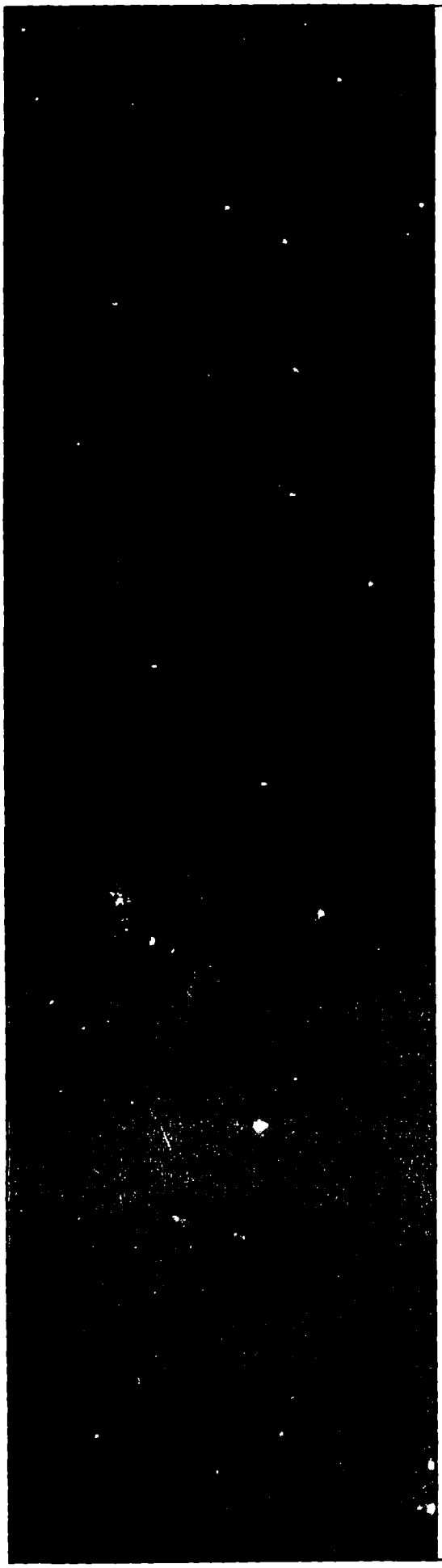

PHASE II
REMEDIAL INVESTIGATION
REPORT

FOR
PETOSKEY MANUFACTURING SITE
PETOSKEY, MICHIGAN

PREPARED FOR
MICHIGAN DEPARTMENT OF
ENVIRONMENTAL QUALITY

FEBRUARY 1998

PREPARED BY
MALCOLM PIRNIE ENGINEERS, LLP
1400 ABBOTT ROAD, SUITE 140
EAST LANSING, MICHIGAN 48823

EPA Region 5 Records Ctr.
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MALCOLM PIRNIE

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FOR
PETOSKEY MANUFACTURING SITE
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PREPARED FOR
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION

DRAFT: JULY 15, 1996
REVISION 1: DECEMBER 15, 1997
REVISION 2: FEBRUARY 18, 1998

PREPARED BY
MALCOLM PIRNIE ENGINEERS, LLP
1400 ABBOTT ROAD
EAST LANSING, MICHIGAN 48823

MALCOLM PIRNIE

PETOSKEY MANUFACTURING
PHASE II REMEDIAL INVESTIGATION REPORT

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1.0 INTRODUCTION

1.1 BACKGROUND

1.1.1 Site Location and Description

Petoskey Manufacturing Company (PMC) is a die casting and plating facility located at 200 West Lake Street, in a residential area of the City of Petoskey, Emmet County, Michigan, as shown on Figure 1-1. For the purpose of the Remedial Investigation, the U.S. Environmental Protection Agency (USEPA) and the Michigan Department of Environmental Quality (MDEQ) define the "site" as the PMC property and the PMC-related contaminated groundwater. The MDEQ is reporting that it is the City of Petoskey's intent to rezone the area where PMC is located to a multi-family residential area, with PMC being a "non-conforming" use. Relevant physical features in the vicinity of PMC are shown on Figure 1-2. PMC began manufacturing small trim parts for the automotive industry in 1946. Painting operations were added to the plant in the late 1960's.

The PMC facility is bordered to the north by a condominium complex. A vacant lot, owned by the City of Petoskey, is located west of the condominium complex. Immediately north of the condominiums is Little Traverse Bay of Lake Michigan, approximately 500 feet north of the facility. Several residences are located to the east and south of PMC. Bear Creek, which drains into Little Traverse Bay, is located approximately 500 feet east of the facility. PMC is bordered on the west by a vacant lot which is occasionally used by the Fraternal Order of Eagles which owns the building immediately west of the lot. Immediately south of Lake Street, behind the row of houses, is a steep bluff running approximately parallel to the shoreline.

The year-round population of Petoskey is approximately 7,000 with a seasonal influx of 3,000 to 5,000 additional residents. Winter and summer tourism is a major economic force in the area. The climate of Emmet County is strongly influenced by its proximity to Lake Michigan. Seasonal temperatures are moderated by the lake, with summer high temperatures averaging 68°F

and winter highs averaging 35°F. The average annual rainfall for Emmet County is 28 inches, and the average annual snowfall is 66 inches per year (McNamee, 1994).

The MDEQ reports that as of December 1997, the City of Petoskey's primary water supply is groundwater provided by the Bay Harbor development. The Ingalls municipal well, located approximately 700 feet northwest of PMC along the shoreline of Little Traverse Bay used to be the primary water supply well for the City and will be used as a backup water supply well until it is eventually abandoned. The Ingalls municipal well is a 36-foot diameter dug well extending to a depth of 16 feet below ground level (bgl) and receiving a large percentage of recharge water from Little Traverse Bay.

1.1.2 Regional Geology and Hydrogeology

The bedrock underlying the site and surrounding areas consists of alternating limestones and shales of the Devonian Traverse Group. These strata were deposited during times of fluctuating marine conditions due to either changing water depths or changes in conditions in adjoining lands. The Traverse Group formation occurs in the Northern and Southern portions of the Lower Peninsula as one of the formations near the outer edge of the Michigan Basin (WMU, 1981). The Traverse Group outcrops in several locations in the vicinity of the site.

Overlying the bedrock in this area is a cover of glacial till, outwash, and alluvium, mainly of late Pleistocene to Holocene age. Regionally, the glacial deposits range in thickness up to approximately 200 feet. The glacial deposits in the vicinity of the site include fine to medium grained lacustrine sand and gravel, dune sand, glacial outwash sand and gravel and coarse-textured glacial till.

The major source of drinking water in the area is groundwater from glacial drift and bedrock aquifers. These aquifers are recharged by infiltrating precipitation or by Lake Michigan. The glacial drift in the vicinity of the site generally consists of interbedded aquifers, aquicludes, and aquitards, and may or may not have an aquifer present near the surface. Dissolved solids concentrations in the

groundwater in the vicinity of the site typically range from 0 to 500 mg/ℓ; specific conductance values typically range from 0 to 830 μmhos/cm (WMU, 1981).

1.1.3 Site History/Previous Investigations

An analysis of 17 site aerial photographs covering the period of 1938 to 1991 has been conducted by the United States Environmental Protection Agency (USEPA). The results of the analysis were presented in the USEPA's 1991 air photo evaluation report entitled "Site Analysis, Petoskey Manufacturing Company, Petoskey, Michigan" (USEPA, 1991b). Based on information presented in the report, historical activities in the area to the north of PMC (the area currently occupied by the condominiums and extending west to the Ingalls well) included a fuel storage area, a coal storage area, and a railroad repair yard. Three vertical and eight horizontal storage tanks, fuel pumps, drums, and large areas of stained soils were identified in photographs taken between 1938 and 1971. Analysis of the 1973, 1974, 1978, and 1982 photographs indicated a decrease in railroad activities over time. The railroad activity may have ended by 1982. In the 1982 photograph, the tanks, drums, and fuel pumps had been removed. In the 1991 photograph, the condominiums had been constructed and the remains of the former railroad operations had been removed and the area graded. The railroad station house is the only remaining railroad structure identified in the 1991 photograph.

The area to the northeast of PMC was not included in the scope of the USEPA aerial photography review report. However, the Phase I Draft Remedial Investigation (RI) Report (Eder, 1993) identified a former coal gasification plant in this area. The report states that the plant was present in the 1938 aerial photo, but did not exist in the 1982 photo. This area is currently used as a city park. The MDEQ is currently undertaking remedial activities at that location to address contaminated soils.

Analyses of water samples collected from the Ingalls well in 1981 by the Michigan Department of Public Health (MDPH) identified the presence of trichloroethene (TCE) at concentrations ranging from 20 μg/ℓ to 50 μg/ℓ, 1,2-dichloroethene (DCE) ranging from 7 μg/ℓ to

conducted in 1982 by the MDEQ (known prior to October 1, 1995 as Michigan Department of Natural Resources) identified the presence of elevated concentrations of volatile organic compounds (VOCs) in soil samples collected from the west side of the PMC building. Based on the soil sample analytical results, USEPA and MDEQ identified PMC as a Potentially Responsible Party, and waste handling practices at the plant as a source of contamination. In 1982, PMC removed contaminated soils from the west side of the building to a depth ranging from two to five feet below ground level (bgl), until large limestone boulders were encountered. The excavation was backfilled with clean soils, covered with a plastic liner, and the liner covered with approximately 6 inches of soil.

In 1982 and 1983, MDEQ installed five groundwater monitoring wells, PS-1, PS-4, PS-6, PS-10, PS-11, shown on Figure 2-2, as part of a preliminary groundwater investigation. This investigation confirmed the presence of groundwater contamination at the PMC site, and identified a northwesterly groundwater flow direction, from the PMC property towards the Ingalls well.

In 1984, a new municipal water supply well was installed approximately one mile to the northeast of the Ingalls well, but the Ingalls well continued to serve as the primary water supply well (providing approximately 65% of the City's water) for the City of Petoskey, until December 1997. At that time, the Bay Harbor groundwater supply became the primary source of City water. Also in 1984, the USEPA issued an Administrative Order (AO) to PMC. The AO required PMC to conduct further hydrogeological studies. PMC then installed four monitoring well clusters, PS-A, PS-B, PS-C, and PS-D. Each cluster consisted of one shallow (approximately 20 feet bgl) and one deep (approximately 40 feet bgl) well. The locations of these well clusters are shown on Figure 2-2. Sampling of these wells in 1985 identified TCE at concentrations up to 144 µg/ℓ and DCE at concentrations up to 44 µg/ℓ. Samples collected from the Ingalls well in 1985 contained TCE and DCE at concentrations of 12 µg/ℓ and 2µg/ℓ, respectively.

In 1987, PMC was directed to conduct a full Remedial Investigation (RI) and Feasibility Study (FS) under a second AO issued by USEPA. PMC began work on the RI in 1988 with the installation of four additional monitoring wells: PS-104, PS-105S, PS-105D, and PS-106 (Figure 2-2).

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In 1990, a hydraulic fluid spill at PMC was reported by the Emmet County Health Department. The report stated that "standing oils" were present in several rooms of the PMC building. During an inspection of the facility in May 1990, MDEQ personnel observed hydraulic fluid on the floors around the die casting machines located in the eastern and northeastern portions of the building and in the compressor room which is located in the northwest corner of the building. The exterior walls of the building were stained up to 3 feet above the ground surface. Soil adjacent to the building was also stained.

On May 31, 1990, the USEPA collected groundwater and soil samples from the northwest and west sides of the PMC building. Analytical data from these samples identified elevated concentrations of semi-volatile organic compounds (SVOCs) in soils, as well as DCE, TCE, and tetrachloroethene (PCE) in the groundwater.

The USEPA assumed responsibility for the remedial investigation in 1990 because of PMC delays in Work Plan development and because PMC filed for bankruptcy under Chapter 11 of federal bankruptcy codes. Lead responsibility for remedial activities at this site was delegated to MDEQ. In 1992, MDEQ retained Eder Associates (Eder) to develop a Phase I Remedial Investigation Work Plan and to implement the investigations. RI field activities were conducted from September 1992 to March 1993. They included the collection and analysis of seven surface soil samples, collection and analysis of subsurface soil samples at 16 locations, installation of three monitoring wells (PS-12, PS-13, PS-1R), collection and analysis of two sets of groundwater and surface water samples, and collection and analysis of a third set of groundwater samples. Data collected during these activities were used to prepare a Phase I Draft RI Report in December 1993 (Eder, 1993). Review of this report by USEPA and MDEQ identified data gaps and the need for additional investigations.

In May 1994, MDEQ requested Malcolm Pirnie to conduct a Phase II Remedial Investigation and prepare a Focused Feasibility Study. This report presents the results of the Phase II Remedial Investigation and soil analytical data from the Phase I Remedial Investigation.

According to MDEQ, in 1995 the USEPA signed a Record of Decision which made available $1,238,000 towards an alternate water supply for the City of Petoskey due to concern about

groundwater contamination in the Ingalls well. To date, the State of Michigan has provided $500,000 towards this alternate water supply (Bay Harbor groundwater) because federal funds have not yet been made available.

1.2 PROJECT PURPOSE AND OBJECTIVES

The overall purpose of the Phase II Remedial Investigation was to collect supplemental soil and groundwater data to address data gaps identified during the Phase I Remedial Investigation, and to be used in evaluating possible remedial action alternatives.

The objectives of the RI were to:

- Evaluate the nature and extent and indirectly estimate the magnitude of volatile organic compound (VOC) contamination in the unsaturated zone under the northwest corner of the PMC building.

- Evaluate the nature and magnitude of VOC contamination in the groundwater at the site, including the area under the northwest corner of the PMC building.

- Evaluate the presence and nature of, and estimate the lateral extent of light non-aqueous phase liquids (LNAPLs) in the vicinity of and underneath the northwest corner of the PMC building.

- Evaluate the nature and extent of pesticide and SVOC contamination in the soil and groundwater at the site.

- Estimate hydraulic properties of the aquifer at the site and characterize hydrostratigraphic zones in the vicinity of the Ingalls municipal well.

- Evaluate the capability of soil vapor extraction (SVE) technology to reduce VOC concentrations in the unsaturated zone under the northwest corner of the PMC building.

- Supplement and update the baseline human heath risk assessment produced by Eder during the Phase I Remedial Investigation, using existing information and newly developed data.

1.3 REMEDIAL INVESTIGATION SCOPE

The activities performed as part of the Phase II Remedial Investigation included:

- Collection and analysis of soil samples at four boring locations adjacent to and underneath the PMC building.

- Collection and analysis of background soil samples from two borings located hydraulically upgradient of the PMC building to assist in determination of background concentrations of analytes.

- Installation of seven monitoring wells at five locations to provide groundwater monitoring points and observation points for a soil vapor extraction test.

- Collection and analysis of one set of groundwater samples from 31 monitoring wells and the Ingalls municipal well to evaluate the nature and extent of any groundwater contamination.

- Measurement of water levels in selected monitoring wells on three occasions.

- Performance of a pumping test to collect data to be used in estimating hydraulic properties of the aquifer.

- Performance of field permeability (slug) tests at five monitoring wells and estimation of hydraulic conductivity values.

- Performance of a soil vapor extraction test to access the presence of VOCs in the unsaturated zone beneath the PMC building.

- Preparation of a baseline human health risk assessment using groundwater analytical data collected during this RI and incorporating new soil analytical data with existing soil analytical data collected during the Phase I RI conducted by Eder Associates.

Soil data from both phases of the RI were used for site evaluation and risk assessment. The soil data obtained through the two phases of the RI represent samples collected from different locations, therefore are complementary. Phase II RI groundwater data were generally obtained from the same locations as during the Phase I RI, and were used for the site evaluation and risk assessment because they represent current site conditions.

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2.0 REMEDIAL INVESTIGATION

2.1 SOIL INVESTIGATION

The following sections provide descriptions of the components of the Phase II Soil Investigation.

2.1.1 Soil Sampling

Soil samples were collected in August, 1995 from four locations adjacent to (SB-201 and SB-202) and under the Petoskey Manufacturing Company (PMC) building (SB-203 and SB-204) to evaluate the presence and nature of soil contamination. Additionally, soil samples were collected from two locations (SB-206 and SB-207) hydraulically upgradient to the PMC building to assist in determining the background concentrations of compounds of concern detected in the soils to their concentrations in the soils near the PMC building. The soil sampling locations are shown on Figure 2-1. The soil samples were collected according to the procedures described in the Work Plan (Malcolm Pirnie, 1995b) and Quality Assurance Project Plan (QAPP) (Malcolm Pirnie, 1995a) for the Phase II Remedial Investigation.

The soil samples collected near the PMC building were, in general, collected from 0 to 2 feet below ground level (bgl), 5 to 7 feet bgl, and directly above the water table (approximately 12 to 16 feet bgl). Several of the proposed soil samples could not be collected because of insufficient soil recovery from specific depths, due to the presence of cobbles or boulders. At depth intervals where sufficient soil volume was recovered, the soil samples were analyzed for Target Analyte List (TAL) and Target Compound List (TCL) analytes. At depth intervals where the soil volume recovery was insufficient for a complete set of analyses, the sample jars were filled in the following order: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides / polychlorinated biphenyls (PCBs), and metals, until the soil recovered from that sampling interval had been exhausted. At boring location SB-203D, additional soil was collected at depth intervals where there

was not sufficient soil collected at the corresponding boring location SB-203S for the full suite of analyses.

The soil samples were submitted to USEPA's Contract Laboratory Program (CLP) facilities for analysis of VOCs, SVOCs, pesticides, PCBs, metals, and cyanide (TCL and TAL compounds) as follows: Envirosystems, Inc. or Clayton Environmental Consultants (organic compounds), and American Analytical and Technical Services or CKY, Inc. (inorganic compounds). The total petroleum hydrocarbons (TPH) and diesel range organics (DRO) analyses were performed by ENCOTEC Laboratory, outside of the USEPA CLP program.

The soil sampling analytical data have been compiled into tables and are presented in this report as follows:

Table 5-2 Volatile Organic Compounds
Table 5-3 Semi-Volatile Organic Compounds
Table 5-4 Pesticides and PCBs
Table 5-5 Inorganic Compounds
Table 5-6 Tentatively Identified Volatile Organic Compounds
Table 5-7 Tentatively Identified Semi-Volatile Organic Compounds

The laboratory data packages are available in the MDEQ-Superfund files. The soil sampling analytical data are discussed in Section 5.1.

2.1.2 Soil Vapor Extraction Test

Two soil vapor extraction (SVE) tests were performed in September, 1995 to assess the magnitude of VOC contamination in the unsaturated soils under the northwest portion of the PMC building and evaluate the effectiveness of SVE technology to remove VOC contamination from this portion of the site. A description of the setup and performance of the SVE tests and the analysis of the data are discussed in Section 3.1.

2.2 GROUNDWATER INVESTIGATION

The following sections provide descriptions of the components of the Phase II Groundwater Investigation.

2.2.1 Monitoring Well Installation

Seven monitoring wells were installed at five locations (3 single monitoring wells and 2 well clusters) in August 1995, in order to evaluate the nature and extent of contaminants in the groundwater. The newly installed monitoring wells are numbered MW-201, MW-202, MW-203S, MW-203D, MW-204, MW-205I, and MW-205D; their locations are shown on Figure 2-2.

The monitoring wells were installed according to the procedures presented in the Work Plan and QAPP for the Phase II Remedial Investigation unless otherwise noted.

2.2.1.1 Drilling Method

The boreholes for monitoring wells MW-201S, MW-202, MW-203S, MW-203D, MW-204 were drilled using specially constructed 4¼-inch I.D. (9½-inch OD) boulder hollow stem augers. The boreholes for monitoring wells MW-205I and MW-205D were drilled with standard 4¼-inch hollow stem augers to approximately 35 feet bgl; the rest of each borehole was drilled using the air rotary method. Drilling and well installation were performed in accordance with the procedures described in the Work Plan and QAPP (Malcolm Pirnie, 1995b and 1995a).

Split spoon samples were collected from several of the borings to provide soil for analytical samples, as described in Section 2.1.1, and to provide stratigraphic information. Descriptions of soil characteristics, photoionization detector (PID) readings, and relevant observations of rig behavior (i.e., change in drilling pressure, rig reaction to cobble zones, etc.) noted during drilling were recorded on boring logs. The boring logs are presented in Appendix A.

Monitoring well MW-202 was installed as a "water table" well. Monitoring wells MW-201S, MW-203S, and MW-204 were installed as dual-purpose "water table and SVE" wells. Monitoring

wells MW-203D, MW-205I, MW-205D were installed as "deep" wells. Well construction information is summarized below and is also presented on the well construction logs which are available in Appendix B.

2.2.1.2 *Water Table Monitoring Well Installation*

The four water table wells were installed inside or adjacent to the PMC building. The primary purpose of the water table wells was to document the presence and extent of any oils or other light non-aqueous phase liquid (LNAPLs) present at the water table.

The water table wells were constructed of 2-inch I.D., 20-slot, 5-foot long stainless steel screens and 2-inch I.D. PVC risers. The screens were set at depths such that they straddled the water table and the water table was two to three feet below the top of the screen.

2.2.1.3 Soil Vapor Extraction Well Installation

Wells MW-201S, MW-203S, and MW-204S were installed as dual-purpose wells. In addition to the screen straddling the water table as described above, the wells also included 8 to 10 foot long screens placed in the unsaturated zone above the water table. This type of construction allowed the wells to be used as groundwater monitoring wells and as observation wells during SVE tests (utilizing inflatable packers). The SVE portions of the wells were constructed of 2-inch I.D., 20 slot PVC screens. A two-foot long piece of PVC riser was placed between the SVE well screen and the water table screen. A bentonite seal was placed in the annular space adjacent to the two-foot piece of PVC riser to provide a barrier between the water table well and the SVE well.

2.2.1.4 Deep Monitoring Well Installation

Monitoring well MW-203D was installed inside the PMC building adjacent to well MW-203S. The well screen was set at 37 to 42 feet bgl, corresponding to the weathered limestone zone (Section 4). This well was installed to evaluate the possible presence of dense non-aqueous phase liquid

(DNAPLs) or phase separated contaminants which may have been present within the fractured limestone bedrock.

Monitoring wells MW-205I and MW-205D were installed as a well cluster located southeast of the Ingalls municipal well. The purpose of installing these wells was to assess any vertical hydraulic gradient and to monitor contaminants potentially present in the deeper portion of the aquifer hydraulically upgradient of the Ingalls municipal well. The well screens of monitoring wells MW-205I and MW-205D were placed at 38 to 43 and 54 to 59 feet bgl, respectively.

The deep monitoring wells were constructed of 2-inch I.D., 20-slot, stainless steel screens and 2-inch I.D. PVC risers.

All water table and deep monitoring wells were secured with either a 4 by 4-inch locking steel above ground protective casing, or a locking J-plug and 9-inch diameter flush-mounted manhole. The protective casings and J-plugs were locked with Master locks, keyed alike.

2.2.2 Groundwater Sampling

Groundwater samples were collected from the Ingalls municipal well and the following 31 monitoring wells located throughout the study area in October, 1995: PS-4, PS-6, PS-10A, PS-11, PS-12, PS-13, PS-1R, PS-104, PS-105S, PS-105D, PS-106, PS-AS, PS-AD, PS-BS, PS-BD, PS-CS, PS-CD, PS-DS, PS-DD, COP-1, COP-2, COP-3, COP-4, COP-5, MW-201S, MW-202S, MW-203S, MW-203D, MW-204S, MW-205I, and MW-205D. At MDEQ direction, the groundwater samples collected from monitoring wells PS-AS, PS-BS, PS-BD, PS-DS, PS-DD, PS-4, PS-6, PS-12, PS-13, PS-10A, PS-104, PS-106, and PS-1R, were submitted to US EPA-Central Regional Laboratory (CRL) for low detection limit analysis of VOCs, SVOCs, pesticides, and PCBs. The low detection limits were requested so that the typically low-concentration analytical data could be compared to the low state cleanup criteria concentrations. The groundwater samples were collected according to the procedures described in the Work Plan and QAPP (Malcolm Pirnie, 1995b and 1995a).

The groundwater samples collected from the Ingalls municipal well and the other monitoring wells were submitted to USEPA CLP facilities for analysis as follows: Ross Analytical Services, Inc.

for organic compounds (VOCs, SVOCs, pesticides, PCBs), and Southwest Laboratory of Oklahoma for inorganic compounds (metals, and cyanide).

Additionally, groundwater samples collected from monitoring wells PS-4, PS-104, COP-4, MW-201S, MW-202S, MW-203S, MW-203D and MW-204S, were submitted to ENCOTEC Laboratory for analysis of total petroleum hydrocarbons (TPH) and diesel range organics (DRO) to evaluate the presence and extent of any oils or other free product potentially present at the water table beneath and adjacent to the northwest portion of the PMC building where in 1990, hydraulic fluid reportedly seeped through the building walls.

The groundwater sampling analytical data have been compiled into tables as follows:

Table 5-13 Volatile Organic Compounds
Table 5-14 Semi-Volatile Organic Compounds
Table 5-15 Pesticides and PCBs
Table 5-16 Inorganic Compounds
Table 5-17 Tentatively Identified Volatile Organic Compounds
Table 5-18 Tentatively Identified Semi-Volatile Organic Compounds

The laboratory data packages are available in the MDEQ-Superfund project files. The groundwater sampling analytical data are discussed in Section 5.2.

2.2.3 Aquifer Testing

2.2.3.1 Water Level Measurements

Water levels were recorded in the monitoring wells (including five City of Petoskey wells), the Ingalls municipal well, and at three surface water measuring locations (two locations on Bear Creek and one location on Lake Michigan) on three occasions: September 25, October 3, and October 16, 1995. The water levels in monitoring wells were measured from the top of the casing (TOC) using an electric water level probe. The measurements at the Ingalls municipal well and the surface water bodies were recorded at pre-marked measurement points. The surface water measuring

locations are indicated on Figure 2-2. The water levels were measured according to the procedures described in the Work Plan and QAPP (Malcolm Pirnie, 1995b and 1995a).

The elevation of the top of casing of each of the new monitoring wells (200 series), the premarked points for the Ingalls municipal well and the northern Bear Creek location, and the TOC of well PS-AS (which had previously been damaged) were surveyed by Jenema Land Surveys of Manistee, Michigan on February 5, 1996. The elevations were referenced to a USGS datum. The benchmark used for the survey was the 'Gas Reset 1984' bronze disk which has an elevation of 592.25 feet above mean sea level, and is located on the north end of the northwest wing of the Petoskey Fire Hall Building on a concrete pad west of the restrooms.

The elevations of the monitoring wells which were installed before 1995 (PS-, COP-, and MW-100 series wells), the southern Bear Creek measuring location, and the Lake Michigan measuring location were referenced in various existing reports, therefore a resurvey was not authorized during the Phase II Remedial Investigation, except for the top of casing of the three monitoring wells (PS-11, PS-104, and MW-105S), which were resurveyed to verify the reported elevations. The resurveyed TOC elevations of these three wells were 0.02 to 0.04 feet greater than the TOC elevations previously reported. Elevation variations of up to 0.04 foot are generally acceptable when surveying across an area the size of this site.

The water level measurements and calculated groundwater and surface water elevations are listed in Table 2-1.

2.2.3.2 Aquifer Pumping Test

A constant rate groundwater pumping test was performed during October 3 through 6, 1995 for the purpose of determining aquifer characteristics. A detailed description of the setup and performance of the pumping test and the analysis of the data is discussed in Section 3.2.

2.2.3.3 Aquifer Field Permeability (Slug) Tests

Upon analysis of the pumping test data (discussed in Section 3.2), it was determined that fluctuations in Lake Michigan levels affected aquifer levels during the test. Therefore, aquifer characteristics could not be accurately estimated using the pumping test data. MDEQ and Malcolm Pirnie decided to perform slug tests at five wells in order to estimate a range of hydraulic conductivity values for the aquifer.

Slug tests were performed at five monitoring wells (MW-201S, PS-CS, PS-CD, MW-105S, and MW-105D) on April 26, 1996. These monitoring wells were selected to provide a representation of conditions across the site. The slug tests were conducted using an air slug. PVC pipes were used to contain the air slug because the slug testing tool could not be attached to the tops of the wells since the tops of the well riser were not threaded. The slug testing procedure was to 'instantaneously' change the head of the water in the well by introducing compressed air into the well casing. The elapsed time and head change as the water level returned to static conditions were recorded using a pressure transducer and data logger.

The slug test data were analyzed using the Bouwer and Rice method (1976). This method is applicable to fully or partially penetrating wells screened within unconfined aquifers, such as the water table aquifer at the Petoskey Manufacturing site (Section 4.2.), as well as for wells screened in leaky (partially) confined aquifers. The hydraulic conductivities calculated using slug test data are generally representative of the formation in the immediate vicinity of the screened interval of the monitoring well and do not take into account any large scale heterogeneities across the site. Actual hydraulic conductivities may be plus or minus one order of magnitude of the hydraulic conductivities estimated using slug test data. The calculated hydraulic conductivity (K) values are presented in Table 2-2 and discussed in Section 4.1.2. The mean hydraulic conductivities ranged from 7.67 x 10-4 at well MW-105D to 2.11 x 10-3 at well MW-201S, which is typical of limestone, silty sand, and sand. The test data, Bouwer and Rice plots, and the analytical solutions are provided in Appendix C.

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3.0 PILOT TEST RESULTS

3.1 SOIL VAPOR EXTRACTION TEST

Two soil vapor extraction (SVE) tests were performed during the period of September 12-15, 1995. The purpose of performing the tests was to develop data which could be used to indirectly evaluate the nature and magnitude of VOC contamination earlier anticipated in the unsaturated soils under the PMC building. The data are also useful in evaluating the effectiveness of using an SVE system for any long-term remediation to be determined by the Feasibility Study.

While the performance of the SVE tests showed that SVE is effective for the physical conditions encountered in the area of concern (under the northwest corner of the PMC building), the applicability and cost-effectiveness of the SVE technology in addressing the relatively low concentrations of VOCs under the building, will be addressed in the Feasibility Study.

3.1.1 Test Set-up

The construction of SVE test wells MW-201S, MW-203S, and MW-204S is described in Section 2.2.1.3. Three temporary two-inch diameter observation points were also set manually, to provide additional shallow soil zone monitoring. Observation points SVE-1 and SVE-2 were set through holes cut into the PMC building floor using a coring machine. These wells were screened from 0.6 to 2.5 feet bgl and 0.6 to 1.5 feet bgl, respectively. Observation point SVE-3 was set outside the PMC building, and was screened from 0.6 to 2.5 feet bgl. All observation points were set at the maximum depth possible and could not be installed manually any deeper due to the presence of cobbles and boulders at 1.5 to 2.5 feet below ground level. The observation points were constructed of 2½ diameter screen and riser with a sand pack around the screened interval which extended several inches above the screen. The remaining annular space was filled with cement. The locations and spacing of the three SVE wells and the three observation points are shown on Figure 3-1.

During the first SVE test, the vacuum was applied to well MW-203S; during the second test, the vacuum was applied to well MW-201S. Based on evaluation of the data obtained from the tests, it was determined that the radius of influence could be adequately determined. The performance of the third test on well MW-204 would not have contributed additional useful information, because the nearest observation point was 29 feet away and much further than the radius of influence estimated from the first two tests.

During each test, induced vacuums were measured at nearby SVE observation points and SVE wells with magnehelic gauges. Samples of the extracted soil gas were collected hourly during the first four hours of the tests and at regular intervals throughout the duration of the test, following the stabilization of system readings after the first four hours. The soil gas samples were screened in the field for trichloroethene (TCE), which is the compound of concern, using a field gas chromatograph (GC). The extracted soil gas stream was also monitored with a photoionizaton detector (PID) which detected total VOC (TVO) concentrations, at the well head and just prior to entering the blower in the SVE test trailer.

The vapor that was pulled from the extraction well was treated through two 55-gallon granular activated carbon (GAC) canisters attached in sequence (the first canister was the "lead" carbon and the second canister was the "lag" carbon). Summaries of the conditions and results of both SVE tests are presented in Appendix D.

Some water was present in the vapor stream during the tests. To ensure that the induced vacuum was only pulling vapors from the unsaturated zone, an inflatable packer was installed in the well directly above the water table to seal the well. This also reduced the potential for pulling significant quantities of water into the SVE blower.

3.1.2 Radius of Influence

Induced vacuum readings recorded at observation wells during the SVE tests were used to determined the radius of influence that the SVE system was able to form during the tests. The first SVE test (using well MW-203S as the extraction well) was conducted for approximately 48 hours.

The second SVE test (using MW-201S as the extraction well) was conducted for approximately 24 hours. The SVE tests were performed for a length of time sufficient for the readings to stabilize and the radius of influence to be estimated.

During the first test, induced vacuum readings were observed in SVE observation wells and points MW-204S, MW-201S, SVE-1, and SVE-2. These wells were located 12.5 to 40 feet from the extraction well. The only substantial induced vacuum readings were recorded at observation point SVE-1 (located approximately 12.5 feet from the extraction well); the readings ranged from 0.28 to 0.35 inches of water. Induced vacuum readings at the other three observation wells were very low, ranging from 0 to 0.045 inches of water.

The second SVE test was performed using well MW-201S (located outside the PMC building) as the extraction well. During this test, no induced vacuum readings were observed at any of the observation points and wells; not even at the closest observation point (SVE-3), which was located approximately 13.5 feet away from the extraction well. The extraction well in this test was located outside the PMC building and therefore, some of the area of influence was not overlain by concrete, as was the case during the first SVE test performed using an extraction well located inside the building. This appears to have affected the radius of influence that could be achieved because air may have been pulled in from the uncovered ground surface.

Based on these results, the radius of influence that was achieved during the first test was estimated at approximately 12.5 feet from the extraction well. However, due to the fractures and other heterogeneities being present in the subsurface, the radius of influence may not be the same in all directions. The fractures and heterogeneities may cause preferential flow pathways that could not be detected by the available observation wells or points. In the vicinity of the SVE test wells, a sand layer is present from the surface to approximately 2.5 feet bgl. Below the sand layer is a layer of boulders and cobbles in a sandy matrix. The differences in the nature of the subsurface soils may affect the observed radius of influence because observation points SVE-1, SVE-2, and SVE-3 were screened in the sand layer while wells MW-201S, MW-203S, and MW-204S were screened in the boulder layer.

3.1.3 Operating Conditions

The vacuum applied during the first SVE test was approximately 43 inches of water, which produced a linear flow velocity ranging from 4800 to 6200 feet per minute. The applied vacuum during the second SVE test was approximately 43 inches of water which produced an air flow velocity ranging from 5400 to 5600 feet per minute.

The blower discharge temperature ranged from 81.5 to 94.5 degrees Fahrenheit during the tests. The blower discharge pressure reached 6 inches of water.

3.1.4 Vapor Stream TCE and Total VOC Concentrations

TCE and total VOC concentrations in the extracted vapor stream were monitored throughout the tests using a portable GC and PID, respectively. The concentrations of TCE in parts per billion (ppb) are shown in Table 3-1. The PID readings, which represent total VOCs (TVO) in parts per million (ppm), are included with the system monitoring results in Appendix D. During the first test, the TCE concentrations ranged from 2 to 9 ppb and decreased throughout the test. During the second test, the TCE concentrations ranged from 1 to 3 ppb, and again decreased to near non-detectable concentrations.

3.2 AQUIFER PUMPING TEST

A constant rate groundwater pumping test was performed during October 3 through 6, 1995 for the purpose of assessing aquifer characteristics. The description of the setup and performance of the pumping test and analysis of the test data are presented in the following sections of this report.

3.2.1 Test Set-up

A 4-inch diameter groundwater extraction well (PW-201D) was installed on August 22 and 23, 1995 to be used for pumping tests. The well was located such that it could be utilized as part

of a future groundwater extraction system, if one is installed for remediation (Figure 2-2). The borehole was drilled to a depth of 55 feet bgl using a combination of large diameter (6.25 inch) specially constructed boulder hollow stem augers and air rotary drilling. The well was constructed of a 20-foot long, 30-slot, continuous wound, PVC screen and 4-inch I.D. PVC riser. The screen was set from 35 to 55 feet bgl. The well was sandpacked using coarse sand from the bottom of the screen to three feet above the top of the screen (32 feet bgl). A two-foot thick bentonite seal was set above the sand pack, and the remaining annular space was filled with cement-bentonite grout. An 8-inch diameter flush mount manhole protector was set in concrete at the surface. The well was secured with a watertight j-plug and lock. The boring and well construction logs for well PW-201D are presented in Appendices A and B, respectively.

A Grundfos submersible pump was installed in the well, with the intake of the pump set at approximately 50 feet bgl (five feet above the well bottom). Pressure transducers were installed in monitoring wells MW-203S, MW-203D, PS-4, and in the pumping well PW-201D. The transducers were connected to two Hermit data loggers located inside the Petoskey Manufacturing building. Another transducer was installed in well PS-105S from October 2 through October 10, 1995, to collect background water level data. This transducer was connected to a Hermit data logger located near the well. Initial test and transducer parameters were entered into the data loggers prior to the start of the pumping test. The data loggers were set up to record water levels in the instrumented wells on a logarithmic time scale.

One "baseline" set of water levels was obtained manually using an electric water level indicator in the monitoring wells and the pumping well for comparative purposes. In addition, water levels were measured at the three surface water measuring points: one located on the breakwater in Lake Michigan and two (C-1 and C-2) located on Bear Creek (Figure 2-2). These measurements were used to evaluate fluctuations in lake and creek water levels.

Two granular activated carbon (GAC) treatment units, containing 2,000 pounds of GAC each, were set up on-site in series to treat the groundwater discharged from the pumping well. A discharge

line was run from the second GAC unit to the sanitary sewer located approximately 200 feet southwest of pumping well PW-201D.

Prior to performing the constant rate pumping test, a step test was performed to evaluate drawdown at various pumping rates. Initially, a pump rated for a maximum pumping rate of 105 gpm was used. This pump proved to be too large and quickly drew down the water level in the pumping well to the pump intake. The large pump was replaced with a smaller pump with an operating range of 20 to 50 gpm. Pumping rates (steps) of 25, 35, and 45 gpm were evaluated. Thirty-five gpm was determined to be the maximum sustainable pumping rate.

3.2.2 Test Implementation

The test was initiated at 4:10 pm on October 3, 1995. The pump was shut off at 2:05 pm on October 6, 1995. The pumping test was conducted for a total of 69 hours and 54 minutes at a constant pumping rate of 35 gpm.

Water level measurements were recorded automatically by the data loggers in monitoring wells MW-203S, MW-203D, PS-4, background well PS-105S, and in pumping well PW-201D. An electric water level indicator was used to measure water levels in other selected monitoring wells and surface water monitoring points during the test.

During the test, samples were collected from the influent groundwater (i.e., pre-treatment prior to entering the GAC units) and from the effluent (i.e., post-treatment after leaving the GAC units) at numerous intervals. These samples were screened in the field for 1,2-Dichloroethene (1,2 DCE) and TCE using a portable GC. The field screening results are summarized in Table 3-2. The data confirmed that there was no breakthrough of 1,2-DCE or TCE during the pumping test.

Just prior to shutting off the pump, a complete set of water levels were measured in the monitoring wells and at the surface water measuring points. Before the pump was shut off, the data loggers were set up to record recovery in the wells. At the same time as the pump was shut off, the data loggers were started and a recovery test was run. During the recovery test, water levels were measured automatically in wells MW-203S, MW-203D, PS-4, background well PS-105S, and

pumping well PW-201 by the data loggers, and in select additional wells using a water level probe. The data logger files for the step, constant, and recovery phases of the test, water level measurement data collected during the test, and elapsed time vs. drawdown curves are included in Appendix E.

3.2.3 Observations / Data Trends

Well response curves for several of the monitoring wells located near pumping well PW-201 were constructed by plotting drawdown (feet) versus elapsed time (min.). These curves were used to evaluate the aquifer response to pumping; they are included in Appendix E. As indicated by the well response curves, water levels in these wells fluctuated up and down throughout the test even though a steady 35 gpm pumping rate was maintained at the pumping well. Based on an evaluation of the change in water level in the wells and the change in Lake Michigan lake level, there appears to be a high degree of influence of lake level on the water level in the monitoring wells.

Water levels in the monitoring wells either dropped or showed no change for the first six to seven minutes of the test. After this, water levels tended to rise until approximately 800 to 900 minutes into the test. During this time, the level of Lake Michigan also rose. From about 900 to 2,700 minutes into the test, the water levels in the monitoring wells dropped, as did the water level in Lake Michigan. The lowest water levels in the wells and in Lake Michigan were recorded from approximately 2,000 to 2,700 minutes into the test. From approximately 2,700 minutes until the end of the test (4,194 minutes elapsed time), the water levels in the wells and in the lake rose.

Figure 3-2 is a plot of elapsed time vs. drawdown in the monitoring wells and Lake Michigan. During the pumping test, the change of water levels in the monitoring wells in general mimicked the change in Lake Michigan water level (i.e., as the lake level rose, the water level in the monitoring wells also rose).

The water levels in a few of the deep wells closest to the pumping well (PS-AD, PS-BD, PS-104, and MW-203D) appeared to have been drawn down during the test, while water levels in the shallow wells closest to the pumping well were not drawn down substantially as shown on Figure 3-2. It is possible that the screens of these wells were not in direct communication with the deeper wells

due to the presence of silty or clayey lenses and/or clay-filled voids/fractures in the aquifer. These zones may essentially act as a barrier to vertical hydraulic communication in the aquifer. This may cause the aquifer to behave as a leaky confined aquifer in the deeper zones. The presence of silt and/or clay was observed in several locations during the drilling of the monitoring wells.

Two weeks after the pumping test, a transducer was placed in the Ingalls municipal well for approximately 25 hours to record water level fluctuations. Over the 25-hour period, the fluctuations in water level in the Ingalls well were of the same order of magnitude as the drawdown caused by pumping well PW-201D during the pumping test. Figure 3-4 shows the substantial fluctuations of the water levels in the Ingalls well which is in direct communication with Lake Michigan due to its proximity to the lake and the nature of the soils and bedrock in that area. The fluctuations in lake level seems to have caused larger changes in water level elevation in the wells than could be induced by pumping PW-201D. Since the lake level fluctuations "mask" the drawdown data, the time vs. drawdown data cannot be used to accurately estimate aquifer parameters.

3.2.4 Supplemental Water Level Measurements

The water level in background observation well PS-105S fluctuated approximately 0.8 feet from October 2 through October 10, 1995 (Figure 3-3). The changes in water level in well PS-105S mimicked the changes in Lake Michigan lake level during the period of the pumping test.

The water level in the Ingalls municipal well, which is located outside the zone of influence of the pumping test well, fluctuates depending on pumping cycles. It fluctuated rapidly over a 0.45 ft. range throughout the day it was monitored frequently (October 16, 1995) (Figure 3-4). This variation in water level is the result of production pumping at this well.

3.2.5 Surface Water Measurements

Barometric pressure appears to have a rapid effect on Lake Michigan's water level as shown on Figure 3-5. Generally, as barometric pressure decreases the lake level increases, and as barometric pressure increases lake level decreases.

Changes in water level elevation as measured at the Lake Michigan and two Bear Creek measuring points during the period of the pumping test are shown on Figure 3-6. Lake Michigan lake level and the water level elevation measured at the northern Bear Creek water measuring point (C-1), located below the dam, appeared to fluctuate in a similar manner, indicating that the lake level fluctuation extends as far south in the creek as measuring point C-1. The water level at the southern Bear Creek measuring point (C-2) located above the dam, varied only slightly ($\leq$0.08 ft.) during the period of the pumping test. This is representative of more stable water conditions along the southeastern portion of the aquifer, due to the presence of the dam.

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4.0 SITE GEOLOGY AND HYDROGEOLOGY

4.1 SITE GEOLOGY

The stratigraphy at the site was interpreted from information obtained from the borings drilled during this phase of the RI, logs from borings previously drilled at the site, and local water well logs.

The unconsolidated deposits at the site range in thickness from approximately 5 to 45 feet. These deposits consist of up to 6 feet of sand overlying a layer of large limestone boulders and cobbles in a clayey, silty, and/or sandy matrix. The limestone fragments vary from a few inches to 10 to 15 feet in diameter. Immediately below this boulder and cobble layer is the limestone bedrock which is part of the Devonian age Traverse Group. The upper portion of the limestone bedrock is highly weathered. The interfaces between the limestone cobbles and weathered bedrock and between the weathered bedrock and competent bedrock are extremely variable along the shore of Lake Michigan in the vicinity of the site, and often difficult to determine.

4.2 SITE HYDROGEOLOGY

The main surface water bodies in the vicinity of the site are Lake Michigan, located at the northern edge of the site, and Bear Creek, which runs roughly north-south and is located approximately 500 feet east of the PMC building.

A single shallow unconfined aquifer, corresponding to the boulder/cobble layer and the limestone bedrock, as described above, was confirmed during this investigation. Groundwater at the site is typically first present at a depth of approximately 8 to 19 feet bgl.

The hydraulic conductivities (K) calculated from slug test data collected at the site are shown in Table 2-2. The mean hydraulic conductivities ranged from 7.67 x 10-4 at well MW-105D to 2.11 x 10-3 at well MW-201S, which is typical of aquifers of limestone, silty sand, and sand.

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Evaluation of data collected during the pumping test indicates that the water level of Lake Michigan exerts a high degree of influence on the water levels recorded in the monitoring wells. During the pumping test, water levels in the monitoring wells located near the pumping well fluctuated up and down even though a constant 35 gpm pumping rate was maintained in the pumping well. Figure 3-2 is a drawdown vs. elapsed time plot of the water levels in the monitoring wells and in Lake Michigan collected during the pumping test. A strong correlation can be seen between fluctuations in lake level and water levels in monitoring wells.

Changes in barometric pressure appear to have an almost immediate effect on the water level in Lake Michigan as shown on Figure 3-5. As barometric pressure decreases, the lake level increases, and as barometric pressure increases, the lake level decreases.

Changes in water level elevation, as measured at the Lake Michigan and two Bear Creek measuring points during the period of the pumping test, are shown on Figure 3-6. Lake Michigan lake level and the water level elevation measured at the northern Bear Creek water measuring point (C-1), located below the dam, appeared to fluctuate in a similar manner, indicating that the lake level fluctuation extends as far south in the creek as measuring point C-1. The water level at the southern Bear Creek measuring point (C-2) located just above the dam, varied only slightly ($\leq$0.08 ft.) during the period of the pumping test. This variation is representative of more stable water conditions along the southeastern portion of the aquifer, due to the presence of the dam.

Local groundwater flow is heavily influenced by changes in lake level. In general, groundwater flows from the highlands toward the lake, but in the beach shelf between the bluff and the lake, where the site is located, water levels are approximately the same as the lake level. There is a lag time associated with the aquifer response to changes in the lake level resulting in local reversals of the flow direction. When the lake is at low ebb, groundwater flow is toward the lake. As the lake level rises, the lake elevation becomes higher than the groundwater elevation in the aquifer and lake water flows into the aquifer (away from the lake). The resulting head change is propagated through the aquifer at a rate controlled by the hydraulic conductivity. This change results in a situation where groundwater near the bluff flows northward toward the lake, while groundwater

near the shore flows southward toward the bluff. There is a theoretical stagnation line separating these two flow patterns, where the horizontal gradient is zero and no flow occurs. As the head change in response to rising lake levels is propagated through the aquifer, the stagnation line moves southward toward the bluff. When the lake level falls, the stagnation line moves northward toward the lake and may disappear if flow toward the lake is reestablished throughout the entire aquifer. Review of historical water level records indicates that the overall groundwater flow from the PMC facility is slightly towards the northwest, including western and northern flow components. Both previous and current water levels show that the horizontal gradient across the site is extremely low (flat).

Groundwater flow at the site is also controlled by the voids between limestone boulders and by fractures in the limestone bedrock. Groundwater flow through fractures near the Ingalls well appears more pronounced, however it is irregular due to the periodic pumping.

As a result of these conditions, equilibrium conditions that are the basis for 'static' water level measurements could not be depicted graphically with the data available in this phase of the RI. These conditions are in a constant state of flux, and based on the data shown in Figure 3-3, undergo a reversal on a frequent basis. Consequently, an equipotential map describing static conditions during the Phase II RI is not a valid concept at this site, and cannot be prepared at the scale of the site investigation. Several attempts to develop potentiometric surface maps resulted in inconsistent and variable configurations based on contour intervals of only few hundreds of a foot. Mapping at a scale that compares groundwater elevations south of the bluff to lake elevations may be valid, but such a map is not useful for the estimation of local gradients or flow velocities at the site. Groundwater elevations measured on several occasions are included in Table 2-1. Vertical hydraulic gradients were calculated at the well clusters using the formula:

$$I_v = \Delta h / \Delta d$$

where: I_v = vertical hydraulic gradient.

Δh = head difference between the water elevation in two wells.

Δd = distance between the bottom of the two well screens.

The results were as follows:

Well Cluster	Vertical Hydraulic Gradient
PS-BS / PS-BD	4.0 x 10-3 ft/ft upward
PS-CS / PS-CD	8.7 x 10-4 ft/ft upward
PS-CS / MW-105D	2.9 x 10-2 ft/ft upward
PS-DS / PS-DD	3.5 x 10-3 ft/ft upward
PS-4 / PS-104	4.4 x 10-3 ft/ft downward
MW-205I / MW-205D	1.3 x 10-3 ft/ft upward
PS-1R / PS-13	6.7 x 10-4 ft/ft downward
MW-203S / MW-203D	1.3 x 10-3 ft/ft downward

Generally, there is a slight upward gradient in the northern and western portions of the site and a slight downward gradient in the central and eastern portions of the site. The strongest vertical gradient calculated is between wells PS-CS and MW-105D, located next to each other, where the screen separation is the greatest, indicating a strong upward vertical groundwater component which weakens closer to the water table.

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5.0 SITE CONTAMINATION CHARACTERIZATION

Soil and groundwater samples were collected and analyzed during both phases of the Remedial Investigations in order to assess the nature and extent of contamination at the site. This section describes soil analytical data obtained from the Phase I RI, supplemented by data obtained during the Phase II RI. The groundwater contamination characterization is based on the most current groundwater analytical data obtained during the Phase II RI.

5.1 EVALUATION OF SOIL ANALYTICAL DATA

5.1.1 Evaluation Criteria

The soil analytical data obtained from the Phase I and II RIs were compared to several applicable cleanup criteria established by the State of Michigan under Part 201, Environmental Remediation, of Act 451, Natural Resources and Environmental Protection Act (PA 1995, as amended). The criteria used for this comparison are:

- Generic Residential Cleanup Criteria (GRCC)
- Groundwater/Surface Water Interface (GSI) Criteria
- Generic Industrial Cleanup Criteria
- Residential Direct Contact Cleanup Criteria
- Industrial Direct Contact Cleanup Criteria
- Generic Inhalation Criteria for Ambient Air

The applicable cleanup criteria for the compounds detected in the soil samples are presented in the soil analytical data tables.

5.1.1.1 Determination of Generic Residential Cleanup Criteria

The GRCC were established by using either the Health-Based or Aesthetic Criteria (MERA Operational Memorandum 8, Revision 4, June 5, 1995), the Soil/Water Partitioning (SWP) Drinking

Water Criteria (Addendum to MERA Operational Memorandum 8, Revision 4, January 17, 1997), the State of Michigan Default Background Concentrations (MERA Operational Memorandum 15, September 30, 1993), or the Site-Specific Calculated Background Concentrations (Table 5-1).

The determination of which Residential Cleanup Criteria are used to evaluate the concentrations of compounds begins by using the most restrictive of the 20X Residential Health-Based and 20X Aesthetic Criteria. Residential Cleanup Criteria are representative of the acceptable Health-Based criteria and 20X the corresponding Groundwater Criteria that are considered protective of groundwater. The most restrictive criteria are then compared to SWP Drinking Water Criteria. The least restrictive criteria are then used as the applicable cleanup criteria.

MERA Operational Memorandum 8, Revision 4, June 5, 1995 allows Background Concentrations (State of Michigan or Site-Specific) for selected inorganic compounds to be used as Residential Cleanup Criteria if such concentrations are higher (less restrictive) than the Residential Cleanup Criteria. If the calculated cleanup criteria are lower (more restrictive) than the target method detection limits (MDLs), the MDLs become the residential cleanup criteria. In cases where a compound is not expected to leach, the Direct Contact Values are used. However, if it appears that a compound may be leaching through the soil, then the cleanup criteria are determined by utilizing the SWP or 20X the more restrictive of the Health-Based or Aesthetic Drinking Water Criteria.

5.1.1.2 Determination of Groundwater/Surface Water Interface Criteria

The 20X GSI criteria are soil criteria protective of surface water. GSI criteria were developed to address risks associated with groundwater discharging to a surface water body, which may or may not be used as a drinking water source. The GSI criteria used for comparison of soil data at this site apply to surface waters not protected as a drinking water source, because Lake Michigan is not a drinking water source for the City of Petoskey. It is not necessary that 20X GSI cleanup criteria in the soil be met, as long as the GSI values are not exceeded at the appropriate compliance points (monitoring wells near Lake Michigan).

The GSI Criteria are described in Addendum to MERA Operational Memorandum 8, Revision 4, and Operational Memorandum 14, Revision 2, dated November 3, 1997. The higher (least restrictive) of the soil 20X GSI criteria or the soil GSI SWP criteria (soil criteria protective of groundwater discharging to the surface water) were compared to the site soil data to ensure that groundwater concentrations did not exceed the GSI criteria. The GSI values were recently updated as part of new administrative rules for Part 31, of Act 451, as amended. However, as of December 10, 1997, the list of GSI values was still being updated. Therefore, the GSI values listed in MERA Operational Memorandum 8, Revision 4 dated June 5, 1995 were used to evaluate compounds for which new GSI criteria are not yet available.

5.1.1.3 Determination of Industrial Cleanup Criteria

The Industrial Cleanup Criteria were determined by using either the 20X Industrial Health-Based or 20X Aesthetic Groundwater Criteria (MERA Operational Memorandum 14, Revision 2, June 6, 1995), the Soil/Water Partitioning (SWP) Industrial Drinking Water Criteria (criteria are currently under State review), the State of Michigan Default Background Concentrations (MERA Operational Memorandum 15, September 30, 1993), or the Site-Specific Calculated Background Concentrations.

The determination of which criteria are used to evaluate specific compounds in soils begins by using the most restrictive of the 20 X Industrial Health-Based and 20X Aesthetic Cleanup Criteria. The most restrictive criteria are then compared to SWP Industrial Drinking Water Criteria. The higher (least restrictive) criteria are then used as the applicable cleanup criteria. MERA Operational Memorandum 14, Revision 2, June 6, 1995 allows the use of Background Concentrations (State of Michigan or Site-Specific) for selected inorganic compounds, if the Background concentrations are higher than the criteria determined using the method discussed above.

In cases where a compound is not expected to leach, the Direct Contact Values are used. However, if evidence indicates that a compound may be leaching through the soil, then the cleanup

criteria is determined by using 20X the more restrictive of the Industrial Health-Based or Aesthetic Drinking Water Cleanup Criteria.

5.1.1.4 Determination of Direct Contact Value Criteria

Residential and Industrial Direct Contact Criteria were also used to evaluate the soil analytical data because of the potential presence of soil contact pathways. These criteria were obtained from MERA Operational Memorandum 8, Revision 4, June 5, 1995 and MERA Operational Memorandum 14, Revision 2, June 6, 1995, respectively.

5.1.1.5 Determination of Generic Soil Inhalation Criteria for Ambient Air

Generic soil inhalation criteria for ambient air was addressed in a MDEQ Addendum to Interim Operational Memorandum #8, Revision 4 and #14, Revision 2 dated April 29, 1997. These generic soil inhalation criteria were developed for residential and industrial/commercial scenaria to assess the potential for human health effects from long-term exposure to airborne soil contaminants in ambient air.

The detected concentrations of contaminants in the site soils were compared to this set of cleanup criteria. None of the detected compounds were present in concentrations that exceeded the residential and industrial/commercial generic soil inhalation criteria.

5.1.2 Evaluation of Soil Analytical Data

Soil samples were collected from the site in 1992 as part of the Phase I RI and in 1995 as part of the Phase II RI. For the purpose of the following discussion both sets of soil analytical data were reviewed.

Soil samples were collected from locations SS-1 through SS-6, SB-1 through SB-12, and B-1 through B-4 in September 1992. The designation "SS" refers to surficial soil samples (<1 foot), while designations "SB" and "B" refer to subsurface soil sampling (>1 foot). The remaining soil samples were collected in August 1995. The soil sampling locations are shown on Figure 2-1. The soil

analytical data are presented by major analytical group (i.e., volatile organic compounds, semi-volatile organic compounds, PCB/Pesticides and inorganic compounds). The soil analytical data are shown on Figures 5-2 through 5-12.

5.1.2.1 Volatile Organic Compounds

The concentrations of the following volatile organic compounds were detected below the applicable GRCC, GSI Criteria and Industrial Cleanup Criteria; the concentration ranges are shown in parentheses: tetrachloroethane (1 to 50 µg/kg); 1,2-dichloroethene (3 to 40 µg/kg); benzene (1 µg/kg); toluene (3 to 70 µg/kg); ethyl benzene (2 to 44 µg/kg); xylene (2 to 240 µg/kg); methylene chloride (4 to 50 µg/kg); and acetone (10 to 46 µg/kg).

Trichloroethene (TCE) was detected in samples at concentrations ranging from 1 to 830 µg/kg. Concentrations of TCE in the soil exceeded both the **Residential and Industrial** 20X Drinking Water Criteria of 100 µg/kg at soil borings SB-1 at 14.5 to 16.5 feet (280 µg/kg); at boring SB-201S at 0 to 2 feet (460 µg/kg) and at 14 to 16 feet (310 µg/kg); at boring SB-203S at 12 to 14 feet (830 µg/kg); and at boring SB-204S at 13 to 15 feet (130 µg/kg).

The locations where the concentrations of TCE in the soil exceeded the 20X Drinking Water Residential and Industrial Cleanup Criterion of 100 µg/kg were generally adjacent to the northwest corner of the PMC building or in the capillary zone adjacent to or underneath the PMC building.

The Phase II August 1995 soil sampling VOC analytical data and criteria comparisons are presented in Table 5-2. The Phase I surface and subsurface VOC soil sampling analytical data and criteria comparisons are presented in Tables 5-8 and 5-10, respectively. The VOCs whose concentration exceeded the Generic Residential Cleanup Criteria, Generic Industrial Cleanup Criteria, and GSI criteria in the Phase II and Phase I soil samples are shown on Figures 5-1, 5-2, and 5-3, respectively.

Phase II tentatively identified compounds (TICs) were present in soil samples collected from background boring locations (borings SB-206 and SB-207). The Phase II TIC analytical data have been compiled and are presented in Table 5-6. TICs were present in boring SB-206 (0.5 to 2.5 foot

bgl), and in boring SB-207 (0.5 to 2.5 foot bgl and 2.5 to 4.5 foot bgl samples). No conclusions may be drawn from the pattern of these TIC occurrences.

5.1.2.2 Semi-Volatile Organic Compounds

The concentrations of the following semi-volatile organic compounds were detected below the applicable GRCC, GSI Criteria and Industrial Cleanup Criteria in soil samples collected at the site; their concentration ranges are shown in parentheses: fluorene (120 to 7,100 µg/kg); anthracene (32 to 9,400 µg/kg); butyl benzyl phthalate (150 to 550 µg/kg); chrysene (29 to 23,000 µg/kg); indeno(1,2,3-cd)pyrene (43 to 13,000 µg/kg); benzo(ghi)perylene (41 to 12,000 µg/kg); di-n-butyl phthalate (82 to 360 µg/kg); dibenzofuran (23 to 3,900 µg/kg); one detection of naphthalene (120 µg/kg); one detection of 2-methylnaphthalene (75 µg/kg); pyrene (36 to 31,000 µg/kg); one detection of di-n-octyl phthalate (3,200 µg/kg); and acenaphthylene (380 to 730 µg/kg).

Phenanthrene was detected in soil samples in concentrations ranging from 59 to 46,000 µg/kg. Phenanthrene exceeds the **Residential, 20X GSI and Industrial** Criteria of 1,100 µg/kg, 12,000 µg/kg, and 34,000 µg/kg respectively, at soil boring SS-6 (46,000 µg/kg). In addition, phenanthrene exceeds the 20X GSI criterion of 1,100 µg/kg at soil borings SS-2 (2,500 µg/kg); SB-4 at 0-2' (2,300 µg/kg); and SB-9 at 2 to 4 feet (2,000 µg/kg). Deeper soil samples collected at the same boring locations did not contain detectable concentrations of phenanthrene, indicating that it is not leaching through the soil.

Acenaphthene was detected in soil samples at concentration ranges of 140 to 6,600 µg/kg with one exceedence of the **GSI** criteria of 4,300 µg/kg at soil boring SS-6 (6,600 µg/kg).

Benzo(a)anthracene was detected in soil samples at concentration ranges of 34 to 23,000 µg/kg with one exceedence of the **Residential** Cleanup Criterion of 14,000 µg/kg at soil boring SS-6 (23,000 µg/kg).

Benzo(a)pyrene was detected in soil samples at concentration ranges of 120 to 18,000 µg/kg with one exceedence of the **Residential** Cleanup Criterion of 1,400 µg/kg at soil boring SS-6 (18,000 µg/kg).

Benzo(b)fluoranthene was detected in soil samples at concentration ranges of 51 to 31,000 µg/kg with one exceedence of the **Residential** Cleanup Criterion of 14,000 µg/kg at soil boring SS-6 (31,000 µg/kg).

Bis (2-ethylexyl phthalate) was detected in soil samples at concentration ranges of 26 to 5,100 µg/kg with exceedences above the **Residential and Industrial** Criteria of 120 µg/kg at soil borings SB-203S at 5 to 7 feet (140 µg/kg); SS-5 (5,100 µg/kg); SB-1 at 4 to 6 feet (640 µg/kg); SB-1 at 14.5 to 16.5 feet (1,800 µg/kg); and SB-5 at 2 to 5 feet (4,300 µg/kg).

Fluoranthene was detected in soil samples at concentration ranges of 28 to 50,000 µg/kg with one exceedence of **20X GSI** Criterion of 7,400 µg/kg at soil boring SS-6 (50,000 µg/kg).

Carbazole was detected in soil samples at concentration ranges of 160 to 7,800 µg/kg with one excedence of the **Residential** Criterion of 860 µg/kg at soil boring SS-6 (7,800 µg/kg).

Dibenzo(a,h)anthracene was detected in soil samples at concentrations ranging from 110 to 7900 µg/kg with one exceedence of the **Residential** Criterion of 1400 µg/kg at soil boring SS-6 (7900 µg/kg).

The Phase II SVOC soil analytical data and comparisons to cleanup criteria are presented in Table 5-3. The Phase I SVOC surface and subsurface soil analytical data and criteria comparisons can be found in Tables 5-8 and 5-11, respectively. The SVOC compounds whose concentrations exceed cleanup criteria are shown on Figures 5-1, 5-2 and 5-3.

Tentatively identified compounds (TICs) were present in soil samples collected from all on-site (borings SB-201, SB-202, SB-203, and SB-204) and background (SB-206 and SB-207) boring locations. While conclusions concerning the presence of TICs cannot be drawn, the majority of the TICs were found at highest concentrations in borings outside the PMC building, primarily at the northeast corner (at boring location SB-202) at all sampled depths at decreasing frequency.

Numerous TICs were identified at both background soil boring locations (SB-206 and SB-207) at increasing frequency and concentration with depth. This data confirms the widespread occurrence of TICs observed during the Phase I Remedial Investigation (including TICs at background boring locations PS-12, B-1, and B-2). The TICs have been compiled and are presented in Table 5-7. Appendix C of the Phase I RI report lists TICs detected in soil samples collected during the Phase I RI. Most of the TICs have not been identified and are listed as "unknowns". Estimated concentrations are listed for both known and "unknown" TICs.

5.1.2.3 Pesticides and PCBs

The following pesticides and PCBs were detected at concentration below the applicable GRCC, GSI Criteria and Industrial Cleanup in soil samples collected at the site; their concentration ranges are identified in parentheses: aldrin (1.0 to 2.0 µg/kg); one detection of alpha chlordane (0.91 µg/kg); and endosulfan I and II (2.9 to 8.2 µg/kg).

The Phase II pesticide and PCB soil sampling analytical data and criteria comparisons are presented in Table 5-4. The Phase I pesticide and PCB soil sampling analytical data can be found in Appendix C of Eder's RI Report (Eder, 1993).

Only 4,4'-DDT was present in surficial sample SS-5, at concentration (92 µg/kg) exceeding the Residential Cleanup Criterion of 50 µg/kg.

5.1.2.4 Inorganic Compounds

Local background concentrations were calculated for all relevant inorganic compounds. The calculations were performed in accordance with MDEQ's "Guidance Document for Verification of Soil Remediation" (MDEQ, 1994). Acceptable background limits were calculated for soils using soil samples B-1 (1 to 3 feet), B-2 (1 to 3 feet), SB-206 (0.5 to 2.5 feet), SB-206 (2.5 to 4.5 feet), SB-207 (0.5 to 2.5 feet) and SB-207 (2.5 to 4.5 feet). The background concentration calculations are presented in Table 5-1.

The following inorganic compounds were detected at concentration below the applicable GRCC, GSI and Industrial Cleanup Criteria in soil samples collected at the site; concentration ranges are identified in parentheses: aluminum (902 to 6090 mg/kg); antimony (2.8 to 15 mg/kg); arsenic (0.7 to 14 mg/kg); beryllium (0.13 to 2.50 mg/kg); cobalt (0.76 to 3.5 mg/kg); copper (0.87 to 39 mg/kg); iron (1460 to 15,300 mg/kg); manganese (25.9 to 293 mg/kg); nickel (1.30 to 35.5 mg/kg); sodium (32.8 to 419 mg/kg); one detection of thallium (0.68 mg/kg); and vanadium (2.5 to 16.8 mg/kg).

Barium was detected in soil samples at concentrations ranging from 4.3 to 305 mg/kg with exceedences above the **GSI** criteria of 120 mg/kg at soil borings SB-201S at 0 to 2 feet (141 mg/kg) and SB-11 (305 mg/kg).

Cadmium was detected in soil samples at concentrations ranging from 0.34 to 28.9 mg/kg with exceedences above the **Residential and Industrial** Cleanup Criteria of 6 mg/kg and the **GSI** criteria of 4.3 mg/kg at soil borings SB-4 at 0 to 2 feet (8.5 mg/kg) and SS-1 (28.9 mg/kg). The cadmium concentration in sample boring SB-5 (4.4 mg/kg) exceeds the **GSI** criteria.

Chromium was detected in soil samples at concentrations ranging from 1.1 to 27.4 mg/kg with exceedences of the **GSI** criterion of 3.4 mg/kg at soil borings SB-201S at 0 to 2 feet (16.3 mg/kg); SB-202S at 0 to 2 feet (6.0mg/kg); SB-203D at 0 to 2 feet (3.5 mg/kg) and 5 to 7 feet (7.7 mg/kg); SB-204S at 0 to 2 feet (4.2 mg/kg); SB-3 at 6 to 7 feet (5.4 mg/kg); SB-4 at 0 to 2 feet (6.1 mg/kg) and in the duplicate (5.5 mg/kg); SB-5 at 2 to 5 feet (19.8 mg/kg); SB-6 at 0 to 2 feet (8.4 mg/kg); SB-11 at 1 to 3 feet (9.4 mg/kg); SS-1 (27.4 mg/kg); SS-2 (3.8 mg/kg); SS-3 (5.1 mg/kg); SS-4 (3.8 mg/kg); SS-5 (12.7 mg/kg); and SS-6 (10.6 mg.kg).

Lead was detected in soil samples at concentrations ranging from 1.1 to 306 mg/kg with exceedences of the **Residential, Industrial, and GSI** criteria at soil borings SB-201S at 0 to 2 feet (306 mg/kg); SS-1 (236 mg/kg); SB-5 at 2 to 5 feet (185 mg/kg); and SB-11 at 1 to 3 feet (199.2 mg/kg).

Magnesium was detected in soil samples at concentrations ranging from 417 to 54,900 mg/kg. Magnesium exceeds the **GSI** criteria of 1,000 mg/kg at soil borings SB-201S at 0-2' (5310

mg/kg); SB-202S at 0 to 2 feet (9820 mg/kg) and at 10 to 12 feet (32,900 mg/kg); SB-203D at 0 to 2 feet (1,370 mg/kg) and at 5 to 7 feet (14,800 mg/kg); SB-204S at 0 to 2 feet (1,350 mg/kg); SB-206 at 2.5 to 4.5 feet (1,910 mg/kg); SS-1 (12,300 mg/kg); SS-2 (4,330 mg/kg); SS-3 (6,620 mg/kg); SS-4 (2,810 mg/kg) and the duplicate (15,900 mg/kg); SS-6 (11,500 mg/kg); SB-1 at 4 to 6 feet (6,230 mg/kg) and 14.5 to 16.5 feet (20,200 mg/kg); SB-2 at 0 to 2 feet (6,170 mg/kg) and 6 to 9 feet (15,400 mg/kg); SB-3 at 6 to 7 feet (5,840 mg/kg); SB-4 at 0 to 2 feet (6,860 mg/kg), the duplicate (7,890 mg/kg) and 2 to 6 feet (54,900 mg/kg); SB-5 at 2 to 5 feet (21,800 mg/kg) and 10 to 13 feet (15,000 mg/kg); SB-6 at 0 to 2 feet (5,050 mg/kg) and 6 to 10 feet (22,300 mg/kg); SB-7 at 2 to 6 feet (12,100 mg/kg) and 10 to 14 feet (22,100 mg/kg); SB-8 at 4 to 8 feet (21,700 mg/kg) and 8 to 11 feet (22,000 mg/kg); SB-9 at 2 to 4 feet (30,900 mg/kg) and 5 to 8 feet (19,900 mg/kg); SB-10 at 1 to 5 feet (19,200 mg/kg), the duplicate (23,000 mg/kg) and 5 to 8 feet (24,200 mg/kg); SB-11 at 1 to 3 feet (3,310 mg/kg); and SB-12 at 1 to 3 feet (17,000 mg/kg) and 4 to 8 feet (36,600 mg/kg). Magnesium exceeds the **Residential Cleanup** Criterion of 15,577 mg/kg at soil borings SB-202S at 10 to 12 feet (32,900 mg/kg); duplicate SS-4 (15,900 mg/kg); SB-1 at 4 to 6 feet (6,230 mg/kg); SB-5 at 2 to 5 feet (21,800 mg/kg); SB-7 at 10 to 14 feet (22,100 mg/kg); SB-4 at 2 to 6 feet (54,900 mg/kg); SB-6 at 6 to 10 feet (22,300 mg/kg); SB-8 at 4 to 8 feet (21,700 mg/kg) and 8 to 11 feet (22,000 mg/kg); SB-9 at 2 to 4 feet (30,900 mg/kg) and 5 to 8 feet (19,900 mg/kg); SB-10 at 1 to 5 feet (19,200 mg/kg), the duplicate (23,000 mg/kg) and 5 to 8 feet (24,200 mg/kg); and SB-12 at 1 to 3 feet (17,000 mg/kg) and 4 to 8 feet (36,600 mg/kg). Magnesium exceeds the **Industrial** Cleanup Criterion of 24,000 mg/kg at soil borings SB-202S at 10 to 12 feet (32,900 mg/kg); SB-4 at 2 to 6 feet (54,900 mg/kg); SB-9 at 2 to 4 feet (30,900 mg/kg); SB-10 at 5 to 8 feet (24,200 mg/kg); and SB-12 at 4 to 8 feet (36,600 mg/kg).

Mercury was detected in soil samples at concentrations ranging from 0.12 to 0.41 mg/kg. Mercury exceeds the **GSI** criterion of 0.0011 mg/kg at soil borings SB-201S at 0 to 2 feet (0.270 mg/kg); SB-202S at 0 to 2 feet (0.210 mg/kg); SS-5 (0.41 mg/kg); SB-5 at 2 to 5 feet (0.20 mg/kg); SB-6 at 0 to 2 feet (0.12 mg/kg); the duplicate SB-10 at 1 to 5 feet (0.20 mg/kg); and SB-11 at 1 to 3 feet (0.15 mg/kg).

Selenium was detected in soil samples at concentrations ranging from 0.58 to 20.7 mg/kg. Selenium exceeds the **Residential** and **Industrial** cleanup criterion of 4.11 mg/kg at soil boring SS-1 (20.7 mg/kg). Selenium exceeds the **GSI** criterion of 0.410 mg/kg at soil borings SB-206 at 2.5 to 4.5 feet (0.970 mg.kg); SS-1 (20.7 mg/kg); SB-4 at 0 to 2 feet (1.10 mg/kg); SB-5 at 2 to 5 feet (0.58 mg/kg); duplicate SB-4 at 0 to 2 feet (0.90 mg/kg); and SB-11 at 1 to 3 feet (0.95 mg/kg).

Silver was detected in soil samples at concentrations ranging from 0.23 to 3.70 mg/kg. Silver exceeds the **GSI** criterion of 0.0077 mg/kg at soil borings SB-202S at 0 to 2 feet (2 mg/kg); SS-3 (0.23 mg/kg); SS-4 (0.31 mg/kg); SS-5 (3.70 mg/kg); and SS-6 (0.29 mg/kg).

Zinc was detected in soil samples at concentrations ranging from 9 to 19,700 mg/kg. Zinc exceeds the **Residential** Cleanup Criterion of 2,400 mg/kg at soil borings SB-201S at 0 to 2 feet (3,080 mg/kg); SS-1 (10,900 mg/kg); SS-5 (19,700 mg/kg); SS-6 (9,780 mg/kg); SB-4 at 0 to 2 feet (3,750 mg/kg) and the duplicate (3,390 mg/kg); and SB-6 at 0 to 2 feet (2,940 mg/kg). Zinc also exceeds the **Industrial** Cleanup Criterion of 5,000 mg/kg at soil borings SS-1, SS-5 and SS-6. Zinc exceeds the **GSI** criterion of 190 mg/kg at soil borings SB-201S at 0 to 2 feet (3,080 mg/kg); SB-202S at 0 to 2 feet (2,270 mg/kg); SS-1 (10,900 mg/kg); SS-2 (2,390 mg/kg); SS-3 (993 mg/kg); SS-4 (794 mg/kg) and the duplicate (1,580 mg/kg); SS-5 (19,700 mg/kg); SS-6 (9,780 mg/kg); SB-4 at 0 to 2 feet (3,750 mg/kg) and the duplicate (3,390 mg/kg); SB-5 at 2 to 5 feet (580 mg/kg); SB-6 at 0 to 2 feet (2,940 mg/kg); SB-10 at 1 to 5 feet (211 mg/kg); SB-11 at 1 to 3 feet (311 mg/kg); and SB-12 at 1 to 3 feet (379 mg/kg).

Cyanide was detected in soil samples at concentrations ranging from 1.8 to 2.4 mg/kg. Cyanide exceeds the **GSI** criterion of 0.1 mg/kg at soil borings SS-1 (2.0 mg/kg) and SB-4 at 0 to 2 feet (2.40 mg/kg) and the duplicate (1.80 mg/kg).

The highest concentrations and greatest number of inorganic compounds detected in soils were in samples collected directly north of the PMC building. Unlike the organic compounds, there is not an overall pattern to the vertical distribution of inorganic compounds. The source(s) of the inorganic compounds present at the site are not known.

The Phase II soil sampling inorganic analytical data and criteria comparisons are presented in Table 5-5. The Phase I soil sampling inorganic analytical data and criteria comparisons are

presented in Tables 5-9 and 5-12. The inorganic compounds whose concentrations exceeded the Residential, Industrial and GSI Criteria are presented on Figures 5-1, 5-2, and 5-3, respectively.

5.2 EVALUATION OF GROUNDWATER ANALYTICAL DATA

5.2.1 Evaluation Criteria

The groundwater analytical data obtained from the Phase II Remedial Investigation were compared to several sets of applicable cleanup criteria established by the State of Michigan under Part 201, Environmental Remediation, of Act 451, Natural Resources and Environmental Protection Act (PA 1995, as amended). The criteria sets used for this comparison were:

- Generic Residential Cleanup Criteria (GRCC)
- Groundwater/Surface Water Interface (GSI) Criteria
- Generic Industrial Cleanup Criteria
- Groundwater Contact Criteria (GCC)

The applicable cleanup criteria for the compounds detected in the groundwater samples are presented in the analytical data tables.

5.2.1.1 Determination of Generic Residential Cleanup Criteria

The GRCC were determined by using either the Health-Based or Aesthetic Cleanup Criteria (MERA Operational Memorandum 8, Revision 4, June 5, 1995), and Site-Specific Background Concentrations.

The determination of which Residential Cleanup Criteria should be used to evaluate the concentrations of the compounds detected in the samples began by using the most restrictive of the Residential Health-Based and Aesthetic criteria. MERA Operational Memorandum 8, Revision 4, June 5, 1995 allows the use of Background Concentrations (Site-Specific) for selected inorganic compounds if they are higher than the criteria established using the method discussed above. Site specific background concentrations could not be determined for groundwater at the site because there

was only one sampling event in the Phase II RI, therefore could not develop statistically valid background values. In cases where GRCC are lower than target method detection limits (MDLs), the target MDLs became the Residential Cleanup Criteria.

5.2.1.2 Determination of GSI Criteria

The GSI criteria are protective of surface water. They were developed to address groundwater discharging to a surface water body which may or may not be used as a drinking water source. The GSI criteria presented for comparison at this site apply to surface waters not protected as a drinking water source, because Lake Michigan is not a drinking water source for the City of Petoskey. Demonstration of compliance with surface water cleanup requirements may be made by assessing groundwater concentrations at the Groundwater-Surface Water Interface or through evaluation of the concentrations at the mixing zone. Predictive modeling and direct monitoring are options available to establish compliance with the GSI Cleanup Criteria at the groundwater-surface water interface. It is not necessary to meet the GSI Criteria throughout the aquifer if the groundwater-surface water interface zone serves as the compliance point. However, a remedial action plan which proposes meeting the GSI values throughout the aquifer in lieu of modeling or monitoring at the interface, is also acceptable.

The GSI Criteria are presented in an Addendum to MERA Operational Memorandum 8, Revision 4, and Operational Memorandum 14, Revision 2, dated November 3, 1997. The GSI values were recently updated as part of new administrative rules for Part 31 of Act 451, as amended. However, as of December 10, 1997, the list of GSI values has not been finalized. Therefore the GSI values in MERA Operational Memorandum 8, Revision 4 dated June 5, 1995 were used to evaluate compounds for which GSI criteria are not yet available.

5.2.1.3 Determination of Generic Industrial Cleanup Criteria

The Industrial Cleanup Criteria were determined by using either the Industrial Health-Based or Aesthetic Groundwater Criteria (MERA Operational Memorandum 14, Revision 2, June 6, 1995),

the SWP-Industrial Cleanup Criteria (currently being developed), and the Site-Specific Background Concentrations.

Deciding which criteria to use to evaluate a compound began by using the most restrictive of the Industrial Health-Based and Aesthetic criteria. The more restrictive of the Industrial Health-Based and Aesthetic Criteria were then compared to the SWP-Industrial Cleanup criteria. The SWP-Industrial Cleanup criteria have not been published yet, but were provided to Malcolm Pirnie on December 8, 1997 by the MDEQ for the purpose of this comparison. In instances where the SWP-Industrial Cleanup criteria were higher than the Industrial Health-Based or Aesthetic criteria, the SWP-Industrial criteria were selected. MERA Operational Memorandum 14, Revision 2, June 6, 1995 permits the use of Background Concentrations (Site-Specific) for selected inorganic compounds if their concentrations are higher than the criteria established using the method discussed above. However, site-specific statistically valid background concentrations could not be developed due to the lack of adequate number of sampling events during the Phase II RI.

5.2.1.4 Determination of Groundwater Contact Criteria

Groundwater Contact Criteria (GCC) may be used to address dermal contact with groundwater contaminants. These criteria have been developed by the State to address contamination at facilities where the groundwater is not classified as an aquifer, or where groundwater is reliably restricted from drinking water use. The GCC were used where it could be demonstrated that:

- Groundwater contaminants are not migrating to an aquifer at concentrations above Residential Drinking Water values, or drinking water use of the aquifer is reliably restricted, **and**
- Contaminants are not migrating to nearby surface water body at concentrations above applicable Generic or mixing zone-based GSI criteria, **and**
- Underground utilities exist in water saturated soils, or underground utilities may be constructed within the saturated soils at a facility.

The GCC address only the dermal route of exposure to groundwater contaminants. Exposure through other pertinent pathways (i.e, indoor or ambient air inhalation, irrigation uses, or swimming uses) may result in the application of more restrictive criteria than the GCC.

Assessment of emissions of groundwater contaminants to indoor air and confined spaces (such as utility trenches) is required for chemicals with a Henry's Law constant greater than 1×10^{-5} atm-m^3/mole ***and*** a molecule weight of less than 200 g/mole. The Indoor Air cleanup criteria are currently being drafted and reviewed by MDEQ. The MDEQ guidance requires that until the MDEQ establishes Generic Groundwater Inhalation Criteria for volatile emissions to Indoor Air and confined spaces, the ASTM Risk-Based screening levels for "groundwater volatile emission to indoor air" may be used to evaluate groundwater contaminant concentrations.

5.2.2 Evaluation of Groundwater Analytical Data

Groundwater samples were collected in 1992, and as part of the Phase II RI in October, 1995. For the purpose of the following evaluation, only the most current Phase II RI groundwater analytical data were evaluated because they are representative of current site conditions. The analytical data of samples collected from 31 monitoring wells and the Ingalls well are presented in Tables 5-13 through 5-18.

5.2.2.1 Volatile Organic Compounds

The following volatile organic compounds were detected at concentrations below the Generic Residential, Industrial, GSI, and Groundwater Contact Criteria in groundwater samples collected at the site; their concentration ranges are shown in parentheses: 1,2-Dichloroethene (total) (0.9 to 4 µg/l); acetone (4 to 15 µg/l); one detection of 2 butanone (13 µg/l); one detection of carbon disulfide (1 µg/l); one detection of cis 1,2-Dichloroethene (3 µg/l); one detection of chloroform (1 µg/l); methylene chloride (0.6-5 µg/l); and one detection of tetrachloroethene (0.8 µg/l).

Vinyl Chloride was detected in samples at concentrations ranging from 1 to 16 µg/l. Vinyl chloride exceeded the **Residential and Industrial** Cleanup Criterion of 2 µg/l, and the **GSI** criterion of 15 µg/l only at well MW-201S (16 µg/l).

Trichloroethene (TCE) was detected in samples at concentrations ranging from 1 to 82 µg/l. TCE exceeded the **Residential and Industrial** Cleanup Criterion of 5 µg/l at wells PS-CD (46 µg/l); duplicate PS-CD (49 µg/l); PS-4 (15 µg/l); PS-11 (19 µg/l); MW-201S (13 µg/l); MW-203S (82 µg/l); and MW-204S (35 µg/l).

The TCE is present in a northwesterly trending plume from the PMC building to the vicinity of the Ingalls well. The TCE is generally present in the shallow portion of the aquifer near the PMC building, but it is encountered deeper in the aquifer northwest of the building. No TCE was detected in wells MW-205I or MW-205D (screened from 38 to 43 feet bgl and 54 to 59 feet bgl, respectively). Since wells MW-205I and MW-205D are screened at similar and deeper intervals than well PS-CD, and no TCE is detected there, it appears that the TCE plume is present north of wells MW-205I and MW-205D. The bottom of the Ingalls municipal well is at 16 feet bgl. This depth is considerably shallower than the TCE plume detected at well PS-CD. The presence of only 2 µg/ℓ of TCE in the Ingalls municipal well indicates that the plume may also be present beneath and/or east of the Ingalls well. The distribution and migration of TCE in the aquifer appears controlled by the presence of fractures in the bedrock, as well as by the pumping of the Ingalls well and the fluctuating water level in Lake Michigan. A schematic cross-section of the site which shows the horizontal and vertical distribution of TCE and other organic compounds whose concentrations exceed applicable cleanup criteria, is presented on Figure 5-5.

The Phase II groundwater VOC analytical data and their comparisons with cleanup criteria are presented in Table 5-13. The tentatively identified compounds (TICs) are presented in Table 5-17. The distribution of the VOCs at concentrations which exceed the Residential, Industrial, and GSI, criteria is presented in Figure 5-4.

5.2.2.2 Semi-Volatile Organic Compounds

The following semi-volatile organic compounds were detected at concentrations below the Generic Residential, Industrial, GSI and Groundwater Contact Cleanup Criteria in groundwater samples collected at the site; their concentration ranges are identified in parentheses: one detection of acenaphthylene (0.1 µg/l); one detection of diethyl phthalate (0.4 µg/l). In addition, total petroleum hydrocarbons (TPH) and diesel range organics (DRO) were present in the groundwater in concentrations up to 23 mg/l and 58 mg/l, respectively.

Bis (2-ethylexyl) phthalate was detected in concentrations ranging from 8 to 38 µg/l. Bis (2-ethylexyl) phthalate exceeded the **Residential and Industrial** Cleanup criterion of 6 µg/l at PS-DD (38 µg/l); duplicate PS-DD (19 µg/l); PS-4 (19 µg/l); PS-6 (16 µg/l); PS-106 (9 µg/l); PS-1R (29 µg/l); and Ingalls Well (8 µg/l). It should be noted that this compound is a common laboratory contaminant. It was detected at various locations away from the PMC building including the upgradient monitoring well PS-1R and, it was also present in some of the method blanks. Therefore it may be attributable to other sources in addition to discharges at the PMC site.

TPH and DRO were detected in low concentrations in the groundwater samples from monitoring wells PS-4, PS-104 and MW-201S. The TPH concentrations were highest at well MW-201S (23 mg/l), while DRO was highest at well PS-104 (58 mg/l). It should be noted that overlying soils at well location MW-201 contained 100 mg/kg each of DRO and TPH. While no soil or groundwater State cleanup criteria are available for these two suites of components, their concentrations are not indicative of substantial contamination or the presence of any non-aqueous phase liquids (NAPLs) at this location.

The Phase II groundwater SVOC analytical data and their comparisons to the cleanup criteria are presented in Table 5-14. The tentatively identified compounds (TICs) are presented in Table 5-18. The only SVOC compound whose concentrations exceed the Residential and Industrial cleanup criteria are shown on Figures 5-4 and 5-5.

5.2.2.3 Pesticides and PCBs

The following pesticides were detected at concentrations below the applicable Generic Residential, Industrial, GSI, and Groundwater Contact Criteria in groundwater samples collected at the site; their concentration ranges are identified in parentheses: one detection each of endrin aldehyde (0.068 µg/l) and heptachlor (0.066 µg/l). No PCBs were detected in the groundwater samples collected at the site.

4,4'-DDT was detected in samples at concentrations ranging from 0.011 to 0.023 µg/l. 4,4'-DDT exceeded the **GSI** criterion of 1.1 E-5 µg/l at wells COP-1 (0.011 µg/l); COP-3 (0.011 µg/l); and COP-4 (0.023 µg/l). A concentration of 0.011 µg/l was also present in the pump blank sample PB-7 which was obtained after sampling well COP-1 and two other wells which did not contain any 4,4'-DDT.

The locations where pesticides were detected in the groundwater are located several hundred feet northwest of the PMC building in an area where unrelated (Pre-1982) storage activities have been reported. No pesticides were detected in any of the monitoring wells located near the PMC building or between the PMC building and the COP wells, indicating that PMC is not a likely source of the pesticides in the groundwater.

The Phase II groundwater pesticide analytical data and their comparisons with relevant criteria are presented in Table 5-15. The pesticide whose concentration exceeded a cleanup criterion are shown on Figure 5-4.

5.2.2.4 Inorganic Compounds

The following eleven inorganic compounds were detected at concentrations below Residential, Industrial, GSI and Groundwater Contact Cleanup Criteria in the groundwater samples collected at the site; their concentration ranges are identified in parentheses: aluminum (8.0 to 50.4 µg/l); arsenic (2.0 to 4.5 µg/l); barium (1.1 to 75.1 µg/l); cobalt (1.0 to 19 µg/l); copper (1.1 to 6.1 µg/l); magnesium (26.2 to 30,200 µg/l); nickel (1.2 to 42.3 µg/l); selenium (2.2 to 3.3 µg/l); sodium (96.5 to 79,400 µg/l); vanadium (1.1 to 1.2 µg/l); and zinc (5.1 to 215 µg/l).

Aluminum exceeded the **Residential and Industrial** Cleanup Criterion of 50 µg/l only in the pump blank sample PB-2 (50.4 µg/l).

Antimony was detected in samples at concentrations ranging from 2.8 to 6.7 µg/l with exceedence of the **Residential and Industrial** Cleanup criterion of 6 µg/l at well COP-5 (6.3 µg/l).

Cadmium was detected in samples at concentrations ranging from 1.1 to 3.8 µg/l with one exceedence of the **GSI** criterion of 3.6 µg/l at well PS-105S (3.8 µg/l).

Chromium was detected in samples at concentrations ranging from 1.5 to 39.9 µg/l with one exceedence of the **GSI** criterion of 11 µg/l at well COP-2 (39.9 µg/l).

Iron was detected in several samples at concentrations ranging from 14.8 to 2,580 µg/l. Iron concentrations exceeded the **Residential and Industrial** Cleanup criterion of 300 µg/l at wells PS-AD (1,250 µg/l); PS-105S (317 µg/l); COP-3 (384 µg/l); COP-4 (1,480 µg/l); MW-201S (2,580 µg/l); and MW-203D (1,270 µg/l).

Lead was detected in samples at concentrations ranging from 2.1 to 44.4 µg/l. Lead concentrations exceeded the **Residential and Industrial** Cleanup criterion of 4 µg/l and the **GSI** criterion of 19 µg/l at well PS-105S (44.4 µg/l).

Manganese was present in samples at concentrations ranging from 1.1 to 194 µg/l. Manganese concentrations exceeded the **Residential and Industrial** Cleanup criterion of 50 µg/l at wells COP-3 (51.5 µg/l); COP-4 (194 µg/l); and MW-201S (91.2 µg/l).

Silver was detected in one sample (PS-CD) at a concentration of 2.1 µg/l, which exceeds the **GSI** criterion of 0.057 µg/l.

Thallium was present in most samples at concentrations ranging from 3.6 to 5.5 µg/l. The concentrations of Thallium exceeded the **Residential and Industrial** Cleanup criterion of 2 µg/l, and the GSI criterion of 3.7 µg/l at wells PS-11 (3.9 µg/l); PS-105D (4.1 µg/l); COP-2 (4.1 µg/l); COP-5 (4.4 µg/l); MW-201S (4.7 µg/l); MW-202S (3.7 µg/l); MW-203D (4.0 µg/l); MW-204S (4.6 µg/l); MW-205I (5.5 µg/l); MW-205D (5.3 µg/l); and Ingalls Well (4.3 µg/l). Thallium concentrations in the samples from wells COP-1 (3.7 µg/l) and COP-3 (3.6 µg/l) only exceeded the Residential and

Industrial Cleanup criterion. It should be noted that Thallium was present in the method blanks and in pump blank samples PB-1(4.0 µg/l), PB-2 (4.6 µg/l) and PB-5 (4.0 µg/l).

The pattern of distribution of the inorganic compounds at the site and the relative absence of inorganic compounds (with the exception of iron, manganese and Thallium) in the groundwater south of Water Street, in the vicinity of the PMC building, suggests that PMC is not the major source of the inorganic compounds in the groundwater.

The distribution of iron is inconclusive and may/be attributable to site activities an/or to natural conditions (i.e., inclusions in the fractured limestone/shale bedrock). Manganese is present next to the PMC building at concentrations exceeding the cleanup criterion, but it is also present at even higher concentrations in downgradient well COP-4, separated by several wells which do not contain excessive manganese concentrations. Therefore, the manganese in the groundwater cannot be conclusively attributed to the PMC building.

The widespread distribution, similarity of concentrations, and presence of Thallium in the laboratory method blanks and pump blanks suggest that it is an analytical artifact.

The inorganic compounds present in the groundwater samples and their comparisons with the applicable cleanup criteria are presented in Table 5-16. The inorganic compounds whose concentrations exceeded any of the cleanup criteria are shown on Figures 5-4 and 5-5.

MALCOLM PIRNIE

6.0 RISK ASSESSMENT

This section presents an assessment of potential human health risks associated with chemical contaminants detected at the PMC site. The objectives of this assessment are to provide an analysis of baseline risks, currently and in the future, in the absence of any actions to control or mitigate site contamination and to assist in determining the need for and extent of remediation.

The risk assessment follows guidance contained in the U.S. Environmental Protection Agency's (USEPA) Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (USEPA, 1991; 1989b). Additional USEPA and MDEQ guidance is cited throughout the assessment.

The potentially exposed populations and exposure pathways evaluated in the risk assessment were selected by the MDEQ (1996), assuming the site is developed for residential use in the future. MDEQ is reporting that the City of Petoskey intends to re-zone the site as multi-family residential, with PMC being a "non-conforming" use. The potentially exposed populations and exposure pathways include:

- Current adolescent resident (termed adolescent trespasser) exposed to contaminated on-site soils (i.e., trespassing).
- Current adult resident and PMC worker (termed PMC worker) exposed to contaminated on-site soils ("limited industrial").
- Future adult "generic residential" use (exposed to contaminated on-site soils and to contaminated groundwater).
- Future child (under 7) "generic residential" use (exposed to contaminated on-site soils and to contaminated groundwater).
- Future limited residential use. This would include a house with a basement on the PMC site. Residents would receive water from the forthcoming new municipal water supply and would not be exposed to the contaminated groundwater plume. Residents would be able to have a garden and plant trees.

- Future limited residential use. This would include a house with a foundation on the PMC site. Residents would receive water from the forthcoming new municipal water supply and would not be exposed to the contaminated groundwater plume. Residents would be able to have a garden and plant trees.

- Future earth mover/contractor (termed construction worker) exposed to on-site soils.

There are typically four components to the risk assessment process: data evaluation, exposure assessment, toxicity assessment, and risk characterization. During data evaluation, relevant site data are compiled and analyzed to ensure the data are of acceptable quality for use and to identify chemicals (termed chemicals of potential concern) that are likely to be representative of site contamination. In the exposure assessment, actual or potential chemical release pathways are analyzed, potentially exposed populations and exposure pathways are identified, chemical concentrations at potential points of human exposure are derived, and chemical intakes are estimated. In the toxicity assessment, qualitative and quantitative toxicity data for each of the chemicals of potential concern are summarized, and appropriate guidance levels with which to characterize risks are identified. The likelihood and magnitude of adverse health risks are estimated in the risk characterization, in the form of noncancer hazard quotients and cancer risks. Sources of uncertainty in the evaluation are then noted and discussed. This integrated approach is used to evaluate and discuss potential human health risks.

6.1 DATA EVALUATION

Soil and groundwater samples were collected at the PMC site as part of Phase I and Phase II Remedial Investigations (RI) conducted by Eder Associates in 1992 and Malcolm Pirnie, Inc. in 1995, respectively. The analytical results for six surface soil (0-6 inches) samples and soil samples at various depths from 15 soil borings from the Phase I RI are used in the risk assessment. The analytical results for soil samples at various depths from six soil borings installed to supplement the

Phase I RI data and groundwater samples collected from 32 monitoring wells (i.e., the latest sampling round) from the Phase II RI are used in the risk assessment. The results of these efforts are briefly summarized and analyzed again here with the intent of identifying those environmental media and chemicals of potential concern that, if contacted, pose potential risks to human health.

In establishing the soil and groundwater data sets, samples and their duplicates were not considered as separate sampling events. Rather, the higher of the detected values from the two was selected for each chemical. Data that were assigned qualifiers indicating that the numerical value is an estimated quantity, or that the identity and quantity are based on presumptive evidence, were treated the same way as data without such qualifiers. Data from environmental samples were then compared with data from sample blanks. Consistent with USEPA guidance (USEPA, 1989b), results for common laboratory contaminants (e.g., acetone, 2-butanone, methylene chloride, toluene and the phthalate esters) were considered positive only if the concentrations in the site sample were found to exceed ten times the maximum amount detected in any blank. For other chemicals that are not considered common laboratory contaminants, results were considered positive only if the concentration of the chemical in the site sample exceeded five times the maximum amount detected in any blank.

6.1.1 Chemicals of Potential Concern

The analytical data are summarized by environmental medium in Tables 6-1 to 6-5 and are briefly discussed in the following subsections.

The selection of chemicals of potential concern is based on:

- Frequency of detection. With samples sizes greater than 20, selection is based on detection in 5% or more of the samples in a medium. Chemicals detected infrequency (i.e., in less than 5% of the samples) and at low concentrations (i.e., in concentrations below the appropriate MDEQ generic residential cleanup criteria presented in Section 5.0) are not selected as chemicals of potential concern. With sample sizes less than 20, selection is based on detection in at least one sample in a medium.

- For the inorganic chemicals, comparison to background. For soils, selection is based on an arithmetic average concentration greater than two times the arithmetic average concentration

in the background samples. For groundwater, selection is based on detection at a concentration greater than that in the one background sample. (While a number of organic chemicals were detected in the background samples for both soil and groundwater, selection of organic chemicals is not based on comparison to background.)

- For the essential nutrients (i.e., calcium, iron, magnesium, potassium and sodium) comparison to reference concentrations derived from recommended daily allowances. Selection is based on concentrations greater than the appropriate reference concentrations. The derivation of reference concentrations is presented in Appendix F.

The chemicals of potential concern, by environmental medium, are summarized in Table 6-6.

6.1.2 Soil Data

The soil data are organized into "shallow soil", "subsurface soil", and "all soil" as described in the following presentations:

Shallow Soil: "Shallow soil" is broadly defined as soil less than 2 feet deep. The samples that comprise the shallow soil data set are predominantly from 0-6 inches and 0-2 feet; a few samples from 1-3 feet, 1-5 feet, and 1-6 feet are included in the data set since the contamination could be at a depth less than 2 feet. These data are used to evaluate potential exposure by adolescent trespassers and PMC workers under current conditions and residents (i.e., "limited residential use") under future conditions. Use of the shallow soil data for residential exposure is based on an assumption that the shallow soil is not mixed with the deeper soil during development of the site.

The analytical data for shallow soil are summarized in Table 6-1; the frequency of detection and detected concentration range in site samples and background samples are provided for comparison. The typical elemental composition of Michigan soils is also provided for comparison.

Eight volatile organic compounds (VOCs), 19 semi-volatile organic compounds (SVOCs), six pesticides, PCBs, 23 inorganic chemicals, and cyanide were detected in the site samples. Three VOCs, nine SVOCs, one pesticide, and 18 inorganic chemicals were detected in background samples.

All of the organic chemicals are selected as chemicals of potential concern. Twelve inorganic chemicals are selected as chemicals of potential concern based on the comparison to background

presented in Table 6-2. Although detected in elevated concentrations relative to background, magnesium is not selected since it was detected at an average concentration less than the reference concentration established for this essential nutrient. The reference concentrations for essential nutrients are presented in Appendix F. Cyanide is also selected as a chemical of potential concern.

Subsurface Soil: "Subsurface soil" is broadly defined as between 2 and 15 feet; two samples from approximately 14-16 feet are included in the data set in order to not exclude otherwise useable data. These data are used to evaluate potential inhalation exposure under future conditions by residents (i.e., "limited residential use") to chemicals released from the subsurface and transported to indoor air.

The analytical data for subsurface soil are summarized in Table 6-3; the frequency of detection and detected concentration range in site samples and background samples are provided. The typical elemental composition of Michigan soils is also provided for comparison.

Eight VOCs, 18 SVOCs, three pesticides, and 21 inorganic chemicals were detected in the subsurface soil samples. Five VOCs and 20 inorganic chemicals were detected in background subsurface soil samples.

All of the VOCs are selected as chemicals of potential concern. No other chemicals are selected as chemicals of potential concern based on the intended use of the data.

All Soils: "All soils" includes shallow and subsurface soil data. These data are used to evaluate potential exposure under future conditions by residents ("generic residential use") and construction workers. Use of all soil data for residential exposure is based on an assumption that the deeper soil is mixed with the shallow soil during development of the site.

The analytical data for all soils are summarized in Table 6-4; the frequency of detection and detected concentration range in site samples and background samples are provided. The typical elemental composition of Michigan soils is also provided for comparison.

With the exception of three SVOCs, three pesticides and PCBs, all other organic chemicals are selected as chemicals of potential concern. The organic chemicals not selected are eliminated based on infrequent detection and low concentration relative to the MDEQ generic residential cleanup

criteria (direct contact values). Eleven inorganic chemicals are selected as chemicals of potential concern based on the comparison to background presented in Table 6-2. Cyanide is also selected as a chemical of potential concern.

6.1.3 Groundwater Data

The analytical data for groundwater from both shallow and deep monitoring wells are summarized in Table 6-5; the frequency of detection and detected concentration range in site samples and background samples are provided. These data are used under future conditions to evaluate potential exposure from potable use by residents ("i.e., generic residential use") and inhalation exposure by residents (i.e., "limited residential use") to chemicals released from the groundwater and transported to indoor air.

Five VOCs, two SVOCs, two pesticides and 17 inorganic chemicals were detected in the groundwater samples. Two VOCs and 10 inorganic chemicals were detected in background groundwater samples.

Three VOCs are selected as chemicals of potential concern. The other organic chemicals are not selected based on infrequent detection and low concentration relative to the MDEQ generic residential cleanup criteria (health-based drinking water values). Since inorganic chemicals were only analyzed in one background or upgradient sample, the maximum concentration detected in each site sample was compared to the concentration in the background sample. With the exception of the essential nutrients (calcium, iron, magnesium, potassium and sodium), all of the inorganic chemicals are selected as chemicals of potential concern. Although detected in elevated concentrations relative to background, calcium, iron, magnesium, potassium and sodium are not selected since they were detected in concentrations less than the reference concentrations derived for these essential nutrients. The reference concentrations for essential nutrients are presented in Appendix F.

6.2 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the type and magnitude of human exposure to the chemicals of potential concern that are present at or capable of migrating from the site. Assessments are made for potentially exposed populations at or near the site considering both current conditions and likely future conditions.

6.2.1 Potentially Exposed Populations and Exposure Pathways

Currently, potentially exposed populations include adult PMC workers and adolescent trespassers. Both populations are assumed to reside in the vicinity of the PMC site. Adults have been selected to represent the PMC worker population while adolescents, ages 12 to 15, have been selected to represent the trespasser population. Evaluation of adolescent trespassers should adequately characterize potential exposure and health risks to adults that might trespass on the site.

Potentially exposed populations in the future may include adult and child residents and construction workers. Adults have been selected to represent the adult resident and construction worker populations. Children represent sensitive receptors as behavior patterns, body size, and exposure rates could lead to greater exposure to the chemicals of potential concern than would be experienced by adults; children, ages 0 to 6, have been selected to represent this population. Sensitive receptors can include any subpopulation that may be at increased risk from chemical exposures due to increased sensitivity, behavior patterns and/or current or past exposures from other sources.

Shallow soil represents the medium of concern regarding the current potential for human exposure as PMC workers and trespassers could contact chemicals of potential concern through inadvertent ingestion and dermal contact. As the municipal water supply provides potable water, there is little likelihood of human contact with groundwater under current conditions.

Shallow soil, subsurface soil, and groundwater represent media of concern regarding the future potential for human exposure. Future residents may contact chemicals of potential concern through inadvertent ingestion of and dermal contact with soil, inhalation of VOCs released from soil

and groundwater and transported to indoor air (i.e., enclosed spaces), and potable use of the groundwater. Future construction workers may contact chemicals of potential concern in soils through inadvertent ingestion and dermal contact and inhalation or respirable particulates released from the soil.

Direct contact exposure by residents is evaluated based on both shallow soil data ("limited residential use") and all soils data ("generic residential use"). Since, as subsequently discussed the exposure assumptions and parameters are the same for each residential use scenario, the estimated chemical intakes and risks for the two soil data sets can be applied to either or both scenarios. Construction worker exposure is based on all soils data.

It should be noted that as of December 1997, the City of Petoskey's primary drinking water supply is groundwater from the new Bay Harbor development. The Ingalls well will be used as a backup well until it is removed from service permanently as required by the Safe Drinking Water Act.

6.2.2 Exposure Point Concentrations

As discussed previously, a chemical-specific value representing the maximum concentration in a sample and its duplicate is used. This may result in an overestimation of exposure point concentrations. However, since relatively few duplicate samples were collected, the overall impact on the exposure and risk estimates should be minimal. If a chemical of potential concern was not detected in a sample, it is assumed to be present at ½ its limit of detection, as a conservative "proxy" concentration. Adjusting non-detects by assigning values at ½ the limit of detection assumes that a chemical may be present at a concentration just below the reported detection limit, and may result in overestimation of the exposure point concentrations. Use of qualified data may result in overestimation or underestimation of the exposure point concentrations.

Exposure point concentrations and parameters and assumptions used to assess exposure are developed to portray reasonable maximum exposures (RME) which might be expected to occur under current and future conditions (USEPA, 1989b). That is to say, the highest exposure that might

reasonably be expected to occur at the site, one that is well above the average case of exposure but within the range of possibility, is considered.

In order to determine the chemical concentrations to which an individual might be exposed over many years, it is necessary to evaluate the entire analytical data set in order to develop representative exposure point concentrations. The USEPA (1992b, 1989b) recommends that the arithmetic average concentration of the data should be used for evaluating long-term exposure and that, because of the uncertainty associated with estimating the true average concentration at a site, the 95% upper confidence limit (UCL) on the arithmetic average should be used as the exposure point concentration. The 95% UCL provides reasonable confidence that the true average will not be underestimated. Since the USEPA also indicates that, in most cases, it is reasonable to assume that Superfund sampling data are lognormally distributed, the following equation (Gilbert, 1987) was used to derive 95% UCL concentrations for chemicals of potential concern in soil and groundwater:

$$UCL = e^{\{x + 0.5s^*s + sH/\sqrt{(n-1)}\}}$$

where:

UCL	=	95% upper confidence limit on the arithmetic average
e	=	constant (base of the natural log)
x	=	the mean of the transformed data
s	=	the standard deviation of the transformed data
H	=	statistic for computing a one-sided 95% confidence limit on a lognormal mean
n	=	sample size

If there is great variability in measured concentrations, the 95% UCL concentration may be high and occasionally exceed the maximum detected concentration. In such cases the maximum con-

centration is used as the exposure point concentration. Using the maximum concentration may result in an overestimation of the exposure point concentration.

Exposure point concentrations of chemicals of potential concern in air were calculated as described in Appendix F. Concentrations of VOCs of potential concern in indoor air from release from groundwater during showering were calculated. Concentrations of VOCs of potential concern in indoor air from release from groundwater and subsurface soil underlying residential construction were also calculated. Two scenarios were considered: residences constructed on foundations (slab-on-grade) and residences constructed with basements. Exposure point concentrations of non-VOC chemicals of potential concern adsorbed to respirable particulates released to air above an excavation were also calculated. A scenario involving the digging of an excavation by a bulldozer in an area of contaminated soils was considered. Only emissions from the digging of the excavation were estimated; the soil removed from the excavation was assumed to be placed on the side of the excavation and covered to prevent further respirable particulate release.

While the derivation of representative exposure point concentrations assumes no transformation or loss due to environmental degradation, the environmental fate and transport of chemicals detected on-site are important in determining the ultimate hazard to populations on or in the vicinity of the site. After a chemical is released to the environment, it may be transformed physically (e.g., by volatilization, precipitation, etc.), chemically (e.g., by photolysis, hydrolysis, oxidation, reduction, etc.), or biologically (e.g., by biodegradation); alternatively, it may be accumulated in one or more media (including biomass) or may be transported (e.g., convected downstream in water or on suspended sediment or through the atmosphere).

6.2.3 Estimates of Chemical Intake

In addition to the derivation of representative exposure point concentrations, evaluation of potential human exposure involves the estimation of several parameters such as ingestion and inhalation rates; skin surface areas available for contact; skin permeability factors; and exposure time, frequency, and duration. The generic equation for estimating chemical intakes, that defines the intake

variables in terms of chemical-related, population-related and evaluation-determined parameters, is presented in Table 6-7. The averaging time (AT) referenced in the equation depends on the type of toxic effect being assessed. When evaluating exposures for potential long-term, non-cancer health effects, intakes are calculated by averaging over the period of exposure. This is equal to the exposure duration (ED) multiplied by 365 days/year. When evaluating potential carcinogenic risks, intakes are calculated by prorating the total cumulative intake over a lifetime (i.e., lifetime average daily intake). For calculation purposes, this is equal to 70 years multiplied by 365 days/year. This distinction is consistent with the hypothesis that the mechanism of action for each of these effects is different. The approach for carcinogens is based on the assumption that a high dose received over a short period of time is equivalent to a corresponding low dose spread over a lifetime.

Other variables used in estimating chemical intakes, as presented in Table 6-8, are described below. Application of the exposure equations results in intake or, for dermal contact exposure, absorbed dose, expressed in milligrams of chemical per kilogram of body weight per day (mg/kg-day).

Soil: Table 6-8 presents the parameters and assumptions used in assessing potential ingestion and dermal contact exposure to the chemicals of potential concern in soils by adolescent trespassers, PMC workers, resident adults and children and construction workers. In evaluating inadvertent ingestion of soil (as might result from hand-to-mouth behavior), the following average soil ingestion rates (IR) are used: 100 mg/day for adolescent trespassers and adult residents, 50 mg/day for PMC workers, 200 mg/day for child residents, and 480 mg/day for construction workers (USEPA, 1991).

The "fraction ingested" (FI) is based on an estimate of the fraction of soil that is presumed to be contaminated. It is assumed that 100% of the soil contacted is contaminated with concentrations equivalent to the appropriate exposure point concentrations.

The exposure frequency (EF) for adolescent trespassers is assumed to be 50 days/year; this represents exposure either twice per week during the warmer months or weekly throughout the year. The exposure duration (ED) is assumed to be 3 years (the duration of years between the ages of 12 and 15). The EF for the PMC worker is assumed to be 112 days per year (3 ½ days per week for 8 months, not including vacation and sick time) (MDNR, 1995b). Since it is assumed that the PMC

worker resides in the vicinity of the site an ED of 30 years (the 90th percentile time at one residence) is used. The EF for resident adults and children is assumed to be 350 days/year for ingestion exposure and 245 days/year for dermal exposure (MDEQ, 1995). The ED for resident adults is assumed to be 30 years; this is computed as 6 years at the child's rate of exposure and 24 years at the adult's rate of exposure (USEPA, 1991). The ED for the resident child is assumed to be 6 years. For the construction worker, the EF is assumed to be 80 days/year and the ED is assumed to be 2 years (MDNR, 1996); this can be interpreted in a number of ways (e.g., as four work months while foundations are being installed during two phases of site development).

The average body weight (BW) of an adolescent ages 12 to 15 is 48.7 Kg (USEPA, 1989a). The average BW of a child ages 0 to 6 is 15 Kg, while that of an adult is 70 Kg (USEPA, 1989a).

In order to evaluate dermal contact with soils, the surface area available for contact (SA), the soil-to-skin adherence factor (AF) and the rate of absorption (ABS) must be considered. A surface area of 3687 cm^2 (the average surface area of hands and arms of a 12-15 year old) is used for the adolescent trespasser. A surface area of 2570 cm^2 (the average surface area of forearms, face, and hands of an adult male) is used for the PMC worker. The surface areas used for a adult and child residents are 5000 and 1820 cm^2, respectively (MDNR, 1995). The surface area used for the construction worker is 4100 cm^2 (the average hands, forearms, and head of an adult male) (USEPA, 1989a). An AF of 1.00 mg/cm^2 (USEPA, 1992a) and ABSs of 10% for VOCs and 1% for other chemicals are used (MDNR, 1995a).

Groundwater: Table 6-8 presents the parameters and assumptions used in assessing potential ingestion, dermal contact and inhalation exposure to the chemicals of potential concern in groundwater by resident adults and children.

An ingestion rate (IR) of 2 liters/day is assumed for resident adults; this represents the 90th percentile value for adult daily water consumption (USEPA, 1989a). An IR of 1 liter/day, which represents the 90th percentile of daily water consumption for infants (USEPA, 1989a), is used for resident children.

For the evaluation of dermal contact with the chemicals of potential concern in groundwater, the greatest, but not the exclusive, opportunity for exposure is during showering. Thus, the entire surface area of the body is used to evaluate exposure via dermal contact. For adults, this value is 19,400 cm^2 which represents the 50th percentile total body surface area (SA) for an adult male (USEPA, 1989a). The 50th percentile total body surface area (SA) for a male child, age 1 to 6 is 6980 cm^2 (USEPA, 1989a). Since the estimated exposure is designed to be the absorbed dose, chemical-specific dermal permeability coefficients (PC) are necessary to assess dermal exposure. The PC reflects movement across the skin to the underlying skin layers and into the bloodstream. The specific PCSs used in this assessment are provided in Table F-5 in Appendix F. An exposure time (ET) of 18 minutes/day (or 0.3 hours/day) is used to evaluate dermal contact with groundwater. This is a composite of showering activities and miscellaneous household tasks. Twelve minutes per day (or 0.2 hours/day) represents the 90th percentile value for showering for all age groups (USEPA, 1989a). It is assumed that 6 minutes/day (or 0.1 hours/day) is spent on miscellaneous tasks which allow for dermal contact with groundwater.

Inhalation rates (IR) of 0.83 and 0.6 m^3/hour for resident adults and children, respectively, are used to evaluate inhalation of airborne (vapor phase) chemicals released from groundwater while showering (USEPA, 1989b). As with dermal exposure to groundwater, exposure time (ET) for the inhalation pathway is estimated as 18 minutes/day.

An EF of 350 days/year and EDs of 30 and 6 years for the adults and child, respectively, are used.

Air: Table 6-8 presents the parameters and assumptions used in assessing potential inhalation exposure to the VOCs of potential concern in indoor air by resident adults and children and to non-VOC chemicals of potential concern adsorbed to respirable particulates by construction workers. Inhalation rates (IR) of 0.83 and 0.6 m^3/hour are assumed for resident adults and children, respectively. The ET is based on an assumption that residents spend 17 hours/day in the home. An

IR of 2.3 m^3/hour and an ET of 8 hours/day are assumed for the construction workers. All other parameters and assumptions for the residents and construction workers are as described previously.

6.3 TOXICITY ASSESSMENT

The toxicity assessment, also termed the dose-response assessment, serves to characterize the relationship between the magnitude of exposure and the potential that an adverse effect will occur. It involves determining whether exposure to a chemical can cause an increase in the incidence of a particular adverse health effect, and characterizing the nature and strength of the evidence of causation. The toxicity information is then quantitatively evaluated and the relationship between the dose of the contaminant received and the incidence of adverse effects in the exposed population is evaluated.

The USEPA and other regulatory agencies have performed toxicity assessments for numerous chemicals and the guidance they provide is used in this risk assessment. These include verified reference doses, or RfDs, for the evaluation of noncarcinogenic effects from chronic exposure and cancer potency slope factors for the evaluation of cancer risk from lifetime exposure. Each of these is discussed below. Sources of toxicological information and criteria, in order of preference, include IRIS (Integrated Risk Information System), which is a USEPA database containing current health risk and regulatory information for many chemicals (USEPA, 1997b), the USEPA Health Effects Assessment Summary Tables (HEAST) which are tabular presentations of provisional toxicity data (USEPA, 1997a), and the USEPA National Center for Environmental Assessment's (NCEA) Superfund Technical Support Center (formerly the Environmental Criteria and Assessment Office, ECAO) (USEPA, 1997c).

6.3.1 Noncarcinogenic Effects

The potential for noncancer health effects associated with chemical exposure is evaluated by comparing an estimated intake [such as a chronic daily intake (CDI)] over a specified time period with

a reference dose (RfD) derived for a similar exposure period. The RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. According to the USEPA, RfDs often have an uncertainty spanning perhaps an order of magnitude or greater. Chronic RfDs, used in this report, are specifically developed to be protective of long-term exposure to a chemical. For the construction worker assumed to have exposure over a 2-year period, subchronic RfDs are the more appropriate criteria. However, as subchronic RfDs are often lacking or in some cases set equal to chronic RfDs, chronic RfDs are used as conservative approximations.

The RfDs for the characterization of chronic noncancer risk via both oral and inhalation exposure routes are presented in Table F-6 in Appendix F, along with the confidence level of the chronic RfD, the critical effect, the basis and source of the RfD, and any uncertainty or modifying factors used in the derivation of the RfD. All of the reference doses and concentrations have been developed by the USEPA.

RfDs for oral exposure are available for most of the chemicals of concern. RfDs are not available, however, for dermal exposure. In their absence, oral RfDs are used and adjusted as per USEPA guidance (USEPA, 1989b) to reflect absorbed dose. This allows for comparison between exposures estimated as absorbed doses and toxicity values expressed as absorbed doses. In the absence of chemical-specific information on oral absorption, a default efficiency was assumed. Oral absorption factors are presented in Table F-7 in Appendix F.

A limited number of reference concentrations (RfCs) for inhalation exposure are available. The available RfCs were converted into RfDs based on a standard inhalation rate of 20 m^3/day , a standard body weight of 70 kg, and appropriate chemical-specific information.

The RfD for Aroclor 1254, the lower of the two available Aroclor-specific RfDs (the RfD for Aroclor 1260 is the other), is used as representative of all PCB mixtures. The RfD for trivalent chromium (Cr III) is used to evaluate exposure to chromium (analyzed and reported as total chromium) as there is no apparent source of hexavalent chromium (Cr VI) at the site and Cr III is the predominant species found in most environmental situations.

The ratio of the estimate of chronic daily intake to the health-protective criterion (CDI/RfD) is called a hazard quotient (USEPA, 1989b). The hazard quotient assumes that there is a level of exposure (i.e., the RfD) below which it is unlikely for even sensitive subpopulations to experience adverse health effects. If the hazard quotient exceeds 1.0, there may be concern for potential non-cancer effects. The greater the hazard quotient above 1.0, the greater the level of concern.

6.3.2 Carcinogenic Effects

Regardless of the mechanism of effect, risk evaluation methods employed by the USEPA generally derive from the hypothesis that thresholds for cancer induction by carcinogens do not exist and that the dose-response relationship is linear at low doses. Such risk evaluation methods require extrapolation from high dose animal studies to evaluate low dose exposure in humans. In the absence of adequate information to the contrary, a linearized, multistage, non-threshold low-dose extrapolation model is recommended by the USEPA as the most appropriate method for assessing chemical carcinogens. The USEPA emphasizes that this procedure leads to a plausible upper limit to the risk that is consistent with some proposed mechanisms of carcinogenesis.

Through application of this approach, the USEPA has derived estimates of incremental excess cancer risk from lifetime exposure to potential carcinogens. This is accomplished by establishing the carcinogenic potency of the chemical substance through critical evaluation of the various test data and fitting dose-response data to a low-dose extrapolation model. The slope factor (which describes the dose-response relationship at low doses) is expressed as a function of intake [i.e., per $(mg/kg\text{-}day)^{-1}$]. The slope factors for the carcinogenic chemicals of concern presented in Table F-8 in Appendix F are used to estimate finite, upper limits of risk at low dose levels administered over a lifetime. For children, the estimated cancer risk reflects the potential risk over a lifetime due to childhood exposure. The weight-of-evidence classification for carcinogenicity, the type of cancer associated with each chemical of potential concern, and the basis and source of the slope factor are also presented in Appendix F.

The USEPA recommends a tiered approach for selecting the appropriate slope factor for evaluating exposure to PCBs (USEPA, 1997b). Based on the approach, since exposure via soil ingestion and dermal contact (with application of an absorption factor), the "high risk and persistence" upper-bound slope factor is used as representative of all PCB mixtures.

A relative potency approach recommended by the USEPA (1993) is used to estimate cancer risks from exposure to the carcinogenic PAHs. The relative potency approach, which takes into account the differing potencies of the carcinogenic PAHs, is used rather than the former practice of assuming that all carcinogenic PAHs are equivalent in potency to benzo[a]pyrene. Estimates of cancer risks under the equivalent potency assumption overestimates the carcinogenic potency of most PAH mixtures since benzo[a]pyrene has been demonstrated to be one of the most potent carcinogenic PAHs. The slope factor for benzo[a]pyrene is adjusted based on the following potencies of the other carcinogenic PAHs relative to benzo[a]pyrene:

benzo[a]pyrene	1.0
benzo[a]anthracene	0.1
benzo[b]fluoranthene	0.1
benzo[k]fluoranthene	0.01
chrysene	0.001
dibenz[a,h]anthracene 1.0	
ideno[1,2,3-c,d]pyrene	0.1

The USEPA has classified lead as a B2 probable human carcinogen because some lead compounds cause kidney tumors in experimental animals. Despite these finding, the USEPA recommends that the quantitative estimates of the potency of lead not be used for risk evaluation purposes because of the considerable uncertainty in the estimates. As discussed above, exposure to chromium (analyzed and reported as total chromium) is evaluated as exposure to Cr III; Cr III is not regarded as a carcinogen.

The following equation is used to arrive at an estimate of incremental cancer risk (USEPA, 1989b):

$$Risk = CDI \times SF$$

where:

Risk = a unitless probability (e.g., 2×10^{-5} or 2 in 100 thousand) of an individual developing cancer;

CDI = chronic daily intake averaged over 70 years (mg/Kg-day); and

SF = slope factor, expressed in $(mg/Kg\text{-}day)^{-1}$

This linear equation is valid only at low risk levels (i.e., below estimated risks of 0.01). According to the USEPA, this approach does not necessarily give a realistic prediction of risk. The true value of the risk at trace ambient concentrations is unknown, and may be as low as zero.

As with RfDs, the USEPA has not derived slope factors for dermal exposure. In their absence, slope factors for oral exposure are used and adjusted to reflect absorbed dose. This allows for risk estimation based on exposures estimated as absorbed doses and slope factors expressed as absorbed doses. The same absorption factors used to adjust RfDs are applied in adjusting slope factors.

6.3.3 Mixtures

The USEPA has also developed guidelines to evaluate the overall potential for noncancer and cancer effects posed by multiple chemicals. For the evaluation of noncarcinogenic health effects, this approach assumes that subthreshold exposures to several chemicals at the same time could result in an adverse health effect. The sum of the hazard quotients (for individual chemicals, exposure routes, exposure pathways, or potentially exposed populations) is the hazard index. When the hazard index exceeds 1.0, there may be concern for potential health effects. Generally, hazard indices are only used in the evaluation of a mixture of chemicals that induce the same effect by the same mechanism of action. In this evaluation, the hazard quotients of a mixture of chemicals which can have different effects are used as a screening-level approach, as recommended by the USEPA (1989b). This approach is likely to overestimate the likelihood of adverse, noncarcinogenic health effects.

For the evaluation of carcinogenic risks, the individual risks associated with exposure to each chemical are summed. This represents an approximation of the precise equation for combining risks which accounts for the joint probabilities of the same individual developing cancer as a consequence of exposure to two or more carcinogens. This additive approach assumes independence of action by the chemicals involved (i.e., that there are no synergistic or antagonistic chemical interactions and all chemicals produce the same effect, i.e., cancer).

6.4 RISK CHARACTERIZATION

The human health risks associated with potential exposure to the chemicals of potential concern for each potentially exposed population, currently and in the future, in the absence of remedial action, are presented in Tables 6-9 to 6-15, summarized in Table 6-16, and discussed below. As described earlier, potential carcinogenic health risks are assessed through the computation of a probability estimate, the likelihood of developing a cancer following exposure to the chemicals of concern under the set of exposure conditions evaluated. Following USEPA guidance (USEPA, 1991), the estimated cancer risks for the resident adult evaluated in the future scenario represent the sum of the cancer risks estimated for 6 years of exposure as a child and 24 years of exposure as an adult.

The estimated risks are compared to the USEPA acceptable levels specified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (USEPA, 1990). For noncarcinogenic health effects, the NCP states that acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. In practice, the USEPA defines this as both hazard quotients and hazard indices less than or equal to 1.0. For known or suspected carcinogens, the NCP states that acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} (1 in 10,000) and 10^{-6} (1 in 1,000,000).

6.4.1 Quantitative Assessment: Current Conditions

Adolescent Trespasser: The potential for noncarcinogenic and carcinogenic health effects associated with possible exposure to individual chemicals in surface soil are presented in Table 6-9 in the form of hazard quotients and estimated cancer risks. Hazard indices and estimated cancer risks for the individual routes of exposure are also presented.

The total hazard index (Table 6-16) for adolescent trespasser exposure to the chemicals of potential concern in surface soil from ingestion and dermal contact is 8E-02 (scientific notation for 0.08); this hazard index is less than the USEPA acceptable level of 1.0, indicating that adverse, noncarcinogenic health effects from such exposure are unlikely. The total estimated cancer risk (Table 6-16) is about 6E-07 (scientific notation for 6 in 10,000,000). This risk is less than the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

PMC Worker: The potential for noncarcinogenic and carcinogenic health effects associated with possible exposure to individual chemicals in surface soil are presented in Table 6-10 in the form of hazard quotients and estimated cancer risks. Hazard indices and estimated cancer risks for the individual routes of exposure are also presented.

The total hazard index (Table 6-16) for PMC worker exposure to the chemicals of potential concern in surface soil from ingestion and dermal contact is 7E-02 (scientific notation for 0.07); this hazard index is less than the USEPA acceptable level of 1.0, indicating that adverse, noncarcinogenic health effects from such exposure are unlikely. The total estimated cancer risk (Table 6-16) is about 5E-06 (scientific notation for 5 in 1,000,000). This risk is within the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

6.4.2 Quantitative Assessment: Future Conditions

Direct contact exposure by residents is evaluated based on both shallow soil data ("limited residential use") and all soils data ("generic residential use"). As discussed previously, since the exposure assumptions and parameters are the same for each residential use scenario, the estimated risks for the two data sets can be applied to either or both scenarios.

"Generic Residential Use": The potential for noncarcinogenic and carcinogenic health effects associated with possible exposure to individual chemicals in soils and groundwater are presented in Tables 6-11 and 6-12 for adults and children, respectively, in the form of hazard quotients and estimated cancer risks. Hazard indices and estimated cancer risks for the individual routes of exposure are also presented.

The total hazard index (Table 6-16) for resident adult exposure to the chemicals of potential concern in soils from ingestion and dermal contact and in groundwater from ingestion, dermal contact and inhalation of volatilized chemicals is 1E+00 (scientific notation for 1.0); this hazard index is equal to the USEPA acceptable level of 1.0. The total estimated cancer risk (Table 6-16) is about 3E-04 (scientific notation for 3 in 10,000). This risk is greater than the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000. Ingestion of vinyl chloride in groundwater is the primary contributor to the estimated cancer risk

The total hazard index (Table 6-16) for resident child exposure to the chemicals of concern in soils from ingestion and dermal contact and in groundwater from ingestion, dermal contact, and inhalation of volatilized chemicals is 3E+00 (or 3); this hazard index is greater than the USEPA acceptable level of 1.0, indicating a potential for adverse, noncarcinogenic health effects. The hazard index for ingestion of groundwater is 2E+00 (or 2), however, none of the hazard quotients for individual chemicals exceed 1.0. The total estimated cancer risk (Table 6-16) is about 1E-04 (or 1 in 10,000). This risk is within the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

"Limited Residential Use" - Basement Construction: The potential for noncarcinogenic and carcinogenic health effects associated with possible exposure to individual chemicals in surface soil and indoor air are presented in Tables 6-13 and 6-14 for adults and children, respectively, in the form of hazard quotients and estimated cancer risks. Hazard indices and estimated cancer risks for the individual routes of exposure are also presented.

The total hazard index (Table 6-16) for resident adult exposure to the chemicals of potential concern in surface soil from ingestion and dermal contact and in indoor air from inhalation of chemicals volatilized from subsurface soil and groundwater is 4E-01 (scientific notation for 0.04); this

hazard index is less than the USEPA acceptable level of 1.0, indicating that adverse, noncarcinogenic health effects from such exposure are unlikely. The total estimated cancer risk (Table 6-16) is about 7E-05 (scientific notation for 7 in 100,000). This risk is within the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

The total hazard index (Table 6-16) for resident child exposure to the chemicals of concern in surface soil from ingestion and dermal contact and in indoor air from inhalation of chemicals volatilized from subsurface soil and groundwater is 2E+00 (or 2); this hazard index is greater than the USEPA acceptable level of 1.0, indicating a potential for adverse, noncarcinogenic health effects. None of the hazard indices for the individual exposure routes exceeds 1.0, although the hazard index for ingestion of surface soil is 1. The total estimated cancer risk (Table 6-16) is about 4E-05 (or 4 in 100,000). This risk is within the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

"Limited Residential Use" - Foundation Construction: The potential for noncarcinogenic and carcinogenic health effects associated with possible exposure to individual chemicals in surface soil and indoor air are presented in Tables 6-13 and 6-14 for adults and children, respectively, in the form of hazard quotients and estimated cancer risks. Hazard indices and estimated cancer risks for the individual routes of exposure are also presented.

The total hazard index (Table 6-16) for resident adult exposure to the chemicals of potential concern in surface soil from ingestion and dermal contact and in indoor air from inhalation of chemicals volatilized from subsurface soil and groundwater is 4E-01 (scientific notation for 0.4); this hazard index is less than the USEPA acceptable level of 1.0, indicating that adverse, noncarcinogenic health effects from such exposure are unlikely. The total estimated cancer risk (Table 6-16) is about 7E-05 (scientific notation for 7 in 100,000). This risk is within the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

The total hazard index (Table 6-16) for resident child exposure to the chemicals of concern in surface soil from ingestion and dermal contact and in indoor air from inhalation of chemicals volatilized from subsurface soil and groundwater is 2E+00 (or 2); this hazard index is greater than the USEPA acceptable level of 1.0, indicating a potential for adverse, noncarcinogenic health effects.

None of the hazard indices for the individual exposure routes exceeds 1.0, although the hazard index for ingestion of surface soil is 1. The total estimated cancer risk (Table 6-16) is about 4E-05 (or 4 in 100,000). This risk is within the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

Construction Worker: The potential for noncarcinogenic and carcinogenic health effects associated with possible exposure to individual chemicals in soils and air are presented in Table 6-15 in the form of hazard quotients and estimated cancer risks. Hazard indices and estimated cancer risks for the individual routes of exposure are also presented.

The total hazard index (Table 6-16) for construction worker exposure to the chemicals of potential concern in surface and subsurface soils from ingestion, dermal contact and inhalation is 1E-01 (scientific notation for 0.1); this hazard index is less than the USEPA acceptable level of 1.0, indicating that adverse, noncarcinogenic health effects from such exposure are unlikely. The total estimated cancer risk (Table 6-16) is about 6E-07 (scientific notation for 6 in 10,000,000). This risk is less than the USEPA acceptable range of 1 in 10,000 to 1 in 1,000,000.

6.4.3 Qualitative Assessment

USEPA-derived toxicological criteria (i.e., RfDs, RfCs, and cancer slope factors for oral and inhalation exposure) are not available to quantitatively assess the potential for human health risks for four chemicals of potential concern: lead, two noncarcinogenic PAHs (benzo[g,h,i]perylene, and phenanthrene) and thallium. Possible health implications that may be associated with exposure to these chemicals are as follows:

Lead: Chronic exposure to low levels of lead may result in hematologic (blood and blood-forming), neurobehavioral, kidney, and other effects in humans (ATSDR, 1993a). Effects such as slowed nerve conduction velocities, altered testicular function, reduced hemoglobin production, and other signs of impaired heme synthesis, and blood pressure effects have been observed in adults. Children, who represent a sensitive portion of the population, may experience an array of pathophysiological effects. Electrophysiological effects, impaired cognitive performance (as measured by IQ tests, performance in school, and other means), heme synthesis impairment, inhibition

of pyrimidine and alanine synthesis, interference with vitamin D hormone synthesis, and early childhood growth reductions have been observed in children. In addition, factors influencing neurological development such as low birth weights and decreased gestational age and deficits in mental indices have been reported in infants.

For this human health evaluation, assessment of the potential for health effects from lead exposure is made by comparison of lead levels in soil to the USEPA's revised interim screening criterion for lead in soil (400 mg/kg) which the agency considers protective for direct contact at residential settings (USEPA, 1994) and comparison of lead levels in groundwater to the USEPA action level for lead in drinking water (15 ug/l).

Lead was detected in 36 of 36 soil samples, however no samples had concentrations greater than 400 mg/kg. Lead was detected in 4 of 18 groundwater samples, however only one sample (PS-105S at 44.4 ug/l) had a concentration greater than 15 ug/l).

Benzo[g,h,i]perylene and Phenanthrene: These two chemicals are among the 17 PAHs typically analyzed for and evaluated at hazardous waste sites; the 17 PAHs often occur together in the environment and many have similar environmental fate and toxicological characteristics (ATSDR, 1993b). However, reliable environmental fate and toxicological information exists for only a few of the 17 PAHs and the potential health effects of the other less well-studied PAHs must be inferred from this information (ATSDR, 1993b). The USEPA (1994a) regards all three chemicals as not classifiable as to carcinogenicity

Benzo[g,h,i]perylene and phenanthrene were detected in soils. However, these chemicals were detected in concentrations within the concentration range of the other noncarcinogenic PAHs and none of the evaluated noncarcinogenic PAHs pose potential noncancer health risks at the concentrations evaluated. They were not detected in groundwater.

Thallium: Thallium is one of the more toxic metals and can cause neural, hepatic, and renal injury, as well as deafness and loss of vision (Amdur et al., 1991); alopecia (hair loss) is the hallmark of long-term thallium poisoning in humans (Carson et al., 1986). Thallium is absorbed through the skin and the gastrointestinal tract and chronic thallium poisoning shows a long latent period.

Thallium was detected in 1 of 36 soil samples at a concentration of 0.68 mg/kg and was not detected in groundwater.

6.4.4 Uncertainty Analysis

Some uncertainty is inherent in the process of conducting predictive, quantitative health risk assessments. Environmental sampling and analysis, fate and transport modeling and human exposure modeling are all prone to uncertainty, as are the available toxicity data used to characterize risks.

Uncertainty associated with environmental sampling is generally related to the limitations of the sampling in terms of the number and distribution of samples, while uncertainty associated with the analysis of samples is generally associated with systematic or random errors (e.g., false positive or negative results). For instance, for the subsurface soil (and, therefore, the combined surface and subsurface soils) data sets, the number of samples collected at depth at each sampling location varied. As each sample was considered an independent data point in determining frequency of detection and exposure point concentrations of the chemicals, such utilization of the data could result in bias towards the more frequently sampled locations. Thus exposure may be overestimated or underestimated depending on how well each environmental medium is characterized.

While aspects of the exposure assessment methodology can result in overestimation or underestimation of long-term exposure, exposure is probably overestimated, overall, for the potentially exposed populations evaluated. The exposure point concentrations used in the exposure assessment (i.e., the 95 % UCL on the average concentration or the maximum detected concentration, without consideration of environmental migration, transformation, degradation, or loss) should result in overestimates of long-term exposure. As discussed in Appendix F, concentrations of chemicals of potential concern in air are based on conservative emissions estimation procedures and air dispersion models that likely overpredict the air concentrations.

Assumptions and model input parameters that result in reasonable maximum exposure estimates are used in the exposure assessment; the actual frequencies and durations of exposure would probably be less than evaluated so that long-term exposure should be overestimated. Model

input parameters (e.g., permeability constants) which are influenced by a number of factors may result in overestimates of long-term exposure.

Potential exposure to chemicals in groundwater from dermal contact during showering (or bathing/washing) is based on data from unfiltered water samples and, as chemicals sorbed to particulates in the water may be unavailable for dermal absorption, exposure may be overestimated. Also, potential exposure to VOCs from the inhalation and dermal exposure pathways was conservatively estimated since depletion of VOC concentrations in air once volatilized from the shower water is not considered.

The derivation of health effects criteria that form the basis of the risk characterization can result in overestimates or underestimates of potential health risks. In most cases, the criteria are derived from extrapolation from laboratory animal data to humans. RfDs and cancer slope factors for oral exposure are used as criteria to assess exposure from dermal absorption. While the criteria for oral exposure are adjusted for such use following USEPA guidance, oral absorption for the organic chemicals is assumed to be 100%; this may underestimate dermal contact risks for some chemicals. For those chemicals with specific oral absorption efficiencies, consideration was not given to the absorption efficiency of the exposure vehicle used in the studies on which the toxicity factors is based; this may overestimate or underestimate dermal contact risks for some chemicals. Furthermore, for some chemicals, health criteria are insufficient to determine reference doses or slope factors for oral and/or inhalation exposure. As a result, the overall risks may be underestimated.

Subchronic RfDs are the appropriate toxicological criteria to estimate the potential for noncarcinogenic health effects in construction workers assumed to have exposure over a 2-year period. However, as subchronic RfDs are often lacking or in some cases set equal to chronic RfDs, chronic RfDs are used as conservative approximations; this may overestimate risks for these workers.

Exposure to total chromium in soils is evaluated based on toxicological criteria for Cr III; health risks based on Cr III would be underestimated if some Cr VI was detected in the soil.

6.5 SUMMARY

The risk assessment addresses the consequences of "reasonable maximum exposure" to site contaminants under current and future conditions in the absence of remedial action. A summary of the risk estimates is presented in Table 6-16.

Based on the assumptions and limitations of this evaluation, none of the exposure pathways and routes considered under current conditions result in risks in excess of the USEPA acceptable levels. Under future conditions, potential exposure of children under all three residential use scenarios evaluated (generic residential use with exposure to soil and groundwater, limited residential use/basement construction with exposure to surface soil and indoor air and limited residential use/foundation construction with exposure to surface soil and indoor air) results in concern for adverse, noncarcinogenic health effects as the hazard indices exceed the USEPA acceptable level. With one exception, none of the hazard indices for the individual exposure routes exceeds 1.0, although the hazard indices for ingestion of shallow soil in the latter two cases equal the USEPA acceptable level. Potential exposure of children assuming generic residential use with exposure to soil and groundwater results in a hazard index greater than the USEPA acceptable level. Ingestion of groundwater is the exposure route of concern although none of the hazard quotients for the individual chemicals in groundwater exceed the USEPA acceptable level. Potential exposure of adults assuming generic residential use with exposure to soil and groundwater results in an estimated cancer risk greater than the USEPA acceptable range. Ingestion of vinyl chloride in groundwater is the primary contributor to the risk estimate. While considered in this risk assessment, potable use of the groundwater is unlikely due to the availability of municipal water supply.

MALCOLM PIRNIE

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TABLES

TABLE 2-1
PETOSKEY MANUFACTURING REMEDIAL INVESTIGATION
WATER LEVEL MEASUREMENTS

Well ID	Top of Casing Elevation	Depth to Water (9/25/95) (1)	Water Level Elevation (9/25/95)	Depth to Water (10/3/95) (2)	Water Level Elevation (10/3/95)
PS-AS	599.89	20.35	579.54		
PS-AD	599.78	20.30	579.48	20.48	579.30
PS-BS	593.81	14.26	579.55	14.51	579.30
PS-BD	593.81	14.34	579.47	14.42	579.39
PS-CS	591.32	11.92	579.40	12.00	579.32
PS-CD	591.37	11.93	579.44	12.03	579.34
PS-DS	595.65	16.25	579.40	16.55	579.10
PS-DD	595.59	16.08	579.51	16.23	579.36
PS-1R	595.79	16.31	579.48		
PS-4	597.26	17.84	579.42	17.90	579.36
PS-6	600.49	NA			
PS-10A	589.53	10.06	579.47		
PS-11	588.48	9.02	579.46	9.06	579.42
PS-12	602.83	23.30	579.53	23.48	579.35
PS-13	595.88	16.40	579.48		
PS-104	596.99	17.60	579.39	17.62	579.37
PS-105S	592.09	12.55	579.54	12.71	579.38
PS-105D	592.09	9.97	582.12	10.11	581.98
PS-106	590.51	11.00	579.51		
COP-1	587.22	NA		9.67	587.55
COP-2	590.29	10.09	580.20		
COP-3	NA	10.02			
COP-4	NA	9.54			
COP-5	NA	13.58			
MW-201S	596.97	17.37	579.60	17.52	579.45
PW-201D	592.98	13.56	579.42		
MW-202S	595.30	15.67	579.63	15.93	579.37
MW-203S	595.68	16.33	579.35	16.34	579.34
MW-203D	595.74	16.31	579.43	16.39	579.35
MW-204S	595.66	16.15	579.51	16.32	579.34
MW-205I	589.68	10.14	579.54		
MW-205D	590.75	11.21	579.54		
Ingalls Well	585.68	NA		NA	
Pier	582.55	2.35	580.20	2.57	579.98
SW River	588.02	2.77	585.25	3.00	585.02
NW River	587.76	NA		8.25	579.51

TABLE 2-1
PETOSKEY MANUFACTURING REMEDIAL INVESTIGATION
WATER LEVEL MEASUREMENTS

Well ID	Top of Casing Elevation	Depth to Water (10/16/95)	Water Level Elevation (10/16/95)
PS-AS	599.89		
PS-AD	599.78	20.81	578.97
PS-BS	593.81	14.81	579.00
PS-BD	593.81	14.72	579.09
PS-CS	591.32	12.37	578.95
PS-CD	591.37	(3) 12.31	579.06
PS-DS	595.65	16.68	578.97
PS-DD	595.59	16.55	579.04
PS-1R	595.79	16.76	579.03
PS-4	597.26	18.22	579.04
PS-6	600.49	21.57	578.92
PS-10A	589.53	10.46	579.07
PS-11	588.48	9.55	578.93
PS-12	602.83	23.81	579.02
PS-13	595.88	16.86	579.02
PS-104	596.99	17.96	579.03
PS-105S	592.09	13.07	579.02
PS-105D	592.09	10.45	581.64
PS-106	590.51	11.54	578.97
COP-1	587.22	10.03	577.19
COP-2	590.29	10.57	579.72
COP-3	NA	10.46	
COP-4	NA	10.05	
COP-5	NA	14.03	
MW-201S	596.97	17.90	579.07
PW-201D	592.98		
MW-202S	595.30	13.53	581.77
MW-203S	595.68	16.65	579.03
MW-203D	595.74	16.74	579.00
MW-204S	595.66	16.59	579.07
MW-205I	589.68	11.73	577.95
MW-205D	590.75	10.64	580.11
Ingalls Well	585.68	(3) 6.72	578.96
Pier	582.55	(3) 2.90	579.65
SW River	588.02	2.84	585.18
NW River	587.76		

(1) - Measurements recorded by MDEQ

(2) - Measurements by MDEQ prior to pumping test (selected wells only)

(3) - Measurements recorded in morning of 10/17/95

TABLE 2-2

PETOSKEY MANUFACTURING SITE

Slug Test Results

Hydraulic Conductivity (K) Values

WELL I.D.	TEST #1	TEST #2	GEOMETRIC MEAN
MW-201S	1.37×10^{-3}	3.25×10^{-3}	2.11×10^{-3}
PS-CS	6.10×10^{-3}	7.59×10^{-3}	6.80×10^{-3}
PS-CD	3.78×10^{-3}	3.98×10^{-3}	3.88×10^{-3}
MW-105S	6.77×10^{-4}	4.47×10^{-4}	5.50×10^{-4}
MW-105D	8.84×10^{-4}	6.65×10^{-4}	7.67×10^{-4}

Hydraulic conductivity values are in cm/sec

TABLE 3-1
PETOSKEY MANUFACTURING SITE
Soil Vapor Extraction Pilot Test
Field Gas Chromatograph Screening Results

SAMPLE I.D.	Date Collected	Time Collected	TCE (ppb)
PT-SVE203S-1	September 12	12:15 PM	9
PT-SVE203S-2	September 12	1:15 PM	8
PT-SVE203S-3	September 12	2:15 PM	8
PT-SVE203S-4	September 12	3:15 PM	7
PT-SVE203S-5	September 12	11:15 PM	2
PT-SVE203S-6	September 13	7:15 AM	3
PT-SVE203S-7	September 13	3:15 PM	3
PT-SVE203S-8	September 13	11:15 PM	3
PT-SVE203S-9	September 14	7:15 AM	2
PT-SVE201S-1	September 14	9:45 AM	3
PT-SVE201S-2	September 14	10:45 AM	3
PT-SVE201S-3	September 14	11:45 AM	3
PT-SVE201S-4	September 14	12:45 PM	2
PT-SVE201S-5	September 14	8:45 PM	2
PT-SVE201S-6	September 15	8:45 AM	1

TABLE 3-2
PETOSKEY MANUFACTURING SITE
Aquifer Pumping Test
Field Gas Chromatograph Screening Results

SAMPLE I.D.	1,2-DCE (ppb)	TCE (ppb)
PM-IN-1	ND	ND
PM-IN-10	ND	ND
PM-IN-100	ND	ND
PM-IN-1000	ND	5
PM-EF-1000	ND	ND
PM-IN-10-4 (2)	ND	20
PM-EF-10-4 (2)	ND	ND
PM-IN-10-5 (1)	ND	12
PM-EF-10-5 (1)	ND	ND
PM-IN-10-5 (2)	ND	26
PM-EF-10-5 (2)	ND	ND
PM-IN-10-6 (1)	ND	26
PM-IN-10-6 (2)	ND	ND

Notes:

IN - Influent to carbon

EF - Effluent from carbon

Samples labelled 1, 10, 100, and 1000 were collected 1, 10, 100, and 1000 minutes after starting the pumping test.

Other samples were collected on date indicated (10-5 is October 5) in morning (1) or evening (2)

ND - Not Detected

TABLE 5-1
PETOSKEY MANUFACTURING REMEDIAL INVESTIGATION
SOIL SAMPLE BACKGROUND CALCULATIONS

BACKGROUND CONCENTRATIONS CALCULATIONS n= 6

Parameter	Background Samples						Background Calculations							Acceptable Background Limit
	206-0 5-2 5 MEZT39 mg/kg	206-2 5-4 5 MEZT40 mg/kg	207-0 5-2 5 mg/kg	207-2 5-4 5 mg/kg	B1-1 3 mg/kg	B2-1-3 mg/kg	SUM	MEAN	Value-Mean	Squared	Variance	Standard Deviation	Coefficient of Variance	mg/kg
Aluminum	1940 00	2020 00	1320 00	1290 00	2440 00	1950 00	10960 00	1826 67	9133 33	83417777 78	16683555 56	4084 55	2 24	14080.32
Antimony	0 43	0 00	0 40	0 00	2 40	0 00	3 23	0 54	2 69	7 25	1 45	1 20	2 24	4 15
Arsenic	1 20	1 20	0 40	0 95	1 30	0 99	6 04	1 01	5 03	25 33	5 07	2 25	2 24	7 76
Barium	14 40	12 30	11 60	14 30	32 70	527 00	612 30	102 05	510 25	260355 06	52071 01	228 19	2 24	786.62
Beryllium	0 09	0 00	0 08	0 00	0 73	0 56	1 46	0 24	1 22	1 48	0 30	0 54	2 24	1.88
Cadmium	0 36	0 46	0 34	0 36	0 22	0 22	1 96	0 33	1 63	2 67	0 53	0 73	2 24	2 52
Calcium	2140 00	9790 00	1400 00	1830 00	71700 00	22300 00	109160 00	18193 33	90966 67	8274934444 44	1654986888 89	40671 53	2 24	140237 92
Chromium	2 40	3 20	2 40	2 00	2 70	4 20	16 90	2 82	14 08	198 34	39 67	6 30	2 24	21 71
Cobalt	0 94	1 10	0 79	1 00	1 20	1 20	6 23	1 04	5 19	26 95	5 39	2 32	2 24	8.00
Copper	1 90	2 20	0 87	1 00	14 80	7 00	27.77	4 63	23.14	535 54	107 11	10 35	2.24	35.68
Iron	2570.00	3600.00	2380 00	2280 00	4690.00	2910 00	18430.00	3071.67	15358.33	235878402 78	47175680 56	6868 46	2.24	23677.03
Lead	15.80	5.70	10.90	13.60	44.10	36.90	127.00	21.17	105 83	11200.69	2240.14	47.33	2 24	163.16
Magnesium	828.00	1910.00	417.00	570.00	5170.00	3230.00	12125.00	2020.83	10104.17	102094184.03	20418836 81	4518 72	2.24	15577.00
Manganese	25.90	125.00	149.00	175.00	155.00	159.00	788 90	131.48	657.42	432196.67	86439 33	294.01	2.24	1013.50
Mercury	0 00	0 12	0.00	0.11	0.00	0 11	0.34	0.06	0.28	0.08	0 02	0 13	2.24	0.44
Nickel	1.50	2 10	1 30	1.30	7.90	4 80	18 90	3.15	15.75	248 06	49 61	7 04	2.24	24.28
Potassium	201.00	222 00	173.00	161.00	450 00	267 00	1474 00	245 67	1228.33	1508802 78	301760 56	549 33	2 24	1893.65
Selenium	0.82	0 97	0 00	0.75	0 00	0 66	3.20	0 53	2.67	7 11	1 42	1 19	2 24	4.11
Silver	0 57	0 00	0 53	0 00	0 22	0 00	1 32	0 22	1 10	1 21	0.24	0 49	2 24	1.70
Sodium	66.00	79 10	55 30	64 00	129.00	64 30	457 70	76.28	381 42	145478 67	29095 73	170 57	2 24	588.01
Thallium	1 10	0 00	0 99	0 00	0 66	0.00	2 75	0 46	2 29	5.25	1 05	1 02	2 24	3 53
Vanadium	3 40	5 00	3 10	3.50	7 70	5 20	27 90	4 65	23 25	540 56	108 11	10 40	2 24	35.84
Zinc	18 70	21 80	25 10	23 00	95 50	355.00	539 10	89 85	449 25	201825 56	40365 11	200 91	2 24	692.58
Cyanide (R)	0 55	0.00	0.00	0.52	0 00	0 55	1 62	0 27	1 35	1 82	0 36	0 60	2 24	2.08

For non-detect values:

- if less than 50% of the background data is below the DL, use one-half of the DL as the value
- if more than 50% of the background data is below the DL, use Alternate "0" and the DL resulting in a net value of one-half of the detection limit with a variance.

TABLE 5-2
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

Parameter	201S-0-2 EWP28 µg/kg	201S-14-16 EWP29 µg/kg	202S-0-2^ EWP30 µg/kg	202S-10-12^ EWP32 µg/kg	203S-0-2 EWP22 µg/kg	203S-5-7 EWP23 µg/kg	203S-12-14 EWP24 µg/kg	204S-0-2 EWP26 µg/kg	204S-13-15 EWP27 µg/kg	206-0 5-2 5^ EWP33 µg/kg	206-2 5-4 5^ EWP34 µg/kg	207 0 5-2 5^ EWP35 µg/kg	207-2 5-4 5^ EWP36 µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/l
1,1,1-Trichloroethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	4,000 [1]	4,000 [2]	4,000 [2]
1,1,2,2-Tetrachloroethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	1,600	86 [2]	340 [2]
1,1,2-Trichloroethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	6,600 [1]	100 [2]	100 [2]
1,1-Dichloroethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	IP	18,000 [2]	50,000 [2]
1,1-Dichloroethene	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	1,300 [1]	140 [2]	140 [2]
1,2-Dichloroethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	200 [1]	100 [3]	100 [2]
1,2-Dichloroethene (total) [7]	<11	<11	<12	<11	<12	<11	3 J	<10	<10	<11	<11	<10	<10	ID	1,400 [2]	1,400 [2]
1,2-Dichloropropane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	5,800 [1]	100 [2]	100 [2]
2-Butanone (MEK)	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	1.4 E+5 [1]	2.6 E+5 [2]	2.6 E+5 [2]
2-Hexanone	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	(B) [10]	20,000 [2]	56,000 [2]
4-Methyl-2-pentanone (MIBK)	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	(B) [10]	7,400 [2]	20,000 [2]
Acetone	<11	<11	<18 B	<12 B	46	11	<11	<10	12	<14 B	<11 JB	<13 B	<10 JB	IP	15,000 [1]	42,000 [2]
Benzene	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	1 J	<10	<10	4,000 [1]	100 [3]	100 [2]
Bromodichloromethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	480 [10]	2,000 [3]	2,000 [2]
Bromoform	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	1300 [10]	2,000 [3]	2,000 [2]
Bromomethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	IP	200 [3]	580 [2]
Carbon Disulfide (R)	<11	<11	<12 JB	<11 JB	<12	<11	<11	<10	<10	<11 JB	<11 JB	<10 JB	<10 JB	(B) [10]	16,000 [1]	46,000 [2]
Carbon Tetrachloride	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	900 [1]	100 [3]	100 [2]
Chlorobenzene	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	940 [1]	2,000 [3]	2,000 [2]
Chloroethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	ID	4,400 [2]	18,200 [2]
Chloroform	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	< 0	3,400	2,000 [2]	2,000 [2]
Chloromethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	< .0	ID	1,300 [2]	5,400 [2]
cis-1,3-Dichloropropene [7]	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	60 [9]	94 [3]	380 [2]
Dibromochloromethane	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	580 [10]	2,000 [2]	2,000 [2]
Ethylbenzene	6 J	17	<12	2 J	<12	<11	3 J	<10	4 J	<11	<11	<10	<10	360 [1]	1,500 [3]	1500 [2]
Methylene Chloride	12	<11	<20 B	<15 B	<12	<11	<11	<10	<10	<18 B	<21 B	<23 B	<16 B	19,000 [1]	100 [2]	100 [2]
Styrene	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	380 [10]	2,700 [4]	2700 [2]
Tetrachloroethene	12	3 J	<12	1 J	<12	<11	4 J	<10	<10	<11	<11	<10	<10	900 [1]	100 [3]	100 [2]
Toluene	18	16	9 J	7 J	14	7 J	24	<10	<10	9 J	70	56	45	2,800 [1]	16,000 [1]	16,000 [2]
total Xylene	33	39 X	<12	4 J	<12	<11	4 J	<10	12 X	2 J	6 J	3 J	4 J	700 [1]	5,600 [2]	5,600 [2]
trans-1,3-Dichloropropene [7]	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	60 [10]	94 [3]	380 [2]
Trichloroethene	460 E	310 E	<12	1 J	29	58	830 E	<10	130	<11	<11	<10	<10	4,000 [1]	100 [3]	100 [2]
Vinyl Chloride	<11	<11	<12	<11	<12	<11	<11	<10	<10	<11	<11	<10	<10	300 [1]	40 [3]	40 [2]

TABLE 5-2
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

Notes:

20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[i] Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

Site Specific Background

[j] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[i] Industial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxologist

20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Exceedances are bolded.

^ Tentatively identified compounds present

* Interim value, currently under review

NLL - Chemical is not likely to leach under most soil conditions

IP - Development of generic GSI value in process but not yet complete.

ID - Insufficient data for calculation

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte detected in the associated blank

J - Estimated value.

X - Indicates manual data entry.

E - Concentration exceeds the calibration range of the instrument

< - indicates that analyte was not detected at detection limit given

[k] Data not broken down into isomers so the most conservative criteria was used which is cis.

[l] Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria.

TABLE 5-3
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	201S-0-2^ EWP28 µg/kg	202S 0-2^ EWP30 µg/kg	202S-5-7^ EWP31 µg/kg	202S-10-12 EWP32 µg/kg	203S-5-7^ EWP23 µg/kg	203D-0-2^ EWP25 µg/kg	204S-0-2^ EWP26 µg/kg	206-0 5-2 5^ EWP33 µg/kg	206-2 5-4 5^ EWP34 µg/kg	207-0 5-2 5^ EWP35 µg/kg	207-2 5-4 5^ EWP36 µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
1,2,4-Trichlorobenzene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	440 [1]	4,100 [4]	4,200 [5]
1,2-Dichlorobenzene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	340 [1]	13,000 [4]	13,000 [5]
1,3-Dichlorobenzene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	1,100 [1]	12,000 [4]	18,000 [5]
1,4-Dichlorobenzene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	280 [1]	1,600 [4]	1,700 [5]
2,2'-Oxybis(1-Chloropropane)	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340			
2,4,5-Trichlorophenol	<950	<880	<880	<890	<910	<850	<860	<900	<950	<860	<860	500 [12]	39,000 [4]	4.6 E+5 [5]
2,4,6-Trichlorophenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	620 [1]	1,500 [4]	45,000 [5]
2,4-Dichlorophenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	680 [1]	1,500 [4]	7,700 [5]
2,4-Dimethylphenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	620 [1]	7,400 [4]	20,000 [5]
2,4-Dinitrophenol	<950	<880	<880	<890	<910	<850	<860	<900	<950	<860	<860			
2,4-Dinitrotoluene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	1800 [1]	3,800 [4]	15,000 [5]
2,6-Dinitrotoluene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340			
2-Chloronaphthalene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	(B) [1]		
2-Chlorophenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	440	900	2,500
2-Methylnaphthalene	<380	<350	35 J	<350	<360	<340	<340	<360	<380	<340	<340	(B) [1]	11,000 [4]	ID
2-Methylphenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	760 [1]	7,400	20,000
2-Nitroaniline	<950	<880	<880	<890	<910	<850	<860	<900	<950	<860	<860			
2-Nitrophenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	(B) [1]	400 [4]	1,160
3,3'-Dichlorobenzidine	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	1.3 [12]	47 [4]	510 [5]
3-Nitroaniline	<950	<880	<880	<890	<910	<850	<860	<900	<950	<860	<860			
4,6-Dinitro-2-methylphenol	<950	<880	<880	<890	<910	<850	<860	<900	<950	<860	<860			
4-Bromophenyl phenyl ether	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340			
4-Chloro-3-methylphenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	88 [12]	3,000 [4]	16,000 [5]
4-Chloroaniline	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	340			
4-Chlorophenyl phenyl ether	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	340			
4-Methylphenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	(B) [12]	740 [4]	2,000
4-Nitroaniline	<950	<880	<880	<890	<910	<850	<860	<900	<950	<860	<860			
4-Nitrophenol	<950	<880	<880	<890	<910	<850	<860	<900	<950	<860	<860			
Acenaphthene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	4,300 [1]	300,000 [4]	8.7 E+5 [5]
Acenaphthylene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	(B) [12]	520 [4]	8,500 [5]
Anthracene	<380	<350	32 J	<350	<360	<340	<340	<360	<380	<340	<340	2.2 E+6 [12]	6.9 E+6 [4]	420,000
Benzo(a)anthracene (Q)	<380	40 J	34 J	<350	<360	<340	190 J	<360	<380	<340	<340	NLL	14,000 [12]	2.1 E+5 [5]
Benzo(a)pyrene (Q)	<380	<350	<350	<350	<360	120 J	<340	<360	<380	<340	<340	NLL	1,400 [12]	21,000 [5]
Benzo(b)fluoranthene (Q)	<380	51 J	<350	<350	<360	170 J	210 J	<360	<380	<340	<340	NLL	14,000 [12]	2.1 E+5 [5]
Benzo(ghi)perylene (Q)	<380	41 J	<350	<350	<360	<340	<340	<360	<380	<340	<340	NLL	1.5 E+6 [12]	1.6 E+7 [5]
Benzo(k)fluoranthene (Q)	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	NLL	1.4 E+5 [12]	2.1 E+6 [5]
bis(2-Chloroethoxy) methane	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340			
bis(2-Chloroethyl) ether	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	84 [12]	15 [4]	64 [5]
bis(2-ethylhexyl)phthalate	<380	26 J	29 J	<350	140 J	<340	<340	<360	<380	<340	<340	NLL	120 [4]	120 [5]
Butyl benzyl phthalate	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	(B) [12]	2.2 E+6 [4]	5.0 E+6 [5]
Carbazole	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340		860 [4]	19,000 [5]
Chrysene (Q)	<380	45 J	29 J	<350	<360	130 J	160 J	<360	<380	<340	<340	NLL	1.4 E+6 [12]	2.1 E+7 [5]
Di-n-Butyl phthalate	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	2.4 E+5 [12]	960,000 [4]	2.7 E+6 [5]
Di-n-octyl phthalate	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	(B) [12]	1.0 E+8 [4]	2.9 E+8 [5]
Dibenz(a,h)anthracene (Q)	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	NLL	1,400 [12]	21,000 [5]
Dibenzofuran	<380	<350	23 J	<350	<360	<340	<340	<360	<380	<340	<340	(B) [12]	ID	ID
Diesel Range Organics (DRO)	100	NA	NA	NA	20	11	16	NA	NA	NA	NA			
Diethyl phthalate	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	2.4 E+6 [12]	1.1 E+5 [4]	1.9 E+5 [5]
Dimethyl phthalate	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	5.8 E+7 [12]	1.5 E+6 [4]	42.0 E+5
Fluoranthene	<380	79 J	28 J	<350	<360	150 J	310 J	<360	<380	<340	<340	7400 [12]	3.0 E+6 [4]	7.2 E+5 [5]

TABLE 5-3
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	201S-0-2^ EWP28 µg/kg	202S-0-2^ EWP30 µg/kg	202S 5-7^ EWP31 µg/kg	202S 10-12 EWP32 µg/kg	203S-5-7^ EWP23 µg/kg	203D-0-2^ EWP25 µg/kg	204S-0-2^ EWP26 µg/kg	206-0.5-2.5^ EWP33 µg/kg	206-2.5-4.5^ EWP34 µg/kg	207-0.5-2.5^ EWP35 µg/kg	207-2.5-4.5^ EWP36 µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
Fluorene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	280000 [*]	390 000 [4]	8.9 E+5 [*]
Gas Range Organics (GRO)	<5.0	NA	NA	NA	<5.0	<5.0	<5.0	NA	NA	NA	NA			
Hexachlorobenzene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	ID	1 800 [3]	1 800 [*]
Hexachlorobutadiene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	ID	19 000 [3]	77 000 [*]
Hexachlorocyclopentadiene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	11 [*]	36 000 [3]	36 000 [*]
Hexachloroethane	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	1 800 [*]	17 000 [3]	69 000 [*]
Indeno(1,2,3-cd)pyrene (G)	<380	43 J	<350	<350	<360	140 J	<340	<360	<380	<340	<340	NLL	1 400 [*]	2.1 E+5 [*]
Isophorone	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	17000 [*]	18 000 [3]	74 000 [*]
N-Nitroso-di-n-propylamine	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	(B) [*]	2.4 [*]	17 000 [*]
N-Nitrosodiphenylamine (1)	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	3200 [*]	3 400 [3]	10 000 [*]
Naphthalene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	850 [*]	17 000 [3]	50 000 [*]
Nitrobenzene	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	38000 [*]	68 [3]	190 [*]
Pentachlorophenol	<950	<880	<880	<890	<910	<850	<850	<900	<950	<860	<860	7 400 [*]	21 [3]	3 200 [*]
Phenanthrene	<380	59 J	140 J	<350	<360	<340	200 J	<360	<380	<340	<340	1 100 [*]	12 000 [3]	50 000 [*]
Phenol	<380	<350	<350	<350	<360	<340	<340	<360	<380	<340	<340	22000	88 000 [3]	250 000 [*]
Pyrene	<380	86 J	36 J	<350	<360	410	160 J	<360	<380	<340	<340	2.2 E+5 [*]	1.8 E+6 [3]	4.1 E+5 [*]
Total Petroleum Hydrocarbons	100	NA	NA	NA	<40	<40	<50 M	NA	NA	NA	NA			

Notes.

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[3] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[4] Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[5] Site Specific Background

[6] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[7] Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[9] Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxologist

[10] Direct Contact Values were used because parameters are not expected to leach

[11] Residential 20X DW criterion were used because parameters are expected to leach

[*] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Exceedances are bolded.

Diesel Range Organics, Gas Range Organics and Total Petroleum Hydrocarbons have no established criterion. The results are presented in mg/kg

^ Tentatively identified compounds present

* Interim value currently under review

NLL - Chemical is not likely to leach under most soil conditions

IP - Development of generic GSI value in process but not yet complete

ID - Insufficient data for calculation

B - Analyte detected in the associated blank

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

J - Estimated value

X - Indicates manual data entry

E - Concentration exceeds the calibration range of the instrument

< - indicates that analyte was not detected at detection limit given

TABLE 5-4
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - PESTICIDES AND PCBs

Parameter	201S-0-2 EWP28 µg/kg	202S 0 2 EWP30 µg/kg	202S-5-7 EWP31 µg/kg	202S 10-12 EWP32 µg/kg	203S 5-7 EWP23 µg/kg	203D-0-2 EWP25 µg/kg	204S-0-2 EWP26 µg/kg	206-0 5-2 5 EWP33 µg/kg	206-2 5-4 5 EWP34 µg/kg	207 0 5-2 5 EWP35 µg/kg	207-2 5-4 5 EWP36 µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
4,4'-DDD	<3 8	<3 5	<3 5	<3 5	<3 5	<3 4	<3 4	<3 6	<3 8	<3 4	<3 4	NLL	41,000 [10]	6 3 E+5 [7]
4,4' DDE	<3 8	<3 5	<3 5	<3 5	<3 5	<3 4	<3 4	<3 6	<3 8	<3 4	<3 4	NLL	50 [11]	200 [7]
4,4' DDT	<3 8	<3 5	<3 5	<3 5	<3 5	<3 4	<3 4	<3 6	<3 8	<3 4	<3 4	NLL	50 [11]	200 [7]
Aldrin	<2 0	2 0	<1 8	1 0 JP	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8	NLL	580 [11]	16,000 [7]
alpha-BHC	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8			
alpha-Chlordane	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	0 91 J	<1 8	NLL	7 600 [10]	1 2 E+5 [7]
Aroclor 1016 (J T)	<38	<35	<35	<35	<35	<34	<34	<36	<38	<34	<34	NLL	2 300 [10]	21 000 [7]
Aroclor 1221 (J T)	<77	<71	<71	<71	<71	<68	<69	<73	<77	<70	<70	NLL	2 300 [11]	21 000 [7]
Aroclor-1232 (J T)	<38	<35	<35	<35	<35	<34	<34	<36	<38	<34	<34	NLL	2 300 [11]	21,000 [7]
Aroclor-1242 (J T)	<38	<35	<35	<35	<35	<34	<34	<36	<38	<34	<34	NLL	2 300 [10]	21,000 [7]
Aroclor-1248 (J T)	<38	<35	<35	<35	<35	<34	<34	<36	<38	<34	<34	NLL	2 300 [11]	21,000 [7]
Aroclor 1254 (J T)	<38	<35	<35	<35	<35	<34	<34	<36	<38	<34	<34	NLL	2,300 [11]	21,000 [7]
Aroclor 1260 (J T)	<38	<35	<35	<35	<35	<34	<34	<36	<38	<34	<34	NLL	2 300 [10]	21,000 [7]
beta-BHC	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8			
delta-BHC	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8			
Dieldrin	<3 8	<3 5	<3 5	<3 5	<3 5	<3 4	<3 4	<3 6	<3 8	<3 4	<3 4	NLL	620 [10]	9,400 [10]
Endosulfan I [2]	8 2 P	<1.8	<1.8	<1 8	<1.8	<1.7	<1.8	<1.8	<2.0	<1.8	<1 8	NLL	97,000 [10]	1 E+6 [10]
Endosulfan II [2]	2 9 J	<3 5	<3 5	<3.5	<3.5	<3.4	<3.4	<3.6	<3.8	<3.4	<3.4	NLL	97,000 [10]	1 E+6 [10]
Endosulfan sulfate	<3.8	<3 5	<3 5	<3.5	<3.5	<3.4	<3 4	<3.6	<3.8	<3 4	<3.4			
Endrin	<3 8	<3.5	<3.5	<3 5	<3.5	<3.4	<3 4	<3 6	<3.8	<3.4	<3 4	NLL	72,000 [10]	7 7 E+5 [10]
Endrin aldehyde	<3 8	<3 5	<3 5	<3.5	<3.5	<3.4	<3.4	<3 6	<3.8	<3.4	<3.4			
Endrin ketone	<3 8	<3 5	<3 5	<3 5	<3.5	<3 4	<3 4	<3.6	<3 8	<3 4	<3 4			
gamma-BHC (Lindane)	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8	1 6 [12]	0 4 [1]	0 4 [7]
gamma-Chlordane	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8	NLL	7,600 [10]	1 2 E+5 [7]
Heptachlor	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8	NLL	2 200 [11]	33 000 [7]
Heptachlor epoxide	<2 0	<1 8	<1 8	<1 8	<1 8	<1 7	<1 8	<1 8	<2 0	<1 8	<1 8	NLL	1 100 [11]	16 000 [7]
Methoxychlor	<20	<18	<18	<18	<18	<17	<18	<18	<18	<18	<18	(B) [13]	130 000 [3]	800 [7]
Toxaphene	<200	<180	<180	<180	<180	<170	<180	<180	<180	<180	<180	0 059 [12]	2 600 [1]	60 [7]

Notes:

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[3] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[4] Residential SWP DW criterion - Addendra (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[5] Site Specific Background

[6] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[7] Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[9] Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxicologist

[10] Direct Contact Values were used because parameters are not expected to leach

Residential 20X DW criterion were used because parameters are expected to leach

[11] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Direct Conatct Values were used because they are more conservative than ambient air for industrial generic soil criteria

TABLE 5-4
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - PESTICIDES AND PCBs

Exceedances are bolded.

^ Tentatively identified compounds present

* Interim value, currently under review

NLL - Chemical is not likely to leach under most soil conditions

IP - Development of generic GSI value in process but not yet complete

ID - Insufficient data for calculation

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte detected in the associated blank.

J - Estimated value

P - more than 25% difference in detected concentrations between the two GC columns. Lower result is reported

M - quantitation limit elevated due to matrix interference

X - Indicates manual data entry

E - Concentration exceeds the calibration range of the instrument

U - indicates that analyte was not detected at detection limit given.

' Data not broken down into isomers so the most conservative criteria was used which is cis.

' Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria

(J) - Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria.

(T) - Toxic Substances Control Act, Subpart G-PCB Spill Cleanup Policy standards may be more restrictive.

TABLE 5-5
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - METALS AND CYANIDE

Parameter	201S-0-2 MEZT36 µg/kg	202S-0-2 MEZT37 µg/kg	202S-10-12 MEZT38 µg/kg	203D-0-2 MEZT33 µg/kg	203D-5-7 MEZT34 µg/kg	204S-0-2 MEZT35 µg/kg	206-0 5-2 5 MEZT39 µg/kg	206-2 5-4 5 MEZT40 µg/kg	207-0 5-2 5 µg/kg	207 2 5-4 5 µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
Aluminum	3 23 E+6	2 09 E+6 E	1 13 E +6 E	1 36 E+6	1 52 E+6	1 33 E+6	1 94 E+6 E	2.02 E+6 E	1 32 E+6 E	1 29 E+6 E	(B) [12]	1 4 E+7 [5]	1 4 E+7 [5]
Antimony	<9,800	<440 N	<410	<8,200	<8,400	<8,200	<430 N	<420 N	<400 N	<390 N	1 [12]	4,300 [4,*]	4,300 [9]
Arsenic	2,400 B	2 000 B	1,600 B	<1,000	<1,000	<1 000	1,200 B	1,200 B	<800	950 B	ID	23,000 [4,*]	23,000 [9]
Barium	**141,000**	22,200 BE	7,800 BE	7,400 B	7,100 B	15,100 B	14,400 BE	12,300 BE	11,600 BE	14,300 BE	120,000 [2]	1 3 E+6 [4,*]	1 3 E+6 [9]
Beryllium	<490	140 B	130 B	<410	<420	<410	<90	<90	<80	<80	130,000 [2]	51,000 [4]	51,000 [9]
Cadmium	3 200	860 B	620 B	<410	<420	<410	360 B	460 B	340 B	360 B	4300 [2]	6,000 [4,*]	6,000 [9]
Calcium	47 3 E+6	59 6 E+6 E	256 E+6 E	7 46 E+6	122 E+6	4 83 E+6	2 14 E+6 E	9 79 E+6 E	1 4 E+6 E	1 83 E+6 E			
Chromium	**16,300**	**6000.0**	2,900	**3,500**	**7,700**	**4,200**	2,400	3,200	2,400	2,000 B	3,400 [2]	30,000 [4,*]	30,000 [9]
Cobalt	<2,500	1,600 B	1,100 B	<2,000	<2,100	<2,100	940 B	1 100 B	790 B	1,000 B	(B) [12]	8,000 [5]	8,000 [5]
Copper	30,900	11 300	3,000 B	<2,000	4 100 B	5,200	1,900 B	2,200 B	870 B	1,000 B	2 4 E+6 [2]	1 6 E+8 [4,*]	1 6 E+8 [9]
Cyanide (R)	<620	<560	<500	<510	<520	<510	<550	<540	<500	<520	100 [1]	4,000 [1]	4,000 [9]
Iron	6 34 E+6	4 53 E+6 E	3 98 E+6 E	1 46 E+6	3 63 E+6	1 65 E+6	2 57 E+6 E	3 6 E+6 E	2 38 E+6 E	2 28 E+6 E	(B) [12]	23 67 E+6 [5]	23 67 E+6 [5]
Lead	**306,000** *	31 100 E	1 100 E	2,500 *	1,400 *	25,100 *	15,800 E	5,700 E	10,900 E	13,600 E	163,160 [5]	163,160 [5]	163,160 [5]
Magnesium	**5.31 E+6**	**9.82 E+6 E**	**32.9 E +6 E**	**1.37 E +6**	**14.8 E+6**	**1.35 E+6**	828,000 BE	**1.91 E+6 E**	417,000 BE	570,000 BE	1 0 E+6 [12]	15 58 E+6 [5]	24 0 E+6 [5]
Manganese	213,000	150,000 E	155,000 E	34,400	124,000	46,800	25,900 E	125,000 E	149,000 E	175,000 E	(B) [12]	1 01 E+6 [5]	1 01 E+6 [5]
Mercury	**270**	**210**	<110	<80	<90	<9	<110	<120	<100	<110	1 1 [2]	1,700 [4,*]	1,700 [9]
Nickel	20,700	35,500 *	4,700 B*	<4,100	<4,200	<4,100	1,500 B*	2,100 B*	1,300 B*	1,300 B*	89,000 [2]	1 0 E+5 [4,*]	1 0 E+5 [9]
Potassium	440,000 B	331,000 B	488,000 B	383,000 B	339,000 B	<165,000	201,000 B	222,000 B	173,000 B	161,000 B			
Selenium	<980	<840	<770	<820	<840	<820	<820	**970 B**	<760	<750	410 [2]	4,110 [5]	4,110 [5]
Silver	<1,500	**2,000 B**	<540	<1,200	<1,300	<1,200	<570	<560	<530	<520	7.7 [2]	4,600 [4,*]	13,000 [9]
Sodium	66,600 B	163,000 B	257,000 B	55,200 B	56,700 B	55,800 B	66,000 B	79,100 B	55,300 B	64,000 B	(B) [12]	3.2 E+6 [3,*]	90 0 E+5 [7]
Thallium	<1,500	<1,100	<1,000	<1,200	<1,300	<1,200	<1,100	<1,000	<990	<980	4,200 [2]	3,530 [5]	3,530 [5]
Vanadium	6,000 B	5,800 BE*	3,900 B	2,500 B	4,200 B	2,800 B	3,400 B	5,000 B	3,100 B	3,500 B		1 0 E+6 [4,*]	2 9 E+6 [9]
Zinc	**3.08 E+6**	**2.27 E+6**	9,000 *	11,400	13,400	75,200	18,700 *	21,800 *	25,100 *	23,000 E*	1 9 E+5 [2]	2 4 E+6 [4,*]	5 0 E+6 [9]

Notes

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[3] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

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[5] Site Specific Background

[6] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[7] Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[9] Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxologist

[10] Direct Contact Values were used because parameters are not expected to leach
Residential 20X DW criterion were used because parameters are expected to leach

[11] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Direct Contact Values were used because they are more conservative than ambient air for industrial generic soil criteria

Exceedances are bolded.

^ Tentatively identified compounds present

* Interim value currently under review

NLL - Chemical is not likely to leach under most soil conditions

IP - Development of generic GSI value in process but not yet complete

ID - Insufficient data for calculation

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte detected in the associated blank

J - Estimated value

P - more than 25% difference in detected concentrations between the two GC columns. Lower result is reported

M - quantitation limit elevated due to matrix interference

X - Indicates manual data entry

E - Concentration exceeds the calibration range of the instrument

< - indicates that analyte was not detected at detection limit given

TABLE 5-6
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS

Parameter	Retention Time	206-0.5-2.5 EWP33	207-0.5-2.5 EWP35	207-2.5-4.5 EWP36
1,1,1,2-Tetrafluoroethane	0.94-0.98	7 JN		
octameth. cyclotetrasiloxane	21.62-21.66		5 JN	5 JN

Notes:

All units are ug/kg.
Sample I.D. indicates boring location and depth - 201S-0-2 indicates sample c from a depth of 0 to 2 feet below ground level.
J - Estimated value.
N - Identification based on mass spectral library search.

TABLE 5-7
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS

Parameter	Retention Time	203S-5-7 EWP23 µg/kg	203D-0-2 EWP25 µg/kg	204S-0-2 EWP26 µg/kg	201S-0-2 EWP28 µg/kg	202S 0-2 EWP30 µg/kg	202S-5-7 EWP31 µg/kg	202S 10-12 EWP32 µg/kg	206-0.5-2.5 EWP33 µg/kg	206-2.5-4.5 EWP34 µg/kg	207 0.5-2.5 EWP35 µg/kg	207-2.5-4.5 EWP36 µg/kg
Unknown	5.07											100 JU
4-methyl-3-penten-2-one	5.09						400 JNA					
Unknown	5.47-5.49					1600 JU		1100 JU		1500 JU	1600 JU	
Unknown	5.51						1800 JU					2800 JU
Unknown	5.53								1800 JU			
4-hydroxy-4-met-2-pentanone	5.87-5.91					73000 JNABU	100000 JNABU	54000 JNABU	75000 JNABU	65000 JNABU	73000 JNABU	120000 JNABU
Hexyl pentyl ether	6.02									300 JN		
Unknown	6.33						73 J			82 J		76 J
Unknown	6.60											81 J
Unknown	6.65-6.67					370 JU	520 JU		420 JU	350 JU		850 JU
4-methyl-4-penten-2-one	6.67							220 JNU				
Unknown	6.68										410 JU	
Unknown	6.81					550 J	420 J	220 J	260 J	650 J	250 J	320 J
Unknown	6.94-6.96					390 JU	400 JU	260 J	500 JU	360 JU	360 JU	670 JU
Unknown	7.13								100 J			120 J
Trimethylbenzene isomer	7.13				1000 J							
Unknown	7.36					510 J	470 J	330 J	580 J	490 J		590 J
Unknown	7.63				1000 J							
Unknown	7.99											260 J
Unknown hydrocarbon	8.02				770 J							
Trimethylbenzene isomer	8.12				1000 J							
Unknown hydrocarbon	8.23				770 J							
Unknown	8.47				270 J							
Unknown alkylbenzene	8.70				770 J							
Unknown	8.88				730 J							
Unknown	9.30				1900 J							
Tetramethylbenzene isomer	9.75				540 J							
Unknown	10.85				340 J							
Unknown	12.72				[illegible]							
Unknown	14.73	[illegible]										
2-Methylbenz(a)azulene	16.14						[illegible]					
Unknown hydrocarbon	16.15	400 J										
1,3,5-triazine-2,4-diamine	16.81					120 JN						
Unknown hydrocarbon	17.30	460 J										
Unknown hydrocarbon	18.38	330 J										
Unknown hydrocarbon	19.43	330 J										
Hexadecanoic acid	20.07-20.08	220 JN			380 J							
Unknown	20.42	220 JN										
1-hexadecol	20.86									350 JN		
Trichloroeicosylsilane	20.86										270 JN	
Unknown	20.92-20.94					83 J				220 J	140 JN	180 J
1,3,5-triazine-2,4-diamine	21.08				1600 JN							
Unknown hydrocarbon	21.37	220 JN										
Unknown	21.55					88 J						
Unknown	21.80	180 J										
Unknown	21.96-21.97							94 J				490 JU
(z)-9-octadecenamide	21.97								98 JN			
Dodecanamide	21.97						1200 JNU					
Hexadecanamide	21.99					150 JN						
Unknown	22.19									100 J		
Unknown hydrocarbon	22.30	150 J										
Unknown	22.31										280 J	
Unknown	22.37								140 J	250 J	350 J	110 J
Benzo(e)pyrene	23.02											
Unknown	23.15-23.17	260 J		140 J								

TABLE 5-7
PETOSKEY MANUFACTURING COMPANY SITE
SOIL SAMPLING - AUGUST 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS

Parameter	Retention Time	203S-5-7 EWP23 µg/kg	203D-0-2 EWP25 µg/kg	204S-0-2 EWP26 µg/kg	201S-0-2 EWP28 µg/kg	202S-0-2 EWP30 µg/kg	202S-5-7 EWP31 µg/kg	202S-10-12 EWP32 µg/kg	206-0.5-2.5 EWP33 µg/kg	206-2.5-4.5 EWP34 µg/kg	207-0.5-2.5 EWP35 µg/kg	207-2.5-4.5 EWP36 µg/kg
Unknown	23.65							86 J				
Unknown	23.74								81 J			
Unknown	23.85	1200 J										
Unknown	23.99											210 J
Hexanedioic acid ester	24.05-24.08	700 J	780 J	1000 J	650 J							
4-octanone	24.81											98 JN
Unknown	24.83			310 J	270 J							
Unknown hydrocarbon	24.83	290 J										
Unknown	24.85		170 J									
Unknown	24.91-24.95					270 J	140 J	77 J		82 J		
Unknown	25.63	290 J										
Unknown	25.92						120 J					
Unknown	25.96					240 J						
Unknown	26.43				310 J							
Unknown hydrocarbon	26.43	260 J										
Unknown	26.47			170 J								
Unknown	26.5		100 J									
Unknown	27.22	990 J										
9-cyclohexyltetr anthracene	27.31					150 JN						
Unknown hydrocarbon	28.03			140 J								
Unknown hydrocarbon	28.05	110 J										
Unknown	28.08				570 J							
Unknown	28.18				540 J							
Unknown	28.57					150 J						
Unknown	29.14									77 J		
Unknown	29.18					120 J						
Unknown	29.47					130 J						
Unknown	30.35-30.37				270 J	140 J						
Unknown	30.47	150 J										
Unknown	30.69									180 J		
Unknown	30.73					230 J						
Unknown	31.60	180 J										

All units are ug/kg

Sample ID indicates boring location and depth. 201S-0-2 indicates sample collected from boring SB-201S from a depth of 0 to 2 feet below ground level

A - Suspected aldol condensation product

B - Analyte was detected in the associated blank

E - Concentration exceeds the calibration range of the instrument

J - Estimated value

N - Identification based on mass spectral library search

U - Indicates that analyte was not detected at detection limit given

TABLE 5-8
PETOSKEY MANUFACTURING COMPANY SITE
SURFACE SOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

VOLATILE ORGANIC COMPOUNDS

Parameter	SS-1 µg/kg	SS-2 µg/kg	SS-3 µg/kg	SS-4 µg/kg	SS-4DUP µg/kg	SS-5 µg/kg	SS-6 µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
Acetone	<10	<12	<11	<11	<11	16	11J	1,700 [2]	15,000 [3]	42,000 [3]
Methylene chloride	11	<12	3J	4J	5J	14	9J	19,000 [2]	100 [3]	100 [3]

SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	SS-1 µg/kg	SS-2 µg/kg	SS-3 µg/kg	SS-4 µg/kg	SS-4DUP µg/kg	SS-5 µg/kg	SS-6 µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
Acenapthene	140J	270J	<350	<360	<360	<350	**6,600J**	4,300 [2]	300,000 [4]	8.7 E+5 [7]
Anthracene	140J	430	<350	<360	<360	<350	9,400J	2.2 E+6 [2]	6.9 E+6 [4]	420,000
Benzo(a)Anthracene	400	1,800	<350	170J	160J	<350	**23,000**	NLL	14,000 [11]	2.1 E+5 [11]
Benzo(a)Pyrene	420	1,300	<350	140J	150J	<350	**18,000**	NLL	1,400 [11]	21,000 [11]
Benzo(b)Fluoranthene	990	2,500	<350	330J	350J	<350	**31,000**	NLL	14,000 [11]	2.1 E+5 [11]
Benzo(g,h,i)Perylene	<340	730	<350	160J	130J	<350	12,000J	NLL	1.5 E+6 [11]	1.6 E+7 [11]
bis(2-Ethylhexyl)Phthalate	<340	<390	87J	<360	**120J**	**5,100E**	<15,000	NLL	120 [11]	120 [11]
Butylbenzylphthalate	150J	<390	<350	<360	<360	<350	<15,000	(B) [12]	2.2 E+6 [4]	5.0 E+6 [7]
Carbazole	160J	510	<350	<360	<360	<350	**7,800J**		860 [3]	19,000 [7]
Chrysene	700	1,800	<350	210J	140J	<350	23,000	NLL	1.4 E+6 [10]	2.1 E+7 [10]
Di Benzo(a,h)Anthracene	<340	340J	<350	<360	<360	<350	**7,900J**	NLL	1,400 [10]	21,000 [10]
Di-n-Butylphthalate	<340	190J	190J	190J	220J	<350	<15,000	2.4 E+5 [2]	960,000 [4]	2.7 E+6 [7]
Dibenzofuran	<340	160J	<350	<360	<360	<350	3,900J	(B) [12]	ID	ID
Fluoranthene	1,000	3,600E	<350	330J	350J	<350	**50,000**	7400 [2]	3.0 E+6 [4]	7.2 E+5 [7]
Fluorene	130J	290J	<350	<360	<360	<350	7,100J	280,000 [2]	390,000 [4]	8.9 E+5 [7]
Indeno(1,2,3-cd)Pyrene	<340	790	<350	140J	150J	<350	13,000J	NLL	14,000 [11]	2.1 E+5 [11]
Phenanthrene	120J	**2,500**	<350	150J	450	<350	**46,000**	1,100 [2]	12,000 [4]	34,000 [7]
Pyrene	800	2,300	<350	220J	140J	<350	31,000	2.2 E+5 [2]	1.8 E+6 [4]	4.7 E+5 [7]

Notes

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[3] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[4] Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[5] Site Specific Background

[6] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[7] Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[9] Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxicologist

[10] Direct Contact Values were used because parameters are not expected to leach

[11] Residential 20X DW criterion were used because parameters are expected to leach

[12] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Exceedances are bolded.

Diesel Range Organics, Gas Range Organics and Total Petroleum Hydrocarbons have no established criterion

^ Tentatively identified compounds present

* Interim value, currently under review

TABLE 5-8
PETOSKEY MANUFACTURING COMPANY SITE
SURFACE SOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

NLL - Chemical is not likely to leach under most soil conditions
IP Development of generic GSI value in process but not yet complete
ID Insufficient data for calculation
B Analyte detected in the associated blank
(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value
J Estimated value
X Indicates manual data entry
E Concentration exceeds the calibration range of the instrument
< Indicates that analyte was not detected at detection limit given

TABLE 5-9
PETOSKEY MANUFACTURING COMPANY SITE
SURFACE SOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - METALS AND CYANIDE

Parameter	MESG-01 SS-1 mg/kg	MESG-02 SS-2 mg/kg	MESG-03 SS-3 mg/kg	MESG-04 SS-4 mg/kg	MESG-05 SS-4 DUP mg/kg	MESG-06 SS-5 mg/kg	MESG-07 SS-6 mg/kg	GSI Criteria mg/kg	Residential Criteria mg/kg	Industrial Criteria mg/kg
Aluminum	3030.00	2,050 00	3,250 00	1,300.00	1,170.00	2,720 00	2,320 00	(B) [*]	14080 [*]	14080 [*]
Antimony	<2.50	<2.50	<2.50	<2 40	<2 40	<2 40	<2.40	1 [**]	4 3 [**]	4 3 [**]
Arsenic	12.00	1.70B	1.00B	1 10B	0.75B	1.20B	0.89B	10	23 [**]	23 [**]
Barium	88.50	13.20B	24.90B	12 50B	21.30B	10 90B	25.90B	120 [*]	1300 [**]	1 300 [*]
Beryllium	0 67B	0 54B	0 62B	0.50B	0 54B	0.58B	0.63B	130 [*]	51 [*]	51 [*]
Cadmium	**28.90**	<0.46	<0 45	<0 44	<0.43	<0 44	1 50	4 3 [*]	6 [**]	6 [*]
Calcium	62,000.00	13,300 00	24,700 00	16,300.00	36,700 00	3.120.00	60.500.00			
Chromium	**27.40**	**3.80**	**5.10**	**3.80**	2 20	**12.70**	**10.60**	3 4 [*]	30 [**]	30 [*]
Cobalt	1 70B	1 90B	2 00B	0 95B	0.87B	2.00B	1.00B	(B) [*]	8 [**]	8 [*]
Copper	36 60	14 70	10 50	8.20	8.60	39.00	25 00	2 900 [*]	160 000 [**]	160 000 [*]
Cyanide	**2.00**	<0.58	<0.57	<0.55	<0.54	<0 55	<0.56	0 1 [*]	4 [*]	4 [*]
Iron	7,030.00	2,970 00	4,120 00	2,000.00	2,040.00	15,300 00	3,860 00	(B) [*]	23,670 [*]	23,670 [*]
Lead	**236.00**	45 10	20 50	49.80	28.40	36.40	58 40	163 16 [*]	163 16 [*]	163 16 [*]
Magnesium	**12,300.00**	**4,330.00**	**6,620.00**	**2,810.00**	**15,900.00**	1,550.00	**11,500.00**	1 0 E+6 [*]	15,577 [*]	24 000
Manganese	142.00	165.00	202.00	50.70	64.70	95.30	105.00	(B) [12]	1,010 [*]	1,010 [*]
Mercury	<0.11	<0.12	<0.11	<0.11	<0.11	0.41	<0 11	0 0011 [2]	1 7 [**]	1 7 [*]
Nickel	26.00	10.40	7.90B	9.90	10.40	17.70	21.00	89 [2]	100 [**]	100 [*]
Potassium	212.00B	210.00B	511.00B	176.00B	158.00B	149.00B	263.00B			
Selenium	**20.70**	<0.46	<0.45	<0.44	<0.43	<0.44	<0.45	0 410 [2]	4.11 [5]	4 11 [5]
Silver	<0.23	<0.23	0.23B	0.31B	<0.21	3.70	0.29B	0.0077 [2]	4 6 [**]	13 [*]
Sodium	92 00B	53.40B	63.60B	46.20B	56.30B	32.80B	85.30B	(B) [12]	3,200 [**]	9 000
Thallium	<0 68	<0.69	<0 68	<0.66	<0 64	<0.66	<0 67	4 2 [*]	3 53 [*]	3 53 [*]
Vanadium	7 60B	5 90B	8 00B	4.10B	3.50B	8 80B	5 80B		1 000 [**]	2 900 [*]
Zinc	**10,900.00**	**2,390.00**	**993.00**	**794.00**	**1,580.00**	**19,700.00**	**9,780.00**	100 [*]	2,400 [**]	5 000 [*]

Notes

[*] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[**] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[5] Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[B] Site Specific Background

[*] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[*] *Industrial 20X DW criterion - Environmental Response* Division Operational Memorandum #14 Revision 2, June 6, 1995

[**] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[5] Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxicologist

[10] Direct Contact Values were used because parameters are not expected to leach

[11] Residential 20X DW criterion were used because parameters are expected to leach

[12] 20X GSI *Criterion - Operational Memorandum #8, Revision 4* (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Exceedances are bolded.

Diesel Range Organics, Gas Range Organics and Total Petroleum Hydrocarbons have no established criterion

^ Tentatively identified compounds present

* Interim value, currently under review

TABLE 5-9
PETOSKEY MANUFACTURING COMPANY SITE
SURFACE SOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - METALS AND CYANIDE

NLL - Chemical is not likely to leach under most soil conditions

IP - Development of generic GSI value in process but not yet complete

ID - Insufficient data for calculation

B - Analyte detected in the associated blank

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

J - Estimated value

X - Indicates manual data entry

E - Concentration exceeds the calibration range of the instrument

U - Indicates that analyte was not detected at detection limit given

TABLE 5-10
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

Parameter	SB-1 4-6' µg/kg	SB-1 14.5-16.5 µg/kg	SB-2 0-2' µg/kg	SB-2 6-9' µg/kg	SB-3 6-7' µg/kg	SB-4 0-2' µg/kg	SB-5 2-5' µg/kg	SB-5 13-15' µg/kg	SB-4 0-2' DUP µg/kg	SB-10 1-5' µg/kg	SB-10 1-5' DUP µg/kg	SB-10 5-8' µg/kg	SB-11 1-3' µg/kg	SB-11 5-8' µg/kg	SB-12 1-3' µg/kg	SB-12 4-8' µg/kg	B-1 1-3' µg/kg	B-1 7-11' µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
Methylene Chloride	11J	15	<11	<11	<11	11J	<11	5J	18	7J	7J	8J	50	11	39	21	46	6J	19,000 [1]	100 [1]	100
Acetone	17	27	<11	<11	<11	<12	<11	<11	<12	<11	<11	<11	<12	<11	12	<11	<11	<11	1,700 [5]	15,000 [1]	42,000
1,2-Dichloroethene (total)	<11	40	6J	6J	<11	<12	<11	<11	<12	<11	<11	<11	<12	<11	<11	<11	<11	<11	ID	1,400 [1]	1,400 [1]
Trichloroethene	13	**280E**	66	79	<11	23	20	53	10J	<11	<11	<11	<12	<11	<11	<11	<11	<11	4,000 [1]	100 [1]	100 [1]
Tetrachloroethene	<11	<10	<11	<11	<11	50	<11	<11	<12	<11	<11	<11	<12	<11	<11	<11	<11	<11	900 [1]	100 [1]	100 [1]
Ethylbenzene	8J	44	<11	<11	<11	<12	<11	18	<12	<11	<11	<11	<12	<11	<11	<11	<11	<11	360 [1]	1,500 [1]	1,500 [1]
Xylene (total)	10J	5J	<11	4J	<11	<12	14	240	<12	<11	<11	5J	<12	<11	<11	<11	4J	<11	700 [1]	5,600 [1]	5,600 [1]
Toluene	<11	<10	<11	<11	<11	<12	<11	<11	<12	<11	<11	6J	<12	<11	<11	<11	<11	<11	2,800 [1]	16,000 [1]	16,000 [1]

Parameter	SB-7 2-6' µg/kg	SB-7 10-14' µg/kg	SB-8 7.5-9.5' µg/kg	SB-6 4-6' µg/kg	SB-6 6-10' µg/kg	SB-8 4-8' µg/kg	SB-8 8-11' µg/kg	SB-9 2-4' µg/kg	SB-9 5-8' µg/kg	B-1 15-17' µg/kg	B-2 5-7' µg/kg	B-2 5-7' µg/kg	B-2 11-15' µg/kg	PS-12 1-6' µg/kg	PS-12 7-13' µg/kg	B-3 1-3' µg/kg	B-3 7-13.5' µg/kg	B-4 1-3' µg/kg	B-4 1-3'DUP µg/kg	B-4 9-13' µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
Methylene Chloride	12	8J	8J	6J	8J	12	17	7J	7J	26	23	6J	30	6J	4J	4J	8J	9J	9J	9J	19,000 [1]	100 [1]	100 [1]
Acetone	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	14	10J	<12	<11	<11	<11	<11	1,700 [5]	15,000 [1]	42,000 [1]
1,2-Dichloroethene (total)	<11	<11	<11	49	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<12	<11	<11	<11	<11	ID	1,400 [1]	1,400 [1]
Trichloroethene	76	55	100	78	100	62	86	10J	12	<11	<11	<11	<11	<11	<11	<12	<11	<11	<11	<11	4,000 [1]	100 [1]	100 [1]
Tetrachloroethene	<11	<11	30	<11	<11	<11	<11	<11	<11	<11	<11	<11	4J	<11	<11	<12	<11	<11	<11	<11	900 [1]	100 [1]	100 [1]
Ethylbenzene	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<12	<11	<11	<11	<11	360 [1]	1,500 [3]	1,500 [8]
Xylene (total)	<11	<11	20	<11	<11	<11	9J	<11	<11	<11	<11	<11	3J	<11	3J	<12	<11	4J	<11	<11	700 [1]	5,600 [3]	5,600 [7]
Toluene	<11	<10	<11	<11	<11	<12	7J	<11	3J	<11	<11	<11	<11	<11	<11	<12	<11	<11	<11	<11	2,800 [1]	16,000 [3]	16,000 [8]

Notes:
20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8 Revision 4 (June 5, 1995)
GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8 Revision 4 (June 5, 1995)
Residential 20X DW criterion - Operational Memorandum #8 Revision 4 (June 5, 1995)
Residential SWP DW criterion - As stated in (January 14, 1997) to Operational Memorandum #8 Revision 4 (June 5, 1995)
Site Specific background
State Background: MDEQ Operational Memorandum #16 Default Type A Cleanup Criteria September 30, 1993
Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2 June 6, 1995
Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2 June 6, 1995
Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxicologist
Direct Contact Values were used because parameters are not expected to leach
Residential 20X DW criterion were used because parameters are expected to leach
20X GSI Criterion - Operational Memorandum #8 Revision 4 (June 5, 1995)
Industrial DC Value and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values
A blank cell indicates no criterion for that parameter
Exceedances are bolded.
Diesel Range Organics, Gas Range Organics and Total Petroleum Hydrocarbons have no established criterion
Tentatively identified compounds present
Interim value - currently under review
LL - Chemicals not likely to leach under most soil conditions
P - Development of generic GSI value in process but not yet complete
ID - Insufficient data for calculation
B - Analyte detected in the associated blank
(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value
J - Estimated value
E - Indicates manual data entry
E - Concentration exceeds the calibration range of the instrument
U - Indicates that analyte was not detected at detection limit given
Data not broken down into isomers so the most conservative criteria was used which is cis
Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria

TABLE 5-11
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - SEMIVOLATILE ORGANIC COMPOUNDS

Parameter	SB-1 4-6' µg/kg	SB-1 14.5-16.5' µg/kg	SB-2 0-2' µg/kg	SB-2 6-9' µg/kg	SB-3 6-7' µg/kg	SB-4 0-2' µg/kg	SB-4 2-6' µg/kg	SB-4 0-2'DUP µg/kg	SB-5 2-5' µg/kg	SB-5 2-5'DL µg/kg	SB-5 10-13' µg/kg	SB-6 4-6' µg/kg	SB-6 6-10' µg/kg	SB-7 2-6' µg/kg	SB-7 10-14' µg/kg	SB-9 2-4' µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/kg
Acenaphthylene	<350	<340	<350	<360	<350	<410	<370	<390	<370	<730	<350	<8,900	<350	<370	<350	<360	(B) [1]	5,20 [2]	8,500 [3]
Acenaphthene	<350	<340	<350	<360	<350	<410	<370	350J	<370	<730	<350	<3,700	<350	<370	<350	340J	4,300 [1]	300,000 [2]	4.7 E+5 [3]
Anthracene	<350	<340	<350	<360	<350	<410	<370	500	<370	<730	<350	<3,700	<350	<370	<350	490	2.2 E+6 [1]	2.9 E+6 [2]	400,000 [3]
Benzo(a)Anthracene	<350	<340	<350	<360	<350	140J	<370	1,100	190J	<730	<350	<3,700	<350	<370	<350	830	NLL	14,000 [2]	2.1 E+5 [3]
Benzo(a)Pyrene	<350	<340	<350	<360	<350	240J	<370	600	220J	<730	<350	<3,700	<350	<370	<350	560	NLL	1,400 [2]	21,000 [3]
Benzo(b)Fluoranthene	<350	<340	<350	<360	<350	310J	<370	1,900	360J	360DJ	<350	<3,700	<350	<370	<350	1,200	NLL	14,000 [2]	2.1 E+5 [3]
Benzo(g,h,i)Perylene	<350	<340	<350	<360	<350	<410	<370	590	190J	<730	<350	<3,700	<350	<370	<350	260J	NLL	1.5 E+6 [2]	1.5 E+7 [3]
Benzo(k)fluoranthene	<350	<340	<350	<360	<350	<410	<370	<390	<370	<730	<350	<3,700	<350	<370	<350	<360	NLL	1.4 E+5 [2]	2.1 E+6 [3]
bis(2-Ethylhexyl)Phthalate	**640**	**1,800**	440BU	<360	<350	<410	<370	<390	**4,300BE**	**2,900D**	<470B	<3,700	<350	<370	<350	<360	NLL	120 [2]	120 [3]
Butylbenzylphthalate	<350	<340	<350	<360	<350	140J	<370	550	<370	<730	<350	<3,700	<350	<370	<350	<360	(B) [1]	2.2 E+5 [2]	5.0 E+6 [3]
Carbazole	<350	<340	<350	<360	<350	<410	<370	390J	<370	<730	<350	<3,700	<350	<370	<350	350J		860 [2]	19,000 [3]
Chrysene	<350	<340	<350	<360	<350	180J	<370	1,200	250J	280DJ	<350	<3,700	<350	<370	<350	730	NLL	1.4 E+6 [2]	2.1 E+7 [3]
Di-N-Butylphthalate	130J	82J	<350	<360	<350	360J	<370	<390	110J	<730	<350	<3,700	<350	<370	<350	<360BJ	2.4 E+5 [1]	960,000 [2]	2.7 E+6 [3]
Di-n-Octyl Phthalate	<350	<340	3,200E	<360	<350	<410	<370	<390	<370	<730	<350	<3,700	<350	<370	<350	<360	(B) [1]	1.0 E+8 [2]	2.9 E+8 [3]
Dibenzo(a,h)Anthracene	<350	<340	<350	<360	<350	<410	<370	310J	190J	<730	<350	<3,700	<350	<370	<350	130J	NLL	1,400 [2]	21,000 [3]
Dibenzofuran	<350	<340	<350	<360	<350	<410	<370	210J	<370	<730	<350	<3,700	<350	<370	<350	250J	(B) [1]	ID	ID
Fluoranthene	<350	<340	<350	<360	<840	220J	<370	2,600	440	390DJ	<350	<3,700	<350	<370	<350	1,800	NLL	3.0 E+6 [2]	7.2 E+5 [3]
Fluorene	<350	<340	<350	<360	<350	<410	<370	350J	<370	<730	<350	<3,700	<350	<370	<350	410	(B) [1]	390,000 [2]	8.9 E+5 [3]
Indeno(1,2,3-cd)Pyrene	<350	<340	<350	<360	<350	<410	<370	680	190J	<730	<350	<3,700	<350	<370	<350	300J	(B) [1]	14,000 [2]	2.1 E+5 [3]
Naphthalene	<350	<340	<350	<360	<350	<410	<370	<390	<370	<730	<350	<3,700	<350	<370	<350	120J	850 [1]	17,000 [2]	50,000 [3]
Phenanthrene	<350	<340	<350	<360	<350	<410	<370	**2,300**	270J	260DJ	<350	<3,700	<350	<370	<350	**2,000**	1,100 [1]	12,000 [2]	34,000 [3]
Pyrene	<350	<340	<350	<360	<350	150J	<370	1,500	260J	270DJ	<350	<3,700	<350	<370	<350	1,200	2.2 E+5 [1]	1.5 E+6 [2]	4.1 E+6 [3]

Notes:

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[3] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[4] Residential SWP DW criterion - Amended (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[5] Site Specific Background

[6] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[7] Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June

[9] Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxicologist

Direct Contact Values were used because parameters are not expected to leach

Residential 20X DW criterion were used because parameters are expected to leach

[10] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Exceedances are bolded.

Diesel Range Organics, Gas Range Organics and Total Petroleum Hydrocarbons have no established criterion

^ Tentatively identified compounds present

* Interim value, currently under review

NLL - Chemical is not likely to leach under most soil conditions

IP - Development of generic GSI value in process but not yet complete

D - Insufficient data for calculation

B - Analyte detected in the associated blank

(B) - Chemical has either not been evaluated for human health effects or the available information is of a poor quality for the

J - Estimated value

X - Indicates manual data entry

E - Concentration exceeds the calibration range of the instrument

< - Indicates that analyte was not detected at detection limit given

[11] Data not broken down into isomers as the most conservative criteria was used, which is 2,3

Chemical may be present in several isomer forms. Isomer specific concentrations must be summed for comparison to criteria

TABLE 5-11
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - SEMIVOLATILE ORGANIC COMPOUNDS

Parameter	SB-9 5-8' µg/kg	SB-10 1-5' µg/kg	SB-10 1-5'DUP µg/kg	SB-6 11-17' µg/kg	SB-8 4-8' µg/kg	SB-8 8-11' µg/kg	B-3 1-3' µg/kg	B-3 1-3'DL µg/kg	B-3 7-13.5' µg/kg	B-4 1-3' µg/kg	B-4 1-3'DUP µg/kg	B-4 9-13' µg/kg	SB-10 1-5'DUP µg/kg	SB-10 5-8' µg/kg	SB-11 1-3 µg/kg	SB-11 5-8' µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/l
Acenapthylene	<350	<350	<370	<3,700	<360	<360	**730**	380DJ	<360	<360	<370	<360	<370	<350	<390	<360	{B}	500	[illegible]
Acenapthene	350	<350	<370	<3,700	<360	<360	<380	<770	<360	<360	<370	<360	<370	<350	<390	<360	4,300	300,000	[illegible]
Anthracene	<350	170J	<370	<3,700	<360	<360	260J	230DJ	<360	<360	260J	<360	<370	<350	<390	<360	2.2 E+6	[illegible]	[illegible]
Benzo(a)Anthracene	<350	600	<370	<3,700	<360	<360	2,000	1,400D	<360	160J	1,200	<360	<370	<350	180J	<360	NLL	[illegible]	[illegible]
Benzo(a)Pyrene	<350	460	<370	<3,700	<360	<360	2,400	**1,400D**	<360	190J	1,100	<360	<370	<350	130J	<360	NLL	[illegible]	[illegible]
Benzo(b)Fluoranthene	<350	730	190J	<3,700	<360	<360	4,000E	3,600D	<360	400	2,200	<360	190J	<350	270J	<360	NLL	[illegible]	[illegible]
Benzo(g,h,i)Perylene	<350	260J	<370	<3,700	<360	<360	2,500	2,700D	<360	<360	320J	<360	<370	<350	150J	<360	NLL	[illegible]	[illegible]
Benzo(k)Fluoranthene	<350	<350	<370	<3,700	<360	<360	<380	<770	<360	<360	<370	<360	<370	<350	<390	<360	NLL	[illegible]	[illegible]
bis(2-Ethylhexyl)Phthalate	<350	<350	<370	<3,700	<360	<360	100J	<770	<360	<360	<370	<360	<370	<350	<390	<360	NLL	[illegible]	[illegible]
Butylbenzylphthalate	<350	<350	<370	<3,700	<360	<360	<380	<770	<360	<360	<370	<360	<370	<350	<390	<360	{B}	[illegible]	[illegible]
Carbazole	<350	<350	<370	<3,700	<360	<360	250J	<770	<360	<360	<370	<360	<370	<350	<390	<360		[illegible]	[illegible]
Chrysene	<350	400	<370	<3,700	<360	<360	2,200	1,600D	<360	240J	1,100	<360	<370	<350	120J	<360	NLL	1.4 E+6	2.1 E+7
Di-N-Butylphthalate	<350BJ	<35BJ	<370 BJ	<3,700	<360BJ	<360	88J	<770	<360	<360	<370	<360	350BJ	<350	<390	<360	2.4 E+5	960,000	2.7 E+6
Di-n-Octyl Phthalate	<350	<350	<370	<3,700	<360	<360	<380	<770	<360	<360	<370	<360	<370	<350	<390	<360	{B}	1.0 E+8	2.9 E+8
Dibenzo(a,h)Anthracene	<350	110J	<370	<3,700	<360	<360	670	540DJ	<360	<360	120J	<360	<370	<350	<390	<360	NLL	1,400	21,000
Dibenzofuran	<350	<350	<370	<3,700	<360	<360	<380	<770	<360	<360	<370	<360	<370	<350	<390	<360	{B}	ID	ID
Fluoranthene	<350	880	160J	<3,700	<360	<360	1,600	2,200D	<360	260J	2,300	<360	160J	<350	260J	<360	NLL	3.0 E+6	7.2 E+5
Fluorene	<350	<350	<370	<3,700	<360	<360	120J	<770	<360	<360	<370	<360	<370	<350	<390	<360	{B}	390,000	8.9 E+5
Indeno(1,2,3-cd)Pyrene	<350	310J	<370	<3,700	<360	<360	2,400	2,300D	<360	140J	350J	<360	<370	<350	130J	<360	{B}	14,000	2.1 E+5
Napthalene	<350	<350	<370	<3,700	<360	<360	<380	<770	<360	<360	<370	<360	<370	<350	<390	<360	850	17,000	50,000
Phenanthrene	<350	370	<370	<3,700	<360	<360	**1,100**	880D	<360	<360	580	<360	[illegible]	<350	<390	<360	1,100	[illegible]	[illegible]
Pyrene	<350	680	<370	<3,700	<360	<360	2,200	1,800D	<360	220J	1,700	<360	[illegible]	<350	260J	<360	[illegible]	[illegible]	[illegible]

Notes

20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)
GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)
Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)
Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)
Site Specific Background
State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993
Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995
Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June
Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxologist
Direct Contact Values were used because parameters are not expected to leach
Residential 20X DW criterion were used because parameters are expected to leach
20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

ID - Insufficient data for calculation
B - Analyte detected in the associated blank
{B} - Chemical has either not been evaluated or an inadequate data base [illegible]
J - Estimated value
X - Indicates manual data entry
E - Concentration exceeds the calibration range of the instrument
< - Indicates that analyte was not detected at detection limit given
Data not broken down into isomers so the most conservative criteria was used [illegible]
Chemical may be present in several isomer forms. Isomer specific concentrations must be [illegible] comparison to criteria

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Exceedances are bolded.

Diesel Range Organics, Gas Range Organics and Total Petroleum Hydrocarbons have no established criterion

^ Tentatively identified compounds present

* Interim value, currently under review

NLL - *Chemical is not likely to leach under most soil conditions*

IP - Development of generic GSI value in process but not yet complete

TABLE 5-11
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - SEMIVOLATILE ORGANIC COMPOUNDS

Parameter	SB-12 1-3' µg/kg	SB-12 4-8' µg/kg	B1 1-3' µg/kg	B-1 7-11' µg/kg	B1 15-17' µg/kg	B2 1-3' µg/kg	B2 5-7' µg/kg	B2 11-15' µg/kg	PS-12 1-6' µg/kg	PS-12 7-13' µg/kg	GSI Criteria µg/kg	Residential Criteria µg/kg	Industrial Criteria µg/l
Acenapthylene	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	(B) [12]	520 [3]	8,500 [9]
Acenapthene	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	4,300 [2]	300,000 [4]	8.7 E+5 [5]
Anthracene	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	2.2 E+6 [12]	6.9 E+6 [4]	420,000 [7]
Benzo(a)Anthracene	190J	320J	750	<350	<370	170J	<350	<370	<360	<350	NLL	14,000 [10]	2.1 E+5 [10]
Benzo(a)Pyrene	200J	350J	690J	<350	<370	150J	<350	<370	<360	<350	NLL	1,400 [10]	21,000 [10]
Benzo(b)Fluoranthene	430	830	1,400	<350	<370	330J	<350	<370	<360	<350	NLL	14,000 [10]	2.1 E+5 [10]
Benzo(g,h,i)Perylene	170J	220J	410J	<350	<370	180J	<350	<370	<360	<350	NLL	1.5 E+6 [10]	1.6 E+7 [10]
Benzo(k)Fluoranthene	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	NLL	1.6 E+5 [10]	2.1 E+6 [10]
bis(2-Ethylhexyl)Phthalate	<370	99J	<710	<350BJ	<370	74J	<350	<370	90J	110J	NLL	120 [3]	120 [7]
Butylbenzylphthalate	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	(B) [12]	2.2 E+6 [4]	5.0 E+6 [7]
Carbazole	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350		860 [3]	19,000 [7]
Chrysene	220J	410	710	<350	<370	160J	<350	<370	<360	<350	NLL	1.4 E+6 [10]	2.1 E+7 [7]
Di-N-Butylphthalate	<370	<370	<710	<350BJ	<370BJ	<350BJ	<350BJ	<370BJ	<360	<350	2.4 E+5 [12]	960,000 [4]	2.7 E+6 [9]
Di-n-Octyl Phthalate	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	(B) [12]	1.0 E+8 [4]	2.9 E+8 [9]
Dibenzo(a,h)Anthracene	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	NLL	1,400 [10]	21,000 [10]
Dibenzofuran	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	(B) [12]	ID	ID
Fluoranthene	350J	570	1,400	<350	<370	220J	<350	<370	<360	<350	NLL	3.0 E+6 [4]	7.2 E+5 [9]
Fluorene	<370	<370	<710	<350	<370	<350	<350	<370	<360	<350	(B) [12]	390,000 [4]	8.9 E+5 [9]
Indeno(1,2,3-cd)Pyrene	200J	260J	320J	<350	<370	180J	<350	<370	<360	<350	(B) [12]	14,000 [10]	2.1 E+5 [10]
Napthalene	<370	<370	<710	<350	<370	<350	<350	<350	<360	<350	850 [2]	17,000 [4]	50,000 [9]
Phenanthrene	180J	<370	<710	<350	<370	<350	<350	<370	<360	<350	1,100 [2]	12,000	34,000 [9]
Pyrene	300J	460	1,100	<350	<370	190J	<350	<370	<360	<350	2.2 E+5 [12]	1.8 E+6	4.7 E+5 [7]

Notes:

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)
[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)
[3] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)
[4] Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)
[5] Site Specific Background
[6] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993
[7] Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995
[8] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995
[9] Industial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxologist
[10] Direct Contact Values were used because parameters are not expected to leach.
[11] Residential 20X DW criterion were used because parameters are expected to leach.
[12] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

ID - Insufficient data for calculation
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* Data not broken down into isomers so the most conservative criteria was used, which is cis
' Chemical may be present in several isomer forms. Isomer specific concentrations must be comp
comparison to criteria

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values
A blank cell indicates no criterion for that parameter
Exceedances are bolded.
Diesel Range Organics, Gas Range Organics and Total Petroleum Hydrocarbons have no established criterion.
^ Tentatively identified compounds present.
* Interim value, currently under review
NLL - Chemical is not likely to leach under most soil conditions
IP - Development of generic GSI value in process but not yet complete.

TABLE 5-12
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - INORGANICS

Parameter	MESG-08 SB-1 4-6' 9/16/92 mg/kg	MESG-09 SB-1 14.5-16.5' 9/16/92 mg/kg	MESG-10 SB-2 0-2' 9/16/92 mg/kg	MESG-11 SB-2 6-9' 9/16/92 mg/kg	MESG-12 SB-3 6-7' 9/16/92 mg/kg	MESG-13 SB-4 0-2' 9/16/92 mg/kg	MESG-14 SB-5 2-5' 9/17/92 mg/kg	MESG-15 SB-5 10-13' 9/17/92 mg/kg	MESG-17 SB-4 0-2' DUP 9/17/92 mg/kg	MESG-18 SB-7 2-6' 9/17/92 mg/kg	MESG-19 SB-7 10-14' 9/17/92 mg/kg	MESG-20 SB-4 2-6' 9/16/92 mg/kg	MESG-23 SB-6 6-10' 9/17/92 mg/kg	GSI Criteria mg/kg	Residential Criteria mg/kg	Industrial Criteria mg/kg
Aluminum	2,360.00	1,980.00	1,200.00	2,590.00	3,270.00	3,290.00	3,500.00	2,260.00	3,380.00	2,560.00	4,590.00	1,850.00	1,500.00	(B) [1]	14,080 [2]	14,080 [2]
Antimony	<12.30	<12.10	<2.30	<2.40	**2.80B**	<2.70	<2.50	**13.10B**	<2.60	<2.50	<11.70	<4.80	<12.00	0.001 [1]	4.3 [2]	4.3 [2]
Arsenic	1.60B	0.95B	0.70B	0.91B	1.10B	3.40	2.90	0.93B	2.90	1.40B	0.94B	1.40B	1.60B	ID	23 [2]	23 [2]
Barium	11.40B	7.70B	4.30B	11.10B	26.90B	79.50	32.50B	8.70B	63.00	17.90B	17.50B	9.70B	6.40B	120 [1]	1,300 [2]	1,300 [2]
Beryllium	2.30B	2.30B	0.52B	0.76B	0.60B	0.73B	0.74B	2.30B	0.72B	0.78B	2.50B	1.20B	2.20B	130 [1]	51 [2]	51 [2]
Cadmium	<2.20	<2.20	<0.42	<0.44	<0.45	**8.50**	**4.40**	<2.10	4.20	<0.45	<2.10	<0.87	<2.20	4.3 [1]	6 [2]	6 [2]
Calcium	243,000.00	314,000.00	46,000.00	146,000.00	23,100.00	53,200.00	79,700.00	294,000.00	55,100.00	174,000.00	293,000.00	217,000.00	280,000.00			
Chromium	<2.20	<2.20	1.20B	1.10B	**5.40**	**6.10**	**19.80**	<2.10	**5.50**	<0.45	<2.10	<0.87	<2.20	3.4 [1]	30 [2]	30 [2]
Cobalt	2.50B	<2.20	0.76B	2.00B	1.70B	1.70B	2.20B	3.00B	1.40B	1.40B	<2.10	1.80B	<2.20	(B) [1]	8 [2]	8 [2]
Copper	7.80B	6.90B	3.90B	9.00	8.30	19.80	11.40	8.70B	23.80	7.10	6.70B	11.50	7.50B	2,400 [1]	160,000 [2]	160,000 [2]
Iron	3,870.00	2,640.00	2,310.00	4,770.00	4,770.00	4,370.00	5,430.00	3,530.00	4,270.00	5,090.00	3,380.00	4,450.00	3,580.00	(B) [1]	23,670 [2]	23,670 [2]
Lead	4.50	2.10	1.60	9.60	13.10	109.00	**185.00**	1.20	125.00	19.00	1.60	2.10	2.10	163.16 [1]	163.16 [2]	163.16 [2]
Magnesium	**6,230.00**	**20,200.00**	**6,170.00**	**15,400.00**	**5,840.00**	**6,860.00**	**21,800.00**	**15,000.00**	**7,890.00**	**12,100.00**	**22,100.00**	**54,900.00**	**22,300.00**	1,000 [1]	15,577 [2]	24,000 [2]
Manganese	202.00	191.00	54.10	159.00	111.00	180.00	203.00	183.00	154.00	215.00	227.00	258.00	226.00	(B) [1]	1,010 [2]	1,010 [2]
Mercury	<0.11	<0.11	<0.11	<0.11	<0.11	<0.12	**0.20**	<0.11	0.12	<0.11	<0.11	<0.11	<0.11	0.0011 [4]	1.7 [3] [4]	1.7 [3] [4]
Nickel	<8.90	<8.80	3.90B	9.70	7.70B	11.30	11.90	<8.50	12.30	7.70B	<8.50	9.10	9.40B^	89 [1]	100 [3] [4]	100 [3] [4]
Potassium	1,450.00B	1,170.00B	226.00B	817.00B	590.00B	392.00B	725.00B	1,280.00B	446.00B	769.00B	2,320.00B	1,090.00B	1,090.00B			
Selenium	<2.20	<0.44	<0.42	<0.44	<0.45	**1.10B**	**0.58B**	<0.42	**0.90B**	<0.45W	<0.43	<0.44	<0.65	0.410 [1]	4.11 [2]	4.11 [2]
Silver	<1.10	<1.10	<0.21	<0.22	<0.22	<0.24	<0.22	<1.10	<0.24	<0.22	<1.10	<0.44	<1.10	0.0072 [1]	4.6 [3] [4]	4.6 [3] [4]
Sodium	327.00B	221.00B	54.70B	144.00B	56.40B	77.40B	121.00B	235.00B	110.00B	171.00B	292.00B	184.00B	204.00B	(B) [1]	3,200 [3] [4]	4,200 [3] [4]
Thallium	<0.67	<0.66	<0.63	<0.66	<0.67	<0.73	<0.67	<0.63	<0.71	<0.67W	<0.65	<0.65	<0.65	4.2 [1]	3.83 [2]	3.83 [2]
Vanadium	4.10B	3.70B	1.00B	7.80B	9.20B	8.70B	9.40B	8.60B	8.00B	9.20B	10.10B	5.60B	4.90B		1,200 [3] [4]	1,200 [3] [4]
Zinc	134.00	18.60B	9.30	17.80	48.50	**3,750.00**	**580.00**	20.10B	**3,390.00**	96.60	16.40B	56.40	17.10B	190 [1]	2,400 [3] [4]	2,400 [3] [4]
Cyanide	<0.56	<0.55	<0.53	<0.55	<0.56	**2.40**	<0.56	<0.53	**1.80**	<0.56	<0.53	<0.55	<0.54	0.1 [1]	4 [2]	4 [2]

Notes

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[3] Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[4] Site Specific Background

[5] State Background. MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[6] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[7] Industrial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxologist

Direct Contact Values were used because parameters are not expected to leach.

Residential 20X DW criterion were used because parameters are expected to leach

[8] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Industrial DCV and Residential DCV columns were not included in this table because none of the Maximum Detection Values exceeded those values

A blank cell indicates no criterion for that parameter

Exceedances are bolded.

^ Tentatively identified compounds present

TABLE 5-12
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - INORGANICS

* Interim value, currently under review
NLL - Chemical is not likely to leach under most soil conditions
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comparison to criteria

TABLE 5-12
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - INORGANICS

Parameter	MESG-25 SB-6 0-2' 9/18/92 mg/kg	MESG-26 SB-8 4-8' 9/18/92 mg/kg	MESG-27 SB-8 8-11' 9/18/92 mg/kg	MESG-28 SB-9 2-4' 9/21/92 mg/kg	MESG-29 SB-9 5-8' 9/21/92 mg/kg	MESG-30 SB-10 1-5' 9/21/92 mg/kg	MESG-31 SB-10 1-5' DUP 9/21/92 mg/kg	MESG-32 SB-10 5-8' 9/21/92 mg/kg	MESG-33 SB-11 1-3' 9/21/92 mg/kg	MESG-35 SB-12 1-3' 9/21/92 mg/kg	MESG-36 SB-12 4-8' 9/21/92 mg/kg	MESG-37 B1 1-3' 9/22/92 mg/kg	MESG-38 B1 7-11' 9/22/92 mg/kg	GSI Criteria mg/kg	Residential Criteria mg/kg	Industrial Criteria mg/kg
Aluminum	2,780.00	1,320.00	1,430.00	2,440.00	2,920.00	3,320.00	902.00	2,570.00	6,090.00	3,040.00	1,720.00	2,440.00	1,530.00	(B) [7]	14,080 [7]	14,080 [7]
Antimony	<2.60	<12.00	<12.40	<2.40	<11.70	<2.50	**14.20B**	**15.00B**	<3.00	<2.50	<11.60	<2.40	<2.40N*	0.001 [7]	4.3 [7,**]	4.3 [7]
Arsenic	1.90B	0.83B	0.95B	1.60B	0.85B	4.40	1.10B	1.30B	14.00	2.20B	0.93B	1.30B	<0.65W	ID	23 [7,**]	23 [7]
Barium	58.70	5.80B	6.20B	14.10B	11.40B	85.30	5.10B	9.10B	**305.00**	25.60B	7.70B	32.70B	8.70B	120 [7]	1,300 [7,*]	1,300 [7]
Beryllium	0.65B	2.20B	2.40B	0.86B	2.30B	0.92B	2.20B	2.40B	1.20B	0.88B	2.10B	0.73B	0.51B	130 [7]	51 [7,*]	51 [7]
Cadmium	0.77B	<2.20	<2.30	<0.44	<2.10	<0.45	<2.10	<2.10	0.75B	<0.45	<2.10	<0.44	<0.43	4.3 [7]	6 [7,**]	6 [7]
Calcium	41,700.00	283,000.00	320,000.00	186,000.00	325,000.00	79,800.00	258,000.00	248,000.00	46,100.00	154,000.00	232,000.00	71,700.00	196,000.00			
Chromium	**8.40**	<2.20	<2.30	<0.44	<2.10	2.60	<2.10	<2.10	**9.40**	1.60B	<2.10	2.70	<0.43	3.4 [7]	30 [7,*]	30 [7]
Cobalt	1.50B	<2.20	<2.30	1.40B	<2.10	2.10B	<2.10	2.50B	3.50B	1.60B	<2.10	1.20B	0.69B	(B)	(B)	(B)
Copper	23.10	5.70B	6.10B	7.90	5.50B	13.10	3.40B	8.70B	25.20	10.40	5.80B	14.80	2.90B	2,400 [7]	160,000 [7,**]	160,000
Iron	3,890.00	3,390.00	2,970.00	4,560.00	2,710.00	4,810.00	2,290.00	4,000.00	7,710.00	5,010.00	4,290.00	4,690.00	2,190.00E	(B) [7]	23,670 [7]	23,670 [7]
Lead	132.00	1.50	1.40	35.00	4.30	92.90	2.50	2.60	**199.20**	85.60	5.70	44.10	2.30	163.16 [7]	163.16 [7]	163.16 [7]
Magnesium	**5,050.00**	**21,700.00**	**22,000.00**	**30,900.00**	**19,900.00***	**19,200.00**	**23,000.00**	**24,200.00**	**3,310.00**	**17,000.00**	**36,600.00***	**5,170.00**	**27,300.00***	1,000 [7]	15,577 [7]	24,000
Manganese	145.00	218.00	224.00	205.00	238.00	293.00	187.00	190.00	274.00	247.00	174.00	155.00	179.00E	(B) [7]	1,010 [7]	1,010 [7]
Mercury	**0.12**	<0.11	<0.11	<0.11	<0.11	<0.11	**0.20**	<0.11	**0.15**	<0.11	<0.11	<0.11	<0.11	0.0011 [7]	1.7 [7,**]	1.7 [7]
Nickel	22.90	<8.80	<9.00	10.00	<8.50	10.60	<8.50	12.20B	13.70	8.50B	<8.40	7.90B	5.90B*	89 [7]	100 [7,**]	100 [7]
Potassium	391.00B	859.00B	988.00B	887.00B	1,720.00B	536.00B	443.00B	1,320.00B	805.00B	627.00B	56.00B	450.00B	748.00B			
Selenium	<0.47	<0.66	<0.68	<0.66	<0.64N	<0.67	<0.64	<0.63	**0.95B**	<0.68	<0.63	<0.66	<0.65WN	0.410 [7]	4.11 [7]	4.11 [7]
Silver	<0.24	<1.10	<1.10	<0.22	<1.10	<0.22	<1.10	<1.10	<0.27	<0.23	<1.10	<0.22	<0.22N	0.0077 [7]	4.6 [7,*]	13 [7]
Sodium	78.30B	218.00B	240.00B	195.00B	287.00B	253.00B	186.00B	236.00B	419.00B	167.00B	155.00B	129.00B	196.00B	(B) [7]	3,200 [7,**]	9,000
Thallium	<0.71	<0.66	<0.68	<0.66	<0.64	<0.67	<0.64	<0.63	<0.82	<0.68	<0.63	<0.66	<0.65WN	4.2 [7]	5.63 [7,*]	5.63 [7]
Vanadium	6.30B	5.60B	7.50B	6.70B	8.20B	12.40	5.80B	7.70B	16.80	8.30B	8.00B	7.70B	5.40B		1,200 [7,*]	1,200 [7]
Zinc	**2,940.00**	16.80B	13.70B	157.20	24.90	**211.00**	10.70B	33.0	**311.00**	**379.00**	24.10	95.50	2.20E	190 [7]	2,300 [7,*]	600 [7]
Cyanide	<0.59	<0.55	<0.56	<0.55	<0.53	<0.56	<0.53	<0.53	<0.68	<0.56	<0.53	<0.55	<0.54N	0.4 [7]	4 [7]	4 [7]

Notes

[1] 20X GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[2] GSI SWP criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[3] Residential 20X DW criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

[4] Residential SWP DW criterion - Addenda (January 17, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[5] Site Specific Background

[6] State Background. MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993
Industrial 20X DW criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[9] Industial SWP DW Criterion - Draft numbers received on December 3, 1997 from MDEQ staff toxologist

[10] Direct Contact Values were used because parameters are not expected to leach

[11] Residential 20X DW criterion were used because parameters are expected to leach

[12] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

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^ Tentatively identified compounds present

TABLE 5-12
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - INORGANICS

* Interim value, currently under review
NLL - Chemical is not likely to leach under most soil conditions
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ID - Insufficient data for calculation
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comparison to criteria

TABLE 5-12
PETOSKEY MANUFACTURING COMPANY SITE
SUBSOIL SAMPLING - SEPTEMBER 1992
ANALYTICAL DATA - INORGANICS

Parameter	MESG-39 B1 15-17' 9/22/92 mg/kg	MESG-40 B2 1-3' 9/22/92 mg/kg	MESG-41 B-2 5-7' 9/22/92 mg/kg	MESG-42 B2 11-15' 9/22/92 mg/kg	MESG-43 PS-12 1-6' 9/22/92 mg/kg	MESG-44 PS-12 7-13' 9/22/92 mg/kg	MESG-45 B3 1-3' 9/24/92 mg/kg	MESG-46 B3 7-13.5' 9/24/92 mg/kg	MESG-47 B4 1-3' 9/24/92 mg/kg	MESG-48 B4 1-3' DUP 9/24/92 mg/kg	MESG-49 B-4 9-13' 9/24/92 mg/kg	GSI Criteria mg/kg	Residential Criteria mg/kg	Industrial Criteria mg/kg
Aluminum	1,310.00	1,950.00	993.00	1,290.00	1,710.00	761.00	2,850.00	2,590.00	2,320.00	2,720.00	2,400.00	(B) [1]	14,080 [3]	14,080 [5]
Antimony	**15.40BN***	<2.40	<2.30	<12.20	<2.40	<11.60	<2.50	**6.60B**	<2.46N	<2.40	<5.00	0.001 [1]	4.3 [3,**]	4.3 [5]
Arsenic	1.10B	0.99B	<0.63	0.88B	<0.65	0.99B	1.40B	1.90B	1.10B	1.30B	0.68B	ID	23 [3,**]	23 [5]
Barium	15.80B	**527.00**	4.20B	9.20B	11.40B	4.50B	40.90B	12.10B	19.80B	31.60B	12.50B	120 [1]	1,300 [3,**]	1,300 [5]
Beryllium	2.30B	0.56B	0.63B	2.20B	0.46B	2.30B	0.62B	<0.46	0.24B	0.24B	<0.45	130 [1]	51 [3]	51 [5]
Cadmium	<2.30	<0.44	<0.42	<2.20	<0.43	<2.10	<0.45	<0.91	<0.44	<0.44	<0.91	4.3 [1]	6 [3,**]	6 [5]
Calcium	280,000.00	22,300.00	147,000.00	299,000.00	8,850.00	327,000.00	44,100.00	290,000.00	47,100.00	48,000.00	236,000.00			
Chromium	<2.30	**4.20**	<0.42	<2.20	3.10	<2.10	**4.00**	<0.91	**3.50**	**4.00**	<0.91	3.4 [1]	30 [3,**]	30 [5]
Cobalt	<2.30	1.20B	0.49B	<2.20	0.62B	<2.10	1.40B	2.40B	1.90B	1.40B	1.40B	(B) [1]	8 [3]	8 [5]
Copper	7.40B	7.00	3.90B	8.30B	2.60B	4.90B	12.70	5.50B	15.70	19.00	4.80B	2,400 [1]	160,000 [3,**]	160,000 [5]
Iron	3,140.00E	2,910.00	2,070.00	3,050.00	2,540.00	1,960.00	3,950.00	4,110.00	4,400.00	3,610.00	3,670.00	(B) [1]	23,670 [3]	23,670 [5]
Lead	2.40	36.90	3.30	1.90	7.30	2.20	6.30	2.00	81.30	122.00	3.30	163.16 [2]	163.16 [3]	163.16 [5]
Magnesium	**24,400.00***	**3,230.00**	**11,700.00***	**15,100.00***	**2,750.00**	**11,500.00**	**5,230.00**	**11,200.00***	**5,220.00**	**4,250.00**	**31,900.00**	1,000 [1,2]	15,577 [3]	24,000 [5]
Manganese	325.00	159.00	113.00	229.00	110.00	201.00	137.00	281.00	137.00	103.00	265.00	(B) [1,7]	1,010 [3]	1,010 [5]
Mercury	<0.12	<0.11	<0.10	<0.11	<0.11	<0.11	**0.17**	<0.11	<0.11	0.33	<0.11	0.0011 [2]	1.7 [3,**]	1.7 [5]
Nickel	<9.20*	4.80B	5.30B	8.80	4.80B	<8.40	6.90B	5.40B	3.90B	4.30B	4.70B	89 [2]	100 [4,**]	100 [5]
Potassium	1,220.00B	267.00B	381.00B	605.00B	124.00B	911.00B	320.00B	1,520.00	342.00B	350.00B	1,090.00B			
Selenium	<0.69WN	<0.66	<0.63	<0.66	<0.65	<0.63	<0.68	<0.23	<0.22	<0.22	<0.23	0.410 [1]	4.11 [3]	4.11 [5]
Silver	<1.20N	<0.22	<0.21	<1.10	<0.22	<1.10	<0.23	<0.46	<0.22	<0.22	<0.45	0.0077 [1]	4.6 [3,*]	13 [5]
Sodium	252.00B	64.30B	179.00B	220.00B	69.90B	225.00B	62.10B	252.00B	82.70B	83.80B	184.00B	(B) [1]	3,200 [1,*]	9,000 [5]
Thallium	<0.69N	<0.66	<0.63	<0.66	<0.65	<0.63	<0.68	<0.23	<0.22	<0.22	<0.23	4.2 [1]	3.53 [3]	3.53 [5]
Vanadium	6.90B	5.20B	3.50B	7.40B	4.30B	4.40B	7.20B	10.50B	8.40B	6.90B	8.80B		1,000 [1,*]	2,900 [5]
Zinc	21.90BE	**355.00**	6.10	13.20B	12.00	10.70B	83.30	10.90	178.00	176.00	12.10	190 [1]	2,400 [3,**]	5,000 [5]
Cyanide	<0.58N	<0.55	<0.52	<0.55	<0.54	<0.53	<0.56	<0.57	<0.55	<0.55	<0.57	0.1 [1]	4 [3]	4 [5]

Notes:

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[7] Industrial 20X Aesthetic drinking water value - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

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[**] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

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SUBSOIL SAMPLING - SEPTEMBER 1992
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comparison to criteria

TABLE 5-13
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

Parameter	96MO03S04 PS-AS µg/l	EYW41 PS-AD µg/l	96MO03S06 PS-BS µg/l	96MO03S07 PS-BD µg/l	EYW57 PS-CS µg/l	EYW58 PS CD µg/l	EYW61 PS-CD dup µg/l	96MO03S09 PS-DS µg/l	96MO03S10 PS-DD µg/l	96MO03D10 PS-DD Dup µg/l	96MO03S02 PS-1R µg/l	96MO03S13 PS-4 µg/l	96MO03S03 PS-6 µg/l	96MO03S08 PS 10A µg/l	EYW59 PS-11 µg/l	Residential Criteria µg/l	GSI Criteria µg/l	Industrial Criteria µg/l
1,1,1-Trichloroethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	200	200 [5]	200 [6]
1,2,2-Tetrachloroethane	<2	<10	<2	<2	<10	<10	<10	<2	<2	<2	<2	<2	<2	<2	<10	4.3 [1]	78 [3]	17 [5]
1,1,2-Trichloroethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	5	330 [3]	5 [5]
1,1-Dichloroethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	880	IP	2,500 [5]
1,1-Dichloroethene	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	7	65 [1]	7 [6]
1,2-Dibromo-3-chloropropane	<1 J	NA	<1 J	<1 J	NA	NA	NA	<1 J	<1 J	<1 J	<1 J	<1 J	<1 J	<1 J	NA			
1,2-Dibromomethane	<1	NA	<1	<1	NA	NA	NA	<1	<1	<1	<1	<1	<1	<1	NA		IBI [4]	
1,2-Dichlorobenzene	<1	NA	<1	<1	NA	NA	NA	<1	<1	<1	<1	<1	<1	<1	NA	600	16 [3]	600 [1]
1,2-Dichloroethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	5	360 [1]	5 [5]
1,2-Dichloroethene (total) [7]	NR	<10	NR	NR	<10	3 J	4 J	NR	NR	NR	NR	NR	NR	NR	0.9 J	70	ID	70 [1]
1,2-Dichloropropane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	5	290 [3]	5 [5]
1,3-Dibromomethane	<1	NA	<1	<1	NA	NA	NA	<1	<1	<1	<1	<1	<1	<1	NA		180 [1]	
1,4-Dibromomethane	<1	NA	<1	<1	NA	NA	NA	<1	<1	<1	<1	<1	<1	<1	NA		15 [3]	
2-Butanone (MEK)	<3	<10	<3	<3	<10	<10	<10	<3	<3	<3	<3	<3	<3	<3	<10	13000	7200 [3]	38,000 [1]
2-Hexanone	<3	<10	<3	<3	<10	<10	<10	<3	<3	<3	<3	<3	<3	<3	<10	1000	IBI 8	2,900 [5]
4-Methyl-2-pentanone (MIBK)	<3	<10	<3	<3	<10	<10	<10	<3	<3	<3	<3	<3	<3	<3	<10	370 [1]	IBI [8]	1,000 [6]
Acetone	<3 J	<10	<3 J	<3 J	<10	<10	<10	<3 J	<3 J	<3 J	<3 J	<3 J	4 J	<3 J	<10	730 [1]	1,700 [5]	2,100 [6]
Benzene	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	5 [1]	200 [5]	5 [6]
Bromochloromethane	<1	NA	<1	<1	NA	NA	NA	<1	<1	<1	<1	<1	<1	<1	NA			
Bromodichloromethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	100	24 [3]	100 [6]
Bromoform	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	100	65 [3]	100 [6]
Bromomethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	10	IP	29 [1]
Carbon Disulfide (R)	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	1 J	<1	<10	800	IBI [4]	2,300
Carbon Tetrachloride	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	5	45	5
Chlorobenzene	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	100	47 [3]	100 [1]
Chloroethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	220	ID	910 [1]
Chloroform	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	100	170 [1]	100 [6]
Chloromethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	66	ID	270 [1]
cis-1,2-Dichloroethene [7]	<1	NR	<1	<1	NR	NR	NR	<1	<1	<1	<1	3	<1	<1	NR	70	ID	70 [1]
cis-1,3-Dichloropropene [2]	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	4.7	3 [3]	19 [1]
Dibromochloromethane	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	100	29 [3]	100 [6]
Ethylbenzene	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	74 [1]	18 [5]	700 [1]
m &/or p-Xylene	<1	NR	<1	<1	NR	NR	NR	<1	<1	<1	<1	<1	<1	<1	NR			
Methylene Chloride	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	0.9 J	5	940 [1]	5 [1]
o-Xylene	<1	NR	<1	<1	NR	NR	NR	<1	<1	<1	<1	<1	<1	<1	NR			
Styrene	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	100	19 [3]	100 [5]
Tetrachloroethene	2	<10	<1	<1	<10	<10	<10	<1	<1	<1	1 J	<1	<1	<1	<10	5	45 [5]	5 [5]
Toluene	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	790 [2]	140 [5]	1,000 [1]
total Xylene	NR	<10	NR	NR	<10	<10	<10	NR	NR	NR	NR	NR	NR	NR	<10	280 [2]	35 [5]	10,000 [1]
trans-1,2-Dichloroethene [7]	<1	NR	<1	<1	NR	NR	NR	<1	<1	<1	<1	<1	<1	<1	NR	100	ID	100 [1]
trans-1,3-Dichloropropene [2]	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<10	4.7	3 [3]	19 [6]
Trichloroethene	2 B	<10	1 B	1 JB	<10	46	49	1 JB	1 JB	1 JB	1 JB	15 JB	1 JB	1 JB	19	5 [1]	200 [5]	5 [1]
Vinyl Chloride	<1	<10	<1	<1	<10	<10	<10	<1	<1	<1	<1	1	<1	<1	<10	2	15 [5]	2 [1]

TABLE 5-13
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

Parameter	96MO03S05 PS-12 µg/l	96MO03S01 PS-13 µg/l	96MO03S12 PS-104 µg/l	EYW43 PS-105S µg/l	EYW44 PS-105D µg/l	96MO03S11 PS-106 µg/l	EYW48 COP-1 µg/l	EYW45 COP-2 µg/l	EYW50 COP-3 µg/l	EYW51 COP-4 µg/l	EYW42 COP-5 µg/l	EYW53 MW-201S µg/l	EYW52 MW-202S µg/l	EYW54 MW-203S µg/l	EYW55 MW-203D µg/l	Residential Criteria µg/l	GSI Criteria µg/l	Industrial Criteria µg/l
1,1,1-Trichloroethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	200	200 [5]	200 [6]
1,1,2,2-Tetrachloroethane	<2	<2	<2	<10	<10	<2	<10	<10	<10	<10	<10	<10	<10	<10	<10	4.3	78 [5]	17 [6]
1,1,2-Trichloroethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	5	330 [5]	5 [6]
1,1-Dichloroethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	880	IP	2,500 [6]
1,1-Dichloroethene	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	7 [1]	65 [5]	7 [6]
1,2-Dibromo-3-chloropropane	<1 J	<1 J	<1 J	NA	NA	<1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA			
1,2-Dibromomethane	<1	<1	<1	NA	NA	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA		(B) [4]	
1,2-Dichlorobenzene	<1	<1	<1	NA	NA	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	600	16 [5]	600 [6]
1,2-Dichloroethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	5	360 [5]	5 [6]
1,2-Dichloroethene (total) [4]	NR	NR	NR	<10	<10	NR	<10	<10	<10	<10	<10	4 J	<10	4 J	<10	70	ID	70 [6]
1,2-Dichloropropane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	5	290 [5]	5 [6]
1,3-Dibromomethane	<1	<1	<1	NA	NA	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA		180 [4]	
1,4-Dibromomethane	<1	<1	<1	NA	NA	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA		15 [4]	
2-Butanone (MEK)	<3	<3	<3	<10	<10	<3	<10	<10	<10	<10	<10	<10	<10	<10	<10	13000 [1]	7200 [5]	38,000 [6]
2-Hexanone	<3	<3	<3	<10	<10	<3	<10	<10	<10	<10	<10	<10	<10	<10	<10	1000 [1]	(B) 8	2,900 [6]
4-Methyl-2-pentanone (MIBK)	<3	<3	<3	<10	<10	<3	<10	<10	<10	<10	<10	<10	<10	<10	<10	370 [1]	(B) [8]	1,000 [6]
Acetone	<3 J	<3 J	<3 J	<10	<10	<3 J	<10	<10	<10	<10	<10	<10	<10	<10	<10	730 [1]	1,700 [5]	2,100 [6]
Benzene	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	5 [1]	200 [5]	5 [6]
Bromochloromethane	<1	<1	<1	NA	NA	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA			
Bromodichloromethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	10	<10	<10	100 [1]	24 [8]	100 [6]
Bromoform	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	100 [1]	65 [8]	100 [6]
Bromomethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	IP	29 [6]
Carbon Disulfide [R]	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	800	(B) [4]	2,300 [6]
Carbon Tetrachloride	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	5	45 [5]	5 [6]
Chlorobenzene	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	100	47 [5]	100 [6]
Chloroethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	220	ID	910 [6]
Chloroform	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	100	170 [5]	100 [6]
Chloromethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	66	ID	270 [6]
cis-1,2-Dichloroethene [4]	<1	<1	<1	NR	NR	<1	NR	NR	NR	NR	NR	NR	NR	NR	NR	70	ID	70 [6]
cis-1,3-Dichloropropene [4]	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	4.7	3 [4]	19 [6]
Dibromochloromethane	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	100	29 [8]	100 [6]
Ethylbenzene	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	74 [2]	18 [5]	700 [6]
m &/or p-Xylene	<1	<1	<1	NR	NR	<1	NR	NR	NR	NR	NR	NR	NR	NR	NR			
Methylene Chloride	<1	<1	<1	1 J	2 J	<1	1 J	1 J	3 J	4 J	<10	<10	4 J	2 J	<10	5	940 [5]	5 [6]
o-Xylene	<1	<1	<1	NR	NR	<1	NR	NR	NR	NR	NR	NR	NR	NR	NR			
Styrene	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	100	19 [8]	100 [6]
Tetrachloroethene	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	5	45 [5]	5 [6]
Toluene	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	790 [2]	140 [5]	1,000 [6]
total Xylene	NR	NR	NR	<10	<10	NR	<10	<10	<10	<10	<10	<10	<10	<10	<10	280 [3]	35 [5]	10,000 [6]
trans-1,2-Dichloroethene [4]	<1	<1	<1	NR	NR	<1	NR	NR	NR	NR	NR	NR	NR	NR	NR	100 [1]	ID	100 [6]
trans-1,3-Dichloropropene [4]	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	<10	<10	<10	<10	4.7	3 [4]	19 [6]
Trichloroethene	1 JB	1 JB	3 JB	<10	<10	1 JB	<10	3 J	<10	<10	<10	13	<10	82	<10	5	200 [5]	5 [6]
Vinyl Chloride	<1	<1	<1	<10	<10	<1	<10	<10	<10	<10	<10	16	<10	<10	<10	2	15 [5]	2 [6]

TABLE 5-13
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

Parameter	EYW56 MW-204S µg/l	EYW46 MW-205I µg/l	EYW47 MW-205D µg/l	EYW49 Ingalls Well µg/l	Dup Ingalls Well µg/l	EYW62 PB-1 µg/l	EZT72 PB-2 µg/l	EZT73 PB-3 µg/l	EZT74 PB-4 µg/l	EZT75 PB-5 µg/l	EZT76 PB-6 µg/l	EZT77 PB-7 µg/l	EZT78 PB-8 µg/l	EZT79 PB-9 µg/l	96MO03R01 TB-1 µg/l	Residential Criteria µg/l	GSI Criteria µg/l	Industrial Criteria µg/l
1,1,1 Trichloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	200	200 [5]	200 [5]
1,1,2,2 Tetrachloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<2	4.3 [1]	78 [5]	17 [5]
1,1,2 Trichloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	5	330 [5]	5 [5]
1,1 Dichloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	880	IP	2,500 [5]
1,1 Dichloroethene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	7	65 [5]	7 [5]
1,2 Dibromo-3-chloropropane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1 J			
1,2 Dibromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1		IBI [4]	
1,2 Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	600	16 [5]	600 [5]
1,2 Dichloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	5	360 [5]	5 [5]
1,2-Dichloroethene (total) [7]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NR	70	ID	70 [5]
1,2 Dichloropropane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	5	290 [5]	5 [5]
1,3-Dibromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1		180 [3]	
1,4-Dibromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1		15 [8]	
2-Butanone (MEK)	<10	<10	<10	<10	<10	<10	<10	<10	13	<10	<10	<10	<10	<10	<3	13000	7200 [8]	38,000 [5]
2-Hexanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<3	1000 [1]	IBI 8	2,900 [5]
4-Methyl-2-pentanone (MIBK)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<3	370 [1]	IBI [8]	1,000 [6]
Acetone	<10	<10	<10	<10	<10	<10	<10	<10	<10	15	<10	<10	<10	<10	<3 J	730 [1]	1,700 [5]	2,100 [6]
Benzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	5 [1]	200 [5]	5 [6]
Bromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1			
Bromodichloromethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	100 [1]	24 [8]	100 [6]
Bromoform	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	100	65 [8]	100 [5]
Bromomethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	10	IP	29 [5]
Carbon Disulfide (R)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	800	IBI [4]	2,300 [5]
Carbon Tetrachloride	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	5	45 [5]	5 [5]
Chlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	100	47 [5]	100 [5]
Chloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	220	ID	910 [5]
Chloroform	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	1 J	100	170 [5]	100 [5]
Chloromethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	66	ID	270 [5]
cis-1,2 Dichloroethene [7]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	<1	70	ID	70 [5]
cis 1,3-Dichloropropene [7]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	4.7	3 [8]	19 [5]
Dibromochloromethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	100	29 [8]	100 [5]
Ethylbenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	74 [1]	18 [5]	700 [5]
m &/or p-Xylene	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	<1			
Methylene Chloride	<10	1 J	1 J	2 J	5 J	0.6 J	<10	<10	1 J	<10	<10	0.9 J	0.8 J	<10	<1	5	940 [5]	5 [6]
o-Xylene	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	<1			
Styrene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	100 [1]	19 [4]	100 [5]
Tetrachloroethene	0.8 J	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	5 [1]	45 [5]	5 [6]
Toluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	790 [2]	140 [5]	1,000 [5]
total Xylene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NR	280 [2]	35 [5]	10,000 [5]
trans-1,2-Dichloroethene [7]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	<1	100	ID	100 [5]
trans-1,3-Dichloropropene [7]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	4.7	3 [8]	19 [5]
Trichloroethene	35	<10	<10	2 J	1 J	<10	<10	<10	<10	<10	<10	2 J	<10	2 J	1 JB	5 [1]	200 [5]	5 [6]
Vinyl Chloride	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1	2 [1]	15 [5]	2 [6]

TABLE 5-13
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS

Notes

[1] Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4 *Generic Residential Cleanup Criteria*, June 5, 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4 Generic Residential Cleanup Criteria, June 5, 1995

[3] Site Specific Background

[4] State Background, MERA Operational Memorandum #15 Default Type A Cleanup Criteria, September 30, 1993

[5] GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[6] Industrial DW Criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[7] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] 20X GSI Criterion Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that compound is not addressed in Operational Memorandums

< - indicates that analyte was not detected at detection limit given

NA - Not analyzed for given parameter

NR - Parameter not reported

J - Estimated value

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte present in method blank

ID Insufficient data for calculation

IP - Development of generic GSI value in process but not yet complete

A - Tentatively identified compounds present

[*] Data not broken down into isomers so the most conservative criteria was used which is cis.

[-] *Chemical may be present in several isomer forms* Isomer specific concentrations must be combined for comparison to criteria

TABLE 5-14
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	PS-AS 96MO03S04	PS-AD ^ EYW41	PS-BS 96MO03S06	PS-BD 96MO03S07	PS-CS ^ EYW57	PS-CD ^ EYW58	PS-CD Dup EYW61	PS-DS 96MO03S09	PS-DD ^ 96MO03S10	PS-DD Dup 96MO03D10	PS-4 ^ 96MO03S13	PS 6 96MO03S03	PS-11 ^ EYW59	PS-12 96MO03S05	PS-13 96MO0301	PS-10 A 96MO03S08	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
1,2,4-Trichlorobenzene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	70	ID	70 ^
1,2-Dichlorobenzene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	600	16 ^	600
1,3-Dichlorobenzene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	600	33	600 ^
1,4-Dichlorobenzene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	75	33	75 ^
2,2' oxybis(1-Chloropropane)	NA	<10	NA	NA	<10	<10	<10	NA	NA	NA	NA	NA	<10	NA	NA	NA			
2,4,5-Trichlorophenol	<20	<25	<20	<20	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20	730	25 ^	2,100
2,4,6-Trichlorophenol	<5 J	<10	<5 J	<5	<10	<10	<10	<5 J	<5 J	<5 J	<5 J	<5 J	<10	<5 J	<5 J	<5 J	77	4.4 ^	320 ^
2,4-Trichlorophenol	<5	<10	<5	<5	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	73	13	210 ^
2,4-Dimethylphenol	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	370	12 ^	1,000 ^
2,4-Dinitrophenol	<20	<25	<20	<20	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20			
2,4-Dinitrotoluene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	1.3	91 ^	5.1 ^
2,6-Dinitrotoluene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5			
2-Chloronaphthalene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5		(B) ^	
2-Chlorophenol	<5	<10	<5	<5	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	45	22	130 ^
2-Methylnaphthalene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	ID	(B) ^	ID
2-Methylphenol	<5	<10	<5	<5	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	370	38 ^	1,000 ^
2-Nitroaniline	<20	<25	<20	<20 J	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20			
2-Nitrophenol	<5	<10	<5	<5	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	20	(B) ^	58 ^
3,3'-Dichlorobenzidine	<5	<10	<5 J	<5 J	<10	<10	<10	<5 J	<5 J	<5 J	<5 J	<5 J	<10	<5	<5	<5 J	1.9 ^	0.063 ^	7.7 ^
3-Nitroaniline	<20	<25	<20	<20 J	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20			
4,6-Dinitro-2-methylphenol	<20	<25	<20	<20	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20			
4-Bromophenyl phenyl ether	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5			
4-Chloro-3-methylphenol	<5	<10	<5	<5	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	150	4.4 ^	420 ^
4-Chloroaniline	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5			
4-Chlorophenyl phenyl ether	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5			
4-Methylphenol	<5	<10	<5	<5	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	37	(B) ^	100
4-Nitroaniline	<20	<25	<20	<20 J	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20			
4-Nitrophenol	<20	<25	<20	<20 J	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20			
Acenaphthene	<5	<10	<5	<5 J	<10	0.1 J	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	1300	9	1,800
Acenaphthylene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	26	(B) ^	75 ^
Anthracene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	7300	110000 ^	21,000 ^
Benzo(a)anthracene (Q)	<5	<10	<5 J	<5 J	<10	<10	<10	<5 J	<5 J	<5 J	<5 J	<5 J	<10	<5	<5	<5 J	1.2	0.31 ^	4.8 ^
Benzo(a)pyrene (Q)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	0.2	0.31 ^	0.2 ^
Benzo(b)fluoranthene (Q)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	1.2	0.31 ^	4.8 ^
Benzo(ghi)perylene (Q)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	26	(B) ^	75 ^
Benzo(k)fluoranthene (Q)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	12	0.31 ^	48 ^
Benzoic acid	<20	NA	<20	<20 J	NA	NA	NA	<20	<20	<20 J	<20	<20	NA	<20	<20	<20	32000	(B) ^	20,000 ^
Benzyl alcohol	<5	NA	<5	<5 J	NA	NA	NA	<5	<5	<5 J	<5	<5	NA	<5	<5	<5	10000	22 ^	20,000 ^
bis(2-Chloroethoxy) methane	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5			
bis(2-Chloroethyl) ether	<5 J	<10	<5 J	<5 J	<10	<10	<10	<5 J	<5 J	<5 J	<5 J	<5 J	<10	<5 J	<5 J	<5 J	0.77	4.2 ^	3.2
bis(2-ethylhexyl)phthalate	<5 B	<10	<5	<5 BJ	<10	<10	<10	<5 BJ	38 B	19 BJ	19 B	16 B	<10 BJ	<5 B	<5 B	<5 B	6	NLL	6
bis-(2-Chloroisopropyl) ether	<5	NA	<5	<5 J	NA	NA	NA	<5	<5	<5 J	<5	<5	NA	<5	<5	<5		59 ^	
Butyl benzyl phthalate	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	1200	(B) ^	3,900 ^
Carbazole	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5			
Chrysene (Q)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	120	0.31 ^	480 ^
Di-n-butyl phthalate	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	880	12000 ^	2,500 ^
Di-n-octyl phthalate	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	130	(B) ^	380 ^
Dibenz(a,h)anthracene (Q)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	0.12	0.31 ^	0.48 ^
Dibenzofuran	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	ID	(B) ^	ID
Diesel Range Organics (DRO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.25	NA	NA	NA	NA	NA			

TABLE 5-14
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	PS-AS 96MO03S04	PS-AD ^ EYW41	PS-BS 96MO03S06	PS-BD 96MO03S07	PS-CS ^ EYW57	PS-CD ^ EYW58	PS-CD Dup EYW61	PS-DS 96MO03S09	PS-DD ^ 96MO03S10	PS-DD Dup 96MO03D10	PS-4 ^ 96MO03S13	PS-6 96MO03S03	PS-11 ^ EYW59	PS-12 96MO03S05	PS-13 96MO03S01	PS-10 A 96MO03S08	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
Diethyl phthalate	<5 J	<10	<5 J	<5 J	<10	<10	<10 BJ	<5 J	<5 J	<5 J	<5 J	<5 J	<10 BJ	<5 J	<5 J	<5 J	5500		16,000 [1]
Dimethyl phthalate	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	73000	2400000 [3]	2.1E+5 [1]
Fluoranthene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	880	370 [3]	2,500 [1]
Fluorene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	880	14000 [3]	2,500 [1]
Hexachlorobenzene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	1	ID	1 [1]
Hexachlorobutadiene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	11	ID	45 [1]
Hexachlorocyclopentadiene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	50	0.54 [3]	50 [1]
Hexachloroethane	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	61	6.7 [3]	260 [1]
Indeno(1,2,3-cd)pyrene (G)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	1.2	0.31 [3]	4.8 [1]
Isophorone	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	900	860 [3]	2,700 [1]
N-Nitroso-di-n propylamine	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	0.12	(B) [4]	0.5 [1]
N-Nitrosodiphenylamine (1)	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	170	140 [3]	710 [1]
Naphthalene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	260	13 [3]	750 [1]
Nitrobenzene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	3.4	1900 [3]	9.6 [1]
Pentachlorophenol	<20	<25	<20	<20	<25	<25	<25	<20	<20	<20 J	<20	<20	<25	<20	<20	<20	1 [1]	2.3 [3]	1 [1]
Phenanthrene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	26 [1]	2.4 [3]	75 [1]
Phenol	<5	<10	<5	<5	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	4400	1100 [4]	13,000 [1]
Pyrene	<5	<10	<5	<5 J	<10	<10	<10	<5	<5	<5 J	<5	<5	<10	<5	<5	<5	550 [1]	11000 [4]	1,600 [1]
Total Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	NA	NA	NA	NA	NA			

Notes.

[1] Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4 Generic Residential Cleanup Criteria, June 5, 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4 Generic Residential Cleanup Criteria, June 5, 1995
Site Specific Background

[3] State Background, MERA Operational Memorandum #15 Default Type A Cleanup Criteria September 30, 1993
GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[4] Industrial DW Criterion - Environmental Response Division Operational Memorandum #14 Revision 2 June 6, 1995

[5] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2 June 6, 1995

[6] GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that compound is not addressed in Operational Memorandums

Diesel Range Organics and Total Petroleum Hydrocarbons have no established criterion. The results are presented in mg/l

< - indicates that analyte was not detected at detection limit given

NR - Parameter not reported

J - Estimated value

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte present in method blank

ID - Insufficient data for calculation

IP - Development of generic GSI value in process but not yet complete

^ - Tentatively identified compounds present

[*] Data not broken down into isomers so the most conservative criteria was used which is cis
Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria

TABLE 5-17
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS (TICs)

Parameter	Retention Time	COP-3 EYW50	COP-4 EYW51
Unknown	13.54	6 J	
Unknown	20.90		11 J
Unknown Cyclic Alkane	21.41		23 J
Unknown	21.80		7 J
Unknown	21.93		18 J
Unknown	22.20		8 J
Unknown	22.87		6 J
Unknown	23.01		12 J
Unknown	23.28		9 J
Unknown	23.47		18 J
Unknown	23.61		8 J
Substituted benzene	23.74		18 J
Unknown	24.01		16 J
Substituted benzene	24.20		7 J
1,3,5-Trimethylbenzene	24.49		26 NJ
Substituted benzene	24.67		6 J
Substituted benzene	24.84		17 J
Unknown PAH	24.99		16 J
1-methyl-2-propylbenzene	25.32		15 NJ
1-methy-2-(2-prope)benze	25.89		14 NJ

All units are ug/l.

J - Estimated value.

N - Identification based on mass spectral library search.

TABLE 5-18
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS (TICs)

Parameter	Retention Time	PS-AD EYW41	PS-CD EYW58	PS-CD Dup EYW61	PS-DD 96M003S02	PS-1R 96M003S02	PS-4 96M003S13	PS-11 EYW59	PS-104 96M003S12	PS-105S EYW43	PS-105D EYW44	COP-1 EYW48	COP-2 EYW45	COP-3 EYW50	COP-4 EYW51	COP-5 EYW42	MW-201S EYW53	MW-202S EYW52
Unknown trichloropropene isom	7.92																	
Unknown alkene	7.92-7.96	4 J																
Unknown alkane	8.21														8 J			
Trimethylbenzene isomer	9.53														9 J			
Unknown alcohol	9.60																	
Unknown cyclic alkene	9.93														6 J			
Substituted benzene	0.25														9 J			
Decahydronaphthalene	10.31														5 NJ			
Unknown alcohol	10.39-10.41																	
trans-1,2-cyclohexanediol	10.38-10.42											<4 NJB						<8 NJB
Unknown alcohol	10.48-10.49																	
Unknown alcohol	10.72														7 J			
Unknown organic acid	11.59-11.61														10 J		2 J	
Unknown alkene	11.83														9 J			
Unknown	11.88																	
Unknown alkene	11.88																	< 2 JB
Unknown nitrile	11.88												< 3 JB					
Unknown	11.89			<4 JB				< 3 JB										
Unknown alkane	11.89									< 3 JB								
Unknown	11.92																	
Unknown alkene	11.93															<4 JB		
Unknown nitrile	11.97																	
Unknown alkene	11.98																	
Unknown	11.99																	
Unknown nitrile	11.99																	
Unknown alkene	12.02														6 J			
Unknown	12.37														5 J			
Unknown	12.44																3 J	
Unknown	12.92														4 J			
Camphor	13.11														8 NJ			
Unknown aldehyde	13.36														10 J			
Substituted benzene	13.41														17 J			
Unknown	13.46																6 J	
Unknown organic acid	13.59																5 J	
Unknown	13.82														6 J			
Unknown alcohol	13.84																3 J	
Unknown organic acid	13.95																2 J	
Unknown	13.97														5 J			
Unknown	14.12														6 J			
Unknown	14.19-14.20														10 J		4 J	
Unknown	14.50																2 J	
Substituted benzene	14.58														12 J			
Octahydro2(1H)-naphthalene	14.65														38 NJ			
Unknown cyclic alkene	14.74														15 J			
Unknown alkene	15.03																4 J	
Unknown organic acid	16.12																4 J	
Unknown	16.38														9 J			
Unknown	16.51																	
Unknown organic acid	16.70														10 J			

TABLE 5-18
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS (TICs)

Parameter	Retention Time	PS-AD EYW41	PS-CD EYW58	PS-CD Dup EYW61	PS-DD 96M003S02	PS-1R 96M003S02	PS-4 96M003S13	PS-11 EYW59	PS-104 96M003S12	PS-105S EYW43	PS-105D EYW44	COP-1 EYW48	COP-2 EYW45	COP-3 EYW50	COP-4 EYW51	COP-5 EYW42	MW-201S EYW53	MW-202S EYW52
Unknown	16.92														20 J			
Chlorophosphate ethanol	17.13-17.17						630 J		210 J									
Butylated hydroxytoluene	17.23-17.25													4 NJ			4 NJ	
Unknown	17.26														7 J			
Unknown cyclic alkene	17.49																3 J	
Unknown organic acid	17.80																3 J	
Unknown	18.08																2 J	
Decahydro-2,6-naphthalene	18.09														7 NJ			
Unknown organic acid	18.13													5 J				
Octahydr-2H-inden-2-one	18.44														11 NJ			
Unknown organic acid	18.61																	
Adamantane	18.82																2 NJ	
Bicyclo(3.3.1)nonan-2-ol	19.34														4 NJ			
Unknown alcohol	20.16														11 J			
Tri(2-chloroethyl) phosphate	20.42-20.52																12 NJ	
Unknown	20.52									240 J								
Unknown	20.59									2 J								
Unknown	20.70						7 J											
Unknown	20.78									2 J								
Hexanedioic acid ester	24.41-24.42				6 J	10 J												
Unknown alcohol	25.88																	
Unknown organic acid	26.70-26.76	< 8 JB		< 18 JB				< 22 JB		<5 JB	< 4 JB	< JB	< 3 JB	< 2 JB		< 7 JB		< 2 JB
bis(2-ethy)hexanedioic acid	26.73																	
2-butoxy-phosphate-ethanol	26.83														5 NJ			
Unknown organic acid	26.85-26.87		<4 JB															
Unknown	29.39																	
Unknown	31.35																	

All units are ug/l
< - indicates that analyte was not detected at detection limit given
B - Analyte detected in the associated blank
J - Estimated value
N - Identification based on mass spectral library search

TABLE 5-18
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS (TICs)

Parameter	MW-203S EYW54	MW-203D EYW55	MW-204S EYW56	MW-205I EYW46	MW-205D EYW47	Ingalls Well EYW60	Ingalls Well Dup EYW60	PB-1 EYW62	PB-2 EZT72	PB-3 EZT73	PB-4 EZT74	PB-5 EZT75	PB-6 EZT76	PB-7 EZT77	PB-8 EZT78	PB-9 EZT79
Unknown trichloropropene isomi					4 J											
Unknown alkene									5 J	2 J						
Unknown alkane																
Trimethylbenzene isomer																
Unknown alcohol															7 J	
Unknown cyclic alkene																
Substituted benzene																
Decahydronaphthalene																
Unknown alcohol								< 13 JB		< 7 JB				< 4 JB	< 5 JB	< 7 JB
trans -1,2-cyclohexanediol			< 4 NJB									< 6 NJB	< 6 NJB			
Unknown alcohol	< 4 JB	< 5 JB														
Unknown alcohol																
Unknown organic acid																
Unknown alkene																
Unknown					< 4 JB										< 6 JB	< 5 JB
Unknown alkene				< 2 JB												
Unknown nitrile																
Unknown						< 4 JB				< 3 JB				< 5 JB		
Unknown alkane													< 2 JB			
Unknown											< 2 JB					
Unknown alkene									< 5 JB							
Unknown nitrile		< 5 JB														
Unknown alkene	< 4 JB															
Unknown																
Unknown nitrile			< 4 JB													
Unknown alkene																
Unknown																
Unknown																
Unknown																
Camphor																
Unknown aldehyde																
Substituted benzene																
Unknown																
Unknown organic acid																
Unknown																
Unknown alcohol																
Unknown organic acid																
Unknown																
Unknown																
Unknown																
Unknown																
Substituted benzene																
Octahydro2(1H)-naphthalene																
Unknown cyclic alkene																
Unknown alkene																
Unknown organic acid																
Unknown																
Unknown							3 J									
Unknown organic acid																

TABLE 5-18
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS
TENTATIVELY IDENTIFIED COMPOUNDS (TICs)

Parameter	MW-203S EYW54	MW-203D EYW55	MW-204S EYW56	MW-205i EYW46	MW-205D EYW47	Ingalls Well EYW60	Ingalls Well Dup EYW60	PB-1 EYW62	PB-2 EZT72	PB-3 EZT73	PB-4 EZT74	PB-5 EZT75	PB-6 EZT76	PB-7 EZT77	PB-8 EZT78	PB-9 EZT79
Unknown																
Chlorophosphate ethanol																
Butylated hydroxytoluene																
Unknown																
Unknown cyclic alkene																
Unknown organic acid																
Unknown																
Decahydro-2,6-naphthalene																
Unknown organic acid																
Octahydr-2H-inden-2-one																
Unknown organic acid							2 J									
Adamantane																
Bicyclo(3.3.1)nonan-2-ol																
Unknown alcohol																
Tri(2-chloroethyl) phosphate												9 NJ				
Unknown																
Unknown																
Unknown																
Unknown																
Hexanedioic acid ester																
Unknown alcohol																
Unknown organic acid				< 2 JB	< 2 JB	< 3 JB		< 6 JB	< 5 JB	< 5 JB	< 5 JB			< 15 JB	< 12 JB	< 10 JB
bis(2-ethy)hexanedioic acid													2 NJBU			
2-butoxy-phosphate-ethanol																
Unknown organic acid	< 6 JB	< 5 JB	< 5 JB													
Unknown							2 J									
Unknown							2 J									

All units are ug/l
< - indicates that analyte was nc
B - Analyte detected in the asso
J - Estimated value
N - Identification based on mass

TABLE 5-14
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	PS-10M ^ 96MO03S12	PS-10SS ^ EYW43	PS-10SD ^ EYW44	PS-106 96MO03S11	PS-1R ^ 96MO03S02	COP-1 ^ EYW48	COP-2 EYW45	COP-3 ^ EYW50	COP-4 ^ EYW51	COP-5 ^ EYW42	MW-201S ^ EYW53	MW-202S ^ EYW52	MW-203S ^ EYW54	MW 203L EYW55	MW-203D Dup	MW-204S EYW56	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
1,2,4 Trichlorobenzene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	70	ID	70 *
1,2 Dichlorobenzene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	600	16 *	600 *
1,3 Dichlorobenzene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	600	38 *	600 *
1,4-Dichlorobenzene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	75	13	75
2,2'-oxybis(1-Chloropropane)	NA	<10	<10	NA	NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10			
2,4,5-Trichlorophenol	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25	730	25 *	2,100 *
2,4,6-Trichlorophenol	<5 J	<10	<10	<5 J	<5 J	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	77	4.4	320 *
2,4-Dichlorophenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	73	19 *	219 *
2,4-Dimethylphenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	370	12	1,000 *
2,4-Dinitrophenol	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25			
2,4-Dinitrotoluene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	1.3	91 *	5.1 *
2,6-Dinitrotoluene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10			
2-Chloronaphthalene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10		(B) *	
2-Chlorophenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	45	22 *	120 *
2-Methylnaphthalene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	ID	(B) *	ID
2-Methylphenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	370 *	38 *	1,000 *
2-Nitroaniline	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25			
2-Nitrophenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	20 *	(B) *	58 *
3,3'-Dichlorobenzidine	<5 J	<10	<10	<5 J	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	1.9 *	0.063 *	7.7 *
3-Nitroaniline	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25			
4,6-Dinitro-2-methylphenol	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25			
4-Bromophenyl phenyl ether	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10			
4-Chloro-3-methylphenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	150 *	4.4 *	420 *
4-Chloroaniline	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10			
4-Chlorophenyl phenyl ether	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10			
4-Methylphenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	3 *	(B) *	100 *
4-Nitroaniline	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25			
4-Nitrophenol	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25			
Acenaphthene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	1300	17 *	2,500 *
Acenaphthylene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	20	(B) *	75 *
Anthracene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	7300	110000	21,000 *
Benzo(a)anthracene (Q)	<5 J	<10	<10	<5 J	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	1.2	0.31 *	4.8 *
Benzo(a)pyrene (Q)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	0.2	0.31 *	0.2 *
Benzo(b)fluoranthene (Q)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	1.2	0.31 *	4.8 *
Benzo(ghi)perylene (Q)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	26	(B) *	75 *
Benzo(k)fluoranthene (Q)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	12	0.31 *	48 *
Benzoic acid	<20	NA	NA	<20	<20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	32000	(B) *	92,000 *
Benzyl alcohol	<5	NA	NA	<5	<5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10000	22 *	29,000 *
bis(2-Chloroethoxy) methane	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10			
bis(2-Chloroethyl) ether	<5 J	<10	<10	<5 J	<5 J	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	0.77	4.2 *	4.2 *
bis(2-ethylhexyl)phthalate	<5 B	<10 BJ	<10 BJ	9 B	29 B	<10 BJ	<10 BJ	<10 BJ	<10 BJ	<10	<10	<10	<10 BJ	<10 BJ	<10	NA	<10	6	NLL	6 *
bis-(2-Chloroisopropyl) ether	<5	NA	NA	<5	<5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		59 *	
Butyl benzyl phthalate	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.2 J	NA	<10	1200	(B) *	3,300 *
Carbazole	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10			
Chrysene (Q)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	120	0.31 *	480 *
Di-n-butyl phthalate	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	880	12000 *	2,500 *
Di-n-octyl phthalate	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	130	(B) *	380 *
Dibenz(a,h)anthracene (Q)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	0.12	0.31 *	0.48 *
Dibenzofuran	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	ID	(B) *	ID
Diesel Range Organics (DRO)	58	NA	NA	NA	NA	NA	NA	NA	<0.20	NA	0.84	<0.20	<0.20	<0.20	<0.20	<0.20			

TABLE 5-14
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	PS-104 ^ 96MO03S12	PS-105S ^ EYW43	PS-105D ^ EYW44	PS-106 96MO03S11	PS-1R ^ 96MO03S02	COP-1 ^ EYW48	COP-2 EYW45	COP-3 ^ EYW50	COP-4 ^ EYW51	COP-5 ^ EYW42	MW-201S ^ EYW53	MW-202S ^ EYW52	MW-203S ^ EYW54	MW-203C EYW55	MW-203D Dup	MW-204S EYW56	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
Dimethyl phthalate	<5 J	<10	<10	<5 J	<5 J	<10	<10	0.4 J	<10	<10	<10	<10	<10	<10	NA	<10	5500		16,000 *
Dimethyl phthalate	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	73000	2900000 *	2.1E+5 *
Fluoranthene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	880	370 *	2,500 *
Fluorene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	880	14000	2,500 *
Hexachlorobenzene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	1	ID	1 *
Hexachlorobutadiene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	11	ID	45 *
Hexachlorocyclopentadiene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	50	0.54 *	50 *
Hexachloroethane	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	61	6.7 *	250 *
Indeno(1,2,3-cd)pyrene (S)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	1.2	0.31 *	4.8 *
Isophorone	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	980	860 *	3,700 *
N-Nitroso-di-n-propylamine	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	0.12	(B) *	0.5 *
N-Nitrosodiphenylamine (1)	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	170	140 *	710 *
Naphthalene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	260	13	750 *
Nitrobenzene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	3.4	1900 *	9.6
Pentachlorophenol	<20	<25	<25	<20	<20	<25	<25	<25	<25	<25	<25	<25	<25	<25	NA	<25	1	2.3 *	1 *
Phenanthrene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	26	2.4 *	75 *
Phenol	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	4400	1100 *	13,000 *
Pyrene	<5	<10	<10	<5	<5	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	550	11000 *	1,600 *
Total Petroleum Hydrocarbons	<1.1	NA	NA	NA	NA	NA	NA	NA	<1.0	NA	23	<1.0	<1.0	<1.1	<1.0	<1.1			

Notes

* Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria, June 5, 1995

* Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria, June 5, 1995

* Site Specific Background

* State Background: MERA Operational Memorandum #15: Default Type A Cleanup Criteria, September 30, 1993

* GSI criterion - As amended January (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

* Industrial DW Criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

* Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

* GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that a compound is not addressed in Operational Memorandums

Diesel Range Organics and Total Petroleum Hydrocarbons have no established criterion. The results are presented in mg/l

- indicates that analyte was not detected at detection limit given.

NR - Parameter not reported

J - Estimated value

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte present in method blank

ID - Insufficient data for calculation

IP - Development of generic GSI value in process but not yet complete

^ - Tentatively identified compounds present

* Data not broken down into isomers so the most conservative criteria was used which is cis

Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria

TABLE 5-14
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	MW-205I ^ EYW46	MW-205D ^ EYW47	Ingalls Well ^ EYW49	Ingalls Well Dup *	PB-1 ^ EYW62	PB-2 ^ EZT72	PB-3 ^ EZT73	PB-4 ^ EZT74	PB-5 ^ EZT75	PB-6 ^ EZT76	PB-7 ^ EZT77	PB-8 ^ EZT78	PB-9 ^ EZT79	TB-1 96MO03R01	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
1,2,4-Trichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	70	ID	70 '
1,2-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	600	16 '	600 '
1,3-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	600 '	38 '	600 '
1,4-Dichlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	75 '	13 '	75 '
2,2'-oxybis(1-Chloropropane)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA			
2,4,5-Trichlorophenol	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20	730	25 '	2,100 '
2,4,6-Trichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5 J	77 '	4 4 '	320 '
2,4-Dichlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	73	19 '	210 '
2,4-Dimethylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	370	12 '	1,000 '
2,4-Dinitrophenol	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20			
2,4-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	1 3	91 '	5 1 '
2,6-Dinitrotoluene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5			
2-Chloronaphthalene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5		(B) '	
2-Chlorophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	45	22 '	130 '
2-Methylnaphthalene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	ID	(B) '	ID
2-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	370 '	38 '	1,000 '
2-Nitroaniline	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20			
2-Nitrophenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	20 '	(B) '	58 '
3,3'-Dichlorobenzidine	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5 J	1 9 '	0 063 '	7 7 '
3-Nitroaniline	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20			
4,6-Dinitro-2-methylphenol	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20			
4-Bromophenyl phenyl ether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5			
4-Chloro-3-methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	150 '	4 4 '	420 '
4-Chloroaniline	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5			
4-Chlorophenyl phenyl ether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5			
4-Methylphenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	37	(B) '	1,00 '
4-Nitroaniline	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20			
4-Nitrophenol	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20			
Acenaphthene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	1300	19 '	3,800 '
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	26	(B) '	75 '
Anthracene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	7300	1 10000 '	21,000
Benzo(a)anthracene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5 J	1 2	0 31 '	4 8 '
Benzo(a)pyrene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	0 2	0 31 '	0 2 '
Benzo(b)fluoranthene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	1 2	0 31 '	4 8 '
Benzo(ghi)perylene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	26 '	(B) '	75 '
Benzo(k)fluoranthene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	12	0 31 '	48 '
Benzoic acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20	32000 '	(B) '	92,000 '
Benzyl alcohol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<5	10000 '	22 '	29,000 '
bis(2-Chloroethoxy) methane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5			
bis(2-Chloroethyl) ether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5 J	0 77 '	4 2 '	3 2 '
bis(2-ethylhexyl)phthalate	<10 BJ	<10	8 BJ	<10 BJ	15 B	<10 BJ	<10 BJ	<10 BJ	<10 BJ	<10 BJ	<10 BJ	<10 BJ	10 BJ	<3 BJ	6 '	NLL	6 '
bis-(2-Chloroisopropyl) ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<5		59 '	
Butyl benzyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	1200 '	(B) '	3 300 '
Carbazole	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5			
Chrysene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	120 '	0 31 '	480 '
Di-n-butyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	880 '	12000 '	2,500 '
Di-n-octyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	130 '	(B) '	380 '
Dibenz(a,h)anthracene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	0 12 '	0 31 '	0 48 '
Dibenzofuran	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	ID	(B) '	ID
Diesel Range Organics (DRO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0 20	<0 20	NA	NA			

TABLE 5-14
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - SEMI-VOLATILE ORGANIC COMPOUNDS

Parameter	MW-205i ^ EYW46	MW-205D ^ EYW47	Ingalls Well ^ EYW49	Ingalls Well Dup *	PB-1 ^ EYW62	PB-2 ^ EZT72	PB-3 ^ EZT73	PB-4 ^ EZT74	PB-5 ^ EZT75	PB-6 ^ EZT76	PB-7 ^ EZT77	PB-8 ^ EZT78	PB-9 ^ EZT79	TB-1 96MO03R01	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
Diethyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5 J	5500 [1]		16,000 [5]
Dimethyl phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	73000 [1]	2900000 [7]	2.1E+5 [5]
Fluoranthene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	880 [1]	370 [7]	2,500 [5]
Fluorene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	880	14000 [8]	2,500 [5]
Hexachlorobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	1 [1]	ID	1 [5]
Hexachlorobutadiene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	11	ID	45 [5]
Hexachlorocyclopentadiene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	50	0.54 [7]	50 [5]
Hexachloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	61	6.7 [7]	250 [5]
Indeno(1,2,3-cd)pyrene (Q)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	1.2	0.31 [7]	4.3 [5]
Isophorone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	900	860 [7]	3,700 [5]
N-Nitroso-di-n-propylamine	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	0.12 [1]	(B) [2]	0.5 [5]
N-Nitrosodiphenylamine (1)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	170	160 [7]	710 [5]
Naphthalene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	260	13 [7]	750 [5]
Nitrobenzene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	3.4	1900 [7]	9.6 [5]
Pentachlorophenol	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<20	1	2.3 [7]	1 [5]
Phenanthrene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	26 [7]	2.4 [7]	75 [5]
Phenol	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	4400 [1]	1100 [6]	13,000 [5]
Pyrene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<5	550 [1]	11000 [8]	1,600 [5]
Total Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	NA	NA			

Notes

[1] Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria, June 5, 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria, June 5, 1995

[3] Site Specific Background

[4] State Background MERA Operational Memorandum #15 Default Type A Cleanup Criteria, September 30, 1993

[5] GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[6] Industrial DW Criterion - Environmental Response Division Operational Memorandum #14 Revision 2 June 6, 1995

[7] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2 June 6, 1995

[8] GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that compound is not addressed in Operational Memorandums

Diesel Range Organics and Total Petroleum Hydrocarbons have no established criterion. The results are presented in mg/l

< - indicates that analyte was not detected at detection limit given

NR - Parameter not reported

J - Estimated value

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte present in method blank

ID - Insufficient data for calculation

iP - Development of generic GSI value in process but not yet complete

^ - Tentatively identified compounds present

[4] Data not broken down into isomers so the most conservative criteria was used which is cis

[1] Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria

TABLE 5-15
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - PESTICIDES AND PCBs

	PS-AS 96MO03S04	PS-AD EYW41	PS-BS 96MO03S06	PS-BD 96MO03S07	PS-CS EYW57	PS-CD EYW58	PS-CD Dup EYW61	PS-DS 96MO03S09	PS-DD 96MO03S10	PS-DD Dup 96MO03D10	PS-4 96MO03S13	PS-6 96MO03S03	PS-10A 96MO03S08	PS-11 EYW59	PS-12 96MO03S05	PS-13 96MO03S01	PS-104 96MO03S12	Residential Criteria	GSI Criterion	Industrial Criteria
Parameter	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
4,4'-DDD	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02	3.5	0.0084 [3]	3.5 [5]
4,4'-DDE	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02	2.5	0.0059 [3]	2.5 [5]
4,4'-DDT	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02	2.5	[illegible] E-5	2.5 [5]
Aldrin	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01	0.05 [4]	0.00014 [3]	0.05 [5]
alpha-BHC	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01			
Alpha-Chlordane	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01			
Aroclor 1016 [T]	<0.2	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2	<0.2		2.0E+5 [3]	
Aroclor 1221 [T]	<0.2	<2.0	<0.2	<0.2	<2.0	<2.0	<2.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2.0	<0.2	<0.2	<0.2		2.0E+5 [3]	
Aroclor 1232 [T]	<0.2	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2	<0.2		2.0E+5 [3]	
Aroclor 1242 [T]	<0.2	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2	<0.2		2.0E+5 [3]	
Aroclor 1248 [T]	<0.2	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2	<0.2		2.0E+5 [3]	
Aroclor 1254 [T]	<0.2	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2	<0.2		2.0E+5 [3]	
Aroclor 1260 [T]	<0.2	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2	<0.2		2.0E+5 [3]	
Beta-BHC	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01			
Chlordane, Technical	<0.2	NA	<0.2	<0.2	NA	NA	NA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	<0.2	<0.2	<0.2	2	IP	2 [5]
Delta-BHC	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01			
Dieldrin	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02	0.053	6.5 E-6 [3]	0.053 [5]
Endosulfan I	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01	1.7 [4]	(B) [8]	1.7 [6]
Endosulfan II	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02		(B) [8]	
Endosulfan sulfate	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02			
Endrin	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02	2 [4]	IP	2 [6]
Endrin aldehyde	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02			
Endrin ketone	<0.02	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.10	<0.02	<0.02	<0.02			
Gamma-BHC (Lindane)	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01		0.08 [3]	
Gamma-Chlordane	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01			
Heptachlor	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01	0.4	0.00018 [3]	0.4 [5]
Heptachlor epoxide	<0.01	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.050	<0.01	<0.01	<0.01	0.2	0.00007 [3]	0.2 [5]
Methoxychlor	<0.1	<0.50	<0.1	<0.1	<0.50	<0.50	<0.50	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.50	<0.1	<0.1	<0.1	40	(B) [8]	40 [5]
Toxaphene	<1	<5.0	<1	<1	<5.0	<5.0	<5.0	<1	<1	<1	<1	<1	<1	<1	<5.0	<1	<1	<1	3	6.8 E-5 [3]	3 [5]

Notes

[1] Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4 Generic Residential Cleanup Criteria, June 5 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8 Revision 4 Generic Residential Cleanup Criteria June 5 1995

[3] Site Specific Background

[4] State Background MERA Operational Memorandum #15 Default Type A Cleanup Criteria, September 30 1993

[5] GSI criterion - Amended version (November 3 1997) to Operational Memorandum #8 Revision 4 (June 5 1995)

[6] Industrial DW Criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6 1995

[7] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] 20X GSI Criterion - Operational Memorandum #8 Revision 4 (June 5 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that compound is not addressed in Operational Memorandums

< - indicates that analyte was not detected at detection limit given

NR - Parameter not reported

J - Estimated value

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B Analyte present in method blank

ID Insufficient data for calculation

IP Development of generic GSI value in process but not yet complete

^ Tentatively identified compounds present

(J) - Chemical may be present in several isomer forms Isomer specific concentrations must be combined for comparison to criteria

(T) - Toxic Substances Control Act, Subpart G PCB Spill Cleanup Policy standards may be more restrictive

TABLE 5-15
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - PESTICIDES AND PCBs

	PS-105S EYW43	PS-105D EYW44	PS-106 96MO03S11	PS-1R 96MO03S02	COP-1 EYW48	COP-2 EYW45	COP-3 EYW50	COP-4 EYW51	COP-5 EYW42	MW-201S EYW53	MW-202S EYW52	MW-203S EYW54	MW-203D EYW55	MW-204S EYW56	MW 205I EYW46	MW-205D EYW47	Ingalls Well EYW49	Residential Criteria	GSI Criterion	Industrial Criteria
arameter	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
4,4-DDD	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	3.5	0.0084 [5]	3.5 [5]
4,4-DDE	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	2.5	0.0059 [5]	2.5 [5]
4,4-DDT	<0.10	<0.10	<0.02	<0.02	**0.011 JP**	<0.10	**0.011 JP**	**0.023 JP**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	2.5	1.1E-5 [5]	2.5 [5]
Aldrin	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.05	0.0014 [5]	0.05 [5]
alpha- BHC	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050			
alpha-Chlordane	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050			
Aroclor 1016 (T)	<1.0	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		2.0E+5 [4]	
Aroclor 1221 (T)	<2.0	<2.0	<0.2	<0.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		2.0E+5 [4]	
Aroclor 1232 (T)	<1.0	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		2.0E+5 [4]	
Aroclor 1242 (T)	<1.0	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		2.0E+5 [4]	
Aroclor 1248 (T)	<1.0	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		2.0E+5 [4]	
Aroclor 1254 (T)	<1.0	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		2.0E+5 [4]	
Aroclor 1260 (T)	<1.0	<1.0	<0.2	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		2.0E+5 [4]	
beta BHC	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050			
Chlordane, Technical	NA	NA	<0.2	<0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	IP	2 [3]
delta-BHC	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050			
Dieldrin	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.053	6.5 E-6 [5]	0.053 [5]
Endosulfan I	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	1.7	(B) [3]	1.7 [3]
Endosulfan II	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10		(B) [3]	
Endosulfan sulfate	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
Endrin	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	2	IP	2 [3]
Endrin aldehyde	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	0.068 J	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
Endrin ketone	<0.10	<0.10	<0.02	<0.02	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
gamma BHC (Lindane)	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050		0.08 [4]	
gamma Chlordane	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050			
Heptachlor	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	0.066 P	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.4	0.00015 [5]	0.4 [5]
Heptachlor epoxide	<0.050	<0.050	<0.01	<0.01	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.2	0.00015 [5]	0.2 [5]
Methoxychlor	<0.50	<0.50	<0.1	<0.1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	40	18 [5]	40 [5]
Toxaphene	<5.0	<5.0	<1	<1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	3	6.8 E-5 [5]	3 [5]

Notes

[1] Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4, Generic Residential Cleanup Criteria, June 5, 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4, Generic Residential Cleanup Criteria, June 5, 1995

[3] Site Specific Background

[4] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[5] GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[6] Industrial DW Criterion - Environmental Response Division Operational Memorandum #14, Revision 2, June 6, 1995

[7] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14, Revision 2, June 6, 1995

[8] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that compound is not addressed in Operational Memorandums

< - indicates that analyte was not detected at detection limit given

NR - Parameter not reported

J - Estimated value

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte present in method blank

ID - Insufficient data for calculation

IP - Development of generic GSI value in process but not yet complete

^ - *Tentatively identified compounds present*

(J) - Chemical may be present in several isomer forms - Isomer specific concentrations must be combined for comparison to criteria

(T) - Toxic Substances Control Act, Subpart G PCB Spill Cleanup Policy standards may be more restrictive

TABLE 5-15
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - PESTICIDES AND PCBs

Parameter	Ingalls Well Dup EYW60 µg/l	PB-1 EYW62 µg/l	PB-2 EZT72 µg/l	PB-3 EZT73 µg/l	PB-4 EZT74 µg/l	PB-5 EZT75 µg/l	PB-6 EZT76 µg/l	PB-7 EZT77 µg/l	PB-8 EZT78 µg/l	PB-9 EZT79 µg/l	TB-1 96MO03R01 µg/l	Residential Criteria µg/l	GSI Criterion µg/l	Industrial Criteria µg/l
4,4'-DDD	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02	3.5 [1]	0.0084 [8]	3.5 [6]
4,4-DDE	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02	2.5 [1]	0.0059 [8]	2.5 [6]
4,4-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.011 JP**	<0.10	<0.10	<0.02	2.5 [1]	1.1E-5 [5]	2.5 [6]
Aldrin	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01	0.05 [1]	0.0014 [8]	0.05 [6]
alpha-BHC	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01			
alpha-Chlordane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01			
Aroclor-1016 (T)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.2		2.0E+5 [8]	
Aroclor-1221 (T)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<0.2		2.0E+5 [8]	
Aroclor-1232 (T)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.2		2.0E+5 [8]	
Aroclor-1242 (T)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.2		2.0E+5 [8]	
Aroclor-1248 (T)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.2		2.0E+5 [8]	
Aroclor-1254 (T)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.2		2.0E+5 [8]	
Aroclor-1260 (T)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.2		2.0E+5 [8]	
beta-BHC	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01			
Chlordane, Technical	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	2 [1]	IP	2 [6]
delta-BHC	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01			
Dieldrin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02	0.053 [1]	6.5E-6 [5]	0.053 [6]
Endosulfan I	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01	1.7 [1]	(B) [8]	1.7 [6]
Endosulfan II	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02		(B) [8]	
Endosulfan sulfate	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02			
Endrin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02	2 [1]	IP	2 [6]
Endrin aldehyde	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02			
Endrin ketone	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.02			
gamma-BHC (Lindane)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01		0.08 [8]	
gamma-Chlordane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01			
Heptachlor	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01	0.4	0.0016 [8]	0.4 [6]
Heptachlor epoxide	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01	0.2	0.0011 [8]	0.2 [6]
Methoxychlor	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.1	40 [1]	(B) [8]	40 [6]
Toxaphene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1	3 [1]	6.8E-5 [5]	3 [6]

Notes

[1] Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria, June 5, 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria, June 5, 1995

[3] Site Specific Background

[4] State Background, MERA Operational Memorandum #15: Default Type A Cleanup Criteria, September 30, 1993

[5] GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[6] Industrial DW Criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[7] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

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(J) - Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria

(T) Toxic Substances Control Act, Subpart G-PCB Spill Cleanup Policy standards may be more restrictive.

TABLE 5-16
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - METALS

Parameter	PS-AD MEYD41 µg/l	PS CS MEYD57 µg/l	PS-CD MEYD58 µg/l	PS-CD Dup MEYD61 µg/l	PS-11 MEYD59 µg/l	PS 105S MEYD43 µg/l	PS-105D MEYD44 µg/l	COP-1 MEYD48 µg/l	COP-2 MEYD45 µg/l	COP-3 MEYD50 µg/l	COP-4 MEYD51 µg/l	COP-5 MEYD42 µg/l	MW-201S MEYD53 µg/l	MW-202S MEYD52 µg/l	MW-203S MEYD54 µg/l	MW-203D MEYD55 µg/l	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
Aluminum	29.3 B	16.7 B	11.9 B	8.4 B	9.5 B	<21.0	<21.0	11.1 B	<21.0	<8.0	8.0 B	26.8 B	<8.0	8.4 B	12.3 B	<8.0	50 [1]	(B) [4]	50 [1]
Antimony	<3.0	5.4 B	<2.0	<2.0	<2.0	<3.0	<3.0	<2.0	<3.0	2.8 B	3.5 B	**6.3 B**	<2.0	<2.0	<2.0	<2.0	6 [2]	4.150 [5]	6 [3]
Arsenic	<2.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<4.0	2.0 B	<4.0	4.5 B	<2.0	<4.0	<4.0	<4.0	<4.0	50 [1]	45 [5]	50 [1]
Barium	43.3 B	24.1 B	58.8 B	58.6 B	69.0 B	31.9 B	43.2 B	26.9 B	26.5 B	75.1 B	55.3 B	16.7 B	48.2 B	64.5 B	70.3 B	43.6 B	2,000 [1]	190 [5]	2,000 [1]
Beryllium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	4 [1]	10 [5]	4 [1]
Cadmium	<1.0	<1.0	<1.0	<1.0	<1.0	**3.8 B**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1 B	<1.0	<1.0	<1.0	5 [1]	3.5 [5]	5 [1]
Calcium	65300	70300	104000	104000	106000	58500	58400	68000	79900	105000	117000	55800	12100	97600	108000	62700			
Chromium	3.5 B	2.9 B	2.4 B	3.8 B	2.9 B	2.6 B	2.4 B	3.0 B	**39.9**	3.4 B	2.5 B	2.0 B	4.7 B	2.4 B	2.3 B	3.1 B	100 [1]	11 [5]	100 [1]
Cobalt	1.4 B	<1.0	1.3 B	1.4 B	1.1 B	<1.0	<1.0	1.3 B	<1.0	<1.0	<1.0	<1.0	<1.0	1.0 B	10.8 B	<1.0	37 [1]	(B) [4]	100 [1]
Copper	<2.0	4.3 B	<1.0	1.1 B	<1.0	<1.0	<1.0	2.0 B	<2.0	1.2 B	<1.0	<1.0	<1.0	1.1 B	1.7 B	1.1 B	<1.0	1,000 [2]	15 [5]	1,000 [3]
Iron	**1250**	20.1 B	40.5 B	48.9 B	36.2 B	**317**	259	27.2 B	221	**384**	**1480**	21.9 B	**2580**	30.4 B	13.0	**1270**	300 [1]	(B) [4]	300 [1]
Lead	<1.0	<2.0	<2.0	<2.0	<2.0	**44.4**	<1.0	<2.0	<1.0	<2.0	<2.0	2.9 B	<2.0	<2.0	<2.0	<2.0	4 [1]	19 [5]	4 [1]
Magnesium	29900	13700	19800	19800	20700	24700	28600	17000	13900	15200	9800	14700	13800	16800	17500	30200	420000	(B) [4]	1.2 E+6 [3]
Manganese	27.1	4.3 B	2.5 B	2.6 B	<1.0	10.4 B	10.5 B	<1.0	4.2 B	**51.5**	**194**	14.2 B	**91.2**	12.1 B	4.7 B	36.0	50 [1]	(B) [4]	50 [1]
Mercury	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	2 [1]	0.0013 [5]	2 [1]
Nickel	2.1 B	3.5 B	2.7 B	4.0 B	2.2 B	1.5 B	1.3 B	2.0 B	29.3 B	3.4 B	2.7 B	3.0 B	3.2 B	21.6 B	6.1 B	2.2 B	100 [1]	85 [5]	100 [1]
Potassium	2860 B	3120 B	3740 B	3750 B	3530 B	3660 B	4400 B	2630 B	5210	3290 B	2710	4630 B	3200 B	3010 B	3160 B	1700 B			
Selenium	<3.0	<2.0	<2.0	2.2 B	<2.0	<3.0	<3.0	<2.0	<3.0	3.3 B	<2.0	<3.0	<2.0	<2.0	<2.0	<2.0	50 [1]	5 [5]	50 [3]
Silver	<1.0	<2.0	**2.1 B**	**2.1 B**	<2.0	<1.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	34 [1]	0.057 [5]	96 [3]
Sodium	21300	32900 E	79400 E	79100 E	49700 E	11100	12900	33200 E	30600	5920 E	4820 E	14200	23100 E	59200 E	45800 E	20900 E	160000 [1]	(B) [4]	4.5 E+5 [3]
Thallium	<4.0	<3.0	<3.0	<3.0	**3.9 B**	<4.0	**4.1 B**	**3.7 B**	**4.1 B**	**3.6 B**	<3.0	**4.4 B**	**4.7 B**	**3.7 B**	<3.0	**4.0 B**	2 [1]	3.7 [5]	2 [3]
Vanadium	<1.0	<1.0	1.1 B	1.2 B	<1.0	<1.0	<1.0	1.1 B	<1.0	<1.0	1.6 B	<1.0	<1.0	<1.0	<1.0	<1.0	64 [1]	8 [5]	180 [1]
Zinc	38.7	29 B	137	136	215	110	127 B	127	30.7	37.3	96 B	51 B	84 B	251	178 B	55 B	2,400 [1]	190 [5]	5,000 [1]

Notes

[1] Residential D/W Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4, Generic Residential Cleanup Criteria, June 5, 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4, Generic Residential Cleanup Criteria, June 5, 1995

[3] Site Specific Background

[4] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[5] GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[6] Industrial D/W Criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[7] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that compound is not addressed in Operational Memorandums

< - indicates that analyte was not detected at detection limit given

NR - Parameter not reported

J - Estimated value

(B) - Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte present in method blank

ID - Insufficient data for calculation

IP - Development of generic GSI value in process but not yet complete

^ - Tentatively identified compounds present

TABLE 5-16
PETOSKEY MANUFACTURING COMPANY SITE
GROUNDWATER SAMPLING - OCTOBER 1995
ANALYTICAL DATA - METALS

Parameter	MW 204S MEYD56 µg/l	MW-205I MEYD46 µg/l	MW-205D MEYD47 µg/l	Ingalls Well MEYD49 µg/l	Ingalls Well Dup MEYD60 µg/l	PB-1 MEYD62 µg/l	PB 2 MEYD63 µg/l	PB-3 MEYD64 µg/l	PB-4 MEYD65 µg/l	PB-5 MEYD66 µg/l	PB-6 MEYD67 µg/l	PB-7 MEYD68 µg/l	PB-8 MEYD69 µg/l	PB 9 MEYD70 µg/l	Residential Criterion µg/l	GSI Criterion µg/l	Industrial Criterion µg/l
Aluminum	<80	<210	<210	<210	<210	263 B	**504 B**	213 B	<210	248 B	<210	102 B	300 B	141 B	50 [1]	(B) [4]	50 [5]
Antimony	<20	<30	<30	36 B	34 B	**6.7 B**	4.1 B	<30	<30	<30	<30	<20	<20	<20	6	4.15 [3]	6
Arsenic	<40	23 B	<20	<20	<20	<20	<20	<20	<20	<20	<20	<40	<40	<10	50	10	50
Barium	70 1 B	258 B	280 B	281 B	286 B	<10	<10	<10	<10	<10	<10	11 B	25 B	17 B	2,000 [1]	100 [1]	2,000 [5]
Beryllium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	4	10	4
Cadmium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	5	3.6 [3]	5
Calcium	99400	68100	66100	65100	64200	282 B	184 B	231 B	588 B	551 B	190 B	907 B	1570 B	854 B			
Chromium	4 3 B	2 1 B	1 6 B	1 8 B	1 6 B	2 0 B	2 2 B	1 7 B	2 6 B	4 5 B	3 4 B	3 6 B	7 0 B	3 6 B	100	11	100 [5]
Cobalt	1 4 B	<10	<10	<10	<10	<10	1 1 B	<10	<10	<10	<10	<10	<10	<10	37	(B) [4]	100 [5]
Copper	1 2 B	<20	<20	5 1 B	3 1 B	6 1 B	4 6 B	<20	<20	2 1 B	<20	<10	1 5 B	<10	1,000 [1]	15 [3]	1,000 [5]
Iron	344 B	122	528 B	<110	<110	148 B	190 B	706 B	<110	273 B	234 B	188 B	372 B	441 B	300 [1]	(B) [4]	300 [5]
Lead	<20	<10	3 6	2 1 B	<10	<10	<10	<10	<10	<10	<10	<20	<20	<20	4	10 [3]	4
Magnesium	18200	23900	23800	16100	15900	92 2 B	<510	<510	<510	<510	<510	61 1 B	26 2 B	91 6 B	420000	(B) [4]	1 2 E+6 [5]
Manganese	23 6	31.3	20 8	<10	<10	1 8 B	<10	<10	<10	<10	<10	1 1 B	2 6 B	1 7 B	50 [1]	(B) [4]	50 [5]
Mercury	<0.20	<0.20	<0.20	<0 20	<0 20	<0 20	<0.20	<0 20	<0.20	<0 20	<0 20	<0 20	<0.20	<0 20	2 [1]	0 0013 [3]	2 [5]
Nickel	42.3	2.5 B	1 7 B	2.0 B	1 4 B	2 7 B	1.8 B	1 6 B	<1.0	1 2 B	1 2 B	2 2 B	4.0 B	2 2 B	100 [1]	85 [3]	100 [5]
Potassium	3250 B	4370 B	3150 B	3990	3580 B	<1730	<1730	<1730	<1730	<1730	<1730	56.4 B	106 B	74 2 B			
Selenium	<2.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<0.20	<3.0	<3.0	<3.0	<2.0	<2.0	<2.0	50 [1]	5 [3]	50 [5]
Silver	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	34 [1]	0 057 [3]	96 [5]
Sodium	64000 E	17600	14500	26600	26200	359 B	<295	<295	<295	<295	<295	96 5 BE	130 BE	215 BE	160000 [1]	(B) [4]	4 5 E+5 [5]
Thallium	**4.6 B**	**5.5 B**	**5.3 B**	**4.3 B**	<4.0	**4.0 B**	**4.6 B**	<4.0	<4.0	**4.0 B**	<4.0	<3.0	<3.0	<3.0	2 [1]	3 7 [3]	2 [5]
Vanadium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	64 [1]	8 [3]	180 [5]
Zinc	8 9 B	13 2 B	6 3 B	6 1 B	9 9 B	13 2 B	24 5	10 1 B	8 5 B	18 6 B	6 3 B	7 7 B	15 4 B	60 2	2,400 [1]	190	5,000 [5]

Notes

[1] Residential DW Criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4, Generic Residential Cleanup Criteria, June 5, 1995

[2] Residential Aesthetic drinking water criterion - Interim Environmental Response Division Operational Memorandum #8, Revision 4, Generic Residential Cleanup Criteria, June 5, 1995

[3] Site Specific Background

[4] State Background, MERA Operational Memorandum #15, Default Type A Cleanup Criteria, September 30, 1993

[5] GSI criterion - Amended version (November 3, 1997) to Operational Memorandum #8, Revision 4 (June 5, 1995)

[6] Industrial DW Criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[7] Industrial Aesthetic drinking water criterion - Environmental Response Division Operational Memorandum #14 Revision 2, June 6, 1995

[8] 20X GSI Criterion - Operational Memorandum #8, Revision 4 (June 5, 1995)

Exceedances are bolded.

Groundwater Contact Criteria was not included in this table because there were no detection limits which exceeded the criteria

Protective of Industrial Drinking Water values were included only if they differed from the Protective of Residential Drinking Water Values

A blank cell indicates that compound is not addressed in Operational Memorandums

< indicates that analyte was not detected at detection limit given

NR - Parameter not reported

J Estimated value

(B) Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value

B - Analyte present in method blank

ID - Insufficient data for calculation.

IP Development of generic GSI value in process but not yet complete

^ - Tentatively identified compounds present

TABLE 6-1

SUMMARY OF SHALLOW SOIL DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL			SITE BACKGROUND [1]		Elements in Michigan Soils [2]	
	Frequency	Range (mg/kg)	Frequency	Range (mg/kg)	Range (mg/kg)	Average (mg/kg)
VOLATILE ORGANICS						
Acetone	5 / 16	0.011 - 0.046	0 / 3	ND	NA	
Benzene	0 / 16	ND	0 / 3	ND	NA	
1,2-Dichloroethene (total)	1 / 16	0.006	0 / 3	ND	NA	
Ethylbenzene	1 / 16	0.006	0 / 3	ND	NA	
Methylene Chloride	11 / 16	0.003 - 0.05	1 / 3	0.046	NA	
Tetrachloroethene	2 / 16	0.012 - 0.05	0 / 3	ND	NA	
Toluene	3 / 16	0.009 - 0.018	2 / 3	0.009 - 0.056	NA	
Trichloroethene	4 / 16	0.023 - 0.46	0 / 3	ND	NA	
Xylenes (total)	1 / 16	0.033	3 / 3	0.002 - 0.004	NA	
SEMI-VOLATILE ORGANICS						
Acenapthene	4 / 16	0.140 - 6.6	0 / 4	ND	NA	
Anthracene	3 / 16	0.140 - 9.4	0 / 4	ND	NA	
Benzo[a]anthracene	5 / 16	0.040 - 0.19	1 / 4	0.17	NA	
Benzo[a]pyrene	4 / 16	0.120 - 0.2	2 / 4	0.15 - 0.69	NA	
Benzo[b]fluoranthene	5 / 16	0.051 - 0.35	1 / 4	0.33	NA	
Benzo[g,h,i]perylene	6 / 16	0.041 - 12	2 / 4	0.18 - 0.41	NA	
bis(2-Ethylhexyl) phthalate	5 / 16	0.026 - 5.1	1 / 4	0.074	NA	
Butyl benzyl phthalate	2 / 16	0.15 - 0.55	0 / 4	ND	NA	
Carbazole	4 / 16	0.16 - 7.8	0 / 4	ND	NA	
Chrysene	6 / 16	0.045 - 0.22	1 / 4	0.16	NA	
Di-n-butyl-phthalate	5 / 16	0.19 - 0.36	0 / 4	ND	NA	
Di-n-octyl phthalate	1 / 16	3.2	0 / 4	ND	NA	
Dibenz[a,h]anthracene	4 / 16	0.110 - 7.9	0 / 4	ND	NA	
Dibenzofuran	3 / 16	0.16 - 3.9	0 / 4	ND	NA	
Fluoranthene	7 / 16	0.079 - 3.6	1 / 4	0.22	NA	
Fluorene	4 / 16	0.130 - 7.1	0 / 4	ND	NA	
Indeno[1,2,3-cd]pyrene	7 / 16	0.043 - 13	2 / 4	0.18 - 0.32	NA	
2-Methylnaphthalene	0 / 16	ND	0 / 4	ND	NA	
Naphthalene	0 / 16	ND	0 / 4	ND	NA	
Phenanthrene	4 / 16	0.059 - 0.29	0 / 4	ND	NA	
Pyrene	6 / 16	0.086 - 0.41	1 / 4	0.19	NA	
PESTICIDES/PCBs						
Aldrin	1 / 16	0.002	0 / 4	ND	NA	
alpha-Chlordane	0 / 16	ND	1 / 4	0.00091	NA	
4-4'-DDD	1 / 16	0.0026	0 / 4	ND	NA	
4,4'-DDE	2 / 16	4.10E-04 - 0.0031	0 / 4	ND	NA	
4,4'-DDT	2 / 16	0.002 - 0.092	0 / 4	ND	NA	
Endosulfan I	1 / 16	0.0082	0 / 4	ND	NA	
Endosulfan II	1 / 16	0.0029	0 / 4	ND	NA	
PCBs	1 / 16	0.030	0 / 4	ND	NA	

TABLE 6-1

SUMMARY OF SHALLOW SOIL DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL			SITE BACKGROUND [1]		Elements in Michigan Soils [2]	
	Frequency	Range (mg/kg)	Frequency	Range (mg/kg)	Range (mg/kg)	Average (mg/kg)
INORGANICS						
Aluminum	17 / 17	1200 - 6090	4 / 4	1320 - 2440	,000 - >100,000	57000*
Antimony	1 / 17	14.2	0 / 4	ND	<1.0 - 3.0	<1.0
Arsenic	14 / 17	0.7 - 14	3 / 4	0.99 - 1.3	1.0 - 10	4
Barium	17 / 17	4.3 - 305	4 / 4	11.6 - 527	100 - 700	444
Beryllium	14 / 17	0.14 - 2.2	2 / 4	0.56 - 0.73	ND - 3.0	0.33
Cadmium	7 / 17	0.75 - 28.9	2 / 4	0.34 - 0.36	0.1 - 1.6**	0.7**
Calcium	17 / 17	4830 - 258000	4 / 4	1400 - 71700	100 - 280,000*	6300*
Chromium	17 / 17	1.2 - 27.4	4 / 4	2.4 - 4.2	3.0 - 70	26
Cobalt	14 / 17	0.62 - 3.5	4 / 4	0.79 - 1.2	ND - 15	3.7
Copper	16 / 17	2.6 - 39	4 / 4	0.87 - 14.8	<1.0 - 70	12
Iron	17 / 17	1460 - 15300	4 / 4	2380 - 4690	100 - >100,000*	25000*
Lead	17 / 17	1.6 - 306	4 / 4	10.9 - 44.1	ND - 30	11
Magnesium	17 / 17	1350 - 23000	4 / 4	417 - 5170	50 - 50,000*	4600*
Manganese	17 / 17	34.4 - 293	4 / 4	25.9 - 159	<2.0 - 7,000*	640*
Mercury	7 / 17	0.12 - 0.41	0 / 4	ND	0.02 - 1.20	0.264
Nickel	15 / 17	3.9 - 35.5	4 / 4	1.3 - 7.9	ND- 30	11
Potassium	16 / 17	124 - 805	4 / 4	173 - 450	50 - 37,000*	12000*
Selenium	3 / 17	0.95 - 20.7	0 / 4	ND	<0.1 - 3.7	0.49
Silver	5 / 17	0.23 - 3.7	0 / 4	ND	0.1 - 1.0**	0.18**
Sodium	17 / 17	32.8 - 419	4 / 4	55.3 - 129	<500 - 50,000*	7800*
Thallium	1 / 17	0.68	0 / 4	ND	0.25 - 10***	2.23***
Vanadium	17 / 17	2.5 - 16.8	4 / 4	3.1 - 7.7	ND - 150	44
Zinc	17 / 17	9.3 - 19700	4 / 4	18.7 - 355	9.0 - 95	48
OTHER						
Cyanide	2 / 17	2 - 2.4	0 / 4	ND	NA	

ND = Not Detected

NA = Not Applicable

1 Shallow soil background samples include samples with ID numbers and (depth in feet): B1 (1-3), B2 (1-3), 206 (0.5-2 5), 207 (0.5-2 Dragun and Chiasson, 1991

* Eastern USA

** Michigan sandy soils

*** Michigan lower peninsula soils

TABLE 6-2

CONPARISON OF SOILS DATA TO BACKGROUND SOIL DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL	SHALLOW SOIL Average (mg/kg)	SHALLOW SOIL BACKGROUND [1] 2X Average (rc) (mg/kg)	ALL SOILS Average (mg/kg)	ALL SOILS BACKGROUND [2] 2X Average (rc) (mg/kg)
Aluminum	2,600	3,825	2,402	3,217
Antimony	14.20	ND	11.28	30.80
Arsenic	3.49	2.33	2.24	2.18
Barium	55.31	293	32.33	130
Beryllium	0.74	1.29	1.27	2.31
Cadmium	6.35	0.70	5.50	0.76
Calcium	54,662	48,770 (1,000,000)	147,002	206,232 (1,000,000)
Chromium	7.40	5.85	7.40	5.63
Cobalt	1.64	2.07	1.77	1.85
Copper	17.74	12.29	12.01	10.05
Iron	4,702	6,275 (200,000)	4,248	5,776 (200,000)
Lead	205	53.85	105	27.38
Magnesium	7,184	4,823 (1,000,000)	14,792	18,125 (1,000,000)
Manganese	148	244	173	327
Mercury	0.21	ND	0.21	ND
Nickel	15.69	7.75	79.28	8.644
Potassium	364	545.5(1,000,000)	729	886 (1,000,000)
Selenium	7.58	ND	5.83	1.94
Silver	1.31	ND	1.31	ND
Sodium	112	157 (1,000,000)	159	261 (1,000,000)
Thallium	0.68	ND	0.68	ND
Vanadium	6.95	9.70	7.16	10.22
Zinc	3,435	247	1,659	118

ND = Not Detected

= Chemical of potential concern

rc = Reference Concentration

1 Shallow soil background samples include samples with ID numbers and (depth in feet): B1 (1-3), B2 (1-3), 206 (0.5-2.5), 207 (0.5-2.5).

2 All soils background samples include samples with ID numbers and (depth in feet): B1 (1-3), B2 (1-3), 206 (0.5-2.5), 207 (0.5-2.5), B1 (7-11), B1 (15-17), B2 (5-7), B2 (11-15), 206 (2.5-4.5), 207 (2.5-4.5).

TABLE 6-3

SUMMARY OF SUBSURFACE SOIL DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL			SITE BACKGROUND [1]		Elements in Michigan Soils [2]	
	Frequency	Range (mg/kg)	Frequency	Range (mg/kg)	Range (mg/kg)	Average (mg/kg)
VOLATILE ORGANICS						
Acetone	5 / 24	0.01 - 0.027	0 / 6	ND	NA	
Benzene	0 / 24	ND	1 / 6	0.001	NA	
1,2-Dichloroethene (total)	4 / 24	0.003 - 0.049	0 / 6	ND	NA	
Ethylbenzene	7 / 24	0.002 - 0.044	0 / 6	ND	NA	
Methylene Chloride	16 / 24	0.004 - 0.021	4 / 6	0.006 - 0.030	NA	
Tetrachloroethene	4 / 24	0.001 - 0.03	1 / 6	0.004	NA	
Toluene	7 / 24	0.003 - 0.024	2 / 6	0.045 - 0.070	NA	
Trichloroethene	19 / 24	0.001 - 0.83	0 / 6	ND	NA	
Xylenes (total)	13 / 24	0.003 - 0.24	3 / 6	0.003 - 0.006	NA	
SEMI-VOLATILE ORGANICS						
Acenapthene	1 / 23	0.34	0 / 6	ND	NA	
Anthracene	1 / 23	0.032	0 / 6	ND	NA	
Benzo[a]anthracene	3 / 23	0.034 - 0.32	0 / 6	ND	NA	
Benzo[a]pyrene	2 / 23	0.22 - 0.35	0 / 6	ND	NA	
Benzo[b]fluoranthene	1 / 23	0.36	0 / 6	ND	NA	
Benzo[g,h,i]perylene	3 / 23	0.19 - 0.26	0 / 6	ND	NA	
bis(2-Ethylhexyl)phthalate	7 / 23	0.029 - 4.3	0 / 6	ND	NA	
Butyl benzylphthalate	0 / 23	ND	0 / 6	ND	NA	
Carbazole	1 / 23	0.35	0 / 6	ND	NA	
Chrysene	2 / 23	0.029 - 0.28	0 / 6	ND	NA	
Di-n-butylphthalate	3 / 23	0.082 - 0.13	0 / 6	ND	NA	
Di-n-octyl phthalate	0 / 23	ND	0 / 6	ND	NA	
Dibenz[a,h]anthracene	2 / 23	0.13 - 0.19	0 / 6	ND	NA	
Dibenzofuran	2 / 23	0.023 - 0.25	0 / 6	ND	NA	
Fluoranthene	2 / 23	0.028 - 0.39	0 / 6	ND	NA	
Fluorene	0 / 23	ND	0 / 6	ND	NA	
Indeno[1,2,3-cd]pyrene	3 / 23	0.19 - 0.3	0 / 6	ND	NA	
2-Methylnaphthalene	1 / 23	0.075	0 / 6	ND	NA	
Naphthalene	1 / 23	0.12	0 / 6	ND	NA	
Phenanthrene	2 / 23	0.14 - 0.26	0 / 6	ND	NA	
Pyrene	2 / 23	0.036 - 0.27	0 / 6	ND	NA	
PESTICIDES/PCBs						
Aldrin	1 / 23	0.001	0 / 6	ND	NA	
alpha-Chlordane	0 / 23	ND	0 / 6	ND	NA	
4,4'-DDD	0 / 23	ND	0 / 6	ND	NA	
4,4'-DDE	1 / 23	0.00018	0 / 6	ND	NA	
4,4'-DDT	3 / 23	0.00064 - 0.0018	0 / 6	ND	NA	
Endosulfan I	0 / 23	ND	0 / 6	ND	NA	
Endosulfan II	0 / 23	ND	0 / 6	ND	NA	
PCBs	0 / 23	ND	0 / 6	ND	NA	

TABLE 6-3

SUMMARY OF SUBSURFACE SOIL DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL			SITE BACKGROUND [1]		Elements in Michigan Soils [2]	
	Frequency	Range (mg/kg)	Frequency	Range (mg/kg)	Range (mg/kg)	Average (mg/kg)
INORGANICS						
Aluminum	19 / 19	761 - 4590	6 / 6	993 - 2020	7,000 - >100,000*	57000*
Antimony	3 / 19	2.8 - 15	1 / 6	15.4	<1.0 - 3.0	<1.0
Arsenic	18 / 19	0.83 - 2.9	4 / 6	0.88 - 1.2	1.0 - 10	4
Barium	19 / 19	4.5 - 26.9	6 / 6	4.2 - 15.8	100 - 700	444
Beryllium	18 / 19	0.13 - 2.5	4 / 6	0.51 - 2.3	ND - 3.0	0.33
Cadmium	2 / 19	0.62 - 4.4	2 / 6	0.36 - 0.46	0.1 - 1.6**	0.7**
Calcium	19 / 19	23100 - 327000	6 / 6	1830 - 299000	100 - 280,000*	6300*
Chromium	5 / 19	1.1 - 19.8	2 / 6	2 - 3.2	3.0 - 70	26
Cobalt	10 / 19	1.1 - 3	4 / 6	0.49 - 1.1	ND - 15	3.7
Copper	19 / 19	3 - 11.5	6 / 6	1 - 8.3	<1.0 - 70	12
Iron	19 / 19	1960 - 5430	6 / 6	2070 - 3600	100 - >100,000*	25000*
Lead	19 / 19	1.1 - 185	6 / 6	1.9 - 13.6	ND - 30	11
Magnesium	19 / 19	6230 - 54900	6 / 6	570 - 27300	50 - 50,000*	4600*
Manganese	19 / 19	111 - 258	6 / 6	113 - 325	<2.0 - 7,000*	640*
Mercury	1 / 19	0.2	0 / 6	ND	0.02 - 1.20	0.264
Nickel	9 / 19	4.7 - 12.2	5 / 6	1.3 - 8.8	ND- 30	11
Potassium	19 / 19	339 - 2320	6 / 6	161 - 1220	50 - 37,000*	12000*
Selenium	1 / 19	0.58	1 / 6	0.97	<0.1 - 3.7	0.49
Silver	0 / 19	ND	0 / 6	ND	0.1 - 1.0**	0.18**
Sodium	19 / 19	56.4 - 327	6 / 6	64 - 252	<500 - 50,000*	7800*
Thallium	0 / 19	ND	0 / 6	ND	0.25 - 10***	2.23***
Vanadium	19 / 19	3.9 - 10.1	6 / 6	3.5 - 7.4	ND - 150	44
Zinc	19 / 19	9 - 580	6 / 6	6.1 - 23	9.0 - 95	48
OTHER						
Cyanide	0 / 19	ND	0 / 8	ND	NA	

ND = Not Detected

NA = Not Applicable

1 Subsurface soil background samples include samples with ID numbers and (depth in feet): B1 (7-11), B1 (15-17), B2 (5-7), B2 (11-15), 206 (2.5-4.5), 207 (2.5-4.5).

2 Dragun and Chiasson, 1991

* Eastern USA

** Michigan sandy soils

*** Michigan lower peninsula soils

TABLE 6-4

SUMMARY OF ALL SOILS DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL			SITE BACKGROUND [1]		Elements in Michigan Soils [2]	
	Frequency	Range (mg/kg)	Frequency	Range (mg/kg)	Range (mg/kg)	Average (mg/kg)
VOLATILE ORGANICS						
Acetone	10 / 40	0.01 - 0.046	0 / 9	ND	NA	
Benzene	0 / 40	ND	1 / 9	0.001	NA	
1,2-Dichloroethene (total)	5 / 40	0.003 - 0.049	0 / 9	ND	NA	
Ethylbenzene	8 / 40	0.002 - 0.044	0 / 9	ND	NA	
Methylene Chloride	27 / 40	0.003 - 0.05	5 / 9	0.006 - 0.030	NA	
Tetrachloroethene	6 / 40	0.001 - 0.05	1 / 9	0.004	NA	
Toluene	10 / 40	0.003 - 0.024	4 / 9	0.009 - 0.070	NA	
Trichloroethene	23 / 40	0.001 - 0.83	0 / 9	ND	NA	
lenes (total)	14 / 40	0.003 - 0.24	6 / 9	0.002 - 0.006	NA	
SEMI-VOLATILE ORGANICS						
Acenapthene	5 / 39	0.14 - 6.6	0 / 10	ND	NA	
Anthracene	4 / 39	0.032 - 9.4	0 / 10	ND	NA	
Benzo[a]anthracene	8 / 39	0.034 - 0.32	1 / 10	0.17	NA	
Benzo[a]pyrene	6 / 39	0.12 - 0.35	2 / 10	0.15 - 0.69	NA	
Benzo[b]fluoranthene	6 / 39	0.051 - 0.36	1 / 10	0.33	NA	
Benzo[g,h,i]perylene	9 / 39	0.041 - 12	2 / 10	0.18 - 0.41	NA	
bis(2-Ethylhexyl)phthalate	12 / 39	0.026 - 5.1	1 / 10	0.074 - 0.00	NA	
Butyl benzylphthalate	2 / 39	0.15 - 0.55	0 / 10	ND	NA	
Carbazole	5 / 39	0.16 - 7.8	0 / 10	ND	NA	
Chrysene	8 / 39	0.029 - 0.28	1 / 10	0.16	NA	
Di-n-butylphthalate	8 / 39	0.082 - 0.36	0 / 10	ND	NA	
Di-n-octyl phthalate	1 / 39	3.2	0 / 10	ND	NA	
Dibenz[a,h]anthracene	6 / 39	0.11 - 7.9	0 / 10	ND	NA	
benzofuran	5 / 39	0.023 - 3.9	0 / 10	ND	NA	
Fluoranthene	9 / 39	0.028 - 3.6	1 / 10	0.22	NA	
Fluorene	4 / 39	0.13 - 7.1	0 / 10	ND	NA	
Indeno[1,2,3-cd]pyrene	10 / 39	0.043 - 13	2 / 10	0.18 - 0.32	NA	
2-Methylnaphthalene	1 / 39	0.075	0 / 10	ND	NA	
Naphthalene	1 / 39	0.12	0 / 10	ND	NA	
Phenanthrene	6 / 39	0.059 - 0.29	0 / 10	ND	NA	
Pyrene	8 / 39	0.036 - 0.41	1 / 10	0.19	NA	
PESTICIDES/PCBs						
Aldrin	2 / 39	0.001 - 0.002	0 / 10	ND	NA	
alpha-Chlordane	0 / 39	ND	1 / 10	0.00091	NA	
4,4'-DDD	1 / 39	0.0026	0 / 10	ND	NA	
4,4'-DDE	3 / 39	0.0002 - 0.0031	0 / 10	ND	NA	
4,4'-DDT	5 / 39	0.0006 - 0.092	0 / 10	ND	NA	
Endosulfan I	1 / 39	0.0082	0 / 10	ND	NA	
Endosulfan II	1 / 39	0.0029	0 / 10	ND	NA	
PCBs	1 / 39	0.03	0 / 10	ND	NA	

TABLE 6-4

SUMMARY OF ALL SOILS DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL			SITE BACKGROUND [1]		Elements in Michigan Soils [2]	
	Frequency	Range (mg/kg)	Frequency	Range (mg/kg)	Range (mg/kg)	Average (mg/kg)
INORGANICS						
Aluminum	36 / 36	761 - 6090	10 / 10	993 - 2440	7,000 - >100,000*	57000*
Antimony	4 / 36	2.8 - 15	1 / 10	15.40	<1.0 - 3.0	<1.0
Arsenic	32 / 36	0.7 - 14	7 / 10	0.88 - 1.3	1.0 - 10	4
Barium	36 / 36	4.3 - 305	10 / 10	4.2 - 527	100 - 700	444
Beryllium	32 / 36	0.13 - 2.5	6 / 10	0.51 - 2.30	ND - 3.0	0.33
Cadmium	9 / 36	0.62 - 28.9	4 / 10	0.34 - 0.46	0.1 - 1.6**	0.7**
Calcium	36 / 36	4830 - 327000	10 / 10	1400 - 299000	100 - 280,000*	6300*
Chromium	22 / 36	1.1 - 27.4	6 / 10	2.00 - 4.20	3.0 - 70	26
Cobalt	24 / 36	0.62 - 3.5	8 / 10	0.49 - 1.20	ND - 15	3.7
Copper	35 / 36	2.6 - 39	10 / 10	0.87 - 15	<1.0 - 70	12
Iron	36 / 36	1460 - 15300	10 / 10	2070 - 4690	100 - >100,000*	25000*
Lead	36 / 36	1.1 - 306	10 / 10	1.90 - 44	ND - 30	11
Magnesium	36 / 36	1350 - 54900	10 / 10	417 - 27300	50 - 50,000*	4600*
Manganese	36 / 36	34.4 - 293	10 / 10	25.90 - 325	<2.0 - 7,000*	640*
Mercury	8 / 36	0.12 - 0.41	0 / 10	ND	0.02 - 1.20	0.264
Nickel	24 / 36	3.9 - 35.5	9 / 10	1.30 - 8.8	ND- 30	11
Potassium	35 / 36	124 - 2320	10 / 10	161 - 1220	50 - 37,000*	12000*
Selenium	4 / 36	0.58 - 20.7	1 / 10	0.97	<0.1 - 3.7	0.49
Silver	5 / 36	0.23 - 3.7	0 / 10	ND	0.1 - 1.0**	0.18**
Sodium	36 / 36	32.8 - 419	10 / 10	55.3 - 252	<500 - 50,000*	7800*
Thallium	1 / 36	0.68	0 / 10	ND	0.25 - 10***	2.23***
Vanadium	36 / 36	2.5 - 16.8	10 / 10	3.1 - 7.7	ND - 150	44
Zinc	36 / 36	9 - 19700	10 / 10	6.1 - 355	9.0 - 95	48
OTHER						
Cyanide	2 / 36	2 - 2.4	0 / 12	ND	NA	

ND = Not Detected
NA = Not Applicable
1 All soils background samples include samples with ID numbers and (depth in feet): B1 (1-3), B2 (1-3), 206 (0.5-2.5), 207 (0.5-2.5), B1 (7-11), B1 (15-17), B2 (5-7), B2 (11-15), 206 (2.5-4.5), 207 (2.5-4.5).
2 Dragun and Chiasson, 1991
* Eastern USA
** Michigan sandy soils
*** Michigan lower peninsula soils

TABLE 6-5

SUMMARY OF GROUNDWATER DATA
PETOSKEY MANUFACTURING SITE

CHEMICAL	GROUNDWATER			SITE BACKGROUND [1]		
	Frequency		Range (mg/l)	Frequency		Range (rc) (mg/l)
	Hits	Total	Min Max	Hits	Total	Min Max
VOLATILE ORGANICS						
Carbon Disulfide	0	27	ND	1	5	0.001
1,2-Dichloroethene (total)	4	27	0.0009 - 0.004	0	5	ND
Methylene Chloride	1	27	0.005	0	5	ND
Trichloroethene	6	27	0.013 - 0.082	0	5	ND
Tetrachloroethene	1	27	0.0008	2	5	0.001 - 0.002
Vinyl Chloride	2	27	0.001 - 0.016	0	5	ND
SEMI-VOLATILE ORGANICS						
Acenaphthene	1	27	0.0001	0	5	ND
Diethyl phthalate	1	27	0.0004	0	5	ND
PESTICIDES/PCBs						
Heptachlor	1	27	0.000066	0	5	ND
Endrin aldehyde	1	27	0.000068	0	5	ND
INORGANICS						
Aluminum	0	18	ND	1	1	0.0293
Arsenic	3	18	0.002 - 0.0045	0	1	ND
Barium	18	18	0.0167 - 0.0751	1	1	0.0433
Cadmium	2	18	0.0011 - 0.0038	0	1	ND
Calcium	18	18	55.8 - 121	1	1	65.3(400)
Chromium	1	18	0.0399	1	1	0.0015
Cobalt	1	18	0.019	0	1	ND
Iron	4	18	0.0528 - 2.58	1	1	1.25(5)
Lead	4	18	0.0021 - 0.0444	0	1	ND
Magnesium	18	18	9.8 - 30.2	1	1	29.9(40)
Manganese	10	18	0.0105 - 0.194	1	1	0.0271
Nickel	3	18	0.0216 - 0.0423	0	1	ND
Potassium	18	18	1.7 - 5.21	1	1	2.86(500)
Selenium	2	18	0.0022 - 0.0033	0	1	ND
Silver	1	18	0.0021	0	1	ND
Sodium	18	18	4.82 - 79.4	1	1	21.3(500)
Vanadium	3	18	0.0011 - 0.0016	0	1	ND
Zinc	11	18	0.0051 - 0.137	1	1	0.0387

ND = Not Detected

NA = Not Applicable

1 Background samples collected by Malcolm Pirnie, Inc. in 1995 include: PS-AS, PS-AD, PS-1R, PS-6, PS-13. note: only PS-AD was analyzed for inorganic chemicals.

rc = Reference Concentration

TABLE 6-6

CHEMICALS OF POTENTIAL CONCERN
PETOSKEY MANUFACTURING SITE

CHEMICAL	GROUNDWATER	SHALLOW SOIL	SUBSURFACE SOIL	ALL SOILS
VOLATILE ORGANICS				
Acetone	ND	X	X	X
1,2-Dichloroethene (total)	X	X	X	X
Ethylbenzene	ND	X	X	X
Methylene Chloride	•	X	X	X
Tetrachloroethene	•	X	X	X
Toluene	ND	X	X	X
Trichloroethene	X	X	X	X
Vinyl Chloride	X	ND	ND	ND
Xylenes (total)	ND	X	X	X
SEMI-VOLATILE ORGANICS				
Acenapthene	•	X	NA	X
Anthracene	ND	X	NA	X
Benzo[a]anthracene	ND	X	NA	X
Benzo[a]pyrene	ND	X	NA	X
Benzo[b]fluoranthene	ND	X	NA	X
Benzo[g,h,i]perylene	ND	X	NA	X
bis(2-Ethylhexyl)phthalate	ND	X	NA	X
Butyl benzylphthalate	ND	X	NA	X
Carbazole	ND	X	NA	X
Chrysene	ND	X	NA	X
Di-n-butylphthalate	ND	X	NA	X
Di-n-octyl phthalate	ND	X	NA	•
Dibenz[a,h]anthracene	ND	X	NA	X
Dibenzofuran	ND	X	NA	X
Fluoranthene	ND	X	NA	X
Fluorene	ND	X	NA	X
Indeno[1,2,3-cd]pyrene	ND	X	NA	X
Phenanthrene	ND	X	NA	X
Pyrene	ND	X	NA	X
PESTICIDES/PCBs				
Aldrin	ND	X	NA	X
4,4'-DDD	ND	X	NA	•
4,4'-DDE	ND	X	NA	X
4,4'-DDT	ND	X	NA	X
Endosulfan I	ND	X	NA	•
Endosulfan II	ND	X	NA	•
PCBs	ND	X	NA	•

TABLE 6-6

CHEMICALS OF POTENTIAL CONCERN
PETOSKEY MANUFACTURING SITE

CHEMICAL	GROUNDWATER	SHALLOW SOIL	SUBSURFACE SOIL	ALL SOILS
INORGANICS				
Antimony	ND	X	NA	•
Arsenic	X	X	NA	X
Barium	X	•	NA	•
Cadmium	X	X	NA	X
Chromium	X	X	NA	X
Cobalt	X	•	NA	•
Copper	ND	X	NA	X
Lead	X	X	NA	X
Manganese	X	•	NA	•
Mercury	ND	X	NA	X
Nickel	X	X	NA	X
Selenium	X	X	NA	X
Silver	X	X	NA	X
Thallium	ND	X	NA	X
Vanadium	X	•	NA	•
Zinc	X	X	NA	X
OTHER				
Cyanide	ND	X	NA	X

ND : Not Detected
• : Detected but not chosen as a chemical of potential concern
X : Selected as a chemical of potential concern
NA : Not Applicable

TABLE 6-7

GENERIC EQUATION FOR CALCULATING CHEMICAL INTAKES
PETOSKEY MANUFACTURING SITE

$$CDI = \frac{C \times CR \times EFD}{BW} \times \frac{1}{AT}$$

Where:

CDI	=	Chronic Daily Intake; the amount of chemical at the exchange boundary (mg/kg body weight-day)
C	=	Chemical concentration; the "average" concentration contacted over the exposure period (e.g., mg/liters water)
CR	=	Contact Rate; the amount of contaminated medium contacted per unit time or event (e.g. liters/day)
EFD	=	exposure frequency and duration; describes how long and how often exposure occurs; often calculated using two terms (EF and ED)
	EF =	exposure frequency (days/year)
	ED =	exposure duration (years)
BW	=	Body Weight; the average body weight over the exposure period (kg)
AT	=	Averaging Time; time period over which exposure is averaged (days)

TABLE 6-8
SUMMARY OF EXPOSURE PARAMETERS FOR
INGESTION OF AND DERMAL CONTACT WITH SOIL
PETOSKEY MANUFACTURING SITE

Population	Ingestion Rate (mg/event)	Fraction Ingested (unitless)	Exposure Frequency (events/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time for Noncarcinogenic Effects (days x years)
Ingestion						
Adolescent Trespasser (Ages 12 - 15 years)	100 [1]	1.0*	50 [2]	3 [2]	48.7 [3]	1095
PMC Worker	50 [1]	1.0*	112 [4]	30 [1]	70 [1]	10950
Adult Resident	100[1]	1.0*	350[1]	24 or30* [1]	70[1]	10950
Child Resident (Ages 0 - 6 years)	200[1]	1.0*	350[1]	6[1]	15[1]	2190
Construction Worker	480 [1]	1.0*	80 [2]	2 [2]	70 [1]	730
Additional Exposure Parameters:						
Chemical Concentration (mg/kg)	Chemical specific	Depending on the sample size, the 95 percent upper confidence limit on the mean of measured concentrations (except when it exceeds the maximum detected concnetration) or the maximum detected concentration.				
Conversion Factor (kg/mg)	1.00E-06					
AveragingTime for Carcinogenic Effects (days)	25550	Period of exposure for carcinogenic effects (70 years x 365 days)				

TABLE 6-8
SUMMARY OF EXPOSURE PARAMETERS FOR
INGESTION OF AND DERMAL CONTACT WITH SOIL
PETOSKEY MANUFACTURING SITE

Population	Surface Area (cm^2/event)	Exposure Frequency (events/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time for Noncarcinogenic Effects (days x years)
Dermal Contact					
Adolescent Trespasser (Ages 12 - 15 years)	3687 [3]	50 [2]	3 [2]	48.7 [3]	1095
PMC Worker	2570 [4]	112 [4]	30 [1]	70 [1]	10950
Adult Resident	5000 [5]	245 [5]	24 or 30* [1]	70[1]	10950
Child Resident (Ages 0 - 6 years)	1820 [5]	245 [5]	6[1]	15[1]	2190
Construction Worker	4100 [3]	80 [2]	2 [2]	70 [1]	730

Additional Exposure Parameters:		
Chemical Concentration (mg/kg)	Chemical specific	Depending on the sample size, the 95 percent upper confidence limit on the mean of measured concentrations (except when it exceeds the maximum detected concnetration) or the maximum detected concentration.
Conversion Factor (kg/mg)	1.00E-06	
Soil Application Rate (mg/cm^2)	1.00	
Absorption Factor (unitless)	Chemical specific	Relative amount of substance on the skin that penetrates through the epidermis into the body.
AveragingTime for Carcinogenic Effects (days)	25550	Period of exposure for carcinogenic effects (70 years x 365 days)

TABLE 6-8
SUMMARY OF EXPOSURE PARAMETERS FOR
INGESTION OF, DERMAL CONTACT WITH, AND INHALATION OF GROUNDWATER
PETOSKEY MANUFACTURING SITE

Population	Ingestion Rate (l/day)	Exposure Frequency (events/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time for Noncarcinogenic Effects (days x years)
Ingestion					
Adult Resident	2 [1]	350 [1]	30 [1]	70 [1]	10950
Child Resident (Ages 0 - 6 years)	1 [6]	350 [1]	6 [1]	15 [1]	2190
Additional Exposure Parameters:					
Chemical Concentration (mg/l)	Chemical specific	the 95 percent upper confidence limit on the mean of measured concentrations (except when it exceeds the maximum detected concentration) or the maximum detected concentrations.			
AveragingTime for Carcinogenic Effects (days)	25550	Period of exposure for carcinogenic effects (70 years x 365 days)			

Population	Surface Area (cm^2)	Exposure Time (hrs/day)	Exposure Frequency (events/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time for Noncarcinogenic Effects (days x years)
Dermal Contact						
Adult Resident	19400 [7]	0.3 [2]	350 [1]	30 [1]	70 [1]	10950
Child Resident (Ages 0 - 6 years)	6980 [7]	0.3 [2]	350 [1]	6 [1]	15 [1]	2190
Additional Exposure Parameters:						
Chemical Concentration (mg/l)	Chemical specific	the 95 percent upper confidence limit on the mean of measured concentrations (except when it exceeds the maximum detected concentration) or the maximum detected concentrations.				
Permeability Coefficient (cm/hr)	Chemical specific	See Appendix F				
Conversion Factor (l/cu.cm)	1.00E-03					
AveragingTime for Carcinogenic Effects (days)	25550	Period of exposure for carcinogenic effects (70 years x 365 days)				

TABLE 6-8

SUMMARY OF EXPOSURE PARAMETERS FOR

INGESTION OF, DERMAL CONTACT WITH, AND INHALATION OF GROUNDWATER

PETOSKEY MANUFACTURING SITE

Population	Inhalation Rate (cu.m/hr)	Exposure Time (hours/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time for Noncarcinogenic Effects (days x years)
Inhalation						
Adult Resident	0.83[3]	0.3 [2]	350 [1]	30 [1]	70 [1]	10950
Child Resident (Ages 0 - 6 years)	0.6[3]	0.3 [2]	350 [1]	6 [1]	15 [1]	2190
Additional Exposure Parameters:						
Chemical Concentration (mg/l)	Chemical specific	the 95 percent upper confidence limit on the mean of measured concentrations (except when it exceeds the maximum detected concentration) or the maximum detected concentrations.				
AveragingTime for Carcinogenic Effects (days)	25550	Period of exposure for carcinogenic effects (70 years x 365 days)				

TABLE 6-8

SUMMARY OF EXPOSURE PARAMETERS FOR
INHALATION OF VOLATILE ORGANIC COMPOUNDS AND RESPIRABLE PARTICULATES
PETOSKEY MANUFACTURING SITE

Population	Inhalation Rate (m^3/hour)	Exposure Time (hours/day)	Exposure Frequency (days/years)	Exposure Duration (years)	Body Weight (kg)	Averaging Time for Noncarcinogenic Effects (days x years)
Respirable Particulate						
Construction Worker	2.3 [3]	8 [2]	80 [2]	2 [2]	70 [1]	365
VOC Intrusion						
Adult Resident, Off-site	0.83[3]	17[3]	350[1]	30 [1]	70 [1]	10950
Child Resident, Off-site (Ages 0 - 6 years)	0.6[3]	17[3]	350[1]	6[1]	15[1]	2190
Additional Exposure Parameters:						
Contaminant Concentration in Air (mg/cu.m)	Chemical specific		Estimated ambient air concentration.			
Averaging Time for Carcinogenic Effects (days)	25550		Period of exposure for carcinogenic effects (70 years x 365 days).			

* Assumes all sediment or soil is contaminated.

[1] USEPA, 1991
[2] Professional judgement
[3] USEPA, 1989a
[4] MDEQ, 1995b
[5] MDEQ, 1995a
[6] USEPA, 1989b
[7] USEPA, 1992a

TABLE 6-9
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADOLESCENT TRESPASSER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS								
Acetone	1.37E-02	UCL	4E-09	1.00E-01	4E-08	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	2E-09	9.00E-03	2E-07	7E-11	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	2E-09	1.00E-01	2E-08	Not Applicable		
Methylene Chloride	1.98E-02	UCL	6E-09	6.00E-02	9E-08	2E-10	7.50E-03	2E-12
Tetrachloroethene	1.08E-02	UCL	3E-09	1.00E-02	3E-07	1E-10	5.20E-02	7E-12
Toluene	8.42E-03	UCL	2E-09	2.00E-01	1E-08	Not Applicable		
Trichloroethene	1.25E-01	UCL	4E-08	6.00E-03	6E-06	2E-09	1.10E-02	2E-11
Xylenes (total)	8.71E-03	UCL	2E-09	2.00E+00	1E-09	Not Applicable		
SEMI-VOLATILE ORGANICS								
Acenaphthene	6.58E-01	UCL	2E-07	6.00E-02	3E-06	Not Applicable		
Anthracene	8.82E-01	UCL	2E-07	3.00E-01	8E-07	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	9E-07	Not Available	No Tox Data	4E-08	7.30E-01	3E-08
Benzo[a]pyrene	1.90E+00	UCL	5E-07	Not Available	No Tox Data	2E-08	7.30E+00	2E-07
Benzo[b]fluoranthene	5.61E+00	UCL	2E-06	Not Available	No Tox Data	7E-08	7.30E-01	5E-08
Benzo[ghi]perylene	1.32E+00	UCL	4E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	6E-07	2.00E-02	3E-05	2E-08	1.40E-02	3E-10
Butyl benzyl phthalate	5.50E-01	MAX	2E-07	2.00E-01	8E-07	7E-09	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	2E-07	Not Available	No Tox Data	9E-09	2.00E-02	2E-10
Chrysene	3.45E+00	UCL	1E-06	Not Available	No Tox Data	4E-08	7.30E-03	3E-10
Dibenz[a,h]anthracene	7.37E-01	UCL	2E-07	Not Available	No Tox Data	9E-09	7.30E+00	6E-08
Dibenzofuran	4.71E-01	UCL	1E-07	4.00E-03	3E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1E-07	1.00E-01	1E-06	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	3E-07	2.00E-02	2E-05	1E-08	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	3E-06	4.00E-02	7E-05	Not Applicable		
Fluorene	6.89E-01	UCL	2E-07	4.00E-02	5E-06	Not Applicable		

TABLE 6-9
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADOLESCENT TRESPASSER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL								
CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
SEMI-VOLATILE ORGANICS								
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	4E-07	Not Available	No Tox Data	2E-08	7.30E-01	1E-08
Phenanthrene	6.52E+00	UCL	2E-06	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	1E-06	3.00E-02	4E-05	Not Applicable		
PESTICIDES/PCBs								
Aldrin	2.00E-03	MAX	6E-10	3.00E-05	2E-05	2E-11	1.70E+01	4E-10
4-4'-DDD	2.60E-03	MAX	7E-10	Not Available	No Tox Data	3E-11	2.40E-01	8E-12
4,4'-DDE	3.10E-03	MAX	9E-10	Not Available	No Tox Data	4E-11	3.40E-01	1E-11
4,4'-DDT	3.81E-02	UCL	1E-08	5.00E-04	2E-05	5E-10	3.40E-01	2E-10
Endosulfan I	8.20E-03	MAX	2E-09	6.00E-03	4E-07	Not Applicable		
Endosulfan II	2.90E-03	MAX	8E-10	6.00E-03	1E-07	Not Applicable		
PCBs	3.00E-02	MAX	8E-09	2.00E-05	4E-04	4E-10	2.00E+00	7E-10

TABLE 6-9
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADOLESCENT TRESPASSER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
INORGANICS								
Antimony	4.18E+00	UCL	1E-06	4.00E-04	3E-03	5E-08	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	2E-06	3.00E-04	5E-03	7E-08	1.50E+00	1E-07
Cadmium	6.89E+00	UCL	2E-06	1.00E-03	2E-03	8E-08	Not Available	No Tox Data
Chromium	1.24E+01	UCL	3E-06	1.00E+00	3E-06	1E-07	Not Available	No Tox Data
Copper	3.86E+01	UCL	1E-05	3.70E-02	3E-04	Not Applicable		
Lead	3.06E+02	MAX	9E-05	Not Available	No Tox Data	4E-06	Not Available	No Tox Data
Mercury	2.61E-01	UCL	7E-08	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	7E-06	2.00E-02	3E-04	3E-07	Not Available	No Tox Data
Selenium	1.79E+00	UCL	5E-07	5.00E-03	1E-04	Not Applicable		
Silver	1.16E+00	UCL	3E-07	5.00E-03	7E-05	Not Applicable		
Thallium	4.94E-01	UCL	1E-07	Not Available	No Tox Data	6E-09	Not Available	No Tox Data
Zinc	1.97E+04	MAX	6E-03	3.00E-01	2E-02	Not Applicable		
OTHER								
Cyanide	7.05E-01	UCL	2E-07	2.00E-02	1E-05	Not Applicable		
				HAZARD INDEX:	**3E-02**		**CANCER RISK:**	**4E-07**

CDI of noncarcinogenic chemicals in shallow soil via ingestion (adolescent trespasser):
(mg/kg soil * 1.00E-06 kg/mg * 100 mg/day * 1 * 50 days/year * 3 years)/(48.7 kg * 1095 days)
CDI of carcinogenic chemicals in shallow soil via ingestion (adolescent trespasser):
(mg/kg soil * 1.00E-06 kg/mg * 100 mg/day * 1 * 50 days/year * 3 years)/(48.7 kg * 25550 days)

TABLE 6-9
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADOLESCENT TRESPASSER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
Acetone	1.37E-02	UCL	1.00E-01	1E-08	1.00E-01	1E-07	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	1.00E-01	6E-09	9.00E-03	7E-07	3E-10	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	1.00E-01	6E-09	1.00E-01	6E-08	Not Applicable		
Methylene Chloride	1.98E-02	UCL	1.00E-01	2E-08	6.00E-02	3E-07	9E-10	7.50E-03	7E-12
Tetrachloroethene	1.08E-02	UCL	1.00E-01	1E-08	1.00E-02	1E-06	5E-10	5.20E-02	2E-11
Toluene	8.42E-03	UCL	1.00E-01	9E-09	2.00E-01	4E-08	Not Applicable		
Trichloroethene	1.25E-01	UCL	1.00E-01	1E-07	6.00E-03	2E-05	6E-09	1.10E-02	6E-11
Xylenes (total)	8.71E-03	UCL	1.00E-01	9E-09	2.00E+00	5E-09	Not Applicable		
SEMI-VOLATILE ORGANICS									
Acenaphthene	6.58E-01	UCL	1.00E-02	7E-08	6.00E-02	1E-06	Not Applicable		
Anthracene	8.82E-01	UCL	1.00E-03	9E-09	3.00E-01	3E-08	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	1.00E-02	3E-07	Not Available	No Tox Data	1E-08	7.30E-01	1E-08
Benzo[a]pyrene	1.90E+00	UCL	1.00E-02	2E-07	Not Available	No Tox Data	8E-09	7.30E+00	6E-08
Benzo[b]fluoranthene	5.61E+00	UCL	1.00E-02	6E-07	Not Available	No Tox Data	2E-08	7.30E-01	2E-08
Benzo[ghi]perylene	1.32E+00	UCL	1.00E-02	1E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	1.00E-02	2E-07	2.00E-02	1E-05	9E-09	1.40E-02	1E-10
Butyl benzyl phthalate	5.50E-01	MAX	1.00E-02	6E-08	2.00E-01	3E-07	2E-09	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	1.00E-02	8E-08	Not Available	No Tox Data	3E-09	2.00E-02	7E-11
Chrysene	3.45E+00	UCL	1.00E-02	4E-07	Not Available	No Tox Data	2E-08	7.30E-03	1E-10
Dibenz[a,h]anthracene	7.37E-01	UCL	1.00E-02	8E-08	Not Available	No Tox Data	3E-09	7.30E+00	2E-08
Dibenzofuran	4.71E-01	UCL	1.00E-02	5E-08	4.00E-03	1E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.00E-02	4E-08	1.00E-01	4E-07	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	1.00E-02	1E-07	2.00E-02	6E-06	6E-09	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	1.00E-02	1E-06	4.00E-02	2E-05	Not Applicable		
Fluorene	6.89E-01	UCL	1.00E-02	7E-08	4.00E-02	2E-06	Not Applicable		

TABLE 6-9
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADOLESCENT TRESPASSER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS									
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	1.00E-02	2E-07	Not Available	No Tox Data	7E-09	7.30E-01	5E-09
Phenanthrene	6.52E+00	UCL	1.00E-02	7E-07	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	1.00E-02	5E-07	3.00E-02	2E-05	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	1.00E-02	2E-10	3.00E-05	7E-06	9E-12	1.70E+01	2E-10
4-4'-DDD	2.60E-03	MAX	1.00E-02	3E-10	Not Available	No Tox Data	1E-11	2.40E-01	3E-12
4,4'-DDE	3.10E-03	MAX	1.00E-02	3E-10	Not Available	No Tox Data	1E-11	3.40E-01	5E-12
4,4'-DDT	3.81E-02	UCL	1.00E-02	4E-09	5.00E-04	8E-06	2E-10	3.40E-01	6E-11
Endosulfan I	8.20E-03	MAX	1.00E-02	9E-10	6.00E-03	1E-07	Not Applicable		
Endosulfan II	2.90E-03	MAX	1.00E-02	3E-10	6.00E-03	5E-08	Not Applicable		
PCBs	3.00E-02	MAX	1.00E-02	3E-09	2.00E-05	2E-04	1E-10	2.00E+00	3E-10

TABLE 6-9
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADOLESCENT TRESPASSER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
INORGANICS									
Antimony	4.18E+00	UCL	1.00E-02	4E-07	4.00E-05	1E-02	2E-08	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	1.00E-02	6E-07	2.40E-04	3E-03	3E-08	1.88E+00	5E-08
Cadmium	6.89E+00	UCL	1.00E-02	7E-07	5.00E-05	1E-02	3E-08	Not Available	No Tox Data
Chromium	1.24E+01	UCL	1.00E-02	1E-06	1.00E-02	1E-04	6E-08	Not Available	No Tox Data
Copper	3.86E+01	UCL	1.00E-02	4E-06	1.85E-02	2E-04	Not Applicable		
Lead	3.06E+02	MAX	1.00E-02	3E-05	Not Available	No Tox Data	1E-06	Not Available	No Tox Data
Mercury	2.61E-01	UCL	1.00E-02	3E-08	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	1.00E-02	3E-06	2.00E-03	1E-03	1E-07	Not Available	No Tox Data
Selenium	1.79E+00	UCL	1.00E-02	2E-07	4.50E-03	4E-05	Not Applicable		
Silver	1.16E+00	UCL	1.00E-02	1E-07	5.00E-04	2E-04	Not Applicable		
Thallium	4.94E-01	UCL	1.00E-02	5E-08	Not Available	No Tox Data	2E-09	Not Available	No Tox Data
Zinc	1.97E+04	MAX	1.00E-02	2E-03	1.20E-01	2E-02	Not Applicable		
OTHER									
Cyanide	7.05E-01	UCL	1.00E-02	7E-08	2.00E-02	4E-06	Not Applicable		
					HAZARD INDEX:	5E-02		**CANCER RISK:**	2E-07

CDI of noncarcinogenic chemicals in shallow soil via dermal contact (adolescent trespasser):
(mg/kg soil * 1.00E-06 kg/mg * 1.00 mg/cm^2 * ABS * 3687 cm^2/event * 50 events /year * 3 years)/(48.7 kg * 1095 days)
CDI of carcinogenic chemicals in shallow soil via dermal contact (adolescent trespasser):
(mg/kg soil * 1.00E-06 kg/mg *1.00 mg/cm^2 * ABS * 3687 cm^2/event * 50 events/year * 3 years)/(48.7 kg * 25550 days)

TABLE 6-10
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A PMC WORKER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL								
CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS								
Acetone	1.37E-02	UCL	3E-09	1.00E-01	3E-08	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	1E-09	9.00E-03	1E-07	6E-10	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	1E-09	1.00E-01	1E-08	Not Applicable		
Methylene Chloride	1.98E-02	UCL	4E-09	6.00E-02	7E-08	2E-09	7.50E-03	1E-11
Tetrachloroethene	1.08E-02	UCL	2E-09	1.00E-02	2E-07	1E-09	5.20E-02	5E-11
Toluene	8.42E-03	UCL	2E-09	2.00E-01	9E-09	Not Applicable		
Trichloroethene	1.25E-01	UCL	3E-08	6.00E-03	5E-06	1E-08	1.10E-02	1E-10
Xylenes (total)	8.71E-03	UCL	2E-09	2.00E+00	1E-09	Not Applicable		
SEMI-VOLATILE ORGANICS								
Acenaphthene	6.58E-01	UCL	1E-07	6.00E-02	2E-06	Not Applicable		
Anthracene	8.82E-01	UCL	2E-07	3.00E-01	6E-07	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	7E-07	Not Available	No Tox Data	3E-07	7.30E-01	2E-07
Benzo[a]pyrene	1.90E+00	UCL	4E-07	Not Available	No Tox Data	2E-07	7.30E+00	1E-06
Benzo[b]fluoranthene	5.61E+00	UCL	1E-06	Not Available	No Tox Data	5E-07	7.30E-01	4E-07
Benzo[ghi]perylene	1.32E+00	UCL	3E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	4E-07	2.00E-02	2E-05	2E-07	1.40E-02	3E-09
Butyl benzyl phthalate	5.50E-01	MAX	1E-07	2.00E-01	6E-07	5E-08	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	2E-07	Not Available	No Tox Data	7E-08	2.00E-02	1E-09
Chrysene	3.45E+00	UCL	8E-07	Not Available	No Tox Data	3E-07	7.30E-03	2E-09
Dibenz[a,h]anthracene	7.37E-01	UCL	2E-07	Not Available	No Tox Data	7E-08	7.30E+00	5E-07
Dibenzofuran	4.71E-01	UCL	1E-07	4.00E-03	3E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	8E-08	1.00E-01	8E-07	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	3E-07	2.00E-02	1E-05	1E-07	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	2E-06	4.00E-02	5E-05	Not Applicable		
Fluorene	6.89E-01	UCL	2E-07	4.00E-02	4E-06	Not Applicable		

TABLE 6-10
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A PMC WORKER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS								
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	3E-07	Not Available	No Tox Data	1E-07	7.30E-01	1E-07
Phenanthrene	6.52E+00	UCL	1E-06	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	1E-06	3.00E-02	3E-05	Not Applicable		
PESTICIDES/PCBs								
Aldrin	2.00E-03	MAX	4E-10	3.00E-05	1E-05	2E-10	1.70E+01	3E-09
4-4'-DDD	2.60E-03	MAX	6E-10	Not Available	No Tox Data	2E-10	2.40E-01	6E-11
4,4'-DDE	3.10E-03	MAX	7E-10	Not Available	No Tox Data	3E-10	3.40E-01	1E-10
4,4'-DDT	3.81E-02	UCL	8E-09	5.00E-04	2E-05	4E-09	3.40E-01	1E-09
Endosulfan I	8.20E-03	MAX	2E-09	6.00E-03	3E-07	Not Applicable		
Endosulfan II	2.90E-03	MAX	6E-10	6.00E-03	1E-07	Not Applicable		
PCBs	3.00E-02	MAX	7E-09	2.00E-05	3E-04	3E-09	2.00E+00	6E-09

TABLE 6-10
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A PMC WORKER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
INORGANICS								
Antimony	4.18E+00	UCL	9E-07	4.00E-04	2E-03	4E-07	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	1E-06	3.00E-04	4E-03	6E-07	1.50E+00	8E-07
Cadmium	6.89E+00	UCL	2E-06	1.00E-03	2E-03	6E-07	Not Available	No Tox Data
Chromium	1.24E+01	UCL	3E-06	1.00E+00	3E-06	1E-06	Not Available	No Tox Data
Copper	3.86E+01	UCL	8E-06	3.70E-02	2E-04	Not Applicable		
Lead	3.06E+02	MAX	7E-05	Not Available	No Tox Data	3E-05	Not Available	No Tox Data
Mercury	2.61E-01	UCL	6E-08	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	5E-06	2.00E-02	3E-04	2E-06	Not Available	No Tox Data
Selenium	1.79E+00	UCL	4E-07	5.00E-03	8E-05	Not Applicable		
Silver	1.16E+00	UCL	3E-07	5.00E-03	5E-05	Not Applicable		
Thallium	4.94E-01	UCL	1E-07	Not Available	No Tox Data	5E-08	Not Available	No Tox Data
Zinc	1.97E+04	MAX	4E-03	3.00E-01	1E-02	Not Applicable		
OTHER								
Cyanide	7.05E-01	UCL	2E-07	2.00E-02	8E-06	Not Applicable		
				HAZARD INDEX:	**2E-02**		**CANCER RISK:**	**3E-06**

CDI of noncarcinogenic chemicals in shallow soil via ingestion (PMC worker):
(mg/kg soil * 1.00E-06 kg/mg * 50 mg/day * 1 * 112 days/year * 30 years)/(70 kg * 10950 days)
CDI of carcinogenic chemicals in shallow soil via ingestion (PMC worker):
(mg/kg soil * 1.00E-06 kg/mg * 50 mg/day * 1 * 112 days/year * 30 years)/(70 kg * 25550 days)

TABLE 6-10
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A PMC WORKER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
Acetone	1.37E-02	UCL	1.00E-01	2E-08	1.00E-01	2E-07	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	1.00E-01	7E-09	9.00E-03	8E-07	3E-09	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	1.00E-01	7E-09	1.00E-01	7E-08	Not Applicable		
Methylene Chloride	1.98E-02	UCL	1.00E-01	2E-08	6.00E-02	4E-07	1E-08	7.50E-03	7E-11
Tetrachloroethene	1.08E-02	UCL	1.00E-01	1E-08	1.00E-02	1E-06	5E-09	5.20E-02	3E-10
Toluene	8.42E-03	UCL	1.00E-01	9E-09	2.00E-01	5E-08	Not Applicable		
Trichloroethene	1.25E-01	UCL	1.00E-01	1E-07	6.00E-03	2E-05	6E-08	1.10E-02	7E-10
Xylenes (total)	8.71E-03	UCL	1.00E-01	1E-08	2.00E+00	5E-09	Not Applicable		
SEMI-VOLATILE ORGANICS									
Acenaphthene	6.58E-01	UCL	1.00E-02	7E-08	6.00E-02	1E-06	Not Applicable		
Anthracene	8.82E-01	UCL	1.00E-02	1E-07	3.00E-01	3E-07	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	1.00E-02	4E-07	Not Available	No Tox Data	2E-07	7.30E-01	1E-07
Benzo[a]pyrene	1.90E+00	UCL	1.00E-02	2E-07	Not Available	No Tox Data	9E-08	7.30E+00	7E-07
Benzo[b]fluoranthene	5.61E+00	UCL	1.00E-02	6E-07	Not Available	No Tox Data	3E-07	7.30E-01	2E-07
Benzo[ghi]perylene	1.32E+00	UCL	1.00E-02	1E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	1.00E-02	2E-07	2.00E-02	1E-05	1E-07	1.40E-02	1E-09
Butyl benzyl phthalate	5.50E-01	MAX	1.00E-02	6E-08	2.00E-01	3E-07	3E-08	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	1.00E-02	9E-08	Not Available	No Tox Data	4E-08	2.00E-02	8E-10
Chrysene	3.45E+00	UCL	1.00E-02	4E-07	Not Available	No Tox Data	2E-07	7.30E-03	1E-09
Dibenz[a,h]anthracene	7.37E-01	UCL	1.00E-02	8E-08	Not Available	No Tox Data	4E-08	7.30E+00	3E-07
Dibenzofuran	4.71E-01	UCL	1.00E-02	5E-08	4.00E-03	1E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.00E-02	4E-08	1.00E-01	4E-07	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	1.00E-02	1E-07	2.00E-02	7E-06	6E-08	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	1.00E-02	1E-06	4.00E-02	3E-05	Not Applicable		
Fluorene	6.89E-01	UCL	1.00E-02	8E-08	4.00E-02	2E-06	Not Applicable		

TABLE 6-10
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A PMC WORKER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS									
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	1.00E-02	2E-07	Not Available	No Tox Data	7E-08	7.30E-01	5E-08
Phenanthrene	6.52E+00	UCL	1.00E-02	7E-07	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	1.00E-02	5E-07	3.00E-02	2E-05	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	1.00E-02	2E-10	3.00E-05	8E-06	1E-10	1.70E+01	2E-09
4-4'-DDD	2.60E-03	MAX	1.00E-02	3E-10	Not Available	No Tox Data	1E-10	2.40E-01	3E-11
4,4'-DDE	3.10E-03	MAX	1.00E-02	3E-10	Not Available	No Tox Data	1E-10	3.40E-01	5E-11
4,4'-DDT	3.81E-02	UCL	1.00E-02	4E-09	5.00E-04	9E-06	2E-09	3.40E-01	6E-10
Endosulfan I	8.20E-03	MAX	1.00E-02	9E-10	6.00E-03	2E-07	Not Applicable		
Endosulfan II	2.90E-03	MAX	1.00E-02	3E-10	6.00E-03	5E-08	Not Applicable		
PCBs	3.00E-02	MAX	1.00E-02	3E-09	2.00E-05	2E-04	1E-09	2.00E+00	3E-09

TABLE 6-10
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A PMC WORKER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
INORGANICS									
Antimony	4.18E+00	UCL	1.00E-02	5E-07	4.00E-05	1E-02	2E-07	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	1.00E-02	7E-07	2.40E-04	3E-03	3E-07	1.88E+00	5E-07
Cadmium	6.89E+00	UCL	1.00E-02	8E-07	5.00E-05	2E-02	3E-07	Not Available	No Tox Data
Chromium	1.24E+01	UCL	1.00E-02	1E-06	1.00E-02	1E-04	6E-07	Not Available	No Tox Data
Copper	3.86E+01	UCL	1.00E-02	4E-06	1.85E-02	2E-04	Not Applicable		
Lead	3.06E+02	MAX	1.00E-02	3E-05	Not Available	No Tox Data	1E-05	Not Available	No Tox Data
Mercury	2.61E-01	UCL	1.00E-02	3E-08	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	1.00E-02	3E-06	2.00E-03	1E-03	1E-06	Not Available	No Tox Data
Selenium	1.79E+00	UCL	1.00E-02	2E-07	4.50E-03	4E-05	Not Applicable		
Silver	1.16E+00	UCL	1.00E-02	1E-07	5.00E-04	3E-04	Not Applicable		
Thallium	4.94E-01	UCL	1.00E-02	6E-08	Not Available	No Tox Data	2E-08	Not Available	No Tox Data
Zinc	1.97E+04	MAX	1.00E-02	2E-03	1.20E-01	2E-02	Not Applicable		
OTHER									
Cyanide	7.05E-01	UCL	1.00E-02	8E-08	2.00E-02	4E-06	Not Applicable		
						HAZARD INDEX:	**5E-02**	**CANCER RISK:**	**2E-06**

CDI of noncarcinogenic chemicals in shallow soil via dermal contact (PMC worker):

(mg/kg soil * 1.00E-06 kg/mg * 1.00 mg/cm^2 * ABS * 2570 cm^2/event * 112 events /year * 30 years)/(70 kg * 10950 days)

CDI of carcinogenic chemicals in shallow soil via dermal contact (PMC worker):

(mg/kg soil * 1.00E-06 kg/mg *1.00 mg/cm^2 * ABS * 2570 cm^2/event * 112 events/year * 30 years)/(70 kg * 25550 days)

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS								
Acetone	9.64E-03	UCL	1E-08	1.00E-01	1E-07	Not Applicable		
1,2-Dichloroethene (total)	7.83E-03	UCL	1E-08	9.00E-03	1E-06	4E-09	Not Available	No Tox Data
Ethylbenzene	7.63E-03	UCL	1E-08	1.00E-01	1E-07	Not Applicable		
Methylene Chloride	1.19E-02	UCL	2E-08	6.00E-02	3E-07	6E-09	7.50E-03	4E-11
Tetrachloroethene	7.97E-03	UCL	1E-08	1.00E-02	1E-06	4E-09	5.20E-02	2E-10
Toluene	7.55E-03	UCL	1E-08	2.00E-01	5E-08	Not Applicable		
Trichloroethene	1.65E-01	UCL	2E-07	6.00E-03	4E-05	8E-08	1.10E-02	9E-10
Xylenes (total)	1.24E-02	UCL	2E-08	2.00E+00	8E-09	Not Applicable		
SEMI-VOLATILE ORGANICS								
Acenaphthene	4.12E-01	UCL	6E-07	6.00E-02	9E-06	Not Applicable		
Anthracene	4.80E-01	UCL	7E-07	3.00E-01	2E-06	Not Applicable		
Benzo[a]anthracene	7.67E-01	UCL	1E-06	Not Available	No Tox Data	4E-07	7.30E-01	3E-07
Benzo[a]pyrene	6.07E-01	UCL	8E-07	Not Available	No Tox Data	3E-07	7.30E+00	2E-06
Benzo[b]fluoranthene	1.02E+00	UCL	1E-06	Not Available	No Tox Data	5E-07	7.30E-01	3E-07
Benzo[ghi]perylene	4.98E-01	UCL	7E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	9.02E-01	UCL	1E-06	2.00E-02	6E-05	4E-07	1.40E-02	6E-09
Butyl benzyl phthalate	4.21E-01	UCL	6E-07	2.00E-01	3E-06	2E-07	Not Available	No Tox Data
Carbazole	4.39E-01	UCL	6E-07	Not Available	No Tox Data	2E-07	2.00E-02	4E-09
Chrysene	7.91E-01	UCL	1E-06	Not Available	No Tox Data	4E-07	7.30E-03	3E-09
Dibenz[a,h]anthracene	4.09E-01	UCL	6E-07	Not Available	No Tox Data	2E-07	7.30E+00	1E-06
Dibenzofuran	3.86E-01	UCL	5E-07	4.00E-03	1E-04	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	5E-07	1.00E-01	5E-06	Not Applicable		
Fluoranthene	1.40E+00	UCL	2E-06	4.00E-02	5E-05	Not Applicable		
Fluorene	4.22E-01	UCL	6E-07	4.00E-02	1E-05	Not Applicable		
Indeno[1,2,3-cd]pyrene	5.19E-01	UCL	7E-07	Not Available	No Tox Data	2E-07	7.30E-01	2E-07

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS								
CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
SEMI-VOLATILE ORGANICS								
Phenanthrene	9.99E-01	UCL	1E-06	Not Available	No Tox Data	Not Applicable		
Pyrene	9.50E-01	UCL	1E-06	3.00E-02	4E-05	Not Applicable		
PESTICIDES/PCBs								
Aldrin	2.00E-03	MAX	3E-09	3.00E-05	9E-05	9E-10	1.70E+01	2E-08
4,4'-DDE	3.10E-03	MAX	4E-09	Not Available	No Tox Data	1E-09	3.40E-01	5E-10
4,4'-DDT	7.70E-03	UCL	1E-08	5.00E-04	2E-05	4E-09	3.40E-01	1E-09
INORGANICS								
Arsenic	2.45E+00	UCL	3E-06	3.00E-04	1E-02	1E-06	1.50E+00	
Cadmium	2.20E+00	UCL	3E-06	5.00E-04	6E-03	1E-06	Not Available	No Tox Data
Chromium	8.87E+00	UCL	1E-05	1.00E+00	1E-05	4E-06	Not Available	No Tox Data
Copper	1.58E+01	UCL	2E-05	3.70E-02	6E-04	Not Applicable		
Lead	1.94E+02	UCL	3E-04	Not Available	No Tox Data	9E-05	Not Available	No Tox Data
Mercury	1.14E-01	UCL	2E-07	Not Available	No Tox Data	Not Applicable		
Nickel	1.28E+01	UCL	2E-05	2.00E-02	9E-04	6E-06	Not Available	No Tox Data
Selenium	7.01E-01	UCL	1E-06	5.00E-03	2E-04	Not Applicable		
Silver	6.74E-01	UCL	9E-07	5.00E-03	2E-04	Not Applicable		
Thallium	4.19E-01	UCL	6E-07	Not Available	No Tox Data	2E-07	Not Available	No Tox Data
Zinc	1.35E+04	UCL	2E-02	3.00E-01	6E-02	Not Applicable		

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
OTHER								
Cyanide	4.19E-01	UCL	6E-07	2.00E-02	3E-05	Not Applicable		
				HAZARD INDEX:	**8E-02**		**CANCER RISK:**	**4E-06**

CDI of noncarcinogenic chemicals in all soils via ingestion (adult resident):
(mg/kg soil * 1.00E-06 kg/mg * 100 mg/day * 1 * 350 days/year * 30 years)/(70 kg * 10950 days)
CDI of carcinogenic chemicals in all soils via ingestion (adult resident):
(mg/kg soil * 1.00E-06 kg/mg * 100 mg/day * 1 * 350 days/year * 24 years)/(70 kg * 25550 days)

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS										
CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS									
Acetone	9.64E-03	UCL	1.00E-01	5E-08	1.00E-01	5E-07	Not Applicable		
1,2-Dichloroethene (total)	7.83E-03	UCL	1.00E-01	4E-08	9.00E-03	4E-06	1E-08	Not Available	No Tox Data
Ethylbenzene	7.63E-03	UCL	1.00E-01	4E-08	1.00E-01	4E-07	Not Applicable		
Methylene Chloride	1.19E-02	UCL	1.00E-01	6E-08	6.00E-02	1E-06	2E-08	7.50E-03	1E-10
Tetrachloroethene	7.97E-03	UCL	1.00E-01	4E-08	1.00E-02	4E-06	1E-08	5.20E-02	7E-10
Toluene	7.55E-03	UCL	1.00E-01	4E-08	2.00E-01	2E-07	Not Applicable		
Trichloroethene	1.65E-01	UCL	1.00E-01	8E-07	6.00E-03	1E-04	3E-07	1.10E-02	3E-09
Xylenes (total)	1.24E-02	UCL	1.00E-01	6E-08	2.00E+00	3E-08	Not Applicable		
SEMI-VOLATILE ORGANICS									
Acenaphthene	4.12E-01	UCL	1.00E-02	2E-07	6.00E-02	3E-06	Not Applicable		
Anthracene	4.80E-01	UCL	1.00E-02	2E-07	3.00E-01	8E-07	Not Applicable		
Benzo[a]anthracene	7.67E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	1E-07	7.30E-01	9E-08
Benzo[a]pyrene	6.07E-01	UCL	1.00E-02	3E-07	Not Available	No Tox Data	1E-07	7.30E+00	7E-07
Benzo[b]fluoranthene	1.02E+00	UCL	1.00E-02	5E-07	Not Available	No Tox Data	2E-07	7.30E-01	1E-07
Benzo[ghi]perylene	4.98E-01	UCL	1.00E-02	2E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	9.02E-01	UCL	1.00E-02	4E-07	2.00E-02	2E-05	1E-07	1.40E-02	2E-09
Butyl benzyl phthalate	4.21E-01	UCL	1.00E-02	2E-07	2.00E-01	1E-06	7E-08	Not Available	No Tox Data
Carbazole	4.39E-01	UCL	1.00E-02	2E-07	Not Available	No Tox Data	7E-08	2.00E-02	1E-09
Chrysene	7.91E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	1E-07	7.30E-03	9E-10
Dibenz[a,h]anthracene	4.09E-01	UCL	1.00E-02	2E-07	Not Available	No Tox Data	7E-08	7.30E+00	5E-07
Dibenzofuran	3.86E-01	UCL	1.00E-02	2E-07	4.00E-03	5E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.00E-02	2E-07	1.00E-01	2E-06	Not Applicable		
Fluoranthene	1.40E+00	UCL	1.00E-02	7E-07	4.00E-02	2E-05	Not Applicable		
Fluorene	4.22E-01	UCL	1.00E-02	2E-07	4.00E-02	5E-06	Not Applicable		

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS									
CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
SEMI-VOLATILE ORGANICS									
Indeno[1,2,3-cd]pyrene	5.19E-01	UCL	1.00E-02	2E-07	Not Available	No Tox Data	9E-08	7.30E-01	6E-08
Phenanthrene	9.99E-01	UCL	1.00E-02	5E-07	Not Available	No Tox Data	Not Applicable		
Pyrene	9.50E-01	UCL	1.00E-02	5E-07	3.00E-02	2E-05	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	1.00E-02	1E-09	3.00E-05	3E-05	3E-10	1.70E+01	6E-09
4,4'-DDE	3.10E-03	MAX	1.00E-02	1E-09	Not Available	No Tox Data	5E-10	3.40E-01	2E-10
4,4'-DDT	7.70E-03	UCL	1.00E-02	4E-09	5.00E-04	7E-06	1E-09	3.40E-01	4E-10
INORGANICS									
Arsenic	2.45E+00	UCL	1.00E-02	1E-06	2.40E-04	5E-03	4E-07	1.88E+00	8E-07
Cadmium	2.20E+00	UCL	1.00E-02	1E-06	2.50E-05	4E-02	4E-07	Not Available	No Tox Data
Chromium	8.87E+00	UCL	1.00E-02	4E-06	1.00E-02	4E-04	1E-06	Not Available	No Tox Data
Copper	1.58E+01	UCL	1.00E-02	8E-06	1.85E-02	4E-04	Not Applicable		
Lead	1.94E+02	UCL	1.00E-02	9E-05	Not Available	No Tox Data	3E-05	Not Available	No Tox Data
Mercury	1.14E-01	UCL	1.00E-02	5E-08	Not Available	No Tox Data	Not Applicable		
Nickel	1.28E+01	UCL	1.00E-02	6E-06	2.00E-03	3E-03	2E-06	Not Available	No Tox Data
Selenium	7.01E-01	UCL	1.00E-02	3E-07	4.50E-03	7E-05	Not Applicable		
Silver	6.74E-01	UCL	1.00E-02	3E-07	5.00E-04	6E-04	Not Applicable		
Thallium	4.19E-01	UCL	1.00E-02	2E-07	Not Available	No Tox Data	7E-08	Not Available	No Tox Data
Zinc	1.35E+04	UCL	1.00E-02	6E-03	1.20E-01	5E-02	Not Applicable		

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
OTHER									
Cyanide	4.19E-01	UCL	1.00E-02	2E-07	2.00E-02	1E-05	Not Applicable		
						HAZARD INDE	**1E-01**	**CANCER RISK:**	**2E-06**

CDI of noncarcinogenic chemicals in all soils via dermal contact (adult resident):
(mg/kg soil * 1.00E-06 kg/mg * 1.00 mg/cm^2 * ABS * 5000 cm^2/event * 245 events /year * 30 years)/(70 kg * 10950 days)
CDI of carcinogenic chemicals in all soils via dermal contact (adult resident):
(mg/kg soil * 1.00E-06 kg/mg *1.00 mg/cm^2 * ABS * 5000 cm^2/event * 245 events/year * 24 years)/(70 kg * 25550 days)

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INGESTION OF CHEMICALS IN GROUNDWATER

CHEMICAL	WATER CONCENTRATION (mg/l)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS								
1,2-Dichloroethene(total)	4.00E-03	MAX	1E-04	9.00E-03	1E-02	5E-05	Not Available	No Tox Data
Trichloroethene	3.14E-02	UCL	9E-04	6.00E-03	1E-01	4E-04	1.10E-02	4E-06
Vinyl Chloride	8.47E-03	UCL	2E-04	Not Available	No Tox Data	1E-04	1.90E+00	2E-04
INORGANICS								
Arsenic	2.27E-03	UCL	6E-05	3.00E-04	2E-01	3E-05	1.50E+00	4E-05
Barium	5.68E-02	UCL	2E-03	7.00E-02	2E-02	7E-04	Not Available	No Tox Data
Cadmium	8.50E-04	UCL	2E-05	5.00E-04	5E-02	1E-05	Not Available	No Tox Data
Chromium	3.99E-02	MAX	1E-03	1.00E+00	1E-03	5E-04	Not Available	No Tox Data
Cobalt	2.54E-03	UCL	7E-05	6.00E-02	1E-03	3E-05	Not Available	No Tox Data
Lead	4.32E-03	UCL	1E-04	Not Available	No Tox Data	5E-05	Not Available	No Tox Data
Manganese	1.94E-01	MAX	5E-03	2.30E-02	2E-01	Not Applicable	Not Available	
Nickel	4.23E-02	MAX	1E-03	2.00E-02	6E-02	5E-04	Not Available	No Tox Data
Selenium	1.61E-03	UCL	4E-05	5.00E-03	9E-03	Not Applicable	Not Available	
Silver	1.06E-03	UCL	3E-05	5.00E-03	6E-03	Not Applicable	Not Available	
Vanadium	7.42E-04	UCL	2E-05	7.00E-03	3E-03	9E-06	Not Available	No Tox Data
Zinc	1.37E-01	MAX	4E-03	3.00E-01	1E-02	Not Applicable	Not Available	
				HAZARD INDEX:	**8E-01**		**CANCER RISK:**	**2E-04**

CDI for noncarcinogenic chemicals in groundwater via ingestion (adult resident):
(mg/l water * 2 l/day * 350 days/year * 30 years)/(70 kg * 10950 days)
CDI for carcinogenic chemicals in groundwater via ingestion (adult resident):
(mg/l water * 2 l/day * 350 days/year * 30 years)/(70 kg * 25550 days)

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN GROUNDWATER									
CHEMICAL	WATER CONCENTRATION (mg/l)		PERMEABILITY CONSTANT (cm/hour)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS									
1,2-Dichloroethene(total)	4.00E-03	MAX	1.00E-02	3E-06	9.00E-03	4E-04	1E-06	Not Available	No Tox Data
Trichloroethene	3.14E-02	UCL	1.60E-02	4E-05	6.00E-03	7E-03	2E-05	1.10E-02	2E-07
Vinyl Chloride	8.47E-03	UCL	7.30E-03	5E-06	Not Available	No Tox Data	2E-06	1.90E+00	4E-06
INORGANICS									
Arsenic	2.27E-03	UCL	1.00E-03	2E-07	2.40E-04	8E-04	8E-08	1.88E+00	1E-07
Barium	5.68E-02	UCL	1.00E-03	5E-06	3.50E-03	1E-03	2E-06	Not Available	No Tox Data
Cadmium	8.50E-04	UCL	1.00E-03	7E-08	2.50E-05	3E-03	3E-08	Not Available	No Tox Data
Chromium	3.99E-02	MAX	1.00E-03	3E-06	1.00E-02	3E-04	1E-06	Not Available	No Tox Data
Cobalt	2.54E-03	UCL	1.00E-03	2E-07	4.80E-02	4E-06	9E-08	Not Available	No Tox Data
Lead	4.32E-03	UCL	1.00E-03	3E-07	Not Available	No Tox Data	1E-07	Not Available	No Tox Data
Manganese	1.94E-01	MAX	1.00E-03	2E-05	2.30E-03	7E-03	Not Applicable	Not Available	
Nickel	4.23E-02	MAX	1.00E-03	3E-06	2.00E-03	2E-03	1E-06	Not Available	No Tox Data
Selenium	1.61E-03	UCL	1.00E-03	1E-07	4.50E-03	3E-05	Not Applicable	Not Available	
Silver	1.06E-03	UCL	1.00E-03	8E-08	5.00E-04	2E-04	Not Applicable	Not Available	
Vanadium	7.42E-04	UCL	1.00E-03	6E-08	7.00E-03	8E-06	3E-08	Not Available	No Tox Data
Zinc	1.37E-01	MAX	1.00E-03	1E-05	1.20E-01	9E-05	Not Applicable	Not Available	
					HAZARD INDEX:	**2E-02**		**CANCER RISK:**	**4E-06**

CDI for noncarcinogenic chemicals in groundwater via dermal contact (adult resident):
(mg/l water * 1.00E-03 l/cm^3 * PC cm/hour * 19400 cm^2 * 0.3 hours/day * 350 days/year * 30 years)/(70 kg * 10950 days)
CDI for carcinogenic chemicals in groundwater via dermal contact (adult resident):
(mg/l water * 1.00E-03 l/cm^3 * PC cm/hour * 19400 cm^2 * 0.3 hours/day * 350 days/year * 30 years)/(70 kg * 25550 days)

TABLE 6-11
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INHALATION OF CHEMICALS VOLATILIZED FROM GROUNDWATER

CHEMICAL	WATER CONCENTRATION (mg/l)		CONCENTRATION IN AIR (mg/m^3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
1,2-Dichloroethene(total)	4.00E-03	MAX	5.17E-03	2E-05	Not Available	No Tox Data	8E-06	Not Available	No Tox Data
Trichloroethene	3.14E-02	UCL	3.90E-02	1E-04	Not Available	No Tox Data	6E-05	6.00E-03	3E-07
Vinyl Chloride	8.47E-03	UCL	1.75E-02	6E-05	Not Available	No Tox Data	3E-05	3.00E-01	8E-06
					HAZARD INDEX:			**CANCER RISK:**	**8E-06**

CDI for noncarcinogenic chemicals in groundwater via inhalation (adult resident):
(mg/m^3 air * 0.83 m^3/hour * 0.3 hours/day * 350 days/year * 30 years)/(70 kg * 10950 days)
CDI for carcinogenic chemicals in groundwater via inhalation (adult resident):
(mg/m^3 air * 0.83 m^3/hour * 0.3 hours/day * 350 days/year * 30 years)/(70 kg * 25550 days)

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS								
Acetone	9.64E-03	UCL	1E-07	1.00E-01	1E-06	Not Applicable		
1,2-Dichloroethene (total)	7.83E-03	UCL	1E-07	9.00E-03	1E-05	9E-09	Not Available	No Tox Data
Ethylbenzene	7.63E-03	UCL	1E-07	1.00E-01	1E-06	Not Applicable		
Methylene Chloride	1.19E-02	UCL	2E-07	6.00E-02	3E-06	1E-08	7.50E-03	1E-10
Tetrachloroethene	7.97E-03	UCL	1E-07	1.00E-02	1E-05	9E-09	5.20E-02	5E-10
Toluene	7.55E-03	UCL	1E-07	2.00E-01	5E-07	Not Applicable		
Trichloroethene	1.65E-01	UCL	2E-06	6.00E-03	4E-04	2E-07	1.10E-02	2E-09
Xylenes (total)	1.24E-02	UCL	2E-07	2.00E+00	8E-08	Not Applicable		
SEMI-VOLATILE ORGANICS								
Acenaphthene	4.12E-01	UCL	5E-06	6.00E-02	9E-05	Not Applicable		
Anthracene	4.80E-01	UCL	6E-06	3.00E-01	2E-05	Not Applicable		
Benzo[a]anthracene	7.67E-01	UCL	1E-05	Not Available	No Tox Data	8E-07	7.30E-01	6E-07
Benzo[a]pyrene	6.07E-01	UCL	8E-06	Not Available	No Tox Data	7E-07	7.30E+00	5E-06
Benzo[b]fluoranthene	1.02E+00	UCL	1E-05	Not Available	No Tox Data	1E-06	7.30E-01	8E-07
Benzo[ghi]perylene	4.98E-01	UCL	6E-06	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	9.02E-01	UCL	1E-05	2.00E-02	6E-04	1E-06	1.40E-02	1E-08
Butyl benzyl phthalate	4.21E-01	UCL	5E-06	2.00E-01	3E-05	5E-07	Not Available	No Tox Data
Carbazole	4.39E-01	UCL	6E-06	Not Available	No Tox Data	5E-07	2.00E-02	1E-08
Chrysene	7.91E-01	UCL	1E-05	Not Available	No Tox Data	9E-07	7.30E-03	6E-09
Dibenz[a,h]anthracene	4.09E-01	UCL	5E-06	Not Available	No Tox Data	4E-07	7.30E+00	3E-06
Dibenzofuran	3.86E-01	UCL	5E-06	4.00E-03	1E-03	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	5E-06	1.00E-01	5E-05	Not Applicable		
Fluoranthene	1.40E+00	UCL	2E-05	4.00E-02	4E-04	Not Applicable		
Fluorene	4.22E-01	UCL	5E-06	4.00E-02	1E-04	Not Applicable		
Indeno[1,2,3-cd]pyrene	5.19E-01	UCL	7E-06	Not Available	No Tox Data	6E-07	7.30E-01	4E-07

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS								
CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
SEMI-VOLATILE ORGANICS								
Phenanthrene	9.99E-01	UCL	1E-05	Not Available	No Tox Data	Not Applicable		
Pyrene	9.50E-01	UCL	1E-05	3.00E-02	4E-04	Not Applicable		
PESTICIDES/PCBs								
Aldrin	2.00E-03	MAX	3E-08	3.00E-05	9E-04	2E-09	1.70E+01	4E-08
4,4'-DDE	3.10E-03	MAX	4E-08	Not Available	No Tox Data	3E-09	3.40E-01	1E-09
4,4'-DDT	7.70E-03	UCL	1E-07	5.00E-04	2E-04	8E-09	3.40E-01	3E-09
INORGANICS								
Arsenic	2.45E+00	UCL	3E-05	3.00E-04	1E-01	3E-06	1.50E+00	4E-06
Cadmium	2.20E+00	UCL	3E-05	1.00E-03	3E-02	2E-06	Not Available	No Tox Data
Chromium	8.87E+00	UCL	1E-04	1.00E+00	1E-04	1E-05	Not Available	No Tox Data
Copper	1.58E+01	UCL	2E-04	3.70E-02	5E-03	Not Applicable		
Lead	1.94E+02	UCL	2E-03	Not Available	No Tox Data	2E-04	Not Available	No Tox Data
Mercury	1.14E-01	UCL	1E-06	Not Available	No Tox Data	Not Applicable		
Nickel	1.28E+01	UCL	2E-04	2.00E-02	8E-03	1E-05	Not Available	No Tox Data
Selenium	7.01E-01	UCL	9E-06	5.00E-03	2E-03	Not Applicable		
Silver	6.74E-01	UCL	9E-06	5.00E-03	2E-03	Not Applicable		
Thallium	4.19E-01	UCL	5E-06	Not Available	No Tox Data	5E-07	Not Available	No Tox Data
Zinc	1.35E+04	UCL	2E-01	3.00E-01	6E-01	Not Applicable		

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
OTHER								
Cyanide	4.19E-01	UCL	5E-06	2.00E-02	3E-04	Not Applicable		
				HAZARD INDEX:	**7E-01**		**CANCER RISK:**	**1E-05**

CDI of noncarcinogenic chemicals in all soils via ingestion (child resident):
(mg/kg soil * 1.00E-06 kg/mg * 200 mg/day * 1 * 350 days/year * 6 years)/(15 kg * 2190 days)
CDI of carcinogenic chemicals in all soils via ingestion (child resident):
(mg/kg soil * 1.00E-06 kg/mg * 200 mg/day * 1 * 350 days/year * 6 years)/(15 kg * 25550 days)

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
Acetone	9.64E-03	UCL	1.00E-01	8E-08	1.00E-01	8E-07	Not Applicable		
1,2-Dichloroethene (total)	7.83E-03	UCL	1.00E-01	6E-08	9.00E-03	7E-06	5E-09	Not Available	No Tox Data
Ethylbenzene	7.63E-03	UCL	1.00E-01	6E-08	1.00E-01	6E-07	Not Applicable		
Methylene Chloride	1.19E-02	UCL	1.00E-01	1E-07	6.00E-02	2E-06	8E-09	7.50E-03	6E-11
Tetrachloroethene	7.97E-03	UCL	1.00E-01	6E-08	1.00E-02	6E-06	6E-09	5.20E-02	3E-10
Toluene	7.55E-03	UCL	1.00E-01	6E-08	2.00E-01	3E-07	Not Applicable		
Trichloroethene	1.65E-01	UCL	1.00E-01	1E-06	6.00E-03	2E-04	1E-07	1.10E-02	1E-09
Xylenes (total)	1.24E-02	UCL	1.00E-01	1E-07	2.00E+00	5E-08	Not Applicable		
SEMI-VOLATILE ORGANICS									
Acenaphthene	4.12E-01	UCL	1.00E-02	3E-07	6.00E-02	6E-06	Not Applicable		
Anthracene	4.80E-01	UCL	1.00E-02	4E-07	3.00E+00	1E-07	Not Applicable		
Benzo[a]anthracene	7.67E-01	UCL	1.00E-02	6E-07	Not Available	No Tox Data	5E-08	7.30E-01	4E-08
Benzo[a]pyrene	6.07E-01	UCL	1.00E-02	5E-07	Not Available	No Tox Data	4E-08	7.30E+00	3E-07
Benzo[b]fluoranthene	1.02E+00	UCL	1.00E-02	8E-07	Not Available	No Tox Data	7E-08	7.30E-01	5E-08
Benzo[ghi]perylene	4.98E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	9.02E-01	UCL	1.00E-02	7E-07	2.00E-02	4E-05	6E-08	1.40E-02	9E-10
Butyl benzyl phthalate	4.21E-01	UCL	1.00E-02	3E-07	2.00E-01	2E-06	3E-08	Not Available	No Tox Data
Carbazole	4.39E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	3E-08	2.00E-02	6E-10
Chrysene	7.91E-01	UCL	1.00E-02	6E-07	Not Available	No Tox Data	6E-08	7.30E-03	4E-10
Dibenz[a,h]anthracene	4.09E-01	UCL	1.00E-02	3E-07	Not Available	No Tox Data	3E-08	7.30E+00	2E-07
Dibenzofuran	3.86E-01	UCL	1.00E-02	3E-07	4.00E-03	8E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.00E-02	3E-07	1.00E-01	3E-06	Not Applicable		
Fluoranthene	1.40E+00	UCL	1.00E-02	1E-06	4.00E-02	3E-05	Not Applicable		
Fluorene	4.22E-01	UCL	1.00E-02	3E-07	4.00E-02	9E-06	Not Applicable		
Indeno[1,2,3-cd]pyrene	5.19E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	4E-08	7.30E-01	3E-08

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS									
Phenanthrene	9.99E-01	UCL	1.00E-02	8E-07	Not Available	No Tox Data	Not Applicable		
Pyrene	9.50E-01	UCL	1.00E-02	8E-07	3.00E-02	3E-05	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	1.00E-02	2E-09	3.00E-05	5E-05	1E-10	1.70E+01	2E-09
4,4'-DDE	3.10E-03	MAX	1.00E-02	3E-09	Not Available	No Tox Data	2E-10	3.40E-01	7E-11
4,4'-DDT	7.70E-03	UCL	1.00E-02	6E-09	5.00E-04	1E-05	5E-10	3.40E-01	2E-10
INORGANICS									
Arsenic	2.45E+00	UCL	1.00E-02	2E-06	2.40E-04	8E-03	2E-07	1.88E+00	3E-07
Cadmium	2.20E+00	UCL	1.00E-02	2E-06	5.00E-05	4E-02	2E-07	Not Available	No Tox Data
Chromium	8.87E+00	UCL	1.00E-02	7E-06	1.00E-02	7E-04	6E-07	Not Available	No Tox Data
Copper	1.58E+01	UCL	1.00E-02	1E-05	1.85E-02	7E-04	Not Applicable		
Lead	1.94E+02	UCL	1.00E-02	2E-04	Not Available	No Tox Data	1E-05	Not Available	No Tox Data
Mercury	1.14E-01	UCL	1.00E-02	9E-08	Not Available	No Tox Data	Not Applicable		
Nickel	1.28E+01	UCL	1.00E-02	1E-05	2.00E-03	5E-03	9E-07	Not Available	No Tox Data
Selenium	7.01E-01	UCL	1.00E-02	6E-07	4.50E-03	1E-04	Not Applicable		
Silver	6.74E-01	UCL	1.00E-02	5E-07	5.00E-04	1E-03	Not Applicable		
Thallium	4.19E-01	UCL	1.00E-02	3E-07	Not Available	No Tox Data	3E-08	Not Available	No Tox Data
Zinc	1.35E+04	UCL	1.00E-02	1E-02	1.20E-01	9E-02	Not Applicable		

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
Cyanide	4.19E-01	UCL	1.00E-02	3E-07	2.00E-02	2E-05	Not Applicable		
					HAZARD INDEX:	**1E-01**		**CANCER RISK:**	**1E-06**

CDI of noncarcinogenic chemicals in all soils via dermal contact (child resident):
(mg/kg soil * 1.00E-06 kg/mg * 1.00 mg/cm^2 * ABS * 1820 cm^2/event * 245 events/year * 6 years)/(15 kg * 2190 days)
CDI of carcinogenic chemicals in all soils via dermal contact (child resident):
(mg/kg soil * 1.00E-06 kg/mg *1.00 mg/cm^2 * ABS * 1820 cm^2/event * 245 events/year * 6 years)/(15 kg * 25550 days)

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INGESTION OF CHEMICALS IN GROUNDWATER

CHEMICAL	WATER CONCENTRATION (mg/l)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS								
1,2-Dichloroethene(total)	4.00E-03	MAX	3E-04	9.00E-03	3E-02	2E-05	Not Available	No Tox Data
Trichloroethene	3.14E-02	UCL	2E-03	6.00E-03	3E-01	2E-04	1.10E-02	2E-06
Vinyl Chloride	8.47E-03	UCL	5E-04	Not Available	No Tox Data	5E-05	1.90E+00	9E-05
INORGANICS								
Arsenic	2.27E-03	UCL	1E-04	3.00E-04	5E-01	1E-05	1.50E+00	2E-05
Barium	5.68E-02	UCL	4E-03	7.00E-02	5E-02	3E-04	Not Available	No Tox Data
Cadmium	8.50E-04	UCL	5E-05	5.00E-04	1E-01	5E-06	Not Available	No Tox Data
Chromium	3.99E-02	MAX	3E-03	1.00E+00	3E-03	2E-04	Not Available	No Tox Data
Cobalt	2.54E-03	UCL	2E-04	6.00E-02	3E-03	1E-05	Not Available	No Tox Data
Lead	4.32E-03	UCL	3E-04	Not Available	No Tox Data	2E-05	Not Available	No Tox Data
Manganese	1.94E-01	MAX	1E-02	2.30E-02	5E-01	Not Applicable	Not Available	
Nickel	4.23E-02	MAX	3E-03	2.00E-02	1E-01	2E-04	Not Available	No Tox Data
Selenium	1.61E-03	UCL	1E-04	5.00E-03	2E-02	Not Applicable	Not Available	
Silver	1.06E-03	UCL	7E-05	5.00E-03	1E-02	Not Applicable	Not Available	
Vanadium	7.42E-04	UCL	5E-05	7.00E-03	7E-03	4E-06	Not Available	No Tox Data
Zinc	1.37E-01	MAX	9E-03	3.00E-01	3E-02	Not Applicable	Not Available	
				HAZARD INDEX:	**2E+00**		**CANCER RISK:**	**1E-04**

CDI for noncarcinogenic chemicals in groundwater via ingestion (child resident):
(mg/l water * 1 l/day * 350 days/year * 6 years)/(15 kg * 2190 days)
CDI for carcinogenic chemicals in groundwater via ingestion (child resident):
(mg/l water * 1 l/day * 350 days/year * 6 years)/(15 kg * 25550 days)

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN GROUNDWATER

CHEMICAL	WATER CONCENTRATION (mg/l)		PERMEABILITY CONSTANT (cm/hour)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS									
1,2-Dichloroethene(total)	4.00E-03	MAX	1.00E-02	5E-06	9.00E-03	6E-04	5E-07	Not Available	No Tox Data
Trichloroethene	3.14E-02	UCL	1.60E-02	7E-05	6.00E-03	1E-02	6E-06	1.10E-02	6E-08
Vinyl Chloride	8.47E-03	UCL	7.30E-03	8E-06	Not Available	No Tox Data	7E-07	1.90E+00	1E-06
INORGANICS									
Arsenic	2.27E-03	UCL	1.00E-03	3E-07	2.40E-04	1E-03	3E-08	1.88E+00	5E-08
Barium	5.68E-02	UCL	1.00E-03	8E-06	3.50E-03	2E-03	7E-07	Not Available	No Tox Data
Cadmium	8.50E-04	UCL	1.00E-03	1E-07	2.50E-05	5E-03	1E-08	Not Available	No Tox Data
Chromium	3.99E-02	MAX	1.00E-03	5E-06	1.00E-02	5E-04	5E-07	Not Available	No Tox Data
Cobalt	2.54E-03	UCL	1.00E-03	3E-07	4.80E-02	7E-06	3E-08	Not Available	No Tox Data
Lead	4.32E-03	UCL	1.00E-03	6E-07	Not Available	No Tox Data	5E-08	Not Available	No Tox Data
Manganese	1.94E-01	MAX	1.00E-03	3E-05	2.30E-03	1E-02	Not Applicable	Not Available	
Nickel	4.23E-02	MAX	1.00E-03	6E-06	2.00E-03	3E-03	5E-07	Not Available	No Tox Data
Selenium	1.61E-03	UCL	1.00E-03	2E-07	4.50E-03	5E-05	Not Applicable	Not Available	
Silver	1.06E-03	UCL	1.00E-03	1E-07	5.00E-04	3E-04	Not Applicable	Not Available	
Vanadium	7.42E-04	UCL	1.00E-03	1E-07	7.00E-03	1E-05	9E-09	Not Available	No Tox Data
Zinc	1.37E-01	MAX	1.00E-03	2E-05	1.20E-01	2E-04	Not Applicable	Not Available	
					HAZARD INDEX:	**3E-02**		**CANCER RISK:**	**1E-06**

CDI for noncarcinogenic chemicals in groundwater via dermal contact (child resident):

(mg/l water * 1.00E-03 l/cm^3 * PC cm/hour * 6980 cm^2 * 0.3 hours/day * 350 days/year * 6 years)/(15 kg * 2190 days)

CDI for carcinogenic chemicals in groundwater via dermal contact (child resident):

(mg/l water * 1.00E-03 l/cm^3 * PC cm/hour * 6980 cm^2 * 0.3 hours/day * 350 days/year * 6 years)/(15 kg * 25550 days)

TABLE 6-12
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN CHILD RESIDENT (GENERIC RESIDENTIAL)
PETOSKEY MANUFACTURING SITE

INHALATION OF CHEMICALS VOLATILIZED FROM GROUNDWATER

CHEMICAL	WATER CONCENTRATION (mg/l)		CONCENTRATION IN AIR (mg/m^3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
1,2-Dichloroethene(total)	4.00E-03	MAX	5.17E-03	6E-05	Not Available	No Tox Data	5E-06	Not Available	No Tox Data
Trichloroethene	3.14E-02	UCL	3.90E-02	4E-04	Not Available	No Tox Data	4E-05	6.00E-03	2E-07
Xylenes (total)	8.47E-03	UCL	1.75E-02	2E-04	Not Available	No Tox Data	2E-05	3.00E-01	5E-06
					HAZARD INDEX:			**CANCER RISK:**	**5E-06**

CDI for noncarcinogenic chemicals in groundwater via inhalation (child resident):
(mg/m^3 air * 0.6 m^3/hour * 0.3 hours/day * 350 days/year * 6 years)/(15 kg * 2190 days)
CDI for carcinogenic chemicals in groundwater via inhalation (child resident):
(mg/m^3 air * 0.6 m^3/hour * 0.3 hours/day * 350 days/year * 6 years)/(15 kg * 25550 days)

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS								
Acetone	1.37E-02	UCL	2E-08	1.00E-01	2E-07	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	8E-09	9.00E-03	9E-07	3E-09	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	8E-09	1.00E-01	8E-08	Not Applicable		
Methylene Chloride	1.98E-02	UCL	3E-08	6.00E-02	5E-07	9E-09	7.50E-03	7E-11
Tetrachloroethene	1.08E-02	UCL	1E-08	1.00E-02	1E-06	5E-09	5.20E-02	3E-10
Toluene	8.42E-03	UCL	1E-08	2.00E-01	6E-08	Not Applicable		
Trichloroethene	1.25E-01	UCL	2E-07	6.00E-03	3E-05	6E-08	1.10E-02	6E-10
Xylenes (total)	8.71E-03	UCL	1E-08	2.00E+00	6E-09	Not Applicable		
SEMI-VOLATILE ORGANICS								
Acenaphthene	6.58E-01	UCL	9E-07	6.00E-02	2E-05	Not Applicable		
Anthracene	8.82E-01	UCL	1E-06	3.00E-01	4E-06	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	4E-06	Not Available	No Tox Data	2E-06	7.30E-01	1E-06
Benzo[a]pyrene	1.90E+00	UCL	3E-06	Not Available	No Tox Data	9E-07	7.30E+00	7E-06
Benzo[b]fluoranthene	5.61E+00	UCL	8E-06	Not Available	No Tox Data	3E-06	7.30E-01	2E-06
Benzo[ghi]perylene	1.32E+00	UCL	2E-06	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	3E-06	2.00E-02	1E-04	1E-06	1.40E-02	1E-08
Butyl benzyl phthalate	5.50E-01	MAX	8E-07	2.00E-01	4E-06	3E-07	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	1E-06	Not Available	No Tox Data	4E-07	2.00E-02	7E-09
Chrysene	3.45E+00	UCL	5E-06	Not Available	No Tox Data	2E-06	7.30E-03	1E-08
Dibenz[a,h]anthracene	7.37E-01	UCL	1E-06	Not Available	No Tox Data	3E-07	7.30E+00	3E-06
Dibenzofuran	4.71E-01	UCL	6E-07	4.00E-03	2E-04	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	5E-07	1.00E-01	5E-06	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	2E-06	2.00E-02	9E-05	6E-07	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	1E-05	4.00E-02	3E-04	Not Applicable		
Fluorene	6.89E-01	UCL	9E-07	4.00E-02	2E-05	Not Applicable		

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS								
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	2E-06	Not Available	No Tox Data	7E-07	7.30E-01	5E-07
Phenanthrene	6.52E+00	UCL	9E-06	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	6E-06	3.00E-02	2E-04	Not Applicable		
PESTICIDES/PCBs								
Aldrin	2.00E-03	MAX	3E-09	3.00E-05	9E-05	9E-10	1.70E+01	2E-08
4-4'-DDD	2.60E-03	MAX	4E-09	Not Available	No Tox Data	1E-09	2.40E-01	3E-10
4,4'-DDE	3.10E-03	MAX	4E-09	Not Available	No Tox Data	1E-09	3.40E-01	5E-10
4,4'-DDT	3.81E-02	UCL	5E-08	5.00E-04	1E-04	2E-08	3.40E-01	6E-09
Endosulfan I	8.20E-03	MAX	1E-08	6.00E-03	2E-06	Not Applicable		
Endosulfan II	2.90E-03	MAX	4E-09	6.00E-03	7E-07	Not Applicable		
PCBs	3.00E-02	MAX	4E-08	2.00E-05	2E-03	1E-08	2.00E+00	3E-08
INORGANICS								
Antimony	4.18E+00	UCL	6E-06	4.00E-04	1E-02	2E-06	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	8E-06	3.00E-04	3E-02	3E-06	1.50E+00	4E-06
Cadmium	6.89E+00	UCL	9E-06	1.00E-03	9E-03	3E-06	Not Available	No Tox Data
Chromium	1.24E+01	UCL	2E-05	1.00E+00	2E-05	6E-06	Not Available	No Tox Data
Copper	3.86E+01	UCL	5E-05	3.70E-02	1E-03	Not Applicable		
Lead	3.06E+02	MAX	4E-04	Not Available	No Tox Data	1E-04	Not Available	No Tox Data
Mercury	2.61E-01	UCL	4E-07	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	3E-05	2.00E-02	2E-03	1E-05	Not Available	No Tox Data
Selenium	1.79E+00	UCL	2E-06	5.00E-03	5E-04	Not Applicable		
Silver	1.16E+00	UCL	2E-06	5.00E-03	3E-04	Not Applicable		
Thallium	4.94E-01	UCL	7E-07	Not Available	No Tox Data	2E-07	Not Available	No Tox Data
Zinc	1.97E+04	MAX	3E-02	3.00E-01	9E-02	Not Applicable		

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
OTHER								
Cyanide	7.05E-01	UCL	1E-06	2.00E-02	5E-05	Not Applicable		
				HAZARD INDEX:	**1E-01**		**CANCER RISK:**	**2E-05**

CDI of noncarcinogenic chemicals in shallow soil via ingestion (adult resident):
(mg/kg soil * 1.00E-06 kg/mg * 100 mg/day * 1 * 350 days/year * 30 years)/(70 kg * 10950 days)
CDI of carcinogenic chemicals in shallow soil via ingestion (adult resident):
(mg/kg soil * 1.00E-06 kg/mg * 100 mg/day * 1 * 350 days/year * 24 years)/(70 kg * 25550 days)

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
Acetone	1.37E-02	UCL	1.00E-01	7E-08	1.00E-01	7E-07	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	1.00E-01	3E-08	9.00E-03	3E-06	1E-08	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	1.00E-01	3E-08	1.00E-01	3E-07	Not Applicable		
Methylene Chloride	1.98E-02	UCL	1.00E-01	1E-07	6.00E-02	2E-06	3E-08	7.50E-03	2E-10
Tetrachloroethene	1.08E-02	UCL	1.00E-01	5E-08	1.00E-02	5E-06	2E-08	5.20E-02	9E-10
Toluene	8.42E-03	UCL	1.00E-01	4E-08	2.00E-01	2E-07	Not Applicable		
Trichloroethene	1.25E-01	UCL	1.00E-01	6E-07	6.00E-03	1E-04	2E-07	1.10E-02	2E-09
Xylenes (total)	8.71E-03	UCL	1.00E-01	4E-08	2.00E+00	2E-08	Not Applicable		
SEMI-VOLATILE ORGANICS									
Acenaphthene	6.58E-01	UCL	1.00E-02	3E-07	6.00E-02	5E-06	Not Applicable		
Anthracene	8.82E-01	UCL	1.00E-02	4E-07	3.00E-01	1E-06	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	1.00E-02	2E-06	Not Available	No Tox Data	5E-07	7.30E-01	4E-07
Benzo[a]pyrene	1.90E+00	UCL	1.00E-02	9E-07	Not Available	No Tox Data	3E-07	7.30E+00	2E-06
Benzo[b]fluoranthene	5.61E+00	UCL	1.00E-02	3E-06	Not Available	No Tox Data	9E-07	7.30E-01	7E-07
Benzo[ghi]perylene	1.32E+00	UCL	1.00E-02	6E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	1.00E-02	1E-06	2.00E-02	5E-05	3E-07	1.40E-02	5E-09
Butyl benzyl phthalate	5.50E-01	MAX	1.00E-02	3E-07	2.00E-01	1E-06	9E-08	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	1E-07	2.00E-02	3E-09
Chrysene	3.45E+00	UCL	1.00E-02	2E-06	Not Available	No Tox Data	6E-07	7.30E-03	4E-09
Dibenz[a,h]anthracene	7.37E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	1E-07	7.30E+00	9E-07
Dibenzofuran	4.71E-01	UCL	1.00E-02	2E-07	4.00E-03	6E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.00E-02	2E-07	1.00E-01	2E-06	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	1.00E-02	6E-07	2.00E-02	3E-05	2E-07	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	1.00E-02	5E-06	4.00E-02	1E-04	Not Applicable		
Fluorene	6.89E-01	UCL	1.00E-02	3E-07	4.00E-02	8E-06	Not Applicable		

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS									
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	1.00E-02	7E-07	Not Available	No Tox Data	2E-07	7.30E-01	2E-07
Phenanthrene	6.52E+00	UCL	1.00E-02	3E-06	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	1.00E-02	2E-06	3.00E-02	7E-05	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	1.00E-02	1E-09	3.00E-05	3E-05	3E-10	1.70E+01	6E-09
4-4'-DDD	2.60E-03	MAX	1.00E-02	1E-09	Not Available	No Tox Data	4E-10	2.40E-01	1E-10
4,4'-DDE	3.10E-03	MAX	1.00E-02	1E-09	Not Available	No Tox Data	5E-10	3.40E-01	2E-10
4,4'-DDT	3.81E-02	UCL	1.00E-02	2E-08	5.00E-04	4E-05	6E-09	3.40E-01	2E-09
Endosulfan I	8.20E-03	MAX	1.00E-02	4E-09	6.00E-03	7E-07	Not Applicable		
Endosulfan II	2.90E-03	MAX	1.00E-02	1E-09	6.00E-03	2E-07	Not Applicable		
PCBs	3.00E-02	MAX	1.00E-02	1E-08	2.00E-05	7E-04	5E-09	2.00E+00	1E-08
INORGANICS									
Antimony	4.18E+00	UCL	1.00E-02	2E-06	4.00E-05	5E-02	7E-07	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	1.00E-02	3E-06	2.40E-04	1E-02	1E-06	1.88E+00	2E-06
Cadmium	6.89E+00	UCL	1.00E-02	3E-06	5.00E-05	7E-02	1E-06	Not Available	No Tox Data
Chromium	1.24E+01	UCL	1.00E-02	6E-06	1.00E-02	6E-04	2E-06	Not Available	No Tox Data
Copper	3.86E+01	UCL	1.00E-02	2E-05	1.85E-02	1E-03	Not Applicable		
Lead	3.06E+02	MAX	1.00E-02	1E-04	Not Available	No Tox Data	5E-05	Not Available	No Tox Data
Mercury	2.61E-01	UCL	1.00E-02	1E-07	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	1.00E-02	1E-05	2.00E-03	6E-03	4E-06	Not Available	No Tox Data
Selenium	1.79E+00	UCL	1.00E-02	9E-07	4.50E-03	2E-04	Not Applicable		
Silver	1.16E+00	UCL	1.00E-02	6E-07	5.00E-04	1E-03	Not Applicable		
Thallium	4.94E-01	UCL	1.00E-02	2E-07	Not Available	No Tox Data	8E-08	Not Available	No Tox Data
Zinc	1.97E+04	MAX	1.00E-02	9E-03	1.20E-01	8E-02	Not Applicable		

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
OTHER									
Cyanide	7.05E-01	UCL	1.00E-02	3E-07	2.00E-02	2E-05	Not Applicable		
					HAZARD INDEX:	**2E-01**		**CANCER RISK:**	**6E-06**

CDI of noncarcinogenic chemicals in shallow soil via dermal contact (adult resident):
(mg/kg soil * 1.00E-06 kg/mg * 1.00 mg/cm^2 * ABS * 5000 cm^2/event * 245 events /year * 30 years)/(70 kg * 10950 days)
CDI of carcinogenic chemicals in shallow soil via dermal contact (adult resident):
(mg/kg soil * 1.00E-06 kg/mg *1.00 mg/cm^2 * ABS * 5000 cm^2/event * 245 events/year * 24 years)/(70 kg * 25550 days)

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INHALATION OF CHEMICALS VOLATILIZED FROM SUBSURFACE SOIL AND GROUNDWATER THROUGH A BASEMENT

CHEMICAL	CONCENTRATION IN AIR (mg/m^3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS							
Acetone	9.08E-10	2E-10	Not Available	No Tox Data	Not Applicable		
1,2-Dichloroethene (total)	1.06E-08	2E-09	Not Available	No Tox Data	Not Applicable		
Ethylbenzene	3.10E-10	6E-11	2.86E-01	2E-10	Not Applicable		
Methylene Chloride	3.16E-09	6E-10	8.60E-01	7E-10	3E-10	1.65E-03	4E-13
Tetrachloroethene	3.16E-09	6E-10	Not Available	No Tox Data	3E-10	2.00E-03	5E-13
Toluene	1.11E-09	2E-10	1.14E-01	2E-09	Not Applicable		
Trichloroethene	1.73E-07	3E-08	Not Available	No Tox Data	1E-08	6.00E-03	9E-11
Vinyl Chloride	8.73E-09	2E-09	Not Available	No Tox Data	7E-10	3.00E-01	2E-10
Xylenes (total)	3.57E-09	7E-10	Not Available	No Tox Data	Not Applicable		
			HAZARD INDEX:	**3E-09**		**CANCER RISK:**	**3E-10**

CDI of noncarcinogenic chemicals via inhalation (adult resident):
(mg/m^3 * 0.83 m^3/hour * 17 hours/day * 350 days/year * 30 years)/(70 kg * 10950 days)
CDI of carcinogenic chemicals via inhalation (adult resident):
(mg/m^3 * 0.83 m^3/hour * 17 hours/day * 350 days/year * 30 years)/(70 kg * 25550 days)

TABLE 6-13

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR AN ADULT RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INHALATION OF CHEMICALS VOLATILIZED FROM SUBSURFACE SOIL AND GROUNDWATER THROUGH FOUNDATIONS

CHEMICAL	CONCENTRATION IN AIR (mg/m^3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS							
Acetone	6.95E-10	1E-10	Not Available	No Tox Data	Not Applicable		
1,2-Dichloroethene (total)	8.14E-09	2E-09	Not Available	No Tox Data	Not Applicable		
Ethylbenzene	2.37E-10	5E-11	2.86E-01	2E-10	Not Applicable		
Methylene Chloride	2.42E-09	5E-10	8.60E-01	5E-10	2E-10	1.65E-03	3E-13
Tetrachloroethene	2.42E-09	5E-10	Not Available	No Tox Data	2E-10	2.00E-03	4E-13
Toluene	8.46E-10	2E-10	1.14E-01	1E-09	Not Applicable		
Trichloroethene	1.32E-07	3E-08	Not Available	No Tox Data	1E-08	6.00E-03	7E-11
Vinyl Chloride	6.68E-09	1E-09	Not Available	No Tox Data	6E-10	3.00E-01	2E-10
Xylenes (total)	2.73E-09	5E-10	Not Available	No Tox Data	Not Applicable		
			HAZARD INDEX:	**2E-09**		**CANCER RISK:**	**2E-10**

CDI of noncarcinogenic chemicals via inhalation (adult resident):
(mg/m^3 * 0.83 m^3/hour * 17 hours/day * 350 days/year * 30 years)/(70 kg * 10950 days)
CDI of carcinogenic chemicals via inhalation (adult resident):
(mg/m^3 * 0.83 m^3/hour * 17 hours/day * 350 days/year * 30 years)/(70 kg * 25550 days)

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS								
Acetone	1.37E-02	UCL	2E-07	1.00E-01	2E-06	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	8E-08	9.00E-03	9E-06	7E-09	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	7E-08	1.00E-01	7E-07	Not Applicable		
Methylene Chloride	1.98E-02	UCL	3E-07	6.00E-02	4E-06	2E-08	7.50E-03	2E-10
Tetrachloroethene	1.08E-02	UCL	1E-07	1.00E-02	1E-05	1E-08	5.20E-02	6E-10
Toluene	8.42E-03	UCL	1E-07	2.00E-01	5E-07	Not Applicable		
Trichloroethene	1.25E-01	UCL	2E-06	6.00E-03	3E-04	1E-07	1.10E-02	2E-09
Xylenes (total)	8.71E-03	UCL	1E-07	2.00E+00	6E-08	Not Applicable		
SEMI-VOLATILE ORGANICS								
Acenaphthene	6.58E-01	UCL	8E-06	6.00E-02	1E-04	Not Applicable		
Anthracene	8.82E-01	UCL	1E-05	3.00E-01	4E-05	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	4E-05	Not Available	No Tox Data	4E-06	7.30E-01	3E-06
Benzo[a]pyrene	1.90E+00	UCL	2E-05	Not Available	No Tox Data	2E-06	7.30E+00	2E-05
Benzo[b]fluoranthene	5.61E+00	UCL	7E-05	Not Available	No Tox Data	6E-06	7.30E-01	4E-06
Benzo[ghi]perylene	1.32E+00	UCL	2E-05	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	3E-05	2.00E-02	1E-03	2E-06	1.40E-02	3E-08
Butyl benzyl phthalate	5.50E-01	MAX	7E-06	2.00E-01	4E-05	6E-07	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	1E-05	Not Available	No Tox Data	9E-07	2.00E-02	2E-08
Chrysene	3.45E+00	UCL	4E-05	Not Available	No Tox Data	4E-06	7.30E-03	3E-08
Dibenz[a,h]anthracene	7.37E-01	UCL	9E-06	Not Available	No Tox Data	8E-07	7.30E+00	6E-06
Dibenzofuran	4.71E-01	UCL	6E-06	4.00E-03	2E-03	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	5E-06	1.00E-01	5E-05	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	2E-05	2.00E-02	8E-04	1E-06	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	1E-04	4.00E-02	3E-03	Not Applicable		
Fluorene	6.89E-01	UCL	9E-06	4.00E-02	2E-04	Not Applicable		

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL								
CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
SEMI-VOLATILE ORGANICS								
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	2E-05	Not Available	No Tox Data	2E-06	7.30E-01	1E-06
Phenanthrene	6.52E+00	UCL	8E-05	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	6E-05	3.00E-02	2E-03	Not Applicable		
PESTICIDES/PCBs								
Aldrin	2.00E-03	MAX	3E-08	3.00E-05	9E-04	2E-09	1.70E+01	4E-08
4-4'-DDD	2.60E-03	MAX	3E-08	Not Available	No Tox Data	3E-09	2.40E-01	7E-10
4,4'-DDE	3.10E-03	MAX	4E-08	Not Available	No Tox Data	3E-09	3.40E-01	1E-09
4,4'-DDT	3.81E-02	UCL	5E-07	5.00E-04	1E-03	4E-08	3.40E-01	1E-08
Endosulfan I	8.20E-03	MAX	1E-07	6.00E-03	2E-05	Not Applicable		
Endosulfan II	2.90E-03	MAX	4E-08	6.00E-03	6E-06	Not Applicable		
PCBs	3.00E-02	MAX	4E-07	2.00E-05	2E-02	3E-08	2.00E+00	7E-08
INORGANICS								
Antimony	4.18E+00	UCL	5E-05	4.00E-04	1E-01	5E-06	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	7E-05	3.00E-04	2E-01	6E-06	1.50E+00	1E-05
Cadmium	6.89E+00	UCL	9E-05	1.00E-03	9E-02	8E-06	Not Available	No Tox Data
Chromium	1.24E+01	UCL	2E-04	1.00E+00	2E-04	1E-05	Not Available	No Tox Data
Copper	3.86E+01	UCL	5E-04	3.70E-02	1E-02	Not Applicable		
Lead	3.06E+02	MAX	4E-03	Not Available	No Tox Data	3E-04	Not Available	No Tox Data
Mercury	2.61E-01	UCL	3E-06	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	3E-04	2.00E-02	2E-02	3E-05	Not Available	No Tox Data
Selenium	1.79E+00	UCL	2E-05	5.00E-03	5E-03	Not Applicable		
Silver	1.16E+00	UCL	1E-05	5.00E-03	3E-03	Not Applicable		
Thallium	4.94E-01	UCL	6E-06	Not Available	No Tox Data	5E-07	Not Available	No Tox Data

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
Zinc	1.97E+04	MAX	3E-01	3.00E-01	8E-01	Not Applicable		
OTHER								
Cyanide	7.05E-01	UCL	9E-06	2.00E-02	5E-04	Not Applicable		
				HAZARD INDEX:	**1E+00**		**CANCER RISK:**	**4E-05**

CDI of noncarcinogenic chemicals in shallow soil via ingestion (child resident):
(mg/kg soil * 1.00E-06 kg/mg * 200 mg/day * 1 * 350 days/year * 6 years)/(15 kg * 2190 days)
CDI of carcinogenic chemicals in shallow soil via ingestion (child resident):
(mg/kg soil * 1.00E-06 kg/mg * 200 mg/day * 1 * 350 days/year * 6 years)/(15 kg * 25550 days)

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
Acetone	1.37E-02	UCL	1.00E-01	1E-07	1.00E-01	1E-06	Not Applicable		
1,2-Dichloroethene (total)	5.99E-03	UCL	1.00E-01	5E-08	9.00E-03	5E-06	4E-09	Not Available	No Tox Data
Ethylbenzene	5.78E-03	UCL	1.00E-01	5E-08	1.00E-01	5E-07	Not Applicable		
Methylene Chloride	1.98E-02	UCL	1.00E-01	2E-07	6.00E-02	3E-06	1E-08	7.50E-03	1E-10
Tetrachloroethene	1.08E-02	UCL	1.00E-01	9E-08	1.00E-02	9E-06	8E-09	5.20E-02	4E-10
Toluene	8.42E-03	UCL	1.00E-01	7E-08	2.00E-01	3E-07	Not Applicable		
Trichloroethene	1.25E-01	UCL	1.00E-01	1E-06	6.00E-03	2E-04	9E-08	1.10E-02	1E-09
Xylenes (total)	8.71E-03	UCL	1.00E-01	7E-08	2.00E+00	4E-08	Not Applicable		
SEMI-VOLATILE ORGANICS									
Acenaphthene	6.58E-01	UCL	1.00E-02	5E-07	6.00E-02	9E-06	Not Applicable		
Anthracene	8.82E-01	UCL	1.00E-02	7E-07	3.00E-01	2E-06	Not Applicable		
Benzo[a]anthracene	3.28E+00	UCL	1.00E-02	3E-06	Not Available	No Tox Data	2E-07	7.30E-01	2E-07
Benzo[a]pyrene	1.90E+00	UCL	1.00E-02	2E-06	Not Available	No Tox Data	1E-07	7.30E+00	1E-06
Benzo[b]fluoranthene	5.61E+00	UCL	1.00E-02	5E-06	Not Available	No Tox Data	4E-07	7.30E-01	3E-07
Benzo[ghi]perylene	1.32E+00	UCL	1.00E-02	1E-06	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	2.04E+00	UCL	1.00E-02	2E-06	2.00E-02	8E-05	1E-07	1.40E-02	2E-09
Butyl benzyl phthalate	5.50E-01	MAX	1.00E-02	4E-07	2.00E-01	2E-06	4E-08	Not Available	No Tox Data
Carbazole	7.87E-01	UCL	1.00E-02	6E-07	Not Available	No Tox Data	5E-08	2.00E-02	1E-09
Chrysene	3.45E+00	UCL	1.00E-02	3E-06	Not Available	No Tox Data	2E-07	7.30E-03	2E-09
Dibenz[a,h]anthracene	7.37E-01	UCL	1.00E-02	6E-07	Not Available	No Tox Data	5E-08	7.30E+00	4E-07
Dibenzofuran	4.71E-01	UCL	1.00E-02	4E-07	4.00E-03	1E-04	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.00E-02	3E-07	1.00E-01	3E-06	Not Applicable		
Di-n-octyl phthalate	1.24E+00	UCL	1.00E-02	1E-06	2.00E-02	5E-05	9E-08	Not Available	No Tox Data
Fluoranthene	9.49E+00	UCL	1.00E-02	8E-06	4.00E-02	2E-04	Not Applicable		
Fluorene	6.89E-01	UCL	1.00E-02	6E-07	4.00E-02	1E-05	Not Applicable		

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS									
Indeno[1,2,3-cd]pyrene	1.47E+00	UCL	1.00E-02	1E-06	Not Available	No Tox Data	1E-07	7.30E-01	7E-08
Phenanthrene	6.52E+00	UCL	1.00E-02	5E-06	Not Available	No Tox Data	Not Applicable		
Pyrene	4.43E+00	UCL	1.00E-02	4E-06	3.00E-02	1E-04	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	1.00E-02	2E-09	3.00E-05	5E-05	1E-10	1.70E+01	2E-09
4-4'-DDD	2.60E-03	MAX	1.00E-02	2E-09	Not Available	No Tox Data	2E-10	2.40E-01	4E-11
4,4'-DDE	3.10E-03	MAX	1.00E-02	3E-09	Not Available	No Tox Data	2E-10	3.40E-01	7E-11
4,4'-DDT	3.81E-02	UCL	1.00E-02	3E-08	5.00E-04	6E-05	3E-09	3.40E-01	9E-10
Endosulfan I	8.20E-03	MAX	1.00E-02	7E-09	6.00E-03	1E-06	Not Applicable		
Endosulfan II	2.90E-03	MAX	1.00E-02	2E-09	6.00E-03	4E-07	Not Applicable		
PCBs	3.00E-02	MAX	1.00E-02	2E-08	2.00E-05	1E-03	2E-09	2.00E+00	4E-09
INORGANICS									
Antimony	4.18E+00	UCL	1.00E-02	3E-06	4.00E-05	9E-02	3E-07	Not Available	No Tox Data
Arsenic	5.87E+00	UCL	1.00E-02	5E-06	2.40E-04	2E-02	4E-07	1.88E+00	8E-07
Cadmium	6.89E+00	UCL	1.00E-02	6E-06	5.00E-05	1E-01	5E-07	Not Available	No Tox Data
Chromium	1.24E+01	UCL	1.00E-02	1E-05	1.00E-02	1E-03	9E-07	Not Available	No Tox Data
Copper	3.86E+01	UCL	1.00E-02	3E-05	1.85E-02	2E-03	Not Applicable		
Lead	3.06E+02	MAX	1.00E-02	2E-04	Not Available	No Tox Data	2E-05	Not Available	No Tox Data
Mercury	2.61E-01	UCL	1.00E-02	2E-07	Not Available	No Tox Data	Not Applicable		
Nickel	2.45E+01	UCL	1.00E-02	2E-05	2.00E-03	1E-02	2E-06	Not Available	No Tox Data
Selenium	1.79E+00	UCL	1.00E-02	1E-06	4.50E-03	3E-04	Not Applicable		
Silver	1.16E+00	UCL	1.00E-02	9E-07	5.00E-04	2E-03	Not Applicable		
Thallium	4.94E-01	UCL	1.00E-02	4E-07	Not Available	No Tox Data	3E-08	Not Available	No Tox Data

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN SHALLOW SOIL

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
Zinc	1.97E+04	MAX	1.00E-02	2E-02	1.20E-01	1E-01	Not Applicable		
OTHER									
Cyanide	7.05E-01	UCL	1.00E-02	6E-07	2.00E-02	3E-05	Not Applicable		
					HAZARD INDEX:	**4E-01**		**CANCER RISK:**	**3E-06**

CDI of noncarcinogenic chemicals in shallow soil via dermal contact (child resident):
(mg/kg soil * 1.00E-06 kg/mg * 1.00 mg/cm^2 * ABS * 1820 cm^2/event * 245 events/year * 6 years)/(15 kg * 2190 days)
CDI of carcinogenic chemicals in shallow soil via dermal contact (child resident):
(mg/kg soil * 1.00E-06 kg/mg *1.00 mg/cm^2 * ABS * 1820 cm^2/event * 245 events/year * 6 years)/(15 kg * 25550 days)

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INHALATION OF CHEMICALS VOLATILIZED FROM SUBSURFACE SOIL AND GROUNDWATER THROUGH A BASEMENT

CHEMICAL	CONCENTRATION IN AIR (mg/m^3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS							
Acetone	9.08E-10	6E-10	Not Available	No Tox Data	Not Applicable		
1,2-Dichloroethene (total)	1.06E-08	7E-09	Not Available	No Tox Data	Not Applicable		
Ethylbenzene	3.10E-10	2E-10	2.86E-01	7E-10	Not Applicable		
Methylene Chloride	3.16E-09	2E-09	8.60E-01	2E-09	2E-10	1.65E-03	3E-13
Tetrachloroethene	3.16E-09	2E-09	Not Available	No Tox Data	2E-10	2.00E-03	4E-13
Toluene	1.11E-09	7E-10	1.14E-01	6E-09	Not Applicable		
Trichloroethene	1.73E-07	1E-07	Not Available	No Tox Data	1E-08	6.00E-03	6E-11
Vinyl Chloride	8.73E-09	6E-09	Not Available	No Tox Data	5E-10	3.00E-01	1E-10
Xylenes (total)	3.57E-09	2E-09	Not Available	No Tox Data	Not Applicable		
			HAZARD INDEX:	9E-09		**CANCER RISK:**	**2E-10**

CDI of noncarcinogenic chemicals via inhalation (child resident):
(mg/m^3 * 0.6 m^3/hour * 17 hours/day * 350 days/year * 6 years)/(15 kg * 2190 days)
CDI of carcinogenic chemicals via inhalation (child resident):
(mg/m^3 * 0.6 m^3/hour * 17 hours/day * 350 days/year * 6 years)/(15 kg * 25550 days)

TABLE 6-14

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CHILD RESIDENT (LIMITED RESIDENTIAL USE)
PETOSKEY MANUFACTURING SITE

INHALATION OF CHEMICALS VOLATILIZED FROM SUBSURFACE SOIL AND GROUNDWATER THROUGH FOUNDATIONS

CHEMICAL	CONCENTRATION IN AIR (mg/m^3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
VOLATILE ORGANICS							
Acetone	6.95E-10	5E-10	Not Available	No Tox Data	Not Applicable		
1,2-Dichloroethene (total)	8.14E-09	5E-09	Not Available	No Tox Data	Not Applicable		
Ethylbenzene	2.37E-10	2E-10	2.86E-01	5E-10	Not Applicable		
Methylene Chloride	2.42E-09	2E-09	8.60E-01	2E-09	1E-10	1.65E-03	2E-13
Tetrachloroethene	2.42E-09	2E-09	Not Available	No Tox Data	1E-10	2.00E-03	3E-13
Toluene	8.46E-10	6E-10	1.14E-01	5E-09	Not Applicable		
Trichloroethene	1.32E-07	9E-08	Not Available	No Tox Data	7E-09	6.00E-03	4E-11
Vinyl Chloride	6.68E-09	4E-09	Not Available	No Tox Data	4E-10	3.00E-01	1E-10
Xylenes (total)	2.73E-09	2E-09	Not Available	No Tox Data	Not Applicable		
			HAZARD INDEX:	**7E-09**		**CANCER RISK:**	**2E-10**

CDI of noncarcinogenic chemicals via inhalation (child resident):
(mg/m^3 * 0.6 m^3/hour * 17 hours/day * 350 days/year * 6 years)/(15 kg * 2190 days)
CDI of carcinogenic chemicals via inhalation (child resident):
(mg/m^3 * 0.6 m^3/hour * 17 hours/day * 350 days/year * 6 years)/(15 kg * 25550 days)

TABLE 6-15
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS								
Acetone	9.64E-03	UCL	1E-08	1.00E-01	1E-07	Not Applicable		
1,2-Dichloroethene (total)	7.83E-03	UCL	1E-08	9.00E-03	1E-06	3E-10	Not Available	No Tox Data
Ethylbenzene	7.63E-03	UCL	1E-08	1.00E-01	1E-07	Not Applicable		
Methylene Chloride	1.19E-02	UCL	2E-08	6.00E-02	3E-07	5E-10	7.50E-03	4E-12
Tetrachloroethene	7.97E-03	UCL	1E-08	1.00E-02	1E-06	3E-10	5.20E-02	2E-11
Toluene	7.55E-03	UCL	1E-08	2.00E-01	6E-08	Not Applicable		
Trichloroethene	1.65E-01	UCL	2E-07	6.00E-03	4E-05	7E-09	1.10E-02	8E-11
Xylenes (total)	1.24E-02	UCL	2E-08	2.00E+00	9E-09	Not Applicable		
SEMI-VOLATILE ORGANICS								
Acenaphthene	4.12E-01	UCL	6E-07	6.00E-02	1E-05	Not Applicable		
Anthracene	4.80E-01	UCL	7E-07	3.00E-01	2E-06	Not Applicable		
Benzo[a]anthracene	7.67E-01	UCL	1E-06	Not Available	No Tox Data	3E-08	7.30E-01	2E-08
Benzo[a]pyrene	6.07E-01	UCL	9E-07	Not Available	No Tox Data	3E-08	7.30E+00	2E-07
Benzo[b]fluoranthene	1.02E+00	UCL	2E-06	Not Available	No Tox Data	4E-08	7.30E-01	3E-08
Benzo[ghi]perylene	4.98E-01	UCL	7E-07	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	9.02E-01	UCL	1E-06	2.00E-02	7E-05	4E-08	1.40E-02	5E-10
Butyl benzyl phthalate	4.21E-01	UCL	6E-07	2.00E-01	3E-06	2E-08	Not Available	No Tox Data
Carbazole	4.39E-01	UCL	7E-07	Not Available	No Tox Data	2E-08	2.00E-02	4E-10
Chrysene	7.91E-01	UCL	1E-06	Not Available	No Tox Data	3E-08	7.30E-03	2E-10
Dibenz[a,h]anthracene	4.09E-01	UCL	6E-07	Not Available	No Tox Data	2E-08	7.30E+00	1E-07
Dibenzofuran	3.86E-01	UCL	6E-07	4.00E-03	1E-04	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	5E-07	1.00E-01	5E-06	Not Applicable		
Fluoranthene	1.40E+00	UCL	2E-06	4.00E-02	5E-05	Not Applicable		
Fluorene	4.22E-01	UCL	6E-07	4.00E-02	2E-05	Not Applicable		
Indeno[1,2,3-cd]pyrene	5.19E-01	UCL	8E-07	Not Available	No Tox Data	2E-08	7.30E-01	2E-08

TABLE 6-15
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS								
Phenanthrene	9.99E-01	UCL	2E-06	Not Available	No Tox Data	Not Applicable		
Pyrene	9.50E-01	UCL	1E-06	3.00E-02	5E-05	Not Applicable		
PESTICIDES/PCBs								
Aldrin	2.00E-03	MAX	3E-09	3.00E-05	1E-04	9E-11	1.70E+01	1E-09
4,4'-DDE	3.10E-03	MAX	5E-09	Not Available	No Tox Data	1E-10	3.40E-01	5E-11
4,4'-DDT	7.70E-03	UCL	1E-08	5.00E-04	2E-05	3E-10	3.40E-01	1E-10
INORGANICS								
Arsenic	2.45E+00	UCL	4E-06	3.00E-04	1E-02	1E-07	1.50E+00	2E-07
Cadmium	2.20E+00	UCL	3E-06	1.00E-03	3E-03	9E-08	Not Available	No Tox Data
Chromium	8.87E+00	UCL	1E-05	1.00E+00	1E-05	4E-07	Not Available	No Tox Data
Copper	1.58E+01	UCL	2E-05	3.70E-02	6E-04	Not Applicable		
Lead	1.94E+02	UCL	3E-04	Not Available	No Tox Data	8E-06	Not Available	No Tox Data
Mercury	1.14E-01	UCL	2E-07	Not Available	No Tox Data	Not Applicable		
Nickel	1.28E+01	UCL	2E-05	2.00E-02	1E-03	6E-07	Not Available	No Tox Data
Selenium	7.01E-01	UCL	1E-06	5.00E-03	2E-04	Not Applicable		
Silver	6.74E-01	UCL	1E-06	5.00E-03	2E-04	Not Applicable		
Thallium	4.19E-01	UCL	6E-07	Not Available	No Tox Data	2E-08	Not Available	No Tox Data
Zinc	1.35E+04	UCL	2E-02	3.00E-01	7E-02	Not Applicable		

TABLE 6-15
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

INADVERTENT INGESTION OF CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
OTHER								
Cyanide	4.19E-01	UCL	6E-07	2.00E-02	3E-05	Not Applicable		
				HAZARD INDEX:	**9E-02**		**CANCER RISK:**	**6E-07**

CDI of noncarcinogenic chemicals in all soils via ingestion (construction worker):
(mg/kg soil * 1.00E-06 kg/mg * 480 mg/day * 1 * 80 days/year * 2 years)/(70 kg * 730 days)
CDI of carcinogenic chemicals in all soils via ingestion (construction worker):
(mg/kg soil * 1.00E-06 kg/mg * 480 mg/day * 1 * 80 days/year * 2 years)/(70 kg * 25550 days)

TABLE 6-15
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
VOLATILE ORGANICS									
Acetone	9.64E-03	UCL	1.00E-01	1E-08	1.00E-01	1E-07	Not Applicable		
1,2-Dichloroethene (total)	7.83E-03	UCL	1.00E-01	1E-08	9.00E-03	1E-06	3E-10	Not Available	No Tox Data
Ethylbenzene	7.63E-03	UCL	1.00E-01	1E-08	1.00E-01	1E-07	Not Applicable		
Methylene Chloride	1.19E-02	UCL	1.00E-01	2E-08	6.00E-02	3E-07	4E-10	7.50E-03	3E-12
Tetrachloroethene	7.97E-03	UCL	1.00E-01	1E-08	1.00E-02	1E-06	3E-10	5.20E-02	2E-11
Toluene	7.55E-03	UCL	1.00E-01	1E-08	2.00E-01	5E-08	Not Applicable		
Trichloroethene	1.65E-01	UCL	1.00E-01	2E-07	6.00E-03	4E-05	6E-09	1.10E-02	7E-11
Xylenes (total)	1.24E-02	UCL	1.00E-01	2E-08	2.00E+00	8E-09	Not Applicable		
SEMI-VOLATILE ORGANICS									
Acenaphthene	4.12E-01	UCL	1.00E-02	5E-08	6.00E-02	9E-07	Not Applicable		
Anthracene	4.80E-01	UCL	1.00E-02	6E-08	3.00E-01	2E-07	Not Applicable		
Benzo[a]anthracene	7.67E-01	UCL	1.00E-02	1E-07	Not Available	No Tox Data	3E-09	7.30E-01	2E-09
Benzo[a]pyrene	6.07E-01	UCL	1.00E-02	8E-08	Not Available	No Tox Data	2E-09	7.30E+00	2E-08
Benzo[b]fluoranthene	1.02E+00	UCL	1.00E-02	1E-07	Not Available	No Tox Data	4E-09	7.30E-01	3E-09
Benzo[ghi]perylene	4.98E-01	UCL	1.00E-02	6E-08	Not Available	No Tox Data	Not Applicable		
bis(2-ethylhexyl) phthalate	9.02E-01	UCL	1.00E-02	1E-07	2.00E-02	6E-06	3E-09	1.40E-02	5E-11
Butyl benzyl phthalate	4.21E-01	UCL	1.00E-02	5E-08	2.00E-01	3E-07	2E-09	Not Available	No Tox Data
Carbazole	4.39E-01	UCL	1.00E-02	6E-08	Not Available	No Tox Data	2E-09	2.00E-02	3E-11
Chrysene	7.91E-01	UCL	1.00E-02	1E-07	Not Available	No Tox Data	3E-09	7.30E-03	2E-11
Dibenz[a,h]anthracene	4.09E-01	UCL	1.00E-02	5E-08	Not Available	No Tox Data	2E-09	7.30E+00	1E-08
Dibenzofuran	3.86E-01	UCL	1.00E-02	5E-08	4.00E-03	1E-05	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.00E-02	5E-08	1.00E-01	5E-07	Not Applicable		
Fluoranthene	1.40E+00	UCL	1.00E-02	2E-07	4.00E-02	4E-06	Not Applicable		
Fluorene	4.22E-01	UCL	1.00E-02	5E-08	4.00E-02	1E-06	Not Applicable		
Indeno[1,2,3-cd]pyrene	5.19E-01	UCL	1.00E-02	7E-08	Not Available	No Tox Data	2E-09	7.30E-01	1E-09

TABLE 6-15
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
SEMI-VOLATILE ORGANICS									
Phenanthrene	9.99E-01	UCL	1.00E-02	1E-07	Not Available	No Tox Data	Not Applicable		
Pyrene	9.50E-01	UCL	1.00E-02	1E-07	3.00E-02	4E-06	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	1.00E-02	3E-10	3.00E-05	9E-06	7E-12	1.70E+01	1E-10
4,4'-DDE	3.10E-03	MAX	1.00E-02	4E-10	Not Available	No Tox Data	1E-11	3.40E-01	4E-12
4,4'-DDT	7.70E-03	UCL	1.00E-02	1E-09	5.00E-04	2E-06	3E-11	3.40E-01	1E-11
INORGANICS									
Arsenic	2.45E+00	UCL	1.00E-02	3E-07	2.40E-04	1E-03	9E-09	1.88E+00	2E-08
Cadmium	2.20E+00	UCL	1.00E-02	3E-07	5.00E-05	6E-03	8E-09	Not Available	No Tox Data
Chromium	8.87E+00	UCL	1.00E-02	1E-06	1.00E-02	1E-04	3E-08	Not Available	No Tox Data
Copper	1.58E+01	UCL	1.00E-02	2E-06	1.85E-02	1E-04	Not Applicable		
Lead	1.94E+02	UCL	1.00E-02	2E-05	Not Available	No Tox Data	7E-07	Not Available	No Tox Data
Mercury	1.14E-01	UCL	1.00E-02	1E-08	Not Available	No Tox Data	Not Applicable		
Nickel	1.28E+01	UCL	1.00E-02	2E-06	2.00E-03	8E-04	5E-08	Not Available	No Tox Data
Selenium	7.01E-01	UCL	1.00E-02	9E-08	4.50E-03	2E-05	Not Applicable		
Silver	6.74E-01	UCL	1.00E-02	9E-08	5.00E-04	2E-04	Not Applicable		
Thallium	4.19E-01	UCL	1.00E-02	5E-08	Not Available	No Tox Data	2E-09	Not Available	No Tox Data
Zinc	1.35E+04	UCL	1.00E-02	2E-03	1.20E-01	1E-02	Not Applicable		

TABLE 6-15
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

DERMAL CONTACT WITH CHEMICALS IN ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		ABSORPTION FACTOR (unitless)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL RfD (mg/kg-day)	HAZARD QUOTIENT	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	ADJUSTED ORAL SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
OTHER									
Cyanide	4.19E-01	UCL	1.00E-02	5E-08	2.00E-02	3E-06	Not Applicable		
					HAZARD INDEX:	**2E-02**		**CANCER RISK:**	**5E-08**

CDI of noncarcinogenic chemicals in all soils via dermal contact (construction worker):
(mg/kg soil * 1.00E-06 kg/mg * 1.00 mg/cm^2 * ABS * 4100 cm^2/event * 80 events /year * 2 years)/(70 kg * 730 days)
CDI of carcinogenic chemicals in all soils via dermal contact (construction worker):
(mg/kg soil * 1.00E-06 kg/mg *1.00 mg/cm^2 * ABS * 4100 cm^2/event * 80 events/year * 2 years)/(70 kg * 25550 days)

TABLE 6-15

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

INHALATION OF RESPIRABLE PARTICULATE MATTER FROM ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CONCENTRATION IN AIR (mg/m3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
SEMI-VOLATILE ORGANICS									
Acenaphthene	4.12E-01	UCL	1.66E-07	1E-08	Not Available	No Tox Data	Not Applicable		
Anthracene	4.80E-01	UCL	1.93E-07	1E-08	Not Available	No Tox Data	Not Applicable		
Benzo[a]anthracene	7.67E-01	UCL	3.08E-07	2E-08	Not Available	No Tox Data	5E-10	Not Available	No Tox Data
Benzo[a]pyrene	6.07E-01	UCL	2.44E-07	1E-08	Not Available	No Tox Data	4E-10	Not Available	No Tox Data
Benzo[b]fluoranthene	1.02E+00	UCL	4.09E-07	2E-08	Not Available	No Tox Data	7E-10	Not Available	No Tox Data
Benzo[g,h,i]perylene	4.98E-01	UCL	2.00E-07	1E-08	Not Available	No Tox Data	Not Applicable		
Butylbenzyl phthalate	4.21E-01	UCL	1.69E-07	1E-08	Not Available	No Tox Data	3E-10	Not Available	No Tox Data
bis(2-Ethylhexyl)phthalate	9.02E-01	UCL	3.63E-07	2E-08	Not Available	No Tox Data	6E-10	1.40E-02	8E-12
Carbazole	4.39E-01	UCL	1.76E-07	1E-08	Not Available	No Tox Data	3E-10	Not Available	No Tox Data
Chrysene	7.90E-01	UCL	3.18E-07	2E-08	Not Available	No Tox Data	5E-10	Not Available	No Tox Data
Dibenz[a,h]anthracene	4.09E-01	UCL	1.64E-07	9E-09	Not Available	No Tox Data	3E-10	Not Available	No Tox Data
Dibenzofuran	3.86E-01	UCL	1.55E-07	9E-09	Not Available	No Tox Data	Not Applicable		
Di-n-butyl-phthalate	3.60E-01	MAX	1.45E-07	8E-09	Not Available	No Tox Data	Not Applicable		
Fluorene	4.22E-01	UCL	1.70E-07	1E-08	Not Available	No Tox Data	Not Applicable		
Fluoranthene	1.40E+00	UCL	5.63E-07	3E-08	Not Available	No Tox Data	Not Applicable		
Indeno[1,2,3-cd]perylene	5.19E-01	UCL	2.09E-07	1E-08	Not Available	No Tox Data	3E-10	Not Available	No Tox Data
Phenanthrene	9.99E-01	UCL	4.02E-07	2E-08	Not Available	No Tox Data	Not Applicable		
Pyrene	9.50E-01	UCL	3.82E-07	2E-08	Not Available	No Tox Data	Not Applicable		
PESTICIDES/PCBs									
Aldrin	2.00E-03	MAX	8.04E-10	5E-11	Not Available	No Tox Data	1E-12	1.70E+01	2E-11
4,4'-DDE	3.10E-03	MAX	1.25E-09	7E-11	Not Available	No Tox Data	2E-12	Not Available	No Tox Data
4,4'-DDT	7.70E-03	UCL	3.10E-09	2E-10	Not Available	No Tox Data	5E-12	3.40E-01	2E-12

TABLE 6-15

SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC HEALTH RISKS
FOR A CONSTRUCTION WORKER
PETOSKEY MANUFACTURING SITE

INHALATION OF RESPIRABLE PARTICULATE MATTER FROM ALL SOILS

CHEMICAL	SOIL CONCENTRATION (mg/kg)		CONCENTRATION IN AIR (mg/m3)	CDI for NONCARCINOGENIC EFFECTS (mg/kg-day)	INHALATION RfD (mg/kg-day)	**HAZARD QUOTIENT**	CDI for CARCINOGENIC EFFECTS (mg/kg-day)	INHALATION SLOPE FACTOR (mg/kg-day)^-1	**CANCER RISK**
INORGANICS									
Arsenic	2.45E+00	UCL	9.85E-07	6E-08	Not Available	No Tox Data	2E-09	1.50E+00	2E-09
Cadmium	2.20E+00	UCL	8.86E-07	5E-08	Not Available	No Tox Data	1E-09	6.30E+00	9E-09
Chromium	8.87E+00	UCL	3.57E-06	2E-07	Not Available	No Tox Data	6E-09	Not Available	No Tox Data
Copper	1.58E+01	UCL	6.35E-06	4E-07	Not Available	No Tox Data	Not Applicable		
Lead	1.94E+02	UCL	7.81E-05	4E-06	Not Available	No Tox Data	1E-07	Not Available	No Tox Data
Mercury	1.14E-01	UCL	4.58E-08	3E-09	8.57E-05	3E-05	Not Applicable		
Nickel	1.28E+01	UCL	5.15E-06	3E-07	Not Available	No Tox Data	8E-09	8.40E-01	7E-09
Selenium	7.01E-01	UCL	2.82E-07	2E-08	Not Available	No Tox Data	Not Applicable		
Silver	6.74E-01	UCL	2.71E-07	2E-08	2.86E-06	5E-03	Not Applicable		
Thallium	4.19E-01	UCL	1.68E-07	1E-08	Not Available	No Tox Data	3E-10	Not Available	No Tox Data
Zinc	1.35E+04	UCL	5.41E-03	3E-04	Not Available	No Tox Data	Not Applicable		
OTHER									
Cyanide	4.19E-01	UCL	1.68E-07	1E-08	Not Available	No Tox Data	Not Applicable		
					HAZARD INDE	5E-03		**CANCER RISK:**	**2E-08**

CDI of noncarcinogenic chemicals via inhalation of particulate matter (construction worker):
(mg/kg * 4.02E-07 kg/m^3 * 2.3 m^3/hour * 8 hours/day * 80 days/year * 2 years)/(70 kg * 730 days)
CDI of carcinogenic chemicals via inhalation of particulate matter (construction worker):
(mg/kg * 4.02E-07 kg/m^3 * 2.3 m^3/hour * 8 hours/day * 80 days/year * 2 years)/(70 kg * 25550 days)

TABLE 6-16

SUMMARY OF HAZARD INDICES AND CANCER RISKS
PETOSKEY MANUFACTURING SITE

EXPOSURE POPULATION AND PATHWAY	HAZARD INDEX	CANCER RISK	
CURRENT SCENARIO			
ADOLESCENT TRESPASSER			
Ingestion of Shallow Soil	3E-02	4E-07	
Dermal Contact with Shallow Soil	5E-02	2E-07	
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**8E-02**	**6E-07**	
PMC WORKER			
Ingestion of Shallow Soil	2E-02	3E-06	
Dermal Contact with Shallow Soil	5E-02	2E-06	
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**7E-02**	**5E-06**	
FUTURE SCENARIO			
RESIDENT ADULT (GENERIC RESIDENTIAL USE)			
Ingestion of All Soils	8E-02	2E-05	*
Dermal Contact with All Soils	1E-01	3E-06	*
Ingestion of Groundwater	8E-01	2E-04	
Dermal Contact with Groundwater	2E-02	4E-06	
Inhalation of Chemicals Volatilized from Groundwater		8E-06	
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**1E+00**	**3E-04**	
RESIDENT CHILD (GENERIC RESIDENTIAL USE)			
Ingestion of All Soils	7E-01	1E-05	
Dermal Contact with All Soils	1E-01	1E-06	
Ingestion of Groundwater	2E+00	1E-04	
Dermal Contact with Groundwater	3E-02	1E-06	
Inhalation of Chemicals Volatilized from Groundwater		5E-06	
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**3E+00**	**1E-04**	
RESIDENT ADULT (LIMITED RESIDENTIAL USE)			
Ingestion of Shallow Soil	1E-01	6E-05	*
Dermal Contact with Shallow Soil	2E-01	9E-06	*
Inhalation of Chemicals Intruding through Basement	3E-09	3E-10	
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**4E-01**	**7E-05**	
RESIDENT CHILD (LIMITED RESIDENTIAL USE)			
Ingestion of Shallow Soil	1E+00	4E-05	
Dermal Contact with Shallow Soil	4E-01	3E-06	
Inhalation of Chemicals Intruding through Basement	9E-09	2E-10	
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**2E+00**	**4E-05**	
RESIDENT ADULT (LIMITED RESIDENTIAL USE)			
Ingestion of Shallow Soil	1E-01	6E-05	*
Dermal Contact with Shallow Soil	2E-01	9E-06	*
Inhalation of Chemicals Intruding through Foundation	2E-09	2E-10	
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**4E-01**	**7E-05**	

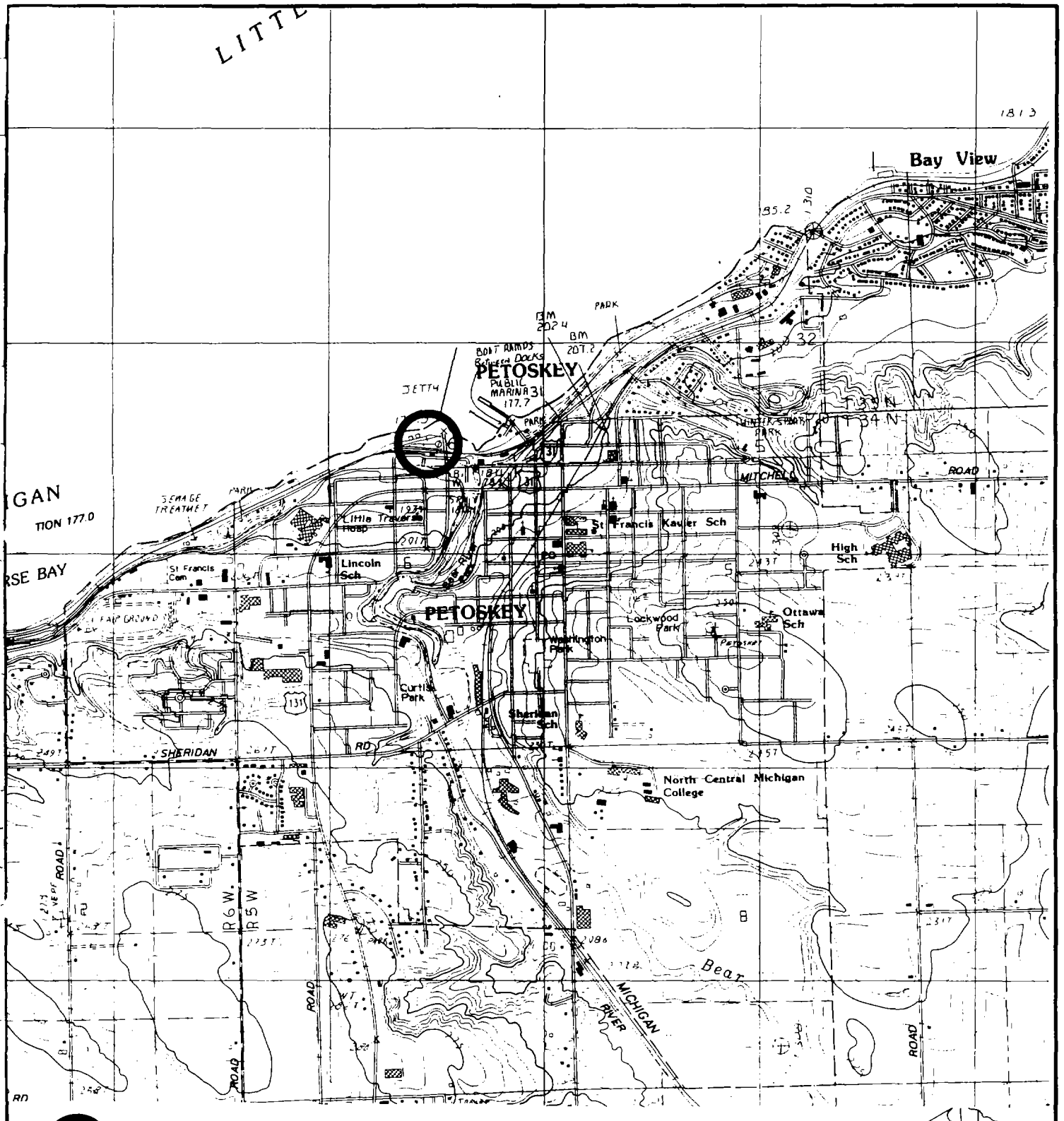
TABLE 6-16

SUMMARY OF HAZARD INDICES AND CANCER RISKS
PETOSKEY MANUFACTURING SITE

EXPOSURE POPULATION AND PATHWAY	HAZARD INDEX	CANCER RISK
RESIDENT CHILD (LIMITED RESIDENTIAL USE)		
Ingestion of Shallow Soil	1E+00	4E-05
Dermal Contact with Shallow Soil	4E-01	3E-06
Inhalation of Chemicals Intruding through Foundation	7E-09	2E-10
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**2E+00**	**4E-05**
CONSTRUCTION WORKER		
Ingestion of All Soils	9E-02	6E-07
Dermal Contact with All Soils	2E-02	5E-08
Inhalation of Respirable Particulates	5E-03	2E-08
TOTAL PATHWAY HAZARD INDEX/CANCER RISK:	**1E-01**	**6E-07**

* Based on 30 year exposure, 6 years child exposure plus 24 years adult exposure.

FIGURES



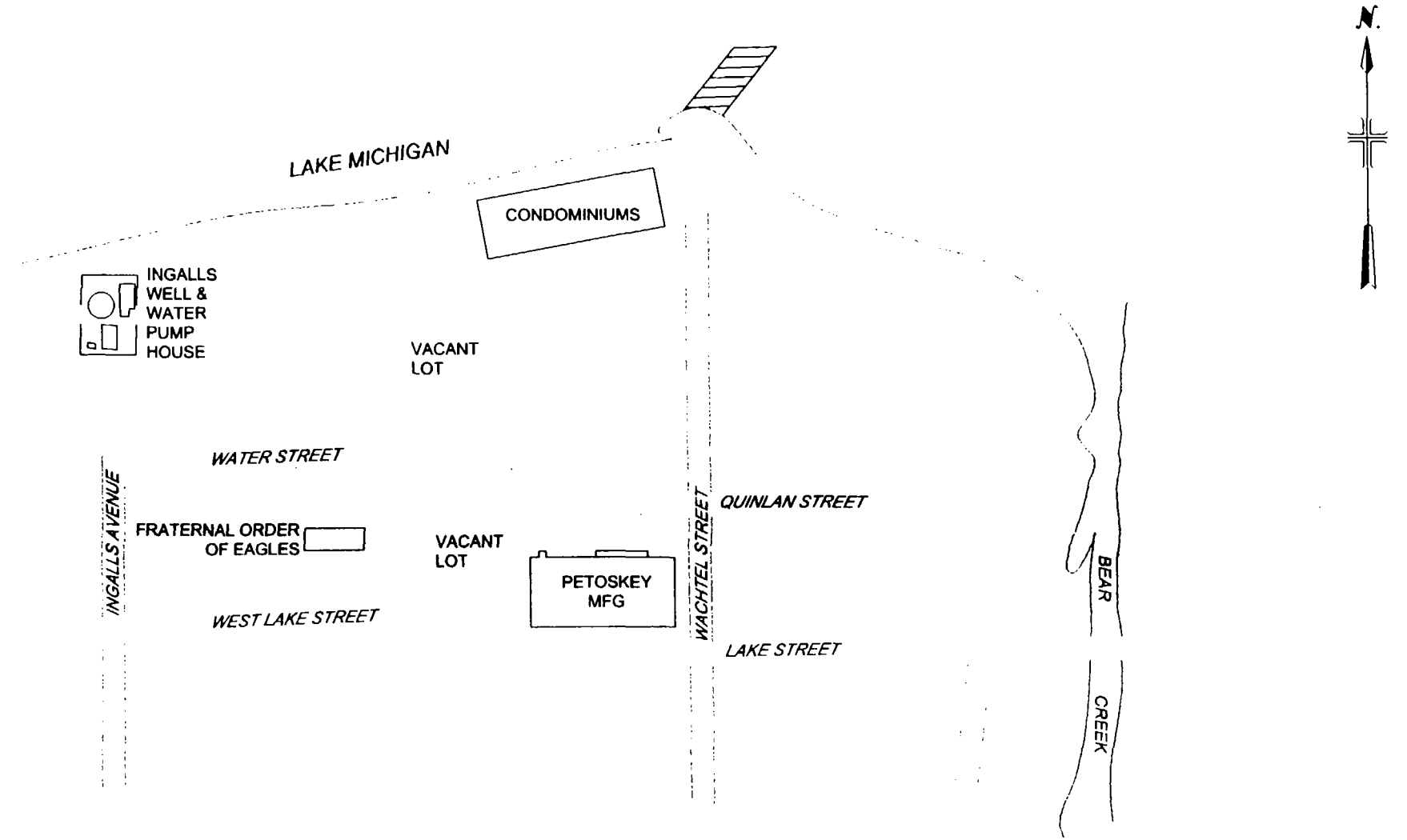
MALCOLM PIRNIE

PETOSKEY MANUFACTURING SITE

SITE LOCATION MAP

MALCOLM PIRNIE ENGINEERS

FIGURE 1-1



NOTES

1. BASE MAP SOURCE: PHASE I REMEDIAL INVESTIGATION, PETOSKEY MANUFACTURING COMPANY; EDER ASSOCIATES CONSULTING ENGINEERS, PC; DECEMBER 1993, PROJECT #720-20.

2. THIS DRAWING MAY BE REPRODUCED FOR USE BY THE STATE OF MICHIGAN OR ITS AUTHORIZED REPRESENTATIVE.

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0 200 400

MALCOLM PIRNIE

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PETOSKEY MANUFACTURING SITE

PETOSKEY, MICHIGAN

SITE MAP

MALCOLM PIRNIE ENGINEERS, LLP
EAST LANSING, MICHIGAN

FIGURE 1-2

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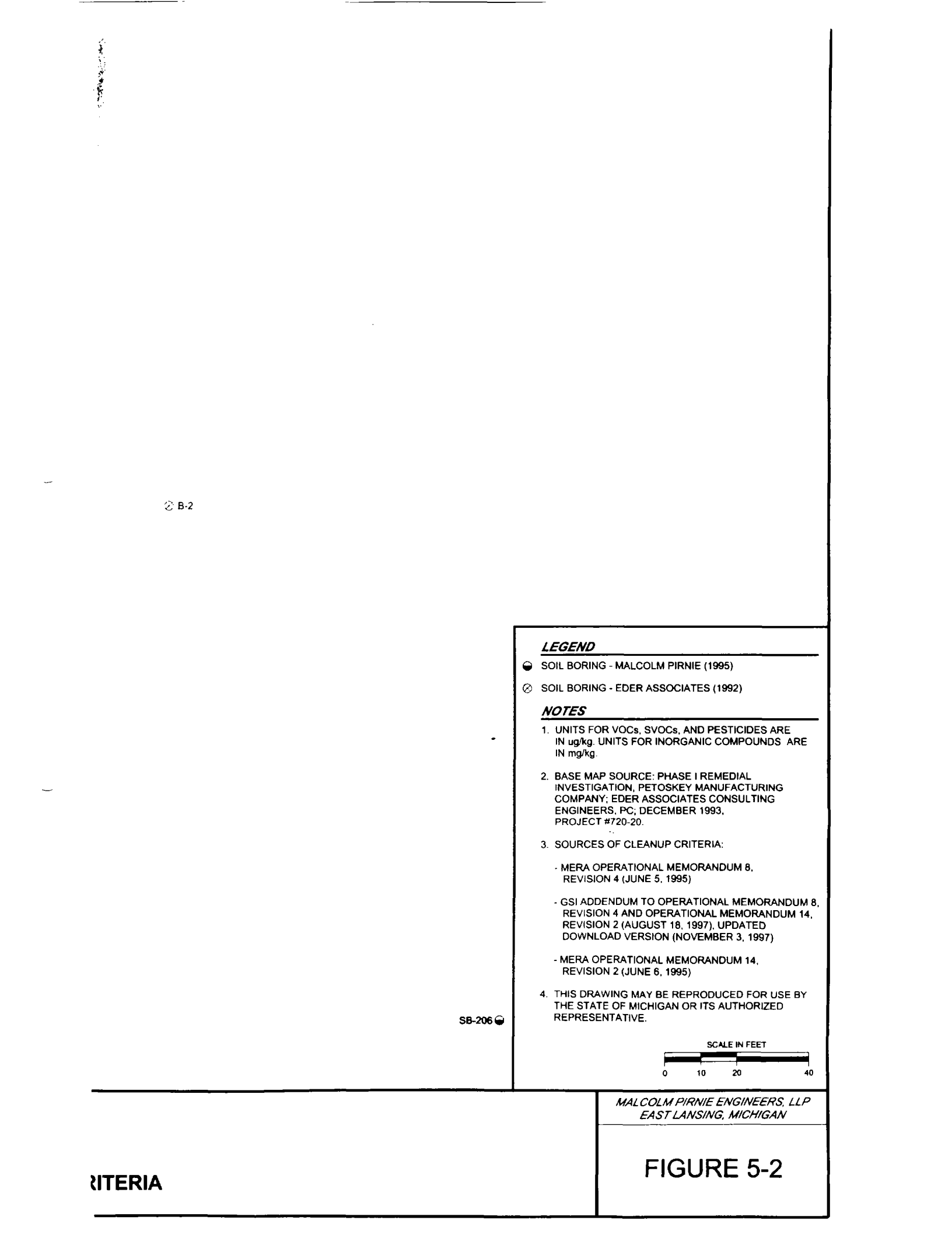
B-2
SB-206
LEGEND
SOIL BORING - MALCOLM PIRNIE (1995)
SOIL BORING - EDER ASSOCIATES (1992)
NOTES
1. UNITS FOR VOCs, SVOCs, AND PESTICIDES ARE IN ug/kg. UNITS FOR INORGANIC COMPOUNDS ARE IN mg/kg.
2. BASE MAP SOURCE: PHASE I REMEDIAL INVESTIGATION, PETOSKEY MANUFACTURING COMPANY; EDER ASSOCIATES CONSULTING ENGINEERS, PC; DECEMBER 1993, PROJECT #720-20.
3. SOURCES OF CLEANUP CRITERIA:
- MERA OPERATIONAL MEMORANDUM 8, REVISION 4 (JUNE 5, 1995)
- GSI ADDENDUM TO OPERATIONAL MEMORANDUM 8, REVISION 4 AND OPERATIONAL MEMORANDUM 14, REVISION 2 (AUGUST 18, 1997), UPDATED DOWNLOAD VERSION (NOVEMBER 3, 1997)
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SCALE IN FEET
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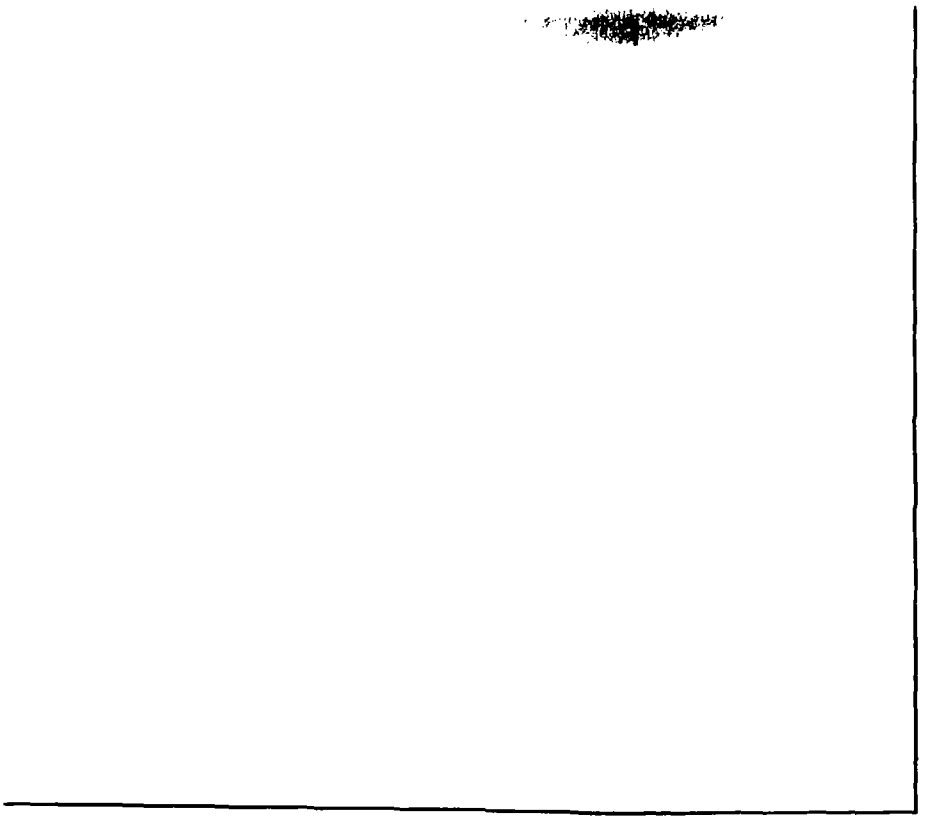
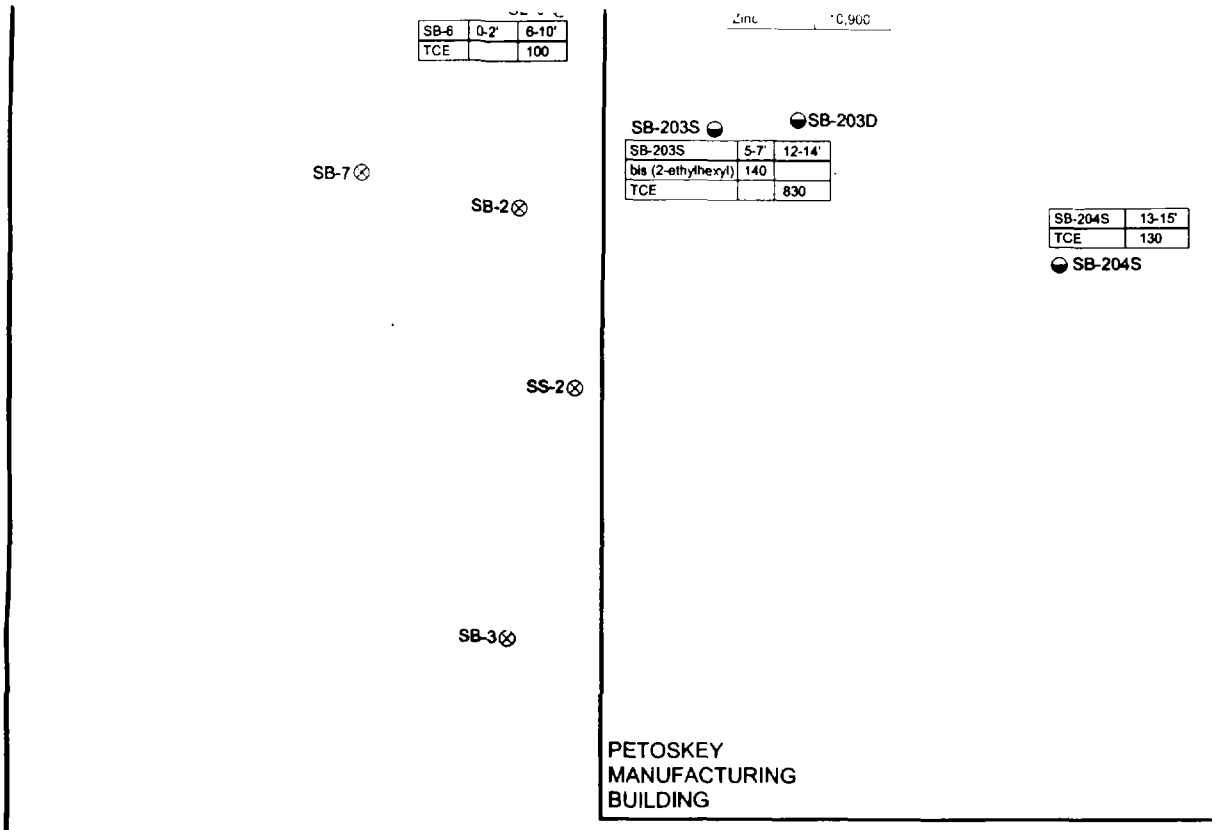
MALCOLM PIRNIE ENGINEERS, LLP
EAST LANSING, MICHIGAN
FIGURE 5-2
RITERIA



PETOSKEY MANUFACTURING SITE

PETOSKEY, MICHIGAN

DATA - ORGANIC AND INORGANIC COMPOUNDS EXCEEDING INDUSTRIAL CLE



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MALCOLM PIRNIE

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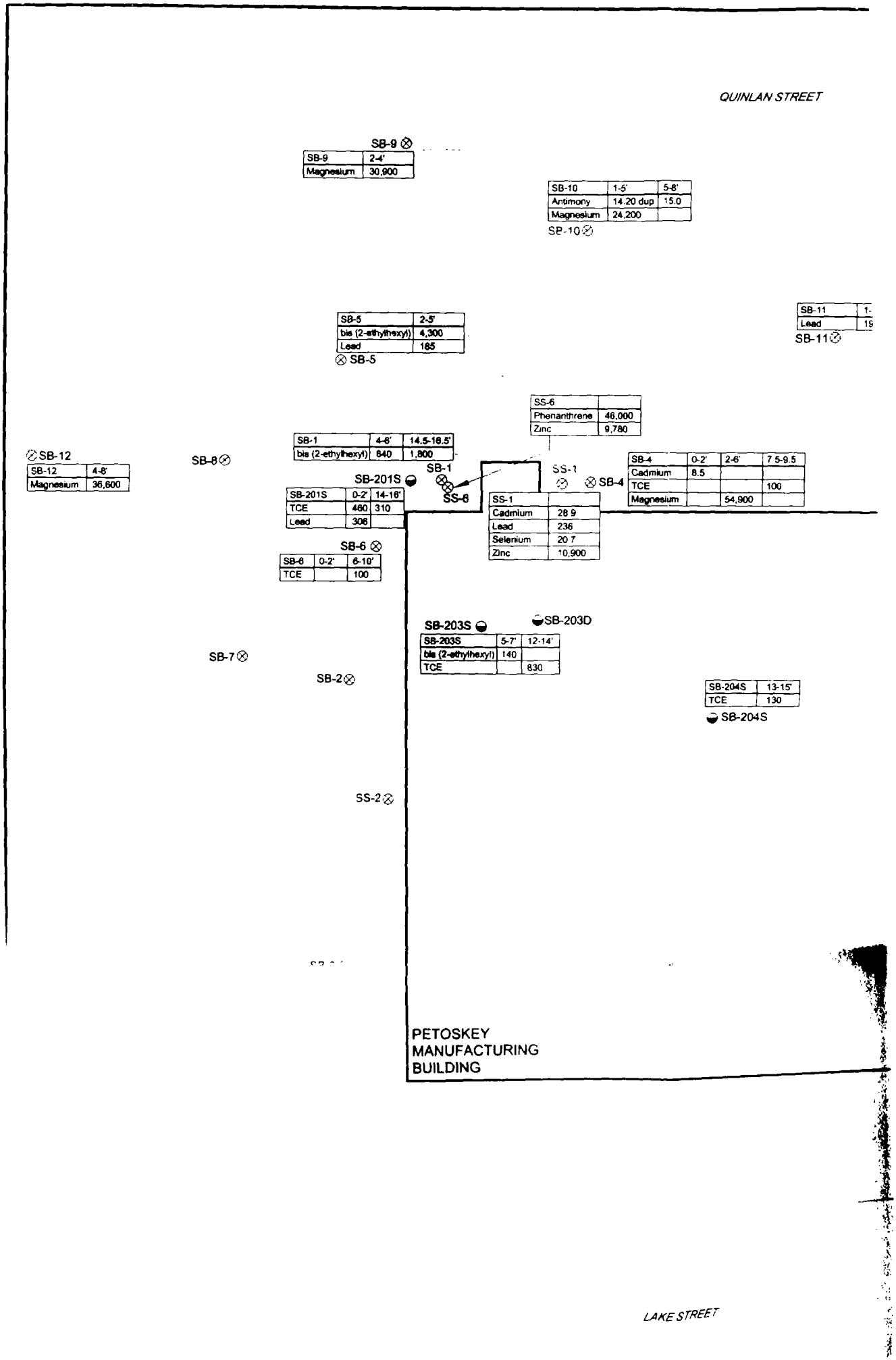
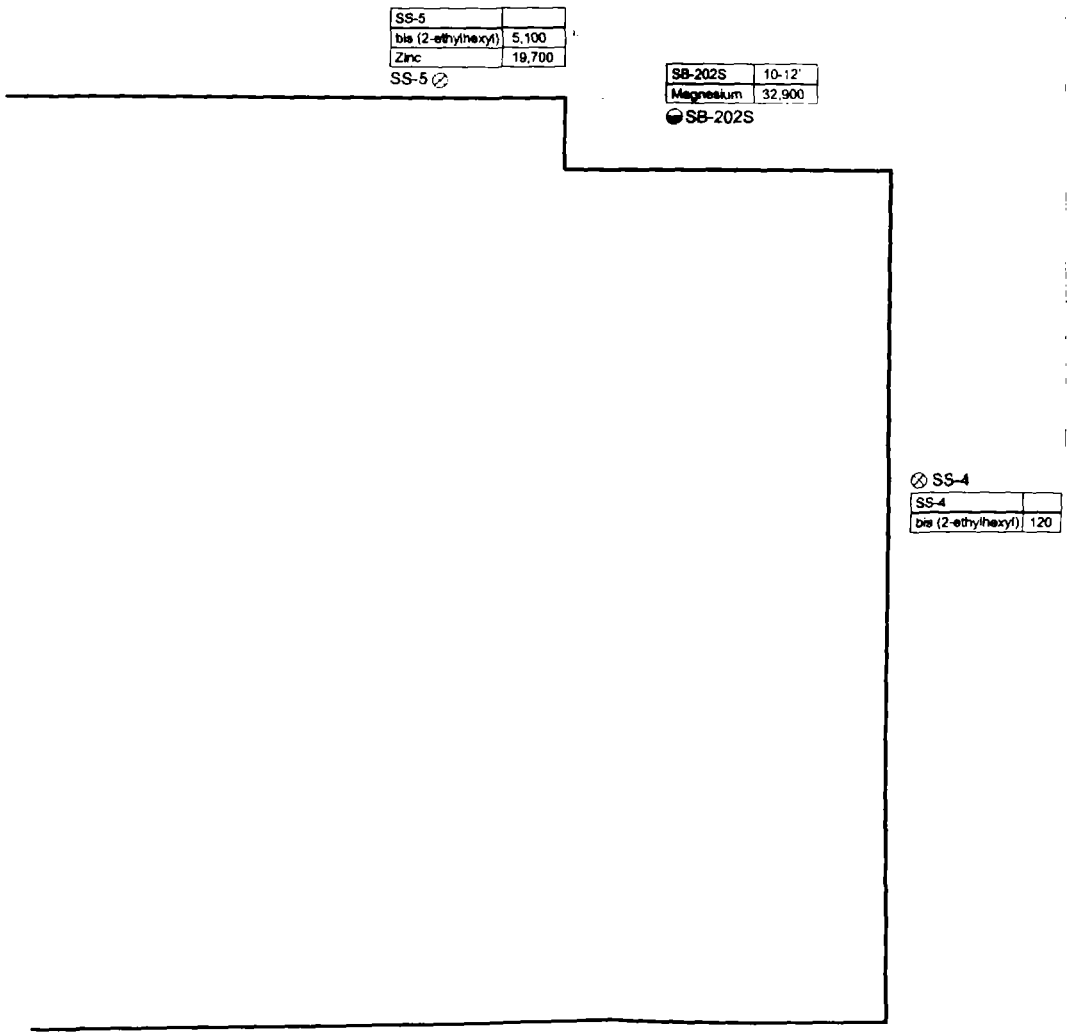
SOIL


QUINLAN STREET
SB-9
SB-9 | 2-4'
Magnesium | 30,900
SB-10 | 1-5' | 5-8'
Antimony | 14.20 dup | 15.0
Magnesium | 24,200
SB-10
SB-5 | 2-5'
bis (2-ethylhexyl) | 4,300
Lead | 185
SB-5
SB-11 | 1-
Lead | 19
SB-11
SS-6
Phenanthrene | 46,000
Zinc | 9,780
SB-12
SB-12 | 4-8'
Magnesium | 36,600
SB-8
SB-1 | 4-6' | 14.5-16.5'
bis (2-ethylhexyl) | 640 | 1,800
SB-1
SB-201S
SS-6
SS-1
SB-4
SB-4 | 0-2' | 2-6' | 7.5-9.5
Cadmium | 8.5
TCE | 100
Magnesium | 54,900
SB-201S | 0-2' | 14-16'
TCE | 480 | 310
Lead | 308
SS-1
Cadmium | 28.9
Lead | 236
Selenium | 20.7
Zinc | 10,900
SB-6
SB-6 | 0-2' | 6-10'
TCE | 100
SB-203S
SB-203D
SB-203S | 5-7' | 12-14'
bis (2-ethylhexyl) | 140
TCE | 830
SB-7
SB-2
SB-204S | 13-15'
TCE | 130
SB-204S
SS-2
PETOSKEY
MANUFACTURING
BUILDING
LAKE STREET


SS-5
bis (2-ethylhexyl) 5,100
Zinc 19,700
SS-5
SB-202S 10-12'
Magnesium 32,900
SB-202S
SS-4
SS-4
bis (2-ethylhexyl) 120
WACHTEL STREET

⊘ B-2

LEGEND

- SOIL BORING - MALCOLM PIRNIE (1995)
- SOIL BORING - EDER ASSOCIATES (1992)

NOTES

1 UNITS FOR VOCs, SVOCs, AND PESTICIDES ARE IN ug/kg. UNITS FOR INORGANIC COMPOUNDS ARE

B-2

SB-206

LEGEND

- SOIL BORING - MALCOLM PIRNIE (1995)
- SOIL BORING - EDER ASSOCIATES (1992)

NOTES

1. UNITS FOR VOCs, SVOCs, AND PESTICIDES ARE IN ug/kg. UNITS FOR INORGANIC COMPOUNDS ARE IN mg/kg.
2. BASE MAP SOURCE: PHASE I REMEDIAL INVESTIGATION, PETOSKEY MANUFACTURING COMPANY; EDER ASSOCIATES CONSULTING ENGINEERS, PC; DECEMBER 1993, PROJECT #720-20.
3. SOURCES OF CLEANUP CRITERIA:
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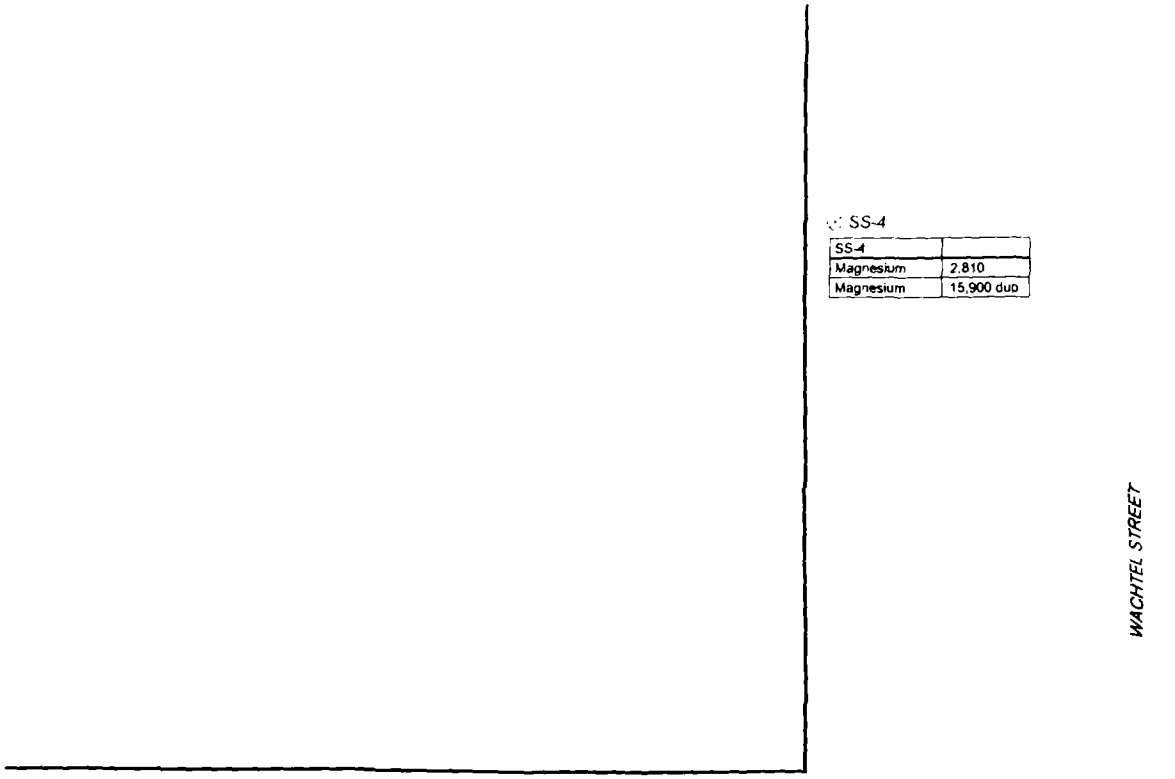
MALCOLM PIRNIE ENGINEERS, LLP
EAST LANSING, MICHIGAN

RITERIA

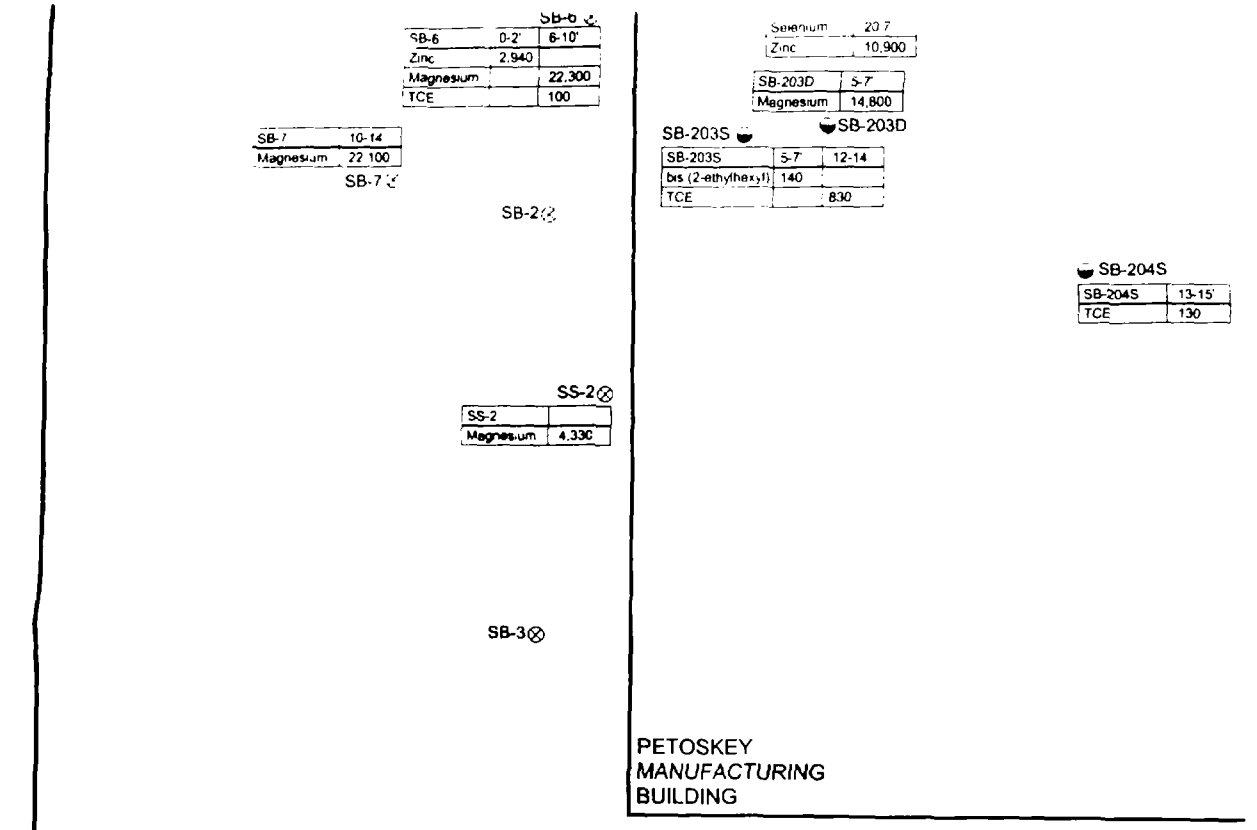
FIGURE 5-1



PETOSKEY MANUFACTURING SITE

PETOSKEY, MICHIGAN

- ORGANIC AND INORGANIC COMPOUNDS EXCEEDING RESIDENTIAL CLEANU



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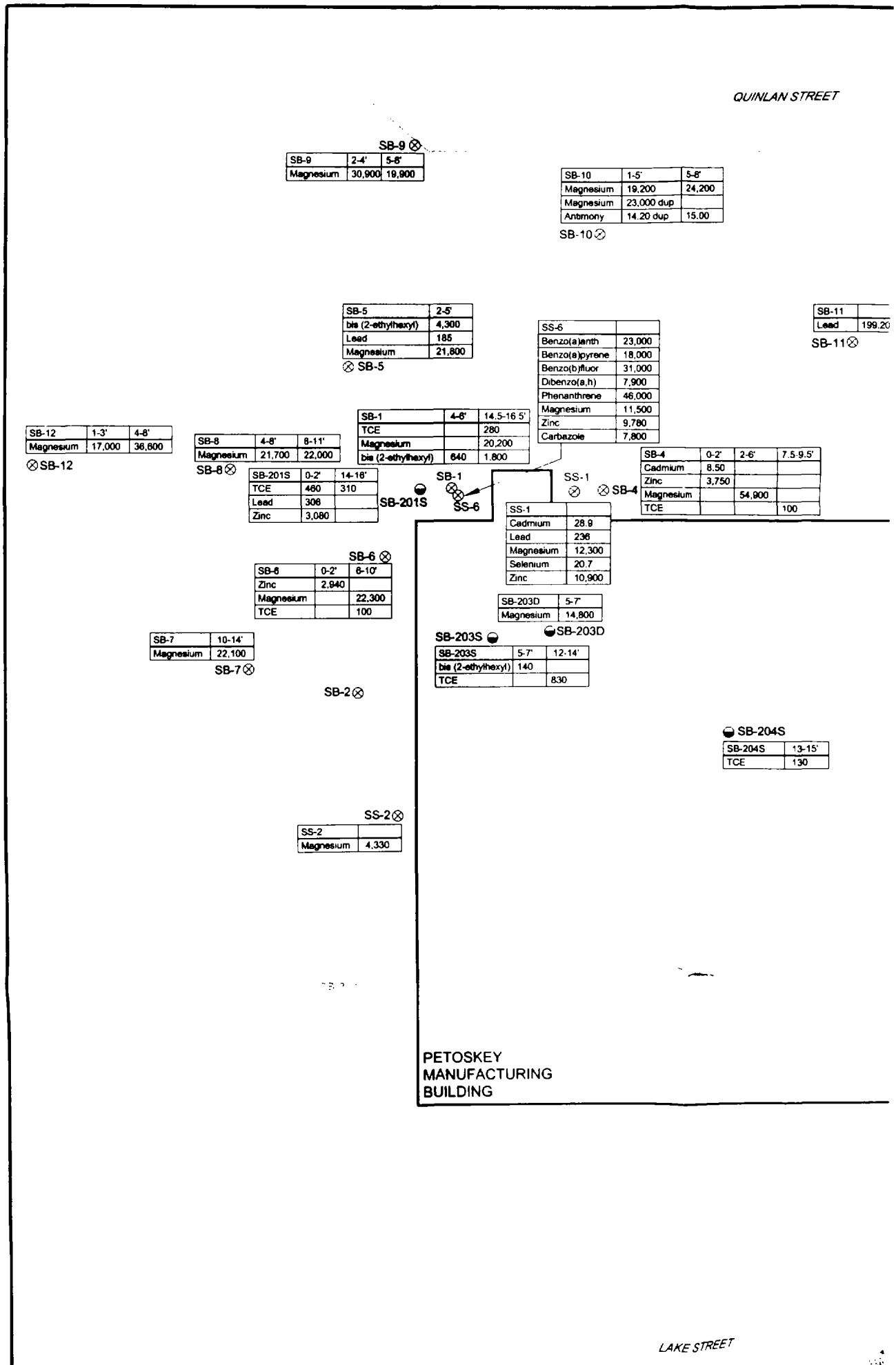
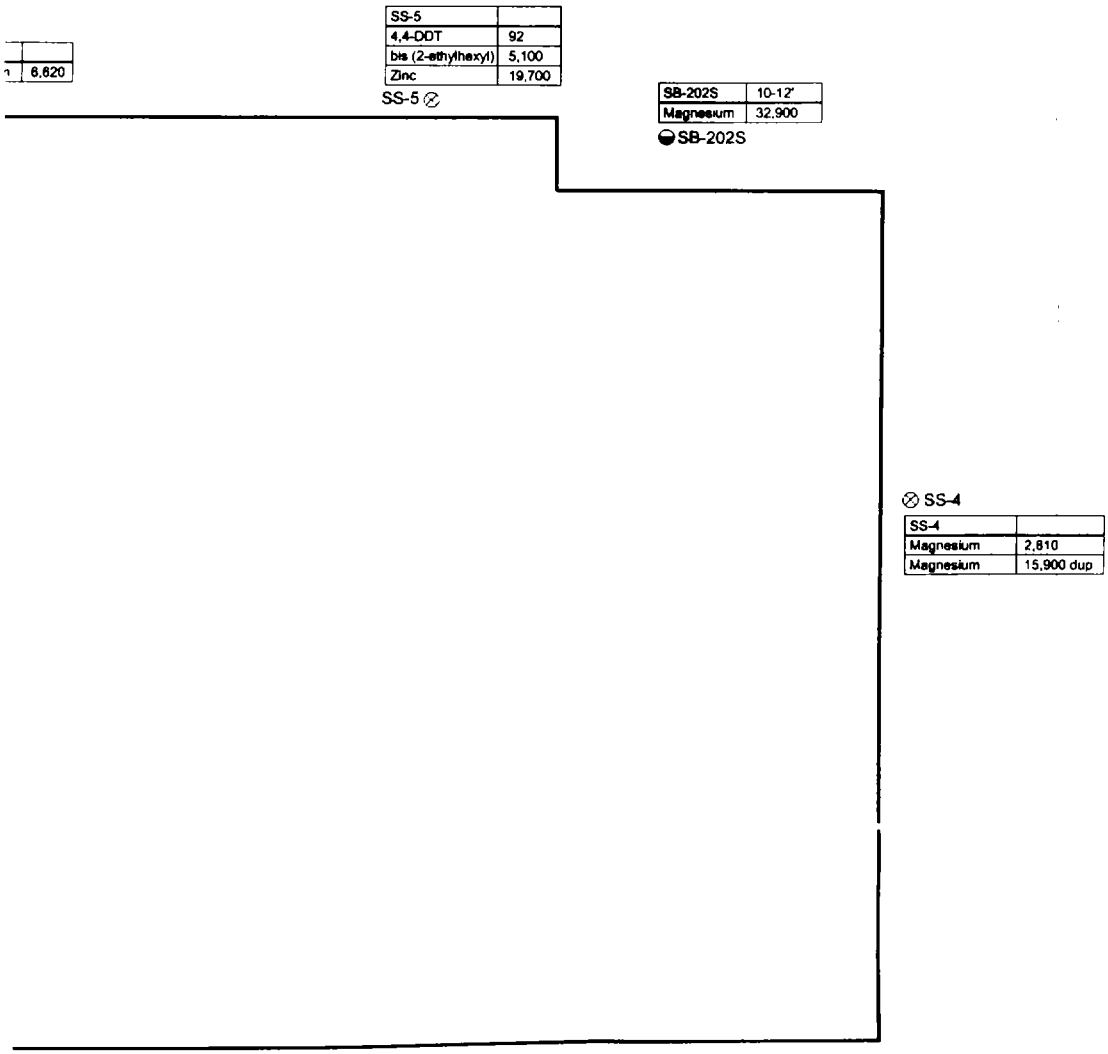
SOIL


QUINLAN STREET
SB-9
SB-9 | 2-4' | 5-8'
Magnesium | 30,900 | 19,900
SB-10 | 1-5' | 5-8'
Magnesium | 19,200 | 24,200
Magnesium | 23,000 dup |
Antimony | 14.20 dup | 15.00
SB-10
SB-5 | 2-5'
bis (2-ethylhexyl) | 4,300
Lead | 185
Magnesium | 21,800
SB-5
SS-6 |
Benzo(a)anth | 23,000
Benzo(a)pyrene | 18,000
Benzo(b)fluor | 31,000
Dibenzo(a,h) | 7,900
Phenanthrene | 46,000
Magnesium | 11,500
Zinc | 9,780
Carbazole | 7,800
SB-11 |
Lead | 199.20
SB-11
SB-12 | 1-3' | 4-8'
Magnesium | 17,000 | 36,800
SB-12
SB-8 | 4-8' | 8-11'
Magnesium | 21,700 | 22,000
SB-8
SB-1 | 4-6' | 14.5-16.5'
TCE | | 280
Magnesium | | 20,200
bis (2-ethylhexyl) | 640 | 1,800
SB-201S | 0-2' | 14-18'
TCE | 460 | 310
Lead | 306 |
Zinc | 3,080 |
SB-201S
SB-1
SS-6
SS-1
SB-4
SB-4 | 0-2' | 2-6' | 7.5-9.5'
Cadmium | 8.50 | |
Zinc | 3,750 | |
Magnesium | | 54,900 |
TCE | | | 100
SS-1 |
Cadmium | 28.9
Lead | 236
Magnesium | 12,300
Selenium | 20.7
Zinc | 10,900
SB-6
SB-6 | 0-2' | 6-10'
Zinc | 2,940 |
Magnesium | | 22,300
TCE | | 100
SB-203D | 5-7'
Magnesium | 14,800
SB-203D
SB-203S
SB-203S | 5-7' | 12-14'
bis (2-ethylhexyl) | 140 |
TCE | | 830
SB-7 | 10-14'
Magnesium | 22,100
SB-7
SB-2
SB-204S
SB-204S | 13-15'
TCE | 130
SS-2
SS-2 |
Magnesium | 4,330
PETOSKEY
MANUFACTURING
BUILDING
LAKE STREET


SS-5
4,4-DDT 92
bis (2-ethylhexyl) 5,100
Zinc 19,700
SS-5
SB-202S 10-12'
Magnesium 32,900
SB-202S
SS-4
SS-4
Magnesium 2,810
Magnesium 15,900 dup
WACHTEL STREET

⊗ B-2

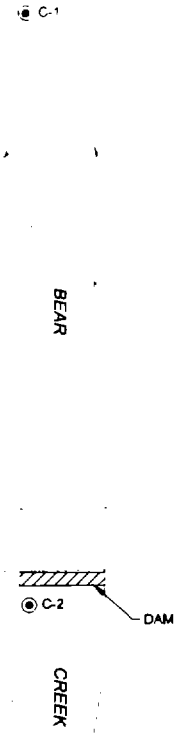
LEGEND

SOIL BORING - MALCOLM PIRNIE (1995)

SOIL BORING - EDER ASSOCIATES (1992)

NOTES

1. UNITS FOR VOCs, SVOCs, AND PESTICIDES ARE IN ug/kg. UNITS FOR INORGANIC COMPOUNDS ARE



LEGEND

- MONITORING WELL
- MONITORING WELL CLUSTER
- PUMPING TEST WELL
- SURFACE WATER LEVEL MEASUREMENT LOCATION
- ABANDONED MONITORING WELL REPLACED BY PS-1R

COP CITY OF PETOSKEY MONITORING WELL

NOTES

1. BASE MAP SOURCE: PHASE I REMEDIAL INVESTIGATION, PETOSKEY MANUFACTURING COMPANY; EDER ASSOCIATES CONSULTING ENGINEERS, PC; DECEMBER 1993, PROJECT #720-20.
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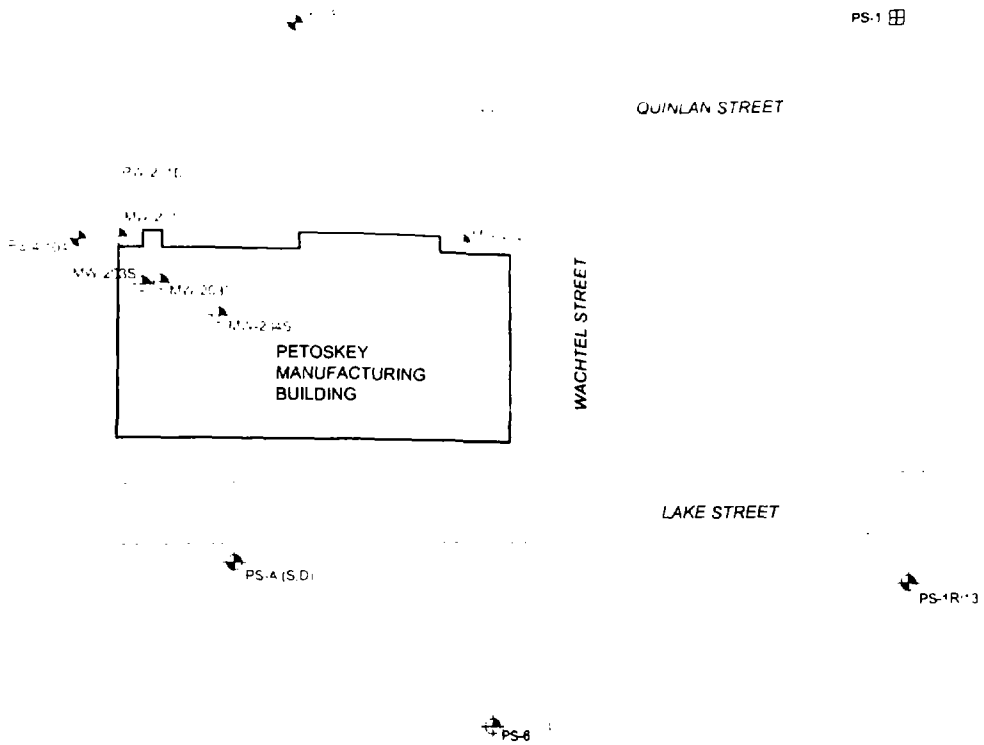
EAST LANSING, MICHIGAN

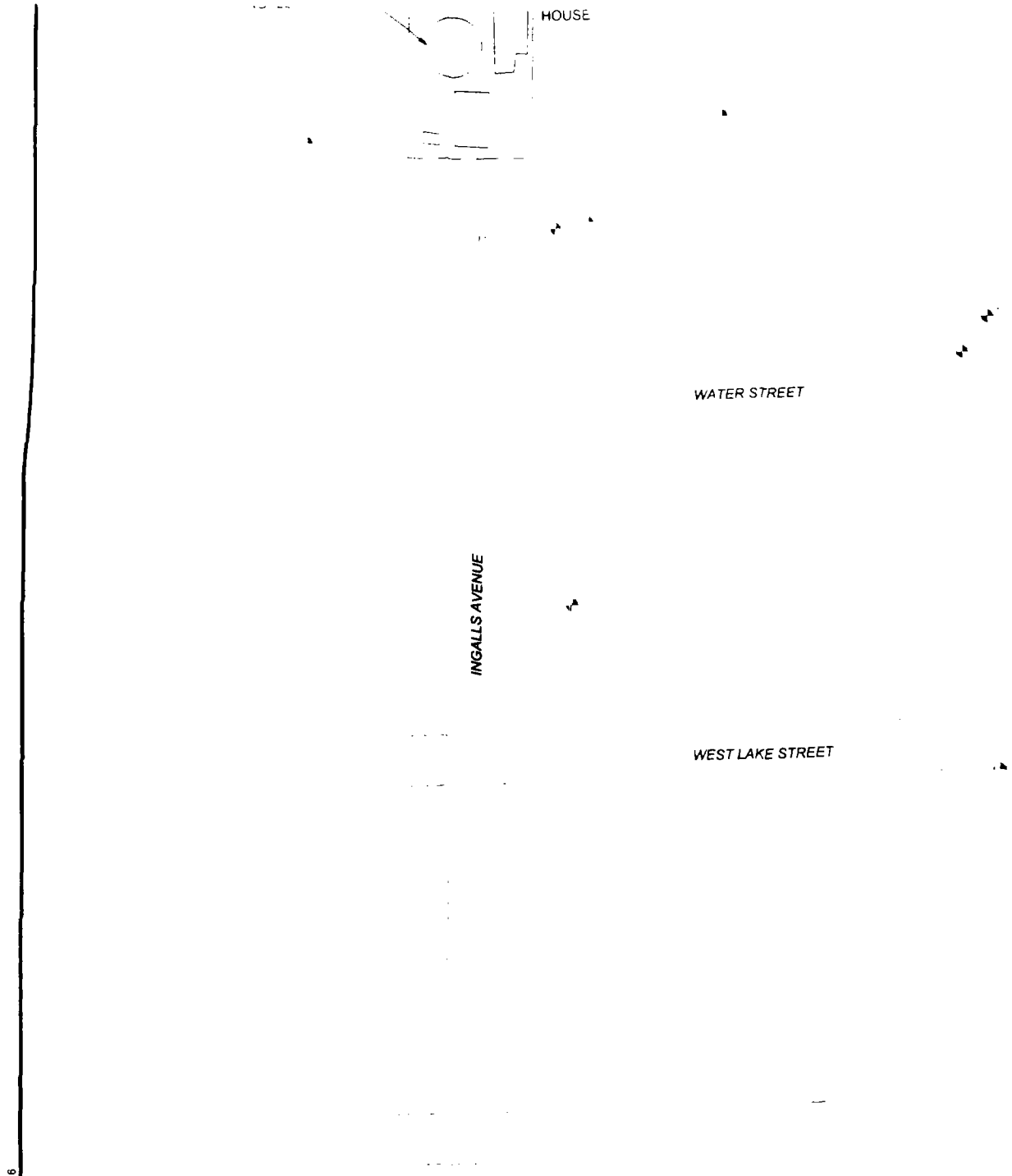
FIGURE 2-2



PETOSKEY MANUFACTURING SITE

PETOSKEY, MICHIGAN

MONITORING WELL LOCATIONS



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MALCOLM PIRNIE

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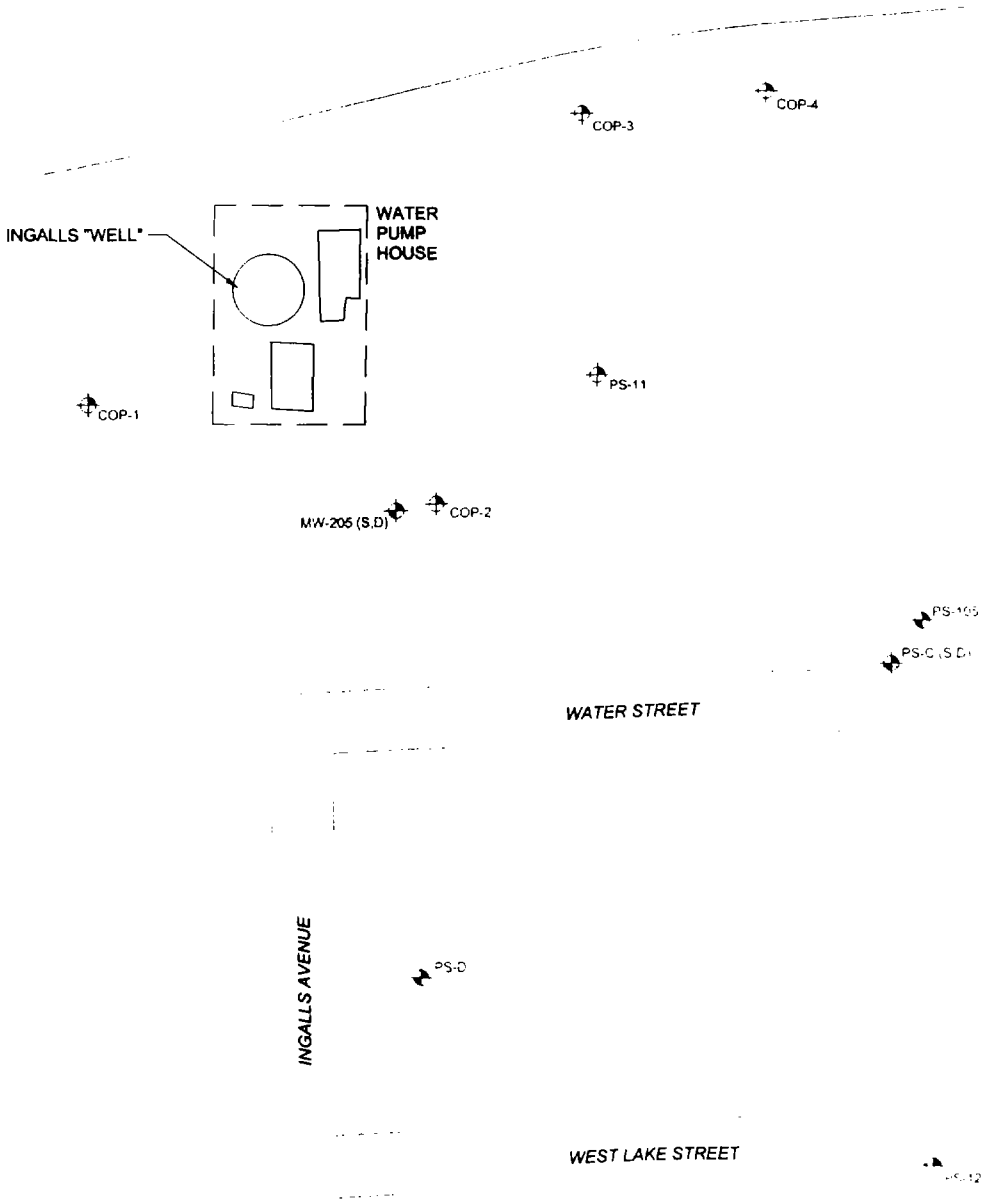
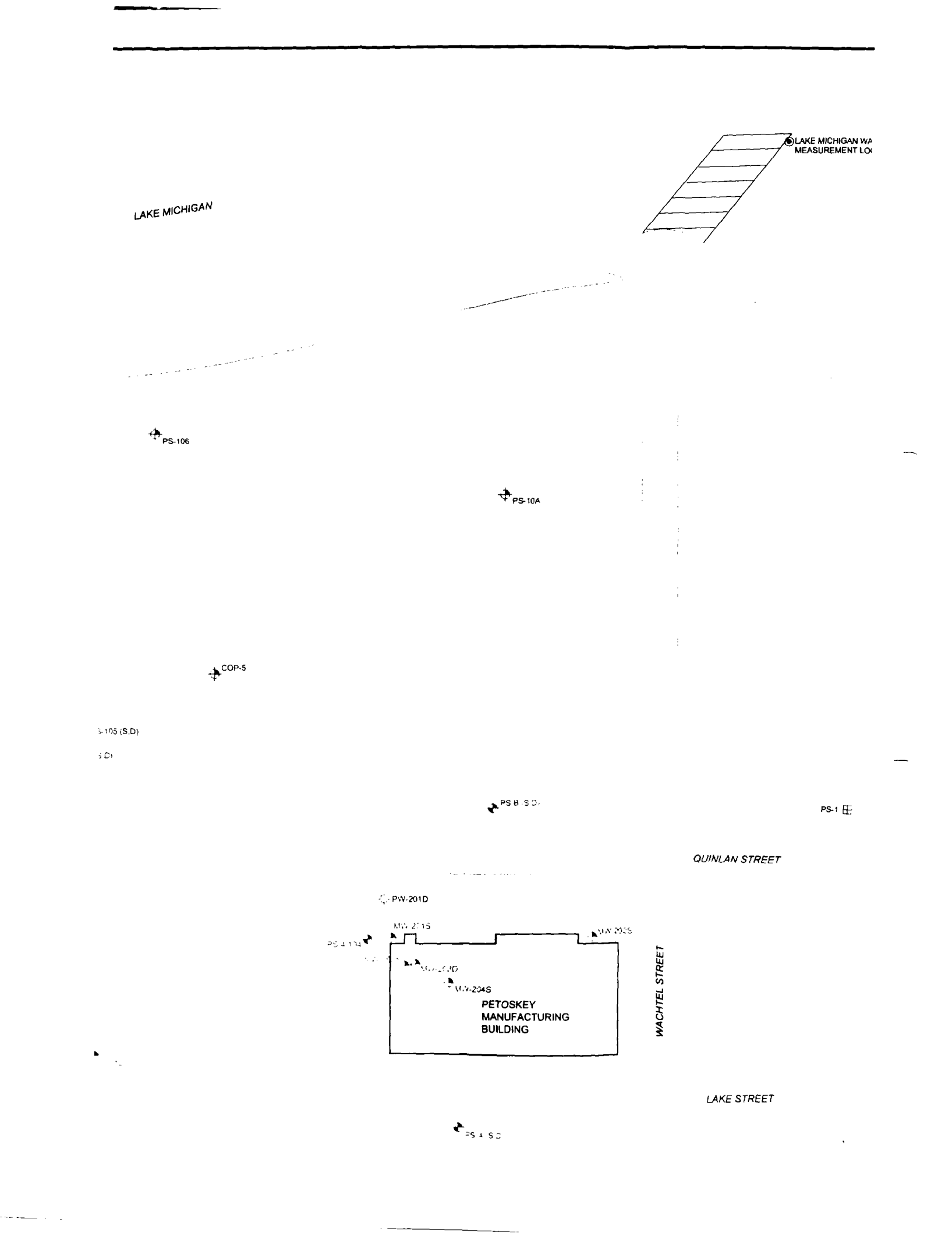
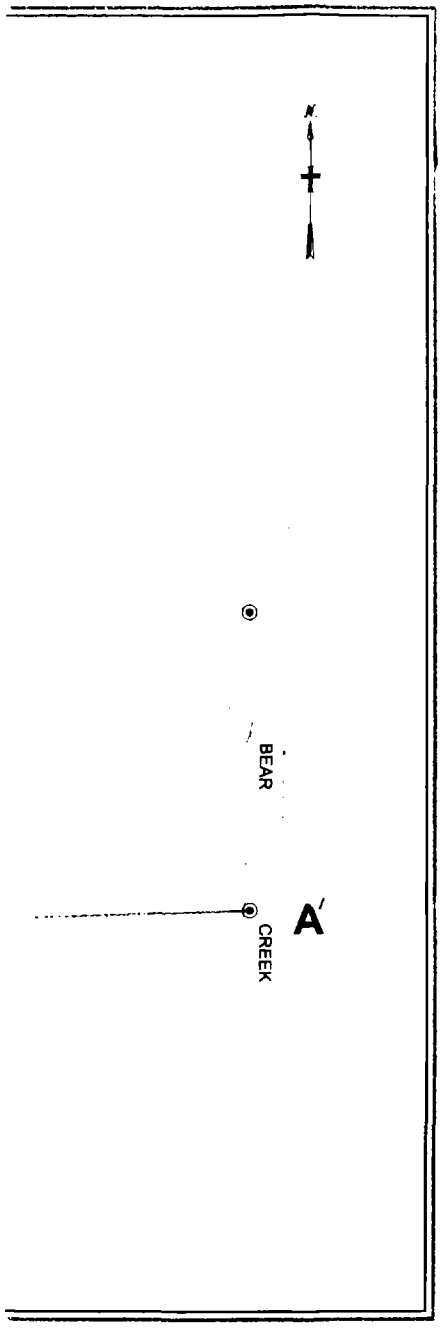

COP-3
COP-4
INGALLS "WELL"
WATER
PUMP
HOUSE
PS-11
COP-1
MW-205 (S,D)
COP-2
WATER STREET
INGALLS AVENUE
PS-D
WEST LAKE STREET


LAKE MICHIGAN WA
MEASUREMENT LO
LAKE MICHIGAN
PS-106
PS-10A
COP-5
PS-1
QUINLAN STREET
PW-201D
PETOSKEY
MANUFACTURING
BUILDING
WACHTEL STREET
LAKE STREET

CREEK
DAM
C-2
BEAR
C-1
N



LEGEND

- MONITORING WELL
- MONITORING WELL CLUSTER
- PUMPING TEST WELL
- SURFACE WATER LEVEL MEASUREMENT LOCATION
- ABANDONED MONITORING WELL REPLACED BY PS-1R
- COP CITY OF PETOSKEY MONITORING WELL
- WATER TABLE
- SCREEN
- 3.8 CONCENTRATION EXCEEDS RESIDENTIAL AND INDUSTRIAL CRITERIA
- 4.1 CONCENTRATION EXCEEDS INDUSTRIAL CRITERIA
- 4.1 CONCENTRATION EXCEEDS RESIDENTIAL CRITERIA
- 3.8 CONCENTRATION EXCEEDS GSI, RESIDENTIAL, AND INDUSTRIAL CRITERIA
- 44.4 CONCENTRATION EXCEEDS GSI CRITERIA

bis	bis(2-ethylhexyl) phthalate
MC	Methylene Chloride
TCE	Trichloroethene
VC	Vinyl Chloride

ALL UNITS ARE SHOWN IN ug/l
B - ANALYTE PRESENT IN METHOD BLANK
J - ESTIMATED VALUE

NOTES

1. BASE MAP SOURCE: PHASE I REMEDIAL INVESTIGATION, PETOSKEY MANUFACTURING COMPANY; EDER ASSOCIATES CONSULTING ENGINEERS, PC; DECEMBER 1993, PROJECT #720-20.
2. SOURCES OF CLEANUP CRITERIA:
   - MERA OPERATIONAL MEMORANDUM 8, REVISION 4 (JUNE 5, 1995)
   - GSI ADDENDUM TO OPERATIONAL MEMORANDUM 8, REVISION 4 AND OPERATIONAL MEMORANDUM 14, REVISION 2 (AUGUST 18, 1997), UPDATED DOWNLOAD VERSION (NOVEMBER 3, 1997)
   - MERA OPERATIONAL MEMORANDUM 14, REVISION 2 (JUNE 6, 1995)
3. THIS DRAWING MAY BE REPRODUCED FOR USE BY THE STATE OF MICHIGAN OR ITS AUTHORIZED REPRESENTATIVE.

HORIZONTAL SCALE IN FEET

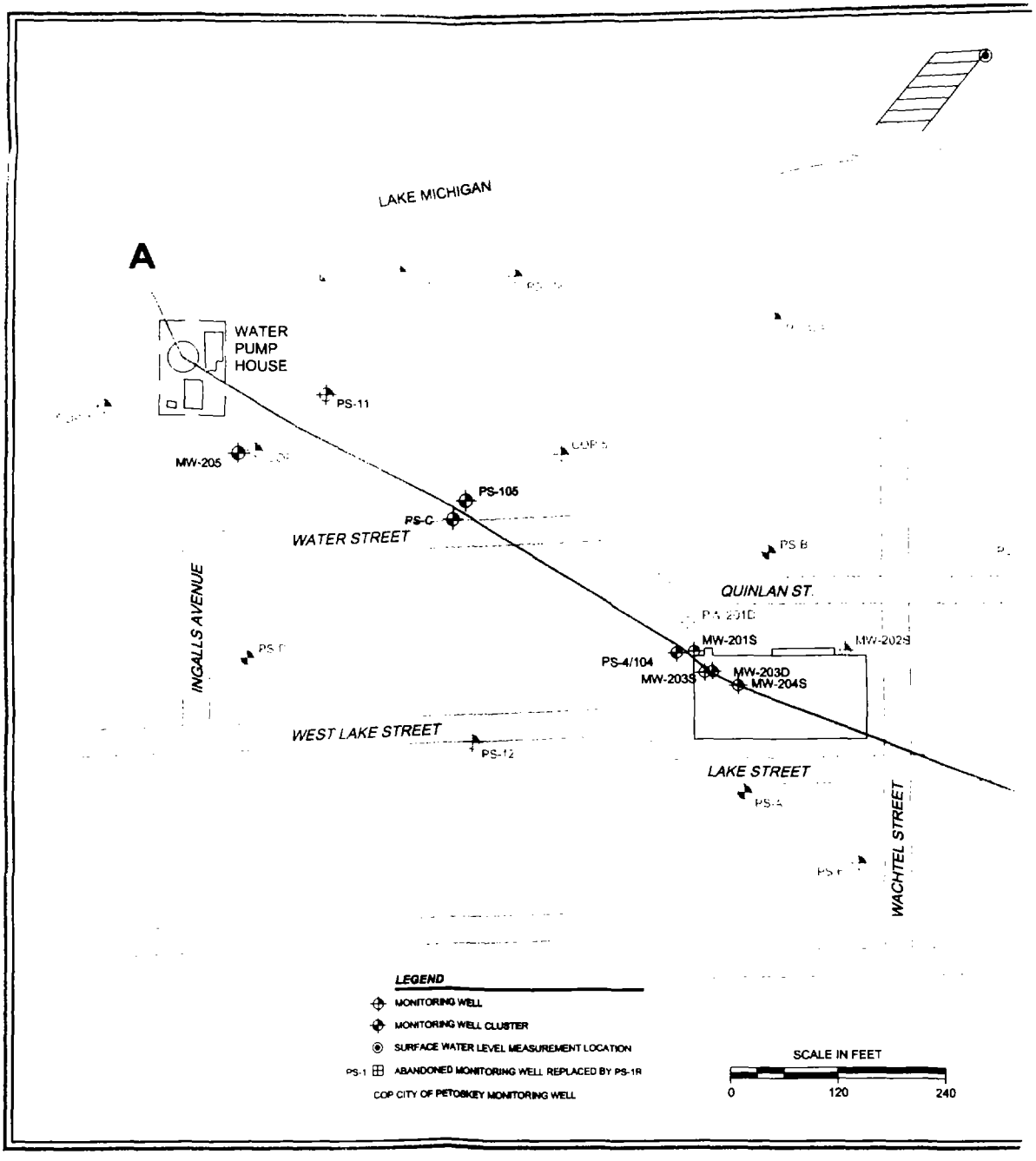
0 60 120

VERTICAL EXAGGERATION=5X

MALCOLM PIRNIE ENGINEERS
EAST LANSING, MICHIGAN

OCTOBER 1995

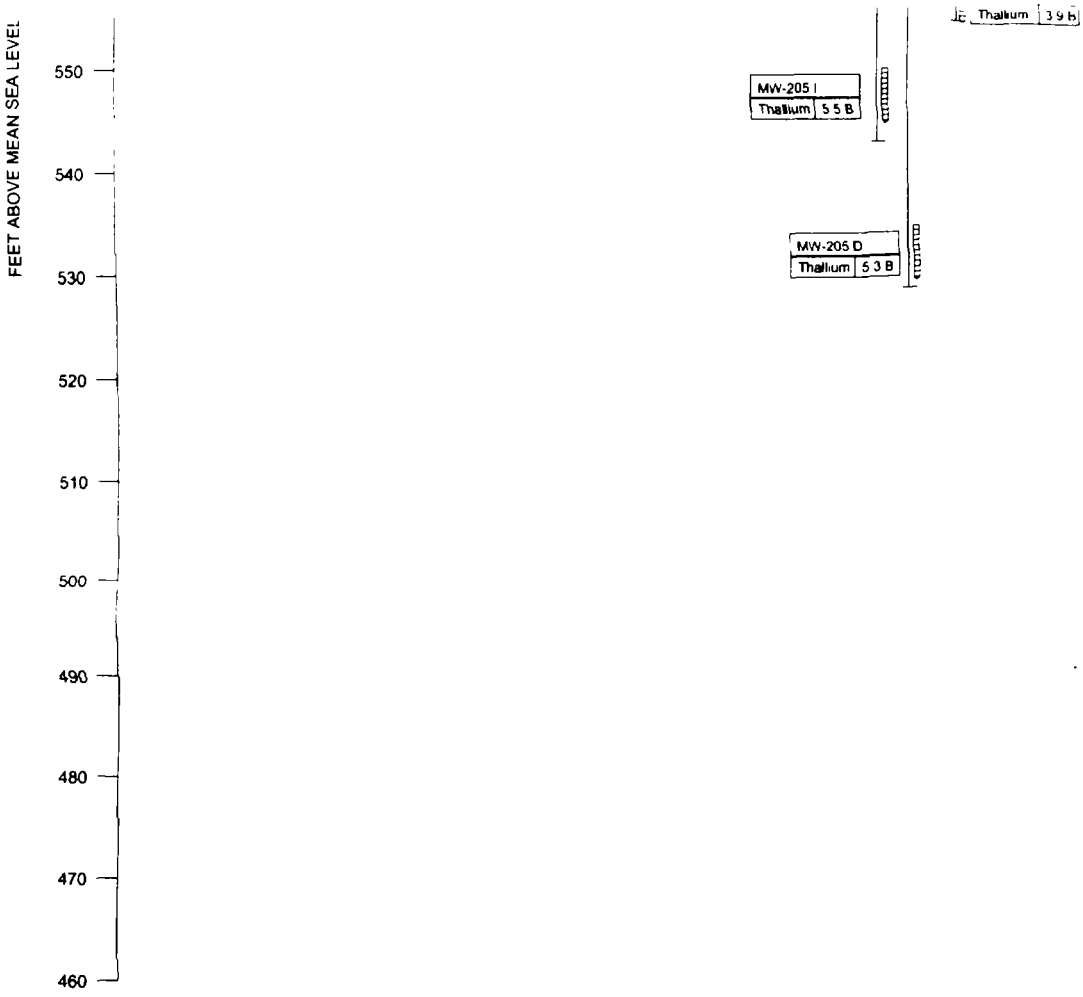
FIGURE 5-5



PETOSKEY MANUFACTURING SITE

PETOSKEY, MICHIGAN

GROUNDWATER ANALYTICAL DATA - COMPOUNDS EXCEEDING CLEANUP CF



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MALCOLM PIRNIE

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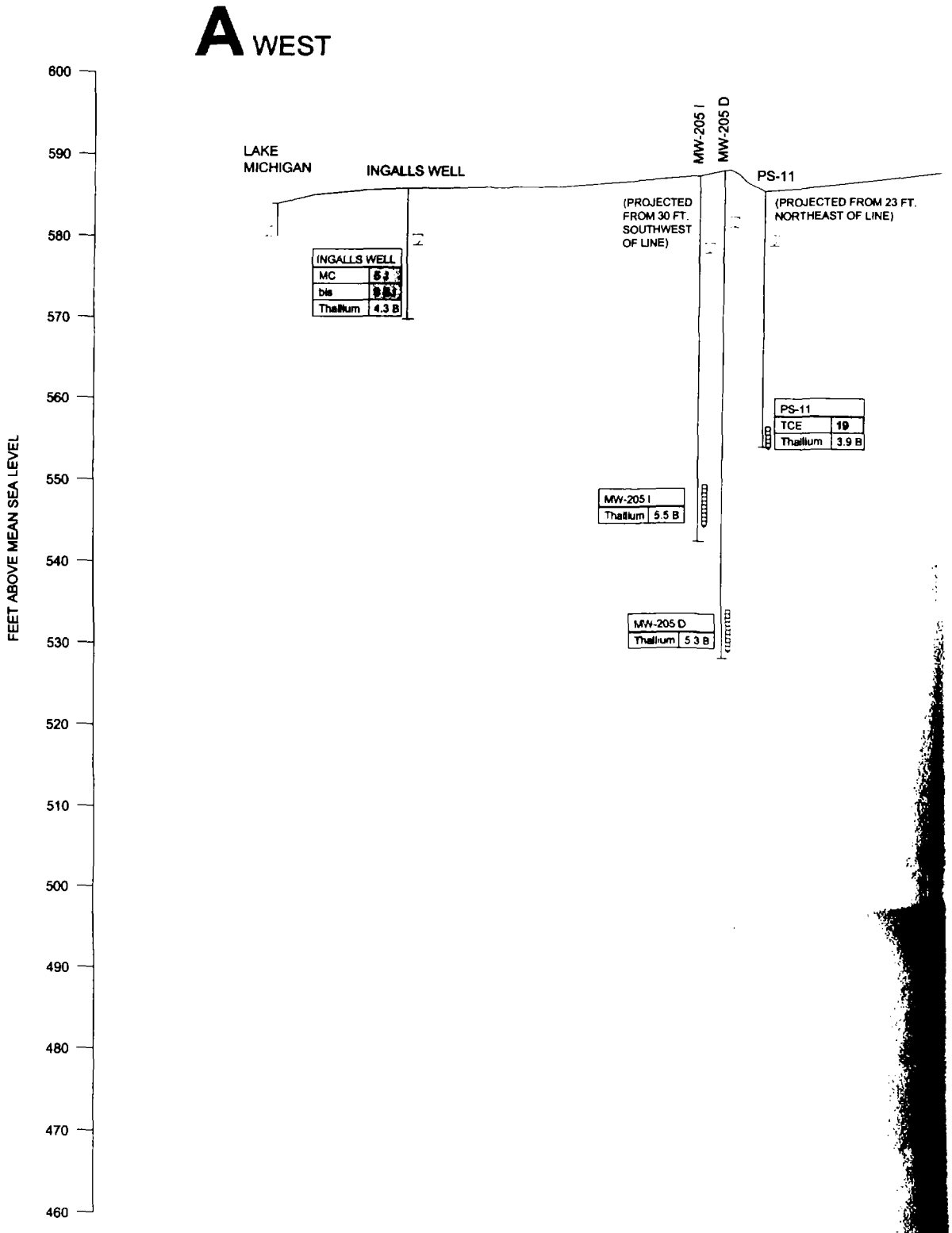
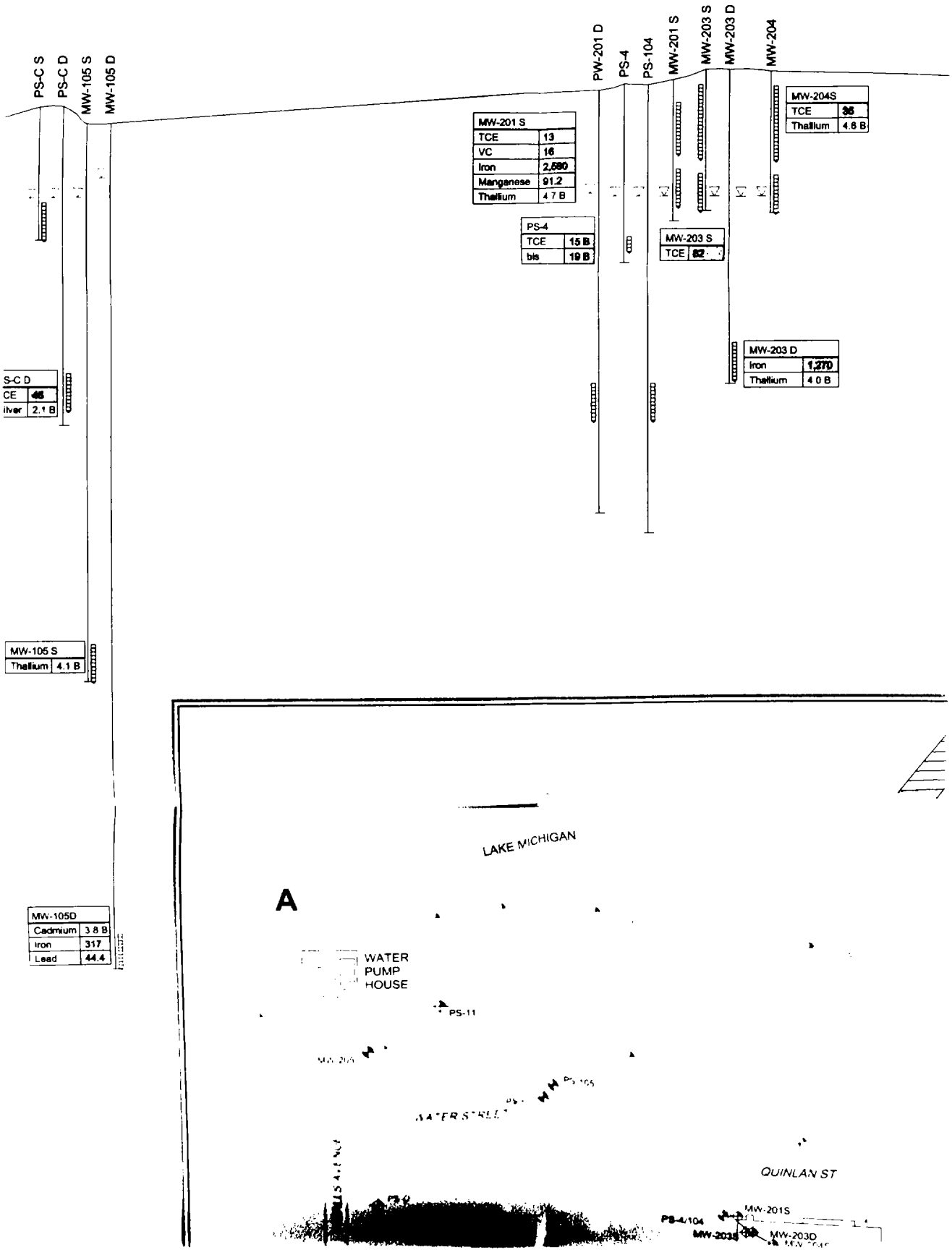
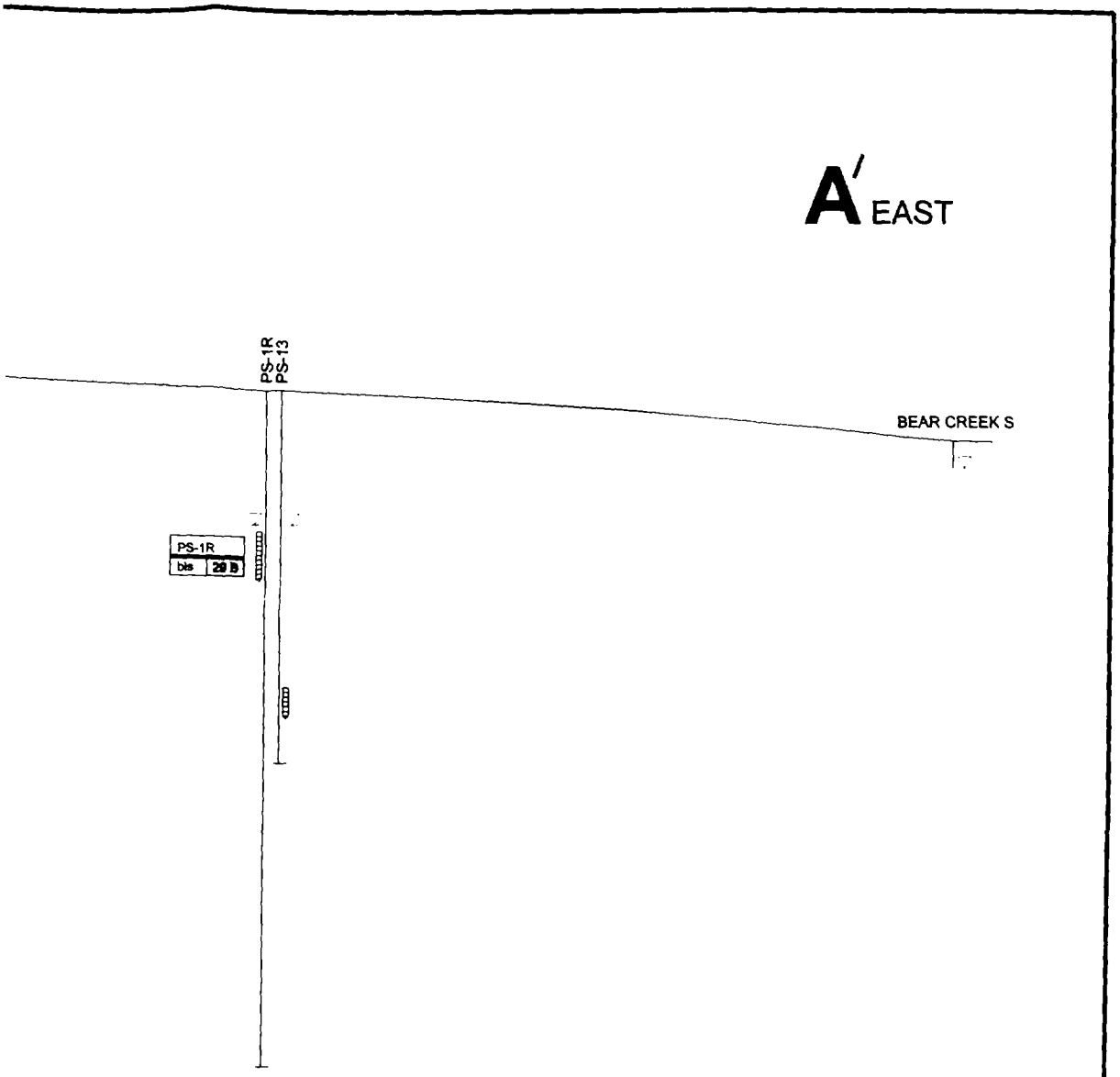
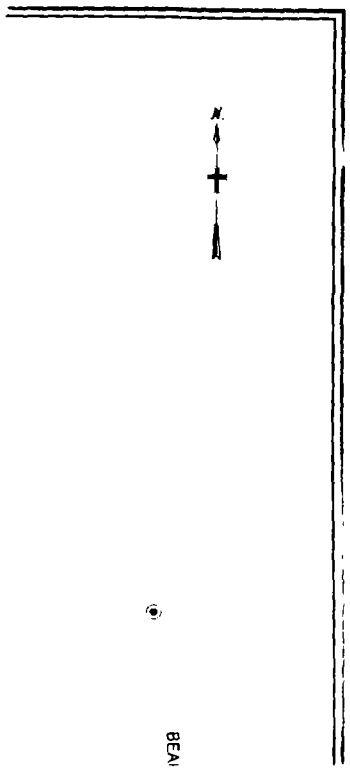
CROSS SEC


A WEST
600
590
580
570
560
550
540
530
520
510
500
490
480
470
460
FEET ABOVE MEAN SEA LEVEL
LAKE MICHIGAN
INGALLS WELL
MW-205 I
MW-205 D
PS-11
(PROJECTED FROM 30 FT. SOUTHWEST OF LINE)
(PROJECTED FROM 23 FT. NORTHEAST OF LINE)
INGALLS WELL
MC
bis
Thallium 4.3 B
PS-11
TCE 19
Thallium 3.9 B
MW-205 I
Thallium 5.5 B
MW-205 D
Thallium 5.3 B


PS-C S
PS-C D
MW-105 S
MW-105 D
PW-201 D
PS-4
PS-104
MW-201 S
MW-203 S
MW-203 D
MW-204
MW-201 S
TCE 13
VC 16
Iron 2,580
Manganese 91.2
Thallium 4.7 B
MW-204S
TCE 35
Thallium 4.6 B
PS-4
TCE 15 B
bis 19 B
MW-203 S
TCE 62
MW-203 D
Iron 1,270
Thallium 4.0 B
S-C D
CE 46
ilver 2.1 B
MW-105 S
Thallium 4.1 B
MW-105D
Cadmium 3.8 B
Iron 317
Lead 44.4
LAKE MICHIGAN
A
WATER
PUMP
HOUSE
PS-11
QUINLAN ST
MW-201S
PS-4/104
MW-203S
MW-203D



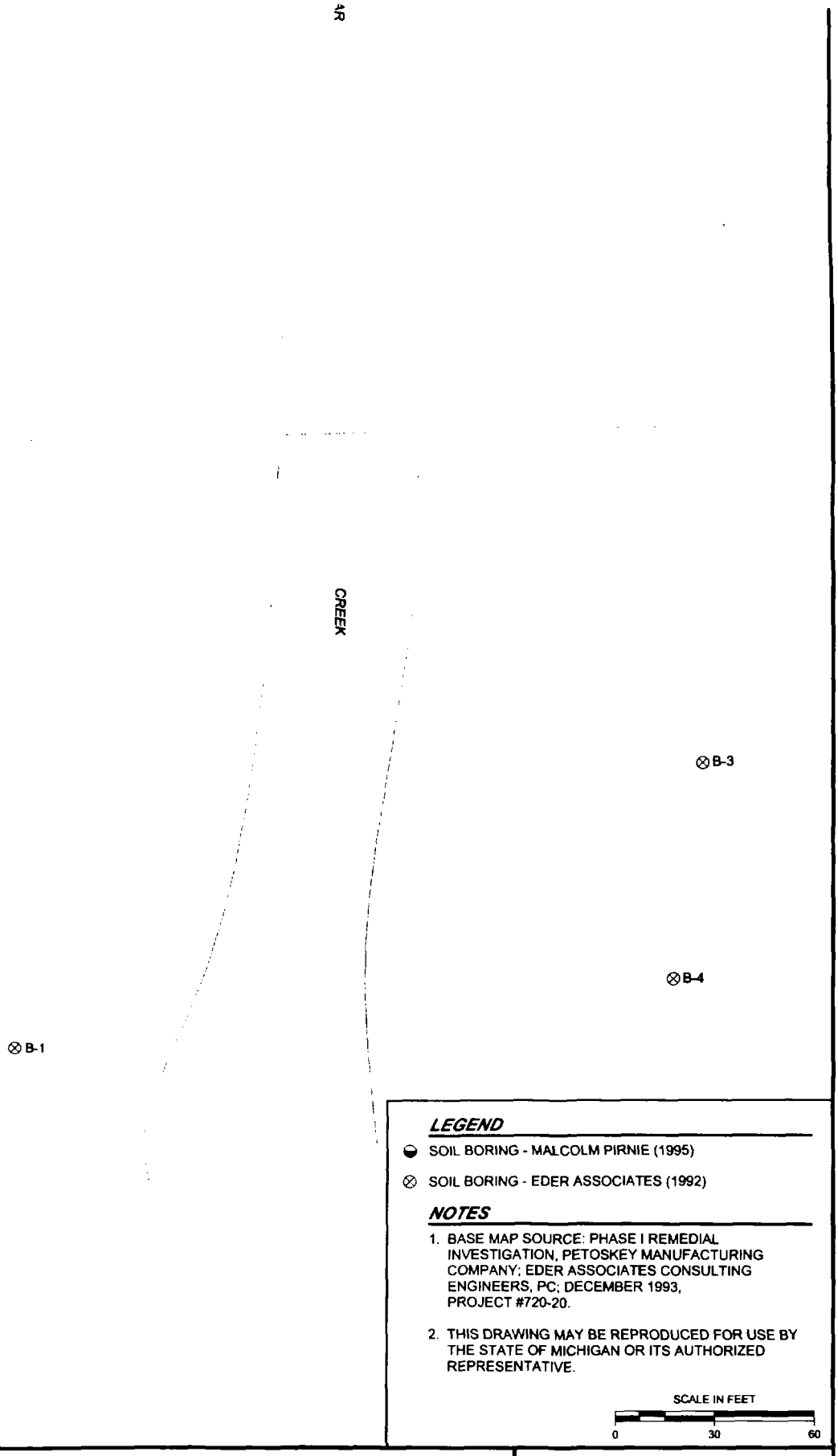


LEGEND

- MONITORING WELL
- MONITORING WELL CLUSTER
- PUMPING TEST WELL
- SURFACE WATER LEVEL MEASUREMENT LOCATION
- ABANDONED MONITORING WELL REPLACED BY PS-1R
- COP CITY OF PETOSKEY MONITORING WELL
- WATER TABLE
- SCREEN
- 3.8 CONCENTRATION EXCEEDS RESIDENTIAL AND INDUSTRIAL CRITERIA
- 4.1 CONCENTRATION EXCEEDS INDUSTRIAL CRITERIA
- 4.1 CONCENTRATION EXCEEDS RESIDENTIAL CRITERIA
- 3.8 CONCENTRATION EXCEEDS GSI, RESIDENTIAL AND INDUSTRIAL CRITERIA
- 44.4 CONCENTRATION EXCEEDS GSI CRITERIA

bis	bis(2-ethylhexyl) phthalate
MC	Methylene Chloride
TCE	Trichloroethene
VC	Vinyl Chloride

ALL UNITS ARE SHOWN IN ug/l
B - ANALYTE PRESENT IN METHOD BLANK
J - ESTIMATED VALUE



LEGEND

- SOIL BORING - MALCOLM PIRNIE (1995)
- SOIL BORING - EDER ASSOCIATES (1992)

NOTES

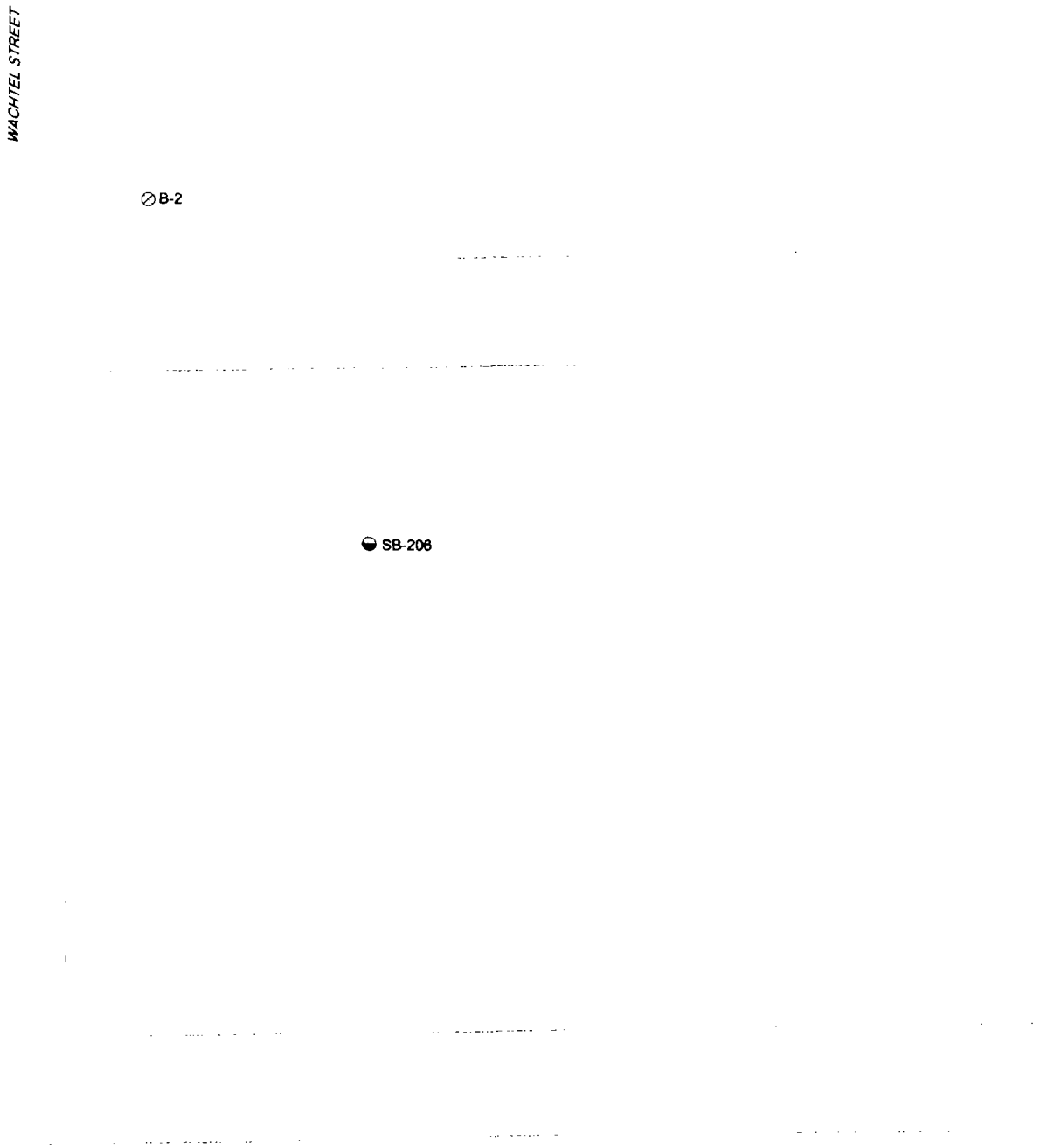
1. BASE MAP SOURCE: PHASE I REMEDIAL INVESTIGATION, PETOSKEY MANUFACTURING COMPANY; EDER ASSOCIATES CONSULTING ENGINEERS, PC; DECEMBER 1993, PROJECT #720-20.
2. THIS DRAWING MAY BE REPRODUCED FOR USE BY THE STATE OF MICHIGAN OR ITS AUTHORIZED REPRESENTATIVE.

SCALE IN FEET

0 30 60

MALCOLM PIRNIE ENGINEERS, LLP
EAST LANSING, MICHIGAN

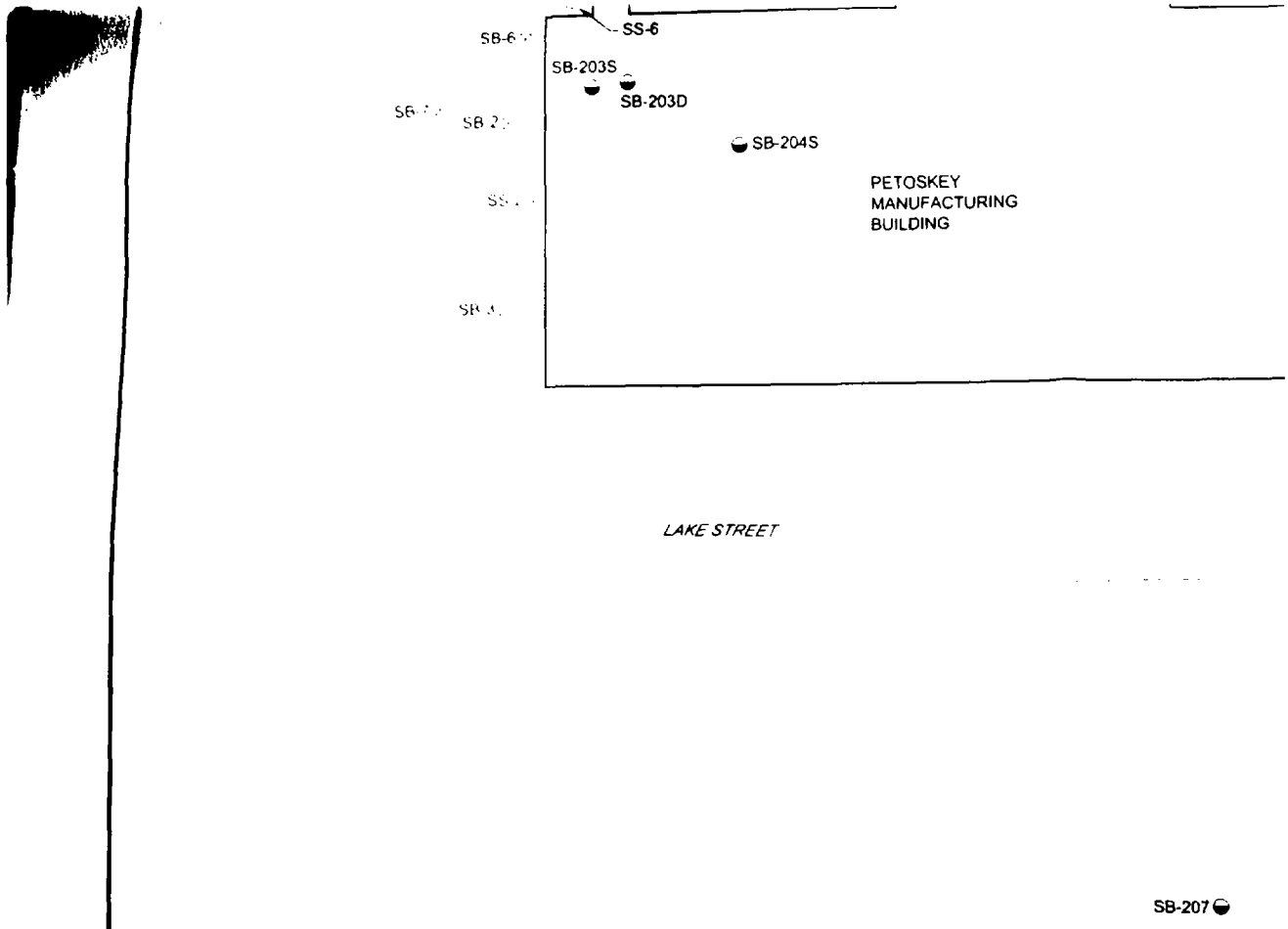
FIGURE 2-1



PETOSKEY MANUFACTURING SITE

PETOSKEY, MICHIGAN

SOIL SAMPLING LOCATIONS



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MALCOLM PIRNIE

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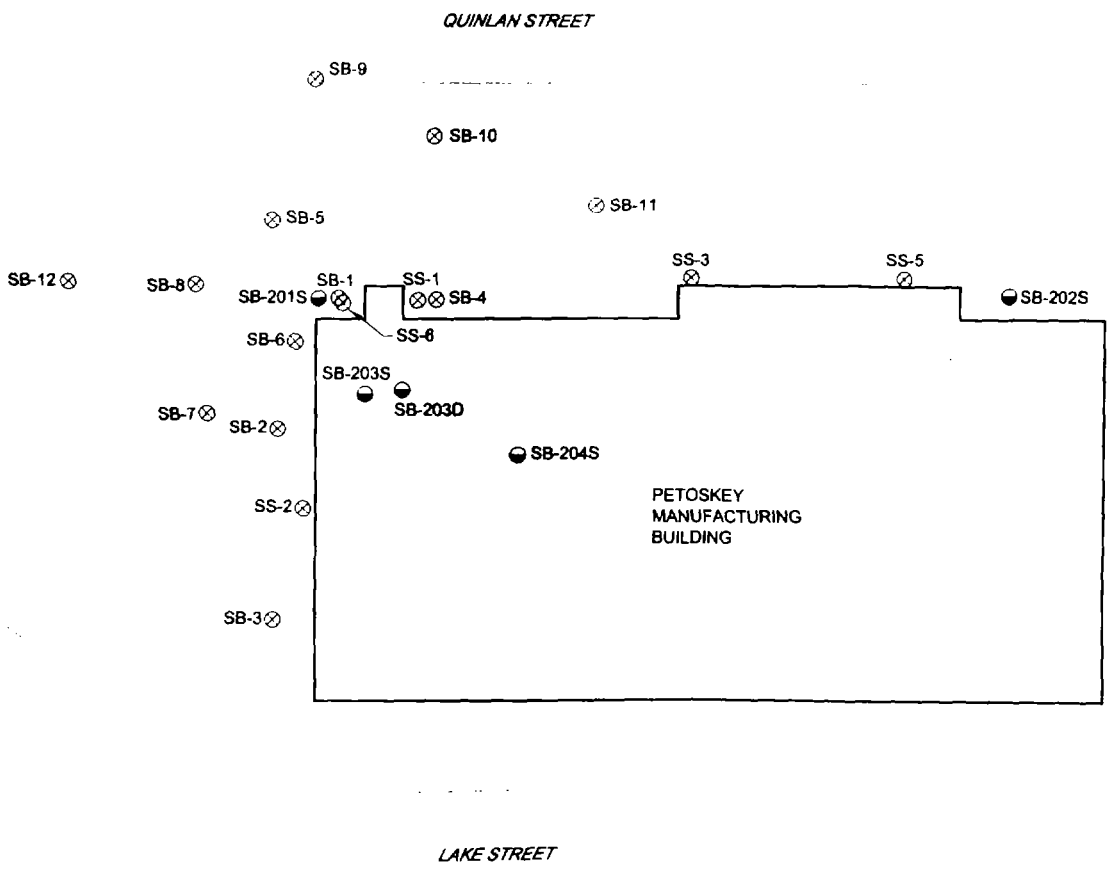
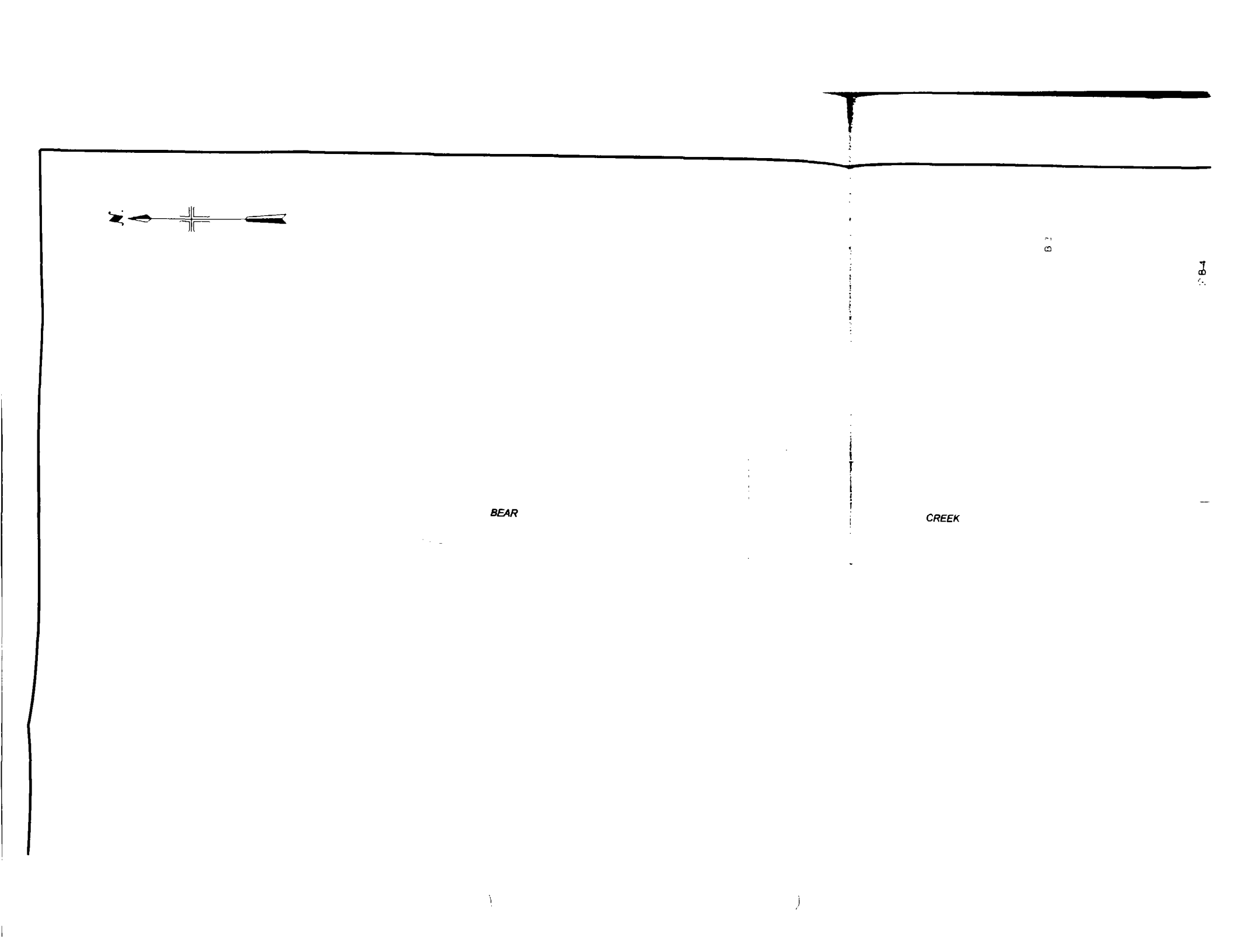
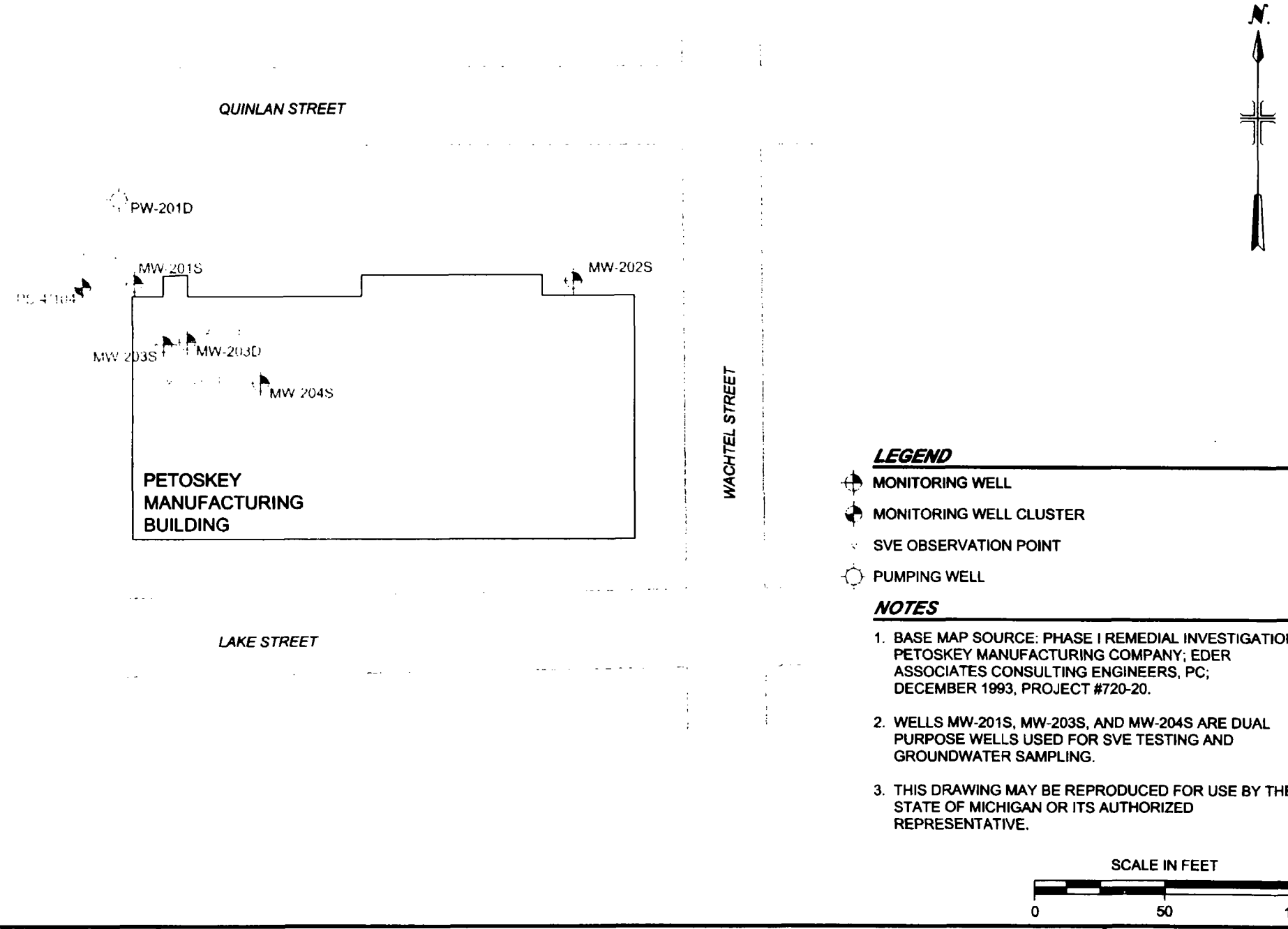

QUINLAN STREET
SB-9
SB-10
SB-11
SB-5
SB-12
SB-8
SB-201S
SB-1
SS-1
SB-4
SS-3
SS-5
SB-202S
SB-6
SS-6
SB-203S
SB-203D
SB-7
SB-2
SB-204S
PETOSKEY
MANUFACTURING
BUILDING
SS-2
SB-3
LAKE STREET
SB-207


BEAR
CREEK



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MALCOLM PIRNIE

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PETOSKEY MANUFACTURING SITE

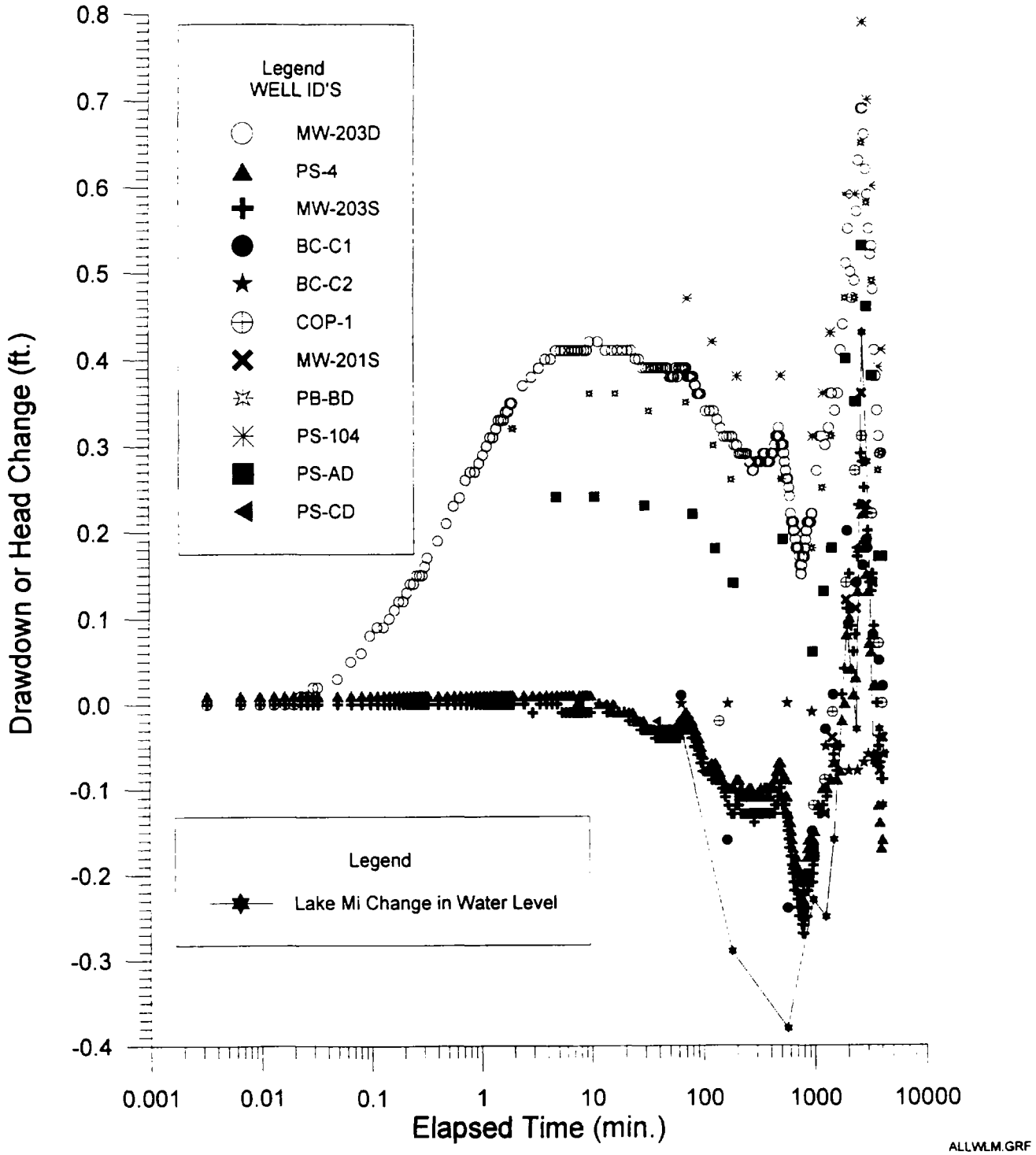
PETOSKEY, MICHIGAN

SOIL VAPOR EXTRACTION PILOT POINT LOCATIONS

MALCOLM PIRNIE ENGINEERS, LLP
EAST LANSING, MICHIGAN

FIGURE 3-1

PETOSKEY MANUFACTURING
AQUIFER PUMPING TEST
OCTOBER 3 - 6, 1995



6919 2420017H40 D:\DWG\PM\PMFR3-2 Scale: 1:1i Date: 0./12/1996 Time: 14:12

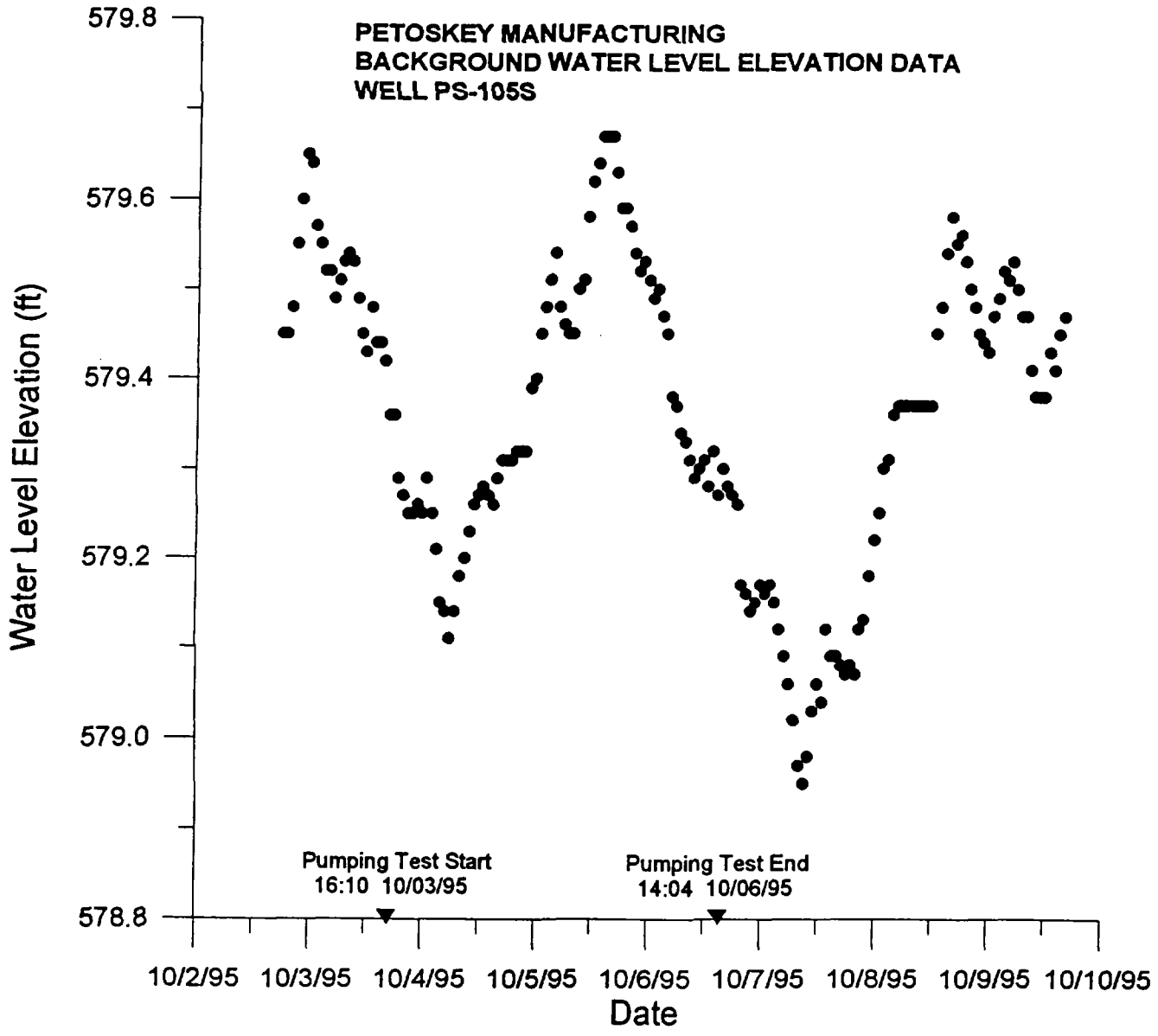
MALCOLM PIRNIE
COPYRIGHT © 1996

PETOSKEY MANUFACTURING SITE

LAKE MICHIGAN AND MONITORING WELLS
DRAWDOWN CURVES

MALCOLM PIRNIE ENGINEERS
EAST LANSING, MICHIGAN

FIGURE 3-2



6919 2420017H40 D:\DWG\PM\PMFR3-3 Scale: 1:1i Date: 0?/12/1996 Time: 14:13

MALCOLM PIRNIE
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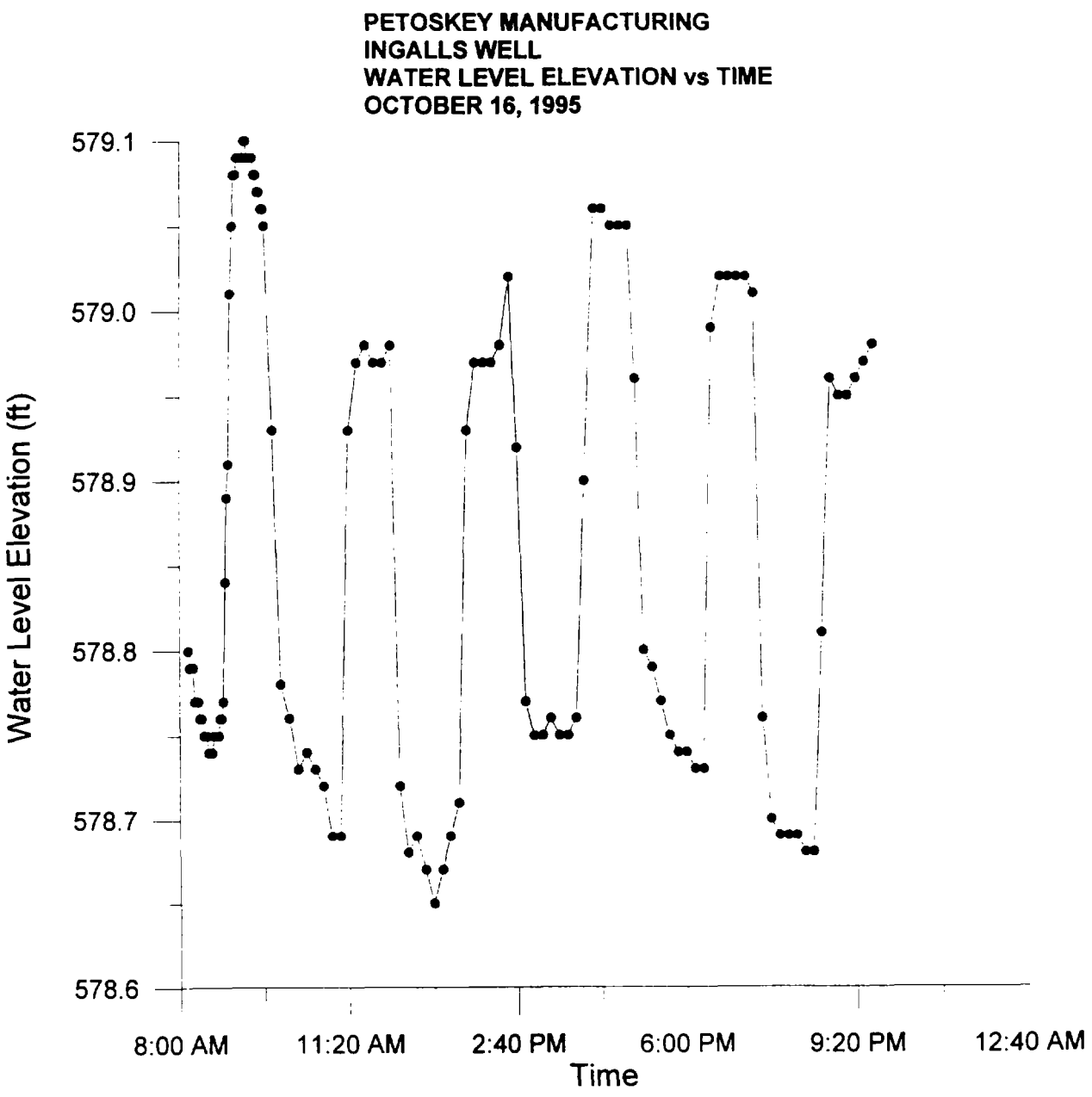
PETOSKEY MANUFACTURING SITE

WELL PS-105S

BACKGROUND WATER LEVEL MEASUREMENTS

MALCOLM PIRNIE ENGINEERS
EAST LANSING, MICHIGAN

FIGURE 3-3



INGAL-L.GRF

6919 2420017H40 D:\DWG\PM\PMFR3-4 Scale: 1:1 Date: 6/12/1996 Time: 14:14

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MALCOLM PIRNIE

PETOSKEY MANUFACTURING SITE

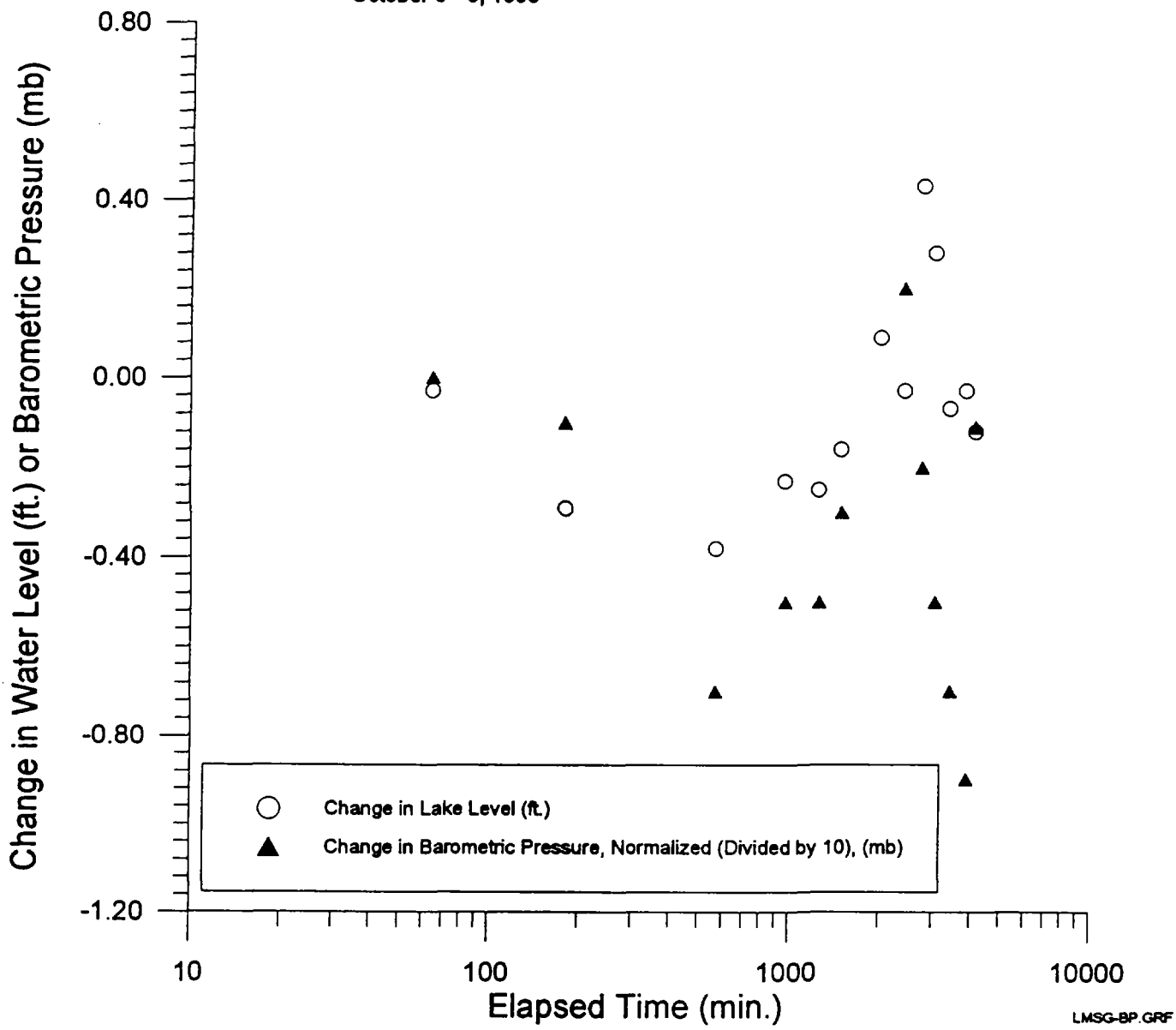
INGALLS MUNICIPAL WELL

BACKGROUND WATER LEVEL MEASUREMENTS

MALCOLM PIRNIE ENGINEERS
EAST LANSING, MICHIGAN

FIGURE 3-4

PETOSKEY MANUFACTURING
AQUIFER PUMPING TEST
LAKE LEVEL COMPARED TO BAROMETRIC PRESSURE
October 3 - 6, 1995



6919 2420017H40 D:\DWG\PM\PMFR3-5 Scale: 1:1i Date: ../12/1996 Time: 14:15

MALCOLM PIRNIE
COPYRIGHT © 1996

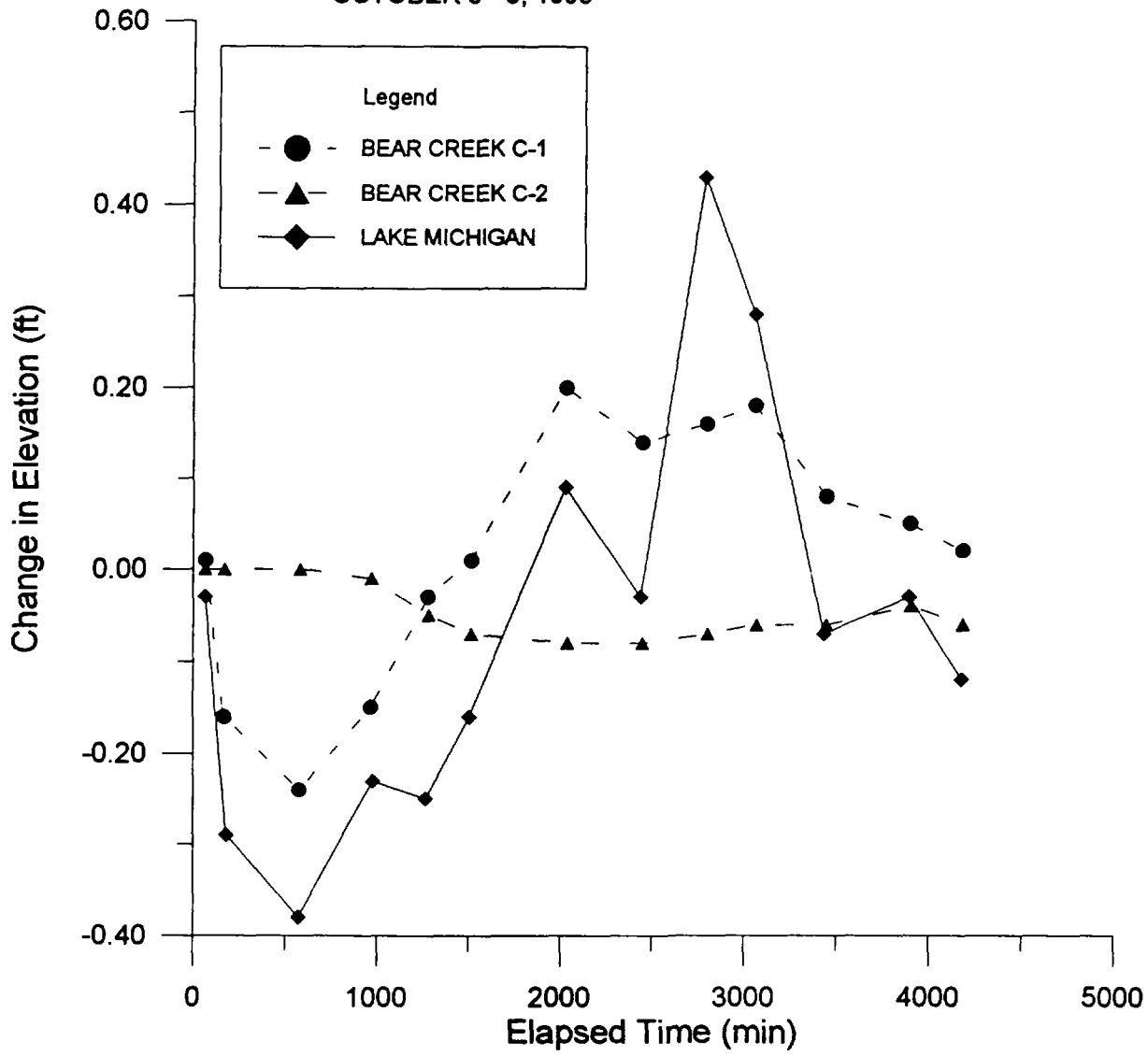
PETOSKEY MANUFACTURING SITE

PETOSKEY, MICHIGAN
BAROMETRIC PRESSURE EFFECTS

MALCOLM PIRNIE ENGINEERS
EAST LANSING, MICHIGAN

FIGURE 3-5

PETOSKEY MANUFACTURING
AQUIFER PUMPING TEST
CHANGE IN WATER LEVEL ELEVATION AT
LAKE MICHIGAN AND TWO STAFF GAGES ON BEAR CREEK.
OCTOBER 3 - 6, 1995



LMBC.GRF

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MALCOLM PIRNIE
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PETOSKEY MANUFACTURING SITE

LAKE MICHIGAN AND STAFF GAGES
DRAWDOWN CURVES

MALCOLM PIRNIE ENGINEERS
EAST LANSING, MICHIGAN

FIGURE 3-6

APPENDICES

APPENDIX A

BORING LOGS

MALCOLM PIRNIE

WELL / BORING LOG

BORING # 201S	WELL #: MW-201S	SITE NAME: PETOSKEY	PROJECT 2420-017-H22
GROUND ELEV.: 594.66'	TOC ELEV.: 596.97'	LOGGED BY: Andy Klakulak	
COUNTY: Emmet	TWP: Resort	SECTION: 6 T: 34N R: 5W 1/4:	1/4:
DRILL CO.: Steams	DRILLER: Mike Heffran	DRILLING RIG Dietrich D-50	DRILL TYPE: 4.25" HSA Boulder
BORING START: 8/18/95	END: 8/18/95	LOCATION SKETCH (not to scale)	
WELL START: 8/18/95	END: 8/18/95	SEE SITE MAP	
WATER FIRST:	AT COMPLETION:		
SCREEN LOCATION: 3-10' AND 12-17'			
TYPE: PVC AND SS	SIZE: 2"		
CASING TYPE: PVC	DIAMETER: 2"		
WEATHER Clear, 80F.			
Measurements in ft bgl.			

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
594.66				0					
	201S-0-2	SSS			Topsoil/sand - fine to medium with gravel and clay - dark brown, moist, slight petroleum odor.				
589.66				5					
					Limestone boulders.				
584.66				10					
	201S-14-16	SSS	100-1" 100-5"		Gravel, limestone.				Two attempts to collect SSS.
				15					
					EOB at 19'				
				20					

LEGEND: TOPSOIL, SAND, CLAY, FILL, GRAVEL

NOTES: bgl - below ground level

MALCOLM PIRNIE

WELL / BORING LOG

BORING # 201D	WELL #: PW-201D	SITE NAME: PETOSKEY	PROJECT 2420-017-H22
GROUND ELEV.: 593.28'	TOC ELEV.: 592.28'	LOGGED BY: Andy Klakulak	
COUNTY: Emmet	TWP: Resort	SECTION: 6 T: 34N R: 5W 1/4:	1/4:
DRILL CO.: Stearns	DRILLER: J. Gryska	DRILLING RIG CME 95	DRILL TYPE: 6 1/4" HSA/Rotary
BORING START: 8/22/95	END: 8/22/95	LOCATION SKETCH (not to scale)	
WELL START: 8/22/95	END: 8/23/95	SEE SITE MAP	
WATER FIRST:	AT COMPLETION:		
SCREEN LOCATION: 35'	TO: 55'		
TYPE: PVC	SIZE: 4"		
CASING TYPE: PVC	DIAMETER: 4"		
WEATHER Clear, 68F.			
Measurements in ft bgl.			

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
593.28				0	Descriptions based on cuttings and driller's observations.				
					Sand with clay, gravel, medium to coarse, tan, loose, dry; mixed with bedrock fragments (variable sizes).				
583.28				10					
573.28				20					
563.28				30					
					Weathered bedrock (limestone).				
553.28				40					
					Bedrock (limestone).				
543.28				50	Shale				
					Interbedded shale and limestone.				
					EOB at 57'				
				60					

LEGEND: TOPSOIL, SAND, CLAY, BEDROCK, GRAVEL

NOTES: bgl - below ground level

MALCOLM PIRNIE

WELL / BORING LOG

BORING # 202S	WELL #: MW-202S	SITE NAME: PETOSKEY	PROJECT 2420-017-H22

GROUND ELEV.: 592.56' TOC ELEV.: 595.30' LOGGED BY: Andy Klakulak

COUNTY: Emmet TWP: Resort SECTION: 6 T: 34N R: 5W 1/4: 1/4:

DRILL CO.: Steams DRILLER: J. Gryska DRILLING RIG CME 95 DRILL TYPE: 4 1/4" HSA

BORING START: 8/22/95 END: 8/22/95

WELL START: 8/22/95 END: 8/22/95

WATER FIRST: ~12.5' AT COMPLETION:

SCREEN LOCATION: 10' TO: 15'

TYPE: SS SIZE: 2"

CASING TYPE: PVC DIAMETER: 2"

WEATHER Clear, 60F.

Measurements in ft bgl.

LOCATION SKETCH (not to scale)

SEE SITE MAP

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
592.56				0					PID = 0.0 bkgd.
	202S-0-2	SSS			Sand - medium to coarse, with some clay and gravel, loose, dry.				PID = bkgd.
587.56				5					
	202S-5-7	SSS	16, 15 100 (5")		Sand - medium to coarse with clay and gravel, loose, dry. About 2" of crushed limestone fragments.				PID = bkgd. 5" recovered
582.56				10					
	202S-10-12	SSS			Sand - medium to coarse with clay. Some gravel/ crushed limestone. Tip of spoon wet.				PID = bkgd. 24" recovered Water level at 12.5"
577.56				15	EOB at 15'				
				20					

LEGEND:

TOPSOIL SAND CLAY BEDROCK GRAVEL

NOTES: bgl - below ground level

MALCOLM PIRNIE

WELL / BORING LOG

BORING # 203S	WELL #: MW-203S	SITE NAME: PETOSKEY	PROJECT 2420-017-H22

GROUND ELEV.: 596.05' TOC ELEV.: 595.68' LOGGED BY: Andy Klakulak

COUNTY: Emmet TWP: Resort SECTION: 6 T: 34N R: 5W 1/4: 1/4:

DRILL CO.: Stearns DRILLER: Mike Heffran DRILLING RIG: Dietrich D-50 DRILL TYPE 4 1/4" Boulder HSA

BORING START: 8/15/95 END: 8/16/95

WELL START: 8/16/95 END: 8/16/95

WATER FIRST: AT COMPLETION:

SCREEN LOCATION: 2-12' AND 14-19'

TYPE: PVC AND SS SIZE: 2"

CASING TYPE: PVC DIAMETER: 2"

WEATHER: Drilling inside, 85F.

Measurements in ft bgl.

LOCATION SKETCH (not to scale)

SEE SITE MAP

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
596.05									PID = 3.8 ppm.
	203S-0-2	SSS	24, 16, 12, 1	0	0-6" Concrete. Fill sand - lower 3" stained, 6" recovery.				PID = bkgd. PID = 4.3 ppm. above bkgd.
591.05				5					
	203S-5-7	SSS	37, 64, 100		Sand - with some clay and fine to coarse gravel, dark brown, loose, dry.				3" Spoon. PID = bkgd.
586.05				10					
	203S-12-14	SSS	100 (6")		Sand - same as above, 6" recovery; rock fragments.				PID = bkgd.
581.05		SSS	120 (3")	15	No recovery - (rock fragments).				
					EOB at 19'				
				20					

LEGEND: TOPSOIL SAND CLAY BEDROCK GRAVEL

NOTES: bgl - below ground level

MALCOLM PIRNIE

WELL / BORING LOG

BORING #: 203D	WELL #: MW-203D	SITE NAME: PETOSKEY	PROJECT #: 2420-017-H22
GROUND ELEV.: 596.09'	TOC ELEV.: 595.74'	LOGGED BY: Andy Klakulak	
COUNTY: Emmet	TWP: Resort	SECTION: 6 T: 34N R: 5W 1/4:	1/4:
DRILL CO.: Stearns	DRILLER: Mike Heffran	DRILLING RIG: Dietrich D-50	DRILL TYPE: 4 1/4" Boulder HSA
BORING START: 8/16/95	END: 8/17/95	LOCATION SKETCH (not to scale)	
WELL START: 8/17/95	END: 8/17/95	SEE SITE MAP	
WATER FIRST:	AT COMPLETION:		
SCREEN LOCATION: 37'	TO: 42'		
TYPE: SS	SIZE: 2"		
CASING TYPE: PVC	DIAMETER: 2"		
WEATHER: Cloudy, 80F.			
Measurements in ft bgl.			

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
596.09									PID = 0 ppm. bkgd.
	203D-0-2	SSS			0-6" Concrete. Sand - fill sand, fine to medium, red/brown, trace gravel, loose dry.				PID = bkgd.
591.09				5					
	203D-5-7	SSS			Sand, medium to coarse - with gravel and some clay, loose, dry.				4" Recovery. PID = bkgd.
586.09				10					
									Boulder 13-19'
581.09		SSS	160 (2")	15	No recovery. (limestone boulder)				
576.09				20	Sand mixed with rock fragments.				
571.09				25					
566.09				30					
561.09				35					
					Weathered limestone.				
556.09				40	EOB at 42.5', limestone.				

LEGEND: TOPSOIL, SAND, CLAY, BEDROCK, GRAVEL

NOTES: bgl - below ground level

MALCOLM PIRNIE

WELL / BORING LOG

BORING # 204S	WELL #: MW-204S	SITE NAME: PETOSKEY	PROJECT 2420-017-H22
GROUND ELEV.: 595.85'	TOC ELEV.: 595.66'	LOGGED BY: Andy Klakulak	
COUNTY: Emmet	TWP: Resort	SECTION: 6 T: 34N R: 5W 1/4:	1/4:
DRILL CO.: Stearns	DRILLER: Mike Heffran	DRILLING RIG: Dietrich D-50	DRILL TYPE 4 1/4" Boulder HSA
BORING START: 8/17/95	END: 8/18/95	LOCATION SKETCH (not to scale)	
WELL START: 8/18/95	END: 8/18/95	SEE SITE MAP	
WATER FIRST: 16'	AT COMPLETION: 16'		
SCREEN LOCATION: 2-10' AND 14-19'			
TYPE: PVC AND SS	SIZE: 2"		
CASING TYPE: PVC	DIAMETER: 2"		
WEATHER: Cloudy, 80F.			
Measurements in ft bgl.			

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
595.85									
	204S-0-2	SSS			0-6" Concrete. Sand - fine to medium, well sorted, some gravel - fill.				
590.85			100 (1")	5	Sand, medium to coarse, poorly sorted, with gravel and some clay, limestone fragments, loose, dry.				3" Recovery.
585.85				10					
	204S-13-16		37,41,100 (3")		*Rock/limestone fragments, some sand, some*				6" Recovery.
580.85				15	gravel, dry. 14-16' Limestone fragments, rust.				Water at 16'.
					EOB at 19'				
				20					
				25					
				30					
				35					
				40					

LEGEND: TOPSOIL SAND CLAY BEDROCK GRAVEL

NOTES: bgl - below ground level

MALCOLM PIRNIE

WELL / BORING LOG

BORING # 205i	WELL #: MW-205i	SITE NAME: PETOSKEY	PROJECT 2420-017-H22
GROUND ELEV.: 587.36'	TOC ELEV.: 589.68'	LOGGED BY: Andy Klakulak	
COUNTY: Emmet	TWP: Resort	SECTION: 6 T: 34N R: 5W 1/4:	1/4:
DRILL CO.: Stearns	DRILLER: J. Gryska	DRILLING RIG CME 95	DRILL TYPE 4 1/4" HSA/Rotary
BORING START: 8/24/95	END: 8/24/95	LOCATION SKETCH (not to scale)	
WELL START: 8/24/95	END: 8/24/95	SEE SITE MAP	
WATER FIRST:	AT COMPLETION:		
SCREEN LOCATION: 38'	TO: 43'		
TYPE: SS	SIZE: 2"		
CASING TYPE: PVC	DIAMETER: 2"		
WEATHER Clear, 76F.			
Measurements in ft bgl.			

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
587.36					Descriptions based on cuttings and driller's observations.				
				0	Sand - medium to coarse with gravel, clay and rock fragments.				
577.36				10					
567.36				20					
557.36				30					
					Weathered bedrock.				
547.36				40					
					Bedrock.				
					EOB at 45'				
				50					
				60					
				70					

LEGEND: TOPSOIL, SAND, CLAY, BEDROCK, GRAVEL

NOTES: bgl - below ground level

MALCOLM PIRNIE

WELL / BORING LOG

BORING # 205D	WELL #: MW-205D	SITE NAME: PETOSKEY	PROJECT 2420-017-H22
GROUND ELEV.: 590.00'	TOC ELEV.: 590.75'	LOGGED BY: Andy Klakulak	
COUNTY: Emmet	TWP: Resort	SECTION: 6 T: 34N R: 5W 1/4:	1/4:
DRILL CO.: Stearns	DRILLER: J. Gryska	DRILLING RIG CME 95	DRILL TYPE 4 1/4" HSA/Rotary
BORING START: 8/23/95	END: 8/23/95	LOCATION SKETCH (not to scale)	
WELL START: 8/23/95	END: 8/23/95	SEE SITE MAP	
WATER FIRST:	AT COMPLETION:		
SCREEN LOCATION: 54'	TO: 59'		
TYPE: SS	SIZE: 2"		
CASING TYPE: PVC	DIAMETER: 2"		
WEATHER Cloudy, rain, 75F.			
Measurements in ft bgl.			

ELEV. FT.	SAMPLE NUMBER	SAMP TYPE	BLOW COUNT	DEPTH (bgl)	STRATIGRAPHIC DESCRIPTION	USCS	STRAT. SYMBOL	VAS	REMARKS ODOR, FLUID LOSS, ...
590					Descriptions based on cuttings and driller's observations.				
				0	*Sand - with gravel and clay, fine to coarse, tan,* loose rock fragments.				
580				10					
570				20					
560				30					Bedrock
					Limestone/shale.				
550				40					
540				50					
530				60	EOB at 60'				
				70					

LEGEND: TOPSOIL, SAND, CLAY, BEDROCK, GRAVEL

NOTES: bgl - below ground level

APPENDIX B

WELL CONSTRUCTION LOGS

WELL CONSTRUCTION LOG

BORING #: 201S	WELL #: MW-201S	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	3' AGL		
STICKUP	3' AGL		
FLUSH MOUNT	—		
CONCRETE	0-2'		
GROUT	—		
BENTONITE SEAL	10.5-11.5'		
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL GRAVELPACK	2-10.5'	11.5-19'	
PERMANENT SCREEN INTERVAL	3-10'	12-17'	
WELL BOTTOM	17'		
BOTTOM OF BORING (EOB)	19'		

SCREEN CONSTRUCTION MATERIALS

MATERIAL	[X]	SS	[X]	OTHER	PVC (SVE)			
NOM. DIA.	[X]	2"	[ ]	OTHER				
PERF. TYPE	[X]	SLOTTED			[ ]	OTHER		
SLOT SIZE	[ ]	7	[ ]	10	[X]	OTHER	20	
LENGTH	5' (GW), 7' (SVE)							

CASING

MATERIAL	[ ]	GS	[X]	PVC	[ ]	OTHER		
NOM. DIA.	[X]	2"	[ ]	4"	[ ]	6"	OTHER	
SCHEDULE	[X]	40		OTHER				
JOINT TYPE	[ ]	COUPLINGS	[X]	THREADED				
SECT. LENGTH	5'							

PROTECTION

PROTECTOR INSTALLED?	[X]	YES	[ ]	NO
NOM. DIA./TYPE	4" X 4" Protective Casing			
LENGTH OVERALL	5'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	[X]	YES	[ ]	NO
KEY NO.	[X]	3374	[ ]	OTHER
PROTECTIVE POSTS?	[ ]	YES	[X]	NO

CASING RECORD (including double casing)

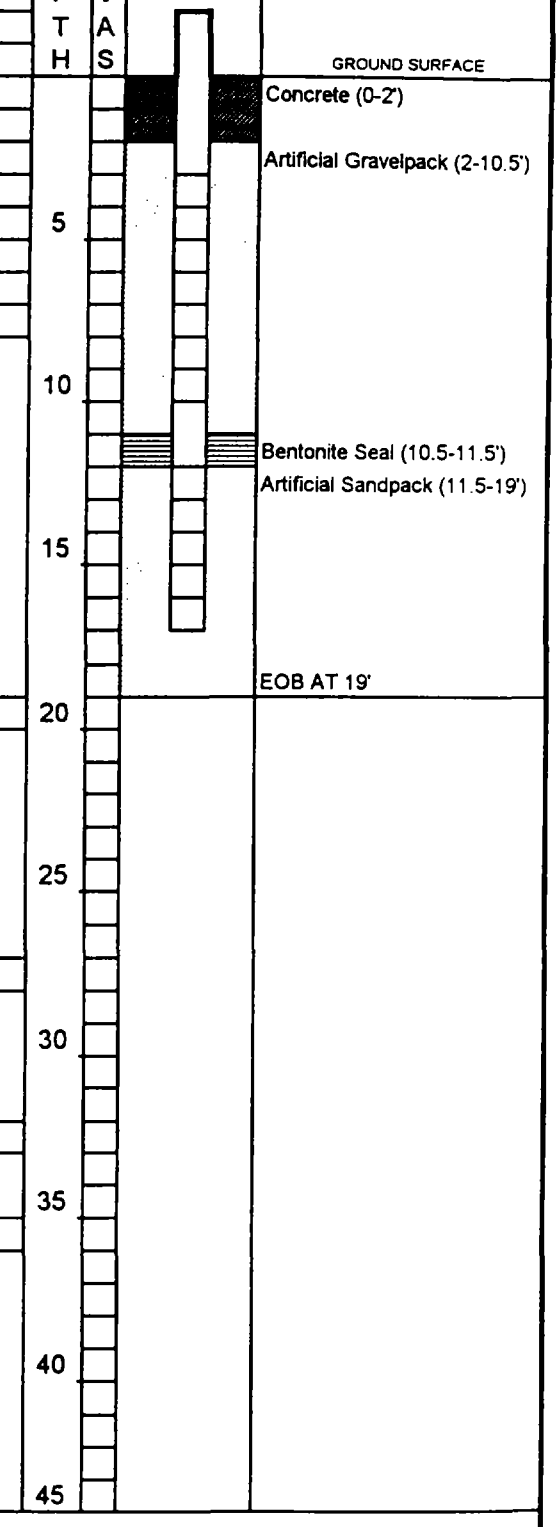
SIZE (DIA.)	2" PVC	FROM	3' AGL	TO	2' BGL
SIZE (DIA.)	2" PVC	FROM	10' BGL	TO	12' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

DRILLING RECORD

METHOD	[X]	4 1/4" ID BOULDER HSA		
FLUID	[ ]	YES	[X]	NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	



LEGEND:

Concrete | Grout | Bentonite Seal | Artificial Gravelpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

WELL CONSTRUCTION LOG

BORING #: 201D	WELL #: PW-201D	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	—		
STICKUP	—		
FLUSH MOUNT	Yes		
CONCRETE	0-3'		
GROUT	3-30'		
BENTONITE SEAL	30-32'		
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL GRAVELPACK	32-57'		
PERMANENT SCREEN INTERVAL	35-55'		
WELL BOTTOM	55'		
BOTTOM OF BORING (EOB)	57'		

SCREEN — CONSTRUCTION MATERIALS

MATERIAL		SS	X	OTHER	PVC			
NOM. DIA.		2"	X	OTHER	4"			
PERF. TYPE	X	SLOTTED					OTHER	
SLOT SIZE		7		10	X	OTHER	30	
LENGTH	20'							

CASING

MATERIAL		GS	X	PVC		OTHER		
NOM. DIA.		2"	X	4"		6"	OTHER	
SCHEDULE		40		X	OTHER	80		
JOINT TYPE		COUPLINGS	X	THREADED				
SECT. LENGTH	35'							

PROTECTION

PROTECTOR INSTALLED?	X	YES		NO
NOM. DIA./TYPE	9" Manhole Cover			
LENGTH OVERALL	2'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	X	YES		NO
KEY NO.	X	3374		OTHER
PROTECTIVE POSTS?		YES	X	NO

CASING RECORD (including double casing)

SIZE (DIA.)	4" PVC	FROM	0'	TO	35' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

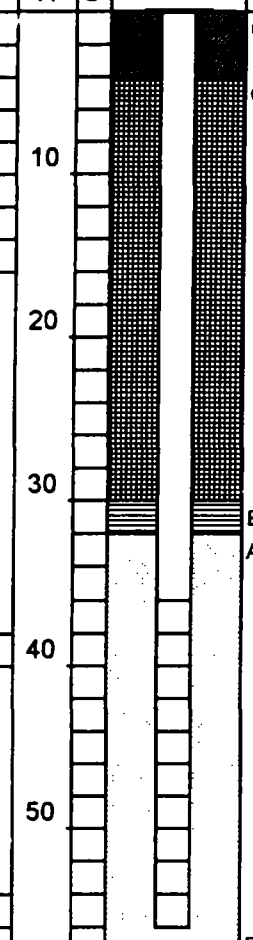
DRILLING RECORD

METHOD	X	4 1/4" ID BOULDER HSA/WATER ROTARY
FLUID	X	YES NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	

DEPTH / VAS / WELL PROFILE / MATERIALS/REMARKS



LEGEND:

Concrete | Grout | Bentonite Seal | Artificial Gravelpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

WELL CONSTRUCTION LOG

BORING #: 202S	WELL #: MW-202S	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	3' AGL		
STICKUP	3' AGL		
FLUSH MOUNT	—		
CONCRETE	0-3'		
GROUT	3-6'		
BENTONITE SEAL	6-8'		
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL SANDPACK	8-15'		
PERMANENT SCREEN INTERVAL	10-15'		
WELL BOTTOM	15'		
BOTTOM OF BORING (EOB)	15'		

SCREEN CONSTRUCTION MATERIALS

MATERIAL	[X]	SS	[ ]	OTHER			
NOM. DIA.	[X]	2"	[ ]	OTHER			
PERF. TYPE	[X]	SLOTTED			[ ]	OTHER	
SLOT SIZE	[ ]	7	[ ]	10	[X]	OTHER	20
LENGTH	5'						

CASING

MATERIAL	[ ]	GS	[X]	PVC	[ ]	OTHER		
NOM. DIA.	[X]	2"	[ ]	4"	[ ]	6"	OTHER	
SCHEDULE	[X]	40		OTHER				
JOINT TYPE	[ ]	COUPLINGS	[X]	THREADED				
SECT. LENGTH	13'							

PROTECTION

PROTECTOR INSTALLED?	[X]	YES	[ ]	NO
NOM. DIA./TYPE	4" X 4" Protective Casing			
LENGTH OVERALL	5'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	[X]	YES	[ ]	NO
KEY NO.	[X]	3374	[ ]	OTHER
PROTECTIVE POSTS?	[ ]	YES	[X]	NO

CASING RECORD (including double casing)

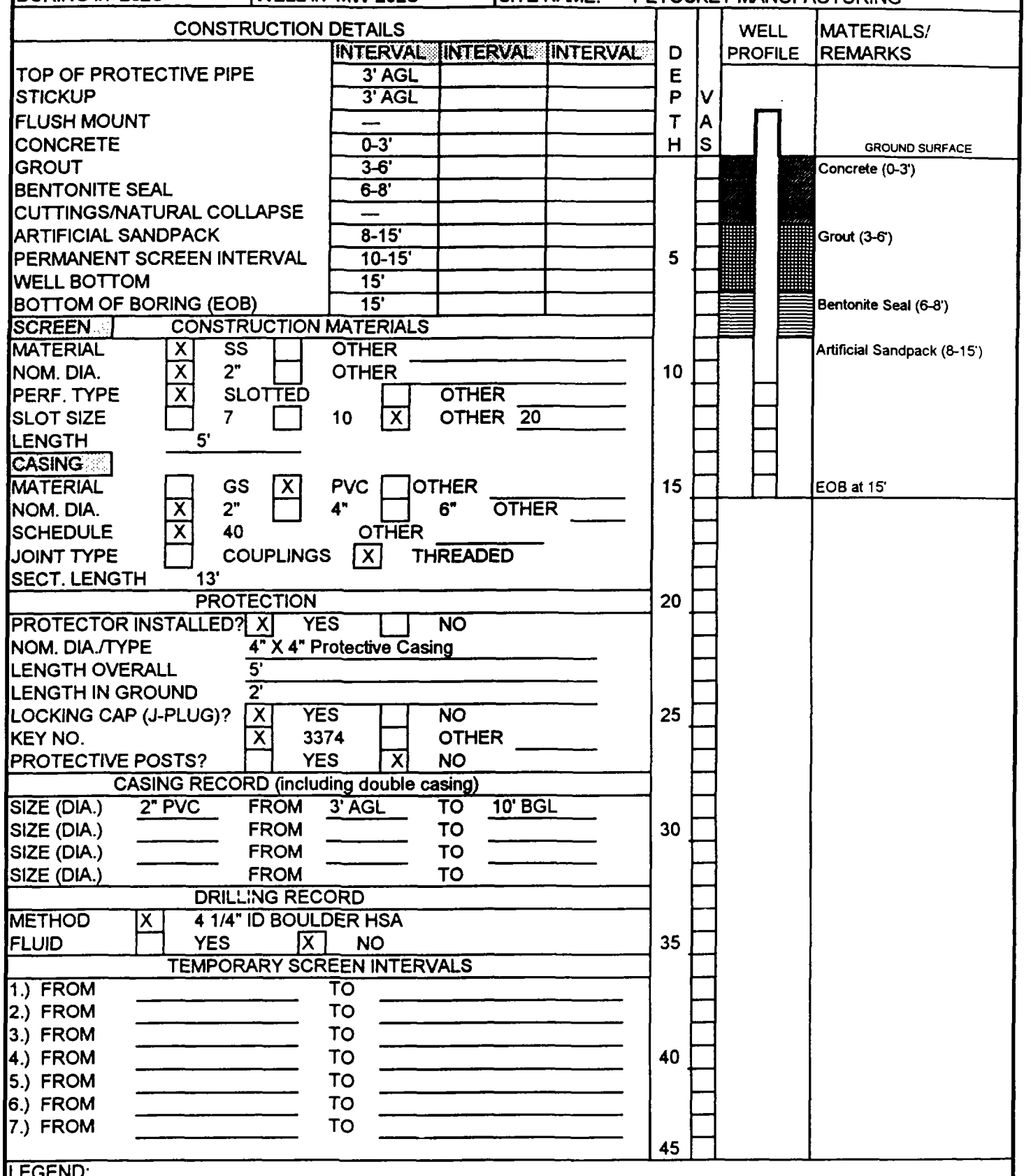
SIZE (DIA.)	2" PVC	FROM	3' AGL	TO	10' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

DRILLING RECORD

METHOD	[X]	4 1/4" ID BOULDER HSA		
FLUID	[ ]	YES	[X]	NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	



LEGEND:

Concrete | Grout | Bentonite Seal | Artificial Sandpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

WELL CONSTRUCTION LOG

BORING #: 203S	WELL #: MW-203S	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	—		
STICKUP	—		
FLUSH MOUNT	Yes		
CONCRETE	0-0.5'		
GROUT	—		
BENTONITE SEAL	0.5-1.5'	12-13.5'	
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL SANDPACK	1.5-12'	13.5-19'	
PERMANENT SCREEN INTERVAL	2-12'	14-19'	
WELL BOTTOM	19'		
BOTTOM OF BORING (EOB)	19'		

SCREEN CONSTRUCTION MATERIALS

MATERIAL	[X]	SS	[X]	OTHER	PVC (SVE)			
NOM. DIA.	[X]	2"	[ ]	OTHER				
PERF. TYPE	[X]	SLOTTED			[ ]	OTHER		
SLOT SIZE	[ ]	7	[ ]	10	[X]	OTHER	20	
LENGTH	10' (SVE), 5' (GW)							

CASING

MATERIAL	[ ]	GS	[X]	PVC	[ ]	OTHER		
NOM. DIA.	[X]	2"	[ ]	4"	[ ]	6"	OTHER	
SCHEDULE	[X]	40	[ ]	OTHER				
JOINT TYPE	[ ]	COUPLINGS	[X]	THREADED				
SECT. LENGTH	3.5'							

PROTECTION

PROTECTOR INSTALLED?	[X]	YES	[ ]	NO
NOM. DIA./TYPE	9" Manhole Cover			
LENGTH OVERALL	2'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	[X]	YES	[ ]	NO
KEY NO.	[X]	3374	[ ]	OTHER
PROTECTIVE POSTS?	[ ]	YES	[X]	NO

CASING RECORD (including double casing)

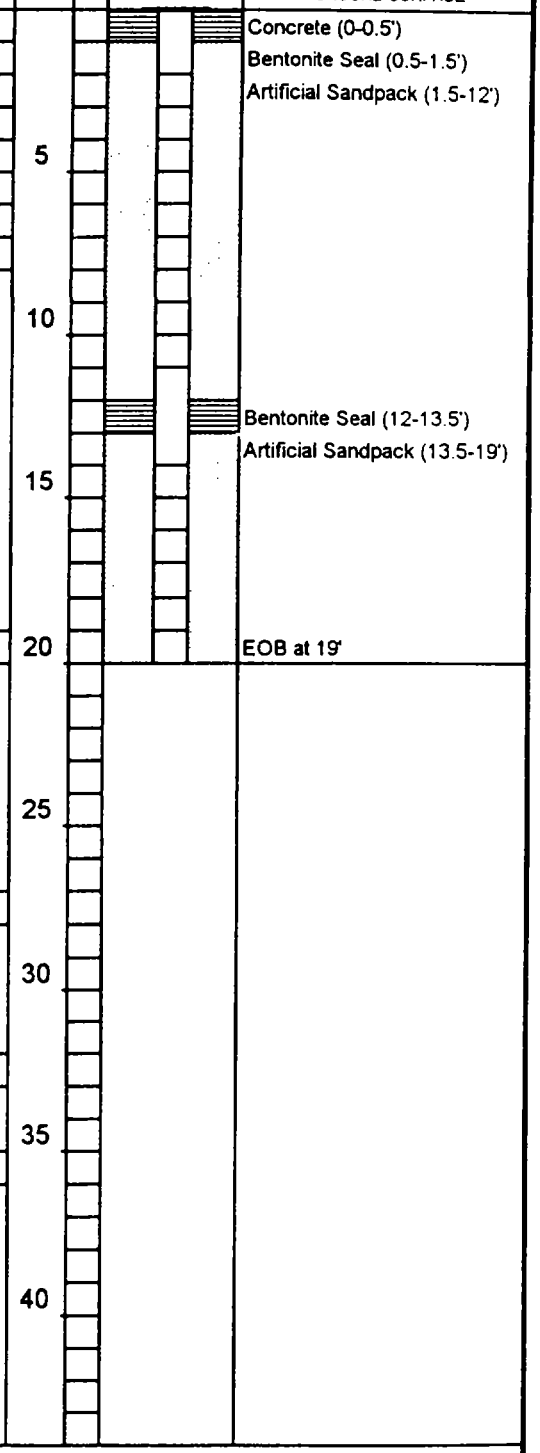
SIZE (DIA.)	2" PVC	FROM	0'	TO	2' BGL
SIZE (DIA.)	2" PVC	FROM	12'	TO	13.5' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

DRILLING RECORD

METHOD	[X]	4 1/4" ID BOULDER HSA		
FLUID	[ ]	YES	[X]	NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	



LEGEND:

Concrete | Grout | Bentonite Seal | Artificial Sandpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

WELL CONSTRUCTION LOG

BORING #: 203D	WELL #: MW-203D	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	—		
STICKUP	—		
FLUSH MOUNT	Yes		
CONCRETE	0-3'		
GROUT	3-33'		
BENTONITE S[illegible]	33-35'		
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL SANDPACK	35-42.5'		
PERMANENT SCREEN INTERVAL	37-42'		
WELL BOTTC[illegible]	42'		
BOTTOM OF BORING (EOB)	42.5'		

SCREEN CONSTRUCTION MATERIALS

MATERIAL	[X]	SS	[ ]	OTHER				
NOM. DIA.	[X]	2"	[ ]	OTHER				
PERF. TYPE	[X]	SLOTTED			[ ]	OTHER		
SLOT SIZE	[ ]	7	[ ]	10	[X]	OTHER	20	
LENGTH	5'							

CASING

MATERIAL	[ ]	GS	[X]	PVC	[ ]	OTHER		
NOM. DIA.	[X]	2"	[ ]	4"	[ ]	6"	OTHER	
SCHEDULE	[X]	40	[ ]	OTHER				
JOINT TYPE	[ ]	COUPLINGS	[X]	THREADED				
SECT. LENGTH	37'							

PROTECTION

PROTECTOR INSTALLED?	[X]	YES	[ ]	NO
NOM. DIA./TYPE	9" Manhole Cover			
LENGTH OVERALL	2'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	[X]	YES	[ ]	NO
KEY NO.	[X]	3374	[ ]	OTHER
PROTECTIVE POSTS?	[ ]	YES	[X]	NO

CASING RECORD (including double casing)

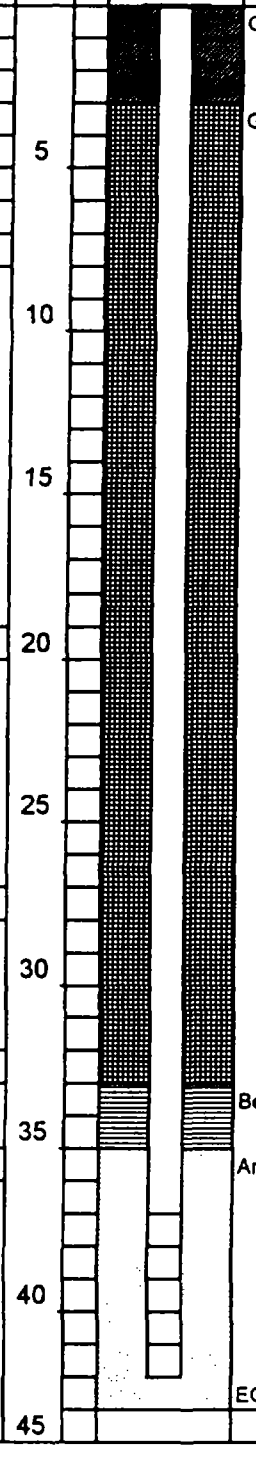
SIZE (DIA.)	2" PVC	FROM	0'	TO	35' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

DRILLING RECORD

METHOD	[X]	4 1/4" ID BOULDER HSA		
FLUID	[ ]	YES	[X]	NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	



LEGEND:

Concrete | Grout | Bentonite Seal | Artificial Sandpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

WELL CONSTRUCTION LOG

BORING #: 204S	WELL #: MW-204S	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	—		
STICKUP	—		
FLUSH MOUNT	Yes		
CONCRETE	0-1.5'		
GROUT			
BENTONITE SEAL	1.5-2'	12-13'	
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL SANDPACK	2-12'	13-19.5'	
PERMANENT SCREEN INTERVAL	2-12'	14-19'	
WELL BOTTOM	19'		
BOTTOM OF BORING (EOB)	19.5'		

SCREEN — CONSTRUCTION MATERIALS

MATERIAL	[X]	SS	[X]	OTHER	PVC (SVE)			
NOM. DIA.	[X]	2"	[ ]	OTHER				
PERF. TYPE	[X]	SLOTTED			[ ]	OTHER		
SLOT SIZE	[ ]	7	[ ]	10	[X]	OTHER	20	
LENGTH	10' SVE, 5' GW							

CASING

MATERIAL	[ ]	GS	[X]	PVC	[ ]	OTHER		
NOM. DIA.	[X]	2"	[ ]	4"	[ ]	6"	OTHER	
SCHEDULE	[X]	40	[ ]	OTHER				
JOINT TYPE	[ ]	COUPLINGS	[X]	THREADED				
SECT. LENGTH	2'							

PROTECTION

PROTECTOR INSTALLED?	[X]	YES	[ ]	NO
NOM. DIA./TYPE	9" Manhole Cover			
LENGTH OVERALL	2'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	[X]	YES	[ ]	NO
KEY NO.	[X]	3374	[ ]	OTHER
PROTECTIVE POSTS?	[ ]	YES	[X]	NO

CASING RECORD (including double casing)

SIZE (DIA.)	2" PVC	FROM	0'	TO	2' BGL
SIZE (DIA.)	2" PVC	FROM	12' BGL	TO	14' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

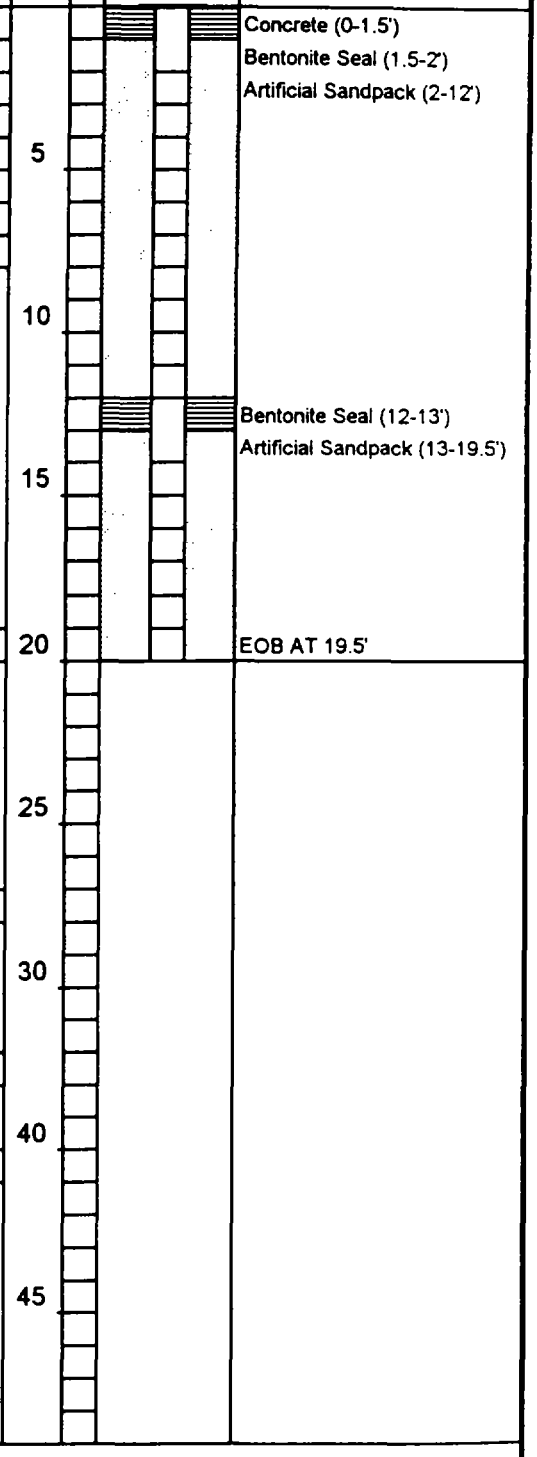
DRILLING RECORD

METHOD	[X]	4 1/4" ID BOULDER HSA		
FLUID	[ ]	YES	[X]	NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	

DEPTH / VAS



WELL PROFILE

MATERIALS/ REMARKS

LEGEND:

Concrete | Grout | Bentonite Seal | Artificial Sandpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

WELL CONSTRUCTION LOG

BORING #: 205i	WELL #: MW-205i	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	3' AGL		
STICKUP	3' AGL		
FLUSH MOUNT	—		
CONCRETE	0-3'		
GROUT	3-34'		
BENTONITE SEAL	34-36'		
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL SANDPACK	36-45'		
PERMANENT SCREEN INTERVAL	38-43'		
WELL BOTTOM	43'		
BOTTOM OF BORING (EOB)	45'		

SCREEN CONSTRUCTION MATERIALS

MATERIAL	[X]	SS	[ ]	OTHER				
NOM. DIA.	[X]	2"	[ ]	OTHER				
PERF. TYPE	[X]	SLOTTED			[ ]	OTHER		
SLOT SIZE	[ ]	7	[ ]	10	[X]	OTHER	20	
LENGTH	5'							

CASING

MATERIAL	[ ]	GS	[X]	PVC	[ ]	OTHER		
NOM. DIA.	[X]	2"	[ ]	4"	[ ]	6"	OTHER	
SCHEDULE	[X]	40		OTHER				
JOINT TYPE	[ ]	COUPLINGS	[X]	THREADED				
SECT. LENGTH	41'							

PROTECTION

PROTECTOR INSTALLED?	[X]	YES	[ ]	NO
NOM. DIA./TYPE	4" X 4" Protective Casing			
LENGTH OVERALL	5'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	[X]	YES	[ ]	NO
KEY NO.	[X]	3374	[ ]	OTHER
PROTECTIVE POSTS?	[ ]	YES	[X]	NO

CASING RECORD (including double casing)

SIZE (DIA.)	2" PVC	FROM	3' AGL	TO	38' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

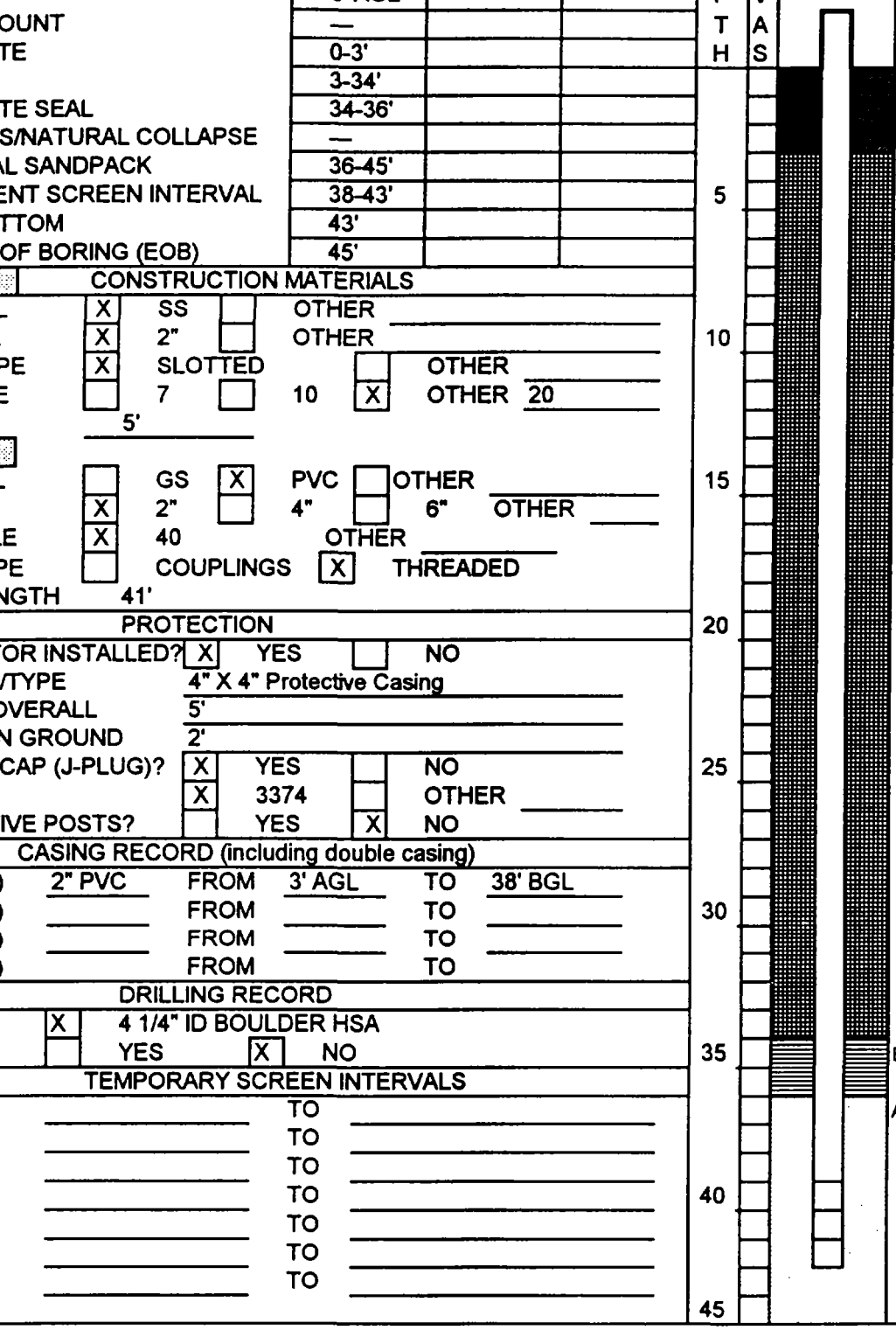
DRILLING RECORD

METHOD	[X]	4 1/4" ID BOULDER HSA		
FLUID	[ ]	YES	[X]	NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	

DEPTH	VAS	WELL PROFILE	MATERIALS/ REMARKS
			GROUND SURFACE
			Concrete (0-3')
5			Grout with sand and gravel (3-34')
10			
15			
20			
25			
30			
35			Bentonite Seal (34-36')
			Artificial Sandpack (36-45')
40			
45			



LEGEND:

Concrete | Grout | Bentonite Seal | Artificial Sandpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

WELL CONSTRUCTION LOG

BORING #: 205D	WELL #: MW-205D	SITE NAME: PETOSKEY MANUFACTURING

CONSTRUCTION DETAILS

	INTERVAL	INTERVAL	INTERVAL
TOP OF PROTECTIVE PIPE	3' AGL		
STICKUP	3' AGL		
FLUSH MOUNT	—		
CONCRETE	0-3'		
GROUT	3-50'		
BENTONITE SEAL	50-52'		
CUTTINGS/NATURAL COLLAPSE	—		
ARTIFICIAL SANDPACK	52-59'		
PERMANENT SCREEN INTERVAL	54-59'		
WELL BOTTOM	59'		
BOTTOM OF BORING (EOB)	60'		

SCREEN CONSTRUCTION MATERIALS

MATERIAL	[X]	SS	[ ]	OTHER				
NOM. DIA.	[X]	2"	[ ]	OTHER				
PERF. TYPE	[X]	SLOTTED			[ ]	OTHER		
SLOT SIZE	[ ]	7	[ ]	10	[X]	OTHER	20	
LENGTH	5'							

CASING

MATERIAL	[ ]	GS	[X]	PVC	[ ]	OTHER		
NOM. DIA.	[X]	2"	[ ]	4"	[ ]	6"	OTHER	
SCHEDULE	[X]	40		OTHER				
JOINT TYPE	[ ]	COUPLINGS	[X]	THREADED				
SECT. LENGTH	57'							

PROTECTION

PROTECTOR INSTALLED?	[X]	YES	[ ]	NO
NOM. DIA./TYPE	4" X 4" Protective Casing			
LENGTH OVERALL	5'			
LENGTH IN GROUND	2'			
LOCKING CAP (J-PLUG)?	[X]	YES	[ ]	NO
KEY NO.	[X]	3374	[ ]	OTHER
PROTECTIVE POSTS?	[ ]	YES	[X]	NO

CASING RECORD (including double casing)

SIZE (DIA.)	2" PVC	FROM	3' AGL	TO	54' BGL
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	
SIZE (DIA.)		FROM		TO	

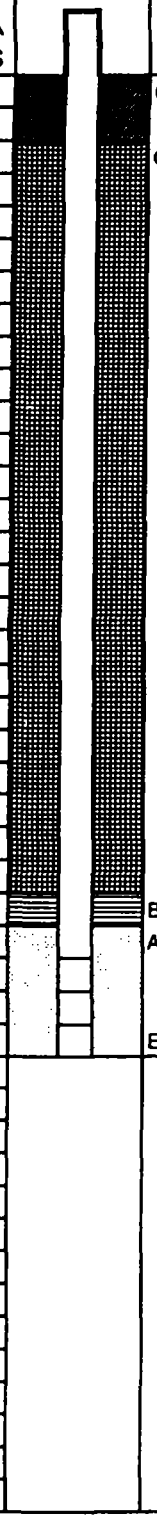
DRILLING RECORD

METHOD	[X]	4 1/4" ID BOULDER HSA		
FLUID	[ ]	YES	[X]	NO

TEMPORARY SCREEN INTERVALS

1.) FROM		TO	
2.) FROM		TO	
3.) FROM		TO	
4.) FROM		TO	
5.) FROM		TO	
6.) FROM		TO	
7.) FROM		TO	

DEPTH / VAS



WELL PROFILE

MATERIALS/ REMARKS

GROUND SURFACE

Concrete (0-3')

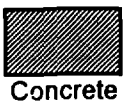
Grout (3-50')

Bentonite Seal (50-52')

Artificial Sandpack (52-59')

EOB at 60'

LEGEND:



Concrete | Grout | Bentonite Seal | Artificial Sandpack | Cuttings/ Natural Collapse

NOTES: AGL - ABOVE GROUND LEVEL BGL - BELOW GROUND LEVEL
MEASUREMENTS IN FT. BGL.

APPENDIX C

SLUG TEST ANALYSIS DATA

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	MW-201S
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	MW-201S
TEST TYPE :	SLUG
RUN NO. :	1

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449	CM
ln[(H-Lw)/rw]:	4.118495	
FACTOR OF ln(Re/rw):	1.118205	

ENTER THE SLOPE OF THE
BEST FIT STRAIGHT LINE: 0.189709 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. MW-201S

K:	1.37E-03	cm/sec
	3.88E+00	ft/d

CONSTANTS

XD REF (FT)...	1.67	
rc (FT)..	0.046	
rw (FT)..	0.375	
Le (FT)..	5	
Lw (FT)..	2.16	
H (FT)...	25.21	
A.....	1.9	
B.....	0.4	
C.....	na	
T-OFFSET (sec)	T	

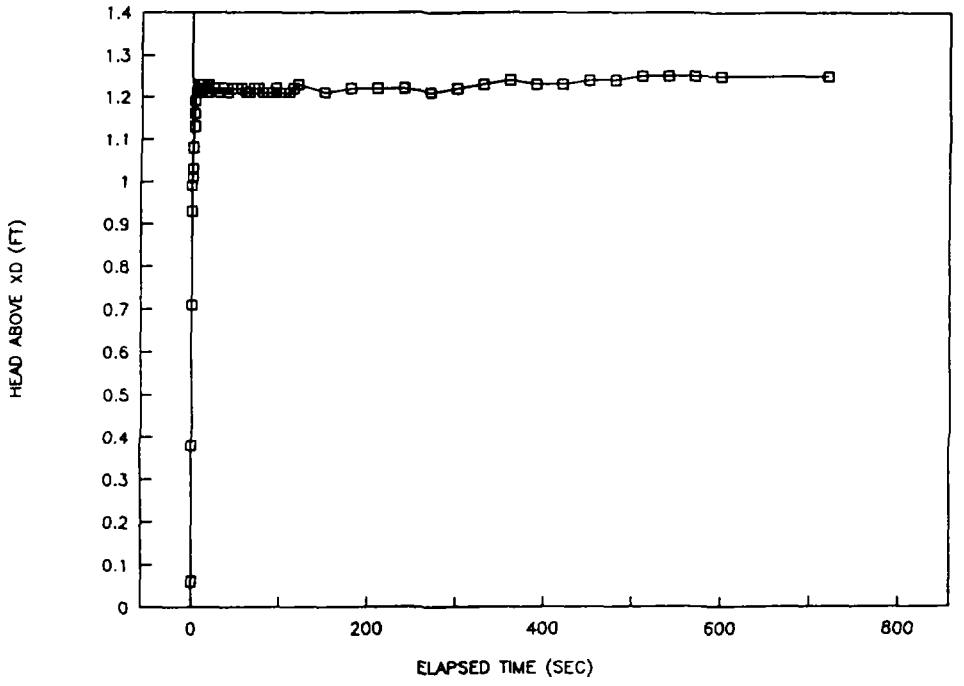
MW-201a TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	0.06	0		1.61	0.4762	0	-0.2197	
0.0033	0.38	0.198		1.29	0.2546	0.198	-0.2572	0.1897091
0.0066	0.71	0.396		0.96	-0.0408	0.396	-0.2948	0.1897091
0.0099	0.93	0.594		0.74	-0.3011	0.594	-0.3323	0.1897091
0.0133	0.99	0.798		0.68	-0.3857	0.798	-0.3710	0.1897091
0.0166	1.01	0.996		0.66	-0.4155	0.996	-0.4086	0.1897091
0.02	1.01	1.2		0.66	-0.4155	1.2	-0.4473	0.1897091
0.0233	1.03	1.398		0.64	-0.4463	1.398	-0.4849	0.1897091
0.0266	1.08	1.596		0.59	-0.5276	1.596	-0.5224	0.1897091
0.03	1.13	1.8		0.54	-0.6162	1.8	-0.5611	0.1897091
0.0333	1.16	1.998		0.51	-0.6733	1.998	-0.5987	0.1897091
0.05	1.19	3		0.48	-0.7340	3	-0.7888	0.1897091
0.0666	1.21	3.996		0.46	-0.7765	3.996	-0.9777	0.1897091
0.0833	1.21	4.998		0.46	-0.7765	4.998	-1.1678	0.1897091
0.1	1.23	6		0.44	-0.8210	6	-1.3579	0.1897091
0.1166	1.22	6.996		0.45	-0.7985	6.996	-1.5469	0.1897091
0.1333	1.22	7.998		0.45	-0.7985	7.998	-1.7370	0.1897091
0.15	1.23	9		0.44	-0.8210	9	-1.9270	0.1897091
0.1666	1.22	9.996		0.45	-0.7985	9.996	-2.1160	0.1897091
0.1833	1.22	10.998		0.45	-0.7985	10.998	-2.3061	0.1897091
0.2	1.23	12		0.44	-0.8210	12	-2.4962	0.1897091
0.2166	1.22	12.996		0.45	-0.7985	12.996	-2.6851	0.1897091
0.2333	1.22	13.998		0.45	-0.7985	13.998	-2.8752	0.1897091
0.25	1.22	15		0.45	-0.7985	15	-3.0653	0.1897091
0.2666	1.21	15.996		0.46	-0.7765	15.996	-3.2542	0.1897091
0.2833	1.23	16.998		0.44	-0.8210	16.998	-3.4443	0.1897091
0.3	1.21	18		0.46	-0.7765	18	-3.6344	0.1897091
0.3166	1.21	18.996		0.46	-0.7765	18.996	-3.8234	0.1897091
0.3333	1.21	19.998		0.46	-0.7765	19.998	-4.0135	0.1897091
0.4167	1.22	25.002		0.45	-0.7985	25.002	-4.9628	0.1897091
0.5	1.21	30		0.46	-0.7765	30	-5.9109	0.1897091
0.5833	1.22	34.998		0.45	-0.7985	34.998	-6.8591	0.1897091
0.6667	1.21	40.002		0.46	-0.7765	40.002	-7.8084	0.1897091
0.75	1.22	45		0.45	-0.7985	45	-8.7566	0.1897091
0.8333	1.22	49.998		0.45	-0.7985	49.998	-9.7047	0.1897091
0.9167	1.22	55.002		0.45	-0.7985	55.002	-10.6540	0.1897091
1	1.21	60		0.46	-0.7765	60	-11.6022	0.1897091
1.0833	1.21	64.998		0.46	-0.7765	64.998	-12.5504	0.1897091
1.1667	1.22	70.002		0.45	-0.7985	70.002	-13.4997	0.1897091
1.25	1.22	75		0.45	-0.7985	75	-14.4478	0.1897091
1.3333	1.21	79.998		0.46	-0.7765	79.998	-15.3960	0.1897091
1.4166	1.21	84.996		0.46	-0.7765	84.996	16.3442	0.1897091
1.5	1.21	90		0.46	-0.7765	90	-17.2935	0.1897091
1.5833	1.22	94.998		0.45	-0.7985	94.998	-18.2416	0.1897091
1.6667	1.21	100.002		0.46	-0.7765	100.002	-19.1909	0.1897091
1.75	1.21	105		0.46	-0.7765	105	-20.1391	0.1897091

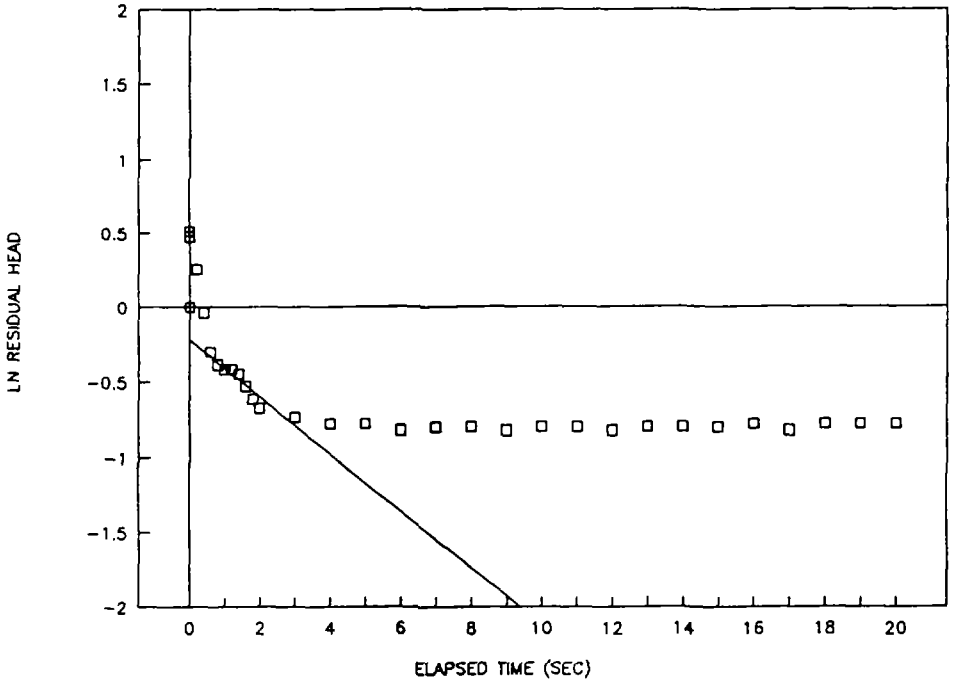
MW-201a TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	1.21	109.998		0.46	-0.7765	109.998	-21.0873	0.1897091
1.9167	1.22	115.002		0.45	-0.7985	115.002	-22.0366	0.1897091
2	1.23	120		0.44	-0.8210	120	-22.9847	0.1897091
2.5	1.21	150		0.46	-0.7765	150	-28.6760	0.1897091
3	1.22	180		0.45	-0.7985	180	-34.3673	0.1897091
3.5	1.22	210		0.45	-0.7985	210	-40.0586	0.1897091
4	1.22	240		0.45	-0.7985	240	-45.7498	0.1897091
4.5	1.21	270		0.46	-0.7765	270	-51.4411	0.1897091
5	1.22	300		0.45	-0.7985	300	-57.1324	0.1897091
5.5	1.23	330		0.44	-0.8210	330	-62.8237	0.1897091
6	1.24	360		0.43	-0.8440	360	-68.5149	0.1897091
6.5	1.23	390		0.44	-0.8210	390	-74.2062	0.1897091
7	1.23	420		0.44	-0.8210	420	-79.8975	0.1897091
7.5	1.24	450		0.43	-0.8440	450	-85.5887	0.1897091
8	1.24	480		0.43	-0.8440	480	-91.2800	0.1897091
8.5	1.25	510		0.42	-0.8675	510	-96.9713	0.1897091
9	1.25	540		0.42	-0.8675	540	-102.6626	0.1897091
9.5	1.25	570		0.42	-0.8675	570	-108.3538	0.1897091
10	1.25	600		0.42	-0.8675	600	-114.0451	0.1897091
12	1.25	720		0.42	-0.8675	720	-136.8102	0.1897091

TEST RECORD



BOUWER & RICE PLOT



WELL MW-201

SLUG TEST PLOTS-TEST No. 1

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	MW-201
PROJECT NAME	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	MW-201
TEST TYPE :	SLUG
RUN NO. :	2

DEFINITIONS

XD REF	*transducer reference level*
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	*Bouwer & Rice coefficients*
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449	CM
ln[(H-Lw)/rw]:	4.118495	
FACTOR OF ln(Re/rw):	1.118205	

ENTER THE SLOPE OF THE BEST FIT STRAIGHT LINE: 0.449965 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. MW-201

K:	3.25E-03	cm/sec
	9.20E+00	ft/d

CONSTANTS

XD REF (FT)...	1.67
rc (FT)..	0.046
rw (FT)..	0.375
Le (FT)..	5
Lw (FT)..	2.16
H (FT)...	25.21
A.....	1.9
B.....	0.4
C.....	na
T-OFFSET (sec)	T

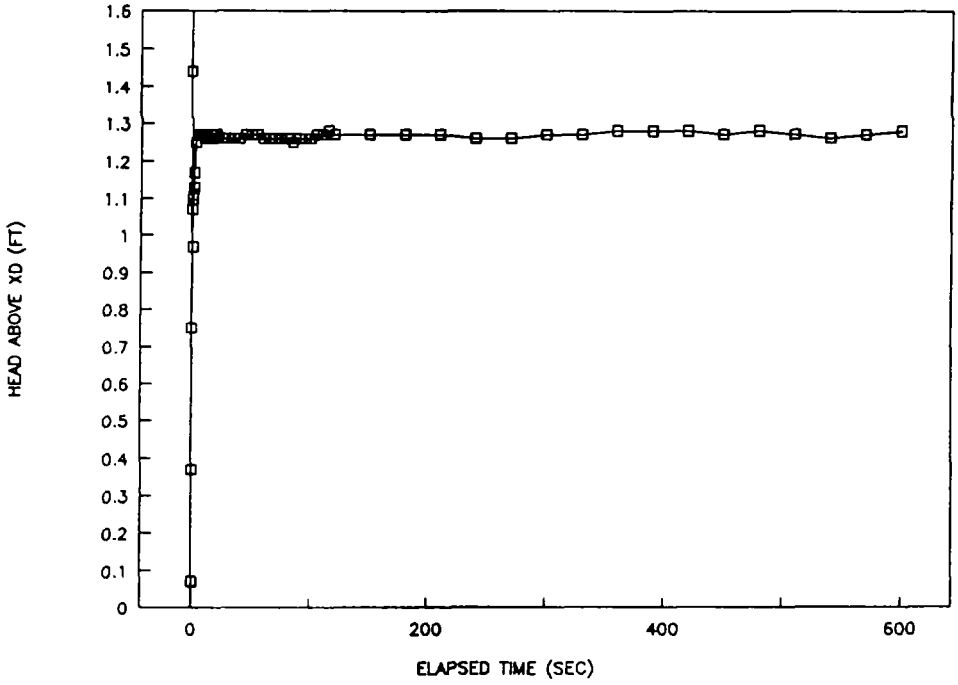
MW-201

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	1.44	0		0.23	-1.4697	0	0.0511	
0.0033	0.07	0.198		1.6	0.4700	0.198	-0.0380	0.4499650
0.0066	0.37	0.396		1.3	0.2624	0.396	-0.1271	0.4499650
0.0099	0.75	0.594		0.92	-0.0834	0.594	-0.2162	0.4499650
0.0133	0.97	0.798		0.7	-0.3567	0.798	-0.3080	0.4499650
0.0166	1.07	0.996		0.6	-0.5108	0.996	-0.3970	0.4499650
0.02	1.1	1.2		0.57	-0.5621	1.2	-0.4888	0.4499650
0.0233	1.1	1.398		0.57	-0.5621	1.398	-0.5779	0.4499650
0.0266	1.11	1.596		0.56	-0.5798	1.596	-0.6670	0.4499650
0.03	1.13	1.8		0.54	-0.6162	1.8	-0.7588	0.4499650
0.0333	1.17	1.998		0.5	-0.6931	1.998	-0.8479	0.4499650
0.05	1.25	3		0.42	-0.8675	3	-1.2988	0.4499650
0.0666	1.27	3.996		0.4	-0.9163	3.996	-1.7469	0.4499650
0.0833	1.27	4.998		0.4	-0.9163	4.998	-2.1978	0.4499650
0.1	1.27	6		0.4	-0.9163	6	-2.6487	0.4499650
0.1166	1.27	6.996		0.4	-0.9163	6.996	-3.0968	0.4499650
0.1333	1.27	7.998		0.4	-0.9163	7.998	-3.5477	0.4499650
0.15	1.27	9		0.4	-0.9163	9	-3.9986	0.4499650
0.1666	1.26	9.996		0.41	-0.8916	9.996	-4.4467	0.4499650
0.1833	1.27	10.998		0.4	-0.9163	10.998	-4.8976	0.4499650
0.2	1.27	12		0.4	-0.9163	12	-5.3485	0.4499650
0.2166	1.26	12.996		0.41	-0.8916	12.996	-5.7966	0.4499650
0.2333	1.26	13.998		0.41	-0.8916	13.998	-6.2475	0.4499650
0.25	1.27	15		0.4	-0.9163	15	-6.6984	0.4499650
0.2666	1.27	15.996		0.4	-0.9163	15.996	-7.1465	0.4499650
0.2833	1.26	16.998		0.41	-0.8916	16.998	-7.5974	0.4499650
0.3	1.27	18		0.4	-0.9163	18	-8.0482	0.4499650
0.3166	1.26	18.996		0.41	-0.8916	18.996	-8.4964	0.4499650
0.3333	1.27	19.998		0.4	-0.9163	19.998	-8.9473	0.4499650
0.4167	1.26	25.002		0.41	-0.8916	25.002	-11.1989	0.4499650
0.5	1.26	30		0.41	-0.8916	30	-13.4478	0.4499650
0.5833	1.26	34.998		0.41	-0.8916	34.998	-15.6968	0.4499650
0.6667	1.26	40.002		0.41	-0.8916	40.002	-17.9484	0.4499650
0.75	1.27	45		0.4	-0.9163	45	-20.1973	0.4499650
0.8333	1.27	49.998		0.4	-0.9163	49.998	-22.4462	0.4499650
0.9167	1.27	55.002		0.4	-0.9163	55.002	-24.6979	0.4499650
1	1.26	60		0.41	-0.8916	60	-26.9468	0.4499650
1.0833	1.26	64.998		0.41	-0.8916	64.998	-29.1957	0.4499650
1.1667	1.26	70.002		0.41	-0.8916	70.002	-31.4473	0.4499650
1.25	1.26	75		0.41	-0.8916	75	-33.6963	0.4499650
1.3333	1.26	79.998		0.41	-0.8916	79.998	-35.9452	0.4499650
1.4166	1.25	84.996		0.42	-0.8675	84.996	-38.1941	0.4499650
1.5	1.26	90		0.41	-0.8916	90	-40.4457	0.4499650
1.5833	1.26	94.998		0.41	-0.8916	94.998	-42.6947	0.4499650
1.6667	1.26	100.002		0.41	-0.8916	100.002	-44.9463	0.4499650
1.75	1.27	105		0.4	-0.9163	105	-47.1952	0.4499650

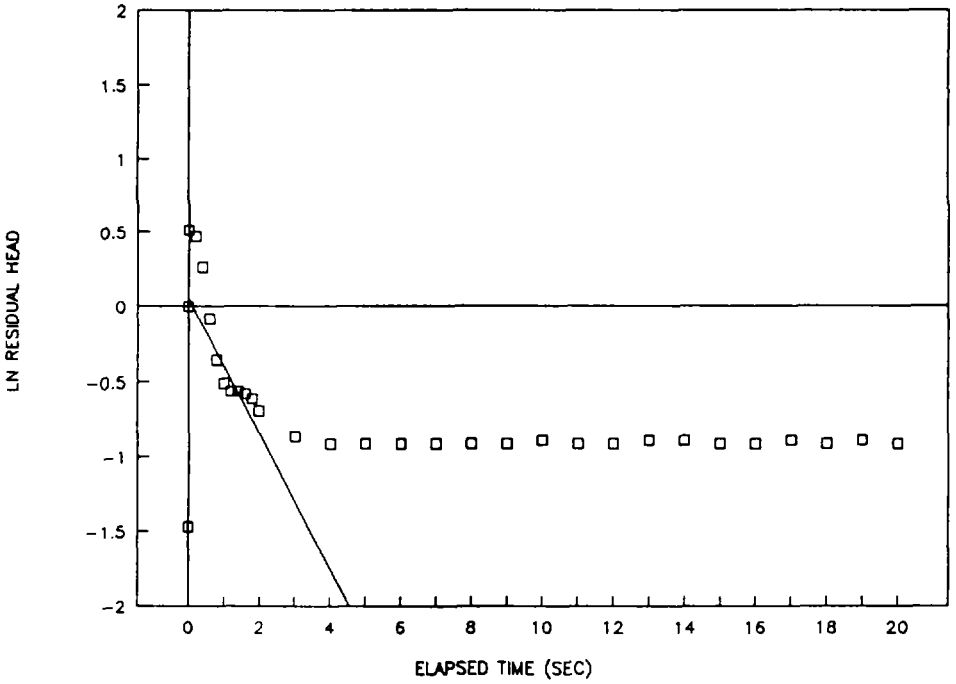
MW-201

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	1.27	109.998		0.4	-0.9163	109.998	-49.4441	0.4499650
1.9167	1.28	115.002		0.39	-0.9416	115.002	-51.6958	0.4499650
2	1.27	120		0.4	-0.9163	120	-53.9447	0.4499650
2.5	1.27	150		0.4	-0.9163	150	-67.4436	0.4499650
3	1.27	180		0.4	-0.9163	180	-80.9426	0.4499650
3.5	1.27	210		0.4	-0.9163	210	-94.4415	0.4499650
4	1.26	240		0.41	-0.8916	240	-107.9405	0.4499650
4.5	1.26	270		0.41	-0.8916	270	-121.4394	0.4499650
5	1.27	300		0.4	-0.9163	300	-134.9384	0.4499650
5.5	1.27	330		0.4	-0.9163	330	-148.4373	0.4499650
6	1.28	360		0.39	-0.9416	360	-161.9363	0.4499650
6.5	1.28	390		0.39	-0.9416	390	-175.4352	0.4499650
7	1.28	420		0.39	-0.9416	420	-188.9342	0.4499650
7.5	1.27	450		0.4	-0.9163	450	-202.4331	0.4499650
8	1.28	480		0.39	-0.9416	480	-215.9321	0.4499650
8.5	1.27	510		0.4	-0.9163	510	-229.4310	0.4499650
9	1.26	540		0.41	-0.8916	540	-242.9300	0.4499650
9.5	1.27	570		0.4	-0.9163	570	-256.4289	0.4499650
10	1.28	600		0.39	-0.9416	600	-269.9279	0.4499650

TEST RECORD



BOUWER & RICE PLOT



WELL MW-201

SLUG TEST PLOTS-TEST No. 2

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	MW-105S
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	MW-105S
TEST TYPE :	SLUG
RUN NO. :	1

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449	CM
ln[(H-Lw)/rw]:	ERR	
FACTOR OF ln(Re/rw):	3.121591	

ENTER THE SLOPE OF THE
BEST FIT STRAIGHT LINE: 0.033614 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. MW-105S

K:	6.77E-04	cm/sec
	1.92E+00	ft/d

CONSTANTS

XD REF (FT)...		10.74
rc (FT)..		0.046
rw (FT)..		0.323
Le (FT)..		5
Lw (FT)..		65.12
H (FT)...		65.12
A.....	na	
B.....	na	
C.....		1.75
T-OFFSET (sec)	T	

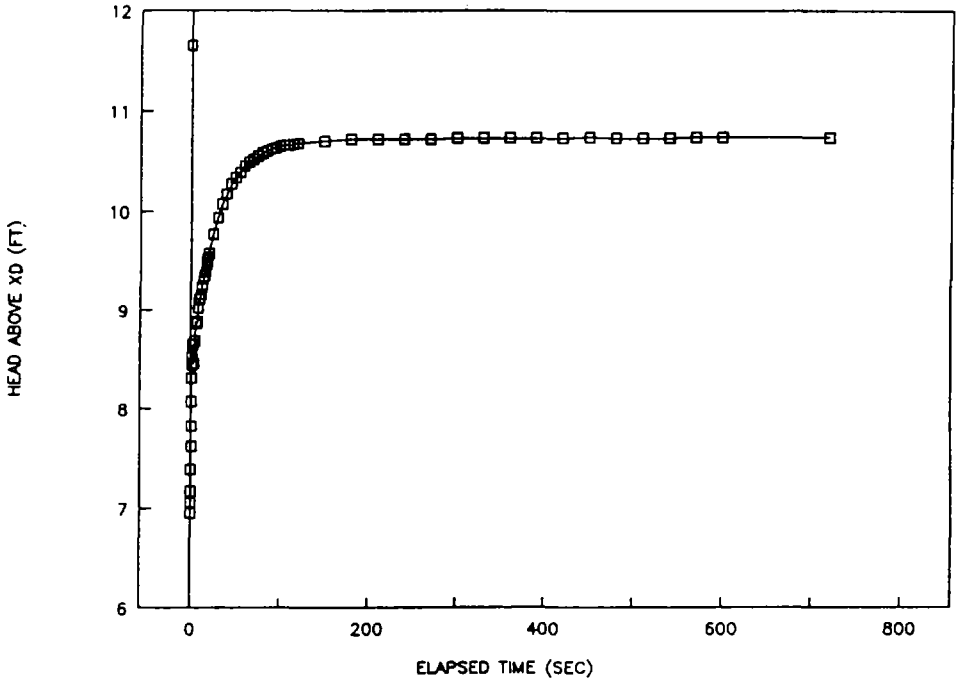
MW-105s TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	11.65	0		0.91	-0.0943	0	0.8436	
0.0033	7.06	0.198		3.68	1.3029	0.198	0.8369	0.0336150
0.0066	6.95	0.396		3.79	1.3324	0.396	0.8302	0.0336150
0.0099	7.17	0.594		3.57	1.2726	0.594	0.8236	0.0336150
0.0133	7.39	0.798		3.35	1.2090	0.798	0.8167	0.0336150
0.0166	7.62	0.996		3.12	1.1378	0.996	0.8101	0.0336150
0.02	7.82	1.2		2.92	1.0716	1.2	0.8032	0.0336150
0.0233	8.07	1.398		2.67	0.9821	1.398	0.7966	0.0336150
0.0266	8.3	1.596		2.44	0.8920	1.596	0.7899	0.0336150
0.03	8.43	1.8		2.31	0.8372	1.8	0.7831	0.0336150
0.0333	8.52	1.998		2.22	0.7975	1.998	0.7764	0.0336150
0.05	8.64	3		2.1	0.7419	3	0.7427	0.0336150
0.0666	8.45	3.996		2.29	0.8286	3.996	0.7092	0.0336150
0.0833	8.68	4.998		2.06	0.7227	4.998	0.6756	0.0336150
0.1	8.88	6		1.86	0.6206	6	0.6419	0.0336150
0.1166	8.86	6.996		1.88	0.6313	6.996	0.6084	0.0336150
0.1333	8.88	7.998		1.86	0.6206	7.998	0.5747	0.0336150
0.15	9.02	9		1.72	0.5423	9	0.5410	0.0336150
0.1666	9.11	9.996		1.63	0.4886	9.996	0.5075	0.0336150
0.1833	9.12	10.998		1.62	0.4824	10.998	0.4739	0.0336150
0.2	9.16	12		1.58	0.4574	12	0.4402	0.0336150
0.2166	9.25	12.996		1.49	0.3988	12.996	0.4067	0.0336150
0.2333	9.32	13.998		1.42	0.3507	13.998	0.3730	0.0336150
0.25	9.35	15		1.39	0.3293	15	0.3393	0.0336150
0.2666	9.39	15.996		1.35	0.3001	15.996	0.3059	0.0336150
0.2833	9.46	16.998		1.28	0.2469	16.998	0.2722	0.0336150
0.3	9.51	18		1.23	0.2070	18	0.2385	0.0336150
0.3166	9.54	18.996		1.2	0.1823	18.996	0.2050	0.0336150
0.3333	9.58	19.998		1.16	0.1484	19.998	0.1713	0.0336150
0.4167	9.77	25.002		0.97	-0.0305	25.002	0.0031	0.0336150
0.5	9.93	30		0.81	-0.2107	30	-0.1649	0.0336150
0.5833	10.07	34.998		0.67	-0.4005	34.998	-0.3329	0.0336150
0.6667	10.17	40.002		0.57	-0.5621	40.002	-0.5011	0.0336150
0.75	10.27	45		0.47	-0.7550	45	-0.6691	0.0336150
0.8333	10.34	49.998		0.4	-0.9163	49.998	-0.8371	0.0336150
0.9167	10.39	55.002		0.35	-1.0498	55.002	-1.0053	0.0336150
1	10.45	60		0.29	-1.2379	60	-1.1733	0.0336150
1.0833	10.49	64.998		0.25	-1.3863	64.998	-1.3413	0.0336150
1.1667	10.52	70.002		0.22	-1.5141	70.002	-1.5096	0.0336150
1.25	10.55	75		0.19	-1.6607	75	-1.6776	0.0336150
1.3333	10.58	79.998		0.16	-1.8326	79.998	-1.8456	0.0336150
1.4166	10.6	84.996		0.14	-1.9661	84.996	-2.0136	0.0336150
1.5	10.62	90		0.12	-2.1203	90	-2.1818	0.0336150
1.5833	10.63	94.998		0.11	-2.2073	94.998	-2.3498	0.0336150
1.6667	10.65	100.002		0.09	-2.4079	100.002	-2.5180	0.0336150
1.75	10.66	105		0.08	-2.5257	105	-2.6860	0.0336150

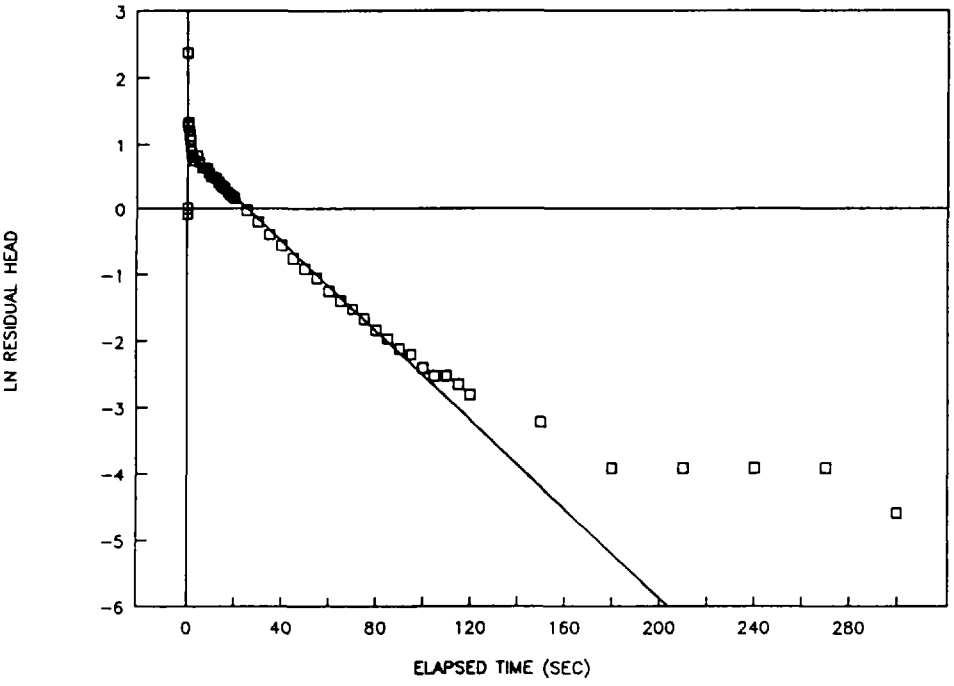
MW-105s TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	10.66	109.998		0.08	-2.5257	109.998	-2.8540	0.0336150
1.9167	10.67	115.002		0.07	-2.6593	115.002	-3.0222	0.0336150
2	10.68	120		0.06	-2.8134	120	-3.1902	0.0336150
2.5	10.7	150		0.04	-3.2189	150	-4.1987	0.0336150
3	10.72	180		0.02	-3.9120	180	-5.2071	0.0336150
3.5	10.72	210		0.02	-3.9120	210	-6.2156	0.0336150
4	10.72	240		0.02	-3.9120	240	-7.2240	0.0336150
4.5	10.72	270		0.02	-3.9120	270	-8.2325	0.0336150
5	10.73	300		0.01	-4.6052	300	-9.2409	0.0336150
5.5	10.73	330		0.01	-4.6052	330	-10.2494	0.0336150
6	10.73	360		0.01	-4.6052	360	-11.2578	0.0336150
6.5	10.73	390		0.01	-4.6052	390	-12.2663	0.0336150
7	10.73	420		0.01	-4.6052	420	-13.2747	0.0336150
7.5	10.74	450		0	ERR	450	-14.2832	0.0336150
8	10.73	480		0.01	-4.6052	480	-15.2916	0.0336150
8.5	10.73	510		0.01	-4.6052	510	-16.3001	0.0336150
9	10.73	540		0.01	-4.6052	540	-17.3085	0.0336150
9.5	10.74	570		0	ERR	570	-18.3170	0.0336150
10	10.74	600		0	ERR	600	-19.3254	0.0336150
12	10.74	720		0	ERR	720	-23.3592	0.0336150

TEST RECORD



BOUWER & RICE PLOT



WELL MW-105S

SLUG TEST PLOTS-TEST No. 1

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	MW-105S
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	MW-105S
TEST TYPE :	SLUG
RUN NO. :	2

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449 CM
ln[(H-Lw)/rw]:	ERR
FACTOR OF ln(Re/rw):	3.121591

ENTER THE SLOPE OF THE
BEST FIT STRAIGHT LINE: 0.022184 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. MW-105S

K:	4.47E-04	cm/sec
	1.27E+00	ft/d

CONSTANTS

XD REF (FT)...	10.74
rc (FT)..	0.046
rw (FT)..	0.323
Le (FT)..	5
Lw (FT)..	65.12
H (FT)...	65.12
A.....	na
B.....	na
C.....	1.75
T-OFFSET (sec)	T

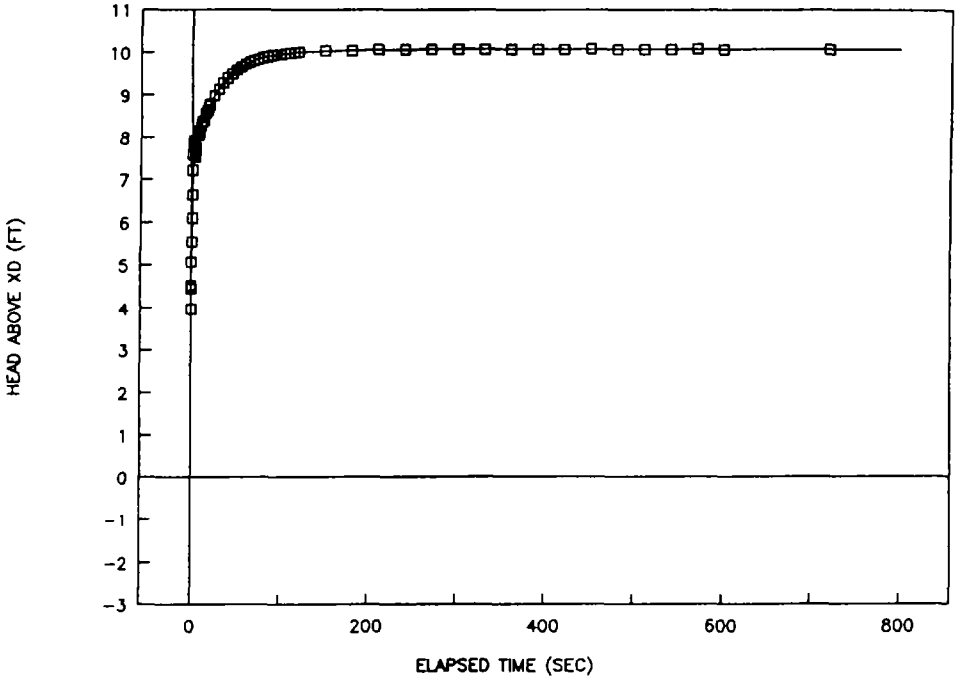
MW-105S TEST No. 2

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	4.53	0		6.21	1.8262	0	1.1383	
0.0033	3.97	0.198		6.77	1.9125	0.198	1.1339	0.0221849
0.0066	4.45	0.396		6.29	1.8390	0.396	1.1295	0.0221849
0.0099	5.07	0.594		5.67	1.7352	0.594	1.1251	0.0221849
0.0133	5.54	0.798		5.2	1.6487	0.798	1.1206	0.0221849
0.0166	6.1	0.996		4.64	1.5347	0.996	1.1162	0.0221849
0.02	6.64	1.2		4.1	1.4110	1.2	1.1116	0.0221849
0.0233	7.21	1.398		3.53	1.2613	1.398	1.1072	0.0221849
0.0266	7.59	1.596		3.15	1.1474	1.596	1.1029	0.0221849
0.03	7.8	1.8		2.94	1.0784	1.8	1.0983	0.0221849
0.0333	7.93	1.998		2.81	1.0332	1.998	1.0939	0.0221849
0.05	7.89	3		2.85	1.0473	3	1.0717	0.0221849
0.0666	7.52	3.996		3.22	1.1694	3.996	1.0496	0.0221849
0.0833	7.74	4.998		3	1.0986	4.998	1.0274	0.0221849
0.1	8.11	6		2.63	0.9670	6	1.0051	0.0221849
0.1166	8.16	6.996		2.58	0.9478	6.996	0.9831	0.0221849
0.1333	8.03	7.998		2.71	0.9969	7.998	0.9608	0.0221849
0.15	8.08	9		2.66	0.9783	9	0.9386	0.0221849
0.1666	8.28	9.996		2.46	0.9002	9.996	0.9165	0.0221849
0.1833	8.38	10.998		2.36	0.8587	10.998	0.8943	0.0221849
0.2	8.37	12		2.37	0.8629	12	0.8720	0.0221849
0.2166	8.38	12.996		2.36	0.8587	12.996	0.8499	0.0221849
0.2333	8.47	13.998		2.27	0.8198	13.998	0.8277	0.0221849
0.25	8.56	15		2.18	0.7793	15	0.8055	0.0221849
0.2666	8.61	15.996		2.13	0.7561	15.996	0.7834	0.0221849
0.2833	8.62	16.998		2.12	0.7514	16.998	0.7612	0.0221849
0.3	8.66	18		2.08	0.7324	18	0.7389	0.0221849
0.3166	8.73	18.996		2.01	0.6981	18.996	0.7168	0.0221849
0.3333	8.78	19.998		1.96	0.6729	19.998	0.6946	0.0221849
0.4167	8.98	25.002		1.76	0.5653	25.002	0.5836	0.0221849
0.5	9.14	30		1.6	0.4700	30	0.4727	0.0221849
0.5833	9.28	34.998		1.46	0.3784	34.998	0.3618	0.0221849
0.6667	9.4	40.002		1.34	0.2927	40.002	0.2508	0.0221849
0.75	9.5	45		1.24	0.2151	45	0.1399	0.0221849
0.8333	9.59	49.998		1.15	0.1398	49.998	0.0291	0.0221849
0.9167	9.66	55.002		1.08	0.0770	55.002	-0.0820	0.0221849
1	9.72	60		1.02	0.0198	60	-0.1928	0.0221849
1.0833	9.77	64.998		0.97	-0.0305	64.998	-0.3037	0.0221849
1.1667	9.81	70.002		0.93	-0.0726	70.002	-0.4147	0.0221849
1.25	9.84	75		0.9	-0.1054	75	-0.5256	0.0221849
1.3333	9.88	79.998		0.86	-0.1508	79.998	-0.6365	0.0221849
1.4166	9.9	84.996		0.84	-0.1744	84.996	-0.7474	0.0221849
1.5	9.92	90		0.82	-0.1985	90	-0.8584	0.0221849
1.5833	9.94	94.998		0.8	-0.2231	94.998	-0.9693	0.0221849
1.6667	9.95	100.002		0.79	-0.2357	100.002	-1.0803	0.0221849
1.75	9.97	105		0.77	-0.2614	105	-1.1912	0.0221849

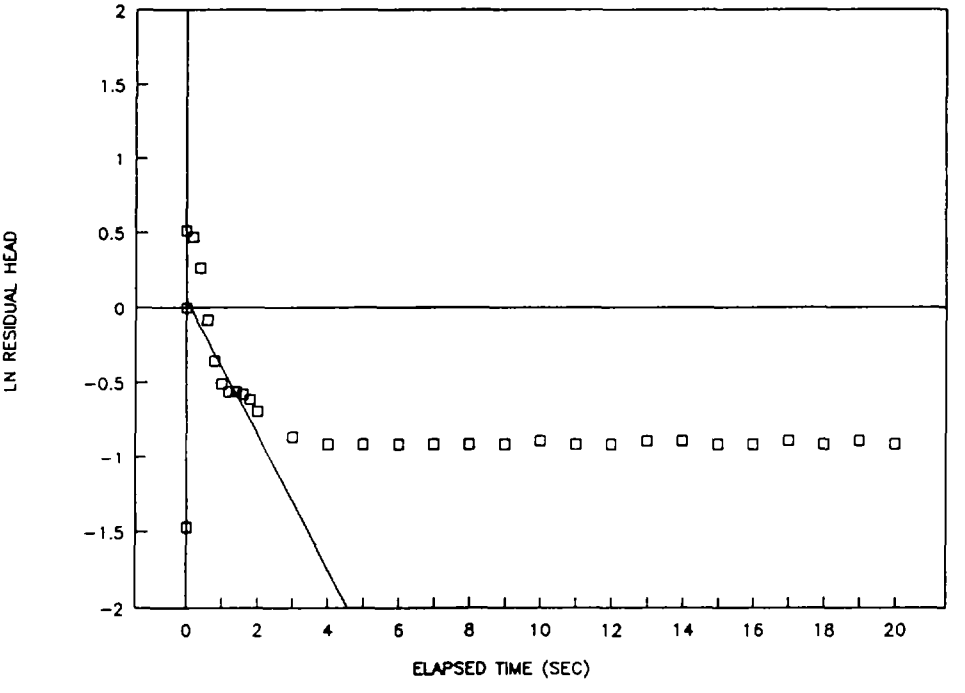
MW-105S TEST No. 2

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	9.97	109.998		0.77	-0.2614	109.998	-1.3020	0.0221849
1.9167	9.99	115.002		0.75	-0.2877	115.002	-1.4130	0.0221849
2	10	120		0.74	-0.3011	120	-1.5239	0.0221849
2.5	10.03	150		0.71	-0.3425	150	-2.1895	0.0221849
3	10.04	180		0.7	-0.3567	180	-2.8550	0.0221849
3.5	10.06	210		0.68	-0.3857	210	-3.5206	0.0221849
4	10.06	240		0.68	-0.3857	240	-4.1861	0.0221849
4.5	10.07	270		0.67	-0.4005	270	-4.8517	0.0221849
5	10.07	300		0.67	-0.4005	300	-5.5172	0.0221849
5.5	10.07	330		0.67	-0.4005	330	-6.1828	0.0221849
6	10.07	360		0.67	-0.4005	360	-6.8483	0.0221849
6.5	10.07	390		0.67	-0.4005	390	-7.5138	0.0221849
7	10.07	420		0.67	-0.4005	420	-8.1794	0.0221849
7.5	10.08	450		0.66	-0.4155	450	-8.8449	0.0221849
8	10.07	480		0.67	-0.4005	480	-9.5105	0.0221849
8.5	10.07	510		0.67	-0.4005	510	-10.1760	0.0221849
9	10.07	540		0.67	-0.4005	540	-10.8416	0.0221849
9.5	10.08	570		0.66	-0.4155	570	-11.5071	0.0221849
10	10.07	600		0.67	-0.4005	600	-12.1727	0.0221849
12	10.07	720		0.67	-0.4005	720	-14.8349	0.0221849
14	10.07	840		0.67	-0.4005	840	-17.4970	0.0221849
16	-2.79	960		13.53	2.6049	960	-20.1592	0.0221849
18	-2.79	1080		13.53	2.6049	1080	-22.8214	0.0221849
20	-2.79	1200		13.53	2.6049	1200	-25.4836	0.0221849

TEST RECORD



BOUWER & RICE PLOT



WELL MW-105S

SLUG TEST PLOTS-TEST No. 2

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	MW-105D
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	MW-105D
TEST TYPE :	SLUG
RUN NO. :	1

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449 CM
ln[(H-Lw)/rw]:	ERR
FACTOR OF ln(Re/rw):	3.307213

ENTER THE SLOPE OF THE BEST FIT STRAIGHT LINE: 0.041449 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. MW-105D

K:	8.84E-04	cm/sec
	2.51E+00	ft/d

CONSTANTS

XD REF (FT)...	10.24
rc (FT)..	0.046
rw (FT)..	0.323
Le (FT)..	5
Lw (FT)..	107.79
H (FT)...	107.79
A.....	na
B.....	na
C.....	1.75
T-OFFSET (sec)	T

MW-105D TEST No. 1

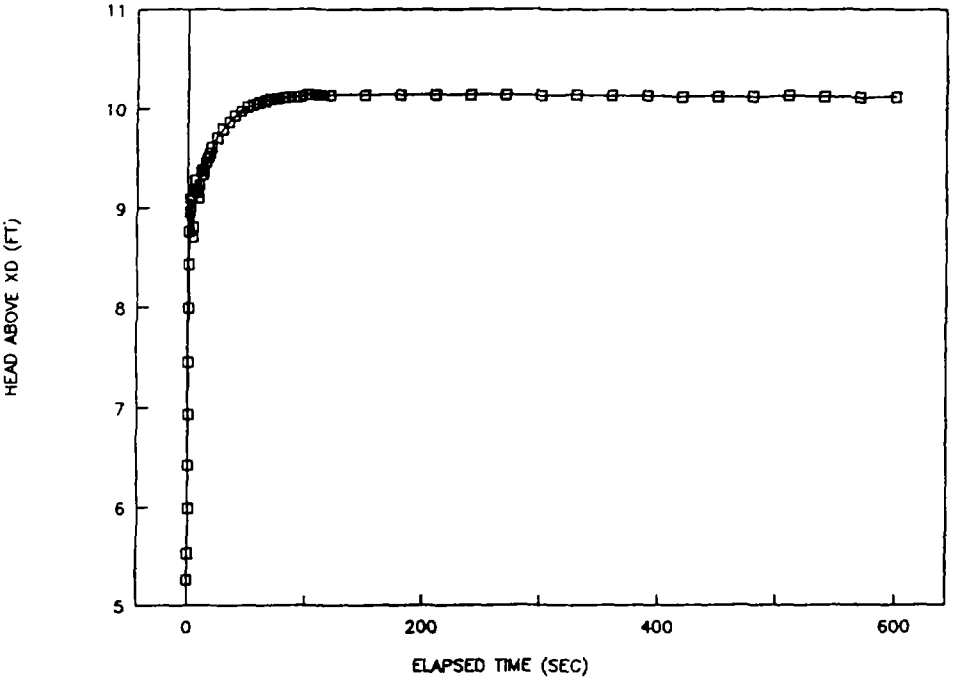
TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	5.26	0		4.98	1.6054	0	0.4061	
0.0033	5.53	0.198		4.71	1.5497	0.198	0.3979	0.0414497
0.0066	5.99	0.396		4.25	1.4469	0.396	0.3897	0.0414497
0.0099	6.42	0.594		3.82	1.3403	0.594	0.3815	0.0414497
0.0133	6.93	0.798		3.31	1.1969	0.798	0.3730	0.0414497
0.0166	7.45	0.996		2.79	1.0260	0.996	0.3648	0.0414497
0.02	7.99	1.2		2.25	0.8109	1.2	0.3564	0.0414497
0.0233	8.43	1.398		1.81	0.5933	1.398	0.3481	0.0414497
0.0266	8.76	1.596		1.48	0.3920	1.596	0.3399	0.0414497
0.03	8.96	1.8		1.28	0.2469	1.8	0.3315	0.0414497
0.0333	9.09	1.998		1.15	0.1398	1.998	0.3233	0.0414497
0.05	9.09	3		1.15	0.1398	3	0.2817	0.0414497
0.0666	8.71	3.996		1.53	0.4253	3.996	0.2405	0.0414497
0.0833	8.81	4.998		1.43	0.3577	4.998	0.1989	0.0414497
0.1	9.17	6		1.07	0.0677	6	0.1574	0.0414497
0.1166	9.28	6.996		0.96	-0.0408	6.996	0.1161	0.0414497
0.1333	9.16	7.998		1.08	0.0770	7.998	0.0746	0.0414497
0.15	9.1	9		1.14	0.1310	9	0.0330	0.0414497
0.1666	9.23	9.996		1.01	0.0100	9.996	-0.0082	0.0414497
0.1833	9.37	10.998		0.87	-0.1393	10.998	-0.0498	0.0414497
0.2	9.38	12		0.86	-0.1508	12	-0.0913	0.0414497
0.2166	9.34	12.996		0.9	-0.1054	12.996	-0.1326	0.0414497
0.2333	9.37	13.998		0.87	-0.1393	13.998	-0.1741	0.0414497
0.25	9.45	15		0.79	-0.2357	15	-0.2157	0.0414497
0.2666	9.5	15.996		0.74	-0.3011	15.996	-0.2569	0.0414497
0.2833	9.5	16.998		0.74	-0.3011	16.998	-0.2985	0.0414497
0.3	9.52	18		0.72	-0.3285	18	-0.3400	0.0414497
0.3166	9.55	18.996		0.69	-0.3711	18.996	-0.3813	0.0414497
0.3333	9.6	19.998		0.64	-0.4463	19.998	-0.4228	0.0414497
0.4167	9.7	25.002		0.54	-0.6162	25.002	-0.6302	0.0414497
0.5	9.79	30		0.45	-0.7985	30	-0.8374	0.0414497
0.5833	9.86	34.998		0.38	-0.9676	34.998	-1.0446	0.0414497
0.6667	9.92	40.002		0.32	-1.1394	40.002	-1.2520	0.0414497
0.75	9.97	45		0.27	-1.3093	45	-1.4591	0.0414497
0.8333	10.01	49.998		0.23	-1.4697	49.998	-1.6663	0.0414497
0.9167	10.03	55.002		0.21	-1.5606	55.002	-1.8737	0.0414497
1	10.05	60		0.19	-1.6607	60	-2.0809	0.0414497
1.0833	10.07	64.998		0.17	-1.7720	64.998	-2.2881	0.0414497
1.1667	10.09	70.002		0.15	-1.8971	70.002	-2.4955	0.0414497
1.25	10.09	75		0.15	-1.8971	75	-2.7026	0.0414497
1.3333	10.1	79.998		0.14	-1.9661	79.998	-2.9098	0.0414497
1.4166	10.11	84.996		0.13	-2.0402	84.996	-3.1170	0.0414497
1.5	10.11	90		0.13	-2.0402	90	-3.3244	0.0414497
1.5833	10.11	94.998		0.13	-2.0402	94.998	-3.5315	0.0414497
1.6667	10.13	100.002		0.11	-2.2073	100.002	-3.7390	0.0414497
1.75	10.13	105		0.11	-2.2073	105	-3.9461	0.0414497

MW-105D TEST No. 1

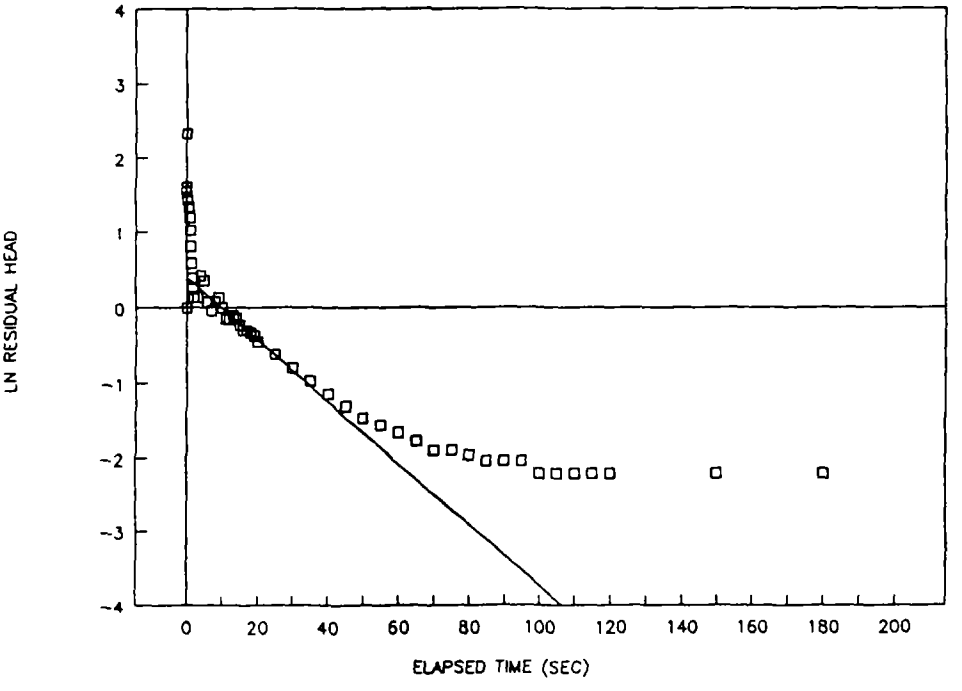
TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	10.13	109.998		0.11	-2.2073	109.998	-4.1533	0.0414497
1.9167	10.13	115.002		0.11	-2.2073	115.002	-4.3607	0.0414497
2	10.13	120		0.11	-2.2073	120	-4.5679	0.0414497
2.5	10.13	150		0.11	-2.2073	150	-5.8114	0.0414497
3	10.13	180		0.11	-2.2073	180	-7.0548	0.0414497
3.5	10.13	210		0.11	-2.2073	210	-8.2983	0.0414497
4	10.13	240		0.11	-2.2073	240	-9.5418	0.0414497
4.5	10.13	270		0.11	-2.2073	270	-10.7853	0.0414497
5	10.12	300		0.12	-2.1203	300	-12.0288	0.0414497
5.5	10.13	330		0.11	-2.2073	330	-13.2723	0.0414497
6	10.12	360		0.12	-2.1203	360	-14.5158	0.0414497
6.5	10.12	390		0.12	-2.1203	390	-15.7593	0.0414497
7	10.11	420		0.13	-2.0402	420	-17.0028	0.0414497
7.5	10.11	450		0.13	-2.0402	450	-18.2463	0.0414497
8	10.1	480		0.14	-1.9661	480	-19.4897	0.0414497
8.5	10.12	510		0.12	-2.1203	510	-20.7332	0.0414497
9	10.11	540		0.13	-2.0402	540	-21.9767	0.0414497
9.5	10.1	570		0.14	-1.9661	570	-23.2202	0.0414497
10	10.11	600		0.13	-2.0402	600	-24.4637	0.0414497

MW-105D

TEST RECORD



BOUWER & RICE PLOT



WELL MW-105D

SLUG TEST PLOTS-TEST No. 1

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	MW-105D
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	MW-105D
TEST TYPE :	SLUG
RUN NO. :	2

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449	CM
ln[(H-Lw)/rw]:	ERR	
FACTOR OF ln(Re/rw):	3.307213	

ENTER THE SLOPE OF THE BEST FIT STRAIGHT LINE: 0.031196 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. MW-105D

K:	6.65E-04	cm/sec
	1.89E+00	ft/d

CONSTANTS

XD REF (FT)...	10.24	
rc (FT)..	0.046	
rw (FT)..	0.323	
Le (FT)..	5	
Lw (FT)..	107.79	
H (FT)...	107.79	
A.....	na	
B.....	na	
C.....	1.75	
T-OFFSET (sec)	T	

MW-105D TEST No. 2

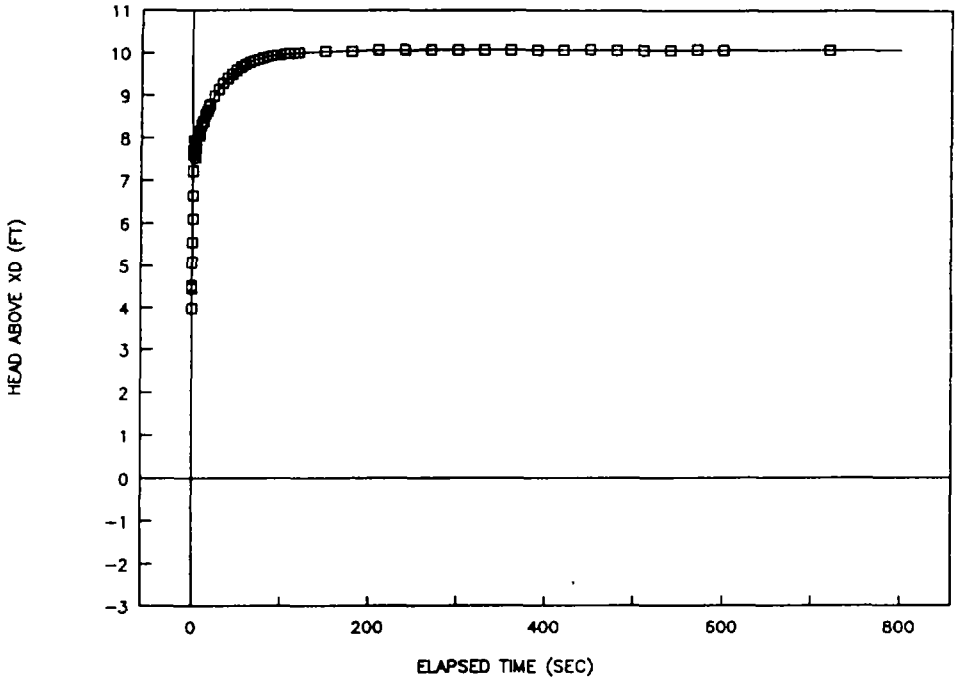
TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	4.53	0		5.71	1.7422	0	1.0081	
0.0033	3.97	0.198		6.27	1.8358	0.198	1.0019	0.0311964
0.0066	4.45	0.396		5.79	1.7561	0.396	0.9958	0.0311964
0.0099	5.07	0.594		5.17	1.6429	0.594	0.9896	0.0311964
0.0133	5.54	0.798		4.7	1.5476	0.798	0.9832	0.0311964
0.0166	6.1	0.996		4.14	1.4207	0.996	0.9770	0.0311964
0.02	6.64	1.2		3.6	1.2809	1.2	0.9707	0.0311964
0.0233	7.21	1.398		3.03	1.1086	1.398	0.9645	0.0311964
0.0266	7.59	1.596		2.65	0.9746	1.596	0.9583	0.0311964
0.03	7.8	1.8		2.44	0.8920	1.8	0.9520	0.0311964
0.0333	7.93	1.998		2.31	0.8372	1.998	0.9458	0.0311964
0.05	7.89	3		2.35	0.8544	3	0.9145	0.0311964
0.0666	7.52	3.996		2.72	1.0006	3.996	0.8835	0.0311964
0.0833	7.74	4.998		2.5	0.9163	4.998	0.8522	0.0311964
0.1	8.11	6		2.13	0.7561	6	0.8209	0.0311964
0.1166	8.16	6.996		2.08	0.7324	6.996	0.7899	0.0311964
0.1333	8.03	7.998		2.21	0.7930	7.998	0.7586	0.0311964
0.15	8.08	9		2.16	0.7701	9	0.7273	0.0311964
0.1666	8.28	9.996		1.96	0.6729	9.996	0.6963	0.0311964
0.1833	8.38	10.998		1.86	0.6206	10.998	0.6650	0.0311964
0.2	8.37	12		1.87	0.6259	12	0.6338	0.0311964
0.2166	8.38	12.996		1.86	0.6206	12.996	0.6027	0.0311964
0.2333	8.47	13.998		1.77	0.5710	13.998	0.5714	0.0311964
0.25	8.56	15		1.68	0.5188	15	0.5402	0.0311964
0.2666	8.61	15.996		1.63	0.4886	15.996	0.5091	0.0311964
0.2833	8.62	16.998		1.62	0.4824	16.998	0.4778	0.0311964
0.3	8.66	18		1.58	0.4574	18	0.4466	0.0311964
0.3166	8.73	18.996		1.51	0.4121	18.996	0.4155	0.0311964
0.3333	8.78	19.998		1.46	0.3784	19.998	0.3843	0.0311964
0.4167	8.98	25.002		1.26	0.2311	25.002	0.2281	0.0311964
0.5	9.14	30		1.1	0.0953	30	0.0722	0.0311964
0.5833	9.28	34.998		0.96	-0.0408	34.998	-0.0837	0.0311964
0.6667	9.4	40.002		0.84	-0.1744	40.002	-0.2398	0.0311964
0.75	9.5	45		0.74	-0.3011	45	-0.3957	0.0311964
0.8333	9.59	49.998		0.65	-0.4308	49.998	-0.5516	0.0311964
0.9167	9.66	55.002		0.58	-0.5447	55.002	-0.7077	0.0311964
1	9.72	60		0.52	-0.6539	60	-0.8637	0.0311964
1.0833	9.77	64.998		0.47	-0.7550	64.998	-1.0196	0.0311964
1.1667	9.81	70.002		0.43	-0.8440	70.002	-1.1757	0.0311964
1.25	9.84	75		0.4	-0.9163	75	-1.3316	0.0311964
1.3333	9.88	79.998		0.36	-1.0217	79.998	-1.4875	0.0311964
1.4166	9.9	84.996		0.34	-1.0788	84.996	-1.6435	0.0311964
1.5	9.92	90		0.32	-1.1394	90	-1.7996	0.0311964
1.5833	9.94	94.998		0.3	-1.2040	94.998	-1.9555	0.0311964
1.6667	9.95	100.002		0.29	-1.2379	100.002	-2.1116	0.0311964
1.75	9.97	105		0.27	-1.3093	105	-2.2675	0.0311964

MW-105D TEST No. 2

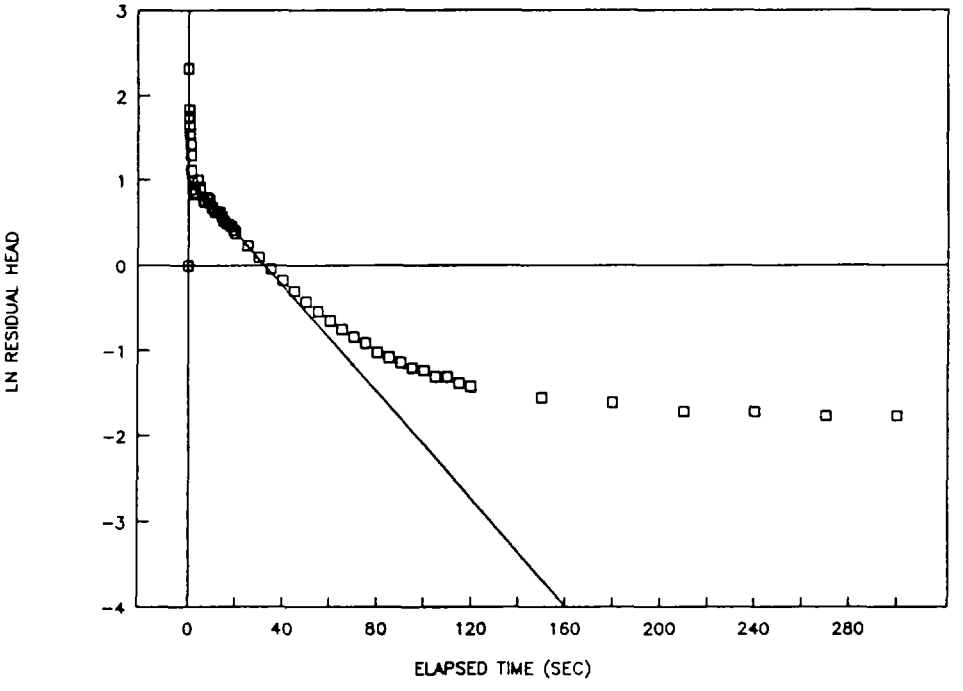
TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	9.97	109.998		0.27	-1.3093	109.998	-2.4234	0.0311964
1.9167	9.99	115.002		0.25	-1.3863	115.002	-2.5795	0.0311964
2	10	120		0.24	-1.4271	120	-2.7354	0.0311964
2.5	10.03	150		0.21	-1.5606	150	-3.6713	0.0311964
3	10.04	180		0.2	-1.6094	180	-4.6072	0.0311964
3.5	10.06	210		0.18	-1.7148	210	-5.5431	0.0311964
4	10.06	240		0.18	-1.7148	240	-6.4790	0.0311964
4.5	10.07	270		0.17	-1.7720	270	-7.4149	0.0311964
5	10.07	300		0.17	-1.7720	300	-8.3508	0.0311964
5.5	10.07	330		0.17	-1.7720	330	-9.2867	0.0311964
6	10.07	360		0.17	-1.7720	360	-10.2226	0.0311964
6.5	10.07	390		0.17	-1.7720	390	-11.1585	0.0311964
7	10.07	420		0.17	-1.7720	420	-12.0944	0.0311964
7.5	10.08	450		0.16	-1.8326	450	-13.0303	0.0311964
8	10.07	480		0.17	-1.7720	480	-13.9661	0.0311964
8.5	10.07	510		0.17	-1.7720	510	-14.9020	0.0311964
9	10.07	540		0.17	-1.7720	540	-15.8379	0.0311964
9.5	10.08	570		0.16	-1.8326	570	-16.7738	0.0311964
10	10.07	600		0.17	-1.7720	600	-17.7097	0.0311964
12	10.07	720		0.17	-1.7720	720	-21.4533	0.0311964
14	10.07	840		0.17	-1.7720	840	-25.1968	0.0311964
16	-2.79	960		13.03	2.5673	960	-28.9404	0.0311964
18	-2.79	1080		13.03	2.5673	1080	-32.6840	0.0311964
20	-2.79	1200		13.03	2.5673	1200	-36.4275	0.0311964

MW-105D

TEST RECORD



BOUWER & RICE PLOT



WELL MW-105D

SLUG TEST PLOTS-TEST No. 2

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	PS-CS
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	PS-CS
TEST TYPE :	SLUG
RUN NO. :	1

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449	CM
ln[(H-Lw)/rw]:	4.436006	
FACTOR OF ln(Re/rw):	1.669106	

ENTER THE SLOPE OF THE
BEST FIT STRAIGHT LINE: 0.566449 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. PS-CS

K:	6.10E-03	cm/sec
	1.73E+01	ft/d

CONSTANTS

XD REF (FT)...	4.34	
rc (FT)..	0.046	
rw (FT)..	0.302	
Le (FT)..	5	
Lw (FT)..	5.85	
H (FT)...	31.35	
A.....	2	
B.....	0.4	
C.....	na	
T-OFFSET (sec)	T	

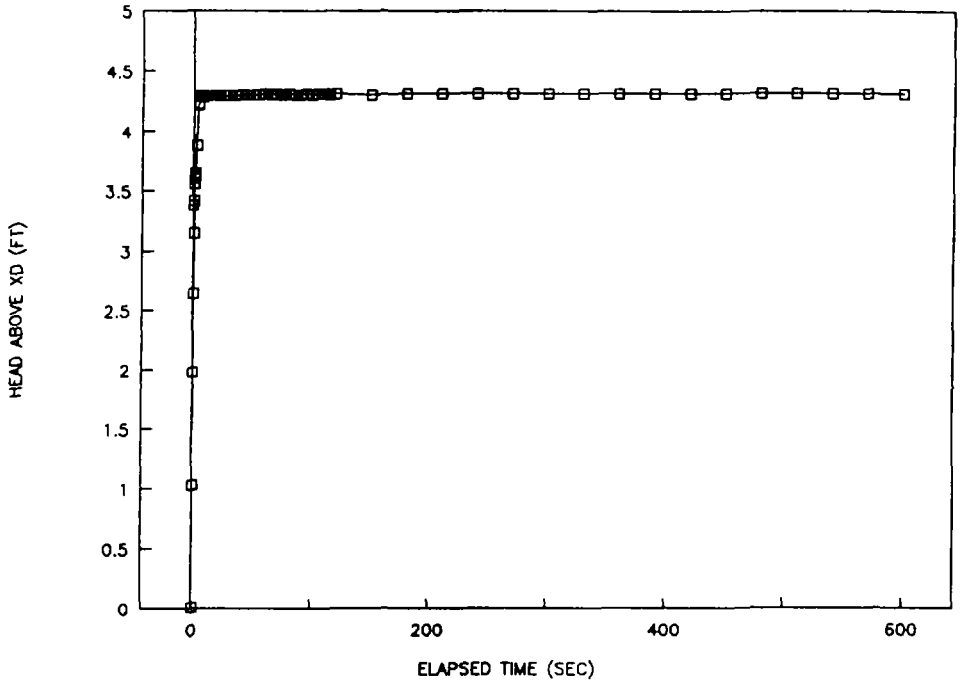
MW-CS TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	3.38	0		0.96	-0.0408	0	0.6345	
0.0033	0.01	0.198		4.33	1.4656	0.198	0.5223	0.5664495
0.0066	1.03	0.396		3.31	1.1969	0.396	0.4102	0.5664495
0.0099	1.98	0.594		2.36	0.8587	0.594	0.2980	0.5664495
0.0133	2.64	0.798		1.7	0.5306	0.798	0.1824	0.5664495
0.0166	3.15	0.996		1.19	0.1740	0.996	0.0703	0.5664495
0.02	3.42	1.2		0.92	-0.0834	1.2	-0.0453	0.5664495
0.0233	3.56	1.398		0.78	-0.2485	1.398	-0.1574	0.5664495
0.0266	3.61	1.596		0.73	-0.3147	1.596	-0.2696	0.5664495
0.03	3.62	1.8		0.72	-0.3285	1.8	-0.3851	0.5664495
0.0333	3.65	1.998		0.69	-0.3711	1.998	-0.4973	0.5664495
0.05	3.88	3		0.46	-0.7765	3	-1.0649	0.5664495
0.0666	4.22	3.996		0.12	-2.1203	3.996	-1.6291	0.5664495
0.0833	4.23	4.998		0.11	-2.2073	4.998	-2.1966	0.5664495
0.1	4.29	6		0.05	-2.9957	6	-2.7642	0.5664495
0.1166	4.29	6.996		0.05	-2.9957	6.996	-3.3284	0.5664495
0.1333	4.28	7.998		0.06	-2.8134	7.998	-3.8960	0.5664495
0.15	4.29	9		0.05	-2.9957	9	-4.4636	0.5664495
0.1666	4.29	9.996		0.05	-2.9957	9.996	-5.0278	0.5664495
0.1833	4.29	10.998		0.05	-2.9957	10.998	-5.5953	0.5664495
0.2	4.29	12		0.05	-2.9957	12	-6.1629	0.5664495
0.2166	4.29	12.996		0.05	-2.9957	12.996	-6.7271	0.5664495
0.2333	4.29	13.998		0.05	-2.9957	13.998	-7.2947	0.5664495
0.25	4.29	15		0.05	-2.9957	15	-7.8623	0.5664495
0.2666	4.29	15.996		0.05	-2.9957	15.996	-8.4265	0.5664495
0.2833	4.29	16.998		0.05	-2.9957	16.998	-8.9940	0.5664495
0.3	4.29	18		0.05	-2.9957	18	-9.5616	0.5664495
0.3166	4.29	18.996		0.05	-2.9957	18.996	-10.1258	0.5664495
0.3333	4.29	19.998		0.05	-2.9957	19.998	-10.6934	0.5664495
0.4167	4.29	25.002		0.05	-2.9957	25.002	-13.5279	0.5664495
0.5	4.29	30		0.05	-2.9957	30	-16.3590	0.5664495
0.5833	4.29	34.998		0.05	-2.9957	34.998	-19.1901	0.5664495
0.6667	4.3	40.002		0.04	-3.2189	40.002	-22.0246	0.5664495
0.75	4.3	45		0.04	-3.2189	45	-24.8558	0.5664495
0.8333	4.3	49.998		0.04	-3.2189	49.998	-27.6869	0.5664495
0.9167	4.3	55.002		0.04	-3.2189	55.002	-30.5214	0.5664495
1	4.31	60		0.03	-3.5066	60	-33.3525	0.5664495
1.0833	4.3	64.998		0.04	-3.2189	64.998	-36.1836	0.5664495
1.1667	4.31	70.002		0.03	-3.5066	70.002	-39.0181	0.5664495
1.25	4.3	75		0.04	-3.2189	75	-41.8492	0.5664495
1.3333	4.31	79.998		0.03	-3.5066	79.998	-44.6804	0.5664495
1.4166	4.3	84.996		0.04	-3.2189	84.996	-47.5115	0.5664495
1.5	4.3	90		0.04	-3.2189	90	-50.3460	0.5664495
1.5833	4.31	94.998		0.03	-3.5066	94.998	-53.1771	0.5664495
1.6667	4.3	100.002		0.04	-3.2189	100.002	-56.0116	0.5664495
1.75	4.31	105		0.03	-3.5066	105	-58.8427	0.5664495

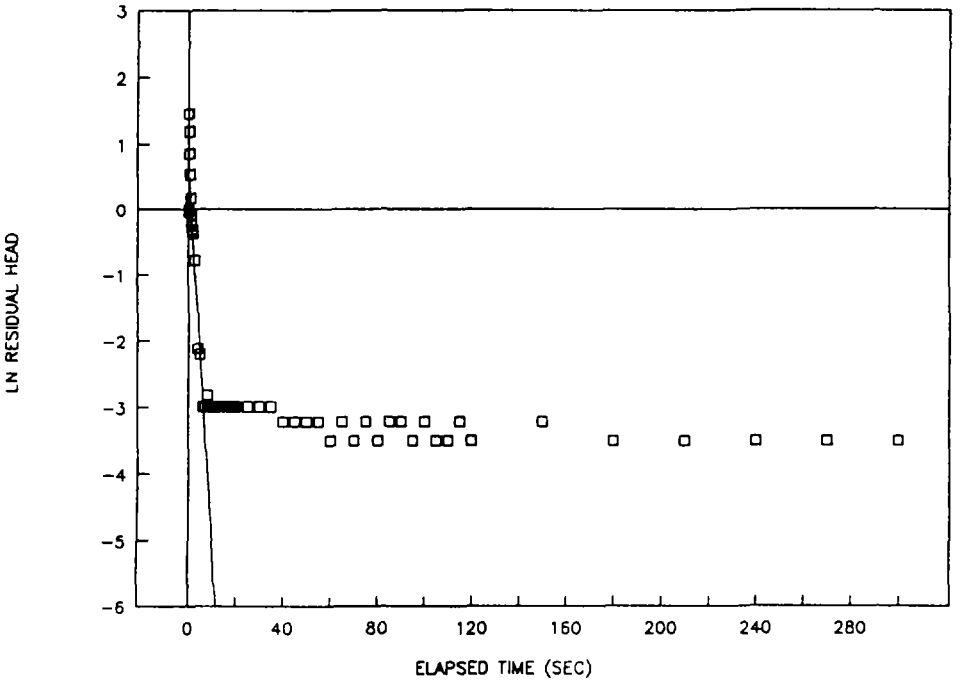
MW-CS TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	4.31	109.998		0.03	-3.5066	109.998	-61.6738	0.5664495
1.9167	4.3	115.002		0.04	-3.2189	115.002	-64.5084	0.5664495
2	4.31	120		0.03	-3.5066	120	-67.3395	0.5664495
2.5	4.3	150		0.04	-3.2189	150	-84.3330	0.5664495
3	4.31	180		0.03	-3.5066	180	-101.3264	0.5664495
3.5	4.31	210		0.03	-3.5066	210	-118.3199	0.5664495
4	4.31	240		0.03	-3.5066	240	-135.3134	0.5664495
4.5	4.31	270		0.03	-3.5066	270	-152.3069	0.5664495
5	4.31	300		0.03	-3.5066	300	-169.3004	0.5664495
5.5	4.31	330		0.03	-3.5066	330	-186.2939	0.5664495
6	4.31	360		0.03	-3.5066	360	-203.2874	0.5664495
6.5	4.31	390		0.03	-3.5066	390	-220.2809	0.5664495
7	4.31	420		0.03	-3.5066	420	-237.2743	0.5664495
7.5	4.31	450		0.03	-3.5066	450	-254.2678	0.5664495
8	4.31	480		0.03	-3.5066	480	-271.2613	0.5664495
8.5	4.31	510		0.03	-3.5066	510	-288.2548	0.5664495
9	4.31	540		0.03	-3.5066	540	-305.2483	0.5664495
9.5	4.31	570		0.03	-3.5066	570	-322.2418	0.5664495
10	4.31	600		0.03	-3.5066	600	-339.2353	0.5664495

TEST RECORD



BOUWER & RICE PLOT



WELL PS-CS

SLUG TEST PLOTS-TEST No. 1

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	PS-CS
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	PS-CS
TEST TYPE :	SLUG
RUN NO. :	2

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449 CM
ln[(H-Lw)/rw]:	4.436006
FACTOR OF ln(Re/rw):	1.669106

ENTER THE SLOPE OF THE
BEST FIT STRAIGHT LINE: 0.704935 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. PS-CS

K:	7.59E-03	cm/sec
	2.15E+01	ft/d

CONSTANTS

XD REF (FT)...	4.34
rc (FT)..	0.046
rw (FT)..	0.302
Le (FT)..	5
Lw (FT)..	5.85
H (FT)...	31.35
A.....	2
B.....	0.4
C.....	na
T-OFFSET (sec)	T

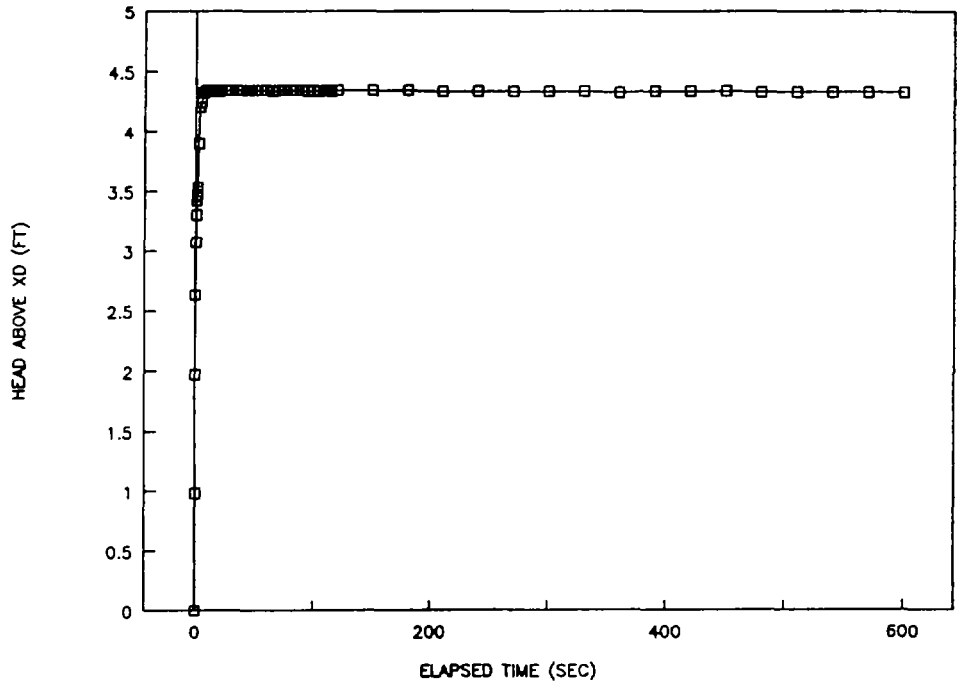
MW-CS TEST No. 2

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	0	0		4.34	1.4679	0	0.9380	
0.0033	0.98	0.198		3.36	1.2119	0.198	0.7984	0.7049358
0.0066	1.97	0.396		2.37	0.8629	0.396	0.6588	0.7049358
0.0099	2.63	0.594		1.71	0.5365	0.594	0.5193	0.7049358
0.0133	3.07	0.798		1.27	0.2390	0.798	0.3755	0.7049358
0.0166	3.3	0.996		1.04	0.0392	0.996	0.2359	0.7049358
0.02	3.42	1.2		0.92	-0.0834	1.2	0.0921	0.7049358
0.0233	3.46	1.398		0.88	-0.1278	1.398	-0.0475	0.7049358
0.0266	3.47	1.596		0.87	-0.1393	1.596	-0.1871	0.7049358
0.03	3.5	1.8		0.84	-0.1744	1.8	-0.3309	0.7049358
0.0333	3.53	1.998		0.81	-0.2107	1.998	-0.4705	0.7049358
0.05	3.9	3		0.44	-0.8210	3	-1.1768	0.7049358
0.0666	4.2	3.996		0.14	-1.9661	3.996	-1.8789	0.7049358
0.0833	4.24	4.998		0.1	-2.3026	4.998	-2.5853	0.7049358
0.1	4.32	6		0.02	-3.9120	6	-3.2916	0.7049358
0.1166	4.32	6.996		0.02	-3.9120	6.996	-3.9937	0.7049358
0.1333	4.33	7.998		0.01	-4.6052	7.998	-4.7001	0.7049358
0.15	4.34	9		0	ERR	9	-5.4064	0.7049358
0.1666	4.33	9.996		0.01	-4.6052	9.996	-6.1085	0.7049358
0.1833	4.34	10.998		0	ERR	10.998	-6.8149	0.7049358
0.2	4.34	12		0	ERR	12	-7.5212	0.7049358
0.2166	4.33	12.996		0.01	-4.6052	12.996	-8.2234	0.7049358
0.2333	4.34	13.998		0	ERR	13.998	-8.9297	0.7049358
0.25	4.34	15		0	ERR	15	-9.6360	0.7049358
0.2666	4.33	15.996		0.01	-4.6052	15.996	-10.3382	0.7049358
0.2833	4.33	16.998		0.01	-4.6052	16.998	-11.0445	0.7049358
0.3	4.34	18		0	ERR	18	-11.7508	0.7049358
0.3166	4.34	18.996		0	ERR	18.996	-12.4530	0.7049358
0.3333	4.33	19.998		0.01	-4.6052	19.998	-13.1593	0.7049358
0.4167	4.34	25.002		0	ERR	25.002	-16.6868	0.7049358
0.5	4.34	30		0	ERR	30	-20.2101	0.7049358
0.5833	4.34	34.998		0	ERR	34.998	-23.7333	0.7049358
0.6667	4.34	40.002		0	ERR	40.002	-27.2608	0.7049358
0.75	4.34	45		0	ERR	45	-30.7841	0.7049358
0.8333	4.34	49.998		0	ERR	49.998	-34.3074	0.7049358
0.9167	4.34	55.002		0	ERR	55.002	-37.8349	0.7049358
1	4.34	60		0	ERR	60	-41.3582	0.7049358
1.0833	4.33	64.998		0.01	-4.6052	64.998	-44.8814	0.7049358
1.1667	4.34	70.002		0	ERR	70.002	-48.4089	0.7049358
1.25	4.34	75		0	ERR	75	-51.9322	0.7049358
1.3333	4.34	79.998		0	ERR	79.998	-55.4555	0.7049358
1.4166	4.34	84.996		0	ERR	84.996	-58.9787	0.7049358
1.5	4.34	90		0	ERR	90	-62.5062	0.7049358
1.5833	4.33	94.998		0.01	-4.6052	94.998	-66.0295	0.7049358
1.6667	4.34	100.002		0	ERR	100.002	-69.5570	0.7049358
1.75	4.33	105		0.01	-4.6052	105	-73.0803	0.7049358

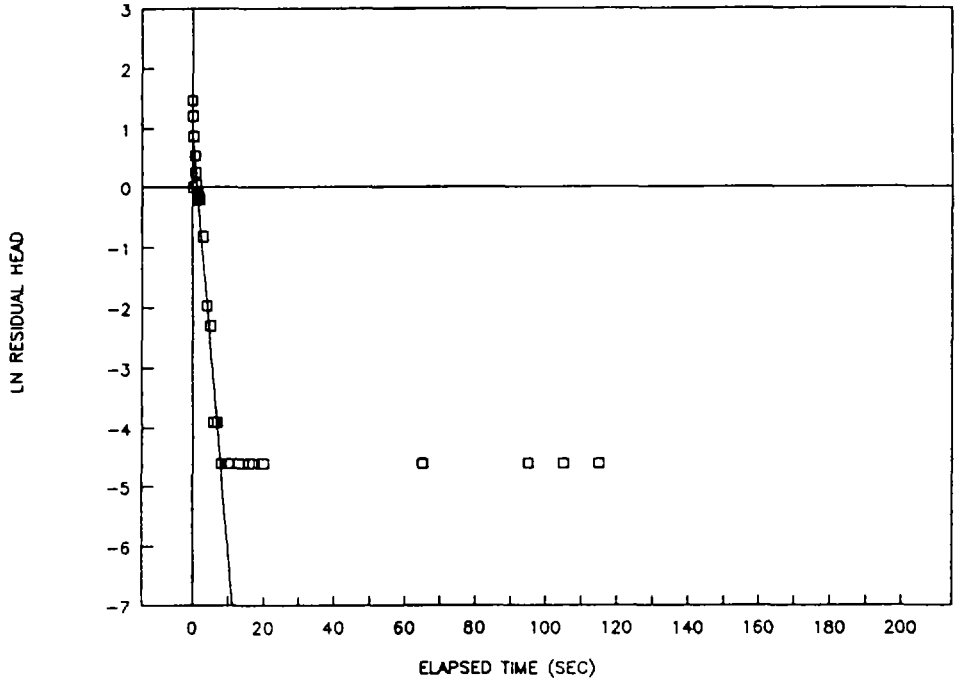
MW-CS TEST No. 2

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	4.34	109.998		0	ERR	109.998	-76.6035	0.7049358
1.9167	4.33	115.002		0.01	-4.6052	115.002	-80.1310	0.7049358
2	4.34	120		0	ERR	120	-83.6543	0.7049358
2.5	4.34	150		0	ERR	150	-104.8024	0.7049358
3	4.34	180		0	ERR	180	-125.9505	0.7049358
3.5	4.33	210		0.01	-4.6052	210	-147.0985	0.7049358
4	4.33	240		0.01	-4.6052	240	-168.2466	0.7049358
4.5	4.33	270		0.01	-4.6052	270	-189.3947	0.7049358
5	4.33	300		0.01	-4.6052	300	-210.5428	0.7049358
5.5	4.33	330		0.01	-4.6052	330	-231.6908	0.7049358
6	4.32	360		0.02	-3.9120	360	-252.8389	0.7049358
6.5	4.33	390		0.01	-4.6052	390	-273.9870	0.7049358
7	4.33	420		0.01	-4.6052	420	-295.1350	0.7049358
7.5	4.33	450		0.01	-4.6052	450	-316.2831	0.7049358
8	4.32	480		0.02	-3.9120	480	-337.4312	0.7049358
8.5	4.32	510		0.02	-3.9120	510	-358.5793	0.7049358
9	4.32	540		0.02	-3.9120	540	-379.7273	0.7049358
9.5	4.32	570		0.02	-3.9120	570	-400.8754	0.7049358
10	4.32	600		0.02	-3.9120	600	-422.0235	0.7049358

TEST RECORD



BOUWER & RICE PLOT



WELL PS-CS

SLUG TEST PLOTS-TEST No. 2

PETOSKEY MFG.

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	PS-CD
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	**********

WELL NO. :	PS-CD
TEST TYPE :	SLUG
RUN NO. :	1

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449	CM
ln[(H-Lw)/rw]:	ERR	
FACTOR OF ln(Re/rw):	2.893023	

ENTER THE SLOPE OF THE
BEST FIT STRAIGHT LINE: 0.202615 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. PS-CD

K:	3.78E-03	cm/sec
	1.07E+01	ft/d

CONSTANTS

XD REF (FT)...		9.26
rc (FT)..		0.046
rw (FT)..		0.302
Le (FT)..		5
Lw (FT)..		31.35
H (FT)...		31.35
A.....	na	
B.....	na	
C.....		1.8
T-OFFSET (sec)	T	

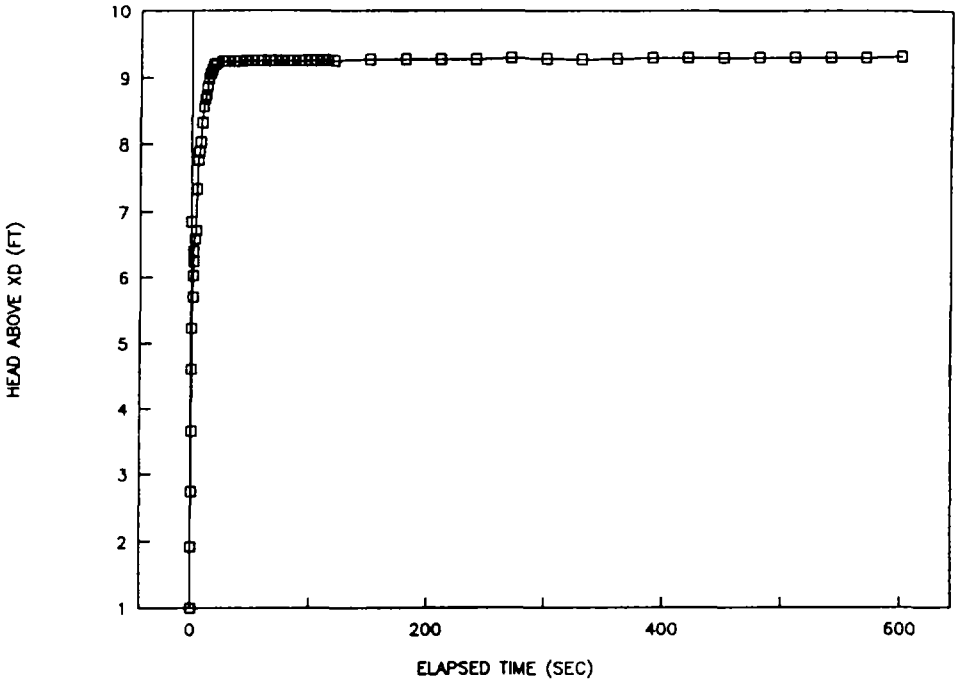
MW-cd TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	6.85	0		2.41	0.8796	0	1.6294	
0.0033	1	0.198		8.26	2.1114	0.198	1.5893	0.2026150
0.0066	1.91	0.396		7.35	1.9947	0.396	1.5492	0.2026150
0.0099	2.74	0.594		6.52	1.8749	0.594	1.5091	0.2026150
0.0133	3.65	0.798		5.61	1.7246	0.798	1.4677	0.2026150
0.0166	4.6	0.996		4.66	1.5390	0.996	1.4276	0.2026150
0.02	5.23	1.2		4.03	1.3938	1.2	1.3863	0.2026150
0.0233	5.7	1.398		3.56	1.2698	1.398	1.3462	0.2026150
0.0266	6.03	1.596		3.23	1.1725	1.596	1.3060	0.2026150
0.03	6.24	1.8		3.02	1.1053	1.8	1.2647	0.2026150
0.0333	6.4	1.998		2.86	1.0508	1.998	1.2246	0.2026150
0.05	6.59	3		2.67	0.9821	3	1.0216	0.2026150
0.0666	6.71	3.996		2.55	0.9361	3.996	0.8198	0.2026150
0.0833	7.34	4.998		1.92	0.6523	4.998	0.6167	0.2026150
0.1	7.77	6		1.49	0.3988	6	0.4137	0.2026150
0.1166	7.89	6.996		1.37	0.3148	6.996	0.2119	0.2026150
0.1333	8.03	7.998		1.23	0.2070	7.998	0.0089	0.2026150
0.15	8.32	9		0.94	-0.0619	9	-0.1941	0.2026150
0.1666	8.56	9.996		0.7	-0.3567	9.996	-0.3959	0.2026150
0.1833	8.67	10.998		0.59	-0.5276	10.998	-0.5990	0.2026150
0.2	8.73	12		0.53	-0.6349	12	-0.8020	0.2026150
0.2166	8.86	12.996		0.4	-0.9163	12.996	-1.0038	0.2026150
0.2333	8.98	13.998		0.28	-1.2730	13.998	-1.2068	0.2026150
0.25	9.05	15		0.21	-1.5606	15	-1.4098	0.2026150
0.2666	9.08	15.996		0.18	-1.7148	15.996	-1.6116	0.2026150
0.2833	9.12	16.998		0.14	-1.9661	16.998	-1.8146	0.2026150
0.3	9.17	18		0.09	-2.4079	18	-2.0177	0.2026150
0.3166	9.2	18.996		0.06	-2.8134	18.996	-2.2195	0.2026150
0.3333	9.2	19.998		0.06	-2.8134	19.998	-2.4225	0.2026150
0.4167	9.24	25.002		0.02	-3.9120	25.002	-3.4364	0.2026150
0.5	9.24	30		0.02	-3.9120	30	-4.4490	0.2026150
0.5833	9.24	34.998		0.02	-3.9120	34.998	-5.4617	0.2026150
0.6667	9.24	40.002		0.02	-3.9120	40.002	-6.4756	0.2026150
0.75	9.25	45		0.01	-4.6052	45	-7.4883	0.2026150
0.8333	9.25	49.998		0.01	-4.6052	49.998	-8.5009	0.2026150
0.9167	9.25	55.002		0.01	-4.6052	55.002	-9.5148	0.2026150
1	9.25	60		0.01	-4.6052	60	-10.5275	0.2026150
1.0833	9.25	64.998		0.01	-4.6052	64.998	-11.5402	0.2026150
1.1667	9.25	70.002		0.01	-4.6052	70.002	-12.5540	0.2026150
1.25	9.25	75		0.01	-4.6052	75	-13.5667	0.2026150
1.3333	9.25	79.998		0.01	-4.6052	79.998	-14.5794	0.2026150
1.4166	9.25	84.996		0.01	-4.6052	84.996	-15.5921	0.2026150
1.5	9.25	90		0.01	-4.6052	90	-16.6059	0.2026150
1.5833	9.25	94.998		0.01	-4.6052	94.998	-17.6186	0.2026150
1.6667	9.26	100.002		0	ERR	100.002	-18.6325	0.2026150
1.75	9.25	105		0.01	-4.6052	105	-19.6452	0.2026150

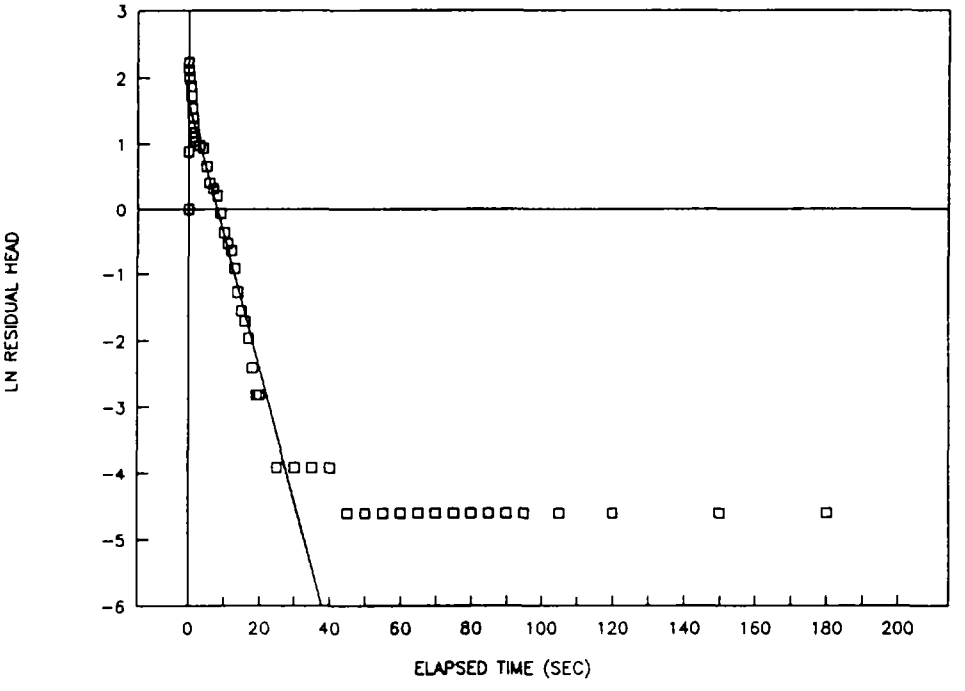
MW-cd TEST No. 1

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	9.26	109.998		0	ERR	109.998	-20.6578	0.2026150
1.9167	9.26	115.002		0	ERR	115.002	-21.6717	0.2026150
2	9.25	120		0.01	-4.6052	120	-22.6844	0.2026150
2.5	9.27	150		0.01	-4.6052	150	-28.7628	0.2026150
3	9.27	180		0.01	-4.6052	180	-34.8413	0.2026150
3.5	9.27	210		0.01	-4.6052	210	-40.9197	0.2026150
4	9.27	240		0.01	-4.6052	240	-46.9982	0.2026150
4.5	9.29	270		0.03	-3.5066	270	-53.0766	0.2026150
5	9.28	300		0.02	-3.9120	300	-59.1551	0.2026150
5.5	9.27	330		0.01	-4.6052	330	-65.2335	0.2026150
6	9.28	360		0.02	-3.9120	360	-71.3120	0.2026150
6.5	9.29	390		0.03	-3.5066	390	-77.3904	0.2026150
7	9.29	420		0.03	-3.5066	420	-83.4689	0.2026150
7.5	9.29	450		0.03	-3.5066	450	-89.5473	0.2026150
8	9.29	480		0.03	-3.5066	480	-95.6258	0.2026150
8.5	9.29	510		0.03	-3.5066	510	-101.7042	0.2026150
9	9.29	540		0.03	-3.5066	540	-107.7827	0.2026150
9.5	9.29	570		0.03	-3.5066	570	-113.8611	0.2026150
10	9.31	600		0.05	-2.9957	600	-119.9396	0.2026150

TEST RECORD



BOUWER & RICE PLOT



WELL PS-CD

SLUG TEST PLOTS-TEST No. 1

PETOSKEY MFG.

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petoskey	**Well I.D.**	Bear Creek - C1		
Date	10/3 - 10/6/95	**Pumping Rate**	35 gpm		
Pump Test Start	4:10pm 10/3/95	**Pump Test End**		**Total Pumping Time (min.)**	
Instrument/ Method				**Distance From Pumping Well**	
Initial Water Level	8.25'	**Final Water Level**		**Total Drawdown**	
Field Staff					

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
2:36pm	—	8.25'	0		Start WL
5:15pm	65	8.26'	.01		
6:56pm	166 min.	8.09'	-.16		
1:47am	577 min.	8.01'	-.24		
8:16am	966 min.	8.10'	-.15		
1:30pm	1280 min.	8.22'	-.03		
5:22pm	1512 min.	8.26'	.01		
2:02am	2039 min.	8.45'	.20		
8:56am	2446 min.	8.39'	.14		
2:51pm	2801 min.	8.41'	.16		
7:16pm	3066 min.	8.43'	.18		
1:37am	3447 min.	8.33'	.08		
9:11am	3901 min.	8.30'	.05		
1:52pm	4182 min.	8.27'	.02		

9/11

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petoskey	**Well I.D.**	~~Irrigation well~~ COP-1		
Date	10/3 - 10/6/95	**Pumping Rate**			
Pump Test Start	4:10pm 10/3/95	**Pump Test End**		**Total Pumping Time (min.)**	
Instrument/ Method				**Distance From Pumping Well**	
Initial Water Level		**Final Water Level**		**Total Drawdown**	
Field Staff					

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:56pm	—	9.69′	Ø		
6:32pm	142 min.	9.67	-.02		
8:45am	995 min	9.57′	-.12		
12:50pm	1240 min	9.60′	-.09		
4:59pm	1489 min	9.68′	-.01		
1:27am	1977 min	9.83′	.14		
8:35am	2405 min.	9.96′	.27		
2:18pm	2768 min.	10.00′	.31		
6:53pm	3043 min.	9.88′	.19		
1:02am	3412 min.	9.91′	.22		* Possible bad measurement.
8:54am	3884 min.	9.76′	.07		
1:23pm	4153 min.	9.69′	Ø		

8/11

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

C:\FORMS\PUMPTEST.FRM

MALCOLM PIRNIE

PUMP TEST DATA

994

Project Name	Petosky	Well I.D.	PS-B2		
Date	10/3/95 -	Pumping Rate	35 gpm		
Pump Test Start	4:10 pm 10/3/95	Pump Test End		Total Pumping Time (min.)	
Instrument/ Method	Keck w/ Probe			Distance From Pumping Well	
Initial Water Level	14.42'	Final Water Level		Total Drawdown	
Field Staff	GF, AK, Chuck Graff (MDNR)				

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:40		14.42			Baro. 994 mb
4:12 pm	2	14.74	.32		
4:20 pm	10	14.78	.36		
4:27 pm	17	14.78	.36		
4:44 pm	34	14.76	.34		
5:23 pm	73	14.77	.35		
6:18 pm	128	14.72	.30		
7:16 pm	186	14.68	.26		
12:58 am 10/4	528	14.68	.26		
8:33 am	979	14.60	.18		
12:37 pm	1323	14.67	.25		
4:43 pm	1469	14.73	.31		
1:04 am 10/5	1976	14.89	.47		
8:23 am	2411	14.89	.47		
1:53 pm	2743	15.07	.65		
6:42 pm	3038	15.00	.58		
12:41 am 10/6	3391	14.91	.49		
8:41 am	3871	14.69	.27		
1:09 pm	4138	14.71	.29		

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petosky	Well I.D.	PS-CD		
Date	10/3/95 -	Pumping Rate	35 gpm		
Pump Test Start	4:10pm 10/3/95	Pump Test End		Total Pumping Time (min.)	
Instrument/ Method	Keck WL Probe			Distance From Pumping Well	
Initial Water Level	12.03'	Final Water Level		Total Drawdown	
Field Staff	GF AK Chuck Graff (MDNR)				

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:50pm		12.03			Bar. Pressure - 994 mb
4:13pm	9	12.03	0		
4:24pm	14	12.02'	-.01		
4:46pm	37	12.01'	-.02		
5:47pm	97	11.95'	-.08		
6:40pm	150	11.93'	-.10		
7:38pm	208	11.92'	-.11		
1:33am	563	11.89'	-.14		
8:52am	1002	11.86'	-.17		
12:55pm	1245 min	11.90'	-.13		
5:09pm	1499	11.98'	-.05		
1:45am	2017	12.14'	.11		
8:46am	2434	12.21'	.18		
2:33pm	2793	12.31	.28		
7:05pm	3055	12.22	.19		
1:19am	3429	12.17	.14		
9:01am	3991	11.99	-.04		
1:33pm	4163	11.97	-.06		

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petosky	**Well I.D.**	MW-203D		
Date	10/3/95	**Pumping Rate**	35 gpm		
Pump Test Start	4:10pm - 10/3/95	**Pump Test End**		**Total Pumping Time (min.)**	
Instrument/ Method	Heath WL Probe - 5' Transducer			**Distance From Pumping Well**	
Initial Water Level	16.39'	**Final Water Level**		**Total Drawdown**	
Field Staff	GF				

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:27pm	—	16.39'			
5:29pm	79 min	16.75'	.36'		
6:12pm	122 min.	16.71'	.32'		
7:47pm	217 min.	16.67'	.28'		
12:46pm	516 min	16.67'	.28'		
9:00am	1310 min	16.60'	.21'		
1:03pm	1253 min	16.65'	.26'		
4:29pm	1461 min.	16.72'	.33'		
12:47am	1959 min.	16.87'	.48'		
8:13am	2403 min.	16.89'	.50'		
1:49pm	2736 min.	17.07'	.68'		
5:35pm	3025 min.	17.00'	.61'		
12:30am	3390 min.	16.90	.51'		
3:35am	3545 min	16.69'	.30'		
1:02pm	4132 min	16.70	.31'		

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MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petosky	**Well I.D.**	MW-201S		
Date	10/3/95	**Pumping Rate**	35 gpm		
Pump Test Start	4:10 pm - 10/3/95	**Pump Test End**		**Total Pumping Time (min.)**	
Instrument/ Method	Keck WL Probe & Transducer			**Distance From Pumping Well**	
Initial Water Level	17.52'	**Final Water Level**		**Total Drawdown**	
Field Staff	GF & Chuck Graff (MWR)				

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:43 pm	—	17.52'			Starting WL
5:25 pm	75 min	17.50'	-.02		
6:19 pm	129 min	17.44'	-.08		
7:42 pm	212 min	17.41'	-.11		
12:55 am	525 min.	17.41'	-.11		
9:55 am	1005 min.	17.34'	-.18		
1:01 pm	1251 min	17.39'	-.13		
4:37 pm	1467 min	17.48'	-.04		
2:59 am	1971 min.	17.64'	.12'		
8:16 am	2404 min	17.63'	.11		
2:03 pm	2753 min	17.88	.36		
6:40 pm	3030 min.	17.75	.23		
12:39 am	3389 min.	17.66	.14		
9:40 am	3870 min.	17.44	-.08		
1:07 pm	4137 min	17.48	-.04		

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petosky	**Well I.D.**	PS-104		
Date	10/3/95	**Pumping Rate**	35 gpm		
Pump Test Start	4:10 pm - 10/3/95	**Pump Test End**		**Total Pumping Time (min.)**	
Instrument/ Method	Keck WL Probe + Transducer			**Distance From Pumping Well**	
Initial Water Level	17.62'	**Final Water Level**		**Total Drawdown**	
Field Staff					

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:40 pm	—	17.62			
5:26 pm	76 min	18.09	.47'		
6:17 pm	127 min	18.04	.42'		
7:41 pm	211 min	18.00'	.38'		
12:53 am	523 min	18.00'	.38'		
8:56 am	1006 min	17.93'	.31'		
12:59 pm	1249 min	17.98'	.36'		
4:35 pm	1463	18.05'	.43'		
2:56 pm	1964	18.21	.59'		
3:20 am	2408	18.21'	.59'		
1:52 pm	2742 min	18.41'	.79'		
6:34 pm	3024 min	18.32'	.70'		
12:37 am	3387 min.	18.22'	.60'		
9:39 am	3869 min.	18.01'	.39'		
1:06 pm	4136 min.	18.03'	.41'		

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

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MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petoskey	**Well I.D.**	PS-4		
Date	10/3/95	**Pumping Rate**	35 gpm		
Pump Test Start	4:10pm - 10/3/95	**Pump Test End**		**Total Pumping Time (min.)**	
Instrument/ Method	Keck WL Probe + Transducer			**Distance From Pumping Well**	
Initial Water Level	17.93'	**Final Water Level**		**Total Drawdown**	
Field Staff	SF, AK, CG				

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:39 pm	—	17.90'			
5:26 pm	76 min.	17.97'	-.07		
6:15 pm	125 min.	17.82'	-.08		
7:42 pm	212 min.	17.78'	-.12		
12:51 am	523 min.	17.77	-.13		
8:52 am	1004	17.71'	-.19		
1:00 pm	1252 min.	17.76'	-.14		
4:33 pm	1465 min.	17.84'	-.06		
12:54 am	1966	18.00'	.10'		
8:18 am	2490 min.	17.99'	.09'		
1:44 pm	2739 min.	18.19'	.29'		
6:33 pm	3028 min.	18.11'	.21'		
12:35 am	3335 min.	18.02	.12'		
9:33 am	3863 min.	17.81	-.09'		
1:05 pm	4135 min.	17.84	-.06'		

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

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MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petosky	Well I.D.	PS- 4D		
Date	10/3/95 -	Pumping Rate	35gpm		
Pump Test Start	4:10pm 10/3/95	Pump Test End		Total Pumping Time (min.)	
Instrument/ Method	Keck w/ Probe			Distance From Pumping Well	
Initial Water Level	20.48	Final Water Level		Total Drawdown	
Field Staff	GF, AK, CG (MDNR)				

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
3:35pm	—	20.48			Bar. 29.4 mb
4:15pm	5	20.72'	.24		
4:21pm	11	20.72'	.24		
4:41pm	31	20.71'	.23		
5:33pm	83	20.70	.22		
6:22pm	132	20.66	.18		
7:22pm	192	20.62	.14		
1:06am	536	20.67	.19		
3:38am	988	20.54	.06		
12:41pm	1231	20.61	.13		
4:50pm	1490	20.66	.13		
1:13am	1995	20.88	.40		
3:26am	2414	20.83	.35		
2:01pm	2751	21.01'	.53		
4:46pm	3036	20.94	.46		
12:48am	3318	20.86	.38		
9:47am	3977	20.65	.17		
1:12pm	4142	20.65	.17		

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APPENDIX E

PUMPING TEST MONITORING DATA

SVE PILOT STUDY DATA

Project # 2420-017-H30

SITE: Petosky Manufacturing SVE WELL SVE-203S

INSPECTOR: M Wehrer/ T Eftaxiadis BLOWER

DATE: 9-12-95 WELL SPEC. 2" ID PVC

COMMENTS: Plug inserted into SVE-203S well to seperate groundwater screen from the SVE screened interval

START 11:30 am 9-12-95

FINISH 8:00 am 9-14-95

TIME	background 11:15 am	START 11:30 am	9-12-95 11:45 am	9-12-95 12:30 pm	9-12-95 1:00 pm	9-12-95 1:30 pm	9-12-95 2:30 pm	9-12-95 3:30 pm	9-12-95 10:30 pm	9-13-95 7:00 am	9-13-95 3:00 pm	9-13-95 10:30 pm	9-14-95 7.00 am
BAROMETRIC PRESSURE (in. Hg)													
AMBIENT TEMPERATURE (F)	69	69.1	69.1	73.6	73.8	72.7	74.3	74.5	63.7	63.5	71.3	62	62.5
PILOT SYSTEM													
BLOWER VACUUM (in. H2O)		43	43	43	43	43	42	42	42	42	42	42	42
WELLHEAD VACUUM (in. H2O)		43	43	43	43	43	42	42	42	42	42	42	42
WELLHEAD VELOCITY (FPM)			6200	5800	5500	5200	5000	4900	4900	4900	4900	4900	4800
INFLUENT at wellhead			66.7	66.5	66.7	67.7	69.2	68	66.5	66	66.2	66	66.1
TEMP (F) at trailer		67.1	67.1	68.9	71	75.3	72.5	73	64.8	63 9	67.5	64	63.5
INFLUENT at wellhead			7	6	5.5	6.5	6.5	6	6	3.5	4	4	4.1
TVO (ppm) at trailer			6.5	5.5	4.5	5.5	4.2	4.5	4.3	4.7	5.3	5	4 5
BLOWER EFFLUENT (ppm)			10.2	8.8	7.3	6.4	8	8	7.8	6.5	7.1	6	5 5
LEAD CARBON EFFLUENT TVO (PPM)			0	0	0	0	0	0	0	0	0	0	0
LAG CARBON EFFLUENT TVO (PPM)			0	0	0	0	0	0	0	0	0	0	0
EFFLUENT TEMPERATURE (F)			87.8	92.3	92	94.2	90	90.2	94.5	93.5	93	92.5	92
EFFLUENT PRESSURE (H20)			6	6	6	6	6	6	6	6	6	6	92 " 6
PIEZOMETER PRESSURE (in. H2O)													
SVE-204S	0		0.02	0.01	0.015	0.015	0.015	0 015	0.01	0.01	0.01	0.01	0.01
SVE-201S	0		0	0.02	0.03	0.035	0.025	0.025	0.02	0.02	0.025	0.025	0.025
SVE - 1	0		0.28	0.28	0.3	0.3	0.31	0.31	0.34	0.34	0.35	0.35	0.35
SVE - 2	0		0.03	0.025	0.03	0.035	0.035	0.035	0.03	0.04	0.045	0.045	0.045

Air Samples collected

PT-SVE203S-1 12:15 pm
PT-SVE203S-2 1:15 pm
PT-SVE203S-3 2:15 pm
PT-SVE203S-4 3:15 pm
PT-SVE203S-5 11:15 pm
PT-SVE203S-6 7:15 am
PT-SVE203S-7 3.15 pm
PT-SVE203S-8 11:15 pm
PT-SVE203S-9 7:15 am

SVE PILOT STUDY DATA

Project # 2420-017-H30

SITE: Petosky Manufacturing
INSPECTOR: M Wahrer
DATE: 9-14-95

SVE WELL SVE-201S
BLOWER
WELL SPEC. 2" ID PVC

COMMENTS:

START 9:00 am 9-14-95
FINISH 9:15 am 9-15-95

TIME	background 8:45 am	START 9:00 am	9-14-95 9:15 am	9-14-95 9:30 am	9-14-95 10:00 am	9-14-95 11:00 am	9-14-95 12:00 pm	9-14-95 1:00 pm	9-14-95 9:00 pm	9-15-95 8:45 am	END TEST 9:15 am
BAROMETRIC PRESSURE (in. Hg)											
AMBIENT TEMPERATURE (F)	59.7	59.7	59.8	59.8	60.1	62	63.5	63.5	58.2	59.7	
PILOT SYSTEM											
BLOWER VACUUM (in. H2O)		43	43	43	43	43	43	43	43	43	
WELLHEAD VACUUM (in. H2O)		43	43	43	43	43	43	43	43	43	
WELLHEAD VELOCITY (FPM)		5500	5500	5500	5600	5500	5500	5400	5400	5400	
INFLUENT at wellhead			63	63.2	63	62.8	62.5	62.5	62.8	63	
TEMP (F) at trailer			54.5	54.8	55	56.5	57	57.5	54.6	54.8	
INFLUENT at wellhead			2.5	2	2	2.1	2.2	2	2	2	
TVO (ppm) at trailer			3	2.8	3	3	3.1	2.8	2.9	2.5	
BLOWER EFFLUENT (ppm)			2.5	2	2	2.3	2.5	2.5	2.8	2.5	
LEAD CARBON EFFLUENT TVO (PPM)			0	0	0	0	0	0	0	0	
LAG CARBON EFFLUENT TVO (PPM)			0	0	0	0	0	0	0	0	
EFFLUENT TEMPERATURE (F)			81.5	81.5	82	82	83.5	85	82	81.5	
EFFLUENT PRESSURE (H20)			6	6	6	6	6	6	6	6	
PIEZOMETER PRESSURE (in. H2O)											
SVE-203S	0		0	0	0	0	0	0	0	0	
SVE-204	0		0	0	0	0	0	0	0	0	
SVE - 1	0		0	0	0	0	0	0	0	0	
SVE - 2	0		0	0	0	0	0	0	0	0	
SVE - 3	0		0	0	0	0	0	0	0	0	

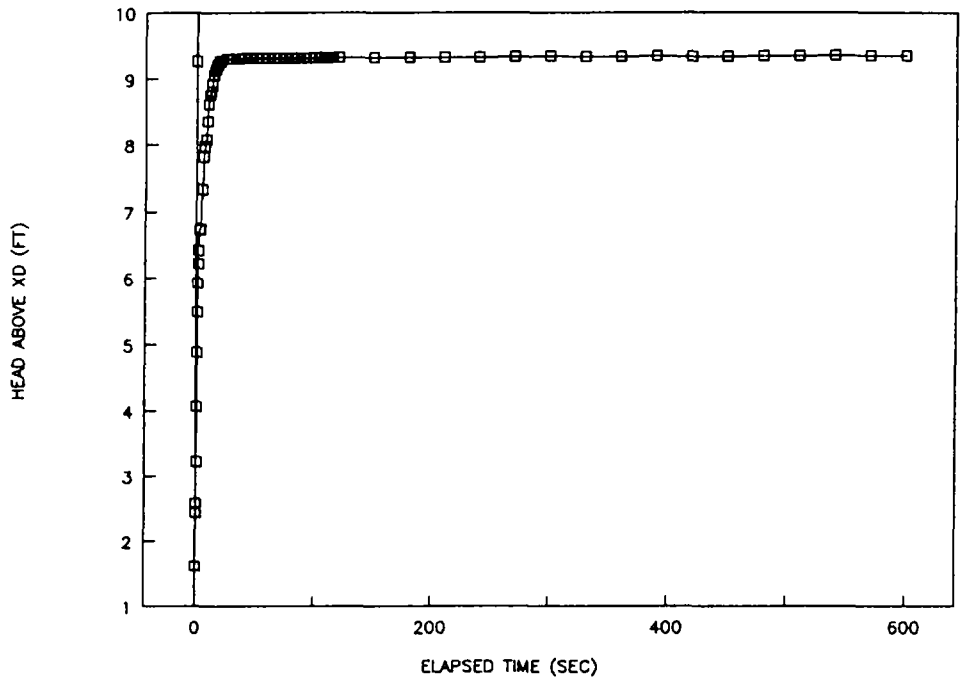
Air Samples collected

PT-SVE201S-1 9:45 am
PT-SVE201S-2 10:45 am
PT-SVE201S-3 11:45 am
PT-SVE201S-4 12:45 pm
PT-SVE201S-5 8:45 pm
PT-SVE201S-6 8:45 am

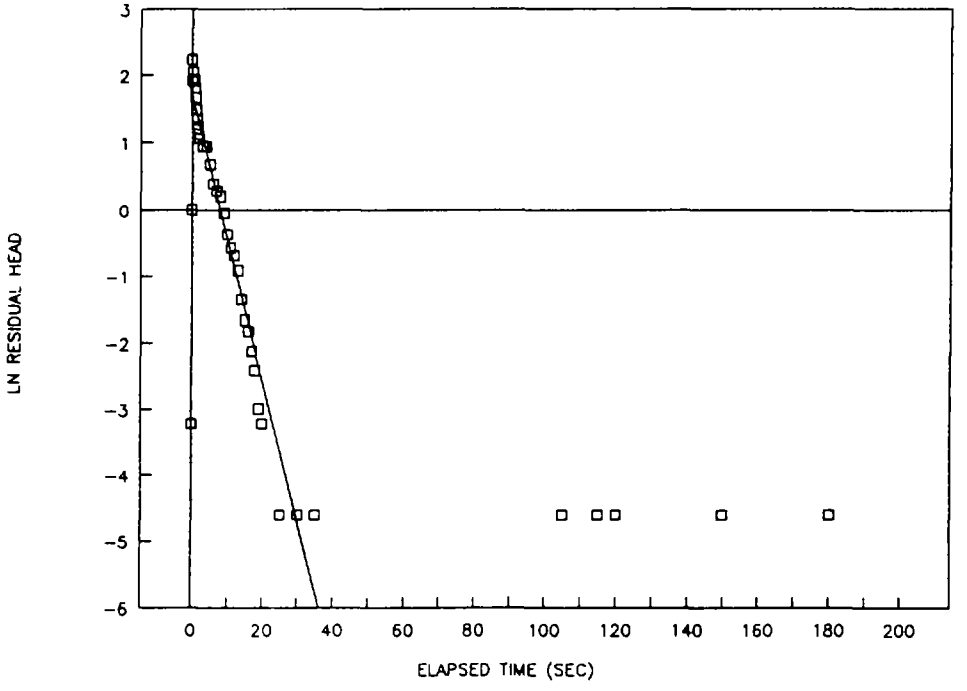
APPENDIX D

SOIL VAPOR EXTRACTION TEST MONITORING DATA

TEST RECORD



BOUWER & RICE PLOT



WELL PS-CD

SLUG TEST PLOTS-TEST No. 2

PETOSKEY MFG.

MW-CD TEST No. 2

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
1.8333	9.31	109.998		0	ERR	109.998	-21.7564	0.2132228
1.9167	9.32	115.002		0.01	-4.6052	115.002	-22.8234	0.2132228
2	9.32	120		0.01	-4.6052	120	-23.8891	0.2132228
2.5	9.32	150		0.01	-4.6052	150	-30.2858	0.2132228
3	9.32	180		0.01	-4.6052	180	-36.6825	0.2132228
3.5	9.32	210		0.01	-4.6052	210	-43.0791	0.2132228
4	9.32	240		0.01	-4.6052	240	-49.4758	0.2132228
4.5	9.33	270		0.02	-3.9120	270	-55.8725	0.2132228
5	9.34	300		0.03	-3.5066	300	-62.2692	0.2132228
5.5	9.33	330		0.02	-3.9120	330	-68.6659	0.2132228
6	9.33	360		0.02	-3.9120	360	-75.0626	0.2132228
6.5	9.34	390		0.03	-3.5066	390	-81.4592	0.2132228
7	9.33	420		0.02	-3.9120	420	-87.8559	0.2132228
7.5	9.33	450		0.02	-3.9120	450	-94.2526	0.2132228
8	9.34	480		0.03	-3.5066	480	-100.6493	0.2132228
8.5	9.34	510		0.03	-3.5066	510	-107.0460	0.2132228
9	9.35	540		0.04	-3.2189	540	-113.4427	0.2132228
9.5	9.35	570		0.04	-3.2189	570	-119.8394	0.2132228
10	9.35	600		0.04	-3.2189	600	-126.2360	0.2132228

MW-CD TEST No. 2

TEST DATA				DATA REDUCTION				
ELAPSED TIME (MIN)	HEAD ABOVE XDUCER (FT)	ELAPSED TIME (SEC)		RESIDUAL HEAD	LOG RESIDUAL HEAD	ADJ TIME (SEC)	CALC LOG RES HD	SLOPE OF BEST FIT LINE (/SEC)
0	9.27	0		0.04	-3.2189	0	1.6976	
0.0033	2.59	0.198		6.72	1.9051	0.198	1.6554	0.2132228
0.0066	1.62	0.396		7.69	2.0399	0.396	1.6132	0.2132228
0.0099	2.45	0.594		6.86	1.9257	0.594	1.5710	0.2132228
0.0133	3.23	0.798		6.08	1.8050	0.798	1.5275	0.2132228
0.0166	4.07	0.996		5.24	1.6563	0.996	1.4853	0.2132228
0.02	4.89	1.2		4.42	1.4861	1.2	1.4418	0.2132228
0.0233	5.5	1.398		3.81	1.3376	1.398	1.3996	0.2132228
0.0266	5.93	1.596		3.38	1.2179	1.596	1.3573	0.2132228
0.03	6.22	1.8		3.09	1.1282	1.8	1.3138	0.2132228
0.0333	6.42	1.998		2.89	1.0613	1.998	1.2716	0.2132228
0.05	6.73	3		2.58	0.9478	3	1.0580	0.2132228
0.0666	6.75	3.996		2.56	0.9400	3.996	0.8456	0.2132228
0.0833	7.34	4.998		1.97	0.6780	4.998	0.6320	0.2132228
0.1	7.83	6		1.48	0.3920	6	0.4183	0.2132228
0.1166	7.98	6.996		1.33	0.2852	6.996	0.2059	0.2132228
0.1333	8.09	7.998		1.22	0.1989	7.998	-0.0077	0.2132228
0.15	8.36	9		0.95	-0.0513	9	-0.2214	0.2132228
0.1666	8.62	9.996		0.69	-0.3711	9.996	-0.4337	0.2132228
0.1833	8.75	10.998		0.56	-0.5798	10.998	-0.6474	0.2132228
0.2	8.81	12		0.5	-0.6931	12	-0.8610	0.2132228
0.2166	8.91	12.996		0.4	-0.9163	12.996	-1.0734	0.2132228
0.2333	9.05	13.998		0.26	-1.3471	13.998	-1.2870	0.2132228
0.25	9.12	15		0.19	-1.6607	15	-1.5007	0.2132228
0.2666	9.15	15.996		0.16	-1.8326	15.996	-1.7131	0.2132228
0.2833	9.19	16.998		0.12	-2.1203	16.998	-1.9267	0.2132228
0.3	9.22	18		0.09	-2.4079	18	-2.1404	0.2132228
0.3166	9.26	18.996		0.05	-2.9957	18.996	-2.3527	0.2132228
0.3333	9.27	19.998		0.04	-3.2189	19.998	-2.5664	0.2132228
0.4167	9.3	25.002		0.01	-4.6052	25.002	-3.6334	0.2132228
0.5	9.3	30		0.01	-4.6052	30	-4.6990	0.2132228
0.5833	9.3	34.998		0.01	-4.6052	34.998	-5.7647	0.2132228
0.6667	9.31	40.002		0	ERR	40.002	-6.8317	0.2132228
0.75	9.31	45		0	ERR	45	-7.8974	0.2132228
0.8333	9.31	49.998		0	ERR	49.998	-8.9631	0.2132228
0.9167	9.31	55.002		0	ERR	55.002	-10.0300	0.2132228
1	9.31	60		0	ERR	60	-11.0957	0.2132228
1.0833	9.31	64.998		0	ERR	64.998	-12.1614	0.2132228
1.1667	9.31	70.002		0	ERR	70.002	-13.2284	0.2132228
1.25	9.31	75		0	ERR	75	-14.2941	0.2132228
1.3333	9.31	79.998		0	ERR	79.998	-15.3598	0.2132228
1.4166	9.31	84.996		0	ERR	84.996	-16.4254	0.2132228
1.5	9.31	90		0	ERR	90	-17.4924	0.2132228
1.5833	9.31	94.998		0	ERR	94.998	-18.5581	0.2132228
1.6667	9.31	100.002		0	ERR	100.002	-19.6251	0.2132228
1.75	9.32	105		0.01	-4.6052	105	-20.6908	0.2132228

SLUG TEST DATA REDUCTION
BOUWER & RICE METHOD

FILENAME :	PS-CD
PROJECT NAME :	Petoskey Manufacturing
PROJECT NUMBER :	2420-017
USER'S NAME :	DMK
DATE OF USE :	*********

WELL NO. :	PS-CD
TEST TYPE :	SLUG
RUN NO. :	2

DEFINITIONS

XD REF	transducer reference level
rc	equivalent casing radius
rw	boring radius
Le	wetted screen length
Lw	wetted well length
H	saturated aquifer thickness
A,B,C	Bouwer & Rice coefficients
T-OFFSET	time interval between the start of the data recorder and the start of the test

DERIVED CONSTANTS (BASED ON CM)

rc*rc/2Le:	0.006449	CM
ln[(H-Lw)/rw]:	ERR	
FACTOR OF ln(Re/rw):	2.893023	

ENTER THE SLOPE OF THE
BEST FIT STRAIGHT LINE: 0.213222 /SEC

HYDRAULIC CONDUCTIVITY (CM/S)

WELL NO. PS-CD

K:	3.98E-03	cm/sec
	1.13E+01	ft/d

CONSTANTS

XD REF (FT)...		9.31
rc (FT)..		0.046
rw (FT)..		0.302
Le (FT)..		5
Lw (FT)..		31.35
H (FT)...		31.35
A.....	na	
B.....	na	
C.....		1.8
T-OFFSET (sec)	T	

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petoskey	Well I.D.	Bear Creek - C2		
Date	10/3- 10/6/95	Pumping Rate	35 gpm		
Pump Test Start	4:10pm 10/3/95	Pump Test End		Total Pumping Time (min.)	
Instrument/ Method	Keck WL Probe			Distance From Pumping Well	
Initial Water Level		Final Water Level		Total Drawdown	
Field Staff					

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Chg in Head ~~Drawdown~~ (ft.)	Recovery (ft.)	Remarks
2:42pm	—	3.00	Ø		Starting WL
5:15pm	65 min	3.00	Ø		
7:00pm	170 min.	3.00	Ø		
1:51am	581 min.	3.00	Ø		
8:20am	970 min.	2.99	-0.01		
1:33pm	1283 min.	2.95	-0.05		
5:24pm	1514 min.	2.93	-0.07		
2:07am	2039 min.	2.92	-0.08		
8:59am	2447 min.	2.92	-0.08		
2:55pm	2805 min.	2.93	-0.07		
7:19pm	3069 min.	2.94	-0.06		
1:38am	3448 min.	2.94	-0.06		
9:13am	3903 min.	2.96	-0.04		
1:53pm	4183 min.	2.94	-0.06		

MALCOLM PIRNIE

PUMP TEST DATA

Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

MALCOLM PIRNIE

PUMP TEST DATA

Project Name	Petoskey	Well I.D.	Lake MI Staff Gage		
Date	10/3 - 10/6/95	Pumping Rate	35 gpm		
Pump Test Start	4:10pm 10/3/95	Pump Test End		Total Pumping Time (min.)	
Instrument/ Method	Keck WL Probe			Distance From Pumping Well	
Initial Water Level		Final Water Level		Total Drawdown	
Field Staff					

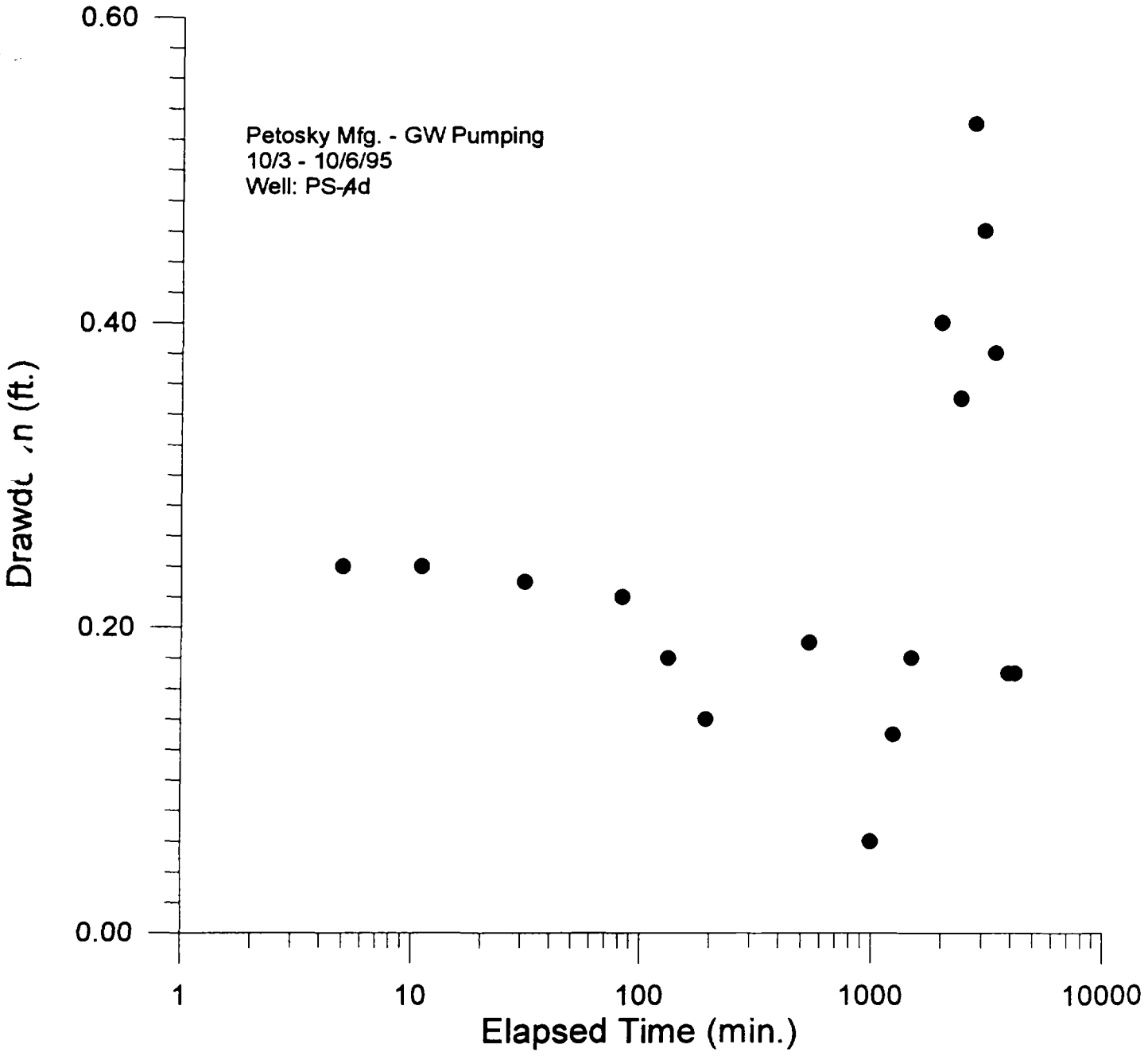
Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks
2:53pm	—	2.57'	0		Starting WL
5:15pm	~~+442~~ 65 min.	2.54'	-.03		
7:11pm	~~+558~~ 186 min.	2.28'	-.29		
1:41am	576 min.	2.19'	-.38		
8:28am	978 min.	2.34'	-.23		
1:15pm	1265 min.	2.32'	-.25		
5:15pm	1505 min	2.41'	-.16		
1:54am	2026 min.	2.66'	.09		
8:51am	2439 min.	2.54'	-.03		
2:41pm	2791 min.	3.0'	.43		strong wave action - measurement not accurate
7:11pm	3061 min.	2.85'	.28		
1:26am	3436 min.	2.50'	-.07		
9:06am	3896 min.	2.54'	-.03		
1:46pm	4176 min.	2.45'	-.12		Final WL before test stop

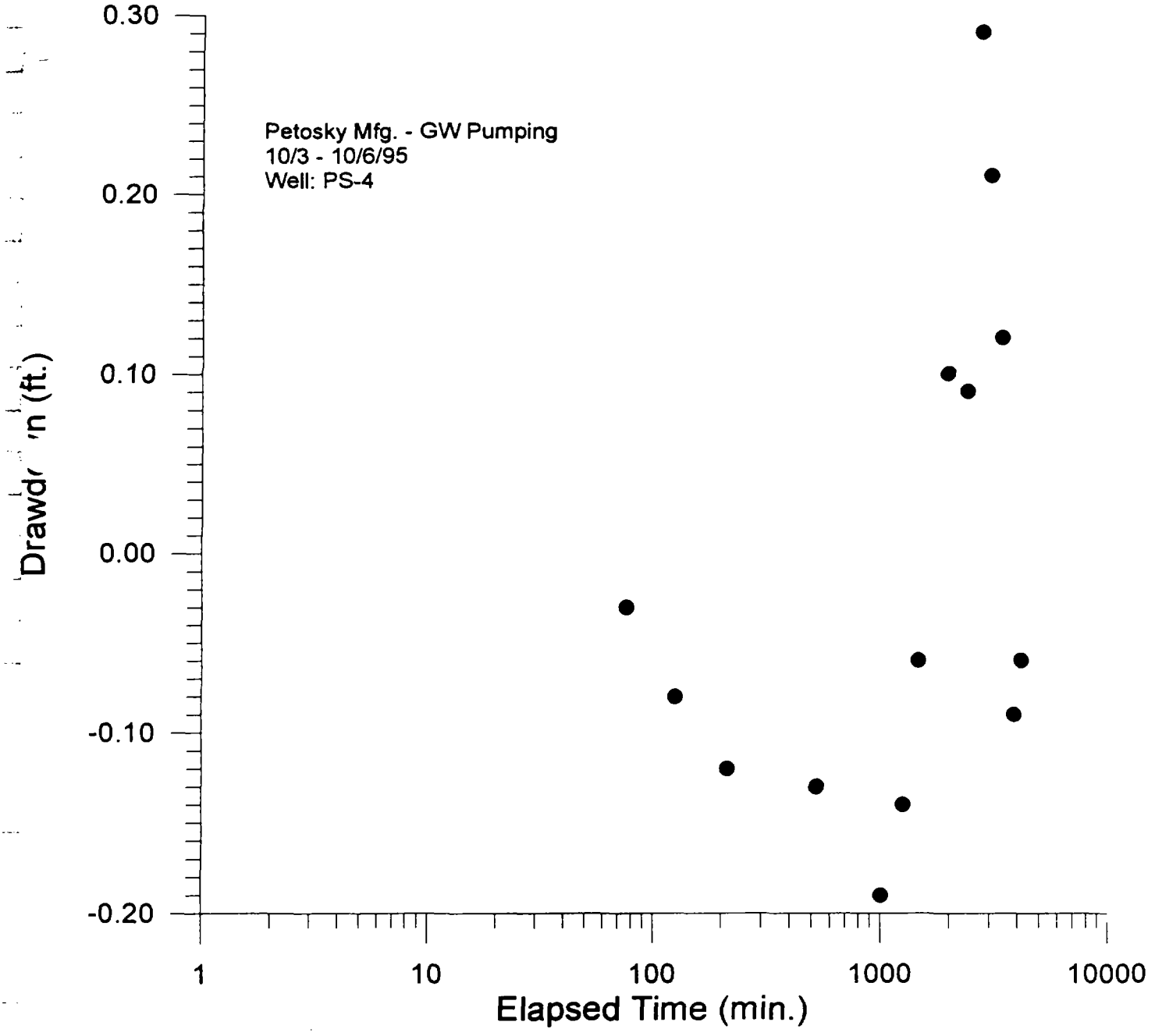
MALCOLM PIRNIE

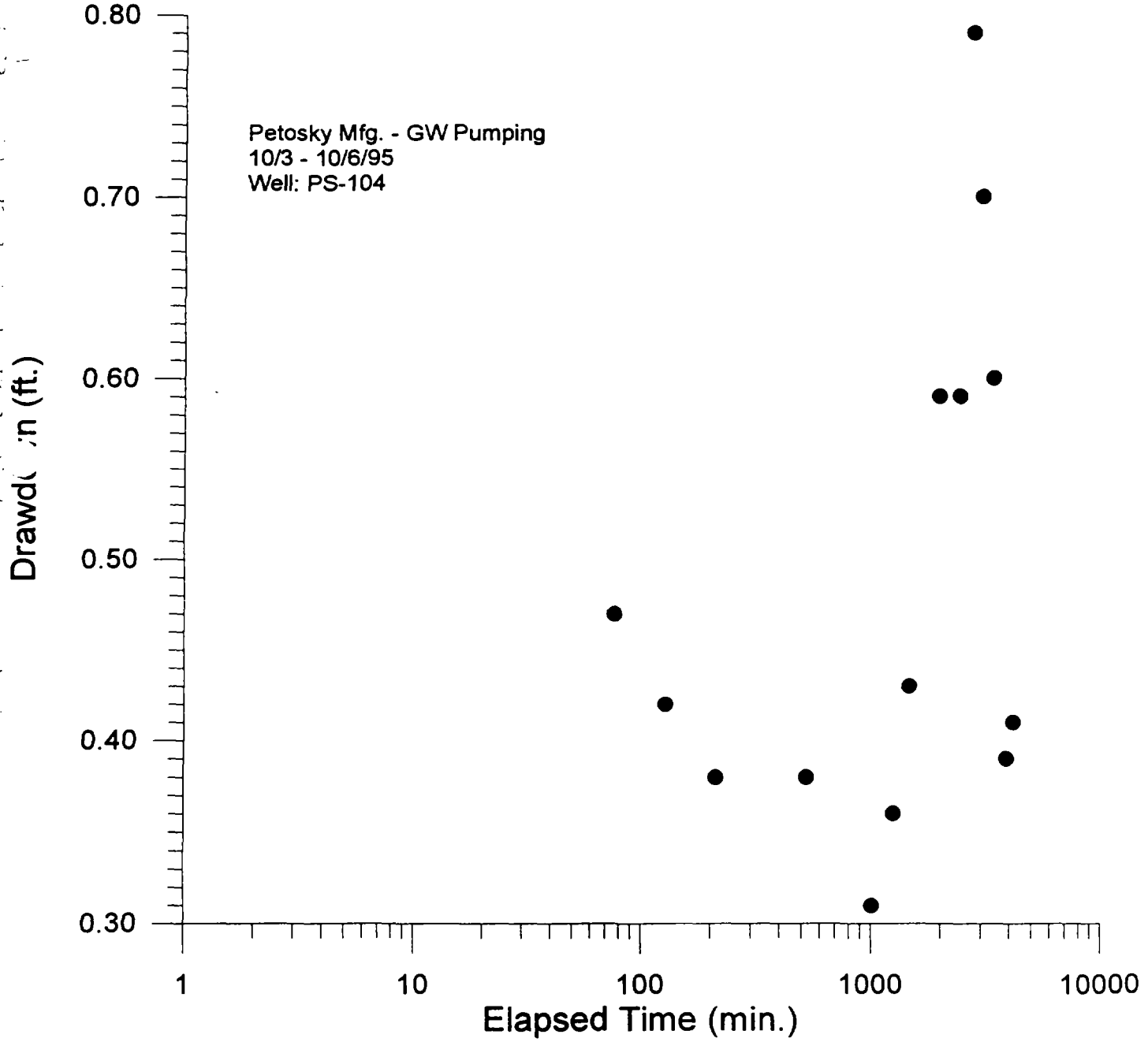
PUMP TEST DATA

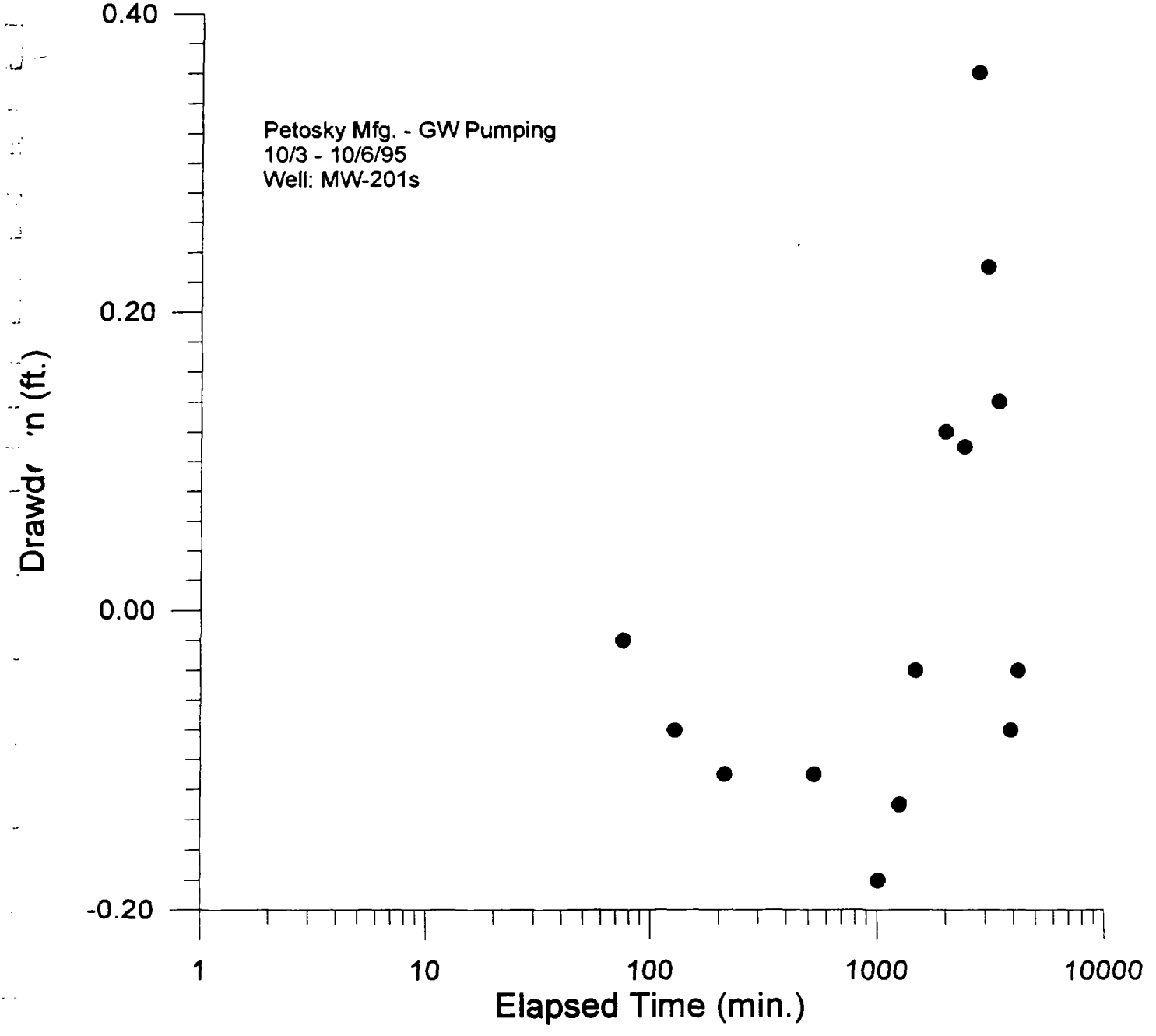
Actual Time	Elapsed Time (min.)	Depth to Water (ft.)	Drawdown (ft.)	Recovery (ft.)	Remarks

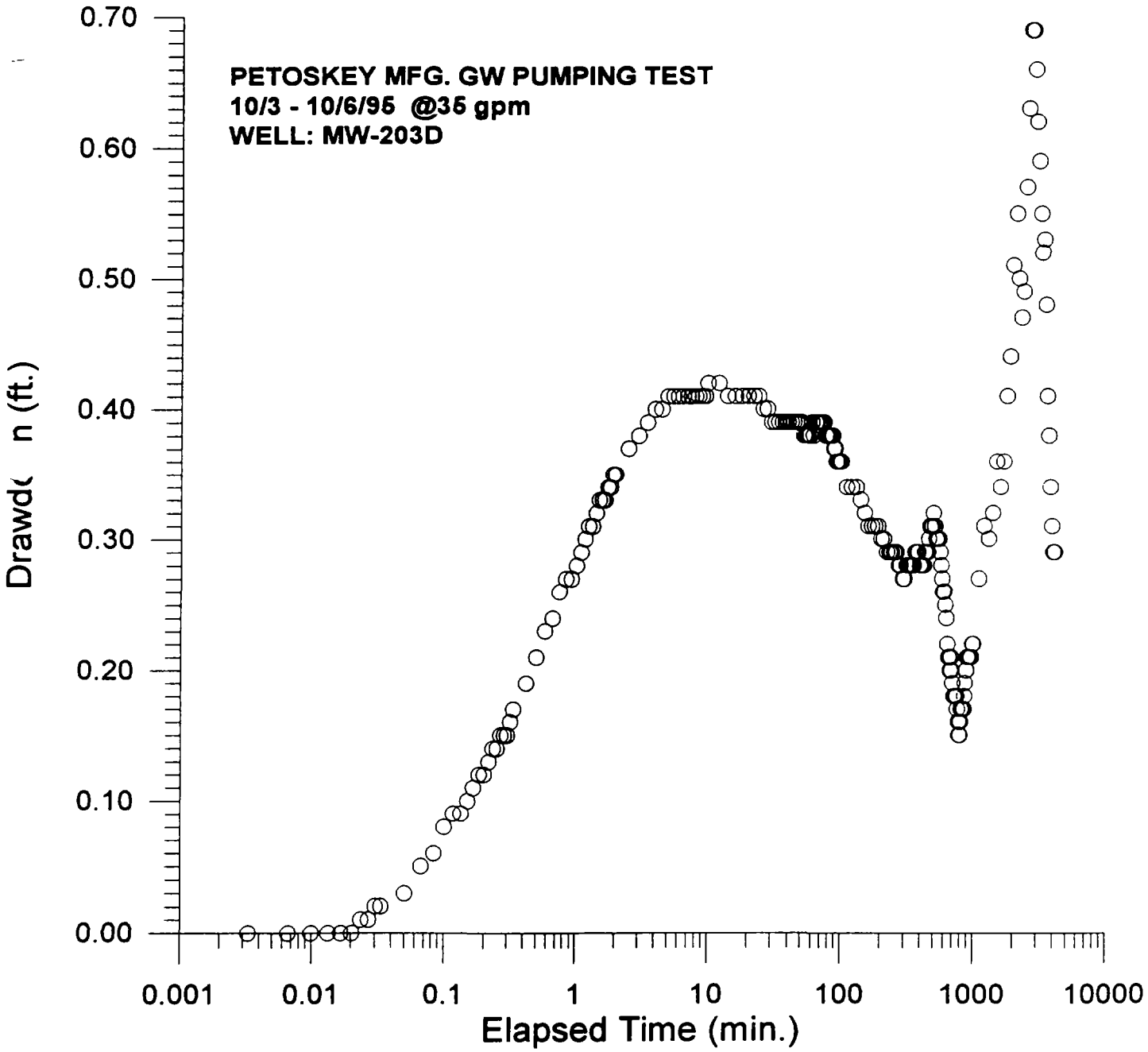
C:\FORMS\PUMPTEST.FRM

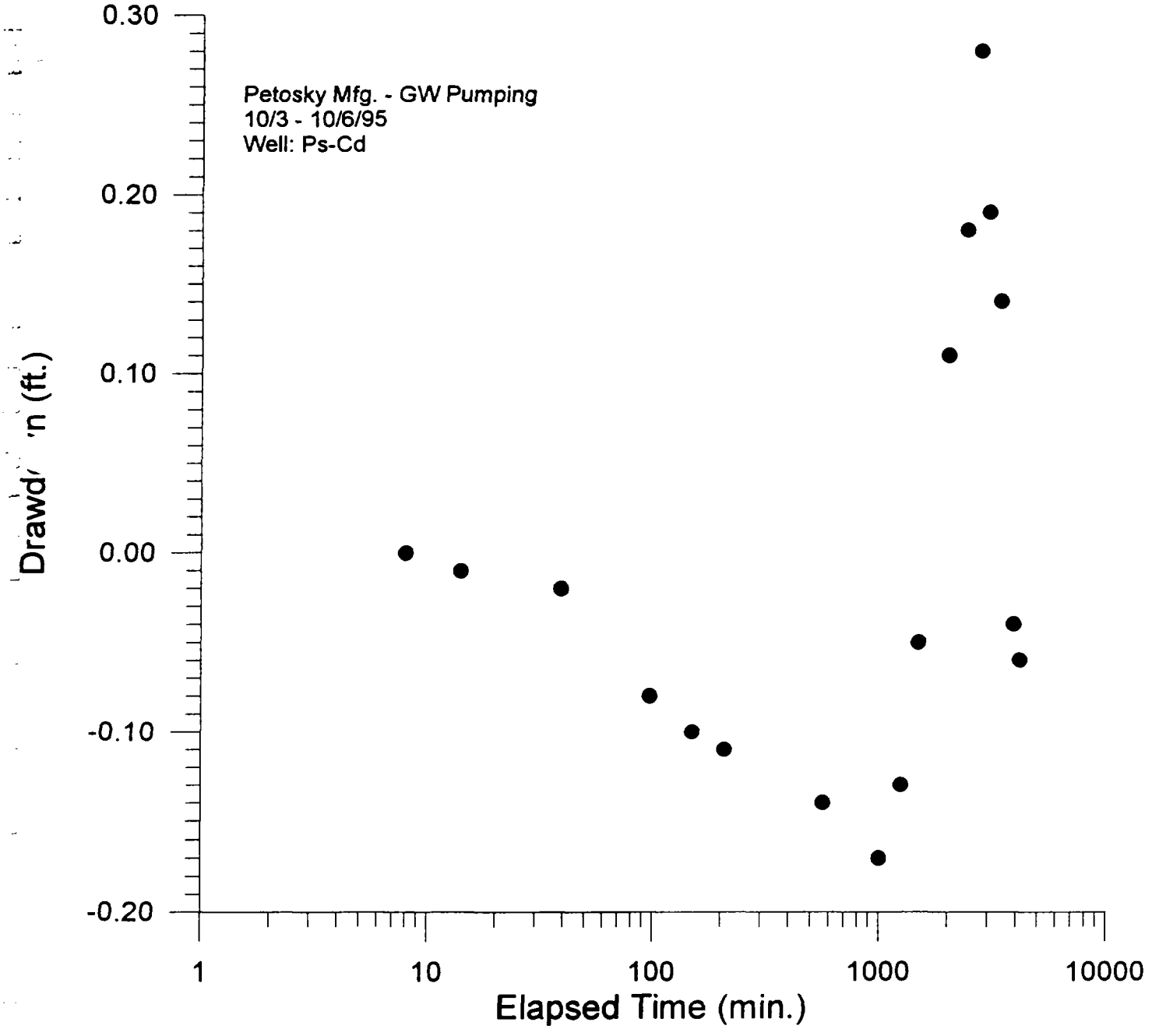

Petosky Mfg. - GW Pumping
10/3 - 10/6/95
Well: PS-Ad
0.60
0.40
0.20
0.00
Drawdown (ft.)
1
10
100
1000
10000
Elapsed Time (min.)

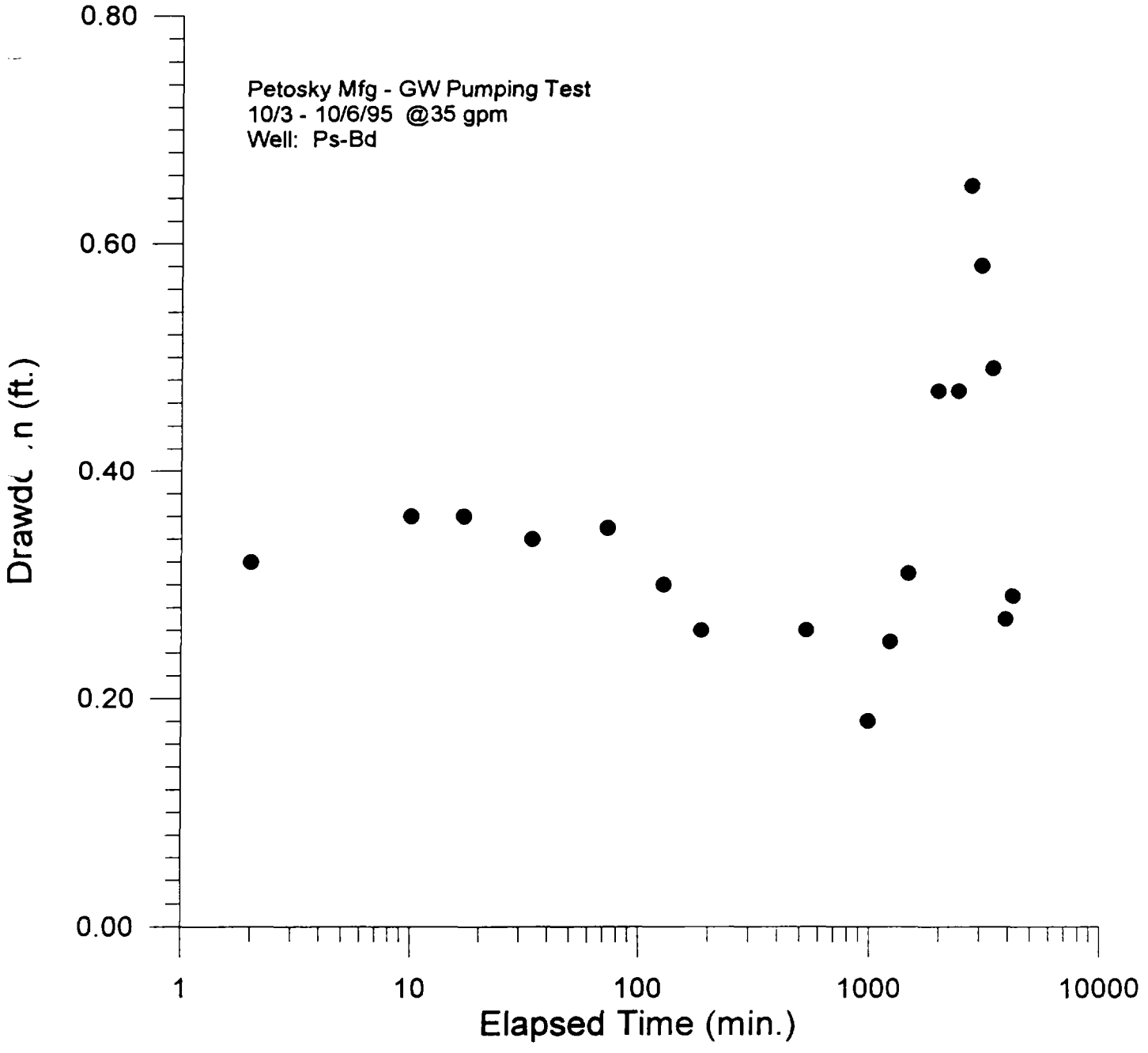

Petosky Mfg. - GW Pumping
10/3 - 10/6/95
Well: PS-4
0.30
0.20
0.10
0.00
-0.10
-0.20
Drawdown (ft.)
1
10
100
1000
10000
Elapsed Time (min.)

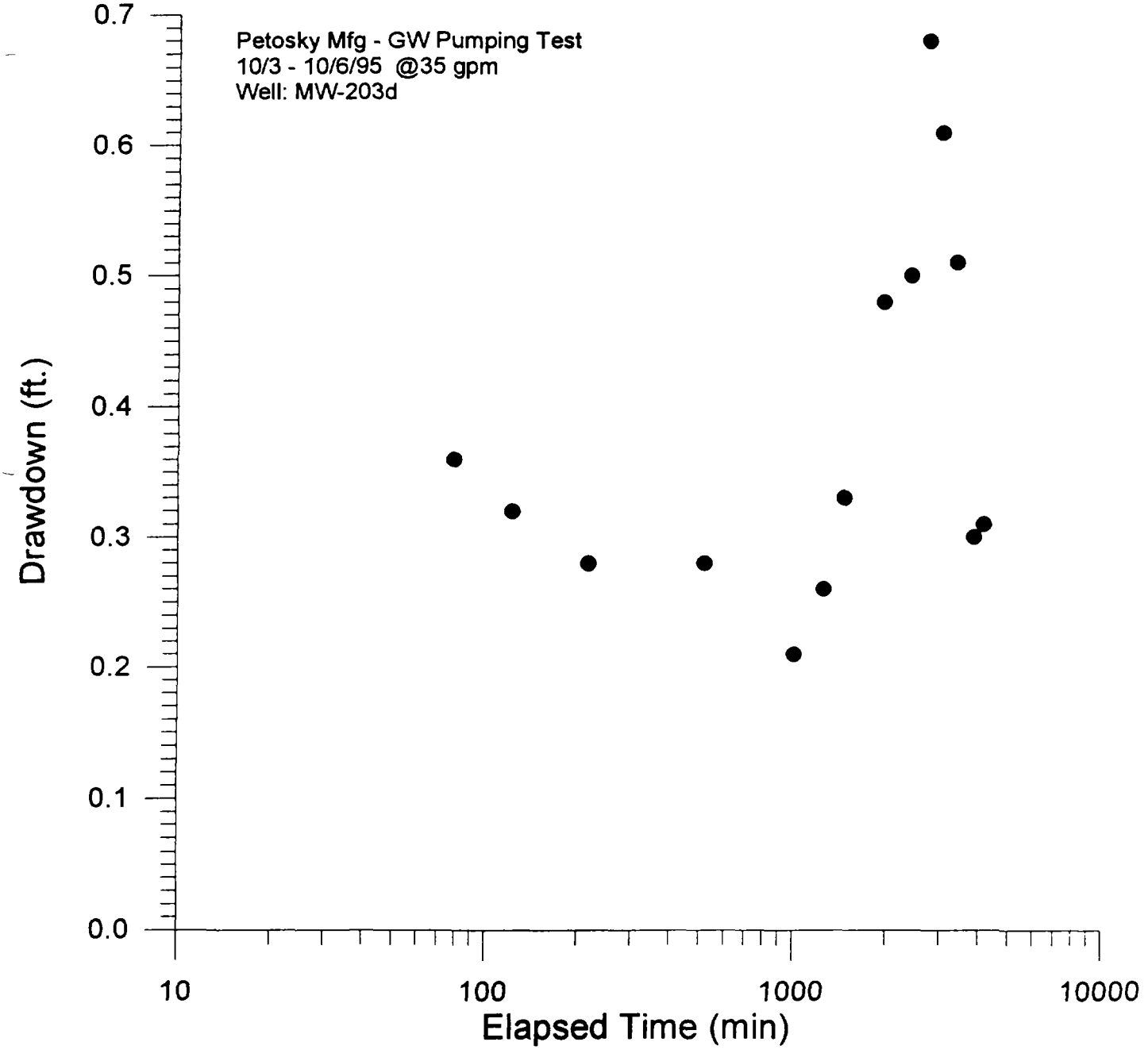

Petosky Mfg. - GW Pumping
10/3 - 10/6/95
Well: PS-104
0.80
0.70
0.60
0.50
0.40
0.30
Drawdown (ft.)
1
10
100
1000
10000
Elapsed Time (min.)

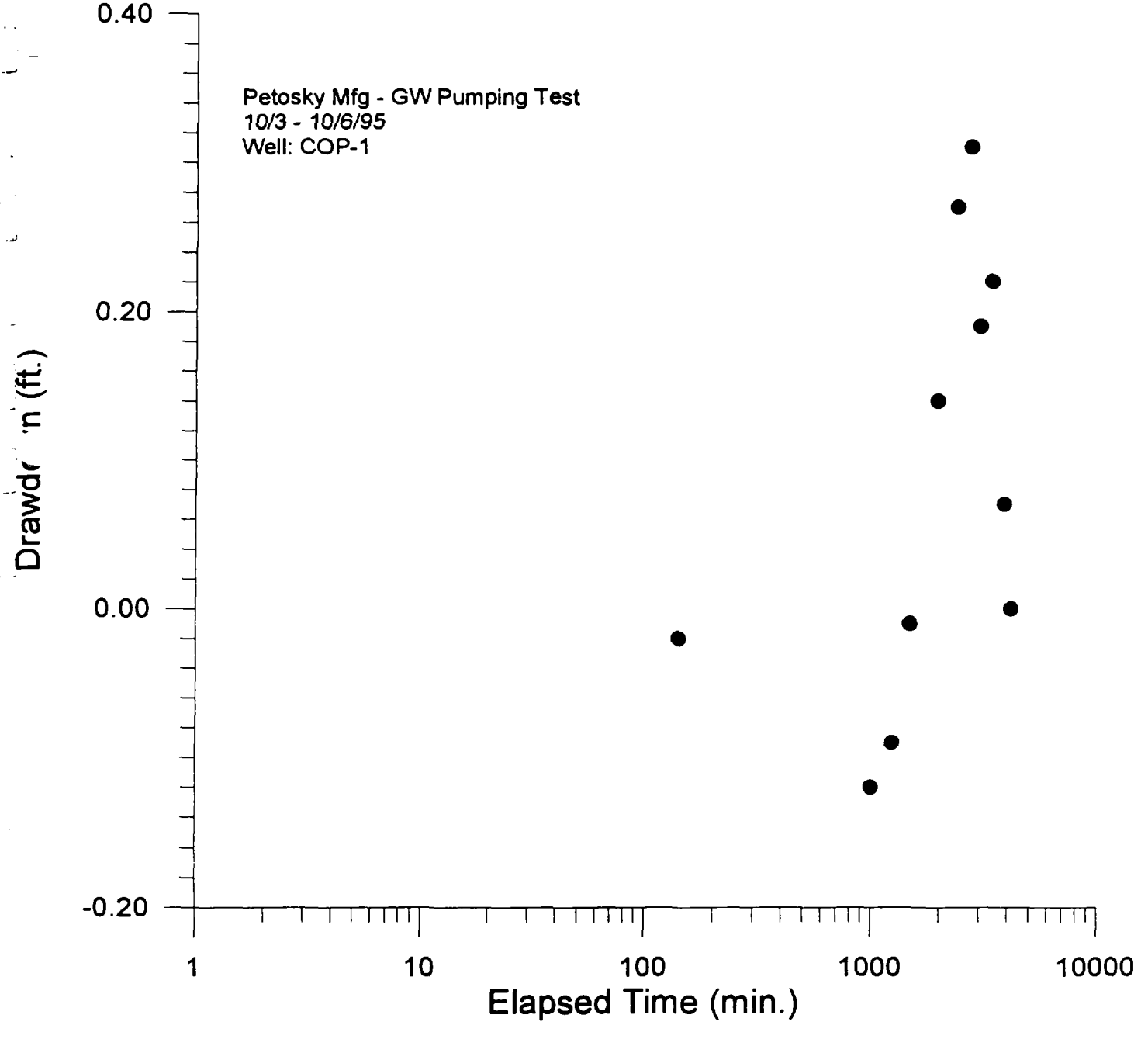

Petosky Mfg. - GW Pumping
10/3 - 10/6/95
Well: MW-201s
0.40
0.20
0.00
-0.20
Drawdr n (ft.)
1
10
100
1000
10000
Elapsed Time (min.)

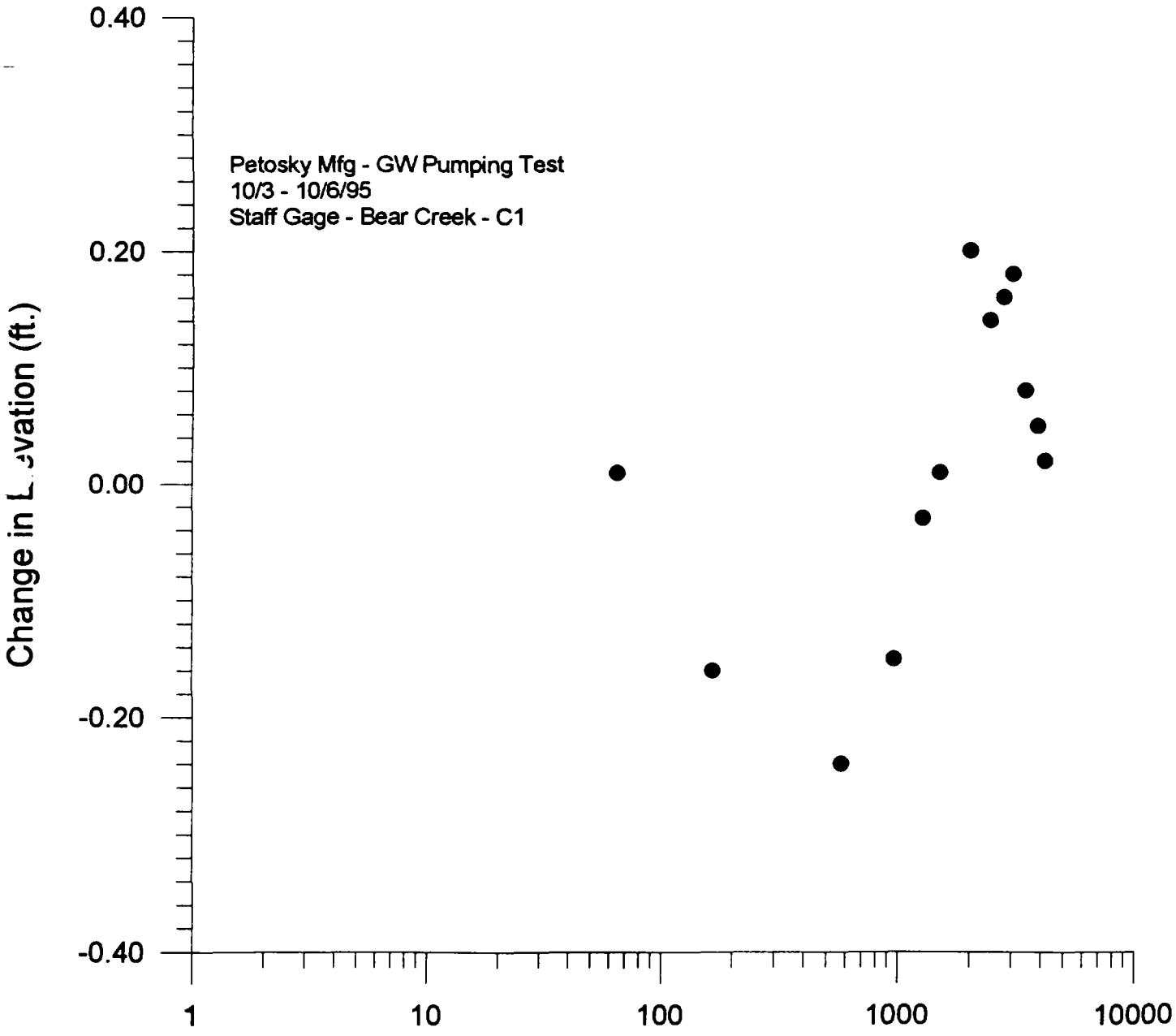

PETOSKEY MFG. GW PUMPING TEST
10/3 - 10/6/95 @35 gpm
WELL: MW-203D
Drawdown (ft.)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.001
0.01
0.1
1
10
100
1000
10000
Elapsed Time (min.)

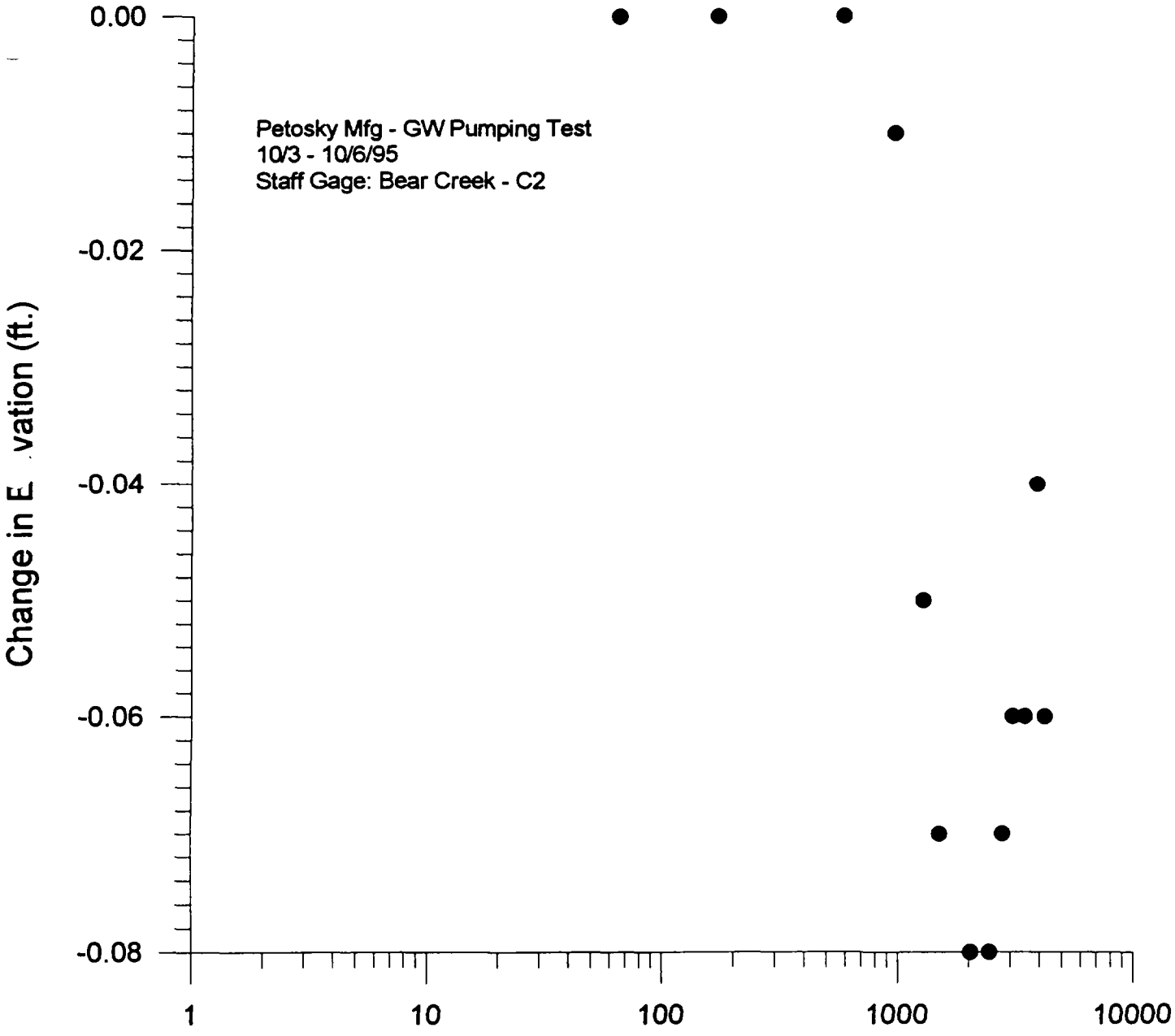

Petosky Mfg. - GW Pumping
10/3 - 10/6/95
Well: Ps-Cd
0.30
0.20
0.10
0.00
-0.10
-0.20
Drawd' 'n (ft.)
1
10
100
1000
10000
Elapsed Time (min.)

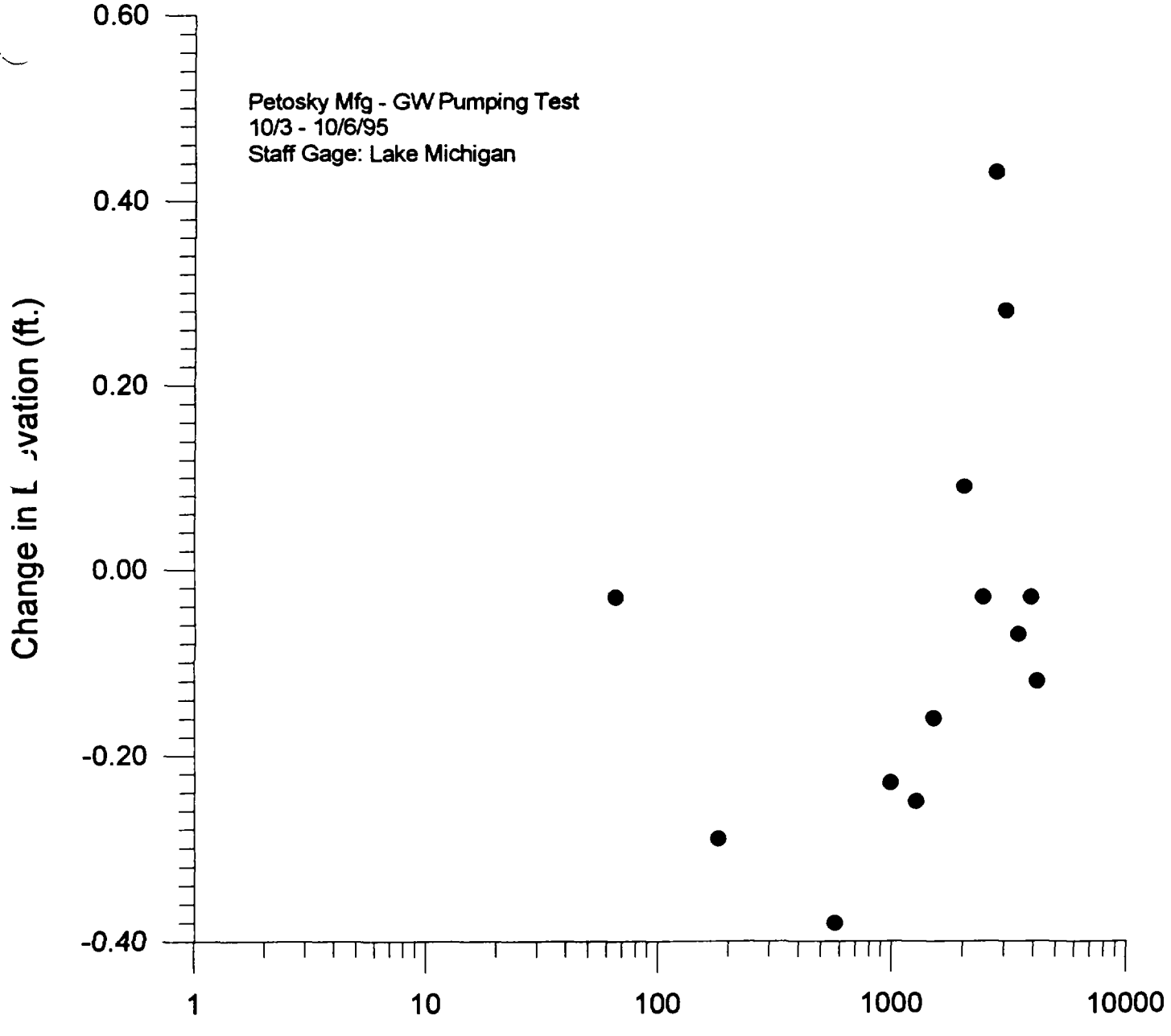

Petosky Mfg - GW Pumping Test
10/3 - 10/6/95 @35 gpm
Well: Ps-Bd
0.80
0.60
0.40
0.20
0.00
Drawdc .n (ft.)
1
10
100
1000
10000
Elapsed Time (min.)


Petosky Mfg - GW Pumping Test
10/3 - 10/6/95 @35 gpm
Well: MW-203d
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Drawdown (ft.)
10
100
1000
10000
Elapsed Time (min)


Petosky Mfg - GW Pumping Test
10/3 - 10/6/95
Well: COP-1
0.40
0.20
0.00
-0.20
Drawdown (ft.)
1
10
100
1000
10000
Elapsed Time (min.)


Petosky Mfg - GW Pumping Test
10/3 - 10/6/95
Staff Gage - Bear Creek - C1
Change in Elevation (ft.)
0.40
0.20
0.00
-0.20
-0.40
1
10
100
1000
10000


Petosky Mfg - GW Pumping Test
10/3 - 10/6/95
Staff Gage: Bear Creek - C2
Change in E .vation (ft.)
0.00
-0.02
-0.04
-0.06
-0.08
1
10
100
1000
10000


Petosky Mfg - GW Pumping Test
10/3 - 10/6/95
Staff Gage: Lake Michigan
Change in L vation (ft.)
0.60
0.40
0.20
0.00
-0.20
-0.40
1
10
100
1000
10000

MALCOLM PIRNIE

APPENDIX F

RISK ASSESSMENT DOCUMENTATION

APPENDIX F

- Essential Nutrient Screen
- Indoor Shower Model
- Enclosed Space Model
- Respirable Particulates Model
- Oral Absorption Efficiencies
- Permeability Coefficients for Dermal Absorption
- Toxicity Values: Potential Noncarcinogenic Effects
- Toxicity Values: Potential Carcinogenic Effects

ESSENTIAL NUTRIENT SCREEN

Reference concentrations to evaluate the concentrations of essential nutrients (i.e., calcium, iron, magnesium, potassium, and sodium) in soil and groundwater were derived from Recommended Daily Allowances (RDAs) and exposure parameters in the models used by the USEPA, Region III in their derivation of risk-based concentrations (USEPA, 1995b). Based on the exposure scenarios considered in the human health risk evaluation, reference concentrations for soil were derived for ingestion by an adult in an industrial setting and reference concentrations for groundwater were derived for residential tap water use by a child; RDAs for an adult male and male child were used (ESHA Research, 1990).

Reference Concentrations for Soil

$$RC_s = RDA_a / IR_s * FI * CF$$

where

RC_s = reference concentration for soil (mg/Kg)
RDA_a = recommended daily allowance for an adult (mg/day)
IR_s = soil ingestion rate (100 mg/day)
RI = fraction ingested (0.5)
CF = conversion factor (10^{-6} Kg/mg)

Reference Concentration for Groundwater

$$RC_w = RDA_c / IR_w$$

where

RC_w = reference concentration for water (mg/L)
RDA_c = recommended daily allowance for a child (mg/day)
IR_w = water ingestion rate (2 L/day)

Essential Nutrient	Recommended Daily Allowance (mg/day; adult male)	Reference Concentration for Soil (mg/Kg)	Recommended Daily Allowance (mg/day; male child)	Reference Concentration for Groundwater (mg/L)
Calcium	800	> 1E+06	800	400
Iron	10	200,000	10	5
Magnesium	350	> 1E+06	80	40
Potassium	2000	> 1E+06	1000	500

Sodium	2400	> 1E+06	975	500

INDOOR SHOWER MODEL

The concentrations of volatile chemicals in air inside a shower during showering are estimated using an approach recommended by the Gas Research Institute (GRI, 1988) based on the work of Andelman (1985a, 1985b, 1984). The concentrations in the air inside the shower are determined by a balance between the rate of release from the shower water and the rate of air exchange between the shower and the bathroom and the rest of the house. The constants in the model have been set to match the observed efficiency of volatilization of trichloroethene in model showers and to fit the observed shower air concentrations of trichloroethene in several homes with contaminated water where measurements have been made. Scaling to other chemicals is accomplished by assuming that the rate of volatilization between shower water and air is proportional to the Henry's Law constant. The explicit time dependence for the concentration in the shower air is important because the time over which chemicals build up is typically comparable to what might be expected for the shower duration.

The average concentration of a volatile chemical in the shower air over a period of t_s minutes (for $t_s > 0$) is estimated from the following equation:

$$C_s = C_{inf} [1 + (1 / (kt_s)) (e^{(-kts)} - 1)]$$

where:

C_s the average concentration of a volatile chemical in the shower air over a duration of t_s minutes (mg/m^3)

C_{inf} the asymptotic concentration of a volatile chemical in the shower air if the shower ran for a long time (>> 5 minutes) (mg/m^3)

k the rate constant for the exponential function (1/minute)

t_s the time in the shower (minutes)

and where:

$$C_{inf} = [(E) (F_w) (C_t / 1000)] / F_a$$

where:

E the efficiency of release of compounds from water to air (unitless)

F_w the flow rate of water in the shower (L/minute)

C_t the concentration of the volatile chemical in shower water (ug/L)

F_a the flow rate of air in the shower (m^3/minute)

$$k = F_a / V_b$$

where:

F_a the flow rate of air in the shower (m^3/minute)

V_b the volume of the bathroom (m^3)

$$E = (E_{TCE})\ (H) / (H_{TCE})$$

where:

E the efficiency of release of a volatile chemical from water to air (unitless); where $0 \leq E \leq 1$ and where E is set equal to 1 if E has a calculated value greater than 1

E_{TCE} the efficiency of release of trichloroethene from water to air (unitless)

H Henry's Law constant for the volatile chemical (m3-atm/mol)

H_{TCE} Henry's Law constant for trichloroethene (m3-atm/mol)

The scenario-specific input variables, calculated values, calculated constants, and estimated chemical concentrations in the shower air are provided **in Table F-1** for each volatile chemical of potential concern in groundwater.

ENCLOSED SPACE MODEL

Two scenarios involving volatile organic compound (VOC) release into enclosed spaces are evaluated: release into a residential structure constructed with a subterranean basement and release into a residential structure constructed slab-on-grade.

Evaluating the potential for VOC release into enclosed spaces involves estimating the rate (termed "flux") at which subsurface chemicals are transported into the region near the building, the infiltration of the chemicals into the building, and the concentration of the chemicals in indoor air. In the scenarios evaluated here, contaminant flux involves release from both groundwater and subsurface soil. Use of the simple screening-level models described below as a first approximation is consistent with the guidance provided by the USEPA in their Air/Superfund National Technical Guidance Study Series (USEPA, 1992a).

The residential structures are assumed to be bi-level single family homes, 25 ft by 50 ft (7.6 m by 15.2 m) typical of the type and size of home currently constructed in the U.S. For the residential structure/basement scenario, the surface area for VOC intrusion (2450 ft^2 or 227.6 m^2) is the foundation (1250 ft^2) and the four basement walls (1200 ft^2, assuming an 8-foot high basement). Taking all three floors into account, the volume of the home is assumed to be 30,000 ft^3 (849.6 m^3). For the residential structure/slab-on-grade scenario, the surface area for VOC intrusion (1250 ft^2 or 116.1 m^2) is just the foundation. Taking the two floors into account, the volume of the home is assumed to be 20,000 ft^3 (or 566.4 m^3). While the City of Petoskey intends to re-zone the site as "multi-family residential", these scenarios should adequately characterize conditions on the lower floors of multi-family dwellings if such construction was to occur.

The Farmer Model most likely overpredicts the contaminant flux since the it ignores all possible attenuating factors. However, it provides a simple screening method to estimate the likely maximum rate at which chemicals would be transported to a building (USEPA, 1992a).

The vapor concentration of the chemical in the pore vapor is estimated assuming the chemical equilibrium follows Henry's Law and is unaffected by other components of the system. Once in the vapor phase, the chemical diffuses through the soil at a rate dependent on the soil porosity, pore space geometry, the air diffusion coefficient of the chemical, and the concentration gradient between the source and the point of exit from the soil.

VOC Flux from Groundwater - VOC release is assumed to originate from dissolved VOCs in groundwater located some distance below ground surface. The modeling equation for VOC flux from groundwater (USEPA, 1992a) is:

$$J = \frac{D_a C_l H P_a^{10/3}}{RTLP_t^2}$$

Where:

J = contaminant flux from water (g/cm^2-s)
D_a = vapor phase diffusion coefficient in air (cm^2-s)
C_l = contaminant concentration in water (g/cm^3; from mg/l * 10^{-3} g/mg * 10^{-3} l/cm^3)
H = Henry's Law Constant (atm - m^3/mole)
P_a = air filled soil porosity (unitless)

$$P_a = P_t - O_m B$$

Where:

O_m = soil moisture content (ml/g or cm^3 - water/g-soil)
B = bulk soil density (g/cm^3)

R = universal gas constant (atm - m^3/mole - °K)
T = soil temperature (°K)
L = distance from source to point of exit (depth of groundwater) (cm)
P_t = total soil porosity (unitless)

A total soil porosity (P_t) of 0.55 for dry non-compacted soils, a soil moisture content (O_m) of 0.1, and a bulk soil density (B) of 1.7 g/cm^3, and a soil temperature (T) of 293° K are assumed. Based on hydrogeological data collected at the site, the depth to groundwater (L) of 13 ft is used. The vapor phase diffusion coefficients in air (D_a) and Henry's Law Constants (H) were obtained from the AWMA/USEPA (1993), the USEPA (1986), or the ASTM (1995), in this order. The universal gas constant is 8.2E-05 atm-m^3/mole-°K.

This approach assumes that the capillary fringe is small compared to the distance to the top of the groundwater table and that the VOC concentrations are the same at the top of the fringe as in the bulk groundwater. Not correcting for the transport resistance provided by the capillary fringe tends to maximize the flux.

VOC Flux from Subsurface Soil - VOC release is assumed to originate from VOCs in subsurface soil located some distance below ground surface. The modeling equation for VOC flux from subsurface soil (USEPA, 1992a) is:

$$J = \frac{D_a C_s H P_a^{10/3}}{K_{oc} f_{oc} L P_t^2}$$

Where:

C_s = contaminant concentration in soil (g/cm^3; from mg/kg * 1.7 g/cm^3 * 10^{-6} kg/mg)
H = Henry's Law Constant (unitless)
K_{oc} = carbon-water sorption coefficient
f_{oc} = fraction organic carbon (unitless)
L = distance from source to point of exit (depth to subsurface soil) (cm)

The carbon-water sorption coefficients (K_{oc}) were obtained from the USEPA (1986) or the ASTM (1995). A fraction organic carbon (f_{oc}) of 0.02 is assumed (USEPA, 1992b). Based on the available subsurface soil data from the site, a depth to subsurface soil (L) of 2 ft is used.

By considering the adsorption of the chemicals to the soil particles and the how the strength of that adsorption affects the concentration in the soil gas, the equation accounts for chemical distribution among soil particles, soil pore moisture, and soil gas.

Indoor Air Concentrations

Consistent with the screening level approach, it is assumed that soil gas enters the building by diffusion only. The more complex case in which pressure coupling to the building results in the entry of soil gas by convective transport is not considered. Thus indoor air concentrations may be underestimated. The modeling equation for estimating VOC concentrations in indoor building air (USEPA, 1992a) is:

$$Cin = E/Q = \frac{\frac{J\ A\ F}{ACH\ V}}{3600}$$

Where:

C = contaminant concentration in indoor air ($g/m3$)
E = contaminant infiltration rate (g/s)

$$E = J\ A\ F$$

Where:

J = contaminant flux (g/m^2 - s)
A = area of subterranean floors/walls (m^2)
F = fraction of floor/walls through which soil gas can enter (unitless)

Q = building ventilation rate (m^3/s)

$$Q = \frac{ACH}{3600} V$$

Where:

ACH = building air exchanges/h
3600 = 3600 s/h
V = volume of building (m^3)

The building air exchange rate (ACH) selected, 1.0 building air exchanges/hour, is the midpoint in the range of values, 0.5 to 1.5, typical of single family residences and slightly greater than the 0.5 to 0.8 range for new or retrofitted energy-efficient structures. A default for F value of 0.01, recommended by the ASTM (1995), is used. The assumptions for the area of subterranean floors/walls (A) and the volume of the buildings (V) are presented above.

The modeling input and results for VOC intrusion from groundwater and from subsurface soil are presented in Tables F-2 and F-3, respectively. The total VOC concentrations in indoor air are presented in Table F-4.

RESPIRABLE PARTICULATES MODEL

The methodology to evaluate the potential exposure of workers to respirable particulates emitted during the course of excavating soil during construction or utility maintenance activities is described below. The modeling requires determination of an emission rate, an emission flux, and the concentration of respirable particulates in the ambient air at the excavation.

Emission Rate and Emission Flux

The emission rate calculation considers the digging of an 1.5 m wide x 5.0 m long x 2.0 m deep excavation by a bulldozer. A bulldozer is assumed for this analysis since an emission rate equation is available for a bulldozer and not a backhoe. Only emissions from the digging of the excavation are calculated; the soil removed from the excavation is assumed to be placed on the side of the excavation and covered to prevent wind-generated respirable particulates.

The following equation (USEPA, 1989) was used to derive an emission rate (in g/s) for respirable particulates (defined in USEPA, 1989 as < 15 microns):

$$[0.45\ (s)^{1.5}\ (M)^{-1.4}]$$

where:

s = silt content of the soil in weight %
M = moisture content of the soil in weight %

A silt content of 8% and a moisture content of 10% are assumed (USEPA, 1993). Solving the above equation results in a respirable particulate emission rate of 0.041 g/s, as presented below:

$= [0.45\ (8)^{1.5}\ (10)^{-1.4}]$
$= [0.45\ (22.63)\ (0.04)]$
$= 0.405$ kg/hour
$= 0.113$ g/s

An emission flux of 0.015 g/s-m^2 is derived by dividing the emission rate by the surface area of the excavation (0.113 g/s ÷ 7.5 m^2).

Air Concentrations

Ambient air concentrations for workers exposed to the enhanced excavation emissions were determined using the USEPA-approved Point, Area and Line source (PAL2.1) model, version 89272, (USEPA, 1987) assuming that the excavation represents an area source of emissions. Unlike other area source models, such as the Industrial Source Complex (ISC)

model and SCREEN3, PAL2.1 has the capability of determining impacts above area sources, as well as downwind of a source. PAL2.1 is a diverse model that can be used to estimate dispersion for point, area and line sources using Gaussian-plume steady-state assumptions. Simultaneous modeling of multiple sources and source types can be performed to calculate impacts of non-reactive chemicals at a large number of receptors. Also, user-specified meteorological options allow for input of site-specific conditions that are representative of the site being modeled.

For this analysis, the source was modeled as a 1.5 m x 5.0 m flat area source. A total of nine receptors were used in the analysis. Eight receptors were placed along the edge of the excavation; one at each of the four corners, and one at the center of each side. In addition, one receptor was placed over the center of the excavation. All receptors were placed at a height of 1.8 m to simulate the height of a worker. The meteorological data consisted of an array of 54 meteorological conditions as used in the USEPA-approved screening level model, SCREEN3 (USEPA, 1995c). These conditions represent 54 combinations of stability classes (1 to 6) and wind speeds (1 m/s to 20 m/s) that could occur in the atmosphere. The wind directions were set so that the wind would blow directly towards each of the receptors. Model options selected for the analysis included: a typical anemometer height of 6.1 meters, a mixing height of 5000 m, and an average temperature of 293 °K. The wind was assumed to be constant below 10 meters (as fixed by PAL2.1). The analysis was performed for both the rural and urban land use classifications. The emission rate of the area source was set at 1 g/s-m^2. Output was then in the form of g/m^3 per g/s-m^2.

Results

The urban and rural modeling analyses predicted maximum 1-hour average unitized impacts of 0.1302 and 0.0268 g/m^3 per g/s-m^2, respectively, at the corners of the excavation. The maximum 1-hour average respirable particulate concentration (in kg/m^3) in the ambient air at the excavation is calculated from the following equation:

C = [1-hour unitized impact in g/m^3 per g/s-m^2] x [emission flux in g/s-m^2] x [0.001 kg/g]

Based on the rural land use classification assumed for the site, the maximum 1-hour average respirable particulate concentration is 4.02E-07 kg/mg, as presented below.

= [0.0268 g/m^3 per g/s-m^2] * [0.015 g/s-m^2] * [0.001 kg/g]
= 0.000000402 kg/m^3

Concentrations of the non-volatile chemicals of potential concern associated with this respirable particulate concentration are calculated in the risk assessment.

TABLE F-1
INDOOR SHOWER MODEL SCENARIO
PETOSKEY MANUFACTURING SITE

CHEMICAL	CONCENTATION IN AIR mg/m³ Cs =	time from beginning of shower min ts =	flow rate of shower L/min Fw =	conc in shower water µg/L Ct =	flow rate of air in shower m³/min Fa =	volume of bathroom m³ Vb =	Henry's law constant m³-atm/mol H =	asymptotic conc in air if shower ran for a long time mg/m³ C_inf =	rate constant for exponential function l/min k =	efficiency of release - E =	efficiency of TCE release from water to air - E_TCE =	Henry's law constant for TCE m³-atm/mol H_TCE =
1,2-Dichloroethene(cis)	5.17E-03	12	8	4.00E+00	2.4	12	9.46E-03	8.32E-03	0.2	6.24E-01	0.6	9.10E-03
Trichloroethene	3.90E-02	12	8	3.14E+01	2.4	12	9.10E-03	6.28E-02	0.2	6.00E-01	0.6	9.10E-03
Vinyl Chloride	1.75E-02	12	8	8.47E+00	2.4	12	8.60E-02	2.82E-02	0.2	1.00E+00	0.6	9.10E-03

Henry's Law from: A & WMA / USEPA, 1996. Value for 1,2-dichloroethene is for trans-1,2-dichloroethene.

TABLE F-2

VOC INTRUSION FROM GROUNDWATER
PETOSKEY MANUFACTURING SITE

Slab Construction									emission							concentration
	DA	Cl	H	PA10/3	R	T	L	Pt2	J	Area	F	E	ACH	V	Q	Cin
	cm2-s	g/cm3	atm-m3/m		atmm3/m	K	cm		g/cm2-s	m2		g/s		m3	m3/s	mg/m3
1,2-Dichloroethene(total)	7.36E-02	4.00E-09	4.55E-03	0.039745	8.20E-05	293	396.24	0.3025	1.85E-14	116.13	0.01	2.15E-14	1	566.4	0.157333	1.36E-10
Trichloroethene	7.90E-02	3.14E-08	9.10E-03	0.039745	8.20E-05	293	396.24	0.3025	3.12E-13	116.13	0.01	3.62E-13	1	566.4	0.157333	2.3E-09
Vinyl Chloride	9.00E-02	8.47E-09	8.60E-02	0.039745	8.20E-05	293	396.24	0.3025	9.05E-13	116.13	0.01	1.05E-12	1	566.4	0.157333	6.68E-09

Basement Construction									emission							concentration
	DA	Cl	H	$PA^{10/3}$	R	T	L	Pt^2	J	Area	F	E	ACH	V	Q	Cin
	cm2-s	g/cm3	atm-m3/m		atmm3/m	K	cm		g/cm2-s	m2		g/s		m3	m3/s	mg/m3
1,2-Dichloroethene(total)	7.36E-02	4.00E-09	4.55E-03	0.039745	8.20E-05	293	396.24	0.3025	1.85E-14	227.61	0.01	4.21E-14	1	849.6	0.236	1.78E-10
Trichloroethene	7.90E-02	3.14E-08	9.10E-03	0.039745	8.20E-05	293	396.24	0.3025	3.12E-13	227.61	0.01	7.09E-13	1	849.6	0.236	3E-09
Vinyl Chloride	9.00E-02	8.47E-09	8.60E-02	0.039745	8.20E-05	293	396.24	0.3025	9.05E-13	227.61	0.01	2.06E-12	1	849.6	0.236	8.73E-09

Notes:

where: Cl (g.cm3) = Cl (mg/l) * 0.001 g/mg * 0.001 l/cm3

TABLE F-3

VOC INTRUSION FROM SUBSURFACE SOIL
PETOSKEY MANUFACTURING SITE

Slab Construction — emission — concentration

	DA	Cs	H	$PA^{10/3}$	Koc	foc	L	Pt^2	J	A	F	E	ACH	V	Q	Cin
	cm2-s	g/cm3					cm		g/cm2-s	m2		g/s		m3	m3/s	mg/m3
Acetone	1.24E-01	1.49E-08	1.04E-03	0.039745	2.2	0.02	60.96	0.3025	9.41E-14	116.1	0.01	1.09E-13	1	566.4	0.157333	6.95E-10
1,2-Dichloroethene (total)	7.36E-02	1.70E-08	3.94E-01	0.039745	49	0.02	60.96	0.3025	1.08E-12	116.1	0.01	1.26E-12	1	566.4	0.157333	8E-09
Ethylbenzene	7.50E-02	1.63E-08	2.68E-01	0.039745	1100	0.02	60.96	0.3025	3.21E-14	116.1	0.01	3.73E-14	1	566.4	0.157333	2.37E-10
Methylene Chloride	1.17E-02	1.72E-08	1.33E-01	0.039745	8.8	0.02	60.96	0.3025	3.28E-13	116.1	0.01	3.81E-13	1	566.4	0.157333	2.42E-09
Tetrachloroethylene	7.20E-02	1.27E-08	1.21E+00	0.039745	364	0.02	60.96	0.3025	3.28E-13	116.1	0.01	3.8E-13	1	566.4	0.157333	2.42E-09
Toluene	8.70E-02	1.32E-08	2.78E-01	0.039745	300	0.02	60.96	0.3025	1.15E-13	116.1	0.01	1.33E-13	1	566.4	0.157333	8.46E-10
Trichloroethene	7.90E-02	6.88E-07	3.79E-01	0.039745	126	0.02	60.96	0.3025	1.76E-11	116.1	0.01	2.05E-11	1	566.4	0.157333	1.3E-07
Xylenes (total)	8.70E-02	3.23E-08	2.93E-01	0.039745	240	0.02	60.96	0.3025	3.7E-13	116.1	0.01	4.29E-13	1	566.4	0.157333	2.73E-09

Basement Construction — emission — concentration

	DA	Cs	H	$PA^{10/3}$	Koc	foc	L	Pt^2	J	A	F	E	ACH	V	Q	Cin
	cm2-s	g/cm3					cm		g/cm2-s	m2		g/s		m3	m3/s	mg/m3
Acetone	1.24E-01	1.49E-08	1.04E-03	0.039745	2.2	0.02	60.96	0.3025	9.41E-14	227.6	0.01	2.14E-13	1	849.6	0.236	9.08E-10
1,2-Dichloroethene (total)	7.36E-02	1.70E-08	3.94E-01	0.039745	49	0.02	60.96	0.3025	1.08E-12	227.6	0.01	2.47E-12	1	849.6	0.236	1.05E-08
Ethylbenzene	7.50E-02	1.63E-08	2.68E-01	0.039745	1100	0.02	60.96	0.3025	3.21E-14	227.6	0.01	7.31E-14	1	849.6	0.236	3.1E-10
Methylene Chloride	1.17E-02	1.72E-08	1.33E-01	0.039745	8.8	0.02	60.96	0.3025	3.28E-13	227.6	0.01	7.46E-13	1	849.6	0.236	3.16E-09
Tetrachloroethylene	7.20E-02	1.27E-08	1.21E+00	0.039745	364	0.02	60.96	0.3025	3.28E-13	227.6	0.01	7.46E-13	1	849.6	0.236	3.16E-09
Toluene	8.70E-02	1.32E-08	2.78E-01	0.039745	300	0.02	60.96	0.3025	1.15E-13	227.6	0.01	2.61E-13	1	849.6	0.236	1.11E-09
Trichloroethene	7.90E-02	6.88E-07	3.79E-01	0.039745	126	0.02	60.96	0.3025	1.76E-11	227.6	0.01	4.01E-11	1	849.6	0.236	1.7E-07
Xylenes (total)	8.70E-02	3.23E-08	2.93E-01	0.039745	240	0.02	60.96	0.3025	3.7E-13	227.6	0.01	8.41E-13	1	849.6	0.236	3.57E-09

Notes:

PA=Pt-OmB

where: Cs (g/cm3) = Cs (mg/kg) * 1.7 g/cm3 * 0.000001 kg/mg

TABLE F-4

TOTAL VOC CONCENTRATION
(GROUNDWATER + SOIL)
PETOSKEY MANUFACTURING SITE

Slab Construction (mg/m^3)

Acetone	6.95E-10
1,2-Dichloroethene(total)	8.14E-09
Ethylbenzene	2.37E-10
Methylene Chloride	2.42E-09
Tetrachloroethylene	2.42E-09
Toluene	8.46E-10
Trichloroethene	1.32E-07
Vinyl Chloride	6.68E-09
Xylenes (total)	2.73E-09

Basement Construction

Acetone	9.08E-10
1,2-Dichloroethene(total)	1.06E-08
Ethylbenzene	3.1E-10
Methylene Chloride	3.16E-09
Tetrachloroethene	3.16E-09
Toluene	1.11E-09
Trichloroethene	1.73E-07
Vinyl Chloride	8.73E-09
Xylenes (total)	3.57E-09

TABLE F-5

PERMEABILITY COEFFICIENTS
PETOSKEY MANUFACTURING SITE

CHEMICAL	MOLECULAR WEIGHT	log(Kow)	ERMEABILITY COEFFICIENT	SOURCE
1,2-Dichloroethene	96.94	1.86	1.0E-02	USEPA, 1992c
Trichloroethene	131.4	2.42	1.6E-02	USEPA, 1992c
Vinyl chloride	62.5	1.36	7.30E-03	USEPA, 1992
Arsenic	74.9		1.00E-03	default USEPA, 1992c
Barium	137.33		1.00E-03	default USEPA, 1992c
Cadmium	112.4		1.00E-03	default USEPA, 1992c
Chromium	52		1.00E-03	default USEPA, 1992c
Cobalt	58.9		1.00E-03	default USEPA, 1992c
Lead	207.2		1.00E-03	default USEPA, 1992c
Manganese	54.94		1.00E-03	default USEPA, 1992c
Nickel	58.7		1.00E-03	default USEPA, 1992c
Selenium	78.96		1.00E-03	default USEPA, 1992c
Silver	107.87		1.00E-03	default USEPA, 1992c
Vanadium	50.94		1.00E-03	default USEPA, 1992c
Zinc	65.37		1.00E-03	default USEPA, 1992c

TABLE F-6

TOXICITY VALUES: POTENTIAL NONCARCINOGENIC EFFECTS
ORAL EXPOSURE

Chemical	Chronic RfD (mg/kg-day)	Critical Effect	RfD Basis	Confidence Level	Uncertainty Factor	Modifying Factor	RfD Source
Acetone	1.00E-01	Increased liver and kidney weights and nephrotoxicity	Oral	Low	1000 for H,C	1	IRIS
1,2-Dichloroethene(total)	9.00E-03	Liver lesions	Water		1000		HEAST
Ethylbenzene	1.00E-01	Liver and kidney toxicity	Oral	Low	1000 for H,A,S	1	IRIS
Methylene chloride	6E-02	Liver toxicity	Oral	Medium	100 for H,A	1	IRIS
Tetrachloroethene	1E-02	--	--	--	--	--	IRIS
Toluene	2E-01	Changes in liver and kidney weights	Gavage	Medium	1000 for H,A,S	1	IRIS
Trichloroethene	6.00E-03	Liver and Kidney	Oral, diet	Low	3000 for H,A,C,O	--	NCEA
Vinyl chloride	--	--	--	--	--	--	IRIS; HEAST
o-Xylene	2.00E+00	Hyperactivity, decreased body weight	Gavage	--	100	--	HEAST
m-Xylene	2.00E+00	Hyperactivity, decreased body weight	Gavage	--	100	--	HEAST
Xylenes (total)	2.00E+00	Hyperactivity, decreased body weight and increased mortality	Gavage	Medium	100 for H,A	1	IRIS
Acenaphthene	6E-02	Hepatotoxicity	Oral	Low	3000 for H,A,S,O	1	IRIS
Anthracene	3.00E-01	Subchronic toxicity	Gavage	Low	3000 for H,A,S,O	1	IRIS
Benzo[g,h,i]perylene	--	--	--	--	--	--	IRIS; HEAST
Fluoranthene	4E-02	Nephropathy hemotological and liver effects	Gavage	Low	3000 for H,A,S	1	IRIS
Fluorene	4.00E-02	Decreased erythrocyte count and hemoglobin	Gavage	Low	3000 for H,A,S	1	IRIS
Phenanthrene	--	--	--	--	--	--	IRIS; HEAST
Pyrene	3E-02	Kidney effects	Oral	Low	3000 for H,A,S	1	IRIS
Benzo[a]anthracene	--	--	--	--	--	--	IRIS; HEAST
Benzo[a]pyrene	--	--	--	--	--	--	IRIS; HEAST
Benzo[b]fluoranthene	--	--	--	--	--	--	IRIS; HEAST
Benzo[k]fluoranthene	--	--	--	--	--	--	IRIS; HEAST
Chrysene	--	--	--	--	--	--	IRIS; HEAST
Dibenz[a,h]anthracene	--	--	--	--	--	--	IRIS; HEAST
Indeno[1,2,3-cd]pyrene	--	--	--	--	--	--	IRIS; HEAST
bis(2-Ethylhexyl)phthalate	2.00E-02	Increased liver weight	Oral	Medium	1000 for H,A,S	1	IRIS
Butylbenzylphthalate	2.00E-01	Increased liver weight	Diet	Low	1000 for H,A,S	1	IRIS
Carbazole	--	--	--	--	--	--	IRIS; HEAST
Dibenzofuran	4E-03	Kidney effects	Diet	Low	3000 for H, A,C,O	1	NCEA
Di-n-butylphthalate	1E-01	Increased mortality	Oral	Low	1000 for H,A,S	1	IRIS
Di-n-octylphthalate	2E-02	Kidney and liver effects	Diet	--	1000	--	HEAST
Polychlorinated biphenyls	--	--	--	--	--	--	IRIS; HEAST
Aroclor 1016	7.00E-05	Reduced birth weights	Oral	Medium	81 for H,A,C,O	1	IRIS
Aroclor 1248	--	--	--	--	--	--	IRIS; HEAST
Aroclor 1254	2.00E-05	cular exudate, inflamed Meibomian glands, distorted nail growth, decreased antibody respons	Oral	Medium	300 for H,A,O	1	IRIS
Aldrin	3.00E-05	Liver	Oral,diet	Medium	1000	1	IRIS
4,4-DDD	--	--	--	--	--	--	IRIS; HEAST
4,4-DDE	--	--	--	--	--	--	IRIS; HEAST
4,4-DDT	5.00E-04	Liver lesions	Diet	Medium	100 for H,A	1	IRIS
Endosulfan	6E-03	Reduced body weight gain, kidney and blood vessel effects	Oral	Medium	100 for H,A	1	IRIS
Antimony	4.00E-04	Longevity, blood glucose, and cholesterol	Oral	Low	1000	1	IRIS
Arsenic	3.00E-04	Hyperpigmentation, keratosis and possible vascular complications	Oral	Medium	3 for O	1	IRIS
Barium	7E-02	Increased blood pressure	Oral	Medium	3 for H,O	1	IRIS
Cadmium (water)	5.00E-04	Significant proteinuria	Oral	High	10 for H	1	IRIS

TABLE F-6

TOXICITY VALUES: POTENTIAL NONCARCINOGENIC EFFECTS
ORAL EXPOSURE

Chemical	Chronic RfD (mg/kg-day)	Critical Effect	RfD Basis	Confidence Level	Uncertainty Factor	Modifying Factor	RfD Source
Cadmium (food)	1.00E-03	Chronic human studies	Oral	High	10 for H	1	IRIS
Chromium III	1E+00	No effects observed	Oral	Low	100 for H,A	10	IRIS
Cobalt	6.00E-02	--	--	--	--	--	NCEA
Copper	3.7E-02	Gastrointestinal irritation	Oral	--	--	--	HEAST
Lead	--	--	--	--	--	--	IRIS; HEAST
Manganese	2.30E-02	CNS effects	Oral	Medium	1 for O	1(3 nondiet)	IRIS
Mercury(elemental)	--	--	--	--	--	--	IRIS; HEAST
Nickel (refinery dust)	2.00E-02	--	--	--	--	--	IRIS
Nickel (soluble salts)	2E-02	Decreased body and organ weights	Oral	Medium	300 H,A,O	1	IRIS
Selenium	5.00E-03	Clinical selenosis	Epidemiology study	High	3	1	IRIS
Silver	5E-03	Argyria	Oral	Low	3 for O	1	IRIS
Thallium	--	--	--	--	--	--	IRIS; HEAST
Vanadium	7.00E-03	--	Water	--	100	--	HEAST
Zinc	3.00E-01	Decrease in erythrocyte superoxide	Diet	Medium	3 for O	1	IRIS
Cyanide	2.00E-02	Weight loss, thyroid effects and myelin degeneration.	Oral	Medium	100	5	IRIS

TABLE F-6

TOXICITY VALUES: POTENTIAL NONCARCINOGENIC EFFECTS
INHALATION EXPOSURE

Chemical	Chronic RfC (mg/m3)	Chronic RfD (mg/kg-day)	Critical Effect	RfD Basis	Confidence Level	Uncertainty Factor	Modifying Factor	RfD Source
Acetone	--	--	--	--	--	--	--	IRIS; HEAST
1,2-Dichloroethene(total)	--	--	--	--	--	--	--	IRIS; HEAST
Ethylbenzene	1.00E+00	2.9E-01	Developmental toxicity	Inhalation	Low	300	1	IRIS
Methylene chloride	3.00E+00	8.6E-01	Liver toxicity	Inhalation	--	100 for H,A,O	--	HEAST
Tetrachloroethene	--	--	Hepatotoxicity	Inhalation	Low	3000 for H,A,S	1	IRIS; HEAST
Toluene	4E-01	1E-01	Neurological effects	Inhalation	Medium	300 for H,S,O	1	IRIS
Trichloroethene	--	--	--	--	--	--	--	IRIS; HEAST
Vinyl chloride	--	--	--	--	--	--	--	IRIS; HEAST
o-Xylene	--	--	--	--	--	--	--	IRIS; HEAST
m-Xylene	--	--	--	--	--	--	--	IRIS; HEAST
Xylenes (total)	--	--	--	--	--	--	--	IRIS; HEAST
Acenaphthene	--	--	--	--	--	--	--	IRIS; HEAST
Anthracene	--	--	--	--	--	--	--	IRIS; HEAST
Benzo[g,h,i]perylene	--	--	--	--	--	--	--	IRIS; HEAST
Fluoranthene	--	--	--	--	--	--	--	IRIS; HEAST
Fluorene	--	--	--	--	--	--	--	IRIS; HEAST
Phenanthrene	--	--	--	--	--	--	--	IRIS; HEAST
Pyrene	--	--	--	--	--	--	--	IRIS; HEAST
Benzo[a]anthracene	--	--	--	--	--	--	--	IRIS; HEAST
Benzo[a]pyrene	--	--	--	--	--	--	--	IRIS; HEAST
Benzo[b]fluoranthene	--	--	--	--	--	--	--	IRIS; HEAST
Benzo[k]fluoranthene	--	--	--	--	--	--	--	IRIS; HEAST
Chrysene	--	--	--	--	--	--	--	IRIS; HEAST
Dibenz[a,h]anthracene	--	--	--	--	--	--	--	IRIS; HEAST
Indeno[1,2,3-cd]pyrene	--	--	--	--	--	--	--	IRIS; HEAST
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	IRIS; HEAST
Butylbenzylphthalate	--	--	--	--	--	--	--	IRIS; HEAST
Carbazole	--	--	--	--	--	--	--	IRIS; HEAST
Dibenzofuran	--	--	--	--	--	--	--	IRIS; HEAST
Di-n-butylphthalate	--	--	--	--	--	--	--	IRIS; HEAST
Di-n-octylphthalate	--	--	--	--	--	--	--	IRIS; HEAST
Polychlorinated biphenyls	--	--	--	--	--	--	--	IRIS; HEAST
Aroclor 1016	--	--	--	--	--	--	--	IRIS; HEAST
Aroclor 1248	--	--	--	--	--	--	--	IRIS; HEAST
Aroclor 1254	--	--	--	--	--	--	--	IRIS; HEAST
Aldrin	--	--	--	--	--	--	--	IRIS; HEAST
4,4-DDD	--	--	--	--	--	--	--	IRIS; HEAST
4,4-DDE	--	--	--	--	--	--	--	IRIS; HEAST
4,4-DDT	--	--	--	--	--	--	--	IRIS; HEAST
Endosulfan	--	--	--	--	--	--	--	IRIS; HEAST
Antimony	--	--	--	--	--	--	--	IRIS; HEAST
Arsenic	--	--	--	--	--	--	--	IRIS; HEAST

TABLE F-6

TOXICITY VALUES: POTENTIAL NONCARCINOGENIC EFFECTS
INHALATION EXPOSURE

Chemical	Chronic RfC (mg/m3)	Chronic RfD (mg/kg-day)	Critical Effect	RfD Basis	Confidence Level	Uncertainty Factor	Modifying Factor	RfD Source
Barium	5.00E-04	1.0E-04	Fetotoxicity	Inhalation	--	1000	--	HEAST
Cadmium (water)	--	--	--	--	--	--	--	IRIS; HEAST
Cadmium (food)	--	--	--	--	--	--	--	IRIS; HEAST
Chromium III	--	--	--	--	--	--	--	IRIS; HEAST
Cobalt	2.00E-05	5.7E-06	--	--	--	--	--	NCEA
Copper	--	--	--	--	--	--	--	IRIS; HEAST
Lead	--	--	--	--	--	--	--	IRIS; HEAST
Manganese	5.00E-05	1.4E-05	Impairment of neurobehavioral functio	Inhalation	Medium	1000 for H,S,O	1	IRIS
Mercury(elemental)	3.00E-04	8.6E-05	Neurotoxicity	Inhalation	Medium	30	1	HEAST
Nickel (refinery dust)	--	--	--	--	--	--	--	IRIS; HEAST
Nickel (soluble salts)	--	--	--	--	--	--	--	IRIS; HEAST
Selenium	--	--	--	--	--	--	--	IRIS; HEAST
Silver	1.00E-05	2.9E-06	Argyrosis	Inhalation	Low	1000 for H,S,C,O	1	NCEA
Thallium	--	--	--	--	--	--	--	IRIS; HEAST
Vanadium	--	--	--	--	--	--	--	IRIS; HEAST
Zinc	--	--	--	--	--	--	--	IRIS; HEAST
Cyanide	--	--	--					IRIS; HEAST

Notes:

-- = Not Available
HEAST = Health Effects Assessment Summary Tables (USEPA, 1997a).
IRIS = Integrated Risk Information System (USEPA, 1997b).
NCEA = National Center for Environmental Assessment (USEPA, 1997c).
* = Uncertainty Factor, to account for inter- and intraspecies extrapolation and extrapolation from subchronic to chronic exposures
** = Modifying Factor, to account for uncertainty in the test program.
H = Variation in Human Sensitivity
A = Animal to Human Extrapolation
S = Extrapolation from Lowest Observed Adverse Effect Level (LOAEL) to No Observed Adverse Effect Level (NOAEL
C = Extrapolation from Subochronic Studies to Chronic
O = Other factors

TABLE F-7

ORAL ABSORPTION EFFICIENCIES
PETOSKEY MANUFACTURING SITE

CHEMICAL	ORAL ABSORPTION	SOURCE
Antimony	*0.1*	*ATSDR, 1991*
Arsenic	0.8	ATSDR, 1993a
Barium	0.05	ATSDR, 1992a
Cadmium	0.05	Carson et al., 1986
Chromium	0.01	Carson et al., 1986
Cobalt	0.8	Carson et al., 1986
Copper	0.5	Carson et al., 1986
Lead	0.15	ATSDR, 1993b
Maganese	0.1	ATSDR, 1992b
Nickel	0.1	Carson et al., 1986
Selenium	0.9	ATSDR, 1989b
Silver	0.1	Carson et al., 1986
Thallium	1	ATSDR, 1992c
Vanadium	1	Default
Zinc	0.4	Carson et al, 1986
Cyanide	1.0	ATSDR, 1989a
Organic Chemicals	1.0	Default

TABLE F-8

TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS
ORAL EXPOSURE

Chemical	Slope Factor (SF) (mg/kg-day)-1	SF Basis	Type of Cancer	Weight-of-Evidence Classification	SF Source
Acetone	--	--	--	D	IRIS; HEAST
1,2-Dichloroethene(total)	--	--	--	--	IRIS; HEAST
Ethylbenzene	--	--	--	D	IRIS
Methylene chloride	7.5E-03	Inhalation	Hepatocellular adrenomas and carcinoma	B2	IRIS
Tetrachloroethene	5.20E-02	--	--	WD	NCEA
Toluene	--	--	--	D	IRIS; HEAST
Trichloroethene	1.10E-02	--	--	WD	NCEA
Vinyl chloride	1.90E+00	Diet	Lung and liver tumors	A	HEAST
o-Xylene	--	--	--	--	IRIS; HEAST
m-Xylene	--	--	--	--	IRIS; HEAST
Xylenes (total)	--	--	--	D	IRIS; HEAST
Acenaphthene	--	--	--	D	IRIS; HEAST
Anthracene	--	--	--	D	IRIS; HEAST
Benzo[g,h,i]perylene	--	--	--	D	IRIS; HEAST
Fluoranthene	--	--	--	D	IRIS; HEAST
Fluorene	--	--	--	D	IRIS; HEAST
Phenanthrene	--	--	--	D	IRIS; HEAST
Pyrene	--	--	--	D	IRIS; HEAST
Benzo[a]anthracene	7.30E-01	--	--	B2	IRIS
Benzo[a]pyrene	7.30E+00	Oral, diet	Forestomach	B2	IRIS
Benzo[b]fluoranthene	7.30E-01	--	--	B2	IRIS
Benzo[k]fluoranthene	7.30E-02	--	--	B2	IRIS
Chrysene	7.30E-03	--	--	B2	IRIS
Dibenz[a,h]anthracene	7.30E+00	--	--	B2	IRIS
Indeno[1,2,3-cd]pyrene	7.30E-01	--	--	B2	IRIS
bis(2-Ethylhexyl)phthalate	1.40E-02	Oral, diet	Hepatocellular carcinoma and adenoma	B2	IRIS
Butylbenzylphthalate	--	--	--	C	IRIS; HEAST
Carbazole	2.00E-02	Oral, diet	Liver	B2	IRIS; HEAST
Dibenzofuran	--	--	--	D	IRIS; HEAST
Di-n-butylphthalate	--	--	--	D	IRIS; HEAST
Di-n-octylphthalate	--	--	--	--	IRIS; HEAST
Polychlorinated biphenyls	2.00E+00	Oral,diet	Trabecelar carcinoma/adenocarcinoma	B2	IRIS
Aroclor 1016	--	--	--	--	IRIS; HEAST
Aroclor 1248	--	--	--	--	IRIS; HEAST
Aroclor 1254	--	--	--	--	IRIS; HEAST
Aldrin	1.70E+01	Oral,diet	Liver	B2	IRIS
4,4-DDD	2.4E-01	Oral	Lung, liver, thyroid	B2	IRIS
4,4-DDE	3.4E-01	Oral	Liver, thyroid	B2	IRIS
4,4-DDT	3.40E-01	Oral, diet	Liver	B2	IRIS
Endosulfan	--	--	--	D	IRIS; HEAST
Antimony	--	--	--	--	IRIS, HEAST
Arsenic	1.50E+00	Oral	Skin	A	IRIS
Barium	--	--	--	--	IRIS; HEAST
Cadmium (water)	--	--	--	B1	IRIS; HEAST

TABLE F-8

TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS
ORAL EXPOSURE

Chemical	Slope Factor (SF) (mg/kg-day)-1	SF Basis	Type of Cancer	Weight-of-Evidence Classification	SF Source
Cadmium (food)	--	--	--	B1	IRIS; HEAST
Chromium III	--	--	--	--	IRIS; HEAST
Cobalt	--	--	--	ND	IRIS; HEAST
Copper	--	--	--	D	IRIS; HEAST
Lead	--	--	--	B2	IRIS; HEAST
Manganese	--	--	--	D	IRIS; HEAST
Mercury(elemental)	--	--	--	D	IRIS; HEAST
Nickel (refinery dust)	--	--	--	A	IRIS; HEAST
Nickel (soluble salts)	--	--	--	--	IRIS; HEAST
Selenium	--	--	--	D	IRIS; HEAST
Silver	--	--	--	D	IRIS; HEAST
Thallium	--	--	--	ND	IRIS; HEAST
Vanadium	--	--	--	ND	IRIS; HEAST
Zinc	--	--	--	D	IRIS; HEAST
Cyanide	--	--	--	D	IRIS; HEAST

TABLE F-8

TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS
INHALATION EXPOSURE

Chemical	Unit Risk (mg/m3)	Slope Factor (SF) (mg/kg-day)-1	SF Basis	Type of Cancer	Weight-of-Evidence Classification	SF Source
Acetone	--	--	--	--	D	IRIS; HEAST
1,2-Dichloroethene(total)	--	--	--	--	--	IRIS; HEAST
Ethylbenzene	--	--	--	--	D	IRIS; HEAST
Methylene chloride	4.7E-07	1.6E-03	Inhalation	Combined adenomas and carcinomas	B2	IRIS
Tetrachloroethene	5.80E-07	2.00E-03	--	--	WD	NCEA
Toluene	--	--	--	--	D	IRIS; HEAST
Trichloroethene	1.70E-06	6.00E-03	--	--	WD	NCEA
Vinyl chloride	8.40E-05	3.00E-01	Inhalation	Liver tumors	A	HEAST
o-Xylene	--	--	--	--	--	IRIS; HEAST
m-Xylene	--	--	--	--	--	IRIS; HEAST
Xylenes (total)	--	--	--	--	D	IRIS; HEAST
Acenaphthene	--	--	--	--	D	IRIS; HEAST
Anthracene	--	--	--	--	D	IRIS; HEAST
Benzo[g,h,i]perylene	--	--	--	--	D	IRIS; HEAST
Fluoranthene	--	--	--	--	D	IRIS; HEAST
Fluorene	--	--	--	--	D	IRIS; HEAST
Phenanthrene	--	--	--	--	D	IRIS; HEAST
Pyrene	--	--	--	--	D	IRIS; HEAST
Benzo[a]anthracene	--	--	--	--	B2	IRIS; HEAST
Benzo[a]pyrene	--	--	--	--	B2	IRIS; HEAST
Benzo[b]fluoranthene	--	--	--	--	B2	IRIS, HEAST
Benzo[k]fluoranthene	--	--	--	--	B2	IRIS; HEAST
Chrysene	--	--	--	--	B2	IRIS; HEAST
Dibenz[a,h]anthracene	--	--	--	--	B2	IRIS, HEAST
Indeno[1,2,3-cd]pyrene	--	--	--	--	B2	IRIS; HEAST
bis(2-Ethylhexyl)phthalate	4.60E-06	1.40E-02	Oral, diet	epatocellular carcinoma and adenom	B2	NCEA
Butylbenzylphthalate	--	--	--	--	C	IRIS; HEAST
Carbazole	--	--	--	--	B2	IRIS; HEAST
Dibenzofuran	--	--	--	--	D	IRIS; HEAST
Di-n-butylphthalate	--	--	--	--	D	IRIS; HEAST
Di-n-octylphthalate	--	--	--	--	--	IRIS; HEAST
Polychlorinated biphenyls	--	2.00E+00	--	--	B2	IRIS; HEAST
Aroclor 1016	--	--	--	--	--	IRIS; HEAST
Aroclor 1248	--	--	--	--	--	IRIS; HEAST
Aroclor 1254	--	--	--	--	--	IRIS, HEAST
Aldrin	4.90E-03	1.72E+01	Oral,diet	Liver carcinoma	B2	IRIS
4,4-DDD	--	--	--	--	B2	IRIS; HEAST
4,4-DDE	--	--	--	--	B2	IRIS; HEAST
4,4-DDT	9.70E-05	3.40E-01	Oral,diet	Liver tumors	B2	HEAST
Endosulfan	--	--	--	--	D	IRIS; HEAST
Antimony	--	--	--	--	--	IRIS; HEAST
Arsenic	4.30E-03	1.51E+01	Inhalation	Respiratory	A	IRIS
Barium	--	--	--	--	--	IRIS; HEAST
Cadmium (water)	1.80E-03	6.30E+00	Inhalation	Respiratory	B1	IRIS

TABLE F-8

TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS
INHALATION EXPOSURE

Chemical	Unit Risk (mg/m3)	Slope Factor (SF) (mg/kg-day)-1	SF Basis	Type of Cancer	Weight-of-Evidence Classification	SF Source
Cadmium (food)	1.80E-03	6.30E+00			B1	IRIS
Chromium III	--	--	--	--	--	IRIS; HEAST
Cobalt	--	--	--	--	ND	IRIS; HEAST
Copper	--	--	--	--	D	IRIS; HEAST
Lead	--	--	--	--	B2	IRIS; HEAST
Manganese	--	--	--	--	D	IRIS; HEAST
Mercury(elemental)	--	--	--	--	D	IRIS; HEAST
Nickel (refinery dust)	2.40E-04	8.4E-01	Inhalation	Respiratory system tumors	A	IRIS
Nickel (soluble salts)	--	--	--	--	--	IRIS; HEAST
Selenium	--	--	--	--	D	IRIS; HEAST
Silver	--	--	--	--	D	IRIS; HEAST
Thallium	--	--	--	--	ND	IRIS; HEAST
Vanadium	--	--	--	--	ND	IRIS; HEAST
Zinc	--	--	--	--	D	IRIS; HEAST
Cyanide	--	--	--	--	D	IRIS; HEAST

Notes:

-- = Not Available
HEAST = Health Effects Assessment Summary Tables (USEPA, 1997a).
IRIS = Integrated Risk Information System (USEPA, 1997b).
NCEA = National Center for Environmental Assessment (USEPA, 1997c).
USEPA = Provisional Guidance for Quantitative Risk Assessment of Polycylic Aromatic Hydrocarbons (USEPA, 1993).
A = Human Carcinogen (sufficient evidence of carcinogenicity in humans)
B1 = Probable Human Carcinogen (limited evidence of carcinogenicity in humans)
B2 = Probable Human Carcinogen (sufficient evidence of carcinogenicity in animal with inadequate or lack of evidence in humans)
C = Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data)
D = Not classifiable as to human carcinogenicity (inadequate or no evidence)

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