, continued operation of the groundwater extraction and treatment system is not required if MCLs are attained at or beyond the APC. However, the groundwater extraction and treatment system will remain in place and operational until MCLs are achieved throughout the contamianted plume. Also, exposure controls and the monitoring plan will remain in place until MCLs and other pertinent Part 201 criteria are attained throughout the contaminated plume.

The residual GAC from this treatment process will be properly treated in accordance with LDR requirements and disposed of off-site at a RCRA permitted landfill because it will contain listed hazardous wastes. If the residual GAC is regenerated it must be done in a RCRA permitted treatment unit which is in compliance with 40 CFR Part 264 Subpart X. The present worth, capital, and O&M costs are $6,200,000, $398,000, and $400,000 respectively, assuming the system operates for thirty years. If the time frame is reduced as a result of compliance with the cleanup goals due to the implementation of institutional controls, the present worth cost would be reduced to $2,000,000, and O&M cost would be $120,000.

VII. Comparative Analysis of Alternatives

In order to determine the most appropriate alternative for the OCI Site, the alternatives were evaluated against each other. Comparisons were based on the nine evaluation criteria. The nine criteria are: 1) overall protection of human health and the environment, 2) compliance with applicable or relevant and appropriate requirements, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, and volume, through treatment, 5) short-term effectiveness, 6) implementability, 7) cost, 8) state acceptance, and 9) community acceptance.

A. Overall Protection of Human Health and the Environment

All of the remedial alternatives considered for the OCI Site are protective of human health and the environment by eliminating, reducing, or controlling risks at the OCI Site with the exception of the no action and institutional control alternative. As the no action and institutional control alternatives do not provide protection of human health and the environment, they are not eligible for selection and shall not be discussed further. Alternatives 3 through 10 would be protective of human health and the environment by eliminating the direct contact exposure pathway (i.e., capping), or by removing contaminated soils from the Site (i.e., landfill disposal), or by immobilizing hazardous constituents in a stabilized matrix (i.e., solidification/stabilization), or by removing or destroying hazardous constituents in the soils (i.e., soil washing and thermal treatment) and by eliminating ingestion of contaminated groundwater.

B. Compliance With ARARs

Each alternative is evaluated for compliance with ARARS, including chemical specific, action specific, and location specific ARARS. Alternatives 4, 5, 6, 8, 9, and 10 would comply with identified federal and state ARARs. Alternatives 3 and 7 may not comply with the EPA land ban requirements because they do not include treatment of all hazardous constituents.

C. Long-Term Effectiveness and Permanence

This evaluation focuses on the results of a remedial action in terms of the risks remaining at the Site after response objectives have been met. The following factors are addressed for each alternative: magnitude of remaining risk, adequacy and reliability of controls.

Alternative 3 would minimize long-term exposure by covering contaminated soil with a concrete cap and through application of deed restrictions. Alternatives 4 through 9 would require excavation and soil removal; thereby, eliminating human exposures and migration of hazardous constituents. Alternative 10 should pose no risk because contaminated water will either be treated to MCLs or due to institutional controls will not allow exposure to residents.

Continued monitoring of the aquifer will preclude contamination reaching a drinking water source. Therefore, the primary remedy and the contingency measures provide overall protection of human health and the environment, either by reducing contaminants to MCLs, or through institutional controls.

D. Reduction of Toxicity, Mobility, or Volume (TMV) Through Treatment

This evaluation addresses the statutory preference for selecting remedial actions that employ treatment technologies which permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. This preference is satisfied when treatment is used to reduce the principal threats at a Site through destruction of toxic contaminants, irreversible reduction of contaminant mobility, or reduction of total volume of contaminated media.

In Alternatives 3 and 4, no reduction of toxicity, mobility and volume through onsite treatment would be experienced.

In Alternatives 5 through 9, approximately 6,041 cubic yards of contaminated soil would be excavated and treated in either a soil washing, solidification/ stabilization or thermal treatment unit. Alternatives 5 through 9 would provide greater reduction in volume, mobility, and toxicity through treatment of Site contaminants than Alternatives 1 through 4. Alternatives 5 through 9 achieve the Superfund Amendments and Reauthorization Act preferred treatment to reduce the toxicity, mobility, and volume for hazardous substances.

The toxicity, mobility, and volume of the contaminated material will not be reduced by Alternative 10 by treatment if the residual carbon is land disposed because the contaminants will only be transferred to the residual carbon. If the residual carbon is regenerated, which will likely be more cost-effective, then the toxicity, mobility, and volume of the contaminated material will be reduced by treatment.

E. Short-Term Effectiveness

This evaluation focuses on the effects to human health and the environment which may occur while the alternative is being implemented and until the remedial objectives are met. The following factors were used to evaluate the short term effectiveness of each alternative: protection of the community during remedial actions, protection of workers during remedial actions, environmental impacts from implementation of alternatives, and time until remedial objectives are met.

Alternatives 3 through 9 would create short-term impacts comparable to one another, including the release of dust and air pollutants during excavation of contaminated soils, increased noise levels, and increased traffic around the Site. Use of engineering controls would limit air emissions. Alternatives 4 through 9 require offsite disposal; however, Alternatives 4 and 8 create more potential for release of contaminants during transportation because most soils will be transported to an offsite disposal facility.

With regard to Alternative 10 there are no construction impacts because construction is complete. With regard to the time until remedial objectives are met, Alternative 10 will be operated until the final remedial objective is met, which could take one to eleven years depending on the point of compliance.

None of these alternatives will result in unacceptable short-term risks to workers, residents, or the environment.

F. Implementablity

This evaluation addresses the technical and administrative feasibility of implementing the alternatives and the availability of the various services and materials required during its implementation.

Technical and administrative requirements for implementing Alternatives 3 and 4 would be moderate. Technical and administrative requirements for implementing Alternatives 5 and 6 would be moderate to high. Technical and administrative requirements for implementing Alternatives 7 through 9 would be high.

Alternatives 4 through 9 would each have to comply with administrative requirements regarding transport of hazardous waste, as set by the U.S. Department of Transportation. Alternatives 7 through 9 would have to comply with strict substantive air permit requirements for thermal treatment. Alternative 10 poses no problems because it is already constructed.

G. Cost

This evaluation examines the estimated costs for implementing the remedial alternatives. Capital and O&M cost are used to calculate estimated present worth costs for each alternative. Capital costs range from a low of $48,000 for Alternative 2 (institutional controls) to a high of $9 million for Alternative 7 (thermal treatment and capping). Alternatives 4, 5, 6, 8, and 9 have a vegetative cover; therefore, the present worth O&M costs over a 30 year period are only approximately $0.1 million. However, for Alternatives 3 and 7, which have a concrete cap, estimated present O&M costs are $0.2 million, because long-term monitoring and maintenance would be required. The present worth cost of Alternative 6 is the lowest of the alternatives that eliminated the principle threat. The present worth for Alternatives 7, 8, and 9 (thermal treatment) are about 3 times the present worth for capping, offsite disposal, soil washing, and stabilization.

The capital cost for alternative 10 was $398,000 and the total present worth cost could be as high as $6,200,000 depending on monitoring frequency and length of operation.

H. State Acceptance

The State of Michigan concurs with EPA's selection of alternatives 6 and 10 for the final actions at the OCI Site.

I. Community Acceptance

Community response to the alternatives is presented in the responsiveness summary, which addresses comments received during the public comment period.

IX. The Selected Remedy

After considering the requirements of CERCLA, the detailed analysis of alternatives, and public comments, EPA has selected Alternatives 6 and 10 for the final actions at OCI:

Alternative 6 - Alternative 6 includes excavation and onsite treatment of contaminated soil by solidification/stabilization and subsequent onsite disposal of stabilized soil. Excavated contaminated soil would be placed in waste piles with an impermeable base and cover. Contaminated soil is screened to remove coarse rock and debris and combined with pozzalanic ingredients (including fly ash and cement binding reagents) and water in a pug mill. For cost estimating purposes, it is assumed 1 percent of the total volume of soil to be treated will consist of cobbles and other large debris, too large to be accepted into the treatment unit. These materials will be disposed of offsite as solid waste.

Wet slurry is returned to excavated areas to cure. Stabilized material would exhibit engineering characteristics similar to those of a low load bearing concrete mixture (i.e., 25-50 psi). It is estimated the net volumetric expansion of stabilized soil would be 25 percent. For cost estimating purposes, it is assumed 10 percent of treated soil will fail the Toxicity Characteristic Leaching Procedure (TCLP) and be disposed of offsite as RCRA hazardous waste.

The present worth, capital, and O&M costs for the selected remedy are $1,704,007, $1,596,399, and $7,000 respectively.

The basis for the remediation goals is to protect future Site workers to a $1x10^{-4}$ excess cancer risk. Table 7 provides the cleanup goals for this risk level.

Alternative 10 - Operate and maintain a ground water extraction and treatment system to contain the contaminated plume within OCI property boundaries and prevent the migration of contaminants to sensitive receptors like the LGS. Groundwater is currently being extracted and treated to comply with NPDES discharge limitations.

A ground water extraction and treatment system will be operated until MCLs are achieved at the point of compliance. The point of compliance is throughout the contaminant plume. A

monitoring plan that meets the substantive requirements of Part 201 will be developed to ensure the effectiveness of the remedial action. Enforceable land use restrictions or other institutional controls will be required for the Site to prevent unacceptable risk from exposures to hazardous substances in the groundwater. Exposure controls will remain in effect until MCLs and other pertinent Part 201 criteria are achieved throughout the contaminated plume. A monitoring plan that meets the substantive requirements of Part 201 will be developed and implemented to ensure the effectiveness of the remedial action.

An APC may be established by the EPA in consultation with the MDEQ if the likelihood of exposure to the aquifer is demonstated to be remote, and enforceable land use restrictions or other institutional controls are in place to prevent unacceptable risk from exposures to hazardous substances in the groundwater. The APC must be protective of human health and the environment, as well as consistent with the NCP and all applicable or relevant and appropriate state requirements, including Part 201. If the EPA establishes an APC, continued operation of the groundwater extraction and treatment system is not required if MCLs are attained at or beyond the APC. However, the groundwater extraction and treatment system will remain in place and operational until MCLs are achieved throughout the contamianted plume. Also, institutional controls and the monitoring plan will remain in place until MCLs and other pertinent Part 201 criteria are attained throughout the contaminated plume.

The total costs of the remedy with and without implementation of institutional controls associated with the APC are: present worth, $3,704,007 and $9,904,007, capital costs, $398,000, and O&M costs $127,000, and $407,000 respectively. The cleanup goals for this remedy are MCLs.

The residuals from this treatment process will be treated in accordance with LDRs and properly disposed off-site at a RCRA permitted landfill or regenerated in a RCRA permitted treatment unit which is in compliance with 40 CFR Part 264 Subpart X because the residuals will contain listed hazardous wastes.

X. Statutory Determinations

The selected remedy must satisfy the requirements of Section 121(a-e) of CERCLA to:

A. Protect human health and the environment;
B. Comply with ARARs;
C. Be cost-effective;
D. Utilize permanent solutions and alternate treatment technologies to the maximum extent practicable; and,
E. Satisfy a preference for treatment as a principle element of the remedy.

The implementation of Alternatives 6 and 10 at the OCI Site satisfies the requirements of CERCLA as detailed below:

A. Protection of Human Health and the Environment

Implementation of the selected alternatives will reduce and control potential risks to human health posed by exposure to contaminated soil, and ground water. Extraction and treatment of contaminated ground water will be conducted to meet federal and state Ground-Water Cleanup Standards. Soil and debris at the Site will be excavated and backfilled so that the direct contact exposure risk will be reduced to 10^{-4} and migration of contaminants to ground water will be mitigated.

With regard to the community and onsite workers, all alternatives will pose potential risks from dust and air emissions generated during excavation activities. Perimeter air monitoring will be needed during remedial activities to determine if steps are needed to protect the community from adverse air emissions. Workers will be required to wear the proper protective health and safety equipment to protect their safety. None of these short-term risks will result in unacceptable exposures to human health or the environment.

B. Compliance With ARARS

The remedies selected for final action, Alternatives 6 and 10, will comply with ARARS that are pertinent to this scope of action. The ARARs for the final response action are listed below.

B.1 Chemical-specific ARARS

Chemical-specific ARARs regulate the release to the environment of specific substances having certain chemical characteristics. Chemical-specific ARARs typically determine the extent of cleanup at a site.

B.1.a Soils

The soil clean-up standards for the OCI Site will be based on risk based criteria for an industrial setting.

B.1.b Groundwater

Maximum Contaminant Levels (MCLs), and the non-zero Maximum Contaminant Level Goals (MCLGs), the Federal drinking water standards promulgated under the Safe Drinking Water Act (SDWA), are applicable to municipal water supplies servicing 25 or more people. At the OCI Site, MCLs and MCLGs are not applicable, but are relevant and appropriate, since the sand and gravel aquifer is a Class IIB source which could potentially be used for drinking in the area of concern (the contaminant plume). MCLGs are relevant and appropriate when the standard is set at a level greater than zero (for non-carcinogens), otherwise, MCLs are relevant and appropriate. The point of compliance for ground water standards may be

attained at an APC in accordance with Part 201, which is applicable, rather than throughout the plume. The timeframe for compliance will depend on the point of compliance.

B.1.b Surface Water

i. State ARARs

Section 303 of the CWA requires the State to promulgate state water quality standards for surface water bodies, based on the designated uses of the surface water bodies. CERCLA remedial actions involving surface water bodies must ensure that applicable or relevant and appropriate state water quality standards are met. The standards established pursuant to R323.2102-.2189 of the Michigan Water Resources Commission Act, Public Act 245 of 1929, as amended, would be applicable to this Site. The Grand River near the OCI Site is designated a cold water fishery as is Roy's Creek where the groundwater treatment system discharges.

B.2 Location-specific ARARs

Location-specific ARARs are those requirements that relate to the geographical position of a site. There are no location-specific ARARs for this Site.

B.3 Action-specific ARARs

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances.

i. Federal and State RCRA ARARs

The substantive requirements of RCRA waste generation and temporary storage regulations under 40 CFR Part 262 and MAC R299.9601-.11107 are applicable when managing the treatment residuals from the ground water system (e.g., residual carbon). Also, Federal and State RCRA LDRs governing off site disposal are applicable to the disposal of treatment residuals.

ii. State ARARS

The State is authorized to implement the National Pollutant Discharge Elimination System (NPDES) program. The requirements of a Michigan Pollutant Discharge Elimination System (MPDES) permit, under MAC R323.2102-.2189 has been applied to the discharge of the treated water into Roy's Creek. Effluent limits for surface water discharge have been established by the MDEQ, with approval by EPA.

Additional action-specific ARARSs are found in the FS.

C. Cost-effectiveness

EPA believes the selected remedy is cost-effective in eliminating the principle threats, and protecting residents and the environment from the contaminated soil at the Site. Cost-effectiveness compares the effectiveness of an alternative in proportion to its cost of providing its environmental benefits. Alternative 6 was the least costly of the seven alternatives that met the objective of the remedial action of eliminating the principle threat at the Site. Alternative 10 was the only alternative for groundwater because it was determined in the FS that the existing system was capable of achieving compliance with the groundwater cleanup goal. Alternatives 6 and 10 provide overall effectiveness proportional to its cost and represents a reasonable value.

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

EPA and the State of Michigan believe the selected remedy for the OCI Site represent the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the final action. The Alternative represents the best balance of tradeoffs among the alternatives with respect to the pertinent criteria given the limited scope of the action. (See above).

E. Preference for Treatment as a Principal Element

The principal threat at the OCI Site is the contaminated soil due to direct exposure. The remedies selected in this ROD satisfy the statutory preference for treatment as a principal element of the remedy by treating the ground water, but does not satisfy the preference by excavating and stabilizing the contaminated soils at the OCI Site.

XI. Documentation of Significant Changes

The preferred alternative in the proposed plan (PP) was to continue operation of the existing groundwater treatment system until the cleanup goals were met. Although not explicitly stated in the PP, the cleanup goals were to be met throughout the plume. Comments received from the two PRP groups requested that institutional controls allow for an APC because the UGS is not used as a drinking water source, is not expected to be used as a drinking water source and the Site is remote. As a result of this comment the Selected Alternative was modified in Section IX to be a remedy allowing for institutional controls to determine an APC.

APPENDIX
RESPONSIVENESS SUMMARY
ORGANIC CHEMICALS INC. SITE
GRANDVILLE, MICHIGAN

I. Responsiveness Summary Overview

In accordance with CERCLA 117, the U.S. Environmental Protection Agency (EPA) held a public comment period from July 15, 1996 through August 28, 1996 for interested parties to comment on the Proposed Plan (PP) for the final remedial action at the Organic Chemicals Inc. (OCI) Site in Grandville, Michigan (the Site").

The PP provides a summary of the background information leading up to the public comment period. Specifically, the PP includes information pertaining to the history of the OCI Site, the scope of the proposed cleanup action and its role in the overall Site cleanup, the risks presented by the Site, the descriptions of the remedial alternatives evaluated by EPA, the identification of EPA's preferred alternative, the rationale for EPA's preferred alternative, and the community's role in the remedy selection process.

EPA held a public meeting at 7:00 p.m. on July 16, 1996, at the Grandville City Council Chambers in Grandville, Michigan to outline the remedial alternatives for the final action described in the PP and to present EPA's proposed remedial alternatives for treating the groundwater and soil contamination at the OCI Site.

The responsiveness summary, required by the Superfund Law, provides a summary of citizens' comments and concerns identified and received during the public comment period, and EPA's responses to those comments and concerns. All comments received by EPA during the public comment period will be considered in EPA's final decision for selecting the remedial alternative for addressing contamination at the OCI Site.

This responsiveness summary is organized into sections and appendices as described below:

I. RESPONSIVENESS SUMMARY OVERVIEW. This section outlines the purposes of the Public Comment period and the Responsiveness Summary. It also references the appended background information leading up to the Public Comment period.

II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS. This section provides a brief history of community concerns and interests regarding the OCI Site.

III. SUMMARY OF MAJOR QUESTIONS AND COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND EPA RESPONSES TO THESE COMMENTS. This section summarizes the oral comments

received by EPA at the July 16, 1996 public meeting, and provides EPA's responses to these comments.

IV. WRITTEN COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND EPA RESPONSES TO THESE COMMENTS. This section contains the written comments received by EPA, as well as EPA's response to those written comments.

II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

Local awareness of the OCI site has been minimal from the onset because the area has been industrial since 1939 and has not impacted the general public. More interest has been shown by adjacent industries and the OCI's former customers that have been named as potentially responsible parties.

A public availability session was held on May 10, 1989, to inform the public of the remedial investigation and sampling and to answer questions concerning the site. Most of the individuals that attended the session included interested land owners adjacent to OCI and were interested in the time frame to perform the investigation and begin remediation.

As part of EPA's responsibility and commitment to the Superfund Program, the community has been kept informed of ongoing activities conducted at the OCI site. EPA has established a repository at the Grandville Public Library, where relevant site documents may be viewed. Documents stored at the repository include:

- The final Phase I Focused Feasibility Study for the site;
- The PP for the interim action at the site;
- Fact sheets summarizing the technical studies conducted at the site;
- The Phase II Remedial Investigation (RI) and Feasibility Study (FS);
- The PP for the final action at the site;
- Public Meeting Transcript for both Public Meetings.

EPA's selection of a remedy to cleanup the contamination at the OCI site will be presented in a document known as a Record of Decision (ROD). The ROD and the documents containing information that EPA used in making its decision (except for documents that are published and generally available) will also be placed in the information repository, as will this responsiveness summary.

III. Summary of Major Questions and Comments Received During the Public Comment Period and EPA Responses to These Comments

Oral comments raised during the public comment period for the OCI Site final remediation have been summarized below together with EPA's response to these comments.

COMMENT: Mr. Ken Cox stated support for preferred alternative of excavating the contaminated soil and on-site remediation by solidification/stabilization.

RESPONSE: EPA acknowledges the comment.

IV. Written Comments Received During the Public Comment Period.

The written comments regarding the OCI site have been summarized below, together with EPA's responses to these comments.

COMMENT: The Toll PRP Group expressed support for the preferred alternative for soil remediation.

RESPONSE: EPA acknowledges the comment.

COMMENT: One comment expressed by the Reclaim and Toll PRP Group was that the cleanup goals for the groundwater should not have to be obtained throughout the contaminated groundwater plume but should be determined by institutional controls because the aquifer is not used as a drinking water source. The Toll Group also requested that the cleanup goals be no more stringent than the MDEQ industrial cleanup goals for the soil and groundwater.

RESPONSE: As a result of this comment the selected remedy was modified to allow for an alternate pont of compliance to be determined through institutional controls to attain the cleanup goals. A monitoring plan that meets the substantive requirements of Part 201 will be developed to ensure the effectiveness of the remedial action.

The groundwater cleanup goals were changed from the residential risk based goal to the Maximum Contaminant Levels (MCLs) determined by the Safe Drinking Water Act. The change was made because MCLs have been used by Region V in the past for similar aquifer conditions. The soil cleanup goals are for an industrial setting.

COMMENT: The Toll Group has requested that deed restrictions be placed on the OCI property to keep it industrial.

RESPONSE: Deed restrictions are not necessary because the position of the City of Grandville is that the zoning of the property will remain industrial.

COMMENT: The Toll Group requested that the groundwater cleanup goals be re-evaluated as part of the five year review.

RESPONSE: Re-evaluation of the groundwater cleanup goals is not a function of the five year review.

COMMENT: The calculated risk and hazard associated with ingestion of groundwater from the upper groundwater system was presented in the Feasibility Study. The UGS does not present an environmental risk, and as such, the evaluation was inappropriate.

RESPONSE: The MDEQ does consider this aquifer to be a usable aquifer and therefore, the evaluation is appropriate.

COMMENT: The groundwater remedy selected in the FS for OU2, was selected in the FS without benefit of the development of other alternatives for comparison of feasibility, cost, contrary to the requirements of the NCP. Also, the FS is not the instrument for selection of remedies in the NCP, but rather is meant solely for the development and comparison of remedial alternatives. The OU1 groundwater remedy was selected as an interim action until OU2 could be implemented, and was not meant to be a final remedy (CERCLA 106 Order, Page 7, Item G).

RESPONSE: The Alternatives Array Technical Memorandum (AATM) issued October 12, 1995, presented the groundwater remedial action objectives and the alternative based on those objectives. The FS did not select the groundwater remedy. It was the only remedial alternative presented in the FS for the groundwater because it was properly screened and made available for comment in the AATM in accordance with the NCP.

The CERCLA 106 Order, Page 7, Item G states:

> "USEPA has divided the site into two operable units. The first operable unit is an interim action that is intended to address the migration of contaminated groundwater in the UGS. The second operable unit will address soil contamination and a final groundwater remedy."

The final groundwater remedy selected in OU2 is consistent with the OU1 interim action groundwater remedy pursuant to 40 CFR 300.430 (f)(ii)(C)(1).

COMMENT: The Reclaim PRP Group provided solvents to OCI for recycling. The Reclaim PRP group should not be considered PRPs for the OU2 soils Remedial Action because they did not provide the constituents which are identified in the FS as contributors to degradation of human health or the environment.

RESPONSE: The EPA considers members of the Reclaim PRP Group to be PRPs, because those PRPs arranged for the disposal or treatment of hazardous substances at the site, and those PRPs' hazardous substances, or hazardous substances similar to those of the PRPs, are present at the site. Because the site contamination is not divisible between OCI's solvent recycling operation and its chemical manufacturing operation, the reclaim and toll manufacturing PRPs are jointly and severally liable for the entire costs of site remediation.

COMMENT: The inorganic chromium (VI) was not analyzed in the RI. Only chromium (III) was analyzed for at the site. Chromium (VI) should not be listed as a compound of concern.

RESPONSE: It was assumed to be present at the site due to the difficulty associated with sampling for chromium (VI). If it can be reliably demonstrated to both EPA and MDEQ that chromium (VI) does not exist at OCI, it can be proposed that it be eliminated as a contaminant of concern.

COMMENT: The FS states that lead is one of the compounds that poses greater than 1 percent of the carcinogenic risk. Examination of the FS current trespasser and future worker scenarios reveals that lead does not contribute to the total carcinogenic risk under either scenario.

RESPONSE: Correct, lead does not contribute to the total carcinogenic risk under either scenario.

COMMENT: A cleanup depth of 10 feet is used in the future worker scenario. However, future workers will not be exposed to Site soils to a depth of 10 feet on a regular basis year after year.

RESPONSE: The cleanup depth scenario is very conservative.

COMMENT: Changes in soil volume and increases in leachate failure could increase the cost of Alternative 6 between two and three million dollars. As a result the Reclaim Group advocates the use of the capping alternative as the alternative that best satisfies the various criteria set out in the NCP for selection of the Remedial Action.

RESPONSE: If as a result of the predesign investigation, the cost of solidification/stabilization and disposing of the contaminated soil on-site significantly increases, the Group can request that the capping alternative be implemented in its place. Table 4-10 evaluates the cost of increasing the soil volume 100% for Alternative 6; the resultant change in soil volume would increase the present worth cost to 2.7 million dollars as compared to 2.3 million for capping, which may not warrant a change in the Selected Remedy. The Group can request that the OU2 ROD be amended and that the cap alternative be implemented.

COMMENT: On page 4-16 of the FS the first paragraph states "A 1-foot vegetative cover would eliminate dermal exposure to the solidified mass" and the second paragraph indicates that a 2-foot vegetative cover is required. The Reclaim Group feels that a 1-foot vegetative cover is adequate.

RESPONSE: The amount of vegetative cover should be determined during design.

COMMENT: Asphalt capping is equivalent in achieving ARARs for the soil contaminants of concern to the stabilization remedy. Concrete capping reduces the mobility of the contaminants by removing the exposure pathways. An asphalt cap achieves the overall purpose of preventing exposure to the soil contaminants of concern.

RESPONSE: Capping does not achieve chemical specific ARARS, the stabilization remedy does.

COMMENT: In Table 4-11 of the FS, low rankings for Alternatives 1, 2, and 3 were awarded for short-term effectiveness, and Alternatives 4 through 9 were awarded high rankings but involve excavation, increased traffic noise and dust.

RESPONSE: Table 4-11 is incorrect with regard to short-term effectiveness as the commenter states, although Alternatives 3 through 9 have comparable short term impacts to one another as stated on page 4-41 of the FS.

COMMENT: Alternative 3-Capping is an effective remedial alternative comparable in long-term effectiveness to Alternative 6-Stabilization. Both alternatives provide long term controls to prevent exposure and migration of hazardous constituents contained in soil.

RESPONSE: In Section 4.4.2 of the FS on pages 4-41 and 42 it explains that Alternative 6 has greater long-term effectiveness than Alternative 3 because it eliminates human exposures and migration of hazardous constituents as compared to minimizing exposure and migration.

COMMENT: Alternative 5-Soil Washing is comparable in cost to Alternative 3 and 4 and should be evaluated with a comparable ranking score in the FS.

RESPONSE: Agreed, although Alternative 6 should have a higher score in the FS because it costs less than Alternatives 3, 4, and 5.

COMMENT: One commeter requested that the FS be revised to eliminate reference to n-nitroso-diphenylamine and replace it with diphenylamine.

RESPONSE: The change is unnecessary due to the change in the groundwater cleanup goals changed from residential risk based to MCLs. There is no MCL for either compound.

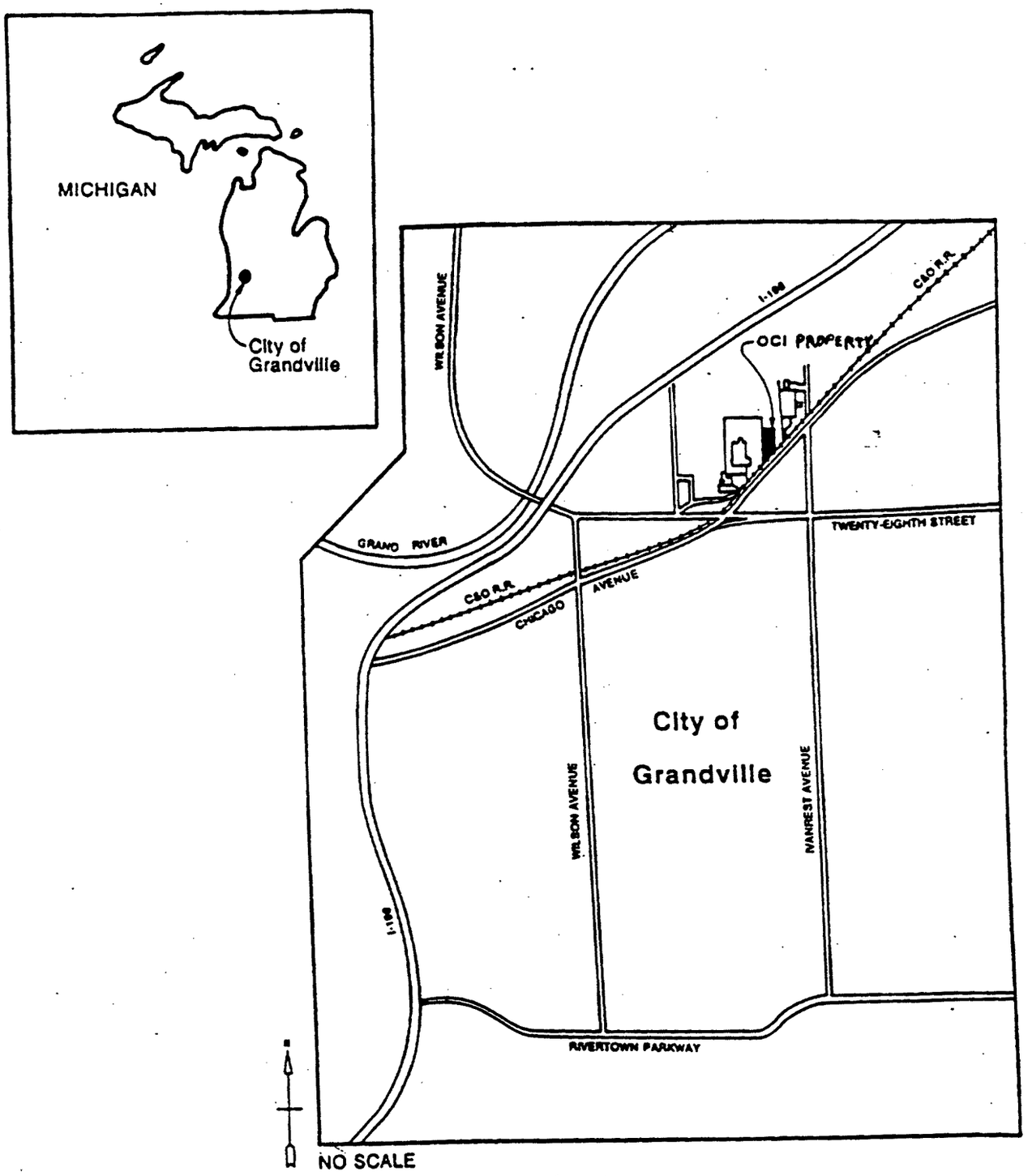


FIGURE 1
OCI SITE LOCATION MAP
ORGANIC CHEMICALS, INC. SITE

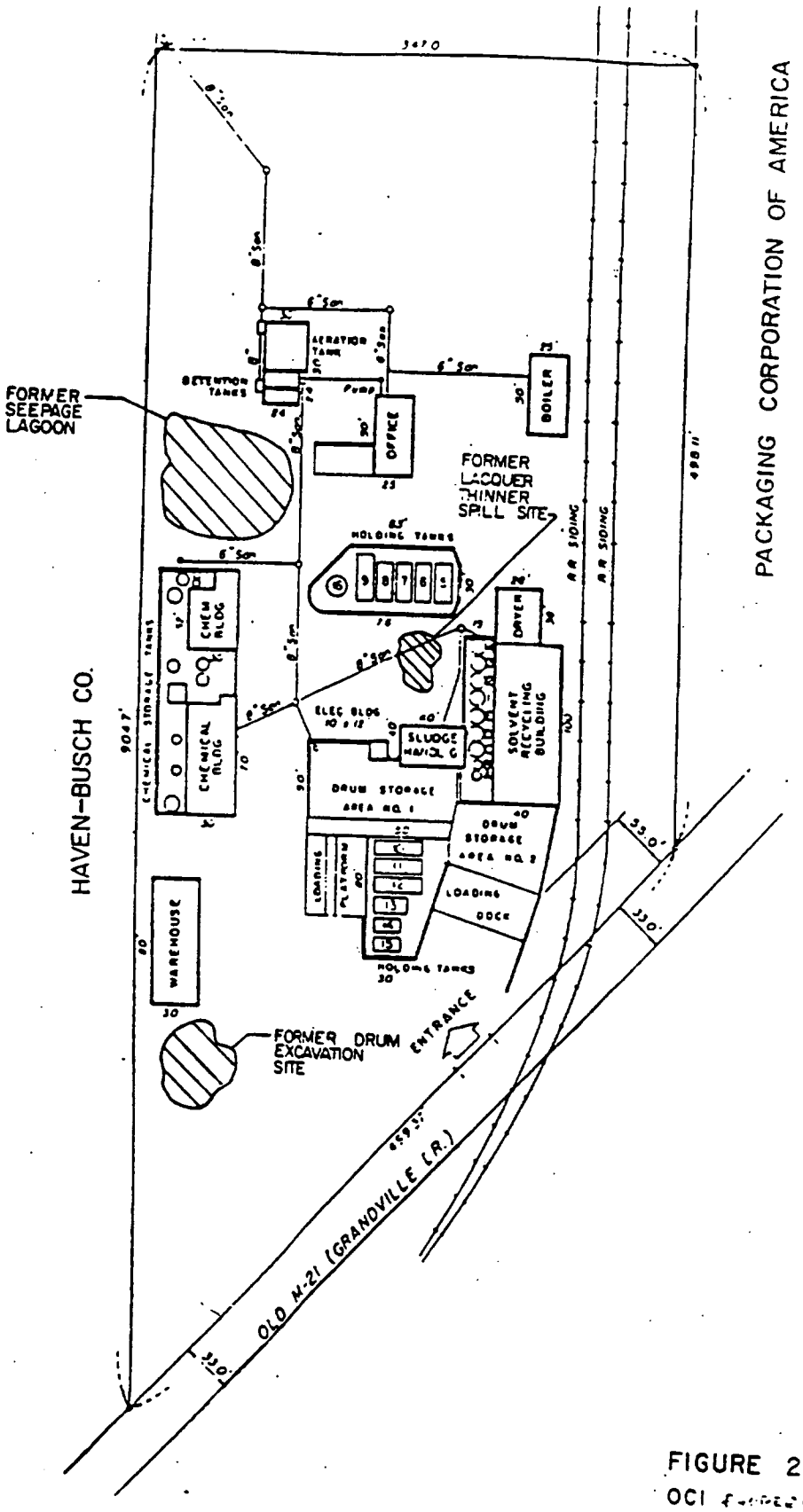
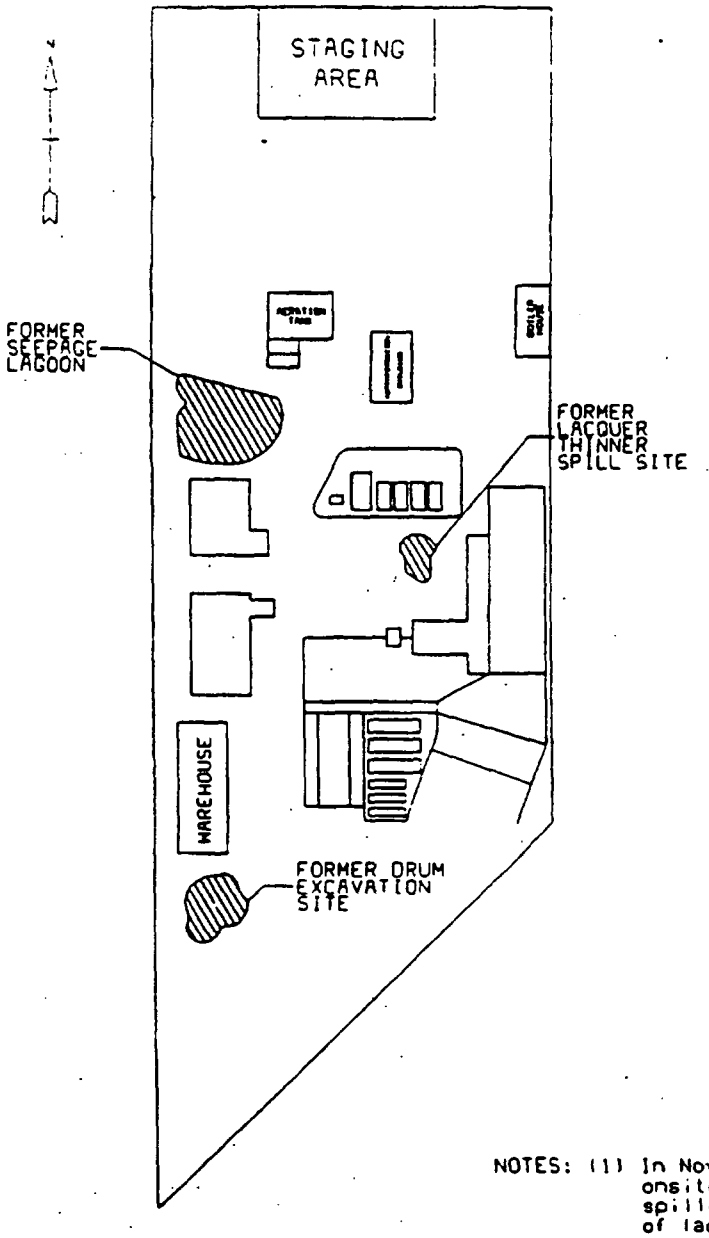


FIGURE 2

OCI [illegible] DETAIL



NOTES: (1) In November 1979, an onsite operator inadvertantly spilled 2,200 gallons of laquer thinner.

(2) In september 1981, 280 cubic yards of seepage lagoon soils and sludges were disposed of at Chem-Met services, Wyandotte, Michigan.

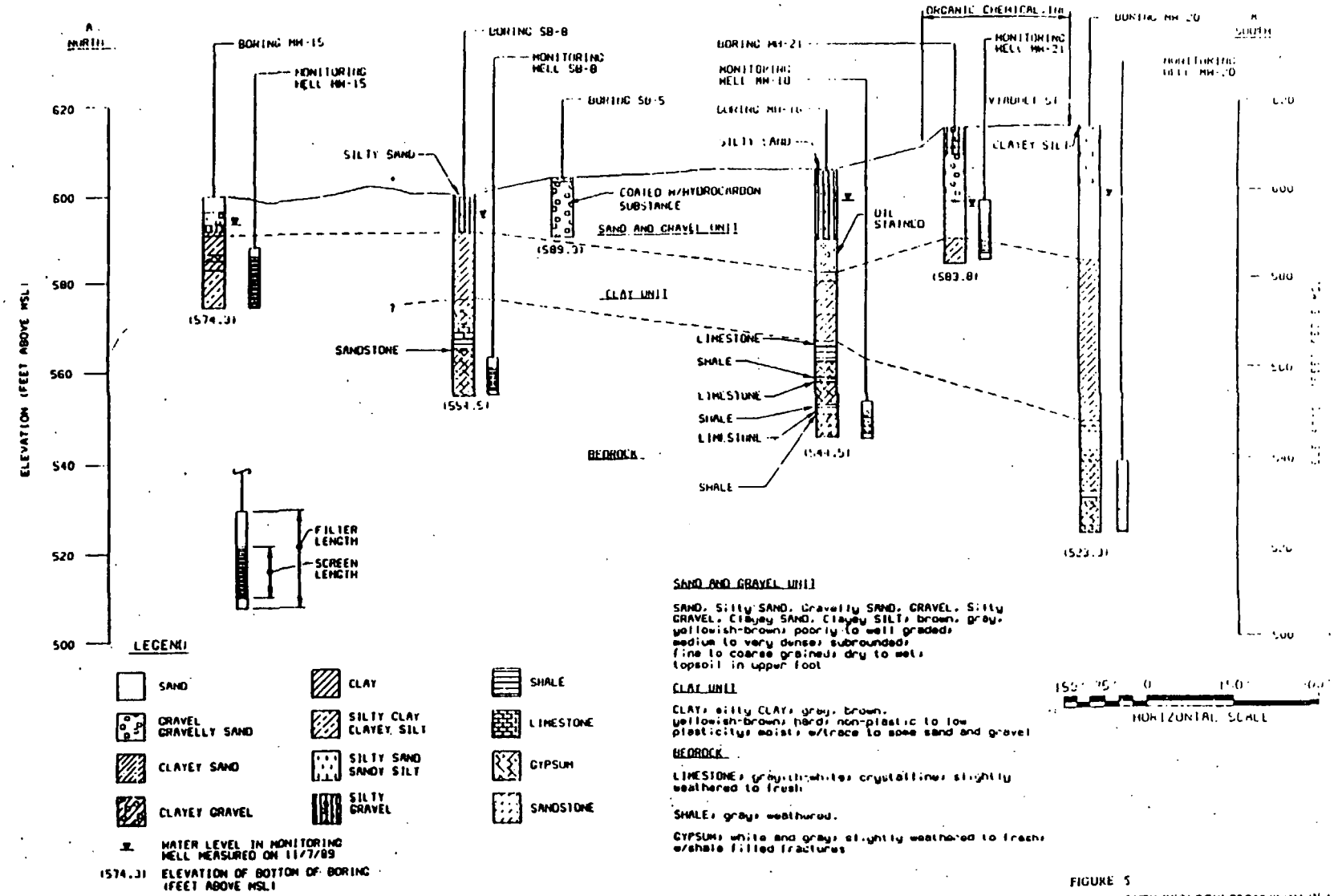
(3) In September 1987, approximately 150 drums were removed

DRAWING NAME: CH100101.DWG
DATE: 6-27-94

0' 100'

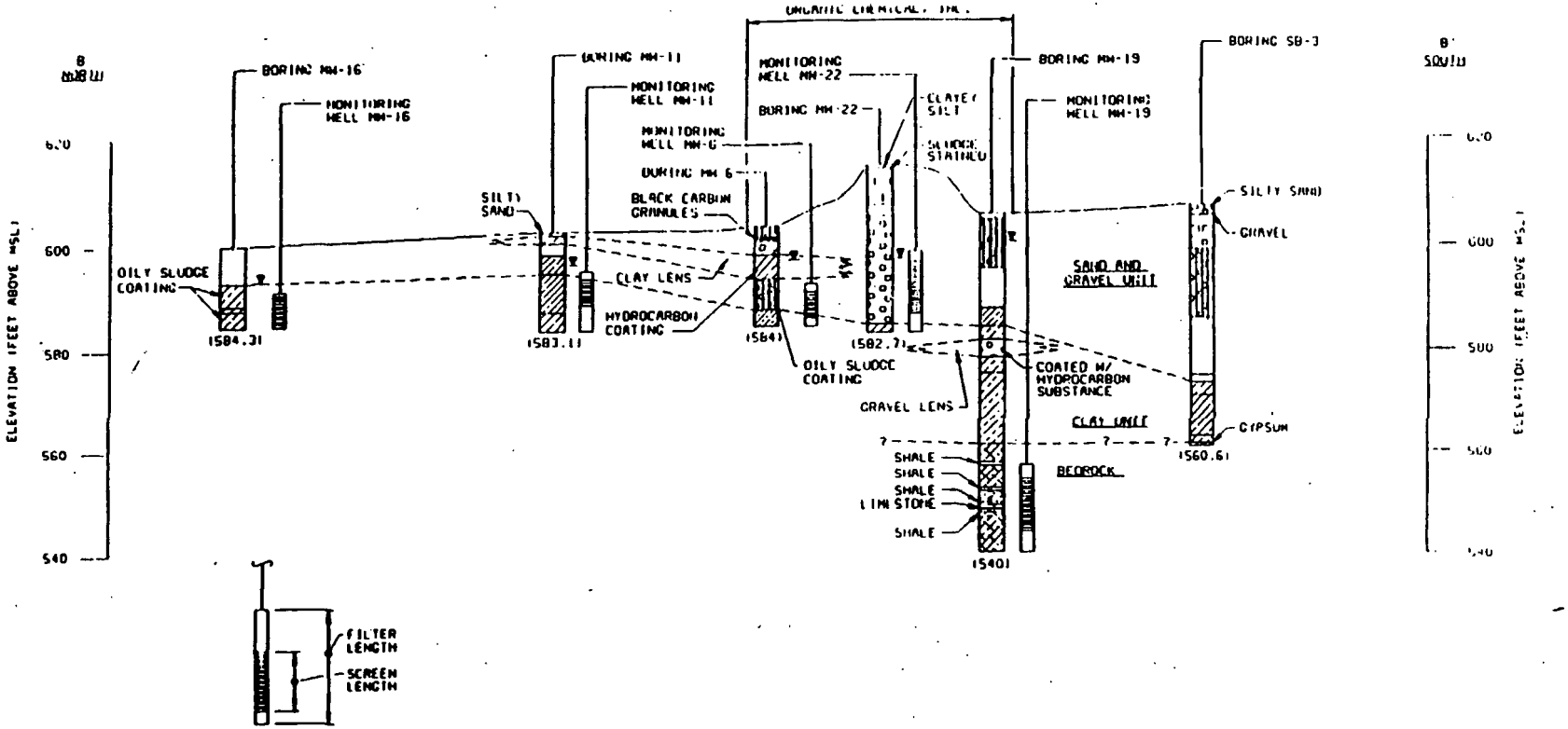
FIGURE 3
FORMER SEEPAGE LAGOON, LACQUER THINNER SPILL, AND DRUM EXCAVATION LOCATIONS

FIGURE 4
PLAN LOCATION OF GEOLOGIC CROSS SECTION
ORGANIC CHEMICALS INC. SITE



CAD DWG NO:C0000329
DATE:02-15-91 MLEE
PLOT SCALE:1=1

FIGURE 5
NORTH-SOUTH GEOLOGIC CROSS SECTION A-A'
ORGANIC CHEMICALS, INC. SITE



LEGEND

- SAND
- GRAVEL, GRAVELLY SAND
- CLAYEY SAND, SANDY CLAY
- SILTY GRAVEL
- CLAY
- SILTY CLAY, CLAYEY SILT
- SILTY SAND, SANDY SILT
- FILL
- SHALE
- LIMESTONE
- GYPSUM

▽ WATER LEVEL IN MONITORING WELL MEASURED ON 11/7/89

(584.1) ELEVATION OF BOTTOM OF BORING (FEET ABOVE MSL)

SAND AND GRAVEL UNIT

SAND, Silty SAND, Clayey SAND, GRAVEL, Silty GRAVEL, Clayey SILT; brown; medium dense to denser; poorly to well graded; subrounded; moist to wet; Topsoil in upper foot

CLAY UNIT

CLAY; Silty CLAY; Sandy CLAY; gray and brown; very stiff to hard; low plasticity; moist; traces of silt, sand and gravel

BEDROCK

SHALE; gray; fractured; weathered to fresh

LIMESTONE; gray

GYPSUM; white; crystalline; slightly weathered and fractured

200' 100' 0 200' 400'

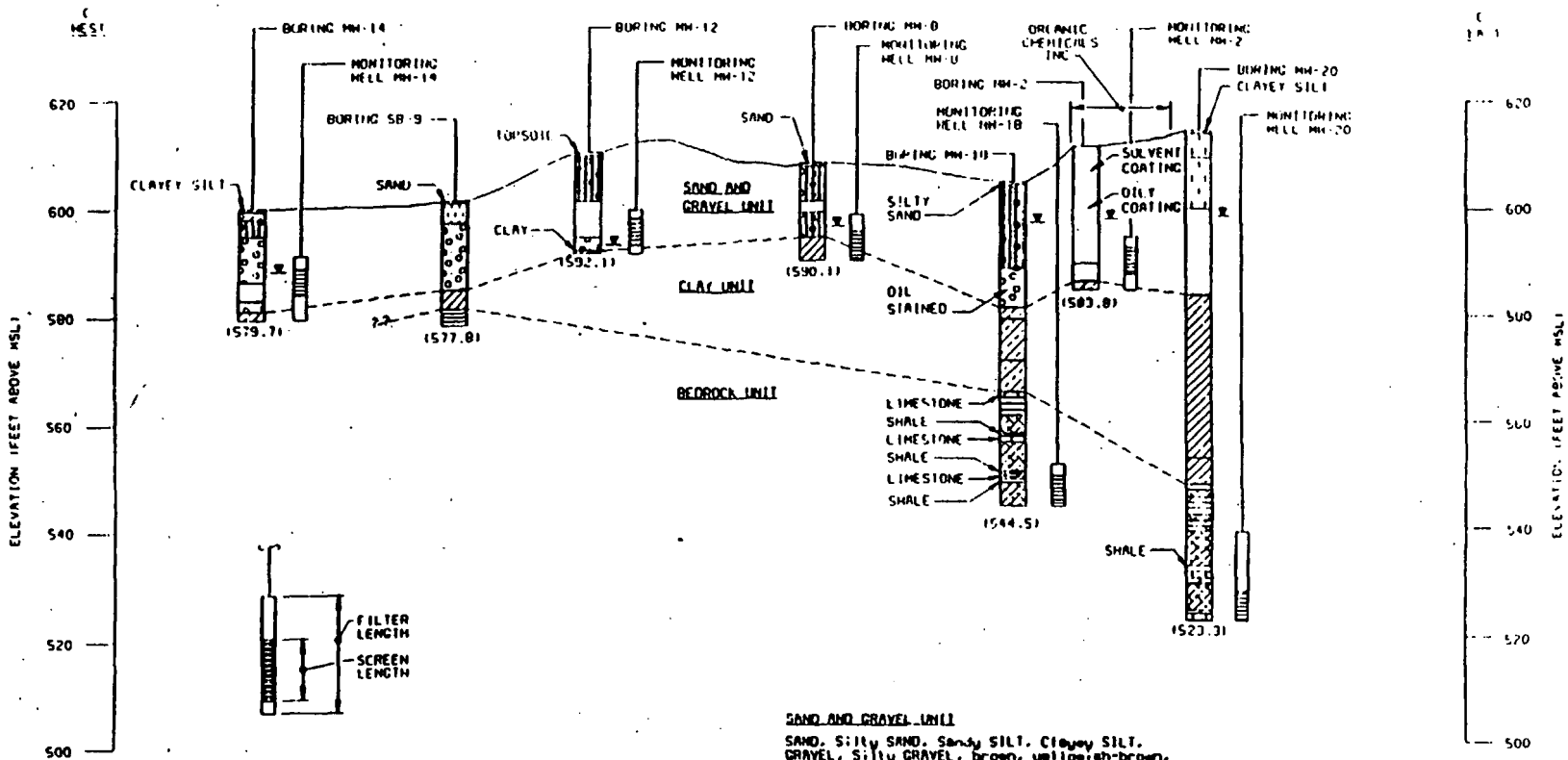
HORIZONTAL SCALE

FIGURE 6

NORTH-SOUTH GEOLOGIC CROSS SECTION B-B'

ORGANIC CHEMICALS, INC. SITE

CAD DWG NO:C0000330
DATE:02-15-91 MLEE
PLOT SCALE:1=1



LEGEND

SAND	CLAY	SHALE
GRAVEL	SILTY CLAY CLAYEY SILT	LIMESTONE
SILTY GRAVEL	SILTY SAND SANDY SILT	GYPSUM

WATER LEVEL IN MONITORING WELL MEASURED ON 11/7/89

(579.7) ELEVATION OF BOTTOM OF BORING (FEET ABOVE MSL)

SAND AND GRAVEL UNIT

SAND, Silty SAND, Sandy SILT, Clayey SILT, GRAVEL, Silty GRAVEL, brown, yellowish-brown, black; loose to very dense; poorly to well graded; fine to coarse grained; subrounded; dry to wet; w/traces of cobbles and clay; topsoil in upper foot at some locations

CLAY UNIT

CLAY; Silty CLAY; brown, gray, bluish-gray, greenish-gray; very stiff to hard; low plasticity; moist; w/traces of silt, gravel and sand

BEDROCK

SHALE; bluish-gray, gray, black, green; slightly weathered to fresh

LIMESTONE; grayish-white; finely crystalline; fresh; w/gypsum and sandstone

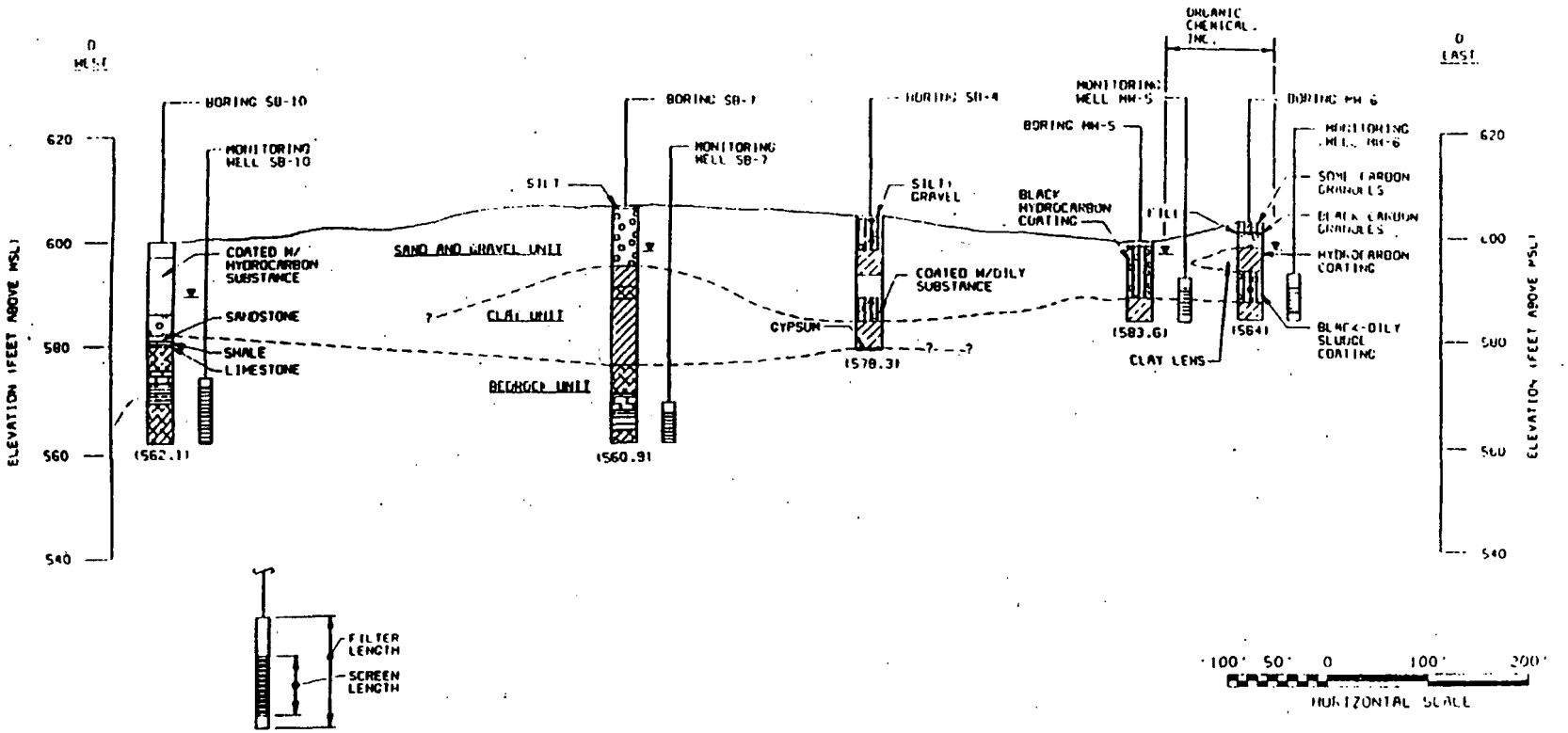
GYPSUM; white; crystalline; weathered to fresh

200' 100' 0 200' 400'

HORIZONTAL SCALE

FIGURE 7
EAST-WEST GEOLOGIC CROSS SECTION C-C
ORGANIC CHEMICALS, INC SITE

CAD DWG NO:C0000331
DATE:10-1-90 MLEE
PLOT SCALE:1=1



LEGEND

SAND	CLAY	SHALE
GRAVEL	SILTY CLAY / CLAYEY SILT	LIMESTONE
CLAYEY SAND	SILTY SAND / SANDY SILT	GYPSUM
FILL	SILTY GRAVEL	SANDSTONE

▼ WATER LEVEL IN MONITORING WELL MEASURED ON 11/7/89

(562.1) ELEVATION OF BOTTOM OF BORING (FEET ABOVE MSL)

SAND AND GRAVEL UNIT

SAND, Silty Sand, Clayey Sand, GRAVEL; Silty GRAVEL, SILT; brown and black; loose to medium dense; poorly to well graded; fine to course grained; subrounded; dry, moist and wet; w/traces of clay, silt, cobbles and fill; topsoil in upper foot.

CLAY UNIT

CLAY; Silty CLAY; brown, gray, bluish-gray; very stiff to hard; low to high plasticity; moist; w/traces of sand, gravel and gypsum.

BEDROCK UNIT

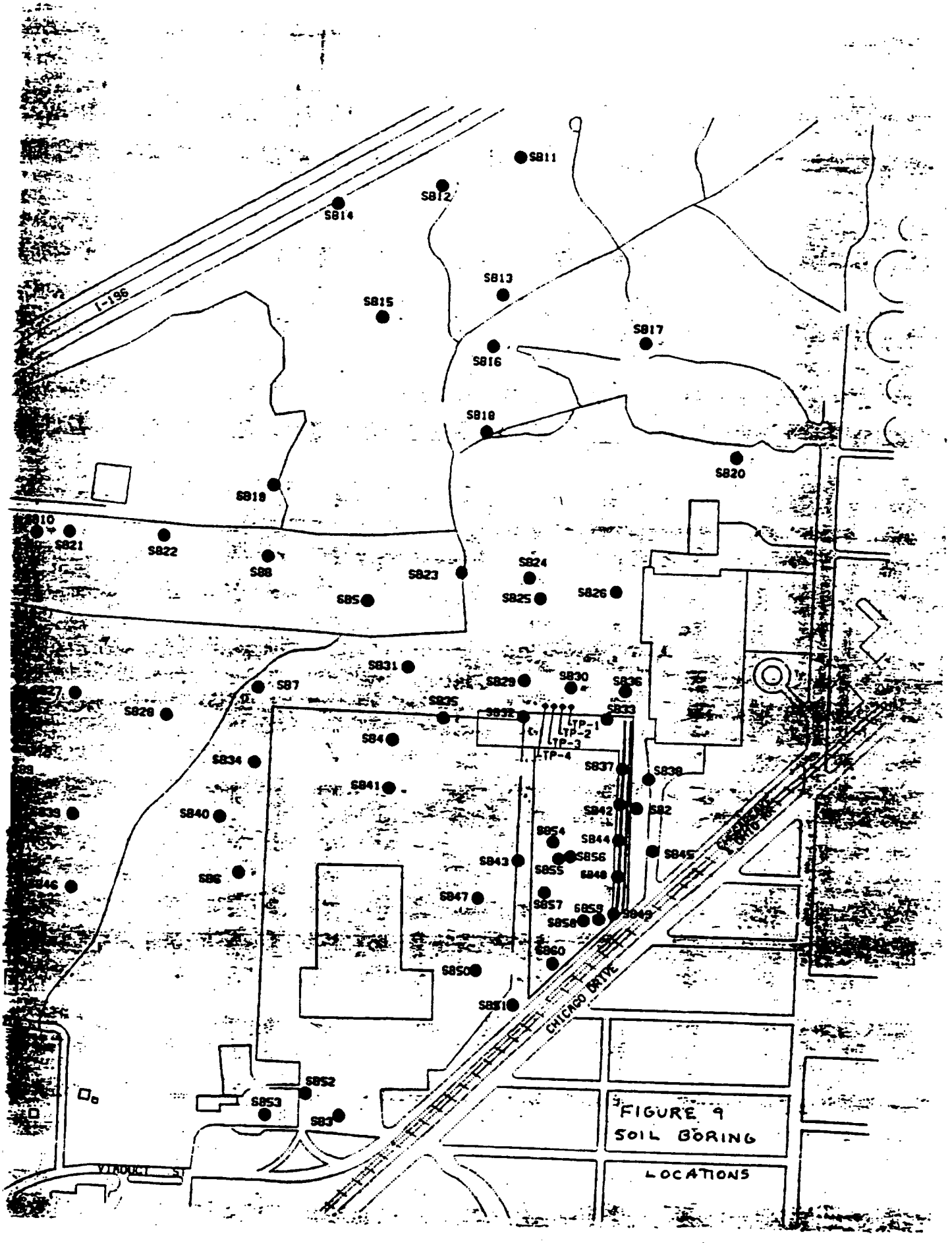
SHALE; gray, dark-gray; fractured.

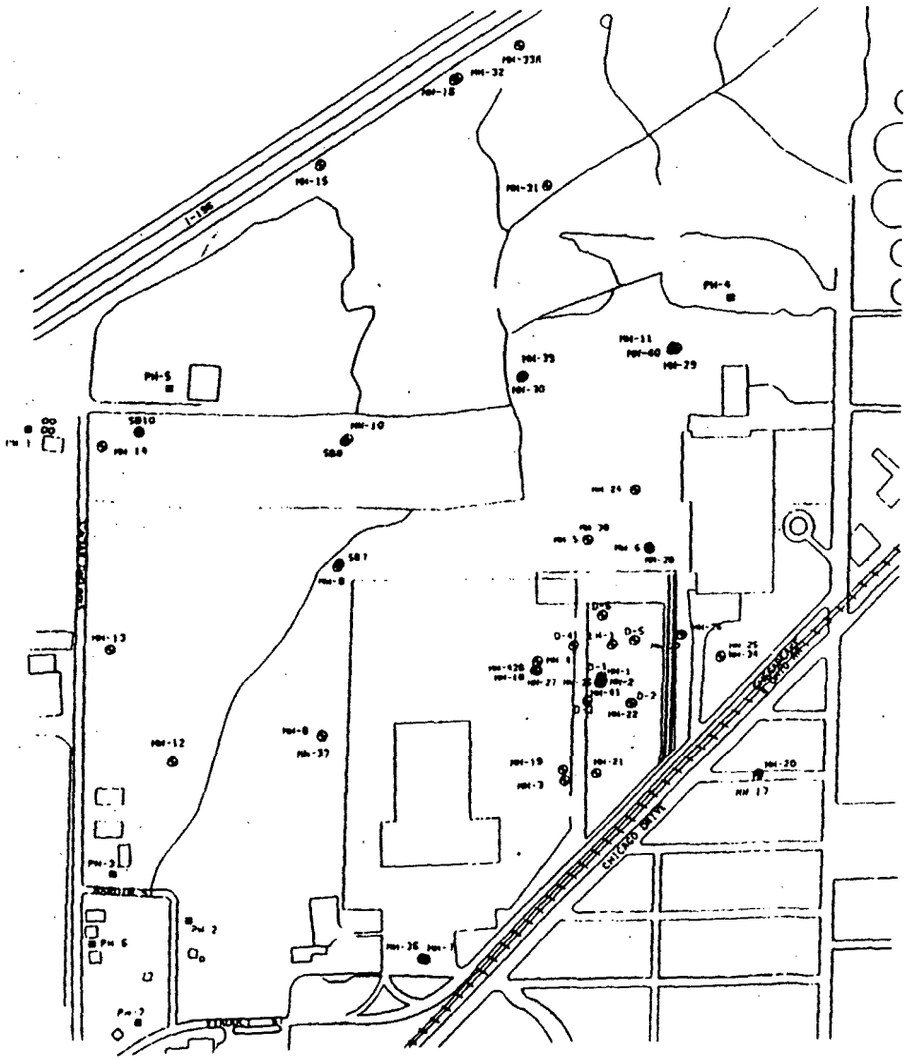
LIMESTONE; shaley; gray; crystalline; w/ sandstone lens.

GYPSUM; white, pink; crystalline; weathered.

CAD DWG NO:C0000332
DATE:10-1-90 MLEE
PLOT SCALE:1=1

FIGURE 8
EAST-WEST GEOLOGIC CROSS SECTION D-D'
ORGANIC CHEMICALS, INC. SITE


I-196
SB11
SB12
SB14
SB13
SB15
SB17
SB16
SB18
SB20
SB19
SB10
SB21
SB22
SB8
SB23
SB24
SB5
SB25
SB26
SB31
SB7
SB29
SB30
SB36
SB28
SB35
SB32
SB33
TP-1
TP-2
TP-3
TP-4
SB4
SB34
SB37
SB38
SB41
SB39
SB40
SB42
SB2
SB54
SB44
SB45
SB56
SB43
SB55
SB48
SB6
SB46
SB47
SB57
SB58
SB59
SB49
SB60
SB50
SB51
CHICAGO DRIVE
SB52
SB53
SB3
VIADUCT
FIGURE 9
SOIL BORING
LOCATIONS



LEGEND:

- ⊕ MONITORING WELL LOCATION
- ● MONITORING WELL LOCATION FROM CONVERTED SOIL BORING
- ■ PRIVATE WELL

USEPA Wells Represented on Figure			
Constructed during the Phase I RI	Well Screen	Constructed during the Phase II RI	Well Screen
MW1	UGS	MW24	UGS
MW2	UGS	MW25	UGS
MW3	UGS	MW26	UGS
MW4	UGS	MW27	UGS
MW5	UGS	MW28	UGS
MW6	UGS	MW29	UGS
MW7	UGS	MW30	UGS
MW8	UGS	MW31	UGS
MW9	UGS	MW32	UGS
MW10	UGS	MW33	UGS
MW11	UGS	MW34	LGS
MW12	UGS	MW35	LGS
MW13	UGS	MW36	LGS
MW14	UGS	MW37	LGS
MW15	UGS	MW38	LGS
MW16	UGS	MW39	LGS
MW17	UGS	MW40	LGS
MW18	LGS	MW41	LGS
MW19	LGS	MW42	LGS
MW20	LGS	D1	UGS
MW21	UGS	D2	UGS
MW22	UGS	D3	UGS
MW23	UGS	D4	UGS
SB7	LGS	D5	UGS
SB8	LGS	D6	UGS
SB10	LGS		

Private Wells Represented on Figure			
PW-1	LGS	PW-5	LGS
PW-2	LGS	PW-6	LGS
PW-3	LGS	PW-7	LGS
PW-4	LGS		

CRA Extraction Well Represented on Figure		
	EW-1	UGS

Note:
UGS= Upper Groundwater System
LGS= Lower Groundwater System

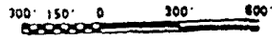
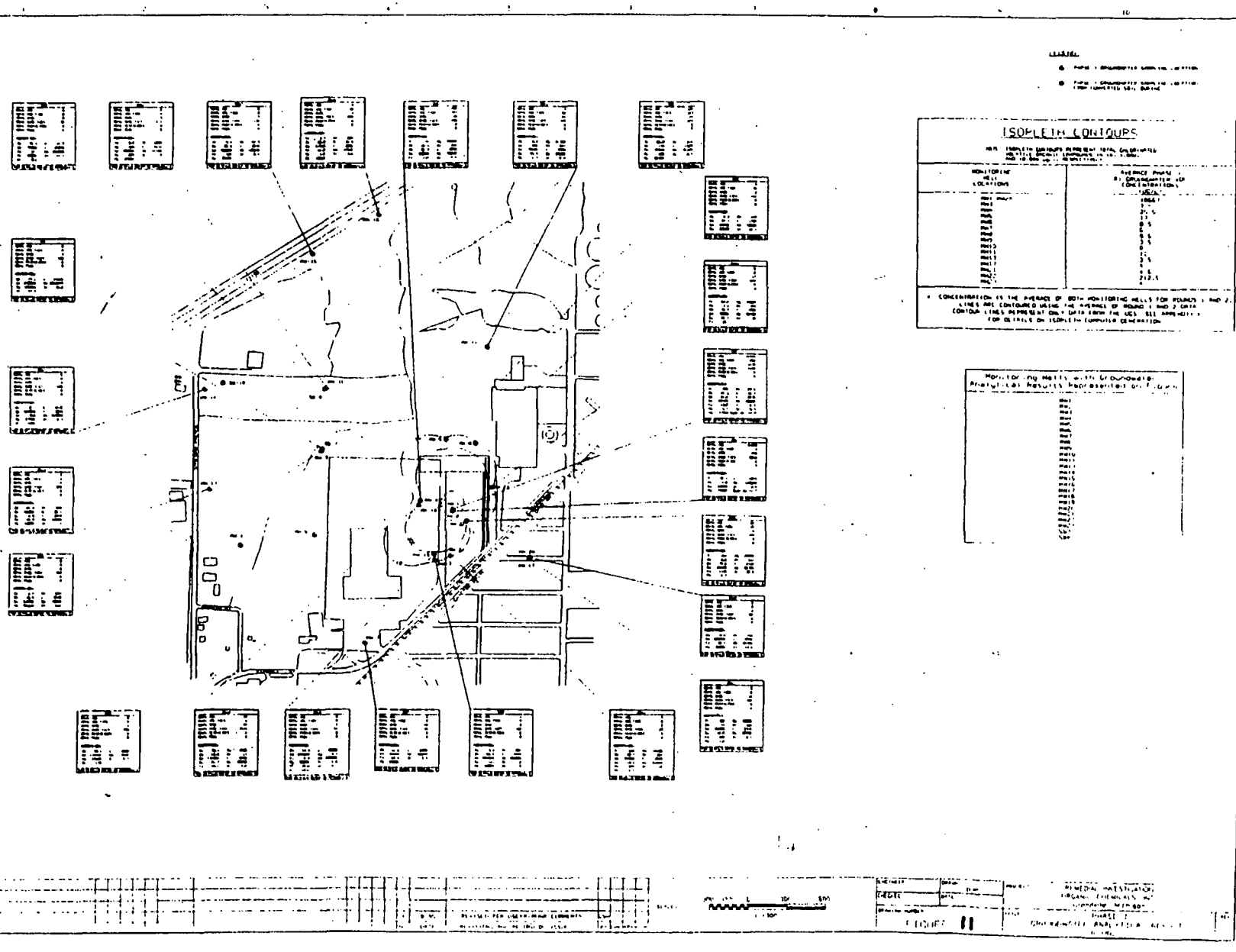
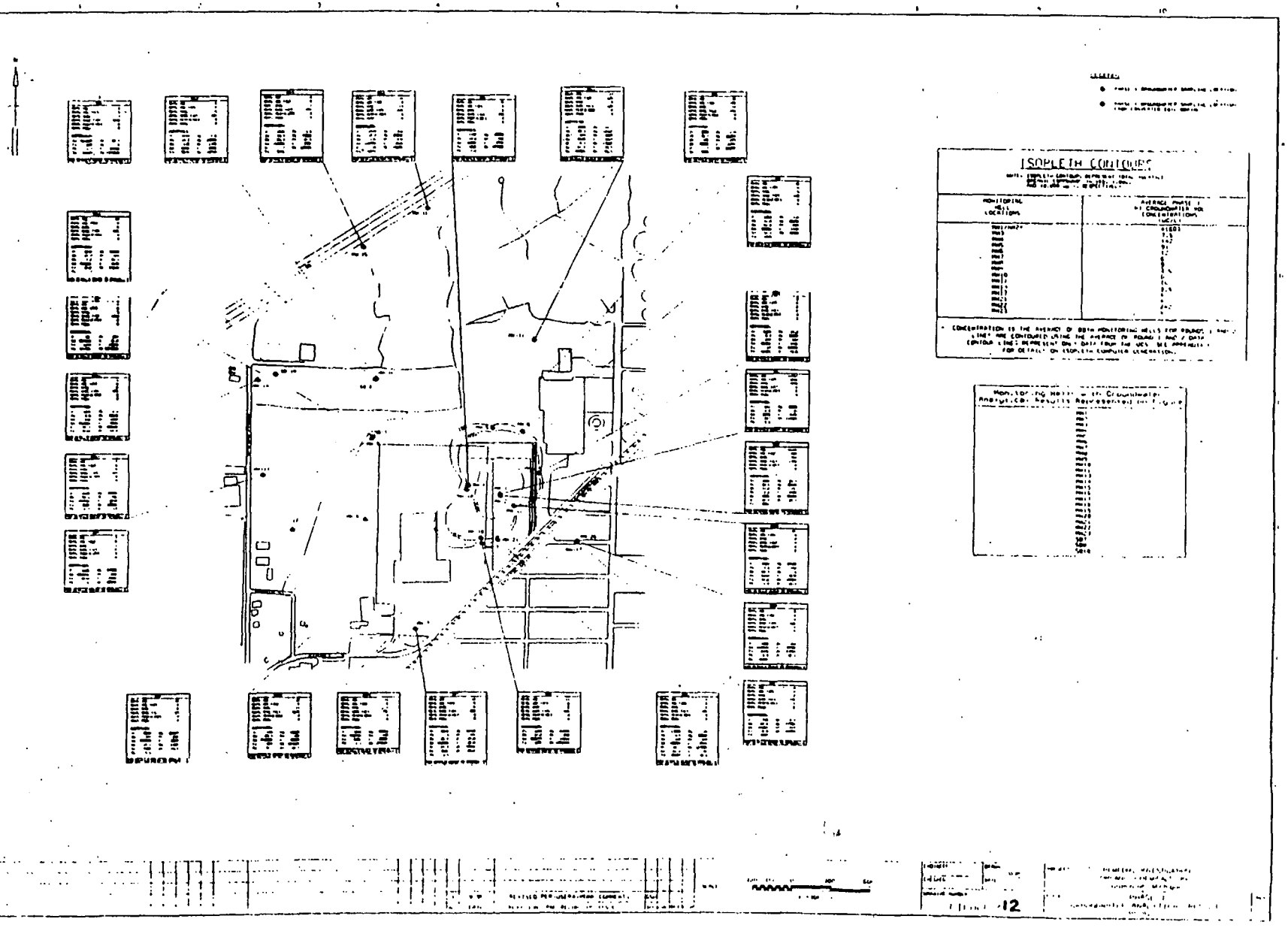


FIGURE 10
MONITORING WELL LOCATIONS


ISOPLETH CONTOURS


ISOPLETH CONTOURS

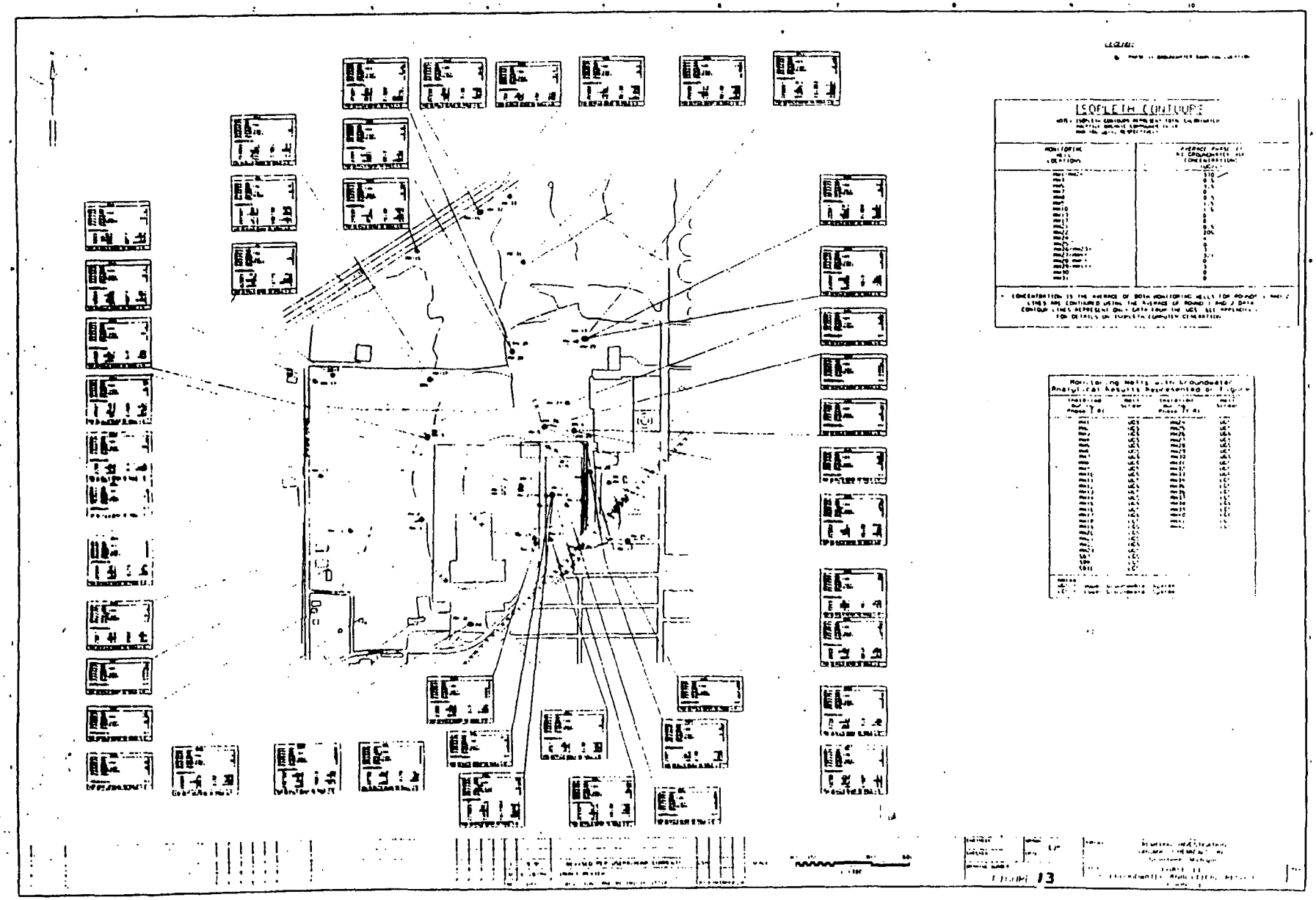
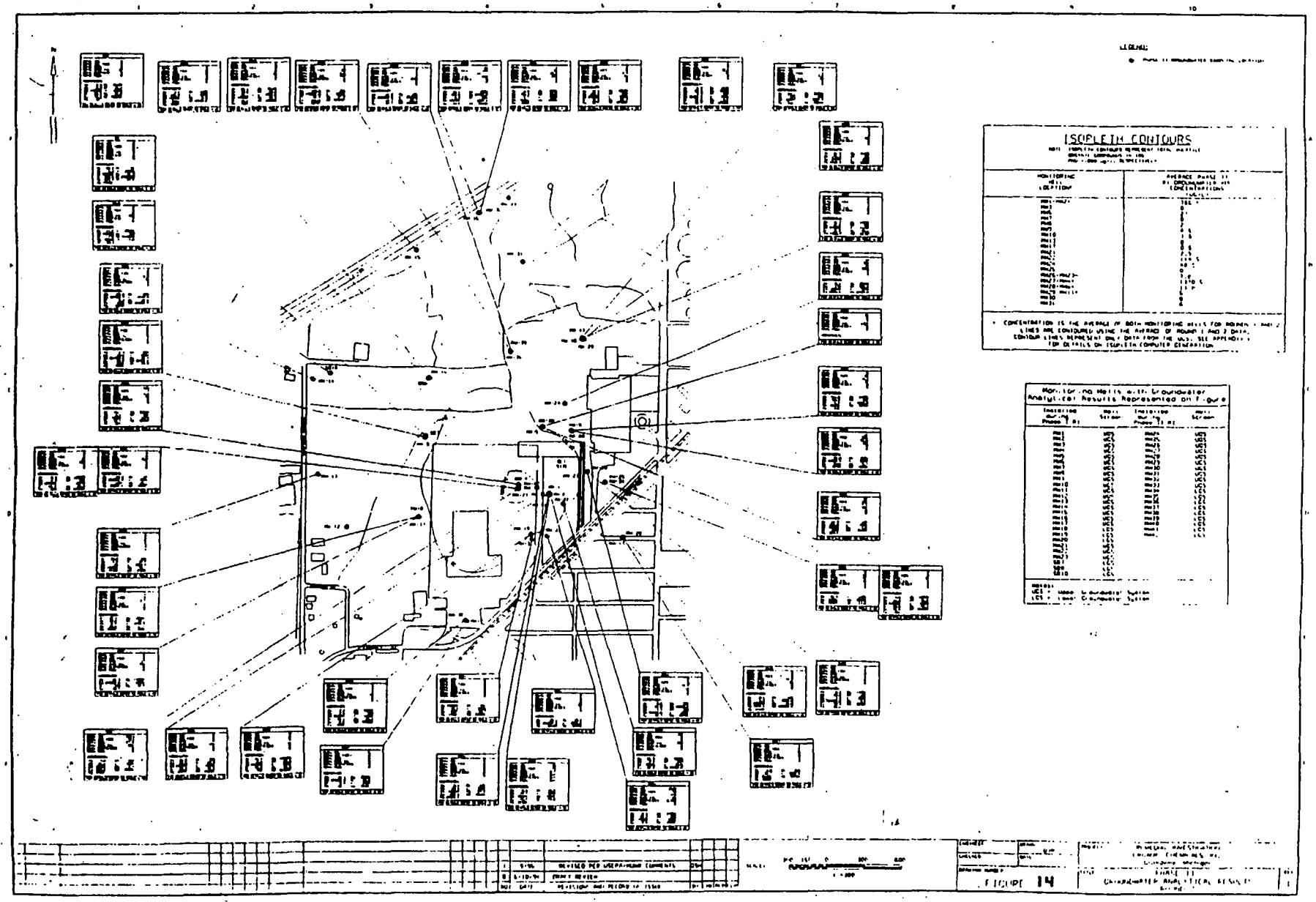
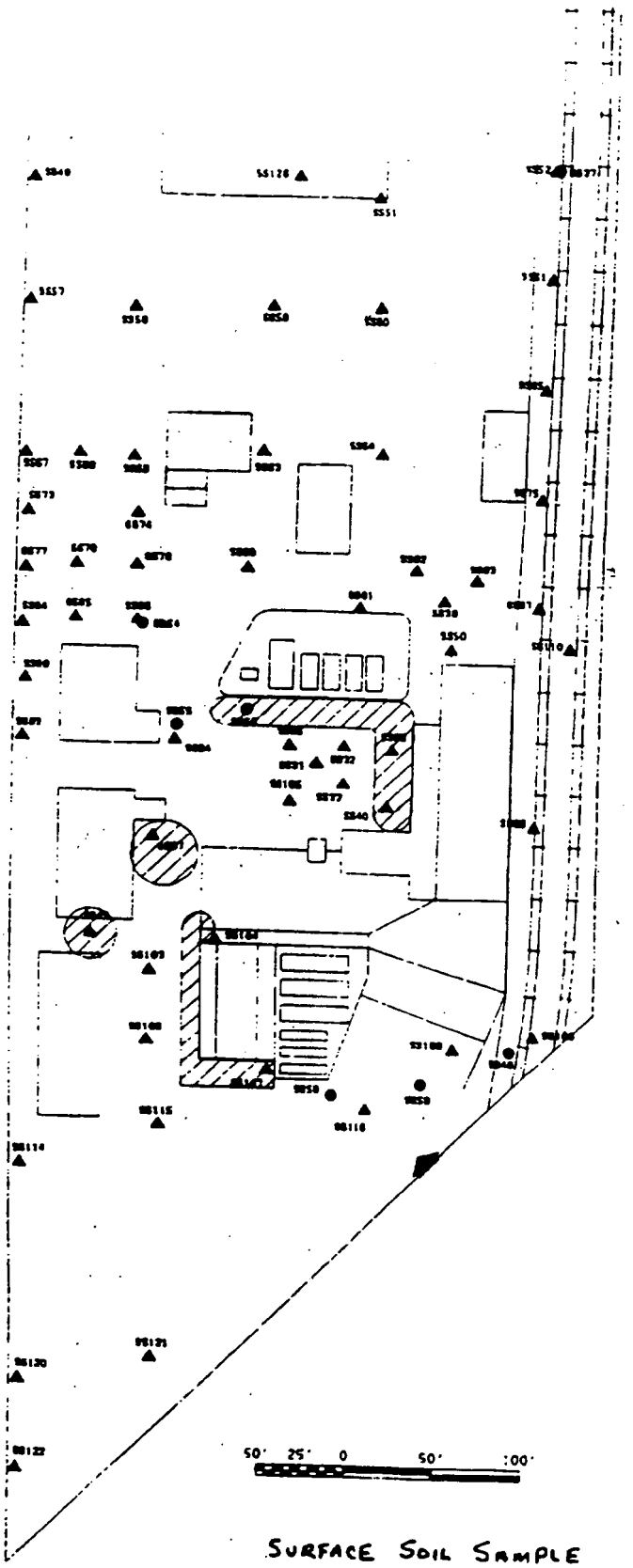


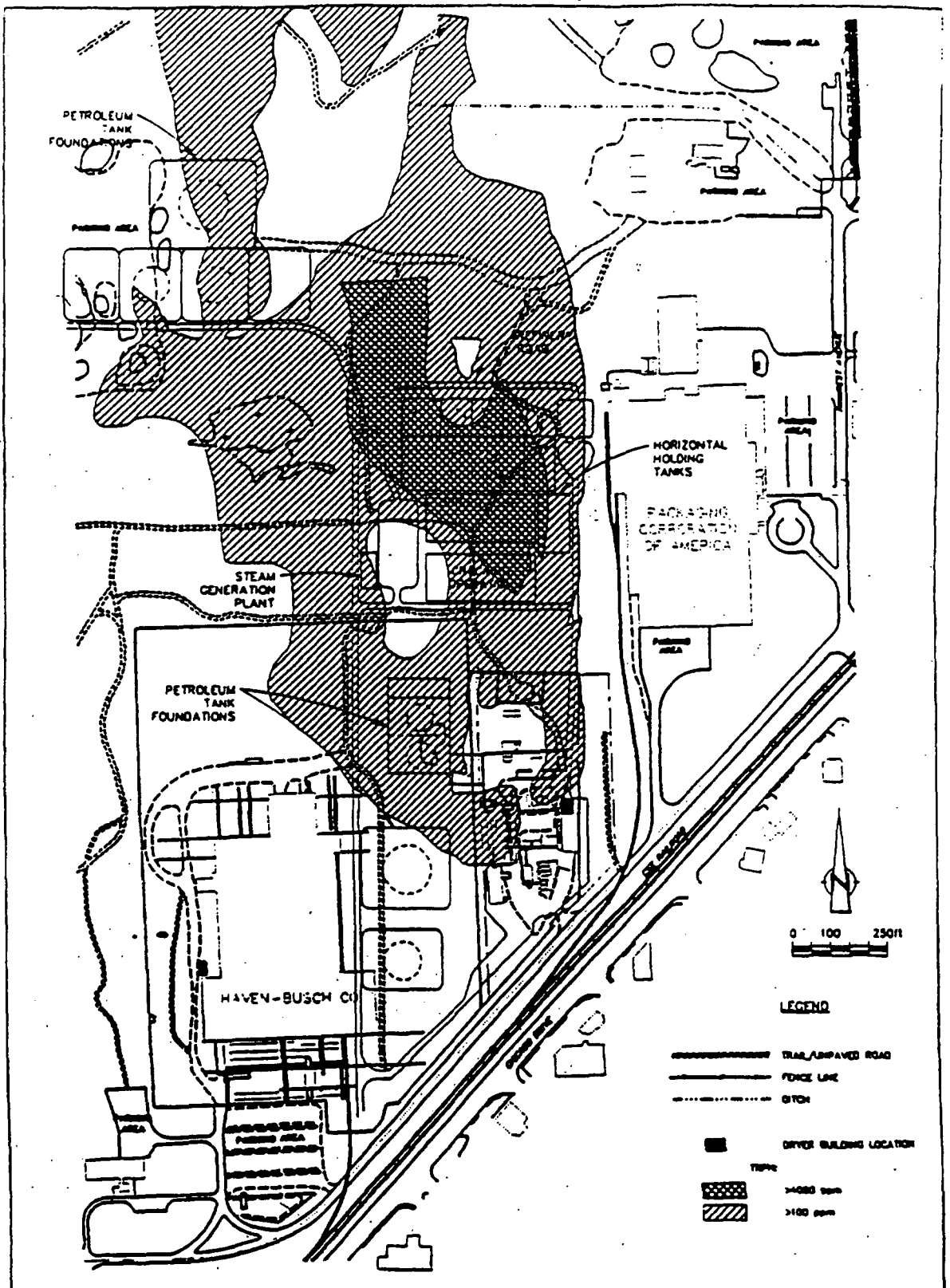
Figure 13


ISOPLETH CONTOURS



SURFACE SOIL SAMPLE LOCATIONS

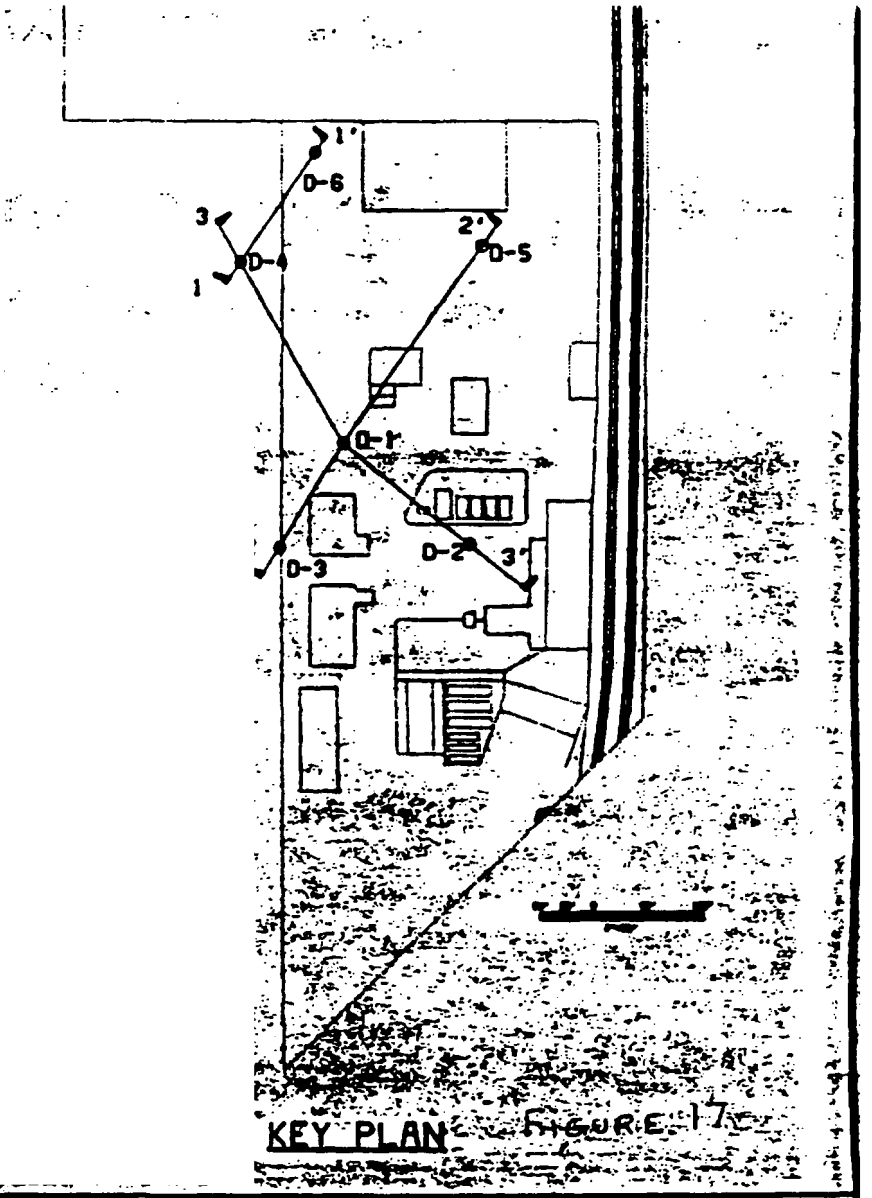
FIGURE 15



SOURCES: 1) CONESTOGA-ROVERS ASSOCIATES
EXHIBIT A: OU1 PRE-FINAL DESIGN REPORT
SEPTEMBER 22, 1993.
2) U.S. ARMY CORPS OF ENGINEERS' REPORT
ENTITLED: USE OF THE SITE CHARACTERIZATION
AND ANALYSIS PENETROMETER SYSTEM AT
GRANDVILLE, MICHIGAN SUPERFUND SITE,
DATED DECEMBER, 1992.
3) 1946 PLAN OF REFINERY,
MIDWEST REFINERIES.

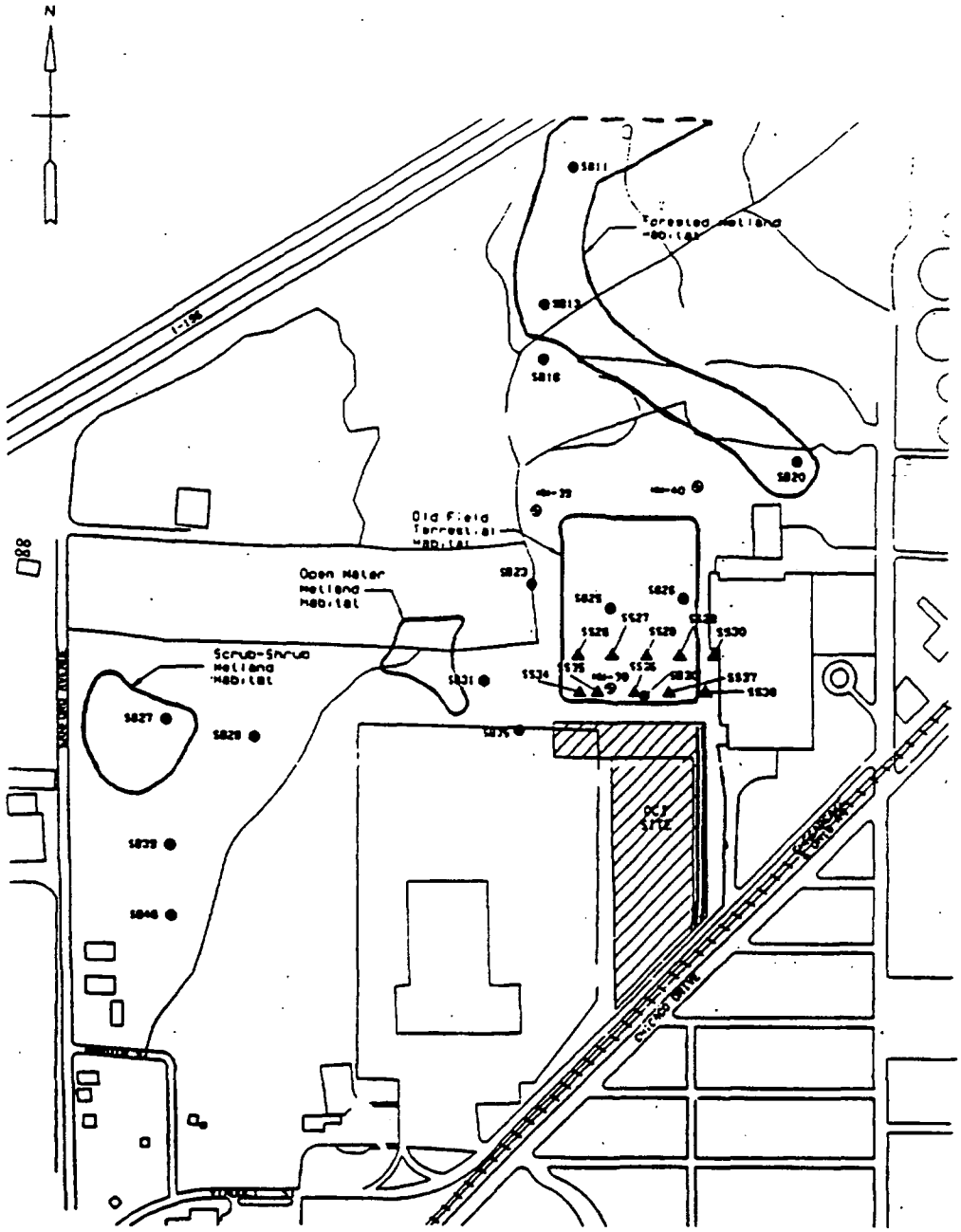
FIGURE 16

FORMER REFINERY PLAN



KEY PLAN FIGURE 17

DRAWN CSR	PROJECT REMEDIAL INVESTIGATION ORGANIC CHEMICALS, INC. Grandville, Michigan	
DATE		
RE 2-	TITLE DNAPL WELL CROSS SECTIONS 1-1', 2-2', 3-3'	REV. 0



NOTE: Scrub-Shrub, Open Water, and Forested Wetland habitats are shown as depicted on National Wetlands Inventory, Grandville and Grand Rapids West, Michigan maps (NWI 1985a and NWI 1985b).

FIGURE 18
HABITAT SAMPLE LOCATION MAP

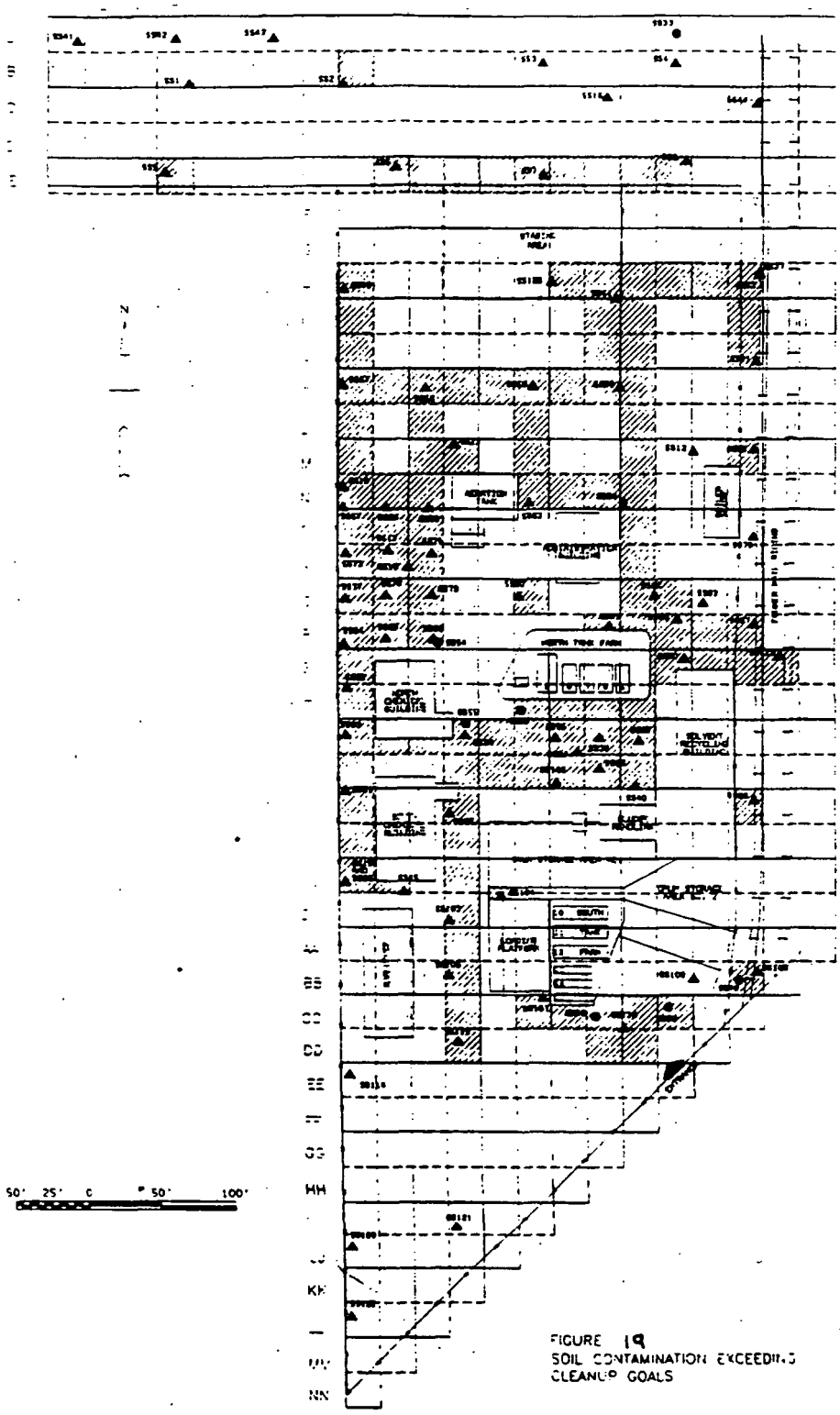


FIGURE 19
SOIL CONTAMINATION EXCEEDING CLEANUP GOALS

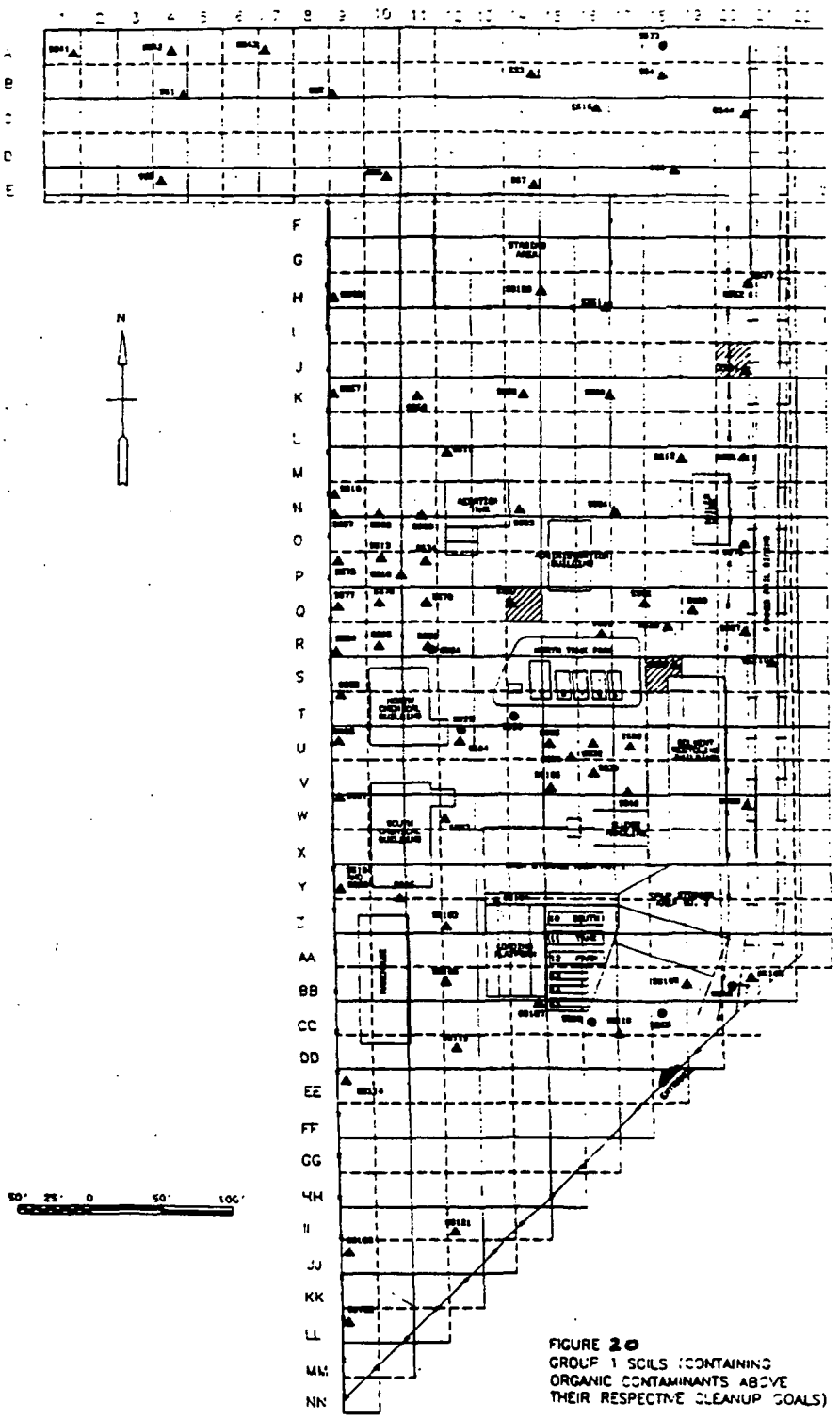


FIGURE 20
GROUP 1 SOILS (CONTAINING ORGANIC CONTAMINANTS ABOVE THEIR RESPECTIVE CLEANUP GOALS)

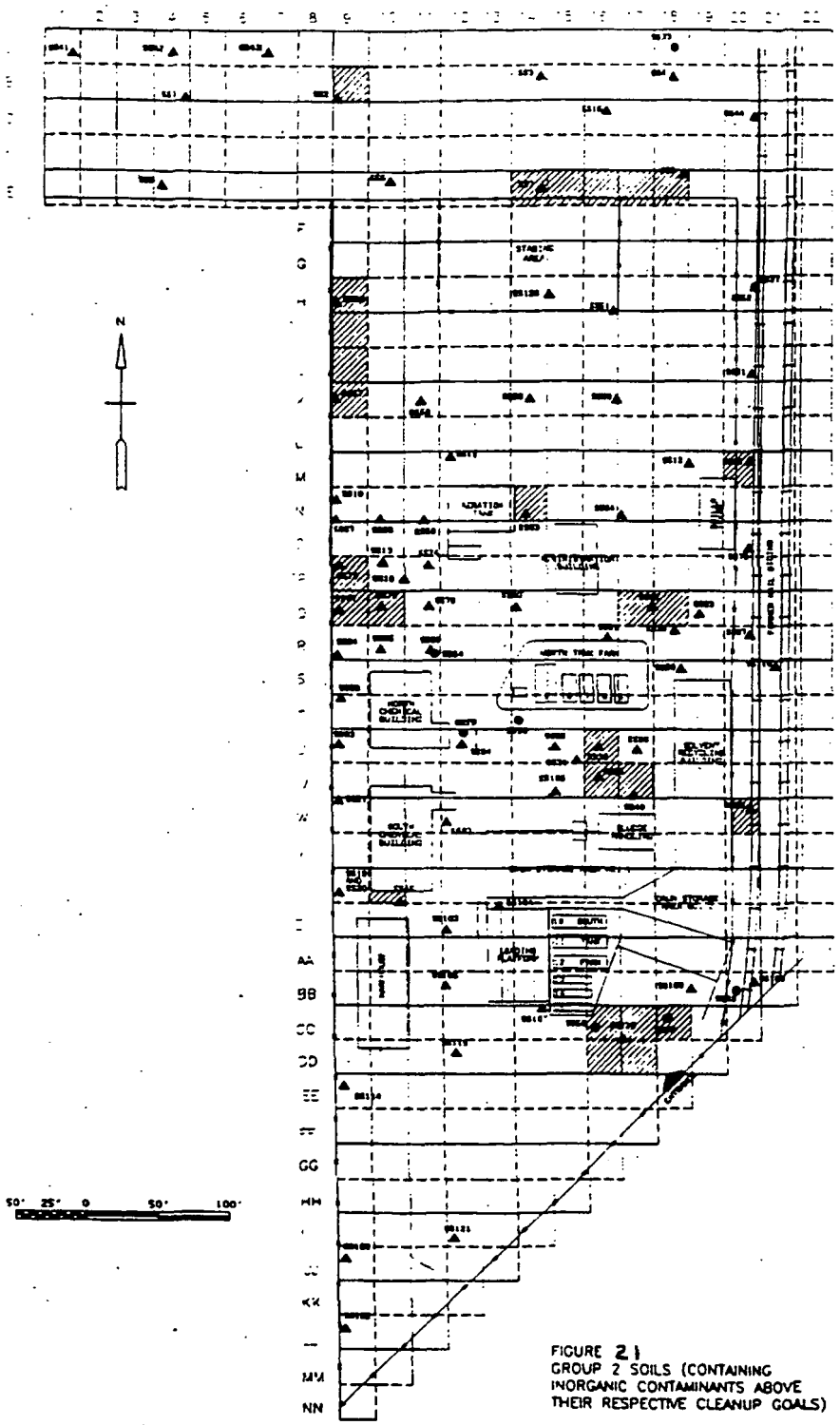


FIGURE 2.1
GROUP 2 SOILS (CONTAINING INORGANIC CONTAMINANTS ABOVE THEIR RESPECTIVE CLEANUP GOALS)

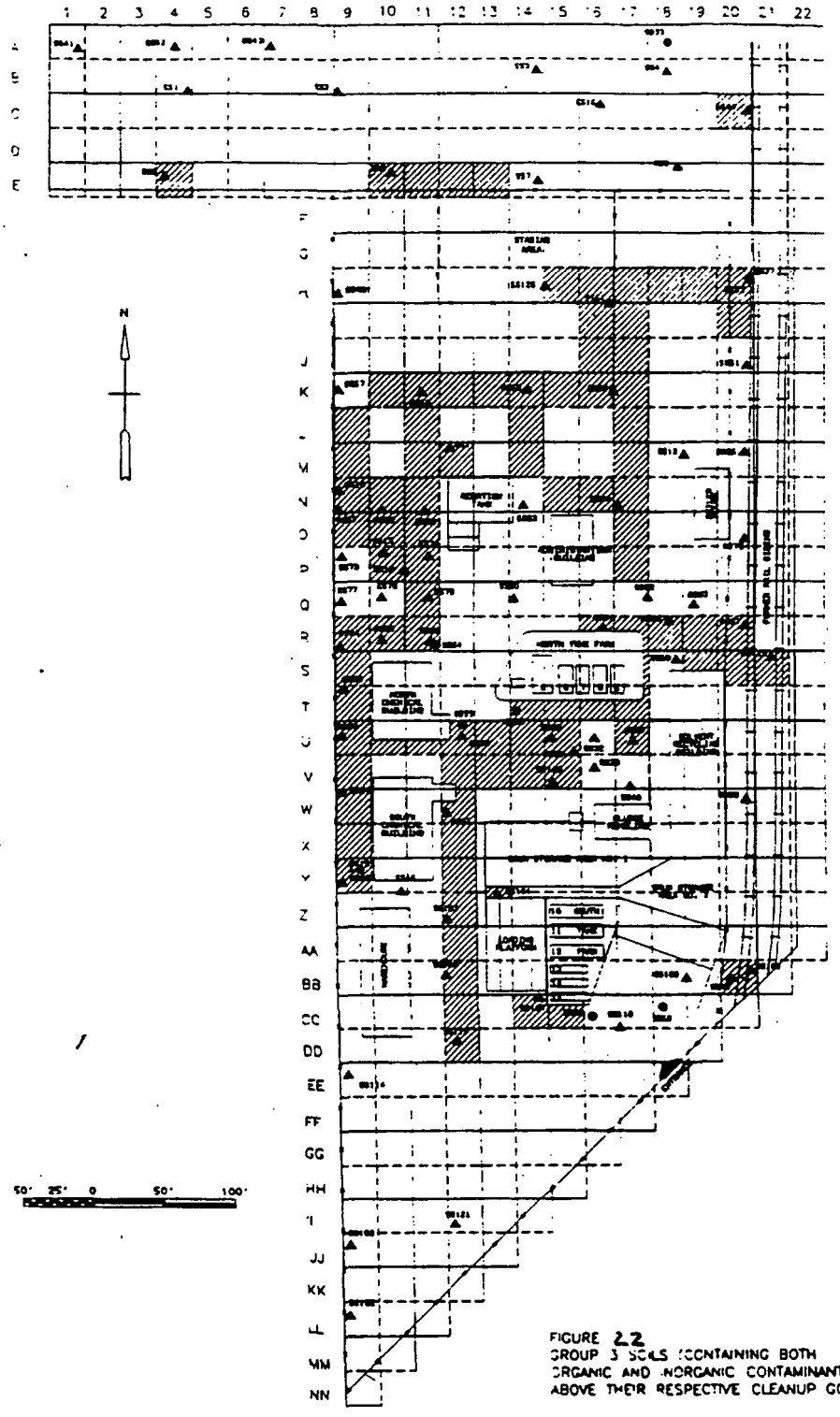


FIGURE 2.2
GROUP 3 SOILS (CONTAINING BOTH ORGANIC AND INORGANIC CONTAMINANTS ABOVE THEIR RESPECTIVE CLEANUP GOALS)

Table 1 Inorganic Background Concentrations for Groundwater Encountered During the Phase II RI.

Analyte	UGS		LGS	
	Round 1 (ug/L)	Round 2 (ug/L)	Round 1 (ug/L)	Round 2 (ug/L)
Aluminum	33.5	28	33.5	28
Antimony	28.7	46	28.7	46
Arsenic	1.6	4.6	16	8.4
Barium	47.3	36.7	7.6	5.2
Beryllium	1.8	1	1.8	1
Cadmium	2	4	2	4
Calcium	74300	61400	559000	580000
Chromium	5	9	5	9
Cobalt	10.4	7	10.4	7
Copper	10.4	9	2.2	9
Iron	93.7	27	1530	1870
Lead	1	3	10	3
Magnesium	20400	15000	39500	41100
Manganese	458	346	121	123
Mercury	0.2	0.2	0.2	0.2
Nickel	17.1	19	15.3	19
Potassium	267	3030	9420	2000
Selenium	1.6	3	16	2
Silver	3.3	7	1.6	35.6
Sodium	77000	60700	101000	105000
Thallium	5.2	2	2	2
Vanadium	4.7	14	4.7	14
Zinc	6.9	7	3.5	7
Cyanide	10	10	10	10

Table. 2 Comparison Between Groundwater Inorganic Concentrations (ug/L) and Their Associated Background Concentrations (ug/L).
Phase II
=greater than 5 times background

Round 1 UGS		Round 2 UGS	
Arsenic		**Arsenic**	
background	1.6	background	4.6
MW02	11.7	MW05	44.8
MW05	27	MW11	27.1
MW11	14	MW13	27.1
MW16	20.7	MW14	27.1
MW20	11.9	MW20	24.8
Barium		**Barium**	
background	47.3	background	36.7
MW11	261	MW05	162
		MW11	320
Calcium		MW13	320
background	74300	MW14	320
MW09	500000	MW33	236
Iron		**Calcium**	
background	83.7	background	61400
MW02	517	MW09	564000
MW03	1100	MW20	473000
MW04	609		
MW05	1670	**Iron**	
MW08	1456	background	27.9
MW10	2810	MW03	1500
MW11	6270	MW04	620
MW14	1330	MW05	1000
MW15	981	MW08	630
MW16	983	MW09	2240
MW20	3000	MW10	9020
MW29	400	MW11	5420
MW31	1540	MW13	5420
MW32	842	MW14	5420
MW33	1050	MW15	1000
		MW16	3700
Potassium		MW23	525
background	267	MW24	3300
MW01	2300	MW27	827
MW03	4330	MW28	5840
MW07	1620	MW29	4540
MW08	3210	MW30	344
MW14	5000	MW31	1470
MW15	1700		
MW21	1370	**Magnesium**	
MW28	1420	background	15000
MW30	7300	MW29	82700
MW31	2830		
MW33	2840	**Manganese**	
		background	346
Sodium		MW20	2100
background	77000	MW32	2140
MW20	570000		

Round 1 LGS		Round 2 LGS	
Copper		**Barium**	
background	2.2	background	6.2
MW08	30.0	MW05	27.9
		MW07	31.3
Potassium		MW09	31.5
background	9430	MW11	29.5
MW09	954000	MW12	30.3
Sodium		**Chromium**	
background	181000	background	9.0
MW10	843000	MW10	56.0
MW15	541000	MW19	40.0
		MW37	140
Zinc			
background	3.5		
MW30	60.0		

TABLE 3
PHYSICAL AND CHEMICAL CONSTANTS OF DETECTED COMPOUNDS

COMPOUND	CAS #	M.W.	S.G.	Solubility (mg/l)	Log Kow	Koc	Vapor Pressure (mmHg)	Henry's Constant (atm-m3/mol)
CHLORINATED HYDROCARBONS								
Vinyl Chloride	75-01-4	63	0.91	2.8E+03	1.38	5.7E+01	2.7E+03	8.2E-02
1,1-Dichloroethane	75-34-3	99	1.18	5.1E+03	1.79	3.0E+01	2.3E+02	5.9E-03
1,2-Dichloroethane	107-06-2	99	1.24	8.5E+03	1.48	1.4E+01	6.4E+01	9.8E-04
1,1-Dichloroethene	75-35-4	97	1.22	2.3E+03	1.84	6.5E+01	5.9E+02	3.0E-02
cis-1,2-Dichloroethene	156-59-2	97	1.28	3.5E+03	0.70	4.9E+01	2.0E+02	7.6E-03
trans-1,2-Dichloroethene	156-60-5	97	1.26	6.3E+03	0.48	5.9E+01	3.4E+02	6.7E-03
Methylene Chloride	75-09-2	85	1.33	2.0E+04	1.25	8.8E+00	3.6E+02	2.7E-03
Tetrachloroethene	127-18-4	166	1.62	1.5E+02	2.60	3.6E+02	1.8E+01	2.5E-02
1,1,1-Trichloroethane	71-55-6	133	1.34	1.5E+03	2.49	1.5E+02	1.2E+02	1.4E-02
1,1,2-Trichloroethane	79-00-5	133	-	4.5E+03	2.47	5.6E+01	3.0E+01	1.2E-03
Trichloroethene	79-01-6	131	1.46	1.1E+03	2.42	1.3E+02	5.8E+01	9.1E-03
Chloroform	67-66-3	119	1.48	8.2E+03	1.97	3.1E+01	1.5E+02	2.9E-03
AROMATICS								
Benzene	79-01-6	78	0.88	1.8E+03	2.13	9.7E+01	9.5E+01	5.5E-03
Chlorobenzene	108-90-7	113	1.11	4.7E+02	2.84	3.3E+02	1.2E+01	3.5E-03
Ethylbenzene	100-41-4	106	0.87	1.5E+02	3.15	1.1E+03	7.0E+00	6.4E-03
Toluene	108-88-3	92	0.87	5.4E+02	2.73	3.0E+02	2.8E+01	5.9E-03
Xylene (mixed)	1330-20-7	106	0.84	2.0E+02	3.26	2.4E+02	1.0E+01	7.0E-03
POLYNUCLEAR AROMATIC HYDROCARBONS								
Acenaphthene	83-32-9	154	1.02	3.4E+00	4.00	4.6E+03	1.6E-03	9.2E-05
Acenaphthylene	208-96-8	152	0.90	3.9E+00	3.70	2.5E+03	2.9E-02	1.5E-03
Anthracene	120-12-7	178	1.28	4.5E-02	4.45	1.4E+04	2.0E-04	1.0E-03
Benzo(a)Anthracene	56-55-3	228	1.11	5.7E-03	5.60	1.4E+06	2.2E-08	1.2E-06
Benzo(b)Fluoranthene	205-99-2	252	-	1.4E-02	6.06	5.5E+05	5.0E-07	1.2E-05
Benzo(g,h,i)Perylene	191-24-2	276	-	7.0E-04	6.51	1.6E+06	1.0E-10	5.3E-08
Benzo(a)Pyrene	50-32-8	252	1.11	1.2E-03	6.06	5.5E+06	5.6E-09	1.6E-06
Chrysene	218-01-9	228	1.27	1.8E-03	5.61	2.0E+05	6.3E-09	1.1E-06
Fluoranthene	206-44-0	202	1.25	2.1E-01	4.90	3.8E+04	5.0E-06	6.5E-06

Table 4
Chemical-Specific Toxicity Values
Ingestion Exposures

Contaminants or Chemicals	Ingestion Exposures: Oral Slope Factor (SF) mg/kg day	Wt of Ev	Oral Reference Dose (RfD) mg/kg day	R o f	Reference Date	Target Organ or System
1,1-Dichloroethene	9.1E-02	B2		I	05/02/94	stomach, circulatory
Acetone		D	1E-01	I	05/02/94	kidney, liver
Chlorobenzene			2E-02	I	05/02/94	liver
Chloroform	6.1E-03	B2	1E-02	I	05/02/94	liver
Chloromethane	1.3E-02	C		H	10/15/93	kidney forestomach
Ethylbenzene		D	1E-01	I	05/02/94	liver,kidney
Methylene Chloride	7.5E-03	B2	6E-02	I	05/02/94	liver
Styrene			2E-01	I	05/02/94	RBC, liver
Tetrachloroethene	5.2E-02		1E-02	EI	05/02/94	liver
Toluene		D	2E-01	I	05/02/94	liver, kidney
Trichloroethene	1.1E-02	B2	6E-03	HE	10/15/93	liver
Xylene (mixed)		D	2E+00	I	05/02/94	CNS, dec. body weight
2,3,7,8-Tetra-CDD	1.5E+05	B2		H	10/15/93	several
bis(2-Ethylhexyl)Phthalate	1.4E-02	B2	2E-02	I	05/02/94	liver,kidney
Dibenzofuran		D		I	05/02/94	
Diethylphthalate		D	8E-01	I	05/02/94	dec growth rate
Di-n-Butylphthalate		D	1E-01	I	05/02/94	liver,kidney,blood
Di-n-Octyl Phthalate			2E-02	H	05/02/94	NA
Isophorone	9.5E-04	C	2E-01	I	05/02/94	kidney
N-Nitrosodiphenylamine(1)	4.9E-03	B2		I	05/02/94	bladder
Phenol		D	6E-01	I	05/02/94	dec. fetal body weight
4,4'-DDD	2.4E-01	B2		I	05/02/94	lung, liver
4,4'-DDE	3.4E-01	B2		I	05/02/94	liver
4,4'-DDT	3.4E-01	B2	5E-04	I	05/02/94	fetotoxic, liver
Aldrin	1.7E+01	B2	3E-05	I	05/02/94	liver
Alpha-BHC	6.3E+00	B2		I	05/02/94	liver
Alpha-Chlordane	1.3E+00	B2	6E-05	I	05/02/94	liver
Aroclor-1248	7.7E+00	B2		I	05/02/94	liver
Delta-BHC		D		I	05/02/94	liver,kidney
Dieldrin	1.6E+01	B2	5E-05	I	05/02/94	liver
Endosulfan II						liver
Endosulfan Sulfate						liver/liver
Endrin		D	3E-04	I	05/02/94	liver
Endrin Ketone						
Gamma-Chlordane	1.3E+00	B2	6E-05	I	05/02/94	liver
Heptachlor	4.5E+00	B2	5E-04	I	05/02/94	liver
Heptachlor Epoxide	9.1E+00	B2	1.3E-05	I	05/02/94	liver
Methoxychlor		D	5E-03	I	05/02/94	fetal mortality

Table 4 (Continued)
Chemical-Specific Toxicity Values
Inhalation Exposures

Contaminant or Constituent	Inhalation Slope Factor (SF) kg day/mg	Wt of ev	Reference Conc. (RfC) mg/m3	Inhalation RfD Converted from RfC mg/kg day	R e f	Reference Date	Value Duration Rate	Target Organ or System
1,1-Dichloroethene	9.1E-02	B2		2.9E-03	HE	05/02/94	1.00E+00	circulatory system
Acetone						05/02/94	1.00E+00	
Chlorobenzene			2E-02	5.7E-03	H	05/02/94	1.00E+00	liver, kidney
Chloroform	8.1E-02	B2			H/I	05/02/94	1.00E+00	liver
Chloromethane	6.3E-03	C			H	10/15/93	1.00E+00	kidney
Ethylbenzene			1E+00	2.9E-01	I	05/02/94	1.00E+00	developmental toxicity
Methylene Chloride	1.6E-03	B2	3E+00	8.6E-01	H	05/02/94	1.00E+00	lung, liver / NA
Styrene	2.0E-03	B2	1E+00	2.9E-01	H	05/02/94	1.00E+00	leukemia, CNS
Tetrachloroethene	1.8E-03	B2			H	05/02/94	1.00E+00	leukemia, liver
Toluene		D	4E-01	1.1E-01	I	05/02/94	1.00E+00	CNS, eye, nose
Trichloroethene	6.0E-03	B2			H	10/15/93	1.00E+00	lung
Xylene (mixed)			1E-01	8.6E-02	H	05/02/94	1.00E+00	CNS, nose, throat
2,3,7,8-Tetra-CDD	1.5E+05	B2			H	10/15/93	1.00E-01	several
bis(2-Ethylhexyl)Phthalate		B2				05/02/94	1.00E-01	NA
Dibenzofuran						05/02/94	1.00E-01	
Diethylphthalate						05/02/94	1.00E-01	
Di-n-butylphthalate						05/02/94	1.00E-01	
Di-n-Octyl Phthalate						05/02/94	1.00E-01	
Isophorone		C				05/02/94	1.00E-01	NA
N-Nitrosodiphenylamine(1)						05/02/94	1.00E-01	
Phenol						05/02/94	1.00E-01	
4,4'-DDD						05/02/94	1.00E-01	
4,4'-DDE		B2			H	05/02/94	1.00E-01	NA
4,4'-DDT	3.4E-01	B2			H	05/02/94	1.00E-01	liver
Aldrin	1.7E+01	B2			I	05/02/94	1.00E-01	liver
Alpha-BHC	6.3E+00	B2			I	05/02/94	1.00E-01	NA
Alpha-Chlordane	1.3E+00	B2			I	05/02/94	1.00E-01	liver
Aroclor-1248		B2			H	05/02/94	1.00E-01	NA
Delta-BHC						05/02/94	1.00E-01	
Dieldrin	1.6E+01	B2			H	05/02/94	1.00E-01	liver
Endosulfan II							1.00E-01	
Endosulfan Sulfate							1.00E-01	
Endrin						05/02/94	1.00E-01	
Endrin Ketone							1.00E-01	
Gamma-Chlordane	1.3E+00	B2			I	05/02/94	1.00E-01	liver
Heptachlor	4.5E+00	B2			H/I	05/02/94	1.00E-01	liver
Heptachlor Epoxide	9.1E+00	B2			H/I	05/02/94	1.00E-01	liver
Methoxychlor						05/02/94	1.00E-01	

Table 4 (Continued)
Chemical-Specific Toxicity Values
Dermal Exposures

Contaminant or Chemicals	Dermal Exposures						
	Oral Absorption Efficiency percent	Oral Absorption Efficiency Reference	Dermal Extrapolated Reference Dose (RfD) mg/kg day	Dermal Extrapolated Slope Factor (SF) kg day/mg	Permeability Constant (PC) cm/hr	Soil Absorption Factor (unitless)	Ref
1,2-Dichloroethane	1.0E+02	ATSDR, 1988		9.1E-02	9.7E-03	2.5E-01	B
Acetone			5.0E-03			2.5E-01	
Chlorobenzene	3.1E+01	ATSDR, 1989	6.2E-03		4.0E-02	2.5E-01	B
Chloroform	1.0E+02	ATSDR, 1987	1.0E-02	6.1E-03	9.6E-03	2.5E-01	B
Chloromethane				2.6E-01	4.9E-03	2.5E-01	B
Ethylbenzene	9.2E+01	ATSDR, 1989	9.2E-02		1.4E+00	2.5E-01	A
Methylene Chloride	5.5E+01	ATSDR, 1987	3.3E-02	1.4E-02	5.1E-03	2.5E-01	B
Styrene			1.0E-02		6.7E-01	2.5E-01	A
Tetrachloroethane	1.0E+02	ATSDR, 1987	1.0E-02	5.2E-02	4.5E-02	2.5E-01	B
Toluene			1.0E-02		1.0E+00	2.5E-01	A
Trichloroethane	9.8E+01	ATSDR, 1988	5.9E-03	1.1E-02	1.6E-02	2.5E-01	B
Xylene (mixed)	9.2E+01	ATSDR, 1989	1.8E+00		5.5E-04	2.5E-01	B
2,3,7,8-Tetra-CDD	8.7E+01	ATSDR, 1989		1.7E+05	3.5E-01	1.0E-01	B
bis(2-Ethylhexyl)Phthalate			1.0E-03	2.8E-01	3.2E-03	1.0E-01	B
Dibenzofuran						1.0E-01	
Diethylphthalate			4.0E-02		1.3E-02	1.0E-01	B
Di-n-Butylphthalate	9.7E+01	ATSDR, 1989	9.7E-02		1.9E+00	1.0E-01	B
Di-n-Octyl Phthalate			1.0E-03			1.0E-01	
Isophorone			1.0E-02	1.9E-02	4.9E-03	1.0E-01	B
N-Nitrosodiphenylamine(1)	Unknown	ATSDR, 1987		9.8E-02	4.7E-04	1.0E-01	B
Phenol			3.0E-02		8.2E-03	1.0E-01	A
4,4'-DDD				4.8E+00	2.1E-01	1.0E-01	B
4,4'-DDE				6.8E+00	1.8E-01	1.0E-01	B
4,4'-DDT			2.5E-05	6.8E+00	3.1E-01	1.0E-01	B
Aldrin	Unknown	ATSDR, 1987	1.5E-06	3.4E+02	1.5E-03	1.0E-01	B
Alpha-BHC				1.3E+02		1.0E-01	
Alpha-Chlordane			3.0E-06	2.6E+01	3.6E-02	1.0E-01	B
Aroclor-1248	9.0E+01	ATSDR, 1987		8.6E+00	2.5E-03	5.0E-02	B
Delta-BHC						1.0E-01	
Dieldrin	Unknown	ATSDR, 1987	2.5E-06	3.2E+02	1.1E-02	1.0E-01	B
Endosulfan II						1.0E-01	
Endosulfan Sulfate						1.0E-01	
Endrin	Unknown	ATSDR, 1989	1.5E-05		1.3E-02	1.0E-01	B
Endrin Ketone						1.0E-01	
Gamma-Chlordane			3.0E-06	2.6E+01	3.6E-02	1.0E-01	B
Heptachlor	1.0E+02	ATSDR, 1987	5.0E-04	4.5E+00	9.4E-03	1.0E-01	B
Heptachlor Epoxide	1.0E+02	ATSDR, 1987	1.3E-05	9.1E+00		1.0E-01	
Methoxychlor			2.5E-04			1.0E-01	

Table 5

Computation of Daily Intake Values From Maximum Habitat Concentrations

Compound	Maximum Concentration(mg/kg)				Daily Intake(mg/kg/day)			
	OWWH	FWH	SSWH	OFTH	OWWH	FWH	SSWH	OFTH
Acetone	0.0295	0.0295	0.044	0.025	0.0003	0.0003	0.00044	0.00025
Barium	108	108	95.1	108	1.08	1.08	0.951	1.08
Benzo(a)Anthracene	0.37	0.37	0.2	6	0.0037	0.0037	0.002	0.06
Benzo(a)Pyrene	0.52	0.2	0.2	6	0.0052	0.002	0.002	0.06
Benzo(b)Fluoranthene	1.2	0.2	0.97	6	0.012	0.002	0.0097	0.06
Beryllium	0.3	0.69	0.57	0.57	0.003	0.0069	0.0057	0.0057
Cadmium	1.1	0.21	0.21	1.1	0.011	0.0021	0.0021	0.011
Chlordane(total)	0.0053	0.001	0.13	5.7	0.00005	0.00001	0.0013	0.057
Chromium	13.2	11	19.3	26.2	0.132	0.11	0.193	0.262
Chrysene	0.365	0.2	0.2	6	0.00365	0.002	0.002	0.06
Dibenzo(a,h)anthracene	0.305	0.2	0.2	6	0.00305	0.002	0.002	0.06
Indeno(1,2,3-cd)pyrene	0.81	0.2	0.2	6	0.0081	0.002	0.002	0.06
Manganese	306	792	972	685	3.06	7.92	9.72	6.85

OWWH = Open Water Wetland Habitat SSWH = Scrub-Shrub Wetland Habitat

FWH = Forested Wetland Habitat OFTH = Old Field Terrestrial Habitat

Daily Intake = (Maximum Concentration, mg/kg) x (0.001 kg/day)/(.1 kg)

Table 6
Determination of Ecological Hazard Indices for the Habitats of Concern

Compound	Appendix O Daily Intake Rate (mg/kg/day)		Ecological Screening Leve (mg/kg/day)	Daily Intake(mg/kg/day)				Hazard Indices (HI)			
				OWWH	FWH	SSWH	OFTH	OWWH	FWH	SSWH	OFTH
	LOAEL	NOAEL									
Acetone	500		500000	0.0003	0.0003	0.00044	0.00025	6E-10	6E-10	9E-10	5E-10
Barium	5.1		5100	1.08	1.08	0.951	1.08	0.00021	0.00021	0.0002	0.00021
Benzo(a)Anthracene	2		2000	0.0037	0.0037	0.002	0.06	2E-06	2E-06	1E-06	0.00003
Benzo(a)Pyrene	0.002		2	0.0052	0.002	0.002	0.06	0.0026	0.001	0.001	0.03
Benzo(b)Fluoranthene	40		40000	0.012	0.002	0.0097	0.06	3E-07	5E-08	2E-07	2E-06
Beryllium		0.166	16.6	0.003	0.0069	0.0057	0.0057	0.00018	0.00042	0.0003	0.00034
Cadmium		0.01	1	0.011	0.0021	0.0021	0.011	0.011	0.0021	0.0021	0.011
Chlordane(total)	0.273		273	0.00005	0.00001	0.0013	0.057	2E-07	4E-08	5E-06	0.00021
Chromium	2.4		2400	0.132	0.11	0.193	0.262	0.00006	0.00005	8E-05	0.00011
Chrysene	99		99000	0.00365	0.002	0.002	0.06	4E-08	2E-08	2E-08	6E-07
Dibenzo(a,h)anthracene	0.006		6	0.00305	0.002	0.002	0.06	0.00051	0.00033	0.0003	0.01
Indeno(1,2,3-cd)pyrene	72		72000	0.0081	0.002	0.002	0.06	1E-07	3E-08	3E-08	8E-07
Manganese	0.06		60	3.06	7.92	9.72	6.85	0.051	0.132	0.162	0.11417
							Total HI	0.07	0.14	0.17	0.17

OWWH Open Water Wetland Habitat SSWH = Scrub-Shrub Wetland Habitat
FWH = Forested Wetland Habitat OFTH = Old Field Terrestrial Habitat
Ecological Screening Criteria = (LOAEL, mg/kg/day) x (1000) or (NOAEL, mg/kg/day) x (100)
Hazard Index = (Daily Intake, mg/kg/day)/(Ecological Screening Criteria, mg/kg/day)

Table 7 Determination of Soil Cleanup Goals Based on Evaluation of Chemical-Specific ARARs and Risk-Based Concentrations

Contaminants of Concern	Chemical-Specific ARARs				Risk-based Acceptable Concentration Levels (ug/kg)
	USEPA^ OSWER Directive for lead (ug/kg)	Background Concentrations for Inorganics (ug/kg)	MDEQ** Generic Industrial Cleanup Criteria (ug/kg)	Analytical Detection Level (ug/kg)	
Benzo(a)anthracene	--	--	210,000	330	3,153
Benzo(a)pyrene	--	--	21,000	330	2,967
Benzo(b)fluoranthene	--	--	210,000	330	3,519
Bis(2-ethylhexyl)phthalate	--	--	1E+07	330	14,488
Beryllium	--	420	35,000	200	333
Chromium (VI)	--	19,840	2.2E+07	200	52,333
Lead	500,000	13,990	400,000	1,000	--
Dibenzo(a,h)anthracene	--	--	21,000	330	2,350
Indeno(1,2,3-cd)pyrene	--	--	210,000	330	2,595
Dieldrin	--	--	9,400	20	19.3
2,3,7,8-TCDD (TEF)	--	--	0.99	0.001	0.085
PCB (Aroclor-1248)	--	--	21,000	330	7,739

^USEPA OSWER Directive #9355.4-02 Memorandum. Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites. 1989.

*USEPA, Drinking Water Regulations & Health Advisories, May 1994.

**MDEQ, MERA Interoffice Communication Operational Memorandum #14, (Revision 2), Remedial Action Plans using Generic Industrial or Generic Commercial Cleanup Criteria, June 5, 1995.

NA = Not available

=chosen cleanup goal for each chemical of concern